



Specifications

Architectural, Mechanical,
Electrical

Specifications for
WILLIAM G MILLER PUBLIC SCHOOL
Accessibility Upgrades
TR-25-0953

60 Bennett Road
Scarborough
Ontario
M1E 3Y3

for the
Toronto District School Board
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Issued for Tender
Project No. A25006

April, 2026



This seal does not govern the following materials bound into these Specifications.

- **DIVISIONS 20, 22, 23, 25 26, 27 MECHANICAL & ELECTRICAL**
- **APPENDIX "B" REPORTS**

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1.0 GENERAL

1.1. SECTION INCLUDES

- .1 Connecting to existing services
- .2 Special scheduling requirements
- .3 TDSB Specific Requirements

1.2. RELATED SECTIONS

- .1 Section 01 53 00 - Temporary Construction.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. EXISTING SERVICES

- .1 Notify Owner and Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Consultant and Owner, forty-eight (48) hours of notice for necessary interruption of mechanical or electrical service throughout course of work.
 - .1 Keep duration of interruptions minimum.
 - .2 Perform interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for vehicular, pedestrian and personnel traffic.
- .4 Construct barriers in accordance with Section 01 53 00.

1.4. AFTER HOURS WORK

- .1 Schedule Work with school staff through the Board's contact so as to limit disruption to school operations. Include for any overtime, to ensure orderly and continuous progression of Work and operation of school.
- .2 Direct calls from Contractors to Board staff to adjust alarms and to arrange for access will not be accepted. All correspondence must be through the Project Manager.
- .3 Arrange 48 hours in advance with Board to obtain an access card and adjust security alarms for after hours Work.
- .4 Bidders are cautioned that the Board will be compensated by the Contractor for false alarms. Any costs associated with each false alarm will be levied against the Contractor for false fire alarm activation or security alarm activation. These costs may include, but are not limited to:
 - .1 Fines or penalties imposed by the local Fire Services,
 - .2 Fines or penalties imposed by the local Police Services,
 - .3 Overtime costs borne by the Board.
- .5 Contractors are responsible for ensuring doors and windows are secured prior to leaving school.
- .6 Unless specifically stated otherwise school activities take precedence over Contractor's activities.

1.5. SPECIAL REQUIREMENTS

- .1 Schedule and perform work in occupied areas to Board Representative's approval.
- .2 Schedule and perform noise generating work to Board Representative's approval.
- .3 Submit schedule of special requirements or disruptions in accordance with Section 01 33 00.

- .4 All Contractor personnel are restricted to the job site and necessary access routes. No personnel shall visit other areas or buildings without specific authorization.

1.6. TDSB SPECIFIC SUPPLEMENTARY REQUIREMENTS

Following are TDSB specific SUPPLEMENTARY requirements which are to be read in conjunction with Division 1 in its entirety.

1.1. COMMUNICATION (TDSB SPECIFIC REQUIREMENTS)

- .1 At the outset of the project the Contractor shall provide to the Board Project Manager all relevant contact information for the Site Superintendent and GC Project Manager including names and cell phone numbers.
- .2 The Contractor shall provide at least one “emergency contact” telephone number at which the Contractor’s representative can be reached directly during all work hours.
- .3 The Site Superintendent must have the ability to be reached directly during all times or a contact provided that can be provided during all times.
- .4 In the event of a safety issue requiring contractual clarification or action (i.e. Change Notice, etc.), the contractor shall ensure that, where applicable, the action is followed up with appropriate documentation.

1.2. OPERATION OF MOTOR VEHICLES (TDSB SPECIFIC REQUIREMENTS)

- .1 Vehicles shall not enter, be parked or operate at school sites without first obtaining authorization from the assigned project manager.
- .2 Such vehicles shall be always operated with due caution while on school property on or near school grounds, conforming to all posted traffic controls such as speed limit, stop signs, etc.
- .3 Vehicles or equipment are not permitted on school yards without prior approval from the project manager. Should approval be granted, vehicles and equipment operated in the school yard are not permitted within 30 minutes of school bell times, during recess, lunch hour or other times of outdoor activity.
- .4 Must employ flag person to manage all operations of vehicles and equipment on site at all times they are in operation.
- .5 Vehicles or equipment must never be left unattended with the engine running. Engines must not be left idling unnecessarily.

1.3. SITE SAFETY SIGNAGE (TDSB SPECIFIC REQUIREMENTS)

- .1 Standardized Safety Signage is required at all construction entrances authorization
- .2 If not designated in the Contract Documents, the location of the Safety Signage shall be confirmed with the Board Project Manager and Consultant at the outset of the Project and before the placement of hoarding and fencing.

- .3 Total surface area of signage is to avoid exceeding municipal standards that would require a separate signage permit.

1.4. WORKING HOURS (TDSB SPECIFIC REQUIREMENTS)

- .1 Are to comply with the requirements of the City of Toronto by-law
- .2 From June 26, 2026, to August 28, 2026, Work can be completed anytime, if it complies with the City of Toronto by-law.
- .3 It is the Successful Bidder's responsibility to schedule shift work (as required) to meet Project schedule deadlines; this may mean daytime as well as after-hours Work.
- .4 Prior to June 26, 2026, and after August 28, 2026, all Work must be completed outside of school operational hours of 8:00AM – 6:30PM and on weekends.
- .5 Prior to June 29, 2026, and after August 28, 2026, all Work which would cause a disturbance or safety hazard (including Work that generates odours, any asbestos abatement, any environmental demolition, or cutting/coring) must be completed prior to 8:00 AM or after 6:30 PM Monday to Friday, or anytime on weekends.
- .6 Prior to June 26, 2026, and after August 28, 2026, all tools, equipment, and materials must be brought into or taken out of the construction space(s) prior to 8:00 AM and/or after 6:30 PM.
- .7 A TDSB Caretaker must always be on the premises while construction works are being completed. Caretaking hours are from 6:00am to 11:00pm Monday to Friday, excluding holidays and board closures.

1.5. SIGN-IN REQUIREMENTS (TDSB SPECIFIC REQUIREMENTS)

- .1 The Contractor shall obtain identification badges by filling out the "Request for Issue of Identification Badges for Consultant/Contractor" form and submitting, along with badge deposit (\$75.00 each). **Contact information will be provided during the pre-construction meeting**
- .2 The Contractor is required to sign-in themselves, their subcontractors or any other person associated with the project at school main office to record their arrival time.
- .3 The Contractor will compile a sign-in sheet with for all forces working on the project and submit to the main office at the start of each day.
- .4 ID badges shall be worn at all times while on Board property. It shall be the Bidder's responsibility to assign and track each badge. The wearing of badges by all personnel shall be strictly enforced.
- .5 At the end of each day the Contractor shall obtain the sign-in sheet previously submitted to the main office, record the departure times of themselves, Subcontractors or any other person associated with the project and return the sign-in sheet to the main office.
- .6 The Bidder's inability to access the site due to not having current badges will not absolve the Bidder of not being able to complete the project by the stipulated date.

1.6. USE OF EXISTING FACILITIES (TDSB SPECIFIC REQUIREMENTS)

- .1 Use of school washrooms, both student and staff is strictly prohibited at all times. It is the responsibility of the Contractor to provide appropriate washroom facilities as per the regulations set out by the Authority Having Jurisdiction for all staff, subcontractors and delivery drivers associated with the construction project and coordinate such location with the project supervisor. The contractor is responsible to secure any portable toilet facilities

to mitigate vandalism, security issues, etc. and is responsible for the ongoing maintenance of such facility.

- .2 Use of existing school elevators by the Contractor, Subcontractor, Suppliers or another individual associated with the project is prohibited. The Contractor will not be permitted to utilize the elevator for moving of materials, equipment or personnel while carrying out the works.
- .3 Use of existing school services, including but not necessarily limited too; Water, Hydro, Internet, Phones/Fax and heat are not permitted. The contractor will include in their contract price all temporary services required to carry out the works.

1.7. CONTRACTOR PARKING (TDSB SPECIFIC REQUIREMENTS)

- .1 Contractor parking is not available. The contractor will need to make all arrangements for offsite parking in accordance to all applicable By-law, zoning, etc.

1.8. CONSTRUCTION STAGING (TDSB SPECIFIC REQUIREMENTS)

- .1 No storage is available on site for the contractor. The contractor must make all necessary arrangements for storage containers as needed and ensure security of such.
- .2 Prior to construction start, the contract must provide the Board and Consultant a copy of their construction staging plan. The plan is to include a site plan identifying location of proposed fencing, location of portable toilets, storage containers, etc. The plan is to identify which doors the contractor will be using to enter the school, path of travel for equipment deliveries etc. The Board and consultant reserve the right to request any changes to the plan to ensure the safety of students, staff and maintaining the ongoing operations of the school.

1.9. BOARD HEALTH & SAFETY DEPARTMENT REP (TDSB SPECIFIC REQUIREMENTS)

- .1 A representative of the Board's Health, & Safety Dept. ('Environment, Health and Safety Officer') may visit site at any anytime throughout the duration of the Contract to review the site, as it relates to the safety of the occupied areas of the site. Such site review shall neither constitute an inspection or approval for the Contractor.
- .2 Concerns or issues identified by the representative from the Board's Health, Wellness & Safety Dept. shall be communicated through the Board Project Manager and the school Principal for corrective action.
- .3 Contractor shall ensure full access to all site areas, at all times, for the Board's Health, Wellness & Safety Department Representative.

1.10. INCIDENT REPORTING (TDSB SPECIFIC REQUIREMENTS)

- .1 If at the workplace an accident, explosion, or fire causes a person injured (where they cannot perform their regular duties), a death or a critical injury the Contractor must follow all applicable regulations with respects to reporting. When reporting to the authority having jurisdiction the Board's Project Supervisor and Health & Safety Representative will be copied on the correspondence.

1.11. SITE MEETINGS (TDSB SPECIFIC REQUIREMENTS)

- .1 The Contractors Site Supervisor and Project Manager are required at all site meetings during the course of the project.
- .2 The Contractor shall record minutes of each meeting and promptly distribute copies to be received by all participants not later than three days after meeting has been held. Distribute minutes of meetings to all Consultants, whether in attendance or not.

1.12. DOCUMENTS ON SITE (TDSB SPECIFIC REQUIREMENTS)

- 1 Contractor's field office shall at all times contain a complete set of Contract Documents (Drawings and Specifications) with all addenda, site instructions, change orders, reviewed shop drawings and samples, colour schedule, paint materials schedules, hardware list, progress reports and meeting minutes.

1.13. CASH FLOW CHART (TDSB SPECIFIC REQUIREMENTS)

- 1 Within 7 days after award of Contract, submit, in form approved by Consultant, cash flow chart broken down on a monthly basis in an approved manner. Cash flow chart shall indicate anticipated Contractor's monthly progress billings from commencement of work until completion.
- .2 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Consultant.
- .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 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.
- .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.

END OF SECTION

1.0 GENERAL

1.1. RELATED DOCUMENTS

- .1 This section describes requirements applicable to all sections within Divisions 02 to 49.

1.2. WORDS AND TERMS

- .1 Conform to definitions and their defined meanings in the Agreement and Definitions portion of CCDC 2 for Supplementary Words and Terms listed in Section 00 56 13.

1.3. COMPLEMENTARY DOCUMENTS

- .1 Generally, drawings indicate graphically, the dimensions and location of components and equipment. Specifications indicate specific components, assemblies, and identify quality.
- .2 Drawings, specifications, diagrams and schedules are complementary, each to the other, and what is required by one, to be binding as if required by all.
- .3 Should any conflict or discrepancy appear between documents, which leaves doubt as to the intent or meaning, apply the Precedence of Documents article below or obtain guidance or direction from Consultant.
- .4 Examine all discipline drawings, specifications, schedules, diagrams and related Work to ensure that Work can be satisfactorily executed.
- .5 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

1.4. PRECEDENCE OF DOCUMENTS

- .1 In the event of conflict within and between the Contract Documents, the order of priority within specifications and drawings for this project are - from highest to lowest:
 - .1 the Agreement and Definitions between the Owner and the Construction
 - .2 the Defined Terms, Definitions;
 - .3 Supplementary Conditions;
 - .4 the General Conditions;
 - .5 Sections of Division 01 of the specifications;
 - .6 Technical specifications Sections of Divisions 02 through 49 of the specifications.
 - .7 Schedules and Keynotes:
 - .1 Material and finishing schedules within the specifications, then;
 - .2 Material and finishing schedules on drawings, then;
 - .3 Keynotes and definitions thereto, then;
 - .8 Drawings:
 - .1 Drawings of larger scale shall govern over those of smaller scale of the same date, then;
 - .2 Dimensions shown on drawings shall govern over dimensions scaled from drawings, then;
 - .3 Location of utility outlets indicated on architectural detail drawings takes precedence over positions or mounting heights located on mechanical or electrical Drawings.
 - .9 Later dated documents shall govern over earlier documents of the same type.

1.5. SPECIFICATION GRAMMAR

- .1 Specifications are written in the imperative command mode, in an abbreviated form.
- .2 Imperative language of the technical sections is always directed to the Contractor identified as a primary constructor, as sole executor of the Contract, unless specifically noted otherwise.
 - .1 This form of imperative command mode statement requires the primary constructor to perform such action or Work.
 - .2 Perform all requirements of the Contract Documents whether stated imperatively or otherwise.
- .3 Division of the Work among subcontractors, suppliers, or others is solely the prime constructor's responsibility. The Consultant(s) and specification authors assume no responsibility to function or act as an arbiter to establish subcontract scope or limits between sections or divisions of Work.

END OF SECTION

1.0 GENERAL

1. Allowances included herein are for items of Work which could not be fully quantified prior to Bidding.
2. Expend each allowance as directed by the Consultant. Work covered by allowances shall be performed for such amounts and by such persons as directed by Consultant.
3. Funds will be expended by means of Cash Allowance allocations and contingency allowance allocations.
4. Progress payments for Work and Products authorized under allowances will be made in accordance with the payment terms set out in the Conditions of the Contract.
5. The Contractor shall bid the work involved and submit the Bids received to the Consultant and the Board, for approval
6. The Contractor shall submit 3 bids unless directed by the Board.

2.0 CASH ALLOWANCES

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. Supply only allowances shall include:
 - .1 Net cost of Products.
 - .2 Delivery to Site.
 - .3 Applicable taxes and duties, excluding HST.
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.
4. Inspection and testing allowances shall include:
 - .1 Net cost of inspection and testing services.
 - .2 Applicable taxes and duties, excluding HST.
5. Other costs related to work covered by cash allowances are not covered by the allowance, but shall be included in the Contract Price.
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.
7. Progress payments on accounts of work authorized under cash allowances shall be included in the monthly certificate for payment.
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.

3.0 ALLOWANCES SCHEDULE

- .1 Include in the Bid Price a total cash allowance as listed in the TDSB Invitation to Tender documents for the following work:

CA Table	
1	Independent Testing & Inspection (Including but not limited to soil, paving, concrete, mortar, structural steel, metal deck, spray foam insulation, sprayed fireproofing, air barrier, painting excluding mechanical & electrical Testing & Inspection) (As directed by the Consultant)
2	Additional hardware not previously identified in contract Documents
3	Unforeseen site conditions
4	Abatement of unforeseen material not identified in designated substances report
5	Unforeseen additional electrical or mechanical work in existing building
6	Door hardware inspection
7	TSSA elevator licensing fee.
8	Window and curtainwall inspection and testing
TOTAL CASH ALLOWANCE CARRIED FOR ITEMS ABOVE	
\$150,000.00	

4.0 CONTINGENCY ALLOWANCE

4.1 NOT APPLICABLE

End of Section

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 53 00 – Temporary Construction Facilities
- .4 Section 01 61 00 – Product Requirements
- .5 Section 01 78 10 – Closeout Submittals and Requirements
- .6 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. PROJECT COORDINATION

- .1 Perform coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities and construction Work, with progress of Work of other contractors, under instructions of the Consultant.
- .2 The Contractor shall have total control of the Work and shall effectively direct and supervise the Work so as to ensure conformity with the Contract Documents and within the Contract Time.
- .3 The Contractor shall be solely responsible for the construction means, methods, sequences, and procedures and for coordinating parts of the Work under the contract.
- .4 Co-ordinate progress of the Work, progress schedules, submittals, use of site, temporary utilities, construction facilities, safety regulations and fire protection, as per authorities having jurisdiction codes.
- .5 The Consultant has the authority to stop the Work:
 - .1 whenever they observe or are made aware of unsafe conditions.
 - .2 whenever it is deemed necessary to protect the interests of the Board,
 - .3 whenever materials or workmanship are in contravention to the Contract Documents

1.3. SITE SUPERVISOR AND PROJECT MANAGER

- .1 If requested, the Contractor shall provide the Consultant, in writing, the name of the Project Manager and Site Supervisor, and proof of competent experience in similar projects.
- .2 Performance of the Contractors Project Manager and Site Supervisor
 - .1 If the Board and or the Consultant become concerned with any of: Site Safety, Project Schedule, or general compliance with the tender documents due to the performance of the Site Supervisor or Project Manager, the Consultant and or the Board will identify the concerns in writing to the Contractor.
 - .2 The Contractor shall respond in writing to the Board and Consultant with a corrective action for each item within 24 hours.
 - .3 If it is found that any of the corrections are not immediately implemented, the Consultant and the Board shall meet with the General Contractor to review the credentials including curriculum vitae and comparable experience of a replacement Site Supervisor and or Project Manager proposed by that Contractor.
 - .4 All outstanding concerns initiating the replacement of the personnel will be immediately addressed to the satisfaction of the Consultant and the Board.
- .3 If the Board and or the Consultant become concerned with site safety, project schedule or general compliance with the tender documents due to the performance of the Site Supervisor or the Project Manager, the Consultant or the Board will issue the concerns in writing to the Contractor. The Contractor shall respond in writing within 24 hours to the

Consultant and the Board. If any of the corrections are not immediately implemented, the Consultant or the Board will schedule a meeting with the Consultant, General Contractor and the Board. At this meeting the Contractor will introduce the new Project Manager, and or Site Supervisor and present the Curriculum Vitae for each showing proof of comparable experience in similar projects. The Contractor will then address the outstanding concerns to the satisfaction of the Consultant and the Board.

- .4 The Project Manager, and/or Site Supervisor shall not be replaced by the Contractor without prior written approval from the Board and the Consultant.

1.4. PERMITS

- .1 **The Board will obtain & pay for all building permits, but the Contractor is responsible for all other permits, including electrical inspection and fire alarm verification.**

1.5. CONSTRUCTION DOCUMENTS

- .1 The Consultant will provide the Contractor with PDF copies of both the drawings and the specification and CAD format files of the drawings at no charge to the Contractor. All printing will be at the cost of the Contractor including the AS-BUILT documents.

1.6. PRECONSTRUCTION MEETING

- .1 Immediately prior to construction and upon notification by the Consultant of a time and date, the Contractor shall attend the preconstruction meeting at a location as determined by the Consultant, along with authoritative representatives of certain key subcontractors as specifically indicated in the conference notice. Agenda to include following:
 - .1 Appointment of official representative of participants in Work.
 - .2 Project communications procedures
 - .3 Schedule of Work, progress scheduling (including long lead items, cash allowance items) as specified in Section 01 32 00.
 - .4 Schedule of submission of shop drawings, samples, colour chips as specified in Section 01 33 00.
 - .5 Requirements for temporary facilities, washrooms, refuse bin, site sign, offices, storage sheds, utilities, fences as specified in Section 01 53 00.
 - .6 Delivery schedule of specified equipment as specified in Section 01 61 00.
 - .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements.
 - .8 Owner furnished products.
 - .9 Record drawings as specified in Section 01 78 10.
 - .10 Maintenance material and data as specified in Section 01 78 10.
 - .11 Take-over procedures, acceptance, and warranties as specified in Section 01 78 10.
 - .12 Monthly progress claims, administrative procedures, photographs, and holdbacks.
 - .13 Appointment of inspection and testing agencies
 - .14 Insurances and transcript of policies.
 - .15 Review Vendor Performance Evaluation for the Contractor and Subcontractors
 - .16 Hot Work Permit Process
 - .17 Security Access, Fire Alarm shut down procedures
 - .18 Any other items as required by owner, contractor or Consultant.

1.7. ON-SITE DOCUMENTS

- .1 Maintain at job site at all times, one copy (written or digital) each of the following:
 - .1 Complete set of Contract drawings.
 - .2 Specifications.
 - .3 All Addenda.
 - .4 Site Instructions and Sketches
 - .5 Reviewed shop drawings and samples.
 - .6 Change Orders and Contemplated Change Orders.
 - .7 Other modifications to Contract.
 - .8 Site Instructions
 - .9 Colour schedule
 - .10 Hardware List
 - .11 Field test reports.
 - .12 Copy of approved Work schedule.
 - .13 Manufacturers' installation and application instructions.
 - .14 Progress reports and meeting minutes.
 - .15 Approved building permit documents.
 - .16 Copy of current Ontario Building Code and National Building Code.
 - .17 CSA Standard, CGSB Specifications. ASTM Documents and other standards referenced to in the specifications.
 - .18 Labour conditions and wage schedules.
 - .19 Applicable current editions of municipal regulations and by-laws. Current building codes, complete with addenda bulletins applicable to the Place of the Work.

1.8. SCHEDULES

- .1 Within three weeks following the award of the Contract, submit a detailed, trade by trade progress schedule for the work in a bar chart form acceptable to the Consultant.
- .2 Submit preliminary construction progress schedule as specified in Section 01 32 00 to Consultant coordinated with Consultant's project schedule.
- .3 After review, revise and resubmit schedule to comply with revised project schedule.
- .4 During progress of Work revise and resubmit as directed by Consultant.
- .5 Provide schedule updates every month with request for Payment, for duration of Contract.

1.9. CONSTRUCTION PROGRESS MEETINGS

- .1 Prior to the commencement of the Work, the Contractor together with the Consultant shall mutually agree to a sequence for holding regular "on site meetings".
- .2 The Contractor will organize site meetings. Ensure persons, whose presence is required, are present and relative information is available to allow meetings to be conducted efficiently.
- .3 Contractor, major subcontractors and consultants involved in Work are to be in attendance.
- .4 Post and forward copies of progress schedules for advice of Subcontractors, Owner and Consultant.
- .5 Notify parties minimum five (5) days prior to meetings.
- .6 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within two (2) days after meeting.
- .7 Agenda to include following:
 - .1 Review, approval of minutes of previous meeting.

- .2 Review of Work progress since previous meeting.
- .3 Field observations, problems, conflicts.
- .4 Problems which impede construction schedule.
- .5 Review of off-site fabrication delivery schedules.
- .6 Corrective measures and procedures to regain projected schedule.
- .7 Revision to construction schedule.
- .8 Progress schedule, during succeeding work period.
- .9 Review submittal schedules: expedite as required.
- .10 Maintenance of quality standards.
- .11 Review proposed changes for effect on construction schedule and on completion date.
- .12 Review site security issues.
- .13 Other business.
- .8 Schedule additional meetings, to expedite progress, should work require it.
- .9 Keep Owner and Consultant informed of progress, of delays and potential delays during all stages of Work. Do everything possible to meet progress schedule
- .10 Schedule and administer pre-installation meetings when specified in sections and when required to coordinate related or affected Work.

1.10. SUBMITTALS

- .1 Prepare and issue submittals to Consultant for review.
- .2 Submit preliminary Shop Drawings, product data and samples for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Consultant.
- .3 Submit requests for payment for review, and for transmittal to Consultant.
- .4 Submit requests for interpretation of Contract Documents, and obtain instructions through Consultant.
- .5 Process substitutions through Consultant.
- .6 Process change orders through Consultant.
- .7 Deliver closeout submittals for review and preliminary inspections, for transmittal to Consultant.

1.11. RECORD (AS-BUILT) DOCUMENTS AND SAMPLES

- .1 Procedures for record as-built documents and samples as specified in Section 01 78 10.
- .2 Keep as-built documents and samples available for inspection by Consultant.

1.12. CLOSEOUT PROCEDURES

- .1 Take-over procedures, acceptance, and warranties as specified Section 01 78 10
- .2 Notify Consultant and Board when Work is considered ready for Substantial Performance.
- .3 Accompany Consultant and Board on preliminary inspection to determine items listed for completion or correction.
- .4 Comply with Consultant's instructions for correction of items of Work listed in executed certificate of Substantial Performance.
- .5 Notify Consultant of instructions for completion of items of Work determined in Consultant's final inspection.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. SCHEDULES

- .1 Within seven 7 days following the award of the Contract, submit a detailed cash flow chart broken down on a monthly basis, in a manner acceptable to the Consultant. Cash flow chart shall indicate anticipated Contractor's monthly progress billings from commencement of work until completion.
- .2 Update cash flow chart whenever changes occur to scheduling and in manner and at times satisfactory to Consultant.
- .3 Submit schedule of values at least fourteen (14) days before the first application
- .4 Submit schedules as follows:
 - .1 Submittal Schedule for Shop Drawings and Product Data.
 - .2 Submittal Schedule for Samples.
 - .3 Submittal Schedule for timeliness of Owner-furnished Products.
 - .4 Product Delivery Schedule.
 - .5 Cash Allowance Schedule for acquiring Products and Installation.
 - .6 Shutdown or closure activity.

1.3. CONSTRUCTION PROGRESS SCHEDULING

- .1 Submit initial schedule to the Consultant and the Board in duplicate within seven (7) days after following the award.
- .2 Schedule Format.
 - .1 Prepare schedule in form of a horizontal bar chart.
 - .2 Split horizontally for projected and actual performance.
 - .3 Provide horizontal time scale identifying each Working Day of each week.
- .3 Schedule Submission.
 - .1 Consultant will review schedule and return reviewed copies within five (5) days after receipt.
 - .2 Submit schedules in electronic format, forward to the Consultant and Owner as a pdf. file.
 - .3 Resubmit finalized schedule within five (5) days after return of review copy.
 - .4 Submit revised progress schedule with each application for payment.
 - .5 Distribute copies of revised schedule to:
 - .1 Job site office.
 - .2 Subcontractors.
 - .3 Other concerned parties.
 - .6 Instruct Consultant to report to Contractor within ten (10) days, any problems anticipated by timetable shown in schedule.
- .4 Submit revised schedules with Application for Payment, identifying changes since previous version.
- .5 Select either of the following paragraphs to identify the type and format of schedule required.

- .6 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- .7 Indicate estimated percentage of completion for each item of Work at each submission.
- .8 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.
- .9 Include dates for commencement and completion of each major element of construction:
- .10 Indicate projected percentage of completion of each item as of first day of month.
- .11 Indicate progress of each activity to date of submission schedule.
- .12 Indicate changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .13 Provide a written report to define:
 - .1 Problem areas, anticipated delays, and impact on schedule.
 - .2 Corrective action recommended and its effect.
 - .3 Effect of changes on schedules of other subcontractors.

1.4. PROGRESS PHOTOGRAPHS

- .1 Digital Photography:
 - .1 Submit electronic copy of progress photographs of project, Digital format, minimum 300 in megapixel resolution.
 - .2 Identification: Name and number of project and date of exposure indicated.
 - .3 Provide both interior and exterior photographs.
 - .4 Number of Viewpoints: Locations of viewpoints determined by Consultant.
 - .5 Frequency: Monthly with progress statement. Provide the required number of pictures to accurately reflect the submitted progress percentage.

1.5. SHOP DRAWING SUBMITTAL SCHEDULE

- .1 Include schedule for submitting shop drawings, product data, samples
- .2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.
- .3 Include dates when shop drawings and samples will be required for Owner-furnished products.
- .4 Include dates when reviewed submittals will be required from Consultant.
- .5 Provide final signed off copies of the shop drawings in digital format to the Board.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 78 10 - Closeout Submittals.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. ADMINISTRATIVE

- .1 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present Shop Drawings, product data, samples and mock-ups in Metric (SI) units. Shop drawings containing imperial measurements will be rejected.
- .4 Where items or information is not manufactured or produced in SI Metric units, converted values within the metric measurement to the next largest imperial size available. Tolerances of .0625 acceptable.
- .5 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.
- .6 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
- .7 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Consultant's final review.
- .8 No work, requiring a shop drawing submission, shall be commenced until the submission has received Consultant's final review. Only shop drawings bearing Consultant's review stamp are to be sent and used on the job site.
- .9 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .10 Shop drawings shall not contain substituted materials unless such substitutions have been requested in advance and approved by Consultant.
- .11 Verify field measurements and affected adjacent Work are coordinated.
- .12 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .13 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .14 Keep one (1) reviewed copy of each submission on site.

1.3. SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 The term "design team" means Consultant and Sub-consultants whether Sub-consultants are employees of Consultant or not, and includes structural, mechanical, electrical, etc.

- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow fourteen (14) days for Consultant's review of each submission.
- .5 Adjustments made on Shop Drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .6 Make changes in Shop Drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to other parts of the Work.
- .9 After Consultant's review, distribute copies.
- .10 Submit Shop Drawings in Pdf. format for each requirement requested in specification Sections and as consultant may reasonably request.
- .11 Submit product data sheets or brochures in Pdf. format for requirements requested in specification sections and as requested by Consultant where Shop Drawings will not be prepared due to standardized manufacture of product.

- .12 Delete information not applicable to project.
- .13 Supplement standard information to provide details applicable to project.
- .14 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, the drawings will be stamped as reviewed or reviewed as modified and will be returned. At this point fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .15 Signed drawings shall be returned to and retained by Contractor who is then responsible for distribution of copies of corrected shop drawing to appropriate Subcontractors for appropriate action and to municipal building department for their records of those subjects required by authorities.
- .16 The Consultant's review is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and this review shall not relieve the Contractor of his responsibility for meeting the requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job 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.

1.4. SAMPLES

- .1 Submit for review to the Consultant three (3) samples as requested in respective specification Sections.
- .2 Submit samples with identifying labels bearing material or component description, manufacturer's name and brand name, Contractor's name, project name, location in which material or component is to be used, and date.
- .3 Deliver samples prepay any shipping charges involved for delivering samples to destination point and returning to point of origin if required.
- .4 Provide samples of special products, assemblies, or components when so specified.
- .5 No work requiring a sample submission shall commence until submission has received Consultant's final review.
- .6 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .7 Where colour, pattern or texture is criterion, submit full range of samples.
- .8 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .9 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .10 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5. MOCK-UP

- .1 Erect mock-ups to Section 01 45 00.

1.6. CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, and prior to commencing the work submit the performance bond and the labour and materials payment bond as described in the bid documents.
- .2 Submit transcription of certified true copies of insurance immediately after award of Contract.
- .3 A current WSIB clearance certificate
- .4 The bidder's health and safety policy for the project.
- .5 A copy of the notice of project issued by the ministry of labour for the project
- .6 Building materials, components and elements specified without the use of trade or proprietary names shall meet requirements specified. If requested by Consultant, submit evidence of meeting requirements specified. Evidence shall consist of certification based on tests carried out by an independent testing agency. Certification based on previous tests for same materials, components or elements is acceptable. Certification shall be in form of written test reports prepared by testing agency.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 14 00 – Work Restrictions.
- .2 Section 01 31 00 - Project Managing and Coordination.
- .3 Section 01 33 00 - Submittal Procedures.
- .4 Section 01 35 23 – Health and Safety
- .5 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. FIRE SAFETY PLAN

- .1 Contractors and their personnel will be familiar with this section and its requirements.
- .2 The contractor must take all necessary precautions during the carrying out of the work to prevent the possibility of fire occurring.

1.3. FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by the governing codes, regulations and bylaws.
- .2 The contractor will, at all times, when welding, brazing and performing any operation with an open flame, combustible adhesives or flammable solvents keep a portable, operable fire extinguisher within 3 meters of the operation.

1.4. HOT WORK

- .1 Take all precautions to Work safely and to provide the necessary protection to persons and property from Hot Work. This includes, but is not limited to Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch Applied Roofing and Welding. With all such activity these steps are to be followed:
 - .1 Whenever possible, complete Hot Work in a welding shop or out of doors at the school.
 - .2 Flammable liquids, dust lint and oily deposits to be removed from within 50-ft (15m) of Work. Remove other combustibles where possible. Otherwise protect with fire-resistive tarpaulins or metal shields.
 - .3 Explosive atmosphere in area eliminated. Floors swept clean. Combustible floors wet down, covered with damp sand or fire-resistive tarpaulins.
 - .4 All wall and floor openings covered. Fire-resistive tarpaulins suspended beneath Work.
 - .5 For on-site Work (indoor and out of doors), advise the Head Custodian, Principal, Consultant (if assigned) and Project Coordinator prior to Work being performed, and of related dangers.
 - .6 Where the Fire Alarm system is required to be set to stand-by to discourage false alarms from smoke detectors provide a firewatch throughout the building or structure being worked on. NEVER put the fire alarm system in stand-by mode when the building is occupied by staff or students.
 - .7 In the event of a fire as a result of the Hot Work, notify the fire department immediately. Report incident to the head custodian, the Consultant, if assigned, and Project Coordinator immediately, whether extinguished or not. Provide a fire incident report to the Board.

- .8 Barriers must be set up to protect staff and students (i.e. pylons, shields, and caution tape) from exposure to arc flash and smoke migration.
- .9 Have all necessary doors, windows and/or drapes closed. Confer with the Head Custodian to shut down all fan systems in the area to reduce or eliminate smoke distribution.
- .10 Provide and keep fire extinguishers handy and in good Working condition. Temporarily cover all smoke detectors in area during time of Work.
- .11 Provide a fire watch/spot check for several hours after Work is completed. Uncover smoke detectors.
- .12 On new construction, the requirements of the Hot Work permit may be waived, until such time as either Substantial Completion or Occupancy is granted, whichever comes first.
- .13 On additions to existing buildings, the requirements for Hot Work permits shall remain in place.

1.5. HOT WORK PERMIT

- .1 **A sample Hot Work Permit is attached to the specifications –**
- .2 Each permit is valid for seven (7) days only and must be renewed prior to its expiration date
- .3 The contractor must obtain Hot Work Permits from the School Board's representative prior to the start of work.
- .4 The contractor must complete the form as required and must keep the form on site.
- .5 Return each completed form to the School Board's representative on date of expiration.
- .6 The most current version of the Permit and it's requirements shall be used for the purposes of the Work.

1.6. FIRE PROTECTION SYSTEMS

- .1 Any Modifications to Fire Alarm system and it's devices including service, additions and changes in device location must be performed only by a Certified Fire Alarm Technician as per the Ontario Fire Code section 1.1, subsection 1.1.5.
- .2 The Contractor will receive from the Board's contact a contact number for the monitoring service and a school system number.
- .3 Bidders are cautioned that the Board will be reimbursed for the cost of false alarms. Refer to Section 01 14 00 Work Restrictions, Para. 1.4.4.
- .4 An approved inspection firm shall verify all new fire alarm devices, in accordance to CSA regulations. Certificate of Verification is required before occupancy.

1.7. FIRE ALARM SHUT-DOWN PROCEDURE

- .1 Do not shut the system down unless necessary. Plan the operation required to reduce system down time to the least amount possible.
- .2 Wherever possible, shut down only the zone needing Work and schedule this down time in unoccupied school hours. Allow for this in your bid pricing.
- .3 Discuss the possible down time with the head custodian and principal prior to any partial or whole system shut down.
- .4 The school or building administration shall advise all staff of fire alarm system shut down. This will include instructions to call 911 if they see a fire and when system is back on line.
- .5 Prior to alarm system shutdown and upon restoring the fire alarm system individuals supervising the shut down must contact Direct Detect at 519-741-2494 and have on hand

the School System Account Number (this number can be found on the decal on the fire alarm panel). The School System Account Number will start with the prefix 209

- .1 The Contractor shall provide full detail to the monitoring company as requested including building number and name (as identified on the fire alarm monitoring panel), contact name, company name, length of time system is down. Call shall be placed just prior to any shut down.
- .6 A fire patrol will need to be established and will include the following at the Contractor's expense:
 - .1 Patrol all halls and high-risk areas affected.
 - .2 Fire patrol shall have access to a phone and call 911 if they see a fire.
 - .3 Report all other problems they encounter.
 - .4 Remain on patrol until system is back on.
- .7 Contact Direct Detect at 519-741-2494 and inform them when the system is put back on line.
- .8 An activated system must not be reset until authorized by the Fire Department and the cause of the alarm has been investigated.

1.8. FIRE PROTECTION EQUIPMENT IMPAIRMENT

- .1 Fire Protection Equipment referred to in this section includes sprinkler systems, special fire suppression systems, and kitchen hood suppression systems.
- .2 The Contractor will take all precautions including restrict all Hot Work operations and shut down hazardous processes during all Fire protection equipment impairment.
- .3 Do not shut the Fire protection equipment down unless necessary Plan the operation required to reduce system impairment time to the least amount possible.
- .4 Wherever possible, shut down only the Fire protection equipment needing Work and schedule this impairment time for unoccupied school hours. Allow for this in your bid pricing.
- .5 Discuss the possible down time with the head custodian and principal prior to any partial or whole system impairment.
- .6 The school administration shall advise all staff of Fire protection equipment shut down. This will include instructions to call 911 if they see a fire and when system is back on line
- .7 The Contractor will plan to use temporary protection such as extra extinguishers, charged hose lines and temporary sprinkler protection during all Fire protection equipment impairment.
- .8 If the sprinkler system is restorable, either in whole or in part, the Contractor or sub-Contractor shall assign someone to restore the system promptly in the event of a fire.
- .9 A fire patrol may need to be established and will include the following at the Contractor's expense:
 - .1 Patrol all halls and high-risk areas affected.
 - .2 Fire patrol shall have access to a phone and call 911 if they see a fire.
 - .3 Report all other problems they encounter.
 - .4 Remain on patrol until system is back on.
- .10 The Contractor shall inform all sub trades that the Board has a Red Tag Permit System and it shall be used for all Fire protection equipment impairment.
- .11 For ease of use, a Factory Mutual hanging wall kit has been place at all Board Fire protection equipment locations. Supplies of Red Tag Permits are provided there.

1.9. FIRE ALARM MODIFICATIONS AND MAINTENANCE

- .1 Very important changes to Ontario Building Code as they relate to the Standard for the Verification of Fire Alarm Systems CAN/ULC-S537-M have taken effect December 24, 1999. (Minister's Ruling 99-BC-01)
 - .1 Clause 5.1; "Addition of conventional field device(s), or modification(s), to existing input circuit(s) or output circuit(s) shall require re-verification of all devices served by those input circuit(s) or output circuit(s)." If one device is added to a zone, the entire zone or in the case of a single zone panel the entire system is to be verified.
 - .2 Clause 5.2 "Addition of input circuit(s) or output circuit(s) to an existing fire alarm system shall require verification of the new circuit(s) in accordance with this standard, and shall also require all previously existing circuit(s) to be tested as follows:
 - .3 TEST: One conventional field device on each circuit shall be operated to confirm activation of all output circuits in accordance with the systems design." Even though no other zones have been touched, one device per input zone is to be tested when the Fire Alarm system is modified.
 - .4 Clause 5.5 "Where a transponder is added to an existing system, the transponder shall be verified in accordance with subsections 3.2, Wiring; and subsection 3.3 Control Units; and with CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems as well as re-verification of existing field devices and verification of new conventional field devices." If a new addressable device is added to a system, the new device is to be tested; as well a test must be conducted on all addressable devices on the loop.
 - .5 Clause 5.6 "Where an existing fire alarm system control unit is replaced with a new control unit, it shall be verified in accordance with CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems. Replacement of any control panel will require the testing of all existing fire alarm devices.
- .2 The Contractor and sub-Contractors shall include in the bid price for the above ULC Standards requirements referenced in the Ontario Building Code.

1.10. INSTALLATION AND/OR REPAIR OF ROOFING

- .1 The Contractor will review with the Consultant and the Board's representative of the location of any asphalt kettles and the dates the kettles will be in use. The Contractor, in the course of performing roofing work, will ensure all personnel utilize the following precautions:
 - .1 Use only kettles equipped with thermometers or gauges in good working order.
 - .2 Locate kettles in a safe place outside of building.
 - .3 Maintain continuous supervision while kettles are in operation and provide metal covers for the kettles to smother any flames in case of fire.
 - .4 All roofing materials stored in locations no closer than 15 meters to any structures.

1.11. FIRE DEPARTMENT ACCESS

- .1 Designated fire routes must be maintained. Fire Department must be advised of any work that would impede fire apparatus response.

1.12. SMOKING PRECAUTIONS

- .1 Smoking is not permitted anywhere on Board properties. Workers who wish to smoke must leave the property, and not within sight of students. Any worker found to be in contravention of the Ontario Smoke Free Act will be subject to legislated fines.

1.13. FLAMMABLE LIQUIDS

- .1 The handling and storage on site of flammable liquids are to be governed by the current National Fire Code of Canada.
- .2 Flammable liquids such as gasoline, kerosene and naphtha may be kept for ready use in quantities not exceeding 10 imperial gallons provided they are stored in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval.
- .3 Transfer of flammable liquids is prohibited within buildings.
- .4 Transfer of flammable liquids must not be carried out in the vicinity of open flame or any type of heat producing devices.
- .5 Flammable liquids having a flash point below 100° F (37.7°C) such as naphtha or gasoline must not be used as solvents or cleaning agents.
- .6 Flammable waste liquids, for disposal, must be stored in approved containers located in a safe ventilated area. Quantities are to be kept to a minimum.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 31 00 - Project Managing and Coordination.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 17 – Fire Safety Requirements
- .4 Section 01 41 00 – Regulatory Requirements
- .5 Section 01 53 00 – Temporary Construction Facilities
- .6 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. REFERENCES

- .1 Province of Ontario, including requirements for a "Prime Contractor" as defined by the Act.

1.3. SAFETY PLAN

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Consultant may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.
- .3 Be governed by pertinent safety requirements of Federal or Provincial Governments and of municipal bodies having authority, particularly the Ontario Construction Safety Act, The Occupational Health and Safety Act for Ontario, and regulations of Ontario Ministry of Labour, and work in conjunction with proper safety associations operating under the authority of Ontario Workers' Compensation Act. Protect Owner, Owner's employees, the public and those employed on the Work from bodily injury and to protect adjacent public and private property and Owner's property from damage. Furnish and maintain protection, such as warning signs, tarpaulins, guard rails, barriers, guard lights, night lights, railings around shafts, pits and stairwells, etc. as required. Remove temporary protective measures when no longer required.

1.4. TEMPORARY WORK

- .1 Temporary work requiring engineering proficiency for the design, erection, operation maintenance and removal shall be designed and bear stamp of the registered professional Engineer or Architect. Detail drawings will be submitted to the Consultant for review prior to commencing any work.
- .2 Before a temporary structure is used, person responsible for design, or their representative, shall inspect structure and certify it has been constructed according to their design.

1.5. RESPONSIBILITY

- .1 The "Prime Contractor" according applicable local jurisdiction, is responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, and follow procedures in place for Employee's Right to

Refuse Work in accordance with Acts and Regulations of Health and Safety Act having jurisdiction. Advise the Board and the Consultant verbally and in writing.

- .4 The Contractor shall make their own arrangements for emergency treatment of accidents. Any accidents shall be reported immediately to the Board contact.
- .5 The Contractor agrees to hold the Board harmless of any and all liability of every nature and description, which may be suffered through bodily injuries, involving deaths of any persons, by reasons of negligence of the Contractor, his agents, employees, or his sub-Contractors.

1.6. SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan: Within ten (10) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation
- .3 Submit one (1) copy of Contractor's authorized representative's work site health and safety inspection reports to Consultant and Owner.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit Material Safety Data Sheets (MSDS) to Consultant.
- .7 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Consultant.
- .9 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.
- .10 File Notice of Project with the Ministry of Labour prior to commencement of Work.

1.7. SAFETY ACTIVITIES

- .1 Perform site specific safety hazard assessment related to project.
- .2 Schedule and administer Health and Safety meeting with Consultant prior to commencement of Work.
- .3 Perform Work in accordance with Section 01 41 00 - Regulatory Requirements and this section.

1.8. HEALTH AND SAFETY COORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
 - .1 have previous experience as a Health & Safety coordinator,
 - .2 have working knowledge of occupational safety and health regulations,
 - .3 be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work,
 - .4 be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan, and

.5 be on site during execution of Work.

1.9. POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Health and Safety Act having jurisdiction, and in consultation with Consultant.

1.10. CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Consultant or by the Board.
- .2 Provide Consultant and/or Board with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Consultant and or the Board may stop Work if non-compliance of health and safety regulations is not corrected.

1.11. PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Refer to Section 01 35 43 Hazardous Materials

1.12. HAZARDOUS WORK

- .1 Blasting or other use of explosives is not permitted at the place of work.

1.13. WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

1.14. LOCKOUT PROCEDURES

- .1 All Work to be done on electrical systems or machinery, where the unexpected switching on of the system or machinery could result in personal injury to a student, staff, employee, or the Contractor's employee, must be done in accordance with the Contractor's standard lockout procedure.
- .2 The Contractor shall provide his/her own locks for the above procedure.
- .3 The lock shall include contact information for the person(s) locking out such device.

1.15. OVERHEAD LIFTING

- .1 Under no circumstances will a crane or lifting device be used over a occupied space.
- .2 When working adjacent to occupied spaces, ensure a clearance of one (empty) classroom, or a minimum of 10m between any occupied space and the furthest possible reach of the crane.

1.16. WARNING SIGNS AND NOTICES

- .1 Notices shall be posted advising of the hazard but will not be considered a substitute for providing approved protection, separation, and space from the hazard.

1.17. FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by the governing codes, regulations and bylaws.

- .2 Burning rubbish and construction waste materials is not permitted on site.
- .3 Maintain placed or installed Fire Protection to protect the portions of the Work during construction.

1.18. SCENT-FREE ENVIRONMENT

- .1 The Board requires that, where advised, a building may be deemed scent-free and as such, the wearing of scented products is prohibited.
- .2 Any methods or materials that are found to create negative responses in staff or students shall cease and be removed under advisement of the Consultant and or the Board, until alternate methods can be determined.

END OF SECTION

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 References and standards.
- .2 Standards producing industry organizations and their addresses.

1.2. RELATED SECTIONS

- .1 Section 01 61 00 – Product Requirements.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. REFERENCES

- .1 For Products or quality specified by association, trade, or other references or consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- .2 Conform to reference standard by Ontario Building Code except where a specific date is established or required by code.
- .3 Obtain copies of standards where required by product specification sections.
- .4 Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Consultant shall be altered from the Contract Documents by mention or inference otherwise, in any reference document.

1.4. STANDARDS

- .1 The following associations and organizations are cited in specification sections. Acronym, name, address, and Internet URL addresses are as follows:
- .2 **Canadian Organizations:**
 - .1 **ACEC** - Association of Consulting Engineers of Canada, 130 Albert Street, Suite 616, Ottawa, ON K1P 5G4; URL: <http://www.acec.ca>.
 - .2 **AWMAC** - Architectural Woodwork Manufacturers Association of Canada, 516-4 Street West, High River, AB T1V 1B6; URL: <http://www.awmac.com>.
 - .3 **Canada Green Building Council**, 330 - 55 rue Murray Street, Ottawa, ON. K1N5M3; Tel: 613-241-1184, Fax: 613-241-5750; URL: <http://www.cagbc.org>.
 - .4 **CCA** - Canadian Construction Association, 75 Albert St., Suite 400, Ottawa, ON K1P 5E7; URL: <http://www.cca-acc.com>.
 - .5 **CCDC** – Canadian Construction Documents Committee, Refer to ACEC, CCA, CSC or RAIC; URL: <http://www.CCDC.org>.
 - .6 **CGA** - Canadian Gas Association, 20 Eglinton Avenue West, Suite 1305, Toronto, ON M4R 1K8; URL: <http://www.cga.ca..>
 - .7 **CGSB** - Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, QC K1A 0S5; URL: <http://w3.pwgsc.gc.ca/cgsb>.
 - .8 **CISC** - Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, ON M2J 4G8; URL: <http://www.cisc-icca.ca>.
 - .9 **CLA** - Canadian Lumbermen's Association, 27 Goulburn Avenue, Ottawa, ON K1N 8C7; URL: <http://www.cla-ca.ca>.
 - .10 **CNLA** - Canadian Nursery Landscape Association, RR #4, Stn. Main, 7856 Fifth Street, Milton, ON L9T 2X8; URL: <http://www.canadanursery.com>.
 - .11 **CRCA** - Canadian Roofing Contractors Association, 155 Queen Street, Suite 1300, Ottawa, ON K1P 6L1; URL: <http://www.roofingcanada.com>.
 - .12 **CSA** - Canadian Standards Association International, 178 Rexdale Blvd., Toronto, ON M9W 1R3; URL: <http://www.csa-international.org>.

- .13 **CSC** - Construction Specifications Canada, 120 Carlton Street, Suite 312, Toronto, ON M5A 4K2; URL: <http://www.csc-dcc.ca>.
- .14 **CSDMA** - Canadian Steel Door Manufacturers Association, One Yonge Street, Suite 1801, Toronto, ON M5E 1W7; URL: <http://www.csdma.org>.
- .15 **CSPI** - Corrugated Steel Pipe Institute, 652 Bishop Street N, Unit 2A, Cambridge, ON N3H 4V6; URL: <http://www.cspi.ca>.
- .16 **CSSBI** - Canadian Sheet Steel Building Institute, 652 Bishop St. N., Unit 2A, Cambridge, ON N3H 4V6; URL: <http://www.cssbi.ca>.
- .17 **CUFCA** - Canadian Urethane Foam Contractor's Association, Box 3214, Winnipeg, MB R3C 4E7; URL: <http://www.cufca.ca>.
- .18 **CWC** - Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, ON. K1J 9B8; URL: <http://www.cwc.ca>.
- .19 **EC** - Environment Canada, Conservation and Protection, Inquiry Centre, 351 St. Joseph Blvd, Hull, QC KIA 0H3; URL: <http://www.ec.gc.ca>.
- .20 **EFC** - Electro Federation of Canada, 5800 Explorer Drive, Suite 200, Mississauga, ON L4W 5K9; URL: <http://www.electrofed.com>.
- .21 **MPI** - The Master Painters Institute, 4090 Graveley Street, Burnaby, BC V5C 3T6; URL: <http://www.paintinfo.com>.
- .22 **NABA** - National Air Barrier Association, PO Box 2747, Winnipeg, MB R3C 4E7; URL: <http://www.naba.ca>.
- .23 **NLGA** - National Lumber Grades Authority, 406-First Capital Place, 960 Quayside Drive, New Westminster, BC V3M 6G2; URL: <http://www.nlga.org>.
- .24 **NRC** - National Research Council, Building M-58, 1200 Montreal Road, Ottawa, ON K1A 0R6; URL: <http://www.nrc.gc.ca>.
- .25 **QPL** - Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, QC K1A 1G6; URL: <http://www.pwgsc.gc.ca/cgsb>.
- .26 **RAIC** - Royal Architectural Institute of Canada, 55 Murray Street, Suite 330, Ottawa, ON K1N 5M3; URL: <http://www.raic.org>.
- .27 **SCC** - Standards Council of Canada, 270 Albert Street, Suite 2000, Ottawa, ON K1P 6N7; URL: <http://www.scc.ca>.
- .28 **TTMAC** - Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, ON L4K 3E8; URL: <http://www.ttmac.com>.
- .29 **ULC** - Underwriters' Laboratories of Canada, 7 Crouse Road, Toronto, ON M1R 3A9; URL: <http://www.ulc.ca>.
- .3 **USA Organizations:**
 - .1 **AA** - Aluminum Association, 900 19th Street N.W., Washington, DC 20006; URL: <http://www.aluminum.org>.
 - .2 **AASHTO** - American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, DC 20001; URL: <http://www.aashto.org>.
 - .3 **AHA** - American Hardboard Association, 1210W Northwest Hwy, Palatine, IL 60067; URL: <http://www.hardboard.org>.
 - .4 **AITC** - American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, CO 80112; URL: <http://www.aitc-glulam.org>.
 - .5 **AMCA** - Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, IL 60004-1893; URL: <http://www.amca.org>.

- .6 **ANSI** - American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036; URL: <http://www.ansi.org>.
- .7 **APA** - The Engineered Wood Association, P.O. Box 11700, Tacoma, WA 98411-0700; URL: <http://www.apawood.org>.
- .8 **API** - American Petroleum Institute, 1220 L St. Northwest, Washington, DC 20005-4070; URL: <http://www.api.org>.
- .9 **ARI** - Air Conditioning and Refrigeration Institute, 4100 N Fairfax Drive, Suite 200, Arlington, VA 22203; URL: <http://www.ari.org>.
- .10 **ASHRAE** - American Society of Heating, Refrigeration and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, GA 30329; URL: <http://www.ashrae.org>.
- .11 **ASME** - American Society of Mechanical Engineers, ASME Headquarters, 3 Park Avenue, New York, NY 10016-5990; URL: <http://www.asme.org>.
- .12 **ASTM International**, 100 Barr Harbor Drive West, Conshohocken, PA 19428-2959; URL: <http://www.astm.org>.
- .13 **AWCI** - Association of the Wall and Ceiling Industries International, 803 West Broad Street, Suite 600, Falls Church, VA 22046; URL: <http://www.awci.org>.
- .14 **AWPA** - American Wire Producer's Association, 801 N Fairfax Street, Suite 211, Alexandria, VA 22314-1757; URL: <http://www.awpa.org>.
- .15 **AWPA** - American Wood Preservers' Association, P.O. Box 5690, Granbury TX 76049-0690; URL: <http://www.awpa.com>
- .16 **AWS** - American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126; URL: <http://www.amweld.org>.
- .17 **AWWA** - American Water Works Association, 6666 W. Quincy Avenue, Denver, CO 80235; URL: <http://www.awwa.org>.
- .18 **EIMA** - EIFS Industry Manufacturer's Association, 3000 Corporate Center Drive, Suite 270, Morrow, GA 30260; URL: <http://www.eima.com>.
- .19 **ISAP** - International Society for Asphalt Paving, 400 Selby Avenue, Suite 1, St. Paul, MN 55102; URL: <http://www.asphalt.org>.
- .20 **IEEE** - Institute of Electrical and Electronics Engineers, IEE Corporate Office, 3 Park Avenue, 17th Floor, New York, NY 10016-5997; URL: <http://www.ieee.org>
- .21 **MSS** - Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, VA 22180-4602; URL: <http://www.mss-hq.com>.
- .22 **NAAMM** - National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, IL 60603; URL: <http://www.naamm.org>.
- .23 **NEMA** - National Electrical Manufacturers Association, 1300 N 17th Street, Suite 1847, Rosslyn, VA 22209; URL: <http://www.nema.org>.
- .24 **NFPA** - National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101 Quincy, MA 02269-9101; URL: <http://www.nfpa.org>.
- .25 **NFSA** - National Fire Sprinkler Association, P.O. Box 1000, Patterson, NY 12563; URL: <http://www.nfsa.org>.
- .26 **NHLA** - National Hardwood Lumber Association, 6830 Raleigh-La Grange Road, Memphis, TN 38184-0518; URL: <http://www.natlhardwood.org>.
- .27 **NSPE** - National Society of Professional Engineers, 1420 King Street, Alexandria, VA 22314-2794; URL: <http://www.nspe.org>.
- .28 **PCI** - Prestressed Concrete Institute, 209 W. Jackson Blvd., Suite 500, Chicago, IL 60606-6938; URL: <http://www.pci.org>.

- .29 **PEI** - Porcelain Enamel Institute, PO Box 920220, Norcross, GA 30010; URL: <http://www.porecelainenamel.com>.
- .30 **SSPC** - The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656; URL: <http://www.sspc.org>.
- .31 **TPI** - Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI 53719; URL: <http://www.tpinst.org>.
- .32 **UL** - Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, IL60062-2096; URL: <http://www.ul.com>.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 21 00 - Allowances.
- .2 Section 01 78 10 – Closeout Submittals and Requirements
- .3 Section 01 79 00 – Demonstration and Training
- .4 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. REFERENCES

- .1 **ISO/IEC 17025-2005** - General Requirements for the Competence of Testing and Calibration Laboratories.
- .2 **SCC** (Standards Council of Canada).

1.3. INSPECTION BY AUTHORITY

- .1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

1.4. REVIEW BY CONSULTANT

- .1 Consultant may order any part of the Work to be reviewed or inspected if Work is suspected to be not in accordance with Contract Documents.
- .2 If, upon review such work is found not in accordance with Contract Documents, correct such Work and pay cost of additional review and correction.
- .3 If such Work is found in accordance with Contract Documents, The owner will pay cost of review and replacement.

1.5. INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection and Testing Agencies will be engaged by Contractor for purpose of inspecting and testing portions of Work.
- .2 The Board may, at their discretion, request that the Consultant direct the Contractor to engage independent inspecting and or testing agencies to review or test the Work.
- .3 Allocate Costs for inspections and testing to Section 01 21 00.
- .4 Provide equipment required for executing inspection and testing by appointed agencies.
- .5 Employment of inspection and testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .6 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to Owner. Contractor shall pay costs directly to the inspection agency for retesting and re-inspection.

1.6. ACCESS TO WORK

- .1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Cooperate to provide reasonable access and facilities for such access.

1.7. CONTRACTOR RESPONSIBILITIES

- .1 Notify appropriate agency minimum 48 hours in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8. DUTIES & AUTHORITY OF TESTING AGENCY

- .1 Testing agency is expected to do the following:
 - .1 Act in a professional and unprejudiced basis and carry out inspection and testing functions to establish compliance with requirements of Contract Documents.
 - .2 Check work as it progresses and prepare reports stating results of tests and conditions of work and state in each report whether specimens tested conform to requirements of Contract Documents, specifically noting deviations.
 - .3 Distribute reports as follows
 - .1 Consultant
 - .2 Owner
 - .3 Contractor
- .2 Testing agency is not authorized to amend or release any requirements of Contract Documents, nor to approve or accept any portion of work.

1.9. REJECTED WORK

- .1 The Contractor shall remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If, it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, the Owner may choose to accept the condition. The difference in value between Work performed and that called for by Contract Documents shall be deducted from the Contract value via Change Order. The amount of this change shall be determined by Consultant. The Contractor shall warrant the work performed for the time period specified as if it were performed in accordance with the Contract Documents.

1.10. TESTING OF EXCAVATION & BACK FILL

- .1 The Consultant must approve all Sample and fill tests prior to purchase.
- .2 In coordination with the Consultant and Contractor, inspect and test backfill and fill to ensure the degree of compaction specified has been obtained.

- .3 Inspect excavation at required levels in regard to bearing values for footings, foundations and floor slabs.
- .4 Authorization and calculation of extra excavation work, if required, due to unsatisfactory bearing shall be adjusted by Unit Price.

1.11. CONCRETE STRENGTH TESTS

- .1 Review the proposed concrete mix design and check test if considered necessary.
- .2 Obtain representative samples of fresh concrete for each mix design of concrete placed in any one day as directed by the Consultant.
- .3 Make standard slump tests.
- .4 Mould three (3) standard 150mm diameter cylindrical test specimens from each sampling of fresh concrete. Store specimens as per best practice while they are on the site. Cure all cylinders in the laboratory under standard moisture and temperature conditions. Compression test one of the cylinders at 7 days and the remaining two at 28 days after sampling. Each concrete cylinder test report shall contain the specific location of concrete represented by sample, design strength, aggregate size, admixtures used, date, hour and temperature at time of sampling, percentage air content, unit weight and test strength of cylinder.
- .5 When concrete is placed under the conditions of "Cold Weather Requirements" make one additional cylinder; store it in a heated enclosure for 24 hours and then store it on the job site in a place protected from disturbance and off the ground. Compressive test this cylinder 7 days after sampling.
- .6 Determine the air content of air entrained standard weight concrete.
- .7 Determine the air content and unit weight of light weight concrete by the volumetric method.
- .8 Additional testing required because of changes in materials or proportions of the mix requested by the Contractor as well as any extra testing of concrete or materials occasioned by their failure to meet specification requirements or testing of the structure or performance of the structure, including load testing, shall be carried out at the Contractor's expense.

1.12. INSPECTION OF STRUCTURAL STEEL

- .1 Ensure all steel has mill test reports that comply with the Specification prior to purchase.
- .2 Inspect fabrication of steel in plant.
- .3 Inspect erection work at site including fit-up, placing, plumbing, levelling, temporary bracing, field cutting and alterations.
- .4 Shop and field inspect welded and bolted connections and painting.
- .5 High strength bolts - the installation and testing of bolts shall conform to the requirements of CSA S16-1969. Check one representative connection in ten by torque testing every bolt, and check each bolt in every connection with a tap of hammer for soundness. Enforce requirements of connection type.
- .6 Examine visually all welded joints for inclusions, porosity, lack of fusion penetration or even contour, undercuts and cracks. Root passes shall be checked for penetration and cracks from the back of the joint. Any suspect welds shall be checked ultrasonically.

1.13. INSPECTION OF METAL DECK

- .1 Check deck for gauge, type and protective coating thickness to ensure compliance with Specification.

- .2 Inspect erection work at the site including anchorage.

1.14. INSPECTION AND TESTING OF PAVING

- .1 Testing shall be carried out in three stages as described below by means of sufficient site visits to ensure satisfactory results but in no case less three site visits.
- .2 Test within 16 hours from time called to do so by Contractor, since paving is a critical item at the end of the project.
- .3 Stage One:
 - .1 Visual inspection and compaction tests of subsoil.
- .4 Stage Two:
 - .1 Inspection of granular sub-base (after each layer is placed or after the last layer is placed and compacted).
 - .2 On site density tests.
 - .3 Verify thickness of various levels. (Minimum of 4 checks shall be done on thickness in a paved area of 250m² or less, and 1 additional check for each additional 250m² or part thereof).
 - .4 Laboratory tests: moisture content and grading of materials.
- .5 Stage Three:
 - .1 Inspection of asphalt installation.
 - .2 Checking of thickness and density of material and checking suitability of equipment used.
- .6 Standard Proctor Test shall be carried out for all projects.
- .7 Further, grain size analysis and Marshall test shall be carried out if visual inspection is not satisfactory or, if there is reason to suspect materials supplied are not acceptable.
- .8 All laboratory tests shall be performed according to A.S.T.M. methods, latest revisions
- .9 Paving Contractor shall obtain from their supplier grading tables of materials used and submit them to the testing laboratory for approval. The paving contractor shall ensure material delivered complies with grading tables.
- .10 Be responsible for all approvals given to Paving Contractor. At completion of paving project, inform Consultant all tests were performed according to the Specifications and the Contractor's performance has been approved.
- .11 The Consultant will not entertain any credits for work either not performed or incorrectly performed by the contractor. If thicknesses or consistencies of sub-base are not as specified, or if asphaltic material is not as specified, then the Contractor shall remove same at their expense and provide proper specified materials.

1.15. BUILDING THERMOGRAPHIC SCAN

- .1 Upon completion of the Work, the Consultant and/or Owner may arrange for an independent agency to carry out a thermographic scan of the building to determine acceptability of thermal performance of the building envelope.
- .2 Consultant, prior to start of construction work, will designate a sample area of the building to include a portion of exterior wall and roof.
- .3 Consultant will implement a special inspection program for this sample area to be carried out as construction progresses. Contractor shall not cover any completed work until notifying Consultant and receiving acceptance of completed work. Contractor shall remove and replace any work which is installed in contravention of this requirement.

- .4 Results of thermographic scan of entire building will be evaluated and compared to those of the sample area to determine acceptance or rejection of any part of the building envelope.
- .5 Contractor shall carry out remedial work as required to bring quality of any rejected portion of the building envelope to that of the sample area. Contractor shall pay for costs of any follow-up thermographic scans required to determine acceptability of remedial work. This procedure shall be repeated until all parts of the building envelope have been accepted.

1.16. TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as may be requested.
- .2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Consultant and may be authorized as recoverable.

1.17. MOCK-UP

- .1 Prepare mock-up for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
- .2 Prepare mock-ups for Consultants review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
- .3 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .4 If requested, Consultant will assist in preparing a schedule fixing dates for preparation.
- .5 Remove mock-up at conclusion of Work or when acceptable to Consultant. Repair any damage and clean-up at place of mock-up.
- .6 Approved mock-up may remain as part of Work.

1.18. EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical and electrical systems to the consultant.
- .2 Refer to Sections 01.78.10 and 01.79.00 for definitive requirements.

END OF SECTION

Part 1 General

1.1 Scope and Purpose:

- .1 These specifications establish the requirements for test specimens, apparatus, sampling, test procedures and test reports to be used in evaluating the performance of newly installed windows, storefronts, curtain walls and sloped glazing systems and their installation during construction; ("Test Area" hereafter referred to as "specimen").
- .1 The purpose of this specification is to provide a method which can be used to evaluate the installed performance of windows, storefronts, curtain walls and sloped glazing systems for air leakage and resistance to water penetration under controllable and reproducible test conditions intended to simulate wind driven rain events. Field air leakage testing is not recommended for a portion of continuous framing systems (spanning multiple floors) due to the complexity of compartmentalizing air chambers and cavities within these systems

1.2 REFERENCE STANDARDS

- .1 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 503-14, Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
 - .2 AAMA 511-08, Voluntary Specifications for Forensic Water Penetration Testing of Fenestration Products.
- .2 ASTM International (ASTM)
 - .1 ASTM E783-02 (2018), Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
 - .2 ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .3 CSA Group (CSA)
 - .1 CSA A440/A440.1 (R2005), Windows/Special Publication, User Selection Guide to CSA Standard CAN/CSA-A440-00

Part 2 Test Methods

2.1 GENERAL

- .1 Field testing procedure and test apparatus shall meet the requirements of the following referenced ASTM test method. The most current revision of the ASTM method shall be identified in the specifications. If a revision number is not referenced, then the version current during the bidding stage of the project shall be used.
- .2 Resistance to air infiltration using static air pressure difference: ASTM E 783, "Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors."

- .3 Resistance to water penetration using static air pressure difference: ASTM E 1105, "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors and Curtain Walls and by Uniform or Cyclic Static Air Pressure Difference."

2.2 TEST CHAMBER ARRANGEMENT

- .1 Joints (i.e. transition seals) between the specimen and the adjacent wall, curb or roof shall be permitted to be included in the test specimen for water penetration testing only. The test chamber shall be applied to the interior or exterior of the wall, curb or roof construction in such a manner as to create a pressure differential across the specimen assembly, including perimeter frame intersections and perimeter seals, subframes, receptors and flashing.
- .2 Testing shall be performed immediately after the first units have been installed and regularly thereafter. All testing is to be performed prior to the installation of drywall or interior finish wall/roof materials if the transition seal from the glazing system to the adjacent wall system is to be tested for water penetration. If interior finish wall/roof materials have been installed, they shall be removed at the test area to allow visual access to these areas to check for water penetration, or other means of visual access shall be provided

Part 3 Sampling

3.1 GENERAL

- .1 As soon as practical after installation has begun, and after the test specimen has been completely installed, adjusted, cleaned and perimeter sealed (including adequate time for the sealant to cure), the specimen shall be tested for air leakage and water penetration resistance as specified in Section 4.0.
 - .1 All trades and contractors involved and responsible for the test specimen performance (i.e. manufacturer, erector, glazier, perimeter caulking contractor, etc.) shall be made aware of the test date and invited to witness the testing.
- .2 If any of the specimen(s) do not conform to the prescribed air leakage and water penetration resistance requirements, the manufacturer and/or the installer shall be afforded the opportunity to perform a site inspection and determine the reason for non-compliance. Non-compliant specimen(s) shall be repaired as required and retested as soon as practical. The remedial work shall be recorded and approved by the specifying authority, architect and/or owner. Upon satisfactorily passing a retest, the remedial work performed shall become punch list items to randomly check for similar conditions on the remainder of the project.
- .3 If water leakage is observed and the source of the leakage cannot be determined, a forensic evaluation using the procedures outlined in AAMA 511 shall be performed while maintaining the test pressures defined in the field testing specifications, and employing the test methods defined in AAMA 503.
- .4 The initial testing shall be paid for through the project inspection and testing allowance. The contractor will be responsible for all costs associated with any retesting or additional

testing that is the result of failures of initial testing; these costs are to include all construction, testing agency, and owner representative consulting fees associated with the retesting.

- .5 Testing shall be performed by a qualified independent testing agency.
- .6 The following testing schedule shall be followed:
 - .1 Test #1: Mock-up Sample, which is considered to be the first assembly installed on the project; installation of the project glazing assemblies is not to progress until the mock-up assembly testing is deemed a pass by the owner's representative or the owner provides instruction to continue with the glazing assembly installation irrespective of the mock-up results.
 - .2 Test three (3) glazing assemblies for the first 100 assemblies installed; test no less than 3 assemblies. Test 1% of the remaining glazing assemblies.
 - .3 For every failure other than the mock-up assembly, test an additional 3 assemblies.

Part 4 TEST PROCEDURES

4.1 General

- .1 Air leakage resistance and water penetration resistance tests shall be performed at pressures specified in Sections 4.1.2 and 4.1.3.
 - .1 Where both tests are to be conducted in sequence, the test for air leakage resistance shall be conducted before the test for water penetration resistance. If there is reason to believe that residual water from rain or other sources may be located in the specimen, a two-minute negative (outward) pressure test followed by a two-minute positive (inward) pressure test shall be conducted at the same pressure differential used for the performance test to purge the specimen of any residual water. The specimen gaskets or weatherstrips shall be examined and shall be dry before proceeding with the air leakage resistance test.
 - .2 An air leakage resistance test shall be conducted at a minimum uniform static test pressure of 75 Pa (for windows) or 300 Pa (for curtain wall) or as specified for the project. Air leakage resistance shall be determined per ASTM E 783.
 - .1 The maximum allowable rates of air leakage for field testing shall meet the rating of A3 as defined in CSA-A440/A440.1. for operable units and "fixed" for non operable units.
 - .3 Water penetration resistance performance shall be determined per ASTM E 1105 using Procedure A, "Uniform Static Air Pressure Difference."
 - .1 The field water penetration resistance tests shall be conducted [500] Pa. The glazing product is to meet the following requirements:
 - .1 With all operable portions of the specimen closed and locked, the specimen shall be subjected to a water penetration test in accordance with ASTM E 1105 with continuous pressure and water application. Observe and note all points of water penetration, if any, that occur during

the test. If the origin of the water leakage cannot be definitively attributed to either the product specimen or the joint between the product specimen and the surrounding condition, a forensic evaluation shall be performed using the procedures outlined in AAMA 511 while maintaining the test pressures defined in the field testing specifications and employing the test methods defined in AAMA 503.

- .4 Water penetration
 - .1 Attributable to the surrounding condition shall be defined as the presence of uncontrolled water which did not originate from the product specimen or the joint between the product specimen and the wall/roof.
 - .2 Water penetration attributable to the product specimen shall be defined as the penetration of water beyond the primary seal/plane of water resistance.
 - .3 Water penetration attributable to the perimeter joint shall be defined as uncontrolled water that indisputably originates at the joint.

Part 5 TEST REPORTS

5.1 General

The report shall include enough information to reproduce the test. At a minimum, the following information shall be included:

- .1 General:
 - .1 The testing agency, name of the individual(s) performing the tests, test witnesses, date and time of test, date of report, identification and location of the building shall be identified. The date of the last equipment calibration and the location of calibration records shall also be included in the report.
- .2 Glazing Product Description
 - .1 The manufacturer, model, operation type (if applicable), dimensions, materials, etc.; identification and location of specimen(s) within the building; physical condition of specimen; description of any modifications made to the specimen; number of retests, etc. The test agency shall report the plumb, level and square condition of the tested specimen.
- .3 Sampling Procedures
 - .1 If applicable, describe or list the procedures established from Section 3.0.
- .4 Test Parameters
 - .1 List or describe the specified static pressure differential(s) used in the test, whether the chamber was affixed to the interior or exterior of the wall/roof, and provide a detailed description (include sketches showing location, if appropriate) of the chamber attachment to the specimen. Provide a written description of any measures that were taken to control ambient conditions. Clearly identify any elements of the specimen that were not tested. Verify in a statement that the sample was inspected immediately prior to the test or installation of the chamber if it conceals portions of the specimen, that the original conditions were observed

and documented, and that all surfaces were dry, such that water observed during or after testing was produced by the test itself and no other possible source.

.5 Test Results

.1 Record the following:

- .1** Actual and allowable air leakage for the product specimen.
- .2** Actual and allowable water penetration for the product specimen.
- .3** Actual and allowable water penetration for the perimeter condition.
- .4** Environmental conditions as measured at the time of the test: wind speed, wind direction, precipitation, barometric pressure and ambient temperature.

.6 Additional Observations

.1 If problems with a specimen installation are observed, they shall be brought to the responsible contractor's and/or manufacturer representative's attention.

- .1** The observations to be recorded shall include but not be limited to the following:
 - .2** Deterioration of building elements due to water penetration
 - .3** Deviations of the installation from the drawings of record
 - .4** Staining or discoloration of building components
 - .5** Evidence of damage to either the installed product or the surrounding building elements
 - .6** Unusual or unexpected evidence of water penetration or air leakage which would require remediation
 - .7** Any observed performance or installation details which might be deemed of importance to a subsequent forensic investigation.

.7 Compliance Statement

- .1** Make a statement that the tests were conducted in accordance with this specification or completely describe any deviation. Also, state whether or not the results indicate compliance with the field testing specification requirements.

Part 6 COST

6.1 General

- .1** Base Project Testing: All costs associated with execution of the mock-up testing and the construction progress testing shall be taken from the project cash allowance.
- .2** Additional Testing or Retesting: Any testing that is required as a result of failure of the base project sample testing, shall be borne by the contractor and cannot be reimbursed from the project cash allowance.

Part 7 CONTRACTOR RESPONSIBILITIES

7.1 General

- .1 The following shall be provided by the Contractor:
- .1 Adequate water supply (standard garden-hose bib with minimum 7 gpm water flow at 45 psi pressure) within 15 m (50') of test area. A booster pump may be required if water flow and pressure cannot be maintained for the entire duration of test.
 - .2 Contractor shall conduct a bucket-and-stopwatch check prior to test date to ensure adequate water supply

Test Requirement	Maximum time allowed to fill a 5-gallon pail
8'x8' Spray Rack, A440 Water Test	50 seconds
10'x10' Spray Rack, A440 Water Test	30 seconds

- .3 Electrical outlet, standard 115V, 15A within 3 m (10') of test area.
- .4 Free and un-encumbered access to both the interior and exterior side of test area, such as removal of curtains and blinds, furniture, etc.
- .5 Free access to the wall cavity immediately beneath the window/door sill in order to inspect for any water penetration (as required by the A440 Window Standard). If such access was not provided, and if the window passes the water penetration test, the window would receive a "qualified Pass" with a note indicating that the area under the sill was not inspected.
- .6 Chamber installation requires installation of attachments and sealing to interior and exterior framing members and wall surfaces. This may result in unavoidable damage or staining of finished surfaces. Testing Agency will not responsible for cleaning/repairing such damage or staining.
- .7 The Contractor shall be responsible to ensure that all areas of the jobsite affected by window testing are protected from unsafe conditions.

PART 8 TESTING COMPANIES

8.1 General

- .1 The following testing companies are acceptable to perform the on site air leakage and water penetration testing:
- .1 Blue Green Consulting Group Inc.
 - .2 CAN-BEST Building Sciences Corporation (CANadian Building Envelope Science and Technology)
 - .3 Terraprobe
 - .4 Engineering Link Incorporated (available for testing where Engineering Link Incorporated is not the prime consultant)

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 52 00 - Construction Facilities.
- .2 Section 01 53 00 - Temporary Construction.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Location of temporary facilities shall be subject to Consultant's approval.
- .3 Salvage and assist in recycling products for potential reuse wherever possible.
- .4 Remove temporary facilities from site when directed by consultant.

1.3. DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water. Provide necessary pumps (including spare pumps) and temporary drainage for keeping the Work free of water throughout construction period. Locate sumps away from foundation elements. Control grading around excavation to prevent surface water from draining into excavation and from damaging adjoining property.
- .2 Provide dry mix low slump concrete mud slabs as required to provide suitable barrier for installation of concrete footings and to maintain construction schedule. Consult with Geotechnical Engineer prior to installation.

1.4. WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use until such time as permanent municipal water supply is available.
- .2 Hose extensions to be provided by subcontractors requiring them.
- .3 Arrange for connection with appropriate utility company and pay all costs for installation, maintenance, removal and usage costs until occupancy has been achieved.

1.5. TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating, including all unit rental costs and maintenance required during construction period including for winter protection.
- .2 Provide temporary heating fuel until such time as a permanent natural gas line is installed. The Contractor shall provide all connections and piping between the permanent fuel source and the heating appliance(s).
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold including winter protection.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum:
 - .1 10 degrees C in areas where construction is in progress, until takeover by Board. Contractor to ensure temporary enclosures remain sealed and penetrations are repaired or closed in a timely fashion.

- .2 16 degrees C in areas where finishes are in progress.
- .3 16 degrees C in building once it is enclosed.
- .4 Refer to other Sections for intermittent heating requirements up to 21 degrees C. Provide insulated tarp enclosures for openings as required to enclose the building after completion of main building shell components and roof.
- .5 If the Contractor fails to ensure the temporary enclosures remained sealed (including temp doors when not in use) the Consultant and or the Board shall require the contractor to pay 40% of that months usage charge
- .5 Use forced hot air heaters. Open-flame type heaters or salamanders are not permitted. Ventilate direct fired heating units to the outside.
- .6 Uniformly distribute heat to avoid hot and cold areas and to prevent excessive drying.
- .7 Early heating of the building shell will be required to expedite interior finishing to meet the project schedule.
- .8 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
 - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
 - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .4 Ventilate storage spaces containing hazardous or volatile materials.
 - .5 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
 - .7 Provide minimum 1 air change per hour for enclosed areas receiving architectural finishes.
 - .8 Do not allow excessive build-up of moisture inside building.
- .9 The permanent mechanical systems for the new building, when installed in safe operating conditions, may be used for temporary heating or cooling if approved in writing by the Consultant, without penalty to the warranty.
- .10 Follow the requirements of "Temporary Use of New Permanent Services and Equipment" if the permanent heating system installed under the contract is intended to be used for temporary heating during the construction.
- .11 Provide competent persons to operate and maintain permanent systems for duration of temporary use period.
- .12 Perform required repairs and maintenance immediately after each inspection. Pay for operating costs. Upon termination of temporary use period, services and equipment shall be inspected, tested, adjusted, fitters replaced, balanced, cleaned and lubricated.
- .13 Permanent services and equipment shall be turned over to Owner in new and perfect operating condition.
- .14 Use of permanent systems and equipment as temporary facilities shall not affect the guarantee conditions and guarantee period for such systems and equipment. Make due allowance to ensure Owner will receive full benefits of equipment manufacturer's warranty from the date of Substantial Performance.
- .15 Ensure date of Substantial Performance of the Work and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Consultant.

- .16 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .17 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6. TEMPORARY POWER AND LIGHT

- .1 Provide temporary electrical service and system including lighting and power system for use by all Sections.
- .2 Contractor will provide a source for, and pay the costs of temporary power during construction for temporary lighting and operating of power tools until such time as permanent source is available.
- .3 Contractor to ensure that the use of power from a source provided by the Board shall not exceed the capacity of the current use required for the operation of any existing facility.
- .4 Install and maintain temporary electrical service and systems in accordance with Construction Safety Association's "Temporary Wiring Standards on Construction Sites", the Ontario Electrical Code and other authorities having jurisdiction.
- .5 Provide at least one temporary panel on each floor with service capacity suitable for construction requirements and to authorities and utilities approval.
- .6 Provide temporary wiring with lighting to all areas of each floor to provide adequate lighting.
 - .1 Lighting levels must be maintained at a minimum of 10 foot candles, or to suit the particular location or operation, whichever is greater.
 - .2 Do not use materials of the temporary service in permanent installation.
 - .3 Increase lighting levels equivalent to the final requirements when finishing operations are underway.
- .7 Extension cords, lights, etc., required by various subcontractors and run from above outlet positions will be supplied and maintained by the party or parties requiring same.
- .8 Follow requirements of "Temporary Use of New Permanent Services and Equipment" if electrical power and lighting systems installed under the contract are intended to be used for temporary electricity and lighting during the construction.
- .9 Electrical power and lighting systems installed under this contract can be used for construction provided damages are made good and all lamps that have been used for more than two months are replaced with new lamps.
- .10 For New Builds arrange for connection with appropriate utility company and pay all costs for installation, maintenance, removal and usage costs until occupancy has been achieved.
- .11 For Additions and renovations the contractor can use existing Board service unless noted otherwise.
- .12 Provide and pay for temporary power for electric cranes and other equipment requiring temporary power in excess of above noted requirements.
- .13 Provide and pay for temporary power for electric cranes and other equipment requiring temporary power in excess of above noted requirements.
- .14 Where Contractor elects to use diesel or gas fueled generators to provide temporary power, Contractor will be responsible for all costs incurred including but not limited to temporary

pad, fuel, unit rental costs, and provision of robust soundproof enclosures or barriers to minimize noise transfer to immediate neighbors.

1.7. TEMPORARY COMMUNICATION FACILITIES

- .1 Contractor to provide and pay for temporary Phone, e-mail and printer hook up, for the duration of contract until completion for use by the contractor.
- .2 The site superintendent is to have e-mail access and a printer on site.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 51 00 - Temporary Utilities.
- .2 Section 01 35 23 – Health and Safety
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. INSTALLATION AND REMOVAL

- .1 Provide temporary construction facilities in order to execute work expeditiously.
- .2 Remove temporary facilities from site when directed by Consultant.

1.3. PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.4. PROTECTION OF SURROUNDING WORK

- .1 Provide protection for finished and partially finished Work from damage.
- .2 Provide necessary cover and protection.
- .3 Be responsible for damage incurred due to lack of or improper or inappropriate protection.

1.5. ROOF AND STRUCTURE PROTECTION

- .1 Ensure no part of Work or existing structures are subjected to a load, which will endanger its safety or will cause permanent deformation.
- .2 The Contractor when indicated by the Board Contact or Consultant shall provide roof protection. Ensure all precautions are taken to avoid liability for roof damage.
- .3 Typical roof protection shall consist of a layer of 1inch rigid foam insulation set directly on the roof surface and a layer of 19 mm (3/4 inch) plywood in all places under scaffold legs, ladder legs and in areas of foot traffic or falling debris.

1.6. WORK SITE ENCLOSURE & SAFETY BARRIERS

- .1 Erect and maintain for the duration of the work:
 - .1 a minimum 1800 mm high chain link fence or self-supporting, heavy duty, interconnected fence panels (commonly referred to as Insta-fence) for a temporary site enclosure (hoarding) completely around perimeter of work site,
 - .2 any temporary posts shall be completely removed by the contractor prior to occupancy,
 - .3 under no circumstance shall t-bar posts be used on board property
 - .4 any additional safety devices including full hoarding as required and noted on the drawings, to protect the students, staff, public and private property from injury and damage,
 - .5 any additional requirements as regulated by authorities having jurisdiction, local by-laws and zoning.
- .2 The Contractor is to assume full responsibility for any injury or damage caused due to failure to comply with Paragraph 1 above.
- .3 Any hazardous conditions identified outside of the main fenced area will be barricaded with a fence complying to the above.

- .4 Provide lockable truck entrance gate/gates and at least one (1) pedestrian door as directed and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys with restricted availability, in the project office.
- .5 Erect and maintain pedestrian walkways including roof and side covers, complete with signs and electrical lighting as required by law.
- .6 Provide barriers around trees and plants designated to remain.
- .7 Protect from damage by equipment and construction procedures.

1.7. TREE PROTECTION

- .1 Protect all existing trees to remain from damage during construction period. Make good, at Contractor's expense, trees damaged during construction.
- .2 Confine movement of heavy equipment, storage of same, and storage of materials to a predetermined area. Do not store materials or place equipment over root systems of any existing trees to remain.
- .3 Install fencing or approved equal at limits of drip line of existing trees to remain unless directed otherwise. Where this case is not practical, and only if approved by the Consultant, the trunks shall be protected with an approved tree guard.
- .4 No rigging cables shall be wrapped around or installed in trees. Do not flush concrete trucks or cement mixing machines over root systems or near trees. Flush concrete trucks or cement mixing machines in areas approved by Consultant.
- .5 Areas where root systems of trees are exposed directly adjacent to a structure will be backfilled with good loam only.
- .6 Whenever excavating is required within branch spread of trees that are to remain, the contractor shall contact the consultant for direction prior to the start of work.
- .7 If any existing tree to remain is injured and does not survive the following year, it will, as determined by the Board, be removed in its entirety and be replaced with a tree of similar size and value, as directed by the Consultant.
- .8 Should the destroyed tree be of such a size or shape that it cannot be feasibly replaced, the Contractor shall compensate the Owner for the minimum sum of five thousand dollars (\$5,000.00) per destroyed tree.

1.8. GUARD RAILS AND BARRIERS

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Erect and maintain for the duration of the Work, safety devices and barricades including hoarding, as required, to protect the staff, students, public and private property, from injury and damage.
- .3 The Contractor is to ensure that all requirements from authorities having jurisdiction and all requirements from the Owner are met.
- .4 The Contractor is to assume full responsibility for any damage caused due to his failure to comply with paragraph 2 above.
- .5 Hazardous conditions on the exterior shall be fenced.

1.9. WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Provide heated enclosures required for winter protection of all work already completed or underway.
- .4 Design enclosures to withstand wind pressure.

1.10. DUST TIGHT BARRIERS

- .1 Provide dust tight barriers and screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.
- .3 Where required adjust air handling units to eliminate migration of dust.

1.11. SCAFFOLDING

- .1 Erect scaffolding independent of walls and use in such a manner limiting interference with other work. When not in use, move scaffolding as necessary to permit installation of other work. Construct and maintain scaffolding in a rigid, secure and safe manner. Remove it promptly when no longer required. Protect surface on which scaffolding is bearing.

1.12. SHORING, BRACING, PILING

- .1 Provide shoring, bracing, piling, sheeting and sheet piling and underpinning required to support soil banks, existing work and property in accordance with Construction Safety Act and other applicable regulations. Maintain shoring until building is strong enough and sufficiently braced to withstand pressure of backfilling. Make construction aids free of permanent work so they may be removed entirely when no longer required, without damaging the Work. Locate construction aids so adequate room is left for damp-proofing foundation walls, laying substructure drainage and other work.
- .2 Shoring and false work over one tier in height shall be designed and shall bear the stamp of a registered professional engineer, having experience in this field.

1.13. HOISTING

- .1 Provide, operate and maintain services required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
- .2 Machinery shall be operated by qualified operator.

1.14. OVERHEAD LIFTING

- .1 Any condition requiring the use of a crane or lifting device over a Board structure must follow the requirements of Health and Safety Section 01 35 23, Paragraph 1.15 Overhead Lifting.

1.15. ELEVATORS/LIFTS - Reserved

1.16. USE OF THE WORK

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with Products.
- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.17. CONSTRUCTION PARKING

- .1 Construction personnel vehicle parking, to be confined to the work site enclosure, or.
- .2 Permission to park vehicles on site does not imply any liability or responsibility for safe keeping of vehicles and contents thereof by the School Board.

1.18. ACCESS TO SITE

- .1 Provide and maintain adequate access to project site.
- .2 Build and maintain temporary roads where necessary and provide snow removal within the area of work, and access to the work, during period of Work. The area shall be restored to the satisfaction of the Board at the completion of the project.
- .3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.
- .4 Clean roadways and taxi areas where used by Contractor's equipment.

1.19. SECURITY

- .1 The Contractor shall ensure the security of the work site, contents, and built structures for the duration of the project.
- .2 The Contractor shall be responsible to provide and pay for security personnel to guard site and contents of site after working hours and during holidays as required.
- .3 Notify the Board of the use of security guards or systems.
- .4 The Board shall not be responsible for the loss, theft, or vandalism.

1.20. OFFICES

- .1 Provide and maintain, until completion of Contract, for Contractor's use, a temporary office, large enough to accommodate site administrative activities and site meetings, complete with light, heat, air conditioning, ventilation, table and chairs. Do not store materials in office area; keep clean and tidy.
- .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors may provide their own offices as necessary. Direct location of these offices.

1.21. EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds and platforms for storage of tools, equipment and materials.
- .2 Review storage areas on site with the Consultant. Store materials and equipment to ensure preservation of quality of product and fitness for the Work. Store materials and equipment on wooden platforms or other hard, clean surfaces, raised above the ground or in water tight storage sheds of sufficient size for storage of materials and equipment which might be damaged by storage in open. Locate stored materials and equipment to facilitate prompt inspection.
- .3 Store packaged materials and equipment undamaged, in their original wrappings or containers, with manufacture's labels and seals intact.
- .4 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.
- .5 Storage sheds required by subcontractors shall be provided by them.

1.22. SANITARY FACILITIES

- .1 Provide weatherproof temporary toilet/sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Service temporary toilet/sanitary facilities as required by authorities but not less than weekly.
- .3 Post notices and take such precautions as required by local health authorities.
- .4 Except where connected to municipal sewer system, periodically remove wastes from Site.
- .5 Keep toilet/sanitary facilities clean and sanitary and protect from freezing.
- .6 Keep sanitary facilities clean and fully stocked with the necessary supplies at all times.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.
- .2 Section 01 31 00 – Project Managing and Coordination

1.2. TERMINOLOGY

- .1 New: Produced from new materials.
- .2 Renewed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .3 Defective: A condition determined exclusively by the Consultant.

1.3. PRODUCT QUALITY

- .1 The term 'new' in the following paragraph does not exclude re-manufactured products that have some or all of the materials recycled from other sources. Preference in recycling is for post-consumer recycled materials.
- .2 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work:
- .3 New Product, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.
- .4 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
- .5 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Consultant.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

1.4. AVAILABILITY

- .1 Immediately upon receipt of Boards Purchase Order, review Product delivery requirements and anticipate foreseeable supply delays for any items.
- .2 Immediately upon receipt of Boards Purchase Order the Contractor shall issue Purchase Orders and or Contracts to all Sub-trades. Provide proof to the Consultant and the Board within 3 days. The Sub-Contractors shall identify in writing any delivery issues within 14 days of receiving the Contractors purchase order or contract. The Schedule noted in 01-31 00 1.7.1 shall incorporate all deliveries and installation.
- .3 If delays in supply of Products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .4 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

1.5. STORAGE AND PROTECTION

- .1 Store and protect Products in accordance with manufacturers' written instructions.
- .2 Store with seals and labels intact and legible.
- .3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.
- .4 For exterior storage of fabricated Products, place on sloped supports above ground.
- .5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- .6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- .7 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- .8 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.6. TRANSPORTATION AND HANDLING

- .1 Transport and handle Products in accordance with manufacturer's written instructions.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.
- .4 Suitably pack, crate and protect products during transportation to site to preserve their quality and fitness for the purpose intended.
- .5 Store products in original, undamaged condition with manufacturer's labels and seals intact until they are being incorporated into completed work.
- .6 Protect materials from damage by extreme temperatures or exposure to the weather.

1.7. EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to the owner.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.8. MANUFACTURER'S WRITTEN INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

1.9. QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Consultant and or Board reserves right to require dismissal from site any workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.
- .4 Products, materials, systems and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the applicable manufacturer's printed directions.
- .5 Where specified requirements are in conflict with manufacturer's written directions, follow manufacturer's directions. Where specified requirements are more stringent than manufacturer's directions, comply with specified requirements.

1.10. COORDINATION

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.
- .3 Contractor is responsible to ensure suppliers or distributors of materials specified or alternatives accepted, which he intends to use, have materials with original schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.
- .4 Contractor shall contact Consultant immediately upon receipt of information indicating materials or items, will not be available on time, in accordance with the latest approved schedule, and similarly it shall be the responsibility of all subcontractors and suppliers to so inform the Contractor.
- .5 The above, in no way releases the Contractor, or their subcontractors and suppliers of their responsibility for ensuring timely ordering of materials and items required, including the necessary expediting, to complete the Work as scheduled in accordance with the Contract Documents including temp accommodations and or materials to ensure occupancy date is achieved.

1.11. CONCEALMENT

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Consultant if there is interference. Install as directed by Consultant at no additional cost to the Board.

1.12. REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.13. LOCATION OF FIXTURES

- .1 Inform Consultant of conflicting installation. Install as directed.

1.14. FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.15. PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of any part of the Project.
- .2 Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Consultant.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. REFERENCES

- .1 Owner's identification of existing survey control points and property limits.

1.3. SUBMITTALS

- .1 Submit name and address of Surveyor to Consultant.
- .2 On request of Consultant, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying that elevations and locations of completed Work conforms with Contract Documents.

1.4. QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practise in the Place of the Work.

1.5. SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on Drawings.
- .2 Locate, confirm and protect control points prior to starting site Work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Consultant.
- .4 Report to Consultant when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.6. SURVEY REQUIREMENTS

- .1 Establish existing and new permanent bench marks on site, referenced to established bench marks by survey control points.
- .2 Record locations, with horizontal and vertical data in Project Record Documents.
- .3 Establish lines and levels, locate and lay out, by instrumentation.
- .4 Establish pipe invert elevations.
- .5 Stake batter boards
- .6 Establish foundation and floor elevations.
- .7 Establish lines and levels for mechanical and electrical work.

1.7. SUBSURFACE CONDITIONS

- .1 Promptly notify Consultant in writing if discovered surface or subsurface conditions at Place of Work differ materially from those indicated in Contract Documents.
- .2 Advise the Consultant of a reasonable assumption of probable conditions when determined.
- .3 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work.

1.8. EXAMINATION

- .1 The Contractor is expected to be totally familiar with site conditions and shall assume full responsibility for the cost involved in repairing any damage to the building, site and

services, city property, adjacent buildings, etc., during general construction, regardless of the extent of the damage.

- .2 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.
- .3 The Contractor shall provide all equipment necessary to make a full and detailed site evaluation. This shall include but not be limited to ladders, flashlights and hand tools.
- .4 The Contractor expressly agrees that conditions above existing suspended acoustic ceilings, but below fixed structure, unless obscured by an additional ceiling above, shall be considered exposed conditions for the purposes of making findings under the provisions of the Contract. There shall be no claims for extra costs for extra Work in these areas.
- .5 After uncovering, inspect conditions affecting performance of the Work.
- .6 Beginning of cutting or patching means acceptance of existing conditions.

1.9. PREPARATION

- .1 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

1.10. EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Consultant of findings.
- .2 Remove abandoned service lines running through within existing and new structures. Cap or seal lines at cut-off points as directed by Consultant.

1.11. LOCATION OF EQUIPMENT AND FIXTURES

- .1 Inform Consultant of conflicting installations, install as directed.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Consultant of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

1.12. SURVEY RECORD

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation: Submittals and scheduling.
- .2 Section 01 61 00 - Product Requirements.
- .3 Section 01 70 00 – Examination and Preparation
- .4 Individual Product Specification Sections:
 - .1 Cutting and patching incidental to work of the section.
 - .2 Advance notification to other sections of openings required in Work of those sections.

1.2. SUBMITTALS

- .1 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of Project.
 - .2 Integrity of weather exposed or moisture resistant element.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight exposed elements.
 - .5 Work of Owner or separate contractor.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work.
 - .3 Necessity for cutting or alteration.
 - .4 Description of proposed Work and Products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of Owner or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.3. TOLERANCES

- .1 Monitor fabrication and installation tolerance control of Products to produce acceptable Work.
- .2 Do not permit tolerances to accumulate beyond effective or practical limits.
- .3 Comply with manufacturers' tolerances. In case of conflict between manufacturers' tolerances and Contract Documents, request clarification from Consultant before proceeding.
- .4 Adjust Products to appropriate dimensions; position and confirm tolerance acceptability, before permanently securing Products in place.

2.0 PRODUCTS

2.1. MATERIALS

- .1 Primary Products: Those required for original installation.
- .2 Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 33 00.

3.0 EXECUTION

3.1. EXAMINATION

- .1 Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering existing Work, assess conditions affecting performance of work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

3.2. PREPARATION

- .1 Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work.
- .3 Maintain excavations free of water.

3.3. CUTTING

- .1 Execute cutting and fitting as needed to complete the Work. Prior to any cutting and or coring of concrete floors the contractor shall confirm the area is free of services or rebar. Notify the Consultant of any interferences.
- .2 Uncover work to install improperly sequenced work.
- .3 Remove and replace defective or non-conforming work.
- .4 Remove samples of installed work for testing for Hazardous materials.
- .5 Provide openings in the Work for penetration of mechanical and electrical work.
- .6 Employ experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- .7 Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- .8 Do all cutting, patching and making good, to leave a finished condition and to make the several parts of the work come together properly. Coordinate work to keep cutting and patching to a minimum.
- .9 Make cuts with clean, true, smooth edges. Fit unit to tolerance established by test standard practice for applicable work. Make patches invisible in final assembly.
- .10 Cutting shall be done in a manner to keep patching to minimum. Obtain Consultant's approval of method to be used to conceal new mechanical and electrical services before beginning cutting. Chasing of concrete surfaces is not permitted.
- .11 Cutting or coring of any structural concrete is to be reviewed and approved by the Consultant.
- .12 Do not endanger any work by cutting, digging or otherwise altering, and do not cut nor alter any load bearing element without written authorization by Consultant. Provide bracing, shoring and temporary supports as required to keep construction safely supported at all times
- .13 Any cost caused by omission or ill-timed work shall be borne by party responsible therefore.
- .14 Regardless of which Section of work is responsible for any portion of cutting and patching, in each case tradesmen qualified in work being cut and patched shall be employed to ensure it is correctly done.

3.4. PATCHING

- .1 Execute patching to complement adjacent Work.
- .2 Fit Products together to integrate with other Work.
- .3 Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- .4 Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
- .5 Restore work with new Products in accordance with requirements of Contract Documents.
- .6 Fit work with adequate support to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with firestop material.
- .8 Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- .9 Complete and tightly fit all construction to pipes, ducts and conduits which pass through construction to completely prevent the passage of air.
- .10 Patching and making good shall be done by trade specialists in material to be treated, and shall be made undetectable in finished work when viewed from distance of 1.5m under normal lighting.

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Common Work by All Trades
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.
- .3 Conduct cleaning and disposal operations to comply with local ordinances and environmental protection legislation.
- .4 Store volatile wastes in covered metal containers, and remove from premises at end of each working day.
- .5 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

2.0 PRODUCTS

2.1. CLEANING PRODUCTS

- .1 Cleaning Agents and Materials: Low VOC content wherever possible. The Consultant and the Board shall be notified prior to use of any exception.

3.0 EXECUTION

3.1. CLEANING DURING CONSTRUCTION

- .1 Maintain the Work in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other Contractors.
- .2 Remove waste material and debris from the work areas and deposit in waste container at the end of each working day.
- .3 Vacuum clean interior areas prior to start of finishing work. Maintain areas free of dust and other contaminants during finishing operations.
- .4 Individual Subcontractors are responsible for the daily clean-up and removal of debris related to, or generated by, their own work. The overall responsibility for project cleanliness rests with the Contractor.
- .5 The Contractor shall be responsible for snow removal within the construction area.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Wherever possible recycle materials
- .8 Containers:
 - .1 Provide adequate number and sizes of on-site garbage and recycling containers within designated work site as required for collection of waste materials and debris on a daily basis.
 - .2 Provide additional waste containers when extent of work warrants.
 - .3 Provide and use clearly marked, separate bins for recycling.
- .9 Dispose of waste materials and debris at registered waste disposal and recycling facility.
- .10 Remove oily rags, waste and other hazardous substances from premises at close of each day, or more often when required.
- .11 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3.2. WASTE MANAGEMENT

- .1 Audit, separate and dispose of construction waste generated by new construction or by demolition of existing structures in whole or in part, in accordance with Ontario Regulations 102/94 and 103/94 made under the Environmental Protection Act.
- .2 Containers:
 - .1 Provide adequate number and sizes of on-site garbage and recycling containers within designated work site as required for collection of waste materials and debris on a daily basis.
 - .2 Provide additional waste containers when extent of work warrants.
 - .3 Provide and use clearly marked, separate bins for recycling.
- .3 Fires, and burning of rubbish or waste on site is strictly prohibited.
- .4 Burying of rubbish or waste materials on site is strictly prohibited.
- .5 Disposal of waste or volatile materials such as mineral spirits, oil, gasoline or paint thinner into ground, waterways, or sewer systems is prohibited.
- .6 Empty waste containers on a regular basis to prevent contamination of site and adjacent properties by wind-blown dust or debris

3.3. PREPARATION FOR FINAL CLEANING

- .1 Prior to final cleaning the General Contractor shall:
 - .1 remove all surplus products, tools, construction machinery and equipment not required for the performance of remaining work, and thereafter remove any remaining materials, equipment, waste and debris,
 - .2 replace all filters installed on any equipment in operation in the area of work,
 - .3 remove all paint spots or overspray from all affected surfaces, and

3.4. FINAL CLEANING PRIOR TO ACCEPTANCE: INTERIOR

- .1 Prior to applying for Substantial Performance of the Work, or, prior to Owner occupancy of the building or portion of the building affected by the Work, whichever comes first, conduct full and complete final cleaning operations for the areas to be occupied.
- .2 Final cleaning operations shall be performed by an experienced professional cleaning company, possessing equipment and personnel sufficient to perform full building cleaning operations. Contractors "broom cleaning" is not acceptable as a "Final Clean". The cleaning contractor shall:
 - .1 clean interiors of all millwork and surfaces of any furniture and equipment present,
 - .2 use only cleaning materials recommended by the manufacturer of the surface to be cleaned,
 - .3 remove all stains, spots, scuff marks, dirt, dust, remaining labels, adhesives or other surface imperfections,
 - .4 clean and polish all glass and mirrors and remove remaining manufacturer's and safety "X" labels,
 - .5 clean and polish all finished metal surfaces such as enamelled or stainless steel, chrome, aluminum, brass, and bronze,
 - .6 clean and polish all vitreous surfaces such as plumbing fixtures, ceramic tile, porcelain enamel, or other such materials,
 - .7 clean all ceramic tile surfaces in accordance with the manufacturer's instructions,
 - .8 vacuum, clean and dust behind grilles, louvres and screens,

- .9 steam clean all unprotected carpets immediately prior occupancy by Owner, and
- .10 clean all equipment and fixtures to a sanitary condition.
- .3 For any areas to be occupied after the owner's initial occupancy, provide full cleaning operations as outlined above prior to turning over to owner,
- .4 The Board's supplies and equipment must not be used for any cleaning operations including, but not limited to: garbage cans, mops, brooms, rags, ladders, chemicals etc.

3.5. FINAL CLEANING PRIOR TO ACCEPTANCE: EXTERIOR

- .1 For areas effected by construction final exterior cleaning operations shall be performed by the General Contractor or competent sub-contractor. Contractor's "broom cleaning" only is not acceptable.
- .2 Final exterior cleaning shall include:
 - .1 broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds,
 - .2 remove dirt and other disfiguration from exterior surfaces,
 - .3 sweep and wash clean paved areas,
 - .4 replace filters of mechanical equipment for all equipment that was in use during construction,
 - .5 clean all roofs, gutters, downspouts, areaways, drywells, and drainage systems,
 - .6 remove debris and surplus materials from crawl areas and other accessible concealed spaces.
 - .7 remove overspray

END OF SECTION

1.0 GENERAL

1.1. RELATED SECTIONS

- .1 Section 01 78 10 – Appendix 1 and 2 – Warranty Card

1.2. TAKE-OVER PROCEDURES

- .1 Take over procedures will be in strict accordance with the requirements as set out in this Section.

1.3. SUBSTANTIAL PERFORMANCE

- .1 Prior to requesting a Substantial Performance deficiency inspection submit 2 hard copies, 1 digital copy of the Operating and Maintenance Manuals for Consultants approval.
- .2 Application for Substantial Performance must include.
 - .1 One (1) electronic copy of inspection and acceptance certificates required from regulatory agencies, including but not limited to.
 - .1 Certificates of Approval of the Work by the local Building Department.
 - .2 Electrical Inspection Certificate of Inspection.
 - .3 Fire Alarm Verification Certificate.
- .3 Advise Consultant in writing, when project has been substantially completed. If Consultant agrees this stage has been reached, the Consultant shall prepare a complete list of deficiencies and submit copies of this list to Contractor and the Board.

1.4. COMMENCEMENT OF LIEN PERIODS

- .1 The date of publication of the Certificate of Substantial Performance of the Work, provided to the contractor by the Consultant, shall be the date for commencement of the lien period.

1.5. TOTAL PERFORMANCE

- .1 Prior to requesting a final inspection submit written certificate that the following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents and is ready for final inspection
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested and are fully operational. Submit two copies of the balancing reports
 - .4 Certificates required by the contractor have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Submit Record drawings.
 - .7 Submit maintenance materials.
 - .8 Provide certified site survey
- .2 When items noted above are completed, request final inspection of Work by consultant, and building inspector. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.

1.6. PAYMENT OF SUBSTANTIAL PERFORMANCE HOLDBACK

- .1 Prior to the release of lien holdback provide one copy of the following by the Contractor and each subcontractor:
 - .1 Statutory Declaration or Declaration of Last supply

- .2 Workplace Safety and Insurance Board "Certificate of Clearance".
- .2 The Contractor shall submit an application for payment of the holdback amount.
- .3 After the receipt of an application for payment which will include a Statutory Declaration and WSIB Clearance from the, the Consultant will issue a certificate for payment of the holdback amount.

1.7. FINAL PAYMENT

- .1 When the Contractor considers final deficiencies and defects have been corrected and it appears requirements of Contract have been completed, make application for final payment.
- .2 When the Consultant finds the Contractor's application for final payment valid, the Consultant will issue a final certificate of payment
- .3 The Board reserves the right to charge the Contractor for school access card(s) that have not been returned.
- .4 The cost to reprogram or replace the card(s) access system is estimated at \$50.00 (fifty dollars) for each card issued, \$30.00 (thirty dollars) for each keybox key, plus \$35.00 (thirty five dollars) administration fee.

1.8. CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products and submit to Consultant for review.
- .2 Copy will be returned to contractor with Consultant's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, the final copies of operating and maintenance manuals.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.9. OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Provide two copies of operating and maintenance data, prepared on 215 X 280mm sheets in printed or typewritten form, contained in 3-ring binders with soft vinyl covers for materials and equipment which require special maintenance or operating procedures.
- .2 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder at the front of each volume.
- .3 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .4 Arrange content by the divisions of the specifications under Section numbers and sequence of Table of Contents.
- .5 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .6 Include the following in each manual:

- .1 Complete list of subcontractors and suppliers, their addresses and telephone numbers. Provide 24 hour emergency telephone number for such subcontractors as Plumbing, Electrical, Sprinklers, Fire System, Heating, etc.
- .2 Specified warranties for contractor, each subcontractor and supplier.
- .3 Boards Warranty Card
- .4 Copy of finish hardware list, complete with all amendments and revisions and lock manufacturer's descriptive and service literature.
- .5 Schedule of paints and coatings. Include sufficient explanation to fully identify each surface with the applicable paint or coating used. Enclose copy of colour schedule.
- .6 Maintenance instructions for finished surfaces.
- .7 Brochures, cuts of equipment and fixtures.
- .8 Operating and maintenance instructions for equipment.
- .9 Submit copies of letters from manufacturers of equipment and systems indicating their technical representatives have inspected and tested systems and are satisfied with methods of installation, connection and operations. These letters shall state names of persons present at testing, methods used and list of functions performed.
- .10 Submit one complete set of reviewed shop drawings of architectural, structural, mechanical and electrical items, folded to 215 x 280mm size, contained in heavy duty manila envelopes, numbered and labelled. Follow specification format with no more than one Section per envelope, hard copy and PDF.
- .11 Relevant certificates issued by authorities having jurisdiction
- .12 Computer disc or flash drive with all the above documentation in PDF format

1.10. RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and within the Project Manual.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain warranties, test reports and samples required by individual specifications sections.

1.11. RECORD (AS-BUILT) DOCUMENTS AND SAMPLES

- .1 Store AS-BUILT documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .2 Label AS-BUILT documents and file in accordance with section number listings in List of Contents of the Project Manual. Label each document AS-BUILT DOCUMENTS in neat, large, printed letters.
- .3 Maintain AS-BUILT documents in clean, dry and legible condition. Do not use as-built documents for construction purposes.
- .4 Keep as-built documents and samples available for inspection by Consultant.

1.12. RECORD DRAWINGS

- .1 Prior to Substantial Performance of the Work, update the marked up information from the AS-BUILT documents to a master set of drawing.
- .2 Submit one set of completed AS-BUILT documents to the Consultant for review.
- .3 Documents will be returned to contractor with Consultant's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 After the review is completed resubmit to the Consultant for Consultant to produce electronic record drawings for the owner to use.

1.13. SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

1.14. REPLACEMENT (MAINTENANCE) MATERIALS

- .1 Deliver to site, unload and store where directed, replacement (maintenance) materials as required elsewhere in these Specifications. Obtain signed receipt from Owner's Representative for delivered materials and include copy of receipt in Operation and Maintenance manuals.
- .2 Package materials so they are protected from damage and loss of essential properties.
- .3 Label packaged materials for proper identification of contents.

1.15. SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual

1.16. FINAL SITE SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 70 00, certifying that elevations and locations of completed Work are in conformance Contract Documents.

1.17. WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined. The date of Substantial Performance of the Work shall be the date for commencement of the warranty period.
- .4 Verify that documents are in proper form, contain full information, and are notarized.
- .5 Co-execute submittals when required.
- .6 Retain warranties and bonds until time specified for submittals.

END OF SECTION

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 Equipment and systems.
- .2 Materials and finishes.
- .3 Spare parts
- .4 Maintenance manuals.
- .5 Special tools.
- .6 Storage, handling and protection.
- .7 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.2. RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 78 40 – Maintenance Requirements.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide coordination Drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00.
- .15 Additional requirements: As specified in individual specification sections.

2.0 PRODUCTS

2.1. MATERIALS AND FINISH

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Building Envelope: include copies of drawings of building envelope components, illustrating the interface with similar or dissimilar items to provide an effective air, vapour and thermal barrier between indoor and outdoor environments. Include an outline of requirements for regular inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
- .5 Additional Requirements: as specified in individual specifications sections.

2.2. SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.3. MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.4. SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

3.0 EXECUTION

3.1. DELIVERY TO SITE

- .1 Deliver to place of work and store.
- .2 General Contractor to receive and acknowledge delivery from contractors and sub-contractors of all parts and materials assembled for maintenance requirements. Provide a summary inventory list to the Consultant and/or the Board after all materials are gathered and verification of location. Signatures of receipt will not be accepted from anyone except the General Contractor's representative.

3.2. STORAGE, HANDLING AND PROTECTION

- .1 Consult with the Board to determine location for storage.

- .2 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .3 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .4 Store components subject to damage from weather in weatherproof enclosures.
- .5 Store paints and freezable materials in a heated and ventilated room.
- .6 Remove and replace damaged products at own expense and to satisfaction of Consultant.

END OF SECTION

1.0 GENERAL

1.1. SECTION INCLUDES

- .1 Procedures for demonstration and instruction of Products, equipment and systems to Owner's personnel.
- .2 Seminars and demonstrations.

1.2. RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3. DESCRIPTION

- .1 At Substantial Performance, at a time acceptable to Owner and Consultant, but not before operations and maintenance manual have been reviewed and accepted by the consultant; contractor shall give a complete demonstration in the presence of consultant; Sub-consultants, Owner and Owner's personnel of operation and maintenance of systems and equipment once they are 100% complete.
- .2 Owner will provide list of personnel to receive instructions and will coordinate their attendance at agreed-upon times.

1.4. COMPONENT DEMONSTRATION

- .1 Manufacturer to provide authorized representative to demonstrate operation of equipment and systems.
- .2 Instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5. SUBMITTALS

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system one (1) week prior to designated dates, for Consultant's approval.
- .2 Submit reports within forty eight (48) after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.6. CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with manufacturer's instructions and contract requirements.
- .2 Testing, adjusting, and balancing have been performed in accordance with manufacturer's instructions and contract requirements, and equipment and systems are fully operational.
- .3 Provide information packages as required for use in demonstrations and instructions.

2.0 PRODUCTS

2.1. NOT USED

- .1 Not used.

3.0 EXECUTION

3.1. PREPARATION

- .1 Verify that suitable conditions for demonstration and instructions are available.
- .2 Verify that designated personnel are present.
- .3 Prepare agendas and outlines.
- .4 Establish seminar organization.
- .5 Explain component design and operational philosophy and strategy.
- .6 Develop equipment presentations.
- .7 Present system demonstrations.
- .8 Accept and respond to seminar and demonstration questions with appropriate answers.

3.2. PREPARATION OF AGENDAS AND OUTLINES

- .1 Prepare agendas and outlines including the following:
 - .1 Equipment and systems to be included in seminar presentations.
 - .2 Name of companies and representatives presenting at seminars.
 - .3 Outline of each seminar's content.
 - .4 Time and date allocated to each system and item of equipment.
 - .5 Provide separate agenda for each system.

3.3. SEMINAR ORGANIZATION

- .1 Coordinate content and presentations for seminars.
- .2 Coordinate individual presentations and ensure representatives scheduled to present at seminars are in attendance.
- .3 Arrange for presentation leaders familiar with the design, operation, maintenance and troubleshooting of the equipment and systems. Where a single person is not familiar with all aspects of the equipment or system, arrange for specialists familiar with each aspect.
- .4 Coordinate proposed dates for seminars with Owner and select mutually agreeable dates.

3.4. EXPLANATION OF DESIGN STRATEGY

- .1 Explain design philosophy of each system. Include following information:
 - .1 An overview of how system is intended to operate.
 - .2 Description of design parameters, constraints and operational requirements.
 - .3 Description of system operation strategies.
 - .4 Information to help in identifying and troubleshooting system problems.

3.5. DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .3 Instruct personnel on control and maintenance of sensory equipment and operational equipment associated with maintaining energy efficiency and longevity of service.
- .4 Review contents of manual in detail to explain all aspects of operation and maintenance. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

END OF SECTION

1. GENERAL INSTRUCTIONS

- 1.1 Requirements specified herein apply to all elements of the exterior building envelope.
- 1.2 Provide continuous examination and inspection of work related to the exterior building envelope assemblies to ensure compliance with Contract Documents.

2. BUILDING ENVELOPE DESIGN AND PERFORMANCE REQUIREMENTS

- 2.1 Portions of the building envelope are specified or indicated to be designed to comply with requirements of this section.
- 2.2 General requirements for building envelope include parts of Work related to the following:
 - .1 Control of condensation in and on, and transfer of heat, air and moisture through building elements and interfaces between building elements that separate:
 - .1 Interior space from exterior space.
 - .2 Interior space from ground.
 - .3 Environmentally dissimilar interior spaces.
 - .2 Conditions at the Place of the Work that may affect moisture loading on building elements that separate interior space from exterior space, and interior space from the ground.
- 2.3 Provide building envelope in compliance with building code, other regulations and requirements of authorities having jurisdiction, with the most stringent requirements to govern.
- 2.4 Building envelope components to withstand own dead loads, snow loads, ice loads, and wind loads, and combinations thereof, in accordance with the building code. Design wind loads shall be based on at least 1150 hourly wind pressure values as indicated in building code and greater values as required.
- 2.5 Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.
- 2.6 Take into account tolerance limitations of structure, creep, deflection and other movements of structure, both during Work and in service.
- 2.7 Allow for expansion and contraction of components caused by ambient, temperature range and surface temperature variation of components, and structural movements, without causing distortion, failure of fastening, joints and/or air barrier seals, undue stress or other defects detrimental to appearance and/or performance.
- 2.8 Accommodate, by means of expansion and contraction provisions, any movements in building assemblies themselves and between assemblies and building structure, caused by structural movements, both deflection and racking; and/or thermal expansion and contraction, without distortion, damage, misalignment of joints, breakage of air barriers, water and air penetration through assembly, or glass breakage.
- 2.9 Method of attachment to structure shall take into account conditions at Place of the Work such that there shall be no possibility of site and air vibrations or normal temperature movements of building to loosen, weaken and/or fracture connection between building envelope assembly components and structure or between the components themselves.

- 2.10 Reinforce building envelope assembly components, as required, so that members can safely sustain design loads.
- 2.11 Assemble and secure assemblies in manner that will keep stresses on sealants within sealant manufacturers' recommended maximum.
- 2.12 Provide building envelope wall and window assemblies based on "Rain Screen" principle as advocated by the National Research Council of Canada. Voids between assembly components as well as those between components and structure shall have:
 - .1 Gaskets, baffles, overlaps, seals and compartmentalization as required to provide a barrier "Rain Screen" to effectively prevent excessive rain water entry into any of the building envelope cavities but allow pressure equalization of cavity air spaces.
 - .2 Air barriers and seals as required to prevent entry of interior building air into building envelope cavities, and exterior air into the building. Air barriers and seals shall be able to withstand design pressures.
 - .3 Make provisions in the form of openings between cavities and building exterior of sufficient cross section area to provide adequate pressure equalization. Openings shall be effectively baffled against direct rain water entry.
 - .4 Provide thermal separators, isolators and seals placed to eliminate contact between interior humid air and a cold surface or structural component that could cause condensation and ice build-up on such surfaces during cold weather.
- 2.13 Comply with requirements specified in building code, with most stringent requirements to govern, and as specified herein, including the following principles:
 - .1 Drain to exterior face of wall or window assembly, any water entering at joints and any condensation occurring within building envelope assembly.
 - .2 Fabricate and install assembly to minimize specified materials' ability to transmit moisture through capillary action.
 - .3 Fabricate and install assembly to be watertight to interior under interior and exterior design conditions in combination with movements occurring due to loads imposed.
- 2.14 Building envelope components shall be water-tight to prevent water intrusion into building.
- 2.15 The requirements for an air barrier and air vapour barrier are intended to be provided at same plane in the building envelope design unless otherwise indicated or specified. In such cases, Contract Documents refer to "air barrier or air vapour or barrier". The definition of air barrier for purpose of these Contract Documents is "a continuous system including joints of materials between components and to adjacent construction which prevents or retards passage of air, and vapour where indicated to be air vapour barrier".
- 2.16 Sealants used for various building envelope assemblies shall be selected from those specified in respective assembly section, and shall be coordinated with sealant being provided under other building envelope sections of specifications. Preferably, one sealant of same manufacturer shall be used throughout. If different sealants are selected from those specified, ensure compatibility between

- selected sealant, substrates, and sealants of other sections of specifications that come in contact with selected sealant.
- 2.17 Provide sealant joints with strict regard for sizing of joint and parallel orientation of contact surfaces. Provide support for both sealant and backer rod.
- 2.18 Provide building envelope assemblies and components with sufficient isolation to prevent galvanic or corrosive reactions of discolouration. Ensure separation of dissimilar metals with neoprene or other suitable material at points of contact.
- 2.19 Provide completed installations free from vibrations, wind whistles, and noise due to thermal and structural movement and wind pressure.
- 2.20 The Work incorporates design principles of positive air and vapour leakage control at building enclosure line. Air barrier extends to encompass the entire building envelope.
- 2.21 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.
- 2.22 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.
- 2.23 Ensure that air spaces within exterior building components are firestopped in accordance with applicable regulations.
- 2.24 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.
- 2.25 Owner may complete a thermographic scan upon completion of the building envelope. Contractor will be responsible to correct identified thermal anomalies.

3. AIR LEAKAGE AND WATER PENETRATION PERFORMANCE REQUIREMENTS

3.1 Fenestrated assemblies:

- .1 Fixed assemblies: Air infiltration and exfiltration through completed fixed glazing systems shall not exceed 0.225 L/s/m² at 75 Pa pressure difference when tested in accordance with ASTM E283-04, unless otherwise specified. This rate and criteria applies to building envelope systems, including interfaces between adjacent assemblies.
- .2 Operable glazing assemblies: Air leakage through the completed operable glazing assemblies shall not exceed 0.5 L/s/m² of glazing area when tested in accordance with ASTM E283-04 at test pressure of 75 Pa.

3.2 Non-fenestrated assemblies:

- .1 Air infiltration and exfiltration through completed non-fenestrated cladding assemblies

shall not exceed 0.02 L/s/m² at 500 Pa pressure difference when tested in accordance with ASTM E283, unless otherwise specified. This rate and criteria applies to building envelope systems, including interfaces between adjacent assemblies.

- 3.3 Water penetration (static): Water penetration testing shall occur at a pressure difference as indicated below. Water penetration shall not occur to interior face of assembly. There shall be no infiltration through assembly into an adjacent system when tested in accordance with ASTM E331-00. There shall be no water trapped in the assembly after pressure has been released at a test pressure of:

.1 300 Pa (6.24 psf).

- 3.4 Maximum air leakage shall be 0.10 L/s/m² when measured with a warm-side relative humidity of 27-55% at 21°C and a measured air pressure difference of 75 Pa.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Alteration project procedures.
- .2 Removal of designated building equipment and fixtures.
- .3 Removal of designated construction.
- .4 Disposal of materials, Storage of removed materials.
- .5 Identification of utilities.
- .6 Refer to items scheduled at end of section, as indicated.

1.2 RELATED SECTIONS

- .1 Section 02 41 16 - Structure Demolition.
- .2 Section 01 74 00 – Cleaning and Waste Management

1.3 ALTERATION PROJECT PROCEDURES

- .1 Materials: As specified in Product sections; match existing Products and work for patching and extending work.
- .2 Employ skilled and experienced personnel to perform alteration work.
- .3 Provide materials, equipment and all shoring required to perform work of this section.
- .4 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- .5 Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to specified original condition.
- .6 Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed specified condition for each material, with a neat transition to adjacent finishes.
- .7 Where new Work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .8 When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Consultant for review.
- .9 Where a change of plane of 6 mm or 1/4 inch or more occurs, request instructions from Consultant, submit recommendation for providing a smooth transition; to Consultant for review.
- .10 Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .11 Finish surfaces as specified in individual Product sections.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling: Schedule work to requirements of Section 01 31 00.
 - .1 Schedule Work to coincide with site excavation work, coincide with new construction, precede new construction, precede site excavation work.
 - .2 Describe demolition removal procedures and schedule.
- .2 Perform dusty, noisy, malodorous work:
 - .1 Between the hours of 7 A.M. and 4.PM
 - .2 On the following days: Monday to Friday.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate removal sequence and location of salvageable items, demolition; location and construction of temporary work.
- .3 As required by authorities having jurisdiction and by other sections of this specification, submit for approval, drawings, diagrams, details and supporting data clearly showing sequence of demolition and removal work of building and shoring designed by a registered professional structural engineer licensed to practice in Ontario.

1.6 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.
- .2 Sustainable Design: **NOT APPLICABLE**
 - .1 Section 01 35 18: LEED documentation procedures. **If applicable**
 - .2 Provide required LEED documentation for Product regional materials, recycled content. **If applicable**
 - .3 Manufacturer's Certificate: Certify that Products meet or exceed, specified requirements.

1.7 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.
- .2 Record Documentation: Accurately record actual locations of capped utilities, subsurface obstructions, and other significant details.
- .3 Sustainable Design Closeout Documentation: If applicable

1.8 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for demolition work, dust control, products requiring electrical disconnection, reconnection.
- .2 Obtain required permits from authorities.
- .3 Do not close or obstruct egress width to any building or site exit.

- .4 Do not disable or disrupt building fire or life safety systems without three (3) days prior written notice to Owner.
- .5 Conform to applicable regulatory procedures when discovering hazardous or contaminated materials.

1.9 PROJECT CONDITIONS

- .1 Conduct demolition to minimize interference with adjacent and occupied building areas.
- .2 Cease operations immediately if structure appears to be in danger and notify Consultant. Do not resume operations until directed.
- .3 Visit the site and the existing building so as to fully understand all existing conditions and extent of work required. No increase in cost or extension of performance time will be considered for failure to know conditions.

1.10 PROTECTION

- .1 Prevent movement or settlement of adjacent work. Provide and place bracing or shoring and be responsible for safety and support of such work. Be liable for any such movement or settlement, and any damage or injury caused.
- .2 Cease operations and notify Project Manager if safety of any adjacent work or structure appears to be endangered. Take all precautions to support the structure. Do not resume operations until reviewed with Project manager.
- .3 Cease operations and notify the Minister immediately for special protective and disposal instructions when asbestos materials or other hazardous materials [, other than those identified,] are uncovered during the work of this project.
- .4 Prevailing weather conditions and weather forecasts shall be considered. Demolition work shall not proceed when weather conditions constitute a hazard to the workers and site.
- .5 Prevent debris from blocking surface drainage inlets and mechanical and electrical systems which remain in operation.
- .6 Temporarily suspended work that is without continuous supervision, shall be closed to prevent entrance of unauthorized persons.

2.0 EXECUTION

2.1 PREPARATION

- .1 Ensure that affected building areas are unoccupied and discontinued in use prior to start of demolition work.
- .2 Verify that existing services in areas affected by demolition work are disconnected, capped or removed, prior to start of work.
- .3 Provide, erect, and maintain temporary partitions, insulated partitions, barriers at locations indicated.
- .4 Erect and maintain weatherproof closures for exterior openings.
- .5 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued Owner occupancy.
- .6 Protect existing materials and structure which are not to be demolished.

- .7 Prevent movement of structure; provide bracing and shoring.
- .8 Notify affected utility companies before starting work and comply with their requirements.
- .9 Disconnect all electrical and telephone service lines in the areas to be demolished in accordance with rules and regulations of authorities having jurisdiction. Post warning signs on all electrical lines and equipment that must remain energized to serve other areas during period of demolition.
- .10 Disconnect and cap mechanical services in accordance with requirements of local authority having jurisdiction.
 - .1 Natural gas supply lines to be removed by qualified tradesman in accordance with gas company instructions.
 - .2 Remove sewer and water lines and cap to prevent leakage.
 - .3 Remove and cap other underground services.
 - .4 In each case notify the affected utility company in advance and obtain approval where required, before commencing with the work on main services.
- .11 Mark location and termination of utilities.
- .12 Do not disrupt active or energized utilities designated to remain undisturbed.
- .13 Provide appropriate temporary signage including signage for exit or building egress.

2.2 DEMOLITION

- .1 Carry out demolition work in accordance with CSA S350, unless otherwise specified.
- .2 Disconnect remove, cap, identify, designated utilities within demolition areas.
- .3 Demolish in an orderly and careful manner. Protect existing supporting structural members.
- .4 Remove from site all materials indicated to be demolished except where specifically noted otherwise. Do not burn or bury materials on site.
- .5 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- .6 Carry out demolition in a manner to minimize inconvenience to adjacent occupied space.
- .7 Demolish work in a safe and systematic manner, from top to bottom.
- .8 Sprinkle exterior debris with water to prevent dust. Do not cause flooding, contaminated runoff or icing. Do not allow waste material, rubbish, and windblown debris to reach and contaminate adjacent properties.
- .9 Lower waste materials in a controlled manner; do not drop or throw materials from heights. Use chutes, conveyors, or hoisting equipment to lower materials.
- .10 Demolish masonry and concrete elements in small sections. Carefully remove and lower structural framing and other heavy and large objects.
- .11 At end of each work period, leave work in a safe condition, so that no part is in danger of toppling or falling.
- .12 Remove temporary Work.

2.3 SCHEDULES

- .1 Remove the equipment and materials for the Owner's retention. Refer to demolition drawings
- .2 Owner will remove and keep material and equipment noted on demolition drawings
- .3 Protect the materials and equipment remaining: Refer to demolition drawings

2.4 CLEAN UP

- .1 For clean up during demolition and for final cleaning , comply with requirements of Section 01 74 00.

END OF SECTION

PART 1 - GENERAL

- | | | | |
|-----|------------------------------------|----|--|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. |
| 1.2 | <u>Related Sections</u> | .1 | Excavating, Backfilling and Grading: Section 02200 |
| 1.3 | <u>Existing Conditions</u> | .1 | Before commencing clearing, ensure by examination of site all possible factors concerning clearing are investigated, and the following are known in particular: <ul style="list-style-type: none">.1 Methods and means available for material handling, disposal, storage and transportation..2 Conformation and condition of ground surfaces..3 Location and elevation of existing services to remain..4 Location and/or limit of existing fences, pavement, trees and shrubs to remain..5 Character, quality and quantity of growth on site. |
| 1.4 | <u>Protection</u> | .1 | Protect public and private property adjacent to clearing performed by this Section. Make good and return property to original condition if damaged by clearing performed by this Section. |
| | | .2 | Do not damage root systems of existing trees, plants, and shrubs which are to remain, and future landscaped areas, by piling of surplus soil or debris over them, or by cutting when clearing. |
| | | .3 | Ensure locations of overhead and underground utility and other services have been established by an investigation conducted together with the utilities and maintenance staff of services concerned. Perform no clearing until locations of services have been verified and protective measures taken are satisfactory to all concerned. |
| | | .4 | Perform relocation, removal, protection and plugging of existing utility services only by the responsible utility, and of other services by licensed mechanics. |
| | | .5 | Immediately repair damage to trees, structures, buried and above ground services, benchmarks, and survey monuments should it occur as a result of clearing performed by this Section. Completely cover wounds of over 25.5mm diameter suffered by trees and shrubs with wound paint. |
| | | .6 | Protect and maintain established survey markers. If these markers are disturbed except where service connections have to be installed, the Contractor shall bear the cost to have them re-established by an Ontario Land Surveyor. |

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|
| 2.1 | <u>Materials</u> | .1 | Wound Paint: Bituminous paint specially prepared for use on trees and shrubs. |
| | | .2 | Cleared and grubbed materials become property of Contractor, unless noted otherwise. |

PART 3 - EXECUTION

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|-----|------------------------|----|---|
| 3.1 | <u>Clearing</u> | .1 | Clear site within limits of the Work site boundary and/or limit of works indicated on drawings, except for items specifically noted on drawings. |
| | | .2 | Remove all pavements, concrete curb and walks, fences, surface debris, trees and shrubs to depth specified under 3.2 Grubbing. |
| | | .3 | Remove trees, saplings, shrubs, bushes, vines and undergrowth to the following heights:
.1 150mm for trees over 150mm diameter.
.2 75mm for shrubs, saplings, bushes and trees under 150mm diameter.
.3 50mm for vines and undergrowth.
.4 Treat stumps over 100mm diameter below grubbing depth specified with herbicide applied in accordance with manufacturer's specifications to prevent regrowth. |
| 3.2 | <u>Grubbing</u> | .1 | Perform grubbing within the limits of the area cleared. |
| | | .2 | Grub out and remove all stumps, roots over 100mm diameter and matted roots to the following depths:
.1 Remove completely under footings, walks, roads, parking areas, slab on grade or other constructions.
.2 200mm under lawns
.3 300mm under planting |
| | | .3 | Do not use explosives unless approved. |
| | | .4 | Leave root systems intact in areas where erosion may occur. |
| 3.3 | <u>Disposal</u> | .1 | <u>Disposal:</u>
.1 Remove and dispose of debris legally away from site daily, as it accumulates, materials and debris resulting from clearing performed by this Section, unless it has been specified for salvage. Do not accumulate materials on site from clearing performed outside of normal working hours for longer than 48 hours.
.2 Do not burn materials or debris at the site. |
| 3.4 | <u>Finished</u> | .1 | Leave ground surface in a condition suitable for immediate grading |

Surface

operations.

End of Section

PART 1 - GENERAL

1.1	<u>General Requirements</u>	.1	Comply with requirements of Division 1.	
1.2	<u>Related Sections</u>	.1	Topsoil and Finish Grading	Section 02212
		.2	Erosion Control	Section 02270
		.3	Asphalt Paving	Section 02510
		.4	Sodding	Section 02933
		.5	Excavation and partial backfilling for mechanical underground services	Division 15
		.6	Excavation and partial backfilling for electrical underground services	Division 16
1.3	<u>Reference Standards</u>	.1	<u>Testing of Aggregate:</u>	
		:	ASTM C117-90, Test Method for Material Finer Than 0.075 mm sieve in mineral aggregates by washing.	
		:	ASTM C136-84a, Method for Sieve Analysis of Fine and Coarse Aggregates.	
		:	ASTM D698-78, Test Methods for Moisture-Density Relations of Soils, and Soil Aggregate Mixture, Using 2.5 kg Rammer and 304.8 mm Drop.	
		:	ASTM D1557-78, Test Methods for Moisture-Density Relation of Soils, Using 4.5 kg Rammer and 457 mm Drop.	
		.2	<u>Sieve Size Designations:</u> CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.	
		.3	<u>Products:</u>	
		:	ASTM Specification C33, Concrete Aggregates.	
		:	CAN3-A23.1-M77, Concrete Materials and Methods of Concrete Construction.	
		:	CSA Standard B182.1-M77, Plastic Drain and Sewer Pipe and Pipe Fittings.	
1.4	<u>Guarantee</u>	.1	<u>Replacement of Defective Work:</u>	
		.1	Correct and make good areas where settlement has occurred during the warranty period of contract.	
1.5	<u>Submittals</u>	.1	<u>Samples</u>	
		.1	Submit samples of fill as specified in Section 01400, Quality Control.	
1.6	<u>Inspection and Testing</u>	.1	The Owner has appointed and will pay for, out of the Allowance specified in Division 1, an independent Inspection Company to conduct tests as	

directed by the Consultant.

- .2 Testing agency may do any or all of the following as directed by the Consultant in accordance with requirements of Section 01400:
 - .1 Determine at what depth existing soil is capable of supporting fill, concrete slabs and superimposed loads without deleterious settlement.
 - .2 Carry out grain size analysis on samples of each type of granular fill to ensure proper materials are being placed.
 - .3 Determine quantity of water to be added to, or removed from, each type of fill to attain correct moisture content for compaction and maximum density.
 - .4 Determine on-site density and moisture content of compacted fills.
- .3 Submit Inspection Reports as specified under Section 01400, Quality Control.
- .4 It is the Contractor's responsibility to contact the Inspection Agency at least 48 hours in advance of the need for inspection.

1.7 Examinations

- .1 Visit and examine the site and note all characteristics and features affecting the work of this Section. No allowance will be made for difficulties encountered or expense incurred resulting from conditions known or visible at the time of tendering.
- .2 Ensure in examination of site, all possible factors concerning earth work are investigated, and the following are known in particular.
 - .1 Methods and means available for material handling, disposal, storage and transportation.
 - .2 Physical conditions of site, including ground water table and drainage courses.
 - .3 Conformation and condition of ground surfaces, including extent of clearing, grading, filling and lawn work.
 - .4 Character, quality, and quantity of surface and sub-surface materials. Remove unsuitable materials or import suitable materials as required at no expense to the Owner.
- .3 Starting work implies acceptance of all conditions, and no consideration for extra compensation will be allowed at a later date if found that actual site conditions and the drawings do not agree.

1.8 Existing Conditions

- .1 Geoenvironmental and geotechnical Investigations have not been carried out for this site.
- .2 Ensure locations of buried utility and other services to remain have been established by an investigation conducted together with maintenance staff and utilities of services concerned. Do not excavate or grade until locations of services to remain have been verified and protective measures taken are satisfactory to all concerned.
- .3 A tolerance of plus or minus three centimetres variation from design levels for grading outside the building is the maximum acceptable.

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| | | .4 | No extra compensation will be allowed for removing rock or other materials encountered during excavation work, site work or laying utility lines. |
| | | .7 | A cut and fill balance has not been made. The Contractor must establish what additional fill is to be imported or excess to be hauled away. No additional compensation will be made for cut and fill. |
| 1.9 | <u>Environmental Requirements</u> | .1 | If excavation reveals unexpected subsurface conditions, advise Consultant immediately. |
| | | .2 | Do not place fill material when temperature is at or below 0 degree C, nor while either fill material or subgrade is frozen. |
| | | .3 | Stockpile each type of fill material separately to prevent integration. Stockpile granular materials so as to prevent segregation. |
| | | .4 | Effect approved measures to minimize dust as a result of this work. |
| | | .5 | Do not stockpile excavated material to interfere with site operation or drainage. |
| 1.10 | <u>Protection</u> | .1 | Protect excavations in accordance with applicable regulations. Provide and maintain in safe condition lining, bracing and shoring required. Protect bottoms and sides from exposure to wet weather, snow and frost, and from drying out; prevent softening or weathering of bearing surfaces. Take special care when excavating for footings. |
| | | .2 | Prevent damage to existing structures and buried services. Make good any damage caused. |
| | | .3 | Provide adequate protection around bench markers, layout markers, survey markers, and geodetic monuments. |
| 1.11 | <u>Basis of Elevation</u> | .1 | Estimate excavation using excavation levels specified and shown on Drawings as a basis. |
| | | .2 | If, upon excavation, load bearing conditions are fulfilled at levels different from those shown on Drawings, excavation levels will be adjusted as required. Consultant will decide whether adjustment in level is required. |
| | | .3 | Additional excavation and backfill work authorized by Consultant will be reimbursed as an extra to the contract. |
| | | .4 | Extras will be allowed if upon excavating to elevations shown, it is found conditions do not meet specified requirements excluding damage to excavation for such reasons as action of ground water, weather, construction activity or the presence of nearby electrical or mechanical service. |

PART 2 - PRODUCTS

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| 2.1 | <u>Materials</u> | .1 | <u>Fill Type 1:</u> Conforming to Class 'A' granular material OPSS 1010 clean, |
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angular crusher run natural stone, free from silt, clay, friable materials, roots and vegetable matter and graded within following limits.

<u>Sieve Size (MTC)</u>	<u>Per Cent Passing</u>
37.5 mm	100
16 mm	62 - 100
9.5 mm	48 - 73
4.75 mm	33 - 55
1.18 mm	15 - 45
0.3 mm	5 - 22
0.075 mm	0 - 8

- .2 **Fill Type 2:** Conforming to Class 'B' granular material OPSS 1010 clean, natural sand and gravel material free from silt, clay, loam friable or soluble materials and vegetable matter and graded within following limits.

<u>Sieve Size (MTC)</u>	<u>Per Cent Passing</u>
106 mm	100
22.4 mm	57 - 100
4.75 mm	25 - 100
1.18 mm	10 - 85
0.300 mm	5 - 40
0.075 mm	0 - 8

- .3 **Fill Type 3:** Conforming to Class 'C' granular material OPSS 1010, clean, washed, coarse sand free from clay, shale and organic matter.

- .4 **Fill Type 4:** Excavated soil either on site or imported, free from roots, rocks larger than 75 mm and building debris capable of being compacted to a density of 98% Standard Proctor. Excavated material shall be approved by Consultant before being used as fill.

- .5 **Fill Type 5:** 19 mm clear, crushed limestone.

PART 3 - EXECUTION

- 3.1 **Topsoil** .1 Remove topsoil completely from area of new paving and areas being regraded. Store good topsoil, acceptable for reuse in stockpile(s) in locations approved by the Consultant, and provide measured quantity of stockpiled material immediately after stripping.
- 3.2 **Grading** .1 Cut or fill the site area to extent shown on drawings and to levels below finish elevations which will allow for specified surface treatments.
- .2 Conform to grades and contours indicated on Drawings. Uniformly slope grade between elevations shown unless otherwise indicated.
- .3 Smoothly slope top and toe of slopes and banks.
- .4 Proofroll, with a heavy roller, existing subgrade below paved areas after excavation. Sub-excavate loose, soft and excessively wet areas and areas containing organic material, and fill with suitable specified fill capable of

being compacted to required density.

- .5 Fill, where required, in accordance with requirements for Backfilling, and Fill Types and Compaction as specified in this section.
- .6 Do not exceed slopes of 1:4 unless indicated otherwise, and ensure sub-grade is sloped to drain water away from building.
- .7 Leave no debris boulders, roots, plant material or other foreign materials showing at graded surfaces.

3.3 Excavation

- .1 Prior to proceeding with excavation, determine accurately the actual founding elevation of any existing footings and report findings to the Consultant.
- .2 Excavate to extent, elevation and depth required for construction of the building site work and grading including pits and building sub-drainage systems, and for a sufficient distance beyond to permit proper construction, shoring, curing and inspection of work.
- .3 Excavate for footings to undisturbed soil capable of sustaining super-imposed loads, and carry exterior footings down to a minimum depth of 1200 mm below the finished grade, or deeper where shown.
- .4 Excavate to well-defined lines to minimize quantity of fill material required.
- .5 Keep a record of founding elevations of footings. This record must be approved by the Consultant before claims for extras will be considered.
- .6 Earth bottoms of excavations to be dry undisturbed soil, level, free from loose or organic matter.
- .7 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.
- .8 When complete, have Consultant inspect excavations to verify depths and dimension of footings before pouring.
- .9 If additional excavation to satisfactory bearing is requested, payment will be made as an extra to the contract. Where such extra excavation is due to the error or misinterpretation by the Contractor no extra payment shall be made.
- .10 If bottom corners of excavation for mechanical or electrical services pits or the like encroach upon a 7 in 10 slope between corners of footings at elevations shown, lower footings as not to encroach upon the permitted slope at no extra cost to the Owner.
- .11 Correct unauthorized excavation at no extra cost as follows:
 - .1 Fill under bearing surfaces and footings with concrete specified for footings. Do not refill over excavated area.
 - .2 Fill under other areas with Fill Type 2 compacted to 100% Standard Proctor Density.

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| | | .12 | Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing. |
| | | .13 | Excavate for footings in a particular area commencing from the lowest footing and proceeding to the higher elevations. |
| 3.3 | Excavation
(Cont'd) | .14 | Use hand methods to carry out final trimming and accurate levelling of footing beds prior to placement of footings. Remove water, disturbed soil and foreign matter from footing excavations before placing reinforcement or concrete. Do not permit the soil at founding elevations to soften due to the presence of water in the excavations or construction activity. |
| | | .15 | During cold weather, prevent soil adjacent to and beneath footings from freezing. If soil at specified founding elevations is frozen or was frozen and thawed, remove effected material and found footings on unaffected soil with the required characteristics at no extra cost to the Owner. |
| | | .16 | Where footings are to be poured without forms, trench sides must be sharp and true. Approval from the Consultant in writing must be obtained before deleting forms. |
| | | .17 | Remove and legally dispose off site, excess fill and existing fill material containing topsoil, organic and debris not capable of meeting specification for Fill Type 4. |
| | | .18 | Observe the rules and regulations governing the respective utilities during excavation. Report existing unlocated services encountered, and do not continue with excavation without directions. Repair damages to services should they occur. |
| | | .19 | Cap off unused services such as drains, sewers, field tile and service pipes uncovered by excavation. Report in writing to the Consultant the discovery of these service. |
| 3.4 | Excavation
For Underground
Service
Trenches | .1 | Trenches for mechanical underground services will be excavated by Division 15. Excavation, will be performed in accordance with this Section. |
| | | .2 | Trenches for electrical underground services will be excavated by Division 16. Excavation will be performed in accordance with this Section. |
| | | .3 | Excavate trenches for underground services shown on drawings. Grade bottom of trenches accurately to suit required service elevations. Trench to width required for specified bedding and backfilling. Ensure that trenches do not drain water into building. |
| 3.5 | Backfilling | .1 | Backfill areas below building and at building perimeter. |
| | | .2 | Do not place backfilling until bearing surfaces, subgrades and work to be covered has been inspected and approved by the Consultant. |

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| | | .3 | Remove debris, rubbish and temporary shoring before commencing backfilling. |
| | | .4 | Areas to be backfilled to be free from debris, snow, ice, water or frozen ground. Backfill materials will not be frozen or contain ice, snow or debris. Do not place backfill in freezing weather without written permission of Consultant. |
| | | .5 | Prior to placing fill under slabs on grade, compact existing subgrade to obtain same compaction as specified for fill. Remove "soft" material and fill with approved materials. |
| 3.6 | Backfilling
(Cont'd) | .6 | Do not commence backfilling until perimeter insulation is installed and inspected and pipe and conduit joints tested and approved by Consultant. |
| | | .7 | Backfill simultaneously each side of walls and other structures to equalize soil pressure. |
| | | .8 | Take care to avoid damage to or displacement of walls, weeping tiles, waterproofing, dampproofing and other work. Whenever temporary unbalanced earth pressures are liable to develop in walls, provide and place the necessary shoring and bracing to counteract the imbalance, and leave shoring/bracing members in place until their removal is approved by the Consultant. Make good, at no cost to the Owner, any damages caused due to inadequate bracing. |
| | | .9 | Place fill materials in layers not exceeding 200 mm compacted depth. Backfill to the level required and as indicated on the Drawings. |
| | | .10 | Compact areas to be backfilled, by mechanical tamping or rolling, to a minimum 98% STANDARD PROCTOR DRY DENSITY, unless noted otherwise. |
| | | .11 | Remove and replace fill until compaction test reports by the independent inspection agency are satisfactory to the Consultant. |
| 3.7 | Backfilling
for Underground
Service
Trenches | .1 | Do not proceed with trench backfilling operations until Consultant has inspected and approved installation. |
| | | .2 | <u>Within building area:</u> Backfill trenches for underground mechanical and electrical services to a level 300mm above service. Backfill below this level is the responsibility of Division 15 and 16. |
| | | .3 | <u>Outside building area:</u> |
| | | .1 | Backfill trenches for underground mechanical and electrical trenches to underside of subgrade level. Backfilling below subgrade level is the responsibility of Division 15 and 16. Supply of fill, placing of fill and compacting will be performed in accordance with this section. |
| | | .4 | <u>Backfilling around installations:</u> |
| | | .1 | Place bedding and surround materials specified elsewhere. |
| | | .2 | Do not backfill around over cast-in-place concrete within 24 hours of placement. |
| | | .3 | Place layers simultaneously on both sides of installed work to |

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- .4 equalize loading.
Place material by hand under, around and over installations until 300mm of cover is provided. Dumping backfill material directly on installations will not be permitted.
- .5 Pipe Crossings:
- .1 Where pipes cross, backfill full width of trenches, between and around pipes, with bedding material.
- 3.7 **Backfilling for Underground Service Trenches (Cont'd)**
- .6 Electrical Trenches Exterior to Building:
- .1 Place plastic 'Buried Cable' warning tape 100 mm wide, 150 mm below finished grade over buried electrical service.
- .7 Shoring, Sheet piling and Bracing:
- .1 Unless otherwise indicated, or directed by Consultant, remove sheet piling and shoring from trench during backfilling operations.
- .2 When sheet piling is to remain in place, cut off tops at elevations directed.
- 3.8 **Fill Types & Compaction**
- .1 Dimensions specified in following paragraph are minimum dimension of fill after compaction.
- .2 Exterior side of perimeter walls: Use Fill type 2 to subgrade level. Compact to 98% Standard Proctor Density.
- .3 Within building area: Use Fill Type 2 to underside of base course for floor slabs. Compact to 100% Standard Proctor Density.
- .4 Under concrete floor slab: Provide minimum 200 mm base course of Fill Type 1 to underside of slab. Compact base course to 100% Standard Proctor Density.
- .5 Backside of retaining walls: Use Fill Type 2 to subgrade level on high side for minimum 500 mm from wall. Compact to 95% Standard Proctor Density.
- .6 Service trenches within building area: After protective cover over service has been installed, fill remainder of trenches with Fill Type 2 to underside of base course for floor slab. Compact to 100% Standard Proctor Density.
- .7 Service trenches outside building area: After protective cover over service has been installed, fill remainder of trench as follows.
- .1 In non pavement area use Fill Type 4 to subgrade level. Compact to a density at least equal to density of adjacent, undisturbed soil, but not less than 95% Standard Proctor Density.
- .2 In pavement areas use Fill Type 2 to subgrade level. Compact to 98% Standard Proctor Density.

- .8 Raise subgrade:
 - .1 Where required raise subgrade to rough grade levels with Fill Type 4. Compact to 98% Standard Proctor Density.
 - .2 In pavement areas where undisturbed soil surface is low bring level up to subgrade with Fill Type 2. Compact to 98% Standard Proctor Density.
 - .9 Unless otherwise indicated, use Fill Type 2 in areas requiring backfill.
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- 3.10 **Completion** .1 Upon completion, remove and dispose of legally off site, surplus topsoil, excavated and graded materials and leave site clean and tidy. Disposal charges are the Contractor's responsibility.

End of Section

PART 1 - GENERAL

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| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Excavation, Trenching and Backfill | Section 02200 |
| | | .2 | Concrete Curbs and Paving | Section 02525 |
| 1.3 | <u>Reference Standards</u> | .1 | <u>Bituminous Concrete Paving</u> | |
| | | .1 | Conform to Ontario Provincial Standard Specifications (O.P.SS) as specified herein. | |
| 1.4 | <u>Qualifications</u> | .1 | The work of this section is to be done by a paving contractor of recognized standing who has personnel with minimum five years experience in this type of work and who has the necessary equipment to complete the work. | |
| 1.5 | <u>Guarantee</u> | .1 | Provide the following Guarantee in accordance with the General Conditions of the Contract, notwithstanding the time provisions therein. | |
| | | .1 | Two years on materials and labour | |
| 1.6 | <u>Inspection & Testing</u> | .1 | Comply with the requirements of Section 01400 Quality Control. | |
| | | .2 | The Owner may appoint and will pay for, out of the Allowances specified in Division 1 an independent inspection agency to conduct any or all of the following as directed by the Consultant. | |
| | | .1 | Carry out grain size analysis. | |
| | | .2 | Determine minimum and maximum moisture content of densities of granular fill. | |
| | | .3 | Determine on-site density, thickness and moisture content of compacted fills. | |
| | | .4 | Check properties of asphalt mixes, including aggregate gradation of asphalt content. | |
| | | .5. | Check suitability of equipment used. | |
| 1.7 | <u>Environmental Requirements</u> | .1 | Lay granular base courses and asphalt paving courses when weather is dry and only on dry bases. | |
| | | .2 | Place granular bases courses only when ambient temperature is above 0°C. Do not place granular materials while either material or subgrade is frozen. | |
| | | .3 | Place asphalt paving courses only when ambient temperature is 7°C or above. | |
| 1.8 | <u>Protection</u> | .1 | Prevent damage to buildings, landscaping, curbs, sidewalks, trees, and adjacent property. | |
| | | .2 | Provide access to building at all times. Arrange paving schedule so as not to interfere with normal use of premises. | |

- 1.8 **Protection (Cont'd)**
- .3 Make special provisions to minimize deterioration of subgrade, particularly when operating during unfavourable weather conditions or when working in wet soil. Use special designated traffic lanes, build temporary roads, reduce traffic to half-loads or take other suitable measures.
 - .4 Do not permit vehicular traffic on finished asphalt pavement until it has cooled and hardened and in no case sooner than 12 hours after completion.
 - .5 Provide barricades and warning devices to protect pavement.

PART 2 - PRODUCTS

- 2.1 **Materials**
- .1 Granular Base: Conforming to Class 'A' granular material OPSS 1010 clean, angular crusher run natural stone, free from silt, clay, friable materials, roots and vegetable matter and graded within following limits.

<u>Sieve Size (MTC)</u>		<u>Per Cent Passing</u>
37.5	mm	100
16	mm	62 - 100
9.5	mm	48 - 73
4.75	mm	33 - 55
1.18	mm	15 - 45
0.3	mm	5 - 22
0.075	mm	0 - 8

- .2 Granular Subbase: Conforming to Class 'B' granular material OPSS 1010 clean, natural sand and gravel material free from silt, clay, loan friable or soluble materials and vegetable matter and graded within following limits.

<u>Sieve Size (MTC)</u>		<u>Per Cent Passing</u>
106	mm	100
22.4	mm	57 - 100
4.75	mm	25 - 100
1.18	mm	10 - 85
0.300	mm	5 - 40
0.075	mm	0 - 8

- .3 Asphalt:
 - .1 Asphalt cement shall be penetration grade 85-100 and conform with OP.SS Specification Form 1101 and aggregates shall conform with OP.SS Form 1003.
 - .2 Asphalt base and surface course, as shown on the drawings shall conform to OP.SS Specification Form 310.
 - .3 Asphalt emulsions shall conform with OP.SS Specifications Form 1102.
 - .4 Tack coat between base and wearing course shall be SS-1 asphalt

emulsion diluted with an equal volume of water.

- PART 3 - EXECUTION**
- .4 Paint: To CGSB 1-GP-74M, alkyd traffic paint, colour yellow.
- 3.1 **Ex. Asphalt Paving Removal**
- .1 Remove existing asphalt paving, including 150 mm depth of existing granular base (for full depth) where shown and noted on drawings for existing asphalt paving to be removed and replaced.
- .2 Dispose of all surplus materials off site at an approved and authorized registered dumpsite licensed to receive these materials
- .3 Proof roll and compact existing sub-base to remain and proceed with replacement of granular base and asphalt paving as specified in this section for new asphalt paving.
- 3.2 **Preparation of Subgrade**
- .1 Examine rough graded subgrade over which asphalt paving system is to be installed to ensure it is suitable for installation. Start of work shall imply acceptance of conditions.
- .2 Fine grade subgrade as required to bring it to required levels and slopes. Meet compaction densities and fill material requirements specified in Section 02200. Slope fine graded subgrade to permit drainage.
- .3 Thoroughly compact subgrade to minimum 98% Standard Proctor Density for at least the uppermost 300 mm. Sub-excavate soft spots that develop during compaction and bring to proper grade by the addition of fill material and then thoroughly compact until satisfactory, adding more fill material as required.
- .4 In the event subgrade cannot be made stable or be compacted with a roller the Consultant will decide if local soft spots are to be excavated and backfilled with 50 mm crusher limestone.
- 3.2 **Granular Base & Subbase**
- .1 Over compacted subgrade place granular base and subbase in layers not exceeding 150 mm thickness. Compact each layer to 100% Standard Proctor Density unless otherwise indicated.
- .2 Compact granular base and subbase by rolling with power rollers capable of reversing without backlash. Use hand tamping or mechanical hand compaction equipment in areas inaccessible to rollers.
- .3 Add water as required to obtain optimum density and to control dust.
- 3.3 **Paving**
- .1 Obtain approval of granular base and subbase, by Consultant, prior to installing asphalt paving. Lay asphalt as soon as base is approved.
- .2 The Contractor shall inform the Consultant at least 48 hours prior to commencing asphalt paving operations or resuming same after a delay of more than one week, in order that the Consultant may inspect the base before asphalt is applied.
- .3 No asphalt shall be laid on a surface which is wet, or covered by snow or

ice, or if the temperature of the air is below 7°C, or if the ground is frozen.

- .4 Slope paving away from building minimum 1%. Slope paving minimum 1% for drainage in all locations unless specifically indicated otherwise on Drawings. Bumps or "bird baths" will not be accepted.
- .5 Finish surface true to grade and free from deviations exceeding 1:1000 when measured with a 3m straight edge.
- .6 In all cases where asphalt base course layer has been in place for a period of two or more months, tack coat shall be placed prior to the placing of asphalt top course layer or at the discretion of the Consultant.
- .7 Minimum asphalt mixture temperature when spread, 118°C.
- .8 Maximum asphalt mixture temperature at anytime, 149°C.
- .9 Compact each course layer with roller when it can support roller mass without undue cracking or displacement, until all roller marks are eliminated.
- .10 Compact each asphalt paving course to 97% Marshall density to ASTM D1559-76.
- .11 Keep roller speed slow enough to avoid mixture displacement.
- .12 Moisten roller wheels to prevent mixture adhesion.
- .13 Compact mixture with hot tampers in areas inaccessible to roller and all exposed edges.

3.4 Joints

- .1 Transverse and longitudinal joints in successive courses shall be offset at least 300 mm from each other.
- .2 All joints shall be coated with tack coat prior to placement of adjacent asphalt if the previous section has been in place for more than two hours.
- .3 Transverse joints shall be cut back at least 300 mm and painted with tack coat before paving proceeds.
- .4 Where tack coat has been applied, it shall be allowed to dry to a tacky texture before new asphalt is laid against it.

3.5 Repairs

- .1 Where repairs are required, include repairs under warranty, cut asphalt to its full depth making straight neat cuts.
- .2 Compact granular base and subbase in accordance with requirements for new asphalt.
- .3 Coat exposed cut edges with a tack coat. Place hot asphalt mixture and compact to thickness required in accordance with requirements for new asphalt.

- 3.6 **Schedule**
- .1 Provide medium duty asphalt paving where indicated to be new.
- .1 **Medium Duty Asphalt Pavement and Base Construction:**
- | | | |
|----|----------------------|------------------------------------|
| .1 | Granular Subbase: | 300 mm Granular 'B' |
| .2 | Granular Base: | 150 mm Granular 'A' |
| .3 | Asphalt Base Course: | 60 mm of HL-8 base course asphalt. |
| .4 | Asphalt Top Course: | 35 mm of HL-3a top course asphalt. |
- .2 Provide medium duty asphalt paving where indicated for existing asphalt paving to be removed and replaced.
- .1 **Medium Duty Asphalt Pavement and Base Construction:**
- | | | |
|----|----------------------|------------------------------------|
| .1 | Granular Sub-base: | Existing Granular 'B' to remain. |
| .2 | Granular Base: | 150 mm Granular 'A' |
| .3 | Asphalt Base Course: | 60 mm of HL-8 base course asphalt. |
| .4 | Asphalt Top Course: | 35 mm of HL-3a top course asphalt. |

End of Section

PART 1 - GENERAL

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|-----|--|----|---|---------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Excavating, Trenching and Backfilling | Section 02200 |
| | | .2 | Asphalt Paving | Section 02510 |
| | | .3 | Cast-In-Place Concrete | Section 03300 |
| 1.3 | <u>Reference Standards</u> | .1 | Do concrete work in accordance with requirements of Division 3 except where otherwise specified herein. | |
| 1.4 | <u>Inspection & Testing</u> | .1 | Comply with the requirements of Section 01400 Quality Control. | |

PART 2 - PRODUCTS

- | 2.1 | <u>Materials</u> | .1 | <u>Concrete Materials:</u> CAN3-A23-M77, 25MPa at 28 days with 6% ∇ 1% air entrainment and not less than 325 kg/m ³ of cement. Maximum slump to be 50mm. | | | | | | | | | | | | | | | | | |
|-------------------------|-------------------------|----|--|--|-------------------------|------------------------|---------|-----|-------|----------|--------|---------|---------|---------|---------|---------|--------|--------|----------|-------|
| | | .2 | <u>Reinforcing Steel:</u> | | | | | | | | | | | | | | | | | |
| | | | 1) Bars: CSA G30.12-M1977, Grade 400. | | | | | | | | | | | | | | | | | |
| | | | 2) Mesh: CSA G30.5-M1983, 150 x 150mm | | | | | | | | | | | | | | | | | |
| | | .3 | <u>Forms:</u> Either steel or wood, capable of producing smooth flat surfaces. Use flexible spring-steel forms or laminated boards to form radius bends as required. | | | | | | | | | | | | | | | | | |
| | | .4 | <u>Expansion Joints:</u> 12mm thick asphalt impregnated fibre board, unless indicated otherwise. | | | | | | | | | | | | | | | | | |
| | | .5 | <u>Granular Base:</u> Granular 'A' material OPSS 1010 clean, angular crusher run natural stone, free from silt, clay, friable materials, roots and vegetable matter and graded within following limits. | | | | | | | | | | | | | | | | | |
| | | | <table border="0" style="width: 100%;"> <tr> <th style="text-align: left;"><u>Sieve Size (MTC)</u></th> <th style="text-align: left;"><u>Percent Passing</u></th> </tr> <tr> <td>37.5 mm</td> <td>100</td> </tr> <tr> <td>16 mm</td> <td>62 - 100</td> </tr> <tr> <td>9.5 mm</td> <td>48 - 73</td> </tr> <tr> <td>4.75 mm</td> <td>33 - 55</td> </tr> <tr> <td>1.18 mm</td> <td>15 - 45</td> </tr> <tr> <td>0.3 mm</td> <td>5 - 22</td> </tr> <tr> <td>0.075 mm</td> <td>0 - 8</td> </tr> </table> | | <u>Sieve Size (MTC)</u> | <u>Percent Passing</u> | 37.5 mm | 100 | 16 mm | 62 - 100 | 9.5 mm | 48 - 73 | 4.75 mm | 33 - 55 | 1.18 mm | 15 - 45 | 0.3 mm | 5 - 22 | 0.075 mm | 0 - 8 |
| <u>Sieve Size (MTC)</u> | <u>Percent Passing</u> | | | | | | | | | | | | | | | | | | | |
| 37.5 mm | 100 | | | | | | | | | | | | | | | | | | | |
| 16 mm | 62 - 100 | | | | | | | | | | | | | | | | | | | |
| 9.5 mm | 48 - 73 | | | | | | | | | | | | | | | | | | | |
| 4.75 mm | 33 - 55 | | | | | | | | | | | | | | | | | | | |
| 1.18 mm | 15 - 45 | | | | | | | | | | | | | | | | | | | |
| 0.3 mm | 5 - 22 | | | | | | | | | | | | | | | | | | | |
| 0.075 mm | 0 - 8 | | | | | | | | | | | | | | | | | | | |
| | | .6 | <u>Non Shrink Grout:</u> Pre-mixed non metallic 30 Mpa compressive strength. | | | | | | | | | | | | | | | | | |
| | | .7 | <u>Tactile Surface Plates:</u> | | | | | | | | | | | | | | | | | |
| | | .1 | Plate shall conform to OPSS 351 -Construction Specification for Concrete Sidewalks. | | | | | | | | | | | | | | | | | |

- .2 Gray cast iron tactile walking surface indicator plates shall be according to ASTM A 48M, Class 35B, and shall be bare and not coated with paint or other coatings or substances. Castings shall be sound, free from pouring faults, cracks, blowholes, and other defects.
- .3 The surface of each new cast iron plate on both the tops of the truncated domes and the field between truncated domes shall have a minimum wet and dry static coefficient of friction of 0.8 according to ASTM C 1028.
- .4 The initials or trademark of the manufacturer, year of manufacture, and country of manufacture shall be distinctly cast and legible in raised letters on the top side of each plate

PART 3 - EXECUTION

- 3.1 **Preparation Subgrade**
 - .1 Examine rough graded subgrade over which curbs and paving are to be installed to ensure it is suitable for installation. Start of work shall imply acceptance of conditions.
 - .2 Fine grade subgrade as required to bring it to required levels and slopes.
 - .3 Compact subgrade to the requirements of Section 02200.
 - .4 Stake out curb and paving areas and obtain Consultants review prior to proceeding.
- 3.2 **Granular Base**
 - .1 Over compacted subgrade place compacted granular base to underside of paving.
 - .2 Compact base courses to 100% Standard Proctor Density.
 - .3 Install granular base within a tolerance of 12mm within 3 metres.
- 3.3 **Installation Cast-In-Place Curbs**
 - .1 Obtain approval of granular base, by Consultant, prior to placement of paving.
 - .2 Erect formwork to obtain the required curb section.
 - .3 Install sufficient quantity of forms to allow continuous progress of work so forms can remain in place at least 24 hours after concrete placement.
 - .4 Obtain approval of forms from Consultant before pouring concrete.
 - .5 Install side forms free of warp. Provide proper support to maintain alignment and grade to the following tolerances.
 - 1) Top of Form
Not more than 3mm in 3.0 metres.
 - 2) Vertical Face
Longitudinal axis not more than 6mm in 3.0 metres.

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- .6 Treat all form lumber with a non-staining mineral oil prior to concrete placement.
 - .7 Unless otherwise detailed, place three continuous 10M reinforcing bars, one near the bottom, one near the top and one in the middle of the curb. Cut reinforcing at expansion joints.
 - .8 Install transverse expansion joints at returns and at 5.5 metres O.C. Install longitudinal expansion joint where curbs and paved areas abut each other, buildings, other concrete slabs or pads or vertical restraints, unless indicated otherwise.
 - .9 Fill joints with specified expansion joint filler cut to the full cross sectional shape of the curb.
 - .10 Moisten subgrade to reduce suction at the time concrete is placed. Do not place concrete around structures until they have been brought to the required grade and alignment.
 - .11 Deposit and spread concrete in a continuous operation between transverse joints. If interrupted for more than 1/2 hour, place a construction joint. Sections less than 5.5 metres in length between transverse joints will not be permitted.
 - .12 After screeding and compacting, finish uniformed surfaces with a wood float to produce a uniform texture and finish throughout.
 - .13 Do not place concrete on fill that is frozen or which contains frozen material. Concrete, when deposited in forms, shall have a temperature of not less than 10°C, nor more than 32°C. Provided means to maintain these limits for 72 hours after placing.
 - .14 Inspect formed surfaces immediately after stripping forms, grind down fins and repair sand runs and honeycombs with the same mix used for the curbs and gutters minus the coarse aggregates.
 - .15 After stripping the forms and finishing, treat curb surfaces with approved curing compound, or use other curing method acceptable to Consultant.
 - .16 Protect concrete from harmful effects of sunshine, drying winds, cold temperatures, and running surface water for a minimum period of five days.
- 3.4 **Installation of Concrete Paving**
- .1 Construct wood forms for all unsupported concrete edges to provide straight, clean lines, and smooth radius curved lines.
 - .2 Place wire reinforcing mesh on top of compacted base. Before pouring concrete raise mesh 25mm above base. Cut mesh at expansion joints.
 - .3 Obtain Consultants approval of granular base and reinforcing steel/mesh installation prior to placing concrete.
 - .4 Install expansion joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structures

- or services. Install expansion joints at approximately 6m O.C. in both directions.
- .5 Divide paving sections between expansion joints into the pattern indicated on the Drawings. Unless otherwise indicated, provide tooled joints during finishing stage at maximum 1500mm O.C. in each direction or saw cut, if directed by Consultant after completion of finishing.
- .6 Round edges, including edges of joints, with 10mm radius edging tool.
- .7 Finish surfaces to within 3mm in 3.0 metres from line, level or grade as measured with a straight edge placed on surface.
- .8 Finish concrete with wooden float to produce an even gritty surface and in accordance with Municipal requirements.
- .9 Treat exposed surfaces with curing, compound in accordance with manufacturers instructions, or moist cure in accordance with CAN3 A23.1-M77.
- .10 Immediately after stripping forms, treat expose edges with curing compound.
- 3.5 **Tactile Walking Surface Indicator Plate Installation**
- .1 Cast iron Tactile walking surface indicator plates shall be set into wet prepared concrete sidewalk ramp as specified in the Contract Documents and according to the plate manufacturer's installation instructions.
- .2 Plates shall be cleaned after installation.
- 3.6 **Schedule**
- .1 Provide heavy duty granular base at driveways and parking lots.
1. Granular Subbase: 400 mm Granular 'B'
2. Granular Base: 200 mm Granular 'A'
- .2 Provide medium duty granular base at pedestrian walkways.
1. Granular Base: 200 mm Granular 'A'

End of Section

PART 1 - GENERAL

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| 1.1 | <u>Related Sections</u> | .1 | Section 02311 | Site Grading |
| 1.2 | <u>Definitions</u> | .1 | COMPOST: A mixture of soil and decomposing organic matter used as a fertilizer, mulch, or soil conditioner. Compost is processed organic matter containing 40% or more organic matter as determined by the Walkley-Black or LOI test. Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth (C:N ratio below (25) (50)), and contain no toxic or growth inhibiting contaminants. Composted bio-solids must meet the requirements of the Guidelines for Compost Quality, Category (A) produced by the Canadian Council of the Ministers of the Environment (CCME). | |

PART 2 - PRODUCTS

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| 2.1 | <u>Topsoil</u> | .1 | Topsoil for sodded and seeded areas and ground-level planting beds: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth. | |
| | | .1 | Soil texture based on The Canadian System of Soil Classification, to consist of 45 % sand, 15 % clay, 40% silt, and contain 4 to 10 % organic matter by weight. | |
| | | .2 | Contain no toxic elements or growth inhibiting materials. | |
| | | .3 | Finished surface free from: | |
| | | .1 | Debris and stones over 50 mm diameter. | |
| | | .2 | Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 2% of soil volume. | |
| | | .4 | Consistence: friable when moist. | |
| | | .5 | Fertility: major soil nutrients present in following amounts: | |
| | | .6 | Nitrogen (N): 20 to 40micrograms of available N per gram of topsoil. | |
| | | .7 | Phosphorus (P): 40 to 50micrograms of phosphate per gram of topsoil. | |
| | | .8 | Potassium (K): 75 to 110micrograms of potassium per gram of topsoil. | |
| | | .9 | Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation. | |
| | | .10 | Ph value: 6.5 to 8.0. | |

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| 2.2 | Soil
Amendments | <ul style="list-style-type: none"> .1 Peatmoss: <ul style="list-style-type: none"> .1 Derived from partially decomposed species of Sphagnum Mosses. .2 Elastic and homogeneous, brown in colour. .3 Free of wood and deleterious material which could prohibit growth. .4 Shredded particle minimum size: 5 mm. .2 Sand: washed coarse silica sand, medium to coarse textured. .3 Organic matter: compost Category A, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements. .4 Limestone: <ul style="list-style-type: none"> .1 Ground agricultural limestone. .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve. .5 Fertilizer: organic, industry accepted standard medium containing nitrogen, phosphorous, potassium and any other micro-nutrients suitable to the specific plant species or application or defined by the soil test. |
| 2.3 | Source Quality
Control | <ul style="list-style-type: none"> .1 Advise Consultant of sources of topsoil to be utilized with sufficient lead time for testing. .2 Contractor is responsible for amendments to supply topsoil as specified. .3 Soil testing by recognized testing facility for pH, N, P and K, and organic matter and other test components as designated by Consultant. Coordinate with Consultant prior to arranging for testing. .4 Testing of topsoil will be carried out by testing laboratory designated by Consultant. Soil sampling, testing and analysis to be in accordance with Provincial standards. Cost of tests will be paid by cash allowance. |

PART 3 - EXECUTION

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| 3.1 | Stripping of
Topsoil | <ul style="list-style-type: none"> .1 Commence topsoil stripping of areas as directed by Consultant after area has been cleared of weeds and grasses and removed from site. .2 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil where textural quality will be moved outside acceptable range of intended application. .3 Stockpile in locations as directed by Consultant. Stockpile height not to exceed 2 m. |
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| 3.1 | <u>Stripping of Topsoil (Cont'd)</u> | .4 | Disposal of unused topsoil is to be in an environmentally responsible manner but not used as landfill. |
| | | .5 | Protect stockpiles from contamination and compaction. |
| 3.2 | <u>Preparation of Existing Grade</u> | .1 | Verify that grades are correct. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant. |
| | | .2 | Grade soil, eliminating uneven areas and low spots, ensuring positive drainage. |
| | | .3 | Remove debris, roots, branches, stones in excess of 50mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 50 mm above surface. Dispose of removed material off site. |
| | | .4 | Cultivate entire area which is to receive topsoil to minimum depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil. |
| 3.3 | <u>Placing and Spreading of Topsoil/Planting Soil</u> | .1 | Place topsoil after Consultant has accepted subgrade. |
| | | .2 | Spread topsoil in uniform layers not exceeding 150 mm. |
| | | .3 | For sodded areas keep topsoil 15 mm below finished grade. |
| | | .4 | Spread topsoil as indicated to following minimum depths after settlement. |
| | | .1 | 150 mm for seeded areas. |
| | | .2 | 135 mm for sodded areas. |
| | | .3 | 600 mm for shrub and perennial beds. |
| | | .5 | Manually spread topsoil/planting soil around trees, shrubs and obstacles. |
| 3.4 | <u>Soil Amendments</u> | .1 | For planting beds and turf: apply and thoroughly mix soil amendments into full specified depth of topsoil. |
| 3.5 | <u>Finish Grading</u> | .1 | Grade to eliminate rough spots and low areas and ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking. |
| | | .2 | Consolidate topsoil to required bulk density. Leave surfaces smooth, uniform and firm against deep footprinting. |
| 3.6 | <u>Acceptance</u> | .1 | Consultant will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading. |
| 3.7 | <u>Surplus Material</u> | .1 | Dispose of materials except topsoil not required off site. |

End of Section

PART 1 - GENERAL

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| 1.1 | <u>Related Sections</u> | .1 | Section 02911 | Topsoil and Finish Grading |
| 1.2 | <u>Samples</u> | .1 | Submit samples in accordance with Section 01300 – Submittals. | |
| | | .2 | Submit: | |
| | | .1 | Sod for each type specified. | |
| | | .1 | Install approved samples in one square metre mock-ups and maintain in accordance with maintenance requirements during establishment period. | |
| | | .3 | Obtain approval of samples by Consultant. | |
| 1.3 | <u>Scheduling</u> | .1 | Schedule sod laying to coincide with preparation of soil surface. | |
| | | .2 | Schedule sod installation when frost is not present in ground. | |
| 1.4 | <u>Maintenance Period</u> | .1 | Maintain sod from date of installation until Substantial Performance, or a 90 day period after sodding, whichever is longer. If Substantial Performance, or the 90 day period after sodding, ends after end of growing season, extend maintenance period until June 30 of the following growing season. Maintain sod layed at end of growing season until August 31 of following season. | |

PART 2 - PRODUCTS

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| 2.1 | <u>Materials</u> | .1 | Number One Turfgrass Nursery Sod: Sod that has been especially sown and cultivated in nursery fields as turfgrass crop. | |
| | | .1 | Turfgrass Nursery Sod types: | |
| | | .1 | Turf-Type Perennial Ryegrass Sod – containing mixture of 70% perennial Ryegrass and 30% Kentucky Bluegrass. | |
| | | .2 | Fine-Leafed Fescue Sod – containing mixture of 70% Fine-Leafed Fescue and 30% Kentucky Bluegrass. | |
| | | .2 | Turfgrass Nursery Sod quality: | |
| | | .1 | Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres. | |
| | | .2 | Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm. | |
| | | .3 | Mowing height limit: 35 to 65 mm. | |
| | | .4 | Soil portion of sod: 6 to 15 mm in thickness. | |

- 2.1 **Materials (Cont'd)**
- .2 Sod establishment support:
- .1 Wooden pegs: 17 x 8 x 200 mm.
- .2 Biodegradable starch pegs: 17 x 8 x 200 mm.
- .3 Water:
- .1 Supplied by Owner at designated source.
- .4 Fertilizer:
- .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
- .2 Complete, natural, organic, slow release with 65 % of nitrogen content in water-insoluble form.
- 2.2 **Source Quality Control**
- .1 Obtain approval from Consultant of sod at source.
- .2 When proposed source of sod is approved, use no other source without written authorization.

PART 3 - EXECUTION

- 3.1 **Preparation**
- .1 Verify that grades are correct and prepared in accordance with Section 02911 - Topsoil and Finish Grading. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.
- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated, to tolerance of plus or minus 8mm, for Turfgrass Nursery Sod, surface to drain naturally.
- .4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.
- 3.2 **Sod Placement**
- .1 Lay sod within 24 hours of being lifted if air temperature exceeds 20°C.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.
- .3 Roll sod as directed by Consultant. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

- 3.3 **Sod Placement on Slopes and Pegging**
- .1 Start laying sod at bottom of slopes.
 - .2 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:
 - .1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
 - .2 Not less than 3-6 pegs per square metre.
 - .3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by Consultant.
 - .4 Drive pegs to 20 mm above soil surface of sod sections.
- 3.4 **Fertilizing Program**
- .1 Fertilize during establishment and warranty periods to following program:

Date	Rate
May 1 to May 31 (first application)	12 kg / 100 cu.m
July 1 to July 31 (second application)	6 kg / 100 cu.m
September 1 to September 15 (third application)	12 kg / 100 cu.m
 - .2 The fertilizer requirements noted above have been included for tendering purposes only. Adjust requirements and rates to conform to soil testing report and subsequent recommendations. Make such adjustments at no extra cost to the contract.
- 3.5 **Maintenance During Establishment Period**
- .1 Perform following operations from time of installation until acceptance at end of maintenance period.
 - .2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.
 - .3 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother grassed areas as directed by Consultant.
 - .4 Maintain sodded areas weed free 95%.
 - .5 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
- 3.6 **Acceptance**
- .1 Turfgrass Nursery Sod areas will be accepted by Consultant provided that:
 - .1 Sodded areas are properly established.

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| | | .2 | Sod is free of bare and dead spots. |
| | | .3 | No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm. |
| | | .4 | Sodded areas have been cut minimum 2 times prior to acceptance. |
| 3.6 | Acceptance
(Cont'd) | .5 | Fertilizing in accordance with fertilizer program has been carried out at least once. |
| | | .2 | Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled. |
| 3.7 | Maintenance
During
Warranty
Period | .1 | Maintenance during Warranty Period will be the responsibility of the Owner. |

End of Section

PART 1 - GENERAL

- 1.1 **Related Work**
- .1 Concrete Reinforcement: Section 03200
 - .2 Concrete Floor Finishing: Section 03345
- 1.2 **References**
- .1 ANSI/ACI 117-81, Tolerances for Concrete Construction and Materials.
 - .2 ASTM C 260-94, Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C 309-94, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .4 ASTM C 494-92, Specification for Chemical Admixtures for Concrete.
 - .5 ASTM D1751-83(1991), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .6 ASTM D 1752-84 (R1992), Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - .7 ASTM E1155M-87, Test Method for Determining Floor Flatness and Levelness Using the F-Number System.
 - .8 CAN/CSA-A5-03, Portland Cement.
 - .9 CSA-A23.1-00, Concrete Materials and Methods of Concrete Construction.
 - .10 CSA-A23.2-00, Methods of Test for Concrete.
 - .11 CAN/CSA-A23.5-03, Supplementary Cementing Materials.
 - .12 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- 1.3 **Certificates**
- .1 Submit certificates in accordance with Section 01300 - Submittals.
 - .2 Minimum 4 weeks prior to starting concrete work submit to Consultant manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Supplementary cementing materials.
 - .3 Grout.
 - .4 Admixtures.
 - .5 Aggregates.
 - .6 Water.
 - .7 Waterstops.
 - .8 Joint Filler.
 - .3 Provide certification that mix proportions selected will produce concrete of

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| | | | quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1. |
| 1.3 | <u>Certificates (Cont'd)</u> | .4 | Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems. |
| 1.4 | <u>Quality Assurance</u> | .1 | Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures in accordance with Section 01400 - Quality Control for Consultant's approval for following items: |
| | | .1 | Hot weather concrete |
| | | .2 | Cold weather concrete |
| | | .3 | Curing |
| | | .4 | Finishes |
| | | .5 | Formwork removal. |
| 1.5 | <u>Records</u> | .1 | Keep record at job site showing date, time, ambient air temperature, place of each pour of concrete, together with transit-mix delivery slip certifying contents of pour. |
| | | .2 | Make records available to Consultant for inspection upon request. |
| | | .3 | Submit mix design for each class of concrete. |
| 1.6 | <u>Cold Weather Curing and Protection Requirements</u> | .1 | Provide adequate protection for the concrete by means of heated enclosures, coverings, insulation, or suitable combination of these methods when the outside air temperature is at or below 5 Deg. C. Conform to Clause 21 of CSA-A23.1. |
| 1.7 | <u>Hot Weather Curing and Protection Requirements</u> | .1 | When the outside air temperature is at or above 27 deg. C., protect freshly deposited concrete from drying too rapidly, to prevent plastic shrinkage cracking. Conform to Clause 21 of CSA-A23.1. |

PART 2 - PRODUCTS

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| 2.1 | <u>Materials</u> | .1 | Portland cement: to CAN/CSA-A5. |
| | | .2 | Supplementary cementing materials: to CAN/CSA-A23.5. |
| | | .3 | Water: to CSA-A23.1. |
| | | .4 | Aggregates: to CSA-A23.1. Coarse aggregates to be normal density. |
| | | .5 | Water reducing admixture: to CAN3-A266.2-M78 and ASTM C494, Type A, Prokrete N by Conchem Lafarge, WR75 by Euclid Chemical Canada Ltd. or Pozzolith 322N by Master Builders Technologies Limited. |
| | | .6 | Air entraining admixture: to ASTM C260 and CAN3-A266.1, Pro Air by Conchem Lafarge, Eucon Air by Euclid Chemical Canada Ltd. or MB-AE10 by Master Builders Technologies Limited. |

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| 2.1 | Materials
<u>(Cont'd)</u> | .7 | Chemical admixtures: to ASTM C 494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing. Use of calcium chloride is not acceptable. |
| | | .8 | Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compression strength of 40 MPa at 7 days. M-Bed Standard by Sternson, V-3 Non-metallic Grout by W.R. Meadows of Canada Ltd., In-Pakt by C.C. Chemicals Canada Ltd. or Progrout by Conchem Lafarge. |
| | | .9 | Liquid Curing/Sealing Compound: to CAN/CSA-A23.1 and to ASTM C 309 Type 1-chlorinated rubber, Class B water based acrylic curing/sealing compound, Acryseal WB by Conchem Lafarge, Masterseal W by Master Builders Technologies Limited, Florseal W.B. by Sternson or Sealtight Intex by W.R. Meadows of Canada Ltd. |
| | | .10 | Waterstops: Volclay waterstop type RX, 25 mm x 19 mm by American Collorid. |
| | | .11 | Premoulded joint fillers: |
| | | .1 | Bituminous impregnated fiber board: to ASTM D1751, 12.7mm thick x depth of slab. |
| | | .2 | Sponge rubber: to ASTM D1752, Type I, flexible grade. |
| | | .12 | Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots. |
| | | .13 | Dampproof membrane: 0.25 mm polyethylene sheet conforming to CAN/CGSB-51.34. |
| | | .14 | Sealant for dampproof membrane: acoustical sealant to CAN/CGSB-19.21. |
| | | .15 | Shrinkage control fibres: Fibre Mesh fibrillated polypropylene fibres by Fibermesh Canada Ltd. or equal, 19 mm in length. |
| | | .16 | Sealant for control joints in concrete floors and where slab abuts foundation wall: polyurethane base, multi-component, to CGSB 19-GP-15A, Type 1, shore hardness of 20-35, Duraseal-U by W.R. Grace and Co. of Canada Ltd. |
| | | .17 | Wet curing: water conforming to CSA-A23.1, Clause 4, clear and entirely free from any elements which might cause staining of concrete, and min. 0.1 mm (4 mils) thick polyethylene film as specified herein. |
| | | .18 | Polyethylene film (for wet curing): minimum 0.1 mm (4 mils) thick, complying with maximum allowable moisture loss requirements of ASTM C156. |
| 2.2 | <u>Mixes</u> | .1 | Ready-mixed concrete and concrete proportions shall be in accordance with CSA-A23.1, Clause 14, and as follows. |

- 2.2 **Mixes (Cont'd)**
- .2 Concrete shall be proportioned by the water-cement ratio and to provide a plastic and workable mix without the formation of free water on the surface.
 - .3 Mix shall be designed for both strength and durability. Submit to Consultant the mix design for the different classes of concrete indicated in the General Construction Notes provided on the structural drawings and listed below.
 - .4 The amount of free moisture in the aggregate shall be deducted from the amount of mixing water being added.
 - .5 Specified slumps shall be maintained and checked periodically with slump tests.
 - .6 Mix shrinkage control fibres into slab mix at rate of 0.9 kg/cu.m of concrete, unless otherwise indicated on drawings. Add admixture as required.
 - .7 Class of exposure: refer to Clause 15 and Tables 7, 8 and 9 of CSA-A23.1, and Class of Concrete Table herein.
 - .8 Air content: to Table 10 of CSA-A23.1, according to category of exposure and Class of Concrete table provided on structural drawings.
 - .9 Concrete mix shall be designed and proportioned to yield the specified ultimate and compressive strength at 28 days as determined by laboratory testing standard 150 mm x 300 mm or 100 mm x 200 mm cylinders moist cured in the laboratory.

.10 Classes of concrete:

CLASS OF CONCRETE	LOCATION	EXPOSURE CLASS	STRENGTH (MPa)	SLUMP (mm)	AIR (percent)
A	Footings	-	20	80	up to 3
B	Foundation Walls	F-2	25	80	4 to 7
C	Slab on Grade Inside Building, Slab on Composite Floor Deck	-	25	80	up to 3
D	Slab on Grade Outside Building	C-1	35	80	5 to 8
E*	Topping for Concrete Slabs	-	25	50	up to 3
F	Concrete Fill	-	5	20-80	

*concrete must utilize plasticizer to facilitate placement.

PART 3 - EXECUTION

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| 3.1 | <u>Preparation</u> | .1 | Obtain Consultant's approval before placing concrete. Provide 24 hour notice prior to placing of concrete. |
| 3.1 | <u>Preparation (Cont'd)</u> | .2 | Pumping of concrete is permitted only after approval of equipment and mix. |
| | | .3 | Ensure reinforcement and inserts are not disturbed during concrete placement. |
| | | .4 | Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing. |
| | | .5 | Maintain accurate records of poured concrete. Items to indicate date, location of pour, quality, air temperature and test samples taken. |
| | | .6 | In locations where new concrete is dowelled into existing work, drill holes in existing concrete. Place steel dowels and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated. |
| 3.2 | <u>Construction</u> | .1 | Do cast-in-place concrete work in accordance with CSA-A23.1. |
| | | .2 | Place concrete to prevent layering and segregation, and vibrate sufficiently to ensure thorough compaction, maximum density, and according to CSA-A23.1 Clause 19. |
| | | .3 | Sleeves and inserts. |
| | | .1 | Set and build in inserts, anchors, frames, angles, sleeves, plates and similar items supplied by other trades. Advise trades well in advance of scheduled placement to allow adequate time for supply of items to be built in. Have respective trades verify location of items supplied by them. |
| | | .2 | No sleeves, ducts, pipes or other openings shall pass through structural members, except where indicated or approved by Consultant. |
| | | .3 | Where approved by Consultant set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Consultant. |
| | | .4 | Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Consultant before placing of concrete. |
| | | .5 | Check locations and sizes of sleeves and openings shown on structural and civil drawings with architectural, mechanical and electrical drawings. |
| | | .4 | Anchor bolts: |
| | | .1 | Set anchor bolts with templates under supervision of appropriate trade prior to placing concrete. |
| | | .2 | With approval of Consultant, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be minimum 100 mm diameter. Drilled holes to be minimum 25 mm larger in diameter than bolts used to manufacturer's recommendations. |
| | | .3 | Protect anchor bolt holes from water accumulations, snow and ice build-ups. |
| | | .4 | Set bolts and fill holes with shrinkage compensating grout or epoxy grout. |
| | | .5 | Locate anchor bolts used in connection with expansion shoes, rollers |

and rockers with due regard to ambient temperature at time of erection.

- 3.2 **Construction**
(Cont'd)
- .5 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
 - .6 Dovetail anchor slots:
 - .1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.
 - .2 Install continuous vertical anchor slots at 800 mm oc where concrete walls are masonry faced.
 - .7 Surface Finishing
 - .1 Finish concrete in accordance with CSA-A23.1.
 - .2 Use procedures acceptable to CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Honeycomb: In locations where the repair of honeycomb is acceptable to Consultant, cut out defective areas and fill the space with a cement mortar of the same materials as the surrounding concrete. Incorporate a liquid latex bonding agent into the mix. Apply in layers not exceeding 25 mm in thickness.
 - .4 Patching: Patching of exposed concrete is not permitted without acceptance of Consultant. Patching prior to acceptance shall be grounds for rejection of the concrete. Where patching is accepted, the exposed patch shall be indistinguishable from the surrounding finish after both are dry. Determine patching mixes by trial batches. Perimeter of cut-out areas shall have edges which are perpendicular to the surface. Incorporate a liquid latex bonding agent into the mix. Just prior to application, coat the base surface with the bonding agent. Cure patches by keeping continuously moist for seven days.
 - .5 Unexposed Concrete Walls: Correct defects and remove fins.
 - .6 Exposed Concrete Walls: Produce finish on concrete no later than one day after forms removed. Wet surface and rub with carborundum brick until uniform colour and smooth texture are produced. Do not use a cement paste. Rub exposed sharp edges to produce a 3 mm radius unless otherwise indicated.
 - .8 Finishing and Curing Concrete Floors.
 - .1 Leave slabs level or uniformly sloped to drain where indicated, ready for finishing.
 - .2 Machine float, power steel trowel and hand trowel interior slabs to produce smooth, dense, satisfactory surface free from ridges, voids or machine marks, whether scheduled to be left exposed or covered. Broom finish exterior slabs.
 - .3 Use only competent mechanics to produce workmanship of highest quality.
 - .4 Liquid curing and sealing compound: treat concrete surfaces with specified compound where floor is to be left exposed with no other finishes. Apply in accordance with manufacturer's instructions. Do not apply membrane curing compound to floor surfaces subsequently to receive additional applied floor finish. Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .5 Water curing: water cure floors designated to receive applied floor

- finish, including paint. Do not use curing/sealing compound. Water down entire floor area and cover with polyethylene sheets for minimum 7 days. Sheet coverage includes exposed edges. Provide suitable weights to prevent blow-off or displacement of sheets. Remove cover after minimum 7 consecutive days. Allow to air dry until concrete has developed design strength.
- 3.2 **Construction**
(Cont'd)
- .6 Provide swirl-trowelled finish where terrazzo is to be applied. Provide depressions to accommodate terrazzo.
- .9 Waterstops
- .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.
- .2 Use only straight heat sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved by Consultant.
- .10 Joint Fillers
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Consultant. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .2 Locate and form isolation and construction joints as indicated. Install joint filler.
- .3 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces, except where perimeter insulation is installed in its place. Extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.
- .11 Sawcut Joints
- .1 Sawcut control joints in slabs-on-grade where indicated on drawings, 5 mm wide x 38 mm deep unless indicated otherwise on drawings. Perform sawcutting 12 to 24 hours after concrete has been placed, as soon as concrete can be cleanly cut and before shrinkage cracks can form.
- .2 Fill sawcut control joints full depth with sealant in accordance with manufacturer's printed instructions, not less than 28 days after concrete placement. Joints shall be clean and dry when filled.
- .12 Patching
- .1 Make good temporary openings left in concrete work for pipes, conduits, ducts, shoring and other such work during construction using mix of same proportions as surrounding work. Reinforce as required and finish to match surrounding work. Carry out patching as specified in standards contained herein.
- 3.3 **Site Tolerance** .1 Concrete tolerance in accordance with CSA-A23.1.
- 3.4 **Field Quality**
Control .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Owner in accordance with CAN/CSA-A23.1 and Section 01400 - Quality Control.
- .2 Costs of tests to be paid as specified in Section 01020 - Allowances.

- 3.4 **Field Quality Control (Cont'd)**
- .3 Each test shall consist of 3 cylinders plus one additional site cured cylinder during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
 - .4 Slump test and air entrainment test shall be made from same batch of concrete from which test cylinders are made.
 - .5 Tests shall include mix proportions and design.
 - .6 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.3.
 - .7 Inspection and testing company shall distribute inspection reports in accordance with Section 01300 - Submittal Procedures.
 - .8 Co-operate with and assist inspection and testing company's personnel during inspection and testing.
 - .9 Remove defective materials and completed work which fail tests and replace as directed by the Consultant.
 - .10 Where work or materials fail to meet strength requirements as indicated by test results, pay costs of additional inspection and testing required for new replacement work or materials.
 - .11 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

End of Section

PART 1 - GENERAL

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|-----|------------------------------------|----|--|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. |
| 1.2 | <u>Related Sections</u> | .1 | Cast-in-Place Concrete: Section 03300. |
| 1.3 | <u>Reference Standards</u> | .1 | Do concrete floor finish in accordance with CAN3-A23.1-M77 except where specified otherwise. |
| | | .2 | Conform to Concrete Floor Finish Specifications of Concrete Floor Contractor's Association of Toronto. |
| | | .3 | Surface tolerances 1:350 from plane, maximum 13 mm from floor level at any point, free from trowel marks and "Washboard" chatters. |
| 1.4 | <u>Qualifications</u> | .1 | The work of this section is to be done by a concrete floor finish contractor of recognized standing having personnel with experience in this type of work and who has the necessary equipment to carry out the work. |
| 1.5 | <u>Guarantee</u> | .1 | Provide the following guarantee in accordance with the General Conditions, notwithstanding the time provisions therein. |

Three year guarantee against defects in workmanship and materials.

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|
| 2.1 | <u>Materials</u> | .1 | <u>Concrete materials and reinforcement</u> : in accordance with Section 03300. |
| | | .2 | <u>Additive</u> : "Albitol" distributed by Albert Chemical Sales of Canada Limited. |
| | | .3 | <u>Curing compound</u> : Mats 3.5.1. |
| | | .4 | <u>Sheet</u> : polyethylene film, 0.1 mm thick, CGSB 51-GP-51M; or waterproof paper, Type 2, ASTM C171. |
| | | .5 | <u>Cement</u> : Mats 3.2.1, normal, false set final penetration minimum 50% when tested in accordance with ASTM C 359. |
| | | .6 | <u>Additives, admixtures and hardeners</u> : to be compatible. |
| | | .7 | <u>Chemical Hardener</u> : Sealhard 400 by Sternson Ltd. or Saniseal 100 by Master Builders. |

PART 3 - EXECUTION

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|-----|-------------------------------------|----|--|
| 3.1 | <u>Inspection</u> | .1 | Check that drains and other insets and inserts are set at correct heights. |
| 3.2 | <u>Preliminary Finishing</u> | .1 | After concrete has been placed to screeds under Section 03300, strike off concrete level and flush with screeds with true, wooden, strike-off bar. |

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| 3.2 | Preliminary Finishing
<u>(Cont'd)</u> | .2 | Immediately after striking off concrete, level it and consolidate it with wooden bull float, or in limited access areas, with wooden darby. Complete levelling and consolidation before free moisture rises to surface (bleeding). |
| | | .3 | Use suitable techniques to finish abutting pours at joints to eliminate "humping". If humping occurs, grind joint down level to surrounding surface. |
| 3.3 | <u>Float Finish</u> | .1 | After preliminary finishing wait until concrete stiffens sufficiently to sustain foot pressure with only about 6 mm indentation. |
| | | .2 | Float concrete with hand float or with disc type power float or power trowel with float shoes attached. |
| | | .3 | Do not bring water and fines to surface by over floating. Where longer floating is required, floating operation shall be repeated after sheen has disappeared and concrete has further hardened. |
| 3.4 | <u>Light Steel Trowel Finish</u> | .1 | After float finish, trowel surface with steel hand trowel or power trowel keeping blade relatively flat at first and raising blade angle a little more on subsequent passes. Do not bring water and fines to surface by over trowelling. |
| | | .2 | Slope surface to drains not less than 1:50, unless different slope is indicated or no slope to drain is required. Surface shall be level where no drainage requirements exist. |
| | | .3 | Trowel surface as required to leave surface even and straight, free of high or low spots, pits, ridges or other surface irregularities and blemishes. |
| | | .4 | Surface shall have firm and even textured finish. |
| 3.5 | <u>Steel Trowel Finish</u> | .1 | After float or shake finish, trowel surface with steel hand trowel or power trowel keeping blade relatively flat at first and raising blade angle a little more on subsequent passes. |
| | | .2 | Trowel surface at least twice and as many times as necessary to produce smooth, dense surface with close surface tolerances. Do not bring fines to the surface by over trowelling. |
| | | .3 | Surface shall have a smooth, level, extremely fine textured but not burnished finish. |
| 3.6 | <u>Chemical Hardened Finish</u> | .1 | Not sooner than 14 days after steel trowel apply chemical hardener. |
| | | .2 | Make sure surface is thoroughly cured, dry and free from dust. Remove dust with heavy duty, commercial vacuum cleaner. |
| | | .3 | Floors which are to receive chemical surface treatment must not be cured using membrane forming liquid curing compound. Use other means of curing. |
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- .4 Remove oil, grease or other foreign substances on surface using suitable floor cleaner. Allow floor to dry thoroughly after cleaning.
- .5 Apply chemical treatment as direct by manufacturer.
- 3.7 **Curing**
- .1 Cure surfaces which are to receive chemical surface treatment. Begin curing immediately after trowelling.
- .2 Other finishes may be cured by any method specified in CAN3-A23. Do not use curing compound without first determining whether subsequent finishes are to be applied. If subsequent finishes are to be applied do not use curing compounds, unless it can be warranted not to affect bond of applied finishes.
- 3.8 **Finishes Schedule**
- .1 Finish top horizontal concrete surfaces in accordance with intended use and any intended applied finish. Conform to room finish schedule and following table of finishes.
- .2
- | <u>Intended Use of Surface or Intended Applied Finish</u> | <u>Integral Finish</u> |
|---|---|
| - surface to receive cementitious beds for subsequent applied hard finishes, e.g. ceramic tile, quarry tile, portland cement bonded terrazzo. | float finish |
| - seamless, liquid applied flooring; liquid applied waterproof membranes. | light steel trowel |
| - resilient flooring, exposed surfaces not indicated to receive other or applied finishes, glued down carpet. | steel trowel finish |
| - exposed surfaces indicated to be chemically hardened, other surfaces. | steel trowel finish, followed by chemical surface treatment |

End of Section

PART 1 - GENERAL

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|-----|--------------------------------------|----|--|---------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Concrete fill for block lintels: | Section 03302 |
| | | .2 | Masonry, including mortar joint workmanship: | Section 04200 |
| 1.3 | <u>Reference Standards</u> | .1 | Quality Standards: meet requirements of CSA A179-94, Mortar and Grout for Unit Masonry. | |
| 1.4 | <u>Source</u> | .1 | Source of Materials: for mortar to remain exposed in finished project, brands | |
| | <u>Quality Control</u> | | of cementitious materials and source of supply of sand, shall remain the same for duration of work. | |
| 1.5 | <u>Delivery & Storage</u> | .1 | Store cementitious materials so as to prevent moisture absorption from any source. Do not use material affected by moisture. | |
| | | .2 | Store mortar and aggregate materials to prevent contamination. Do not use contaminated materials. | |

PART 2 - PRODUCTS

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| 2.1 | <u>Materials</u> | .1 | Water: potable and non-staining. |
| | | .2 | Aggregate - Sand: CSA A82.56M |
| | | .3 | Portland cement: CAN/CSA-A5-93, Type 10. |
| | | .4 | Masonry cement: CAN/CSA-A8-93, Type H. |
| | | .5 | Waterproofer: Master Builders "Omnicon" |
| | | .6 | Lime: Hydrated lime 'S' Type to ASTM C207. |

PART 3 - EXECUTION

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|-----|--|----|--|
| 3.1 | <u>Proportioning & Mixing</u> | .1 | Mix mortar in accordance with table 2 of CSA A179-94 and the recommended procedures of the Brick Institute of America Manual MI except as specified herein. |
| | | .2 | Mix mortar to proportions indicated in Mortar Schedule. |
| | | .3 | An experienced competent tradesman must supervise mortar mixing. |
| | | .4 | Mix mortar in watertight mechanical mixers. Measure ingredients accurately by volume. Bring mortar to required elasticity. Continue mixing mortar until materials are blended to uniform colour, but not less than 3 minutes, or more than 5 minutes. Do not mix longer than 10 minutes. |

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| 3.1 | Proportioning
& Mixing
(Cont'd) | .5 | Do not use admixtures of any kind in mixes except where specified otherwise. |
| | | .6 | Prehydrate pointing mortar by mixing ingredients dry then mix again adding just enough water to provide a damp workable mix that will retain its form when pressed into a ball. Allow to stand for not less than two hours then remix with sufficient water to produce mortar of the proper consistency for pointing. |
| 3.2 | Time Limits &
Retempering | .1 | Use and place mortar in final position within the following time limits after mixing: |
| | | .1 | Air Temp. above 25 degrees C - 12 hours. |
| | | .2 | Air Temp. below 25 degrees C - 2.5 hours. |
| | | .2 | Standard mortar that has stiffened within above time limits because of evaporation of water may be retempered by adding water as frequently as needed to restore required consistency. Discard mortar not used within above time limits. |
| 3.3 | Mortar
Schedule | .1 | Bearing walls: Type S mortar. |
| | | .2 | Non bearing walls: Type N mortar consisting of 1 part Masonry Cement, 3 parts aggregate. |
| | | .3 | Where cement mortar is called for on Structural Drawings: Type S mortar. |
| | | .4 | At solid bearing courses and foundation walls: type S mortar. |
| | | .5 | Exterior brick and block veneer: Type N mortar. |

End of Section

PART 1 - GENERAL

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|-----|---|----|---|------------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Mortar | Section 04100 |
| | | .2 | Metal Fabrications | Section 05500 |
| | | .3 | Air Barrier | Section 07196 |
| | | .4 | Caulking: | Section 07900 |
| | | .5 | Supply of steel door frames | Section 08100 |
| | | .6 | Supply of access doors for mechanical and electrical Work. | Sections 20 & 26 |
| 1.3 | <u>Work Installed But Supplied By Others</u> | .1 | Build into masonry elements inserts, anchors, bolts, sleeves and other items supplied by other Sections and which are required for installation and performance of work of other Sections. | |
| | | .2 | Install loose steel lintels. | |
| | | .3 | Coordinate installation of lateral supports required for final support of masonry partitions with Section 05500. | |
| | | .4 | Install steel window and door frames and access doors occurring in masonry elements. | |
| | | .5 | Install reinforcing steel and concrete fill into block lintels. | |
| 1.4 | <u>Reference Standards</u> | .1 | Confirm to requirements of CSA A370.94, CSA A371.94 and CSA S304.1.94. | |
| 1.5 | <u>Qualifications</u> | .1 | The work of this section is to be done by a masonry contractor of recognized standing having personnel with experience in this type of work and who has the necessary equipment to carry out the work. | |
| | | .2 | Ensure that work is executed under the continuous supervision and direction of a competent foreman. | |
| 1.6 | <u>Submittals</u> | .1 | Before ordering any materials submit two samples of all materials for approval. | |
| | | .2 | Submit additional materials as required for testing to a Testing Company approved by the Consultant and provide results of standard tests on the actual production run of exterior brick including compression, absorption and saturation coefficient and 50 cycle freeze thaw resistance test. | |
| | | .3 | Submit shop drawings in accordance with the General Conditions of all special masonry units. | |
| 1.7 | <u>Inspection & Testing</u> | .1 | The Consultant may at his discretion call for tests of mortar or other masonry materials to be made by an independent inspection company. | |
| | | .2 | A Cash Allowance for these tests will be carried by the General Contractor | |

in accordance with the General Conditions.

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|------|--|----|--|
| 1.8 | <u>Source Quality Control</u> | .1 | Submit laboratory test reports certifying compliance of masonry units and mortar ingredients with Specification requirements. |
| | | .2 | For clay units, in addition to requirements set out in referenced Standards include data indicating initial rate of absorption for units proposed for use. |
| 1.9 | <u>Product Handling & Storage</u> | .1 | Handle masonry units so as to prevent soiling and chipping and deliver to the job site in dry condition. |
| | | .2 | Store masonry units above and off ground on level platforms which permit air circulation under stacks. |
| | | .3 | During storage, protect masonry units against moisture absorption, damage, staining and freezing. |
| | | .4 | Keep materials dry until use. |
| 1.10 | <u>Environmental Conditions</u> | .1 | In cold weather, construct and protect masonry elements in accordance with Clause 5.15.2 and 5.15.3 of CAN3-A71-M84. Maintain temperature of mortar between 5 degrees C and 50 degrees C until used. |
| 1.11 | <u>Protection</u> | .1 | Keep masonry dry using waterproof non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain. Anchor securely in position. |
| | | .2 | In hot weather, protect freshly laid masonry from drying too rapidly by means of waterproof, non-staining coverings. |
| | | .3 | Protect sills, projections and exposed edges so that finished work will not be damaged or defaced. |
| | | .4 | Protect face work from splashing or marking. Protect interior block walls which are to be painted or left unfinished from staining and other damage. |
| | | .5 | Protect all work installed by other trades from splashing and marking and other damage. |
| | | .6 | Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place. |

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|
| 2.1 | <u>Materials</u> | .1 | <u>Face Brick</u> |
| | | .1 | Hard burned clay brick to CSA A82.1-M87. |
| | | .2 | <u>Brick Veneer:</u> |
| | | | Size: Metric Jumbo - 90 x 90 x 290 |
| | | | Series: Contemporary Series |
| | | | Colour: St. John |
| | | | Distributor: Brampton Brick |

Contact: Andrew Bimm
abimm@bramptonbrick.com

2.1 **Materials
(Cont'd)**

.2 **Concrete Masonry Veneer**

.1 **Architectural Stone Veneer:**

Size: 90 x 90 x 590 & 90 x 190 x 590
polished with chamfered upper edges
Series: Finesse
Colour: Polar White, Smooth Finish
Distributor: Brampton Brick
Contact: Andrew Bimm
abimm@bramptonbrick.com

Reference the following;
<https://bramptonbrick.com/en/finesse-stone?f%5B0%5D=color%3AWhite>

.3 **Concrete Block:** Metric size and autoclaved.

- .1 Lightweight block: Ultra Lite to CSA Standard A-165.1M
- .2 Standard weight block: to CAN3-A165.1M85.
- .3 Units must be cured for at least 28 days before delivery and shall have a moisture content of not more than 30% of total absorption.
- .4 Size: unless indicated otherwise 190 x 390 mm x thickness as shown on drawings.
- .5 Exposed block units shall be uniform in size, free of perceptible warp or twist, without chipped, ragged or broken edges; have a uniform surface texture, free of cracks, blemishes or defects detrimental to appearance or performance.
- .6 Where indicated on Drawings and/or Specifications, provide solid or semi-solid units.
- .7 Provide manufacturer's catalogued special units such as bullnose corner, lintel block and 45° corner blocks.

.4 **Acoustic Block Masonry**

.1 **RESERVED**

.5 **Metal Reinforcement and Anchors**

- .1 Material: high tensile strength steel wire meeting ASTM A82, by Bloklok or Durowall.
- .2 Finish: hot dip galvanized after fabrication to ASTM A153, Class B.
- .3 Provide prefabricated assemblies for corners and intersections.

2.1 **Materials**
(Cont'd)

.4 Horizontal Reinforcement:

- .1 Single wythe and solid walls: truss type with minimum 3.66 mm thick side and cross rods unless otherwise indicated; width 50 mm less than wall thickness: BLOK-TRUS BL30.
- .2 Cavity walls at walls with concrete block back-up: Refer to Structural drawings. Ferro Slotted Block Tie (type i) consisting of 1.6 mm thick steel connector plate of length to suit insulation and concrete block thickness, steel wire V-tie, 4.8 mm diameter. Refer to structural drawings.
- .3 Cavity walls at walls with structural steel backup: Ferro Rap Tie consisting of slotted connector plate of length to suit insulation thickness, anchored with predrilled anchors, and steel wire V-tie. Refer to structural drawings.

.5 Anchors and Ties:

- .1 Non-bearing walls and partitions to bearing walls: corrugated wall ties minimum 0.7 mm thick, 21 x 175 mm BLOK-LOK BLT7A.
- .2 Masonry walls, partitions and veneer to concrete elements: Flexible wire tie, 4.76 mm thick, length to suit wall condition, and dovetail anchor slot: BLOK-LOK BLT8, or POS-1-TIE NWTC-TAPCON screw anchors by National Wire Products Industries Inc.
- .3 Masonry to structural steel: flexible triangular 4.76 mm thick ties and weld on anchor straps: BLOK-LOK FLEX-O-LOK BLT9 or POS-1-TIE NWDI-DRIL-IT screw anchors by National Wire Products Industries Inc.
- .4 Masonry veneer to exterior wall steel stud: M.A.S.S. Assembly by A.C. Wild Inc., consisting of reinforce stainless steel angle clip, screws fastened to steel stud with co-polymer coated, self drilling screws (with EPDM Gasket) spring steel washer, stainless steel washer, stainless steel insulation retainer, stainless steel wire tie.
- .5 Strap anchors: galvanized, 2 mm thick, crimped, 50 mm x 150 mm.

.6 Cavity Wall Insulation:

- .1 Semi-rigid mineral wool insulation to CAN/ULC S702 and ASTM C612, CAVITYROCK DD by Roxul Inc., R15, 88 mm thickness.
- .2 Wedge type plastic fastener: BLOK-LOK Wedge-Lok.

2.1 **Materials
(Cont'd)**

- .7 **Membrane Flashing/Dampproof Course:** Minimum 0.5 mm thick flexible membrane: Bakor Blueskin TWF (self adhering SBS Modified Flashing Membrane) or F20 by Lexsuco or Rodoply (20 mils) by Sternson.
- .8 **Membrane Flashing Back-up:** minimum 0.9 mm thick hot dipped galvanized sheet steel meeting Z275 zinc coating designation
- .9 **Weep Holes, Vent Holes:** Weep Hole Ventilator by BLOK-LOK Ltd. or Goodco Plastic Brick Vent.
- .10 **Nailing Inserts:** 0.6 mm purpose made galvanized steel inserts for setting in mortar joints.
- .11 **Premoulded Joint Filler** - Closed cell vinyl foam, compressed 25% when in joint, one of the following:
 - .1 Unifoam R 1009 - Flexible by Goodco Ltd
 - .2 Rodofoam PR by Sternson Ltd.
- .12 **Fire stop:** ULC labelled, firebarrier mineral wool by Double A/D Distributors Ltd., Fire-Bloc by M.W. McGill and Associates. Use Bakelite 910-10 Adhesive.
- .13 **Dovetail anchor slots:** 26 ga. galvanized steel, glass fibre filled. Supply to Section 03300 for installation.
- .14 **Preformed Control Joint Key:** Titewall BL.A Rubber Preformed Joint Key by BLOK-LOK.
- .15 **Bond Break:** 0.1 mm thick polyethylene.
- .16 **Compressible Filler:** Rockwool Insulation
- .17 **Asphalt Impregnated Board:** 12 mm thick asphalt impregnated fibre boards.
- .18 **Mortar Drainage System**
 - .1 **Products:** "Mortar Net" manufactured by Mortar Net USA Ltd., supplied by JV Building Supply, 905-851-3744.

PART 3 - EXECUTION

3.1 **Erection
General**

- .1 Build masonry work true to line, plumb, square and level, with vertical joints in proper alignment.
- .2 Assume complete responsibility for dimensions, plumbness and levels of this work and constantly check same with graduated rod.
- .3 Masonry courses to be of uniform height, and both vertical and horizontal joints to be of equal and uniform thickness.

- .4 Extend all non-bearing partitions to within 25 mm of underside of floor or roof construction above and pack joint with a compressible filler of fire stop mineral wool, leave no voids.
 - .5 Carry wall up in uniform manner, no one portion being raised more than 750 mm above another at any time. Build no more than 1500 mm of wall measured vertically in any one day.
 - .6 Buttering corners of units, throwing mortar into joints, deep or excessive furrowing of bed joints not permitted. Do not shift or tap units after mortar has taken initial set. Where adjustments must be made after mortar has started to set, remove mortar and replace with fresh supply.
 - .7 Isolate masonry from vertical structural framing in exterior walls using 12 mm thick asphalt impregnated rigid board cemented to columns.
 - .8 Cut exposed masonry units with power driven masonry saw only. Ragged or chipped edges will not be permitted.
 - .9 Consult with other sections to avoid cutting and patching. Co-operate in setting and aligning built-in items. Build in conduit and piping so that they are not exposed. Do not break masonry bond to accommodate concealed built-in items.
 - .10 Install access doors occurring in masonry elements, required by Division 15 and 16. Install access doors, level, plumb properly aligned and securely anchored, in locations directed by Division 15 and 16.
 - .11 Grout solid with mortar all spaces around built-in items.
 - .12 Build in metal nailing plugs, grounds, inserts, anchor bolts, bearing plates, loose and miscellaneous items of steel and iron, isolated beams, lintels and shelf angles, sleeves, blocking and items furnished by other Sections.
- 3.2 **Blockwork**
- .1 Lay all block in running bond, except where noted to be stack bond, with thicker end of face shell upward. Coursing to be modular 200 mm for one block and one joint.
 - .2 Do not wet blocks before laying.
 - .3 Lay units with webs aligning one over the other in full bed of mortar over entire laying surface including webs. Vertical joints shall be fully filled with mortar on both faces and squeezed tight.
 - .4 Exposed faces shall be full units laid out to minimize cutting with not less than 100 mm at any vertical edge or corner.
 - .5 Top course of block walls shall be laid with semi-solid blocks at door and window sills, at wall changes to brick and where shown on Drawings.
 - .6 Use solid block for at least two courses under all point bearing loads.
 - .7 Use special shaped units where indicated, specified or required. Use bull

nosed units for exposed external corners, window jambs, door jambs and as detailed. Exposed open cells not permitted.

- .8 Use square cornered block for first course at floor at locations with exposed external bullnose corners. Grind square corner above top of base to match bullnose of blocks above as detailed.
- .9 Where resilient base is indicated, tool the joints to within 100 mm of the floor. Cut joints flush behind the base.
- .10 Provide minimum 400 mm solid or grouted block for jambs of openings and at ends of walls.
- .11 Cope or cut with power saw exposed units to accommodate flush mounted electrical outlets, grilles and other components. Leave maximum 5 mm clearance. Cover plates and flanges must cover cut edges.
- .12 Take special care to prevent mortar or other substances from staining exposed block faces. Replace stained blocks as directed by the Consultant at no extra cost to Contract.
- .13 Tie intersecting non-bearing walls together with masonry reinforcing every second course.
- .14 Concrete block to receive thinset ceramic tile installation shall be laid plumb with maximum variation of 3 mm in 2 M with joints finished flush.
- .15 Provide continuous 0.1 mm thick polyethylene bond breaker at base of partitions and walls which bear on concrete slabs.
- .16 Use lightweight blocks for all interior block walls and partitions.

3.3 Face Brick

- .1 Lay face brick in common running bond except where specifically shown otherwise. Provide special band courses, where indicated.
- .2 Completed brickwork shall appear uniform and well blended, free of contrasting areas. Replace at no cost to contract, brickwork which does not meet this requirement.
- .3 Brick with an absorption rate of over 1g/min./100 sq.mm when tested in accordance with ASTM C67 shall be dampened before laying.
- .4 Tops of walls which have been left exposed for any period of time shall be dampened before work is commenced again, if required.
- .5 Brickwork at different levels shall be stepped in regular proportions between levels.
- .6 Brickwork shall be laid up with the shave joint method in full bed of mortar with vertical and horizontal joints filled flush. Slushing mortar into joints after brick is laid, is not permitted.
- .7 All joints in brickwork, including bed and collar joints, shall be filled full as each course is laid. Pull down and rebuild walls/partitions which do not meet this requirement as directed by consultant and at no extra cost to Contract.

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| | .8 | Variations in size of brick shall be evenly distributed in wall so that mortar joints are uniform throughout. |
| | .9 | At first brick course over steel lintels place brick directly on membrane flashing without mortar. |
| 3.4 | <u>Cavity Walls</u> | |
| | .1 | Discuss all aspects of cavity wall construction with Consultant before proceeding to ensure that the cavity wall is constructed in accordance with the best masonry practice and recommendations of the Ontario Masons' Relations Council (O.M.R.C.). |
| | .2 | Keep the cavity completely clean and free from mortar droppings or projection. Bevel the "cavity" edge of the mortar bed immediately after "stringing" the mortar. Following the setting of the masonry unit, spread any mortar which protrudes into the cavity over the back of the unit using the back of the trowel. |
| | .3 | Bond inner and outer wythes of cavity wall with cavity wall reinforcement system at 400 mm vertically. Provide additional reinforcement at openings as specified hereinafter. |
| | .4 | Ensure that sheet air barrier and foamed insulation is complete and has been inspected and accepted by Consultant prior to installation of face brick |
| | .5 | Provide, unless otherwise indicated, mineral wool fire stops to block off concealed spaces within a cavity wall.
a) at every floor level;
b) so that the maximum horizontal dimension is not more than 20 m and the maximum vertical dimension is not more than 3 m. |
| | .6 | Provide continuous mortar drainage system at bottom of cavity and at all areas where cavity is interrupted with thru wall flashings. |
| 3.5 | <u>Mortar & Pointing</u> | |
| | .1 | Make all joints uniform in thickness, straight, in line, with mortar compressed to form concave joints. |
| | .2 | After joints have been tooled rub walls with burlap. |
| | .3 | Strike joints flush where walls are to receive insulation, ceramic tile or similar finishes. |
| 3.6 | <u>Building-In</u> | |
| | .1 | Build in door and window frames, steel lintels, sleeves, anchor bolts, anchors, nailing strips and other items to be built into masonry. |
| | .2 | Do not distort metal frames. Bed anchors of frames in mortar and fill frame voids with mortar or grout as wall is erected. |
| 3.7 | <u>Bearings</u> | |
| | .1 | Fill concrete block solid with 20 mPa concrete for two courses below bearing points of structural members, and where indicated. |
| | .2 | Install building paper and wire mesh reinforcing in the bed below second block course from top. |
| | .3 | Use 100% solid concrete blocks where indicated. |

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| | | .4 | Build masonry neatly around beam and lintel bearings. |
| | | .5 | Complete fill voids beneath steel bases bearing on masonry with an approved non-shrink grout having a compressive strength at 28 days of at least 35MPa. Where grout is exposed to view or weather, use no-ferrous expansion agents. |
| 3.8 | Membrane Flashings/
Dampproof Course | .1 | Install dampproof course on top of foundation walls above grade. |
| | | .2 | Install membrane flashing at bottom of cavity walls, at door and window heads, immediately above horizontal interruptions with exterior walls and elsewhere where shown on drawings. |
| | | .3 | Lap membrane flashing minimum 100 mm at joints./ Seal lap with adhesive. |
| | | .4 | Extend membrane flashing 13 mm beyond face of wall or outside edge of steel lintels. Trim as required to Consultants later instructions. |
| | | .5 | Carry membrane flashing up behind exterior wythe masonry minimum 300 mm and coordinate with Sections 07196 and 07219. |
| | | .6 | At wall/ low roof junctions coordinate with Section 07513. DO NOT INSTALL VENEER UNTIL COMPLETED MEMBRANE FLASHING INSTALLATION HAS BEEN WATER TESTED AND INSPECTED BY CONSULTANT. |
| 3.9 | <u>Control Joints</u> | .1 | Provide continuous vertical control joints in concrete block partitions and walls at locations indicated and at heads of all doors and openings over 300 mm wide. Provide continuous vertical control joints maximum 10 M apart and at all corners and intersections. |
| | | .2 | Form control joints as detailed. Stop masonry reinforcing each side of joints and provide continuous preformed rubber joint key. |
| 3.10 | <u>Construction Joints</u> | .1 | Where fresh masonry joins partially or totally set masonry, clean exposed surfaces of set masonry and remove loose mortar and foreign material prior to laying fresh masonry. |
| | | .2 | If necessary to stop off a horizontal run of masonry, rack back one-half masonry length in each course. Toothing will not be permitted unless approved by the Consultant. |
| 3.11 | <u>Expansion Joints</u> | .1 | Construct expansion joints where indicated, as detailed. |
| 3.12 | <u>Chases, Openings & Holes</u> | .1 | Chases and openings shall be built in during erection of masonry work, and purpose-made chased units shall be built into proper position. |
| | | .2 | Openings in masonry work exceeding 200 mm opening width shall be provided with lintels in accordance with lintel schedule. |
| | | .3 | No horizontal or diagonal chasing of completed walls or formation of holes |

- shall only be carried out with Consultant's prior approval, and then only with a tool designed to cleanly cut masonry units.
- .4 Chases shall be plumb and shall be minimum of one unit length from jambs of openings.
- 3.13 **Anchoring, Bonding & Reinforcement**
- .1 Anchor or bond walls and partitions at points where they intersect.
- .2 Anchor masonry walls and partitions to concrete elements with anchors spaces at 400 mm vertically.
- .3 Unless otherwise indicated reinforce all walls and partitions with continuous horizontal metal reinforcement, installed at 400 mm o.c. vertically.
- .4 At all wall openings place continuous reinforcement in first and second mortar joints above and below openings. Additional reinforcement at openings shall extend 610 mm beyond both sides of openings.
- .5 Install prefabricated corner assemblies at outside corners.
- .6 Lap continuous reinforcement 150 mm at splices. Cut reinforcement at control joints.
- 3.14 **Cutting Masonry**
- .1 Cutting of masonry units exposed in finished work shall be done with approved type power saw. Where electrical conduit outlet or switch boxes occur, grind and cut units before services installed.
- .2 Obtain Consultant's approval before cutting any part or area which may impair appearance or strength of work.
- .3 Patching of masonry not permitted.
- 3.15 **Reinforced Lintels**
- .1 Install reinforced concrete block lintels at openings where steel lintels are not indicated.
- .2 Support masonry units of reinforced block lintels built in place. Provide a level platform, true to the proper elevation and of sufficient strength to support the load without visible deflection. Maintain supports in place for a minimum of 7 days and for a period sufficient to permit the concrete to cure and gain sufficient strength to safely support all loads.
- .3 Cast and cure lintels on a plank. Set special channel lintel blocks using specified mortar. Place wood stops at each end of lintel to prevent movement.
- .4 Place 25 mm of 20 mPa concrete in voids, lay in reinforcing bars as indicated on drawings and place concrete to level of block sides. Rod and tamp concrete well without disturbing reinforcing. Allow lintels to cure 7 days before moving.
- .5 Minimum bearing shall be 200 mm each side.
- .6 Provide building paper in joint at bearings and at vertical joint at ends of block lintels to break bond.
- 3.16 **Reglets & Recesses**
- .1 Form continuous reglets and recesses in masonry elements as shown on Drawings and as required to accommodate work of other Sections.

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| | .2 | Rake out mortar joints and make sawcuts in masonry elements as shown on Drawings and as required to accommodate work of other Sections. |
| | .3 | Make reglets 25 mm deep, unless otherwise shown. |
| 3.17 | <u>Steel Door Frames</u> | |
| | .1 | Install steel frames in masonry walls. Build in frames rigid, true and plumb. Fill voids between frames and masonry with mortar grout. |
| | .2 | Brace frames solidly in position while being built in. Provide temporary horizontal wood spreader at mid-height of frames to ensure maintenance of required frame width until masonry work is completed. For frames over 1200 mm width provide temporary vertical support at centre of head. |
| | .3 | Comply with installation requirements specified under Section 08100. |
| 3.18 | <u>Weep & Vent Holes</u> | |
| | .1 | Form weep holes by inserting weep hole inserts into brick mortar joint immediately above all membrane flashings and where shown on Drawings; space weep holes at 600 mm o.c. horizontally. |
| | .2 | Form vent holes by placing inserts near top of cavity compartments and where indicated on drawings. Space inserts at 600 mm o.c. |
| | .3 | Keep face of inserts back from face of brick minimum 6 mm. Keep weep/vent holes free of mortar. |
| 3.19 | <u>Patching & Cleaning</u> | |
| | .1 | At completion of work, holes and other defects in masonry joints shall be repaired, and masonry surfaces shall be thoroughly cleaned. |
| | .2 | Holes in masonry joints shall be filled with mortar and suitably tooled. Cut out and repoint defective joints. |
| | .3 | Dry brush masonry surfaces at end of each day's work and after all final pointing. |
| | .4 | Remove mortar smears and droppings from concrete block masonry surfaces after such smears and droppings have dried. When mortar joints are dry and hard, clean masonry surfaces by rubbing down with abrasive blocks and stiff fibre brushes. |
| | .5 | Remove large particles from brickwork and with wood paddles without damaging surface. Do not use wire brushes. Saturate masonry with clean water and flush off loose mortar and dirt. Scrub with solution of 25 mL trisodium phosphate and 25 mL household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by brick masonry manufacturer in accordance with manufacturer's directions. Repeat cleaning process as often as necessary to remove mortar and other stains. |
| | .6 | Remove efflorescence from masonry surfaces by wet cleaning in accordance with manufacturer's recommendations. |
| | .7 | Upon completion of work, clean blockwork by brushing and washing. In |

extreme cases a 5% solution of muriatic acid may be used preceded and followed by a copius bath of clean water. Clean blockwork to be painted to suit requirements of Section 09900.

End of Section

PART 1 - GENERAL

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| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Metal Doors and Frames | Section 08100 |
| | | .2 | Painting: | Section 09900 |
| 1.3 | <u>Reference Standards</u> | .1 | Do welding work to C.S.A. W59-1984 unless specified otherwise. | |
| | | .2 | Comply with the Ontario Building Code latest edition. | |
| 1.4 | <u>Submittals</u> | .1 | Submit shop drawings in accordance with the General Conditions. Clearly indicate such items as design calculations, materials, thickness, construction, connections, joints, anchorage, supports, reinforcements, and other relevant details. | |
| | | .2 | Shop drawings for ladders and pit covers shall bear stamp of a professional engineer registered in Ontario. | |
| 1.5 | <u>Work Supplied To Other Trades</u> | .1 | Supply the following items for installation under other Sections of work: Anchor bolts, bearing plates, sleeves and other inserts to be built into concrete and masonry elements and required for anchorage and support of work of this section. | |
| | | .2 | Supply other Sections with instructions, and if required, templates, necessary for accurate setting of inserts and components. | |
| 1.6 | <u>Product Delivery & Storage</u> | .1 | Deliver, handle and store fabricated components to prevent permanent distortion, corrosion and damage. | |

PART 2 - PRODUCTS

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| 2.1 | <u>Materials</u> | .1 | Material to be free from defects impairing strength durability or appearance and be of best commercial quality for purposes specified. |
| | | .2 | <u>Steel sections and plates:</u> To C.S.A. GRO.21-M1978. Type (300W). |
| | | .3 | <u>Steel Pipe:</u> To CSA B63-1966 (R1971) standard weight, extra strong, double extra strong, black, galvanized finish. |
| | | .4 | <u>Square steel tube:</u> CAN3-G40.21-M81, Grade 350W, Class H. |
| | | .5 | <u>Sheet steel:</u> Hot dip galvanized, cold rolled, with stretcher level degree of flatness to ASTM A526; zinc coating designation Z275. |
| | | .6 | <u>Stainless steel:</u> To C.S.A. G110.6-1968 Type 302, exposed surfaces to have No. 4 polished finish. |

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| 2.1 | <u>Materials</u>
<u>(Cont'd)</u> | <p>.7 <u>Welding materials:</u> To C.S.A. W59-1984.</p> <p>.8 <u>Bolts and anchor bolts:</u> To ASTM A307-76B.</p> <p>.9 <u>Galvanizing:</u> Hot dipped galvanizing with minimum zinc coating of 600 g/m² to CSA G164-1965 (1972).</p> <p>.10 <u>Chromium plating:</u> Chrome on steel with plating sequence of 9 micrometres thickness of copper, 10 micrometres thickness of nickel and 2.5 micrometres thickness of chromium.</p> <p>.11 <u>Galvanized primer:</u> Zinc rich, ready mix to CGSB 1-GP-181M.</p> <p>.12 <u>Cast Iron:</u> Soft grey iron.</p> <p>.13 <u>Wrought Iron:</u> Best quality, strong homogeneous, ductile forged iron to CSA standards latest edition for wrought iron.</p> <p>.14 <u>Shop primer:</u> CGSB 1-GP-40M.</p> <p>.15 <u>Zinc rich paint:</u> CGSB 1-GP-181M.</p> <p>.16 <u>Bituminous enamel:</u> Alkali resistant asphaltic coating.</p> <p>.17 <u>Non-shrink grout:</u> Por-Rok by Hallemite Products Ltd., or SET 15 Minute Anchoring Cement by SET Products Ltd.</p> |
| 2.2 | <u>Fabrication</u> | <p>.1 Fabricate components in the shop in largest size practicable to minimize field jointing.</p> <p>.2 Fabricate components square, straight, true, free from warpage and other defects. Accurately cut, machine file and fit joints, corners, copes and mitres.</p> <p>.3 Fabricate items from steel unless otherwise noted.</p> <p>.4 Reinforce fabricated components to safely withstand expected loads.</p> <p>.5 Make joints in built-up sections with hairline joints in least conspicuous locations and manner.</p> <p>.6 Make allowance for thermal expansion and contraction when fabricating exterior work.</p> <p>.7 Joints shall be welded unless otherwise indicated and unless details of construction do not permit welding. Exposed welds shall be continuous and shall be ground smooth.</p> <p>.8 Close exposed open ends of tubular members with welded on steel plugs.</p> <p>.9 Curved work to be made true radii.</p> <p>.10 Use self-tapping shake-proof countersunk flat headed screws on items required to be assembled by screws or as indicated.</p> |
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| 2.2 | <u>Fabrication (Cont'd)</u> | .11 | Where work of other Sections is to be attached to work of this Section, prepare work by drilling and tapping holes, as required to facilitate installation of such other work. |
| | | .12 | Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation by drilling, countersinking and tapping holes, forming shapes and cutting to required sizes. |
| | | .13 | Grind off mill stampings and fill recessed markings on steel components left exposed to view. |
| 2.3 | <u>Connections</u> | .1 | All exposed fastenings to be of same material, colour and finish as the metal to which it is applied. |
| | | .2 | Connections and accessories must be adequate to sustain safely and withstand stresses and strains to which normally subjected. |
| | | .3 | Shop and field connections to be riveted or welded and where indicated or required, blind riveted. Rivets, screws and fastenings to be countersunk into exposed work and finished flush. |
| | | .4 | Connect all members to form a homogeneous structure. Connections to develop the full strength in the member connected before failure. |
| 2.4 | <u>Finishes</u> | .1 | Thoroughly clean steel of loose scale, rust, oil, dirt and other foreign matter. Suitably prepare steel surfaces by power tool cleaning to receive specified finishes. |
| | | .2 | Grind smooth sharp projections. |
| | | .3 | Remove oil and grease by solvent cleaning. |
| | | .4 | Apply coatings in the shop and before assembly. Where size permits, galvanize components after assembly. |
| | | .5 | Shop apply coat of primer to interior components after fabrication except where galvanized or zinc rich paint finish is required. |
| | | .6 | Do not paint surface to be field welded. |
| | | .7 | Dip bolts that are to remain permanently in the structure, in oxide paint before placing in position. |
| | | .8 | Hot dip galvanize all exterior components and, where so indicated, interior components, after fabrication. |
| | | .9 | Apply coat of bituminous enamel to surfaces of metal components in contact with cementitious materials and dissimilar metals. |

PART 3 - EXECUTION

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| 3.1 | <u>Installation</u> | .1 | Erect metal work square, plumb, straight and true, accurately fitted, with tight joints and intersections. Drill, cut and fit as necessary to attach this work to adjoining work. |
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- 3.1 **Installation (Cont'd)**
- .2 Provide suitable and acceptable means of anchorage such as dowels anchor clips, bar anchors, expansion bolts and shields, toggles.
 - .3 Make field connections with high tensile bolts, or weld to CSA S16-1969 and CSA S16S1-1975.
 - .4 Provide temporary supports and bracing required to position components until they are permanently anchored in place.
 - .5 Securely anchor components in place; unless otherwise indicated, anchor components as follows:
 - .1 To concrete and solid masonry with expansion type anchor bolts.
 - .2 To hollow construction with toggle bolts.
 - .3 To thin metal with screws or bolts.
 - .4 To thick metal with bolts or by welding.
 - .5 To wood with bolts or lag screws.
 - .6 Fill space between railing members and sleeves with non-shrink grout.
 - .6 Hand items to be cast into concrete or built into masonry over to appropriate trades together with setting templates.
 - .7 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.
 - .8 Touch-up galvanized surfaces with zinc primer where burned by field welding.
 - .9 Dissimilar metals and metals in contact with cementitious elements shall have contact surfaces coated with bituminous paint or be isolated by other means as approved by Consultant.
- 3.2 **Schedule of Components**
- .1 Elevator Pit Ladder
 - .1 Fabricate ladder from 19 mm diameter rungs welded to 10 mm x 65 mm stringers 400 mm apart. Space rungs 300 mm o.c. Set ladder 200 mm clear of wall on bracket supports at 1200 mm o.c.
 - .2 Stringers shall extend from 300 mm above floor.
 - .3 Ladder rungs will be capable of safely supporting 115 kg. each.
 - .4 Finish: Hot dipped galvanized finish.
 - .2 **Hollow Metal Frame Supports**
 - .1 Provide supplementary steel supports for hollow metal frames as detailed.

.3 Miscellaneous Steel Items

- .1 Miscellaneous steel angles, plates and lintels indicated on Architectural Drawings, but not included on Structural Drawings.
- .2 Other metal fabrications shown on Drawings and not specifically covered in other Sections. All steel components indicated on Structural Drawings will be provided by Section 05123.

.4 Bollards

- .1 Fabricate from 150 mm diameter heavy walled steel pipe, concrete filled as detailed. Unless otherwise indicated extend bollard 914 mm above grade and 1220 mm below grade.
- .2 Finish: Hot dipped galvanized with 6mm HDPE dome top bollard cover – colour yellow with two reflective tape strips.

.5 Elevator Rail Supports

- .1 Supply appropriate steel plates for support of elevator rails for casting into concrete at each floor level. Co-ordinate size and number required with Section 14200.

End of Section

PART 1 - GENERAL

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| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. |
| 1.2 | <u>Work Supplied to Other Trades</u> | .1 | Supply following items for installation under other Sections of work: Anchor bolts, bearing plates, sleeves and other inserts to be built into concrete and masonry elements and required for anchorage and support the work of this section. |
| | | .2 | Supply other Sections with instructions, and if required, templates, necessary for accurate setting of inserts and components. |
| 1.3 | <u>Source Quality Control</u> | .1 | Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board. |
| | | .2 | Plywood identification: by grade mark in accordance with applicable CSA standards. |
| 1.4 | <u>Product Delivery & Storage</u> | .1 | Store material on site on skids off the ground and covered for protection from rain. |
| | | .2 | Take adequate measures to prevent moisture gain of kiln dried materials. |

PART 2 - PRODUCTS

- | 2.1 | <u>Lumber Material</u> | .1 | Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards: | | | | | | | | | | | | | | | | | | | | | |
|-------------|-------------------------------|--------------|--|------------|----------------|--------------|----------|--------|---|-------|--------|---|--------|--------|---|-------|--------|---|-------|-------------|---|-------------|-------------|---|
| | | .1 | CAN 3-086-M84 | | | | | | | | | | | | | | | | | | | | | |
| | | .2 | CSA 0141-1970 | | | | | | | | | | | | | | | | | | | | | |
| | | .3 | NLGA Standard Grading Rules for Canadian Lumber, 1980 edition revised according to Supplement No. 1, 1981. | | | | | | | | | | | | | | | | | | | | | |
| | | .2 | Furring, blocking, railing strips, grounds, rough bucks, curbs. | | | | | | | | | | | | | | | | | | | | | |
| | | | <table border="0"> <thead> <tr> <th><u>USE</u></th> <th><u>SPECIES</u></th> <th><u>GRADE</u></th> </tr> </thead> <tbody> <tr> <td>Blocking</td> <td>Spruce</td> <td>2</td> </tr> <tr> <td>Studs</td> <td>Spruce</td> <td>1</td> </tr> <tr> <td>Plates</td> <td>Spruce</td> <td>1</td> </tr> <tr> <td>Other</td> <td>Spruce</td> <td>1</td> </tr> <tr> <td>Cants</td> <td>Douglas Fir</td> <td>2</td> </tr> <tr> <td>Wood Fascia</td> <td>Douglas Fir</td> <td>1</td> </tr> </tbody> </table> | <u>USE</u> | <u>SPECIES</u> | <u>GRADE</u> | Blocking | Spruce | 2 | Studs | Spruce | 1 | Plates | Spruce | 1 | Other | Spruce | 1 | Cants | Douglas Fir | 2 | Wood Fascia | Douglas Fir | 1 |
| <u>USE</u> | <u>SPECIES</u> | <u>GRADE</u> | | | | | | | | | | | | | | | | | | | | | | |
| Blocking | Spruce | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Studs | Spruce | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Plates | Spruce | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Other | Spruce | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Cants | Douglas Fir | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Wood Fascia | Douglas Fir | 1 | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | <u>Plywood</u> | .1 | Douglas Fir to CSA 0121-M1978 Unsanded Sheathing Grade. | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | <u>Fasteners</u> | .1 | Nails: to CSA B111-1974, hot dip galvanized steel for exterior work including components located in exterior walls and roofs; bright finish steel in all other locations. Unless otherwise indicated use common spiral flathead nails. | | | | | | | | | | | | | | | | | | | | | |

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| | .2 | Bolts, nuts, washers: ASTM A307, hot dip galvanized steel. |
| | .3 | Connectors, anchors, brackets, spikes: hot dip galvanized structural quality steel. |
| | .4 | Plugs for masonry walls: 4.5 mm galvanized sheet steel wall plugs by Drummond & Reeves, approx. 75 mm deep and 57 mm wide. |
| | .5 | Screws: to CSA B35.4-1972 zinc, cadmium or chrome plated. |
| | .6 | Nailing discs: flat caps, minimum 1" diameter, maximum 16 ga thick sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable. |
| 2.4 | <u>Wood Treatment</u> | |
| | .1 | Preservative pressure treated components: to CSA, using alkaline copper quaternary (ACQ). |
| | .2 | Surface, cut, bore and trim components to sizes required as much as possible prior to pressure treatment. |

PART 3 - EXECUTION

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| 3.1 | <u>General</u> | |
| | .1 | Erect work plumb, level, square and to required lines, Ensure that materials are rigidly and securely attached to each other and to adjacent building elements and will not be loosened by work of other trades. |
| | .2 | Where other materials and components are to be applied directly over wood members recess heads of fastening devices below wood surfaces. |
| | .3 | Where work remains exposed to view, fasteners shall be uniformly and evenly spaced and neatly installed. |
| 3.2 | <u>Nailers, Blocking Copings Grounds</u> | |
| | .1 | Provide wood nailers, blocking, copings, strapping, bucks, grounds and other rough carpentry components to sizes and in locations required for satisfactory supply of fabricated items and other work. |
| | .2 | Unless otherwise indicated, provide minimum 38 mm thick material. Grounds may be 21 mm thick material unless otherwise indicated. |
| | .3 | Install wood members plumb, level, straight, true to line and solidly anchored to adjacent building elements. |
| | .4 | Provide rough bucks where indicated or required for windows, doors lockers and other elements. |
| 3.3 | <u>Anchors & Fasteners</u> | |
| | .1 | Provide rough hardware including nails, screws, bolts, washers, brackets, hangers, and fastening devices of all types. |
| | .2 | Unless otherwise indicated, attach wood members at maximum 600 mm . o.c. as follows: |
| | .1 | To concrete and solid masonry with expansion type anchor bolts. |
| | .2 | To hollow masonry with toggle bolts. |

- .3 To heavy gauge metal with bolts.
- .4 To light gauge metal with screws or bolts.
- .5 To wood with nails, screws or bolts as required to ensure stability.
- .3 Bucks and plates shall be anchored to masonry walls with 13 mm galvanized steel bolts 450 mm long.
- .4 Fasten wood copings to supporting masonry elements with 13 mm galvanized steel bolts min. 450 mm long spaced max. 600 mm o.c. Where width of coping plate exceeds 100 mm, stagger bolts off centre.
- 3.4 **Pressure Treated Components**
 - .1 Use preservative pressure treated lumber and Treated plywood within exterior wall and roof systems and other locations indicated on drawings.
 - .2 Where it is necessary to cut, bore or otherwise alter pressure treated components in the field, treat cut surfaces with heavy coat of wood preservative.

End of Section

PART 1 - GENERAL

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| 1.1 | <u>Reference</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Rough Carpentry | Section 06100 |
| | | .2 | Cabinet Work | Section 06400 |
| | | .3 | Supply of Finishing Hardware | Section 08710 |
| | | .4 | Painting & Finishing | Section 09900 |
| 1.3 | <u>Reference Standard</u> | .1 | Do millwork to Millwork Standards of the Architectural Woodwork Manufacturers Association of Canada (AWMAC) | |
| 1.4 | <u>Qualifications</u> | .1 | The work of this section is to be done by a Millwork Contractor of recognized standing having personnel with experience in this type of work and who has the necessary equipment to carry out the work. | |
| | | .2 | Restrict execution of this work to Journeyman Finish Carpenters for actual cutting and fitting of trim and finish materials and be completely familiar with materials involved and Manufacturer's recommended methods of installation. | |
| 1.5 | <u>Guarantee</u> | .1 | Provide the following guarantee in accordance with the General Conditions, notwithstanding the time provisions therein. | |
| | | .1 | Two years against defects in workmanship and materials. | |
| 1.6 | <u>Submittals</u> | .1 | Submit shop drawings in accordance with the General Conditions of the contract. Draw plans and elevations at 1:50 scale details at 1:20 minimum. Clearly indicate methods of construction, profiles, jointing, fastening and other related details. Indicate wood species. | |
| | | .2 | Submit the following samples: | |
| | | .1 | Duplicate 1000 mm x 1000 mm samples of each type of panelling and each type of solid wood or plywood to receive stain or natural finish. | |
| | | .2 | Duplicate 1000 mm long samples of each type of trim and moulding. | |
| 1.7 | <u>Product Delivery & Storage</u> | .1 | Do not deliver materials until suitable heated dry storage space is available. Deliver materials with protective coverings and maintain in undamaged condition. | |
| | | .2 | Store materials on site in such a way as to prevent deterioration or loss or impairment of essential properties. Do not store or install materials in areas where relative humidity is less than 25% or greater than 60% at 22°C. | |
| | | .3 | Cover finished plastic laminate surfaces with heavy craft paper or put in cartons during shipment. Protect installed plastic laminate surfaces by approved means. Do not remove until immediately before final inspection. | |

PART 2 - PRODUCTS

- 2.1 **Materials**
- .1 All lumber and plywood shall be identified by grade stamped by an approved agency as listed in the Ontario Building Code.
 - .2 All lumber shall be kiln dried.
 - .3 Softwood Lumber: To C.S.A. 0141-1970 and National Lumber Grades Authority requirements, with maximum moisture content of 7%, with a permitted range of 5 - 9% in individual pieces, for interior work, 12% with a permitted range of 10 - 1% in individual piece, for exterior work. Lumber pine species to AWMAC custom grade for opaque finishes AWMAC premium grade for clear finishes.
 - .4 Hardwood Lumber: Clear maple to National Hardwood Lumber Association (NHLA) requirements, maximum moisture content of 7% with a permitted range of 5% - 9% in individual pieces to AWMAC Custom grade for opaque finishes AWMAC premium grade for natural finishes.
 - .5 Hardwood Plywood: Multicore plywood to CSA 0115-1967 of thickness indicated. Rotary cut face birch species with select white veneer. G15 or G25 when exposed both sides. Use veneer core with Type I bond. Select veneers to provide book match.
 - .6 Douglas Fir Plywood: To CSA 0121-M1978 good one side. Select high density overlaid grade.
 - .7 Perforated Hardboard: To CGSB 11-GP-3M type 6 mm thick with 3m holes at 25 mm o.c.
 - .8 Nails and staples: To CSA B111-1974, galvanized for exterior work, interior highly humid areas and for treated lumber, plain finish elsewhere.
 - .9 Plastic Laminate: From full range of products by Formica, Arborite, Wilsonart, Pionite and Nevamar as selected by Consultant.
 - .10 Plastic Laminate for Flat Work: To CAN3-A172-M79. Grade; General Purpose Standard Duty 1.27 mm thick, Gloss and suede finish.
 - .11 Plastic Laminate Backing Sheet: Supplied by same manufacturer as facing sheet, same thickness and colour as face laminate.
 - .12 Laminated plastic for post forming work: To CSA A172 1974 type 2b, 1.6 mm thick, gloss and suede finish.
 - .13 Plywood Core: Douglas Fir to CSA 0121-M1978 solid two sides 19 mm thick, exterior grade for high moisture areas.
 - .14 Plastic Laminate Adhesive: As recommended by manufacturer to suit application.

- 2.2 **Shop Fabrication**
- .15 Sealer: Water resistant sealer or glue acceptable to laminate manufacturer.
- .16 Sealant: Proglaze by Tremco Silicone Construction Sealant.
- .1 Plastic Laminate:
- .1 Comply with CSA A172 - 1974, Appendix "A".
- .2 Obtain governing dimensions before fabrication items which are to accommodate or abut appliances, equipment and other materials.
- .3 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .4 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 3000 mm. Keep joints 600 mm from cut outs.
- .5 Form shaped profiles and bends as indicated, using post forming grade laminate to laminate manufacturer's instructions.
- .6 Use straight self edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 deg. Do not mitre laminate work.
- .7 Apply laminate backing sheet to reverse side of core of plastic laminate work.
- .8 Apply laminated plastic liner sheet where indicated.
- .9 As required and as indicated in Section 00865 Colour Schedule, treat selected plastic laminate for chemical resistance where applicable.
- .2 Wood Work
- .1 Workmanship: conform to AWMAC Premium requirements.
- .2 Apply preservative treatment to members in contact with flooring in accordance with requirements of AWMAC and manufacturer's printed instructions. Use dipping method only.
- .3 All interior woodwork shall be made for transparent finish unless otherwise specified.
- .4 Interior wood work for paint finish: workmanship shall conform to AWMAC Custom Grade requirements.
- .5 Set nails and screws, apply stained plain wood filler to indentations, sand smooth and leave ready to receive finish.
- .6 Recess shelf standards unless noted otherwise.

3.1 **Installation**

- .1 Install finish carpentry components plumb, true and level and securely fasten in place. Accurately scribe and closely fit components to irregularities of adjacent surfaces.
- .2 Accurately fit joints in true plane, locate joints over bearing or supporting surfaces.
- .3 Provide heavy duty fixture attachments for wall mounted work.
- .4 Prepare external exposed and semi-exposed surfaces ready for sealing, staining and varnishing or painting.
- .5 Prepare internal non-exposed surfaces ready for sealing with varnish or shellac.
- .6 Apply bituminous coating over wood framing members in contact with masonry or cementitious construction.
- .7 Provide mechanical fastening devices such as nails, screws, and bolts required for fastening wood components. Unless permitted, provide concealed fastening of components.

- | | | | |
|-----|-------------------------------------|-----|---|
| | | .8 | Where permitted, nail with small headed finishing nails. Countersink nail heads with nail setter. |
| 3.1 | <u>Installation (Cont'd)</u> | .9 | Where components are fastened with screws or bolts, countersink screw and bolt heads and provide wood plugs matching surrounding wood. |
| | | .10 | Install caps, rails, base, casings and trim in longest practicable lengths; accumulation of short pieces not permitted. No edge grain shall be visible; mitre corners. Slope cut intermediate joints. |
| | | .11 | Provide interior wood trim where indicated and where required to complete work. |
| 3.2 | <u>Interior Trim</u> | .1 | Standing and running trim to be AWMAC premium grade construction. |
| 3.3 | <u>Finishing</u> | .1 | Sand finished wood surfaces thoroughly as required to produce uniformly smooth surface, always sanding in direction of grain run. Coarse grained sandpaper marks, hammer marks, or other similar imperfections in finished work are not acceptable. |
| 3.4 | <u>Plastic Laminate</u> | .1 | Install work plumb, true and square, neatly scribed to adjoining surfaces. |
| | | .2 | Make allowances around perimeter where fixed objects pass through or project into laminated plastic work to permit normal movement without restriction. |
| | | .3 | Use draw bolts and splines to counter top joints. Maximum spacing 450 mm o.c., 75 mm from edge. Make flush hairline joints. |
| | | .4 | Provide cutouts for inserts, grilles, appliances, outlet boxes, etc. Round internal corners, chamfer edges and seal exposed core. |
| | | .5 | At junction of laminated plastic counter back splash and adjacent wall finish, apply small bead of sealant. |
| | | .6 | Site or shop apply laminated plastic to units as indicated. Adhere laminated plastic over entire surface. Make corners with hairline joints. Use full sized laminate sheets. Make joints only where indicated or approved. Slightly bevel arises. |
| | | .7 | For site application, offset joints in plastic laminate facing from joints in core. |
| 3.5 | <u>Finish Schedule</u> | .1 | Unless specifically indicated otherwise, all finish carpentry components shall receive transparent stain and varnish by Section 09900. |

End of Section

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide rigid board insulation.

1.3 REFERENCES

- .1 CAN/ULC-S102; Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.
- .3 CAN/ULC-S701; Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 CAN/ULC-S704; Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.
- .5 CAN/ULC-S770; Standard for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams.
- .6 CGSB 71-GP-24; Adhesive, Flexible, for Bonding Cellular Polystyrene Insulation.

1.4 SUBMITTALS

- .1 **Samples:** Submit samples of insulation furring system channels, fasteners and accessories, in accordance with Section 01 30 00.
- .2 **Product Data:** Submit manufacturer's printed product literature, MSDS sheets, and application instructions for insulation materials in accordance with Section 01 30 00.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to the site in their original unopened packages, bearing all manufacturer's labels.
- .2 Protect packages from damage, and materials from effects of weathering.

2.0 PRODUCTS

2.1 INSULATION

- .1 **Foundation Insulation & General Applications:** extruded closed-cell polystyrene foam insulation (XPS), Type 4 to CAN/ULC-S701, shiplapped edges, manufactured using HCFC-free blowing agents, thickness as shown on the drawings, and as follows;
 - .1 Board size: 600mm x 2400mm.
 - .2 Compressive strength: 210kPa.
 - .3 Flame Spread: less than 50, to CAN/ULC-S102.
 - .4 Vapour Permeance: 90ng/Pa s m² maximum.

- .5 Long Term Thermal Resistance (LTTR)
 - .1 (R 5.0) RSI 0.87 per 25mm thickness of board.
- .6 Acceptable Products
 - .1 STYROFOAM™ SM™, by Dow Chemical Canada Inc.
 - .2 CELFORT® 300, by Owens-Corning Canada Inc.
- .2 **Perimeter Foundation Insulation:**
~~Tech Crote CFI, 90 mm (R20) STYROFOAM with tongue and groove profile and factory applied 8 mm thick latex modified concrete facing. Broomed finish. Complete with galvanized panel clips and metal corner and top flashings.~~
- .3 **Above Grade Exterior Wall Application (Cavity Wall Applications and elsewhere where shown on drawings):**
~~Expanded polyisocyanurate rigid board, to CAN/ULC-S704, with ship lapped edges, where shown on drawings, and as follows.~~
 - .1 ~~Board size: 600mm x 2400mm.~~
 - .2 ~~Thickness: 152 mm~~
 - .3 ~~Compressive strength: 140kPa.~~
 - .4 ~~Vapour Permeance: 300ng/Pa s m² maximum.~~
 - .5 ~~Long Term Thermal Resistance (LTTR)~~
 - .1 ~~(R 6.0) RSI 1.04 per 25mm thickness of board.~~

2.2 ADHESIVES

- .1 To CGSB 71-GP-24M.

3.0 EXECUTION

3.1 QUALITY OF WORK

- .1 Install thermal Insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Install insulation after building substrate materials are dry.
- .3 Fit insulation tightly around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75mm from heat emitting devices such as recessed light fixtures.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Consultant.

3.2 EXAMINATION

- .1 Examine substrates and immediately inform Consultant in writing of defects.
- .2 Prior to commencement of work ensure substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.3 INSTALLATION

.1 General Application

- .1 Apply adhesive to substrate by notched trowel in accordance with manufacturer's instructions.
- .2 Embed insulation boards into adhesive, prior to skinning of adhesive.
- .3 In addition to adhesive. Install mineral fibre insulation boards with insulation clips, 2 per board minimum, fit boards tight, cut off fastener spindle 3mm beyond disc.
- .4 Leave unbonded joints in insulation board over line of expansion and control joints.

.2 Exterior Wall Applications

- .1 Fasten insulation with manufacturer-recommended fasteners.
- .2 Butt board joints tightly together with vertical joints staggered.

.3 Foundation Insulation

.1 Perimeter Interior Application:

- .1 Extend boards vertically below finish grade to depths detailed on the drawings. Install on interior face of perimeter foundation wall with adhesive.

.2 Under Slab Application:

- .1 Extend boards (2'-0") 600mm in from perimeter foundation wall, where indicated on the drawings.
- .2 Provide insulation under all concrete floor slabs on grade where shown and noted on drawings
- .3 Lay boards on level compacted fill with joints tightly butted..

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide batt and blanket insulation.

1.3 REFERENCES

- .1 CSA-B111; Wire Nails, Spikes and Staples.
- .2 CAN/ULC-S102; Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S114; Determination of Non-Combustibility in Building Materials.
- .4 CAN/ULC-S702; Standard for Mineral Fibre Thermal Insulation for Buildings.

2.0 PRODUCTS

2.1 INSULATION

- .1 **Thermal Insulation:** mineral fibre, processed from rock or slag, to CAN/ULC-S702, Type 1; thicknesses as shown on the drawings;
 - .1 Thermal Resistance: RSI 0.74/25mm.
 - .2 Acceptable Products
 - .1 Rockwool Curtainrock 80, by Rockwool LLC.
 - .2 CW8 Mineral Fibre Insulation, by Johns-Manville.
 - .3 Thermafiber® RainBarrier 45, by Owens Corning Canada Inc.
- .2 **Fire Blanket Insulation:** mineral fibre processed from rock, slag, or glass, to CAN/ULCS702 Type 1, non-combustible to CAN/ULC-S114, thickness as shown on the drawings;
 - .1 Fire Hazard Classification: flame spread 25 or less, smoke developed 50 or less, to CAN/ULC-S102.
 - .2 Thermal Resistance: RSI 0.71/25mm.
 - .3 Acceptable Products
 - .1 Unfaced Thermal Fiber Glass Insulation, by Johns-Manville.
 - .2 Thermafiber SAFB, by Owens Corning Canada Inc.
 - .3 Rockwool AFB, by Rockwool LLC.
- .3 **Sound Attenuation Insulation:** mineral fibre processed from glass, to CAN/ULC-S702, Type 1, thickness as shown on the drawings;
 - .1 Acoustical Performance:
 - .1 Airborne sound transmission loss: To ASTM E90.
 - .2 Rating sound insulation: To ASTM E413.
 - .3 Sound absorption co-efficients: To ASTM E423.
 - .4 NRC: 0.95 at 50mm thickness.

- .2 Acceptable Products
 - .1 Sound Attenuation Batt Insulation, by Owens Corning Canada Inc.
 - .2 Sound-SHIELD® Insulation Batts by Johns-Manville.
 - .3 Noise Reducer Sound Attenuation Batt, by CertainTeed Canada .

2.2 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50mm cold-rolled carbon steel 0.8mm thick, self-adhesive back, spindle of 2.5mm diameter annealed steel, length to suit insulation, 25mm diameter self-locking washers.
- .2 Tape: CCMC approved, Tuck 20502 Sheathing Tape, by Canadian Technical Tape Ltd., Montreal PQ.

3.0 EXECUTION

3.1 INSULATION INSTALLATION

- .1 Install Thermal Insulation to maintain continuity of thermal protection to building elements and spaces.
- .2 Where no means of securing is present, retain insulation in position with insulation clips, installed as recommended by manufacturer. Insulation clips shall be spaced 400mm vertically.
- .3 Fit insulation closely around electrical boxes, pipes, ducts, frames, and other objects in or passing through insulation. Do not compress insulation to fit into spaces.
- .4 Keep insulation minimum 75mm away from heat emitting devices such as recessed light fixtures.
- .5 Do not enclose or build over insulation until it has been inspected and approved by Consultant.
- .6 Install Sound Attenuation insulation in non fire-rated interior wall assemblies, as shown on the drawings.
- .7 ~~Install Ceiling Sound Attenuation insulation in non fire-rated ceiling assemblies, as shown on the drawings. Lay batts loosely over ceiling assembly, butted together.~~
- .8 ~~Install Fire Blanket/Sound Attenuation insulation in all fire-rated interior wall and ceiling assemblies, where indicated as having fire resistance ratings on the drawings.~~

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract as supplemented in Section 00 73 00, and the General Requirements form part of this section, and must be read in conjunction with the requirements of this section.

1.2 SECTION INCLUDES

- .1 Built-up membrane roofing, cold-applied method.

1.3 REFERENCES

- .1 ASTM D4601: Standard Specification for Asphalt-Coated Glass Fibre Base Sheet Used In Roofing.
- .2 CSA A123.4: Bitumen for Use in Construction of Built-Up Roof Coverings and Dampproofing and Waterproofing Systems.
- .3 CGSB 37-GP-9Ma: Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .4 CGSB 37-GP-52M: Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric.
- .5 CAN/CGSB-51.33: Vapour Barrier Sheet, Excluding Polyethylene, for Use In Building Construction.
- .6 CAN/ULC-S704: Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .7 CAN/ULC-S706: Standard for Wood Fibre Thermal Insulation for Buildings.
- .8 Must be in compliance with Ontario Building Code Act: sections 3.1.15 (Roof Covering) and 5.2.2.2. (Determination and Wind Load) or Part 11 (Renovations); and all support sections.
Submit evidence if requested of compliance by a Third Party Verified Listed Assembly (such as Underwriters Laboratory; Factory Mutual or Florida Building Code).

1.4 SYSTEM DESCRIPTION

- .1 **Roofing System:** two ply cold-applied built-up roofing system with underlay board, vapor barrier, rigid board insulation, sloped insulation, composite ply roofing membrane, aggregate surfacing and roof pavers.
- .2 Provide products that are compatible with one another under field conditions, as demonstrated by roofing manufacturer.
- .3 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 Make Submittals in accordance with Section 01 00 00.
- .2 Product Data
 - .1 Submit Product data for each major component, including membrane, vapour retarder, rigid board insulation, adhesives and pavers. Highlight critical criteria for proper installation.
- .3 Shop Drawings
 - .1 Submit Shop Drawings for prefabricated work and details.
 - .2 Include plans, sections, details in accordance with performance requirements, and for attachment to other portions of the Work.

- .3 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 Submit test reports as specified in Section 01 00 00.
- .2 Product Test Reports: based on the evaluation of comprehensive tests conducted by an independent testing agency of the specified roofing Products.
- .3 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 built up roofing, with minimum 8 years documented experience and approved to apply roofing system by manufacturer.
- .3 Conform to CRCA Roofing Specifications and roofing membrane manufacturer's instructions.

1.9 PRE-INSTALLATION MEETINGS

- .1 Conduct pre-installation meeting.
- .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 representatives of the Owner,
 - .2 authorized architect, engineer,
 - .3 roofing Subcontractor, roofing manufacturer, and installers of roof accessories and roof-mounted equipment.
- .3 Review methods and procedures related to roofing installation, including manufacturer's written installation instructions.
- .4 Review construction schedule and confirm availability of Products, Subcontractor personnel, equipment and facilities.
- .5 Review deck installation criteria and finishes for conformance with roofing system criteria, including issues of flatness and fastening.
- .6 Review structural loading conditions and limitations of roof deck both during and after roofing application.

- .7 Review flashing details, special roofing details, roof drainage, roof penetrations, equipment curbs, and other conditions affecting roofing installation.
- .8 Review governing regulatory requirements, and requirements for insurance and certificates as applicable.
- .9 Review safety requirements, including temporary fall-arrest measures.
- .10 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.

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 -5 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 OIRCA 2 year warranty, commencing from the date of Substantial Performance of the Work.
- .3 Manufacturer's Extended Warranty: The Manufacturer shall issue a non-prorated warranty for a period of Twenty (20) Years. All components including the vapor retarder, insulation, cover board, membrane, flood coat, perimeter flashings including metal shall be covered under this warranty. Wind uplift warranty shall cover wind velocity up to a maximum wind speed of not greater than 117km/h (73 mph).

Warranty shall include inspections in years 2, 5, 10 & 15 of the warranty. The following duties shall be carried out at no extra cost to the Owner as required, by the Manufacturer.

- Sealing of flashing seam
- Filling of pitch pockets
- Repairs to blisters and ridges
- Caulking at metal details as required
- Written inspection report
- Removal of light debris from roof
- Cleaning of drain screens

1.13 MAINTENANCE

- .1 The manufacturer shall provide a non-prorated warranty for a period of Twenty (20) years covering all components from the vapor retarder up.
- .2 Prior to the 2-year expiration of the contractor's warranty, the manufacturer shall carry out an Infra-Red Scan of the roof areas completed under this contract.

2.0 PRODUCTS

2.1 ROOF SYSTEM MANUFACTURERS

- .1 Products and systems specified herein are based on the BurMastic Cold-Applied system by Tremco Canada. Soprema, JohnsManville and IKO are accepted alternate manufacturers.

2.2 MATERIALS

- .1 Primer: non-fibred, asbestos free, water-based, low-VOC formulation; to CGSB 37-GP-9Ma; equivalent to Tremco Improved Tremprime WB.
- .2 **Thermal Barrier Underlay Board:** Lightweight moisture resistant fiberglass-faced 16 mm (5/8") Type X gypsum sheathing panel
- .3 **Roof Vapour Retarder:** Self adhering 1.0 mm (40 mil) thick, self adhered air and vapour control membrane consisting of SBS rubberized asphalt laminated to slip-resistant, cross-laminated polyethylene surface film, with release paper backing. Provide substrate primer as recommended by manufacturer. AVC Membrane and Primer by Tremco Canada.
- .4 **Roof Insulation:** Polyisocyanurate rigid board; to CAN/ULC-S704, Type 3, Class 2, closed cell type:
 - .1 Board Size: (4'-0" x 4'-0") 1220 x 1220mm.
 - .2 Long Term Thermal Resistance (CAN/ULC-S770): (R6.0) RSI 1.04 per (1") 25mm thickness of board.
 - .3 Compressive Strength: (20psi) 140kPa minimum.
 - .4 Dimensional Stability (ASTM D2126): < 2 percent linear change.
 - .5 Water Absorption (ASTM C209): < 1 percent by volume.
 - .6 Edges: square.
 - .7 Faces: non-asphaltic, fibre-reinforced felt facers both sides.
 - .8 Combustibility: meets CAN/ULC-S107-M87 and CAN/ULC-S126-M86.
 - .9 Thickness: minimum two layers required, total thickness: 3.5 inches.
 - .10 Acceptable Products:
 - .1 Trisotech Roof Insulation by Tremco Canada.

- .5 **Tapered Thermal Insulation & Slope Saddles:** Tapered insulation from polyisocyanurate thermal insulation boards, composed of closed cell polyisocyanurate foam core between polymer coated reinforced glass fibres faces.
 - 1 Approved products:
 - .1 Sopra-ISO Plus Tapered by Soprema Inc.
 - .2 Posi-Slope Enterprises,
 - .3 Accu-Plane Enterprises.
 - .2 Minimum Slope: 2%
- .6 **Tapered Drain Sumps:** Tapered insulation from polyisocyanurate thermal insulation boards, composed of closed cell polyisocyanurate foam core between polymer coated reinforced glass fibres faces.
 - 1 Minimum Slope: 4%
 - 2 Overall Size:
 - .1 Drain Sumps: 1.22m x 1.22m
 - 3 Minimum Slope: 4%
- .7 **Overlay Board:** (1/2") 13mm thick asphalt-coated (6 sides) fiberboard, to CAN/ULC-S706, Type II, Class 1.
- .8 **Roofing Ply Membrane:** polyester-glass-polyester tri-laminate reinforced asphalt-coated sheet, (0.055") 1.4mm thick, (31 lb/100ft²) 1.5 kg/m² weight, to ASTM D4601, Type II; BURmastic Composite Ply HT by Tremco Canada.
- .9 **Flexible Flashing Membrane:** (0.045") 1.14 mm thick, reinforced EPDM/SBR elastomeric sheeting; TRA by Tremco Canada.
- .10 **Aggregate Ballast:** pea gravel free of fines, long splinters, dust or foreign matter, nominal (3/8") 10mm diameter.

2.3 ACCESSORIES

- .1 **Adhesive for Roof Insulation Boards and Overlay Boards:** Two component (1:1 ratio) solvent free, elastomeric urethane adhesive. Asbestos free, low odor and does not contain any bitumen or VOC's. Tremco Low Rise Foam Adhesive.
- .2 **Adhesive for Aggregate Ballast and Roofing Plies:** Asbestos-free, cold-process asphalt adhesive; Tremco BurMastic Adhesive.
- .3 **Adhesive for Flashing Membranes:** Single-component, bitumen-modified, moisture cure polyurethane; Tremlar –LRM-V by Tremco Canada.
- .4 **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.
- .5 **Pavers:** (24" x 24" x 2" thick) 610 x 610 x 50mm thick, precast concrete paver units; diamond surface pattern; color as selected by Owner.
- .6 **Stack Flashings:** to CSA-B272, insulated aluminum stack jacks complete with bitumen protection dam and screw-secured cover;
 - .1 SJ-26/SJ-27, by Thaler Metal Industries Ltd., Mississauga ON.
 - .2 Flash-Tite VSC-S Series, by Lexcor, Etobicoke ON.

- .7 **Roof Penetration Flashings:** to CSA-B272, insulated aluminum, complete with bitumen protection dam and screw-secured cover;
 - .1 Thaler Metal Industries Ltd., Mississauga ON, or
 - .2 Flash-Tite™, by Lexcor, Etobicoke ON.
- .8 **Irregular Roof Protrusion Flashings:** Pre-fabricated mastic sealer pockets; (5") 127mm high x appropriate diameter to exceed diameter or width of protrusion by (2") 50mm. Pockets to be sealed with pourable self-leveling sealant;
 - .1 Chemlink Advanced Construction Products.
 - .2 Hi-Tuff TPO Molded Sealant Pockets by Lexcan Limited.
- .9 **Roof Drains:** as specified in Section 22 14 26.
- .10 **Prefinished Sheet Metal:** for flashing & copings exposed to view, (24ga.) 0.7mm minimum base thickness commercial quality sheet steel to CSA-S136, hot-dip galvanized to CAN/CSA-G164, prefinished with factory applied 2-coat silicon-modified polyester system, Stelco 8000 Series finish; color as selected by Owner.
- .11 **Miscellaneous Sheet Metal:** for hook strips, fastening strips, metal bellows, and other flashings generally concealed from view; (22ga.) 0.93mm galvanized steel.
- .12 **Cant Strips:** purpose made asphalt-impregnated fiberboard, (3" x 3") 75 x 75 mm size.
- .13 **Stripping Membrane:** Vinyl-coated fiberglass mesh; Burmesh by Tremco Canada.
- .14 **Stripping Adhesive:** Single-component bitumen modified polyurethane, vertical grade, Tremlar LRM-V by Tremco Canada.
- .15 **Pitch Pan:** pre-manufactured type; (24 gauge) 0.7mm thick galvanized steel sheet, minimum (4") 100mm high.
- .16 **Pitch Pan Filler:** Quick set grout. Tremseal PP Sealer by Tremco.
- .17 **Sealants:** as specified in Section 07 92 00.
- .18 **Termination Bar:** (1/8") 3mm thick aluminum bar, (1") 25mm wide profile, pre-drilled for mechanical attachment.
- .19 **Prefabricated Control or Expansion Joint Flashing:** sheet butyl reinforced with closed cell urethane foam backing, seamed into metal flashing flanges, including sheet butyl counter flashing each side.

3.0 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 EXISTING ROOF AND ROOFING SYSTEM

- .1 Roofing on the existing building roof is under an active warranty from IKO. Any roof related work along the tie-in has of this addition to be executed by the TSDN and IKO approved roofing contractors ensuring advanced coordination with existing roofing system manufacturer.

3.3 PREPARATION

- .1 Protect existing roofing from damage with minimum (1/2") 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 (200 ft²/gal.) 4.9 m²/litre. Allow to cure.
- .4 Ensure primer does not enter building through cracks and other openings.

3.1 THERMAL BARRIER UNDERLAY BOARD

- .1 Mechanically secure thermal barrier underlay board to all metal roof decks with screws and plates using one fastener per 0.27 m². Stagger boards 300 mm. Drive fasteners flush to top surface.

3.2 VAPOUR RETARDER

- .1 Adhere roof vapour retarder to existing substrate with approved primer at manufacturer's recommended rate.
- .2 Overlap vapour retarder minimum (4") 100mm for side laps and (6") 150mm for end laps.
- .3 Extend vapour retarder under cant strips and blocking. Extend to perimeter and deck protrusions.
- .4 Seal roof vapour retarder to wall air/vapour barrier system with flexible flashing membranes to ensure continuity of building air/vapour barrier envelope.

3.3 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 manufacturer's recommended rate.
- .3 Adhere intermediate layer of roof insulation to base layer of roof insulation with approved adhesive at manufacturer's recommended rate.
- .4 Adhere tapered roof insulation where indicated and in accordance with approved layout.
- .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 (12") 300 mm.
- .9 Adhere single layer of overlay board over roof insulation with approved adhesive at manufacturer's recommended rate.

- .10 Stagger overlay board seams over base layers of insulation board seams.

3.4 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.

3.5 ROOF MEMBRANE

- .1 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.
- .2 Overlap starter strips (26") 660mm with first ply, then overlap each succeeding ply (25") 625mm.
- .3 Place ply sheets to ensure water will flow over or parallel to, but not against, exposed edges.
- .4 Shingle in direction to shed water. Extend ply membranes over and terminate beyond cants and cut evenly.
- .5 Embed plies in approved adhesive, at manufacturer's recommended rate, and solidly coating each ply for full width.
- .6 Ensure complete and continuous seal and contact between adhesive and ply membranes, including ends, edges and laps without wrinkles, fish mouths or blisters.
- .7 Do not step or walk on felts during or immediately after application until adhesive has set.
- .8 Install each ply so that it shall be firmly and uniformly set, without voids, into adhesive. Thoroughly and effectively broom or roll each membrane application to ensure full adhesion.
- .9 Lap ply membrane ends (6") 150 mm. Stagger end laps (39") 1 metre minimum.
- .10 Overlap previous day's work (24") 600 mm, as required.
- .11 Terminate all ply layers to outer edge of roof perimeter.

3.6 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 flashing membrane minimum (6") 150 mm over roof membrane.
- .4 Extend flashing membranes minimum (10") 250 mm up vertical surfaces.
- .5 Secure flashings at (8") 200 mm OC. Secure vertical flashings through termination bar.
- .6 Overcoat lap edges with end lap 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.
- .8 **Canted Eave:**
 - .1 Extend reinforced elastomeric sheeting over outside face of cant and extend minimum (1") 25 mm below blocking. Mechanically fasten with (1½") 38mm common roofing nails, (8") 200 mm OC.
 - .2 Extend reinforced elastomeric sheeting down over cant strip and embed in flashing adhesive from top of cant to at least (6") 150 mm beyond toe of cant onto roof.
 - .3 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends (4") 100 mm and adhere with flashing adhesive.
- .9 **Canted Eave with Fascia**
 - .1 Extend reinforced elastomeric sheeting over outside face of cant and fascia and secure to underside of fascia. Mechanically fasten with (1½") 38mm common roofing nails, (8") 200 mm OC.
 - .2 Extend reinforced elastomeric sheeting down over cant strip and embed in flashing adhesive onto roof surface a minimum of (6") 150 mm.
 - .3 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends (4") 100 mm and adhere with flashing adhesive.
- .10 **Low Parapet Wall Flashing**
 - .1 Seal exposed joint between the wall and roof deck for airtight seal.
 - .2 Adhere elastomeric sheeting completely to flashing surface, cant, and roofing with flashing adhesive.
 - .3 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
 - .4 Extend elastomeric sheeting up and over parapet at least (1½") 38mm and face nail with 38 mm common roofing nails, (8") 200 mm OC.
- .11 **Gravel Stop**
 - .1 Prior to setting and nailing horizontal flanges of edge flashings, uniformly trowel a (0.060") 1.5 mm thick layer of cold flashing adhesive to roofing surface designated to receive metal flange.
 - .2 Install metal gravel stop with formed drip edge, incorporating lock-type joints to allow expansion and contraction. Set flange in cold flashing adhesive.
 - .3 Nail interior portion of flange to wood blocking (3") 75mm OC, staggered.
 - .4 Prime metal flange with asphaltic primer.
 - .5 Fully adhere a sufficiently wide strip of elastomeric sheeting to flashing with flashing adhesive. Ensure complete bond and continuity without wrinkles or voids lap sheeting ends (4") 100mm and adhere with flashing adhesive.

Elastomeric sheeting to cover gravel stop completely and overlapping onto adjacent roof minimum (6") 150mm.

- .6 Seal edge of flashing membrane at metal upturn.

.12 Flashing At [Edges] [and] [Gutters]

- .1 Fabricate and install new one-piece [edge.] [gutter with downspouts. Slope gutter to downspouts.]
- .2 Prior to setting and nailing horizontal flanges of gutter, uniformly trowel a (0.60") 1.5mm thick layer of cold flashing adhesive to roofing surface designated to receive metal flange.
- .3 Nail flange to wood blocking (3") 75mm OC, staggered.
- .4 Prime metal flange with asphaltic primer.
- .5 Adhere sufficiently wide strip of elastomeric sheeting completely to flashing surface with flashing adhesive. Ensure complete bond and continuity without wrinkles or voids lap sheeting ends (4") 100 mm and adhere with flashing adhesive. Elastomeric sheeting to cover gravel stop completely and overlap onto adjacent roof a minimum of (6") 150 mm.
- .6 Seal edge of flashing membrane at metal upturn.

.13 Wall Flashing

- .1 Seal exposed joint between the wall and roof deck for airtight seal.
- .2 Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive.
- .3 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends 100 mm and adhere with flashing adhesive.
- .4 Elastomeric sheeting width: sufficient to extend at least (6")150 mm beyond toe of cant onto roof surface and (8") 200 mm above the roof surface.
- .5 Secure top of elastomeric sheeting to vertical plane with termination bar. Mechanically fasten (12") 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

.14 Building Expansion Joints

- .1 Fill joint with loose insulation.
- .2 Provide ([1/2"][3/4"]) [13][19]mm thick plywood to top of wood blocking, secured one side only; as specified in Section 06 10 00.
- .3 Apply foam rubber or (1") 25 mm thick mineral fibre insulation to top of plywood.
- .4 Install elastomeric sheeting centred over expansion joint.
- .5 Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity

without wrinkles or voids.

.6 Elastomeric Sheeting Width: Sufficient to extend onto adjacent roofing minimum (6") 150 mm.

.7 Lap sheeting ends (4") 100 mm and adhere with flashing adhesive.

.15 Expansion Joint at Wall

.1 Extend vapour retarder from deck level up wall sufficiently and secure to wall.

.2 Fill joint with loose insulation.

.3 Install blocking, sheathing and compressible insulation as detailed on Drawings and as specified in Section 06 10 00.

.4 Adhere elastomeric sheeting completely to flashing surface, cant and roofing with flashing adhesive.

.5 Ensure complete bond and continuity without wrinkles or voids. Lap sheeting ends (4") 100 mm and adhere with flashing adhesive.

.6 Elastomeric Sheeting Width: sufficient to extend at least 150 mm beyond toe of cant onto roof surface and (8") 200 mm above the roof surface.

.7 Secure top of elastomeric sheeting to vertical plane with a termination bar. Mechanically fasten (12") 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

.16 Area Divider

.1 Install elastomeric sheeting centered over area divider extending onto roof membrane a minimum of (6") 150 mm beyond toe of cant on either side.

.2 Fully adhere sheeting with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.

.3 Lap sheeting ends (4") 100 mm and adhere with flashing adhesive.

.17 Control Joint

.1 Install elastomeric sheeting centered over joint.

.2 Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.

.3 Flashing Width: Sufficient to extend onto adjacent roofing minimum (6") 150mm.

.4 Lap sheeting ends (4") 100mm and adhere with flashing adhesive.

.18 Curb Flashing

.1 Fully adhere sheeting to horizontal and vertical blocking surfaces with flashing adhesive. Press sheeting into adhesive. Ensure complete bond and continuity without wrinkles or voids.

.2 Elastomeric Sheeting Width: Sufficient to extend from top of curb down onto

adjacent roofing minimum (6") 150mm. Mechanically fasten sheeting on top face of curb.

- .3 Lap sheeting ends (4") 100 mm and adhere with flashing adhesive.
- .4 If membrane does not completely cover sleeper, secure top edge with a termination bar. Mechanically fasten (12") 300 mm OC. Overcoat bar with end lap stripping adhesive and membrane.

.19 Projection Flashing

- .1 Apply flashing adhesive to prepared area and Provide aluminum base over pipe and set into the flashing adhesive.
- .2 Select proper step of rubber cap and cut off above index ring.
- .3 Install cap onto base collar and press edge to ensure proper seal.
- .4 Provide clamp around pipe and rubber cap. Prime flange.
- .5 Install elastomeric sheeting with stripping ply adhesive and membrane.
- .6 Cover flange completely. Extend flashing minimum (4") 100 mm onto adjacent roofing. Remove wrinkles and voids. Lap flashing ply ends (4") 100 mm.

.20 Cartwheel and Collar

- .1 Provide cartwheel and collar flashing around projection using elastomeric sheeting and flashing adhesive.

.21 Coping

- .1 Test mortar bond of coping units. Remove loose mortar from bell joint and clean surfaces.
- .2 Pack flashing adhesive into bell joint and extend up onto bell approximately (3") 75mm and down onto shank of adjoining unit a similar distance.
- .3 Cut proper lengths of (6") 150 mm wide reinforcement membrane and dry trowel membrane into flashing adhesive; tight and wrinkle-free.
- .4 Overcoat reinforcing membrane with flashing adhesive.

.22 Pitch Pans

- .1 Uniformly apply a (1/8") 3mm thick layer of flashing adhesive to surfaces designated to receive metal flange.
- .2 Install pre-manufactured pitch pan into adhesive. Prime flange prior to installation.
- .3 Ensure minimum (2") 50mm clearance between projection and side wall.
- .4 Fully adhere elastomeric sheeting to flashing surface with flashing adhesive. Cover flange completely. Extend flashing at least (4") 100 mm onto adjacent roofing. Ensure complete bond and continuity without wrinkles and voids. Lap sheeting ends minimum (4") 100 mm.

- .5 Fill pitch pan (1") 25mm from top with pitch pan base filler.
- .6 Fill remainder with rubberized elastomer mastic. Crown top of mastic to ensure water run-off.

.23 Equipment Stands (Pipe)

- .1 Provide (8") 200mm high sleeve flashing with (4") 100mm wide flange. Flange to extend completely around flashing periphery. Solder joints. Double solder vertical joints.
- .2 Nail flange to wood blocking minimum (3") 75mm OC; staggered.
- .3 Prime flange with asphaltic primer.
- .4 Install elastomeric sheeting to stand and roofing with continuous (0.60") 1.5mm thick application of flashing adhesive.
- .5 Sandwich top edge of sheeting between two layers flashing tape.
- .6 Secure top of sheeting with stainless steel drawband. Seal top of drawband and sheeting-to-pipe interface. Provide watershed and tool neatly.
- .7 Fabricate umbrella and install drawband; cover sleeve flashing minimum (3") 75mm. Install immediately above sleeve flashing. Tighten drawband.
- .8 Wipe clean top of umbrella and projection with metal cleaner. Prime surface with metal primer.
- .9 Seal projection-to-sheet metal interface. Provide watershed and tool neatly.

.24 Piping Through Roof Boxes

- .1 Install wood blocking as specified in Section 06 10 00.
- .2 Provide two-piece pipe box. Fabricate bottom portion with (4") 100mm flange. Notch top section to fit over piping. Provide openings (8") 200mm above the roof surface.
- .3 Set flange in mastic, nail flange to wood blocking at (3") 75mm OC. Prime flange.
- .4 Fill box interior with mineral fibre insulation.
- .5 Fasten top and closure detail to bottom.
- .6 Clean surfaces of box and piping with metal cleaner and then prime. Seal joint between box and piping.
- .7 Install elastomeric sheeting with flashing adhesive and membrane.

.25 Roof Drain

- .1 Install drain assembly in accordance with manufacturer's written installation guidelines.
- .2 Plug and seal drain to prevent water entry until service connection is completed.

- .3 Provide (24" x 24") 600mm x 600mm size elastomeric sheeting reinforcement, centered over drain; and fully adhered with flashing adhesive. Remove wrinkles and entrapped air.
- .4 Apply mastic to exposed edge of membrane inside the drain opening.
- .5 Reclamp flashing collar to drain in bed of flashing adhesive.
- .6 Trim excess sheeting within drain.

.26 Roof Drain Insert

- .1 Cut (9") 225 mm OD opening through membrane and insulation; coinciding with existing drain opening.
- .2 Install roof drain insert into existing drain pipe in accordance with drain insert manufacturer's written installation guidelines.
- .3 Adhere drain flange to membrane with flashing adhesive.
- .4 Provide (36" x 36") 914mm x 914mm size elastomeric sheeting reinforcement, centered over drain; and fully adhere sheeting with flashing adhesive. Remove wrinkles and entrapped air.
- .5 Trim excess sheeting within drain.
- .6 Seal leading edge of sheet with reinforcing membrane embedded between alternate continuous courses of flashing adhesive.

3.7 SURFACING

- .1 Install concrete pavers on pedestals where indicated on Drawings.
- .2 Flood coat roof surface with cold-process asphalt adhesive, applied at manufacturer's recommended rate.
- .3 Immediately broadcast aggregate ballast into cold adhesive at a rate of (416 lb/sq) 20 kg/m², covering flood coat completely.
- .4 Do not use power buggies or heavy equipment to distribute ballast.
- .5 Rake out aggregate to a neat, even surface.

3.8 FIELD QUALITY CONTROL

- .1 Contractor Inspection: Prior to application 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 (12") 300mm beyond damaged area in all directions, and seal seams.
- .3 Manufacturer's Field Service: arrange for manufacturer's technical representative to regularly (daily) inspect the roofing application and confirm that the roofing system installation is in strict accordance with manufacturer's recommendations.

3.9 CLEANING

- .1 Refer to Section 01 00 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.

3.10 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

1.0 GENERAL

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1.

1.0 RELATED WORK

- .1 Fire stopping and smoke seals within mechanical assemblies (i.e inside ducts, dampers) and electrical assemblies (i.e. inside cable trays) and at mechanical and electrical penetrations are specified in Division 21 and 26 respectively.
- .2 Coordinate work of this section with other sections as required to properly execute the work and as necessary maintain satisfactory progress of the work of other sections.

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 45 00 – Quality Control.
- .3 Divisions 21 and 26.

1.2 REFERENCES

- .1 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN-S115, Fire Tests of Firestop Systems.

1.3 SUBMITTALS

- .1 Submit duplicate 300 x 300 mm samples showing actual firestop material proposed for project.
- .2 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
- .3 Submit manufacturer's engineering judgement identification number and drawing details when no ULC or cUL system is available. Engineering judgement must include both project name and contractor's name who will install firestop system as described in drawing.
- .4 Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation. Include manufacturer's specifications, training letter, and technical data for each material including the composition and limitations, documentation of ULC or CUL firestop systems to be used.
- .5 Submit material safety data sheets provided with product delivered to job site.

1.4 MOCK-UP

- .1 Construct mock-up in accordance with Section 01400 – Quality Control.
- .2 Construct mock-up showing service penetrations, fire separation and floor assemblies. Mock-up may be part of finished work.
- .3 Allow 48h for inspection of mock-up by Consultant before proceeding with membrane work.

1.5 MANUFACTURER'S REPRESENTATIVE

- .1 A manufacturer's representative is to be on site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures and at commissioning stage to certify acceptance completed installation. Training will be done as per manufacturer's written recommendations published in their literature and drawing details.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance.
- .2 Fire stopping and smoke seal systems: in accordance with CAN-S115.
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN-S115 and not to exceed opening sizes for which they are intended.
 - .2 Firestop system rating: as indicated on drawings.
- .3 Service penetration assemblies: certified and tested by ULC or cUL in accordance with CAN-S115.
- .4 Service penetration firestop components: certified and tested by ULC or cUL in accordance with CAN-S115.
- .5 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .6 Non-curing, re-penetrable intumescent sealants, caulking or putty material for use with flexible cables or cable bundles.
- .7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal. Consult with Consultant and damper manufacturer prior to installation ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- .8 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed,

flexible cable or cable bundles and plastic pipe. No silicone based firestop are allowed to be applied on plastic pipes.

- .9 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .10 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .11 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .12 Sealants for vertical joints: non-sagging.

3.0 EXECUTION

3.1 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification or UL Products Certified for Canada (CUL) and manufacturer's instructions.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to a neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.3 INSPECTION

- .1 Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.4 SCHEDULE

- .1 Firestop and smoke seal at:
 - .1 Penetrations through all fire-resistance rated masonry, concrete, and gypsum board partitions and walls including walls required to provide a fire separation but having no required fire resistive rating .
 - .2 Edge of floor slabs at curtain wall and precast concrete panels.
 - .3 Top of fire-resistance rated masonry and gypsum board partitions.
 - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
 - .7 Openings and sleeves installed for future use through fire separations.
 - .8 Around mechanical and electrical assemblies penetrating fire separations.
 - .9 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

3.5 CLEAN UP

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

1.0 GENERAL

The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.1 SECTION INCLUDES

- .1 Materials, preparation and application for caulking and sealant.
- .2 Text to complete other various Sections containing sealant or caulking specifications, including Section [07 52 00 – Modified Bituminous Membrane Roofing].

1.2 RELATED SECTIONS

- .1 Section 04 90 00 – Masonry.
- .2 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .3 Section 08 11 13 – Hollow Metal Doors and Frames
- .4 Section 08 11 16 – Aluminum Doors and Frames.
- .5 Section 08 44 13 – Aluminum Curtain Walls.
- .6 Section 08 51 13 – Aluminum Windows and Operable Sashes.
- .7 Section 08 80 00 – Glass and Glazing

1.3 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C 510-[16] Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
 - .2 ASTM C 661-[15] Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
 - .3 ASTM C 719-[14(2019)] Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
 - .4 ASTM C 794-[18] Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - .5 ASTM C 834-[17] Standard Specification for Latex Sealants.
 - .6 ASTM C 919-[18], Standard Practice for Use of Sealants in Acoustical Applications.
 - .7 ASTM C 920-[18] Standard Specification for Elastomeric Joint Sealants.
 - .8 ASTM C 1087-[16] Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
 - .9 ASTM C 1135-[19] Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
 - .10 ASTM C 1184-[18e1] Standard Specification for Structural Silicone Sealants.
 - .11 ASTM C 1193-[16] Standard Guide for Use of Joint Sealants.
 - .12 ASTM C 1247-[20] Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.

- .13 ASTM C 1248-[18] Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- .14 ASTM C 1311-[14] Standard Specification for Solvent Release Sealants.
- .15 ASTM C 1330-[18] Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .16 ASTM C 1564-[15] Standard Guide for Use of Silicone Sealants for Protective Glazing Systems
- .17 ASTM D 412-[16] Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- .18 ASTM D 2203-[01(2018)] Standard Test Method for Staining from Sealants.
- .19 ASTM D 2240-[15e1] Standard Test Method for Rubber Property—Durometer Hardness
- .20 ASTM D 3960-[05(2018)] Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- .21 ASTM E 119-[19] Standard Test Methods for Fire Tests of Building Construction and Materials
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS) GANA Glazing Manual - 2008.
 - .1 Safety Data Sheets (SDS),

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section Consultant to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review mock-ups and procedures.
 - .5 Review manufacturer's written installation instructions and warranty requirements.
 - .2 Ensure subcontractor representatives, site supervisor and project manager attend.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Manufacturer's product to describe:
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Joint backing.
 - .4 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .3 Submit 2 copies of WHMIS SDS.
- .2 Samples:

- .1 Submit 2 samples of each type of material and colour.
- .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .3 Manufacturer's Instructions:
 - .1 Submit instructions to include installation instructions for each product used.

1.6 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
- .2 Warranty Documentation: Submit Warranty Documents Specified.

1.7 QUALITY ASSURANCE

- .1 Perform the work in accordance with the manufacturer's written project recommendations.
- .2 Obtain each type of joint sealant through one source from a single manufacturer.
- .3 Qualifications:
 - .1 The installation of the sealant work shall be performed by a recognized specialized applicator, having at least five (5) years of experience, with skilled mechanics, thoroughly trained and competent in all phases of the work.
- .4 Mock-up:
 - .1 Construct mock-ups two (2) weeks prior to commencement of the work to demonstrate all of the joints encountered in this project.
 - .2 The mock-ups shall be 1 m in length for each type of sealant and substrate.
 - .3 Locate mock-ups where directed by the Consultant.
 - .4 The mock-ups shall demonstrate the surface preparation prior to the sealant installation and the location, size, shape, colour, depth of joints, and adhesion and cohesion, complete with back-up material, primer, and new sealant.
 - .5 Allow 48 hours for inspection by the Consultant before proceeding with the sealant work.
 - .6 Upon receipt of written confirmation from the Consultant, the mock-up may remain as part of the finished work.
 - .7 The approved mock-up shall be the standard to which all work shall be performed.
 - .8 The mock-up shall be performed prior to the pre-installation conference

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 At time of delivery, the Contractor is to verify the sealant expiry dates. Any sealants that have expired or will expire prior to installation are to be returned to the supplier/manufacturer and should not be accepted on site.
- .4 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect joint sealants from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

1.9 SITE CONDITIONS

- .1 Ambient Requirements:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
 - .2 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials. Labelling and provision of Safety Data Sheets (SDS) shall be acceptable to Health Canada.
- .2 Ensure that all materials, containers, rags, etc. are disposed of in accordance with the local Waste Management Plan and hazardous material disposal regulations and requirements.
- .3 Ventilate area of work by use of approved portable supply and exhaust fans.
- .4 VOC limit 250 g/L maximum.

1.11 ALTERNATIVES

- .1 Alternatives to manufacturer's brands or supply sources of materials will not be accepted.

1.12 WARRANTY

- .1 Contractor shall provide a warranty by the sealant manufacturer covering a period of five (5) years for all labour and materials from the date of Substantial Performance of the contract agreeing to furnish sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within the specified warranty period.
- .2 Defective work shall include, but is not limited to, joint leakage, cracking, crumbling, melting, running, loss of adhesion or loss of cohesion, and substrate staining.

1.13 ANTICIPATED FIELD TESTING PROGRAM

- .1 Material and adhesion tests shall be conducted at the discretion of the Consultant on a random basis to show that properties are appropriate to the particular sealant and proper bond is achieved.
- .2 Extent of testing shall be as follows:
 - .1 Ten (10) tests for the first 1 000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
 - .2 One (1) test for each 1 000 feet (300 m) of joint length therefore or one test per each floor per elevation.
- .3 The Contractor shall repair all test areas as part of the work in accordance with this section.

- .4 All sealant installation failing material and adhesion tests shall be rectified in accordance with manufacturer and Consultant approved methods. Rectified areas will be retested until results confirm compliance with the manufacturer's written requirements

Part 2 Products

2.1 SEALANT

- .1 Porous Substrates (Clay Brick, Concrete, Stone, etc.)
 - .1 Dow Corning 790 Silicone Building Sealant manufactured by Dow Corning Corporation.
 - .2 Dow Corning 756 SMS; Silicone Building Sealant manufactured by Dow Corning Corporation.
 - .3 Dow Corning CCS (Contractors Concrete Sealant) manufactured by Dow Corning Corporation.
 - .4 Silpruf NB SCS 9000 manufactured by GE Silicones.
 - .5 Spectrem 1 manufactured by Tremco Ltd.
 - .6 Spectrem 2 manufactured by Tremco Ltd.
- .2 Non-porous Substrates (Glass, Metal, etc.)
 - .1 Dow Corning 756 SMS Silicone Building Sealant manufactured by Dow Corning Corporation.
 - .2 Dow Corning 791 manufactured by Dow Corning Corporation.
 - .3 Dow Corning 795 manufactured by Dow Corning Corporation.
 - .4 Dow Corning CWS (Contractor's Weather Sealant) manufactured by Dow Corning Corporation.
 - .5 Spectrem 1 manufactured by Tremco Ltd.
 - .6 Spectrem 2 manufactured by Tremco Ltd.
- .3 Porous Substrate/Metal Substrate
 - .1 Dow Corning 756 SMS Silicone Building Sealant manufactured by Dow Corning Corporation.
 - .2 Dow Corning 790 Silicone Building Sealant manufactured by Dow Corning Corporation.
 - .3 Dow Corning Contractors Weatherproofing Sealant (CWS)
 - .4 SilPruf NB SCS 9000 manufactured by GE Silicones.
 - .5 Spectrum 1 manufactured by Tremco Ltd.
 - .6 Spectrem 2 manufactured by Tremco Ltd.
- .4 Continuous Immersion – Applicable for Potable Water (Not for Chlorine/Bromine Exposure, i.e. pool water)
 - .1 Vulkem 116 manufactured by Tremco Ltd.
 - .2 Vulkem 45 SSL manufactured by Tremco Ltd.
- .5 Self-Levelling
 - .1 Vulkem 45 SSL manufactured by Tremco Ltd.
 - .2 Sikaflex 2C SL manufactured by Sika Canada.
 - .3 THC-901 manufactured by Tremco Ltd.

- .6 Interior – Applicable for Window Perimeter
 - .1 Tremflex 834 manufactured by Tremco Ltd
- .7 Acoustic Sealant
 - .1 Tremco Acoustical Sealant manufactured by Tremco Ltd.
- .8 Butyl Rubber
 - .1 Butyl Sealant manufactured by Tremco Ltd.
- .9 Self-Adhered Waterproof SBS Membrane Sealant
 - .1 Dow Corning 758 Silicone Weather Barrier Sealant manufactured by Dow Corning Corporation.
- .10 Silicone Sealant with Fungicides: for use in washrooms and Food Prep areas, (interior counter back splash and washroom fixtures):
 - .1 SCS1700 Sanitary Silicone Sealant by GE Silicones.
- .11 Sealant colour to later selection by Consultant and/or Owner from manufacturer's full range of colours.
- .12 The Contractor shall obtain written confirmation of the sealant suitability for this project. A copy of this confirmation shall be forwarded to the Consultant prior to commencing with the work of this section.

2.2 PRIMERS

- .1 Primer shall be as specified by the sealant manufacturer.

2.3 JOINT BACKING

- .1 Butt Joint and Bridge Joint Applications
 - .1 Cylindrical Sealant Backing, of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance. Material shall be of type that will not adhere to the specified sealant:
 - .1 Closed-cell material (i.e. polyethylene) with a surface skin. Do not puncture backer; rod may cause bubbling in sealant.
 - .2 Bi-cellular material with a surface skin.
 - .3 [Open-cell foam backer rod shall be used for the exterior (secondary) sealant bead in a two-stage sealant joint].
 - .4 [Open-cell material OR Open cell foam backer rod shall not be used on this project].
 - .2 Where the joint size cannot accommodate foam rod, polyethylene tape or other joint backing material recommended by sealant manufacturer shall be used.
- .2 Fillet Joint Applications
 - .1 Bond breaker tape, polyethylene tape or other plastic tape recommended by the sealant manufacturer shall be used to prevent adhesion to the specified sealant or to the back of joint.

2.4 CLEANING AGENT

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.

2.5 MASKING TAPE

- .1 Non-staining, non-absorbent material compatible with joint sealant and surface adjacent to joints.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for joint sealants installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- .2 The Contractor shall arrange for the sealant Manufacturer's representative to visit the site and review the surface preparation and installation procedures at the start of the work.

3.2 PREPARATION

- .1 Consult and follow the sealant manufacturer's project recommendations.
- .2 Remove the existing sealant around the joints and penetrations without causing damage to the substrates.
- .3 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .4 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .5 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .6 Ensure joint surfaces are dry and frost free.
- .7 Do not apply sealant to masonry until mortar has cured. Refer to Section 04 90 00 – Masonry.
- .8 Butt and Bridge Joint Applications
 - .1 Examine the joint sizes and correct as required to allow for the anticipated movement and to achieve proper width / depth ratio in accordance with the manufacturer's recommendations for the specified sealant unless indicated differently on the drawings, or by the Consultant.
 - .2 Should joint width correction be required, ensure that the correction is distributed appropriately to each side of joint.
- .9 Fillet Joint Applications
 - .1 Remove oil, grease and other coatings from non-ferrous metals with an approved cleaning solvent or abrasive technique. Obtain approval from the Consultant prior to commencing.

3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
- .3 Primers that require application by the wipe of a clean soft cloth, shall be poured onto the cloth. Do not dip the cloth into the primer container.
- .4 Prime only as much area as can be sealed in the same working day

3.4 BACKUP MATERIAL

- .1 Cylindrical Sealant Backing:
 - .1 Install the backer rod without stretching, twisting, braiding or puncturing the outer skin. Do not leave gaps between ends of sealant backings.
 - .2 Use an approved installation tool that is blunt surfaced and is designed accurately to place the backer rod.
 - .3 Using the approved tool, smoothly and uniformly place the backer rod to the recommended joint depth and rod compression.
 - .4 The minimum compression of the foam backer rod is twenty-five (25) percent. Vary backer rod size as required to achieve specified compression.
- .2 Bond Breaker Tape:
 - .1 Install bond breaker tape without stretching, twisting or puncturing the tape.
 - .2 Use an approved installation tool that is blunt surfaced and is designed accurately to place tape within the joint.
 - .3 Width of bond breaker tape shall fit exactly the width of the joint.
 - .4 Install tape at the back of the joint.
 - .5 Do not leave gaps between ends of bond breaker tape.
- .3 Three-sided adhesion is not permitted.
- .4 Foam backer rod shall only be installed in areas that can be sealed in the same working day.

3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

- .1 Sealant:
 - .1 The Contractor shall have a trained representative on site at all times who is responsible for all sealant applications.
 - .2 Perform all work in strict accordance with the manufacturer's printed instructions. The Contractor shall provide the Consultant a copy of these instructions prior to commencing with the injection and sealing operations.
 - .3 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .4 Apply sealant in continuous beads.
 - .5 Apply sealant using gun with proper size nozzle.
 - .6 Use sufficient pressure to fill voids and joints solid.

- .7 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .8 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .9 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing:
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place

3.7 TWO-STAGE SEALANT JOINT

- .1 A two-stage sealant bead consists of two sealant beads separated by a drained air space with each sealant bead having its own appropriate joint backing material.
- .2 The interior sealant bead shall be allowed to fully cure prior to the installation of the exterior bead. Sealant cut tests to confirm adhesive properties must be completed by the Consultant and repaired by the Contractor prior to the installation of the exterior bead. Obtain written confirmation from the Consultant prior to proceeding with the installation of the exterior bead.
- .3 A minimum of 25 mm must be maintained between the exterior face of the interior sealant bead and the back of the joint backing material for the exterior bead.
- .4 The Contractor is to ensure that the installation of a primer or surface preparation procedures for the interior sealant bead do not inhibit the adhesion of the exterior sealant bead.
- .5 At the intersection of horizontal and vertical sealant joints, return the horizontal interior sealant bead to interface with the exterior sealant bead closing the air space between sealant beads.
- .6 Install gap in the exterior vertical sealant joint at all intersections of horizontal and vertical sealant joints as per the details

3.8 ROUT AND SEAL REPAIRS

- .1 Grind sides of crack to a minimum width of 6mm and depth of 6mm (1/4 inch).
- .2 Apply bond breaker tape inside the joint.
- .3 Fill the joint with sealant. Tool sealant following application

3.9 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
 - .2 Clean adjacent surfaces immediately.
 - .3 Remove excess and droppings, using recommended cleaners as work progresses.
 - .4 Remove masking tape after initial set of sealant
- .2 Final Cleaning:
 - .1 Upon completion remove surplus materials, rubbish, tools and equipment.
 - .2

3.10 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

END OF SECTION

PART 1 - GENERAL

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|-----|------------------------------------|----|---|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. |
| 1.2 | <u>Reference</u> | .1 | CGSB 37-GP-54M (79) Waterproofing membrane, sheet applied. |
| 1.3 | <u>Quality Assurance</u> | .1 | Membrane: Applied by applicator trained and approved by manufacturer for application of its products. |
| 1.4 | <u>Warranty</u> | .1 | The warranty period stated in the General Conditions is extended from two years to five years stating that the waterproofing work of this Section is guaranteed against leakage and failure of membrane, except where such failures are the result of failure of the structure. |

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|
| 2.1 | <u>Materials</u> | .1 | Membrane: Bituthene 3000 composite rubberized asphalt and polyethene membrane system by Grace Construction Products or equal products by Henry Inc. (Bakor) meeting the requirements of this specification. |
| | | .2 | <u>Primer:</u> Primer B1 rubber based primer by Grace Construction Products |
| | | .3 | <u>Protection Board:</u> Bituthene Protection Board by Grace Construction Products. |
| | | .4 | <u>Protection Board Adhesive:</u> Bitustick 4000 by Grace Construction Products. |
| | | .5 | <u>Drainage Board:</u> Hydroduct 220 by Grace Construction Products. |

PART 3 - EXECUTION

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|-----|---------------------------|----|---|
| 3.1 | <u>Preparation</u> | .1 | Examine surfaces to receive waterproofing for materials detrimental to bonding of waterproofing and check that form ties have been properly cut back and patched. Surface shall be smooth with no projections, indentations, rough edges, clean and dry prior to and during application. Report in writing to Consultant any defects requiring correction by other Sections. Commencement of work shall imply acceptance of conditions. |
| | | .2 | Do not apply to frozen or frost covered surfaces. |
| | | .3 | Prime all surfaces to receive membrane. To avoid excess pick up of air borne dust once priming has been completed, treat only as much area as can be covered with membrane the same working day. If not covered in the same working day, repeat surface preparation. |
| | | .4 | Over all non-working joints or cracks up to a maximum of 5mm, apply a reinforcing strip of membrane, not less than 229mm in width centered over the joint/crack. Install a reinforcing ply of membrane over all outside corners. Using a width of membrane not less than 203mm center over the corner and press into full contact with the substrate. Reinforcing strips shall be installed prior to the field membrane application. |
| | | .5 | At inside corner where foundation wall meets footing trowel apply liquid membrane to a point not less than 100mm up the vertical and 150mm onto |

the horizontal to provide a fillet to receive sheet membrane. Install membrane into still wet liquid membrane and over trowel the bottom edge of membrane with the liquid membrane.

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| 3.2 | <u>Membrane Installation</u> | <p>.1 On horizontal surface, membrane installation should commence at the low point of all slopes and proceed to the high point to ensure drainage over and not against membrane laps.</p> <p>.2 Apply membrane to primed surfaces after removing the first few feet of release paper from the membrane. Continue to pull the release paper from the roll thereby dispensing the membrane onto the wall or deck. Proceed at a rate that allows the opportunity to broom out or otherwise prohibit air from becoming entrapped between membrane and substrate.</p> <p>.3 Continue with subsequent rolls aligning each with the previous along the lap lines provided on the membrane. Maintain a minimum overlap of 64mm. End laps as encountered at roll ends and splices should overlap the previous membrane a minimum of 152mm. Stagger all end laps.</p> <p>.4 Lay membrane carefully to ensure a uniform application and to minimize fish-mouths. Immediately following placement, roll the membrane in its' entirety to ensure continuous adhesion to the substrate.</p> <p>.5 Around penetrations through the plane of the waterproofing, trowel in place a coat of liquid membrane a minimum of 152mm in all directions from the base of the penetration. Follow immediately with a reinforcing ply of membrane minimum of 305mm in all directions from the point of the penetration.</p> <p>.6 At all drain locations follow procedure as described immediately above and complete by sealing between the top layer of membrane and the clamping collar.</p> <p>.7 On vertical and horizontal applications membrane terminations shall receive an edge dressing of Mastic.</p> <p>.8 Inspect membrane thoroughly before placement of protection board and make any corrections or repairs as necessary. Patch tears and any inadequately lapped seams. Cut out fishmouths and patch. Seal perimeter of all repairs.</p> |
| 3.3 | <u>Protection Board</u> | <p>.1 Provide protection board covering for all surfaces having received membrane. Adhere each board using protective board adhesive. Press each board into intimate contact with the waterproofing membrane and slide into position tightly against the previous. Ensure gaps are no larger than 6mm.</p> |
| 3.4 | <u>Drainage Board</u> | <p>.1 Provide drainage board covering for all surfaces having received membrane. Install in strict accordance with manufacturers written instructions</p> |

- 3.5 **Schedule** .1 Provide sheet membrane waterproofing to the following surfaces:
- 1) Perimeter of ALL new elevator shaft walls below grade.
- 3.6 **Clean-Up** .1 Promptly as the work proceeds and on completion, clean up and remove from the premises all rubbish and surplus material.

End of Section

PART 1 - GENERAL

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|-----|--|----|---|----------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Cast-in-place Concrete: | Section 03300. |
| | | .2 | Membrane Waterproofing | Section 07114 |
| 1.3 | <u>Qualifications</u> | .1 | Installer's qualifications: licensed or approved by material manufacturer. | |
| | | .2 | Workmanship standard: execute work in strict accordance with manufacturer's printed directions. | |
| 1.4 | <u>Product Delivery & Storage</u> | .1 | Deliver materials to site in original containers with seals and labels intact. | |
| | | .2 | Store material in dry place, protected from moisture. | |

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|--|
| 2.1 | <u>Materials</u> | .1 | <u>Waterproofing system:</u> | |
| | | .1 | Xypex Concrete Waterproofing by Xypex Chemicals (Canada) Ltd., concentrate modified at minimum 1.35 kg/m ² . | |
| | | .2 | <u>Mortar cove and plug:</u> | |
| | | .1 | Xypex Drypack. | |
| | | .3 | <u>Water:</u> CSA CAN3-A23.1-M77, clean, potable. | |
| 2.2 | <u>Mixing</u> | .1 | Use separate containers for measuring quantities of waterproofing materials and water. | |
| | | .2 | Water temperature shall be minimum 15°C. | |
| | | .3 | Mix only enough material that can be applied before mixture starts to thicken. Stir frequently but do not add more water to restore workability. | |
| | | .4 | Mix materials to proportions recommended by manufacturer. | |

PART 3 - EXECUTION

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|-----|------------------------------------|----|--|--|
| 3.1 | <u>Substrate Conditions</u> | .1 | Surfaces shall be clean and free of oil, grease, paint, loose dust and laitance. | |
| | | .2 | Surfaces and ambient temperature shall be minimum 5°C for a period of 24 hours before the installation, during and after the installation. | |
| | | .3 | Surface of concrete must be "green" for application purposes or thoroughly saturated with clean water. | |

KINGSLAND + Architects Inc.

PART 1 - GENERAL

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|-----|--|----|---|---------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Masonry: | Section 04200 |
| 1.3 | <u>Qualifications</u> | .1 | All air barrier materials shall be applied by an independent company that specializes in the installation of air barriers and currently approved by W.R. Grace & Co. of Canada. Installation by the mason will not be accepted. Provide written evidence of approval from manufacturer prior to commencement of the work. | |
| 1.4 | <u>Guarantee</u> | .1 | Provide the following guarantee in accordance with the General Conditions notwithstanding the time provision therein. | |
| | | .1 | Five (5) years against all air tightness defects. | |
| | | .2 | Ten (10) years manufacturers warranty. | |
| 1.5 | <u>Submittals</u> | .1 | Submit duplicate 200 mm x 300 mm samples of air barrier material to the Consultant for approval prior to ordering materials. | |
| | | .2 | Submit original copy of test data from certified independent testing laboratory confirming performance requirements of air barrier membrane as specified. | |
| 1.6 | <u>Inspection and Testing</u> | .1 | Owner will appoint and pay, out of allowance carried in Division I, for independent inspection agency to inspect work of this Section as directed by the Consultant. | |
| | | .2 | Scaffolding must be provided by this contractor for the use of the Inspection Company, Consultant and School Board. | |
| 1.7 | <u>Description of System</u> | .1 | The air barrier system specified herein is based on Perma Barrier Membrane system by W.R. Grace & Co. The following manufacturers will also be acceptable, subject to the Consultant's detailed review and acceptance: | |
| | | .1 | Soprema Waterproofing Inc.- Sopreseal 1100T | |
| | | .2 | Bakelite Thermosets Ltd. | |
| | | .3 | Henry Co. | |
| 1.8 | <u>Product Delivery & Storage</u> | .1 | Deliver materials in original unopened containers. | |
| | | .2 | Containers are to be labelled with manufacturer's name, brand name, installation instructions and identification of various items. | |
| | | .3 | All materials must be stored between 10°C and 26°C. If exposed to lower temperature, restore materials to 15°C minimum temperature before using. | |

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| 1.8 | Product Delivery & Storage (Cont'd) | .4 | All materials must be stored in a dry area and protected from water and direct sunlight. Replace damaged materials at no extra cost. |
| | | .5 | Store membrane rolls off ground, flat, protected from moisture and well ventilated. |
| | | .6 | Store solvent base liquids away from excessive heat and open flame. |
| 1.9 | <u>Job Conditions</u> | .1 | Prior to the use of any product consult the manufacturer's safety data bulletin for applicable cautions and warnings. |
| | | .2 | Substrates which are to receive air barrier materials shall be sound and dry. |
| | | .3 | Apply materials only within application limitations specified by respective product manufacturers. |
| 1.10 | <u>Protection</u> | .1 | Make good damage to building and to work of Other Contractors and Subcontractors arising from this Section of Work to the satisfaction of the of the Consultant. |
| 1.11 | <u>Compatibility</u> | .1 | Assure that all components are compatible with each other. |

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|
| 2.1 | <u>Materials</u> | .1 | Membrane: Perm-A Barrier Membrane minimum 1.02mm composite sheet, dark grey, supplied in widths to suit reinforcing. Membrane shall incorporate 6mm edge bead of rubberized asphalt on all side laps. |
|-----|-------------------------|----|--|

Properties

<u>Property</u>	<u>Value</u>	<u>Test Method</u>
Colour	Dark Grey	N/A
Pliability 180° bendover 25mm mandril at 32°C.	Unaffected	ASTM D146
Tensile Strength - membrane	1.7 MPa min.	ASTM D412 (Die C) modified
Elongation	300 min.	ASTM D412
Ultimate failure of rubberized asphalt (%)		
Cycling over crack at - 26°C	No effect	
	100 cycles	
Cycling over 25mm joint at	No effect	
	1000 cycles	
Peel adhesion (N/mm width) 28 days wet (submerged aging)	0.822 min.	

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|-----|--|---|---------------------------|-------------------------------|
| 2.1 | Materials
<u>(Cont'd)</u> | Puncture resistance (N)
(stretched by blunt object) | 178 min. | ASTM E154 |
| | | Puncture resistance
polyethylene film (mm N tear)
(compact from sharp object) | 1,746.23 min. | ASTM D781 |
| | | Air Permeance
of "In Place" System
(Pressure difference
of 75 Pa) | less than .01 litre sq.m. | ASTM E283-83 |
| | | Resistance to 2 kPa
Air Pressure Difference | No increase | ASTM E283-83
in equivalent |
| | | Permeance | 0.517 metric perms | ASTM E96 |
| | | Water Absorption
72 hours (% weight) | 0.25 max. | ASTM D1228 |
- .2 **Mastic:** Bituthene EM3000 Mastic - Rubber based mastic.
 - .3 **Liquid Membrane:** Liquid Membrane LM3000 - two component liquid membrane with 100% solids content.
 - .4 **Primer:** Bituthene Primer - P3100 - rubber based solvent used to condition all substrates.
 - .5 **Insulation Attachments**
 - .1 Type "N" sticklip and type "S" adhesive as manufactured by ECKEL Industries Ltd., or an approved alternative.
 - .2 Wedge fasteners type "WEDGE-LOK", as manufactured by BLOK-LOK, or an approved alternative for board insulation.
 - .6 **Flexible Flashings** - Perm-A-Barrier wall flashing, thickness 1mm.

PART 3 - EXECUTION

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|-----|---------------------------|----|---|
| 3.1 | <u>Preparation</u> | .1 | Examine all surfaces to receive air barrier for conformance to recommended surface conditions. |
| | | .2 | Do not proceed with air barrier installation until all defects are repaired. |
| | | .3 | Acceptable surfaces include cast-in-place concrete, masonry gypsum board, and plywood. |
| | | .4 | All surfaces to receive air barrier must be smooth, clean, dry and in good condition. All moisture, grease, machine oil or other foreign material shall be removed. |
| | | .5 | Concrete must be smooth, monolithic, free from voids, spalled areas, loose aggregates or sharp protrusions. |

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|-----|---|-----|---|
| 3.1 | <u>Preparation
(Cont'd)</u> | .6 | Concrete must be cured minimum (7) days and dry before air barrier is applied. Cure concrete with clear resin-based curing compounds containing no oil, wax or pigment. |
| | | .7 | Allow concrete to dry following rain. |
| | | .8 | Repair defects such as spalled or poorly consolidated areas. Remove sharp protrusions and form match lines. |
| | | .9 | If walls are rough use a well adhered parge coat to achieve a smooth finish. |
| | | .10 | Concrete Blocks: |
| | | .1 | Unevenness between blocks shall not exceed 2mm. |
| | | .2 | Holes and openings must be patched. |
| | | .3 | Excess mortar shall be removed. |
| | | .11 | Cast-In-Place Concrete: |
| | | .1 | Reliefs at framework joints shall not exceed 5mm. |
| | | .2 | Concrete lumps shall be removed. |
| | | .3 | Tie holes shall be filled. |
| | | .4 | All surfaces shall be clean, dry, free from oil, etc. |
| 3.2 | <u>Primer
Application</u> | .1 | Apply primer with lambs wool roller 6 to 8 sq. metres per litre and allow 30 minutes for drying to a tacky surface. Prime only the area to be covered in a working day. Areas not covered with membrane in 24 hours must be reprimed. |
| 3.3 | <u>Membrane
Installation</u> | .1 | Apply Perm-A Barrier to primed structured substrates, in accordance with the manufacturer's recommendations. |
| | | .2 | All side laps shall be 64mm minimum and all end laps shall be 150mm. |
| | | .3 | At top and bottom terminations heavy pressure should be applied to membrane with the back of utility knife to assure positive adhesive at the edge. |
| | | .4 | The membrane shall be rolled, firmly and completely immediately after each sheet is applied. An extrusion handled counter top roller shall be used. |
| | | .5 | Apply a trowelled bead of EM3000 Mastic to all terminations of membrane at the end of the day's work. |
| | | .6 | Inspect membrane thoroughly before covering and make any corrections immediately. |
| | | .7 | Misaligned or inadequately lapped seams, punctures or other damage shall be repaired with a patch of Perm-A-Barrier extending 150mm in all directions from the edge of the damaged area. Seal all edges of patch with EM3000 Mastic. |

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| 3.3 | Membrane Installation
<u>(Cont'd)</u> | .8 | Perm-A-Barrier shall be covered immediately to protect the air barrier from other trades. |
| | | .9 | Fit membrane tightly around all penetrations through it and seal using EM 3000 Mastic. |
| | | .10 | At all detail areas take extra care to ensure continuity of the air barrier. |
| | | .11 | Provide flexible flashings around the perimeter of all openings including window and door frames. Mechanically secure flashings to frames. Reinforce all inside and outside corners. |
| | | .12 | All gaps or joints wider than 6mm shall be filled with LM3000 or a foam backer rod and reinforced with a 300mm piece of membrane prior to application of field membrane. |
| | | .13 | Liquid Membrane LM3000 shall be used at all protrusions which do not allow for easy installation of sheet membrane. LM3000 shall be placed over or under Perm-A-Barrier with at least a 64mm overlap required. |
| | | .14 | Provide flexible flashings at the base of the cavity wall, at the head of windows and doors, at horizontal interruptions in exterior walls, and where shown on drawings. |
| | | .15 | In all cases extend flexible flashings 13mm beyond outside face of wall or outside edge of steel lintel. Trim as required to Consultants later instruction. |
| | | .16 | Unless otherwise indicated carry flexible flashing up behind brick masonry units minimum 200mm and adhere to air barrier membrane with adhesive in accordance with manufacturers recommendations. |
| 3.4 | Roof/Wall Junctions
<u></u> | .1 | Coordinate proper construction of roof/wall junction with roofing contractor so as to maintain continuity of air barrier from wall to roof. |
| | | .2 | Ensure compatibility of air barrier with roofing membrane and flashing. |
| 3.5 | Inspection
<u></u> | .1 | Inspect completed air barrier for punctures, tears and discontinuous seams. Apply additional layer of membrane over punctures and tears, extending min. 50 mm (2 in.) beyond damaged area in all directions. |
| 3.6 | Clean-Up
<u></u> | .1 | Promptly as the work proceeds and on completion, clean up and remove from the premises all rubbish and surplus materials. |

End of Section

PART 1 - GENERAL

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|-----|---|----|--|---------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Masonry | Section 04200 |
| | | .2 | Rough Carpentry | Section 06100 |
| | | .3 | Air Barrier | Section 07196 |
| 1.3 | <u>Guarantee</u> | .1 | Provide the following guarantee in accordance with the General Conditions, notwithstanding the time provision therein:

Two (2) years materials and labour.
Twenty (20) years manufacturers warranty | |
| 1.4 | <u>Samples</u> | .1 | Submit two 2 sets of samples of manufacturer's full range of precoated metal finishes, or custom colours as specified. | |
| 1.5 | <u>Design and Performance Criteria</u> | .1 | Appearance: neatly and evenly lay out and install components. Exposed fastening devices not permitted. | |
| | | .2 | Effects of wind: resist positive and negative wind pressures without detrimental effects. | |
| | | .3 | Water control: prevent passage of water. | |
| | | .4 | Thermal movement: Accommodate expansion and contraction of component parts without buckling, failure of joints, undue stress on fasteners and other detrimental effects. | |
| | | .5 | Compatibility: Components shall be compatible with dissimilar metals and materials with which they are in contact or fastened to so as to prevent corrosion, staining and other detrimental effects. If required, treat or separate contact surfaces with inert and non-staining insulation material to achieve compatibility. | |
| 1.6 | <u>Job Conditions</u> | .1 | Schedule and coordinate installation of metal flashing components with work of other Sections where it is integral or contiguous therewith. | |
| | | .2 | Install metal counter and cap flashings immediately after installation and inspection of roofing membrane base flashings. | |

PART 2 - PRODUCTS

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|-----|-------------------------|----|--|
| 2.1 | <u>Materials</u> | .1 | <u>Precoated Sheet Steel</u> |
| | | .1 | Meet requirements of CSSBI Technical Bulletin No. 7, Proven Colour. |
| | | .2 | <u>Base metal:</u> galvanized sheet steel meeting requirements of ASTM A446, Grade A, zinc coating designation Z275, 24 ga. |
| | | .3 | <u>Colour:</u> Stelco or Dofasco 8000 Series: Colour to be selected by Consultant from <u>full</u> range of colours. |

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| 2.1 | Materials
<u>(Cont'd)</u> | .2 | Galvanized Sheet Steel: Hot dip galvanized, cold rolled with stretcher level degree of flatness to ASTM A 526; zinc coating designation Z275. |
| | | .3 | <u>Cleats and Edge Strips</u> : Non-corrosive metal compatible with sheet metal, thickness as required to provide rigid support and positive securement for metal flashings. |
| | | .4 | <u>Mechanical Fastening Devices</u> : Non-corrosive metal compatible with sheet metal. |
| | | .5 | <u>Sealant</u> : One of the following:
.1 Two-part polysulphide to CGSB 19-GP-24M.
.2 One part low modulus silicone to CGSB 19-GP-28M.
.3 Dymeric by Tremco. |
| | | .6 | <u>Asphaltic Paint</u> : Alkali resistant asphalt based enamel: CGSB 1-GP-108M. |
| 2.2 | Fabrication
<u>General</u> | .1 | Shop fabricate metal flashing components to profiles indicated. Where flashings are required but not detailed follow applicable requirements of SMACNA Architectural Manual. Provide minimum 24 ga. material for all components unless otherwise indicated. |
| | | .2 | Provide components free from distortion, waves, twists, buckles and other defects detrimental to performance and appearance. Form sections square, true and accurate to size. |
| | | .3 | Double back exposed edges at least 12 mm. |
| | | .4 | <u>Seams</u> : space seams uniformly at maximum 3 m o.c. Unless otherwise indicated, use flat locked seams, lapped 25 mm. Make horizontal seams in directions of water flow. Mitre and seal corners. Make allowance for expansion. |
| | | .5 | Unless otherwise indicated, counter flashings shall completely cover base flashings. |
| | | .6 | Furnish everything necessary for complete metal flashing installation, including clips and fastening devices. |
| | | .7 | Back paint metal flashings with asphaltic paint. |
| 2.3 | Sleeve Flashing System
<u>System</u> | .1 | Aluminum 1.5 mm thick 3-part flashing system by Thaler Roofing Specialties Products. Conduit flashing – MEF-1A, vandal proof stack flashing SJ -31 |
| | | .2 | Fabricate sleeve flashings square or circular and of size to suit components being flashed. Unless otherwise indicated, fabricate sleeves 450 mm high. |
| | | .3 | System shall consist of bitumen protection cup, sleeve with flange and rain collar. |
| | | .4 | Inside of jacket base flange and all sides of protection cup still be coated with bituminous paint. |
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- .5 Size sleeves to allow minimum 25 mm thick insulation between component and sleeve.

PART 3 - EXECUTION

3.1 Installation

- .1 Provide all metal flashings required to render roof and wall systems watertight, whether specifically shown on Drawings or not.
- .2 Provide under this Section, concealed sheet metal components forming part of air and vapour barrier system, located within building envelope and not provided under work of other Sections. Unless otherwise detailed provide galvanized sheet steel, minimum 0.7 mm thick.
- .3 Clean surfaces to be covered with metal flashings of dirt and other foreign matter. Drive projecting nails flush with substrate. Do not apply metal flashings over substrates likely to cause rupture.
- .4 Provide underlay of resin sized paper under metal flashings installed over masonry, concrete or wood. Lay underlay dry as sheet metal work is installed. Secure in place and lap joints 100 mm.
- .5 Provide sheet metal flashing at roof curbs, copings, penetrations, at junction of roof to wall, and where shown on Drawings.
- .6 Protect all membrane flashings with metal counter flashings.
- .7 Wherever possible, secure flashings to supporting building elements with concealed continuous edge strips; avoid exposed surface fasteners.
- .8 Fill and seal seams with sealant; rivet corners.
- .9 Where flashing is punctured by bolts, provide sheet lead or neoprene washers, 6 mm larger than bolt hole.
- .10 Where flashing is installed around circular components and upper flashing edge is exposed, provide draw band around upper edge of flashing collar.
- .11 At reglets in masonry walls, secure metal flashings to reglet with mechanical fasteners at maximum 610 mm o.c.
- .12 Except where premoulded pipe flashings are provided by Section 07513 install sleeve flashing systems at penetrations through roof membrane. Install systems in accordance with manufacturer's directions. Insulate between penetrating elements and sleeve with 25 mm thick fibrous insulation. Sweat solder or weld on rain collar.
- .13 Imperfections in metal flashing work such as holes, dents, creases, or oil-canning will not be accepted.

End of Section

PART 1 - GENERAL

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|-----|---|----|--|------------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Caulking at frame perimeters: | Section 07900 |
| | | .2 | Finish Hardware: | Section 08710 |
| | | .3 | Glazing: | Section 08 88 00 |
| | | .4 | Painting: | Section 09 21 16 |
| 1.3 | <u>Qualifications</u> | .1 | Acceptable manufacturers: Member of The Canadian Steel Door & Frame Manufacturers' Association. | |
| | | .2 | Reference standards: Unless otherwise specified, meet requirements of "Canadian Manufacturing Specification for Steel Doors and Frames" published by the Canadian Steel Door & Frame Manufacturers' Association. | |
| | | .3 | Fire protection requirements: fire rated doors, frames and screens shall bear ULC labels. | |
| | | .4 | One manufacturer is to provide doors and frames unless specified otherwise. | |
| 1.4 | <u>Guarantee</u> | .1 | Provide the following guarantee in accordance with the General Conditions, not withstanding the time provision therein. | |
| | | .1 | Three years on materials and labour. | |
| 1.5 | <u>Submittals</u> | .1 | Submit shop drawings in accordance with Division 1. | |
| | | .2 | Clearly indicate each type of frame, door, material, core thickness reinforcements, glazing stops, location of anchors, exposed fastenings and finishes. | |
| 1.6 | <u>Work Supplied to Other Trades</u> | .1 | Supply frames and anchors to other Sections where it is necessary to build frames into work of other Sections. | |
| | | .2 | Supply instructions required for accurate positioning and proper installation of components supplied to other Sections. | |
| 1.7 | <u>Design Requirements of Doors & Frames</u> | .1 | Exclusion of water. | |
| | | .2 | Prevent air infiltration in excess of 0.5 cubic feet/minute/linear foot. | |
| | | .3 | U factor of 0.56 or less | |
| | | .4 | S.T.C. 20. | |

PART 2 - PRODUCTS

- 2.1 **Materials**
- .1 Sheet Steel: Cold rolled steel with stretcher level degree of flatness, meeting requirements of ASTM A366 Class 1.

Finish:
 - .1 W25 wipe coated zinc finish to ASTM A526.
 - .2 Hot dipped galvanized zinc to ASTM A526M for all doors and frames where indicated.
 - .2 Core Material:
 - .1 Fire rated doors: in accordance with fire test requirements.
 - .2 Exterior doors: semi-rigid glass fibre insulation minimum density of 24 kg/m².
 - .3 Interior doors, except fire rated doors: honeycomb core of rigid pre-expanded resin impregnated Kraft paper having maximum 20mm hexagonal shaped cells.
 - .3 Finishing Materials:
 - .1 Touch up paint: zinc rich paint CGSB 1-GP-181M.
 - .2 Metal filler: two component epoxy type.
 - .3 Shop primer: zinc or lead chromate type.
 - .4 Door Bumpers: Gray neoprene double stud.
- 2.2 **Reinforcement & Hardware Preparation**
- .1 Templated hardware: prepare work in accordance with templates supplied by Section 08710. ANSI Standards will not necessarily be used. Drill and tap doors for templated hardware. Provide door latch guide.
 - .2 Blank, reinforce, drill and tap doors and frames for concealed, mortised and surface mounted hardware and concealed magnetic contacts. Provide door closer reinforcement at all steel doors and frames whether closer is required by hardware list or not.
 - .3 Hardware reinforcements shall be minimum 3.4mm thick.
 - .4 Guard boxes: 0.9 mm (20 ga.) steel welded to back of frame at hardware cutouts where mortar or other materials could obstruct hardware operation.
 - .5 Provide steel angle high frequency top hinge reinforcing in doors and frames. Weld both legs of angle to adjoining surfaces.

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- 2.3 **Doors**
- .1 Construct fire rated doors in accordance with fire test requirements.
 - .2 Provide all doors of seamless construction with no visible seams or joints on faces and vertical edges. Render joints invisible by grinding, filling and dressing smooth.
 - .3 Exterior doors: 1.6 mm (16 ga.) thick base sheet steel of urethane core construction. Fully weld vertical seams for full height of door and grind smooth. Mechanically interlock face sheets at vertical edges and continuously weld seams extending full height of door. Fill all seams and grind smooth.
 - .4 Interior doors: 1.2 mm (18 ga.) thick base sheet steel of honeycomb core construction. Mechanically interlock, with adhesive, face sheets at vertical edge to form a tight straight joint. Tack weld every 6" for full height of door. Fill all seams with epoxy and grind smooth
 - .5 Provide condensation weep holes at bottom edge of exterior doors.
 - .6 Provide flush end steel closures at top edge of all exterior doors and where required for attachment of hardware, weather stripping and concealed magnetic switches.
 - .7 Prepare doors as required for louvres, glazing and between glass blinds where indicated. Surround openings in flush doors with minimum 1.2mm thick steel edge channels, welded to both face sheets. Where prepared openings in doors exceed 35% of the total door area, face sheets at vertical edges must be continuously welded.
 - .8 Provide 0.9 mm thick removable glazing stops of zinc coated steel channels mitred at corners, accurately fitted into position and fastened with countersunk Phillips, flathead sheet metal screws.
 - .9 Glazing stops at outside of exterior doors shall be rendered non-removable.
 - .10 Doors to be square and true. Maximum twist 3mm measured on the diagonal of the door.
 - .11 Construct rail and stile doors in same manner as flush doors.
 - .12 Undercut doors where shown or required to suit floor finish.
- 2.4 **Frames**
- .1 Provide welded frames of 1.6 mm thick sheet steel to profiles shown on Drawings.
 - .2 Shop assemble components with accurately cut joints. Mitre outside corner joints of frames. Weld joints on inside of profile; grind welds, flush and sand to smooth uniform surface.
 - .3 Glazing stops shall be minimum 0.9 mm thick steel, drilled and secured with oval headed screws.

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| 2.4 | Frames
<u>(Cont'd)</u> | .4 | Drill interior door frames for double stud rubber bumpers. Drill strike jamb of each single frame for 3 bumpers. Drill head member of double door frames for 2 bumpers. |
| | | .5 | Provide full height 3.4 mm thick steel reinforcement at hinge side of all frames. |
| | | .6 | Provide steel channel head reinforcement for door frames wider than 915 mm. |
| | | .7 | Tack weld two removable 1.2 mm thick steel spreader channels to inside faces of door frames at base. |
| | | .8 | Provide adjustable base clips for anchorage to floor at bottom of each door jamb. |
| | | .9 | Provide 0.9 mm guard boxes at all strike and hinge reinforcements. |
| | | .10 | Provide welded on drip at head of exterior door frames. |
| | | .11 | For screens with between the glass blinds, prepare frame to accept tilt control knob assembly. |
| | | .12 | Prepare frames as required to accommodate wiring to electrical hardware devices. |
| | | .13 | Provide removable mullions where indicated. |
| | | .14 | Provide 1.2 mm thick continuous steel closer panels at all exposed backs of head and jamb frame conditions. |
| | | .15 | Prepare frames as required to accommodate supplementary steel supports provided by Section 05500. |
| | | .16 | Provide 1.6 mm thick anchors for frames. |
| 2.5 | Transom
<u>Panels</u> | .1 | Provide insulated metal transom panels at head of doors where shown on drawings. |
| | | .2 | Construct panels in manner specified for hollow metal doors. |
| | | .3 | Secure panels to frame with concealed fastenings. |

PART 3 - EXECUTION

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| 3.1 | Frame &
Screen
<u>Installation</u> | .1 | Set frames plumb, square, level and at correct elevation. |
| | | .2 | Allowable limit of distortion shall be 1.5mm out of plumb at each jamb, measured on face of frame, resulting in maximum twist of frame of 3mm measured from upper corner to lower diagonal corner. |

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| 3.1 | Frame &
Screen
Installation
(Cont'd) | .3 | Generally anchorage of frames shall be by means of standard anchors. Where standard anchors cannot be used, provide special anchors to ensure proper installation. Method of anchorage shall not be visible when frames are installed. |
| | | .4 | Provide minimum 3 anchors at each jamb. At frames exceeding 2150 mm in height provide one additional anchor for each additional 610mm or part thereof. |
| | | .5 | Anchor intermediate vertical frame members to structure above as required to ensure stability. Where required, provide steel frame extensions. Provide flexible connection at structure to allow for deflection. |
| | | .6 | Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 950mm wide. Remove temporary spreaders after frames are built-in. |
| | | .7 | Remove spreader channels only after frames are securely anchored in place. |
| 3.2 | <u>Doors</u> | .1 | Install doors after wet finishes are completed. |
| | | .2 | Doors must be square and true within frame. Maintain approximately 3mm between perimeter outside edge of sides and head of door and inside edge of frame. |
| | | .3 | Exterior doors and fire doors must seal tight against weatherstrip and smoke gaskets. |
| | | .4 | Install transom panels where indicated on drawings. |
| | | .5 | Install hardware in accordance with hardware supplier's instructions. |
| | | .6 | Adjust operable parts to ensure proper operation. |
| 3.3 | <u>Touch-up</u> | .1 | Patch damaged shop primer. Remove rust, sand damaged and abraded surfaces and touch-up with prime paint matching original finish. |
| | | .2 | Touch-up damaged zinc coating with zinc rich paint prior to application of shop primer. |

End of Section

PART 1 - GENERAL

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|-----|--|----|--|---------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Installation of finish hardware | Section 08100 |
| | | . | | |
| 1.3 | <u>Scope of Work</u> | .1 | Supply only of | |
| | | .1 | Finishing Hardware | |
| | | . | | |
| 1.4 | <u>Quality Assurance</u> | .1 | The products listed in the finishing hardware schedule establish the minimum quality standards for this project. Deviations are not permitted. | |
| | | .2 | Companies tendering this project shall retain a qualified Architectural Hardware Consultant (A.H.C.) who will assume responsibility relative to their profession. | |
| | | .3 | Finishing Hardware companies tendering on this project shall BID only those products specified, or for the purpose of tendering products listed here in as equivalents. Alternates will be allowed only as outlined in Section 2.1. | |
| | | .4 | The Architect's Consultant will be provided with a copy of the approved hardware schedule and all approved change notices to complete a quality assurance inspection at completion of the project. It will be the hardware supplier's responsibility to correct any hardware found to be improperly supplied, including installation, painting and reworking of doors and/or frames. | |
| 1.5 | <u>Handling, Delivery and Storage</u> | .1 | Package finishing hardware for each opening, identified shall correspond with hardware schedule. | |
| | | .2 | Copy of finishing hardware schedule shall accompany hardware shipments. | |
| | | .3 | Deliver all hardware to job site and obtain signed receipt. | |
| | | .4 | The general contractor shall provide on site an adequate, enclosed, lockable, clean and dry storage area. Access to locked storage area will be the responsibility of the general contractor. | |
| | | .5 | All hardware shall be checked in jointly by representatives of the general contractor and hardware supplier to avoid discrepancies. | |
| | | .6 | The general contractor shall protect the finish and function of the installed hardware from the other trades (paint, plaster, cleaners, etc.) during the construction period. | |

- 1.6 **Warranty** .1 Submit a written warranty covering finish hardware against defects in materials and workmanship. The warranty period shall be two years generally and five years for closers. Warranty commences on date of Substantial Completion.
- .2 Hardware products found defective within warranty period shall be removed by the general contractor or owner and returned to the distributor for evaluation.
- 1.7 **Submittals** .1 Submit templates when requested to contractor for use by installers and fabricators as required for proper location and installation of hardware.
- .2 Submit 4 (four) copies of the hardware schedule complete with a list and legend of abbreviations used. It is the Suppliers responsibility to thoroughly check the Hardware Schedule and working drawings to ensure, all handlings are correct, product will function as listed and that there are no errors or omissions before submitting for approval.
- .3 Upon request submit physical samples of each type of hardware for the project. Samples which may be required shall be tagged for their intended use and shall be incorporated into the supply of finishing hardware.
- .4 Supply wiring schematics and product information for all electronic hardware supplied under this section.
- 1.8 **Codes and Regulations** .1 All hardware listed or furnished shall meet requirements of Federal, Provincial and Local Codes having jurisdiction over this installation.

PART 2 - PRODUCTS

- 2.1 **Manufacturers** .1 The following is a list of acceptable manufacturers for work under this contract. The listed acceptable alternative manufacturers must provide products which are of equal quality of better than the specified manufacturers products.

	Manufacturer As Specified	Acceptable Alternative Manufacturer
Hinges	Stanley	Hager
Locks	Schlage	No substitution
Exit Devices	Sargent	Von Duprin (Full stainless steel)
Closers	LCN4041 Cush	Sargent 351 PS
Kickplates	Gallery	Hager/CBH
Push/Pulls	Gallery	Hager/CBH
Overhead Stops	Sargent Glynn Johnson	
Weatherstrip	Hager	KN Crowder National Guard

PART 3 - EXECUTION

- 3.1 **Execution**
- .1 The contractor installing the hardware shall carefully follow manufacturer's instructions for installation of all finish hardware.
 - .2 The finish hardware installer shall be experienced in the installation of architectural hardware and have general knowledge of the functions of the various types of hardware.
 - .3 Thru bolts for door pulls are to be counter sunk and concealed by push plates where push plates are listed.
 - .4 Manufacturer's fasteners supplied are to be used. It is the installers responsibility to ensure fasteners are not over tightened or stripped by use of screw guns, etc.
 - .5 Provide finished hardware for all display cases. Refer to Architectural drawings for locations.
- 3.2 **Keying**
- .1 All locks shall be interchangeable core and to be keyed to a factory registered master key system.
 - .2 Furnish the following quantities of keys:
 - 2 Grand master keys
 - 3 Master keys per level
 - 2 Change keys per lock
 - 10 Construction keys
 - .3 All permanent Cores and Keys are to be delivered to the end user.
- 3.3 **Adjusting**
- .1 It is the hardware installer's responsibility to adjust the hardware as per the manufacturer's specifications. Final adjustments to closers shall be made at final completion of products.
- 3.4 **Documentation**
- .1 The finish hardware supplier shall include copies of the as-built finishing hardware schedule, and maintenance manuals to the owner on completion of this project.
- 3.5 **Finishes**
- .1

Standard N.B.H.A. Code	BHMA Base Material & Description Code
32D	630 Stainless Steel, Satin
EN	689 Silver Enamel
CH	Charcoal Grey
- 3.6 **Hardware Schedule**
- .1 Refer to the Finishing Hardware List, dated _____ prepared by Empire Hardware Ltd included within this section.

End of Section

1.0 GENERAL

1.01 SUMMARY OF WORK

- .1 This Section specifies aluminum swing doors, thermally broken aluminum swing doors and accessories.
 - .1 Section does not include framing of door opening.

1.02 RELATED REQUIREMENTS

- .1 Section: 08 44 13 - Glazed Aluminum Curtain Wall: Mock-up.
- .2 Section: 08 80 00 – Glazing: Insulating glass units.

1.03 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 DAF 45 [2003], Designation System For Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA).
AAMA-2603-[2013], Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 1. AAMA-2604-[2013], Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 2. AAMA-2605-[2013], Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA CW-10-[2012], Care and Handling of Architectural Aluminum From Shop to Site.
- .3 ASTM International (ASTM).
 - 1. ASTM B209-[2010], Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM B221-[2013], Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. ASTM C612 – [2014], Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 4. ASTM E283-[2012], Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 5. ASTM E331 - [00], Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
 - 6. ASTM E1105 – [2008], Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
 - 7. ASTM D2240 – [2010], Standard Test Method for Rubber Property—Durometer Hardness.
- .4 Canadian General Standards Board (CGSB).
 - 1. CAN/CGSB-12.8-[97], Insulating Glass Units.
 - 2. CAN/CGSB-12.20-[M89], Structural Design of Glass for Buildings.
 - 3. CAN/CGSB-19.13-[M87], Sealing Compound, One-Component, Elastomeric, Chemical Curing.

- .5 CSA International (CSA)
 - .1 CAN/CSA-S157-[2005], Strength Design in Aluminum.
 - .2 CAN/CSA W59.2-[M1991(R2003)], Welded Aluminum Construction.
- .6 Environmental Choice Program (ECP)
 - .1 CCD-45-[1995], Sealants and Caulking Compounds.

1.04 ADMINISTRATIVE REQUIREMENTS

- .1 Co-ordination: Co-ordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.
- .2 Pre-installation Meeting: Convene pre-installation meeting after Award of Contract and one week prior to commencing work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer's written installation instructions.
 - .1 Comply with Section 01 31 00 - Project Meetings and co-ordinate with other similar pre-installation meetings.
 - .2 Notify attendees 2 weeks prior to meeting and ensure meeting attendees include as minimum:
 - .1 Owner;
 - .2 Consultant;
 - .3 Glazing subcontractor;
 - .4 Manufacturer's Technical Representative.
 - .5 Ensure meeting agenda includes review of methods and procedures related to aluminum door installation including co-ordination with related work.
 - .6 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting.

1.05 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Contract Conditions and Section 01 33 00 - Submittal Procedures.
- .2 Product Data: Submit product data including manufacturer's literature for aluminum, panels, styles, rails, components and accessories, indicating compliance with specified requirements and material characteristics.
 - .1 Submit list on aluminum door manufacturer's letterhead of materials, components and accessories to be incorporated into Work.
 - .2 Include product names, types and series numbers.
 - .3 Include contact information for manufacturer and their representative for this Project.
- .3 Shop Drawings: Submit drawings stamped and signed by Professional Engineer registered or licensed in Province of Ontario, Canada. Include on shop drawings:
 - .1 Indicate materials and profiles and provide full-size, scaled details of components for each type of door. Indicate:
 - .1 Core thicknesses of components.
 - .2 Type and location of exposed finishes.
 - .3 Size of door opening and tolerances.
 - .4 Arrangement of hardware and required clearances.
 - .2 Include catalogue details for each type of door illustrating profiles, dimensions and methods of assembly.
- .5 Test Reports:
 - .1 Submit test reports showing compliance with specified performance characteristics and physical properties including air infiltration, water infiltration and structural

performance.

- .6 Field Reports: Submit manufacturer's field reports within 3 days of manufacturer representatives site visit and inspection.
- .7 Installer Qualifications:
 - .1 Submit letter verifying installer's experience with work similar to work of this Section.

1.06 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: Supply maintenance data for curtain wall for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Record Documentation: In accordance with Section 01 78 00 - Closeout Submittals.
 - .1 List materials used in door work.
 - .2 Warranty: Submit warranty documents specified.

1.08 DELIVERY STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver material in accordance with Section [01 61 00 - Common Product Requirements].
 - .2 Deliver aluminum door materials and components in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- .2 Material Handling: To AAMA CW-10.
- .3 Storage and Handling Requirements: Store materials off ground and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .1 Material storage: To AAMA CW-10.
- .4 Packaging Waste Management:
 - .1 Separate and recycle waste packaging materials.
 - .2 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling.

1.09 WARRANTY

- .1 Project Warranty: Refer to Contract Conditions for project warranty provisions.
- .2 Manufacturer's warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.
- .3 Warranty period: 2 years commencing on Date of Substantial Performance of Work.
 - .1 Insulating glass units: 10 years, on Date of Substantial Performance of Work.

2.0 PRODUCTS

2.01 MANUFACTURERS

- .1 The following specification is based on products by Alumicor Limited,, email: info@Alumicor.com, The following manufacturers, providing products meeting the requirements of this specification are also acceptable:
 - .1 Sherwood Windows Limited.

- .2 Kawneer Limited.

2.02 DESCRIPTION

- .1 Aluminum-framed swing door with glass panel insert suitable for inclusion in curtain wall or storefront system.

2.03 DESIGN CRITERIA

- .1 Design aluminum components to [CAN/CSA S157].
- .2 Air infiltration: [0.3] L/s/m² **([0.63] cfm)** maximum of wall area to [AAMA 501] [ASTM E283] at differential pressure across assembly of [300] Pa **(0.044 psi)**.

2.04 MATERIALS

- .1 Aluminum Door Components:
 - .1 Extruded aluminum: To ASTM B221, 6063 alloy with T6 temper.
 - .2 Sheet aluminum: To [ASTM B209], utility grade for unexposed surfaces, anodizing quality for exposed surfaces.
 - .3 Fasteners, screws and bolts: Cadmium plated stainless steel 400 series to meet curtain wall requirements and as recommended by manufacturer.
 - .5 Insulating glass units for exterior glazed door: In accordance with Section 08 80 50 – Glazing.
 - .7 Aluminum panels: [25.4] mm **(1 inch)** thick shop fabricated panels.
 - .1 Finish to match doors.

2.05 DOOR FABRICATION

- .1 Do aluminum welding to CAN/CSA W59.2.
- .2 Fabricate aluminum assemblies of extruded sections to sizes and profiles indicated.
 - .1 Ensure stiles and rails are tubular extrusions designed for mechanical shear block fastening in combination with SIGMA deep penetration plug welds and fillet welds at all stile/rail connections.
- .3 Door Thickness: 50 mm **(2 inches)**
- .4 Construct doors square, plumb and free from distortion, waves, twists, buckles or other defects detrimental to performance or appearance.
- .5 Fabricate infill panels of aluminum sheet laminated to marine grade plywood.
 - .1 Aluminum sheet minimum thickness 3mm **(0.125 inches)**.
 - .2 Marine grade plywood thickness 19mm **(0.750 inches)**.
- .6 Accurately fit and secure joints and corners.
 - .1 Ensure joints are flush and hairline
- .7 Use only concealed or semi-concealed fasteners
 - .1 Where fasteners cannot be concealed, countersunk screws finished to match adjacent material may be used.
- .8 Install door hardware.
- .9 Locate manufacturer's labels on exterior side of door bottom rail.
- .10 Acceptable standard for all manufacturers: Alumicor Limited, Canadiana SERIES

200B HEAVY DUTY INSTITUTIONAL DOOR PACKAGE

2.06 FINISHES

- .3 Exposed aluminum surfaces: To AA DAF-45-M12C22A31, Architectural Class II, clear anodized [10 µm (0.0004 inches)] minimum thickness.
 - .1 Acceptable material: Class II Anodic Finish.
 - .2 Colour: Clear to match existing

2.07 HARDWARE

- .1 Hardware: Supply and factory-install hardware as follows and as identified in Manufacturer's literature for Institutional Setting with the following exceptions:
- .2 Modify hardware as required to suit Owners function requirements as follows:
 - 1. All doors to have panic devices, closures, or as required to conform to the most stringent function requirements of the door.
 - 2. All Doors are manually opened by Building Operator during facility operation. All Doors and manually closed by Building Operator during facility closures.
 - 3. In emergency, User will push via panic bar to exit facility.
 - 4. Barrier Free operation: User to depress Barrier Free button. Door to be released open.
- .3 Modify or addition of Hardware to suit Owners function requirements to be provided at no additional cost to the contract.
- .4 Door hardware is schematic only and to be modified to suit TDSB intended door functions as identified above and manufacturer's requirements to suit door size.
- .5 Aluminum Door Hardware Schedule : Refer to Finishing Hardware schedule in Section 08710

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2.08 ACCESSORIES

- .1 Gasketing: To CCD-45 EPDM gaskets.
- .2 Setting Blocks: To EPDM] 80 - 90Shore A Durometer hardness.
- .3 Spacers: To EPDM 50 - 60 Shore A Durometer hardness.
- .4 Sealant: To CAN/CGSB-19.13, Class 40, one-component, cold-applied, non-sagging silicone.
 - .1 Acceptable material: Dow Corning 795.
- .5 Sealant Bond Breaker: Open cell foam backer rod sized to suit project requirements.

3.0 EXECUTION

3.01 INSTALLERS

- .1 Use only installers with 2 years minimum experience in work similar to work of this Section.

3.02 EXAMINATION

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

- .1 Visually inspect substrate in presence of Consultant.
- .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.03 INSTALLATION

- .1 Install aluminum swing doors in accordance with manufacturer's written instructions.

3.04 ADJUSTING

- .1 Adjust operable parts for correct function.
- .2 Ensure doors do not bind while opening and closing.

3.04 FIELD QUALITY CONTROL

- .1 Field Inspection: Coordinate field inspection in accordance with Section 01 45 00 - Quality Control.
- .2 Manufacturer's Services:
 - .1 Coordinate manufacturer's services with Section 01 45 00 - Quality Control.
 - .2 Submit to Consultant a written agreement from the manufacturer to perform the manufacturer's services.
 - .3 Schedule manufacturer's review of work procedures at stages listed:
 - 1. Product Application: 1 off site reviews.
 - 2. Fabrication and Handling: 1 reviews at authorized installers fabrication facilities.
 - 3. Installation: 3]site reviews at commencement of Work, 50% completion of Work and Upon completion of Work.
 - .4 Submit manufacturer's written reports to Consultant describing:
 - .1 The scope of work requested.
 - .2 Date, time and location.
 - .3 Procedures performed.
 - .4 Observed or detected non-compliances or inconsistencies with manufacturers' recommended instructions.
 - .5 Limitations or disclaimers regarding the procedures performed.
 - .6 Obtain reports within seven days of review and submit immediately to Consultant.

3.05 CLEANING

- .1 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01 74 00 - Cleaning and Waste Management.
 - .1 Leave work area clean end of each day.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.
- .3 Waste Management:
 - .1 Co-ordinate recycling of waste materials with 01 74 19 - Construction Waste Management and Disposal.
 - .2 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.

- .3 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.06 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by aluminum door installation.

END OF SECTION

PART 1 - GENERAL

- | | | | |
|-----|--|----|---|
| 1.1 | General Requirements | .1 | The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements. |
| 1.2 | <u>Section Includes</u> | .1 | Provision of all labour, materials, equipment and incidental services for the provision of Interior solid core wood doors. |
| 1.3 | <u>Reference Standards</u> | .1 | Meet requirements of CSA Standard 0132.2-M1977 except where specified otherwise and AWMAC premium standards for custom curved doors and wood frames. |
| | | .2 | Fire rated doors shall bear ULC label. |
| 1.4 | <u>Guarantee</u> | .1 | Provide the following guarantee in accordance with the General Conditions, notwithstanding the time provisions therein to remedy any defects in work, due to defects in doors for the following period.

Three years on material and labour |
| | | .2 | Defects covered under guarantee shall include warp exceeding 3 mm. |
| | | .3 | Guarantee shall cover all costs for replacement of defective doors including hanging, fitting and finishing. |
| 1.5 | <u>Submittals</u> | .1 | Submit shop drawings in accordance with the General Conditions. |
| | | .2 | Submit 300 mm x 300 mm sample section of door complete with specified finish. |
| 1.6 | <u>Product Delivery & Storage</u> | .1 | Protect doors from dampness. Arrange for delivery after work causing high humidity has been completed. |
| | | .2 | Store doors in a warm dry location flat on a level bed off the ground and protect from excessive dampness or dryness. |
| | | .3 | Protect doors from scratches, handling marks and other damage. Individually package doors in scuff and water resistant wrappings. |
| | | .4 | Label each door with manufacturer's name, product identification, door size and type. |
| 1.7 | <u>Allowable Tolerances</u> | .1 | Tolerance of plus or minus 1.5 mm on specified height, width and thickness dimension shall be allowed. |
| | | .2 | Regardless of tolerances allowed all four corners of doors shall be square. The length of the diagonal measurement of the face of the door from the upper right hand corner to the lower left hand corner, shall be within 3 mm of the length of the reciprocal diagonal. |

PART 2 - PRODUCTS

- 2.1 **Solid Core Doors**
- .1 Solid core doors shall be 45 mm thick, Bison Core doors by Dormond Industries Ltd., or similar by Cambridge Door Co. Ltd., Premium Doors, Boleo Doors, Superstructure Door Co.
 - .2 Construct fire doors in accordance with fire test requirements.
 - .3 Core: solid particleboard, to CAN3-188.1, Type II Grade E. For fire rated doors, provide core in accordance with fire test requirements.
 - .4 Door facing: Select rift cut maple, book matched, minimum 3 ply door skin.
 - .5 Edge bands: maple 19 mm thick for stiles, two pieces of 19 mm thickness for top and bottom edges. Laminate edge bands to core with urea resin adhesive.
 - .6 Adhesive: urea resin by hot plate process for laminating crossbanding to core.
 - .7 Glazed openings: prepare openings where indicated to receive glazing. Provide hardwood glazing stops 12 x 21 mm, installed as detailed, mitred at corners. Provide glazing stops for fire rated doors, in accordance with fire test requirements.
 - .8 Prepare openings as required for door louvres.
 - .9 All wood doors and frames are to be shop prepared for hardware and shop finished with stain and clear lacquer to consultants approval.
- 2.2 **Installation**
- .1 Prepare doors in accordance with templates supplied by Section 08710.
 - .2 Accurately fit doors into frames to ensure smooth operation without binding. Doors shall have 1.5 mm clearance at head and jambs and 6 mm over finished floor surfaces unless otherwise indicated.
 - .3 Undercut doors where shown on Drawings.
 - .4 Install louvres and stops.
 - .5 Secure transom and side panels by means of concealed fasteners or countersunk screws concealed by means of plugs matching panel.
 - .6 Install door grilles where shown on drawings.
 - .7 Install hardware in accordance with hardware supplier's instructions.
 - .8 Readjust doors and hardware just prior to completion of the building to function freely and properly.

End of Section

Part 1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements

1.2 SECTION INCLUDES

- .1 Provision of labour and materials as necessary to provide aluminum curtainwall systems.

1.3 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA CW-10-15, Care and Handling of Architectural Aluminum From Shop to Site.
 - .2 AAMA CW-11-85, Design Wind Loads and Boundary Layer Wind Tunnel Testing.
 - .3 AAMA TIR-A1-15, Sound Control for Fenestration Products.
 - .4 AAMA 501-15, Methods of Test for Exterior Walls.
 - .5 AAMA 611-14, Voluntary Specifications for Anodized Finishes Architectural Aluminum.
 - .6 AAMA 612-17a, Voluntary Specifications, Performance Requirements, and Test Procedures for Combined Coatings of Anode Oxide and Transparent Organic Coatings on Architectural Aluminum.
 - .7 AAMA 2603-17a, Voluntary Specification Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - .8 AAMA 2604-17a, Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .3 ASTM International (ASTM)
 - .1 ASTM A36/A36M-14, Specification for Carbon Structural Steel.
 - .2 ASTM A123/A123M-17, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

- .3 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .4 ASTM B209-14, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .5 ASTM B221-14, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .6 ASTM E283-04(2012), Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .7 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .8 ASTM E331-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform Static Air Pressure Difference.
- .9 ASTM E413-16, Classification for Rating Sound Insulation.
- .10 ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
- .5 CSA Group (CSA)
 - .1 CSA G40.20-13/G40.21-13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA S136/S136.1-16, North American Specification for the Design of Cold Formed Steel Structural Members.
 - .3 CAN/CSA-S157/S157.1-17, Strength Design in Aluminum/Commentary on CAN/CSA-S157, Strength Design in Aluminum.
 - .4 CSA W59.2-18, Welded Aluminum Construction.
- .6 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #79, Primer, Alkyd, Anti-Corrosive for Metal.
- .7 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .8 Society for Protective Coatings (SSPC)
 - .1 SSPC - Paint 20-02(R2004), Zinc Rich Primers Inorganic and Organic.
 - .2

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting one (1) week prior to beginning the work of this Section, with Consultant and TDSB Project Supervisor to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordinate with other building subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for curtain wall components, anchorage and fasteners, glass and infill, and internal drainage details and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two (2) copies of WHMIS MSDS to the Consultant and TDSB Project Supervisor.
- .2 Test Reports:
 - .1 Submit substantiating engineering data, test results of previous tests by an independent laboratory which purport to meet performance criteria, and supportive data. Reports shall be less than five (5) years old.
 - .2 All test reports are to be based on AAMA 501 indicating conformance to design and performance requirements, performed by an AAMA qualified North American independent testing laboratory within the past five (5) years. The report must include at minimum:
 - .1 Pre-load: Load the test assembly to 0.5 times the specified design wind pressure and inspect the assembly for detrimental effects.
 - .2 Static Pressure Air Infiltration: To ASTM E283-04(2012) Standard Test Method for Rate of Air Leakage.
 - .3 Static Pressure Water Infiltration: To ASTM E331-00(2016) Standard Test Method for Water Penetration by Uniform Static Air Pressure Difference.
 - .4 Dynamic Pressure Water Infiltration: To AAMA 501.1-17, Standard Test Method for Water penetration of Windows, Curtain Walls, and Doors Using Dynamic Pressure.
 - .5 Structural Loads: To ASTM E330/E330M-14 Structural Performance by Uniform Static Air Pressure Difference, to 75% and 100% of design load. Record deflection at 75% load. Hold pressure for sixty (60) seconds.
 - .6 Repeat Static Pressure Air Infiltration.

- .7 Repeat Static Pressure Water Infiltration.
 - .8 Condensation Resistance / Thermal Cycling: five (5) cycles, one (1) held for condensation resistance test.
 - .9 Supporting Structure Displacement: The anticipated design displacement or deflection will be simulated for the supporting condition of the mockup. Three (3) cycles of movement.
 - .10 Structural Proof Loads: To ASTM E330/E330M-14, Structural performance by Uniform Static Air Pressure Difference, to 150% of design loads. Record permanent set. Hold pressure for ten (10) seconds.
- .3 Structural Sealant Data:
- .1 Submit product information on the sealants to be used, complete with all recommendations and installation instructions, including cleaning and priming procedures.
 - .2 Submit to sealant manufacturer, samples of each type of glass, gasket, glazing accessory and glass framing member that will contact or affect glazing sealants for compatibility and adhesion testing. Submit test samples in sufficient time for testing and analysis of results to prevent delay in progress of work.
 - .3 Submit sealant manufacturer's test reports on adhesion to metal and glass production samples tested in accordance with ASTM C794, 7 day cure and 7 day water submersion, tensile strength at 100% elongation and bite size of sealants.
 - .4 Submit test report for tensile adhesion properties of structural silicone sealants in accordance with test method procedures conforming to ASTM C1135.
 - .5 Submit sealant manufacturer's compatibility statement that all materials in contact with the sealants are compatible with the sealants in accordance with procedures of ASTM C1087.
 - .6 Submit sealant manufacturer's statement and test data indicating that the stress on the sealants when exposed to the maximum load does not exceed 138 kPa (20 psi) and a safety factor of 5:1.
 - .7 Submit sealant manufacturer's verification that sealants are suitable for purposes intended.
 - .8 Provide Quality control test in accordance with ASTM C1401, Standard Guide for Structural Sealants Glazing
 - .9 Submit test result in accordance with ASTM C1294, Compatibility for Insulation Glass Edge Sealants with Liquid-Applied Glazing Materials
- .4 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer licensed in the province of Ontario, Canada.
 - .2 Indicate materials and details in full size scale for head, jamb and sill, profiles of components, junction between combination units, interior and exterior trim, elevations of unit, location of isolation coating, description of related

components and exposed finishes, fasteners, and caulking. Indicate location of manufacturer's nameplates.

- .3 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.
- .4 Fastening of wood bucks to building structure to be included in curtain wall shop drawings or to be submitted as a separate engineered shop drawing confirming that the wood bucks can support the curtain wall lateral loads.
- .5 Indicate locations, dimensions, openings and requirements of related work.
- .6 Do not order materials or start fabrication until shop drawings have been reviewed.
- .5 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .1 Submit one (1) complete full-size window sample of each window type.
 - .1 Include frame, sash, sill, glazing and weatherproofing method, insect screens, surface finish and hardware. Show location of manufacturer's nameplates.
 - .2 Include 150 mm (6") long samples of head, jamb, sill and intermediate mullion to indicate profile.
 - .3 Submit one 305mm (12") long sample of each muntin profile proposed for the project complete with manufacturer's product sheet and adhesive tape product sheet

1.6 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data for glazed aluminum curtain wall for incorporation into manual.
- .2 As-Built drawings: Submit "As-Built" drawings to Consultant at the completion of work. As-Built drawings are to legibly record all actual construction which deviates from the project drawings; using red-lines on black-line prints of the project drawings.
- .3 Warranty Documentation: submit warranty documents specified.

1.7 QUALITY ASSURANCE

- .1 Work of this section is to be done by Manufacturers of recognized standing, having personnel with minimum five (5) years experience in successful manufacture and installation of work specified herein, and who have the necessary equipment to carry out the work.
- .2 Fabrication of curtain wall to be done by the curtain wall manufacturer.

- .3 Installation shall be by the curtain wall manufacturer or their approved installer using only mechanics skilled in this trade and in sealant trade as applicable.
- .4 Certifications: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements
- .5 Mock-ups:
 - .1 Provide site mock-up for work of this Section indicating methods and materials, and procedures proposed to achieve final results and to comply with following requirements, using materials indicated for completed work:
 - .1 Build mock-ups in location and of size as directed by Consultant.
 - .2 Build a separate mock-up for each curtain wall type/configuration in the project.
 - .3 Mock-up to include review of:
 - .1 Rough Opening preparation.
 - .2 Curtain wall frame installation.
 - .1 Curtain wall anchors
 - .2 Vision glass lite
 - .3 Spandrel panel
 - .4 Corner Mullion
 - .5 Column cover
 - .6 Expansion joint
 - .3 Air/Vapour barrier installation.
 - .4 Glazing and Sealant installation.
 - .5 Louver Installation.
 - .6 Pre-finished insulating metal panel installation.
 - .4 To properly review all of the items listed in 1.6.5.3, the mock up will need to be reviewed by the Consultant at multiple stages during the installation. The Contractor is to allow 24 hours for review of mock-up by the Consultant before proceeding with the work, The Contractor is to provide the Consultant with 48 hours notice for mock-up review.
 - .5 Obtain Consultant's acceptance of mock-ups before starting construction; mock-up will be used throughout the construction period as standard of acceptance for subsequent work.
 - .2 Mock-up may form part of permanent structure when accepted by the Consultant. The Contractor is to repair or replace unacceptable mock-ups at no additional cost to Owner.
- .6 Inspection and Testing:
 - .1 Windows are to be tested in accordance with Section 01 45 24 – Glazing Testing

- .2 A minimum of two (2) curtain wall sections of each curtain wall type are to be tested.
 - .1 Approved curtain wall mock-up for each curtain wall type/configuration and;
 - .2 One (1) curtain wall section for every 20 curtain wall sections of each type as directed by the Consultant.
- .3 The fixed and operable portions of a curtain wall system are to be tested separately for air leakage.
- .4 In the event of a failed air leakage and water penetration test, the Contractor shall complete the necessary remedial work and retest the curtain wall until the system passes. This shall be done at no cost to the Owner.
 - .1 Once the failed curtain wall test section has passed the air leakage and water penetration test, the remedial work performed on the failed curtain wall is to be completed on all of the remaining curtain wall of that type.
- .7 Once a curtain wall section has failed its initial test, an additional curtain wall section shall be chosen by the Consultant to be tested once the remedial work has been carried out on all of the curtain wall sections.
- .8 The mock-up is to be considered complete once it has passed the on site air leakage and water penetration testing

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Handle work of this Section in accordance with AAMA CW-10.
 - .2 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .3 Store and protect aluminum glazed curtain wall components from nicks, scratches, and blemishes.
 - .4 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
 - .5 Replace defective or damaged materials with new.

1.9 WARRANTY

- .1 Manufacturer's warranty: Submit, for Consultant acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty in addition to and not limit other rights Owner may have under Contract Documents.

- .2 The Contractor is to warrant work of this Section against defects and deficiencies for a period of five (5) years from the date the Work is certified as substantially performed in accordance with the General Conditions of the Contract and as amended by the Supplementary General Conditions.
- .3 The Contractor is to promptly correct deficiencies which become apparent within the warranty period without cost to the Owner. Defects shall include, but not limited to, leaking, deformation of members, loss of seal in sealed glass units, breakage of glass caused by frame distortions and thermal forces, mechanical failure and discolouration of finishes.

Part 2 Products

2.1 SYSTEMS

- .1 Description:
 - .1 Vertical glazed aluminum curtain wall system includes thermally broken tubular aluminum sections with self supporting framing, shop fabricated, factory prefinished, vision glass, insulated metal panel spandrel infill, and louvers; related flashings, anchorage and attachment devices.
 - .2 Assembled system to permit re-glazing of individual glass (and infill panel) units from exterior without requiring removal of structural mullion sections.
- .2 Performance Requirements:
 - .1 Design and size components to withstand dead and live loads caused by pressure and suction of wind, acting normal to plane of system as calculated in accordance with applicable codes.
 - .2 Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable codes.
 - .3 Design curtain wall framing and connections to substrate, where the bottom of the curtain wall extends to a point below 1070mm (3'-6") 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. Compliance with guard and handrail requirements is to be indicated on the sealed shop drawings.
 - .4 Limit horizontal and vertical mullion deflection to less than L/175 and 19mm maximum for heights under 4115mm and L/240 and 25mm maximum for heights over 4115mm. Prevent deflection and permanent or progressive glazing displacement and allow for full recovery of glazing materials.
 - .5 For vertical and horizontal glazing members, the reduction of glass bite shall not exceed 3mm (1/8") at mid-span of any glass lite due to member deflection. Deflection limits to be such that the integrity of the glass and air seals are maintained at design loading. Permanent deformation of members due to applied loads are not permitted.

- .6 Size glass units and glass dimensions to limits established in CAN/CGSB-12.20.
- .7 Ensure system is designed to accommodate the following without damage to components or deterioration of seals:
 - .1 Movement within system.
 - .2 Movement between system and perimeter framing components.
 - .3 Dynamic loading and release of loads.
 - .4 Deflection of structural support framing.
 - .5 Shortening of building concrete structural columns.
 - .6 Creep of concrete structural members.
 - .7 Mid-span slab edge deflection of 6mm (1/4").
- .8 Maximum U values of curtain wall assemblies (including frame, edge, centre of glass and spandrel effects) conditions shall be based on winter design night-time air temperatures and shall be as follows:
 - .1 Typical curtain wall vision area shall have a maximum U value of $1.44\text{W/m}^2 \text{ hr K}$
 - .2 Typical curtain wall spandrel area shall have a maximum U value of $1.0\text{W/m}^2 \text{ hr K}$
- .9 Acoustic:
 - .1 Sound transmission class (STC) of curtain wall system (exterior to interior) shall not be less than 35, when tested in accordance with ASTM E90.
 - .2 Sound transmission class (STC) of party walls and floor including the fire stopping and smoke seals system at the slab edges and at the demising walls shall not be less than 45 when tested in accordance with ASTM E336.
- .10 Limit air infiltration through assembly to 0.3 L/s m^2 of wall area, measured at a reference differential pressure across assembly of 300 Pa as measured in accordance with ASTM E283.
- .11 Vapour seal with interior atmospheric pressure of 25 mm sp, 22 degrees C, 40% RH: no failure.
- .12 Static water penetration: none, when tested in accordance with ASTM E331 under a static pressure difference of 700 Pa for a period of fifteen (15) minutes.
- .13 Dynamic water penetration: none when tested in accordance with AAMA 501 under a dynamic pressure difference of 700 Pa for a period of fifteen (15) minutes.
- .14 Static Structural performance test in accordance with ASTM E330. Design load for testing shall be taken as the greater of applicable wind design loads and PSOS requirements.
- .15 Condensation resistance/thermal cycling test consisting of at least five (5) cycles ranging from -18°C to 60°C exterior and 21°C interior. One (1) cycle shall be maintained at the design winter exterior temperature for a period sufficient to

allow temperatures within the test assembly to stabilize. Maintain air pressure differential of 15Pa between the top and bottom surfaces in the cold drainage chamber so to create air flow through the chamber. Thermocouples are to be placed on interior and exterior surfaces to record surface temperatures. As a minimum, interior thermocouples are to be placed on coldest expected surfaces as determined by computer simulations. Exterior thermocouples are to be placed in exterior chambers. At interior design conditions (69.8°F (21°C), 45% RH) minimize condensation on room side surfaces. Testing to be performed in accordance with AAMA 501.

- .16 Ensure system allows for expansion and contraction within system components when temperature range is 95 degrees C over 12 hour period without causing detrimental affect to system components.
- .17 Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.
- .18 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
 - .1 Position thermal insulation on exterior surface of air barrier and vapour retarder.
- .19 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system occur.
- .20 Reinforce curtain wall system to accommodate window washing guide rails.
 - .1 Supply sufficiently rigid anchors to resist loads caused by equipment platform, without damage to wall system.

2.2 MATERIALS

- .1 Extruded aluminum: to ASTM B221/B221M, AS6063-T6, alloy and temper for framing, and otherwise where not exposed to suit specified and fabricator's requirements. Exposed surfaces of aluminum to be free of die marks, scratches, blisters, "leave-off" marks, or other blemishes, whether left unfinished or finished.
- .2 Sheet aluminum: to ASTM B209, AA1100-H14 or AA3003-H14 alloy.
- .3 Sheet steel: to ASTM A653/A653M; zinc coated (galvanized) sheet steel with metallic designation Z275 (G90), minimum 1.0 mm thickness.
 - .1 For back pans up to 2.3 m² : minimum 100 mm deep, top hat section, glazing adapter section, bird beak section or box section, with corners sealed with one component butyl sealant.
 - .2 Over size back pans: for back pans greater than 2.3 m² , custom fabricated with integrated stiffener system
- .4 Steel sections: to CSA G40.20/G40.21; shaped to suit mullion sections.
- .5 Anchors: 3-way adjustable hot-dip galvanized steel.

- .6 Fasteners:
 - .1 300 series stainless steel to meet window requirements and as recommended by the manufacturer.
 - .2 Use only concealed fasteners.
 - .3 Where fasteners cannot be concealed, countersunk screws finished to match adjacent material may be used upon receipt of written approval from Consultant.
- .7 Isolation Coating:
 - .1 Bituminous paint in accordance with CAN/CGSB 1.108, Type 1, without thinner.
 - .2 Isolate aluminum from following components, by means of isolation coating:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood
- .8 Exterior Metal Sills:
 - .1 Extruded aluminum of type and size to suit job conditions; minimum 2mm thick complete with joint covers, jamb drip deflectors, chairs, anchors and anchoring devices.
- .9 Flashings and Trims:
 - .1 3.2mm pre-finished factory formed aluminum to match curtain wall mullion sections where exposed. Flashings and trims to be mechanically fastened and thermally separated from the interior tubular curtain wall section
- .10 Glazing:
 - .1 Refer to Section 08 80 00 for glazing and accessories.
- .11 Louvers:
 - .1 Refer to Section 08 90 00 – Louvers.
 - .2 Louvers to be supplied with a glazing adapter.
- .12 Operable Sash:
 - .1 Refer to Section 08 51 13 – Aluminum Windows and Vents.
 - .2 Operable Sash to be supplied with a glazing adapter.
 - .3 Operable Sash frame to match Curtain Wall framing.
- .13 Fire Safety Materials:
 - .1 Refer to Section 07 84 00 - Fire Stopping.
- .14 Sealant:
 - .1 Refer to Section 07 92 00 – Sealants.

- .15 Semi-Rigid Insulation:
 - .1 To ASTM C612
 - .2 Type: 1VB
 - .3 Density: 64 kg/m³ (4 lbs/ft³)
 - .4 Thickness: 100mm (4") minimum.
 - .5 Acceptable material: CurtainRock by Roxul Inc. or equal.
- .16 Self Adhesive Modified Bitumen Sheet Membrane Vapour Retarder
 - .1 Self-adhering membrane of rubberized-asphalt integrally bonded to high density, cross-laminated polyethylene film.
 - .2 Acceptable products:
 - .1 Blueskin SA by Henry Company
- .17 Air Barrier Membrane:
 - .1 Gaps equal to or less than 13mm (1/2"): for tie-ins to adjacent construction, minimum 1mm (40mil) self adhering modified bituminous sheet with manufacturer recommended primers, sealants and mastics.
 - .1 Acceptable products:
 - .1 Air and vapour barrier 3015 by 3M
 - .2 Blueskin SA by Henry Company
 - .2 Gaps greater than 13mm (1/2") and where indicated on the drawings: Pre-engineered aluminum extrusion adapter, silicone rubber extrusion sheet runs and corners, sealant tape secondary seal, and sealant.
 - .1 Acceptable products:
 - .1 Tremco Proglaze ETA (Engineered Transition Assembly)
 - .2 DOWSIL Silicone Transition Strip by DOW Chemical Company
- .18 Foam Insulation Sealant:
 - .1 All voids between perimeter aluminum window frames and window rough opening to be filled with liquid foam insulation - Single Component, moisture cure, low expansion rate spray-in-place polyurethane liquid foam insulation to ULC-S710.1
 - .2 Acceptable Products: CF-I XTW Extreme-Weather Insulating Foam by Hilti or equal

2.3 COMPONENTS

- .1 Stick-built curtain wall:
 - .1 218mm (8.58") Thermally broken, captured, vertically stick-built, triple glazed aluminum curtain wall system of tubular aluminum sections with self supported framing:
 - .1 Structural mullion depth: 168mm

- .2 Curtain Wall Cap depth: 50mm
- .3 Acceptable products:
 - .1 Alumicor Limited: ThermaWall TW2600 Series
 - .2 Oldcastle Building Envelope: 6500 Series Arctic Curtain Wall System
 - .3 Kawneer Company Inc.: 1600 UT Curtain Wall System.
 - .4 Windspec Inc.: 5500 HTP Curtain Wall System.
 - .5 Alwind Industries Ltd.: CDS 2500 Series Curtain Wall (complete with polyamide pressure plates).

2.4 FABRICATION

- .1 Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof
- .3 Prepare components to receive anchor devices. Install anchors.
- .4 Arrange fasteners and attachments to ensure concealment from view.
- .5 Prepare system components to receive exterior doors, specified in Section 08 11 16 – Aluminum Doors and Frames
- .6 Reinforce framing members for external imposed loads.
- .7 Visible manufacturer's identification labels not permitted.
- .8 Infill Panels:
 - .1 Fabricate infill panels with metal covered edge seals around perimeter of panel assembly, enabling installation and minor movement of perimeter seal.
 - .2 Reinforce interior surface of exterior panel sheet from deflection caused by wind and suction loads.
 - .3 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
 - .4 Place insulation within panel, adhered to exterior face of interior panel sheet over entire area of sheet with impale fasteners.
 - .5 Ventilate and pressure equalize the air space outside the exterior surface of the insulation, to the exterior.
 - .6 Arrange fasteners and attachments to ensure concealment from view.

2.5 ALUMINUM FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with Aluminum Association Designation System for Aluminum Finishes.

- .1 Anodized (Colour):
 - 1. Type: Architectural Class I Colour Anodizing
 - 2. AAMA Specification: Comply with AAMA 611
 - 3. Aluminum Association Designation: AA-M10-C21-A44
 - 4. Colour: Match existing

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum curtain wall installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of the Consultant.
 - .2 Verify dimensions, tolerances, and method of attachment with other work.
 - .3 Verify wall openings and adjoining air barrier and vapour retarder materials are ready to receive work of this Section.
 - .4 Inform the Consultant of unacceptable conditions immediately upon discovery.
 - .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.

3.2 INSTALLATION

- .1 Install curtain wall system in accordance with the manufacturer's instructions.
- .2 Do Aluminum welding to CAN/CSA W59.2
- .3 Attach curtain wall assemblies to structure plumb and level, free from warp, and allow for sufficient adjustment to accommodate construction tolerances and other irregularities.
 - .1 Maintain dimensional tolerances and align with adjacent work.
 - .2 Use alignment attachments and shims to permanently fasten elements to building structure.
 - .3 Clean welded surfaces and apply protective primer to field welds and adjacent surfaces.
- .4 Use thermal isolation where components penetrate or disrupt building insulation.
- .5 Install sill flashings:
 - .1 Support extruded sills throughout their lengths.
 - .2 Mitre and weld corner sections of metal sills, install drip deflectors and joint covers. Locate joint covers at centres of mullions or columns.

- .6 Co-ordinate installation of fire stop insulation and smoke seal, specified in Section 07 84 00- Fire Stopping, at each floor slab edge and intersection with vertical construction where indicated.
- .7 Co-ordinate attachment and seal of perimeter air barrier and vapour retarder materials.
- .8 Install engineered transition assembly in accordance with manufacturer's instructions and recommendations.
- .9 Fill voids between frames and rough openings, and in mullions with foam insulation in accordance with manufacturer's instructions to maintain continuity of thermal barrier.
- .10 Install operating sash in accordance with Section 08 80 00 – Glass and Glazing.
 - .1 Exterior Dry Method of glazing.
- .11 Install louvres, associated flashings, blank-off plates and screening. Fit blank-off plates tight to ductwork.
 - .1 Exterior Dry Method of glazing.
- .12 Install glass and infill panels in accordance with Section 08 80 00 – Glass and Glazing.
 - .1 Exterior Dry Method of glazing.
- .13 Sealant: in accordance with Section 07 92 00 – Sealant.
 - .1 Seal metal to metal joints between components to provide a weathertight assembly, and in accordance with sealant manufacturer's instructions.
 - .2 Seal between frame members, sills and adjacent construction.

3.3 SITE TOLERANCES

- .1 Curtain wall framing to be installed within the following erection tolerances:
 - .1 Vertical position: plus/minus 3mm (1/8")
 - .2 Horizontal position: plus/minus 3mm (1/8")
 - .3 Racking on face: maximum 6mm (1/4")
 - .4 Racking on elevation: nil
 - .5 Deviation from true plumb over full height of building: 6mm (1/4") maximum.
 - .6 Deviation from true straightness in plane over full length of each building face: 6mm (1/4") maximum.
- .2 Tolerances of relationship of individual components to be as follows:
 - .1 Member to member: 0.2mm (8 mils) maximum.
 - .2 Out of plane between faces of two halves of split mullions, 0.8mm (32 mils) maximum.
 - .3 Joint width, mullion snap-on cap to mullion snap-on cap: 1.5mm (1/16") maximum. Each joint to be uniform width.
 - .4 Joint width between base and sill panels: 3mm (1/8") maximum, and of uniform width. Do not apply sealants to joints between panels.

- .5 Sealant space between curtain wall and adjacent construction: 13mm (1/2") maximum.
- .6 Tolerances are non-cumulative.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Submit to Consultant a written agreement from the manufacturer to perform the manufacturer's services.
 - .2 Ensure manufacturer's representative of curtain wall is present before and during critical periods of installation.
 - .3 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 [Twice] during progress of Work at [25%] and [60%] complete.
 - .3 Upon completion of Work, after cleaning is carried out.
 - .4 Submit manufacturer's written reports to Consultant describing:
 - .1 The scope of work requested.
 - .2 Date, time and location.
 - .3 Procedures performed.
 - .4 Observed or detected non-compliance or inconsistencies with manufacturer's recommended instructions.
 - .5 Limitations or disclaimers regarding the procedures performed.
 - .6 Obtain reports within five (5) business days of review and submit immediately to Consultant.

3.5 ADJUSTING

- .1 Adjust operating sash for smooth operation, with proper tension, throughout their full range of motion and to fit tightly when closed and locked.

3.6 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
 - .2 Remove protective material from prefinished aluminum surfaces.
 - .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
 - .4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

- .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by glazed aluminum curtain wall installation.

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide glass and glazing for:
 - .1 Interior doors and screens,
 - .2 Exterior doors, and screens,
 - .3 Exterior windows,
 - .4 Exterior curtain wall systems,
 - .5 Unframed mirror glazing.
- .2 Section includes but is not limited to the provision of:
 - .1 Glass
 - .2 Specialty glazing products
 - .3 Glazing sealants, gaskets, tapes, and backing materials
 - .4 Miscellaneous glazing materials necessary to complete the work of this section

1.3 ALTERNATE PRICE

- .1 Submit an Alternative Price to delete sprinkler protection, and substitute Fire Rated Glazing assembly, where indicated on the drawings.

1.4 REFERENCE STANDARDS

- .1 ANSI/ASTM E330; Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- .2 ASTM C509; Standard Specification for Elastomeric Cellular Gasket and Sealing Material.
- .3 ASTM C542; Specification for Lock-Strip Gaskets.
- .4 ASTM C864; Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- .5 ASTM C920; Specification for Elastomeric Joint Sealants.
- .6 ASTM C1115; Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
- .7 ASTM D790; Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- .8 ASTM D2240; Test Method for Rubber Property - Durometer Hardness.
- .9 ASTM E84; Test Method for Surface Burning Characteristics of Building Materials.
- .10 ASTM F1233; Test Method for Security Glazing Materials and Systems.
- .11 CAN/CGSB-12.1; Tempered or Laminated Safety Glass.
- .12 CAN/CGSB-12.3; Flat, Clear Float Glass.
- .13 CAN/CGSB-12.5; Mirrors, Silvered.

- .14 CAN/CGSB-12.8; Insulating Glass Units.
- .15 CAN/CGSB-12.9; Spandrel Glass.
- .16 CAN/CGSB-12.11; Wired Safety Glass.
- .17 CAN/CGSB-12.20; Structural Design of Glass for Buildings.
- .18 Flat Glass Manufacturers Association (FGMA) Glazing Manual.
- .19 Laminators Safety Glass Association Standards Manual.

1.5 PERFORMANCE REQUIREMENT

- .1 Provide continuity of building enclosure vapour and air barrier using glass and glazing material as follows:
 - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
 - .2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure measured in accordance with the Ontario Building Code and CAN/CGSB-12.20.
 - .3 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
 - .4 Provide thermal stress analysis for all single glazed lites and all sealed glass units. Make recommendations for additional heat treatment, thickness change, or other required modifications prior to ordering of materials or manufacture of sealed glass units.

1.6 SAMPLES

- .1 Submit 300mm x 300mm samples of all tinted, coated, and surface treated glass in accordance with Section 01 30 00.

1.7 QUALITY ASSURANCE

.1 Manufacturer/Fabricator

- .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 Installation/Application

- 1 Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 Documentation

- .1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

.4 Pre-application Meeting

- .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated

environment for 24 hours after application.

- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 MAINTENANCE DATA

- .1 Provide maintenance data including cleaning instructions for incorporation into Operations and Maintenance manual.

1.10 EXTENDED WARRANTY

- .1 Provide sealed glass unit manufacturer's warranty certificate stating that the factory sealed insulating glass units specified under this section are guaranteed against failure of seal of enclosed air space and deposits on inner faces of glass detrimental to vision, for a period of ten (10) years from the Date of Substantial Performance.

2.0 PRODUCTS

2.1 FLAT GLASS

.1 Safety Glass

- .1 **Tempered (TG):** to CAN/CGSB-12.1, tong-free, roller marks free, with visible after installation factory-applied permanent impression in one corner identifying each pane as tempered. Glass must have smooth ground edges where used in Draft Stop applications. Thickness as indicated in schedules and on drawings.

- .2 **Laminated (LG):** to UL 972, constructed of 2 layers of heat-strengthened glass, with 1.5mm Saflex® PVB interlayer, CPSC Category II.

- .2 **Low Emissivity (Low-E) Glass:** minimum 6mm thick, PPG "Solarban 70 Clear" by PPG Industries Inc.

- .1 Coating: soft-sputtered.
- .2 Visible Light Transmittance: 64%.
- .3 Shading co-efficient: 0.44.
- .4 Visible Light Reflectance: 11%.
- .5 Tempered Low-E Glass; to CAN/CGSB-12.1, 6mm thick, tong free, roller marks free, with visible after installation factory-applied permanent impression in one corner identifying each pane as tempered. Low-E coating one face.

- .3 **Spandrel Glass:** to CAN/CGSB-12.9, PPG Starfire Glass with Opacicoat coating on Surface #4, custom colours as selected by Consultant, minimum 6mm thick.

- .1 Type: 1 – Tempered safety glass.
- .2 Class: A - Float
- .3 Style: 3 - Organic coated.
- .4 Form: M - Monolithic.

- .4 **Fire Resistive Glass (FRG):** laminated fire-resistive glass with surface-applied film; **FireLite PLUS**, as manufactured by Nippon Electric Glass Company, Ltd., distributed by Technical Glass Products, Kirkland WA, or **PYRAN PLATINUM L** manufactured by Schott AG, and distributed by Glassopolis (Toronto).

- .1 Properties:

- .1 Thickness: 8mm overall.
 - .2 Weight: 2.4 lbs./sq. ft.
 - .3 Approximate Visible Transmission: 88 percent.
 - .4 Approximate Visible Reflection: 9 percent.
 - .5 Fire-rating: 20 minutes to 3 hours for doors; 20 minutes to 90 minutes for other applications.
 - .6 Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
 - .7 STC Rating: Approximately 35 dB.
 - .8 Surface Finish: Premium (polished).
 - .9 Positive Pressure Test: UL 10C, UBC 7-2 and 7-4; passes.
 - .10 Labelling: Permanently label each piece of FR glass with the FR glass logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the appropriate label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).
 - .11 Fire Rating: Fire rating listed and labelled by ULC for fire rating scheduled at opening locations on drawings, when tested in accordance with ULC Standards CAN4 S-104 and CAN4 S-106.
- .5 **Mirror Glass (MR-1 & MR-2):**
- .1 Unframed Mirrors: (1/4") 6mm thick, tempered safety glass, back finished with one coat silver, one coat copper, and two coats backing paint. Provide continuous trim on all perimeter edges of mirror installation (butt joints between mirror sheets, with edges ground and polished). Mirrors to be adhesive mounted to wall. Refer to drawings for sizes.
 - .1 Edge Trim:
 - .1 Schluter®-SCHIENE-AE, by Schluter Systems (Canada) Inc.
- .6 **Sealed Insulating Glass Units (IGU):**
- .1 **Double Glazed Units (IGU-2)**
To CAN2-12.8 and composed of two lites of minimum 6 mm thick glass separated by a 13mm wide "warm edge" spacer, double sealed and atmospheric pressure equalized to prevent bowing of the glass lites in the vertical position. All units shall be Argon Gas filled.
Edges of glass shall be straight cut, free of nicks and other imperfections conducive to breakage. 25mm overall thickness for double glazed units.
 - .1 **U-Value: 0.24,**
 - .2 **SHGC: 0.27.**
 - .1 **Vision Units (IGU-2):** Double-glazed, double sealed insulating glass units, clear tempered safety glass inner and outer lites, with specified low emissivity coating on No. 3 surface.
 - .2 **Spandrel Glass Units (SP-1):** Double-glazed, double-sealed insulating glass units, with tempered spandrel glass inner lite - coating on Surface #4 (Spandrel Colour 1), and specified low emissivity coating on Surface No. 3. Tempered clear safety glass outer lite.
 - .3 **Light Diffusing Units (LD-1)**
 - .1 Oakalux type 37/40 light diffusing unit, 24 mm thick composed of two lites of 6 mm tempered glass (TG) separated by 13mm air filled cavity with Okalux 12 mm capillary slab and fibre tissue.

The inner core constructed of acrylic fiber for STC class rating minimum 38db. Minimum Light diffusing Power (LDP) of 0.80

- .1 Direct VLT minimum : 33%
- .3 Diffuse VLT minimum : 27%
- .4 **SHGC : 0.33**
- .5 Shading Coefficient ratio minimum: TSET/0.86
- .6 **U-Value: 0.44**

.7 Glazing Films

- .1 Film Coatings for glass, 75 micron thick film, self-adhesive, as supplied by Convenience Group Inc., Toronto ON; 3M Fasara, white semi-transparent film. Custom hexagonal pattern as detailed on the drawings.

.8 Float Glass (GL)

- .1 Clear float glass to CAN2-12.3 Glazing Quality. Unless otherwise indicated provide 6 mm thick glass for panes up to 2.25 m², 6 mm thick glass for panes up to 4 m² and 8 mm thick glass for panes in excess of 4 m².

2.2 GLAZING MATERIALS

.1 Setting Blocks:

EPDM or Neoprene, 80 – 90 (Shore A) durometer hardness to ASTM D2240, to suit glazing method, glass weight, and area.

.2 Spacer Shims:

EPDM or Neoprene, 50 – 60 (Shore A) durometer hardness to ASTM D2240, 75mm long x one half height of glazing stop x thickness to suit application. Self adhesive on one face.

.3 Glazing Tapes:

- .1 Compression: 100% solids, preformed macro-polyisobutylene/butyl rubber with integral synthetic rubber spacing rod; coiled on release paper; size as required for frame stop heights; POLYSHIM II, by Tremco.
- .2 Non-compression: 100% solids, preformed butyl rubber to ASTM C1281, 66 (Shore 00) durometer hardness to ASTM D2240; coiled on release paper; size as required for frame stop heights; Tremco 440 tape.
- .3 Fire Rated Glass Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent.

.4 Glazing Gaskets:

- .1 Dense Gaskets for Compression Glazing
 - .1 Extruded from ozone-resistant compound, resistant to sunlight, weathering, oxidation and permanent deformation under load. Gasket Configuration shall provide for mechanical engagement with the metal. Gaskets shall meet either ASTM C-864 Option II, or ASTM C-1115 Type C (for silicone compounds).
 - .1 Dense Neoprene extrusions: Tremco Incorporated, 50, 60 and 70 durometer hardness.
 - .2 Dense EPDM extrusions: Tremco Incorporated, 40, 50, 60 and 70 durometer hardness.

- .3 Dense SCR-900 extrusions: Tremco Incorporated, 60 and 70 durometer hardness.
- .4 Dense Silicone extrusions: Tremco Incorporated, 40, 60 and 70 durometer hardness.
- .2 Cellular Gaskets for Compression Glazing:
 - .1 Extruded from ozone-resistant compound, resistant to sunlight, weathering, oxidation and permanent deformation under load. Gasket configuration shall provide for mechanical engagement with the metal. Gaskets shall meet ASTM C-509 Option II.
 - .1 Cellular extrusions: Tremco Incorporated, Closed Cell Neoprene extrusions.
 - .2 Cellular extrusions: Tremco Incorporated, Closed Cell EPDM extrusions.
- .5 **Glazing Sealants:**
 - .1 Cap Beads:
 - .1 Commercial Glazing: single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part neutral cure silicone; equivalent to Spectrem 2, by Tremco.
 - .2 Heel and Toe Beads
 - 1 Commercial Glazing: single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part medium modulus silicone sealant; equivalent to Tremsil 600, by Tremco.
 - .3 Perimeter Seals
 - .1 Single or multi-component, elastomeric sealant to ASTM C920;
 - .1 One part neutral cure silicone; equivalent to Spectrem 2, by Tremco.
 - .2 One part low modulus neutral cure silicone; equivalent to Spectrem 3, by Tremco.
 - .4 Metal Expansion Seals
 - .1 Single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part, neutral curing, silicone sealant; equivalent to Spectrem 2, by Tremco.
 - .5 Metal to Metal Joinery Seals
 - .1 Single or multi-component, non-acid curing silicone sealant to ASTM C920;
 - .1 One part medium modulus silicone sealant; equivalent to Tremsil 600, by Tremco.
 - .6 Concealed Splice Sleeve Conditions
 - .1 Single component, non-drying, non-skinning synthetic rubber sealant;
 - .1 One part synthetic rubber; equivalent to Tremco Curtain Wall Sealant, by Tremco.

- .7 Fire Rated Glass Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Acceptable Products:
 - .1 Dow Corning 795 - Dow Corning Corp.
 - .2 Silglaze-II 2800 - General Electric Co.
 - .3 Spectrem 2 - Tremco Inc.

2.3 GLAZING ACCESSORIES

- .1 **Glazing Clips:** manufacturer's standard type.
- .2 **Mirror Attachment:** mirror adhesive.

2.4 SEALED GLASS UNIT FABRICATION

- .1 Fabricate sealed glass units through the Insulating Glass Manufacturers Association of Canada Certification Program to CAN/CGSB 12.8. Sealed units shall bear IGMAC Certified Products List number and be properly identified.

3.0 EXECUTION

3.1 EXAMINATION

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 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 recommended for use by the sealant manufacturer, and wipe dry thoroughly.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.3 EXTERIOR GLAZING

- .1 Aluminum Frames - Tape / Gaskets
 - .1 Cut glazing tape to length and set against permanent stops, level with sight line. Seal corners by butting tape and dabbing with sealant.
 - .2 Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.
 - .3 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.
 - .4 Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.
 - .5 Install removable stops with gaskets inserted between glazing and applied stops.

3.4 INTERIOR GLAZING

.1 Wet Method - Sealant / Sealant

- .1 Install glazing resting on setting blocks. Install applied stop and centre light by use of spacer shims at 600mm centres, 6mm below sight line.
- .2 Locate and secure glazing light using spring wire clips or glazers' clips.
- .3 Fill gaps between glazing and stops with glazing sealant until flush with sight line. Tool surface to straight line.

.2 Steel Frames - Tape / Sealant

- .1 Cut glazing tape to length and set against permanent stops, 3mm below sight line. Seal corners by butting tape and dabbing with sealant.
- .2 Place setting blocks at 1/4 points, with edge block maximum 150mm from corners.
- .3 Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of light or glass unit.
- .4 Install removable stops with spacer strips inserted between glazing and applied stops below sight line. Place glazing tape on glazing light or unit with tape 6mm below sight line.
- .5 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 6mm below sight line.
- .6 Apply cap bead of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

.3 Glazing Film Installation

- .1 Clean glass to receive film, thoroughly and let dry.
- .2 Install plastic film in accordance with film manufacturer's instructions.
- .3 Remove all air bubbles, creases or visible distortion.
- .4 Fit tight to glass perimeter. Do not leave clear gaps.
- .5 Provide glazing film to interior mirrors, screens and windows where indicated on the drawings. Final extent and design by the Consultant.

3.5 MIRROR INSTALLATION

- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions. Install Schluter trim at perimeter edges of mirror installation.
- .2 Place plumb and level, in locations indicated on the drawings.

3.6 CLEANING & PROTECTION

- .1 During installation, remove all corrosive or foreign materials or droppings resulting from work of this trade.
- .2 Perform initial cleaning operation of all glass and mirrors upon completion of installation. Do not remove labels or protective films until time of final cleaning.

- .3 After initial cleaning, mark large lites with an "X" by using removable plastic tape. Do not use masking tape. Do not mark heat absorbing or reflective glass units.
- .4 Provide instructions for the proper method and materials to be used in the cleaning and maintenance of finished surfaces. Remove all remaining labels and protective films at time of final cleaning.

3.7 GLAZING TYPES SCHEDULE

- .1 Refer to the Drawings for the locations and extent of all glazing types.
Provide the following glass types:
 - .1 **IGU-2:** Double glazed Insulating Glass Unit; Tempered
Clear Glass outer lite and Tempered Low-E Glass (3) inner lite.
All exterior glazing
 - .2 **LD1:** Double glazed light diffusing unit, tempered clear glass outer and inner
lites separated by 13mm air filled cavity with 12 mm capillary slab and fibre
tissue.
Exterior glazing where noted on drawings
 - .3 **IGU-3: Reserved**
 - .4 **SP1:** Insulating Glass Spandrel Units, with tempered spandrel glass inner lite -
coating on Surface #4 (Spandrel Colour 1), and specified low emissivity
coating on Surface No. 3. Tempered clear safety glass outer lite.
Exterior glazing where noted on drawings. Refer to Colour Schedule for
colour
 - .5 **TG:** Clear tempered safety glass. thickness as shown on the documents.
 - .1 Interior doors and screens:
 - .2 Display case glass shelves and doors.
 - .6 **FRG:** Fire Rated safety glass.
 - .1 Interior Fire Rated Doors and Screens where indicated on the
documents.
 - .7 **LG:** Laminated Glass (Interior Screens); 2 layers - 8mm heat strengthened
glass with 1.52mm Vanceva PVB interlayer.
 - .1 Interlayer Colour: Vanceva Clear.
 - .8 **MR1 & MR2:** Mirror glass:
thickness as indicated on the drawings.
 - .9 **GL:** 6 mm thick glass for panes up to 2.25 m2, 6 mm thick glass for panes up
to 4 m2 and 8 mm thick glass for panes in excess of 4 m2.

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide acoustic panel ceiling systems including the following:
 - .1 Non-load bearing steel stud systems
 - .2 Steel ceiling & soffit suspension systems
 - .3 Gypsum board
 - .4 Sheathing Board
 - .5 Taping & Jointing
 - .6 Accessories

1.3 REFERENCES

- .1 ASTM C473; Test Methods for Physical Testing of Gypsum Panel Products.
- .2 ASTM C475; Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C630/C630M; Specification for Water-Resistant Gypsum Backing Board.
- .4 ASTM C645; Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- .5 ASTM C840; Specification for Application and Finishing of Gypsum Board.
- .6 ASTM C954; Specification for Steel Drill Screws for the Application of Gypsum Board.
- .7 ASTM C1002; Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
- .8 ASTM C1047; Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .9 ASTM C1178; Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .10 ASTM C1395/C1395M; Specification for Gypsum Ceiling Board.
- .11 ASTM C1396/C1396M; Specification for Gypsum Board.
- .12 ASTM D3273; Test Method for Resistance to Mold Growth on the Surface of Interior Coatings in an Environmental Chamber.
- .13 ASTM-E90; Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- .14 ASTM-E119; Test Methods for Fire Tests of Building Construction and Materials.
- .15 CAN/CGSB-51.34; Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .16 CAN/CGSB-71.25; Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

- .17 CAN/ULC-S102; Building Materials and Assemblies, Standard Method of Test for Surface Burning Characteristics
- .18 CAN/ULC-S114; Determination of Non-combustibility of Building Materials.
- .19 CAN/CSA-S136; Cold Formed Steel Structural Members.

1.4 QUALITY ASSURANCE

.1 MANUFACTURER/FABRICATOR

- .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 INSTALLATION/APPLICATION

- 1. Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 DOCUMENTATION

- 1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

.4 PRE-APPLICATION MEETING

- .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.5 SUBMITTALS

- .1 Samples: Submit samples in accordance with Section 01 30 00.

- .2 Submit duplicate (4" x 4") 102mm x 102mm samples of each type of gypsum board panels in specified finishes.

1.6. SYSTEM REQUIREMENTS

- .1 Performance Requirements: Fabricate and install systems as indicated but not less than that required to comply with ASTM C754 under the following conditions:
 - .1 Standard systems: Maximum deflection of $l/240$ of partition height.
 - .2 Systems to receive water resistant gypsum board or backer board: Maximum deflection of $l/360$ of partition height.
 - .3 Interior suspended ceilings: Maximum deflection of $l/360$ of distance between supports.
 - .4 Exterior soffits and interior vestibule ceilings: Withstand minimum positive and negative pressure of 0.95kPa with maximum deflection of $l/360$ of distance between supports.
- .2 Partition Walls
 - .1 Partitions exceeding 9m in height are considered tall walls. Use double structural studs back-to-back 610mm on center. Attach studs back to back with screws approximately 1220mm on center. Alternately, use engineered steel stud assemblies. Refer to Section 05 41 00.
 - .2 All stud assemblies requiring wind load resistance design shall be Engineered Steel Stud assemblies as specified in Section 05 41 00.
 - .3 Fire Resistance Ratings: Where fire resistance classifications are indicated, provide materials and application procedures identical to those listed by UL/ULC or tested according to ASTM-E119 for type of construction shown.
 - .4 Acoustical Ratings: Where sound ratings are indicated, provide materials and application procedures identical to those tested by manufacturer to achieve Sound Transmission Class (STC) scheduled or indicated in accordance with ASTM-E90.

1.7. DELIVERY, STORAGE & HANDLING

- .1 Deliver material to site promptly without undue exposure to weather.
- .2 Deliver in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade.
- .3 Store above ground in dry, ventilated space.
- .4 Protect materials from soiling, rusting, or damage.

- .5 Store board to be directly applied to masonry walls at 21°C for 24 hours prior to installation.

1.8. ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature minimum 10°C, maximum 21°C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost-free surfaces.

1.9. SEQUENCING

- .1 Co-ordinate installation of ceiling suspension systems with work of mechanical and electrical trades. Allow for completion of major items of work by mechanical and electrical trades prior to installation of ceiling grid systems.

2.0 PRODUCTS

2.1 STEEL MATERIALS

- 1 Sheet Steel: Cold-rolled, commercial grade structural quality sheet steel, to ASTMA924/a924M; Zinc-Coated (Hot Dip Galvanized) to ASTM A653/A653M; coating designation Z275.

2.2 PARTITION FRAMING

- .1 Partition Stud Framing: to ASTM C645, stud sizes as indicated, roll-formed from 0.53mm thick, hot-dip galvanized sheet steel. Knock-out service holes at 460mm centres.
- .2 Partition Floor & Ceiling Tracks: to ASTM C645, 0.91mm thickness hot-dip galvanized sheet steel, widths to suit stud sizes, 32mm flange height for standard applications; 50mm flange height for deflection applications.
- .3 Stiffener Channels: 38mm or 64mm width, 1.3mm thick hot-dip galvanized sheet steel, cold rolled channels.

2.3 FURRING SYSTEMS

- .1 Metal furring runners, hangers, tie wires, inserts, anchors: to ASTM C645.
- .2 Drywall Furring Channels: 0.53mm core thickness hot-dip galvanized, steel channels for screw attachment of gypsum board.
- .3 Sound Isolation Clips: RISC-1 Sound Isolation Clips, by PAC International Inc.

2.4 FLAT CEILING SUSPENSION SYSTEM

- .1 Suspension System: tested in accordance with ASTM C635, roll formed from hot dip galvanized, sheet steel; USG Drywall Suspension System by CGC Inc., or an approved alternative, and as follows:
 - .1 Main Tees: 38mm x 38mm, single web construction.
 - .2 Wall-to-Wall Main Tees: 38mm x 38mm, single web construction.
 - .3 Cross Tees: 38mm x 38mm, single web construction.
 - .4 Cross Channels: 73x22mm, with 37mm face width.
 - .5 Wall Channels: 40x25mm, "C" channel.
 - .6 Wall Molds: 38 x 25mm "L" profile.
 - .7 Splice and Transition clips: purpose-made, roll formed from hot-dip galvanized steel sheet by USG, or an approved alternative.

- .8 Suspension wire: 2.75mm galvanized wire.

2.5 BOARD MATERIAL

- .1 Standard Board: to ASTM C36, regular 16mm thick, 1220mm wide x maximum practical length, ends square cut, edges tapered.
 - .1 AirRenew Essential Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Gypsum Board, by CGC Inc.
 - .3 Gold Bond Gypsum Board, by National Gypsum.
 - .4 ToughRock®, by G-P Gypsum (Georgia-Pacific)
- .2 Fire Rated Board (Type C): to ASTM C36, (5/8") 16mm thick, (48") 1220mm wide x maximum practical length, ends square cut, edges tapered.
 - .1 AirRenew Essential Type C Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Firecode Type C, by CGC Inc.
 - .3 Gold Bond Fire-Shield C Gypsum Board, by National Gypsum.
 - .4 ToughRock™ Fireguard C Gypsum Board, by Georgia Pacific.
- .3 Fire Rated Board (Type X): to ASTM C36, Type X to ASTM E119, (5/8") 16mm thick, (48") 1220mm wide x maximum practical length, ends square cut, edges tapered.
 - .1 AirRenew Essential Type X Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock® Firecode Type X, by CGC Inc.
 - .3 Gold Bond Fire-Shield Gypsum Board, by National Gypsum.
 - .4 ToughRock™ Fireguard Gypsum Board, by Georgia Pacific.
- .4 Moisture Resistant Gypsum Board: to ASTM C36, with water resistant facing, Type X to ASTM E119, 16mm thick, 1220mm wide x maximum practical length;
 - .1 M2Tech® Moisture and Mold Resistant Type X Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock Mold-Tough Panels, by CGC Inc.
 - .3 Gold Bond XP Gypsum Board, by National Gypsum.
 - .4 ToughRock® Mold-Guard, by G-P Gypsum (Georgia-Pacific)
- .5 Abuse Resistant Gypsum Board: to ASTM C36, with water resistant facing, Type X to ASTM E119, 16mm thick, 1220mm wide x maximum practical length;
 - .1 M2Tech® Extreme Impact Type X HPD Gypsum Board, by CertainTeed Gypsum Canada Inc.
 - .2 Sheetrock Glass-Mat Mold-Tough VHI Fire code X Panels, by CGC Inc.
- .6 Interior Ceiling Panels: to ASTM C1395, Type X to ASTM E119, 16mm thick, 1220mm wide x 2440mm long;
 - .1 Sheetrock® Interior Ceiling Board, by CGC Inc.
 - .2 Easi-Lite Lightweight Interior Ceiling Board, by CertainTeed Gypsum Canada Inc.
 - .3 Gold Bond Interior High-Strength LITE, by National Gypsum.
 - .4 ToughRock™ Span 24, by G-P Gypsum (Georgia-Pacific)
- .7 Tile Backer Board: to ASTM C1178, standard Type X to ASTM E119, 16mm thick, 1220mm wide x 2440mm long;
 - .1 DensShield® Tile Backer, by G-P Gypsum (Georgia-Pacific).

- .2 Diamondback Tile Backer Type X, by CertainTeed Gypsum Canada Inc.
- .3 Gold Bond e²XP® Tile Backer, by National Gypsum.
- .8 Glass Mat Exterior Sheathing Board: to ASTM C931, C1177, and C1278; standard 16mm thick, 1220mm wide x maximum practical length;
 - .1 DensGlass Gold Exterior Guard, by G-P Gypsum (Georgia-Pacific).
 - .2 Securock® Glass-Mat Sheathing, by CGC Inc.
 - .3 GlasRoc™ Sheathing by CertainTeed Gypsum Canada Inc.
 - .4 Gold Bond e²XP® Extended Exposure Gypsum Sheathing, by National Gypsum.

2.6 ACCESSORIES

- .1 Hanger Wire: 4.8mm galvanized pencil rod.
- .2 Screws
 - .1 For interior board: #6 or #8 bugle head, to ASTM C954, hardened and phosphate plated, drywall screws. Use self-drilling type for heavier thickness framing material.
 - .2 For exterior sheathing board: self-tapping, corrosion-resistant, screws and plates, Deklite by DeckFast, or equivalent.
- .3 Laminating Compound: as recommended by gypsum board manufacturer for laminating multiple layers of gypsum board, or for laminating gypsum board to masonry or concrete.
- .4 Corner Beads: 0.53mm thick, commercial grade, hot-dip galvanized sheet steel, to ASTM C645, perforated flanges, one piece length per location, refer to drawings for details and locations;
 - .1 "D-100" series, by Bailey Metal Products.
- .5 Drywall Trims: 6063-T5 extruded aluminum trims and moldings, factory primed finish for site painting, one-piece length per location, by Fry Reglets. Refer to drawings for details and locations;
 - .1 Reveal Molding: Drywall Reveal Molding, non-vented, "DRM 50-50" Series (13mm wide x board thickness).
 - .2 Reveal Molding: Acoustic Ceiling Reveal Molding WDM 50-50.
 - .3 Reveal Molding: Ceiling Reveal Molding DRWT 50-50.
 - .4 F Reveal Molding: F Reveal Molding 13mm x 16mm.
 - .5 Control Joint: DRM 50-50 2PC, and DRM 50-50 3PC.
 - .6 Z Reveal Molding: DRMZ 50-50.
- .6 Polyethylene: to CAN/CGSB-51.34.
- .7 Acoustical Sealant: to Section 07 92 00.
- .8 Firestop and Smoke Sealants: to Section 07 84 00.
- .9 Insulating Strip: rubberized, moisture-resistant, 3mm thick, closed cell neoprene strip, 12mm wide, with self sticking permanent adhesive on one face; lengths as required.
- .10 Joint Tape: Paper tape, nominal 50mm wide.

- .11 Joint Compounds: to ASTM C475, dry powder for mixing with water, or ready-mix compounds;
 - .1 Standard Interior Use Joint Compound
 - .1 DensArmor™ Sandable Joint Compound, by Georgia-Pacific.
 - .2 ProFin Taping and Joint Compound, by CertainTeed Gypsum Canada Inc.
 - .3 Sheetrock Setting-Type Joint Compound, by CGC Canada Inc.
- .12 Water: potable

3.0 EXECUTION

3.1 GENERAL

- .1 Perform work in accordance with ASTM C840 except where specified otherwise.

3.2 PARTITION CONSTRUCTION

- .1 Align top and bottom partition tracks at floor and ceiling and secure at 610mm o.c. maximum.
- .2 Secure partitions under acoustic ceiling grids with partition clips at 1220mm o.c. maximum and additionally at ends of return walls, and above each door jamb.
- .3 Install polyethylene dampproof course under stud shoe tracks of partitions on slabs on grade.
- .4 Place studs vertically at 406mm or 610mm o.c. as scheduled, and not more than 50mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .5 Erect metal studding to tolerance of 1:1200.
- .6 Attach studs to bottom and ceiling track using screws.
- .7 Coordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .8 Coordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end,

in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.

- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .12 Install steel studs or furring channels between studs as required for attaching electrical and other boxes.
- .13 Extend framing above suspended ceilings for fire and sound separations and to form plenum areas as indicated.
- .14 Extend partitions to underside of floor/roof deck above except where noted otherwise on drawings. Provide cross-bracing above ceilings, where recommended by manufacturer.
- .15 Where partitions are fire, smoke, or sound separations, and occur parallel to, and under structural members, offset and continue partitions to underside of floor/roof deck above to maintain continuity of partition.
- .16 Maintain clearance under beams, joists, and structural slabs to avoid transmission of structural loads to studs. Use 50mm leg ceiling tracks or double track slip joint as indicated.
- .17 Install continuous insulating strips to isolate studs from uninsulated surfaces, or dissimilar metals.
- .18 Install two continuous beads of acoustical sealant or insulating strip under studs and tracks around perimeter of sound control partitions.

3.3 FURRING INSTALLATION

- .1 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .2 Furr for gypsum board faced vertical bulkheads within or at termination of ceilings.
- .3 Install wall furring for gypsum board wall finishes where indicated.
- .4 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .5 Furr, beams, columns, pipes and exposed services where indicated.
- .6 Install sound isolation clips and channels to assemblies indicated where scheduled on the drawings.

3.4 CEILING SYSTEM INSTALLATION

- .1 Erect metal framing to tolerance of 1:1200.
- .2 Install perimeter wall molds or channels level and straight, above elevation equal to thickness of board ceiling finish.
- .3 Install main channels/tees in parallel rows 1220mm o.c., supported on hanger wire at maximum 1220mm o.c. Align cross channel slots from one main runner to the next. End splices must be fully interlocked.
- .4 Install cross channels perpendicular to hanger channels at 405mm o.c. for moisture resistant board, soffit panels, and cement board; 610mm o.c. for all other installations. Screw fasten ends of furring channels to wall angles.
- .5 Provide wind support posts at 1220mm o.c. each way at exterior soffit applications.
- .6 Install additional cross channels within 200mm of parallel running walls where wall moulds or angles are not present.
- .7 Install cross channels parallel to, and at exact locations of steel stud partition header track.
- .8 Install standard cross tees at long edges of all rectangular light fixtures.
- .9 Frame openings and around built-in equipment, cabinets, access panels, on four sides with cross tees. Extend framing into reveals. Check clearances with equipment suppliers.
- .10 Ceiling suspension system shall not be used as primary support for mechanical/electrical equipment, other than those items penetrating the ceiling membrane or, to be installed on the underside of the ceiling. Other equipment must have its own support system.
- .11 Fire Rated System
 - .1 Install additional cross channels 200mm each side of ceiling board butt joints for full length of joint.
 - .2 Install additional cross channels 200mm from long edges of light fixture openings for additional board support.
 - .3 Install additional wire hangers at all corners of light fixtures and at centre points of supporting cross tees.
 - .4 Install ceiling edge fascias where indicated on the drawings.

.5 Construct ceiling suspension systems to the following minimum fire rated designs:

- .1 Up to 1 1/2 hours: UL Design G-528.
- .2 Up to 2 hours: ULC Design I-517.
- .3 Up to 3 hours: UL Design G-529.

3.5 BOARD APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
- .2 Apply single layer gypsum board to wood or metal furring or framing using screw
- .3 Apply double layer gypsum board to wood or metal furring or framing using screw fasteners for first layer, and laminating adhesive for second layer. Maximum spacing of screws 305mm o.c.
- .4 Apply single layer gypsum board to concrete or concrete block surfaces, where indicated, using laminating adhesive.
- .5 Apply moisture resistant gypsum board to walls and ceilings in Pool, Change Rooms, Washrooms, Janitor's rooms, and garbage rooms. Apply silicone sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.
- .6 Apply cement board panels to all exterior soffit surfaces and interior surfaces where noted and scheduled.
- .7 Apply tile backer board to all wall surfaces to receive ceramic tile finish. Apply using screw fasteners, at 305mm o.c maximum spacing.
- .8 Apply 13mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustical sealant.
- .9 Apply glass mat gypsum sheathing board in single layer, to exterior side of load bearing steel studs, using pan-head screw fasteners. Maximum spacing of screws 305mm o.c.
- .10 Install abuse resistant gypsum board on all interior wall locations to height of 2400 above finished floor and where noted or detailed. Install regular gypsum board from 2400 height to U/S of structure.

3.6 INSTALLATION OF ACCESSORIES

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly

secured. Mitre and fit corners accurately, free from rough edges. Secure with screws at 152mm o.c., or using contact adhesive for full length.

- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .3 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .4 Construct control joints of back-to-back casing beads, set in gypsum board facing and supported independently on both sides of joint.
- .5 Provide continuous polyethylene dust barrier behind and across control joints.
- .6 Locate control joints at changes in substrate construction, at approximately 10000mm spacing on long corridor runs, at approximately 15200mm on ceilings.
- .7 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous dust barrier.
- .8 Install access doors to electrical and mechanical equipment where specified in Section 08 31 13 and by Mechanical and Electrical subtrades. Rigidly secure frames to furring or framing systems.
- .9 Install continuous aluminum soffit vents as indicated on the drawings. Install vent strip straight and true to line.

3.7 TAPING AND JOINTING

- .1 Provide levels of gypsum board finish for locations as follows, in accordance with Gypsum Association GA 214, Recommended Specification: Levels of Gypsum Board Finish.
 - .1 Level 1: Ceiling plenum and concealed areas, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.
 - .2 Level 2: Gypsum board substrate at tile, except remove tool marks and ridges.
 - .3 Level 3: Gypsum substrate under textured or applied coatings such as plaster.
 - .4 Level 4: Gypsum board surfaces to receive paint finish.
- .2 Interior Gypsum Board
 - .1 Pre-fill

-
- .1 Use setting-type joint compound. Mix joint compound according to manufacturer's directions.
 - .2 Fill joints between boards flush to top of eased or beveled edge.
 - .3 Fill joints of gypsum board above suspended ceilings in fire-rated partitions.
 - .4 Wipe off excess compound and allow compound to harden.
 - .2 Taping (Level 1)
 - .1 Butter taping compound into inside corners and joints.
 - .2 Center tape over joints and press down into fresh compound.
 - .3 Remove excess compound.
 - .4 Tape joints of gypsum board above suspended ceilings.
 - .3 First coat (Level 2)
 - .1 Use taping or all-purpose drying-type compound.
 - .2 Immediately after bedding tape, apply skim coat of compound and allow to dry completely in accordance with manufacturer's instructions.
 - .3 Apply first coat of compound over flanges of trim and accessories, and over exposed fastener heads and finish level with board surface.
 - .4 Second coat (Level 3)
 - .1 After first coat treatment is dried, apply second coat of compound over tape and trim, feathering compound 2 inches beyond edge of first coat.
 - .5 Third coat (Level 4)
 - .1 After second coat has dried, sand surface lightly and apply thin finish coat to joints, fasteners and trim, feathering compound 2 inches beyond edge of second coat.
 - .2 Allow third coat to dry. Apply additional compound, and touch-up and sand, to provide surface free of visual defects, tool marks, and ridges, and ready for application of finish.
 - .3 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
-

- .4 Sand lightly to remove burred edges and other imperfections.
Avoid sanding adjacent surface of board.
- .5 Completed installation to be smooth, level or plumb, free from
waves and other defects and ready for surface finish.

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide acoustic panel ceiling systems including the following:
 - .1 Acoustic ceiling panels
 - .2 Suspension grid systems
 - .3 Hangers and inserts

1.3 REFERENCES

- .1 ASTM-C635; Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2 ASTM-C636; Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- .3 CAN/CGSB-51.34; Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .4 CAN/CGSB-92.1 Sound Absorptive Prefabricated Acoustical Units.
- .5 CSA-B111; Wire Nails, Spikes and Staples.
- .6 CAN/ULC-S102; Surface Burning Characteristics of Building Materials.

1.4 REGULATORY REQUIREMENTS

- .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by a Canadian Certification Organization accredited by Standards Council of Canada.

1.5 DESIGN REQUIREMENTS

- .1 Maximum deflection: 1/360th of span to ASTM-C635 deflection test.

1.6 QUALITY ASSURANCE

.1 MANUFACTURER/FABRICATOR

- .1 Manufacturers or fabricators providing Products under this Section shall have sufficient plant, equipment and competent personnel to provide the Products, in accordance with the Contract Documents. Firm(s) shall have past experience in the manufacture or fabrication of the Products specified herein, and shall have successfully completed Projects of similar scope and type.

.2 INSTALLATION/APPLICATION

1. Installers or applicators of the Products specified herein, shall be competent in the skills required to perform such tasks. Installation/ shall be performed in accordance with industry standards specified herein, warranty requirements, and in accordance with generally accepted, industry best practices.

.3 DOCUMENTATION

- 1 If requested by the Consultant, submit documentation to support the competency of firms and personnel.

.4 PRE-APPLICATION MEETING

- .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
- .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturer and/or Distributor (Technical Representatives)
 - .4 Related Subcontractors whose work is affected by that of this Section.

1.7 SUBMITTALS

.1 SUBMITTALS:

- .1 Make submittals in accordance with Section 01 30 00.

.2 SAMPLES:

- .1 Submit duplicate (4" x 4") 102mm x 102mm samples of each type of acoustical panels in specified finishes.

.3 CLOSEOUT SUBMITTALS

.1 Maintenance Materials

- .1** Provide acoustical ceiling panels amounting to $\pm 2\%$ of gross ceiling area for each pattern and type required for project, in accordance with Section 01 78 00.
- .2** Extra materials shall be from same production run as installed materials, in unopened packages clearly identified as to its contents.
- .3** Store where directed.

1.8 MOCK-UPS

- .1** Construct mock-ups in accordance with Section 01 30 00.
- .2** Construct one 3mx 3m mock-up of each type of acoustic panel ceiling in place, complete with wall molds suspension system grid and panels.
- .3** Allow for review by Consultant. Correct deficiencies.
- .4** Approved mock-up may form part of the finished Work, and shall serve as the minimum standard for work of this type.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1** Permit wet work to dry before commencement of installation.
- .2** Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.
- .3** Store materials in work area 48 hours prior to installation.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- .1** Suspension Grid
 - .1** CertainTeed
 - .2** Armstrong World Industries
 - .3** CGC
- .2** Acoustic Panels
 - .1** CGC

2.2 STEEL MATERIALS

- .1** Sheet Steel: Cold-rolled, commercial grade structural quality sheet steel, to ASTM A635/A635M; Zinc-Coated (Hot Dip Galvanized) to ASTM A653/A653M; coating designation Z275.

2.3 SUSPENSION GRID SYSTEMS

- .1** Intermediate duty suspension grid systems, all components to be sheet steel to ASTM A635, galvanized to ASTM A653/A653M. Die cut components; double web main tees with rectangular bulb and rolled cap on exposed face; shop painted baked enamel finish.
Cross tees with rectangular bulb and web extended to form positive interlock with main tee webs, lower flange extended and offset to provide flush intersection.

- .2 Standard Grid (**ACT-1**): (15/16") 23mm wide exposed T-grid;
 - .1 Colour: white.
 - .2 Acceptable Products:
 - .1 Prelude XL, by Armstrong.
 - .2 15/16" EZ Stab Classic System, by CertainTeed.
 - .3 Wall Molds: 23mm wide;
 - .1 Colour: to match grid.
 - .2 Prefabricated shadow mold profile for all ceilings.

2.4 ACOUSTIC CEILING PANELS

- .1 Lay-in Acoustic Panels (**ACT-1**): to ASTM E1264 Type IV Form 2 Pattern E, square-cut edges for standard grid;
 - .1 Panel Size: (24" x 48") 610mm x 1220mm & (12" X 48") 305MM x 1220mm
 - .2 Finish: factory-applied latex paint.
 - .3 Colour: White.
 - .4 Pattern: fine textured.
 - .5 Fire Resistance: Class A - Firecode.
 - .6 NRC: 0.55.
 - .7 CAC: >35.
 - .8 Acceptable Products
 - .1 2315 Firecode Radar by CGC

2.5 ACCESSORIES

- .1 Hanger Wire: galvanized soft annealed steel wire, 3.6mm diameter for access tile ceilings to ULC/UL tested design requirements for fire rated assemblies, 2.6mm diameter for other ceilings.
 - .1 Hanger Inserts: purpose-made for individual substrate.
- .2 Carrying Channels: 38mm or 64mm, hot-dip galvanized steel.

3.0 EXECUTION

3.1 EXAMINATION

- .1 Do not install ceiling suspension system or acoustical panels and tiles until the work above ceiling has been inspected by Consultant.

3.2 SUSPENSION SYSTEM INSTALLATION

- .1 Install suspension system in accordance with ASTM-C636, to manufacturer's instructions, ULC/UL requirements, and this specification.
- .2 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .3 Install hangers spaced at maximum 1220mm centres and within 150mm from ends of main tees.
- .4 Where mechanical or electrical equipment prohibit installation of hangers, provide carrying channels as required to span under equipment.
- .5 Lay out system according to reflected ceiling plan.
- .6 Ensure suspension system is coordinated with location of related components.
- .7 Install wall mold level to provide correct ceiling height.

- .8 Completed suspension system to support superimposed loads, such as lighting fixtures, diffusers, grilles, and speakers.
- .9 Support light fixtures with additional ceiling suspension hangers at each corner and at maximum 600mm around perimeter of fixture.
- .10 Supplementary support hangers for all tile-mounted mechanical and electrical fixtures shall be provided by those trades.
- .11 Interlock cross members to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Finished ceiling system to be square with adjoining walls and level within 1:1000.

3.3 EXPANSION JOINTS

- .1 Supply and install "Z" shaped metal trim pieces at each side of expansion joint. Design to accommodate plus or minus 25mm movement and maintain visual closure. Finish metal components to match adjacent exposed metal trim. Provide backing plates behind butt joints.

3.4 ACOUSTIC PANEL INSTALLATION

- .1 Install lay-in panels in correct seated position in ceiling suspension system.
- .2 In fire rated ceiling/floor and ceiling/roof systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to ULC/UL design requirements.
Note: In accordance with ANSI / UL 263 Item III. Floor-Ceilings and Roof-Ceilings item 10. Acoustical Materials, hold down clips only required for ceiling panels weighing less than 1 lb. per SQ.FT.

3.5 COORDINATION

- .1 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.6 INSPECTION AND CLEANING

- .1 Thoroughly inspect all ceiling tiles and remove any chipped, marked, scratched, stained, discoloured or otherwise damaged units, and replace with new units. Do not take replacement units from maintenance materials.
- .2 Thoroughly inspect all ceiling grid and remove any marked, scratched, dented or otherwise, damaged pieces, and replace with new.

END OF SECTION

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to cover with paint the interior surfaces of the building or structure, and the building services and accessories not otherwise protected or covered, to the full intent of the drawings and specifications.
- .2 Surface preparation of substrates to receive painting and finishing is included in this section of work.
- .3 This section of work shall include the painting and finishing of all exposed surfaces of the following substrates:
 - .1 Wood
 - .2 Steel (Prime-painted & galvanized)
 - .3 Concrete
 - .4 Masonry
 - .5 Gypsum board surfaces
 - .6 All exposed surfaces and materials not factory finished / prefinished

1.3 REFERENCE STANDARDS

- .1 CAN2-85.100, National Standards of Canada, Painting.
- .2 Master Painters Institute (MPI) Architectural Painting Specification Manual.

1.4 MATERIALS AND EQUIPMENT NOT TO BE PAINTED

- .1 Surfaces not to be painted shall be left completely free of droppings, over-spray, or accidentally applied materials resulting from the work of this Section.
- .2 Items not to be painted include concealed structural elements, and equipment furnished with complete factory-applied, coloured paints and finish systems.

1.5 COOPERATION WITH OTHER TRADES

- .1 Schedule and coordinate this work with other trades and do not proceed until other work and/or job conditions are as required to achieve satisfactory results.
- .2 Examine all specification sections for materials and products and become thoroughly familiar with all provisions regarding painting.

1.6 QUALITY ASSURANCE

- .1 Acceptable Manufacturers
 - .1 Paints Stains and varnish.
 - .1 Benjamin Moore
 - .2 Sherwin Williams
 - .3 ICI (Glidden) Paints
 - .4 Para Paints
 - .5 Pratt & Lambert
 - .6 Sico Coatings
 - .2 All paints and finish products to be best quality from manufacturers listed
- .2 Applicators
 - .1 The painting subcontractor shall have a minimum of five (5) years documented experience in commercial painting and finishing, and shall maintain a qualified crew of size necessary to fully satisfy the requirements of this section.
- .3 Pre-application Meeting
 - .1 Convene a pre-application meeting for the Products specified in this section. Attendees must include, as a minimum, representatives of the following:
 - .1 Contractor (Site Superintendent & Project Manager)
 - .2 Application Subcontractor (Site Foreman & Project Manager)
 - .3 Product Manufacturers and/or Distributors (Technical Representatives)
 - .4 Related Subcontractors (i.e.. Mechanical and/or Electrical)

1.7 MOCK-UP REQUIREMENTS

- .1 Finish one complete room of each colour scheme required, showing selected materials, colours and textures. Have Consultant review mock-up for acceptance of colour and finish, prior to ordering of materials for further work.
- .2 Consultant reserves the right to change colour and/or finish selection upon review of mock-up, if deemed unacceptable.
- .3 Refinish rejected areas until acceptance is achieved.
- .4 Once approved by the Consultant, mock-ups shall serve as the minimum acceptable standard for similar work throughout the Project.

1.8 COLOUR SCHEDULE

- .1 Refer to the Room Finish Schedule and the Colour Schedule for colours and surface textures of all finishes. The final selection shall rest solely with the Consultant.

1.9 COMPLETION SCHEDULE

- .1 Furnish the Consultant with a schedule showing expected completion of the respective coats of paint for the various areas and surfaces. Keep this schedule current as the job progresses.

1.10 SUBMITTALS

- .1 Product Codes
 - .1 Submit a complete list of product codes from the manufacturer(s) proposed for use on this project, for all products listed in finish systems specified herein, in accordance with Section 01 30 00.
- .2 Samples
 - .1 Submit samples of all paints and finishes specified herein, in accordance with Section 01 30 00.
 - .2 Submit triplicate (8" x 12") 200 x 300mm sample panels of each type of paint and finish application for approval by the Consultant.
 - .3 Where manufacturer of paint differs from that listed in the colour schedule, employ spectrograph technology to ensure accurate colour match. Selection of the "next nearest colour" by another manufacturer will not be acceptable.
 - .4 Use birch plywood for wood finishes, gypsum board for paint finishes over smooth surfaces. Refer to Mock-up Requirements for masonry finishes.
 - .5 Finished work to match approved samples.
 - .6 The Consultant reserves the right to alter colour selections following sample review.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Paint and finish materials shall be delivered to the site in sealed original labelled containers bearing manufacturer's name, type of paint, brand name, colour designation and instructions for mixing and/or reducing.
- .2 Store materials in a heated, dry, well-ventilated, indoor place having a minimum ambient temperature of (45°F) 7°C.
- .3 Keep waste rags in metal drums and remove all rags, waste and trash from the building at the end of each working shift.
- .4 Provide CO2 fire extinguisher of minimum (20 lb) 9kg capacity in storage area.
- .5 Ensure that health and fire regulations are complied with in storage area.

1.12 GENERAL COLOUR REQUIREMENTS

- .1 Refer to the Room Finish Schedule and the Colour Schedule for type and extent of finishes, and for individual colour and sheen selections.
- .2 Where manufacturer of paint differs from that listed in the colour schedule, employ spectrograph technology to ensure accurate colour match. Selection of the "next nearest colour" by another manufacturer will not be acceptable.

- .3 The following, generally, will be painted colour, and sheen to match adjacent surfaces
 - .1 Access doors and electrical panel covers in public spaces including resource rooms and classrooms
 - .2 Exposed piping, conduit, and ductwork.
 - .3 Unfinished exposed materials.
- .4 Access doors and electrical panel covers shall be powder coated with colour to match adjacent wall colour.

1.13 ENVIRONMENTAL CONDITIONS

- .1 Temperatures: No painting shall be performed when substrate or ambient air temperatures are below (41°F) 5°C. Minimum allowable temperature for application of Latex paints is (45°F) 7°C.
- .2 Relative humidity: shall not exceed 85%.
- .3 Moisture content of substrates: Masonry and concrete materials shall be allowed to cure for a minimum of 28 days before application of paints. Substrates shall be measured by electronic moisture meter, to the following maximums:
 - .1 Plaster and Gypsum board: 12%.
 - .2 Masonry, concrete/concrete block: 12% for solvent based paints.
 - .3 Wood: 15%.
- .4 Lighting: Painting shall not proceed unless a minimum of (15 cd/ft²) 1.3 lx lighting is provided on the surfaces to be painted.
- .5 Ventilation: All areas where painting is proceeding require adequate continuous ventilation and sufficient heating facilities to maintain temperatures above (45°F) 7°C for 24 hours before during and after paint application.

1.14 MAINTENANCE MATERIALS

- .1 Supply Owner with one clearly identified, new and unopened gallon of each colour and type of paint, stain and varnish used for this work, in accordance with Section 01 78 00.
- .2 All colour mixing codes must be clearly labeled, and colour numbers (P1, P2, etc.) must be marked on the container.

1.15 EXTENDED WARRANTY

- .1 Provide upon completion of the work, a Warranty Certificate, in the name of the Owner, stating that the work of this section was performed in accordance with these specifications and the MPI manual (latest edition), and is warranted against defects in material or installation, for a period of two (2) years from Date of Substantial Performance.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Paint, varnish, stain, enamel, lacquer and fillers shall be of a type and brand herein specified and/or listed under Chapter 5 (Approved Products List) of the MPI manual.

- .2 Paint materials such as linseed oil, shellac, turpentine, and any materials not specified herein but required for first class work with the finish specified shall be the highest quality product of an approved manufacturer. All materials shall be compatible with finish paint or coating materials.

2.2 MIXING

- .1 Paints shall be ready-mixed unless otherwise specified, except that any coating in paste or powder form, or to field-catalyzed shall be field-mixed in accordance with the directions of its manufacturer. Pigments shall be fully ground and shall maintain a soft paste consistency in the vehicle during storage that can and shall be dispersed readily and uniformly by paddle to a complete homogeneous mixture.
- .2 The paint shall have good flow and brush properties and shall dry or cure free of sags or runs to yield the desired finish specified.

2.3 GLOSS LEVELS

- .1

MPI Gloss and Sheen Levels;	Gloss @60°	Sheen @85°
Level G1 – (Flat):	max. 5	max. 10.
Level G2 – (Velvet):	max. 10	10-35.
Level G3 – (Eggshell):	10-25	10-35.
Level G4 – (Satin):	20-35	min.35.
Level G5 – (Semi-Gloss):	35-70.	
Level G6 – (Gloss):	70-85.	
Level G7 – (High Gloss):	85.	
- .2 Provide Level G5 (Semi-Gloss) finish in corridors, stairwells, washrooms, service rooms, metal work and elsewhere where noted on the Room Finish Schedule.
- .3 Provide Level G3 (Egg Shell) finish in all classrooms and offices

3.0 EXECUTION

3.1 INSPECTION OF SURFACES

- .1 Examine surfaces to receive paint finishes for defects which cannot be corrected by procedures specified herein, and which may result in unsatisfactory paint finishes. Report items to the Consultant and the Contractor in writing, prior to commencement of work of this section, or after initial prime coat shows defects in substrate.
- .2 The application of subsequent prime and finish coats shall be construed as acceptance of the surfaces, and thereafter this subcontractor shall be fully responsible for satisfactory work as required herein.

3.2 PREPARATION OF SURFACES

- .1 Refer to the MPI manual Chapter 3 for surface preparations not specified in this section.
- .2 Perform mandatory surface cleaning and preparation prior to commencing work of this section

3.3 PROTECTION

- .1 Protect all adjacent surfaces from paint and damage resulting from the work of this section and make good any damage caused by failure to provide such protection.
- .2 Mask all adjacent finishes and surfaces with masking tape as required. Remove tape promptly after final finish coat has been applied and allowed to dry.
- .3 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or dropping from fouling surfaces not being painted or where painting has been completed.
- .4 Cotton waste, cloths and material, which may constitute a fire hazard, shall be placed in closed metal containers and removed daily from the site.
- .5 Remove and protect, prior to painting operations, all hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items, or provide ample in-place protection such as masking tape. If removed, these items shall be labelled, stored, cleaned if necessary and re-installed following successful completion of the work in each area. Solvents detrimental to lacquer finishes are not to be used for cleaning these items.

3.4 APPLICATION

- .1 Apply paints and coatings by currently accepted trade methods. Application of primers and finishes shall be by brush, roller, spray, or a combination of those methods.
- .2 Painting coats specified are intended to cover surfaces satisfactorily when applied in strict accordance with manufacturer's recommendations. Where proper coverage has not been attained, the Consultant may ask for additional coats as required, at no additional cost.
- .3 Apply each coat at the proper consistency. Sand lightly between coats.
- .4 Tint primers to same colour range as finish coats.
- .5 Do not apply finishes on surfaces that are not sufficiently dry. Each coat of finish should be dry and hard before a following coat is applied unless specified otherwise by the manufacturer.
- .6 Tint filler to match wood for clear finishes. Work filler well into wood grain and remove excess prior to setting.
- .7 Interior woodwork to receive paint or enamel finish shall be back-primed upon arrival on site with enamel undercoater.
- .8 All edges of wood doors shall be primed with undercoater, stain, or varnish, as required by specified finish.
- .9 Where spraying of paint is required by surface conditions, mask and seal off areas to be sprayed, and back-roll all coats. Provide ventilation for areas to be sprayed.
- .10 Where spray painting is specified, finish (100ft²) 10m² by spraying a sample of the finish upon the request of the Consultant, using materials specified.

- .11 Provide complete coverage and hide. When colour, stain, dirt or undercoats show through final coat of paint, provide additional coats until the paint film is of uniform finish, colour, appearance and coverage, at no additional cost to the Owner.
- .12 Allow all coats to dry to manufacturer's recommendations before applying succeeding coats.
- .13 Touch up all suction spots or "hot spots" in concrete after the application of the first coat, before applying the second coat.
- .14 Surfaces to be stained shall appear uniform in shading with colour variations caused only by the natural wood grain.
- .15 Barricade areas where finishing is in progress to prevent traffic or other activities, and otherwise protect work until dry. Post "Wet Paint" signs and remove when no longer required.
- .16 Replace at the expense of this section, materials soiled or damaged by finishing materials which cannot be removed.
- .17 **New block masonry:**
 - 1. Do not apply finish coats until block filler application has been inspected to identify visible pin holes. Should visible pin holes be identified, additional coats of block filler are to be applied until there are no visible pin holes.
 - 2. Where inspections identify pin holes on a finished surface, the area noted shall be repainted first with block filler then the entire wall plane is to be refinished.

3.5 PAINTING AND FINISHING OF EXISTING MATERIALS AND SURFACES

- .1 Remove, label and store, prior to painting of existing materials and surfaces the following items:
 - .1 Door hardware signage and accessories,
 - .2 Device plates,
 - .3 Lighting fixtures,
 - .4 Factory finished work,
 - .5 Signage where removable.
- .2 Where such items are not removable, provide proper masking and protection prior to commencement of painting.
- .3 Clean such items if deemed necessary by the Consultant, before being re-installed following successful completion of the work in each area. Solvents detrimental to lacquer finishes are not to be used for cleaning these items.
- .4 All surface contaminants such as wax, oils, grease, dirt, tire marks (horizontal surfaces), etc., must be removed from the surface. Oil and grease can be removed by detergent cleaning, followed by a rinse with clean water; solvent cleaning can be used as an alternative on areas with a concentration of oil or grease. All loose and flaking paint must be removed by hand cleaning, power tool cleaning, or pressure washing.
- .5 All blisters must be removed from the surface and the edges feathered. Areas showing mildew growth must be treated. Glossy finishes must be 'dulled' by sanding, by a TSP treatment, or by sweep blasting to create an anchor pattern to promote adhesion of the new coating.

- .6 Rust stains can be removed with an oxalic acid treatment. If large amounts of efflorescence is present, mechanical removal (e.g. abrasive sweep blasting or power tool grinding) may be required, after which acid etching shall be performed.
- .7 After any application of muriatic acid, the surface must be flushed with large amounts of clean water to remove any residue, and then allowed to dry thoroughly. The pH of the surface shall be tested, as specified in 1.2 pH Testing before the application of paint. All bare areas must be spot primed.

3.6 PAINTING APPLICATION SCHEDULE

- .1 Application of finishes on various material surfaces to be as follows:
 - .1 **Concrete Finishing Systems** (Low contact areas – Mechanical, Electrical and Service Rooms where noted on Room Finish Schedule)
 - .1 Concrete Horizontal Surfaces; Premium Grade Finish.
 - .1 Concrete Floor Sealer, Gloss/Sheen – G3.
 - .2 Epoxy Concrete Floor Sealer
 - .2 **Masonry Finishing Systems; Premium Grade Finish**
 - .1 **Concrete Masonry Units – Previously Painted.**
 - Latex super adherent primer – 1 coat
 - Latex pre-catalyzed water based epoxy (LEP) – 2 coats or latex G3 or G5 where noted on Room Finish Schedule.
 - .2 **Concrete Masonry Units – New.**
 - Latex block filler – 2 coats (for lightweight block -apply additional coat)
 - Latex pre-catalyzed water-based epoxy (LEP) – 2 coats or latex G3 or G5 where noted on Room Finish Schedule.
 - .3 **Metal Finishing Systems**
 - .1 **Structural Steel; Premium Grade Finish.**
(Low contact overhead structural steel ductwork and decking)
 - Dry Fall (over Q.D. shop primer), Gloss/Sheen G2.
 - .2 **Metal Fabrications; Premium Grade Finish.**
(High contact doors and frames, railings, balustrades, etc)
 - Latex super adherent metal primer.
 - Latex pre-catalyzed water-based epoxy (LEP) – 2 coats
Gloss/Sheen – G5.
 - .4 **Wood Finishing Systems**
 - .1 **Painted Wood** (miscellaneous wood items); Premium Grade (3-coat) Finish.
 - Latex Gloss/Sheen -G4.
 - .2 **Clear Finish Wood** (miscellaneous wood items); Premium Grade (3-coat) Finish.
 - .1 Clear Polyurethane (single component) finish, Gloss/Sheen -G4.

- .5 **Plaster & Gypsum Board Finishing Systems**
 - .1 **Gypsum Board; (walls)** Premium Grade Finish.
 - Latex water based epoxy (LEP) (over latex primer sealer), Gloss/Sheen – G3.
 - .2 **Gypsum Board; (ceilings)** Premium Grade Finish.
 - Latex (over latex primer sealer), Gloss/Sheen – G1.

3.7 CLEAN-UP

- .1 Upon completion of the work, remove all paint and varnish spots from floors, glass and other surfaces. Remove from the premises all rubbish and accumulated materials of whatever nature, not caused by others, and leave this work in clean, orderly and acceptable conditions.

END OF SECTION

PART 1 - GENERAL

- | | | | | |
|-----|------------------------------------|----|---|------------------|
| 1.1 | <u>General Requirements</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Finishing of Concrete Slabs: | Section 03302 |
| | | .2 | Sealants | Section 07900 |
| 1.3 | <u>Reference Standards</u> | .1 | Do tile work in accordance with installation manual 200-1979 (Revised 1989), 'Ceramic Tile', by Terrazzo Tile and Marble Association of Canada and CSC Architectural Specification Study 09300 on Ceramic Tile. | |
| | | .2 | American National Standards Institute (ANSI) / Ceramic Tile Institute (CTI) | |
| | | .1 | ANSI A108.1, Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1) | |
| | | .3 | American Society for Testing and Materials (ASTM) | |
| | | .1 | ASTM C144, Specification for Aggregate for Masonry Mortar. | |
| | | .2 | ASTM C207, Specification for Hydrated Lime for Masonry Purposes. | |
| | | .4 | Canadian General Standards Board (CGSB) | |
| | | .1 | CGSB 71-GP-22M, Adhesive, Organic, for Installation of Ceramic Wall Tile | |
| | | .2 | CAN/CGSB-75.1, Tile Ceramic | |
| | | .5 | Canadian Standards Association (CSA) | |
| | | .1 | CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A5, A8, A23.5, A362, A363, A456.1, A456.2, A456.3) | |
| 1.4 | <u>Qualifications</u> | .1 | <u>Installer:</u> Work to be performed by a qualified Contractor and who has personnel with experience of successful work on similar projects, and who has the necessary equipment to complete the work. | |
| 1.5 | <u>Guarantee</u> | .1 | Provide the following guarantees in accordance with the General Conditions, notwithstanding the time provisions therein, including but not limited to such defects as cracks and delamination, except where proven the defect is a direct result of structural failure. | |
| | | .2 | Provide certificate of quality compliance from tile manufacturer. | |
| | | .3 | Provide certificate of quality compliance from tile installer upon satisfactory completion of installation. | |
| | | .1 | General Tile Work | - 2 years |

- 1.6 **Submittals** .1 **Samples:**
- .1 Prior to ordering materials submit, for Consultant's review, duplicate samples of each tile, trim, fitting and base, mounted on panels complete with grout and mortar joints. Also submit samples of mitre cut base (if indicated on Finishes Drawings and Colour Schedule) and field tiles.
- .2 **Maintenance Data:**
- .1 Submit manufacturer's maintenance data for inclusion into the maintenance manuals specified in Division 1. Also submit manufacturer's specification sheets for mortar and grout systems installed.
- .3 **Maintenance Materials:**
- .1 Supply a minimum 2%, but not less than 1 box, of each tile specified, for maintenance purposes. Store material where directed by Consultant.
- .2 Maintenance materials to be of same run as materials installed.
- 1.7 **Site Mock-Up** .1 Prior to commencing work, review all details and provide mock-up for Consultants review. Mock-up will remain in place throughout installation as a representation of finish work standard and may become part of the finished work if approved by Consultant.
- .2 Review tile patterns and layout with Consultant, on site, prior to commencing work.
- 1.8 **Product Delivery & Storage** .1 Deliver materials to site in original unopened containers. Store in safe dry protected area free of moisture. Take precautions so no foreign matter contaminates materials.
- 1.9 **Environmental Conditions** .1 Do not install tiles when ambient air temperature and substrate temperature is less than 12°C.
- .2 Maintain a temperature of between 12°C to 20°C in areas of work for 24 hours prior to and during installation and for duration of curing time.
- .3 Inspect areas to receive work and certify surfaces are acceptable for installation. Do not commence installation until improper conditions have been corrected.
- 1.10 **Protection** .1 Exclude construction traffic from areas to receive tile, during installation and for duration of curing time.

PART 2 - PRODUCTS

- 2.1 **Tile General** .1 Specifications for tile and supporting accessories is based on materials manufactured and/or distributed by Olympia Tile International Inc., at 1-800-268-1613.

		.2	<u>Tile:</u> CAN2-75T-M77, except that no blisters or chips will be allowed; colours and patterns selected by Consultant.
2.3	Ceramic & Porcelain Tile	.1	Colour to be selected by Consultant. Refer to Section 00865 Colour Schedule for material selections.
2.4	Mortar/ Adhesives & Grout	.1	All interior wall tile to use Ultra/Mastic 1.
		.2	All floor tiles to use Karalastic/Karabond.
		.3	Colour to be selected by Consultant. Refer to Section 00865 Colour Schedule for material selections.
		.4	Provide "Grout Boost" Stain resistant grout additive by Specialty Construction Brands Inc, to grout for all porcelain floor tile applications.
		.5	Unless otherwise indicated all grout lines on walls to line up with grout lines on floors in all directions.
		.6	Apply grout conditioner to all exposed grout.
		.7	Apply grout sealer to all exposed grout.
2.5	Transition Strips	.1	Provide Schluter Schiene transition strips in satin anodized aluminum at the top edge and exposed side edges of porcelain tiles (where indicated on the finishes drawings and interior elevations).
		.2	Transitions strips are required to clean up edge of tiles where different thicknesses of tiles are specified and vertical edges. Refer to interior elevations for notes regarding location of transition strips.
		.3	Provide Schluter Quadec in brushed stainless steel for at outside corners where tile meets tile unless otherwise specified. Refer to Section 00865 Colour Schedule.
		.4	Grind all sharp edges smooth. Careful attention to corner conditions to ensure smooth finish to touch.
		.5	Use full length strips where possible. All connecting transition strips to have a seamless appearance and smooth to the touch.
2.8	General Materials	.1	<u>Water:</u> Potable and non-staining
		.2	<u>Portland Cement:</u> CAN3-A5-M83.
		.3	<u>Sand:</u> CSA A82.56-M1976.
		.4	<u>Control Joint Sealant:</u> Urethane sealant equal to Vulkem 245 self leveling sealant manufactured by Mameco Canada Ltd. Colour to match grout. Architect to make final colour selection.

PART 3 - EXECUTION

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| 3.1 | <u>Inspection</u> | .1 | Examine floors for defects that are detrimental to installation and bonding of tile. |
| | | .2 | Examine drywall surfaces for adequate fixing, plumb, joint filling and freedom from waves. |
| | | .3 | Examine masonry and concrete surfaces for soundness, excessive moisture, efflorescence and variation tolerance. |
| 3.2 | <u>Preparation</u> | .1 | Substrates to be clean and free of foreign matter and minimum 10° C. |
| | | .2 | Clean substrates as required to produce acceptable surface. |
| | | .3 | Where substrate conditions require it, apply leveling coat and allow to cure. |
| 3.3 | <u>Tile / Stone General</u> | .1 | Finished work shall be level, plumb, or sloped as shown, true, square and free of defective, chipped, broken, discoloured or blemished tiles. Maximum allowable finished surface variation is 3 mm in 3 m when measured, in any direction, with a 3 m straightedge. |
| | | .2 | Lay out tile patterns symmetrically within each area using full tiles where possible, and to patterns shown. Unless otherwise indicated provide stacked pattern. Review with architect/interior designer on site prior to installation of any and all tiles. |
| | | .3 | Joints shall be parallel, uniform, neat, straight, square and completely filled. |
| | | .4 | Fit tile or stone accurately against and around interruptions, penetrations and abutting dissimilar surfaces. Wherever possible, drill holes for penetrating elements to ensure neat fitting. |
| | | .5 | After setting, sound tiles and replace hollow backed tiles. |
| | | .6 | Provide tile manufacturer's standard trim pieces at changes in direction and at terminations. Unless otherwise indicated provide the following corner and edge conditions. |
| | | .1 | Internal horizontal corners: coved. |
| | | .2 | External vertical and horizontal corners and edges: bullnose. |
| | | .3 | Internal vertical corners and unexposed edges: square butt joint. |
| | | .4 | Top of base: curved surface cap. |
| 3.4 | <u>Floor Tile Installation</u> | .1 | At floors shown to be sloped install setting bed to slopes indicated screed and tamp firmly, minimum 20 mm thick, with reinforcing mesh embedded approximately in centre of setting bed. Lap mesh 50 mm at joints. |
| | | .2 | Over setting bed trowel or brush on bond coat approximately 1.5 mm thick, or apply evenly over back of tiles. Set tiles onto setting bed and beat firmly and evenly in place so as to achieve true, uniform and properly bonded |

installation but without causing damage to tiles.

- .3 Provide minimum 1% slope to floor drains.
- .4 Floor tiles at floors without slopes, and base tiles may be installed with the thin set method using dry set mortar.
- .5 Unless otherwise indicated provide 3 mm wide joints.
- .6 Provided caulked control joints at 6 m on centres.

**3.5 Wall Tile
Installation**

- .1 Install tile on dry wall surfaces with organic adhesive or thin set bond coat (TTMAC 200-5 & -5A). Install wall tile on masonry or concrete with organic adhesive or dryset mortar (TTMAC 200-3, -3A).
- .2 Use presanded dry set mortar or latex Portland Cement mortar for setting tile on glass fiber reinforced concrete backer board base as follows:
 - .1 Fill space between edge of board and tub or shower receptor with mortar.
 - .2 Fill backer board joints and joints between backer board and other materials solid with mortar. Apply skim coat of mortar and embed fiberglass tape over joints.
 - .3 Apply mortar setting bed in one coat to 2.4 mm minimum thickness after tiles are beat in. Initially apply mortar coat smoothly, then notch.
- .3 Set wall tile in adhesive with 2 mm joint maximum both vertically and horizontally. Carry tile to ceiling unless otherwise indicated.
- .4 At internal corners where tile abuts tile, tile and grout one plane before commencing work on intersecting plane to ensure proper filling of void at corners. Grout corner joint with sealant, same colour as mortar grout.
- .5 Do tile work before ceilings are begun. Provide level and straight termination 50 mm above ceiling heights.
- .6 On cast-in-place concrete wall, use bonding agent before applying adhesive.
- .7 Install joint filler and seal behind escutcheon plates at every pipe penetrating tile work.
- .8 Consult and review tile patterns with architect/interior designer on site prior to installation.

3.6 Grouting

- .1 Remove mortar and adhesive from tile face as work progresses with CLEAN water.
- .2 Commence grouting not earlier than 24 hours after setting tiles unless otherwise directed by grout manufacturer.

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| | | .3 | Force maximum grout into joint so as to fill them flush, leaving no voids. |
| | | .4 | Promptly as work progresses remove excess grout from adjacent tile surfaces with CLEAN water before grout establishes tight permanent adhesion. |
| | | .5 | Cure grout in accordance with manufacturer's directions, minimum of 10 days. |
| | | .6 | Use MORE™ Surface Acidic Cleaner - to remove grout haze from the surface. Product supplied by Olympia Tile & Stone. |
| | | .7 | Seal all polished tiles and grout with manufacturer's recommended sealer prior to and after grouting. Review and consult architect prior to tile installation and grouting. |
| 3.7 | <u>Control Joints</u> | .1 | Provide control joints at substrate control joint locations, at abutting dissimilar materials. |
| | | .2 | Unless otherwise detailed provide control joints 10 mm wide and fill with control joint sealant. |
| 3.8 | <u>Cleaning</u> | .1 | Thoroughly clean tiles in accordance with manufacturers' instructions rinse with clean water and polish with clean dry cloths. |

End of Section

PART 1 - GENERAL

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|-----|--|----|---|---------------|
| 1.1 | <u>Reference</u> | .1 | Comply with requirements of Division 1. | |
| 1.2 | <u>Related Sections</u> | .1 | Concrete Floor Finishing | Section 03302 |
| 1.3 | <u>Qualifications</u> | .1 | Flooring Contractor(s) shall be established firms, experienced in the field, and appointed as a distributor by the manufacturer of the flooring product specified. | |
| 1.4 | <u>Submittals</u> | .1 | <u>Samples:</u> | |
| | | .1 | Submit duplicate tiles/planks/or sheet sample pieces of each colour specified for approval. | |
| | | .2 | Direction of veining or marbleization in the floor tile will be in accordance with instructions issued by the Consultant when colour selection is made. Refer to Finishes Drawings. | |
| | | .2 | <u>Maintenance Data:</u> | |
| | | .1 | Furnish the Owner with three copies of manufacturers printed maintenance instruction for inclusion in the maintenance manuals. | |
| | | .3 | <u>Maintenance Materials:</u> | |
| | | .1 | Deliver 25 tiles and/or planks and/or 1 box of sheet flooring of each colour pattern and type flooring material required for this project for maintenance use. Store where directed. Clearly identify each box. | |
| | | .2 | Furnish to the Owner additional materials containing a total of at least 1% of each different colour or design of the indoor resilient athletic surface used on the project. | |
| | | .3 | Delivery 10 m length rubber base. Store where directed. | |
| | | .4 | Maintenance materials to be same production run as installed materials. | |
| 1.5 | <u>Delivery and Storage</u> | .1 | Deliver materials to the job in sealed, original, labeled containers. | |
| | | .2 | Store flooring materials in areas of application for at least 48 hours prior to installation. | |
| 1.6 | <u>Environmental Requirements</u> | .1 | Maintain minimum 20°C air temperature at flooring installation area for 3 days before, during and for 48 hours after installation. | |
| 1.7 | <u>Warranty</u> | .1 | Provide three (3) year material and labour warranty for all products specified in this section | |

PART 2 - PRODUCTS

2.1 Materials

.1 Mastic Fill (latex underlayment): Bakelite Co. latex underlayment power/liquid or other approved manufacturer.

.2 RUB – Rubber Base: to meet the performance requirements of ASTM F-1861, Type TP and TV, Group 1 (Solid), Standard Specification for Resilient Wall Base.

.1 TighLock Carpet wall base is a wedge shaped toeless base specifically designed to be installed prior to traditional, direct, or double glue down carpet installations.

.2 Tightlock Resilient Topset wall base is specifically designed for resilient installations where there is a transition from resilient flooring to carpet.

.3 6.35mm (1/4") thick – wedge design, ± 100mm (4") high, complete with inside/outside corners.

.4 Should not crack, break, or show any signs of fatigue when bent around a (6.4mm (1/4") diameter cylinder.

.5 Product Performance and Technical Data
ASTM F 1515 (Resistance to Light)..... ΔE<8
ASTM F 925 (Chemical Resistance)..... Pass
5% acetic acid
70% isopropyl alcohol, mineral oil
5% sodium hydroxide solution
5% hydrochloric acid solution
5% sulfuric acid solution
5% household ammonia solution
5.25% household bleach solution

Vinyl Wall Base:

<450 ASTM E 84/ NFPA 255 (Flame/Smoke)..... Class B,

ASTM E 648/ NFPA 253 (Critical Radiant Flux)..... Class I

Rubber Wall Base:

<450 ASTM E 84/ NFPA 255 (Flame/Smoke)..... Class A,

ASTM E 648/ NFPA 253 (Critical Radiant Flux)..... Class I

Acceptable rubber base manufacturers: Johnsonite, Nora, Roppe, Armstrong, Mannington.

Refer to Section 00865 Colour Schedule for colour selection(s).

.3 Metal Edge Strips: aluminum extruded, smooth mill finish with lip to

1. Physical properties of the indoor resilient athletic surfacing shall conform to the following minimums:

Force reduction (shock absorption) DIN V 18032-2 (April 2001)....16%

- j. 100% Recyclable
- k. NSF-332 Platinum Certified
- l. Phthalate-free (except for recycled material)
- m. iQ Natural contains 16% rapidly renewable content (Castor Oil) and 75% Natural Materials
- n. SCS FloorScore® Certified and meets California Specifications Section 01350
- o. LEED contributions for Homogeneous Vinyl Sheet Flooring includes MR2; MR4; MR6 (iQ Natural) and EQ4.3
- p. Johnsonite facilities are ISO 9001 and ISO 14001 Certified

Refer to Section 00865 Colour Schedule for colour selection(s).
Weld rods to match colour of product selected as per Colour Schedule.

.5 Luxury Vinyl Tile (LVT): Tandus / Centiva, A Tarkett Company.

Classification:	ASTM F1700 Class III Type B
Total Thickness:	3.0mm (0.120")
Wear Layer Thickness:	0.5mm (20 mil)
Adhesive:	CENTI 2001 Wet Set, CENTI 6000 SP, CENTI 2000 EP or other Tandus Centiva LVT preferred adhesives.
ASTM F137 (Flexibility).....	Pass
ASTM F2199 (Dimensional Stability).....	Pass
ASTM F970 (Static Load).....	Pass
ASTM F1914 (Residual Indentation).....	Excellent
ASTM E648 (Flammability).....	CRF ≥0.45 watts/cm² NFPA Class 1
ASTM D2047 (Slip Resistance).....	Pass >0.5 ADA Compliant
ASTM E662 (Smoke Density).....	Pass <450 D ^{MC}
ASTM F1515 (Resistance to Light).....	Excellent
ASTM F925 (Chemical Resistance).....	Excellent
ASTM F1514 (Resistance to Heat).....	Excellent

Refer to Section 00865 Colour Schedule for colour selection(s).

PART 3 - EXECUTION

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| 3.1 | <u>Inspection</u> | .1 | Ensure concrete floors are dry by using test methods recommended by tile resilient flooring manufacturers, and exhibit negative alkalinity, carbonization for dusting. Follow current ASTM F710 guidelines for the preparation of concrete slabs to receive resilient flooring. |
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3.2	<u>Subfloor Treatment</u>	.1	Remove subfloor rides and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.
		.2	Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured.
		.3	Apply filler as necessary where resilient flooring terminates at adjacent thicker flooring materials to insure top of finished flooring materials are flush Feather filler sufficiently to eliminate abrupt changes in elevation.
		.4	Prime concrete to floor manufacturer's recommendations.
3.3	<u>General Application</u>	.1	All flooring materials are to be installed wall to wall over entire floor areas prior to the installation of any cabinet work.
3.4	<u>Resilient Flooring Application</u>	.1	Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
		.2	Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
		.3	Install flooring to square grid pattern with all joints aligned.
		.4	Cut tile and fit neatly around fixed objects.
		.5	Install flooring in pan type floor access covers. Maintain floor pattern.
		.6	Terminate flooring at centerline of door in openings where adjacent floor finish, material or colour is dissimilar.
		.7	Provide reducer strip fully bonded to floor where floor covering terminates exposing edge of floor.
3.5	<u>Resilient Base Application</u>	.1	Set base in adhesive tightly against wall and floor surfaces. Use lengths as long as practicable and not less than 600 mm long.
		.2	Install straight and level to variation of 1:1000.
		.3	Scribe and fit to door frames and other obstructions.
		.4	Wrap base around exterior corners as recommended by base manufacturer. Miter internal corners.
		.5	Apply base to all millwork surfaces in contract with the floor unless otherwise detailed.
3.6	<u>Resilient Sheet Installation</u>	.1	Install in accordance with manufacturer's recommendations.
		.2	Heat weld all seams to create a monolithic and impermeable surface.

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| | | .3 | Install resilient sheet flooring minimizing cross seams. Provide seam diagram during submittal process for approval prior to installation. |
| | | .4 | Install the indoor resilient athletic surfacing in strict accordance with the indoor resilient athletic surfacing manufacturer's written instructions. |
| | | .5 | Install the indoor resilient athletic surfacing minimizing cross seams. Provide a seam diagram during the submittal process for approval prior to installation. |
| 3.7 | <u>Sheet LVT Installation</u> | .1 | Install in accordance with manufacturer's recommendations. |
| 3.8 | <u>Games Lines</u> | .1 | Provide painted games lines in Gym Paint to be 2 part polyurethane paint as approved by flooring manufacturer. |
| | | .2 | Submit shop drawing for review by consultant showing games lines layout, line thickness, line colours and floor socket locations. Final layout on floor shall be reviewed by Consultant prior to painting. |
| | | .3 | Using the highest quality masking tape, tape the floor. Thoroughly mix the two-component games line paint, and paint between the tape. Remove all tape prior to the paint curing. |
| 3.9 | <u>Protection and Cleaning</u> | .1 | Protect all adjacent surfaces from damage resulting from the work of this scope. Make good all damage. |
| | | .2 | Prior to final completion, inspect the work and do all necessary replacement or repair. Replace or repair floor covering which has not seated in a level plane with surrounding material. Replace all damaged rubber base. |
| | | .3 | Promptly as the work proceeds and on completion, clean-up and remove from the premises all rubbish and surplus material resulting from the work of this Section. |
| | | .4 | Promptly remove adhesive from surface of resilient materials as work progresses. |
| | | .5 | Leave resilient floors broom clean, free of building materials, rubbish, paint, adhesives, stains and spills. |

End of Section

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, Products, equipment and incidental services necessary to Provide all washroom accessories specified herein.
- .2 Washroom accessories not specified herein, will be supplied and installed by the Owner.
- .3 The following washroom accessories will be supplied by the Owner and installed by the Contractor. The Contractor shall be responsible to provide any and all concealed blocking and supports necessary to properly support Owner-supplied washroom accessories.
 - .1 Toilet tissue dispensers **(TTD)**.
 - .2 Paper towel dispensers **(PTD)**
 - .3 Soap dispensers. **(SD)**
 - .4 Sanitary napkin disposal **(SND)**
 - .5 Sanitary napkin / tampon vender **(SNV)**
 - .6 Waste receptacle **(WR)**
- .4 The following washroom accessory will be provided by the Electrical Division:
 - .1 Electric Hand Dryer **(HD)**

1.3 REFERENCE STANDARDS

- .1 ASTM A167; Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- .2 ASTM A525M; Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process.
- .3 ASTM A526M; Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process, Commercial Quality.
- .4 ASTM B456; Specification for Electro-deposited Coating of Copper + Nickel + Chromium and Nickel + Chromium.
- .5 ASTM C1503; Specification for Silvered Flat Glass Mirror.
- .6 CAN/CGSB-12.5; Mirrors, Silvered.
- .7 CAN/CSA-B651; Barrier-Free Design.
- .8 CAN/CSA-G164; Hot Dip Galvanizing of Irregularly Shaped Articles.

1.4 SHOP DRAWINGS

- .1 Make submittals in accordance with Section 01 30 00.
- .2 **Product Data**
 - .1 Submit manufacturer's Product data for all items specified herein.
 - .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks.

3 **Shop Drawings**

- .1 Submit shop drawings of all items specified herein.
- .2 Indicate attachment devices, description of rough-in frame, and building-in details of anchors for grab bars.

1.5 **MAINTENANCE MATERIALS AND DATA**

- .1 Provide operation and maintenance data for washroom accessories for incorporation into Maintenance Manual in accordance with Section 01 78 00.
- .2 Provide two (2) complete sets of special tools required for accessing, assembly/disassembly or removal of washroom accessories.

2.0 **PRODUCTS**

2.1 **ACCEPTABLE MANUFACTURERS**

- .1 ASI Group Canada
- .2 Bobrick Washroom Equipment of Canada
- .3 Bradley Washroom Equipment
- .4 Frost Washroom Equipment

2.2 **MATERIALS**

- .1 Sheet Steel: commercial quality, to ASTM A526 with ZF001 zinc coating.
- .2 Stainless Steel Sheet Metal: to ASTM A167, Type 304, minimum (22 gauge) 0.80mm thick.
- .3 Stainless Steel Tubing: Type 304, commercial grade, seamless welded, (18 gauge) 1.27mm wall thickness.
- .4 Fasteners: concealed screws and bolts shall be hot-dip galvanized or stainless steel; all exposed fasteners stainless steel to match face of unit. Use plastic or lead expansion shields as recommended by fixture manufacturer for component, and its intended use.

2.3 **FINISHES**

- .1 Chrome and Nickel Plating: to ASTM B456, polished finish.
- .2 Stainless Steel: AISI No. 4 finish, (satin).

2.4 **COMPONENTS**

The following is a complete list of accessories some of which may or may not apply to this project. Provide accessories according to the accessories schedule.

- .1 **Grab Bars (GB):** (1¼") 32mm diameter, Type 304, (18 gauge) 1.27mm satin finish stainless steel tubing grab bars, with peened grip. Concealed mounting flange (1/8") 3mm thick, Type 304 stainless steel plate, (2") 50mm W x (3 1/8") 80mm H, with screw holes for concealed anchors. Cover of (3¼") 85mm diameter (12 gauge) 2.78mm stainless steel wall flanges. Grab bars to withstand downward force of 2.2N;
 - .1 **GB.1:** (24") 610mm long, mounted horizontally behind WC;
 - .1 Acceptable Products:
 - .1 B-5806.99x24 by Bobrick.
 - .2 812 Series by Bradley.
 - .3 Model 1001-24 by Frost.
 - .4 Model 3101-24P by ASI.

- .2 **GB.2:** (30" x 30") 762 x 762mm L-shaped; mounted beside WC;
 - .1 Acceptable Products:
 - .1 B-716722.99-L30x30 by Bobrick.
 - .2 837-057 Series by Bradley.
 - .3 Model 1003-30x30 by Frost.
 - .4 Model 3104-M3030P by ASI.
- .3 **GB.3:** (30" x 36") 762mm x 914mm L-shaped, mounted in showers;
 - .1 Acceptable Products:
 - .1 B-68137.99 by Bobrick.
 - .2 837-057 Series by Bradley.
 - .3 Model 1016 by Frost.
 - .4 Type 56P by ASI.
- .4 **GB.4:** (30") 762mm long, mounted vertically in Showers;
 - .1 Acceptable Products:
 - .1 B-5806.99x24 by Bobrick.
 - .2 812 Series by Bradley.
 - .3 Model 1001-24 by Frost.
 - .4 Model 3101-24P by ASI.
- .5 **GB.5:** Swing up / swing down barrier free grab bar.
Swing-up grab bar shall be manually raised for approach or departure and lowered to horizontal position for support. Counterweighted design shall prevent grab bar from falling back down to the full horizontal position once grab bar is raised to the full upright (vertical) position.
 - .1 Acceptable Products:
 - .1 B-4998.99 by Bobrick
- .6 **GB.6:** (30") 762mm long, mounted vertically each side of BF urinals;
 - .1 Acceptable Products:
 - .1 B-6806 x 30 (762mm), 38mm OD by Bobrick
- .2 **Framed Mirrors (MIR):** Vandal resistant 6mm tempered glass with #304 stainless steel channel frame polished to #4 satin finish and heavy gauge galvanized steel back
 - .1 **(MIR 1):** (18" x 30") 460 x 740mm framed tilted barrier free mirror
 - .1 Acceptable Products:
 - .1 Model B293 by Bobrick
 - .2 **(MIR 2):** (18" x 30") 460 x 740mm framed tilted barrier free mirror
 - .1 Acceptable Products:
 - .1 Model B290 by Bobrick
- .3 **Coat Hooks (CH):** Satin finish stainless steel safety release coat for installation in Barrier Free stall and elsewhere where noted on drawings.
 - .1 Single Hook;
 - .1 Acceptable Products:
 - .1 Model 1150-S by Frost.

- .4 **Mop Hooks (MH):** Type 304 stainless steel, satin finish. Anti-slip mop holders have spring-loaded rubber cam that grips handles (7/8" to 1-1/4") 20–30mm diameter. Holds 1 mop (3-1/4") 85mm from wall.
.1 Acceptable Products:
.1 B-223 by Bobrick.
- .5 **Mop Racks/Shelves (MR):** (24") 610mm long. Type 304 stainless steel, satin finish. Antislip mop holders have spring-loaded rubber cam that grips handles (7/8" to 1-1/4") 20–30mm diameter. Holds 3 mops (3-1/4") 85mm from wall. Height (5") 125mm.
.1 Acceptable Products:
.1 B-224x36 by Bobrick.
.2 Model 9984 by Bradley.
.3 Model 1115 by Frost.
.4 Model 1315-4 by ASI.
- .6 **Storage Shelf (STS):** (18") 457mm long x (4") 100mm wide, surface mounted Type 304 stainless steel, AISI No. 4 brushed finish with (3/4") 19mm return edge;
.1 Acceptable Products:
.1 MS-18, by Gamco Commercial Restroom Accessories (Div. of Bobrick).
.2 Model 950-4-18 by Frost.
- .7 **Folding Shower Seat (FSS):** wall-mounted, folding seat; colour as selected by Consultant;
.1 Acceptable Products:
.1 Model C9014-3 by Dunleavy-Cordun.
.2 B-5181 by Bobrick.
.3 Model 9569 by Bradley.
.4 Model 975 by Frost.
.5 Model 8206-28 by ASI.
- .8 **Shower Rod & Curtain (SRC):** (1") 25mm diameter, Type 304 stainless steel shower rod, vinyl shower curtain, and steel hooks.
.1 Acceptable Products:
.1 B-6107 rod, B204-2 vinyl shower curtains, B204-1 hooks, by Bobrick.
.2 Model 9538 rod, 9533 vinyl shower curtains, 9536 hooks, by Bradley.
.3 Model 1145-S rod, 1144-502 vinyl shower curtains, 1144-501L hooks, by Frost.
.4 Model 1214 rod, 1200-V vinyl shower curtains, 1200-SHU hooks, by ASI.
- .9 **Infant Change Station (ICS):** wall mounted fold down change station with liner dispenser; Fill dispenser with Sanitary Bed Liners.
.1 Surface-mounted, polyethylene;
.1 Acceptable Products:
.1 Koala Care Products KB110-SSWM by Bobrick.
.2 Model 962-11 by Bradley.
.3 Model 1124-S by Frost.
.4 Model 9013-9, by ASI.

- .10 **Special Needs Change Station (SNCS):** wall mounted fold down change station with liner dispenser; Fill dispenser with Sanitary Bed Liners. Fully stainless steel Type 304 brushed, extended length, CW dual pneumatic gas valve springs, replaceable ABS tray and safety straps. Dimensions: 64.75" L x 23.5" W x 4" H
 - .1 Surface-mounted, stainless steel
 - .1 Acceptable Products:
 - .1 Foundations Worldwide Inc. by GSR Storage systems (Canada).

2.5 FABRICATION

- .1 Weld and grind joints of fabricated components flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- .5 Back-paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot-dip galvanize concealed ferrous metal anchors and fastening devices to CSA G164.
- .7 Shop-assemble components and package complete with anchors and fittings.
- .8 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install and secure fixtures rigidly in place as follows:
 - .1 Stud walls: install steel back-plate or 2x10 solid wood blocking to stud prior to plaster or drywall finish. Provide plate with threaded studs or plugs.
 - .2 Hollow masonry units: use toggle bolts drilled into cell/wall cavity.
 - .3 Solid masonry: use bolt with lead expansion sleeve set into drilled hole.
 - .4 Toilet/shower compartments: use male/female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer. Supply templates, details and instructions for building in anchors in toilet compartments. Provide through bolt fastening of grab bars in toilet compartments.
- .3 Use tamperproof screws/bolts for fasteners.
- .4 Install mirrors using concealed fasteners in locations indicated.

- .5 Locate accessories where indicated on the drawings and/or as directed by the Consultant.

3.2 ACCESSORIES SCHEDULE

- .1 Provide the following accessories in the rooms listed as follows:

.1 **New Universal Washroom 111**

One(1)	.CH	Coat Hook
One(1)	.GB-1	Horizontal Grab Bar
One (1)	.GB-2	L-shaped Grab Bar
One(1)	.MIR1	Framed Tilted Mirror Barrier Free
One(1)	.SD	Soap Dispenser
One(1)	.SNS	Sanitary Napkin Disposal
One(1)	.STS	Stainless Steel Shelf
One(1)	.TTD	Toilet Tissue Dispenser
One(1)	.HD	Wall Mounted Hand Dryer
One(1)	SNCS	Special Needs Change Station (Wall Mounted)

.2 **Existing Washroom 111**

One(1)	.MIR1	Framed Tilted Mirror Barrier Free
One(1)	.SD	Soap Dispenser

End of Section

PART 1 - GENERAL

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|-----|------------------------------------|----|---|
| 1.1 | <u>General Requirements</u> | .1 | The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1, |
| | | .2 | This Contractor shall report in writing to the General Contractor and to the Consultant any defects of surfaces or work prepared by other trades which affect the quality or dimensions of this Contractor's work. Commencement of this Contractor's work shall imply complete acceptance of all work by other trades. |
| 1.2 | <u>Section Includes</u> | .1 | Gearless electric traction passenger elevator. |
| | | .2 | Elevator car enclosures, hoistway entrances and signal equipment. |
| | | .3 | Operation and control systems. |
| | | .4 | Accessibility provisions for physically disabled persons. |
| | | .5 | Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity. |
| | | .6 | Materials and accessories as required to complete the elevator installation |
| 1.3 | <u>Manufacturer</u> | .1 | Basis of Design
This specification is based on a Evolution 200 Self-Supported Machine Room Less (MRL)Traction Passenger Elevator by TK Elevator Canada . |
| 1.4 | <u>Quality Assurance</u> | .1 | Employ fully trained mechanics who are regularly employed in this field. |
| 1.5 | <u>Shop Drawings</u> | .1 | Submit five (5) copies of all shop drawings for the Architect to review. Do not commence work until reviewed drawings have been returned. |
| 1.6 | <u>Guarantee</u> | .1 | The Elevator Contractor shall guarantee the work and materials and will make good any defects, not due to ordinary wear and tear, or to improper use or care, which may develop within One (1) year from the date of substantial performance. |
| | | .2 | In addition, the Elevator Contractor shall provide a Ten (10) year manufacturer's extended warranty |
| | | .3 | Workmanship and any materials supplied and used in this work to be in strict accordance with this specification. |
| 1.7 | <u>Measurements</u> | .1 | General Contractor to confirm all hoist way measurements as per Elevator shop drawings. |
| 1.8 | <u>Maintenance</u> | .1 | A quality maintenance service consisting of regular examinations at least once a month, adjustments and lubrication of the elevator equipment shall be provided by the Elevator Contractor for a period of twelve (12) months after the elevator has been turned over for the owner's use and this service shall not be subcontracted. |
| | | .2 | All work shall be performed by competent employees during regular working hours of regular working days and shall include emergency 24 |

hour call back service. This service shall not cover adjustments or repairs due to negligence, misuse, abuse or accidents caused by persons other than the Elevator Contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided. This service shall be supplied by the elevator contractor and shall not be subcontracted.

.3 Separate Price

Provide a Separate Price for additional maintenance for a term of **sixty (60) months**. A detailed report at the end of the period is to be submitted by Elevator. Manufacturer to TDSB.

**1.9 Work
By Others**

.1 A properly framed and enclosed legal hoistway, including adequate guards and protection of hoistway during the erection period.

.2 Door jamb controller option - controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the top floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Final location must be coordinated with elevator contractor. These requirements must be coordinated between the general contractor and the elevator contractor.

.3 Hoistway must be maintained between 32°F (0°C) and 122°F (50°C) measured at the machine.

.4 Adequate supports to carry the loads of all equipment, including overhead machine and machine beams located in hoistway including supports for guide rail brackets.

.5 Complete 3 phase connections from the electric power mains to each controller, including necessary circuit breakers and fused mainline disconnect switches unless otherwise specified herein by elevator manufacture.

.6 Electric power of the same characteristics as the permanent supply without charge for the construction, testing and adjusting.

.7 Provide proper piping and conduit.

.8 Divider beams for rail bracket support as required.

.9 Cutting of walls floor, etc. and removal of such obstructions as may be necessary for proper installation of the elevator.

.10 Grouting of door sills, hoistway frames, and signal fixtures after installation of the elevator equipment.

1.9 Work

.11 All painting, except as otherwise specified.

By Others
(Cont'd)

- .12 Provide hoistway walls designed and constructed in accordance with the required fire rating (including those places where elevator fixture boxes, rail bracket fastenings, and any other penetration into the hoistway walls).
- .13 Temporary enclosures, barricades and other protection from open hoistways and elevator work area during the time the elevator is being installed to meet all permanent installation safety codes. A temporary work platform to be provided at the top landing across the hoistway; if required, it should conform to all code and safety requirements.
- .14 Smoke detector /sensing devices and contacts wired to elevator control as required by local code. A means to automatically disconnect the main line power supply to the elevator prior to the application of water in the elevator controller room shall be furnished by the electrical contractor. This means shall not be self-resetting.
- .15 Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
- .16 A standby power source, including necessary transfer switches and auxiliary contact, where elevator operation from an alternate power supply is required.
- .17 Adequate storage facilities for elevator equipment prior to and during installation at ground level within 150 feet of hoistway.
- .18 Setting of anchors and sleeves.
- .19 Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
- .20 For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
- .21 Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
- 22. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2019 areas) shall be provided at the same height, above sill of access door or handgrips.

1.10 **Codes**

- .1 Installation, elevator, components, accessories and operation must comply with all governing Codes and By-Laws including A17.1/CSA B44.
- .2 All welding of elevator components shall be done by a CWB certified company according to CSA Standards W47.1-92 and W59-1989.

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|------|--|----|--|
| 1.11 | <u>Fire-Rated Entrance Assemblies</u> | .1 | Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing 2-hour label by a Nationally Recognized Testing Laboratory |
| 1.12 | <u>Permit and Inspections</u> | .1 | Elevator contractor shall obtain and pay for all required inspections, tests, permits and fees for elevator installation. |
| | | .2 | Arrange for inspections and make required tests. |
| | | .3 | Deliver to the Owner upon completion and acceptance of elevator work. |
| 1.13 | <u>Site Conditions</u> | .1 | The Elevator Contractor to be familiar with job conditions on the site. |
| | | .2 | Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement. |

PART 2 - PRODUCTS

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|-----|------------------------|--|
| 2.1 | <u>Elevator</u> | MRL Gearless Traction Passenger |
| | | Rated Load: 1361 kg (3000 lb.) |
| | | Rated Speed: 200 fpm |
| | | Car Inside Dimensions: 2033 mm wide x 1676 mm deep |
| | | Hoistway Size: Refer to Architectural Drawings |
| | | Operation: EOX controller. Selective Collective (Simplex) |
| | | Car Controls: Illuminated Type with faceplate in Stainless Steel #4 finish. |
| | | Hall Call Stations: Illuminated type. Stainless steel #4 Cover plates. |
| | | Hoistway Entrances Size: 1067 mm wide by 2134 mm high |
| | | Door Frame: Non Standard: 240 mm thick block |
| | | Type: Single Slide Left or Right |
| | | Door Operations: Automatic ECI operator for hoistway and car. Opening and closing speed to suit Barrier Free requirements. |
| | | Travel: Refer to Architectural Drawings. |

Stops: **Two (2)**

Openings: **Two (2 Front)**

Power Supply: 400 V, 3 phase, 60 Hertz.

Lighting Supply: 120 Volts, 60 Hertz.

Elevator must comply with CAN 3-B44- (Latest Version Including Supplements) Code for Passenger and Freight Elevators. Elevators must meet the appendix E barrier free requirements.

2.2 **Car Cab**

.1 Shell Enclosure:

- .1 Car Top 14 g. (1.9mm) furniture steel, white enamel finish.
- .2 Shell Walls 16 ga. (1.52mm) furniture steel - cage frame type construction.
- .3 Strike Column 16 ga. (1.52mm) Stainless steel #4.
- .4 Fascia 16 ga. (1.52mm) Stainless steel #4, full width, straight type.
- .5 Car Doors 16 ga. (1.52mm) Stainless steel #4 clad car door.

.2 Architectural Features:

- .1 Side Walls: Plastic Laminate - raised hang-on panels removable from inside the car. Colour to be selected by Consultant from full range of colours. Refer to Colour Schedule.
- .2 Front Return: Stainless steel
- .3 Car Door: Stainless steel
- .4 Base: **Stainless Steel # 4**
- .5 Reveals: **Stainless Steel # 4**
- .6 Flooring: Shall be supplied and installed by others.
- .7 Hoistway Doors and Frames: At All Floors: Finish to be **Stainless Steel #4**.

.3 Supplementary Features:

- .1 Lighting: LED downlight type mounted in stainless steel #4 ceiling panels.
- .2 Ventilation: Single speed fan.
- .3 Emergency Exit: Top exit in car top in accordance with code.
- .4 Car sill(s): Extruded Aluminum.

2.2 **Car Cab
(Cont'd)**

- .5 Overall Height: 2438mm (8' 0") (2286mm clear inside)
- .6 Car Operating Station Buttons:
 - .1 Braille and tactile buttons to be horizontally sequenced rather than vertically
 - .2 Buttons located maximum 890 -1220mm from floor for accessibility by the handicapped.
- .7 Handrail: Located on all non-entrance walls: **6 mm x 102 mm Flat Stainless Steel #4.**
- .8 Pad Hooks with Cab Pads –One set for each elevator.
- .9 Other Buttons: Emergency stop switch, alarm button door open button, door close button.
- .10 Emergency Car Lighting: An emergency power unit employing a 6 volt sealed rechargeable battery and totally static circuits shall be provided that shall illuminate the elevator car and provide current to the alarm bell in the event of normal power failure. The equipment shall comply with the requirements of the current Code.
- .11 Labels: Entrances shall be manufactured in accordance with procedures established by Under-Writers laboratories and shall be so labelled.
- .12 Sight Guards: Sight guards shall be furnished on the leading edge of the doors to conceal the hoistway beyond the doors. Finish to match door panels.
- .13 Car Floor Indicator: One (1) to be installed in each car as part of the car station.
- .14 Hall Floor Indicator: One (1) for each elevator to be installed at main landing.
- .15 Certificate Frame: Stainless Steel #4.
- .16 Car Lantern and Gong: A directional lantern visible from the corridor shall be provided in the car entrance.
- .17 Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.3 **Hoistway
Equipment**

- .1 Platform: Fabricated frame of formed or structural steel shapes, gusseted and riveted/clinch. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

- .2 Deflector Sheaves: None
- .3 Guide Rails: Dry, non-lubricated steel, fastened to the building with steel brackets.
- .4 Guides: Slide guides shall be mounted on top and bottom of the car.
- .5 Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Predefined buffer stands for 4' and 5' pit depths.
- .6 Machine: The hoisting machine shall be a compact energy efficient permanent magnet Gearless traction type, consisting of PMAC motor, brake and driving sheave mounted on a rigid bedplate in the top of the hoistway. A large solid, forged shaft shall serve as support for the motor rotor assembly and for the drive sheave and brake system. It shall be supported by roller bearings mounted in the machine housing.
- .7 Drive System:
 - .1 The drive system shall be of the Variable Voltage Variable Frequency (VVVF) regenerative.
 - .2 The system shall be a vector controlled pulse-width modulated AC drive. The variable voltage variable frequency drive shall convert the AC power supply using a two-step process to a variable voltage variable frequency power supply for use by the hoist motor.
 - .3 The speed control shall be by means of vector control providing direct torque and field excitation automatically provided by permanent magnet. A digital absolute velocity encoder shall be provided giving feedback to the controller on armature position and motor speed.
 - .4 Dual solid state electronics (IGBT Insulated Gate Bipolar Transistor) in series shall be used in place of mechanical contactors.
- .8 Motor/Machine: The motor shall be PMAC, totally enclosed, non-ventilated with class "F" insulation. The motor armature shall be dynamically balanced and supported by roller bearings of ample capacity. The armature and driving sheave shall be properly balanced for smooth, high-speed elevator performance. The PM machine shall be mounted horizontally in the top of the hoistway in a unitized formed steel structure on bearing plates furnished by the elevator installer. The unitized formed steel structure shall be securely fastened to the supports supplied by other trades.
- .9 Brake: The brake shall be a spring applied electric brake; held open by an electro-magnet actuated by a digital brake controller and designed to make smooth, positive stops. The Brake shall be designed to

automatically apply in the event of interruption of power supply from any cause. Operation and control of the brake shall be all digital. The setting and lifting of the brake shall be software based and all electronic. All adjustments and setup of the brake shall be made using a PC interface. No contactors or resistors shall be used in the actuation of the brake.

- .10 **Suspension Belts and Governor Rope:** Suspension belts shall be flat belts of polyurethane with an inner core of 14 steel cords with an FT1 fire rating such that hoistway sprinklers are not required by NFPA-13. Each belt shall have a suspension strength of 64 KN (14,388 pounds) for 150 and 200 fpm car speed. Suspension strength increases to 80 KN (17,985 pounds) for 350 fpm car speed.
 - .1 Three belts.
 - .2 Suspension tension monitor shall detect differences in belt tension and for loss of tension. If fault is detected, the car shall stop at the nearest floor and an Out of Service call be registered.
 - .3 Trip criteria shall be monitored, and data shall be stored in redundant non-volatile locations. Belts shall be replaced prior to the end of service life. Messages shall be issued at 180, 90, and 30 days prior to the last day of service life.
 - .4 Governor ropes shall be of steel wire construction.
 - .5 Any special tools, devices, software or equipment required for monitoring the wear of suspension shall be included with the installation of the equipment and become the property of the owner at time of elevator completion. This includes special ongoing monitoring systems, special tools and instruction needed to monitor the suspension system.
- .11 **Counterweight:** Counterbalance each elevator for smooth and economical operation by using steel and/or cement weights securely fastened in a steel counterweight frame. Counterweight shall equal the weight of the complete elevator car and approximately 50 percent of the specified capacity load.
- .12 **Safety and Governor:** Car safety shall be mounted on the bottom members of the car frame and be operated by a centrifugal speed governor. The governor shall be designed to cut off power to the motor and apply the brake whenever the governor indicates the car has excessive speed. The governor shall function when the car over speeds.
- .13 **Emergency Terminal Limits:** Place electric limit devices in the hoistway near the terminal landings. Limit switch(es) shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.
- .14 **Automatic Self-Leveling:** Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for

over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained at approximately level with the landing irrespective of its load

**2.4 Control
Systems**

- .1 Controller: The elevator control system shall be microprocessor based and software oriented. The system shall operate in real time, continuously analyzing the car(s) changing position, condition, and work load. All controller and operational circuits including the brake control and drive system shall be digital. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
 - .1 Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.
 - .2 When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.
 - .3 When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.
 - .4 A car that is stopping for the last hall call in the preference direction, and that hall call is for the opposite direction with no onward car calls, shall reverse preference when the selector position advances to the landing at which the car is committed to stop. A car that is stopping for the last hall call in the preference direction, and that hall call is for the same direction, shall hold its preference until the door is almost closed allowing time for a passenger to register an onward car call which shall maintain the preference. If no car call is registered before the door is almost closed, the car shall lose its preference and shall be available to accept calls in either direction.
- .2 Operation: Selective Collective – ETA based. The system is optimized to get a car to the floor where a hall call has been registered, in the

shortest time. The system receives input information from standard call pushbuttons located in the hall, car position and car load information from individual car loadweighers.

- .1 When group operation is required, the group supervisory operation shall be embedded within selected car controllers. No separate group controller shall be supplied. The microprocessor shall constantly scan the system for hall calls. When hall calls are registered, the control system shall immediately calculate the estimated time for arrival using such information as, number of floors to travel from the current position, the time it takes to travel one floor at top speed, calls assigned to a car, and car reversal time to respond to a call in the opposite direction of travel. When a car's status changes or additional hall calls are registered, the estimated time of arrival shall be recalculated and calls reassigned if necessary.
- .2 Traffic Pattern: The microprocessor shall provide flexibility to meet well defined patterns of traffic, including up peak, down peak, and heavy interfloor demands, and adjust for indeterminate variations in these patterns which occur in buildings.
- .3 Artificial Intelligence: Artificial Intelligence shall be an integral part of the group control system software. The enhanced artificial intelligence shall optimize the interfloor traffic performance. Inputs for the artificial intelligence shall include accurate passenger load from an electronic loadweigher, probable car calls generated from each hall call, type of building and observed traffic patterns.
- .3 Load Weighing Device: Provide a load weighing device on each car which, when the particular car is filled to an adjustable percentage of the capacity load, shall cause the car to bypass landing calls but not car calls. The passed landing calls shall remain registered for the next following car.
 - .1 The device shall be unaffected by the action of compensating chain or rope. The device shall detect a 50-pound (23 Kg.) load change under all conditions.
 - .2 The load sensor shall use a load cell to accurately measure the weight in the car. The information shall be transferred via a serial link to the elevator controller.
- .4 Anti-Nuisance Call Control: The microprocessor control system shall evaluate the number of people on the car and compare that value to the number of car calls registered. If the number of car calls exceeds the number of people by a field programmable value, the car calls shall be canceled after the first call has been answered.
- .5 Position Selector: The position selector shall be part of the microprocessor system. The car position in the hoistway shall be digitized through a primary position encoder. The microprocessor control system shall store the floor position and slow down points in memory.

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- .6 Motion Control: The drive control system shall be dual-loop feedback system based primarily on car position. The velocity profile shall be calculated by the microprocessor control system producing extremely smooth and accurate stops. The velocity encoder shall permit continuous comparison of machine speed to velocity profile and to actual car speed. This accurate position/velocity feedback shall permit a fast and accurate control of acceleration and retardation.
- .7 Motor Pre-Torque: Current shall be applied to the elevator drive before the brake is released and the speed pattern is dictated to eliminate roll back and sling shot effects of unbalanced loads in the car. The electronic loadweigher shall determine the load on the car determining a pre-torque reference to send to the drive.
- .8 Emergency Power Operation: In the event of power loss, this elevator(s) should be equipped with a battery powered automatic rescue operation device. This operation is designed to only move the car up or down to the nearest landing depending on the load in the car. It is NOT designed to lower the car to a specified landing such as Battery Lowering used for Hydraulic applications. An isolation transformer is required if the building voltage is NOT 480VAC. A single rescue unit is not capable of rescuing a group of cars --- this is a per car option. Maximum travel on rescue operation is 100 feet. Average time of operation for Rescue is 3 minutes. This feature is only available for jobs with 60HP and below. This battery automatic rescue operation is not allowed with the Green Drive.
- .9 Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- .10 Digital Services:
Cloud-based IoT Monitoring System (standard): Contractor shall provide a cloud-based IoT (internet of things) monitoring system capable of tracking door movements and timing, trips, power cycles, car calls, out-of-service events and modes. This observation will continue 24/7 and it shall be capable of providing service technicians a minimum of three recommended solutions for defined failure events and automatically dispatch service technicians in the event of failure(s) while sending notifications to end users of changes in their equipment's state via both email and mobile device. Access to IoT and related equipment data and status will be made available in both a web portal and mobile application secured by password and username with at least two-factor authentication. Finally, this system must be self-contained and not require internet provision by others.
- 2.5 **Door Operation**
- .1 Doors on the car and at the hoistway entrances shall be power operated by means of a quality operator mounted on top of the car. The motor shall have positive control over the door movement for smooth operation. The car door shall have a safety shoe to cause instant re-opening should contact be made with any obstruction during the closing cycle.
- .2 Door operation shall be automatic at each landing with door opening

being initiated as the car arrives at the landing and closing taking place after expiration of a time interval. A car door electric contact shall prevent starting the elevator away from the landing unless the car door is in its closed position.

- .3 Door hold / delay button to be provided to allow disabled persons to control door close operation as needed.
- .4 An approved positive interlock shall be provided for each hoistway entrance which shall prevent operation of the hydraulic unit unless all doors for that elevator are closed and shall maintain the doors in their closed position while the elevator is away from the landing. Provide emergency access to the hoistway as required by governing codes.
- .5 The elevator contractor shall install at each landing served, a hoistway entrance of the type and size as previously described. Each entrance shall consist of flush hollow metal doors with build in hanger assembly, frames assembled for one piece unit installation, extruded aluminum sill, fascia, toe guard, hanger cover, header, hanger track assembly, and formed structural strut supports. Entrance design and construction must be in compliance with NBC 1975 requirements for fire labels.
- .6 Sill supporting angles required for flush hoistway construction shall be furnished by the elevator contractor.
- .7 Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams supporting 2D or 3D light curtains per code. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.6 **Telephone &
Video**

- .1 Elevator shall have two way verbal and non verbal communication via video (in-cab camera) and audio (VoIP phone lines) and LCD screen within the cab, with 24/7 monitoring, separate internet connection from the rest of the building (such as direct data cable connection or cell modem sim card data drop coordination with client networks, firewalls, security protocols-extensive) within the machine room..
- .2 All communication systems must operate for a least 4 hours during a power loss.
- .3 An ADA-approved AUTODIAL telephone shall be furnished and installed as part of the car station A separate phone line to the elevator controller shall be provided and located in the elevator machine room under another section of the specifications.
- .4 Must be compatible with TDSB software for audio & visual 2 way communication **MosaicONE by MAD Elevator INC.**

2.7 **Special**

- .1 Provision for card reader in car (card reader provided and installed by

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| | <u>Emergency Service</u> | others). |
| | | .2 Battery powered emergency lowering operation. |
| | | .3 Provide equipment according to seismic zone |
| 2.8 | <u>Non-Proprietary Controls</u> | .1 Elevator control equipment must be non-proprietary, a site specific service tool which renders the control equipment non-proprietary must be provided with the elevator (ie. Map unit type, diagnostic service tool). The controller interface/service tool shall allow full access to fault codes and maintenance related parameters, and shall allow complete and thorough maintenance service to be performed by any properly licensed and qualified elevator Service Company. The controller and/or site specific service tool must come with a user's manual that effectively communicates to a qualified mechanic how to use the controller and/or tool, and also defines and explains all respective error codes, including required fixes. The service tool shall remain property of the building owner. |
| 2.9 | <u>Controller Location</u> | Location: Door Jamb Mount is integrated with controller in the door jamb. Control power and cab light are provided by the elevator contractor and included with the integrated assembly. Main power disconnect is provided by others. |

PART 3 - EXECUTION

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| 3.1 | <u>Examination</u> | .1 Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer. |
| | | .2 Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. |
| 3.2 | <u>Installation</u> | .1 Install elevator systems components and coordinate installation of hoistway wall construction. |
| | | .1 Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings. |
| | | .2 Comply with the National Electrical Code for electrical work required during installation. |
| | | .2 Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced |

foreman.

- .3 Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- .4 Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS Standards for workmanship and for qualification of welding operators.
- .5 Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- .6 Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- .7 Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- .8 Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- .9 Lubricate operating parts of system, including ropes, as recommended by the manufacturer.

3.3 Field Quality Control

- .1 Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- .2 Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 Adjusting

- .1 Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

-
- 3.5 **Cleaning**
- .1 Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.
- .2 At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
- .1 Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.
- 3.6 **Protection**
- .1 At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.
- 3.7 **Demonstration**
- .1 Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- .2 Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

End of Section

1.0 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 The General Conditions of the Contract, Supplementary Conditions, and the General Requirements of Division 1, form part of this section, and must be read in conjunction with the requirements of this section. The work of this section shall comply with all requirements of Division 1 – General Requirements.

1.2 SECTION INCLUDES

- .1 Provision of all labour, materials, equipment and incidental services necessary to provide window shades as follows:
 - .1 Unenclosed vertical platform lift.

1.3 REFERENCES

- .1 CSA B44 - Safety Code for Elevators and Escalators.
- .2 CSA B355 - Lifts for Persons with Physical Disabilities.
- .3 ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- .4 NFPA 70 - National Electric Code.
- .5 CSA - National Electric Code.

1.4 SUBMITTALS

- .1 Submit under provisions of Section 01 30 00:
 - .1 **Product Data:** Manufacturer's data sheets on each product to be used, including:
 - .1 Submit manufacturer's installation instructions, including preparation, storage and handling requirements.
 - .2 Include complete description of performance and operating characteristics.
 - .3 Show maximum and average power demands.
 - .2 **Selection Samples:** For each finished product specified, provide two complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - .3 **Verification Samples:** For each finished product specified, two samples, minimum size 1-3/4 inch by 2-1/4 inches, representing actual product, color, and patterns
 - .4 **Shop Drawings:**
 - .1 Show typical details of assembly, erection and anchorage.
 - .2 Include wiring diagrams for power, control, and signal systems.
 - .3 Show complete layout and location of equipment, including required clearances and coordination with shaftway.

1.5 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Firm with minimum 10 years experience in manufacturing of vertical platform lifts, with evidence of experience with similar installations of type specified.
- .2 Installer Qualifications: Licensed to install equipment of this scope, with evidence of experience with specified equipment. Installer shall maintain an adequate stock of replacement parts, have qualified people available to ensure fulfillment of maintenance and callback service without unreasonable loss of time in reaching project site.

1.6 REGULATORY REQUIREMENTS

- .1 Provide platform lifts in compliance with:
 - CSA B355 - Lifts for Persons with Physical Disabilities.
 - CSA B44.1/ASME A17.5 - Elevator and Escalator Electrical Equipment.
 - CSA - National Electric Code.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Store products in manufacturer's unopened packaging until ready for installation.
- .2 Store components off the ground in a dry covered area, protected from adverse weather conditions.

1.8 PROJECT CONDITIONS

- .1 Do not use wheelchair lift for hoisting materials or personnel during construction period

1.9 CLOSEOUT SUBMITTALS

- .1 Operations and Maintenance Data
 - .1 Submit data for inclusion into Operations and Maintenance manuals in accordance with Section 01 78 00.

1.10 WARRANTY

- .1 Submit a manufacturer's warranty certificate in the name of the Owner, warranting the Products specified under this section against defects in material or manufacture for a period of Two (2) years from Date of Substantial Performance.
- .2 **Extended Warranty:** Provide an extended manufacturer's warranty covering the wheelchair lift materials and workmanship for the following additional extended period beyond the initial two year warranty. Preventive Maintenance Agreement required. Five Years (7 years total).

2.0 PRODUCTS

2.1 MANUFACTURERS

- .1 Acceptable Manufacturers:
 - .1 Savaria – V-1504
 - .2 Garaventa Lift Group -Genesis compact lift

2.2 VERTICAL PLATFORM LIFT

.1 ENCLOSED VERTICAL PLATFORM LIFT

- .1 Capacity:** 750 lbs (340 kg) rated capacity.
- .2 Mast height:** model GVL-EN-42, (1143mm) maximum lifting height
- .3 Platform size:** nominal clear platform dimensions:
 - .1** Garaventa Compact size: 36 inches (914 mm) by 49 1/2 inches (1257 mm) clear platform dimensions.
- .4 Platform configuration:**
 - .1** Straight through: front and rear opening.
- .5 Landing openings:**
 - .1** Lower landing: door
 - .2** Upper landing: gate.
- .6 Door and gates:**
 - .1** To be self closing type
 - .2** Door height: flush mount, 80 inches (2032)
 - .3** Gate height: flush mount, 42 1/8 inches (1070)
 - .4** Door construction: aluminum frame with:
 - .1** Panels of 1/4 inch (6mm) laminated safety glass with 16 gauge stainless steel kickplate.
 - .2** D- handle pull: 12inch (305 mm) offset D-handle
- .7 Power door/gate operator:** automatically opens door/gate when platform arrives at a landing. Will also open at landing by pressing call button.
 - .1** Low voltage, 24 vdc with all wiring concealed.
 - .2** Location:
 - .1** Lower landing: door
 - .2** Upper landing: gate
- .8 Lift Components:**
 - .1** Machine Tower: Extruded aluminum.
 - .2** Base Frame: Structural steel.
 - .3** Platform Side Wall Panels: 42-1/8 (1070 mm) inches high. 16 gauge (1.5 Custom aluminum extrusion tubing frame.
 - .4** Enclosure Panels:
1/4 inch (6 mm) laminated safety glass.
 - .5** Enclosure Height Above Upper landing:
 - .1** Enclosure shall extend 42-1/8 inches (1070 mm) above the upper landing level.
- .9 Pit**
 - .1** Nominal 75 mm depth or as required by lift manufacturer
 - .2** Required pit light and power receptacle by Division 26

3.1 EXECUTION

3.1 INSTALLATION

.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 Verify shaft and machine space are of correct size and within tolerances.
- .3 Verify required landings and openings are of correct size and within tolerances.
- .4 Verify electrical rough-in is at correct location.
- .5 If substrate preparation is the responsibility of another installer, notify Consultant of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- .1 Install lifts in accordance with applicable regulatory requirements including CSA B355, and manufacturer's instructions.
- .2 Install system components and connect to building utilities.
- .3 Accommodate equipment in space indicated.
- .4 Startup equipment in accordance with manufacturer's instructions.
- .5 Adjust for smooth operation.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in compliance with CSA B355 and required by authorities having jurisdiction.
- .2 Schedule tests with agencies and Architect, Owner, and Contractor present.

3.5 PROTECTION

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion

END OF SECTION

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23 34 00	HVAC Fans
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23 82 29	Convectors, Cabinet Heaters and Radiant Panels
25 20 11	Building Automation Systems and Controls

END OF SECTION

PART 1 – GENERAL

1.1 WORK INCLUDED IN THIS SECTION

- .1 Refer to drawings for detailed demolition scope of work.
- .2 All existing building services not affected by this work shall be maintained in operation during and after the demolition work is complete. Any accidental interruption of existing building services not required by this project will be promptly repaired at no additional cost to the Board.
- .3 Prior to removing any piping, ensure the system is completely isolated and is not live.
- .4 Complete all work impacting existing Building Operations after hours only.

1.2 QUALIFICATIONS

- .1 Work of this section shall be executed by trades personnel having a minimum of five years' experience in the demolition field and capable to deploy adequate equipment to complete the work in an efficient and orderly manner.

1.3 EXAMINATION

- .1 Examine existing property. Determine the nature of materials to be removed.

1.4 SALVAGE

- .1 The Board Representative will review the Site prior to commencement of demolition and instruct the Contractor, in writing, as to the items to be retained for re-use or be turned over to the Board. In the absence of such specific instructions, materials from demolition shall become property of Mechanical Contractor who shall promptly remove all salvageable material and debris from Site.
- .2 Remove and store indicated items for future use by the Board. Remove, handle and transport such items to storage area designated by the Board Representative. Perform such work carefully and with diligence to prevent any damage to the items during removal and in storage. Store material to be salvaged, neatly on wooden pallets, where directed by Board.

1.5 MAINTAINING TRAFFIC

- .1 Maintain and preserve Board's access requirements within, to and from existing building in areas where demolition and removal work is being carried out.
- .2 Do not close, obstruct, place or store material in Board's driveways and passageways. Conduct operations with minimum interference with roads, streets, driveways, user traffic and passageways.

1.6 HAULING OPERATIONS

- .1 Maintain roadways and paving in the hauling areas clean on a daily basis and as required by Municipal Authorities.

1.7 INTERRUPTIONS TO BOARD'S OPERATIONS

- .1 There will be absolutely no interruptions to the School schedule during demolition work. Therefore, it is imperative that operations and machine and equipment movements, deliveries and removals are executed at time or times that will permit uninterrupted Board's operations in and around the school, including parking, receiving areas, deliveries and site and access and egress.
- .2 Where interruptions of domestic cold and hot water are necessary, coordinate with the School Representatives the timing and duration of such interruptions.

1.8 SAFETY REQUIREMENTS

- .1 Coordinate posting of danger signs conspicuously around property. Close doorways and thoroughfares giving access to area of demolition with barricades.
- .2 Provide a competent, experienced supervisor in charge of the Work and on Site while work is in progress.
- .3 Should any suspect designated substance not already identified, be encountered, cease work in the immediate area and immediately report, to the Board. Board is responsible for removal of designated substances.

1.9 PROTECTION

- .1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, parts of existing building to remain. Make good any collateral damage caused by demolition.
- .2 Take precautions to support affected structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify Board.
- .3 Prevent debris from blocking drainage systems (floor drains) or other mechanical and electrical systems that must remain in operation.
- .4 Protect building floors against damage from demolition work. Use ½" plywood covers over floor where lifting, moving, rolling of removed equipment is anticipated. Be responsible for repairing any damage to flooring caused by the work defined in this section. Execute repairs to the satisfaction of the Board at no cost to the Board.

PART2 - PRODUCTS

Not applicable

PART3 – EXECUTION

3.1 DEMOLITION

- .1 At the end of each day's work, leave site in a safe condition and erect safety barriers and lights as required. Ensure that no parts of the existing building are in danger of collapsing.
- .2 Review the requirements of new equipment to be installed. Perform all demolition work required to allow for the new equipment to be installed, whether shown on the drawings or not.
- .3 Control dust and dirt produced during demolition.
- .4 Provide any additional labour, materials and services not specifically indicated on the drawings but required to complete the work.
- .5 Dispose of demolished materials in accordance with the requirements of Authorities Having Jurisdiction.
- .6 At the end of demolition work, leave site in broom-clean condition. Clean existing surfaces specified to receive new applied finishes to ensure proper adherence.
- .7 Do not disturb adjacent structures or equipment designated to remain in place.
- .8 Confine operations and workers to those parts of the building which are defined on the drawings and exercise great care not to damage existing construction beyond that necessary for the carrying out of new work. Make good any such damage in every respect, to the satisfaction of the Board.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 This section of the specification is an integral part of the Contract Documents and shall be read accordingly.
- .2 Where applicable, all portions of the Mechanical Supplementary Tender Form shall be submitted by bidders.

1.2 DUTIES OF MECHANICAL CONTRACTOR

- .1 The mechanical contractor shall assume the responsibilities and duties including but not limited to the ones described below:
- .2 Superintendence
 - .1 Provide full time on-site superintendent personnel and supporting staff with proven experience in project of similar value and complexity.
 - .2 Site superintendent shall have over-all authority to speak for and represent the mechanical contractor.
- .3 Coordination
 - .1 Coordinate the work with all the sub-trades involved to ensure that the work will be carried out on schedule and in proper sequence.
 - .2 Take complete responsibility for all remedial work that results from failure to coordinate any aspect of the mechanical work prior to its fabrication and/or installation.
 - .3 Take responsibility for the delivery of equipment necessary to complete the work in accordance with the approved schedule.
- .4 Staffing and Scheduling
 - .1 Within seven days after the award of the contract, the Mechanical Contractor shall provide to the Owner's representative the following information:
 - 1 Appointment of official representatives in the project.
 - 2 Schedule of work.
 - 3 Delivery schedule for specified equipment.
 - 4 Requirements for temporary facilities, site signs, storage, etc.
- .5 Work Completion Meeting
 - .1 Prior to application for Substantial Performance of the Work, the mechanical contractor shall participate in the take-over meeting. Agenda to include the following:

- 1 Review of outstanding deficiencies.
- 2 Submission of maintenance manuals, warranties and as-built drawings.
- 3 Results of performance tests and described further in this section.
- 4 Scheduling of training to Owner's personnel.

1.3 INTENT

- .1 Bidders for this work shall include for all labor, material, equipment and all other related cost including all applicable taxes (except HST) and fees to provide the work as indicated on the drawings.
- .2 Misinterpretation of any requirement of the drawings and specifications will not relieve the Mechanical Contractor of responsibility. If in any doubt, the Mechanical Contractor shall contact the Consultant for written clarification prior to submitting a bid for the Work.
- .3 Supplementary to definitions established are:
 1. "Concealed" means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, or partitions.
 2. "Exposed" means work normally visible, including work in equipment rooms, tunnels, and similar spaces.
 3. "Provide" (and all tenses) means supply and install for a complete, operational, and code-compliant system, including all devices, equipment, materials, accessories and/or components as specified or as otherwise required for a complete, operational, and code-compliant installation.
 4. "Install" (and all tenses) means secure in position, connect as specified, test, and verify.
 5. "Supply" means to supply all devices, equipment, materials, accessories and/or components to the responsible trade.
 6. "Remove" means to isolate, disconnect, disassemble, remove, and dispose of all devices, equipment, materials, accessories and/or components. Patch and make good all surfaces affected by the removal. Remove and dispose of all redundant material off site.
- .4 Where used, wordings such as "approved, to approval, as directed, permitted, permission, accepted, acceptance", shall mean: approved, directed, permitted, accepted, by authorized representative of the Owner.

1.4 INTERFERENCES

The mechanical drawings do not show all the architectural and structural details, and any information involving accurate measuring of the building shall be taken from the building drawings or at the building. Make without additional change, any necessary changes or additions to the runs of drains, pipes, ducts, etc., to accommodate the above conditions. The

- location of equipment may be altered without charge providing the change is made before installation and does not necessitate major additional material.
- .2 Wherever differences occur between specifications, riser diagrams or schematics and drawings, the maximum conditions shall govern and the bid shall be based on whichever information indicates the greater cost.
 - .3 Field verifications of dimensions on plans shall be made since actual locations, distances, and levels will be governed by actual field conditions.
 - .4 Discrepancies between different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the Consultant for a decision.
 - .5 Install all mechanical services including but not exclusive to drains, pipes, and ducts, to conserve headroom and interfere as little as possible with the free use of the space through which they pass. Install as high as possible, unless otherwise directed by the Consultant. All drains, pipes, ducts, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, shall be installed only after the locations have been approved by the Consultant. Special care shall be taken in the installation of all mechanical services including, but not exclusive to drains, pipes, and ducts, which are to be concealed, to see that they come within the finished lines of floors, walls, and ceilings. Where such drains, pipes, ducts, etc., have been installed in such a manner as to cause interference, they shall be removed and re-installed in suitable locations without extra cost to the Owner.
 - .6 Before commencing work, check and verify all grade and invert elevations, stacks, levels, and dimensions, to ensure proper and correct installation of the work.
 - .7 In every place where there is space indicated as reserved for future or other equipment, leave such space clear, install blank offs, shut off valves with blind flanges and other work so that the necessary connections can be made without any stoppages to the system. Consult with the consultant whenever necessary for this purpose.
 - .8 In addition to the work specifically mentioned in the Specifications and shown on the drawings, provide all other items that are obviously necessary to make a complete working installation, including those required by the Authorities Having Jurisdiction over the work.
 - .9 The mechanical plans show approximate locations for wall mounted devices. Obtain Consultant's approval of mounting heights and locations before commencement of work.
 - .10 Prepare and submit complete interference drawings (in PDF format) to avoid and/or resolve conflict of trades and to coordinate the work of the Mechanical Division with that of all other Trades. Submission of interference drawings shall be done no later than 10 business days after the Project has officially begun. The cost of producing the interference drawings shall be included for in the Base Tender Price.
 - .11 Include costs (in the Base Tender Price) for the services of a third-party to 3D scan the entire area of construction upon completion of demolition. System shall be Matterport or similar. The

intent to is capture and submit to the Consultant a full 3D perspective of the space. This model shall be used to identify any potential conflicts ahead of installation and ordering of equipment to allow for quick resolution of site conflicts. 3D Model shall capture all architectural, structural, mechanical and electrical conditions on site and all such conditions shall be part of the model. The model, along with site verifications, shall be used as the basis for interference drawings.

1.5 EXAMINE SITE

- .1 Examine the site and the local conditions affecting the work. Examine carefully all drawings and the complete specifications to ensure that the work can be satisfactorily carried out as shown. No allowance will be made later for any expenses incurred through the failure to make these examinations or to report any such discrepancies in writing to the Consultant.

1.6 SUBCONTRACTOR'S SHOP

- .1 Provide Job site office, work-shop, tools, scaffolds, material storage, etc., as required to complete the work.

1.7 CLEANING

- .1 During the performance of the work and on the completion, remove from the place of the work all debris, rubbish and waste materials caused by the performance of the work. Remove all tools and surplus materials after completion and acceptance of the work.
- .2 All equipment shall be thoroughly vacuumed out at the time of final acceptance of the work.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Protection of Equipment:
 - .1 Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 - .2 Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Consultant. Such repair or replacement shall be at no additional cost to the Owner.
 - .3 Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 - .4 Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- .2 Cleanliness of Piping and Equipment Systems:

- .1 Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
- .2 Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
- .3 Clean interior of all tanks prior to delivery for beneficial use by the Owner.
- .4 Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.9 INSTALLATION OF WORK

- .1 Be responsible for:
 - .1 The layout of the work shown on the drawings and specified herein, and for any damage caused to the Owner by improper location or carrying out of this work.
 - .2 The prompt installation of the work in advance of concrete pouring or similar work.
 - .3 The condition of all material and equipment supplied and for the protection and maintenance of work completed.
- .2 Coordinate with other trades and schedule all work to suit the date for the substantial performance established in the construction contract.
- .3 Furnish items to be "built-up" in ample time and give necessary information and assistance in connection with the building in of the same.
- .4 Proceed with the work as quickly as practical so that construction may be completed in as short a time as possible and in accordance with the building schedule.
- .5 Ensure that all equipment and material is ordered in time to meet the building schedule. Provide a schedule of equipment deliveries to the Owner within the time limit stipulated.
- .6 Furnish promptly information required for the construction schedule.
- .7 Manufactured products supplied with instructions for their installation shall be installed in strict accordance with those instructions.
- .8 All new ductwork and piping shall be supported from a secondary structure site supplied and installed by the Contractor consisting of unistruct (or alternate as necessary) structure fastened to the building OWSJ structure. No supporting of piping, conduits ductwork or equipment from the roof deck will be permitted.

1.10 CODES, PERMITS, FEES AND CONNECTIONS

- .1 Conform to Federal, Provincial and Municipal regulations and perform work in accordance

- with requirements of By-Laws and Regulations in force in area where the building is to be erected.
- .2 Apply for, obtain, and pay for all permits, fees and service connections for the work and the inspections required by Authorities Having Jurisdiction in the area where the building is to be erected.
 - .3 In particular, coordinate with and pay for the local gas supply company to adjust/modify/replace the existing gas meter assembly and PRV as required to ensure that the available gas pressure is adequate for all gas fired equipment to operate simultaneously at maximum capacity. The minimum gas pressure at the boiler shall not be less than 8" w.g. under simultaneous maximum operating condition of all gas-fired equipment.
 - .4 For information, a specific code or standard might be mentioned. This information must not be taken as the only code or standard applicable.
 - .5 When part of equipment does not bear the required CSA label, the contractor shall obtain from CSA or Hydro Electric Power Commission, when that part of the equipment is an electric component, a special approval and pay the applicable fees.
 - .6 Furnish necessary certificates as evidence that the work installed conforms with laws and regulations of Authorities having jurisdiction. Changes in work requested by an Authority having jurisdiction shall be carried out without charge.

1.11 MATERIALS

- .1 Where materials, equipment, apparatus, or other products are specified by the manufacturer, brand name, type or catalogue number, such designation is to establish standards of desired quality style or dimensions and shall be the basis of the Bid. Materials so specified shall be furnished under this Contract, unless changed by mutual agreement. Where two or more designations are listed, the Contractor shall base the submitted Tender Price based on the base specified equipment; any approved alternate will only be entertained after Notification of Award.

1.12 BASE BID SPECIFIED EQUIPMENT & SUBSTITUTIONS WITH APPROVED ALTERNATES

- .1 Requests for substitutions will not be accepted prior to the Notification of Award. Substitutions will be considered:
 - 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.

1.13 MATERIAL SUBSTITUTIONS

- .1 After execution of the Contract, requests for substitution of materials of makes other than those specifically named in the Contract Documents may be approved by the Consultant, subject to owner's review and acceptance of the financial credits involved.
- .2 In the absence of such express approval by the Consultant, the Mechanical Contractor will be held to furnish specified items under the base bid.

1.14 SHOP DRAWINGS AND SAMPLES

- .1 Submit to the Consultant detailed dimension shop drawings and installation wiring diagrams for all mechanical equipment. Further details and special requirements called for in these specifications shall be shown on the shop drawings.
- .2 Ensure that copies of all reviewed shop drawings are available on the job site for reference.
- .3 Provide samples of mechanical equipment as requested in the specification at the same time as the shop drawing submission.
- .4 **The Mechanical Contractor is responsible for consolidating all Mechanical Shop Drawings and submitted them in no more than three (3) packages as per the following:**
 1. HVAC Equipment and Material.
 2. Plumbing Equipment, Fixtures and Material.
 3. Fire Protection Equipment, Fixtures and Material.

Individual shop drawings not consolidated will not be accepted.

1.15 AS-BUILT DRAWINGS

- .1 Maintain up to date "as built" drawings on site.
- .2 At the conclusion of the project, the Consultant will forward to the Contractor a set of electronic files of the project. The Contractor shall modify the files as required, to reflect the as-built conditions, mark them conspicuously in the title block as "as-built drawings" and submit the modified files to the Consultant for review. Completion of the As-Built Drawings in AutoCAD will be the responsibility of the Mechanical Contractor at no extra cost to the project. The

Mechanical Contractor is responsible for updating all Architectural Plans based on the Architectural As-Builts while producing the Mechanical As-Builts

- .3 Put a digital copy of the as-built files (in AutoCAD 2017 format) as part of the Operations and Maintenance manuals.
- .4 Any subsequent changes found by the Consultant shall remain the responsibility of the Contractor at no charge to the Owner.

1.16 TEMPORARY AND TRIAL USAGE

- .1 After any part of the work has been completed, the Consultant will make an inspection, and performance tests of such parts shall be carried out under the direction of the Consultant. If deficiencies are found, they shall be immediately rectified to the satisfaction of the Consultant. After such deficiencies have been rectified, the work shall be placed in service at such time and in such order as the Consultant may direct. If, in placing a portion of the equipment in service, it is necessary to make temporary connections in the wiring in order to obtain proper operation, such connections shall be provided to the extent and in the manner required by the Consultant.
- .2 Temporary or trial usage of any mechanical devices, machinery, apparatus, equipment or materials shall not be construed as evidence of the acceptance of same.
- .3 No claims for damage will be considered for injury to, or the breaking of any parts of such work which may be used.

1.17 CONSULTANT'S INSTRUCTIONS

- .1 During construction the Consultant will issue such instructions as may be necessary for verification and corrections of the work. These instructions shall be binding as part of the specification.

1.18 ADDITIONAL WORK AND CHANGES

- .1 Unless a written order, reviewed by the Consultant and countersigned or otherwise approved by the Owner Representative, no additional work shall be undertaken by the Contractor.

1.19 WARRANTY

- .1 The Mechanical Contractor shall guarantee all work and apparatus installed under his contract against all defects of workmanship and material for a period of one (1) year after the Substantial Performance of the Work , unless otherwise mentioned in the Specifications, and shall make good any and all defects developing during such time without expense to the Owner. Any materials shall be further guaranteed as may be called for in these specifications. Where warranties on equipment extend beyond one (1) year the Mechanical Contractor shall honor the extended warranty.

1.20 SCHEDULING OF WORK

- .1 For all work to be performed under this contract, adhere to Construction Schedule agreed upon with the Owner Representative.

1.21 ENERGY CONSUMPTION

- .1 The Consultant may reject equipment submitted for approval on basis of performance or energy consumed or demanded.
- .2 All equipment installed on the project shall conform to the requirements outlined in ASHRAE 90.1 latest edition.

1.22 ELECTRIC MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install an acceptable motor for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 All motors shall be manufactured and installed in accordance with CSA requirements.
- .4 Motor speed shall be 1750 rpm unless otherwise specified.
- .5 All motors shall be "T" frame CEMA Standard Design "B" with Class "B" insulation, 40°C ambient, standard drip-proof with a 1.15 service factor, or as otherwise specified. Motors in air stream or exposed shall be TEFC type.
- .6 Motors shall be of adequate size to operate associated equipment and drive mechanisms under all conditions of load and service and to bring equipment up to operating speed within 13 seconds without overloading, and be not less than the nameplate HP specified or indicated on the Drawings.
- .7 Integral HP motor sizes ½ HP and above shall be squirrel cage induction motors rated 575 volt or 230volt, 3 phase, 60 hertz, unless noted otherwise.
- .8 Fractional HP motors up to but not including ½ HP shall be rated 120 volt, single phase, 60 hertz and will be capacitor start, induction motors, with adequate thrust capacity when used with direct mounted equipment, and shall be provided with integral overload and overheating protection. Shaded pole starting devices will not be accepted.
- .9 Multi-speed motors and associated switching devices shall be circuited to protect the motor at each speed.
- .10 All motors, 1 HP and up shall comply with the Ontario Hydro EnerMark Motor Efficiency Level as tested either CSA 390 M 1985, or IEEE 112B, and be approved under the Canadian Electrical Safety Code.
- .11 All starter panels shall be lockable and supplied with locks.

.12 Special Requirements:

- .1 Where motor power requirements of equipment furnished deviate from power shown on plans, provide electrical service designed under the requirements of NFPA 70 without additional time or cost to the Owner.
 - .2 Assemblies of motors, starters, controls and interlocks on factory assembled and wired devices shall be in accordance with the requirements of this specification.
- .13 Wire and cable materials specified in the electrical division of the specifications shall be modified as follows:
- .1 Wiring material located where temperatures can exceed 71 degrees C (160 degrees F) shall be stranded copper with Teflon FEP insulation with jacket. This includes wiring on the boilers.
 - .2 Other wiring at boilers and to control panels shall be NFPA 70 designation THWN.
 - .3 Provide shielded conductors or wiring in separate conduits for all instrumentation and control systems where recommended by manufacturer of equipment.
- .14 Select motor sizes so that the motors do not operate into the service factor at maximum required loads on the driven equipment. Motors on pumps shall be sized for non-overloading at all points on the pump performance curves.
- .15 Motors utilized with variable frequency drives shall be rated "inverter-ready" per NEMA Standard, MG1, Part 31.4.4.2. Provide motor shaft grounding apparatus that will protect bearings from damage from stray currents.
- .16 Insulation Resistance: Not less than one half meg-ohm between stator conductors and frame, to be determined at the time of final inspection.

1.23 EQUIPMENT REQUIREMENTS AND INSTALLATION

- .1 Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.
- .2 Provide accessible means for lubricating equipment including permanent lubricated bearings.
- .3 For all base mounted boilers, pumps, compressors, air handling units, fans and other rotating equipment, provide chamfered edge housekeeping pads a minimum of 4" high and 4" larger than equipment dimensions all around. Work shall be performed by the trades specializing in this work.
- .4 Pipe drain lines, overflows and safety relief vents to drains. If the horizontal drains present a tripping hazard, use aluminum checkered plate covers.

- .5 Line-up equipment, rectangular cleanouts and similar items with building walls wherever possible.

1.24 LIFTING ATTACHMENTS

- .1 Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

1.25 THERMOMETERS AND PRESSURE GAUGES

- .1 General:

- .1 Locate direct reading thermometers and gauges for reading from floor or platform.
- .2 Provide remote reading thermometers and gauges where direct reading instruments cannot be satisfactorily located.
- .3 Locate engraved lamacoid nameplate as specified in Section Identification, identifying medium adjacent to thermometers and gauges.

- .2 Thermometers:

- .1 Industrial, 9" adjustable angle cast aluminum case, CGSB standard CAN/CGSB-14.4-M88 red reading mercury, lens front tube, white scale black embossed figures, clear glass or acrylic window, tapered aluminum stem.
- .2 Scale shall be suitable for 2 times the temperature range of service. Scale shall be combined Celsius and Fahrenheit.
- .3 Standard of Acceptance: Weiss, Ashcroft, Terrice.

- .3 Pressure Gauges:

- .1 5" dial, solid front blow out back, fibreglass reinforced polypropylene case, phosphor bronze bourdon tube and brass 1/4" N.P.T. socket, bottom connection, stainless steel rotary type movement, gauge to be registered with the Provincial Boiler and Pressure Vessel Safety Branch with a registration number and conform to ANSI B40.1. Accuracy to be grade "A".
- .2 On pumps liquid filled gauges shall be utilized.
- .3 Standard of Acceptance: Weiss, Ashcroft, Terrice.
- .4 Provide bronze stop cock, bronze bar stock 1/4" N.P.T. bronze porous core pressure snubber for pulsating operation and diaphragm for corrosive service.

- .5 Use materials compatible with system requirements.
- .6 Gauges shall have combined kilopascal and psi scales.

1.26 PIPE HANGERS AND SUPPORTS

- .1 General
 - .1 Pipe Supports: Comply with MSS SP 58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP 69.
- .2 Attachment to Concrete Building Construction:
 - .1 Concrete insert: MSS SP-58, Type 18.
 - .2 Self drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 102 mm (four inches) thick when approved by the Consultant for each job condition.
 - .3 Power driven fasteners: Permitted in existing concrete or masonry not less than 102 mm (four inches) thick when approved by the Resident Engineer for each job condition.
- .3 Attachment to Steel Building Construction:
 - .1 Welded attachment: MSS SP 58, Type 22.
 - .2 Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C clamp may be used for individual copper tubing up to 23mm (7/8 inch) outside diameter.
- .4 Attachment to Metal Pan or Deck:
 - .1 As required for materials specified Steel Decking section of the specification.
- .5 Attachment to Wood Construction:
 - .1 Wood screws or lag bolts.
- .6 Hanger Rods
 - .1 Hot rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP 58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn buckles shall provide 38 mm (1 1/2 inches) minimum of adjustment and incorporate locknuts. All thread rods are acceptable.
- .7 Hangers Supporting Multiple Pipes (Trapeze Hangers):
 - .1 Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 mm by 41 mm (1 5/8 inches by 1 5/8 inches), 2.7 mm (No. 12 gage), designed to accept special

spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.

- .2 Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
- .3 Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 13mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
- .8 Supports for Piping Systems:
 - .1 Select hangers sized to encircle insulation on insulated piping. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
- .9 Piping Systems (MSS SP 58):
 - .1 Standard clevis hanger: Type 1; provide locknut.
 - .2 Riser clamps: Type 8.
 - .3 Wall brackets: Types 31, 32 or 33.
 - .4 Roller supports: Type 41, 43, 44 and 46.
 - .5 Saddle support: Type 36, 37 or 38.
 - .6 Turnbuckle: Types 13 or 15. Preinsulate.
 - .7 U bolt clamp: Type 24.
 - .8 Copper Tube:
 - 1 Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non adhesive isolation tape to prevent electrolysis.
 - 2 For vertical runs use epoxy painted or plastic coated riser clamps.
 - 3 For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
- .9 Insulated Lines:
 - 1 Provide pre-insulated calcium silicate shields sized for copper tube.
- .10 Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
- .10 Piping with Vertical Expansion and Contraction:
 - .1 Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - .2 Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral

adjusting nut, turn buckle and travel position indicator. //

.11 Heat Exchanger and Expansion Tank Hangers:

- .1 May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

1.27 PIPE PENETRATIONS

- .1 Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- .2 To prevent accidental liquid spills from passing to a lower level, provide the following:
 - .1 For sleeves: Extend sleeve 25 mm (one inch) above finished floor and provide sealant for watertight joint.
 - .2 For blocked out floor openings: Provide 40 mm (1 1/2 inch) angle set in silicone adhesive around opening.
 - .3 For drilled penetrations: Provide 40 mm (1 1/2 inch) angle ring or square set in silicone adhesive around penetration.
- .3 Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of Consultant.
- .4 Sheet Metal: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- .5 Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- .6 Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms. Except in mechanical rooms, connect sleeve with floor plate.
- .7 Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- .8 Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- .9 Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

1.28 SPECIAL TOOLS AND LUBRICANTS

- .1 Furnish, and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- .2 Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- .3 Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the Owner
- .4 Lubricants: A minimum of 0.95 L (one quart) of oil, and 0.45 kg (one pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

1.29 WALL, FLOOR AND CEILING PLATES

- .1 Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- .2 Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025-inch) for up to 80 mm (3 inch pipe), 0.89 mm (0.035-inch) for larger pipe.
- .3 Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

1.30 EXCAVATION AND BACKFILL

- .1 Grade the bottom of the pipe trench excavation as required.
- .2 In firm, undisturbed soil, lay pipes directly on the soil, and shape soil to fit the lower one-third segment of all pipes and pipe bells. Ensure even bearing along the barrels. Backfill excess excavation with 25 mPa concrete.
- .3 Where rock or shale is encountered, arrange to have this excavated and removed. After excavation, backfill with a bedding of 10 mm crushed stone.
- .4 Prepare new bedding under the pipe in unstable soil, in fill, and in all cases where pipe bedding has been removed in earlier excavation, particularly near perimeter walls of buildings, at manholes and catch basins. Compact to maximum possible density and support the pipe by 200 mm (8 inches) thick firm supports. Install reinforcing steel in cradle or construct piers every eight feet or closer, down to solid load bearing strata. Provide a minimum of one pier per length of pipe. Use same method where pipes cross.
- .5 Where excavation is necessary in proximity to and below the level of any footing, backfill with 25 mPa concrete to the level of the highest adjacent footing. Proximity is determined by the

- angle of repose as established by the consultant.
- .6 Provide support over at least the bottom one third segment of the pipe in all bedding methods.
 - .7 Do not open trench ahead of pipe laying and backfilling more than weather will permit. Keep walls of trenches straight to at least 450 mm (18") above the top of the pipe to keep the diameter load within the pipe design limits. Have excavations inspected at least once a week by authorities. .
 - .8 Before backfilling, obtain approval. Remove all shoring during backfill.
 - .9 Backfill trenches within building, with clean sharp sand or gravel in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of pipe. Hand or machine compact the balance up to grade, using approved equipment.
 - .10 Backfill trenches outside buildings, not under roads, parking lots, or traffic areas, up to a compacted level of 450 mm (18") above the pipes with individual layers of material 150 mm (6") thick, hand compacted to a density of 95% Standard Proctor, using approved 10 mm (3/8") crushed stone. Backfill the balance with 150 mm (6") layers of approved excavated material, compacted to 95% Standard Proctor, using approved equipment.
 - .11 Backfill all other trenches outside buildings with 150 mm (3/8") crushed stone in layers not exceeding 6" thickness, compacted to 100% Standard Proctor density up to grade level. Manual compaction up to 450 mm (18") above the pipe with approved equipment for the balance.
 - .12 Fill all depressions to a correct grade level with appropriate material. After a period has passed adequate to reveal any settlement, use maximum possible compaction. Pay all costs required to make good all damages caused by settlement.
 - .13 Dispose of excavated materials in accordance with the requirements of the Authorities having Jurisdiction.

1.31 TESTS

- .1 Do not insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.
- .2 Conduct tests in presence of Consultant.
- .3 Bear costs including retesting and making good.
- .4 Pipe pressure:
 - .1 Hydraulically test piping systems at 1.5 times system operating pressure or minimum 125 psi, whichever is greater.
 - .2 Maintain test pressures without loss for 4 hours unless otherwise specified.
 - .3 Test natural gas systems to requirements of authorities having jurisdiction and as per Ontario Gas Utilization Code O.Reg. 452/89.

- .4 Test drainage, waste and vent piping to code.
- .5 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures.

1.32 PAINTING

- .1 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.
- .2 Touch-up paint all damaged equipment with products matching original finish in quality and appearance.
- .3 Paint the entire gas line where with two coats of yellow paint.

1.33 SPECIAL TOOLS AND SPARE PARTS

- .1 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One glass for each gauge glass installed.
 - .3 One set of v-belts/bolts for each piece of machinery.
 - .4 One spare set of filters for each filter bank installed.
- .2 Upon completion of project and immediately before hand-over, replace all filters.

1.34 DIELECTRIC COUPLINGS

- .1 Provide wherever pipes of dissimilar metals are joined.
- .2 Provide insulating unions for pipe sizes larger than 2" diam. and under; same for flanges of pipe sizes over 2" diam.
- .3 Cast brass adapters may be used on domestic water systems and where approved by the Consultant.
- .4 Provide rubber gaskets to prevent dissimilar metals contact.

1.35 INSTRUCTION OF OPERATING STAFF

- .1 Supply certified personnel to instruct Owner operating staff on operation of new mechanical equipment. Supply maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.
- .2 Provide min. 6 hrs of instruction time during regular work hours prior to acceptance and turn-over to operating staff for regular operation.

- .3 Use operation and maintenance data manual for instruction purposes. On completion of instruction, turn manuals over to the Consultant.
- .4 Scheduling of the timing for the training of the operating staff shall be arranged 10 days prior to the completion of the project.
- .5 For training on controls, refer to section 15900

1.39 MAINTENANCE MANUALS

- .1 Provide minimum of one (1) hard (hard cover binder) and three (3) soft (USB's) copies of Mechanical Maintenance Manuals, in accordance to the following:
 - .1 Mechanical Maintenance Manuals to be delivered to the Consultant's office 10 days prior to the substantial completion of the Contract.
 - .2 Manuals to be bound in a hard cover neatly labeled: "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - .3 The Maintenance Manuals shall be divided into sections with neatly labeled and tabbed dividers between each section. The sections to be included in the manual are:
 - .1 Section I - General.
 - .2 Section II - Piping and Pump Systems, Plumbing Fixtures and Accessories.
 - .3 Section III - Boilers, Heat Exchangers, Pool Filters and Accessories
 - .4 Section IV - Automatic Controls
 - .5 Section V - Air and Water Balancing
 - .4 The following information shall be contained within the sections:
 - .1 SECTION I: A list giving name, address and telephone number of the Consultant, Engineers, General Contractor, Mechanical Trade and Controls Trade. Written guarantees for the Mechanical Systems. A copy of the Valve directory giving number, valve location, normal valve position, and purpose of valve (a framed copy of Valve Directory to be hung in Boiler Room). Equipment lists and certificates shall be provided - certificates shall be signed and sealed by the appropriate suppliers.
 - .2 SECTION II, III: A copy of all pressure tests and operational tests. A copy of Gas Operational Tests for gas fired equipment. A list giving name, address and telephone number of all suppliers. Details of chemical treatment equipment and substances. A copy of all reviewed Shop Drawings for all mechanical equipment and ancillary devices (valves, expansion tanks, pumps, strainers, plumbing, etc). Copies of warranties.
 - .3 SECTION IV: Complete Control Diagrams, Wiring Diagrams and description of Control system and the functioning sequence of the system. Also refer to section 15900.
 - .4 SECTION V: For balancing reports and formats, refer to section 15015 of these specifications.

1.40 CONCRETE

- .1 All concrete work required to complete this project, whether shown on the drawings or not, shall be the Contractor's responsibility.
- .2 Refer to this specification section for requirements for housekeeping pad.

1.41 METALS

- .1 All steel construction required for the completion of this project, whether shown on the drawings or not, shall be the Contractor's responsibility.

1.42 CUTTING, PATCHING, ROOFING AND X-RAY

- .1 All cutting, patching, roofing and X-Rays required for the completion of this project whether shown on the drawings or not, shall be the Contractor's responsibility. The cutting and patching work shall be performed in accordance with the following:
 - .1 All cutting and patching shall be done by the trades specializing in the materials to be cut.
 - .2 All flashing and equipment supports on the roof shall be done in strict accordance with the Owner standards by Owner-approved roofing contractors only.
- .2 Should any cutting, roofing and/or repairing of finished surfaces be required, the Sub-trade contractor for the Contractor shall employ the particular trades engaged on the site for this type of work to do such cutting and/or repairing. Obtain the approval of the Consultant before doing any cutting. In the event that tradesmen required for particular cutting and/or repairing are not already on the site, bring to the site tradesmen to do this work.
- .3 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as approved by the Consultant.
- .4 Where slabs in the portions of the building which are existing must be saw-cut or core drilled, all locations shall be x-rayed prior to saw-cutting or core-drilling. All x-raying shall be done by personnel qualified in the use of the type of equipment required to x-ray the saw-cuts shall be permitted to perform this work on the site. No allowance will be made later for expenses incurred through the failure of performing these x-rays.

1.43 INTERFERENCE DRAWINGS

- .1 The Mechanical Contractor is responsible for preparing detailed interference drawings once demolition work has proceeded to the point where all existing conditions are visible. Provide 2D plan view and 3D isometric view layouts for all project areas depicting site measurements of all floor areas, height, width and depth of all existing structural elements, new architectural walls, ceilings and floor assemblies, new structural elements and new mechanical ductwork and piping plans. Prior to proceeding with new work, ensure that any concerns of interference are alleviated; consult with the Engineer as necessary. Provide written notice to the Engineer of any potential interferences of concerns with existing conditions based on the site findings after demolition.

1.44 MECHANICAL PROJECT COMPLETION

- .1 10 (ten) days prior to substantial performance of work obtain documentation and/or prepare certification of the following items and submit them to the Owner's representative.
 - .1 All inspection certificates including drainage, Plumbing, and refrigeration.
 - .2 Guarantee certificates as called for under "Warranty".
 - .3 Record drawings.
 - .4 Operating and Maintenance Manuals.
 - .5 Test certifications as called for under "Testing".
 - .6 Provide a signed statement to the effect that all tests for mechanical systems and equipment have been completely carried out in the Trade Sections of these Specifications and to the manufacturer's recommendations, and in accordance with the requirements of all authorities having jurisdiction.

1.45 PERFORMANCE TESTS AND EQUIPMENT START-UP

- .1 After all equipment has been installed, adjusted, balanced and started up, subject equipment to a series of performance tests, as soon as conditions permit.
- .2 The timing of the tests shall be arranged to suit the convenience of the Consultant, and the manner and duration shall be as the Consultant deems necessary. Record the daily start and stop times, operating hours and functions performed. Ensure that the performance tests are witnessed by the Consultant.
- .3 All major equipment including but not limited to boilers, pumps, sand filters are to be inspected by the manufacturer to ensure that the equipment has been installed in accordance with their recommendations.
- .4 Operate equipment under varying load conditions, demonstrate start-up sequence, normal shutdown, simulated emergency shutdown, operation of temperature, etc., and safety controls. Operate switches and electrical devices for correct wiring sequences. Adjust components to achieve a proper functional relationship among all the components of all the systems. Repeat these functions as many times as deemed necessary by the Consultant to achieve reliable operation.
- .5 Repair defects and repeat tests as necessary. During test maintain lubrication schedule, set, align and tension drives.
- .6 At the successful completion of Performance Tests and all testing and balancing, make the systems ready for final inspection and subsequent acceptance of the Owner. Replace and clean filters, flush out lines and equipment, remove and clean strainers, fill liquid systems and purge air. Provide water treatment to pipes and report in accordance to Section 15602. Disinfect all domestic water as required by current by-laws and Authorities Having Jurisdiction.

- .7 Conduct tests to demonstrate operation and ability to meet requirements of all equipment and freedom from undue noise and vibration at the time of final inspection, having ensured that it has previously been subjected to Performance Tests.

1.46 PROJECT SPECIFIC NOTES

1. Obtain all approvals from public authorities having jurisdiction prior to commencing any work. Include, in the tender price, for all permit and inspection fees required by Authorities having Jurisdiction. Arrange for and attend all inspections required as per requirements of the Building Department or an Authority having Jurisdiction.
2. Examine architectural drawings and specifications and all contract documents before proceeding with the work. Any discrepancies between the drawings and specifications of all disciplines must be referred to the architect before any affected work is commenced.
3. The Mechanical Contractor shall furnish all labour, material, tools, equipment, etc. required to complete all work shown on the drawings and as specified in the contract documents. The work shall be performed in accordance with rules and regulations of all authorities having legal jurisdiction over the work. This Contractor shall provide any small items of work not specifically called for but required to complete the intended installation and/or required to achieve the desired intent or functional utility.
4. Perform all work in full accordance with the Ontario Building Code, All Applicable Codes, TDSB standards and good practices and the requirements of all other Authorities Having Jurisdiction. All work performed by this division shall be done in accordance with all manufacturer's recommendations. Obtain all available manufacturer's recommendations and comply.
5. All cutting, patching, coring, scanning, xraying, making good and fire stopping required for the work of this division shall be carried out by this division. The Mechanical Contractor is responsible for and shall pay for any and all damage to the building and/or surrounding area incurred by work of this division.
6. Review the designated substances survey provided by the board in detail prior to commencing any work.
7. The Mechanical Contractor must review and submit shop drawings for all materials to be supplied as a part of the Contract in conjunction with the General Contractor to the Architect and Mechanical Consultant prior to ordering. Order only upon receipt of approval. Order, supply and install as per all comments. The Shop Drawings must be reviewed and ensured for compliance with the Contract Documents by the Mechanical Contractor and General Contractor prior to submission; confirmation of review and confirmation that the submittal is in compliance with the Contract Documents is the responsibility of the Mechanical Contractor and General Contractor to include in writing with each Shop Drawing Submittal. Any non-conformance of the Submittal with the Contract Documents identified by the Mechanical Consultant will require a resubmission of the Shop Drawing Submittal by the Mechanical Contractor prior to review. The Mechanical Contractor shall bear all costs of any review by the Mechanical Consultant

beyond the Original Shop Drawing Submission at a cost of \$250.00 CAD + HST per resubmission.

8. All access panel ratings shall match that of the surface in which it is being installed. All access panels requiring supply/install as a part of the project work shall be included for in the Base Tender Price.
9. Coordinate with all other trades present on site throughout the full course of construction. Lay out of all work so as not to conflict with the work of other trades. Carry out work promptly which may interfere with the work and/or schedule of any other trades.
10. Cleanup and garbage: the contractor is responsible for maintaining as clean of a work area as possible during construction. The contractor is responsible to clean-up and remove tools from the site at the end of every working day. Disposal of all redundant materials, devices, and equipment is the responsibility of the contractor on a daily basis.
11. All work shall be done with minimum possible interruption to the existing building systems and in the time schedule permitted by the school board. Consult with the project supervisor prior to pricing. Complete the project within the allocated schedule.
12. Unless otherwise explicitly stated in writing in the Contract Documents, all materials, labour, scope and descriptions of work described in the Contract Documents is the responsibility of the Mechanical Contractor to supply and install as a part of the Base Tender Price. No materials and/or labour is to be completed under the Project Allowances unless explicitly noted as such in the Contract Documents.
13. All demolition and new work shall be completed in strict accordance with the Contract Documents with no deviations unless instructed by the Mechanical Consultant in writing prior to execution of the work. The Mechanical Consultant is not responsible, nor required, to accept any work (regardless of its compliance with code) not completed in accordance with the Contract Documents. The Mechanical Contractor will be responsible, at his/her cost, of furnishing a Sealed Letter from a Professional Engineer licensed in the Province of Ontario to accept and assume responsibility for all work not completed in accordance with the Contract Documents. The cost of obtaining this letter and the retaining of the Engineer, including all associated inspection charges, is the sole responsibility of the Contractor.
14. Unless otherwise noted, all devices, equipment, material, supplies, etc. shown on the drawings or otherwise required for a fully operational system as described/illustrated on the Drawings shall be supplied and installed under this Project. It shall not be assumed that any of the devices, equipment, material, supplies, etc. shown on the Drawings are to be provided (in part or in whole) by any other Party.
15. The Mechanical Contractor is responsible for taking pictures of work completed at the end of each week for record purposes. Pictures shall be taken throughout the work space and shall demonstrate all work completed that past week. When requested, share the pictures with the Mechanical Consultant. Pictures may be used for review of the monthly draws, conflicts identified on site, etc.

1.47 CLOSEOUT DOCUMENTS

- .1 Coordinate with the General Contractor to submit a comprehensive Closeout Document Package incorporating documents from all trades in one consolidated package. Closeout Documents shall consist of one (1) 3-ring binder hard copy and 3 USBs/CDs. The Mechanical Section of the Closeout Documents shall consist of the following:
 - (a) Mechanical Contractor Warranty Letter, signed and dated. Warranty shall be for a period of twelve (12) months starting on the Date of Substantial Completion.
 - (b) Project Shop Drawings, in consecutive order of the Consultant's number scheme.
 - (c) O&M Manuals for all equipment supplied on the project.
 - (d) AHJ Inspection Certificates & All Test Certificates.
 - (e) Fire Damper installation letter from the Sheet Metal Contractor stating 'All fire dampers and fire flaps have been installed in strict accordance with the Manufacturer's recommendations and requirements as well as Code Requirements.'
 - (f) Start-Up Reports for all Equipment.
 - (g) Red-Line As-Builts and CAD As-Builts (both completed by the Mechanical Contractor).

1.48 PROJECT PROGRESS THROUGHOUT CONSTRUCTION

- .1 The Mechanical Contractor is responsible for taking photos of all existing conditions and mechanical systems on site being affected by the Project at the onset of construction. All photos shall be date stamped.
- .2 The Mechanical Contractor is responsible for taking photos of the project's progress throughout the construction site every two weeks. All progress photos shall be shared and sent electronically to the Mechanical Consultant on the 15th and 30th of every month. Photos are meant to illustrate the progress of the project and correction of any deficiencies identified in routine site reviews and review of progress photos.
- .3 The Mechanical Consultant will, from time-to-time, visit the Project Site and issue a Field Review Report. The Mechanical Contractor is obligated to rectify any deficiency identified within 7 working days of receipt of the Report. The Mechanical Contractor is responsible for signing the Field Review Report upon 72 hours of the report being sent to the General Contractor, acknowledging receipt of the report. The Mechanical Contractor must take photos of all remedial work within 7 working days of receipt of the Report and distribute to the Consultant.

1.49 FIRESTOPPING & SEALING

- .1 Make fire rated and/or watertight where applicable seals at sleeves and other opening through floors and walls where conduit/cable/piping/ductwork/services passing through. Sleeves to extend minimum 25mm (1 inch) from both ends of the opening.
- .2 Provide firestopping protection of **all existing and new openings** through the floor, through the ceiling assembly, through the wall assembly regardless of the presence of any existing firestopping for existing penetrations.

- .3 Caulk spaces between piping, ductwork, servicesconduit, cables, bus ducts, raceways, cabletrays with "Cerafibre" 2300 F packing to Building Department approval. Pack and seal both sides of openings with Electrovert "Flameseal" putty, minimum thickness 25 mm (1"). Install in accordance with Electrovert Instruction Bulletin #3601.
- .4 The Mechanical Contractor is responsible for retaining the services of a specialized third-party Inspection Agency to inspect all firestopping completed for this project by the Mechanical Division. Include all costs of the Inspection Agency in the Base Tender Price. The Inspection Agency is to provide a report certifying acceptance of all firestopping work completed as part of this project.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 Conform to Section 20 05 11 Mechanical General Requirements as applicable.

1.2 RELATED SECTIONS

1.2.1 Installation of inserts, sleeves and anchors supplied by this Section: Section 04200, Masonry.

1.3 REFERENCES

ANSI B31.1 to B31.9 inclusive: Piping

CAN/CGSB-1.40-97

CSA B51-03

CSA B52-99

CAN/CSA-G40.20/G40.21-98

CAN/CSA-S16-01

CSA W47.1-92(R2001)

CAN/CSA W48-01

CSA W59-M1989(R2001)

CAN/CSA W117.2-01

Primer, Structural Steel, Oil Alkyd Type

Boiler, Pressure Vessel, and Pressure Piping Code

Mechanical Refrigeration Code

General Requirements for Rolled or Welded Structural
Quality Steel/Structural Quality Steel

Limit States Design of Steel Structures

Certification of Companies for Fusion Welding of Steel
Structures

Filler Metals and Allied Materials For Metal Arc
Welding.

Welded Steel Construction (Metal Arc Welding)

Safety in Welding, Cutting and Allied Processes

1.4 SUBMITTALS

1.4.1 **Shop Drawings:** Prepare and submit shop drawings for equipment covered by this Section including upper, middle and pipe attachments, riser clamps, shields and saddles, and sway braces.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Welding Studs

-Graham

-Omark

-Nelson

2.1.2 Concrete Inserts and Anchors

-Readhead by ITW

-SSS by Star

-Parabolt by USM

- Kwik-Bolt by Hilti

2.1.3 Beam Clamps

- Grinnell
- Myatt
- Hilti

2.1.4 Concrete Grout:

- Sikagrout 212 by Sika Canada Inc.
- Embeco 636 Grout by Master Builders
- Sealtight V-3 Grout by W.R. Meadows

2.1.5 Pipe Hangers:

- Grinnell
- Myatt
- Hilti

2.1.6 Zinc-Rich Paint: Galvafroid by W.R. Meadows.

2.1.7 Primer: CAN/CGSB-1.40-M.

3 EXECUTION

3.1 GENERAL CONSTRUCTION REQUIREMENTS

3.1.1 Attachment to Building Construction

- 3.1.1.1 Use welding studs of size not larger than 10 mm (3/8") for attaching miscellaneous materials and equipment to building steel. If weight of materials or equipment require bolts or studs larger than 10 mm (3/8") dia, use steel clips or brackets, secured to building steel by welding or bolting method of attachment as approved by Consultant.
- 3.1.1.2 Use self drilling expansion type concrete inserts for securing miscellaneous equipment and materials to masonry or concrete construction already in place, of sufficient number and size to prevent concrete from breaking away. Use of powder or power actuated fasteners will not be allowed unless prior written approval is obtained from Consultant.
- 3.1.1.3 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
- 3.1.1.4 Provide beam clamps of 2-bolt design and of such type that rod load is transmitted only concentrically to beam web centreline. Use of "C" and "I" beam side clamps and other similar items will not be allowed without written consent of Consultant.
- 3.1.1.5 Where roof or floor framing consists of open web or long span steel joists, ensure that hangers are located at or within 150 mm (6") of joist top or bottom chord panel points, otherwise

provide additional structural steel as required where hanger spacing does not coincide with joist spacing. Design suspension assembly such that hanger load is transmitted only concentrically to supporting joist. Do not use "C" and "I" beam side clamps, brackets and other similar, without written consent of Consultant.

- 3.1.1.6 Locate secondary structural steel members between joists at or within 150 mm (6") of top or bottom chord panel points. Where secondary structural steel member cannot be located at or near joist panel point, provide additional diagonal structural steel web member(s) designed for applicable load to nearest panel point in opposite chord member. This condition may be waived if load to be suspended between panel points is not in excess of 45 kg (100 lbs). Diagonal hangers which will induce lateral stresses in chord members of joist will not be permitted. Submit shop drawings of suspension assembly indicating location of suspension or support points, max load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

3.2 PIPING CONSTRUCTION METHODS

3.2.1 General

- 3.2.1.1 Unless specified otherwise herein, construct and install piping in accordance with ANSI Sections B31.1 to B31.9 as applicable to service, except that soldered joints will not be permitted in compressed air piping.
- 3.2.1.2 To avoid unnecessary cutting of masonry, provide inserts, sleeves and anchors to other trades for building in as Work proceeds. Arrange with other trades to leave openings, slots and chases to accommodate later installation of mechanical work.

3.3 PIPE HANGERS AND SUPPORTS

3.3.1 General

- 3.3.1.1 Support or suspend piping with necessary hangers, structural supports and/or brackets as indicated on Drawings and/or as required, to prevent sagging, warping and vibration and to allow for movement due to expansion and contraction. Place hangers and supports close to fittings, valves and/or other heavy parts.
- 3.3.1.2 Do not allow loads of any nature to be transmitted through piping connections to equipment not specifically designed for such loads. Where flexible connections are not called for at connections to equipment, support pipe by stands attached to both pipe and supporting structure so that force in any direction is not transmitted to equipment.
- 3.3.1.3 Provide suitably dampened spring hangers for first 3 supports from equipment connection on piping subject to excessive movement or shock from any source, thermal expansion and contraction, selected in accordance with ANSI B31.1. Where it is evident that no undue loads will be transmitted to equipment by system concerned, i.e. small bore connections to comparatively large equipment, cold service piping not subject to shock, etc., then spring hangers may be omitted and standard hangers used.

3.3.1.4 Use trapeze type hangers where pipes are grouped together, unless specifically indicated otherwise on Drawings. Suspend horizontal member by adjustable rods with locking feature for maintaining level and slope. Space trapeze type hangers based on closest interval required by any pipe supported thereon. Provide any auxiliary steel required to support trapeze between building steel.

3.3.1.5 Do not hang any pipe from another pipe unless specifically indicated on Drawings.

3.3.2 Saddles and Roller Supports

3.3.2.1 Provide saddles at roller supports for piping carrying liquids at 10.5 deg C (51 deg F) or higher. Weld saddles to black or galvanized steel piping. Refinish galvanized surfaces destroyed by welding with zinc rich paint.

3.3.3 Hangers

3.3.3.1 For insulated piping up to NPS 4 carrying liquids at temperatures 10.5 deg C (51 deg F) and higher, use standard weight clevis hangers with level adjustment and locknut.

3.3.3.2 For insulated lines of NPS 4 dia and larger carrying liquids at temperatures 10.5 deg C (51 deg F) or higher, use adjustable roller type hangers with locknuts, and rollers of sufficient width to clear outside diameter of insulation on piping. Support rollers at both ends, either by yoke, swivel type hanger or by 2 adjustable rods with locknuts.

3.3.3.3 For insulated piping carrying liquids at temperature of 10 deg C (50 deg F) or less, use elongated clevis type hangers, with clevis of sufficient width to fit over insulation bearing plate.

3.3.3.4 Provide insulation protection bearing plates at hangers and supports for piping carrying liquids at temperature of 10 deg C (50 deg F) or less. Install temporary spacers between plate and pipe equal to thickness of insulation specified. (Refer to Section 15081, Piping Insulation).

3.3.3.5 Bearing plates may be either shop fabricated, or manufactured plates of size required to properly fit outside diameter of pipe insulation.

3.3.3.6 Fabricate bearing plates conforming to following table for various pipe sizes:

Pipe Size (NPS)	P	Length of Thickness of	
		plate mm (in)	Plate mm (ga)
1/2 thr. 1-1/2		130 (5)	1.2 (18)
2		150 (6)	.52 (16)
2-1/2		200 (8)	1.52 (16)
3		230 (9)	1.52 (16)
4 and up		250 (10)	1.52 (16)

3.3.3.7 Form bearing plates to outside diameter of adjoining pipe insulation and extend plate up to

horizontal centre line of pipe.

3.3.3.8 For non-insulated piping use clevis type of wrought steel construction with adjustable rod, level locking feature and backnuts.

3.3.3.9 For copper tubing provide copper coated hangers. Regulations of some municipalities require that copper tubing be taped with plastic tape at hanger location, or hanger be provided with plastic insert. Meet these requirements when required, in which case copper coating may be omitted on hanger.

3.3.3.10 Attach hanger rods to building structure by means of malleable iron beam clamps, concrete inserts, and/or approved anchors as hereinbefore specified.

3.3.4 **Hanger Spacing**

3.3.4.1 For horizontal runs of plumbing and drainage piping comply with hanger spacing requirements of OBC.

3.3.4.2 For horizontal runs of black or galvanized steel pipe, other than for plumbing service, do not exceed max distances between supports and with min dia rods as follows:

<u>Pipe Size (NPS)</u>	<u>Distance m (ft)</u>	<u>Dia. of Rod mm (in)</u>
Up thru 1-1/4	1.8 (6)	10 (3/8)
1-1/2	1.8 (6)	10 (3/8)
2	3.05 (10)	10 (3/8)
2-1/2 & 3	3.66 (12)	12 (1/2)
4	4.27 (14)	16 (5/8)
6	5.18 (17)	19 (3/4)
8	5.79 (19)	22 (7/8)
10 & 12	6.71 (22)	22 (7/8)

3.3.4.3 Provide additional hangers in locations where there are concentrated loads such as valves, specialties and other such items.

3.3.4.4 For horizontal runs of copper tubing for services other than plumbing, do not exceed 1.8 m (6 ft) between hangers for lines up to and including NPS 3/4 and 2.4 m (8 ft) for lines of NPS 1 and larger.

3.3.4.5 For horizontal runs of piping fabricated of PVC, use hanger spacing as recommended by manufacturer.

3.3.5 **Vertical Piping Supports**

3.3.5.1 Support vertical plumbing and drainage piping as required by OBC, unless more stringent requirements are specified herein.

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- 3.3.5.2 Support cast iron soil pipe at every floor and other piping at every other floor unless otherwise required by expansion conditions or otherwise specified.
- 3.3.5.3 Support bottom of riser with base fitting set on concrete pier or by hanger located at top of riser pipe as close to riser as possible.
- 3.3.5.4 For supports at intermediate floors, use Grinnell Fig. 261 or approved equal steel extension pipe clamp, bolted securely to pipe. Rest ends of clamp on pipe sleeve or on floor.
- 3.3.5.5 Provide lateral stability of vertical piping by fabricated brackets or malleable iron, extension type split hangers. Run vertical piping at columns in column webs, on either or both sides of column, unless otherwise directed.
- 3.3.6 **Anchors and Guides**
- 3.3.6.1 Supply and install anchors where indicated on Drawings and/or as required to maintain permanent location of pipe lines. Construct anchors for steel or galvanized pipe of approved steel straps and/or rods and for anchoring copper lines use copper plated anchors or provide insulation bands between tubing and clamps if steel straps or rods are used. Install anchors and guides in approved manner.
- 3.3.6.2 Acceptable Materials: Grinnell #256 or Myatt.
- 3.4 **MISCELLANEOUS STEEL**
- 3.4.1 **General**
- 3.4.1.1 Supply and install miscellaneous structural supports, platforms and braces as may be required to hang or support piping unless Drawings or other Sections of Specifications state otherwise.
- 3.4.1.2 Submit detailed shop drawings to structural engineer for review before commencing fabrication.
- 3.4.2 **Materials and Fabrication**
- 3.4.2.1 Conform to CAN/CSA-S16 for materials, design of details and execution of work.
- 3.4.2.2 Conform to CAN/CSA-G40.20/G40.21, grade 300W for structural shapes, plates, and other similar items.
- 3.4.2.3 Use welded construction wherever practicable, with bolted joints allowed for field assembly using high strength steel bolts. Chip welds to remove slag, and grind smooth.
- 3.4.2.4 Conform to latest issue of following CSA Specifications.
- CSA W47.1, for qualification of welders
CSA W48.1-M, for electrodes (only coated rods allowed)

CSA W59-M, for design of connections and workmanship
CSA W117.2, for safety

3.4.3 Painting and Cleaning

3.4.3.1 Touch up minor damage to finish on equipment with standard factory applied baked enamel finish. If, in Consultant's opinion, damage is too extensive to be remedied by touch up, replace damaged equipment.

3.4.3.2 Clean steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.

3.4.3.3 Apply 1 coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40-M to miscellaneous steel.

3.4.3.4 In field, touch up bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as herein before specified.

3.4.3.5 Give 2 coats of primer to surfaces which will be inaccessible after erection.

3.4.3.6 Remove foreign matter from steelwork on completion of installation.

3.4.4 With exception of prime painting of miscellaneous steel or any other specific requirements as specified above or under respective Sections of the Mechanical Contractor, or equipment otherwise factory painted, painting will be provided under Division 9, Finishes.

3.5 CONCRETE INSERTS

3.5.1 Install inserts required for attachment of hangers, either for suspension of piping or equipment.

3.5.2 For masonry or poured concrete construction use expansion type units. Insert into concrete after concrete has cured. Anchors or inserts installed by explosive means shall not be used.

3.6 SEALED (STAMPED) SHOP DRAWINGS FOR PIPE SUPPORT SYSTEM

3.6.1 The Mechanical Contractor, as part of the Base Tender Price, is responsible for retaining the services of a Professional Engineer licensed in the Province of Ontario to prepare detailed support drawings (sealed by the Professional Engineer), with the drawings outlining the following information:

- .1 Floor Plans depicting support types being proposed in each area of work for each type of piping system (plumbing, drainage, heating, etc.). The support types are to be reviewed and approved by the Engineer for use in this application.
- .2 Floor Plans depicting attachment method of attaching the supports to the Building Structures.
- .3 Floor Plans depicting the maximum span of the supports in each area of work.

The Professional Engineer is responsible for overseeing the construction and supply/installation of the supports and provide a Letter of Completion at the end of the

work confirming that all work has been completed in accordance with the Engineered Plans.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- 1.1.1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 SHOP DRAWINGS

- 1.2.1 Submit shop drawings in accordance with 20 05 11 Mechanical General Requirements.
- 1.2.2 Submit for approval, manufacturer's catalogue literature related to installation and fabrication.

PART 2 - PRODUCTS

2.1 GENERAL

- 2.1.1 Supply access doors to the relevant building trade to provide access in furred ceilings for the following:
- .1 Servicing equipment
 - .2 Access to plumbing cleanouts
 - .3 Access to shut off valves.
 - .4 Inspection of life safety equipment.
 - .5 Service of operating devices
 - .6 All locations where periodic maintenance is required.
- 2.1.2 Access door sizes shall be as follows:
- .1 Body Entry: 24" x 24" (600 x 600 mm)
 - .2 For Hand Entry: 18" x 18" (450 x 450 mm)
 - .3 For Viewing Only: 12" x 12" (300mm x 300mm)
- 2.1.3 All doors shall open 180 degrees and have rounded safety corners
- 2.1.4 For fire rated ceilings or wall provide a fire rated access door that will match the fire rating of the wall that the access door is installed in. The Mechanical Contractor shall be responsible for reviewing the drawings and providing fire rated access doors where they are required.
- 2.1.5 Where body access is possible the access doors shall be provided with a releasing mechanism on both sides of the door.

2.1.6 Provide access panels in all ductwork where fire dampers or combination fire/smoke dampers are shown on the Drawings to allow for inspection of the dampers.

2.1.7 Provide access panels at all balancing damper locations to allow access to the damper in the future.

2.2 RECESSED ACCESS DOOR FOR DRYWALL APPLICATIONS

2.2.1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.

2.2.2 Door shall be provided with a 25 mm (1") recess or 14mm (5/8") to suit the thickness of the drywall ceiling.

2.2.3 The frame shall be provided with a galvanized steel drywall taping bead on all sides.

2.2.4 The hinge shall be a concealed pivoting rod.

2.2.5 The latch shall be a flush to the surface, screwdriver operated cam latch.

2.2.6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

2.2.7 Standard of Acceptance: Acudor DW-5015, Mifab, Zurn, Watrous, Williams Brothers

2.3 RECESSED ACCESS DOOR FOR PLASTER APPLICATIONS

2.3.1 Door shall be 16 gauge steel. Mounting frame shall be 14 gauge galvanized steel.

2.3.2 Door shall be provided with a 14mm (5/8") recess and shall be lined with self furring galvanized lath.

2.3.3 The frame shall be provided an expansion casing bead with 75 mm (3") wide galvanized lath, recessed 20mm (3/4") to receive plaster.

2.3.4 The hinge shall be a concealed pivoting rod.

2.3.5 The latch shall be a flush to the surface, screwdriver operated cam latch.

2.3.6 The steel finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.

2.3.7 Standard of Acceptance: Acudor AP-5010, Mifab, Zurn, Watrous, Williams Brothers

2.4 FLUSH ACCESS DOORS FOR TILED WALL APPLICATIONS

2.4.1 For doors 400mm x 400mm (16" x 16") and smaller the door shall be 16 gauge with 18 gauge mounting frame.

2.4.2 For doors over 400mm x 400mm (16" x 16") the door shall be 14 gauge with 16 gauge mounting frame.

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- 2.4.3 Door shall be flush to frame with rounded safety corners.
 - 2.4.4 The frame shall be one piece welded to the mounting frame.
 - 2.4.5 The hinge shall be a continuous concealed hinge.
 - 2.4.6 The latch shall be a stainless steel screwdriver cam latch.
 - 2.4.7 The finish shall be type 304 #4 satin polish stainless steel.
 - 2.4.8 Standard of Acceptance: Acudor UF-5000, Mifab, Zurn, Watrous, Williams Brothers

2.5 FIRE RATED ACCESS DOOR

- 2.5.1 Door shall be constructed of 20 gauge steel with a 16 gauge mounting frame.
- 2.5.2 Door shall be filled with 50mm (2”) thick fire rated insulation.
- 2.5.3 The door frame shall be provided with a 25mm (1”) wide flange and mounting frame to have anchor straps.
- 2.5.4 The hinge shall be concealed and shall be provided with a spring closer.
- 2.5.5 Door shall be UL/ULC rated for 1 ½ hour “B” label with 250 degree F temp rise in 30 minutes.
- 2.5.6 The latch shall be a universal self latching bolt, operated by either a knurled knob.
- 2.5.7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.
- 2.5.8 For drywall applications provide a galvanized steel drywall taping bead flange.
- 2.5.9 Standard of Acceptance: Acudor FB-5050, Mifab, Zurn, Watrous, Williams Brothers

2.6 FIRE RATED ACCESS DOOR WITH INSIDE LATCH RELEASE

- 2.6.1 Door shall be constructed of 16 gauge steel with a 16 gauge mounting frame.
- 2.6.2 Door shall be flush to frame with reinforced edges.
- 2.6.3 The door frame shall be provided with a 25 mm (1”) wide flange and shall be provided with anchor straps.
- 2.6.4 The hinge shall be concealed and shall be provided with a spring closer.
- 2.6.5 The door shall be UL/ULC rated for 1 ½ hour “B” label or 2 hour “B” label as required where temperature rise is not a factor.
- 2.6.6 The latch shall be a universal self latching bolt, operated by either a knurled knob.

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- 2.6.7 The steel finish shall be 5 stage iron phosphate prepared with a prime coat of grey baked enamel.
 - 2.6.8 Door shall be provided with an interior latch release.
 - 2.6.9 For drywall applications provide a galvanized steel drywall taping bead flange.
 - 2.6.10 Standard of Acceptance: Acudor FB-5060, Mifab, Zurn, Watrous, Williams Brothers

2.7 VALVE BOX – SURFACE MOUNT

- 2.7.1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.
- 2.7.2 Door and box shall be 16 gauge steel.
- 2.7.3 The door shall overlap the box, providing a tight and secure fit.
- 2.7.4 The box shall be fully enclosed, attached to the door.
- 2.7.5 The hinge shall be a continuous piano hinge.
- 2.7.6 The door shall be provided with a cylinder lock and key.
- 2.7.7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.
- 2.7.8 Stainless steel doors shall be #4 satin finish.
- 2.7.9 Standard of Acceptance: Acudor ASVB, Mifab, Zurn, Watrous, Williams Brothers

2.8 VALVE BOX – RECESSED

- 2.8.1 Door shall be stainless steel in public areas and steel in mechanical rooms and service areas.
- 2.8.2 Door and box shall be 16 gauge steel.
- 2.8.3 The door shall be flush to the frame with rounded safety corners.
- 2.8.4 The box shall be fully enclosed, completely attached to the frame.
- 2.8.5 The hinge shall be a continuous concealed hinge.
- 2.8.6 The door shall be provided with a cylinder lock and key.
- 2.8.7 For steel doors the finish shall be 5 stage iron phosphate preparation with prime coat of grey baked enamel.
- 2.8.8 Stainless steel doors shall be #4 satin finish.
- 2.8.9 Standard of Acceptance: Acudor ARVB, Mifab, Zurn, Watrous, Williams Brothers

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 On some drawings, access door locations have been indicated for coordination. The drawings do not show all access doors required.
- 3.1.2 The Mechanical Contractor shall provide a set of drawings showing locations and types of all access doors located in public areas to the Consultant for approval, prior to commencing the installation of any piping or ductwork within these areas.
- 3.1.3 Access doors shall be turned over to the building trade that is responsible for finishing the wall or ceiling where the access door is required.
- 3.1.4 The Mechanical Contractor shall be responsible for providing the access doors required to be installed in ductwork. Refer to other sections for requirements.

END OF SECTION

1 GENERAL

1.1 GENERAL

- .1 Section Includes:
 - .1 Valve Tags.
 - .2 Pipe Markers/Arrow Tape Above Ground.
 - .3 Underground Piping Warning Tape.
 - .4 Mechanical Equipment and HVAC Controls Identification.
 - .5 Safety Signs.
 - .6 Isolation Valves Numbering.

1.2 DEFINITIONS

- .1 Exposed Areas
 - .1 Finished areas and other areas used by personnel in normal use of building, such as equipment rooms and storage rooms.
- .2 Concealed Areas
 - .1 Duct or pipe tunnels, duct or pipe chases, spaces above accessible ceilings, and crawl spaces.

2 PRODUCTS

2.1 STANDARD OF ACCEPTANCE

- .1 W. H. Brady Co. catalogue numbers are used as a basis of identification.
- .2 Stock catalogue numbers are listed in these specifications. Subcontractor is responsible to review schedules and provide required markers. In some instances, "non-stock" markers (special) may be required.

2.2 MANUFACTURER'S NAMEPLATES

- .1 Manufacturer's nameplates:
 - .1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
 - .2 Provide Underwriters' Laboratories or CSA registration plates, as required by respective agency.
 - .3 Manufacturers nameplate to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.
 - .4 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

2.3 VALVE TAGS

- .1 Metal Tags: Brass or aluminium with stamped or engraved letters; tag sizes minimum 2 inches (round, square, or rectangle) with smooth edges. Thickness 19 gauge (.040 inches) minimum.
- .2 Beaded Chain: Size 6, brass or aluminium, 4 1/2 inches long with locking link.

2.4 PIPE MARKERS/ARROW TAPE ABOVE GROUND

- .1 Colour: Conform to ANSI A13.1.
- .2 Self-Sticking Pipe Markers/Arrow Tape: Material B-946, flexible, vinyl film tape with pressure sensitive permanent adhesive backing and printed markings.
- .3 Suitable for indoor/outdoor application.
- .4 Temperature range: Minus 40 degrees to 180 degrees F.

2.5 UNDERGROUND PIPING WARNING TAPE

- .1 Tracer wire and test station(s) required when burying cast iron, ductile iron, or non-metallic piping.
- .2 Tracer Wire: #10AWG THHN/THWN, yellow, solid copper.
- .3 Tracer Wire Test Station: C.P. Test Services. Test Station: Plastic Pipe, cast iron cover, 2-point terminal box.

2.6 CONTROLS IDENTIFICATION

- .1 Refer to section 25 20 11.

2.7 EQUIPMENT IDENTIFICATION

- .1 Labelling shall be furnished and installed by the contractor
- .2 Engraved signs shall be dark letters on light background.
- .3 Identify mechanical equipment and HVAC controls, e.g., air handling units, pumps, heat transfer equipment, water treatment devices, controls instruments, stationary tanks/containers, and similar items, with nameplates or tags.
- .4 Provide engraved nameplates made of rigid plastic laminate in which colored top and bottom layers of the material are thermoset with a contrasting color core. Minimum thickness 0.062 inch.
- .5 Size: min. 1" x 3".
- .6 Material Colour: White background/ black lettering.

- .7 Manufacturer: Brady, No. B-1
- .8 Provide lettering as follows:
 - .1 Size: 10 point minimum
 - .2 Spacing: 1/4 inch from top, 1/8 inch from bottom, 1/16 inch between lines.
 - .3 Provide nameplate with component nomenclature as noted in the Equipment Schedules. Coordinate with the controls sub-contractor.
- .9 As a minimum, identify the system, e.g., HVAC (heating, ventilating, and air conditioning), the component, e.g., FGF (furnace, gas fired), and the sequence number.

2.8 SAFETY SIGNS

- .1 Colors associated with specific words such as "Danger," "Warning," "Caution," or "Notice" shall conform to ANSI Z35.1.

2.9 DUCTWORK IDENTIFICATION

- .1 Provide labels on the two sides and the bottom of all ductwork at intervals of every 5' to note the System Type ('Fresh Air Supply', 'Return', 'Exhaust') and directional arrows.

3 EXECUTION

3.1 PREPARATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- .1 Valve Tags:
 - .1 Install with brass beaded chain.
 - .2 Steel stamp or engrave valve tag in accordance with schedule herein.
 - .3 Letter style block, 1/4-inch height minimum.
 - .4 Tag all valves in concealed or exposed areas except isolation and by-pass valves installed adjacent to the equipment they serve.
 - .5 Provide typewritten letter size list of applied tags and location. Frame under glass and hang where directed.
- .2 Pipe Markers Above Ground:
 - .1 Install in accordance with manufacturer's instructions.
 - .2 Seal markers with clear lacquer.
 - .3 Identify piping in exposed or concealed areas in accordance with schedule herein.
 - .4 Pipe marker consists of pipe contents identification with flow direction arrow tape. Provide consistent color scheme, unless otherwise noted.
 - .5 Wrap arrow tape completely around pipe at both ends of pipe markers.

- .6 Install in clear view and align with axis of piping.
- .7 Label piping at intervals of not more than 20 feet on horizontal and vertical runs, at each branch connection, and where pipe penetrates walls, ceilings and floors (both sides).
- .8 Size of label depends on outside diameter (OD) of pipe. Pipe OD includes insulation or protective coating.
- .9 Minimum length of marker including arrows:

- | | |
|-------------------------------|-----|
| (a) 2" diam. pipe or smaller: | 8" |
| (b) 2" to 8" | 12" |
| (c) 8" to 10" | 24" |
| (d) Over 10": | 32" |

.3 Safety Signs

- .1 Install in clear view.

END OF SECTION

1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 20 05 11.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.
- .3 Submit type of isolator, size, height when uncompressed and maximum allowable static deflection weight of all isolated equipment, loads on each isolator and static deflection of each isolator under the specific design load.
- .4 Submit marked up plans indicating all locations where pipes are to be isolated in mechanical rooms and as specified.

2 PRODUCTS

2.1 GENERAL

- .1 Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
- .2 Elastomeric elements that will be exposed to temperatures below freezing shall be fabricated from natural rubber instead of neoprene.
- .3 All isolators to be installed outdoors or exposed to weather shall be hot dipped galvanized and shall be furnished with neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.
- .4 Standard of Acceptance: Kinetics Noise Control, Vibro-Acoustics.

2.2 FLEXIBLE PIPE CONNECTORS

- .1 Flexible pipe connectors shall be used on all piping connected to rotating equipment (Chiller, pumps, air handling equipment) to reduce the transmission of noise and Vibration, and to eliminate stresses in piping systems due to misalignment and thermal movement of the piping.
- .2 Flexible connectors shall be of the single- or double-sphere molded joint configuration and shall meet or exceed specifications of the Rubber Expansion Joint Division, Fluid Sealing Association.

- .3 Connectors shall be made of molded neoprene reinforced with nylon tire cord and shall have mild steel floating flanges or female union ends.
- .4 Control rods shall be used with unanchored systems or with spring-mounted equipment where the pressures and movements exceed those the connectors are designed to withstand.
- .5 Standard of acceptance: Kinetics model Kinflex

2.3 FLEXIBLE DUCT CONNECTORS

.1 Flexible Connections

- .1 Where duct connections are made to fans and air handling units (not internally isolated), install a non combustible flexible connection of 822 g (29 ounce) neoprene coated fiberglass fabric approximately 150 mm (6 inches) wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc coated iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 50 mm (2 inches) on center. Fabric shall not be stressed other than by air pressure. Allow at least 25 mm (one inch) slack during operation to insure that no vibration is transmitted.
- .2 Length of connection: 6"
- .3 Minimum distance between metal parts when system in operation: 3"
- .4 Install in accordance with recommendations of SMACNA.

2.4 ELASTOMERIC PADS

- .1 Neoprene waffle or ribbed; 9mm minimum thick; 50 durometer; maximum loading 350kPa. Mason type W
- .1 Application: between all floor-mounted pumps supports and the house-keeping pads

2.5 ELASTOMERIC MOUNTS

- .1 Neoprene, moulded from oil-resistant compounds, with a cast-in-top steel load transfer plate for bolting to supported equipment and a bolt-down plate with holes provided for anchoring to the supporting structure. Isolator shall provide lateral load resistance for loads applied parallel to mounting surface. Neoprene vibration isolators shall be Model RQ, by Kinetics Noise Control, Inc.
- .1 Application: between boilers and domestic hot water heaters support frames and house-keeping pads.

2.6 PIPE HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Swivel arrangement to permit hanger box or rod to move through a 30 deg. arc without metal to metal contact. Unless specified otherwise, the static deflection shall be 9mm, with a strain not exceeding 15%, and spring hangers to have minimum static deflection of 2". A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 19mm larger than the diameter of the hanger rod.
- .2 Standard of acceptance: Kinetics model SRH

3 EXECUTION

3.1 INSTALLATION

- .1 Provide vibration isolation for new equipment as noted in the specification, listed in the schedule and shown on the drawings.
- .2 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mountings to level equipment.
- .3 Ensure piping and electrical connections to isolated equipment do not reduce system flexibility.
- .4 All suction and discharge from the pumps shall be provided with flexible pipe connections.
- .5 Unless indicated otherwise, support all piping connected to the pumps and boilers with spring equipped hangers as described in these specifications, as follows:
 - .1 First 3 points of support.
 - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 2".
- .6 Unless specified otherwise, all pump supports will be mounted on elastomeric pads.
- .7 Unless specified otherwise, the boilers, indoor air handlers, indoor chillers will be mounted on elastomeric mounts
- .8 All wiring connections to the pumps shall be made in a 360 degree loop; minimum conduit length: 3 ft. Cut any ties used to install this loop prior to adjusting the isolators.

- .9 Provide suitable supports for all equipment which does not have a frame with adequate rigidity.
- .10 There shall be a minimum of 4" clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.
- .11 Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators. Such elements shall be supported on or suspended from building structure.

END OF SECTION

1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 QUALITY ASSURANCE

- .1 Comply with OBC and NFPA 90A requirements, particularly paragraphs pertaining to the maximum flame spread index (currently set at 25) and maximum smoke development index (currently set at 50).
- .2 All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- .3 Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 20 05 11 shop drawings and product data
- .2 Provide the following:
 - .1 Insulation materials: Specify each type used and state surface burning characteristics.
 - .2 Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
 - .3 Insulation accessory materials: Each type used.
 - .4 Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

1.4 STORAGE AND HANDLING OF MATERIAL

- .1 Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.5 STANDARDS OF ACCEPTANCE

- .1 Knauf Fiber Glass
- .2 Owens/Corning Fiberglass
- .3 Armstrong
- .4 Johns Manville
- .5 Rockwool Manufacturing

2 PRODUCTS

2.1 GENERAL

- .1 K-factors (thermal conductivity) shown are expressed in BTU•in/hr•ft²•F.

2.2 FIBERGLASS PIPE INSULATION

- .1 Insulation:

- .1 Rigid molded in compliance with ASTM C547, Class 1, minimum density 3.5 pounds/cubic foot, K-factor of approximately 0.24 at 75 degrees F, suitable for temperatures from minus 20 degrees F to 450 degrees F.

- .2 Vapor Barrier

- .1 Factory applied vapor barrier all-service type with self-sealing lap and butt strips.

- .3 Valves and Fitting Covers

- .1 Pre-molded PVC covers with fiber glass insert. Manufacturers: Proto Corp., Ceelco.

- .4 Provide insulation on all new piping installed as part of this project or removed as part of this project. Applications

- .1 All domestic cold water piping.
- .2 All domestic hot water and recirculation piping.
- .3 All hot water heating piping.
- .4 All glycol heating piping
- .5 All condensate piping.
- .6 All horizontal and vertical sections of storm drainage.
- .7 All horizontal and vertical sections of sanitary drainage.

2.3 INSULATION THICKNESS

- .1 Hot water heating, all piping sizes: 1"
- .2 Domestic hot water less than 2" 1"
- .3 Domestic hot water larger than 2" 1½"
- .4 Domestic cold water, all piping sizes: 1"
- .5 Condensate, all piping sizes: 1"
- .6 Storm & Sanitary Piping, all piping sizes: 1"

2.4 ADHESIVE, MASTIC, CEMENT

- .1 ASTM C449: Mineral fiber hydraulic setting thermal insulating and finishing cement.
- .2 Other: Insulation manufacturers' published recommendations.

2.5 MECHANICAL FASTENERS

- .1 Wire: 1.3 mm thick (18 gage) soft annealed galvanized or 1.9 mm (14 gage) copper clad steel or nickel copper alloy.
- .2 Bands: 20 mm (3/4 inch) nominal width, brass, galvanized steel, aluminum or stainless steel.

2.6 CANVAS JACKETING

- .1 Apply in concealed areas, compact, firm ULC listed heavy plain weave, cotton fabric at 220 g/m sq.

2.7 PVC JACKETING

- .1 Apply in exposed areas on piping with operating temperatures less than 180°F. (80°C.).
- .2 Piping: ULC listed PVC moulded type jacketing material, gloss white complying with 25 Flame Spread and 50 Smoke Developed ratings.
- .3 Fittings: ULC listed PVC, gloss white, 1-piece, pre-moulded fittings complying with 25 Flame Spread and 50 Smoke Developed ratings.
- .4 PVC Application: strictly in accordance with the requirements of Authorities having jurisdiction.
- .5 Ultraviolet resistant.
- .6 Fastenings: To manufacturer's standard(s).

2.8 METAL JACKETING

- .1 At all locations where the pipe is located outdoors or in heavy abuse areas, use metal jacketing to protect piping or ductwork insulation.
- .2 Jacketing: Aluminum, 0.016 inches thick, embossed surface, with factory bonded moisture barrier.
- .3 Valve and Fitting Insulation Covers: Fabricate from same material as jacketing or use prefabricated insulation covers made in two matching halves.
- .4 Metal Jacketing Bands: 1/2 inch wide, aluminum or stainless.

2.9 PROTECTION SADDLES AND SHIELDS

- .1 Provide factory engineered galvanized steel hanger shields on horizontal insulated pipe complying with MSS SP-58 and MSS SP-59 standards for gauge and length of saddle.

2.10 SADDLES (PIPING/TUBING UP TO 2 INCHES)

- .1 Use 180 degree saddle on systems utilizing teardrop type hangers.

- .2 Use 360 degree saddle on systems utilizing trapeze hangers or clamps.

2.11 INSERTS AND SHIELDS (PIPING/TUBING OVER 2 INCHES)

- .1 Use 360 degree calcium silicate insert with a 180 degree shield on systems utilizing clevis or teardrop type hangers.
- .2 Use 360 degree calcium silicate with a 360 degree shield on systems utilizing trapeze hangers or clamps.
- .3 The unit shall have an integral moisture barrier consisting of a tri-laminate All-Service Jacket equal and similar to the jacketing on the adjoining insulation.
- .4 Insert: Calcium silicate, minimum density 9 pounds/cubic foot.

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that items to be insulated have been pressure tested and approved before applying insulation material.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION - GENERAL

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Required pressure tests of piping joints and connections shall be completed and the work approved by the Consultant for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- .3 Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories). Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full length section will fit.
- .4 Insulation materials shall be installed with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- .5 Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- .6 Insulation on hot piping and equipment shall be terminated square at items not to be insulated, such as access openings and nameplates. Cover all exposed raw insulation with white sealer or

-
- jacket material.
- .7 Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
 - .8 Piping work not to be insulated:
 - .1 In hot piping: Unions, flexible connectors, control valves, PRVs, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 75 mm (3 inches) of uninsulated items.
 - .9 Plumbing work not to be insulated:
 - .1 Piping and valves of fire protection system.
 - .2 Chromium plated brass piping.
 - .3 Piping in pipe basement serving wall hydrants.
 - .4 Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 900 mm (3 feet).
 - .10 Work shall be performed by qualified insulation journeymen.
 - .11 Apply insulation and coverings on hot piping while surface is between 50 to 60°C
 - .12 Vapor barriers and insulation to be complete over full length of pipe or surface, without penetration for hangers, and without interruption at sleeves, pipe and fittings.
 - .13 Do not insulate factory-insulated equipment.
 - .14 Do not insulate nameplates.
 - .15 Fit insulation tightly against surface to which it is applied.
 - .16 For non-fire rated barriers (e.g., wall, floor, ceiling, or roof) continue insulation and vapor barrier through penetrations. For fire rated barriers, provide ULC/FM approved through penetration stop systems.
 - .17 Weatherproof outdoor installations of piping or ductwork covered with aluminum jacket. Provide watershed lap joints and seal with mastic as required.
 - .18 Do not install metal jacketing with raw edges; provide a safety edge.

3.3 INSTALLATION - PIPING

- .1 On exposed piping located in finished areas, locate cover seams in least visible area.
- .2 Provide continuous insulation through pipe hangers or supports. Do not notch insulation. Provide shields or saddles to prevent crushing insulation.

-
- .3 Where insulation terminates, taper to pipe and finish with insulating cement or acrylic mastic.
 - .4 Cover insulated pipes located outdoors or in utility tunnels with aluminum jacket. Secure with aluminum bands and screws as required.
 - .5 Tape circumferential joints of pipe insulation with 3 inch wide white vinyl tape.
 - .6 Insulate fitting and valves where required with same material thickness as specified for adjacent pipe.
 - .7 Insulate potable and non-potable cold water piping within walls, chases, or ceiling plenums where return air is present.
 - .8 Insulate potable and non-potable cold water piping in equipment rooms.
 - .9 Do not insulate unions, flanges and valves in potable or non-potable piping systems of 140 degrees F or less, except for chilled water.
 - .10 Vertical pipe over 3" diameter: use insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter locate on 12 ft centers and at each valve and flange.
 - .11 Expansion joints: Terminate single layer and each layer of multiple layers in straight cut. Leave space of 1" between terminations. Pack void tightly with glass wool. Protect joints with aluminum sleeves.
 - .12 Use factory fabricated, easily disassembled insulation, for valves, fittings and process equipment requiring periodic maintenance of parts and sub-assemblies listed or indicated.

END OF SECTION

1 GENERAL

1.1 DESCRIPTION

- .1 Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
 - .1 Systems Inspection report.
 - .2 Duct Air Leakage test report.
 - .3 Balancing air and water distribution systems; adjustment of total system to provide design performance;
 - .4 Recording and reporting results.

1.2 DEFINITIONS

- .1 TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
- .2 CAABC: Canadian Associated Air Balance Council.
- .3 Hydronic Systems: Includes heating hot water, domestic hot water recirculation, and glycol water systems, as applicable to the project.
- .4 Air Handling Systems: Includes all central and distributed air handling equipment that provide outside air, supply air, return air, exhaust air and relief air to and from the building, as applicable to the project.
- .5 Air distribution systems: Includes all grilles, diffusers, terminal units (by pass/VAV).
- .6 Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.3 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 TAB Agency: The TAB agency shall be a Sub-Contractor of the Mechanical Contractor and shall report to and be paid by the Mechanical Contractor.
 - .2 The TAB agency shall be one of the following Vendors:
 - (i) Enviro Balance Inc.
 - (ii) National Air Balance Inc.
 - .3 TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency.
- .2 TAB Agency shall be identified by the Mechanical Contractor within 15 days after the award of the contract.

-
- .3 The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Consultant. The responsibilities would specifically include:
 - .1 Shall directly supervise all TAB work.
 - .2 Shall sign the TAB reports that bear the seal of the TAB Agency. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC.
 - .3 Would follow all TAB work through its satisfactory completion.
 - .4 Shall provide final markings of settings of all HVAC adjustment devices.
 - .5 Permanently mark location of duct test ports.
 - .4 Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards and or by the instrument manufacturer.
 - .5 Tab Criteria:
 - .1 Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - .2 Flow rate tolerance:
 - .1 Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0% to plus 10%.
 - .2 Grilles, diffusers and air terminal units (maximum values): 0% to +10%.
 - .3 Exhaust hoods/cabinets: 0 % to + 10 %.
 - .4 Minimum outside air: 0 % to +10 %.
 - .5 Individual room air outlets and inlets, and air flow rates not mentioned above: 0% to +10 % except if the air to a space is 100 CFM or less the tolerance would be 0 to plus 5 %.
 - .6 Heating hot water pumps and hot water coils: 0 % to +5 %.
 - .7 Heating hot water convectors, forced flow heaters, unit heaters: 0 % to +5 %.
 - .8 Chilled water and condenser water pumps: 0% to +5 %.
 - .9 Chilled water coils: 0 % to +5 %.

1.4 SUBMITTALS

- .1 Submit Following for Review to the Consultant:
 - .1 Systems inspection report on equipment and installation for conformance with design.
 - .2 Duct Air Leakage Test Report, demonstrating compliance with all ASHRAE 90.1 ductwork sealing requirements.
 - .3 Final TAB reports covering flow balance and adjustments, performance tests.
 - .4 Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

1.5 APPLICABLE PUBLICATIONS

- .1 The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- .2 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): HVAC Applications ASHRAE Handbook, Testing, Adjusting, and Balancing
- .3 Associated Air Balance Council (AABC): AABC National Standards for Total System Balance
- .4 Sheet Metal and Air Conditioning Contractors National Association (SMACNA): HVAC SYSTEMS Testing, Adjusting and Balancing

2 Products

2.1 PLUGS

- .1 Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

- .1 Coordinate with the mechanical Contractor the TAB activity such that it does take place before the insulation is installed on ductwork and piping.
- .2 In the absence of such coordination, the mechanical contractor shall be responsible for the repair to the ductwork and or piping insulation removed for TAB purposes, including the integrity of the vapor barrier material and the insulation jacket.

3 Execution

3.1 GENERAL

- .1 Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 SYSTEMS INSPECTION REPORT

- .1 Inspect equipment and installation for conformance with design.
- .2 The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- .3 Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed. Provide a report to the Consultant.
- .4 Reports: Follow check list format developed by CAABC or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals.

Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

3.3 TAB REPORT

- .1 Format to be in accordance with referenced standard listed above, but using design drawing units.
- .2 Produce "as-built" full system schematics. Use as-built drawings for reference.
- .3 Submit 1 copy of preliminary TAB reports, each in "D" ring binders, complete with index tabs for verification and approval of Consultant.
- .4 Submit copies of final TAB reports after approval by the Consultant, to be incorporated into the Maintenance and Operations Manual.

3.4 PROCEDURES

- .1 Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified.
- .2 Start final TAB only when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows and other construction affecting TAB.
 - .2 Application of sealing, caulking and weather-stripping.
 - .3 Normal operation of mechanical systems affecting TAB.
- .3 General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

3.5 AIR BALANCE AND EQUIPMENT TEST:

- .1 Include all air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, as applicable to this project.
- .2 Adjust fan speeds to provide design air flow.
- .3 Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
- .4 Parameters to be Measured
 - .1 Air Flow
 - .2 Air velocity.
 - .3 Static pressure.
 - .4 Velocity pressure.
 - .5 Temperature:
 - .1 Wet bulb.

- .2 Dry bulb.
- .6 Cross sectional area.
- .7 Fans RPM
- .8 Electrical power:
 - .1 Voltage
 - .2 Current draw.

.7 Locations of Measurements

- .1 Inlet and outlet of each
 - .1 Fan.
 - .2 Coil.
 - .3 Filter.
 - .4 Balancing damper.
 - .5 Other auxiliary equipment.
- .2 Main ducts.
- .3 Main branch ducts.
- .4 Sub-branch ducts.
- .5 Each supply, exhaust and return air inlet and outlet.
- .6 Before and after the silencers.

3.6 WATER BALANCE AND EQUIPMENT TEST:

- .1 Include all circulating pumps, heat exchangers, boilers, coils, as applicable to this project.
- .2 Adjust flow rates for equipment to the values indicated on the drawings and schedules. Set balancing valves and circuit setters to the values on indicated on the equipment schedules
- .3 Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils, and for heat exchangers. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.
- .4 Parameters to be Measured
 - .1 Water/Glycol Flow (as applicable to the project)
 - .2 Pressure.
 - .3 Temperature.
 - .4 Specific gravity.
 - .5 Pumps RPM
 - .6 Electrical power:
 - .1 Voltage
 - .2 Current draw.
- .5 Locations of Measurements
 - .1 Inlet and outlet of each
 - .1 Pump.
 - .2 Coil.

- .3 Boiler.
- .4 Balancing valve.
- .5 Automatic control valves
- .6 Chiller.

3.7 VERIFICATION

- .1 Reported measurements shall be subject to verification by Consultant. Provide instrumentation and manpower to verify results of up to 30 % of all reported measurements. Number and location of verified measurements to be at discretion of Consultant.
- .2 Bear costs to repeat TAB, as required, to satisfaction of Consultant.

3.8 MARKING OF SETTINGS

- .1 Following approval of TAB final Report, the setting of all HVAC adjustment devices including balancing valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Consultant.

3.9 CONDUCTING THE TESTING AND BALANCING PROCEDURE

- .1 Part 1 - The Mechanical Contractor is responsible for conducting testing and balancing of all new mechanical systems and equipment as specified on the Drawings, Specifications and/or other Contract Documents and providing the comprehensive report to the Engineer.
- .2 Part 2 - The Contractor shall include for a repeat of all testing procedures to be conducted in witness of the Consultant on site after the completion of Part 1 (see .1). This is intended to demonstrate the operating characteristics of all mechanical systems once balancing has been complete and once the Engineer has had a chance to review the comprehensive report. The TAB Agency shall include for additional balancing during this Part as advise by the Engineer on site.

3.10 IDENTIFICATION OF TEST PORTS

- .1 The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- 1.1.1 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements.
- 1.1.2 All valves must have a valid CRN Number. Statutory declaration must be provided on request.
- 1.1.3 NO USE OF VICTAULIC OR 'GROOVED END' PRODUCTS WILL BE ALLOWED.

1.2 REFERENCE STANDARDS

- 1.2.1 Do the work in accordance with the Ontario Building Code Plumbing Code and local authority having jurisdiction.
- 1.2.2 ASTM B62-09 Specifications for Composition Bronze or Ounce Metal Castings.
- 1.2.3 ANSI/ASME B16.5-2005 Pipe Flanges and Flanged Fittings.
- 1.2.4 ANSI/ASME B16.11-2009 Forged Fittings, Socket Welding.
- 1.2.5 ASTM B88-03 Specifications for Seamless Copper Water Tube.
- 1.2.6 CSA B242-M80 Groove and Shoulder Type Mechanical Pipe Couplings.
- 1.2.7 MSS SP 67-2002 Butterfly Valves
- 1.2.8 MSS SP 70-2006 Cast Iron Gate, Globe, Angle and Check Valves
- 1.2.9 MSS SP 71-2005 Cast Iron Swing Check Valves Flanged and Threaded Ends.
- 1.2.10 MSS SP 80-2003 Bronze Gate, Globe, Angle and Check Valves

1.3 SHOP DRAWINGS

- 1.3.1 Submit product data in accordance with Section 20 05 11.
- 1.3.2 Indicate following: valves.

PART 2 - PRODUCTS

2.1 PIPING

- 2.1.1 Domestic hot, cold and recirc tubing, within building.
- .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
- .2 Buried: copper tube, soft annealed, type K: to ASTM B88M.

2.1.2 All piping shall have certification markings for compliance with ASTM B88.

2.2 FITTINGS

2.2.1 Brass or bronze flanges and flanged fittings: to ANSI B16.24.

2.2.2 Brass or bronze threaded fittings: to ANSI B16.15.

2.2.3 Cast bronze to ANSI B16.18- 1984 or wrought copper and bronze to ANSI B16.22.

2.3 JOINTS

2.3.1 Rubber gaskets, 0.063" (1.6 mm) thick: to AWWA C111 -95.

2.3.2 Bolts, nuts, hex head and washers: to ASTM A307-92a-07b, heavy series.

2.3.3 For installation of the potable water system only lead free solder shall be used in accordance with Ontario Building Code Standards.

2.3.4 Solder, tin antimony, 95:5: to ASTM B32.

2.4 GATE VALVES

2.4.1 Gate valves shall only be utilized where specifically noted on the drawings. For all other shut off valve applications utilize ball valves for 2" (50 mm) or smaller and butterfly valves for 2.6" (65 mm) and larger.

2.4.2 NPS 2 and under, soldered:

.1 Non-rising stem to MSS SP-80, Class 125, 860 kPa, bronze body, screw-in or bolted bonnet.

.2 Standard of Acceptance: Jenkins, Crane, Toyo 281, Kitz 41, Grinnell

2.4.3 NPS 2 and under, screwed:

.1 Rising stem: to MSS SP-80, class 125, 860 kPa, bronze body, solid wedge disc.

.2 Standard of Acceptance: Jenkins, Crane, Toyo 293, Kitz 24, Grinnell

2.4.4 NPS 2-1/2 and over, in mechanical rooms, flanged:

.1 Rising stem: to MSS SP-70, class 125, 860 kPa, FF flange, cast-iron body, OS&Y bronze trim.

.2 Standard of Acceptance: Jenkins, Crane, Toyo 421, Kitz 72, Grinnell

2.4.5 NPS 2-1/2 and over, other than mechanical rooms, flanged:

.1 Non-rising stem: to MSS SP-70, class 125, 860 kPa, FF flange, cast-iron body, bronze

trim, bolted bonnet.

- .2 Standard of Acceptance: Jenkins, Crane, Toyo 415, Kitz 75, Grinnell

2.5 GLOBE VALVES

2.5.1 NPS 2 and under, balancing, soldered:

- .1 To MSS SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet.
- .2 Lockshield handles: as indicated.
- .3 Standard of Acceptance: Jenkins, Crane, Toyo 222, Kitz 10, Grinnell

2.5.2 NPS 2 and under, balancing, screwed:

- .1 To MSS SP-80, class 125, 860 kPa, bronze body, screwed over bonnet, renewable composition disc.
- .2 Lockshield handles: as indicated.
- .3 Standard of Acceptance: Jenkins, Crane, Toyo 220, Kitz 09, Grinnell

2.6 SWING CHECK VALVES

2.6.1 NPS 2 and under, soldered:

- .1 To MSS SP-80, class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 237, Kitz 23, Grinnell

2.6.2 NPS 2 and under, screwed:

- .1 To MSS SP-80, class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 236, Kitz 22, Grinnell

2.6.3 NPS 2-1/2 and over, flanged:

- .1 To MSS SP-70, class 125, 860 kPa, cast iron body, FF flange, regrind renewable seat, bronze disc, bolted cap.
- .2 Standard of Acceptance: Jenkins, Crane, Toyo 435, Kitz 78, Grinnell

2.7 BALL VALVES

2.7.1 NPS 2 and under, branch isolators, screwed:

- .1 600 WOG, bronze body, solid chrome plated bronze ball, with Teflon seal.
- .2 Ball valves shall have full port opening.
- .3 Standard of Acceptance: Jenkins, Crane, Toyo 5044A, Kitz 58, Grinnell, Apollo.

2.8 AUTOMATIC CIRCUIT BALANCING VALVES

2.8.1 Circuit balancing valves shall be of the automatic variety. Manual circuit balancing valves will not be accepted.

2.8.2 Circuit Balancing Valves are required on the domestic hot water recirculation system.

2.8.3 Provide the following sizes:

- .1 Provide 0.032 l/s (0.5 gpm) for 12 mm pipe size.
- .2 Provide 0.063 l/s (1.0 gpm) for 20 mm pipe size.

2.8.4 Product Warranty and Performance Guarantee

- .1 Valves shall be warranted by the manufacturer to be free of defects in material and workmanship for a period of five years.
- .2 Valves shall control flow to within plus/minus 5 percent of design over an operating differential range of at least 14 times the minimum required for control. Four operating pressure ranges shall be available with the minimum range requiring less than 3 psid to actuate the mechanism.
- .3 The valve flow curve shall be smooth over its entire nominal control range. Gaps, bumps and dips in flow curves shall not be acceptable.

2.8.5 Shop Drawing Submission

- .1 The Balancing Valve Manufacturer shall submit a complete list of balancing valves, their location and their performance.
- .2 The Balancing Valve Manufacturer shall mark up a set of full size plans showing the location of each balancing valve and assign an appropriate identification tag for the balancing valve.
- .3 The Balancing Valve Manufacturer shall submit these drawings for the Consultant to review, incorporate any comments from the Consultant and then submit copies of this drawing to the Mechanical Contractor, Mechanical Consultant, Architect and Construction Manager.
- .4 All balancing valves shall be shipped to site with this tag number firmly attached to the

valve and the full size drawings shall be utilized to identify the location where they are to be installed.

2.8.6 Valve Flow Control Cartridge (Typical for all valves)

- .1 The non adjustable flow control cartridge shall be 100% stainless steel. Parts made of soft metals such as brass with only a coating of hard metal such as nickel shall not be allowed. Rubber based materials whose properties change with temperature and pressure shall not be allowed.
- .2 The cartridges shall have segmented ports through which water can pass, rather than a continuous large port, to eliminate noise and full travel linear coil spring.
- .3 The cartridge movement shall result in a shearing action that will dislodge or shear any particle that may tend to get stuck in a port.
- .4 Cartridge shall be removable from the housing and shall be held in place in the housing without adhesive.
- .5 All flow control cartridges shall be warranted by the manufacturer for five years from the date of sale.

2.8.7 Sizes 40mm and smaller

- .1 Valves shall have forged brass bodies and stainless steel cartridge assembly rated for a minimum of 230 psi/250F.

2.8.8 Valve end connections shall be either female sweat or FPT.

2.8.9 Valves shall be provided with two pressure/temperature taps.

2.8.10 Valves shall be provided with a union tailpiece and built in isolation valve.

2.8.11 The body design shall allow for inspection or removal of the cartridge without disturbing piping connections.

2.8.12 The valve shall come fully assembled and shall be permanently marked to show direction of flow and shall have a body tag to indicated flow rate and model number.

2.8.13 Provide a shut off valve upstream of the valve to allow the system to be shut off and the balancing valve to be removed without shutting down the entire heating system.

2.8.14 Standard of Acceptance: Griswold Isolator R valve.

PART 3 - EXECUTION

3.1 INCOMING WATER MAIN

- 3.1.1 The products utilized to build the meter assembly shall be in accordance with the Local Authorities requirements.
- 3.1.2 Where the Local Authority requires that this assembly use gate valves with all soldered connections the Mechanical Contractor shall solder all of the joints and use gate valves as specified above.

3.2 INSTALLATION

- 3.2.1 Connect to fixtures and equipment in accordance with manufacturers instructions.
- 3.2.2 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- 3.2.3 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- 3.2.4 Lay buried tubing in accordance with AWWA Class "B" bedding.
- 3.2.5 Isolate equipment, fixtures and branches with ball valves.
- 3.2.6 New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority having jurisdiction or in the absence of a prescribed method as follows:
 - .1 The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
 - .2 The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200mg/l) of chlorine and allowed to stand for three (3) hours.
 - .3 Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.
 - .4 The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.
- 3.2.7 Compression fittings are not acceptable.
- 3.2.8 All valves packing shall be asbestos free.
- 3.2.9 Provide isolation valves on all main branch feeds to each washroom group.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

1.1.1 This section of the specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements of the specification.

1.2 REFERENCE STANDARDS

- 1.2.1 Do the work in accordance with the Ontario Building Code Plumbing Code and local authority having jurisdiction.
- 1.2.2 CSA B70 - 2006 Specifications for Cast Iron Soil Pipe Fittings and Means of Joining.
- 1.2.3 CSA B125 - 2005 Specifications for Plumbing Fittings
- 1.2.4 ASTM B32 - 2008 Specifications for Solder Metal
- 1.2.5 ASTM B306 - 2009 Specifications for Copper Drainage Tube (DWV)
- 1.2.6 ANSI B16.29
- 1.2.7 ASTM B88, ASTM B88M - 2003 Specifications for Seamless Copper Water Tube
- 1.2.8 ASTM A74 - 2009 Specification for Cast Iron Soil Pipe and Fittings
- 1.2.9 ASTM C564 -2009 Specification for Rubber Gasket for Cast Iron Soil Pipe and Fittings

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- 2.1.1 For all above grade vent, sanitary and storm piping, Type DWV to:
- .1 ASTM B306 - Specification for copper drainage tube (DWV).
 - .2 CSA B158 for cast brass fittings.
 - .3 ANSI B16.29 for wrought copper fittings.
 - .4 Solder: tin-lead, 50:50, to ASTM B32, type 50A - Specification for solder metal.
 - .5 ASTM B88.
 - .6 ASTM C564

2.2 CAST IRON PIPING AND FITTINGS

2.2.1 For above grade storm, sanitary and vent piping, minimum NPS 3, to CSA B70, ASTM A74 with heavy bituminous coating.

2.2.2 For above grade storm, sanitary and vent piping 4" (100 mm) size and larger: Cast iron.

2.2.3 For storm, sanitary and vent piping joints.

.1 Mechanical joints.

.1 Neoprene or butyl rubber compression gaskets for all pipe connections.: to ASTM C564-2009.

.2 SS clamps.

2.2.4 Provide PVC piping for Urinals in accordance with OBC for above-grade drainage in lieu of Cast Iron.

2.3 PUMPED DRAINAGE

2.3.1 Pumped drains shall be galvanized steel.

2.4 DRAINAGE AND VENTS

2.4.1 Piping And Fittings

2.4.2 For buried sanitary, storm and vent piping:

.1 ASTM D2665, ASTM D2949, ASTM B251

.2 ASTM D3034, ASTM F891

.3 CAN/CSA- B181.2 for PVC DWV or

.4 CAN/CSA B182.1- for plastic DWV.

2.4.3 Joints

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

.3 For sizes above 4" (100mm).

Provide Ring-Tite joints Canron Ring-Tite joints PVC DR35 gravity sewer pipe, with locked in rubber ring sealing feature providing tight flexible seal.

Spigot ends to be supplied complete with bevel.

2.4.4 All PVC piping below grade shall be a minimum of SDR 35.

2.5 CONDENSATE DRAIN PIPING

2.5.1 All condensate piping shall be Copper water tube, ASTM B88, Type L for runouts and Type M for mains.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Install piping parallel and close to walls to conserve space, and to grade indicated, and to suit installation of related work.

3.1.2 Apply two coats of asphalt paint to pipe laid in, or passing through concrete.

3.1.3 Where piping passes through floor or wall below grade pack and seal in concrete complete with Link Seal in accordance with Specification Section 20 05 11.

3.1.4 PVC piping shall not be utilized above grade. PVC piping is acceptable for below grade piping where permitted by Code. The PVC piping shall convert to cast iron prior to the point where it penetrates the floor slab.

3.1.5 Provide venting to plumbing fixtures and fixture groups in accordance with the Ontario Building Code Plumbing Code and local authorities having jurisdiction.

3.1.6 Install buried pipe on 6" (150 mm) bed of clean sand, shaped to accommodate hubs and fittings, to line and grade as indicated. Backfill with clean sand.

3.1.7 Install piping parallel and close to walls to conserve space and to grade indicated, and to suit the installation of related work.

3.1.8 Apply solvent to male end of joints only.

3.1.9 Pipe installation: Pipe shall be installed as specified and indicated on the drawings.

3.1.10 The piping system shall be installed in accordance with the manufacturers current published installation procedures.

3.1.11 PVC piping shall not be utilized above grade. PVC piping is acceptable for below grade piping where permitted by Code. The PVC piping shall convert to cast iron prior to the point where it penetrates the floor slab.

3.1.12 Where piping passes through floor or wall below grade pack and seal in concrete in accordance with Mechanical General Requirements.

3.1.13 Provide venting to all plumbing fixtures and fixture groups in accordance to the Ontario

Building Code - Plumbing Code and local authorities having jurisdiction.

3.1.14 If tests are required by an authority having jurisdiction, perform tests in presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.

3.1.15 Test pressure shall not exceed 1-1/2 times the maximum rated pressure of the lowest related element in the system.

3.1.16 Remove all fittings which do not withstand test pressure, replace and retest.

3.1.17 Eliminate leaks, or remove and refit defective parts.

3.2 TESTING

3.2.1 The drainage and vent system shall be tested in accordance with the Ontario Building Code - Plumbing Code and tested in accordance with the requirements of the authority having jurisdiction, perform tests in the presence of each governing authority and obtain certification. Repeat tests as often as necessary to obtain certification.

3.2.2 Perform tests before piping is covered or concealed.

3.2.3 Remove all fittings which will not withstand test pressure, and replace after test.

3.2.4 Eliminate leaks, or remove and refit defective parts.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 1 as applicable.

1.1.1 Conform to General Mechanical Requirements, Section 20 05 11 Mechanical General Requirements as applicable.

1.1.2 All plumbing fixtures depicted on the Drawings with a “Fixture Tag” (‘WC-1’ or WC-1) is a new plumbing fixtures and to be supplied and installed by the Mechanical Contractor in full complete with all necessary cold/hot water supply, drainage and vent piping.

1.2 REFERENCES

ANSI/ARI	Drinking Fountains and Self-Contained, Mechanically Refrigerated Drinking Water Coolers.
ANSI/ARI 1020	Application and Installation of Drinking Fountains and Drinking Water Coolers.
CAN/CSA-B45 Series-02	CSA Standards on Plumbing Fixtures.
CAN/CSA-B125-01	Plumbing Fittings.

1.3 SUBMITTALS

1.3.1 Product Data

1.3.1.1 Submit product data in accordance with the Mechanical General Requirements.

1.3.1.2 Indicate dimensions, construction details and roughing-in dimensions for all fixtures and trim.

1.3.2 Maintenance Data

1.3.2.1 Provide maintenance data for incorporation into manual specified in the Mechanical General Requirements.

1.3.2.2 Data to include:

- Description of plumbing fixtures and trim giving manufacturers name, type, model, year capacity and flow.
- Details of operation, servicing and maintenance.
- Recommended spare parts list.

1.4 FIXTURES AND TRIM

1.4.1 Manufacture plumbing fixtures in accordance with CAN/CSA-B45 Series. Conform to latest code requirements for water saving features noted in the Ontario Building Code.

1.4.2 Manufacture plumbing fittings in accordance with CAN/CSA-B125.

1.4.3 Architectural drawings to govern in determination of number and location of fixtures.

- 1.4.4 Fixtures in any one washroom or location to be product of one manufacturer and of same type, unless otherwise noted.
- 1.4.5 Trim in any one washroom or location to be product of one manufacturer and of same type, unless otherwise noted.
- 1.4.6 Exposed plumbing brass to be chrome plated.
- 1.4.7 The type number and letter allocated to each style of fixture identifies that particular fixture on Mechanical Drawings.

2 PRODUCTS

2.1 WALL HUNG WATER CLOSET, "WC-1" [BARRIER FREE DESIGN]

- 2.1.1 Water Closet: Wall hung exposed flush valve (barrier free design)- American Standard "Afwall Elongated" low consumption toilet #3351.101 "Low Consumption", wall hung for flush valve, vitreous china, elongated syphon jet flush action bowl, fully glazed 2-1/8" (54 mm) internal trap way, 10"x12" (254 mm x 305 mm) large water surface 1.6 gal (6 L) flush, 1-1/2" (38 mm) top spud.
- 2.1.2 Flush Valve: Flush Valve & Supplies: Sloan Regal #111-XL-CP, exposed manual Flushometer for Top Spud toilet, chrome plated, 6L (1.6 US Gal) factory set flow, quiet action diaphragm type, non-hold open feature, A. D. A oscillating handle, back-check angle stop (screwdriver operated), flush tube for 292mm (11-1/2") rough-in, vacuum breaker.
- 2.1.3 Seat: Centoco #AM820STS toilet seat, elongated heavy duty plastic open front with cover, reinforced S.S. check hinge, post, washers and nuts. Power for device by electrical trade. Ensure that sensor clear seat cover.
- 2.1.4 Supply & Installation: To meet Code requirements for Barrier free access.
- 2.1.5 Coupling: Mission Heavy Weight #HW Coupling, couplings, constructed of four extra wide corrugated type 304 stainless steel bands, connect from 100mm (3-15/16") MJ to 100mm (3-15/16") MJ, from cast iron to cast iron, heavy duty worm drive clamps.
- 2.1.6 Floor Supported Carrier: Jay R. Smith #0208Y single, horizontal carrier, 3" (75 mm) drain, all duco coated cast iron fittings, rear anchor bolt, face plate, heavy duty legs, adjustable nipple, plated hardware, cap nuts, test plug and protection cap.

2.2 LAVATORY, "LV-1" [BARRIER FREE DESIGN]

- 2.2.1 Lavatory: American Standard "Murro" #0954.123EC - 22" x 21" x 5-7-1/2" deep, wall hung, vitreous china, rear overflow, for concealed arm carrier. American Standard #0059 020EC shroud/knee contact guard to cover exposed piping. Provide RH Hole for new Soap Dispenser (soap dispenser is to be supplied and installed by the Architectural Division).
- 2.2.2 Faucet: Chicago Faucets No. 420-E2805ABCP, Deck Mounted 4" Fixed Centers Single Lever

Hot and Cold Water Mixing Sink Faucet, Chrome Plated solid brass construction. 4 5/8" Center to Center Rigid Cast Brass Spout. 0.5 GPM (1.9 L/min) Pressure Compensating Econo-Flo Vandal Proof Non-Aerating Spray. 1/2" NPSM Supply Inlets for 3/8" or 1/2" Flexible Riser. ECAST® construction with less than 0.25% lead content by weighted average. CALGreen Compliant. Secondary Control Valve: 4 5/8" Center to Center Rigid Cast Brass Spout.

- 2.2.3 Balancing Valve: Supply to hot water side of faucet and cold water supply to cold water side of faucet. Mechanical mixing valve with thermostatic limit stop by Lawler model TMM-1070 with temperature adj. dial & with integral back checks. Set valve temperature at 115F, shut-off at 120F. ASSE1070 approved. Provide tee, adaptor and flex copper tubing to suit installation.
- 2.2.4 Supplies: McGuire #H170BVRB supplies, C.P., polished brass, rigid short horizontal integral copper sweat tube nipples 1/2"x5" long, all brass 1/4 turn ball valve angle stops with combination V.P. loose key, and handles, escutcheons and S.S. braided flexible risers. McGuire #8872C-17T 'P' trap, C.P. brass adjustable body, 17 gauge, 1-1/4" and escutcheon.
- 2.2.5 Carrier: Jay R. Smith #0700-Z-M basic carrier, with concealed arms and block base feet support with semi-pedestal supported plate.

2.3 HANDHELD SHOWER, 'HS-1'

- 2.3.1 American Standard #7866.115 with brass control valve complete with wheel handle, vacuum breaker, and 10" spray end with self-closing hand valve, 46" hose, wall bracket with hook.
- 2.3.2 Thermostatic Water Mixing Valve: Symmons 5-120CK-TB or approved equal complete with recessed stainless steel (SS) cabinet with hinged & lockable SS door. 1/2" inlet and outlet. Set temperature regulator to a maximum 37 degrees Celsius (98 degrees Fahrenheit).

3 EXECUTION

3.1 FIXTURE INSTALLATION

- 3.1.1 Install wall hung lavatory and urinal hanger brackets supplied with fixtures to wall by means of a manufactured chair carrier of MIFAB, Smith, Watts or Zurn.
- 3.1.2 Install wall-hung water closets with chair carriers of MIFAB, Smith, Watts or Zurn manufacture, and of type and model recommended by manufacturer for each particular installation with due regard to construction and piping details.
- 3.1.3 Prior to commencing any work, refer to Architectural Drawings for exact placement location and mounting height of all plumbing fixtures. Failure to do so resulting in an install not complying with the Architectural Drawings or code compliance shall require the Mechanical Contractor to rectify the installation at no extra cost.
- 3.1.4 Insulate indirect waste of handicapped usage lavatory with 25 mm (1") thick insulation as described in Piping Insulation Specification.
- 3.1.5 Adjust flush valves to limit the quantity of water per flush cycle allowed by code. Consult

manufacturer for adjustment procedures.

- 3.1.6 Provide institutional grade caulking (clear colour) of all plumbing fixtures at all surfaces where the plumbing fixture interfaces with the wall or floor. Review extent of caulking with the Architect prior to commencing work. Any damage, discolouration or build up of dust resulting in subsequent construction activities by any trade prior to handing over of the Spaces to the Owner shall require removal of the caulking and installation of new. Caulking shall be done in a neat manner.

3.2 **ADJUSTMENT**

- 3.2.1 Verify maximum settings of thermostatic mixing valves.
- 3.2.2 Adjust stream regulator of drinking fountains as necessary to ensure proper operation.
- 3.2.3 Clean out aerator screens and strainers after lines have been flushed.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 Conform to Sections of Division 1, as applicable.
- .2 Conform to Section 20 05 11 Mechanical General Requirements as applicable.

1.2 RELATED SECTIONS

- .1 Plumbing Fixtures and Trim: Section 22 44 13.

1.3 REFERENCES

CAN3-B79-94	Floor Drains and Trench Drains
PDI-G101	Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI-WH201	Water Hammer Arrestors

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 20 05 11 - Mechanical General Requirements.
- .2 Indicate dimensions, construction details and materials for the following: floor drains, cleanouts, water hammer arrestors, strainers, traps, trap seal primers.

1.5 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in the Mechanical General Requirements.
- .2 Data to include:
 - 1. Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - 2. Details of operation, servicing, and maintenance.
 - 3. Recommended spare parts list.

PART 2 **PRODUCTS**

2.1 **GENERAL**

- .1 Furnish plumbing and drainage specialties. Ancon catalogue numbers are specified to indicate quality and features required. Furnish sizes as shown on Drawings.
- .2 Acceptable Manufacturers: Ancron, Zurn, Empoco.

2.2 **FLOOR DRAINS**

- .1 General: all floor drains to be provided with trap primer tapping.
- .2 Floor Drains - (Mech. Rooms/Unfinished Areas)

Duco coated cast body and flashing collar, with 200 mm (8") round cast iron vandalproof top grate and sediment bucket. Complete with trap priming connection. Outlet size: as indicated on the drawings.

Standard of Acceptance: JR Smith 2220 series
- .3 Funneled Floor Drains - Mechanical and Service Rooms

Duco cast iron flanged receptor, bar grate and funnel, c/w vandal-proof secured grate and sediment bucket. Used to receive the drip, condensate or waste water from indirect waste lines. The funnel prevents splashing and directs the waste into the drain. The exposed portion of grate serves as drain for any other waste on the floor. The funnel is attached to the grate by means of concealed screws and it may be moved to any grate location desired. Outlet size: as indicated on the drawings.

Standard of Acceptance: J R Smith 3750 series.
- .4 Floor Drains (Finished Areas, Washrooms, Janitor)

Duco coated cast iron body with flashing collar and adjustable strainer head, 150 mm (6") round or square top strainer head. The round top strainer may be used in all poured finished floors. Square top strainer shall be used in all tiled areas - aligned with the tile pattern. Refer to architectural floor material schedules. Floor drains c/w trap primer connection, vandal proof screws, sediment bucket. Reversible flashing collar permits adjustment of the strainer to meet finished floor level.

Standard of Acceptance: JR Smith 2005 series.
- .5 Hub Drains (Condensate Drain)

Duco Cast Iron Body with 5" Adjustable Cast Iron Strainer Head and Grate, with Oval Funnel Assemble

Standard of Acceptance: JR Smith SQ-4-1753-A

2.3 FLOOR DRAIN TRAPS AND PRIMERS

- .1 Furnish each floor drain installation with a deep seal "P" trap unless otherwise shown.
- .2 Furnish trap seal primer valves Ancon No. M3-810 with cast brass body, vacuum breaker and NPS 1/2 sweat connections.
- .3 Where a floor drain trap is not within a reasonable distance from a plumbing fixture, furnish an automatic flush tank for priming of trap, Crane No. 7-170 1/2 L, or American Standard No. AF-4104L, complete with automatic syphon, tank liner, concealed top cover, bottom supply and screw driver stop.
- .4 As an alternative to automatic flush tanks for remote floor drains, furnish ZURN Model Z1022 trap primers and distribution units, as supplied by S-M-S Ltd.

2.4 DRAINAGE CLEANOUTS

- .1 Stack Cleanout - Exposed Drains
 1. In base of cast iron stacks with neoprene gasketed secured cover. Duco Cast Iron Cleanout Tee and Countersunk Plug
 2. Standard of Acceptance: JR Smith 4510 series
- .2 Stack Cleanout - Drains Behind Finished Walls.
 1. In base of cast iron stacks with neoprene gasketed secured cover. Duco cast iron cleanout tee and countersunk plug with chrome plated bronze square frame and secured cover. nickel bronze frame with stainless steel cover.
 2. Standard of Acceptance: J R smith 4550 series.
- .3 Floor Cleanouts
 1. In Ceramic Tiled Areas
 - .1 Duco cast iron cleanout with square 6"x6" adjustable scoriated secured nickel bronze top. Vandal proof top, flashing flange and clamp. Gasket seal, bronze plug
 - .2 Standard of Acceptance: J R Smith 4052 series.
 2. In Vinyl Tiled Areas
 - .1 Duco Cast Iron Cleanout with Square Adjustable Secured Nickel Bronze Top with 1/8" Tile Recess. Vandal proof top, flashing flange and clamp. Gasket seal, bronze plug
 - .2 Standard of Acceptance: J R Smith 4172 series
 3. In Terrazzo Areas
 - .1 Floor cleanout, above with square nickel bronze cover and frame recessed for terrazzo. Cover can be adjusted to suit floor lines when installing finished floor.
 - .2 Standard of Acceptance: JR Smith 4180.

4. Carpeted and Other Finished Areas
 - .1 Duco cast iron cleanout with round adjustable scoriated secured nickel bronze top. Vandal proof top, flashing flange and clamp. Gasket seal, bronze plug
 - .2 Standard of Acceptance: JR Smith 4032
5. In Unfinished Areas and Outside Area.
 - .1 Epoxy coated cast body with integral clamp device, and removable positive seal cleanout plug and heavy duty scoriated safety finish adjustable cover secured with stainless steel screws.
 - .2 Standard of Acceptance: JR Smith 4232
6. For Heavy Traffic Areas
 - .1 Floor cleanout, above with extra heavy nickel bronze cover and frame. Gasket seal, bronze plug
 - .2 Standard of Acceptance: JR Smith 4112

2.5 SHOCK ABSORBERS

- .1 Size shock absorbers in accordance with P.D.I.-WH201.

Ancon	“Shok-Gard”
Zurn	Z-1700
Enpoco	HT Series

- .2 Provide shock absorbers for all new plumbing piping.

2.6 NON-FREEZE WALL HYDRANT (HOSE BIBB):

- .1 Encased recessed non-freeze wall or ground hydrant with NPS 3/4" hose outlet with vacuum breaker. Bronze quarter turn non-freeze hydrant with hose connection, integral vacuum breaker, "T" handle key, and stainless steel box with full 180 deg. cover opening. Meets ANSI A112.21.3
- .2 Standard of Acceptance: JR Smith 5509 QTNB.

2.7 ROOF DRAINS

- .1 Roof Drains - Controlled Flow

Duco cast iron body with combined flashing clamp and gravel stop with adjustable "flow rate control" assembly and aluminium dome, trapezoidal weirs limit the flow to the leaders. Adjustable to provide various flow rates as required. Outlet diameter as indicated on the drawings.

Standard of Acceptance: J R Smith 1083 series.

.2 Roof Drains – Standard Un-Controlled Flow

FLOFORCE™ High efficient flow performing roof drain. Roof drain engineered to evacuate water off of roof structure by incorporating a smooth funnel shaped interior surface, providing a seamless transition to outlet connection, and eliminating internal obstructions. Complete with Dura-Coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette Poly-Dome. Flashing clamp/gravel guard provided to prevent debris from entering the drain while allowing water to immediately pass through at zero head level. Poly-dome designed to maximize effective open area and promote efficient flow.

Standard of Acceptance: Zurn Z100F complete with large sump, roof membrane waterproof flange, under-deck clamp, sump extension, roof sump receiver, cast iron dome strainer and vandal-proof secured top. Provide all accessories necessary to install the roof drain with the proposed roofing type (see Architectural Drawings).

2.8 ELECTRONIC TRAP SEAL PRIMER

- .1 Provide a 120V, manifold trap seal primer system to provide trap seal primer to all floor drains. Provide an Electronic Trap Seal Primer on each floor – for a total of 3. Coordinate with Electrical for receptacle location.
- .2 System shall be Zurn Z1020 or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, provincial codes and local authority having jurisdiction except where specified otherwise.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 CLEANOUTS

- .1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks and rainwater leaders and where indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

3.3 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to each fixture or group of fixtures and where indicated.

- .2 Hot and cold water fixture outlets provided with a vertical air chamber, a minimum of 450 mm long. Air chamber of the same pipe dimension as the branch pipe diameter leading to the fixture, and located as close to the fixture as possible.
- .3 Hot and cold water main branches 75 mm (3") diameter and under to 25 mm (1") diameter: Provided with vertical air chambers of sizes and dimensions specified above, located at points where the pipe line changes direction through 90 degrees in horizontal plane, and at the top of all hot and cold water risers.

3.4 TRAP SEAL PRIMERS

- .1 Install trap seal primer valve in cold water supply line to nearest plumbing fixture (preferably a water closet) and run NPS 1/2 Type K copper piping to primer connection on floor drain body. Obtain Minister's Designee's approval for location of primer valves prior to installation.
- .2 Install trap primer tank in truss space or other suitable location as directed by ORC Designee, or as shown on Drawings.
- .3 (Install in access pit as indicated).

3.5 COMMISSIONING

- .1 After start-up, test, adjust and prove operation as indicated, to suit conditions.
- .2 Clean out strainers periodically until clear.
- .3 Clean out and prime all floor drain traps using trap seal primers or other means acceptable to the Canadian Plumbing Code.
- .4 Prove freedom of movement of cleanouts.

END OF SECTION

1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 QUALITY ASSURANCE

- .1 Comply with OBC and NFPA 90A requirements, particularly paragraphs pertaining to the maximum flame spread index (currently set at 25) and maximum smoke development index (currently set at 50).
- .2 All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.
- .3 Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.3 SUBMITTALS

- .1 Submit in accordance with Section 20 05 11 shop drawings and product data
- .2 Provide the following:
 - .1 Insulation materials: Specify each type used and state surface burning characteristics.
 - .2 Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
 - .3 Insulation accessory materials: Each type used.
 - .4 Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.

1.4 STORAGE AND HANDLING OF MATERIAL

- .1 Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.5 STANDARDS OF ACCEPTANCE

- .1 Knauf Fiber Glass
- .2 Owens/Corning Fiberglass
- .3 Armstrong
- .4 Johns Manville
- .5 Rockwool Manufacturing

.6 Armaflex.

2 PRODUCTS

2.1 GENERAL

.1 K-factors (thermal conductivity) shown are expressed in BTU•in/hr•ft²•F.

2.2 MINERAL FIBRE BLANKET WITH VAPOUR BARRIER

.1 Provide external insulation on all new supply and return ductwork.

.2 Provide external insulation on all new exhaust ductwork for its entire length.

.3 Material:

.1 Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, for use to 450 deg. F, with a factory-applied jacket manufactured from foil, reinforcing scrim, and kraft paper (FSK). Minimum density of 3/4 lb./cu.ft., maximum conductivity of 0.43 (BTU-in./hr.-sq.ft.-deg. F) at 200 deg. F.

.2 Acceptable Material: Fiberglas, Knauf, Manson.

.3 Thickness: 1".

2.3 FIBROUS GLASS RIGID WITH VAPOUR BARRIER

.1 Apply on all indoor supply rectangular ductwork larger than 30" wide and on all ductwork located outdoors, regardless of size.

.2 Material:

.1 Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, for use to 450 deg. F, with a factory-applied jacket manufactured from foil, reinforcing scrim, and kraft paper (FSK). Minimum density of 3 lb./cu.ft., maximum conductivity of 0.40 (BTU-in./hr.-sq.ft.-deg. F) at 300 deg. F.

.2 Acceptable products: Fiberglas AF 530, Manson, Knauf.

.3 Thickness: 1"

2.4 CANVAS JACKETS

.1 Apply in mechanical rooms where rigid insulation is applied: compact, firm ULC listed heavy plain weave, cotton fabric at 220 g/m sq.

2.5 METAL JACKETING

- .1 At all locations where the ductwork is located outdoors or in heavy abuse areas, use metal jacketing to protect piping or ductwork insulation.
- .2 Jacketing: Aluminum, 0.016 inches thick, embossed surface, with factory bonded moisture barrier.
- .3 Metal Jacketing Bands: 1/2 inch wide, aluminum or stainless.

2.6 EXTERIOR INSULATION

- .1 Cover all joints of the rigid insulation and fastener penetration with 3" wide pressure sensitive All Service Jacket (ASJ) tape. Rub tape hard with a nylon sealing tool. Over the entire surface apply a weave glass reinforcing cloth embedded between two 1/8" thick wet coats of Breather mastic, i.e., B. Foster Seal Fast 6 PM 35-00-4500.

2.7 FASTENINGS

- .1 Tape: self adhesive, 100 mm wide rated under 25 for flame spread and under 50 for smoke development.
- .2 Contact adhesive: quick-setting, non-flammable fire resistive adhesive to adhere fibrous glass to ducts. Flame spread 15 smoke development 0.
 - .1 Acceptable Products Foster 85-20 Asbestos Free, Armstrong 520.
- .3 Lap Seal Adhesive: Quick-setting adhesive for joints and lap sealing of vapour barriers. Flame spread 10 smoke development 0.
 - .1 Acceptable Products Foster 85-75, Asbestos Free, Drion.
- .4 For Canvas:
 - .1 Washable adhesive for cementing canvas lagging cloth to duct insulation.
 - .2 Acceptable Products: Foster 30-36 Asbestos Free.
- .5 Pins:
 - .1 Weld pins 4 mm diameter, with 1 1/2" diameter head for installation through the insulation. Length to suit thickness of insulation.
 - .2 Weld pins: If duct is over 24" wide, use on bottom of duct as well.
 - .3 Acceptable Products: Duro Dyne, Clip-Pin.

3 Execution

3.1 **APPLICATION**

- .1 Apply insulation after required tests have been completed and approved by Consultant. Insulation and surfaces shall be clean and dry when installed and during application of any finish.
- .2 Work shall be preformed by insulation journeymen.
- .3 Apply insulation and coverings on hot equipment while surface is between 50 to 60°C.
- .4 Vapour barriers and insulation to be complete over full length of duct or surface, without penetration for hangers, standing duct seams and without interruption at sleeves.
- .5 Install insulation with smooth and even surfaces.
- .6 Apply insulation materials accessories and finishes to manufacturer's recommendations.
- .7 Apply 1.0mm thick metal corners to all ductwork in mechanical rooms to a height of 7 ft.
- .8 Use stand-offs for all duct mounted accessories.
- .9 The last 3.0 meters of all exhaust ductwork shall be insulated, whether shown on the Drawings or not.

3.2 **DUCT INSULATION**

.1 General:

- .1 Adhere and seal vapour barrier using vapour seal adhesives.
- .2 Stagger longitudinal and horizontal joints, on multi-layered insulation.

.2 Mechanical Fasteners:

- .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 14" centres, but not less than 2 rows per side.

3.3 **JACKETS**

- .1 Provide fire retardant coating on canvas jackets.
- .2 Fire retardant coating shall be approved by authority having jurisdiction prior to application. Consultant reserves right to remove sample of covering for testing.
- .3 Coat canvas covering exposed in finished spaces with diluted coat of lagging adhesive.

As recommended by insulation manufacturer for priming. Dilution: 2 parts of water to 3 parts of lagging adhesive.

- .4 For all ductwork externally insulated inside of the building, provide 3M VentureClad Insulation Jacketing.

END OF SECTION

1.1. REQUIREMENTS INCLUDED

- 1.2. Procedures for onsite demonstration and testing of equipment and systems, including temporary facilities.

1.3. INSTRUCTION OF CLIENT'S OPERATING PERSONNEL.

- 1.3.1. All demonstrations, instructions and testing must be completed prior to Client acceptance for beneficial use. All safety devices must pass 100 percent before the mechanical systems can be accepted for beneficial use.
- 1.3.2. Plumbing and emergency power systems are not included.

1.4. DEFINITIONS

- 1.4.1. Start Up: Initial inspection, cleaning, lubrication, adjustment, and operation of equipment and systems by the contractor with the assistance of the representatives of the equipment manufacturers.
- 1.4.2. Pre Tests: The final stage of the startup procedure. This occurs after all adjustments have been made except for minor fine-tuning that can be done during the pre test. Serves as verification that the systems are ready for the final test. Witnessing of pre test by the Consultant is not required.
- 1.4.3. Final Tests: Tests, witnessed by the Commissioning Agent or their representative, which demonstrate that all equipment and systems are in compliance with requirements.

1.5. QUALITY ASSURANCE

- 1.5.1. Experienced, trained technical service personnel who are representatives of the equipment manufacturers and system designers shall demonstrate, provide instructions, pre test and final test, as specified, the following equipment:
- 1.5.1.1. Boilers and economizers
 - 1.5.1.2. Burners
 - 1.5.1.3. Control systems.
 - 1.5.1.4. Instrumentation.
- 1.5.2. Experienced technicians shall demonstrate and provide instructions on the following equipment (as applicable to the project):
- 1.5.2.1. Boilers and Burners
 - 1.5.2.2. Chillers and Cooling Towers

- 1.5.2.3. Pumps and piping systems
 - 1.5.2.4. Air handling equipment
 - 1.5.2.5. Exhaust/Return Fans
 - 1.5.2.6. Control and safety valves
 - 1.5.2.7. BAS and VFDs
- 1.5.3. The person responsible for programming the BAS shall demonstrate and provide instructions on hardware, software and programming.
- 1.5.4. The Board will provide a list of personnel to receive instructions and will coordinate their attendance at agreed upon times.
- 1.5.5. All safety devices shall comply with the TSSA requirements.

1.6. SUBMITTALS

- 1.6.1. Names and qualifications of personnel performing demonstrations, instructions and tests.
- 1.6.2. Certification that pre testing is complete.
- 1.6.3. Preliminary schedule of all demonstrations, instructions and final tests two weeks prior to proposed dates.
- 1.6.4. Provide reports within three weeks after satisfactory completion of demonstrations, instructions, and tests. List date, type of work, persons participating, amount of time, test results, calculations of test results, test data.
- 1.6.5. Completed System Readiness Checklists provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion,

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1. PREPARATION FOR FINAL TESTS, DEMONSTRATIONS, AND INSTRUCTIONS

- 3.1.1. Verify that equipment and systems are fully operational. Complete all start up and pre test activities for all equipment and systems. Complete all construction and finish work.
- 3.1.2. Arrange for all test personnel for all equipment to be continuously present during one period of time so that all equipment and systems can be tested in their interrelated functions.

For instance, the burner in a heating system shall be tested during the boiler testing, and instrumentation performance will be evaluated in conjunction with boiler testing.

3.1.3. Deliver maintenance and operating manuals four weeks prior to instruction period.

3.1.4. Furnish all special tools.

3.2. FINAL TESTS

3.2.1. Demonstrate proper operation of each equipment and system.

3.2.2. Provide tests on equipment as specified in the individual specification sections.

3.3. STARTUP AND TESTING

3.3.1. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.4. COMMISSIONING

3.4.1. Provide commissioning documentation in accordance with the requirements of the Commissioning Agency for all inspection, start up, and contractor testing required above and required by the Systems Readiness Checklist.

3.5. DEMONSTRATIONS AND TRAINING

3.5.1. Demonstrate operation and maintenance of equipment and systems to Board personnel no more than two weeks prior to scheduled Board operation of the plant.

3.5.2. Use operation and maintenance manuals as basis of instruction. Review contents of manuals with personnel in detail to explain all aspects of operation and maintenance.

3.5.3. Demonstrate start up, operation, control, adjustment, trouble shooting, servicing, maintenance, and shut down of each item of equipment. Allow Government personnel to practice operating the equipment under supervision of instructors.

3.5.4. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.

3.5.5. Submit training plans and instructor qualifications

3.6. TIME ALLOCATED FOR DEMONSTRATIONS AND INSTRUCTIONS

- 3.6.1. At least 8 total instructor hours to include all new building services installed under this project.
- 3.6.2. At least 4 total instructor hours to include BAS and computer workstation and programs.
- 3.6.3. Do not exceed three trainees per session, one four hour session, per day, per trainee.

END OF SECTION

PART 1 - GENERAL

1.1. DESCRIPTION

1.1.1. Hydronic piping to connect HVAC equipment, including the following:

1.1.1.1. Chilled water, condenser water, heating hot water/glycol as applicable to the project.

1.1.2. NO USE OF VICTAULIC OR 'GROOVED END' PRODUCTS WILL BE PERMITTED.
All piping 2" and larger shall be welded.

1.2. RELATED WORK

1.2.1. Section 20 05 11, MECHANICAL GENERAL REQUIREMENTS.

1.2.2. Section 23 05 11, COMMON WORK RESULTS FOR HVAC:

1.2.3. Section 23 74 03, HYDRONIC PUMPS

1.3. QUALITY ASSURANCE

1.3.1. Submit prior to welding of steel piping a certificate of Welder's certification. The certificate shall be current and not more than one year old.

1.3.2. All joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.3.3. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.4. SUBMITTALS

1.4.1. Submit in accordance with Section 20 05 11, MECHANICAL GENERAL REQUIREMENTS.

1.4.2. Manufacturer's Literature and Data:

1.4.2.1. Pipe and equipment supports.

1.4.2.2. Pipe and tubing, with specification, class or type, and schedule.

1.4.2.3. Pipe fittings, including miscellaneous adapters and special fittings.

1.4.2.4. Flanges, gaskets and bolting.

1.4.2.5. Valves of all types.

1.4.2.6. Strainers.

1.4.2.7. Flexible connectors for water service.

1.4.2.8. All specified hydronic system components.

1.4.2.9. Water flow measuring devices.

1.4.2.10. Gages.

1.4.2.11. Thermometers and test wells.

1.4.2.12. Air separators.

1.4.2.13. Expansion tanks.

1.5. APPLICABLE PUBLICATIONS

- 1.5.1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. American National Standards Institute, Inc.
- 1.5.2. American Society of Mechanical Engineers/American National Standards Institute, Inc. (ASME/ANSI):
 - 1.5.2.1. B1.20.1-83(R2006) Pipe Threads, General Purpose (Inch)
 - 1.5.2.2. B16.4 06 Gray Iron Threaded Fittings B16.18-01 Cast Copper Alloy Solder joint Pressure fittings
 - 1.5.2.3. B16.23-02 Cast Copper Alloy Solder joint Drainage fittings
 - 1.5.2.4. B40.100-05 Pressure Gauges and Gauge Attachments
- 1.5.3. American Society of Mechanical Engineers (ASME):
 - 1.5.3.1. B16.1-98 Cast Iron Pipe Flanges and Flanged Fittings
 - 1.5.3.2. B16.3-2006 Malleable Iron Threaded Fittings: Class 150 and 300
 - 1.5.3.3. B16.4 2006 Gray Iron Threaded Fittings: (Class 125 and 250)
 - 1.5.3.4. B16.5-2003 pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - 1.5.3.5. B16.9-07 Factory Made Wrought Butt Welding Fittings
 - 1.5.3.6. B16.11-05 Forged Fittings, Socket Welding and Threaded
 - 1.5.3.7. B16.18-01 Cast Copper Alloy Solder Joint Pressure Fittings
 - 1.5.3.8. B16.22-01 Wrought Copper and Bronze Solder Joint Pressure Fittings.
 - 1.5.3.9. B16.24 06 Cast Copper Alloy Pipe Flanges and Flanged Fittings
 - 1.5.3.10. B16.39 06 Malleable Iron Threaded Pipe Unions
 - 1.5.3.11. B16.42-06 Ductile Iron Pipe Flanges and Flanged Fittings
- 1.5.4. American Society for Testing and Materials (ASTM):
 - 1.5.4.1. A47/A47M-99 (2004) Ferritic Malleable Iron Castings
 - 1.5.4.2. A53/A53M-07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 1.5.4.3. A126 04 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 1.5.4.4. A183 03 Standard Specification for Carbon Steel Track Bolts and Nuts
 - 1.5.4.5. A536 84 (2004) Standard Specification for Ductile Iron Castings
 - 1.5.4.6. B32 08 Standard Specification for Solder Metal
 - 1.5.4.7. B62 02 Standard Specification for Composition Bronze or Ounce Metal Castings
 - 1.5.4.8. B88 03 Standard Specification for Seamless Copper Water Tube

PART 2 - PRODUCTS

2.1. PIPE AND TUBING

- 2.1.1. Chilled Water/Glycol, Condenser Water, Heating Hot Water/Glycol, as applicable to the project:

2.1.1.1. 38 mm (1-1/2") diam and smaller:

- 2.1.1.1.1. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with threaded ends.
- 2.1.1.1.2. Type "L" hard drawn copper tubing conforming to ASTM B88. Type "L" soft annealed copper tubing may be used only within convactor enclosures.

2.1.1.2. 50 mm (2") diam and larger

- 2.1.1.2.1. Schedule 40 continuous weld or electric resistance welded black carbon steel conforming to ASTM A53 84a Grade B, with bevelled ends.

2.1.2. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

2.2. FITTINGS FOR COPPER TUBING

2.2.1. Joints 50 mm (2") and smaller:

- 2.2.1.1. *Solder Joints:* Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
- 2.2.1.2. *Screwed Joints:* Pipe Thread: ANSI B1.20. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.2.2. Joints 65 mm (2½") and larger:

- 2.2.2.1. Bronze Flanges and Flanged Fittings: ASME B16.24.
- 2.2.2.2. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.

2.3. FITTINGS FOR STEEL PIPE

2.3.1. 38 mm (1-1/2 inches) and Smaller: Screwed or welded joints.

- 2.3.1.1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
- 2.3.1.2. Forged steel, socket welding or threaded: ASME B16.11.
- 2.3.1.3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.

2.3.2. 50 mm (2 inches) and Larger: Welded or flanged joints.

- 2.3.2.1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
- 2.3.2.2. Welding flanges and bolting: ASME B16.5:
- 2.3.2.3. Weld neck or slip on, plain face, with 6 mm (1/8 inch) thick full face neoprene gasket suitable for 104 degrees C (220 degrees F).
- 2.3.2.4. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.

2.4. DIELECTRIC FITTINGS

- 2.4.1. Provide where copper tubing and ferrous metal pipe are joined.
- 2.4.2. 50 mm (2 inches) and Smaller: Threaded dielectric union, ASME B16.39.
- 2.4.3. 65 mm (2 1/2 inches) and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- 2.4.4. Temperature Rating, 99 degrees C (210 degrees F).

2.5. UNION

- 2.5.1. 50 mm (2") diam and smaller:
 - 2.5.1.1. All brass construction with ground joint and either solder joint or screwed ends as required.
 - 2.5.1.2. Class 150 black malleable iron construction with brass to iron ground joint and screwed ends, conforming to ASTM A197 and ANSI/ASME B1.20.1.
 - 2.5.1.3. Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping or equipment.

2.6. FLANGES

- 2.6.1. Class 150 forged steel slip-on or weld-neck raised face type conforming to ASTM A181 Grade 1 and ANSI/ASME B16.5. Remove raised face where flanges connect to Class 125 cast iron valves.
- 2.6.2. Hinged, two piece, shouldered or keyed cast malleable iron
- 2.6.3. Conforming to ASTM A47 Grade 32510 with elastomeric gasket suitable for service and lock bolt.

2.7. GASKETS AND BOLTS

- 2.7.1. Gaskets
 - 2.7.1.1. 1.6 mm (1/16") Garlock 3200 with SBR binder or equivalent asbestos free material.
- 2.7.2. Bolts
 - 2.7.2.1. Semi finished hex head machine bolts and semi finished hex nuts, both of carbon steel conforming to ASTM A307 Class A.

2.8. PLUGS

- 2.8.1. 50 mm (2") diam and smaller: Class 3000 screwed, square head, machined from solid steel or forging to ASTM A105 Grade 2.

2.9. SCREWED JOINTS

- 2.9.1. Pipe Thread: ANSI B1.20.
- 2.9.2. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

2.10. VALVES

- 2.10.1. Asbestos packing is not acceptable.
- 2.10.2. All valves of the same type shall be products of a single manufacturer.
- 2.10.3. Provide chain operators for valves 150 mm (6 inches) and larger when the centerline is located 2400 mm (8 feet) or more above the floor or operating platform.
- 2.10.4. *Standard of Acceptance: Apollo, Armstrong, Bell & Gossett, Belimo, Crane, Nibco*
- 2.10.5. Shut-Off Valves
 - 2.10.5.1. Ball Valves (Pipe sizes 50 mm [2"] and smaller): MSS-SP 110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at 2760 kPa (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
 - 2.10.5.2. Butterfly Valves (Pipe Sizes 65 mm [2½"] and larger): Provide stem extension to allow 50 mm (2 inches) of pipe insulation without interfering with valve operation. MSS SP 67, flange lug type or grooved end rated 1205 kPa (175 psig) working pressure at 93 degrees C (200 degrees F). Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Not permitted for direct buried pipe applications. Construction:
 - 2.10.5.2.1. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47 electro-plated, or ductile iron, ASTM A536, Grade 65 45 12 electro-plated.
 - 2.10.5.2.2. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
 - 2.10.5.2.3. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.
 - 2.10.5.2.4. Valves 150 mm (6 inches) and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.
 - 2.10.5.2.5. Valves 200 mm (8 inches) and larger: Enclosed worm gear with handwheel, and where required, chain wheel operator.
 - 2.10.5.3. Gate Valves (Contractor's Option in lieu of Ball or Butterfly Valves):

- 2.10.5.3.1. 50 mm (2 inches) and smaller: MSS SP 80, Bronze, 1034 kPa (150 psig), wedge disc, rising stem, union bonnet.
- 2.10.5.3.2. 65 mm (2 1/2 inches) and larger: Flanged, outside screw and yoke. MSS SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.

2.10.5.4. Globe and Angle Valves

2.10.5.4.1. Globe Valves

- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Globe valves shall be union bonnet with metal plug type disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for globe valves.

2.10.5.4.2. Angle Valves:

- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.) Angle valves shall be union bonnet with metal plug type disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 85 for angle.

2.10.5.4.3. Check Valves

- *Swing Type Check Valves*
- 50 mm (2 inches) and smaller: MSS SP 80, bronze, 1034 kPa (150 lb.), 45 degree swing disc.
- 65 mm (2 1/2 inches) and larger: 861 kPa (125 psig), flanged, iron body, bronze trim, MSS SP 71 for check valves.
- *Non Slam or Silent Check Valve:* Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
- Body: MSS-SP 125 cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, grooved, or wafer type.
- Seat, disc and spring: 18 8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.

2.10.5.4.4. Water Flow Balancing Valves: For flow regulation and shut off. Valves shall be line size rather than reduced to control valve size. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.

- *Valves ½" to 2" diam:*

Valves are to be of the 'Y' pattern, equal percentage globe-style and provide three functions: 1) Precise flow measurement, 2) Precision flow balancing, 3) Positive drip-tight shut-off.

Valve shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature, which will provide a means for locking the valve position after the system is balanced.

Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, ¼" threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The handwheel shall be high-strength resin.

- *Valves 2-1/2" to 12" diam:*

Valves are to be of the 'Y' pattern, equal percentage globe-style and provide three functions: 1) Precise flow measurement, 2) Precision flow balancing, 3) Positive drip-tight shut-off.

Valve shall provide multi-turn, 360° adjustment with micrometer type indicators located on the valve handwheel. Valves shall have a minimum of five full 360° handwheel turns. 90° 'circuit-setter' style ball valves are not acceptable. Valve handle shall have hidden memory feature, which will provide a means for locking the valve position after the system is balanced.

Valves shall be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi shall have two, ¼" threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves shall be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug shall be brass. The hand wheel shall be high-strength resin.

- *Standard of acceptance: Armstrong, T&A, Bell and Gossett*

2.11. STRAINERS

2.11.1. Basket or Y Type.

- 2.11.1.1. Screens: Bronze, monel metal or 18 8 stainless steel, free area not less than 2 1/2 times pipe area, with perforations as follows: 1.1 mm (0.045 inch) diameter

perforations for 100 mm (4 inches) and larger: 3.2 mm (0.125 inch) diameter perforations.

2.11.1.2. Suction Diffusers: Specified in Section 23 74 03, HYDRONIC PUMPS.

2.12. HEAT EXCHANGER FOR HVAC SERVICE (FLUID TO FLUID):

2.12.1.1. Furnish a plate and frame heat exchanger to meet the operating conditions as indicated in the attached schedule.

2.12.1.2. The exchanger shall be designed, constructed and tested in accordance with Section VIII, Division I of the ASME Pressure Vessel Code, and shall be code stamped. Pressure vessels provided for installation in Canada shall be marked with the appropriate CRN number.

2.12.1.3. Preference will be given to single pass designs with all system connections to be located on the face of the fixed cover plate.

2.12.1.4. The plate and frame heat exchanger's fixed and movable covers shall be designed to provide sufficient uniform thickness to withstand all loading. Stiffeners and welded reinforcements shall not be permitted. Any plate within the exchanger's plate pack shall be replaceable without the need to remove other plates.

2.12.1.5. The heat exchanger plate material shall be stainless steel type AISI 316L.

2.12.1.6. A roller bearing shall be provided on the movable cover for all units with port sizes 3" or larger. The frame assembly shall be of bolted construction. Welding to the pressure retaining components is not permitted.

2.12.1.7. The frame assembly design shall allow the addition of a minimum of 10% additional plates.

2.12.1.8. Each plate shall be pressed from a homogenous metal sheet in one step. Each plate channel shall be designed to allow full design pressure on one side with no pressure on the adjacent plate channel. Contact between adjacent plates is required to optimize structural integrity and elimination of vibration.

2.12.1.9. Gaskets shall be designed to indicate leakage across the sealing gaskets prior to the intermixing of fluids.

2.12.1.10. The suspension and guidance method in the design of the plates, frame, carrying and guide bars shall mechanically align the plates during tightening. Gasket surfaces shall be used for sealing not for plate alignment. The carrying and guide bar surfaces in contact with the plate pack shall be stainless steel. All other carbon steel surfaces except the bolts shall be epoxy painted.

2.12.1.11. An aluminum or optional 304 stainless steel OSHA shroud could be provided. A comprehensive operations and maintenance manual and ASME nameplate shall be attached on the face of the fixed cover.

2.12.1.12. Connections less than or equal to 2-inch shall be NPT type. Connections larger than 2-inch shall be of studed port design. Each studed port shall be lined with a fluid compatible material to prevent process fluid from coming in contact with the painted cover.

2.12.1.13. The exchanger shall be hydrostatically tested in accordance with the requirements of the ASME Code Section VIII Div 1, para. UG-99. A computer generated submittal and specification sheet indicating the criteria used in each unit's selection shall be submitted for approval.

2.13. HYDRONIC SYSTEM COMPONENTS

2.13.1. Air Purger: Cast iron or fabricated steel, 861 kPa (125 psig) water working pressure, for in line installation. *Standard of Acceptance: Amtrol, Armstrong*

2.13.2. Tangential Air Separator: ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, flanged tangential inlet and outlet connection, internal perforated stainless steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. Provide a removable stainless steel strainer element having 5 mm (3/16 inch) perforations and free area of not less than five times the cross sectional area of connecting piping. *Standard of Acceptance: Amtrol, Armstrong.*

2.13.3. Diaphragm Type Expansion Tank: Full acceptance type, ASME Pressure Vessel Code construction for 861 kPa (125 psig) working pressure, welded steel shell, rust proof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 116 degrees C (240 degrees F). Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre charged to a minimum of 83 kPa (12 psig). Capacity: as indicated on the equipment schedules. *Standard of Acceptance: Amtrol, Armstrong.*

2.13.4. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 28 kPa (4 psig) above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 861 kPa (125 psig) working pressure at 107 degrees C (225 degrees F). *Standard of Acceptance: Watts, Bell and Gossett.*

2.13.5. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.

2.13.6. Automatic Air Vent Valves: Automatic air vent should be used only on air separators and similar applications in mechanical rooms. When used, pipe outlet to floor drain to prevent damage from leaks. Cast iron or semi steel body, 1034 kPa (150 psig) working pressure, stainless steel float, valve, valve seat and mechanism, minimum 15 mm (1/2 inch) water connection and 6 mm (1/4 inch) air outlet. Air outlet shall be piped to the nearest floor drain.

2.13.7. Radiator/Convactor Automatic Air Vent: N/A

2.14. GLYCOL FILL TANK

2.14.1. Glycol auto fill unit complete with expansion tank to control and provide expansion and maintain the glycol system pressure by providing glycol make-up automatically upon a drop in system pressure

2.14.2. Construction

- 2.14.2.1. Polypropylene Tank 200 liter (53 gallon) capacity
- 2.14.2.2. Pump construction: all bronze
- 2.14.2.3. Water fill connection: ball valve - 304 SS ball, brass body
- 2.14.2.4. Glycol fill connection: ball valve - 304 SS ball, brass body
- 2.14.2.5. Contacts for BAS remote indication for: high level/low level/pump run

2.14.3. The glycol autofill shall be provided with the following standard features:

- 2.14.3.1. The unit shall monitor and maintain the minimum system pressure at all times
- 2.14.3.2. Low mixture cut-out level switches shall monitor the status of the mixing tank
- 2.14.3.3. Level switches shall be 24 volt maximum to ensure intrinsic electrical safety
- 2.14.3.4. Pump suction isolation valve
- 2.14.3.5. Pump suction strainer
- 2.14.3.6. Single phase power connection
- 2.14.3.7. 45 psi (300 kPa) fill pressure

2.14.4. Standard of Acceptance: Armstrong GLA Series

2.15. WATER FILTERS AND POT CHEMICAL FEEDERS

2.15.1. See section 23 25 00, HVAC WATER TREATMENT

2.16. GAGES, TEMPERATURE, PRESSURE AND COMPOUND

2.16.1. See section 23 05 11 COMMON WORK RESULTS FOR HVAC

2.16.2. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gages in water service.

2.16.3. Range of Gages: Provide range equal to at least 150 percent of normal operating range.

2.17. WATER FILTERS AND POT CHEMICAL FEEDERS

2.17.1. See section 23 25 13, CHEMICAL TREATMENT – CLOSED LOOPS

2.18. PRESSURE/TEMPERATURE TEST PROVISIONS

2.18.1. Pete's Plug: 6 mm (1/4 inch) MPT by 75 mm (3 inches) long, brass body and cap, with retained safety cap, nordelfself closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

2.19. FIRESTOPPING MATERIAL

2.19.1. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC

PART 3 - EXECUTION

3.1. GENERAL

- 3.1.1. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the Board. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- 3.1.2. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- 3.1.3. Support piping securely. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- 3.1.4. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 25 mm (one inch) minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 25 mm (one inch) in 12 m (40 feet). Provide eccentric reducers to keep bottom of sloped piping flat.
- 3.1.5. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- 3.1.6. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping.
- 3.1.7. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
- 3.1.8. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.
- 3.1.9. Connect piping to equipment as shown on the drawings and as recommended by the manufacturer.

3.1.10. Install components furnished by others such as:

- 3.1.10.1. Water treatment pot feeders and condenser water treatment systems.
- 3.1.10.2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- 3.1.10.3. Thermometer Wells: In pipes 65 mm (2 1/2 inches) and smaller increase the pipe size to provide free area equal to the upstream pipe area.

3.1.11. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 07 11, INSULATION – HVAC SYSTEMS.

3.1.12. Where copper piping is connected to steel piping, provide dielectric connections.

3.2. PIPE JOINTS

- 3.2.1. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.
- 3.2.2. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- 3.2.3. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- 3.2.4. Solvent Welded Joints: As recommended by the manufacturer.

3.3. BRAZING

- 3.3.1. Flux shall not be allowed to penetrate to the inside of the pipe. The outside of the tube and fittings shall be cleaned by washing with hot water in order to remove any residual flux.
- 3.3.2. During the brazing of the pipe connections, except when performing final connections and emergency repairs, the interior of the pipe shall be maintained with a nitrogen atmosphere. This shall be done by purging the pipe a sufficient number of times to remove all air and oxygen and by maintaining a small purge flow.

3.4. EXPANSION JOINTS (BELLOWS AND SLIP TYPE)

- 3.4.1. N/A

3.5. LEAK TESTING ABOVEGROUND PIPING

- 3.5.1. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Resident Engineer. Tests may be either of those below, or a combination, as approved by the Resident Engineer.
- 3.5.2. An operating test at design pressure, and for hot systems, design maximum temperature.
- 3.5.3. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

3.6. FLUSHING AND CLEANING PIPING SYSTEMS

- 3.6.1. Water Piping: Clean systems as recommended by the suppliers of chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- 3.6.2. Initial flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system component. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 1.8 m/S (6 feet per second), if possible. Connect dead end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps. Flush until clean as approved by the Resident Engineer.
- 3.6.3. Cleaning: Using products supplied in Section 23 25 00, HVAC WATER TREATMENT, circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 1.8 m/S (6 feet per second). Circulate each section for not less than four hours. Blow down all strainers, or remove and clean as frequently as necessary. Drain and prepare for final flushing.
- 3.6.4. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.

3.7. WATER TREATMENT

- 3.7.1. Install water treatment equipment and provide water treatment system piping.
- 3.7.2. Close and fill system as soon as possible after final flushing to minimize corrosion.
- 3.7.3. Charge systems with chemicals specified in Section 23 25 00, HVAC WATER TREATMENT.
- 3.7.4. Utilize this activity, by arrangement with the Resident Engineer, for instructing VA operating personnel.

3.8. OPERATING AND PERFORMANCE TEST AND INSTRUCTION

- 3.8.1. Refer to PART 3, Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- 3.8.2. Adjust red set hand on pressure gages to normal working pressure.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- 1.1.1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 DESCRIPTION

- 1.2.1 Ductwork and accessories for HVAC including the following:
1.2.1.1 Supply air, return air, outside air, exhaust, and relief systems.

1.3 DEFINITIONS

- 1.3.1 SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
1.3.2 Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
1.3.3 Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
1.3.4 Exposed Duct: Exposed to view in a finished room, and/or exposed to weather.

1.4 QUALITY ASSURANCE

- 1.4.1 Fire Safety Code: Comply with NFPA 90A.
1.4.2 Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
1.4.3 Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
1.4.4 Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.

1.5 SUBMITTALS

- 1.5.1 Submit in accordance with the Mechanical General Requirements:
.1 Rectangular ducts:
.1 Schedules of duct systems, materials and selected SMACNA construction alternatives for joints, sealing, gage and reinforcement.
.2 Sealants and gaskets.
.3 Access doors.
1.5.2 Round and flat oval duct construction details:
.1 Manufacturer's details for duct fittings.
.2 Sealants and gaskets.
1.5.3 Access sections.
1.5.4 Volume dampers, back draft dampers.

- 1.5.5 Upper hanger attachments.
- 1.5.6 Fire dampers, fire doors, and smoke dampers with installation instructions.
- 1.5.7 Sound attenuators, including pressure drop and acoustic performance.
- 1.5.8 Flexible ducts and clamps, with manufacturer's installation instructions.
- 1.5.9 Flexible connections.
- 1.5.10 Instrument test fittings.
- 1.5.11 Details and design analysis of alternate or optional duct systems.

1.6 APPLICABLE PUBLICATIONS

- 1.6.1 The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- 1.6.2 Air Moving and Conditioning Association (AMCA):
 - .1 500D-98 Laboratory Method of Testing Dampers for Rating
 - .2 500L-99 Laboratory Method of Testing Louvers for Rating
- 1.6.3 American Society for Testing and Materials (ASTM):
 - .1 A653-01 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
 - .2 A1011-02 Standard Specification for Steel Sheet and Strip Hot rolled Carbon structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
 - .3 B209-01 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate
 - .4 C1071-00 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
 - .5 E84-01 Standard Test Method for Surface Burning Characteristics of Building Materials
- 1.6.4 National Fire Protection Association (NFPA):
 - .1 90A-99 Standard for the Installation of Air Conditioning and Ventilating Systems
 - .2 96-01 Ventilation Control and Fire Protection of Commercial Cooking Operations
- 1.6.5 Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
 - .1 2nd Edition – 1995 HVAC Duct Construction Standards, Metal and Flexible
 - .2 1st Edition - 1985 HVAC Air Duct Leakage Test Manual
 - .3 6th Edition – 1992 Fibrous Glass Duct Construction Standards

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

- 2.1.1 General: Except for systems specified otherwise on drawings, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A527, coating G90.

2.2 GALVANIZED STEEL - RECTANGULAR DUCTWORK

- 2.2.1 G-90 coated galvanized of lock-forming grade conforming to ASTM A653 and A924 Standards. Minimum yield strength for steel sheet and reinforcements shall be 30,000 PSI (207 kPa).
- 2.2.2 Thickness: to ASHRAE and SMACNA.
- 2.2.3 Fabrication: to ASHRAE and SMACNA.
- 2.2.4 Joints: to ASHRAE and SMACNA or proprietary manufactured duct joint. Proprietary

- manufactured flanged duct joint shall be considered to be a class B seal.
- .1 Standard of Acceptance: Namasco Ductmate; Exanno Nexus.
- 2.2.5 Fittings
- .1 Fabrication: to SMACNA.
- .2 Radiused elbows: standard radius.
- .3 Square elbows: over 16" with double thickness vanes. Not to be used unless specifically shown on drawings.
- .4 Main supply duct branches with splitter damper. If splitter damper is not used, provide branch and main duct balancing damper.
- .5 Sub branch duct with 45° entry and balancing damper on branch.
- 2.2.6 Transitions:
- .1 Diverging: 20° maximum included angle.
- .2 Converging: 30° maximum included angle.
- 2.2.7 Offsets: radiussed elbows as indicated.
- 2.2.8 Obstruction deflectors: maintain full cross- sectional area. Maximum included angles as for transitions.

2.3 SEALING CLASSIFICATION

- .1 Sealing classification as follows:

Seal Class	Sealing Requirements	Applicable Static Pressure Construction Class	Allowable Leakage Rate
A	All traverse joints, longitudinal seams and duct wall penetrations	4" w.g. (1000 Pa) -4" w.g. (-1000 Pa)	1% of total system design at system operating pressure 4"(1000 Pa)
B	All transverse joints and longitudinal seams	Up to 3" w.g. (750 Pa) -3" w.g. (-750 Pa) and less	1% of total system design at 3" w.g. (750 Pa)
C	All transverse joints only	Up to 2" w.g. (500 Pa) -2" w.g. (500 Pa) and less	1.5% of total system design at 2" w.g. (500 Pa)
D	Not sealed	Up to 1" w.g. (250 Pa) -1" w.g. (-250 Pa) and less	5% of total system design at 1" w.g. (250 Pa)

2.4 PRESSURE CLASSIFICATIONS

- .1 Ductwork material shall be constructed in accordance with SMACNA ratings for the following pressure classifications. Seal classifications shall be in accordance with the following table:

Ductwork	Operating Pressure	Seal Classification	Remarks
All supply ductwork	Up to 2". w.g. (500 Pa)	B	

All return ductwork	Up to 1 " w.g. (250 Pa)	B	
All exhaust ductwork	Up to -1" w.g. (-250 Pa)	B	
All Other Ductwork	Up to 0.5" w.g. (125 Pa)	D	

2.5 SEALANT AND TAPE

- 2.5.1 Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.
- 2.5.2 Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
- 2.5.3 Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
- 2.5.4 Gaskets in Flanged Joints: Soft neoprene.
- 2.5.5 Approved factory made joints such as DUCTMATE SYSTEM may be used.

2.6 DUCT CONSTRUCTION AND INSTALLATION

- 2.6.1 Follow SMACNA HVAC Duct Construction Standards.
- 2.6.2 Where specified, all ductwork shall be made liquid tight with continuous external weld for all seams and joints. Provide neoprene gaskets at flanged connections. Where ducts are not self-draining back to the equipment, provide low point drain pocket with copper drainpipe to sanitary sewer. Provide access door in side of duct at drain pockets.
- 2.6.3 Casings and Plenums
- .1 Construct in accordance with SMACNA HVAC Duct Construction Standards Section 6, including curbs, access doors, pipe penetrations, eliminators and drain pans. Access doors shall be hollow metal, insulated, with latches and door pulls, 500 mm (20 inches) wide by 1200 - 1350 mm (48 54 inches) high. Provide view port in the doors where shown. Provide drain for outside air louver plenum. Outside air plenum shall have exterior insulation. Drain piping shall be routed to the nearest floor drain.
- 2.6.4 Volume Dampers
- .1 Opposed blade, multi louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- 2.6.5 At the onset of the project, the Sheet Metal Contractor shall submit a sketch demonstrating and confirming the ability to transition the ductwork from the unit to the size shown on the Drawing within the Roof Curb. Advise of any issues prior to fabrication.
- 2.6.6 For all down-discharge rooftop unit, any elbows or transitions within 60' of the unit shall be equipped with turning vanes.

2.7 HANGERS AND SUPPORTS

- 2.7.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
- 2.7.2 Hanger configuration: to ASHRAE and SMACNA. Maximum size duct supported by straphanger: 500mm.
- 2.7.3 Hangers: galvanized steel angle with black galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1500	40 x 40 x 3	10
1501 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- 2.7.4 Upper hanger attachments:
- .1 For concrete: manufactured concrete inserts.
 - .1 Standard of Acceptance: Myatt fig 485.
 - .2 For concrete after concrete pour:
 - .1 Expanded concrete anchors shall be made of steel.
 - .2 Powder actuated fasteners shall only be utilized for slabs that are thicker than 100 mm (4") and shall not be utilized in lightweight aggregate concretes.
 - .3 Holes for expanding fasteners shall be drilled either by a carbide bit or by the teeth on the fastener itself. Expansion shield shall be "set" by driving it into the hole and expanding it with a conical plug.
- 2.7.3 For steel joist: manufactured joist clamp or steel plate washer.
- .1 Standard of Acceptance: Grinnell fig 61 or 86 for joist clamps.
- 2.7.4 For steel beams: manufactured beam clamps:
- .1 Standard of Acceptance: Grinnell fig. 60
- 2.7.5 For round ductwork the duct shall be supported as follows:
- .1 For duct dimensions 900 mm (36") single hangers are acceptable.
 - .2 For duct dimensions over 900 mm (36") hanger rods shall be provided on both sides of the duct.
 - .3 Minimum hanger sizes shall be in accordance with table 4-2 of SMACNA.
- 2.7.6 Loading on trapeze bars shall be in accordance with Table 4-3 of SMACNA.

2.8 DUCT ACCESS DOORS, PANELS AND SECTIONS

- 2.8.1 Provide access doors, sized and located for maintenance work, upstream and downstream of:
- .1 Each duct mounted coil.
 - .2 Each fire damper (for link service), smoke damper and automatic control damper.

- .3 Each duct mounted smoke detector.
- 2.8.2 Openings shall be as large as feasible in small ducts, 300 mm by 300 mm (12 inch by 12inch) minimum where possible. Access sections in insulated ducts shall be double wall, insulated. Transparent shatterproof covers are preferred for un insulated ducts.
- 2.8.3 For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2 12).
- 2.8.4 For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure2-11).

2.9 FIRE DAMPERS

- 2.9.1 Galvanized steel, interlocking blade type, UL listing and label, 1 1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- 2.9.2 Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
- 2.9.3 Provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
- 2.9.4 Submit manufacturer's installation instructions conforming to ULC rating test.
- 2.9.5 Combination fire and smoke dampers: Multi louver or curtain type units meeting all requirements of both dampers shall be used where shown and may be used at the Contractor's option where applicable.
- 2.9.6 Standard of Acceptance: Nailor, Ruskin

2.10 INSTALLATION

- 2.11.1 Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
- 2.11.2 Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
- 2.11.3 Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
- 2.11.4 Supply and install volume control dampers on all branch take-offs (applicable to supply, return and exhaust ductwork) whether shown on the drawing or not.
- 2.11.5 Provide bolted construction and tie rod reinforcement in accordance with SMACNA Standards.
- 2.11.6 Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- 2.11.7 Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.

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- 2.11.8 Install fire dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test.
- 2.11.9 Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- 2.11.10 Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.
- 2.11.11 Control Damper Installation:
- .1 Provide necessary blank off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
 - .2 Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 - .3 Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
 - .4 Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- 2.11.12 Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.
- 2.11.13 Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition, or return to source of supply for repair or replacement, as determined by the Consultant. Protect equipment and ducts during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.
- 2.11 DUCT LEAKAGE TESTS AND REPAIR**
- 2.12.1 Ductwork leak test shall be performed for the entire air distribution supply and return system including fans, coils and filter section designated as static pressure class 750 Pa (3 inch W.G.) and above.
- 2.12.2 All supply ductwork less than 500 Pa (2 inch W.G) shall also be tested to the air distribution equipment or terminal device (where applicable).
- 2.12.3 Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- 2.12.4 All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- 2.12.5 All tests shall be performed in the presence of the Consultant and the TAB agency. The Test and Balance agency shall measure and record duct leakage and report to the Consultant and identify leakage source with excessive leakage.
- 2.12.6 If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Consultant.
- 2.12.7 All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- 2.12.8 Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 20 05 11 Mechanical General Requirements.

PART 2 PRODUCTS

2.1 SPLITTER DAMPER

- .1 Of same material as duct but one sheet metal thickness heavier.
- .2 Single thickness construction.
- .3 Size and configuration to recommendations of SMACNA.
- .4 Control rod with locking device.
- .5 Bend end of rod to prevent end from entering duct.
- .6 Pivot: piano hinge.

2.2 SINGLE BLADE DAMPER

- .1 Of same material as duct. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 10"
- .3 Locking quadrant.
- .4 Inside and outside end bearings.

2.3 MULTI-BLADE DAMPER

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration to recommendations of SMACNA.
- .3 Maximum blade height: 4"
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame complete with angle stop.

2.4 DIVERTING DAMPER

- .1 Adjustable, curved vanes, mounted in supporting frame.
- .2 All aluminum construction.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install where indicated on the drawings and identified herein. For ducts concealed behind plaster or drywall ceilings, provide dampers where specifically shown on the drawings.
- .2 Provide splitter damper at every main branch take-off from main duct.
- .3 Provide balancing damper on all sub-branch ducts.
- .4 Install in accordance with recommendations of SMACNA.
- .5 Provide balancing dampers on all return air ducts connected to air handling units.

END OF SECTION

PART 1 **GENERAL**

1.1 **GENERAL**

- .1 This section of the Specification shall be read in conjunction with and shall be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements.

1.2 **REFERENCE STANDARDS**

- .1 Comply with requirements of:
 - 1. ULC S110M - Fire Tests for Air Ducts
 - 2. UL 181-2008 - Standards for Safety, Factory Made Air Ducts and Air Connectors
 - 3. NFPA 90A-2009 - Standard for the Installation of Air Conditioning and Ventilating Systems
 - 4. NFPA 90B-2009 - Standard for the Installation of Warm Air Heating and Air Conditioning Systems
 - 5. SMACNA – 2005 - HVAC Duct Construction Standards - Second Edition

1.3 **SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 20 05 11 Mechanical General Requirements.

1.4 **CERTIFICATION OF RATINGS**

- .1 Catalogue or published ratings shall be those obtained from tests carried out by the manufacturer or Independent Testing Agency signifying adherence to Codes and Standards.
- .2 Product Requirements.

PART 2 **PRODUCTS**

2.1 **GENERAL**

- .1 Factory fabricated.
- .2 Pressure drop coefficients listed below are based on sheet metal duct pressure drop coefficient of 1.00.
- .3 Fire retardant type insulation materials, coverings and adhesives with maximum flame spread rating of 25 and maximum smoke developed rating of 50 when tested in accordance with CAN/ULC-S102 and NFPA 255-2006. Materials tested in accordance with ASTM C411-05 shall not flame, smoulder, glow or smoke at temperature to which exposed in

service. Flexible duct system shall meet OBC requirements for smoke and flame spread for return air plenums.

2.2 METALLIC-INSULATED

.1 Spiral wound flexible aluminum with 1" (25 mm) external insulation.

.2 Performance:

- Temperature range: -40°F to 250°F (-40°C to 120°C)
- Minimum bend radius: 1.5 x diameter
- Vinyl sleeve outer covering
- Maximum working pressure: 12" (3000 Pa)
- Class 1 duct material

PART 3 EXECUTION

3.1 DUCT INSTALLATION

.1 Install where indicated and in accordance with preferred method of SMACNA and the following:

1. Connections:

a. Duct Sizes 300 mm (12") and Under:

- i. Provide a minimum of three (3) #8 sheet metal screws equally spaced to hold the flexible duct.

b. Duct sizes above 300 mm (12"):

- i. Provide a minimum of five (5) #8 sheet metal screws equally spaced to hold the flexible duct.

c. Screws shall be located at least 1/2" (12 mm) from the end of the duct.

d. The collar to which the flexible duct is attached shall be a minimum 2" (50 mm) in length.

e. Cover entire joint with tape and seal as specified in Section 15801.

2. Supports:

a. Support shall be in accordance with SMACNA.

b. The maximum amount of sag for flexible duct shall not exceed 1/2" (12 mm) per foot. Provide additional supports as required.

3. Length:

- a. Maximum length of flexible duct: 1500 mm (5 ft.).
- b. Minimum length of flexible duct connecting to light fixture troffers or ceiling diffusers shall be 72" (1800 mm).

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 11 Mechanical General Requirements.
- .2 Product data to include fan curves and sound rating data.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Section 20 05 11.

1.4 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

PART 2 PRODUCTS

2.1 FANS GENERAL

- .1 Capacity, static pressure, revolutions per minute, power, model, size and sound power levels: as indicated on the schedules.
- .2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301-76 tested to AMCA 300-67. Sound power levels shall not exceed those of the fan selected on the Schedule.
- .3 The fans shall bear the AMCA Certified Ratings Seal for air performance.
- .4 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99-76.
- .5 Ratings: based on tests performed in accordance with AMCA 210-74, and ASHRAE 51-75.
- .6 Accessories and hardware: gravity back-draft dampers, wall sleeves and grilles (where applicable), insect screens.
- .7 Factory primed before assembly in colour standard to manufacturer.

- .8 Scroll drains: where indicated.

2.2 BELT DRIVE CENTRIFUGAL ROOF EXHAUST FANS

- .1 Roof exhaust fans shall be centrifugal belt drive type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall consist of the motor cover, shroud, curb cap and lower windband, and shall be constructed of heavy-gauge aluminum. The housing shall have a rigid internal support structure and leakproof design. The fan shroud shall be one piece with a rolled bead for extra strength which directs exhaust air downward. The lower windband shall be one piece with formed edges for added strength and the curb cap shall include prepunched mounting holes to ensure correct attachment.
- .2 The fan shall have sleeve bearing motors, carefully matched to the fan load, and furnished at specified voltage, phase and enclosure. Motors shall be mounted on true vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. True vibration isolators shall be double-studded with no metal-to-metal contact. Each vibration isolator shall be sized to match the weight of each fan.
- .3 A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment.
- .4 A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.
- .5 All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
- .6 Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- .7 Standard of acceptance: Greenheck Model G, Penn, Carnes

2.3 CEILING MOUNTED WASHROOM/UTILITY EXHAUST FANS

- .1 Ceiling mounted exhaust fans shall be of the centrifugal direct drive type. The fan housing shall be constructed of steel. The plastic duct collar shall be a tapered sleeve for ease of connection to 3 in. and 4 in. round ductwork and shall include a backdraft damper.
- .2 The grille shall be constructed of non-yellowing high strength polymer and attached to the housing with torsion springs. The wheels shall be constructed of high strength polymer. The access for wiring shall be external. The motor disconnect shall be internal and of the plug in type.

- .3 All fans shall bear the AMCA Certified Ratings Seals for sound and air performance and shall be U.L. Listed.
- .4 Standard of Acceptance: Greenheck model SP, Penn, Jenn.

2.4 CEILING MOUNTED IN-LINE EXHAUST FANS

- .1 Duct-mounted exhaust or return air fans shall be of the centrifugal direct drive type. The fan housing shall be constructed of heavy-gauge galvanized steel. The housing interior shall be lined with ½" (13mm) acoustical insulation. The outlet duct collar shall include an aluminum backdraft damper and shall be adaptable for horizontal or vertical discharge. The access for wiring shall be external. The motor disconnect shall be internal and of the plug-in type.
- .2 The motor shall be mounted on vibration isolators. The fan wheel shall be of the forward-curved centrifugal type and dynamically balanced.
- .3 All fans shall bear the AMCA Certified Ratings Seals for sound and air performance and shall be U.L. Listed.
- .4 Standard of Acceptance: Greenheck model SQ, Carnes, Penn, Twin City, Loren Cook

2.5 DRYER BOOSTER FAN

- .1 Dryer booster fan shall be capable of maintaining an air velocity of 6 meters per second (1200 fpm) with an equivalent duct length of 40 meters (130 feet) of 100mm (4 inch) rigid steel duct. The dryer booster fan shall be capable of exhausting air up to 75°C. Unit shall have a five year warranty. Motor shall be a permanently lubricated, enclosed, external rotor design. The blower wheel shall be a self cleaning backward curved impeller design. The dryer booster fan shall have a galvanized steel housing with powder coat finish. A 15 meter (50 foot) cable shall be provided to connect the remote mount indicator panel to the dryer booster fan. Unit shall be provided with a 1.7 meters (5-1/2 foot) long 120 Vac power cord. Dryer booster fan is to be provided with inlet and outlet flanges for connection to 100mm (4") duct. Quick disconnect duct clamp to be provided. Galvanized mounting bracket and hardware are to be provided. Unit shall be provided with 450mm (18") of pressure sensing tubing with mounting grommet.
- .2 Standard of acceptance: Reversomatic, Fantech Model DBF4XLT, Greenheck, Carnes, Penn

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings. For all roof-mounted fans, manufacturer shall provide the matching curb.

- .2 Provide a flexible connection on fans connections to ductwork. Each flexible connection shall be installed with at least 3" of slack across a clear metal to metal gap of 4" Each flexible connection shall consist of a minimum of 6" of fabric. Ensure metal bands of connectors are parallel with minimum 3" flex between ductwork and fan during running.
- .3 Install fan restraining snubbers as indicated. Flexible connections shall not be in tension during running. Provide all sheaves and belts required for final air balance.
- .4 The exact location of each fan is to be site approved by the Engineer prior to installation; seek the Consultant's approval and site review prior to commencing install. Any install completed without the Consultant's approval will require the Contractor to move the exhaust fan as directed at no extra cost to the Contract.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

- .1 This section of the specification shall be read in conjunction with and be governed by the requirements of Section 20 05 11 Mechanical General Requirements.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 20 05 11 Mechanical General Requirements.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 20 05 11 Mechanical General Requirements.
- .2 Submit samples for the following:
 - a. None

1.4 MANUFACTURED ITEMS

- .1 Grilles, registers and diffusers shall be product of one manufacturer for generic type (i.e. grilles and registers by one, diffusers by one, or same).

1.5 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Provide standard product to meet capacity, throw, noise level, throat and outlet velocity.
- .2 Where grilles, registers and diffusers penetrate fire walls and fire partitions, provide approved steel sleeve secured to structure in accordance with NFPA 90A-1993 and required fire damper.
- .3 Frames:
 - a. Steel: primed cold rolled steel with exposed welded joints and mitred corners.
 - b. Aluminum: extruded satin finish with mechanical fasteners and mitred corners.
 - c. Provide full perimeter gaskets.
 - d. Provide plaster frames as plaster stops where set into plaster or gypsum board.
 - e. Provide concealed fasteners and balancing operators in all finished areas.

- f. Final finish to be selected by Architect from standard manufacturer finishes at shop drawing stage.
 - g. Style, frame, and installation details as indicated.
- .4 Sizes and capacities: as indicated in the schedule.
- .5 Standard of Acceptance: E.H. Price, Titus, Tittley Baily, Krugger

2.2 SQUARE PLAQUE DIFFUSERS

- .1 Square type 600 x 600 (24" x 24"), having fixed pattern, plaque-type, and volume control dampers with flow straightening devices and blank-off quadrants. Diffuser to be finished in off-white baked enamel and to be suitable for the ceiling in which it is installed.
- .2 Square type 300 x 300 (12" x 12"), having fixed pattern, and volume control dampers with flow straightening devices and blank-off quadrants. Diffuser to be finished in off-white baked enamel and to be suitable for the ceiling in which it is installed.
- .3 Standard of Acceptance: E. H. Price Model SPD, Titus., Tittley Baily, Krugger

2.3 LOUVERED RETURN GRILLES

- .1 Supply and install return grilles of the sizes and mounting types indicated on the plans and outlet schedule. Grilles shall be 0 degree deflection fixed louver type with blades spaced 1/2" (13) on center. The outlet shall have heavy extruded aluminum border and blades held in place with aluminum mandrel tubes not to exceed 12" (305) on center. Blades shall run parallel to the long dimension of the grille. The grille shall be finished as per the architectural requirements.
- .2 Standard of Acceptance: E H price 635DAL series, Tittley Baily, Krugger.

2.4 EGG-GRATE EXHAUST GRILLES

- .1 Furnish and install exhaust registers of the sizes and mounting types indicated on the plans and outlet schedule. Registers shall be of aluminum construction, consisting of aluminum 1/2" x 1/2" x 1/2" (13 x 13 x 13) grid (egg crate core) and an extruded aluminum border. The integral volume control damper (where required) shall be of the opposed blade type and shall be constructed of heavy gauge cold rolled steel. The damper shall be operable from the register face. The damper shall be coated steel. The grille shall be finished as per the architectural requirements.
- .2 Standard of Acceptance: E H Price model 80, Titus, Tittley Baily, Krugger

2.5 DOUBLE DEFLECTION SUPPLY GRILLES - ADJUSTABLE BLADES

- .1 Furnish and install aluminum supply registers of the sizes and mounting types indicated on the drawings. Registers shall be double deflection type with two sets of fully

adjustable deflection blades spaced 3/4" (19) on center. The front set of blades shall run parallel to the long dimension of the register. The integral volume control damper shall be of the opposed blade type and shall be constructed of cold rolled steel. The damper shall be operable from the register face. The grille shall be finished in a color selected by the Architect at shop drawings stage.

- .2 Standard of acceptance: E.H.Price model 610DAL, Titus, Tittley Baily, Krugger

2.6 TRANSFER GRILLE TYPES

- .1 Aluminum construction, 32 mm flat border, sightproof appearance, off-white baked enamel finish.
- .2 Standard of Acceptance: E.H.Price Model ATG1, Titus.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 All diffusers and grilles in finished areas to have concealed mounting. In unfinished areas and where grilles or diffusers are to be installed in ductwork, install with bulkheads tight to either side. Site measure for exact fit.
- .3 Final locations of diffusers and grilles to be in accordance with details of Architect's reflected ceiling plan. Coordinate with lighting fixtures installation by Div. 16.
- .4 Install and adjust air registers to provide noiseless and draftless distribution. Primary air balance to be done at duct dampers with final adjustment only at diffusers and grilles.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- 1.1.1 This section of the specification shall be read in conjunction with and be governed by the requirements outlined in Section 20 05 11 Mechanical General Requirements.

1.2 SHOP DRAWINGS

- 1.2.1 Submit shop drawings in accordance with Section 20 05 11 Mechanical General Requirements.
- 1.2.2 Indicate:
- .1 Equipment, capacity, piping, and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Shop drawings shall indicate location of supply and return hook-ups in addition to interconnection details for each zone.
 - .4 Total pressure drop through each cabinet heater and convector systems.

1.3 MAINTENANCE DATA

- 1.3.1 Provide maintenance data for incorporation into maintenance manual specified in Section 20 05 11 Mechanical General Requirements.

1.4 SAMPLES

- 1.4.1 A mockup of each of the convector shall be provided at the Shop Drawing stage. Mockup to be approved prior to the order for the convectors being placed.

1.5 CAPACITY AND PERFORMANCE

- 1.5.1 Capacity, performance, sizes and specifications shall be as indicated on the Drawings and Equipment Schedule.

PART 2 - PRODUCTS

2.1 GENERAL

- 2.1.1 All convector covers, force flow heaters and radiant panels shall be factory painted with factory baked enamel finish. Colour to be chosen at shop drawings stage. A physical paint chip of all options shall be provided to the Architect.
- 2.1.2 Provide for noiseless expansion of all components.
- 2.1.3 Radiation to give output indicated on the schedule.

2.2 WALL FIN CONVECTOR

2.2.1 Enclosure lengths are assembled together using concealed joiner strips to give a single unit look in every room. Enclosures shall come with all brackets, element hangers, joggle strips, end caps, inside and outside corners, laps, access doors, pilaster kits and manual dampers as required for a full install.

2.2.2 Enclosures are made of quality cold rolled steel, 16 gauge, formed and reinforced with top supports, degreased, phosphatized and coated inside and out with a corrosion resistant tan primer. Factory paint with enamel finish; colour to be coordinated with the architect.

2.2.3 Panels are manufactured in lengths of 2'0" to 8'0" by 6" increments. Enclosure complete with components for wall to wall installation, following the contour of the wall, complete with end caps, wall trim, concealed joiners, inside corners, outside corners, access doors and pipe covers as required. Joints and filler pieces to be recessed. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to be clear of cover grilles.

2.2.4 Elements:

- .1 Elements are seamless copper tube with aluminum fins. The tubes are expanded within the fins to obtain a permanent thermal bond between the two. These are manufactured in lengths of 1'0" to 10'0" by 6" increments. Both elements can be used on either steam or hot water systems.
- .2 The aluminum fins are square 4" x 4", min. 52 fins/linear foot of heating element.
- .3 All tubes are manufactured to receive standard sweat fittings. The elements designed for use at 300 degree F entry water temperature maximum working conditions.

2.2.5 Enclosure Accessories:

- .1 End Piece: End pieces are used to close off enclosure ends when cabinets do not terminate on an adjacent wall. The end piece is manufactured with rounded corners and protrudes 1" beyond enclosure to give a neat finished appearance.
- .2 Wall Trim: Joiners are manufactured to overlap enclosures and cover the gap between cabinet end and adjacent wall or columns. These are usually supplied in 4", 5", 6" or 8" lengths.
- .3 Concealed Joiner (Butt Joint): This piece fits between two enclosure lengths to give a clean hairline joint appearance to the installation.
- .4 Inside Corner: Inside corners are manufactured to overlap enclosures and are used when piping runs on two or more inside walls to meet heating requirements. These are usually supplied at 90 deg. angles, however may be modified to meet project conditions.

- .5 Outside Corner: Outside corners are manufactured to overlap enclosures and are used when piping runs on two or more outside walls to meet heating requirements. These are usually supplied at 90 deg. angles, however may be modified to meet project conditions.
- .6 Access Doors: Access doors are manufactured to permit access to valves or other controls located inside enclosure. Two types are available, factory installed 5" x 7" or field mounted 5" x 7" with frame. They are supplied as standard with a screw lock, however a camlock type is also available. For field mounted access doors, the contractor is required to perforate the enclosure.
- .7 Pipe Covers: Pipe covers are used to hide pipes that run around a column. These are supplied in 5", 11" or 17" heights and are 3 3/4" deep.
- .8 The Contractor is responsible for supply and installing 3/4" thick mineral wool insulation on the inside surface of the convector enclosure over the full length and height of all convector enclosure. Adequately adhere (with adhesive) the insulation to the enclosure. The intent of this is to minimize the surface temperature of the convector enclosure for staff and students.

2.2.6 Controls – Refer to the Controls Specifications.

2.2.7 Standard of Acceptance: Engineered Air, Sigma.

2.3 FORCE FLOW UNIT HEATERS

2.3.1 Cabinet:

- .1 The cabinets are constructed of heavy 16 gauge furniture steel with removable fronts to provide easy access to motor, blower and heating element. The cabinets are rust proofed and then finished with a prime coat. Units furnished with a factory enamel finish; colour to be coordinated with the architect.
- .2 1/2" flexible fiber glass duct liner on back and sides off external box, for recess arrangement only. Allows easy access to the piping, valve, filter and full access to fan deck.

2.3.2 Coils

- .1 The heating coils are of 5/8" O.D. seamless copper tubes expanded into aluminum fins to form a permanent mechanical bond. Two rows for hot water or steam. Female pipe coil connections. Steam distributing coils have cast iron headers. Supply and return connections on left side of units on all models and sizes.

2.3.3 Blowers

- .1 The blowers consist of two double inlet type centrifugal aluminum fans mounted directly on a double ended motor shaft.

2.3.4 Access Door

- .1 Provides easier access to controls on left side with camlock fastener.

- 2.3.5 Hinged Panel
 - .1 Supplied on ceiling arrangements to remove fan deck & filter.
- 2.3.6 Motors
 - .1 Permanent split capacitor type. Steel shell, die cast aluminium shields, galvanized steel cradle. Resilient mount. Self aligning sleeve bearings, horizontal mount, class “B” insulation, thermally protected.
- 2.3.7 Speed Switch
 - .1 Solid state three speed control with off position.
- 2.3.8 Controls
 - .1 Fan operation controlled by the self contained thermostat. No water flow control required. On a call for heat, the fan shall be energized, until setpoint is achieved; at that time, the fan will stop.
- 2.3.9 Filters
 - .1 Filters in these cabinet heaters are removable in seconds, without tools. After simply opening the unit’s front panel, the filter easily slides out. Filters are provided as standard. Filters clean air entering the cabinet heater before it is discharged into conditioned space.
- 2.3.10 Piping
 - .1 Space is provided to allow all piping connections to be made inside the cabinet. Manual reset toggle switch starter with overload protection.
- 2.3.11 Standard of Acceptance: Engineered Air, Sigma.

2.4 RADIANT PANEL

- 2.4.1 Panels shall be provided as shown on the drawings and details. Radiant panel shall be constructed and installed strictly as shown on details, deviation from this details and Specifications shall not be accepted. Fabrication of non-custom and modular units shall be same as custom made units. Radiant ceiling manufacturer shall prove that they have similar installation in Ontario, utilizing custom made panels.
- 2.4.2 Connections between lengths of panel to be as detailed.
- 2.4.3 The panels shall be extruded aluminum with copper tubing of 12.8 mm I.D. mechanically attached to the aluminum face plate. The copper tube shall be held in place by an aluminum saddle which extends more than half way around the diameter of the tube. A non hardening heat conductive paste shall be placed between the copper tubing and the aluminum face plate. Panels shall weigh no more than 10.5 kg/m² (2.15 lb/ft²) when operating. The use of adhesive and/or clips to attach the copper tube to the extrusion will not be acceptable.
- 2.4.4 Panel colour shall be selected by the Architect at the shop drawing stage.
- 2.4.5 Panel capacities shall be based on an entering and leaving water temperatures as per the Drawings.

- 2.4.6 The supplier shall provide a sample section of the proposed radiant panel on site prior to the order for the balance of the radiant panel. A 3 metre section of the radiator shall be provided for review by the Consultant after the shop drawings have been approved and prior to the order for the balance of the radiant panels.
- 2.4.7 Radiant panels shall be fully assembled at the manufacturer factory, with all integral bends so as to leave each panel with one supply and one return connection. Panel widths as shown on the drawings are minimum widths and shall not exceed the dimensions as noted. Field assembled and field cut panels will not be accepted. Length of all panels shall be site measured prior to fabrication. Unit manufacturer to coordinate with Division 15.
- 2.4.8 Panels shall be complete with removable flush mounted access panels. For sizes and locations of access panels refer to drawings.
- 2.4.9 Radiant panels shall be complete with factory installed integral mounted border frame suitable for drywall installation.
- 2.4.10 Radiant ceiling manufacturer shall supply the panels with insulation connected to the panels. Insulation shall be foil faced back, minimum 50 mm (2") thick.
- 2.4.11 Standard of Acceptance: Engineered Air, Sigma.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- 3.1.1 Install in strict accordance with the manufacturer's instruction and with all fittings indicated on the drawings and schematics. Support finned elements using the manufacturer's supplied brackets; space wall-fin supports in accordance with the manufacturer's instructions.
- 3.1.2 Install according to the piping layout. Provide for pipe movement during normal operation.
- 3.1.3 Ensure that adequate space is provided within the equipment enclosures for the isolation valves, control valves and strainers. Ensure that access doors are provided to all control elements. Panels shall be constructed in a manner to allow for disassembly and access to hot water piping connections without damaging the radiator panel.
- 3.1.4 Manufacturer to visit the site prior to submission of shop drawings and perform accurate measurements, to ensure that the wall-fin covers match the exact room sizes.
- 3.1.5 Where redundant openings are left above, below or around the new heating equipment, make good wall to match existing. Where necessary, enlarge the existing wall openings as required to fit the new equipment. Make good all surfaces affected by the work and paint to match existing wall finishes.
- 3.1.6 Provide power and wiring to all new forced flow heaters; provide all new thermostats, sensors, control valves and control wiring.

- 3.1.7 Automatic control valves shall be supplied, installed and wired by the Mechanical Contractor and Controls Contractor.
- 3.1.8 Mechanical contractor shall supply the step-down transformers required to power the control valves. Line voltage to the step-down transformers shall be provided by Division 16. Coordinate the location of junction boxes that will provide the power to the step-down controls transformers.
- 3.1.9 Coordinate with Division 26 the location of junction boxes required.
- 3.1.10 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- 3.1.11 Refer to manufacturer's installation drawings. Verify electrical service work with characteristics stamped on unit.
- 3.1.12 Check that all openings for appurtenances and operating weight conform to shop drawings.
- 3.1.13 Valves
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating ball valves and circuit balancing valves on each unit.
- 3.1.14 Provide screwdriver vent on convectors and radiators. Clean all finned tubes and comb straight.
- 3.1.15 Provide clear caulking at all corners of the forced flow heaters and convectors interfacing with a block wall. Verify extent of caulking with the Architect prior to starting caulking work.

END OF SECTION

PART 1 GENERAL

- ## **PART 2 PRODUCTS**

- SAL Project No. 26-105

- 2.4.9 Current Sensors (Analogue)
- 2.4.10 Status Relays (Solid State)
- 2.4.11 Duct Humidity Sensors
- 2.4.12 Space Humidity Sensors
- 2.4.13 Liquid and Steam Pressure Transmitters
- 2.4.14 Air Static Pressure Transmitter
- 2.4.15 Water Flow Sensors
- 2.4.16 Duct Temperature Sensors
- 2.4.17 Duct Averaging Temperature Sensors
- 2.4.18 Outdoor Air Temperature Sensors
- 2.4.19 Immersion Temperature Sensors
- 2.4.20 Strap-on Temperature Sensor
- 2.4.21 Pushbuttons
- 2.4.21 Spring-Wound Timers
- 2.4.23 Current Switches
- 2.4.24 Occupancy Sensors
- 2.4.25 Firestopping and Smoke Seal Materials
- 2.4.26 Wall Opening Cover Plates
- 2.4.27 Access Doors
- 2.4.28 Motor Starters and Accessories
- 2.4.29 Variable Frequency Drives
- 2.4.30 LAN Cabling
- 2.4.31 Lighting Relays
- 2.4.32 CO2 Sensors
- 2.4.33 Thermostat Guards
- 2.4.34 Thermostats for Force Flow Heaters (Fan Cut-Out)
- 2.4.35 Cold Alarm Aquastat Wired to Building Surveillance System

PART 3 EXECUTION

- 3.1 Coordination with New Mechanical Work
- 3.2 General - Installation of Controls
- 3.3 Power Sources and Wiring Methods
- 3.4 Installation of Temperature Sensors in Piping
- 3.5 Installation of Standard Control Dampers and Actuators.
- 3.6 Installation of Automatic Control Valves and Actuators.
- 3.7 Installation of Outdoor Air Temperature Sensors
- 3.8 Installation of Water Flow Meters
- 3.9 Installation of Water Differential Pressure Sensors
- 3.10 Cold Alarm Aquastats in Existing Buildings
- 3.11 Pneumatic Fail Safe Interlocks
- 3.12 Boiler Selector Switches
- 3.13 Installation of Firestopping and Smoke Seal Materials
- 3.14 Installation of Wall Opening Cover Plates

- 3.15 Cutting and Patching
- 3.16 Packing and Sealing Core Drilled Conduit Openings
- 3.17 Access Doors Installation
- 3.18 Electrical Wiring and Accessories
- 3.19 Installation of Motor Starters and Accessories
- 3.20 Installation of Variable Frequency Drives
- 3.21 Equipment Enclosures and Location
- 3.22 Identification and Labelling of Control Equipment
- 3.23 Systems Hardware Commissioning
- 3.24 TDSB Review and Site Report
- 3.25 Training

APPENDIX 1 – VFD Requirements

PART 1 GENERAL

1.1 General Requirements

- 1.1.a The controls contractor shall provide the necessary design, installation, power wiring, equipment, programming, supervision, commissioning and operator training to ensure for a complete and fully operational system.
- 1.1.b The controls contractor shall perform a review of all existing control components (e.g. control valves, control dampers, linkages, actuators, etc.) to be re-used by the newly installed BAS. Immediately report any defective or inoperative components to the caretaker.
- 1.1.c The controls contractor shall coordinate the work of the Mechanical Contractor (see Section 3.1) and all sub-contractors required to complete the scope of work as specified in the contract documents.
- 1.1.d The controls contractor and all sub-contractors shall employ only certified tradespersons to carry out all applicable work.
- 1.1.e Urinal tank solenoids are to be supplied and installed by TDSB. The controls contractor shall provide wiring and termination to the specified urinal tank locations.
- 1.1.f Where not already existing, the controls contractor shall provide hand-off-auto (H-O-A) switches for existing equipment starters connected to the BAS.
- 1.1.g Provide all necessary power wiring and hardware to complete the entire project, including but not limited to, wiring, fittings, connectors, conduits, hangers/supports, box covers and all other accessories required to ensure complete, safe and fully operational systems. This shall include the power wiring for all the equipment installed by the Mechanical Contractor.
- 1.1.h The controls contractor shall arrange for Electrical Authority inspection of all electrical work. Arrange for a separate inspection of any field assembled electrical panels or systems that have not been pre-approved by CSA/ULC. Submit the Certificate of Inspection and Product Approval Certificate with the as-built documentation.
- 1.1.i The controls contractor shall provide written notification to TDSB, prior to tender closing, of any errors, omissions, discrepancies or ambiguities contained in the tender documents. Following the award of the contract, TDSB reserves the right to act as the sole arbiter of any disputes arising from the interpretation of the tender documents.

1.2 Approved Control System Manufacturers

- 1.2.a Only approved building automation systems will be accepted. No substitutes or alternates are allowed. The accepted system manufacture and vendor is:
 - 1. ESC Automation Toronto**
5525 Eglinton Ave. West, Suite 100
Toronto, Ontario, M9C 5K5

647-789-2600

- 2. Automated Logic Corporation**
5201 Explorer Dr.
Mississauga, ON, L4W 4X3
905-660-0878

- 1.2.a The Controls Contractor shall be a Sub-Contractor of the Mechanical Contractor. The costs of the Controls Contractor shall be included in the Base Tender Price of the Mechanical Contractor.

1.3 Shop Drawing Submittals

- 1.3.a The controls contractor shall prepare and submit shop drawings for the review and approval of TDSB and the mechanical consultant. Under no circumstances shall the controls contractor commence site work prior to the acceptance of shop drawings by TDSB and the mechanical consultant.

- 1.3.b The shop drawing submittal shall include the following:

1. Control schematics for each system
2. Detailed sequence of operation for each controlled system.
3. System Architecture indicating the type and model number for all BAS components, the proposed interconnection and location of all panels, network connection and key peripheral devices.
4. BAS points list indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e. AO/DO/AI/DI), end device fail position, end device manufacture and model number and wire tag ID.
5. Wiring diagrams including complete power system, interlocks, control and data communications.
6. Manufacturers' data/specification sheets and catalogue cuts for all material and equipment supplied.
7. Automatic control valve and damper, VAV box, terminal unit and control module schedules where required.
8. Bill of materials included as part of the project.
9. An As-Found Conditions report where existing controls are being replaced or upgraded and mechanical equipment or controls sensors are being reused. See section 1.8.
10. Commissioning (prefunctional) test sheets for each controller (new or existing) to be commissioned.

1.4 As-Built Documentation

- 1.4.a Prepare one (1) preliminary copy of BAS As Built and Operating/Maintenance manuals and submit directly to TDSB and the mechanical consultant for review and acceptance.

- 1.4.b Upon acceptance, include a link to the As-Built Documents on the main BAS graphics page for the site.
- 1.4.c The As-built documentation shall include the following:
1. An Title sheet that contains:
 - School Name and address
 - Project name
 - A brief description of the control details: total number of inputs and outputs in the scope of the project and total number of controllers existing on site.
 - Software version.
 - BAS/TDSB WAN IP address.
 - BAS contractor Name, address, and Phone number.
 2. Detailed sequence of operation for each controlled system.
 3. Control schematics for each system.
 4. A System Architecture indicating the type and model number for all BAS components, the proposed interconnection and location of all panels, network connection and key peripheral devices.
 5. BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e. AO/DO/AI/DI), end device fail position, end device manufacture and model number and wire tag ID.
 6. Floor plan with the location of all field mounted control devices.
 7. Programming code for all DDC controllers.
 8. List of alarms and equipment schedules.
 9. Wiring diagrams including power supply system, interlocks, control and data communications.
 10. Manufacturers' Operation and Maintenance Manuals and catalogue cuts for all material and equipment supplied (e.g. valves, starters, VFDs, etc.), including material supplied under a separate mechanical scope of work. This section shall include a summary sheet that indicates all BAS Device, Manufacturers', model number, and quantity of each used on this job.
 11. Equipment calibration certificates (e.g. water flow sensors).
 12. Air and water balancing reports.
 13. Automatic control valve and damper, VAV box and terminal unit schedules where required.
 14. Electrical Authority Inspection Certificates – General Inspection and Product Approval Inspection.
 15. Completed commissioning reports signed and dated by the BAS contractor's field technician.
 16. As found condition report.
 17. Signed warranty letter
 18. Certificate of completion

1.4.d Consult with the head caretaker at the conclusion of the project to determine the specific equipment operating schedules required for the facility. Ensure that BAS weekly and holiday schedules for all controlled equipment are customized to match the actual occupancy requirements of the facility. See training requirements for schedule setup.

1.4.e Provide information required for the future replacement and activation of the panel by TDSB staff. This information should include a listing of all network addresses and configuration settings for each DDC panel (new and existing) within the facility.

1.5 Warranty

1.5.a All labour and material (hardware and software) supplied under this contract shall be warranted free from defects for a period of **three (3) years** after final completion and acceptance. Final completion and acceptance is defined as the date of the project turnover meeting or the date of the certificate of completion (C of C) issued by the TDSB BAS Coordinator, whichever occurs first. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost to TDSB. The contractor shall respond to TDSB's request for warranty service within one (1) business day.

1.5.b All work shall have a single warranty date, even when TDSB has received beneficial use of part of the system in advance of the final completion date.

1.5.c The contractor shall be responsible for correcting any deficiencies, errors or omissions in operating strategies, programming code, system functionality or parameters and operator workstation graphics during the warranty period.

1.6 Ownership of Proprietary Material

1.6.a All project-developed software and documentation shall become the property of TDSB. These include, but are not limited to:

1. Project graphic images
2. Record drawings
3. Project database
4. Project application programming code
5. All documentation

1.7 Facilities with Existing BAS

1.7.a Where a facility has an existing BAS that is to be replaced, modified or upgraded, the controls contractor shall be responsible for ensuring that the entire system (hardware, programming and system graphics) and all integral parts (new and re-used) function as an integrated and seamless system. Specifically, the interactive workstation graphics shall be created for both the new and re-used parts of the BAS using the latest and most up-to-date version of the manufacturer's graphics software (see also 1.7.d, 1.7.e, 1.7j).

-
- 1.7.b Provide current generation products only. The supply of out-of-date or obsolete products shall not be accepted. The supply of discontinued products or products no longer supported by the manufacturer shall not be accepted.
- 1.7.c Ensure complete interoperability and compatibility between new and existing DDC systems and components. Provide system firmware and/or hardware upgrades to existing DDC panels/modules where required to ensure a complete working system to the satisfaction of TDSB and the mechanical consultant. Ensure that firmware revision level of all controllers is the most up to date as recommended by the manufacturer and is consistent throughout the facility.
- 1.7.d For existing Automated Logic installations, provide only native ALC WebCtrl controllers and devices compatible with Exec 6 or Exec B firmware or later. For all controllers (new or existing), provide WebCtrl graphics throughout.
- 1.7.e For existing Delta Controls installations, provide only Delta Version 3 series controllers and devices. For all controllers, provide programming and graphics for specific use with the Delta Version 3 series system.
- 1.7.f Where an existing DDC panel is re-used, ensure that sufficient controller memory is present to provide for all specified control functions. Provide memory and/or panel upgrades where required to meet system memory requirements.
- 1.7.g Ensure that all re-used DDC panels/modules are upgraded to be compatible with the latest version of system firmware and system operating software.
- 1.7.h Provide new labelling for wiring, devices and equipment where existing labelling does not meet the requirements of these specifications or where panel hardware addressing is modified as a result of the new project work.
- 1.7.i Provide only new, customized WebCtrl or Delta v3 graphics for any existing automation panels that are re-used and remain part of the BAS network within the facility. Programming and graphics must be fully compatible with the BAS manufacturer's latest software and firmware revision level.
- 1.7.j Where approved in writing by the TDSB, native-BACnet controllers from Automated Logic or Delta Controls may co-exist within the same facility where there will not be any legacy controllers from either vendor remaining in the facility at the conclusion of the project. The successful bidder is responsible for providing new graphics for the entire facility and shall be responsible for interfacing all required BACnet objects from the other vendor's controllers to the new BAS. The BACnet router and TDSB data drop serving the previous vendor's BAS shall remain in service to allow for remote access to these modules as before.
- 1.8 As Found Conditions Report for Existing BAS**
- 1.8.a Where modifications, upgrades or additions are made to an existing BAS, facility, the BAS contractor shall carry out an operational review of all existing BAS devices prior to the start of any project work related to this contract. The purpose of the review is to provide a "snap shot"

- of found conditions prior to the start of work and to identify any operational deficiencies or abnormalities related to the existing BAS equipment.
- 1.8.b The report shall include the following:
- A report or screen shot of all inputs to the system to verify correct readings (i.e. no open circuits or failed devices)
 - A report to indicate whether any hardware I/O's or software objects are found in manual mode or overridden
 - A screen shot showing whether all DDC panels are on-line and communicating normally
 - Copies of existing panel databases and graphics files
 - Copies of existing logic
 - Copies of existing points list
- 1.8.c The report shall be included in the shop drawing submittal and submitted to the TDSB BAS Coordinator prior to the start of any site work. If this report is not provided, or is provided after site work has commenced, then it will be assumed that the existing BAS at the facility is operating without problems or defects.
- 1.8 d This report shall be included in the As-Built Documents.
- 1.9 Interoperability with Third Party Devices**
- 1.9.a Where the BAS is interfaced to third party devices (i.e. VFDs, chiller panels, equipment controllers, etc.), use only hard-wired, physical I/O's to achieve desired interoperability.
- 1.9.b The use of industry standard communication protocols (i.e. BACnet, LONWorks MODBUS) shall not be used to control third party devices, unless specifically approved by the TDSB.
- 1.9.c Acceptable use of standard communication protocols to third party devices shall be for monitoring purposes only.
- 1.10 Testing, Adjusting and Balancing (TAB)**
- 1.10.a Where specified, provide the services of an approved TAB company. Ensure that all applicable site personnel employed by the TAB company meet TDSB trades certification and registration requirements.
- 1.10.b The controls contractor shall assist the TAB contractor where necessary to carry out their duties.
- 1.10.c TAB work shall be performed to ANSI/ASHRAE-III-1988 and 62-1989. Other standards are as listed in the NBCTA 1995 Directory, AABC and NEBB publications.
- 1.10.d The TAB report shall be based on true tests which are properly documented. The report shall have all elements of description, design, equipment supplier and testing data. The testing method (set up), applied testing instruments, achieved accuracy and comfort level need to be described and commented.

- 1.10.e Where applicable, the TAB report shall have the following structure:
- Front Title Sheet
 - Table of Content
 - Systems Description, Testing Method and Comments
 - Performance Table, which includes all systems
 - Equipment Test Sheet c/w S.P. profile
 - Autocad Schematics
 - Report Certification
 - Performance Curves
 - Building Pressurization Diagnosis
 - Deficiencies
 - Any system setpoints required by the BAS
- 1.10.f The BAS contractor shall program and document all VFD modulations and differential pressure setpoints based on measurements provided by the TAB contractor.

PART 2 PRODUCTS

2.0 SYSTEM HARDWARE

2.1 General Requirements

- 2.1.a The system architecture will be comprised of PCUs (Primary Control Units), PACs (Programmable Application Controllers), ASCs (Application Specific Controllers) and any required communications or interface components networked together to provide a system of connected controllers that operate as a single BAS for the entire project.
- 2.1.b The building operator shall be able to access the local BAS by logging onto an existing TDSB network PC. All required site database and graphics files shall reside on the TDSB central BAS server.
- 2.1.c Supply PCU's and PAC's as required to interface to all specified equipment.
- 2.1.d Allow for a minimum of 25% spare program and trend memory capacity in each PCU and PAC.
- 2.1.e For each specified BAS control point, the contractor shall supply the hardware point type (e.g. AI, AO, DI, DO) as indicated on the controls points list. The use of alternate hardware point types or the use of external interface cards or devices to simulate the function of a specified hardware point type is not acceptable. For example, the use of a DO point and an external PWM card to simulate the function of a physical AO point shall not be accepted.

2.1.1 Primary Control Units (PCU)

- 2.1.1.a Use only Primary Control Units to directly control any major mechanical equipment. Major mechanical equipment includes air handling units, boiler plants, chiller plants, cooling towers, roof-top units and other critical equipment.
- 2.1.1.b For Delta Controls, examples of controllers that shall be accepted as a PCU:
- DSC 1616
 - DSC 1212
 - DSC 1280
- 2.1.1.c For Automated Logic, examples of controllers that shall be accepted as a PCU:
- ME-Line modules
 - SE-Line modules
- 2.1.1.d Each PCU shall contain a real time clock and sufficient memory to store the its own application database, operating parameters, user programs and trend data storage.
- 2.1.1.e Battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours to eliminate operating data reload in case of power failure.

2.1.1.f Each PCU output shall include a Hand/Off/Auto (HOA) selector switch for each analogue and digital output.

2.1.1.g Each PCU shall have a minimum of 10% spare capacity for each type of input and output channels.

2.1.2 Programmable Application Controllers (PAC)

2.1.2.a Programmable Application Controllers (PAC) are fully programmable controllers used for controlling distributed equipment including, but not limited to, VAV boxes, heat pumps, force flow units and unit ventilators. The TDSB considers examples of PAC's to include the ALC ZN series controllers and the Delta DVC, DFC and DAC series controllers.

2.1.2.b PACs shall not be used for controlling major mechanical equipment as described above in 2.1.1.a.

2.1.2.c Each PAC shall contain a real time clock and sufficient RAM to store its own application database, operating parameters, user programs and trend data storage.

2.1.2.d Battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours to eliminate operating data reload in case of power failure.

2.1.3 Application Specific Controllers (ASC)

2.1.3.a Application Specific Controllers (ASC) are pre-programmed controllers used to control large quantities of distributed equipment such as heat pumps or VAV boxes.

2.1.3.b The use of ASCs shall not be permitted unless written approval is obtained from TDSB.

2.1.4 Temporary Site Workstation PC

2.1.4.a The server-based BAS shall not require dedicated BAS site workstation PC, unless specifically noted in the drawings.

2.1.4.b Provide a temporary workstation PC for use during the commissioning and verification of the BAS. Install the PC in the head caretaker's office or other location designated by TDSB.

2.1.4.c The temporary workstation PC shall remain the property of the BAS contractor and may be removed from site once the project is certified to be substantially completed.

2.1.5 Connection to the TDSB WAN

2.1.5.a Advise the TDSB Project Supervisor of the proposed location of the system router/gateway panel within the facility. The TDSB shall provide a network jack (RJ45) in the specified location. The controls vendor shall connect the BAS to the TDSB WAN and confirm that network access to the BAS has been established.

- 2.1.5.b Submit the proposed site-specific BAS network wiring diagram to TDSB for approval. The use of field installed hubs/switches is not allowed under any circumstances.

2.1.6 TDSB Central Server

- 2.1.6.a Site databases and graphics files shall be installed on the designated central TDSB central server located at 140 Borough Drive.
- 2.1.6.b Submit a change request form to the TDSB Energy Project Engineer prior to installing new site databases on the TDSB server. Do not install software or make any changes to the server without the written consent of the TDSB.
- 2.1.6.c Set up and configure the server software and area routers (Delta) to allow for seamless access to the site BAS via the TDSB WAN.
- 2.1.7.d Include the cost of providing additional Delta router(s) to 140 Borough Drive if the existing area routers (Delta) have reached maximum capacity.
- 2.1.6.e Coordinate all activities related to the central server with the TDSB Project Engineer and the TDSB ITS group. Provide the TDSB with detailed documentation related to any changes made to the server software, settings or protocols.
- 2.1.6.f Provide designated TDSB Operations staff with at least 24 hours notice of any planned BAS server shutdowns or disruptions.

2.1.7 Local Service Ports (Ethernet)

- 2.1.7.a Where specified, provide dedicated network of CAT6 cabling and RJ45 jacks in each mechanical room. The service connections shall provide access to the TDSB WAN. Ensure compliance with section 2.4.29 of these specifications.

2.1.8 Fail State Position of Outputs

- 2.1.8.a Unless specified otherwise, configure BAS output points for the following fail state (e.g. device position upon panel failure):

All Fans	OFF
Heating Valves	Full heat to terminal device
Mixing Dampers	Full recirculation air
Face/Bypass Dampers	Full to face
Zone Dampers	Full heat
Heating Pumps	ON (except boiler belly pumps)
Boiler Belly Pumps	OFF
Variable Frequency Drives	ON, minimum programmed speed
Lighting Relays	Last State
Boilers (1 stage)	ON
Boilers (Multi-stage)	LOW ON, HIGH OFF

Cooling Equipment	OFF
Electric Heating	OFF
Domestic Hot Water Pumps	OFF
Roof-top Gas Burners	OFF

2.2 SYSTEM SOFTWARE

2.2.1 BAS Workstation Software

2.2.1.a Site licenses are not required.

2.2.2 Trend Logs

2.2.2.a Provide trend logs for all hardware inputs, outputs and control setpoints.

2.2.2.b All relevant trends should be accessible via the graphical interface.

2.2.2.c Multi-trends shall contain all related variables of a control loop (i.e. setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph.

2.2.2.d Trends shall be configured as follows:

Variable Type	Sample Rate	Trend History	Samples
Slow Acting (e.g. Space Temp)	30 minutes	5 days	240
Fast Acting (e.g. SAT)	5 minutes	2 days	576
Binary (On/Off)	COV	-	100

2.2.2.e The primary input sensor (measured variable) for all control loops must physically be wired to the same panel containing the control loop output (e.g. boiler water temperature and burner control output).

2.2.2.f Trend data storage must be in the same panel as the hardware or logical points being trended.

2.2.3 User Access

2.2.3.a Provide TDSB-standard user IDs and passwords for operations, maintenance and engineering staff.

2.2.4 Alarms and Totalizers

2.2.4.a Alarms shall be assigned the following categories:

Maintenance Alarms

- Mismatch of equipment control and status.
- Any other miscellaneous alarm not specifically noted herein

Energy

- a. Run time of major equipment exceeds a weekly limit (72 hours nominal)
 - b. Any space temperature exceeds 24°C and the outdoor air temperature is below 5°C.
 - c. Any space temperature in an air conditioned area is below 22.5°C and the outdoor air temperature is above 21°C.
 - d. Any air handling unit mixed air temperature is less than 7°C and the supply fan has been running for at least 30 minutes.
 - e. Any classroom space temperature drops below 10°C.
 - f. The BAS Alarm is active.
- 2.2.4.b Alarms shall not require any acknowledgment before automatic reset by the system.
- 2.2.4.c An alarm notification shall not be issued when an alarm condition returns to normal.
- 2.2.4.d The controls contractor shall provide additional alarms as directed by the mechanical consultant.
- 2.2.4.e Provide totalizers to record the operating hours for all air handling units and chillers. Separate totalizers shall be provided to record daily, weekly and yearly run times. Provide a corresponding trend log to record the run time total for each day. This trend shall sample the run time total once per day at 11:59pm and shall contain a total of 365 samples. The daily totalizer shall be reset immediately after the daily trend sample is taken.

2.2.5 BAS Alarm Output / Surveillance System Armed Status

- 2.2.5.a If not already existing, provide a binary output point and normally-open relay for the BAS Alarm. The BAS Alarm output shall be activated when any space temperature is less than 10°C and the outdoor air temperature is less than 5°C. Space temperatures to be monitored include classrooms, offices, gyms, auditoriums, cafeterias and libraries.
- 2.2.5.b When installing a new BAS Alarm, provide a binary input and 10vdc relay to monitor the building surveillance panel armed status. The relay shall be energized when the building surveillance system is armed.
- 2.2.5.c Provide wiring from the BAS panel to the designated building surveillance panel. Termination to the surveillance panel shall be performed by TDSB. Ensure sufficient spare cabling is provided to allow for termination by others.

2.2.6 Space Temperature Setpoints

- 2.2.6.a Standard Zones include Classrooms, Offices, Library, Washrooms, Auditorium, Cafeteria and Change Rooms. Space temperature setpoints shall be configured as follows:

Space Type	Occ Htg	Unocc Htg	Occ Clg
Standard Zone	21 °C	14 °C	24 °C
Pool	29 °C	29 °C	N/A
Gym	19 °C	14 °C	24 °C
Corridor	20 °C	14 °C	24 °C

Entrance	18 °C	14 °C	24 °C
Indoor Storage	18 °C	14 °C	N/A
Mech Room	18 °C	14 °C	24 °C
Outdoor Storage	14 °C	14 °C	N/A

2.3 BAS DYNAMIC GRAPHICS

- 2.3.a Provide customized, site specific dynamic graphics to meet the requirements of the mechanical consultant and TDSB.
- 2.3.b Contact TDSB for specific requirements regarding BAS graphics content, layout and functionality.

2.4 FIELD DEVICES

2.4.1 Automatic Control Valves

- 2.4.1.a Automatic control valves shall be supplied by the controls contractor and installed by the mechanical contractor.
- 2.4.1.b Automatic control valves 2" (50mm) and smaller shall be threaded Characterized Ball Valves. Modulating valves between 2.5" (65 mm) to 6" (150 mm) shall be flanged globe valves. Valves and actuators shall be ordered as one factory-assembled and tested unit.
- 2.4.1.c Submit for review, a valve schedule containing the following information for each valve:
 - a. Valve type and size
 - b. Connection type
 - c. Line size
 - d. Valve manufacturer and model number
 - e. Valve flow coefficient
 - f. Design flow
 - g. Pressure drop across valve
 - h. Maximum close-off pressure
 - i. Actuator manufacturer and model number
 - j. Actuator maximum torque
- 2.4.1.d Valves 2" (50mm) and smaller shall be constructed of bronze. Valves 2 1/2" (65mm) and larger shall have iron bodies and bronze mountings.
- 2.4.1.e All control valves shall have stainless steel stems. Ball valves shall be equipped with stainless steel balls and stems.
- 2.4.1.f The bronze in bodies and bonnets of all bronze valves shall conform to ASTM B62 for valves rated up to 150psig (1035 Kpa) working pressure and to ASTM B61 for valves rated at 200 psig (1380 Kpa) working pressure.
- 2.4.1.g The bodies and bonnets of iron body valves shall conform to ASTM A126, Class B.

- 2.4.1.h Control valve discs and seats shall be of bronze for 100 °C or less fluid temperature and of stainless steel for fluid temperatures above 100 °C.
- 2.4.1.i Control valves 2" (50mm) and smaller shall be complete with screwed ends type, except for bronze valves installed in soldered copper piping which shall be complete with soldering ends. Control valves larger than 2" (50mm) shall be complete with flanged end type and proper flanged adapters to copper shall be provided where flanged valves are installed in copper piping.
- 2.4.1.j The water control valves shall be sized for a pressure drop of 6 ft. water column (2.6 psi) or as indicated on mechanical drawings.
- 2.4.1.k Steam control valves shall be sized for the respective steam flows and a pressure drop of 25% of the inlet absolute maximum operating pressure.
- 2.4.1.l Each automatic control valve must provide the design output and flow rates at pressure drops compatible with equipment selected.
- 2.4.1.m Each automatic control valve must be suitable for the particular system working pressure.
- 2.4.1.n Each automatic control valve shall be fitted with a position indicator.
- 2.4.1.o Each automatic control valve must have the manufacturer's name, pressure rating and size clearly marked on the outside of the body.
- 2.4.1.p Heating valves shall be normally open and cooling valves are to be normally closed, unless otherwise specified.
- 2.4.1.q Standard of Acceptance
 - a. Siemens Flowrite Globe Valve with SKB/SKC/SKD actuators.
 - b. Belimo G-Series Globe Valves
 - c. Belimo B2/B3 Series CCV Ball Valve, stainless steel, (sizes 2" (50 mm) and smaller)
 - d. Belimo B2-HT (high temperature) Ball Valve, stainless steel, for low pressure steam applications (sizes 1" (25 mm) and smaller)

2.4.2 Automatic Control Valve Actuators

- 2.4.2.a Each automatic control valve shall be fitted with a "fail-safe" operator capable of tight shut-off against the differential imposed by the system.
- 2.4.2.b Operators for valves in electric-electronic control systems shall be single phase AC, 24V electric motor operators.
- 2.4.2.c Valve actuators shall accept a 0-10VDC control signal for all proportional applications
- 2.4.2.d The use of floating point control valve actuators is not acceptable under any circumstances.

2.4.3 Butterfly Valves - Motorized and Supervised Manual Actuators

2.4.3.a This contractor shall provide motorized butterfly valves and/or supervised manual butterfly valves where specified.

2.4.3.b The standard of acceptance for motorized butterfly valves shall be either of the following:

Bray Series 30, cast iron body, ASTM A126 Class B, aluminium bronze disk ASTM B148-954, stainless steel stem ASTM 416 and EPDM seat. Bray R4 Series 70 proportional (4 to 20mA) electric actuator, manual override hand wheel, position display visible from any angle at a distance, end switches for both open and closed positions

Challenger Butterfly Valve with cast iron body, ductile iron/brite nickel full rated disk, stainless steel stem and EPDM seat. OM electric actuator, proportional (4 to 20mA), manual override handwheel, position display visible from any angle at a distance, end switches for both open and closed positions and local/remote switch.

2.4.3.c The standard of acceptance for supervised manual butterfly valves shall be:

Challenger Butterfly Valve with cast iron body, ductile iron/brite nickel full rated disk, stainless steel stem and EPDM seat and equipped with a manual, handwheel and worm gear actuator. Complete with valve position transmitter and position display visible from any angle at a distance. Provide chain and padlock to lock the valve in place, complete with minimum of 3 keys with lamicoid labels on key rings to identify the keys or combination lock and show combination on the summary page of the site as-built documentation.

2.4.4 Automatic Control Dampers

2.4.4.a The automatic control dampers not provided as part of the packaged equipment shall be supplied by the Control Subcontractor and installed by the Mechanical Contractor.

2.4.4.b The automatic control dampers shall be opposed blade type for modulating applications and parallel blade type for 2-position applications.

2.4.4.c Maximum damper blade length shall be 4'-0" (1.2m). Maximum permissible leakage shall not exceed 1% of the total flow based on an approach velocity of 1,500fpm (7.5m/s) over a temperature range of -30 °F (-34.4 °C) to 100 °F (37.7°C) and a pressure of 3 in H₂O (0.75 kpa). Unless otherwise noted, blades are to be constructed of formed galvanized steel with neoprene seal edges, continuous stops and seals on all sides, oil impregnated bronze bearings and galvanized steel channel frames.

2.4.4.d Centre bar linkage connectors shall be used wherever possible but where centre bar linkage cannot be used due to space limitations, external linkage connectors may be used.

2.4.5 Automatic Control Damper Actuators

- 2.4.5.a All new actuators for control dampers shall be electric type and be powered by a single phase AC 24V overload-proof synchronous motor.
- 2.4.5.b All newly provided actuators shall be direct-coupled type for both modulating or two position control dampers.
- 2.4.5.c Damper actuators shall accept a 0-10VDC control voltage signal for all proportional applications
- 2.4.5.d All damper actuators shall be selected to operate maximum damper loads of 28 sq.ft. (2.6 sq.m.)
- 2.4.5.e Each actuator shall be “fail safe”, complete with external adjustable stops to limit the length of stroke in either direction and mounted on an adjustable bracket. Operating arms shall have double yoke linkages and double set of screws for fastening to the damper shaft.
- 2.4.5.f 2-position damper actuators shall be provided with an end-switch to indicate the open position.
- 2.4.5.g The standard of acceptance shall be Belimo.

2.4.6 Space Temperature Sensors

- 2.4.6.a Sensors shall utilize a 10Kohm thermistor to sense temperature.
- 2.4.6.b Provide stainless steel, ventilated plate-type temperature sensors.
- 2.4.6.c Mount sensors at a height of 60” above the finished floor. Unless indicated otherwise, mount new sensors adjacent to the existing thermostat in the space.
- 2.4.6.d End-to-end accuracy +/- 0.3 °C over the entire operating range.
- 2.4.6.e Provide a heavy-duty metal guard for existing zone thermostats that remain in service. In a typically classroom, this would be a pneumatic thermostat controlling a perimeter heating valve. In this situation, the space sensor is monitoring temperature only and not directly controlling an end device.
- 2.4.6.f Do not mount sensors on outside walls or other locations influenced by external thermal sources (e.g. computers, boiler rooms, printers).
- 2.4.6.g Standard of acceptance:

Greystone, BAPI

2.4.7 Heating/Cooling Thermostats (Low Voltage)

- 2.4.7.a Provide new thermostats to replace existing where specified.

- 2.4.7.b Unless indicated otherwise, thermostats shall be equipped with coiled bimetal sensing elements and mercury switches, individual heating and cooling setpoint levers, multiple stages of heating and cooling as required, adjustable heating anticipator and fixed cooling anticipator, system and fan switching subbase (off-heat-cool-auto) and key lock cover with internal thermometer.
- 2.4.7.c Mount new thermostats in the same location as existing.
- 2.4.7.d The standard of acceptance shall be Honeywell T874 with Q674E subbase and TG504A1025 key lock cover with internal thermometer.
- 2.4.7.e The use of a fully programmable, Native BACnet, digital room controller shall be accepted as an alternate to the thermostat in 2.4.7.d. The controller shall be equipped with a stylized housing suitable for wall mounting in finished areas, an LCD display and keypad. The standard of acceptance shall be Delta DNT-T305.
- 2.4.7.f Where replaced, return existing thermostats to TDSB.

2.4.8 Electric to Pressure Transducers (EPT)

- 2.4.8.a Provide electric to pneumatic transducers with the following minimum characteristics:
 - a. Input range of 2 - 10 vdc or 4 - 20 mA.
 - b. Directly proportioned output range of 3 to 15 psi.
 - c. Dust-proof housing unless panel mounted.
 - d. Combined non-linearity, repeatability and hysteresis effects not to exceed +/-2% of full scale over entire range of operation
 - e. Integral zero and span adjustment
 - f. Temperature effect of +/-2% full scale at 50 °C or less
- 2.4.8.b Provide a 1-1/2" diameter pressure gauge (0-30psi) on the input and output air lines for each transducer.
- 2.4.8.c For each transducer, provide a separate, dedicated supply air line filter rated at 0.2 microns that changes colour when contaminated by oil.
- 2.4.8.d Standard of acceptance:

Greystone

2.4.9 Current Sensors (Analogue)

- 2.4.9.a Current sensors (CT) shall be used for status monitoring of all motor-driven equipment, where specified.

2.4.9.b Technical Performance – Output should be only 4-20mA only. Voltage output will not be accepted. End-to-end accuracy +/- 1% of full scale at each range.

2.4.9.c The current sensors shall be mounted inside the starter cabinets whenever possible. If this is not possible due to space limitation, provide an enclosure to house the sensor.

2.4.9.d Standard of Acceptance:

Greystone

2.4.10 Status Relays (Solid State)

2.4.10.a The status relays shall be mounted inside newly provided enclosures mounted near the respective equipment starter cabinets.

2.4.10.b Standard of Acceptance:

Omron G7L-1A, LY2N

2.4.11 Duct Humidity Sensors

2.4.11.a Provide humidity sensors with the following minimum characteristics:

- a. Operating range from 10% - 90%RH over 0-60 °C temperature range.
- b. End-to-end accuracy of +/- 2% of operating range, with maximum temperature dependence of 0.2% per °C change.
- c. 200mm long probe, with enclosure for mounting in duct.
- d. 4-20mA output only. Voltage output is not acceptable

2.4.11.b Standard of Acceptance:

Greystone

2.4.12 Space Humidity Sensors

2.4.12.a Provide space RH sensors with the following minimum characteristics:

- a. Minimum operating range from 10% - 90%RH over 0-60 degrees C temperature range.
- b. End-to-end accuracy of +/- 2% of operating range, with maximum temperature dependence of 0.2% per °C change.
- c. Assembly shall be complete with a base plate for wall mounting, and a rigid circuit board for all circuitry and sensing element.
- d. Assembly shall be complete with a ventilated enclosure.

- e. 4-20mA output only. Voltage output is not acceptable.
- 2.4.12.b Humidity sensors installed in swimming pool areas shall be supplied with a conformal coating to protect electronic components from corrosion.
- 2.4.12.c Standard of Acceptance:

Greystone

2.4.13 Liquid and Steam Pressure Transmitters

- 2.4.13.a Provide liquid and steam pressure transmitters with the following minimum characteristics:
 - a. Minimum pressure operating range from 0 – 60 psi over 0-85 degrees C ambient/medium temperature range, for the liquid type.
 - b. Minimum pressure operating range from 0 – 30 psi over 0-85 degrees C ambient/medium temperature range, for the steam type.
 - c. End-to-end accuracy of +/- 1% of operating pressure range over 0-85 degrees C ambient/medium temperature range.
 - d. Wetted parts shall be stainless steel 316L complete with SS304 for the case.
 - e. 4-20mA output
- 2.4.13.b Provide a 3-valve manifold assembly (optional kit to be ordered with sensor) to facilitate sensor servicing and maintenance.
- 2.4.13.c Provide a pressure gauge (Winters P1S 100 series, 3-1/2” dia.) to measure the pressure of the high and low side piping connected to the transducer. Consult with the mechanical consultant for suitable gauge pressure range. The tap point(s) for the gauge shall be the same as those used by the pressure transducer and the gauge shall be installed adjacent to the transducer. For single pressure applications, provide a manual shut-off valve. For differential pressure applications, provide a t-connection and manual shut-off valves for the high and low side lines so that the gauge can display either pressure.
- 2.4.13.d Coordinate with the mechanical contractor to provide a pressure tap complete with shut-off valve and “pig tail” tubing (primed with water) for each sensor used to monitor steam pressure.
- 2.4.13.e Standard of Acceptance:

Greystone PGS100A (for low pressure steam monitoring)
Greystone WP-D-103-LCD-VB

2.4.14 Air Static Pressure Transmitter

- 2.4.14.a Provide air pressure transmitters with the following minimum characteristics:
 - a. Solid State design.
 - b. Operating on capacitance principle.

- c. With non-interactive fine resolution zero and span adjustments.
 - d. End-to-end accuracy +/- 1% of full scale pressure range, including temperature compensation.
 - e. 4-20mA output only. Voltage output is not acceptable.
- 2.4.14.b Provide a pitot-tube style static or velocity pressure probe (8" nominal) and fitting for insertion into ductwork. Follow manufacturer's instructions for correct installation method.

2.4.14.c Standard of Acceptance:

Setra model 264

2.4.15 Water Flow Sensors

- 2.4.14.a Flow sensors must be insertion, electromagnetic technology.
- 2.4.14.b Calibration certificate must be included in as-built documents.
- 2.4.14.c Output shall be 4-20 mA.
- 2.4.14.d Standard of Acceptance:

Onicon F-3500 Series

2.4.16 Duct Temperature Sensors

- 2.4.16.a Provide duct mounted temperature sensors (DTS) with the following minimum characteristics:
- a. Sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe.
 - b. Operating range 0-60 degrees C.
 - c. End-to-end accuracy +/- 0.3 °C.
 - d. Assembly complete with wiring housing and mounting flange.

2.4.16.b Standard of Acceptance:

Greystone

2.4.17 Duct Averaging Temperature Sensors

- 2.4.17.a Provide plenum mounted mixed air temperature averaging type sensors with the following minimum characteristics:
- a. Constructed of FT6 plenum rated cable incorporating a minimum of 9 temperature sensors encapsulated at equal distances along the 24 foot length of the element. The

assembly acts as a single sensor reporting the average temperature from all individual sensors.

- b. End-to-end accuracy +/- 0.3 °C.
- c. Mount in a zigzag manner to provide continuous coverage of the entire duct cross-sectional area.
- d. The use of thermistor type sensors is required.

2.4.17.b Standard of Acceptance:

Greystone

2.4.18 Outdoor Air Temperature Sensors

2.4.18.a Provide outdoor air temperature sensors with the following minimum characteristics:

- a. Each sensor shall be 10Kohm thermistor probe
- b. Provide two sensors for each site.
- c. Both sensors shall be mounted inside a heavy-duty (blow-proof) solar shield.
- d. Provide a heavy-duty, metal, wire guard.

2.4.18.b Standard of Acceptance:

Greystone

2.4.19 Immersion Temperature Sensors

2.4.19.a Use immersion temperature sensors with thermowells for all applications where a temperature of a fluid in a pipe is being sensed.

2.4.19.b Provide well-mounted water temperature sensors with the following minimum characteristics:

- a. The sensors shall be 10k ohm thermistor encapsulated in a 6mm OD, 50m long probe, with screw fitting for insertion into a standard thermowell.
- b. Operating range -10 to +100 degrees C.
- c. End-to-end accuracy +/- 0.3 °C over the entire operating range.
- d. The sensors shall be complete with brass thermowell. Provide a stainless steel thermowell where exposed to corrosive liquids.
- e. Use thermal conductive gel when mounting the sensor in the thermowell.
Sensors mounted on insulated piping shall be installed clear of the insulation.

2.4.19.c Standard of Acceptance:

Greystone

2.4.20 Strap-on Temperature Sensors

- 2.4.20.a Obtain written approval from the mechanical consultant and TDSB before using any strap-on type sensor.
- 2.4.20.b Where approved, provide strap-on type water temperature sensors with the following minimum characteristics:
- a. The sensors shall be 10k ohm thermistor encapsulated in a 6mm OD, 50mm long probe to be strapped-on the pipe.
 - b. Operating range -10 - +100 degrees C.
 - c. End-to-end accuracy +/- 0.3 °C over the entire operating range.

- 2.4.20.c Standard of Acceptance:
- Greystone

2.4.21 Pushbuttons

- 2.4.21.a Where specified, provide a push button with the following minimum characteristics:
- a. The pushbutton shall be surface mounted.
 - b. The unit shall have a button that is flush with casing.
 - c. The casing shall be heavy-duty and abrasion-proof.

- 2.4.21.b Standard of Acceptance:
- Danfoss RB2-BA2/RB2-BZ101
BACO LBX10110

2.4.22 Spring-Wound Timers

- 2.4.22.a Where specified, provide a spring-wound timer without a hold feature for the time interval indicated.
- 2.4.22.b Where the timer is used to directly switch the power supply to an air conditioning unit, provide a time delay relay (set to 3 minutes delay on make) and horsepower rated relay. Wire the devices such that the air conditioning compressor will have a minimum off time of 3 minutes between any timer activation. Mount all devices within an electrical enclosure complete with hinged door and key lock. Provide a lamicoid label to describe the timer operation. Consult with the TDSB for exact wording to be used in the label.
- 2.4.22.c Standard of Acceptance:
- a. Intermatic FF series

2.4.23 Current Switches

- 2.4.23.a The current switch shall induce power from the monitored load

- 2.4.23.b The current sensor shall provide on/off status indication of electrical loads from 0.15 to 60A (minimum).
- 2.4.23.c The current sensors shall be mounted inside the starter cabinets whenever possible. If this is not possible due to space limitation, provide an enclosure to house the sensor.
- 2.4.23.d The current sensor shall be isolated to 600VAC RMS (UL ratings), 300VAC RMS (CE ratings)
- 2.4.23.e The current sensor output shall be N.O., Solid State, 1A @30VAC/DC
- 2.4.23.f Standard of Acceptance:

Greystone

2.4.24 Occupancy Sensors

- 2.4.24.a The Occupancy Sensor system shall detect the presence of human activity within the desired space and activate automatically.

Sensors shall be installed to activate when detecting motion within 2 feet of entrance and shall not initiate based on motion outside of entrance.

Sensing technologies shall be completely passive in nature, in that the occupancy sensor system shall not emit or interfere with any other electronic device, or human characteristic. Acceptable known technologies are Passive Infrared (PIR), or Microphonic.

All sensors shall have non-adjustable factory calibrated sensitivity for maximum performance. Time Delay and Photocell field adjustments shall be provided as needed.

All sensors, power packs, and relays shall be UL Listed under either Industrial Control Equipment, or Energy Management Equipment. Appliance Control listing shall not be accepted.

- 2.4.24.b Low Voltage Ceiling and Wall Sensors

Sensors must be designed to work in conjunction with remote power packs, relays, or other control systems. Sensors must operate with a Class 2, low voltage wiring strategy. Sensors must be capable of being parallel wired for multi-sensor applications.

Sensors must accept 12 to 24 volts AC or DC. Sensor must provide a transistor output, returning the voltage input rectified to DC, to control remote power packs, relays, or other control systems.

Sensor must have optional single pole, double throw signal relay capable of being wired open on occupancy, or closed on occupancy.

Sensor must also provide optional photocell output for daylight override. Sensor shall not consume more than 14 milliamps of current.

Sensor Time Delay shall be factory set for typical applications, and field adjustable from 30 seconds to 20 minutes.

Photocell override shall be factory set in the off mode, but be field adjustable. All adjustments shall be concealed once installed.

Sensor shall provide a green LED motion indicator. Red LED denoting life safety shall not be permitted.

2.4.24.c Standard of Acceptance:

Sensor Switch
WattStopper

2.4.25 Firestopping and Smoke Seal Materials

2.4.25.a Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115-M85, for installation in U.L.C. designated firestopping and smoke seal Systems. These Systems shall provide a positive fire, water and smoke seal and a fire- resistance rating (flame, smoke hose stream and temperature) not less than the fire resistance rating of surrounding construction.

2.4.25.b Materials shall form ULC listed or UL classified assemblies and be compatible with abutting dissimilar materials and finishes.

2.4.25.c Standard of Acceptance:

- a. 3M Canada Limited
- b. A/D Fire Protection System Ltd.
- c. Fire Stop System

2.4.26 Wall Opening Covering Plates

2.4.26.a All hole covering plates used on this project shall be stainless steel 18-8 chrome metal alloy, type 302, non-magnetic type for finished areas and pressed steel for unfinished areas. Finish brush marks shall be run in a vertical direction.

2.4.27 Access Doors

2.4.27.a Access doors installed in unfinished areas shall be constructed of 12 ga prime coated steel and of stainless steel for all areas finished with tile or marble surfaces.

2.4.27.b Access doors shall be complete with 180° opening door, round safety corners, concealed hinges, screwdriver latches, plaster lock and anchor straps.

- 2.4.27.c Access doors shall be 24'x 24' or 12'x 18' as per site condition.
- 2.4.27.d Access doors in fire rated construction shall be ULC listed and labeled and of a rating to maintain the fire separation integrity.
- 2.4.27.e Standard of Acceptance:
 - a. Zurn Industries Canada Limited
 - b. LeHage Industries Limited
 - c. Acudor Acorn Limited.

2.4.28 Motor Starters and Accessories

- 2.4.28.a Starters shall be CSA and ULC approved.
- 2.4.28.b Starters shall be full voltage, non-reversing magnetic starters. Full protection is to be provided in the starters by means of one thermal overload relay per phase per starter with manual reset button to suit the service factor and acceleration time of the motor served.
- 2.4.28.c Starters shall be equipped with auxiliary contacts to satisfy interlocking and automatic control requirements, "Hand-Off-Automatic" switches, pilot lights (green-On; red-Off), thermal overloads, necessary fuses and control transformer (if required) for operation of all controls on 120V single phase.
- 2.4.28.d Where required by applicable codes, starters shall be equipped with "quick-make" and "quick-break" fused disconnects.
- 2.4.28.e Standard of Acceptance:
 - a. Eaton/Cutler-Hammer
 - b. Schneider
- 2.4.28.f Fuses in starters to be CSA certified Form 1, current and energy limiting type 200,000 ampere interrupting capacity with NEMA Class "J" rejection type mountings.
- 2.4.28.g Size fuses installed in starters or in disconnect switches used in conjunction with magnetic starters, for motor and branch circuit protection in accordance with fuse manufacturer's recommendations. Provide one spare set of three fuses for each rating and type of fuse used.
- 2.4.28.h Enclosures for loose starters are to be EEMAC 1A, unless otherwise specified.

2.4.29 Variable Frequency Drives

- 2.4.29.a See Appendix 1.
- 2.4.29.b Standard of Acceptance:
 - a. ABB
 - b. Danfoss

2.4.30 LAN Cabling

- 2.4.30.a All LAN cabling shall be Category V as defined by EIA/TIA 568A. The contractor shall test all cabling to verify that 100Mb bandwidth is supported. See commissioning requirements.
- 2.4.30.b Cabling shall be 4 pair, 100 ohm UTP, #24 AWG solid copper conductor PVC insulated, with blue or grey colour coded jacket. FT6 rated cable shall be used unless otherwise required to meet building codes or by-laws.
- 2.4.30.c Data outlets shall be RJ45, 8 pin connectors, with 50 microns of hard gold over nickel, minimum durability of 750 mating cycles and contact pressure of 100 grams per contact. Transmission characteristics shall meet TSB-40 Category V.
- 2.4.30.d Provide one RJ45 data outlet adjacent to each device to be terminated (e.g. workstation PC, DDC panel, hub, etc.) Use a flexible patch cable to connect from the data outlet to the end device. For Delta Controls installations, provide a duplex data outlet at the workstation PC to accommodate the remote security key wiring. LAN cabling shall not be directly terminated to any device.
- 2.4.30.e Provide protection from EMI sources in accordance with CSA-T530 article 4
- 2.4.30.f The contractor shall test all cabling to verify conformance with TIA /EIA TSB-67 - Basic Link Test using a Level 2, bi-directional tester. See commissioning requirements.
- 2.4.30.g Where there are more than 2-90 degree in a conduit run, provide a pull box between sections so that there are two bends or less in any one section.
- 2.4.30.h Where a conduit run requires a reverse bend, between 100 degrees and 180 degrees, insert a pull box at each bend having an angle from 100 degrees to 180 degrees.
- 2.4.30.i Ream all conduit ends and install insulated bushings on each end.
- 2.4.30.j Terminate all conduits that protrude through the structural floor 2” above the concrete base.
- 2.4.30.k Do not use a pull box in lieu of a conduit bend. Align conduits that enter a pull box from opposite ends with each other.

2.4.31 Lighting Relays

- 2.4.31.a All relays used for switching lighting loads shall be the latching type. Maintained relays or contactors shall not be accepted.
- 2.4.31.b Provide custom lighting enclosures to house all lighting relays. The enclosures shall be equipped with barriers to separate the control and load wiring.

2.4.31.c Provide local ON pushbuttons at each lighting relay enclosure to allow for manual operation of all lighting relays in the case of BAS panel failure. Pressing the pushbutton shall turn on all lighting relays by applying voltage directly to the relay (i.e. bypass the BAS). If a lighting panel is located in an area accessible by students or teaching staff, provide momentary key switches in lieu of pushbuttons. The key type shall be designated by TDSB. Deliver all keys to TDSB at the completion of the project.

2.4.31.d The standard of acceptance shall be G.E. RR-7 and RR-8 relays.

2.4.32 CO2 Sensors

2.4.32.a Provide CO2 sensors for either wall or duct mounting applications as specified. Provide a heavy duty metal guard to protect the sensor when mounted on walls. Provide the factory-supplied duct mounting kit for all duct mount applications.

2.4.32.b The sensor shall be microprocessor controlled, fully digital, non-dispersive dual wavelength infrared technology with temperature compensation. The device output shall be 4 to 20mA.

2.4.32.c The sensor shall have a measurement range of 0 to 2000ppm with an accuracy of +/-30ppm..

2.4.32.d Install the sensor in accordance with all manufacturer's instructions. Wall mounted sensors shall be installed at a minimum height of 60" above the finished floor. Sensors shall not be mounted on an outside wall, close to a window, door or in draft areas with direct airflow.

2.4.32.e The sensor shall be auto calibrating for a guaranteed interval of 5 years.

2.4.32.f Standard of acceptance:

Greystone CCD4A.

2.4.33 Thermostat Guards

2.4.33.a Provide a heavy duty, metal thermostat guard for specified existing, stand-alone thermostats.

2.4.33.b The guard shall be have a minimum 18 guage metal cover and 22 guage ring base. The unit shall be tamper-resistant and equipped with a lock and key. The colour of the unit shall be beige.

2.4.33.c The standard of acceptance shall be White Rodgers Model #F29-0222.

2.4.34 Thermostats for Force Flow Heaters (Fan Cut-Out)

2.4.34.a Where indicated, provide thermostats to disable fan operation of force flow heaters when the unit supply water temperature is less than 35C. This will prevent the fan from operating when the building heating system is off or operating in setback mode. The thermostat shall be

- equipped with a remote capillary which shall be attached to the heating supply water piping serving the heating coil.
- 2.4.34.b Ensure that the bulb of the thermostat is rated for a minimum temperature of 93C (200F).
- 2.4.34.c Install the thermostat within the force flow enclosure in a manner that facilitates servicing. Adhere to manufacturer's installation instructions.
- 2.4.34.d Standard of acceptance:
Honeywell T675A1540
Johnson A19AAF-12C.
- 2.4.35 Cold Alarm Aquastat Wired to Building Surveillance System**
- 2.4.35.a Provide a low temperature aquastat (strap-on type) and affix to the boiler primary loop piping at a location where the boiler supply water temperature from all boilers in the plant can be measured. The aquastat shall be set to trip at temperatures below 40C to indicate that the boilers have failed.
- 2.4.35.b Provide an additional thermostat with remote bulb and capillary to measure the outdoor air temperature. Wire the outdoor air thermostat in parallel with the low temperature aquastat so that the aquastat contact is bypassed when the outdoor air temperature is above 5 C.
- 2.4.35.c Provide wiring from the cold alarm aquastat to the designated building surveillance panel. Termination to the surveillance panel shall be performed by TDSB. Ensure sufficient spare cabling is provided to allow for termination by others.
- 2.4.35.d Test trip the aquastat and verify that a correct alarm signal is received by the building surveillance system.
- 2.4.35.e Refer to section 3.8 for work in existing boiler plants.

PART 3 **EXECUTION**

3.1 **Coordination with New Mechanical Work**

- 3.1.a In a facility where mechanical retrofits are planned, obtain and review the mechanical drawings and mechanical specifications for each site. Coordinate all site work with the mechanical contractor.
- 3.1.b Provide all specified labour and material as indicated in the Mechanical Drawings and/or Specifications. Provide written installation instructions for all supplied equipment and devices to be installed by the Mechanical Contractor.
- 3.1.c The Controls contractor shall supply all required controls equipment (e.g. valves, dampers, thermowells, pressure sensors etc.) to the Mechanical Contractor for installation, where specified. If a separate Mechanical Contractor has not been hired by TDSB to work on the project, the Controls Contractor shall be responsible for the installation of these devices.
- 3.1.d The controls contractor shall be responsible for identifying and marking the location of all controls equipment to be installed by the mechanical contractor.

3.2 **General - Installation of Controls**

- 3.2.a Remove all existing field and panel mounted control devices (e.g. transducers, controllers, thermostats, etc.) that have been made redundant or inoperative by the new BAS control strategies. Remove any other controls as specified or directed by TDSB or the mechanical consultant.
- 3.2.b Ensure that all systems remain operative at all times, whether under the existing controls or under the new controls. Do not leave any system without some form of automatic control.
- 3.2.c Properly cut and cap all remaining active control air lines.
- 3.2.d Provide properly sized cover plates for all openings resulting from the removal of redundant control devices. This shall be applicable to walls, ductwork and control panels. In occupied areas, cover plates shall be stainless steel.
- 3.2.e Provide new cabling, conduits, control cabinets, power supplies and other auxiliary equipment, as required for a complete operational system.

3.3 **Power Sources and Wiring Methods**

- 3.3.a All wiring shall be installed in EMT conduit unless specified otherwise. Exposed wiring in finished areas (e.g. corridors, classrooms, gymnasiums, etc.) shall be installed in wiremold (colour to match surrounding area).

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- 3.3.b Wiring from DDC controllers to sensors and actuators and control system network and low voltage wiring running in accessible ceilings may be installed using LVT cable. Where the ceiling is used as a return air plenum, plenum rated cable shall be used in lieu of LVT cable.
- 3.3.c Install EMT and cable at right angles to building lines, securely fastened, and in accordance with current electrical codes and standards.
- 3.3.d Power and control wiring shall be copper conductor (RW90). For power wiring, provide #12 AWG (minimum) with a 3% maximum voltage drop in accordance with CEC requirements. Control wiring shall be a minimum of #14 AWG, unless otherwise specified.
- 3.3.e **Wiring smaller than 18 gauge shall not be accepted on the project.** Exceptions are made for wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.
- 3.3.f The wiring from panels to devices shall be installed without splices. The use of crimp connectors is not allowed when connecting field wiring to sensor or device leads. The use of wire nuts is acceptable in this application.
- 3.3.g Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently switched off. Only dedicated circuit(s) shall power the control system. Provide additional breakers or electrical panels as required.
- 3.3.h Mount transformers and other peripheral equipment in panels located in serviceable areas. Provide line-side breakers/fuses for each transformer.
- 3.3.i All 120 VAC power for any controls equipment shall be from dedicated circuits. Provide a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.
- 3.3.j A dedicated power circuit may be used to power DDC panels and equipment within the same or adjoining mechanical rooms. The use of one power circuit to power DDC panels distributed throughout the building is not acceptable.
- 3.3.k The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, rooftop unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status.
- 3.3.l Provide all required code gauge boxes, connectors and other wiring accessories.
- 3.3.m For all DC wiring, positive conductors shall be WHITE or RED in colour while negative conductors shall be BLACK in colour.
- 3.3.n On exterior building surfaces, wiring shall be rated for 90C and wet environments. Conduit shall be rigid metal or rigid PVC with waterproof joints and connectors used throughout.

3.4 Installation of Temperature Sensors in Piping

- 3.4.a The controls contractor shall supervise and direct the Mechanical Contractor to ensure that thermowells are installed as described herein.
- 3.4.b For each immersion sensor, provide a compatible thermowell to the Mechanical Contractor for installation. Provide stainless steel thermowells where installed in piping carrying corrosive or chemically reactive fluids.
- 3.4.c Install thermowells in piping such that the bottom of the well does not make contact with the pipe. Install the well at a 90 degree elbow or tee where the pipe diameter is less than the well length.
- 3.4.d If the use of strap-on sensors has been approved by TDSB or the mechanical consultant, use metal clamps to securely fasten the sensor to the piping. Apply heat transfer compound to the contact area between the sensor and piping. Re-insulate all piping.

3.5 Installation of Standard Control Dampers and Actuators.

- 3.5.a Supply new automatic control dampers where specified.
- 3.5.b The new ducts and/or plenums-mounted dampers shall be installed as part of the air distribution Work specified in a different section of the Specification.
- 3.5.c The dampers shall be made available at the site at the location where they are required.
- 3.5.d Ensure that each damper assembly is properly mounted.
- 3.5.e The linkage and motors shall be provided and completely connected for all control dampers, including for dampers factory supplied with equipment.
- 3.5.f Where newly installed damper sizes exceed 28 sq. ft. (2.6 sq. m) multiple operators shall be provided.
- 3.5.g Wherever possible, the new damper actuators shall be installed so they are accessible from outside ducts, plenums and equipment casings.

3.6 Installation of Automatic Control Valves and Actuators.

- 3.6.a All control valves shall be supplied by the Controls Contractor and installed by the Mechanical Contractor, unless specified otherwise.
- 3.6.b Each control valve shall be equipped with its own actuator.
- 3.6.c The controls contractor shall ensure that each control valve assembly is properly connected and installed.

3.6.d The controls contractor shall test, adjust and verify the operation of each control valve to ensure that it is properly functioning, as required and left in safe working order.

3.6.e Motorized butterfly valves (usually installed for boiler isolation) shall be supplied and installed by the Mechanical Contractor but shall be wired up by the controls contractor. The valve details are in the Mechanical specifications.

3.7 Installation of Outdoor Air Temperature Sensors

3.7.a The outdoor air sensors shall be mounted so that the ventilation slots on the solar shields are facing downward (when mounted horizontally) or towards the wall (when mounted vertically).

3.7.b Mount the sensors on the north-facing side of the building away from direct sunlight.

3.7.c Mount the sensors in an easily serviceable location.

3.7.d Ensure that the sensors are located away from building exhaust air or equipment air flows.

3.8 Installation of Water Flow Meters

3.7.a The controls contractor shall identify the location and advise the mechanical contractor where the flow meters shall be installed.

3.7.b Flow meters shall be installed in the mechanical room or the closest possible location.

3.8.c Water flow meters shall be installed with a minimum of 5 pipe diameters upstream and 10 pipe diameters downstream of straight piping.

3.9 Installation of Water Differential Pressure Sensors

3.9.a The controls contractor shall identify the location and advise the mechanical contractor where the differential pressure sensor shall be installed.

3.9.b Differential pressure sensors shall be installed across the main supply and return lines in the mechanical room as far away from the pumps as possible.

3.9.c Where possible, differential pressure sensors should be mounted on a wall at a serviceable height.

3.10 Cold Alarm Aquastats in Existing Buildings

- 3.10.a Identify the location of all existing cold alarm aquastats installed on the heating water piping. These aquastats (usually strap-on type) are normally located in the boiler room but may also be found in other fan rooms throughout the building.
- 3.10.b For information purposes only, the location of known cold alarm aquastats may be indicated in the site specific information for each site (see Appendix A). Regardless of the information provided, if any, the controls contractor shall be solely responsible for locating all existing cold alarm aquastats in each facility and carrying out the work described herein.
- 3.10.c Once all existing cold alarm aquastats in the facility have been located, relocate one functional aquastat (or provide one new aquastat) to the boiler primary supply water header. Provide new wiring to connect to the existing alarm circuit. The relocated boiler room aquastat shall be the only device in the alarm circuit.
- 3.10.d Remove all additional cold alarm aquastats and wiring in the facility.
- 3.10.e Test trip the relocated or new boiler room aquastat and verify that a correct alarm signal has been received by the building surveillance system.

3.11 Pneumatic Fail Safe Interlocks

- 3.11.a Existing pneumatic damper actuators under BAS control shall be physically interlocked (e.g. solenoid air valve exhausts control air when fan is off) to return to their fail safe positions when their respective fan is off, regardless of BAS command.
- 3.11.b The controls contractor shall immediately report to TDSB and the mechanical consultant any situation in which an existing pneumatic damper actuator to be placed under BAS control is not pneumatically interlocked to the fan starter or where an existing pneumatic interlock is inoperative or defective.
- 3.11.c If the controls contractor fails to report to TDSB and the mechanical consultant any abnormalities as described in 3.9.b, it shall be assumed that all pneumatic interlocks were present and functioning at the time of the Controls installation. Any subsequent deficiencies related to missing or defective pneumatic interlocks shall be corrected by the controls contractor at no additional cost to TDSB.
- 3.11.d Unless specified otherwise, pneumatic heating valves under BAS control in air handlers shall not be physically interlocked (e.g. solenoid air valve exhausts control air when fan is off) to the respective fan starter.
- 3.11.e Provide labour and material, as required, to ensure that all new and existing electric-to-pressure transducers (EPT) controlling heating valves are supplied with non-switched main control air.

3.12 Boiler Selector Switches

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- 3.12.a Provide a two-position selector switch (toggle or rotary) for each boiler under BAS control. Provide lamicoid labels to indicate “Local” and “BAS” positions.
- 3.12.b Where modulating burner controls are present, provide an additional two-position selector switch (toggle or rotary) to switch between the local potentiometer and the BAS modulation signal. Provide lamicoid labels to indicate “Local” and “BAS” positions.
- 3.12.c Mount the override switch on the boiler panel adjacent to the existing on-off switch.
- 3.12.d Wire the override switch such that in the “BAS” position, the boilers operate under normal BAS control. Wire the “Local” position such that the boilers are forced to the ON position regardless of the signal from the BAS. For multi-stage boilers, the “Local” position shall be wired to force low fire ON and high fire OFF.

3.13 Installation of Firestopping and Smoke Seal Materials

- 3.13.a Where conduits penetrate the fire rated construction, ULC listed and labelled firestopping and smoke seal materials shall be supplied and installed in accordance with ULC Firestop System requirements to seal holes and voids in the walls or slabs and as follows:
1. Conduit through a floor with a sleeved or core drilled circular opening – ULC System SP115.
 2. Conduit through a floor with a cast or cut rectangular opening – ULC System SP116.
 3. Conduit through a wall with a sleeved or core drilled circular opening – ULC System SP114.
 4. Conduit through a wall with a rectangular cast or cut opening – ULC System SP107.
- 3.13.b Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.
- 3.13.c At time of application all surfaces shall be properly cleaned, dried and free from dust, oil, grease, loose or flaking paint and foreign materials.

3.14 Installation of Wall Opening Cover Plates

- 3.14.a All existing wall openings of the removed electrical and control devices shall be covered with properly sized plates in an approved manner so that the finished Work presents a neat and clean appearance.

3.15 Cutting and Patching

- 3.15.a All cutting, patching, painting and making good for the installation of the BAS work shall be done by the BAS Contractor. All cutting shall be performed in a neat and true fashion, with proper tools and equipment to the mechanical consultant and/or TDSB Project Representative approval. The surfaces shall be made good to reasonably match existing finishes to the mechanical consultant and/or TDSB Project Representative approval.
- 3.15.b Location of the existing services concealed in the construction, if any, shall be determined prior to drilling or cutting an opening. If required, the Contractor is to x-ray the walls or slabs and

- in any case he shall not drill or cut any surface without the TDSB project representatives approval.
- 3.15.c The Contractor shall be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of this Work.
- 3.16 Packing and Sealing Core Drilled Conduit Openings**
- 3.16.a The void between the conduit opening and the conduit shall be packed and sealed for the length of the opening as follows:
1. Pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a watertight seal.
 2. Pack and seal openings in fire rated walls and slabs as specified in this Section and as per article entitled "Installation of Firestopping and Smoke Seal Materials"
- 3.17 Access Doors Installation**
- 3.17.a All access doors shall be flush mounted.
- 3.17.b Access doors shall be installed such as to give proper access to all newly installed electrical and control equipment and other similar electrical Work which may need maintenance or repair but which are concealed in inaccessible construction.
- 3.17.c All access doors shall be installed by the professional trades specialized in working on the particular type of construction in which the doors are required.
- 3.18 Electrical Wiring and Accessories**
- 3.18.a Install all electrical materials and equipment conform to Canadian Electrical Code as amended to date and as specified below.
- 3.18.b Provide conduit, electrical wiring and fittings from load side of starters and/or disconnects to motor or electrical connected item, including the connections to all mechanical equipment.
- 3.18.c Provide control wiring, conduit and relays to interlock starters and connect safety and operating controls as required.
- 3.18.d Wire final 12 in to 18 in of motor connections with flexible liquid tight conduit, with insulated throat connectors.

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- 3.18.e Use thin wall conduit up to and including 1 ¼ in size for wiring in ceiling, furred spaces and where not exposed to mechanical injury. Use rigid galvanized steel conduit for exposed wiring and for conduit 1 ½ in size and larger.
- 3.18.f Provide branch circuit wiring and an outlet for each motorized damper control.
- 3.18.g Conduit shall be in accordance with the following CSA standards:
1. C22.2 No.813 - 1976 - Electric Metallic Tubing
 2. C22.2 No.56 - 1977 - Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit
 3. C22.2 No.136 - 1966 - Rigid PVC Conduit
- 3.18.h Install all wiring in conduit, unless otherwise specified.
- 3.18.i Conduit accessories, conduits and fittings shall conform to C.S.A. Standard C22.2 No.18 - M1987.
- 3.18.j Use thin wall conduit for branch circuit and signal wiring in ceiling, furred spaces and where not exposed to mechanical injury.
- 3.18.k Conduit shall be of sufficient size to permit easy removal of conductors at any time. Do not bend conduit over sharp objects. Do not use bends and fittings together.
- 3.18.l All conduit connections made to enclosures housing electrical devices (e.g. DDC panels, transformers, etc.) shall be made on the sides or bottom end of the enclosure. No openings of any kind shall be made to the top side of such enclosures.

3.19 Installation of Motor Starters and Accessories

- 3.19.a Provide magnetic starters for new motorized equipment.
- 3.19.b Provide an identification nameplate for each motor starter.

3.20 Installation of Variable Frequency Drives

- 3.20.a Install each VFD in accordance with manufacturer's recommendations and local, provincial and national safety codes.
- 3.20.b Use motors with a minimum of CLASS F insulation. Motor shall be rated for inverter duty.
- 3.20.c Provide verification and start-up certificate from the VFD supplier for each unit supplied. Incorporate these certificates in the Documentation Manuals.
- 3.20.d Install floor mounted units on 100mm (4") thick concrete pad extending a minimum of 100mm (4") beyond the foot print of the unit. Chamfer all pad edges to avoid spalling.

3.21 Equipment Enclosures and Locations

- 3.21.a Provide new enclosures for all field equipment (e.g. DDC panels, transducers, relays, etc.). Enclosures shall be equipped with a hinged door and latch. Provide a TDSB-standard key/lock set for each enclosure.
- 3.21.b Existing enclosures can be reused if they are in good condition and meet the requirements of 3.21.a
- 3.21.c Mount all enclosures in serviceable areas of mechanical rooms, storage rooms or janitor closets. Obtain written approval of the mechanical consultant prior to mounting any enclosure in ceiling spaces or more than 5'-6" above the finished floor.
- 3.21.d All transformers and power supplies for control equipment shall be installed in new dedicated metal cabinets with hinged, lockable covers located in the proximity of their dedicated controller cabinets.
- 3.21.e Include within a DDC panel enclosure one 120 VAC duplex receptacle for portable PC power, if the controller cabinet is located further than 5'-0" from the nearest wall receptacle.
- 3.21.f Ensure that enclosures are sized to allow for ease of servicing of all equipment contained within. Enclosures containing DDC panels shall be sized to allow for the installation of the maximum allowable number of expansion panels/boards. Do not mount other equipment in a manner that may interfere with the future installation of expansion panels/boards.
- 3.21.g For enclosures containing pneumatic transducers or devices, provide one pressure gauge (1-1/2" dial, 0-30psi) for the main air line supply.

3.22 Identification and Labelling of Control Equipment

- 3.22.a All lamacoids must be minimum 3"x1".
- 3.22.b All installed field sensors and control devices must have lamacoids on or adjacent to them and visible from the ground.

Lamacoids are required to indicate point name, controller address and point address.

Lamcoids must be secured by adhesive or tie-wrap for indoor applications and by screws where mounted outside of the building, in un-heated spaces, in high humidity areas or where subject to vibration.
- 3.22.c All controllers and panels require a lamacoid indicating designation and function (i.e. "BAS Panel 1" or "Relay Panel 3"). Controller lamacoids require indication of equipment controlled and address (i.e. Heating Plant Add 4)
- 3.22.d All devices within a field enclosure shall be identified via a label or tag.

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- 3.22.e All transformer panels supplied by the BAS contractor must be labelled with a Lamacoid indicating the panel and circuit number that it is fed from (e.g. “120vac fed from LP-2A cct #1).
- 3.22.f All field control equipment (e.g. relay panels) panels fed from more than one power source must have a warning label on the front cover.
- 3.22.g All wires shall be identified with the hardware address with a band-type self-adhesive strips or clip-on plastic wire markers at both ends.
- 3.22.j All BAS panels will be supplied with a point’s list sheet (within a plastic sleeve) attached to the inside door.
- 3.22.k The points list shall identify the following for each point:
- a. Panel number.
 - b. Panel location.
 - c. Hardware address.
 - d. Software name.
 - e. Point description.
 - f. Field device type.
 - g. Point type (i.e. AI or DO).
 - h. Device fail position.
 - i. Device manufacturer.
 - j. Model number or reference.
 - k. Wire tag reference.
- 3.22.l Where requested by TDSB or the mechanical consultant, provide a wiring diagram affixed to the inside of any relay panel or similar enclosure.
- 3.22.m Provide laminated wiring diagrams or modify existing equipment wiring diagrams wherever the BAS interfaces to other equipment. (e.g. boilers, chillers, etc.). Securely attach to the inside of the respective control cabinet.
- 3.22.o Provide lamicoid or machine labels (as outlined above) for all interposing relays or contactors used in control circuits. The labels shall include the related point software name and hardware address
- 3.22.p Provide a lamicoid label to identify the location of concealed devices above the ceiling space. Mount the label on the ceiling grid t-bar or a permanent surface adjacent to the devices. The label shall contain the wording “BAS Devices Above”.
- 3.22.q Provide lamicoid labels for all auxiliary HVAC equipment (e.g. force flow cabinets, unit ventilators, unit heater, window AC units, etc.) controlled by the BAS. Mount the labels in the vicinity of the existing thermostat or power switch for the unit. The label shall contain the wording “Under BAS Control”.

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- 3.22.r Where directed by TDSB or the mechanical consultant, provide any and all additional labelling, diagrams, schematics or instructions as may be required to facilitate the correct operation and maintenance of controlled building systems.

3.23 Systems Hardware Commissioning

- 3.23.a This contractor shall be responsible for the “end to end” commissioning, testing, verification and start-up of the complete control system hardware including panels, sensors, transducers, end devices, relays and wiring. Where applicable, this shall include any points from an existing and/or re-used automation system in the building.
- 3.23.b The contractor shall conduct the hardware commissioning at each facility in conjunction with a team of Skilled Trades staff (normally 2 tradespersons) designated by TDSB. The contractor shall supervise the hardware commissioning process and ensure that the Skilled Trades staff are actively participating in all facets this work.
- 3.23.c When the site hardware installation is 100% completed (including all labelling and documentation), the contractor shall provide written notification to the TDSB Project Supervisor to schedule the hardware commissioning dates for each facility.
- 3.23.d TDSB reserves the right, at it’s sole discretion, to discontinue site commissioning at any time if any part of the site hardware installation is found to be incomplete on the date of commissioning. If this occurs, the Contractor shall assume responsibility for any additional costs related to rescheduling of the site commissioning.
- 3.23.e The Contractor shall prepare a hardware commissioning report containing the following information and test results:
- a. Analogue inputs (i.e. temperatures, pressure, etc.) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1C of the readings observed at the workstation. Record calibration adjustments and settings.
 - b. Analogue outputs shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100% range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100% range from a minimum control range of 10-90%. Record the actual output scale range (channel output voltage versus controller command) for each analogue end device
 - c. Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.
 - d. Digital inputs shall be verified by witnessing the status of the input point as the equipment is manually cycled on and off.
 - e. Record all out-of-season or unverified points in the commissioning report as “non-commissioned”.
 - f. Identify any existing equipment (valves, dampers, fan starters, etc..) that are inoperative or require maintenance or repair.

- g. The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all controlled system outputs shall go to their fail-safe position.
 - h. Verify PID loop tuning parameters by applying a step change to the current setpoint and observing the response of the controlled device. Setpoint should be reached in an acceptable period of time without excessive cycling or hunting of the controlled device. Provide a graph of the trend response to setpoint change for important controlled devices (e.g. valves 1-inch or larger, dampers on major air handlers, etc.)
 - i. Provide confirmation that a series of test alarms has been successfully received at a designated remote monitoring workstations.
- 3.23.f Include with the hardware commissioning report a site floor plan indicating the location of all equipment installed in concealed or recessed locations (e.g. interposing relays in ceiling spaces).
- 3.23.g Provide testing of all LAN cabling to ensure that 100Mb bandwidth is supported. Verify conformance with TIA /EIA TSB-67 - Basic Link Test using a Level 2, bi-directional tester. Provide all equipment necessary to carry out the required tests.
- 3.23.h The hardware commissioning report must be signed and dated by the Contractor's technician performing the tests and participating TDSB trades staff.
- 3.23.i At the completion of site commissioning, submit four (4) copies of hardware commissioning report to the TDSB Project Supervisor.
- 3.24 TDSB Review and Site Report**
 - 3.24.a At the completion of the site hardware inspection, TDSB shall issue a site report within ten (10) business days detailing the deficiencies in the as-built documentation, labelling, hardware, programming and graphics.
 - 3.24.b The contractor shall respond to the site reports detailing when all the items have been completed or addressed.
 - 3.24.c Upon completion of all the site report items being addressed, TDSB will issue a certificate of completion.
 - 3.24.d Any deficiency item missed in an previous site report revision can be added to a later site report revision.
 - 3.24.e Any items missed during the site report do not relieve the contractor of their responsibility to comply with all standards during the warranty period.

3.25 Training

- 3.25.a Provide four (4) hours of operator training per facility. The allocation of training hours and the number of participants shall be determined by TDSB. The training hours may be divided over several training sessions. The number of trainees to be determined by TDSB but shall not exceed 8 for any one session. Training may take place on site, at another TDSB location, at the Contractor's office or any combination thereof.
- 3.25.b During training, the contractor shall work with the caretaker to setup occupancy schedules for all equipment (ie. new and existing) at the facility. Equipment schedules for individual zones must reflect zone occupancy. For example, classroom schedules should only be occupied during normal school hours (i.e. M-F 7:00 AM to 5:00 PM).
- 3.25.d Provide a record of training indicating:
- a. Date of training
 - b. School name and project
 - c. Names and signatures of participants and trainers
 - d. Training topics covered
 - e. Completed check-in protocol

APPENDIX 1 Variable Frequency Drives

A.1 Products

1. Environmental operating conditions: 0 to 40°C continuous. VFD's that can operate at 40° C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
2. Enclosure shall be rated UL type 1 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable.
3. For 600V networks, the input voltage of the VFD shall be rated 500V -10% to 600V + 10% minimum. VFD rated for 575V +/- 10% or less are not acceptable.
4. All VFDs shall have the following standard features:
 - a. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 - b. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
 - c. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital

input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

- d. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
- e. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, operating temperature will be monitored and used to cycle the fans on and off as required.
- f. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
- g. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
- h. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
- i. The VFD shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add AC line reactors.
- j. The input current rating of the VFD shall be no more than 3% greater than the output current rating.
- k. The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
- l. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signalling a false under-load condition.
- m. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
- n. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.

5. All VFDs to have the following adjustments:

- a. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
- b. Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the VFD keypad, analogue inputs, or over the communications bus. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analogue input and modulate one of the analogue outputs to maintain setpoint of an independent process (e.g. valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network. The setpoints shall be set in Engineering units and not require a percentage of the transducer input.
- c. Two (2) programmable analogue inputs shall accept current or voltage signals.
- d. Two (2) programmable analogue outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
- e. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices, typically programmed as follows:
- f. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications) the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate).
- g. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to an VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided.
- h. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety status shall also be transmitted over the serial communications bus. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.
- i. Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. Default settings shall be for run, not faulted (fail safe), and run permissive. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable.
- j. Seven (7) programmable preset speeds.
- k. Two independently adjustable acceleration and deceleration ramps with 1 – 1800 seconds adjustable time ramps.
- l. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

- m. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without de-rating the VFD or operating at high carrier frequency only at low speeds.
 - n. The VFD shall include password protection against parameter changes.
6. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). The keypad shall utilize the following assistants:
- a. Start-up assistants
 - b. Parameter assistants
 - c. Maintenance assistant
 - d. Troubleshooting assistant
7. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
- a. Output Frequency
 - b. Motor Speed (RPM, %, or Engineering units)
 - c. Motor Current
 - d. Calculated Motor Torque
 - e. Calculated Motor Power (kW)
 - f. DC Bus Voltage
 - g. Output Voltage
8. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analogue/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.
9. Serial Communications
- a. The VFD shall have an RS-485 port as standard. The protocols shall be **BACnet**. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority. Use of non-certified protocols is not allowed.
 - b. The BACnet connection shall be an RS485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

- a. Data Sharing – Read Property – B.
- b. Data Sharing – Write Property – B.
- c. Device Management – Dynamic Device Binding (Who-Is; I-AM).
- d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
- e. Device Management – Communication Control – B.

If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.

- c. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, acceleration/deceleration time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (re-settable), operating hours (re-settable), and drive temperature.
 - d. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analogue input and analogue output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.
 - e. The VFD shall allow the DDC to control the drive’s digital and analogue outputs via the serial interface. This control shall be independent of any VFD function. For example, the analogue outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analogue inputs shall be capable of being monitored by the DDC system.
 - f. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value control, etc. Both the VFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFD shall keep the last good set-point command and last good DO & AO commands in memory in the event the serial communications connection is lost.
10. All VFD’s through 60HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad.
11. OPTIONAL FEATURES to be provided are:

2. Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed and CSA Approved by the drive manufacturer as a complete assembly and carry a UL508 and CSA label.
3. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection and shall be provided in both drive and bypass modes.
4. Door interlocked, padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.
5. Fused VFD only disconnect (service switch). Fast acting fuses exclusive to the VFD – fast acting fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.
6. The drive / bypass shall provide single-phase motor protection in both the VFD and bypass modes.

The following operators shall be provided:

- a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
7. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.
- a. Power-on (Ready)
 - b. Run enable (safeties) open
 - c. Drive mode select damper opening
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Bypass H-O-A mode
 - j. Automatic transfer to bypass selected
 - k. Safety open
 - l. Damper opening
 - m. Damper end-switch made
8. The following relay (form C) outputs from the bypass shall be provided:
- a. System started
 - b. System running
 - c. Bypass override enabled
 - d. Drive fault
 - e. Bypass fault (motor overload or under-load (broken belt))
 - f. Bypass H-O-A position

9. The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.
10. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not functional in Fireman's Override 2). The remote start/stop contact shall operate in VFD and bypass modes.
11. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure for fireman's override. Two modes of operation are required.
 - a. One mode forces the motor to bypass operation and overrides both the VFD and bypass H-O-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.
 - b. The second fireman's override mode remains as above, but will also defeat the overload and single-phase protection for bypass and ignore all keypad and digital inputs to the system (run until destruction).
12. The VFD shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VFD or bypass mode). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VFD system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
13. Class 20 or 30 (selectable) electronic motor overload protection shall be included.
14. There shall be an internal switch to select manual or automatic bypass.
15. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.
16. Startup:

Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner.

Provide an allowance for the factory-authorized technician of one site visit of one day to train operating staff in the operating and maintenance of the drive.

For the duration of the warranty period, provide a call back within 30 minutes of receiving an emergency call for service and provide on-site service within two (2) hours.

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26 05 00	Common Work Results for Electrical
26 05 01	Basic Materials & Methods
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26 05 73	Short Circuit, Coordination & Arc Flash Study
26 50 00	Lighting Systems
26 52 13	Emergency Lighting Systems
26 52 15	Lighting Controls

END OF SECTION

1.1 REFERENCES

- .1 Division 1, General Requirements, is a part of this Section and shall apply as if repeated here.

1.2 APPLICATION

- .1 This Section applies to and is a part of all Sections of the Electrical Contractor.

1.3 WORK INCLUDED

- .1 Sections of these Electrical Specifications are not intended to delegate functions nor to delegate work and supply to any specific trade and the work shall include all labour, materials, equipment and tools required for a complete and working installation as described.

1.4 INTENT

- .1 Mention herein or indication on drawings of articles, materials, operations or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated and; performance of each operation prescribed with furnishing of necessary labour, equipment and incidentals for Electrical Trade, The Electrical Contractor.
- .2 Supplementary to definitions established are:
 - 1. “Concealed” means hidden from normal sign in furred spaces, shafts, ceiling spaces, walls, or partitions. Wiring, raceways, and electrical boxes for all new or relocated devices shall be concealed.
 - 2. “Exposed” means work normally visible, including work in equipment rooms, tunnels, and similar spaces.
 - 3. “Provide” (and all tenses) means supply and install for a complete, operational, and code-compliant system, including all devices/equipment as specified complete with wiring, raceways, electrical boxes, and all other accessories or components required for a complete, operational, and code-compliant installation.
 - 4. “Install” (and all tenses) means secure in position, connect as specified, test, and verify.
 - 5. “Supply” means to supply all devices/equipment to the responsible trade.
 - 6. “Remove” means to isolate, disconnect, disassemble, remove, and dispose of all devices, equipment, wiring, raceways, and connections to other equipment. Patch and make good all surfaces affected by the removal. Remove and dispose of all redundant material off site

- .3 Where used, wordings such as "approved, to approval, as directed, permitted, permission, accepted, acceptance", shall mean: approved, directed, permitted, accepted, by authorized representative of the Owner.

- .4 Equipment and installation provided under this Division shall conform to applicable standards and regulations of the following organizations:

Canadian Standards Association (CSA)
Underwriter's Laboratories of Canada (ULC)
Ontario Electrical Safety Code (OESC)
Electrical Safety Authority (ESA)
Ontario Building Code (OBC)

1.5 WORKMANSHIP

- .1 Workmanship and method of installation shall conform to best standards and practice. Where required by local or other By-Laws and Regulations, tradesmen shall be licensed in their trade.

1.6 TEMPORARY & TRIAL USAGE

- .1 Temporary or 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..

1.7 BY-LAWS & REGULATIONS

- .1 Work shall conform with latest rules, regulations and definitions of Canadian Electrical Code and applicable Municipal and Provincial Codes and Regulations, and with requirements of other authorities having jurisdiction in the area where work is to be performed. Minor changes required by an authority having jurisdiction shall be carried out without change to the Contract amount. Standards established by drawings and specifications shall not be reduced by applicable codes or regulations.

1.8 PERMITS & FEES

- .1 File Contract Drawings with proper authorities and obtain their approval of installation and permits for same before proceeding with work. Prepare and submit necessary detailed shop drawings as required by Authorities.
- .2 Pay all fees in connection with examination of drawings, permits, inspections and final certificate of approval.
- .3 All ESA Costs shall be included in the Electrical Contractor's Base Tender Price.

1.9 CERTIFICATES

- .1 Furnish necessary certificates as evidence that work installed conforms with laws and

regulations of authorities having jurisdiction.

1.10 GUARANTEE - WARRANTY

- .1 All material and labour provided as a part of the project shall be warrantied for a period of twelve (12) months starting from the Date of Substantial Completion for the Project, except for Fire Alarm Work which shall be warrantied for eighteen (18) months starting from the Date of Substantial Completion for the Project

1.11 SPECIFICATIONS, DRAWINGS & JOB CONDITIONS

- .1 Electrical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes or additions to electrical work or equipment locations to accommodate structural conditions. Equipment locations may be altered by Engineer without extra charge provided change is made before installation and does not necessitate major additional material.
- .2 Examine site and local conditions. Examine carefully all drawings and complete specifications to ensure that work can be satisfactorily carried out as shown. Before commencing work, examine the work of other Sections and report at once any defect or interference affecting the work, its completion or warranty. No allowance will be made later for any expense incurred through failure to make these examinations or to report any such discrepancies in writing.
- .3 Relocate equipment and/or material installed but not coordinated with work of other Sections as directed, without extra charge.
- .4 Furnish "built-in" items in ample time and give necessary information and assistance in connection with building-in of same. Notify Section concerned in writing of size and location of recesses, openings and chases at least 48 hours before walls are erected, floors poured and similar work.

1.12 TENDER & SUBSTITUTIONS

- .1 The Base Tender Price shall be submitted based on the Base Specified Manufacturer as listed on the Drawings and/or Specifications. Any manufacturers listed as "equal" or "equivalent" may be proposed as an alternate to the Base Specified Manufacturer prior to Contract Execution with written approval only by the Consultant and Owner. Any changes to the Manufacturer of any materials/labour after execution of the Project Contract is not permitted.

1.13 INTERFERENCE DRAWINGS

- .1 Prepare and submit complete interference drawings (in PDF format) to avoid and/or resolve conflict of trades and to coordinate the work of the Electrical Division with that of all other Trades. Submission of interference drawings shall be done no later than 20 business days after the Project has officially begun. The cost of producing the

interference drawings shall be included for in the Base Tender Price.

- .2 Interference drawings shall indicate exact arrangements, of all areas and equipment to scale with dimensions.
- .3 Cooperate with work of the Mechanical Contractor and provide data requested and as required in the preparation of interference drawings for the work of The Mechanical Contractor.
- .4 Make interference drawings in conjunction with all parties and trades concerned showing sleeves and openings and passage of electrical work through building structure. Drawings shall also show inserts, special hangers and other features to indicate routing through confined spaces, installation of equipment in such areas.
- .5 Provide detail drawings, fully dimensioned, of equipment in Boiler and Mechanical Equipment Rooms, Electrical Rooms, Fan Rooms, etc. Base equipment drawings on approved Shop Drawings and include, but do not necessarily limit to, details pertaining to access, clearances, sleeves, connections, etc.
- .6 Provide detail drawings of pulling pits, equipment bases, anchors, floor and roof curbs, etc., pertaining to Electrical work.

1.14 SHOP DRAWING MATERIAL & LISTS

- .1 Prepare and submit shop drawings and lists of materials for review in accordance with Architectural Sections. Make submittals of more than two pages in booklet form. Individual and loose drawings will not be accepted for review.
- .2 Prior to equipment fabrication, delivery or installation, submit complete lists of materials proposed, indicating manufacturer, catalogue numbers and complete performance data.
- .3 Review of Shop Drawings by Consultant is for sole purpose of ascertaining conformance with general design concept. This review shall not mean that Architect and/or Engineer approves detail design inherent in Shop Drawings, responsibility for which shall remain with Contractor and such review shall not relieve Contractor of his responsibility for meeting all requirements of Contract Documents. Contractor is responsible for dimensions to be confirmed and correlated at site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of work with all trades.
- .4 Shop drawings transmitted via facsimile (fax) machines, or copies of same, will not be accepted for review.

1.15 RECORD DOCUMENTS

- .1 Conform to General Requirements. Maintain at least two (2) sets of documents and clearly mark in RED on same as job progresses, changes and deviations from work shown so that on completion Owner will have records of exact location of ducts and

equipment and record of material and equipment changes.

- .2 Record all homerun conduits, junction boxes for complete lighting, power and systems on As-Built Drawings.
- .3 Contractor shall obtain clean set of prints from Consultant at start of Contract Work and shall keep these prints up-to-date at jobsite, accurately recording all changes made on project and locating all services, equipment, etc. which may have been shown only diagrammatically on Contract Documents.
- .4 Contractor shall ensure that as-built information is accurately recorded and shall check same. As-Built drawings shall be reviewed with Consultant at each jobsite meeting.
- .5 Upon completion of Contract Work, prior to Substantial Performance inspection and after final review with Consultants, Contractor shall neatly transfer recorded information and make final As-Built submission to Consultant in the following form:
 - One (1) set of clean, legible prints.
 - Updated AutoCad 2004 drawings. The cost of transferring all redline markups from the PDFs to the CAD files is the responsibility and cost of the Contractor.
- .6 Consultants shall be responsible for reviewing As-Built information provided by Contractor. Revise drawings to suit any comments until acceptable for submission to the Owner.
- .7 The Contractor is responsible for incorporating all information from Project Addenda, Contemplated Changes Notices, Site Instructions, Change Directives and as-found existing conditions into CAD format at no extra cost to the Contract.

1.16 JOB SITE WORK SHOP AND STORAGE

- .1 Supply job site office, workshop, tools, scaffolds and material storage as required to complete the work of this Division. Location of temporary buildings, use of space on site or within building shall be to later direction.

1.17 PROTECTION

- .1 Securely plug or cap open ends of electrical raceways or equipment to prevent entry of dirt, dust, debris, water, snow or ice. Clean all equipment inside and outside before testing.
- .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 work installed from damage. Secure all unfinished or loose work to prevent movement.

1.18 INSTRUCTIONS TO OPERATOR

- .1 Instruct Building Operators in repair, maintenance and operation of Electrical Systems and associated equipment.
- .2 Supply three (3) full Operation and Maintenance Instructions each in stiff cover, three-ring binder suitably indexed, separated and labeled. Operate each item of equipment in presence of Operators to ensure understanding of working parts and function of each item of equipment. Supply one complete set of "Reviewed" Shop Drawings in separate hard cover binder suitably separated and labelled for Owner's use.
- .3 Operation and maintenance manuals shall be carefully prepared in co-operation with equipment manufacturers and include miscellaneous parts necessary for proper, efficient operation of all equipment.
- .4 Manuals shall also include spare parts list for each type of equipment, component, control and device installed together with manufacturer's name and address so such items can be suitably identified and purchased. Include list of recommended spares.

1.19 CLEANING, LUBRICATION AND ADJUSTMENT

- .1 Immediately prior to completion of work:
 1. Remove all dust, dirt and other foreign matter from internal surfaces of enclosed electrical apparatus and equipment.
 2. Remove all temporary protective coverings and coatings, temporary labels.
 3. Clean, repair, lubricate and adjust all mechanism and moveable parts of apparatus and equipment leaving it in new condition and operating properly.
 4. Balance demand loads for service and distribution feeders within 5 percent upon completion of work and after the building is in full operation.

1.20 INSPECTION AND TESTING

- .1 Systems, equipment, and all major items of material shall be tested to the satisfaction of the Architect, and as required to establish compliance with plans and specifications, and with the requirements for the Supply and Inspection Authorities.
- .2 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.
- .3 Tests shall include but are not limited to the following:
 1. Test of secondary voltage cables shall include megger tests to establish proper insulation resistance, and phase-to-ground resistance of cables.

2. Proper functioning of all systems.
3. Polarity tests - to establish proper polarity connections to all sockets and receptacles.
4. Test of system neutral to establish proper insulation resistance and isolation of neutral from ground except for required ground connection at Service.

1.21 CERTIFICATE OF TESTS

- .1 When work is complete submit three copies of test results and a signed statement listing all tests that have been performed as required by specifications and manufacturer's instructions.

1.22 COMPLETION

- .1 Provide receipts from designated representative of Owner for portable and loose materials (e.g. spare fuses, fixture re-lamping equipment and the like).
- .2 Provide copy of final inspection certificate from Electrical Inspection Authority and fire alarm verification report.
- .3 Provide manufacturers corrected "as built" shop drawings for all major electrical items and systems, including all shop drawings returned for modifications.

1.23 ALTERATIONS TO EXISTING BUILDING

- .1 Note that certain alterations and structural changes are to be made to existing building. Architectural drawings and site are to be examined to determine extent of alterations affecting existing electrical systems. Where existing conduits and wires run through areas to be altered, to feed other parts of existing building, they shall be re-routed and reconnected to maintain their original function. Drawings do not necessarily indicate outlets, switches, receptacles, and the like, and other electrical equipment which are required to be relocated or abandoned. Provide decorative blank cover plates for obsolete outlet boxes remaining.
- .2 Electrical services and auxiliary services (fire alarm, P.A. intercom, and the like) shall be maintained continuously without interruption. Interruptions to services shall be confined to periods of time to be designated by Architect, and/or Owner's designated representative. Include in tender for temporary connections, overtime labour charges, and such related allowances in order to conform with these conditions.
- .3 The Electrical Contractor is responsible for removal, reinstallation, cutting and patching of ceiling and walls as required in the existing building.
- .4 Cutting directly related to electrical work, regardless of whether such work occurs in new or existing construction, shall be coordinated and paid for by Electrical Subcontractor involved, under supervision of Contractor.

- .5 Where existing electrical items or systems are demolished and removed from existing construction assemblies, Electrical Subcontractor involved shall be responsible for infilling entire hole left after removal of item or system with new construction assembly to match existing. Where new electrical items or systems are installed through existing construction assemblies, Electrical Subcontractor involved shall be responsible for properly sized and accurate cutting of existing construction assembly to allow installation of new work.
- .6 Include all efforts for the tracing and verifying of all branch circuits and panels as required to complete the scope of work proposed on the drawings.

1.24 PROJECT SPECIFIC NOTES

- 1. Obtain all approvals from public Authorities Having Jurisdiction prior to commencing any work. Include, in the tender price, for all ESA permit and inspection fees. Arrange for and attend all inspections required as per requirements of the Electrical Safety Authority, the Building Department and any other Authorities Having Jurisdiction; attendance for all Inspections shall extend to all Sub-Trades of the Electrical Contractor and Supplier/Manufacturers.
- 2. Examine Architectural Drawings and Specifications and all Contract Documents before proceeding with the work. Any discrepancies between the drawings and specifications of all disciplines must be referred to the architect before any affected work is commenced.
- 3. The Electrical Contractor shall furnish all labour, material, tools, equipment, etc. required to complete all work shown on the drawings and/or complete all work specified in the contract documents. The work shall be performed in accordance with rules and regulations of all Authorities Having Jurisdiction over the work. This Contractor shall provide any small items of work not specifically called for but required to complete the intended installation and/or required to achieve the desired intent or functional utility.
- 4. Perform all work in full accordance with the Ontario Building Code, Ontario Electrical Safety Code, TDSB standards and good practices and the requirements of all other Authorities Having Jurisdiction. All work performed by this division shall be done in accordance with all Manufacturers' recommendations. Obtain all available manufacturer's recommendations and comply.
- 5. All cutting, patching, coring, scanning, x-raying, making good and fire stopping required for the work of this division shall be carried out by this division. The Electrical Contractor is responsible for and shall pay for any and all damage to the building and/or surrounding area incurred by work of this division.
- 6. Review the Designated Substances Survey provided by the Owner in detail prior to commencing any work. All abatement work necessary for this project shall be included for in the Base Tender Price.
- 7. The Electrical Contractor must review and submit shop drawings for all materials to be supplied as a part of the Contract in conjunction with the General Contractor to the

Architect and Electrical Consultant prior to ordering. Order only upon receipt of approval. Order, supply and install as per all comments. The Shop Drawings must be reviewed and ensured for compliance with the Contract Documents by the Electrical Contractor and General Contractor prior to submission; confirmation of review and confirmation that the submittal is in compliance with the Contract Documents is the responsibility of the Electrical Contractor and General Contractor to include in writing with each Shop Drawing Submittal. Any non-conformance of the Submittal with the Contract Documents identified by the Electrical Consultant will require a resubmission of the Shop Drawing Submittal by the Electrical Contractor prior to review. The Electrical Contractor shall bear all costs of any review by the Electrical Consultant beyond the Original Shop Drawing Submission at a cost of \$250.00 CAD + HST per resubmission.

8. All materials used throughout shall be new, of best quality, C.S.A. approved, and of one manufacturer. Wherever trade names are not used to describe materials, these materials shall be of the best available quality. Obtain and pay for special ESA inspections of specified non-C.S.A. electrical equipment.
9. Provide all wiring, raceways, electrical boxes, and such components as required for a complete and operational installation.
10. All conduit shall be rigid steel or EMT with gland watertight connectors and compression type couplings, unless otherwise noted. Exposed raceways in finished areas shall be wiremold channels installed neatly in appearance, run parallel to building lines, and concentric right angle bends only shall be used. Exterior exposed conduit shall be rigid galvanized steel. Supply and install access doors as necessary due to the proposed work. All access panel ratings shall match that of the surface in which it is being installed.
11. All access panels ratings shall match that of the surface in which it is being installed. All access panels requiring supply/install as a part of the project work shall be included for in the Base Tender Price.
12. All wiring shall be of minimum #12 gauge copper, except as otherwise noted or as required based on the intended use of the device/equipment. All wiring shall be 600 Volt Type RW90. All wiring shall be run in conduit from the source to the load. BX cable may be used where permitted by code in ceiling space for final connections only and for a maximum length of 5'. Maximum voltage drop shall not exceed 2 percent.
13. Coordinate with all other trades present on site throughout the full course of construction. Lay out of all work so as not to conflict with the work of other trades. Carry out work promptly which may interfere with the work and/or schedule of any other trades.
14. After completion of the work, provide the consultant with a set of 'as-built' record drawings in pdf format prior to submission to the owner. Incorporate all changes in the pdf drawings.
15. Alterations and additions: contractors shall note that this contract is an alteration to an existing building and as such the contractor shall thoroughly investigate the existing electrical installation and electrical, mechanical, structural, and architectural conditions

prior to pricing and construction.

16. Demolition: remove all exposed conduits, branch wiring, outlets, etc. from surfaces being demolished.
17. Cleanup and garbage: the Contractor is responsible for maintaining as clean of a work area as possible during construction. The contractor is responsible to clean-up and remove tools from the site at the end of every working day. Disposal of all redundant materials, devices, and equipment is the responsibility of the contractor on a daily basis.
18. All work shall be done with minimum possible interruption to the existing Building systems and in the time schedule permitted by the Owner. Any work involving shut down of power or fire alarm coverage to parts of the Building or the entire Building shall be completed during weekend hours only. Provide labour accordingly and include for all premium costs associated with Weekend Labour in the Tender Price. Any shutdown exceeding two (2) hours shall require the Electrical Contractor to provide a backup diesel-fired generator and backing up select Life Safety and Essential Loads of the building for the duration of the shutdown. Include all costs of the temporary generator in the Base Tender Price. Coordinate timing of the shutdown with the Project Manager a minimum of five (5) business days in advance of the scheduled shutdown.
19. Paint all exposed conduit and backboxes, inside and outside of the building, to match the surrounding wall/ceiling colour. Minimize exterior conduit run where feasible.
20. All backboxes installed indoors shall be Wiremold. All backboxes installed outside shall be of cast aluminum finish.
21. For all panels where new circuits are added, provide a new typed panel directory based on the new loads. Incorporate all existing circuit information from the existing panel directory on site in the new panel directory.
22. Unless otherwise explicitly stated in writing in the Contract Documents, all materials, labour, scope and descriptions of work described in the Contract Documents is the responsibility of the Electrical Contractor to supply and install as a part of the Base Tender Price. No materials and/or labour is to be completed under the Project Allowances unless explicitly noted as such in the Contract Documents.
23. All new raceways and wiring installed shall be:
 - a. Concealed in new partitions.
 - b. Concealed above existing drop ceilings where present.
 - c. Concealed above new drop ceilings where present.
 - d. No exposed run of raceway/wiring will be permitted whatsoever in the new construction area.
 - e. Where the existing walls are block, all exposed raceways shall be Wiremold unless approved in writing by the Owner.
 - f. Where the existing walls are drywall, cut/patch/make good wall and conceal all raceways and backboxes.
 - g. In the new Universal Washroom, all raceways shall be concealed in the wall,

regardless of whether the wall is existing or not. Cut/patch/make good the block wall to conceal the conduit in the block wall.

24. All demolition and new work shall be completed in strict accordance with the Contract Documents with no deviations unless instructed by the Electrical Consultant in writing prior to execution of the work. The Electrical Consultant is not responsible, nor required, to accept any work (regardless of its compliance with code) not completed in accordance with the Contract Documents. The Electrical Contractor will be responsible, at his/her cost, of furnishing a Sealed Letter from a Professional Engineer licensed in the Province of Ontario to accept and assume responsibility for all work not completed in accordance with the Contract Documents. The cost of obtaining this letter and the retaining of the Engineer, including all associated inspection charges, is the sole responsibility of the Contractor.
25. Unless otherwise noted, all devices, equipment, material, supplies, etc. shown on the drawings or otherwise required for a fully operational system as described/illustrated on the Drawings shall be supplied and installed under this Project. It shall not be assumed that any of the devices, equipment, material, supplies, etc. shown on the Drawings are to be provided (in part or in whole) by any other Party.
26. Leave two (2) full sets of As-Built Drawings in full size (36"x48") on site at the conclusion of the project; handover to the Caretaker.
27. Panel directories shall include room numbers and names to identify the location of the device/equipment; obtain the finalized room numbering from the Architect at the time of preparation.
28. Run all raceways/wiring concealed above drop ceilings. Where there is an accessible drop ceiling, raceways shall be run in the accessible drop ceiling.
29. For all new circuits proposed on the Drawings, provide new breakers suitable for the respective power source. The Contractor is responsible for running new conduit into the panelboard as the existing conduits may not have space to accommodate new wiring. Allow for the necessary cutting, patching and making good of the existing wall to achieve this.

1.25 CLOSEOUT DOCUMENTS

- .1 Coordinate with the General Contractor to submit a comprehensive Closeout Document Package incorporating documents from all trades in one consolidated package. Closeout Documents shall consist of one (1) 3-ring binder hard copy and 3 USBs/CDs. The Electrical Section of the Closeout Documents shall consist of the following:
 - (a) Electrical Contractor Warranty Letter, signed and dated. Warranty shall be for a period of twelve (12) months starting on the Date of Substantial Completion, except for the Fire Alarm System Work which shall be for a period of eighteen (18) months starting on the Date of Substantial Completion.
 - (b) Project Shop Drawings, in consecutive order of the Consultant's number scheme.
 - (c) O&M Manuals for all equipment supplied on the project.

- (d) ESA Inspection & 'Final' Certificates.
- (e) Red-Line As-Builts (by the Electrical Contractor) and CAD As-Builts (completed by the Electrical Contractor in 2004 Format).
- (f) Emergency Lighting Letter, signed and dated, stating "The emergency lighting for the project has been supplied and installed in strict accordance with the Drawings, Specifications, Contract Documents, Code Requirements, Manufacturer's Recommendations and the requirement of all Authorities having Jurisdiction. The emergency lighting system as a whole has been tested and confirmed to be in continuous operation for a consecutive period of thirty minutes or more. All emergency lighting has been tested on site and confirmed to provide illumination as per OBC requirements with no deficiencies."
- (g) Fire Alarm Installation Letter, signed and dated, stating "The fire alarm system for the project has been supplied and installed in strict accordance with the Drawings, Specifications, Contract Documents, Code Requirements, Manufacturer's Recommendations and the requirement of all Authorities having Jurisdiction. All new devices and equipment have been supplied and installed in accordance with CAN/ULC-S524 and verified as per CAN/ULC-S537."
- (h) Emergency Lighting Illumination Testing results.
- (i) Emergency Lighting Voltage Drop Test.
- (j) Fire Alarm Verification Report.
- (k) Lighting Control Commissioning Report, by the Lighting Controls Manufacturer.
- (l) Short Circuit Calculation, Coordination and Arc Flash Study Report.
- (m) Integrated Systems Testing Certification, Plan and Final Report.
- (n) Data Cabling Testing Report.
- (o) ULC Monitoring Certificate.
- (p) Firestopping Inspection Report.

1.26 TRAINING & DEMONSTRATION

- .1 At the completion of the project, provide a complete training and walkthrough of all new and/or replaced electrical systems provided as part of the project. Participants of the training and walkthrough will be established by the Owner. Responsibilities including the following:
 - (a) Demonstrate to the appointed Staff the intent of all new devices, equipment and system and how to operate them and maintain them in accordance with the Manufacturer's Requirements.
 - (b) Provide end-to-end training on how to use the new devices, equipment and systems installed for the School's day-to-day operations.

1.27 PROJECT PROGRESS THROUGHOUT CONSTRUCTION

- .1 The Electrical Contractor is responsible for taking photos of all existing conditions and mechanical systems on site being affected by the Project at the onset of construction. All photos shall be date stamped.
- .2 The Electrical Contractor is responsible for taking photos of the project's progress throughout the construction site every two weeks. All progress photos shall be shared and sent electronically to the Electrical Consultant on the 15th and 30th of every month. Photos

are meant to illustrate the progress of the project and correction of any deficiencies identified in routine site reviews and review of progress photos.

- .3 The Electrical Consultant will, from time-to-time, visit the Project Site and issue a Field Review Report. The Electrical Contractor is obligated to rectify any deficiency identified within 7 working days of receipt of the Report. The Electrical Contractor is responsible for signing the Field Review Report upon 72 hours of the report being sent to the General Contractor, acknowledging receipt of the report. The Electrical Contractor must take photos of all remedial work within 7 working days of receipt of the Report and distribute to the Consultant.

1.28 FIRE ALARM WORK

- .1 All Fire Alarm Work shall be performed by Certified Fire Alarm Technicians only. Supply the name and registration number of all workers proposed to be on site at the onset of the project.

1.29 CAN/ULC-S1001 INTEGRATED SYSTEMS TESTING

1. The Contractor shall retain a ULC-Certified Integrated Testing Provider to provide Integrated Systems Testing for the new Fire Alarm System. The Integrated Testing Provider, in addition to being ULC-Certified, shall be a Professional Engineer Licensed in the Province of Ontario to be permitted to do Integrated Testing for this project. All costs of the Integrated Testing Provider shall be included for in the Base Tender Price.
2. The Electrical Contractor, Fire Alarm Technicians utilized for the new fire alarm install and the System Manufacturer shall include for all materials and labour, in the base tender price, necessary to conduct the Integrated Systems Testing in accordance with the Integrated Testing Provider's protocol. Demonstrate and test all systems as required. Re-demonstrate and test all systems until all systems pass the requirements of the Integrated Testing Provider and Building Department.
3. The Systems to be included in the Integrated Systems Testing include, but are not limited to the following:
 - a. Air Handling Unit and Fan Shut-Downs.
 - b. Sprinkler Flow and Supervisory Devices.
 - c. Elevator Recall.
 - d. Hold-Open Devices.
 - e. Door Operator Fire Alarm disabling.
 - f. Combination Fire/Smoke Dampers
4. In addition to the Integrated Testing Provider's Site Visit to complete the Integrated Testing, allow for the following:
 - a. A Second Visit (after the original Integrated Testing is completed) demonstrating successful Integrated Testing with the Electrical Contractor, Integrated Testing Provider and Project Engineer to demonstrate acceptable results at the time of the Engineer's Sign-Off.

- b. A Third Visit (after the original Integrated Testing is completed) demonstrating successful Integrated Testing with the Electrical Contractor, Integrated Testing Provider and the Building Inspector during the City's Inspection.
- c. Completion of a Second Integrated Test at the 1-Year Post Installation mark. Date and time will be coordinated with the School Board.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 Conform to Section 26 05 00 Common Work Results for Electrical.

1.2 MATERIALS

- .1 Materials shall be new, of Canadian manufacture where available, first quality and uniform throughout. Submit tender based on the use of materials and equipment specified, or on the listed acceptable alternate equipment as further detailed.
- .2 Electrical materials shall be C.S.A. approved and be so labeled. Material not C.S.A. approved shall receive acceptance for installation by Electrical Safety Authority (ESA) Special Inspections Branch before delivery, and modifications and charges required for such acceptance shall be included in work of this Section. Material shall not be installed or connected to the source of electrical power until approval is obtained.
- .3 Confirm capacity, ratings and characteristics of equipment items being provided to supply power to equipment provided under other Sections of the work. Resolve discrepancies before such items are purchased.

1.3 MATERIAL ACCEPTANCE

- .1 Acceptance of materials installed presumes that materials have not been damaged or exposed to conditions that would adversely affect performance and life expectancy.
- .2 If in the opinion of the Consultant, materials have sustained damage, or have been exposed to abnormal conditions it shall be the responsibility of the Contractor to have such tests performed as deemed necessary by the Consultant to establish condition and therefore, acceptability of installed materials.

PART 2 - PRODUCTS

2.1 RACEWAYS

- .1 Rigid galvanized steel conduit shall comply with CSA Specification C22.2 No. 45.
- .2 Electrical metallic tubing (EMT) may be used in place of rigid conduit in dry locations subject to governing regulations, embedded in masonry walls, and concealed above suspended ceilings. Connectors shall be of gland watertight EMT type with factory-installed insulated throats and provide compression type EMT couplings (cast fittings/set-screws are not acceptable) to be forged steel.
- .3 Rigid PVC conduit shall comply with CSA Specification C22.2 No. 136.
- .4 Watertight flexible conduit: "Sealtite" PVC jacketed flexible steel with Hubbell-Kellum strain relief grips; shall comply with CSA Standard C22.2 No. 56.

- .5 Surface wall-mounted raceways shall be Wiremold No. 4000 metallic type complete with two channels and all necessary fittings, closers, device modules, etc. Wiremold or approved equal only.

2.2 WIRE & CABLE

- .1 Branch wire and cable shall comprise copper conductors, sized as noted, rated 75 deg. C., 600 volt minimum flame retardant insulation, and CSA approved for application.
- .2 Wire and cable installed in conduit shall be PVC insulated Type TWH - Flame retardant and comply with CSA Specification C22.2 No. 75.
- .3 Use Electrovert "Z-Type" code markers for control & communication conductors.
- 4. All branch wiring shall be RW90.
- 5 All feeder cables shall be XLPE RW90.
- 6. All underground feeders and branch circuits run from and to outdoor environment shall be XLPE RWU90.

2.3 DEVICES

- .1 Wiring devices unless otherwise specified herein, or noted, shall be as manufactured by Hubbell, Leviton or Pass & Seymour.
- .2 Light Switches for shall be of low-voltage type as scheduled on the Drawings.
- .3 Occupancy sensors shall be of low-voltage type as scheduled on the Drawings.
- .4 Key-operated switches shall be of low-voltage type as scheduled on the Drawings.
- .5 Standard 15 Ampere, 120 volt duplex receptacles generally shall be specification grade Hubbell, White, CSA #5-15R and tamperproof type throughout the Area of Work.
- .6 Special purpose receptacles as noted on the drawings shall be Hubbell Conforming to CSA configurations (Table 46 and Table 47 of Canadian Electrical Code) for non-locking and locking receptacles. Provide attachment cap for each special purpose receptacle.
- .7 "Range" receptacles shall be CSA Type 14-50R, 50 amp. 3 pole, 4 wire, grounding 125/250V flush receptacle. Provide the above with 5 foot rubber cord set, 50 amp. and connect equipment.
- .8 Receptacles with integral ground fault interrupter shall be Hubbell No. GF-5252 or approved equal.
- .9 Service receptacle shall be Hubbell No. 5262-RD.

- .10 Clock receptacle shall have recessed fitting, Leviton No. 5261/CH. Mount as per the Modular Control Panel detail.

2.4 DEVICES - SPECIALIZED

- .1 Flush floor boxes shall be Hubbell Cat. No. 3SFB-SSC 3-service box complete with devices shown on drawings.
- .2 Provide low-voltage lighting control, as detailed.

2.5 DEVICE COVER PLATES

- .1 Switch and receptacle and other device faceplates for flush mounted devices, generally shall be single or multi-gang as required, type 301, stainless steel, #4 brushed finish with removable protective covering.
- .2 Weatherproof enclosures for outdoor receptacles shall be P&S 4600 with 4600-26 Mounting Plate, duplex ground fault receptacles and two #4609 Keys.
- .3 Cover plates for other devices such as flush fan controls, telephone, etc., shall be stainless steel to match above.

2.6 PANELBOARDS

- .1 See Section 26 05 20 for details.

2.7 SWITCHES

- .1 Provide fusible and non-fusible switches, NEMA Type 'HD' with quick-make, quick-break contacts, horsepower-rated where required, to match the motor protected. Provide holders to accept specified fuses. Switches to include mechanical cover interlocks and line side barriers.
- .2 Where applicable and available, switches shall be CSA "Approved For High Service Factor".
- .3 Provide safety disconnect switches adjacent to motors and other equipment when required by regulations.

2.8 FUSES

- .1 Provide fuse holders in fusible equipment with a complete set of proper size Form 1, HRC Nema J or L current limiting fuses. Fusible equipment so provided shall be adapted to reject CSA Standard C22.2 No. 59 fuses. Fuses shall be Federal Pioneer - "Econolim".
- .2 Provide one complete set of spare fuses for each rating and type used, unless otherwise scheduled.

- .3 Apply Thomas & Betts "Kopr/Shield" conductive anti-seize compound to all fuse ferrules and holders.

2.9 PUBLIC ADDRESS SPEAKERS

- .1 Procure all Public Address Speakers from Baldwin Sound Systems (Toronto). No alternate supplier for Public Address components will be permitted.
- .2 Site verify the existing public address speaker operating voltage and order new speakers to match.
- .3 Speakers shall be McBride 8229/25/7025 – Pre-assembled ceiling speaker (includes 8” dual cone speaker with 6 oz. magnet, 12-1/2” square steel baffle and 70/25 dual voltage 5 watt transformer). Speaker shall be supplied with SMC20E finished surface-mounted backbox.

PART 3 - EXECUTION

3.1 EQUIPMENT LOCATIONS

- .1 Approximate locations of electrical equipment, fixtures switches, outlets, and the like, are given on the drawings. Refer to the architectural drawings and room elevations for application. In absence of definite detail exact location of outlets shall be determined on site as work progresses.
- .2 Device plates shall cover opening left for outlet box, and plates shall be attached to boxes in an approved manner. Outlets and fixtures are to be located symmetrically, (i.e. centered in wall panels, ceiling panels or tiles, columns, between and above doors and the like).
- .3 The right is reserved to alter the location of equipment and outlets a distance of up to 3 metres without involving a change to the Contract amount, providing notice is given prior to installation.

3.2 MOUNTING HEIGHTS

- .1 Mounting heights of outlets, center of outlet to finished floor, except for exposed masonry construction, shall generally be as follows:
 - Light Switches - 1100 mm
 - Receptacles - 450 mm
 - Television Outlets - 400 mm
 - Data/Telephone Outlets - 400 mm
 - Manual Fire Alarm Stations – 1,150 mm
 - Panelboards – 2,000 mm to top of trim for standard panels.
 - Clocks - 2000 mm or 300 mm below ceiling (except where mounted in a Control Panel).
 - Thermostats – 1,200 mm
 - Fire Alarm Audible Temporal Pattern Horn/Strobes – As per CAN/ULC-S524.

3.3 HOLES & DRILLING

- .1 Pneumatic hammers and percussion drills are prohibited.
- .2 Where not sleeved, make holes through concrete walls and floors by core-drill only. Obtain Architect's approval before drilling.
- .3 Seal holes and sleeves through floors to serve as water dam.

3.4 CUTTING & PATCHING

- .1 Layout and install work in advance of other Sections for all new work. Bear all costs resulting from failing to comply with this requirement.
- .2 Pay for cutting and patching and making good as required for work of this Division by reason of faulty or late work. Employ appropriate trades already engaged on the site to perform such cutting, patching and making good existing walls, floor, ceiling, etc. Before commencing, obtain Architect's approval for extent and nature of cutting. Make good, disturbed surfaces to the Architect's approval.

3.5 EXCAVATION & BACKFILL

- .1 Provide necessary excavating and backfilling inside and outside building required for work of this Division, performed as specified under another Division of the work, except as modified below.
- .2 Keep excavations free from water, pump as necessary.
- .3 Excavation for underground services shall be to required depths and dimension and shall be prepared as required, so that no portion of any conduit, bears directly against any rock or other hard surface.
- .4 Remove and dispose of all surplus excavated material.
- .5 Backfill promptly after approval of work. Prevent damage to or displacement of walls, piping, conduits, waterproofing and other work.
- .6 For direct buried conduit and 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 sand.
- .7 Backfill trenches within building, with clean sharp sand in individual layers of maximum 150 mm (6") thickness, compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum one foot. Hand or machine compact the balance up to grade, using approved equipment.

- .8 Backfill trenches outside buildings with granular 'A' gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level; manual compaction up to 450 mm (18") and mechanical compaction, using approved equipment, for the balance.
- .9 Make good work where damaged by excavation and filling work of this Division. Repair any subsequent settlement of fill placed under this Division and pay all costs in replacement of other work damaged by such settlement and restoration.

3.6 CONCRETE WORK

- .1 Provide concrete work where required for work of this Division in accordance with applicable requirements specified in Concrete Division 3.
- .2 Provide concrete Lighting Standard Bases, required for the work of this Division. Refer to detail on drawings.
- .3 Provide concrete Duct Banks required for the work of this Division. Refer to detail on drawing for typical construction details.
- .4 Reinforced concrete duct banks shall be keyed into sides of foundation walls. Extend and connect reinforcing steel of duct banks to reinforcing steel of foundation wall construction to prevent failure at the junction of the pipe support and wall.
- .5 Provide 100 mm (4") high housekeeping pads for all floor mounted electrical equipment, such as switchboard, distribution panels and transformer, etc.

3.7 HANGERS & INSERTS

- .1 Provide necessary hangers and inserts for work of this Division.
- .2 Fasten to cast-in place concrete by suitable drilled or cast-in inserts.
- .3 Fasten to structural steel using bolts or welded fasteners.
- .4 Do not use wood, chain, wire lashings, strap or grappler bar hangers except where noted or detailed.
- .5 Support fixtures independently of ceiling suspension systems. Provide additional supports as required, which shall be fastened to building structure steel members, joists, beams, etc., but not metal pan or roof decking. Material for additional supports and their installation shall comply with requirements of U.L.C. Refer to "List of Equipment and Materials" Vol. 2, and "Supplement" for application to rated assemblies.
- .6 Support outlet and junction boxes independently of the conduits running to them where required by electrical code and where deemed necessary by the Architect, use steel angle brackets or steel rods to support outlets and fixtures, to the building structure.

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- .7 Drilled fastenings to concrete shall be self-drilling concrete anchors, Phillips 'Red-Head' or approved equal. The maximum weight per fastening shall not exceed 25% of manufacturer's 'pull-out' load data.
 - .8 Surface mounted or stem suspended fixtures fastened to non-removable ceilings, 2 hr. fire rated ceiling assemblies, or mounted between metal suspension of exposed T-grid ceilings, shall be provided with minimum of two points of attachment for each 300 mm x 1200 mm (1' x 4') luminaire, using metal 'channel-bar' fastened to building structure. Attach luminaires to 'channel-bar' by means of threaded steel rods. Channel-bar shall be adequately supported and of a construction to prevent deflection under load, as selected from manufacturer's published data, and to Architect's approval. 'Channel-bar' shall be Unistrut, Burndy, Flexibar, Cantrough or Canadian Strut Products or approved equal.
 - .9 Use support clips (e.g. Caddy Type IDS) for suspension of fixtures attached to exposed T-grid ceilings. Clips shall be supported directly from building structure and not from suspended ceiling system.
 - .10 Provide recessed fluorescent fixtures with support frames, and plastering frames where applicable.
 - .11 Chain where permitted and specified for the installation of fluorescent lighting fixtures shall be No. 4, 2 mm (.080") Tenso Pattern coil steel chain, plated with a strength of 82 kg (180 lbs.) as manufactured by Dominion Chain Co. Ltd. or approved equal. Where 'S' hooks are used with chain, they shall be No. 6 type with open strength of 82 kg (180 lbs.) minimum. Attachment of chain at both ends of support shall develop full strength of chain.
 - .12 Support outlet boxes, junction boxes, conduit and the like, mounted on exposed steel deck roofing by means of self-tapping minimum #10 gauge screws, secured through bottom member of deck corrugation. Do not pierce top of steel deck.

3.8 PAINTING

- .1 Hangers, support framing and all equipment fabricated from ferrous metals which are not protected with zinc or other suitable corrosion-resistant finish shall have at least one coat of a corrosion-resistant paint applied before shipment or immediately on arrival at the site.
- .2 After installation, touch up all scratches, chips, other damage and defects in paint, using zinc chromate primer or paint or special enamels as necessary to match the original.
- .3 Finish and colour of all equipment shall be coordinated to provide uniform appearance.
- .4 Painting of conduits and supports and other exposed surface work will be done under Painting Section except as noted. Install materials in time to be painted together with mounting surfaces.
- .5 Do not paint over nameplates.

- .6 Refer to other Sections for special paint finishes of equipment.

3.9 NAMEPLATES & SCHEDULES

- .1 Identify electrical equipment supplied under this Division with 3 mm thick black laminated plastic nameplate to indicate equipment controlled to provide instruction or warning. Fasten each plate with two chrome plated screws. Lettering shall be 6 mm high for small devices such as control stations and at least 13 mm high for all other equipment. Submit a list of proposed nameplates for approval before manufacture.
- .2 Provide panelboards with typewritten schedules identifying outlets and equipment controlled by each branch circuit including existing panels being changed. Protect schedules with non-flammable clear plastic.
- .3 Identify junction boxes, pull boxes, cover plates, conduits and the like, provided for future extension, indicating their function (e.g. power, fire alarm, communication).
- .4 Verify room names and numbers prior to listing on nameplates and schedules.

3.10 BRANCH CIRCUIT WIRING & FEEDER CABLES

- .1 Provide branch circuit wiring, conduits and feeders as required for Lighting, Power and Auxiliary Systems. Separate conduit systems shall be provided for feeder, lighting and power systems, for exit light system and auxiliary communication systems.

3.11 CONDUIT, RACEWAYS AND WIREWAYS

- .1 Wire and cable shall be installed in conduit as follows:
 - Rigid galvanized steel conduit shall be used:
 - .1 Where noted and required by regulations.
 - .2 Where subject to mechanical damage.
 - .3 For all exposed conduit work.
 - .2 Electrical metallic tubing (EMT) may be used in place of rigid conduit in dry locations subject to governing regulations, embedded in masonry walls, and concealed above suspended ceilings. Connectors shall be of gland watertight EMT type with factory-installed insulated throats and provide compression type EMT couplings (cast fittings/set-screws are not acceptable) to be forged steel.
 - .3 Use flexible metallic conduit for connections to chain suspended and recessed fixture drops, motors and similar equipment to prevent transmission of vibration. A code-gauge green grounding conductor shall be provided for all such connections. Use "Sealtite" conduit with Hubbell-Kellum Sealtite conduit strain relief grips for all such connections at motors.
 - .4 Fasten every conduit and cable to structure by means of approved conduit clamps or clips. Wire lashing is not acceptable.

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- .5 Conceal conduits and wiring except where noted. Run exposed conduits parallel to building lines and to other conduits. Provide every empty conduit with a pull rope (3 mm polypropylene rope) and identify to designate its function (Power, Telephone, Fire Alarm and the like).
 - .6 Where conduit is installed in concrete slabs, obtain general approval, prior to commencing the work, on both maximum dimension and cross-overs which may be used therein.
 - .7 Install conduits in such a manner as to conserve head room and interfere as little as possible with free use of space through which they pass. Obtain approval for routing of same. Keep conduits at least 150 mm clear high temperature work.
 - .8 Conduit installed at the roof level of exposed structures, shall be run tight to roof deck, above purlins and beams.
 - .9 Conduit and cables for electrical work in demountable type and drywall type partitions shall enter from above, from a junction box concealed in the ceiling above and shall comprise a flexible conduit connection.
 - .10 All branch wiring shall be provided with a separate code gauge supplementary grounding conductor run in each conduit or duct, terminating at ground block at panelboards.
 - .11 Run conduit exposed in mechanical equipment rooms, electrical rooms, fan rooms, and the like, and installed after mechanical and other equipment is completed. Install fixtures, outlets, starters, etc., to clear and to suit application.
 - .12 Wiring, boxes, conduit fittings, etc., in hazardous areas shall conform with Ontario Electrical Code, covering explosion-proof areas. Provide conduit seals where required by these regulations.
 - .13 Provide housekeeping curbs around exposed conduits feeding panels, disconnect switches, starters, etc. penetrating floors in front of walls.

3.12 WIRE & CABLE

- .1 Wire and cable shall not be installed at temperatures below 20°C unless "minus 40" type is used. Wiring to heating equipment shall be rated 90°C minimum, the ampacity of which shall be limited to 75°C value.
- .2 Conductors used for all auxiliary systems (e.g. Fire Alarm) shall be tagged and/or colour-coded, and where applicable shall agree with manufacturer's wiring diagrams.
- .3 Minimum wire size for power wiring shall be No. 12 AWG gauge unless specified otherwise. Minimum wire size for "Common" neutral conductors shall be No. 10 AWG. Control wiring shall be #14 AWG red insulation. Maximum voltage drop between furthest outlet of any circuit, when fully energized, and panel to which it is connected shall not exceed two percent except for electric heating circuits which shall not exceed

one percent.

- .4 Cables shall be terminated with moisture-proof connectors, clamped to sheet metal enclosure by a single non-ferrous locknut and grounding bushing.
- .5 Sheaths of multi-conductor cables shall be grounded at both cable ends.
- .6 Sheaths of single conductor cables shall be grounded at supply end only. Provide a Code Gauge Grounding Conductor with each feeder cable run.
- .7 Number of wires indicated for lighting and power, motor and motor control, alarm, signal, communications, and auxiliary systems is intended to show general scheme only. The required number and types of wires shall be installed in accordance with equipment manufacturer's diagrams and requirements, and with requirements of the installation, except that specification standards shall not be reduced.
- .8 Solderless connectors with nylon-jacketted "Vibration-proof" screw-on wire connectors ideal "Wing Nuts", rated 600 volts shall be used for joints in Branch Wiring.
- .9 Use compression joints and terminals for all control wiring; and all conductors #4 AWG and larger. Mechanical connections are acceptable at panelboards and circuit breakers where these are part of factory-assembly.
- .10 Wire or cables in feeders, sub-feeders and branch circuits shall be colour-coded in accordance with Ontario Electrical Safety Code. Each end of feeder terminations (e.g. in Switchboard, Panelboards, switches, splitters and the like) Code Phase A - Red, Phase B - Black, Phase C - Blue, Neutral - White.
- .11 Use C.G.E. Vulkan X-Link insulated cables for circuits protected by ground fault circuit interrupters.
- .12 Include in each conduit, tubing and raceway, a code gauge green supplementary grounding conductor which shall be connected to suitable ground bus in equipment.
- .13 Armoured or sheathed cables may be used only for wiring within demountable and dry wall type partitions and if additionally specified or detailed; however it shall not be directly buried in or below concrete slabs.

3.13 OUTLET, JUNCTION & PULL BOXES

- .1 Use suitable electrical boxes for terminations and junctions on conduit work. Install pull boxes where necessary to permit installation of conductors. Support pull boxes, outlet boxes, panels and other cabinets independently of conduit.
- .2 Provide each light switch, wall receptacle and other device with an outlet box of suitable dimensions and a faceplate. Outlet boxes shall be adapted to their respective locations.
- .3 "Thruwall" and "Utility" type boxes shall not be used.

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- .4 Electrical boxes and panels shall be CSA approved, code-gauge sheet metal, galvanized or with suitable protective treatment. Secure covers with screws or bolts.
 - .5 Outlet boxes shall not be installed "Back-to-Back" in walls; separate by a minimum of 150 mm.
 - .6 Use "Masonry Type" outlet boxes for flush installation in masonry walls as detailed on standard Detail Drawings attached hereto.) Standard sectional boxes, 1004, 1104 and the like, shall not be used).
 - .7 Install surface mounted devices, in cast conduit fittings, with threaded hubs and suitable stainless steel faceplates.
 - .8 Paint the full length of conduits (installed above accessible and inaccessible ceilings) and main pull and junction boxes (excluding obvious outlet boxes) as per the following colour scheme:

- Lighting	Yellow
- Lighting Controls	Orange
- Power	Blue
- Fire Alarm	Red
- Telephone/Data	Green
- Public Address, Sound and Clock System	Purple

All conduits shall be painted with minimum three (3) coats of paint along the full circumference of the conduit for a clean and consistent finish. Conduits shall be painted prior to installation.

- .9 In addition, each box shall be identified with a system and service designator of logic reference to the service.

3.14 ACCESS DOORS & ACCESS MARKERS

- .1 Supply access doors for installation under the work of other Division where electrical equipment requiring maintenance or adjustment or inspection is located above ceilings, within walls or behind furring; except ceilings of lay-in removable panel type.
- .2 Access doors shall be 12 gauge hinged metal Stelpro Ltd. or equal #722 flush type, minimum size 300 mm x 300 mm (12" x 12") "Reach-in" 300 mm x 600 mm (12" x 24") "Crawl-in", with prime coat finish, concealed hinges, screwdriver lock and plaster key. Access doors in finished masonry or drywall construction shall be #722 less plaster key. Access doors shall be #726 in acoustic tile ceilings; #704 in drywall ceiling and #726E in plaster ceilings.
- .3 Access doors in fire rated ceiling assemblies, all fire rated walls, duct shaft or in corridor walls shall be UL, ULC or WHI listed 1-1/2 hour fire rated access doors equal to LeHage #L1010 or Acudor #150B with screwdriver lock.

- .4 Where lay-in removable panel ceilings requiring hold-down clips are used, access doors are not required but panels shall be secured with accessible hold-down clips and marked with Buildemup #6 RH brass paper fasteners inserted through acoustic panel and bent over. paint heads with blue enamel before installation.
- .5 Obtain approval for sizes and locations.

3.15 PANELBOARDS

- .1 Provide handle locking devices on circuit breakers feeding Plumbing, Heating, Ventilating equipment and controls and all auxiliary systems, time switches, and other devices as noted. Paint handles white, to permanently identify location and function. Provide 30 spare handle locking devices for future use.
- .2 Circuit numbers on drawings do not necessarily correspond to the numbers on the lighting panels. Circuits sharing a common neutral shall not be connected to the same main. Panel circuit breakers which are used directly for the switching of lighting fixtures shall be grouped in consecutive numbers commencing at breaker number one.
- .3 Use "Panduit" lok-strap cable ties for panelboard branch wiring.
- .4 Provide empty conduits from flush panelboards, and others as noted, terminating in accessible ceiling spaces, sized to accommodate spare and space breaker provisions. One 25 mm (1") conduit for each three spare breakers or spaces.
- .5 Provide two (2) 1" empty conduits c/w pull strings to the floor below ceiling space.

3.16 ELECTRIC WORK FOR OTHER DIVISIONS

- .1 Examine Architectural and Mechanical (Plumbing, Heating, Ventilating and Air Conditioning) plans and specifications to determine extent of electrical work in connection with these Divisions which is to be done under the work of the Electrical Division.
- .2 In general, all loose motor starters and associated controls for mechanical equipment will be supplied under Division 26 for installation and connection to both source and load side of the equipment.
- .3 Co-ordinate the exact location and verify characteristics of electrical provisions for the work of the Mechanical Division.
- .4 Coordinate locations of starters, motors and associated equipment with the work of the Mechanical Contractor's Sections to ensure proper location of equipment. The exact locations of conduit terminations at Mechanical units shall be determined from equipment manufactures' approved shop drawings. Conduits must be installed to enter only in the locations designated by equipment manufactures.
- .5 Provide safety switches required for disconnection of remotely controlled motors, and

where required at motors by C.E.C. regulations whether shown on the drawings or not. Where required at fan motors, they shall be concealed in the fan housing if possible.

- .6 Provide for the 120 volt mechanical equipment where noted, all necessary wiring and connections including wiring and installation of starters, thermostats, aquastats, speed controllers and time switches controlling equipment.
- .7 Where motor starters, switches and the like, are grouped together, a suitable 19 mm (3/4") thick plywood panelboard shall be provided to which all such equipment shall be secured. Provide all necessary angle iron supports for support of panelboard and paint entire assembly with two coats of fire retardant type enamel acceptable to Building Inspection Department.
- .8 Provide weatherproof unfused safety disconnect switches, fastened to exterior of roof mounted units, to approval.
- .9 Connect high temperature thermostats "Firestats" provided in ductwork by the Mechanical Contractor, to exhaust fan systems, to provide fan shutdown on activation.

3.17 GROUNDING & BONDING - GENERAL

- .1 Ground and bond all electrical systems in accordance with provisions of the Ontario Electrical Code.
- .2 Provide a grounding electrode in accordance with Section 10 of the Canadian Electrical Code.
- .3 Install grounding conductors to permit the shortest and most direct path from equipment to ground. Install grounding conductors in rigid galvanized conduit with both conductor and conduit bonded at both ends. Provide bonding jumpers with approved clamps to maintain ground continuity of metallic raceway systems at all expansion joints.
- .4 Ground connections to grounding conductors shall be accessible for inspection and made with approved solderless connectors bolted to the equipment of structure to be grounded. Clean contact surface prior to making connections to ensure proper metal to metal contact. Connections shall be of the type that grounds both conduit and conductor, and cap screws, bolts, nuts and washers shall be silicon bronze.

3.18 FIRESTOPPING & SEALING

- .1 Make fire rated and/or watertight where applicable seals at sleeves and other opening through floors and walls where conduit/cable passing through. Sleeves to extend minimum 25mm (1 inch) from both ends of the opening.
- .2 Provide firestopping protection of **all existing and new openings** through the floor, through the ceiling assembly, through the wall assembly regardless of the presence of any existing firestopping for existing penetrations.

- .3 Caulk spaces between conduit, cables, bus ducts, raceways, cabletrays with "Cerafibre" 2300 F packing to Building Department approval. Pack and seal both sides of openings with Electrovert "Flameseal" putty, minimum thickness 25 mm (1"). Install in accordance with Electrovert Instruction Bulletin #3601.
- .4 The Electrical Contractor is responsible for retaining the services of a specialized third-party Inspection Agency to inspect all firestopping completed for this project by the Electrical Division. Include all costs of the Inspection Agency in the Base Tender Price. The Inspection Agency is to provide a report certifying acceptance of all firestopping work completed as part of this project.

END OF SECTION

PART 1 GENERAL

1.1 RELATED INSTRUCTIONS

1.1.1 Refer to Section 26 05 00, Common Work Results for Electrical.

1.2 SCOPE

1.2.1 Work includes, but not limited to:

1.2.1.1 Providing new Electrical Panels throughout the Project Site as per the Drawings.

1.2.1.2 Obtaining approvals from and cooperation with Authorities having Jurisdiction, before and commencing Work.

1.2.1.3 Preparation of all necessary Working Drawings for submission to Inspection Authorities.

1.3 INSPECTION & TESTING

1.3.1 Systems, equipment and all major items of material shall be tested to the satisfaction of the Consultant, and as required to establish compliance with plans and specifications, and with the requirements for the Authorities having jurisdiction.

1.3.2 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.

1.3.3 Tests shall include but are not limited to the following:

1.3.3.1 Test of power cables shall include megger tests to establish proper insulation resistance, and phase-to-ground resistance of cables.

1.3.3.2 Test of all adjustable electrical protective devices of switchgear to establish calibration and operation in accordance with Specifications and approved co-ordination curves.

1.3.3.3 Visual examination of switchgear to determine adherence to allowable manufacturing tolerance and compliance with manufacturer's recommended installation requirements.

1.3.3.4 Proper functioning of all systems.

1.3.3.5 Polarity tests - to establish proper polarity connections to all sockets and receptacles.

1.3.3.6 Calibration setting, and test-tripping, of all protective relays and devices, using "Primary-injection" equipment, in accordance with approved co-ordination schedule.

1.3.3.7 Test of all alarm devices and contacts.

1.3.3.8 Inspection after system is energized shall include infrared thermo graphic examination of

current carrying parts in switchgear, transformers, and at ducts. The Contractor shall cooperate with Inspection personnel, open all equipment enclosures to permit inspection, and make good defective conditions.

1.3.4 Testing Company

- 1.3.4.1 Retain the services of an independent testing company, to Consultant's approval to perform the above tests.
- 1.3.4.2 The testing company shall submit test results directly to the Consultant.
- 1.3.4.3 Include copies of tests in Maintenance and Operating Manual.

1.3.5 Certification of Tests

- 1.3.5.1 When work is complete, submit three (3) copies of test results and a signed statement listing all tests that have been performed as required by Specifications and manufacturer's instructions.

PART 2 PRODUCTS

2.1 ELECTRICAL PANELS:

- 2.1.1 Panelboards as scheduled, shall comprise "Branch" panelboards, with fixed bolted connection thermal-magnetic, quick-make, quick-break, 40oC, calibrated ULC rated 'SWD' switching duty, molded-case circuit breaker branches. "Plug-in" breakers are not acceptable. Multipole breakers shall be common trip type.
- 2.1.2 Panelboards shall include the following features:
 - .1 Flush or surface trim as noted.
 - .2 Concealed hinges and lockable door.
 - .3 Combination catch and lock semi flush tumbler type - all keyed alike.
 - .4 Adjustable self-positioning trims.
 - .5 Plain trims not displaying any names or Symbols.
"Vault" type handles shall not be used except in unfinished areas.
 - .6 Typed schedules of circuits indicating equipment and area controlled on the backs of panel doors, in a steel trim pocket, covered with transparent non-inflammable plastic.
 - .7 Insulated neutral block.
 - .8 Supplementary ground block.
 - .9 Copper Bus.
 - .10 Isolated ground bar, as noted.
 - .11 Surge-suppression system, as noted.
 - .12 Sprinkler-proof
- 2.1.3 Power and Distribution type panelboards shall be breaker type, as scheduled on the drawings.
- 2.1.4 Unless noted otherwise, panelboards with main breakers or remote controlled switches shall be

provided with an indicating pilot lamp flush mounted in top of face trim which shall be connected to a 15 amp. circuit in the panelboard which shall be locked on and shall serve to indicate when the main breaker is in the closed position. Pilot lamp units shall be LED type or other approved types designed to provide maximum lamp life. Provide lamacoid nameplate to identify main breaker.

- 2.1.5 Panelboard shall be of circuit breaker type 120/208 Volt, 3 Phase, 4 Wire mains, minimum interrupting rating of 22,000A, RMS symmetrical at 208 Volt.
- 2.1.6 All panels shall be of code gauge steel with prime coat finish for painting. All locks on all panels shall be common to one key and shall also be common to the locks on the distribution panel. The Subcontractor shall be deliver three duplicate keys to the Owners. All panel hardware shall be chrome plated. All tubs shall be a minimum of 6" deep. Where panels are surface mounted they shall be sprinkler-proofed.
- 2.1.7 All panels shall be equipped with breaker-level metering capable of metering each load at each circuit/breaker level.
- 2.1.8 Acceptable Manufacturers are:
 - .1 Eaton (Cutler-Hammer)
 - or equivalent from:
 - .2 Schneider (Square `D')
 - .3 Siemens

PART 3 EXECUTION

3.1 ELECTRICAL PANELBOARDS

- 3.1.1 Provide complete electrical service as shown on the drawings and as further described here.
- 3.1.2 Grounding service, equipment, feeders, and the like shall be performed in accordance with Electrical Safety Regulations.
- 3.1.3 Submit shop drawings of all panelboards prior to ordering.
- 3.1.4 Any work involving shut down of power to parts of the Building or the entire Building shall be completed during weekend hours only. Provide labour accordingly and include for all premium costs associated with Weekend Labour in the Tender Price. Any shutdown exceeding two (2) hours shall require the Electrical Contractor to provide a backup diesel-fired generator and backing up select Life Safety and Essential Loads of the building for the duration of the shutdown. Include all costs of the temporary generator in the Base Tender Price. Coordinate timing of the shutdown with the Project Manager a minimum of five (5) business days in advance of the scheduled shutdown.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

1.2 STANDARDS

- 1.2.1 ANSI/IEEE Standard 242 Recommended practice for protection and coordination of commercial power system most current edition.
- 1.2.2 ANSI/IEEE Standard 399 Recommended practice for power system analysis most current Edition.
- 1.2.3 NETA STANDARD ATS 2005: Electrical Acceptance Testing Specification for electrical power equipment and distribution system most current Edition.
- 1.2.4 NFPA 70-E Standard for Electrical Safety in the Work Place most current Edition.
- 1.2.5 IEEE STD- 1584 Guide for performing Shock and Arc Flash Hazard Calculations most current Edition.
- 1.2.6 Canadian Electrical Code most current Edition.
- 1.2.7 Ontario Electrical Safety Code most current Edition.
- 1.2.8 CSA Z462 Electrical Safety in the Work Place (Draft).

1.3 SCOPE OF WORK

- 1.3.1 The Short Circuit; Protection and Coordination and Shock & Arc Flash Studies shall be completed for all distribution system modes of operation;
- 1.3.2 Normal power distribution operating mode;
- 1.3.3 The studies need to take into account how the about power distribution system modes of operation interrelate to each other in completion of the studies and recommendations provided with the studies.
- 1.3.4 The following minimum Utility Design Fault Levels shall be used in completion of the studies:
- 1.3.5 13,800 volts the minimum Design Fault Level to be used is 500 MVA.
- 1.3.6 27,600 volts the minimum Design Fault Level to be used is 835 MVA.
- 1.3.7 The Professional Engineer, licensed to practice in the Province of Ontario, completing the studies shall confirm the noted Design Fault Levels with the Local Power Utility. The above is the minimum that shall be used in the completion of the studies.
- 1.3.8 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E – 2004 annex D

- 1.3.9 The power system(s) short circuit; protection and coordination; shock and arc flash studies shall be completed by a Professional Engineer, licensed to practice in the Province of Ontario, specializing in this field. All information required to complete these studies shall be obtained through formal requests to related Trade(s) such as the Local Power Utility and manufacturers supplying the equipment.
- 1.3.10 Once the required Short Circuit; Protection and Coordination and Shock & Arc Flash Studies have been completed and submitted for review by the Consultant and all clarification have been provided and the reviewed studies have been acknowledged by the Consultant. The recommendations shall be implemented by the Contractor and a letter confirming that the implementations of the recommendations have been completed shall be submitted by the Contractor to the Consultant.
- 1.3.11 Arc Flash Study shall be focused on achieving incident energy level “Category 2” in the main electrical room; sub electrical rooms; and other associated electrical spaces.
- 1.3.12 No exceptions shall be permitted with respect to these required studies.
- 1.3.13 The Study shall be completed by Qualus Corporation or Brosz Technical Services.

1.4 DESCRIPTION OF WORK

- 1.4.1 The Contractor shall provide all studies as required by code and as outlined within this Specification section. The studies shall cover all electrical distribution systems and all of the various modes of operation of the electrical distribution systems.
- 1.4.2 The Study shall be a fully comprehensive study including the following:
- .1 All Utility Equipment upstream of the Main Service.
 - .2 The Main Service Equipment (including the main switchboard/main distribution panel and switch).
 - .3 All new panelboards, transformers, motor loads, PV Equipment and mechanical equipment throughout the Renovated Areas.
 - .4 All existing panelboards, transformers, motor loads, PV Equipment and mechanical equipment throughout the Existing School.
 - .5 No use of ‘lump sum’ motor inputs into the calculations will be permitted.
- 1.4.3 No electrical distribution equipment Shop Drawings for any of the electrical distribution systems shall be reviewed by the Consultant prior to the required studies being submitted and the review process with respect to the studies being completed. Should the Contractor order any or all of the electrical distribution equipment they do so at their own risk. Should changes be required to be made to any or all of the distribution equipment the Contractor will cover all costs.
- 1.4.4 It is important that all requests to related trades such as mechanical, equipment supplier is completed and information obtained in less than ten (10) working days of commencing of contract.
- 1.4.5 No assumption shall be made where it is possible to obtain the information from the manufacturer and equipment suppliers regarding impedances, protective device time current curves and cable lengths, type and size from the Contractor.

1.4.6 The Contractor will need to provide following information to the Consultant completing the studies:

- 1.4.6.1 Preliminary types and cable lengths.
- 1.4.6.2 All of the required equipment data from the electrical equipment vendor(s);
- 1.4.6.3 All of the required equipment data from the generator vendor(s);
- 1.4.6.4 All of the required equipment data from the UPS vendor(s);
- 1.4.6.5 All of the required equipment data from the transformer (power and distribution transformers) vendor(s);
- 1.4.6.6 All protective device co-ordination curves;
- 1.4.6.7 All protective device ground fault curves;
- 1.4.6.8 All damage curves for equipment and cables;
- 1.4.6.9 All required electrical data for elevators;
- 1.4.6.10 All required electrical data for mechanical equipment; and
- 1.4.6.11 Other data as required and requested by the Professional Engineer completing the studies.

1.4.7 The “ input data revised or modified “ for performing studies will be required to be updated and resubmitted to the Consultant once the Contractor has finalized all of his actual electrical types and feeder lengths.

1.4.8 These studies of high important and shall be completed and submitted within 20 - 25 working days after the letter of intent has been issued to the Contractor.

1.5 SYSTEM PROTECTION AND CO-ORDINATION

1.5.1 Retain one of the designated testing companies who specialize in this type of Work to prepare an equipment coordination study and schedule for all protective devices in the system in cooperation with suppliers of all pertinent switchgears; testing covered under cash allowance.

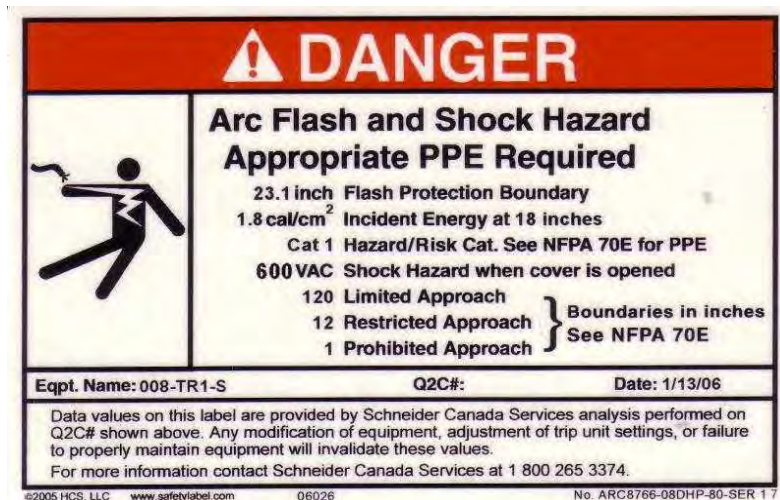
1.5.2 The firm of testing specialists shall be responsible for calculating short circuit kA rating, checking, adjusting, calibration and setting up of all protective devices in accordance with the values shown in the reviewed coordination study under this Contract.

1.5.3 Coordinate the relays, breakers and fuses to provide selective tripping or blowing. Coordinate the breakers, fuses, protective relaying and ground fault protection so that the breaker or fuse immediately ahead of a fault will trip or blow clearing the fault and leaving the system ahead of the tripped or blown protective device in the normal operating mode the study must also address the other distribution system modes of operation.

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- 1.5.4 The curves shall be accompanied by the individual time current curves of each device to enable the verification of the ratings and settings used. These coordination curves shall be submitted for review and the various ratings and settings shall be made by the manufacturer's before the equipment is shipped. Review of these coordination curves will not eliminate the responsibility of the Contractor to provide correct protection and coordination.
- 1.5.5 Co-ordination curves shall be plotted showing the following:
- 1.5.5.1 Plot utility relays or fuses protecting the incoming service. This information shall be obtained directly from the Local Utility;
 - 1.5.5.2 Main and feeder protection devices at every voltage level;
 - 1.5.5.3 Main and feeder protection devices ground fault curves at every voltage levels;
 - 1.5.5.4 Protection devices associated with the largest motor or refrigeration compressor; and
 - 1.5.5.5 Protection devices associated with the emergency power distribution system; UPS power distribution system and the Co-Generation power distribution system and showing all fault levels.
- 1.5.6 Each co-ordination time-current curve shall include:
- 1.5.6.1 A single line diagram for the portion of the system involved;
 - 1.5.6.2 Transformer and cable damage curves where applicable;
 - 1.5.6.3 Available fault current level on the portion of the system involved;
 - 1.5.6.4 Ground fault curves; and
 - 1.5.6.5 Generator fault and damage curves where applicable.
- 1.5.7 Protection and Coordination curves shall be submitted as part of a report outlining the protection and coordination procedures, final breaker and relay settings and fuse ratings for the entire power distribution system(s) and modes of operation. The report shall clearly list all the breakers with their tag and final settings even if there are identical systems on the Project. I.e. information about the same settings can be duplicated if applicable with breaker in different locations. This list will be checked and signed off by the Professional Engineer who prepared and completed the studies.
- 1.5.8 Co-ordinate with the electrical equipment vendors; mechanical equipment vendors and obtain the recommended settings on protection devices (re: breaker and overloads). Incorporate this information on the associated studies.
- 1.5.9 The goal of this portion of the study is to achieve selective protection and coordination of protective devices including ground fault and to reduce the incident energy levels to within "Category 2" where applicable.

1.6 SHOCK AND ARC FLASH HAZARDS

- 1.6.1 This portion of the study shall be prepared and completed by a Professional Engineer, licensed to practice in the Province of Ontario. The study shall be based on power distribution systems diagrams and the various power distribution operating modes.
- 1.6.2 The Contractor shall obtain and provide all required information as required for the study to be completed.
- 1.6.3 The study and the report shall provide a full summary of the shock and arc flash hazard. The completion of the study shall with compliance with NFPA 70E and related standards and methods established in the industry.
- 1.6.4 The IEEE-1584 must be used for the calculation of the incident energy.
- 1.6.5 The study will ensure that worst case hazards are identified. This means that arc flash energy is calculated at the maximum fault and to include overloads conditions where applicable.
- 1.6.6 The study shall cover all electrical distributed equipment and distribution systems operating modes and voltage levels within the facility and site as well as the main incoming service to the building(s) and site.
- 1.6.7 The study will identify the arc flash boundaries, and incident energy at suggested distance of working. Determination of system operating modes and conditions that can impact short circuit currents and arc flash hazard energy levels shall be identified well in advance and shall be conveyed to the Owner and Consultant for confirmation.
- 1.6.8 The study will clearly state any assumptions made for arc-fault currents. L-G ground fault and L-L. The worst case scenario(s) shall be reflected in the reported as minimum requirement.
- 1.6.9 Arc-flash labels shall be created and installed on each piece of electrical distribution equipment for all electrical distribution systems.
- 1.6.10 The labels shall be per ANSI Z535. The labels shall identify the hazard level and protective clothing required.
- 1.6.11 Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 Cal / cm².
- 1.6.12 The label reflected below is an example of the required detail of what is to be on the label. A separate label shall be provided for each piece of the electrical distribution systems.



1.6.13 The shock and arc flash warning label shall have as a minimum the following information reflected on it:

- 1.6.13.1 Boundaries as per NFPA and CSA Z462 (Draft);
- 1.6.13.2 Flash Protection boundary;
- 1.6.13.3 Limited shock approach boundary;
- 1.6.13.4 Restricted shock approach boundary;
- 1.6.13.5 Prohibited shock approach boundary;
- 1.6.13.6 Personal protective equipment required to be employed and used with respect to each piece of electrical distribution equipment;
- 1.6.13.7 Incident Energy per IEEE 1584 recommended distance; and
- 1.6.13.8 Voltage value for Shock Hazard.

1.6.14 At least 24-hour training shall be provided to the staff employed at the facility to explain meaning of labels and protective equipment, and work permits for energized work. This is to ensure the implementation of the safety program that addresses the following as a minimum:

- 1.6.14.1 Ministry of Labour requirements;
- 1.6.14.2 Personal protective equipment;
- 1.6.14.3 Understanding of the shock and arc flash categories;
- 1.6.14.4 Electrical equipment labeling requirements;
- 1.6.14.5 Development of local Standard Operating Procedures (SOPs);

1.6.14.6 Lock out and tag out; and

1.6.14.7 Remote switching of equipment.

1.7 INSTALLATION

1.7.1 On completion of the calibration and testing, a full report shall be prepared by the testing specialists and submitted to the Consultant for review, comments and approval.

1.7.2 The report shall confirm that all protective devices have been adjusted and set in accordance with the protection and coordination study and that the protective systems provide the necessary degree of selective protection as well as selective ground fault protection.

1.7.3 The report shall include tabulation of settings and/or rating of all protective devices.

1.7.4 Each protective device shall be labelled with the proper setting for the device. Labels shall be installed or marked on the protective device behind glass windows. Fusible devices shall be labelled showing the size, type and current rating of the fuse element.

1.7.5 The firm conducting the protection and coordination study shall conduct on-site verification testing to ensure that all relays, breaker settings and fuse sizing has been set in accordance with the coordination study recommendations.

1.7.6 All shock and arc flash labels have been installed.

1.7.7 The Owner reserves the right to retain the services of an independent testing company to monitor, review and verify the results of the test report submitted by the Contractor.

1.7.8 Provide the services of electricians to assist in equipment tests performed by the independent testing companies appointed by the Owner, including thermo graphic (infrared) testing of bus bar joints and contacts of circuit breakers, etc. Remove cover plates, etc. to enable testing company to gain access to the equipment.

1.7.9 The Contractor shall be responsible to co-ordinate with equipment manufacturers to ensure that the equipment is furnished with protection as recommended in the co-ordination study.

1.7.10 Upon completion of the Project, after the commissioning stage has been completed and all commissioning deficiencies have been corrected and the Owner has acknowledged the commissioning is now complete. The Contractor shall conduct a complete thermo infrared scan of the entire electrical distribution systems. The timing of this scan shall be coordinated with the Owner.

1.7.11 The Short Circuit; protection and coordination; shock and arc flash studies shall be completed and the Consultants review process finalized in advance of any electrical equipment being manufactured, ordered and delivered to the Project.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED INSTRUCTIONS

- .1 Refer to Section 26 05 00 Common Work Results for Electrical.

1.2 WORK INCLUDED

- .1 Provide electrical lighting fixtures and systems scheduled, complete with drivers, mounting kits and necessary accessories required for their installation and performance.
- .2 Obtain and review all information with regards to the proper installation of all lighting systems from the Manufacturer. No installation shall be completed without a thorough review of the Manufacturer's recommendations and guidelines for installation. All installations shall comply with these recommendations and guidelines as well as any other requirements mandated by Authorities having Jurisdiction and local governing codes.

1.3 DRIVER CONDITIONING

- .1 All LED fixtures shall remain energized for a stabilizing period as recommended by the Manufacturer.

1.4 SHOP DRAWINGS

- .1 Conform to requirements of Section 26 05 00 Common Work Results for Electrical.
- .2 Submit for review an electronic submission of shop drawings containing illustrations of each fixture. Illustrations to be complete showing dimensions light distribution and mounting requirements. Illustrations to be noted to indicate special features and finishes. A copy is to be retained by the Contractor on the site, to ensure co-ordination of installation requirements.
- .3 LED fixture shop drawings must indicate Driver Manufacturer and Model No. for each fixture.
- .4 No light fixtures shall be ordered without the review and written approval of the Electrical Engineer. Shop drawings should indicate proposed mounting method and hardware required to facilitate a complete and safe installation.

PART 2 - PRODUCTS

2.1 REFERENCE NUMBERS

- .1 Catalogue reference numbers given for individual fixture types are intended as a guide when read with the description and the fixture as finally applied. Verify catalogue references with description and coordinated with installation conditions, with particular regard to ceiling construction details, type and finish before ordering fixtures.

2.2 LENSES

- .1 Plastic lenses in lighting fixtures shall be acrylic with minimum thickness of 3 mm (0.125 inches) and, providing flame spread and smoke density ratings, complying with applicable Federal and Provincial Codes; Ontario Fire Marshal's Fire Safety Design Standard; and the Ontario Building Code. Paragraph 3.1.13.1 (1).
- .2 Removable components of fixtures (louvres, lenses, wire guards, and the like) to be limited to maximum 1220 mm (48") in length.

2.3 FIXTURE SCHEDULE

Refer to Drawings for Specifications.

2.4 LIGHTING HARDWARE

- .1 The Contractor must supply and install all light fixtures as per the Manufacturer's recommendations as well as to the satisfaction of all Authorities having Jurisdiction, Code requirements, the Architect, and the Electrical Engineer.
- .2 Include, in the tender price, for all lighting hardware required for a complete and safe installation.
- .3 Lighting hardware includes, but isn't limited to, the mounting hardware required for each fixture. The Contractor is responsible for reviewing architectural finishes in all areas and providing lighting and mounting hardware to suit.
- .4 All parts used as a part of the installation must be of the same manufacturer as the respective light fixture. Wherever available, all parts must be unique to the respective fixture and purchased with the light fixture from the same supplier and manufacturer.

2.5 PHOTOMETRIC

- .1 The Electrical Contractor is responsible for obtaining a complete photometric of the entire area of lighting installation, both interior and exterior, prepared by a professional, third-party specializing in such work. All fixtures of all types shall be depicted on one layout. Refer to Architectural drawings for ceiling heights. Submit a copy of the interior and exterior photometric with the shop drawing submittal for the light fixtures. The Electrical Contractor in conjunction with the Manufacturer remains responsible for the accuracy of the photometric results and acceptance of fixtures based on this.
- .2 Photometric statistics shall be prepared for each zone/room. Statistics such as max/min and average footcandle readings shall be included in the photometric submittal.
- .3 Photometric shall take into account site condition impacts such as partitions, washroom stall partitions, suspended ceilings, reflectances, etc.

2.6 APPROVED EQUAL PRODCUTS

- .1 The Contractor is permitted to provide alternate products to the base product specified as long as the alternate fixture is equal or superior to the base bid product in all specifications. The Contractor remains responsible for ensuring compliance of the alternate product to the base specifications outlined above.
- .2 All alternate fixtures must be reviewed and approved in writing by the Electrical Engineer or Owner **during pricing**. No substitutions will be permitted to the base product upon award of the Contract.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Provide two new safety chains per new light fixture. Mount from the building structure. Provide unistrut supports throughout as necessary to support the safety chains where obstructions (ductwork, etc.) might prohibit installation without Unistrut.

3.2 RECESSED FIXTURES

- .1 Provide plaster and/or framing rings for recessed fixtures (except for 'Lay-in Tee-Bar' types) the installation of which shall be the responsibility of this Section.

3.3 SUSPENSION STEEL

- .1 Provide supports for light fixtures from new unistrut members attached and/or secured to building structure. No supports shall be attached to metal deck.

3.4 SITE AIMING

- .1 Position and aim adjustable lighting equipment as directed on the site. Position outdoor units after daylight hours as directed. Provide labour and materials necessary to accomplish this.

3.5 COMPLETION

- .1 Fixtures shall be clean at the time of final acceptance.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 Refer to Section 26 05 00 Common Work Results for Electrical.
- .2 All specifications must be read in conjunction with the Electrical Drawings.
- .3 The drawings and specifications must be read in conjunction with all front-end and tender documents (RFQ, etc.) issued by the Board and/or its representative along with the Drawing and Specification package.

1.2 WORK INCLUDED

- .1 Provide emergency lighting fixtures and systems scheduled, complete with lamps, and all necessary accessories required for their complete installation, performance, and on-going operation.
- .2 Additional details of 'Work Included' may be found throughout the specifications and/or drawing package.

1.3 SHOP DRAWINGS

- .1 Conform to requirements of Section 26 05 00.
- .2 The Contractor must submit electronic copies of all shop drawings for the Engineer's review and approval prior to ordering anything. The shop drawing package must include shop drawings for the following (as applicable):
 - .1 Exit Signs
 - .2 Remote Heads
 - .3 Battery Units

Each package must contain illustrations of each fixture. Illustrations are to be complete showing dimensions light distribution and mounting requirements. Illustrations to be noted to indicate special features and finishes. A copy is to be retained by the Contractor on the site at all times, to ensure co-ordination of installation requirements. The Contractor must work with the Manufacturer to provide a photometric study based on the proposed design and the selected devices/equipment. CAD will be made available by the Engineer for the Contractor to use.

PART 2 - PRODUCTS

2.1 REFERENCE NUMBERS

- .1 Catalogue reference numbers given for individual fixture types are intended as a guide when read with the description and the fixture as finally applied. Verify catalogue references with description and coordinated with installation conditions, with particular regard to wall or ceiling construction details, type and finish before ordering fixtures.

2.3 EMERGENCY LIGHTING SYSTEM

.1 Emergency Lighting Battery Units:

- .1 Provide Emergency Lighting Units and Wiring Systems as noted.
- .2 Supply and install the Emergi-Lite® Distinction™ Series battery units. The battery unit will supply the rated load for a minimum of **one hour** to 87.5% of the rated battery/voltage. The unit shall be rated 120 or 347V, 60 Hz and be CSA No.141 listed. The charger shall be fully computer tested and its charge voltage factory set to + or – 1% tolerance. A pulse type charger shall be employed to promote long battery life and reduce the potential for grid corrosion. The charger shall provide continuous high charge to recharge the battery. When the battery is at full capacity the charger will shut off. The pulse charge shall be current limited and precisely regulated by an electronic circuit which samples the battery in relation to its temperature, state of charge and input voltage fluctuations. The charger shall be current limited, temperature compensated, short-circuit proof and reverse polarity protected. The unit shall be furnished with an electronic lockout circuit, which will connect the battery when the AC circuit is activated, and an electronic brownout circuit, which will activate the emergency lights when utility power dips below 75% of nominal voltage. A low voltage battery protection circuit will disconnect the battery at end of the discharge. The unit will come complete with the Distinction™ Series diagnostics micro-controller board option. The unit shall self-test for 1 minute every 30 days, 10 minutes on the 6th month and 30 minutes every 12 months. The unit shall be furnished with a sealed dust tight relay, a selectable test switch 1 minute, 5 minutes, 10 minutes or 20 minutes and diagnostics LED indicator lights to continuously monitor the status of the unit: battery failed, battery disconnect, charger failure, lamp failure, service alarm, AC “ON” and charger “ON”.
- .3 Wall mounted unit shall be provided with recessed back box and mounting template to allow pre-installation feeds of A.C. input and D.C. output. Both A.C. input and D.C. output shall enter unit through back face without any visible cable or conduit feeds. Provide wall mounted shelf for each battery unit.
- .4 Provide a 120 volt input circuit for each unit wired to un-switched circuit indicated. Wire to exit signs from battery units. Size conductors to all remote lamps to provide maximum voltage drop of three percent.
- .5 Battery Capacities shall be as per the Drawings.

.2 Emergency Single Remote Heads:

- .1 Remote heads EF26/EF26DS/EF26D Series shall be comprised of one (single) or two (double or twin) 6W adjustable heads with LED lamps. Each lamp shall be housed in an impact-resistant polycarbonate cube. The cube lens shall be frosted to diffuse the light. Heads shall provide mounting holes for installation on a standard octagonal box.

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- .2 Single remote unit shall be Emergi-Lite Model: EF26MLM or approved equal.
Specifications:
- Single Cube.
 - One (1) 6W, 24V MR16, LED lamps.
 - White Finish
- .3 Wireguard shall be Emergi-Lite Model: 460.0035-E or approved equal.
- .3 Emergency Dual Remote Heads:
- .1 Remote heads EF26/EF26DS/EF26D Series shall be comprised of one (single) or two (double or twin) 6W adjustable heads with LED lamps. Each lamp shall be housed in an impact-resistant polycarbonate cube. The cube lens shall be frosted to diffuse the light. Heads shall provide mounting holes for installation on a standard octagonal box.
- .2 Dual/Double head remote unit shall be Emergi-Lite Model: EF26DSMLM or approved equal.
Specifications:
- Double Cube.
 - Two (2) 6W, 24V MR16, LED lamps.
 - White Finish
- .3 Wireguard shall be Emergi-Lite Model: 460.0032-E or approved equal.
- .4 Exit Sign (without built-in battery unit & remote heads):
- .1 Supply and install the Emergi-Lite® EAE Series slim-profile pictogram edge-lit sign. The unit shall operate with universal 2-wire AC input voltage of 120 to 347VAC at less than 3W and universal 2-wire DC input voltage from 6 to 24VDC at less than 2.5W. The housing assembly shall be constructed of extruded aluminum with textured finish and colour. The canopy shall be of die-cast aluminum and allow for wall, end, or ceiling mount. The legend shall be printed on a pure-acrylic panel. The panel shall come standard with double-face legend, for single-face and double-face applications. The light source shall be longlife white light-emitting diodes (LED) and shall provide even illumination in normal and emergency operation.
- .2 Exit sign shall be Emergi-Lite Model: EAE-UNIVERSAL-TA-U or approved equal.
Specifications:
- Universal faces.
 - Universal mounting kit
 - 120 to 347VAC input; 6 to 24VDC output.
- .3 Wireguard shall be Emergi-Lite Model: 460.0079-E (wall-mount), 460.0027-E (end-mount) or 460.0028-E (ceiling-mount) or approved equal.

.5 Acceptable Alternate Manufacturers

1. Lumacell
2. Beghelli
3. Stanpro

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Do not install or energize lamps until directed by Consultant which generally shall be just prior to occupancy of the building by the Owner.
- .2 Provide wiring in conduit and install devices in accordance to all Manufacturer recommendations and instructions. Advise the Consultant of any discrepancies or conflicts between the instructions set out in these drawings and specifications and the Manufacturer's recommendations and instructions prior to commencing work.
- .3 Connect remote heads to the respective battery unit as indicated on the drawing. Read all notes on the drawings prior to commencing work.
- .4 Provide remote heads as specified and as required for compliance with the Ontario Building Code. Install remote heads in the locations as shown on the drawings. Note that in most cases, the proposed location of new heads do not match the location of existing devices. The Contractor must locate remote heads in the new positions as proposed. The Contractor must make allowance for minor revisions to the system, including relocations and re-aiming, as required upon review of the testing results. Generally, all wiring shall be provided in accordance with the Manufacturer's requirements and be minimum No. 10 AWG. The wire size might need to be increased to satisfy voltage drop requirements. Verify voltage drops requirements with the Manufacturer prior to installation.
- .5 Prior to installation of any devices, verify the existing conditions around the proposed location and ensure there are no conditions that restrict visibility of exit signs, may affect coverage of emergency lighting, or atmospheric or climate conditions that may affect the operation of new devices (unheated areas, moist/damp air, etc.). Advise the Consultant in writing of all such conditions prior to installation and seek instruction prior to proceeding.

3.2 SITE AIMING

- .1 Position and aim adjustable lighting equipment as directed on site and to obtain light levels as required by code. Position outdoor units after daylight hours as directed. Provide labour and materials necessary to accomplish this.
- .2 Locate and aim emergency lighting remote heads to optimally illuminate egress route to meet or exceed all code requirements.

3.3 COMPLETION

- .1 Fixtures shall be clean and 100% operational at the time of final acceptance.
- .2 Upon a complete installation of the systems as proposed on the drawings, as per all code requirements, and to the satisfaction of all Authorities having Jurisdiction, commission and test the new system in entirety with the Manufacturer's Representative. Make allowance for adjustments as required by the Manufacturer or Authorities having Jurisdiction. Provide a letter to the Consultant that the system is complete, has been tested, adjusted (as required), and is in proper operating condition. Testing shall be performed during non-daylight hours.
- .3 Upon completion of installation, engage a professional third-party Professional Engineer (licensed by the Professional Engineers of Ontario) to complete an illumination level test throughout all areas of the building where the installation has taken place. The Contractor must work with the third-party agency to properly aim remote light heads, recording light level readings on a record set of floor plans, calculating light level readings, and issuing to the Consultant a letter stating that the emergency lighting levels meet the requirements of the Ontario Building Code. Notify the Owner and Consultant at least ten (10) days prior to the proposed testing and verification data and schedule a time and date that is acceptable to all.
- .4 The Contractor is responsible for engaging a professional third-party Professional Engineer (licensed by the Professional Engineers of Ontario) to complete a voltage drop test testing the voltage at each panel as well as the voltage at the most remote fixture.
- .5 Include (in the tender price) for the hiring of all third-party agencies (including, but not limited to, the Manufacturer's representative) as required by the drawing and specifications.

END OF SECTION

PART 1: GENERAL

- 1.0 Section Includes
 - A. Lighting Control Components and Systems:
 - 1. Line Voltage Wall Switches Low Voltage Wall Switches and Sensors
 - 2. Occupancy / Vacancy Sensors Detection
 - 3. Power Interfaces
 - 4. Line Voltage Wall Switches and Sensors
 - 5. Wireless Devices and Systems
- 1.1 Related Requirements
 - B. Section 26 50 00 – Lighting Systems
- 1.2 References
 - A. Underwriters Laboratories (UL):
 - 1. UL 916- Energy Management Equipment
 - 2. UL 924 - Emergency Lighting and Power Equipment
 - 3. UL 1472 – Standard for Safety Solid-State Dimming Controls
 - B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electric Code
 - C. IEC 61000-4-2 Electromagnetic Compatibility (EMC) – Part 4-2: Testing and Measurement Techniques-Electrostatic Discharge Immunity Test; 2008
 - D. NEMA WD 7-2011: Occupancy Motion Sensors
 - E. NEMA SSL 7A: Phase Cut Dimming
 - F. FCC Part 15 and equivalent ISED / NOM
- 1.3 Administrative Requirements
 - A. Coordination
 - 1. Coordinate placement of daylight and occupancy sensors to achieve optimum performance. Proper sensor placement should be coordinated with others to avoid obstructions that would interfere with maintaining prescribed light levels
 - 2. Coordinate the work to provide luminaires and lamps that are compatible with the lighting controls to be installed
 - 3. Notify architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work
- 1.4 Submittals
 - A. Submit under provisions of the Electrical General Requirements.
 - B. Specification Conformance Document. Clearly define where the equipment submitted for review:
 - 1. Meets specification exactly as specified
 - 2. Meets specification as an alternate with clear definition of compliance
 - C. Shop Drawings include
 - 1. CAD renderings of the device with precise dimensions
 - 2. System schematic/typical riser diagrams
 - D. Product Data Sheets

- 1.5 Project Closeout Documentation
 - A. Provide a factory published manual
 - 1. Warranty
 - 2. Technical support contact
 - 3. Electronic manual on manufacturer's website for free download
- 1.6 Quality Assurance
 - A. Manufacturer Qualifications:
 - 1. 20+ years of experience designing and assembling lighting controls.
 - 2. Phone Support: Toll-free technical support available from manufacturer through an online tool to schedule a technical support appointment and provide 24/7 emergency support.
 - 3. Remote Support: Manufacturer capable of providing remote support and ability to virtually connect with customers to address issues.
 - 4. On-Site Support: Manufacturer capable of providing on-site response time within the continental United States
 - 5. Service Contracts: Manufacturer capable of providing service contracts for continued on-site and remote support of the lighting control system post-installation for terms up to 10 years from substantial completion.
 - B. All devices are 100% factory function tested prior to delivery
 - C. Compliant with the requirements of NFPA 70
 - D. All power components UL listed for required loads
- 1.7 Project Conditions
 - A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C); unless specified extended temperature operation within the product specification sheet.
 - 2. Relative Humidity less than 90% non-condensing
 - B. Standard electrical enclosures are permanently installed
 - C. Equipment is protected from dust, debris and moisture
- 1.8 Warranty
 - A. Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace (same device or equivalent), materials, and devices that fail to perform as specified within extended warranty period.
 - B. Five (5) years from the date of shipment

PART 2: PRODUCT INFORMATION

2.1 Manufacturers

- A. Acceptable: Acuity Brands Lighting, Inc. – System: SensorSwitch Brand
- B. Basis of controls design Manufacturer: Acuity Brands, One Lithonia Way, Conyers GA 30012 Steven Downs Manager of Senior Product Markets or Dennis Hoskins, Director of Product Market.

One of the following may be acceptable with approval if compliant with this specification:

- 1. Sensorswitch
- 2. Cooper

3. Hubbell
- C. Substitutions: Not Permitted
 4. All substitutions must be submitted in writing for approval at least 14 days prior to bid date.
 5. Proposed substitute products must be documented with a line by line compliance review

2.2 General:

- A. Provide system hardware that is designed, tested, manufactured, warranted by a single manufacturer
- B. Operational Life: At least 10 years expected life while operating within the specified ambient temperature and humidity range
- C. Power Failure Memory: automatically store system settings and recover from a power failure without requiring user input.

Occupancy Detection Technology Requirements:

- D. The occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
- E. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or based sensing technologies shall not be accepted.
- F. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
- G. Dual technology sensors shall have one of its two technologies do not require motion to detect occupancy. Acceptable dual technology includes PIR / Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect nothing (PIR/Ultrasonic) shall not be acceptable.
- H. All sensing technologies shall be acoustically passive meaning they do not transmit sound waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic based sensing technologies shall not be accepted.
- I. Sensors shall offer a settable minimum on timer of at least 15 minutes, to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time. This timer shall be in addition to the regular occupancy time delay that keeps lights on after last detected occupancy. User shall be able to disable/enable and change the value of this timer.
- J. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 10 minutes.
- K. Allow adjustments to the occupancy time delay based on owner preference, fixture life extension or increase energy savings. Should be done in consultation with the building owner and specifying engineer.
- L. Installer, in accordance with manufacturer’s recommendation, shall determine final sensor location. All sensors shall be factory calibrated for optimum performance for its installed PIR lens, and shall not require initial or subsequent field adjustment of detection sensitivity.

- M. All sensor setting adjustments shall be digital; comprising of a one or more user interfaces: Push-button, Visual Light Infrared, RFID or Bluetooth Programming methods
- N. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

2.3 Low Voltage Wall Switches

- A. Shall be capable of the following:
 - 1. Accept 12-24VAC/VDC
 - 2. Suitable for installation in a single-gang switch box
 - 3. Support On / Off / Dimming and 3-way Connection
 - 4. single and dual pole options
 - 5. Programmable via push button programming with visual LED visual feedback
- B. Product Series
 - 1. SPODM(A)
 - 2. SWS
 - 3. WSD LV

2.4 Line Voltage Wall Switches

- A. Shall be capable of the following:
 - 1. Shall accept Class 1 wiring directly.
 - 2. Devices will operate as On / Off and Dimming (pending model variant)
 - 3. Dimming devices shall be 0-10V sink devices
 - 4. Multi-way switches allow for 3-way, 4-way and up to 9 connections.
 - 5. All Multi-Way devices On / Off loads will operate and respond in unison.
 - 6. Multi-way devices with dimming loads will operate in unison when initiated by a dimming device
 - 7. Multi-way device is a class 1 low voltage data bus and must not be used with a standard toggle switch.
 - 8. Count down timer capabilities
 - 9. Single and dual pole options
- B. Phase Dimming Wall Switches;
Shall be capable of the following:
 - 1. Shall accept Class 1 wiring directly.
 - 2. Devices will operate on / off and dimming various load types: LED, Incandescent, CFL, ELV and MLV per the designated load rating based on support technology
 - 3. Compatible with NEMA SSL 7A
- C. Product Series
 - 1. PTS(A)
 - 2. SPODMR(A)
 - 2. SPODMRA MWO
 - 3. SPODMR(A) WR
 - 3. SPODMRA SSA (wireless)
 - 4. WPD
 - 5. ASD

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- 2.5 Line Voltage Wall Switch with Occupancy Sensor
- A. Sensor shall provide wall-to-wall PIR occupant movement supporting small (hand motions) and large (walking motion) detection .
 - B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 1.1, Occupancy Sensor Technology Requirements).
 - C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.
 - D. Sensors shall be capable of switching both 120 VAC and 277 VAC (models allowing 120-277 VAC input) and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
 - E. Light Commercial devices will be designated as 120 VAC and lower load rating compared to commercial based products.
 - F. Sensor shall recess into single gang switch box and fit a standard GFI opening.
 - G. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection internally and intrinsically through its mounting strap.
 - H. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
 - I. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology (only exception is versions with lighted push-buttons).
 - J. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (off) condition. Sensor shall not require a minimum load to be connected to function.
 - K. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, low temperature/high humidity operation.
 - L. All sensor settings, including time delay and photocell settings shall be digital and accessible for adjustment via one or more user interfaces push-button, visual light, Bluetooth programming without requiring removal of cover plate or tools of any kind.
 - M. Wall Switch sensors shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point as applicable.
 - N. All models shall be capable of both Auto-On, Manual On, and Partial-On operation.
 - O. All models shall be capable of a "Reduced Turn On" operation where the initial PIR turn on level is higher in order to eliminate PIR from reflective surfaces from being detected. PIR shall be returned to normal levels upon initial PIR detection.
 - P. All models shall have a "Predictive Off" mode where user can manually turn the lights off when leaving the room and still have them come on automatically when they return to space.
 - Q. All models shall be capable of disabling override switch.
 - R. Multiple switches controlling the same load (3-way or 4-way applications) shall use multi-way based devices.
 - S. The following SensorSwitch models numbers color and optional features like dimming and out-of-box default behaviors are specified within the product datasheets. The list below is subject to change.
 - T. Product Series
 - 1. WSRA (PIR)
 - 2. WSRA 2P FAN (PIR, Dual Relay)
 - 3. WSX(A) (PIR)

4. WSX(A) MWO (PIR)
5. WSX(A) 2P (PIR, Dual Relays, Auto On Pole 1/Manual On Pole 2)
6. WSX(A) PDT (PIR/Microphonics)
7. WSX(A) MWO PDT (PIR/Microphonics)
8. WSX(A) PDT 2P (PIR/Microphonics, Dual Relays, On Pole 1/Manual On Pole 2)
9. WSX(A) SA (PIR, Manual On by default; programmable)
10. WSX(A) MWO SA (PIR, Manual On by default; programmable)
11. WSX(A) PDT SA (PIR/Microphonics, Manual On by default; programmable)
12. WSX(A) MWO PDT SA (PIR, Manual On by default; programmable)
13. WSX(A) VA (PIR, Manual On by default)
14. WSX(A) MWO VA (PIR, Manual On by default)
15. WSX(A) PDT VA (PIR/Microphonics Manual On by default)
16. WSX(A) MWO PDT VA (PIR/Microphonics Manual On by default)
17. WSX NL (PIR, lighted push-button, neutral required)
18. WSX PDT NL (PIR/Microphonics, lighted push-button, neutral required)
19. WSD LV (PIR, low voltage, power pack required)
20. WSD PDT LV (PIR/Microphonics, low voltage, power pack required)

2.6 Wall Switch Occupancy Sensors – Large Areas

- A. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 40 ft (12.19 m).
- B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 1.1, Occupancy Sensor Technology Requirements).
- C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.
- D. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz. A version capable of switching 347 VAC shall also be available. Load ratings shall be 13A each pole, ¼ HP motor load.
- E. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
- F. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
- G. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology.
- H. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (Off) condition. Sensor shall not require a minimum load to be connected in order to function.
- I. Sensor shall be the following SensorSwitch model numbers. Device color and optional features as specified.
- J. Product Series
 1. LWS(H) (PIR)
 2. LWS(H) 2P (PIR, Dual Relays)
 3. LWS(H) PDT (PIR/Microphonics)
 4. LWS(H) PDT 2P (PIR/Microphonics, Dual Relays)

2.6. Low Voltage Occupancy Sensors

- A. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
- B. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 2.2, Occupancy Sensor Technology Requirements).
- C. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, to provide a high degree of RF immunity.
- D. Sensors shall interconnect with other sensors and power/relay packs with class 2, three-conductor wire.
- E. Sensors shall operate on 12 to 24 VAC or VDC and consume no more than 5 mA so that up to 14 sensors may be connected to a single power pack.
- F. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.
- G. Each designated zone shall contain one sensor with a SPDT class 2 auxiliary relay, providing an input to building automation system (BAS). All sensors in designated zone shall communicate to sensor with relay for status to BAS. Sensor relay coil shall energize in the unoccupied state to load share the low voltage current from power pack. Note that power pack must be installed on the Line side of the local toggle switch for auxiliary relay to work properly.
- H. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
- I. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.
- J. Sensors with a recessed profile are acceptable substitutes for above ceiling mount sensors (e.g. CM => RM)
- K. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors (e.g. CM => CMB)
- L. Sensors shall be the following SensorSwitch model numbers.
 - 1. CM (PIR, Ceiling Mount, Standard Range)
 - 2. CM PDT (PIR/Microphonics, Ceiling Mount, Standard Range)
 - 3. RM (PIR, Ceiling Mount, Extended Range)
 - 4. RM PDT (PIR/Microphonics, Ceiling Mount, Extended Range)
 - 5. WV 16 (PIR, Corner Mount, Wide View)
 - 6. WV PDT 16 (PIR/Microphonics, Corner Mount, Wide View)
 - 7. HW 13(PIR, Wall Mount, Hallway View)
 - 8. HMB 10 (PIR, Box Mount, High Bay Aisle Way)
 - 9. MSD
 - 10. MSOD
 - 11. TLS

2.7 Power Packs

- A. Power packs shall accept and switch 120 or 277 VAC, be plenum rated, and provide class 2 power for up to 14 remote sensors.

- B. Power pack shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
- C. When required by local code, power pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- D. Power pack shall incorporate a Class 1 relay and an AC electronic switching device. The AC electronic switching device shall make and break the load, while the relay shall carry the current in the on condition. This system shall provide full 20 Amp switching of all load types, and be rated for 400,000 cycles.
- E. Power packs shall be single circuit, or two circuits. Slave packs may be used to control additional circuits. When two circuit power packs, or slave packs are used, the power packs must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.
- F. MP20 used as a dry contact relay to connect BMS, HVAC, Fan, etc....
- G. Power packs shall be the following SensorSwitch model numbers.
 - 1. PP20 (Single Pole)
 - 2. SP20 (Secondary Pack)
 - 3. MP20
 - 4. PP16 Shunt
 - 5. PP5LV Shunt
 - 6. PP5 SSA (wireless)

2.8 Line Voltage Occupancy Sensors

- A. Sensors shall be self-contained and accept Class 1 wiring directly without the use of a power pack.
- B. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
- C. In areas with periodic or permanent obstruction to a sensor's field of view, sensors that utilize dual technology (PIR/Microphonics) detection shall be used (as specified in above section 2.2, Occupancy Sensor Technology Requirements).
- D. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.
- E. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
- F. Multiple sensors controlling the same load shall be wired in parallel.
- G. For applications requiring independent control of two loads, a sensor with two dual relays shall be required. Each relay shall have independent programmable occupancy time delays.
- H. Dual relay sensors shall have an optional operational mode called "Alternating On" where when during unoccupied periods, one relay is always left closed (thus one load is always on). The particular relay that is left closed alternates each cycle so that the aging of the connected lamps is even.
- I. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off 50/60 Hz power. Many devices include intermediate voltage ratings at 220 and 230 VAC. A version capable of

-
- switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
- J. Specific sensors capable of switching 5 Amps of two-phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.
 - K. Wall mounted sensors must be installed at 7 to 8 feet above the floor. Single and two circuit units shall be available.
 - L. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
 - M. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.
 - N. Sensor settings may be programmed via pushbutton or via mobile application, check the most recent datasheet for more information.
 - O. Sensors shall be the following SensorSwitch model families.
 - 1. CMR / CMR 2P (Standard Range 360°, PIR, Ceiling Mount – Single / Two Pole)
 - 2. CMR PDT / CMR PDT 2P (Standard Range 360°, PIR/Microphonics Dual Technology, Ceiling Mount – Single / Two Pole)
 - 3. CMRB / CMRB 12P (Extended Range 360°, PIR, Fixture Mount Box – Single / Two Pole)
 - 4. WVR 16 / WVR 16 2P (Wide View, PIR, Wall Mount – Single / Two Pole)
 - 5. WVR PDT 16 / WVR PDT 2P (Wide View, PIR/Microphonics Dual Technology, Wall Mount – Single / Two Pole)
 - 6. HMRB 10 (High Bay End-of-Aisle, PIR, Fixture Mount Box)
 - 7. HWR 13
 - 8. LSXR
 - 9. SBGR
 - 10. SBOR
 - P. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors (e.g. CMR=> RMR)
- 2.9 Indoor Photocells and Daylight Harvesting Controls
- A. Low voltage photocell shall accept 12 to 24 VAC or VDC and provide a SPDT relay for interface with remote switching system. Sensor shall interface with occupancy sensors, directly with power pack, or other system as shown.
 - B. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 - C. Photocell set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Further adjustment may be made manually if needed.
 - D. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

-
- E. Low voltage dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more fixtures).
 - F. Low voltage dimming sensor's set point shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 - G. Combination photocell/dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control the on/off function as well as the dimming function of 0 to 10 VDC dimmable ballasts.
 - H. Combination photocell/dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set point may be manually entered.
 - I. Dual zone option shall be available for photocell, dimming, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.
 - J. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
 - K. Line voltage versions of the above described dimming sensors shall be capable of powering off 120/277 VAC. Many devices include intermediate voltage ratings at 220 and 230 VAC check product specification sheet for more details
 - L. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching 5 Amps of two phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.
 - M. Sensors shall be the following SensorSwitch model numbers.
 - 1. CM PC (Photocell, On/Off, Low Voltage, Ceiling Mount)
 - 2. CM ADC (Dimming Photocell, Low Voltage, Ceiling Mount)
 - 3. CM PC ADC (Combination Photocell/Dimming Sensor, Low Voltage, Ceiling Mount)
 - 4. CM PC DZ, CM ADC DZ, or CM PC ADC DZ (Dual Zone, Low Voltage)
 - 5. CMR PC (Photocell, On/Off, Line Voltage, Ceiling Mount)
 - 6. CMR ADC (Dimming Photocell, Line Voltage, Ceiling Mount)
 - 7. CMR PC ADC (Combination Photocell/Dimming Sensor, Line Voltage, Ceiling Mount)
 - 8. CMR PC DZ, CMR ADC DZ (Dual Zone, Line Voltage)
 - 9. LSXR PC
 - 10. SBOR PC
 - N. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors (e.g. CMR PC => RMR PC)
Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors (e.g. CMR PC => CMRB PC)

2.10 Wireless Devices and Systems

- A. Automatically sync for system operation
 - 1. Shall conform to SOC2 criteria
 - 2. Must not use a predefine PIN.
- B. Send and receive messages for real-time operation and feedback
- C. Use industry standard RF protocols (list is subject to change)
 - 1. Bluetooth Devices must be listed with the Bluetooth SIG organization
 - 2. Conform to EnOcean communication requirements
- D. All devices are FCC / Industry Canada compliant with most devices certificated under Mexico's IFETAL and European Union CE check product specification for more detail.
- E. Settings shall be programmable via push-button or mobile device application (Apple iOS and Android Operating Systems).
- F. The following SensorSwitch family of devices: color and optional features are specified within the product datasheets.
 - 1. SensorSwitch AIR Product line Family of Devices
 - a. SPODMRA SSA
 - b. WSXA SSA
 - c. PP5 SSA
 - d. CMS SSA
 - e. Fixture Embedded under nomenclature SSAIR and SSAIRVTX
 - 2. BTP Family of Devices
 - a. Haleon BTP
 - b. LSX BTP
 - c. SBG BTP
 - d. SBO BTP
 - 3. RDT Family of Devices
 - a. SPODMR(A) WR
 - b. CM WR
- G. There are many lighting fixture families with embedded SensorSwitch wireless controls. All wireless devices and fixtures shall have accurate markings per its certification compliance

PART 3: EXECUTION

3.1 Installation

- A. Follow manufacturer's instructions for all installation steps
- B. Provide a complete installation per Contract Documents
- C. Where applicable provide FAQs and Quick Start Guides

3.2 Startup and Programming

- A. Provide telephone support via toll free line
- B. Factory trained service available for purchase
- C. Where applicable training video and elearning content

3.5 Maintenance

- A. Factory trained service technicians available within the continental US
- B. Offer integrated help on-screen and via online videos
- C. Factory telephone support via toll free line

END OF SECTION

APPENDIX 'A'

00850	LIST OF DRAWINGS
00860	ROOM FINISH SCHEDULE
00861	DOOR AND FRAME SCHEDULE
00865	COLOUR SCHEDULE
00870	LIST OF DETAIL DRAWINGS
	DETAIL DRAWINGS

1.1 ARCHITECTURAL

A0-0 COVER PAGE INC. BUILDING CODE ANALYSIS
 (OBC MATRIX)
A1-1 SITE PLAN – OVERALL
A2-0 OVERALL FLOOR PLANS
A2-0a OVERALL FIRST FLOOR PLAN
A2-1 PARTIAL ENLARGED FIRST FLOOR PLAN-DEMOLITION
A2-2 PARTIAL ENLARGED FIRST FLOOR PLANS – NEW
 (UNIVERSAL WASHROOM & STAGE LIFT)
A2-3 PARTIAL ENLARGED FLOOR PLANS – DEMOLITION
A2-4 PARTIAL ENLARGED FLOOR PLANS- NEW (ELEVATOR)
A3-1 ELEVATOR ADDITION ELEVATIONS
A3-2 ELEVATOR SHAFT SECTION
A3-3 SECTIONS

1.2 STRUCTURAL

S1-1 GENERAL NOTES
S1-2 GENERAL NOTES
S1-3 TYPICAL DETAILS
S1-4 TYPICAL DETAILS
SD2-1 FRAMING PLANS
S2-2 FRAMING PLANS
S2-3 FRAMING PLANS
S4-1 DETAILS

1.3 MECHANICAL

M1 MECHANICAL LEGEND AND NOTES
M2 FIRST FLOOR KEY
M3 SECOND FLOOR KEY PLAN
M4 ELEVATOR - MECHANICAL PART PLANS
M5 WASHROOM - MECHANICAL PART PLANS

1.4 ELECTRICAL

E1 ELECTRICAL LEGEND AND NOTES
E2 FIRST FLOOR KEY PLAN
E3 SECOND FLOOR KEY PLAN
E4 ELECTRICAL PART PLANS
E5 ELECTRICAL PART PLANS
E6 ELECTRICAL PART PLANS

End of Section

Room Finish Schedule

Room No.	Room Name	Floor		Base		Wall		Ceiling			Remarks
		mat'l	finish	mat'l	finish	mat'l	finish	mat'l	finish	height	
111	Universal Washroom	CONC.	POR	-	RUB	CONC BLK	SG-PT	ACT	-	2500	POR ON PLUMBING WALLS (SINK & TOILET)
112	Existing Washroom	CONC	EX	-	RUB	CONC BLK	SG-PT	EX	-	EX	MAKE GOOD NEW SINK AREA
113	Existing Stage	WD	WD	-	WD	EX	ST	EX	-	EX	MAKE GOOD EXSITNG WD FLOOR
114	Existing Vestibule	CONC	VCT	-	RUB	EX / BLK	SG-PT	GB	EG-PT	MATCH EX	WOOD STAIR
101	Existing Corridor	CONC	MATCH EX	-	MATCH EX	EX GB	SG-PT	EX	-	EX	MAKE GOOD AFFECTED AREA
102	Existing Corridor	CONC	MATCH EX	-	MATCH EX	EX	MATCH EX	EX	-	EX	NEW INFILL BLOCK WALL TO MATCH EX
7-1	New Vestibule	CONC.	POR	-	RUB	CONC. GB	SG-PT	ACT	-	3050	
7-2	New Vestibule	CONC	POR	-	RUB	CONC. GB	SG-PT	ACT	-	2725	
201	Existing Corridor	CONC	MATCH EX	-	MATCH EX	EX GB	SG-PT	EX	-	EX	MAKE GOOD AFFECTED AREA

LEGEND:

ACRYL	INTERIOR ACRYLIC PAINT	EP	EPOXY	P.LAM	PLASTIC LAMINATE	S/S	STAINLESS STEEL
ACT	ACOUSTIC CEILING TILE	EX	EXISTING	POR	PORCELAIN TILE	TER	TERRAZZO
BLK	BLOCK	EXP	EXPOSED	PT	PAINT	RUB	RUBBER BASE
CONC	CONCRETE	GYP	GYPSUM BOARD	SFT	SAFETY FLOORING	VCT	VINYL COMPOSITE TILE
CPT	CARPET	LEP	LATEX EPOXY	SG	SEMI-GLOSS		
EG	EGGSHELL	LVT	LUXURY VINYL TILE	SPF	SPORTS FLOORING		

End of Section

Door and Frame Schedule

Door No.	Door										Frame			Fire Rating	Remarks
	no. of leaves - width	height	thick	type	mat'l	finish	glass	ADO	HO	AI & CR	type	mat'l	finish		
	FIRST FLOOR														
1-1	2-EX.	EX	EX	EX HM	EX	PT EP	EX	✓		✓	EXT. EX	EX. HM	PT EP	?	<u>Main Entrance 1.</u>
GYM-1	2-±860	2150	45	C	WD	PT.	FG	✓			-	HM	PT EP	45MIN	<u>Gymnasium</u> -New doors in existing door opening. -Remove and re-install doors pull on pull side. -Existing door had WD frame, but new HM frame is proposed instead for new doors. -Existing door was type A solid door with no glass, new door is type “C” with top glass panel-see drawing detail 8-401.
GYM-2	1-950	2150	45	B	WD	PT.	TG	✓			-	HM	PT EP	-	<u>Stage Lift Area</u> New door in new opening. Provide new struc. Lintel-see struc. -Existing door was type A solid door with no glass, new door is type “B” with narrow top glass panel-see drawing detail 8-401.
OFF-1	1-EX.	EX	EX	EX	EX	PT EP	EX		✓		EX	EX	PT EP	EX. 45MIN	<u>Main Office.</u>

Abbreviations

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Ex–Existing Ext–Exterior FG–Fire Rated Tempered Glass HO– Hold-Open Device (Electromagnetic) IGU–Insulated Glazed Unit LG–Laminated Glass
PL–P.Lam w/ High Quality Transparent Finish PRE–Prefinished PSF–Pressed Steel Frame PT–Paint TB –Thermally Broken TG–Clear Tempered Glass
VAR–Varnish WD–Wood

Door and Frame Schedule

Door No.	Door										Frame			Fire Rating	Remarks
	no. of leaves - width	height	thick	type	mat'l	finish	glass	ADO	HO	AI & CR	type	mat'l	finish		
COR-1-1	2-EX	EX	EX	EX	EX. WD	EX.	EX.		✓		EX	EX. HM	PT EP	EX. 45MIN	<u>Ex. Corridor</u>
COR-1-2	1-EX	EX	EX	EX	EX. WD	EX.	EX.		✓		EX	EX. HM	PT EP	EX. 45MIN	<u>Ex. Corridor</u>
RES-1	3-EX	EX	EX	EX	HM	PT EP	EX.	✓			EX	HM	PT EP	-	<u>RESOURCE CENTRE</u>
UNI-1	950	2150	45	A	WD	VAR	-	✓			-	HM	PT EP		<u>New Univ. WR .</u>
7-1-1	2-950	2150	45	D	AL	PRE	TG	✓		✓	EXT. TB	AL	PRE	-	<u>BF. Entrance 7</u>
7-1-2	2-950	2150	45	D	HM	PT EP	FG	✓		✓	-	HM	PT EP	1.5 HRS	<u>BF. Entrance 7 Vestibule</u> BF. Leaf to open at 180°
6-1	2-EX.	EX.	EX.	EX.	EX. HM	PT EP	EX.	✓		✓ CR ONLY	EXT. EX.	EX. HM	PT EP.	-	<u>BF. Entrance 6</u>
6-2	2-EX.	EX.	EX.	EX.	EX. HM	EX.	EX.	✓			EX.	EX. HM	EX.	EX. 45MIN	<u>BF. Entrance 6 Vestibule</u>
3-1	2-EX	EX	EX	EX	EX. AL	EX.	EX.	EX.		✓	EXT. EX	EX. AL	EX.	-	<u>Ex. Entrance 3</u> At Kindergarten Add push buttons for existing ADO

Abbreviations

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VAR–Varnish WD–Wood

Door and Frame Schedule

Door No.	Door										Frame			Fire Rating	Remarks
	no. of leaves - width	height	thick	type	mat'l	finish	glass	ADO	HO	AI & CR	type	mat'l	finish		
3-2	2-EX	EX	EX	EX	EX. HM	PT EP	EX.	EX.			EX	EX. HM	PT EP	-	<u>Ex. Entrance 3 Vestibule</u> At Kindergarten Add push buttons for existing ADO
GP-1	3-950	EX	EX	EX	EX	PT EP	EX	✓			EX	HM	PT EP	-	<u>General Purpose</u>
HSP-1	1-EX	EX	EX	-	EX	EX	-	✓			EX	HM	PT EP	-	<u>Ex. HSP/RES CLASSROOM</u>
	SECOND FLOOR														
COR-2-1	1-950 +1-740	EX	45	D	WD	VAR	FG		✓		-	HM	PT EP	45 MINS	<u>Ex. Corridor</u> -New doors within glazed screen frames -GC to site verify. Hold open to be door frame mounted.
COR-2-2	1-EX	EX	EX	D	WD	VAR	EX		✓		EX	HM	PT EP	45 MINS	<u>Ex. Corridor</u> -GC to site verify. Hold open to be door frame mounted.
7-2-1	1-950	2150	45.	D	HM	PT EP	FG	✓			-	HM	PT EP	1,5 HRS	<u>Vestibule 7-2</u> ADO mounted on glazed screen

Abbreviations

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Door and Frame Schedule

General Notes:

•	All ex. HM doors and frames proposed to be painted "PT", to be well prepared first to receive new painting -see specs and should be painted both sides.
•	Reuse ex. HM frames where new doors to be installed in ex. openings. All ex. HM frames to be repainted.
•	Refer to Colour Schedule for paint colors of HM doors and frames.
•	Turn in all the old hardware on ex. Doors to be removed and/or replaced to TDSB but temporary remove & reuse the cylinder cores. Before temporarily storing the cylinder cores, label by marking on the core itself, which room number it came out from.
•	Site verify ex. door openings widths before door manufacturing. Wherever ex. door openings widths do not allow for installation of a min. 950mm wide door for new doors to be installed in ex. openings, GC to inform K+/TDSB to provide further direction.
•	All tempered, fire rated glass/firelite to be labelled by the manufacturer as such.
•	All fire rated doors to be labelled by Intertek or equivalent as such.
•	All new electromagnetic hold opens to be connected to the fire alarm system – see elec.
•	Refer to floor plan for the location side of the door operator, regardless GC is responsible to site verify the side the door operator can be mounted on where there is enough headroom to ceiling above the door. Preference is to mount the door operator on the push side, however if no enough headroom to ceiling ceiling space exists , GC to install on the opposite side and door operator to be specified as such. If no enough headroom to ceiling exists on either side, door operator to be installed within the ceiling bulkhead and be of the "recessed" type. Wherever an ADO is proposed for a double door, on door to be ADO operated and the other leaf to have a door closer.
•	Installation of new doors cylinders for <u>existing doors</u> , will be done by TDSB hardware vendor (N.I.C.). All permanent cylinders will be purchased by the TDSB and installed by the school board hardware vendor-see hardware schedule. However, where indicated in the hardware schedule to provide new locksets for existing doors, the new locksets to have <u>compatible</u> temporary construction cylinders within and both to be provided by GC. Locksets to also be <u>compatible</u> with permanent construction cylinders which in turn will be provided by TDSB.
•	GC to install temporary construction cylinders within permanent locksets, compatible with the school's master keying system of interchangeable core, for all <u>new doors</u> requiring keying. All permanent cylinders will be purchased by the TDSB after and installed by the school board hardware vendor-see hardware schedule.
•	AI and Card readers will be provided by TDSB. GC to provide and allow for the electric strikes and electrical connections and install only the AI and Card readers.

Abbreviations

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VAR–Varnish WD–Wood

Door and Frame Schedule

End of Section

Abbreviations

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VAR–Varnish WD–Wood

Colour Schedule

PART 1 - GENERAL

1.1 Reference

- .1 Comply with requirements of Division 1. This Colour Schedule is to be read in conjunction with all other contract documents.
- .2 Colour selections are based on specific manufacturers products and that further review and adjustments will be made once successful suppliers and/or manufacturers are known.

PART 2 - LIST OF FINISHES

1. Porcelain Tile:

1. **(POR-1):**

Manufacturer:	Olympia Tile	
Series:	Pinch	
	Through body, glazed porcelain	
Colour:	Light Grey	Looks like terrazzo
Code:	MZ.PC.LGR.2424.MT	
Finish:	Matte	
Shade Variation:	V-2	
Size:	600mm x 600mm (24" x 24")	
Thickness:	9 mm (3/8")	
Application:	Floor	
2. **(POR-2):**

Manufacturer:	Olympia Tile	
Series:	Blend	
	Through body, glazed porcelain	
Colour:	Elite (Turquoise Blue-Green)	Looks like slate
Code:	BC.BL.ELT.1224	
Finish:	Matte	
Sade Variation:	V-2	
Size:	300mm x 610mm (12" x 24")	
Thickness:	9 mm (3/8")	
Application:	Wall	

2. Grout:

1. **(GT-1)**

Manufacturer:	Mapei	
Colour:	11 Sahara Beige	
Application:	Floor – sanded Karalastic/ Karabond	
Paired with Tile(s):	POR-1	
2. **(GT-2)**

Manufacturer:	Mapei	
Colour:	11 Sahara Beige	
Application:	Wall – unsanded Ultra/ Mastic 1 with Plastijoint acrylic latex grout additive	
Paired with Tile(s):	POR-2	

-1

Contact:	Mapei	Jeff McCoppen	905-799-6884
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Colour Schedule

PART 2 - LIST OF FINISHES (cont'd)

3. Paint:

- | | | | | |
|----|---------------|---------------|---------------------------|--------------------|
| 1. | (PT-1) | Manufacturer: | Dulux Paints | |
| | | Colour: | Winter Bird | (white) |
| | | Code: | 30YY 78/018 | |
| | | Application: | Wall – Universal Washroom | |
| 2. | (PT-2) | Manufacturer: | Dulux Paints | |
| | | Colour: | Sea Gull Grey | (warm medium grey) |
| | | Code: | 30YY 42/083 | |
| | | Application: | Ceilings | |

DIVISION – 1

- 1-101 Standard abbreviations
- 1-102 Standard abbreviations
- 1-103 Standard symbols

DIVISION – 2

- 2-105 Typical Bollard Details

DIVISION 4 – 1

- 4-101 Control Joint at Interior Door
- 4-103 Typical Bullnose Block Corner Detail.
- 4-107 Typ. Door Jamb at Block Wall

DIVISION – 5 - 1

- 5-117 Steel Ladder Detail at Elevator Pit

DIVISION – 7 - 0

- 7-041 Expansion Joint cover Plan Detail

DIVISION – 7 - 2

- 7-201 First Floor Plan Detail Grid 1/B
- 7-202 First Floor Plan Detail Grid 1/C
- 7-203 First Floor Plan Detail Grid 2/C
- 7-204 First Floor Plan Detail Grid 1/C

DIVISION – 7 - 5

- 7-501 Section Roof Detail Roof Curb
- 7-502 Spare
- 7-503 Section Roof Detail
- 7-504 Section Roof Detail Roof Curb
- 7-505 Section Roof Detail at Existing Roof
- 7-506 Section Detail at Foundation
- 7-507 Section Detail at Curtainwall
- 7-508 Section Detail at Sill
- 7-509 Section Detail at 2nd Floor Level
- 7-510 Section Detail at Foundation
- 7-511 Section Roof Detail at curtainwall
- 7-512 Section Detail at Door Head
- 7-513 Section Detail at 2nd Floor Level
- 7-514 Section Detail at Door Head
- 7-515 Section Detail at Floor Level

DIVISION – 8 – 4

- 8-401 Door Types
- 8-402 Window Schedule
- 8-403 Window Schedule
- 8-404 Hollow Metal Screen

DIVISION – 8 - 5

8-500 Hollow Metal Frame Details
8-501 Hollow Metal Frame Details

DIVISION 10 – 1

10-100 Barrier-Free Washroom Front Elevation
10-101 Barrier-Free Washroom Side Elevation
10-102 Barrier-Free Washroom Accessory Installation

End of Section

AC/ACT	ACOUSTIC CEILING TILE	DF	DRINKING FOUNTAIN	GR	GRADE
ACR	ACRYLIC	DG	DOUBLE GLAZE	GSR	GAS SERVICE REGULATOR
AD	AREA DRAIN	DH	DOUBLE HUNG	GRA	GRAVEL
ADJ	ADJUSTABLE	DIA.	DIAMETER	GWG	GEORGIAN WIRE GLASS
AFF	ABOVE FINISHED FLOOR	DIM	DIMENSION	GYP	GYPSUM
AGGR	AGGREGATE	DISP	DISPENSER		
AL	ALUMINUM	DK	DECK	HB	HOSE BIB
AP	ACOUSTIC PANEL	DN	DOWN	HC	HOLLOW CORE
APG	ARMoured PLATE GLASS	DO	DOOR OPENING	HDWD	HARDWOOD
APPROX.	APPROXIMATE	DS	DOWNSPOUT	HD	HAND DRYER
ARCH	ARCHITECTURAL	DW	DISHWASHER	HDWE	HARDWARE
AS SPEC.	AS SPECIFIED	DWG	DRAWING	HGT	HEIGHT
ASPH	ASPHALT	DWR	DRAWER	HM	HOLLOW METAL
ASS'Y	ASSEMBLY			HORIZ.	HORIZONTAL
ATTEN.	ATTENUATION	E	EAST	HP	HYDRO POLE
A/V	AIR VAPOUR	EA.	EACH	HR	HOUR
		EF	EXHAUST FAN	HSS	HOLLOW STEEL SECTION
BAT	BATTENS	EJ	EXPANSION JOINT	HTG	HEATING
BC	BOTTOM CURB	EL	ELEVATION	HW	HOT WATER HEATER
BD	BOARD	ELECT	ELECTRICAL		
BF	BARRIER-FREE	EMER	EMERGENCY	ID	INSIDE DIAMETER
BITUM.	BITUMINOUS	EN	ENAMEL	IFOB	INSIDE FACE OF BLOCK
BKCS	BOOKCASE	ENCL	ENCLOSURE	IMP	INSULATED METAL PANEL
BLDG	BUILDING	EP	EPOXY	INV	INVERT
BLK	BLOCK	EQ	EQUAL	INSUL	INSULATION
BLKHD	BULKHEAD	EQMT	EQUIPMENT	INT	INTERIOR
BM	BEAM	ES	EGG SHELL		
BOT	BOTTOM	EX.	EXISTING	JAN	JANITOR
BRK	BRICK	EXPAN	EXPANSION	JT	JOINT
BUR	BURLAP	EXP	EXPOSED		
		EXT	EXTERIOR	KIT	KITCHEN
C	CHAIR				
CB	CATCH BASIN	FA	FIRE ALARM	LAM	LAMINATE
CFI	CONCRETE FACED INSULATION	FAAP	FIRE ALARM ANNUNCIATION PANEL	LAV	LAVATORY
CEM	CEMENT	FD	FLOOR DRAIN	LDIG	LIGHT DIFFUSING INSULATED GLASS
CER	CERAMIC TILE	FDC	FIRE DEPARTMENT CONNECTION	LEP	LATEX EPOXY PAINT
CG	CORNER GUARD	FDN	FOUNDATION	LF	LATERAL FILE
CHBD	CHALKBOARD	FE	FIRE EXTINGUISHER	LF	LATERAL FILE
CI	CAST IRON	FEC	FIRE EXTINGUISHER CABINET	LKR	LOCKER
CJ	CONTROL JOINT	FF	FORCED FLOW HEATER	LP	LIGHTING PANEL
CL	CENTRE LINE	FG	FIXED GLASS	LS	LIGHT STANDARD
CLB	CENTRE LINE OF BLOCK	FHC	FIRE HOSE CABINET	LT WT	LIGHT WEIGHT
CLG	CEILING	FIN	FINISH	LV	LATERAL FILE
CLO	CLOSET	FL	FLOOR	LVT	LUXURY VINYL TILE
CLR	CLEAR	FLASH	FLASHING		
CM	COFFEE MACHINE	FLEX.	FLEXIBLE	M	METAL
CNTR	COUNTER	FLUOR	FLUORESCENT	MAX.	MAXIMUM
CO	CASED OPENING	FLT	FLOAT	MCT	MARMOLEUM COMPOSITE TILE
COL	COLUMN	FOB	FACE OF BLOCK	M.D.F.	MEDIUM DENSITY FIBREBOARD
CONC	CONCRETE	FOB(EX.)	FACE OF BLOCK (EXISTING)	MECH	MECHANICAL
CONN	CONNECTION	F.PT	FLAT PAINT	MEMB	MEMBRANE
CONSTR.	CONSTRUCTION	FR	FRIDGE	MFR	MANUFACTURER
CONT.	CONTINUOUS	F.RET	FIRE RETARDENT	MGAT	MAKE GOOD ALL TRADES
CORR	CORRIDOR	FRR	FIRE-RESISTANCE RATED	MH	MAINTENANCE HOLE
CP	CONTROL PANEL	FT	FOOT or FEET	MIN	MINIMUM
CPAN	COMPOSITE PANEL	FTG	FOOTING	MIR	MIRROR
CPT	CARPET	FURR	FURRING	MISC	MISCELLANEOUS
CTG	COATING	FUT	FUTURE	MO	MASONRY OPENING
CTR	CENTRE	F&G	FELT & GRAVEL	MOR	MORTAR
CTSK	COUNTER SUNK			MR	MOISTURE RESISTANT
C/W	COMPLETE WITH	GA	GAUGE	MSB	MEDIUM SAND BLAST
CV	CONVECTOR	GALV	GALVANIZED	MTD	MOUNTED
		GB	GRAB BAR	MUL	MULLION
		GL	GLASS	MW	MICROWAVE
DBL	DOUBLE	GL.BL.	GLAZED BLOCK		
DEPT	DEPARTMENT	GND	GROUND		
DET.	DETAIL				


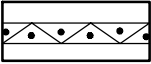
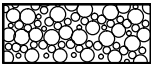
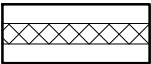
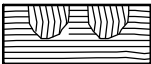
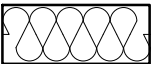



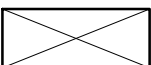
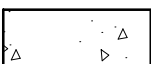
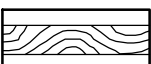
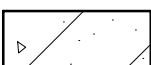
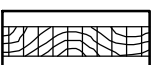
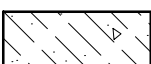
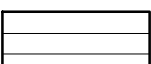
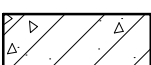
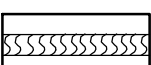
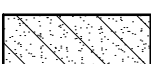
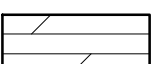
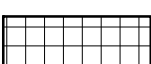
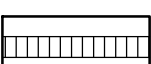
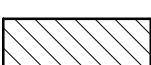



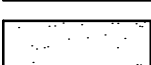
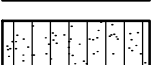
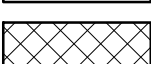

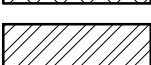
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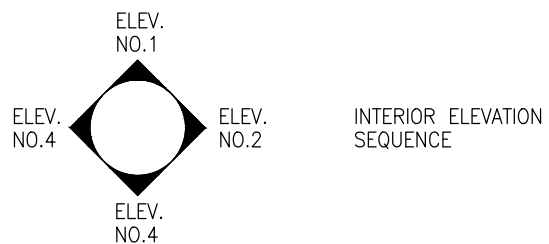
Kingsland + ARCHITECTS INC.	ISSUED:	DRAWING NAME: STANDARD ABBREVIATIONS		DATE: MAR 2026		SCALE: N.T.S.	
		PROJECT NAME: William G Miller-Bundle 5		DRAWN: K+		PROJECT NO: A25006	
				CHECKED: K+		DWG NO: 1-101	REV. 0

KINGSLAND + ARCHITECTS INC
110 Cumberland Street, Suite 262
Toronto, Ontario M5R 3V5
ph 416.203.7799
fax 416.203.7763

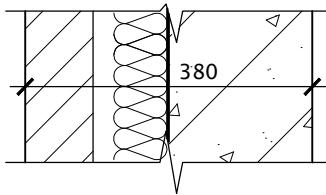
N	NORTH	S	SOUTH	VRT	VINYL REINFORCED TILE
ND	NAPKIN DISPOSAL	SC	SOLID CORE	VSF	VINYL SAFETY FLOOR
NIC	NOT IN CONTRACT	SCHED	SCHEDULE	VWC	VINYL WALLCOVERING
NO. or #	NUMBER	SD	SOAP DISPENSER		
NOM.	NOMINAL	SECT	SECTION		
NS	NON SLIP	SG	SEMI GLOSS	W	WEST
NTS	NOT TO SCALE	SH	SHELF	W/	WITH
		SHR	SHOWER	W.C.	WATER CLOSET
OA	OVER ALL	SHT	SHEET	WD	WOOD
OBS	OBSCURE	SIL	SILICONE	W/O	WITHOUT
O.C.	ON CENTRE	SIM	SIMILAR	WHBD.	WHITEBOARD
OFB	OUTSIDE FACE OF BLOCK	SL.BLK.	SLAG BLOCK	WP	WATERPROOF
OD	OUTSIDE DIAMETER	SP	SPRAYED	WR	WASHROOM
OHD	OVERHEAD DOOR	SPAN	SPANDREL PANEL	WSCT	WAINSCOT
OPNG	OPENING	SPEC.	SPECIFICATION	WT	WEIGHT
OPP	OPPOSITE	SPF	SPORTS FLOORING	WWM	WELDED WIRE MESH
OWSJ	OPEN WEB STEEL JOIST	SPG	SPANDREL GLASS		
		SP.BK.	SPLASHBACK		
P	PLASTIC	SQ	SQUARE		
PARG	PARGING	SS	STAINLESS STEEL		
PART	PARTITION	SSCG	STAINLESS STEEL CORNER GUARD		
PB	PARTICLE BOARD	SSKP	STAINLESS STEEL KICKPLATE		
PC	PRECAST	S.SUR.	SOLID SURFACE		
PERF	PERFORATED	ST	STOVE		
PG	PLATE GLASS	STA	STATION		
PL	PLATE	STD	STANDARD		
P.LAM	PLASTIC LAMINATE	STN	STAIN		
PLAS.	PLASTER	STL	STEEL		
PLY	PLYWOOD	STG	STORAGE		
PNEU	PNEUMATIC	STRUCT	STRUCTURAL		
POL	POLISHED	STY	STYLE		
POR	PORCELAIN TILE	SUP	SUPPORT		
PP	POWER PANEL	SUSP	SUSPENDED		
PPG	POLISHED PLATE GLASS	SVF	SHEET VINYL FLOORING		
PR	PAIR	SYM	SYMMETRICAL		
PREFIN	PREFINISHED				
PT	PAINT	T	TREADS		
PTD	PAPER TOWEL DISPENSER	TB	TOWEL BAR		
QT	QUARRY TILE	TBL	TABLE		
		TC	TOP OF CURB		
R	RISER	TEC	TECTUM		
RAD	RADIUS	TEL	TELEPHONE		
RD	ROOF DRAIN	TER	TERRAZZO		
REF	REFERENCE	T&G	TONGUE & GROOVE		
REFR	REFRIGERATOR	THK	THICK		
REINF	REINFORCED	THRES	THRESHOLD		
RESIL.	RESILIENT	TKBD	TACKBOARD		
REQ.	REQUIRED	T/O	TOP OF		
RFG	ROOFING	TPG	TEMPERED PLATE GLASS		
RGTR	REGISTER	TR	TRIM		
RH	ROOF HOPPER	TRAN	TRANSITION		
RM	ROOM	TTD	TOILET TISSUE DISPENSER		
RO	ROUGH OPENING	TV	TELEVISION		
RTT	RESILIENT TERRAZZO TILE	TW	TOP OF WALL		
RUB	RUBBER	TYP.	TYPICAL		
RWL	RAIN WATER LEADER				
		UNF	UNFINISHED		
		UNGL	UNGLAZED		
		UNIV.	UNIVERSAL		
		U.O.N.	UNLESS OTHERWISE NOTED		
		UR	URINAL		
		U/S	UNDERSIDE		

Kingsland + ARCHITECTS INC.	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		STANDARD ABBREVIATIONS	MAR 2026	N.T.S.	
		(CONT'D)	DRAWN:	PROJECT NO:	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	K+	A25006	
			CHECKED:	DWG NO:	REV.
		William G Miller—Bundle 5	K+	1-102	0

	EARTH		TERRAZZO
	CRUSHED STONE		QUARRY TILE
	ROCK		BATT INSULATION
	CINDER OR SLAG FILL		FINISHED WOOD
	SAND, PLASTER & CEMENT		WOOD BLOCKING
	CAST-IN-PLACE CONCRETE		WOOD STUD PARTITION
	PRECAST CONCRETE		INSULATION WOOD STUD PARTITION
	LIGHT WEIGHT CONCRETE		METAL STUD PARTITION
	CONCRETE BLOCK		INSULATION METAL STUD PARTITION
	SLAG BLOCK		PLYWOOD/M.D.F./PARTICLE BOARD
	GLAZED SLAG BLOCK		ACOUSTIC TILE
	FACE BRICK		METAL LATH & PLASTER
	FIRE BRICK		GYPSUM BOARD
	FACING STONE		TECTUM
	SPRAY FOAM INSULATION		RIGID INSULATION
	METAL, STEEL		

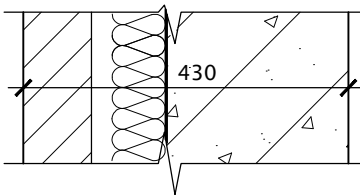


<div>Kingsland + ARCHITECTS INC.</div> <div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div>	ISSUED:	DRAWING NAME: STANDARD SYMBOLS	DATE: MAR 2026	SCALE: N.T.S.	
			DRAWN: K+	PROJECT NO: A25006	
		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+	DWG NO: 1-103	REV. 0



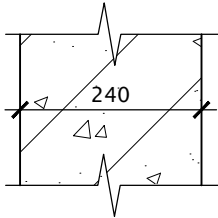
W1

190mm CONCRETE BLOCK
AIR BARRIER
75mm MINERAL INSUL.
25mm AIR SPACE
90mm MASONRY VENEER

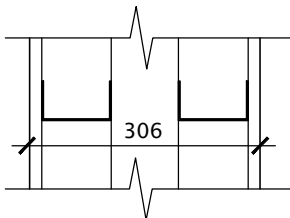


W2

240mm CONCRETE BLOCK
AIR BARRIER
75mm MINERAL INSUL.
25mm AIR SPACE
90mm MASONRY VENEER




W3 240mm CONCRETE BLOCK



W4 16mm GYPSUM BOARD ON 92mm METAL STUD 90mm SPACE
92mm METAL STUD 16mm GYPSUM BOARD

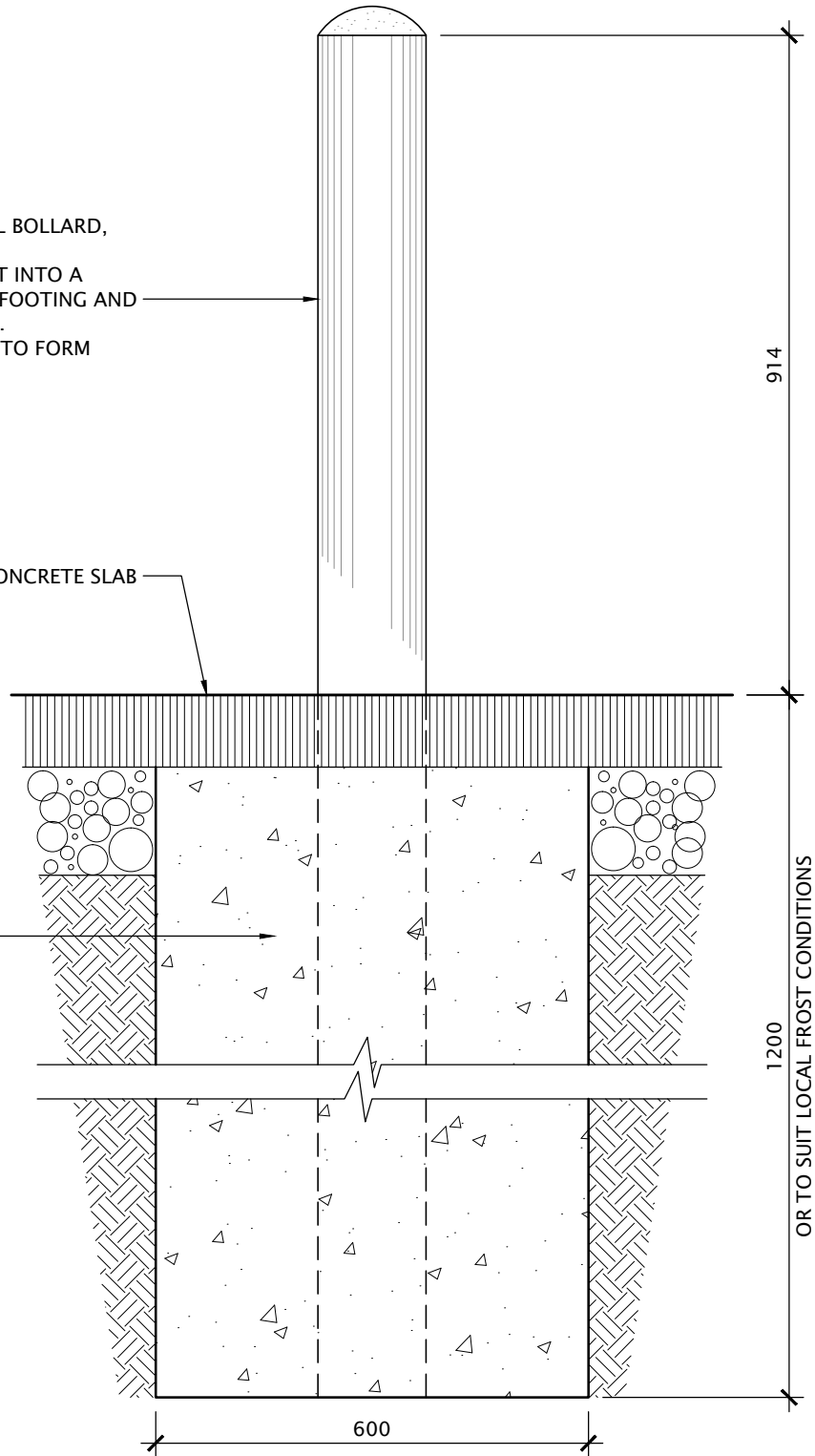


<div>Kingsland + ARCHITECTS INC.</div> <div></div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		WALL TYPE SCHEDULE	MAR 2026	1:10	
			DRAWN:	PROJECT NO:	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	K+	A25006	
		William G Miller—Bundle 5	CHECKED:	DWG NO:	REV.
			K+	1-104	0

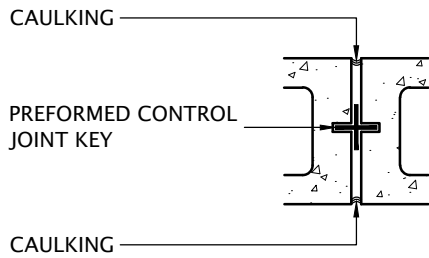
150mm OD GALV. STEEL BOLLARD,
PAINTED
2114mm IN LENGTH SET INTO A
600mm OD CONCRETE FOOTING AND
FILLED WITH CONCRETE.
ROUND OFF CONCRETE TO FORM
SMOOTH CAP

ASPHALT PAVING OR CONCRETE SLAB

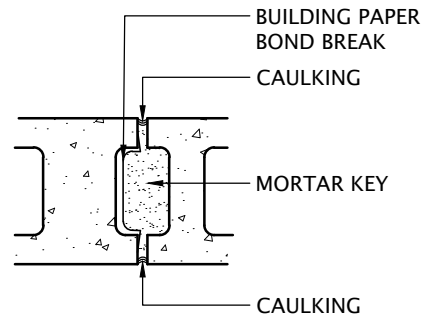
POURED CONCRETE
FOUNDATION



<div>Kingsland + ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		TYPICAL BOLLARD DETAIL	MAR 2026	1:10	
				DRAWN:	PROJECT NO:
<div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div>			K+	A25006	
	PROJECT NAME:	CHECKED:	DWG NO:	REV.	
	William G Miller—Bundle 5	K+	2–105	0	

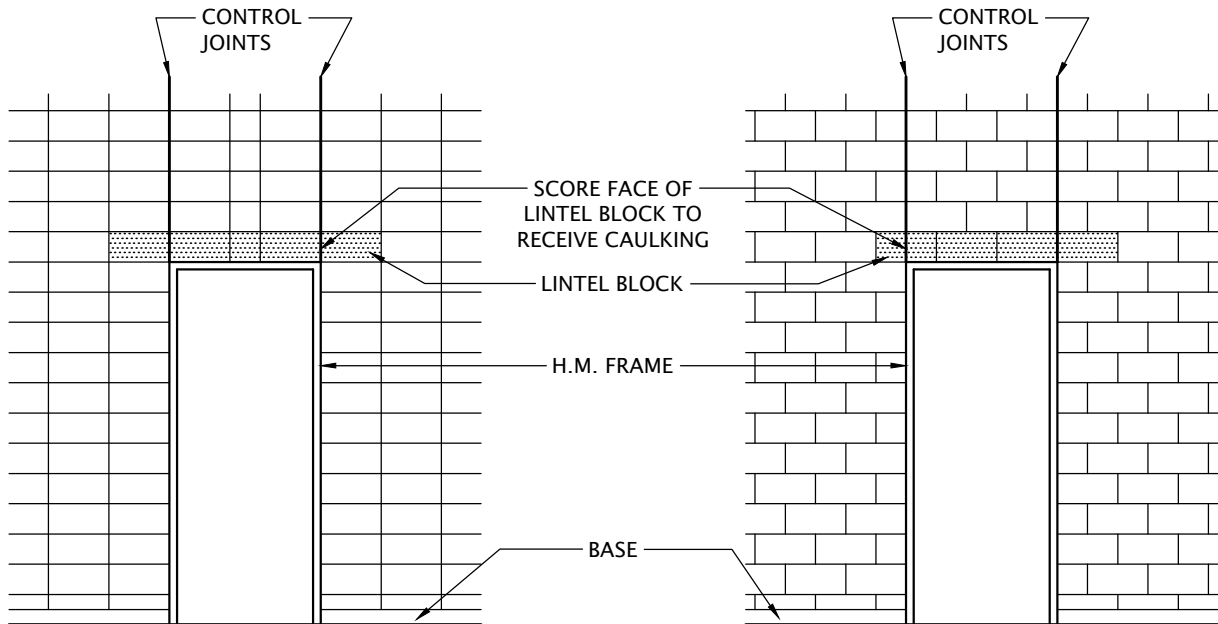


CONTROL JOINT FOR NON
LATERAL STABILITY OF WALL



CONTROL JOINT FOR
LATERAL STABILITY OF WALL

SECTIONS

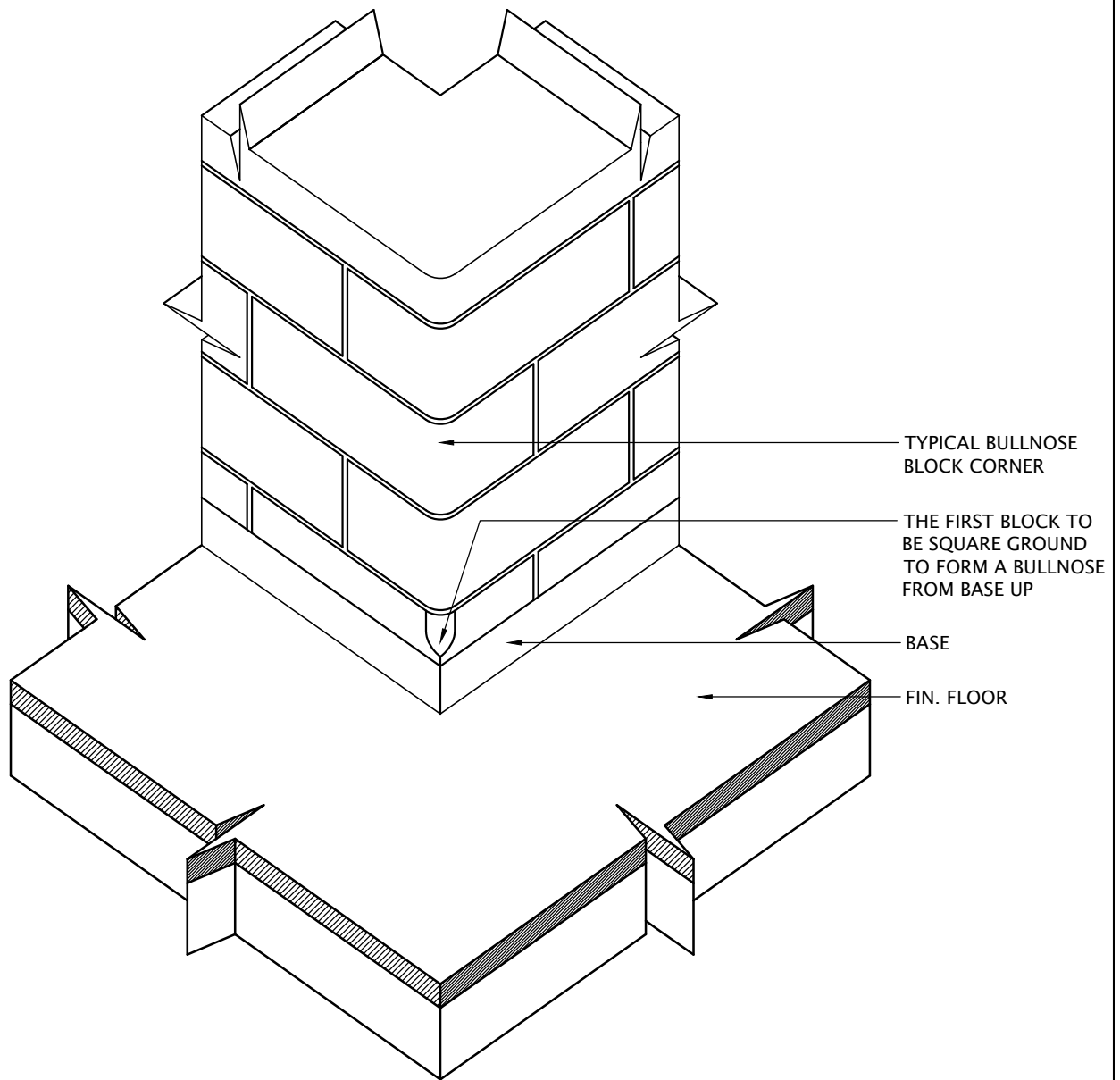


STACK BOND ELEVATION

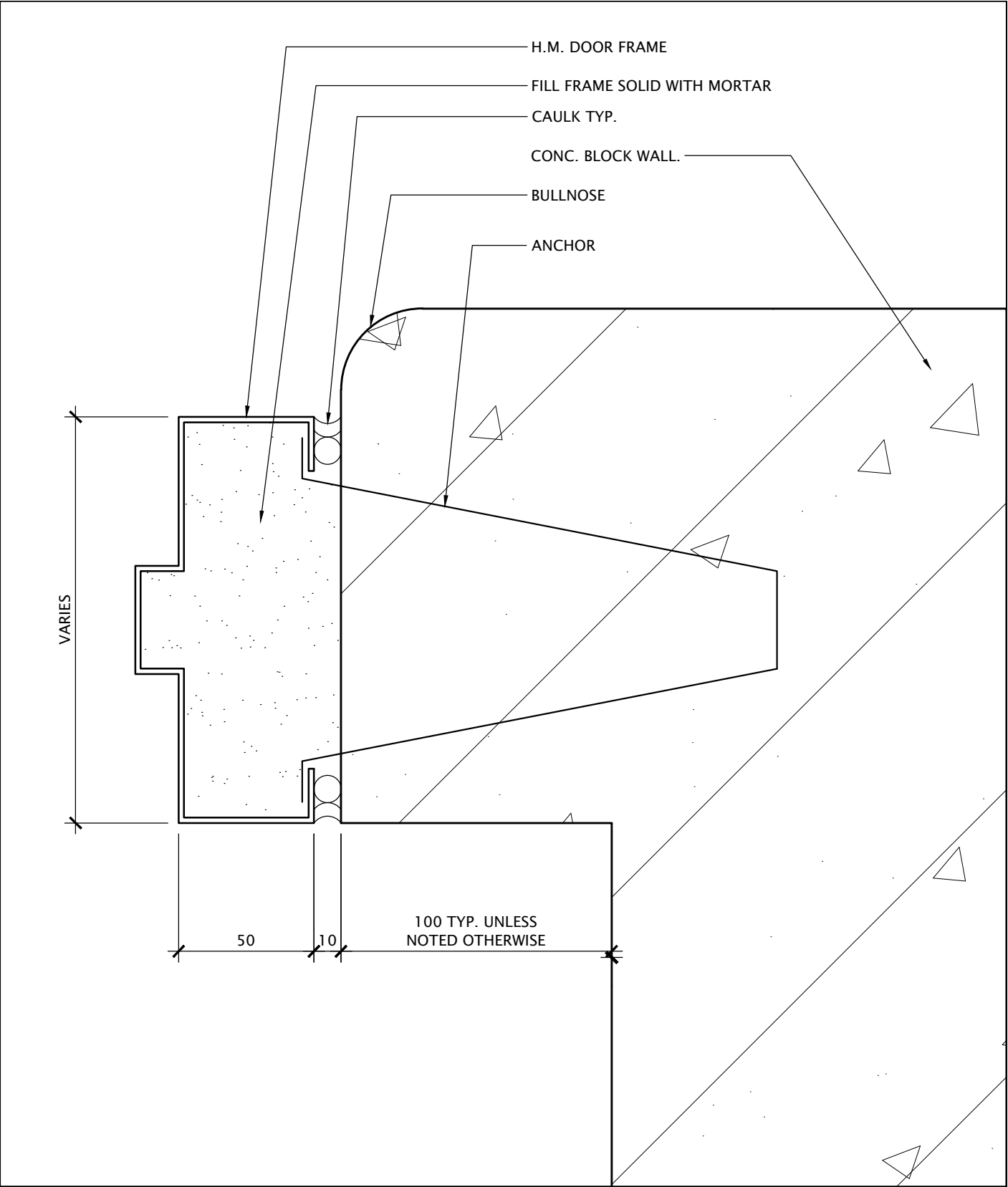
RUNNING BOND ELEVATION

NOTE: EXTEND CONTROL JOINT TO U/S OF STRUCTURE ABOVE

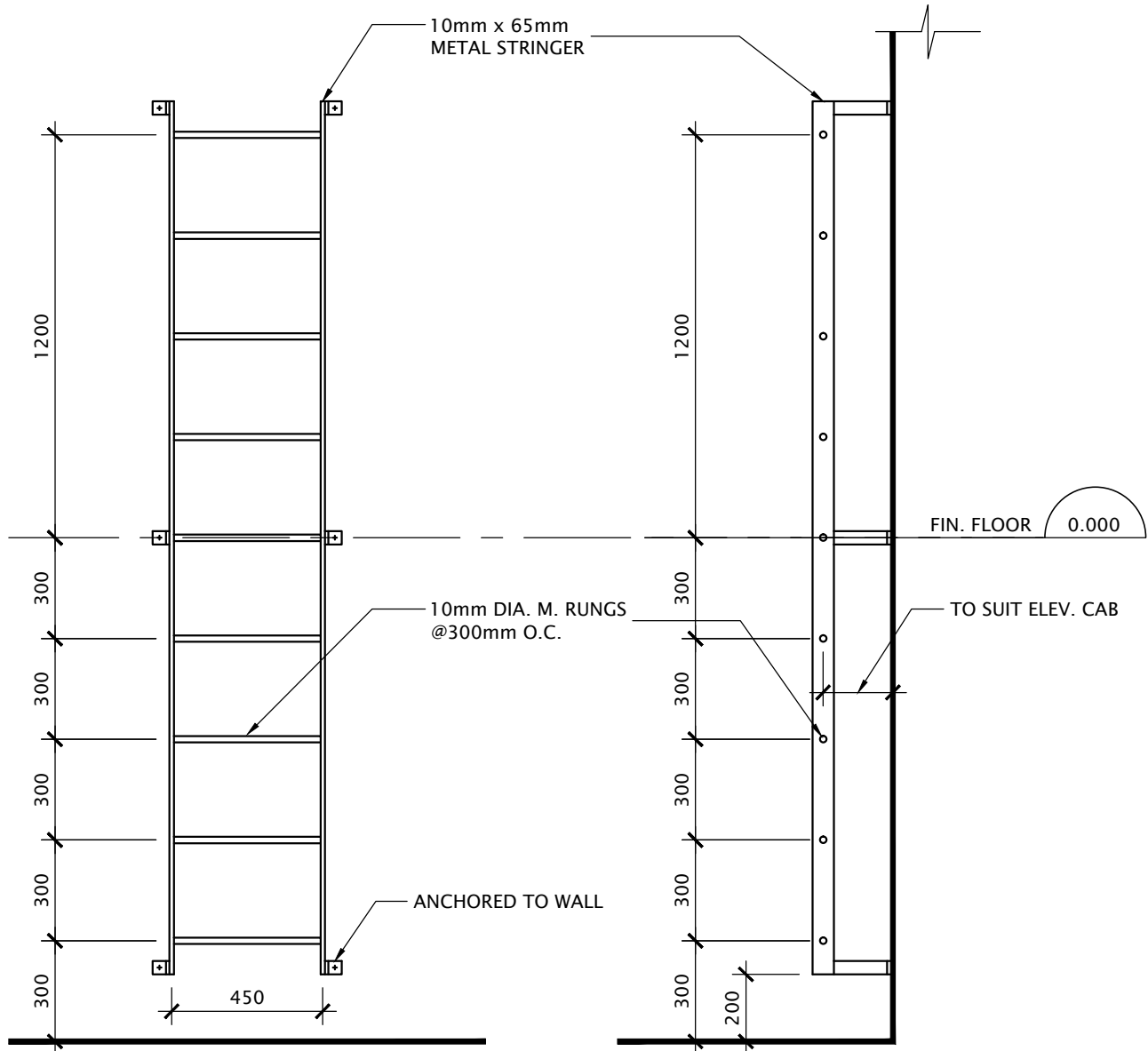
Kingsland + ARCHITECTS INC.	ISSUED:	DRAWING NAME: CONTROL JOINT AT INTERIOR DOOR	DATE: MAR 2026		SCALE: N.T.S.	
			DRAWN: K+		PROJECT NO: A25006	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+		DWG NO: 4-101	REV. 0



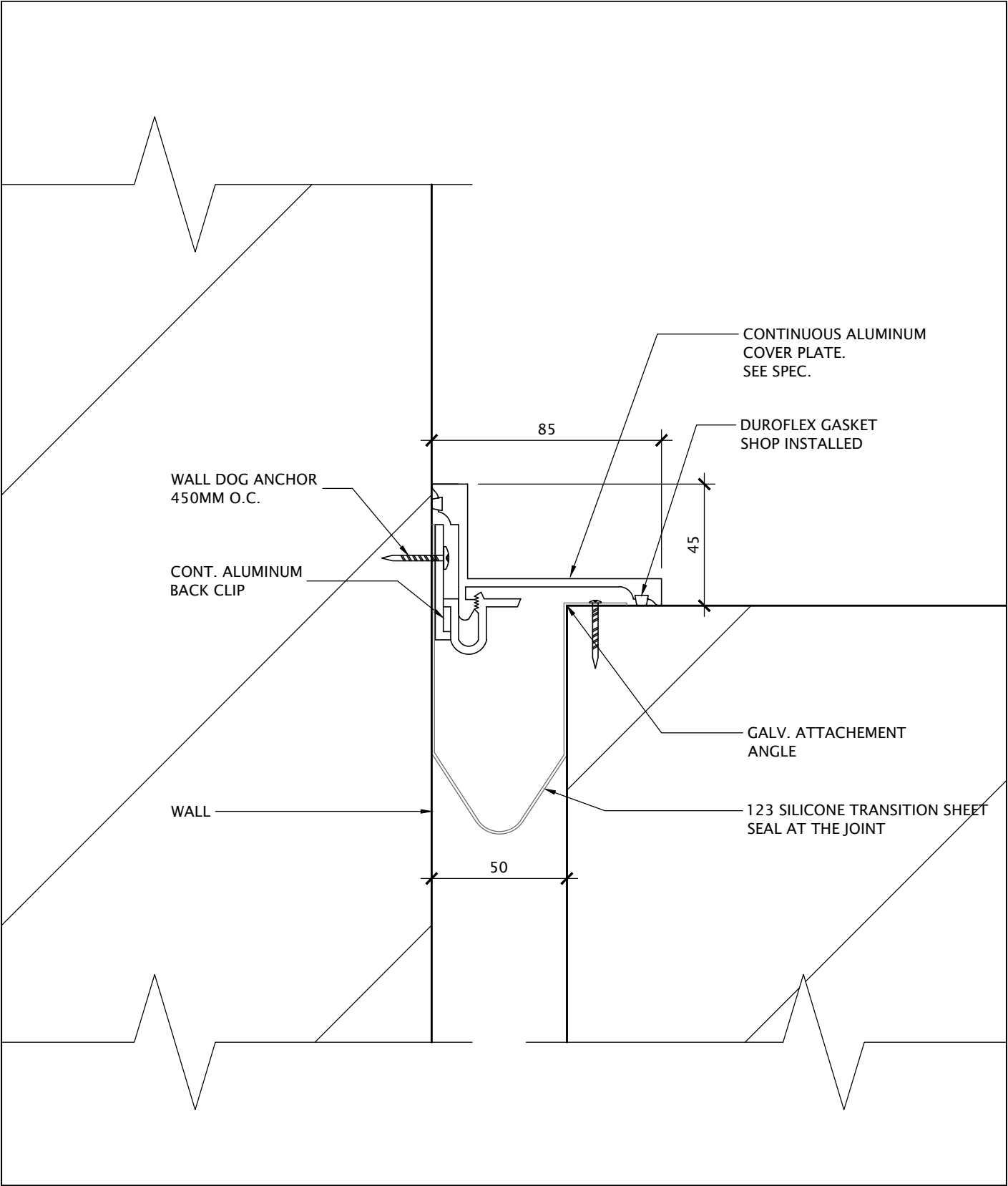
Kingsland + ARCHITECTS INC.	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		TYP. BULLNOSE BLOCK CORNER DETAIL	MAR 2026	1:5	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller—Bundle 5	K+	A25006	
			CHECKED:	DWG NO:	REV.
			K+	4-103	0



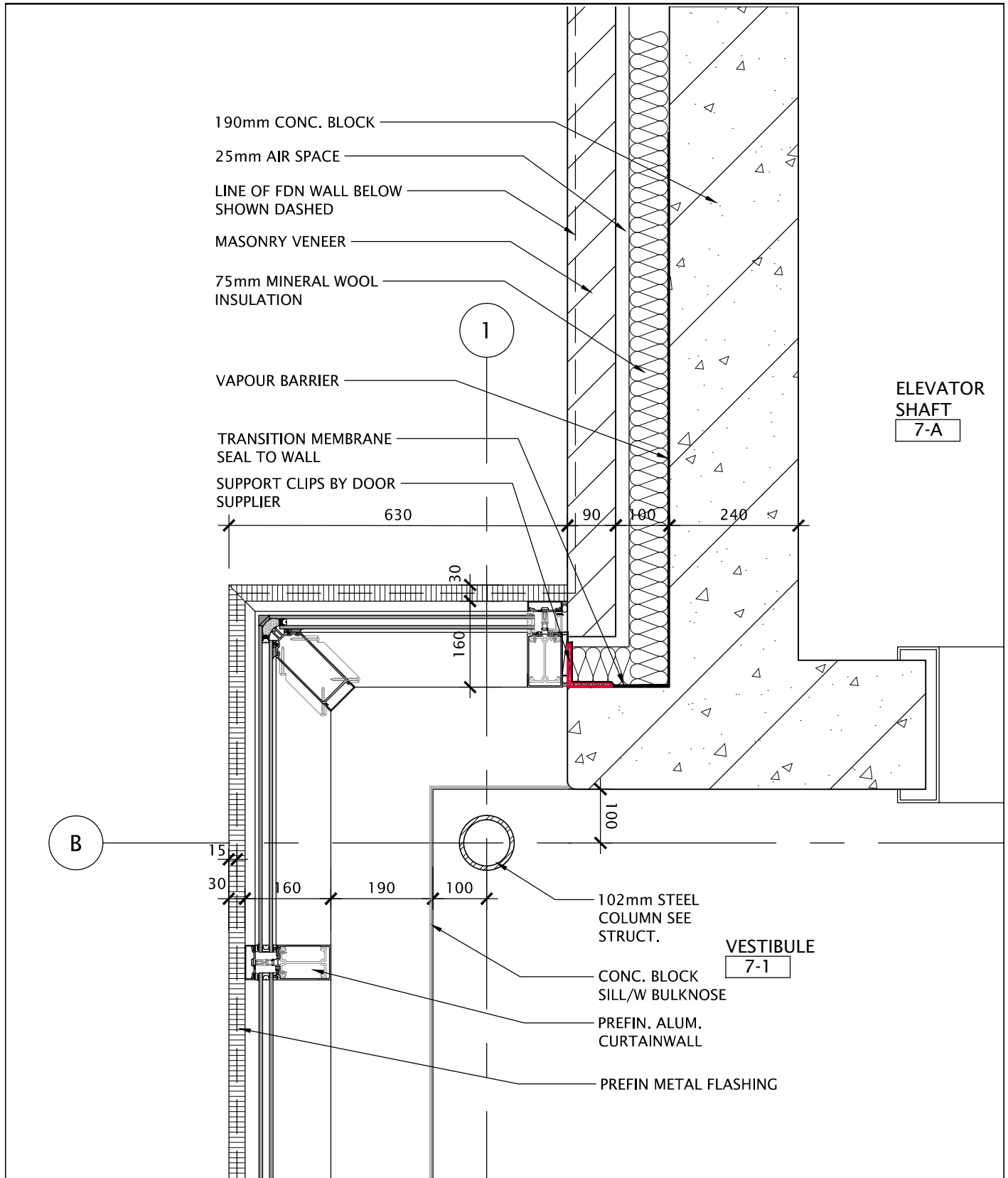
<div><div>Kingsland + ARCHITECTS INC.</div><div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div></div>	ISSUED:	DRAWING NAME: TYP. DOOR JAMB AT BLOCK WALL		DATE: MAR 2026		SCALE: 1:2	
		PROJECT NAME: William G Miller—Bundle 5		DRAWN: K+		PROJECT NO: A25006	
				CHECKED: K+		DWG NO: 4-107	REV. 0



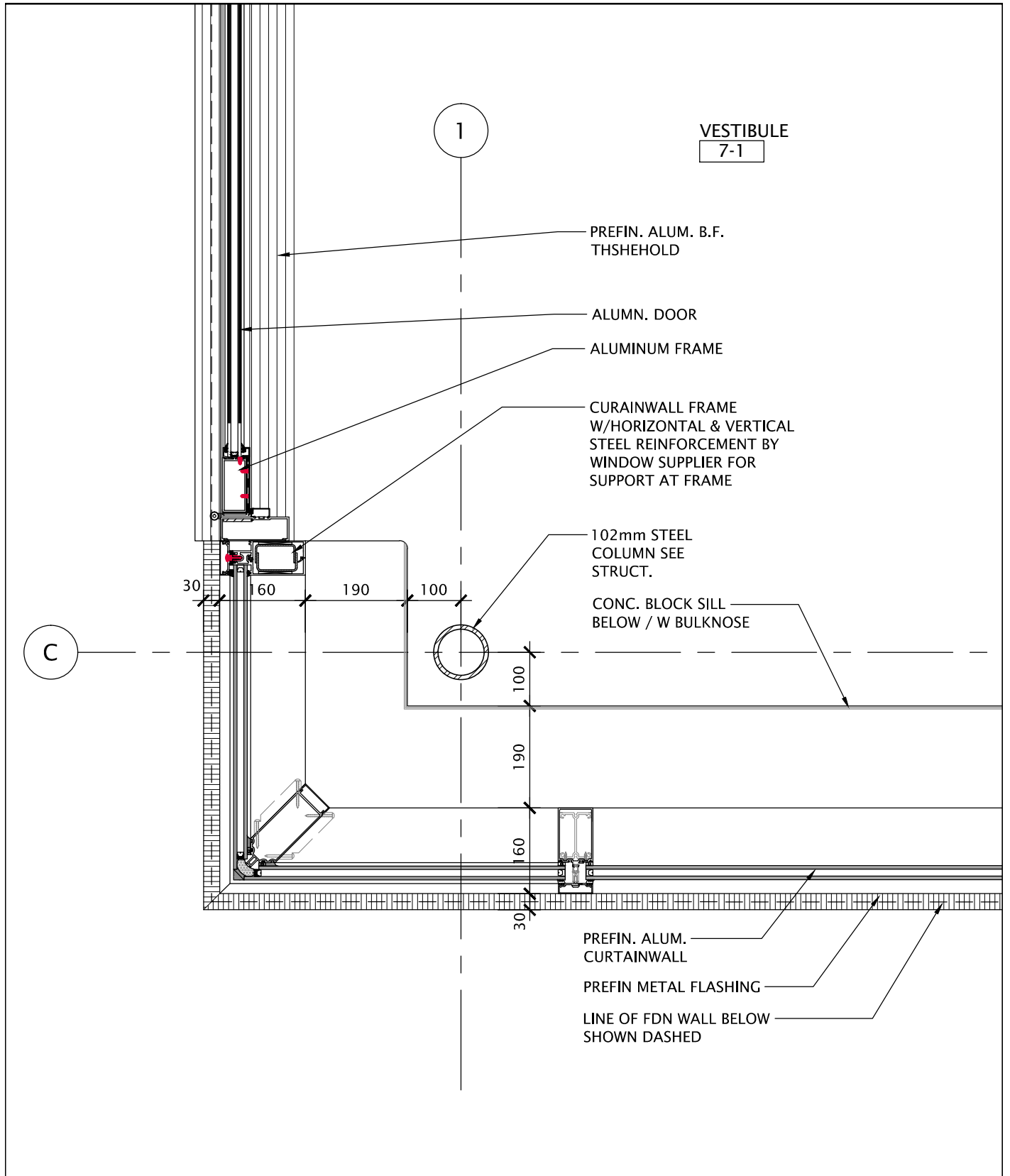
<div>Kingsland + ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		STEEL LADDER DETAIL AT ELEVATOR PIT	MAR 2026	1:20	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller—Bundle 5	K+	A25006	
			CHECKED:	DWG NO:	REV.
			K+	5-117	0



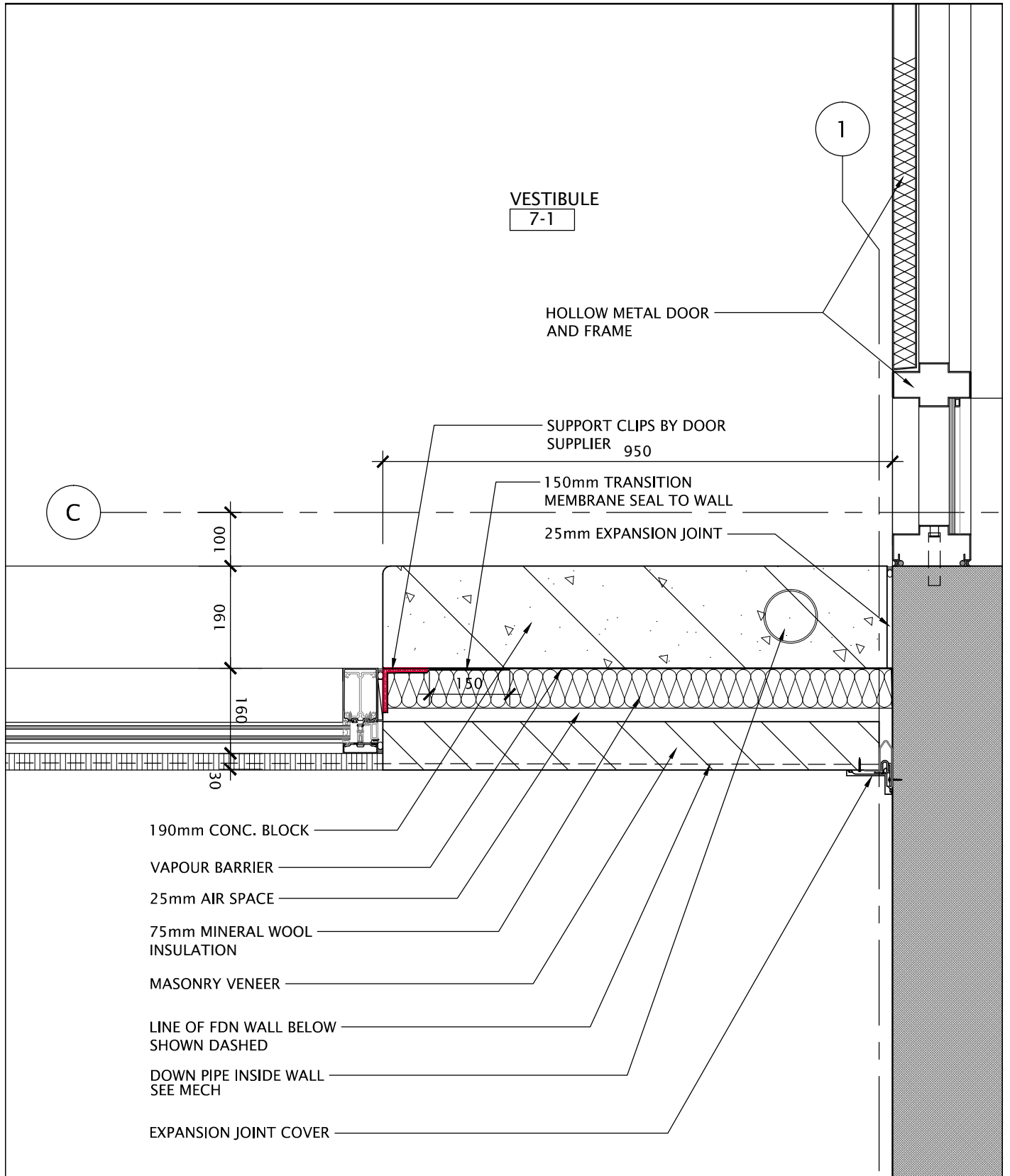
<div><div>Kingsland + ARCHITECTS INC.</div><div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div></div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		EXPANSION JOINT COVER PLAN DETAIL	MAR 2026	1:2	
		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller—Bundle 5	K+	A25006	
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			K+	7-041	0



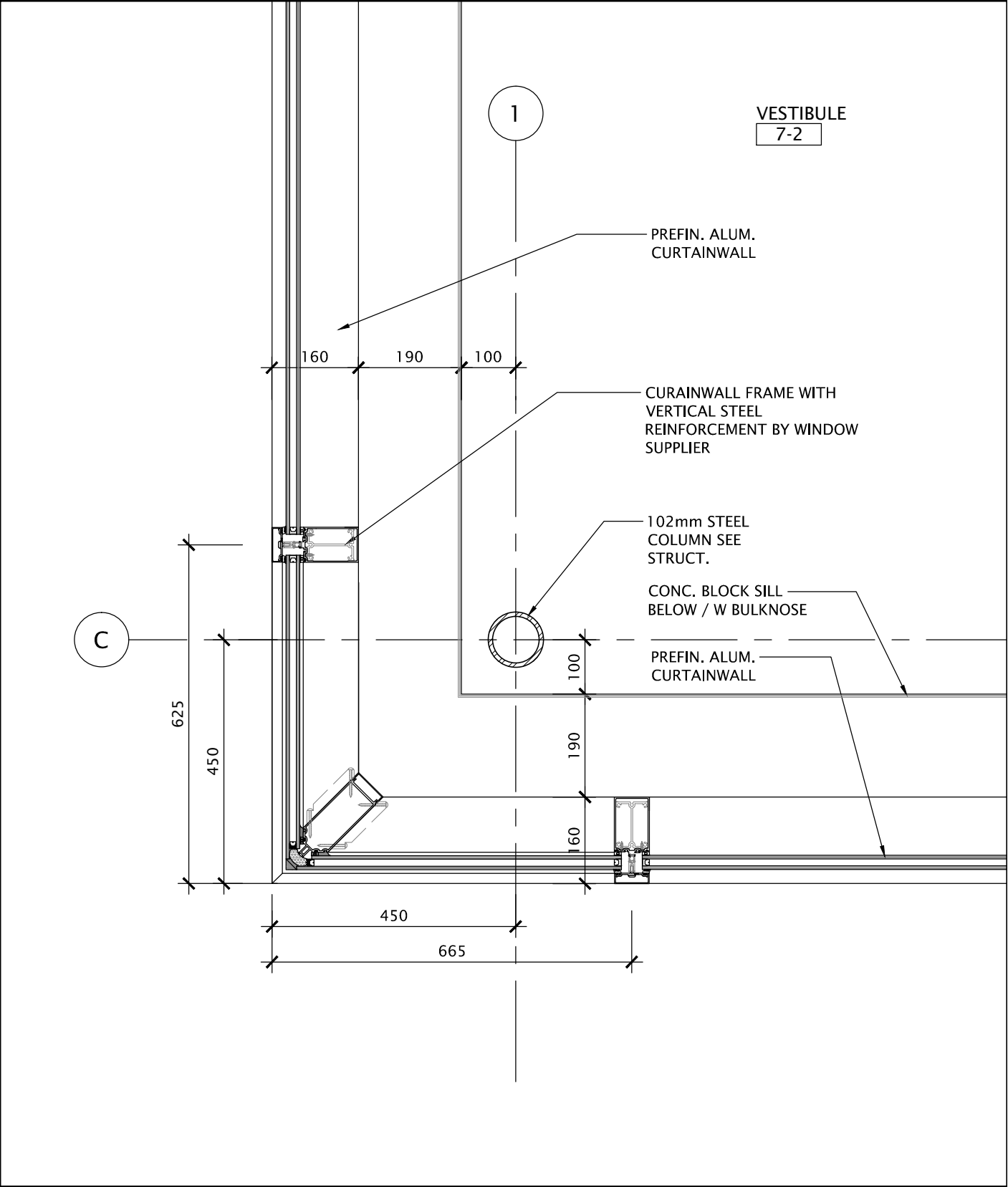
<div>Kingsland + ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME: FIRST FLOOR PLAN DETAIL GRID 1/B	DATE: MAR 2026		SCALE: 1:10	
			DRAWN: K+		PROJECT NO: A25006	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+		DWG NO: 7—201	REV. 0



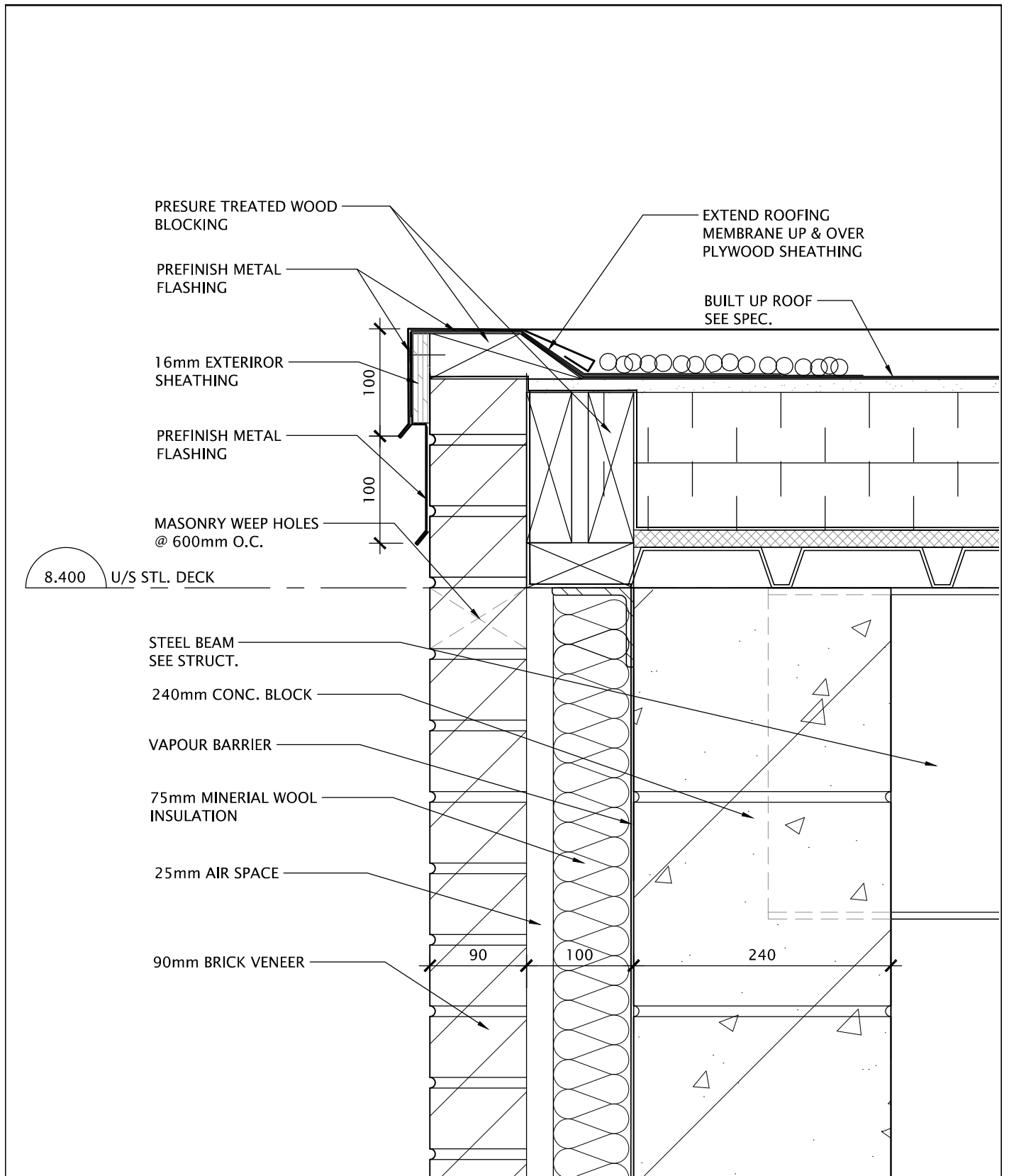
<div>Kingsland + ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME: FIRST FLOOR PLAN DETAIL GRID 1/C	DATE: MAR 2026		SCALE: 1:10	
			DRAWN: K+		PROJECT NO: A25006	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller-Bundle 5	CHECKED: K+		DWG NO: 7-202	REV. 0



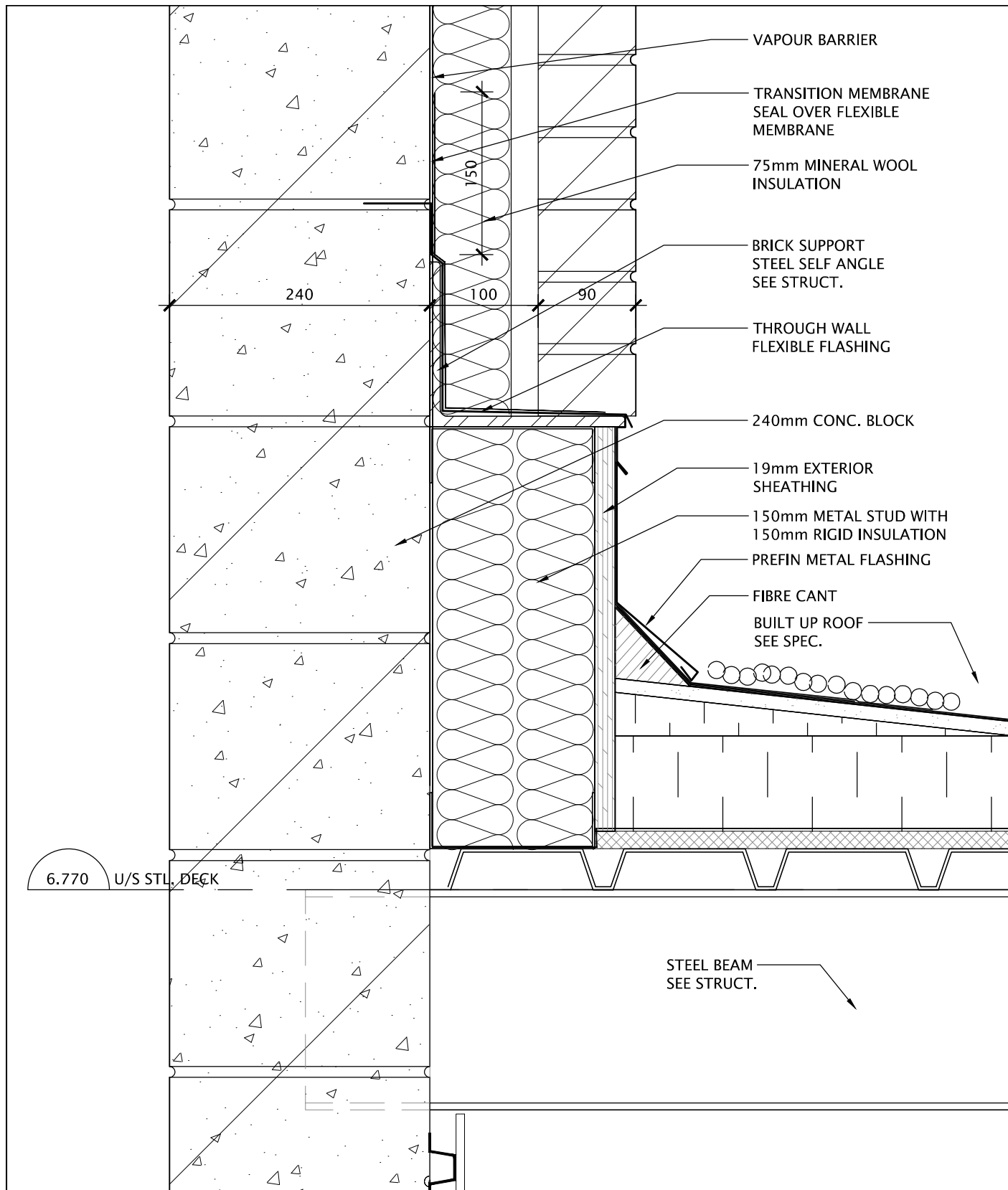
<div>Kingsland + ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		FIRST FLOOR PLAN DETAIL GRID 2/C	MAR 2026	1:10	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller-Bundle 5	K+	A25006	
			CHECKED:	DWG NO:	REV.
			K+	7-203	0



<div><div>Kingsland + ARCHITECTS INC.</div><div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div></div>	ISSUED:	DRAWING NAME: SECOND FLOOR PLAN DETAIL GRID 1/C	DATE: MAR 2026	SCALE: 1:10	
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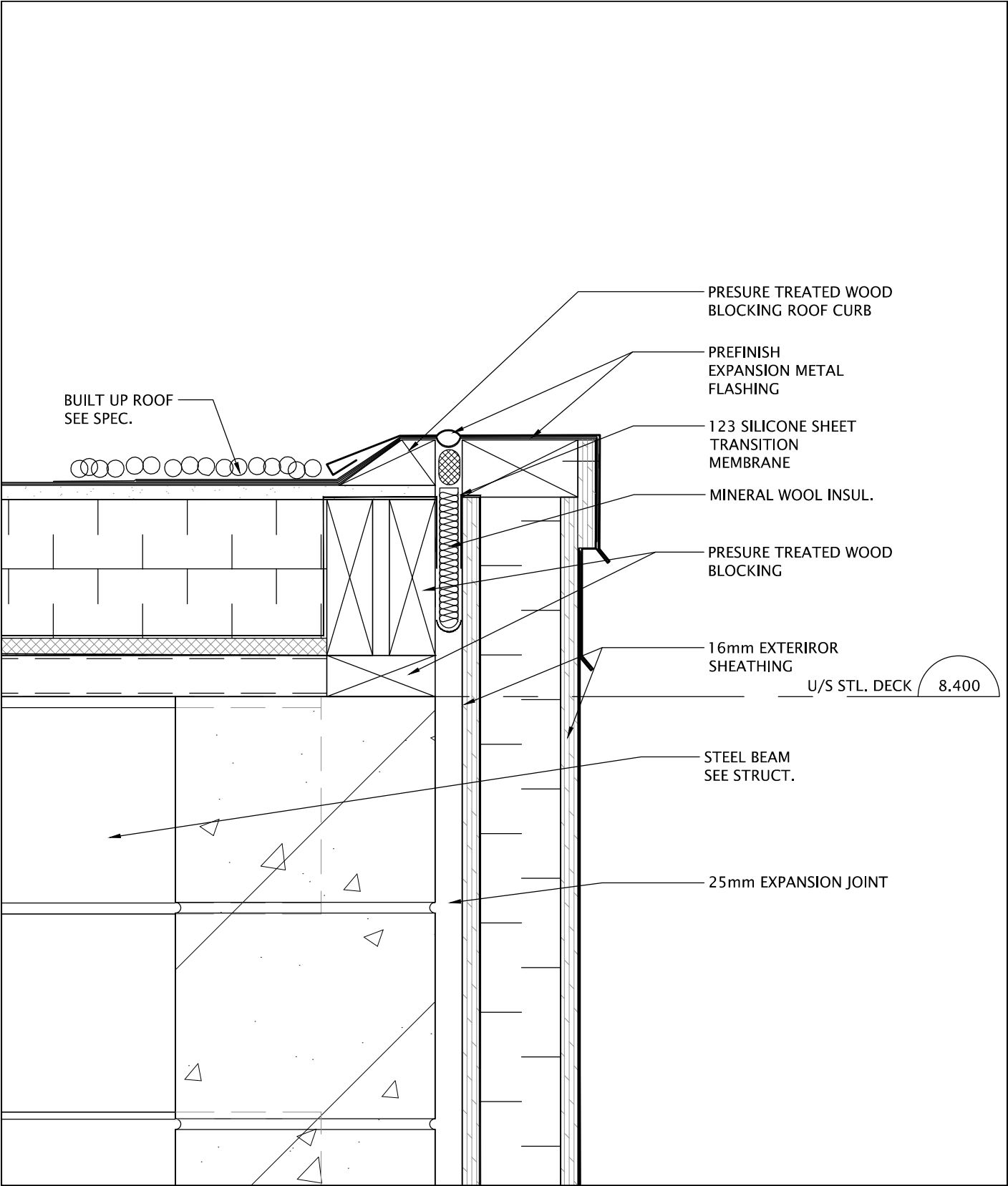


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PROJECT NAME:			DRAWN:	PROJECT NO:	
	William G Miller—Bundle 5	K+	A25006		
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763			CHECKED:	DWG NO:	REV.
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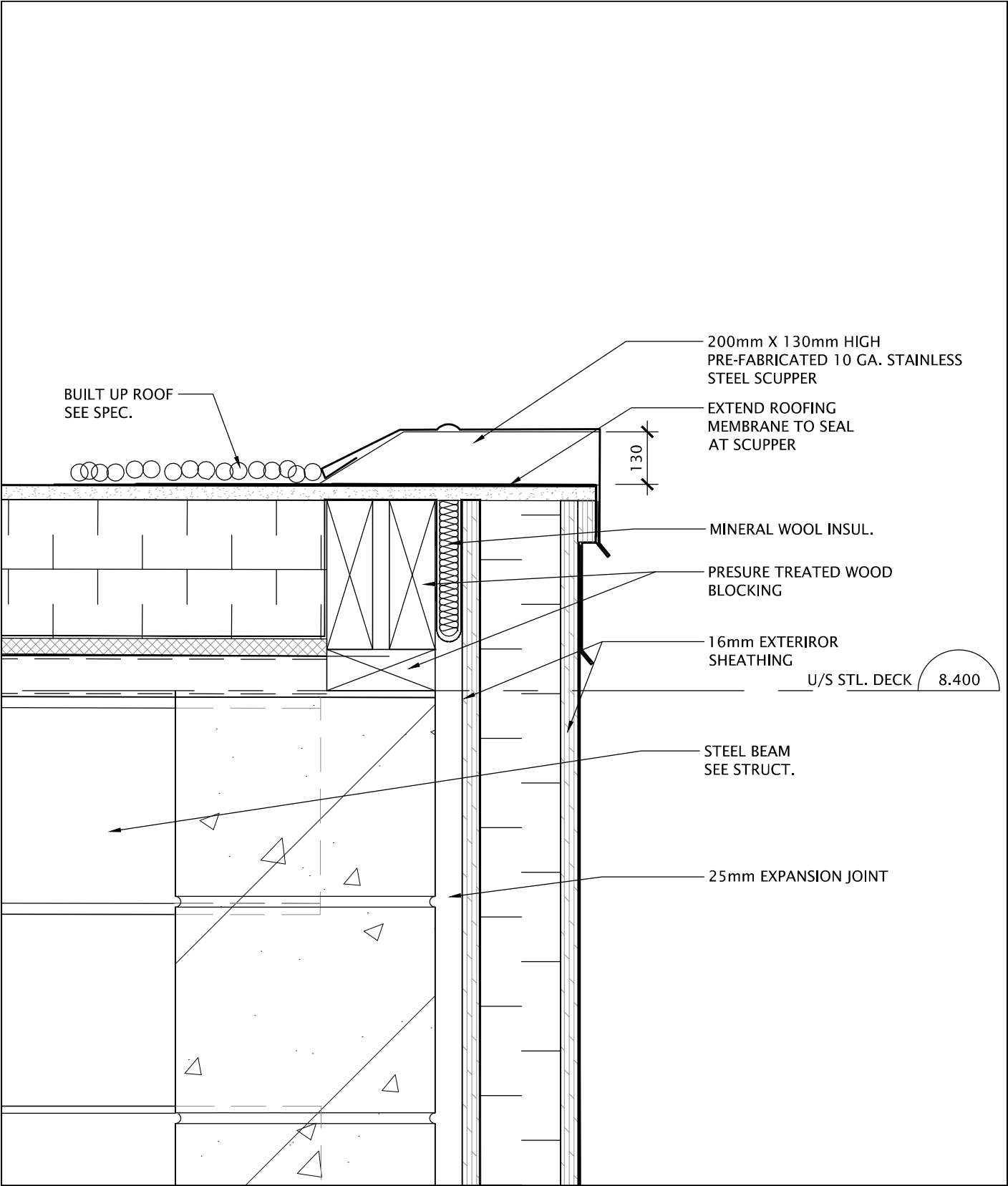


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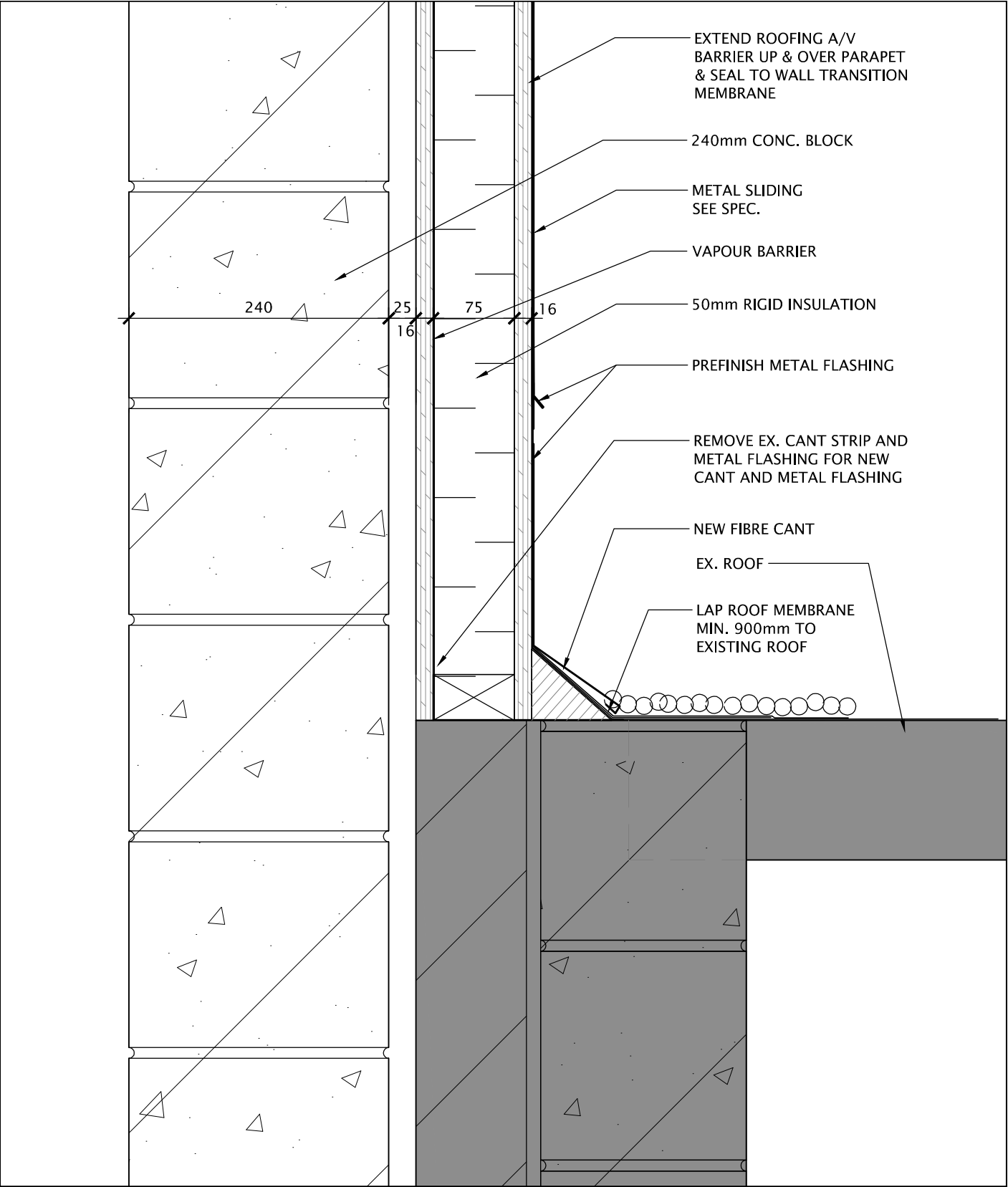
KINGSLAND + ARCHITECTS INC
110 Cumberland Street, Suite 262
Toronto, Ontario M5R 3V5
ph 416.203.7799
fax 416.203.7763



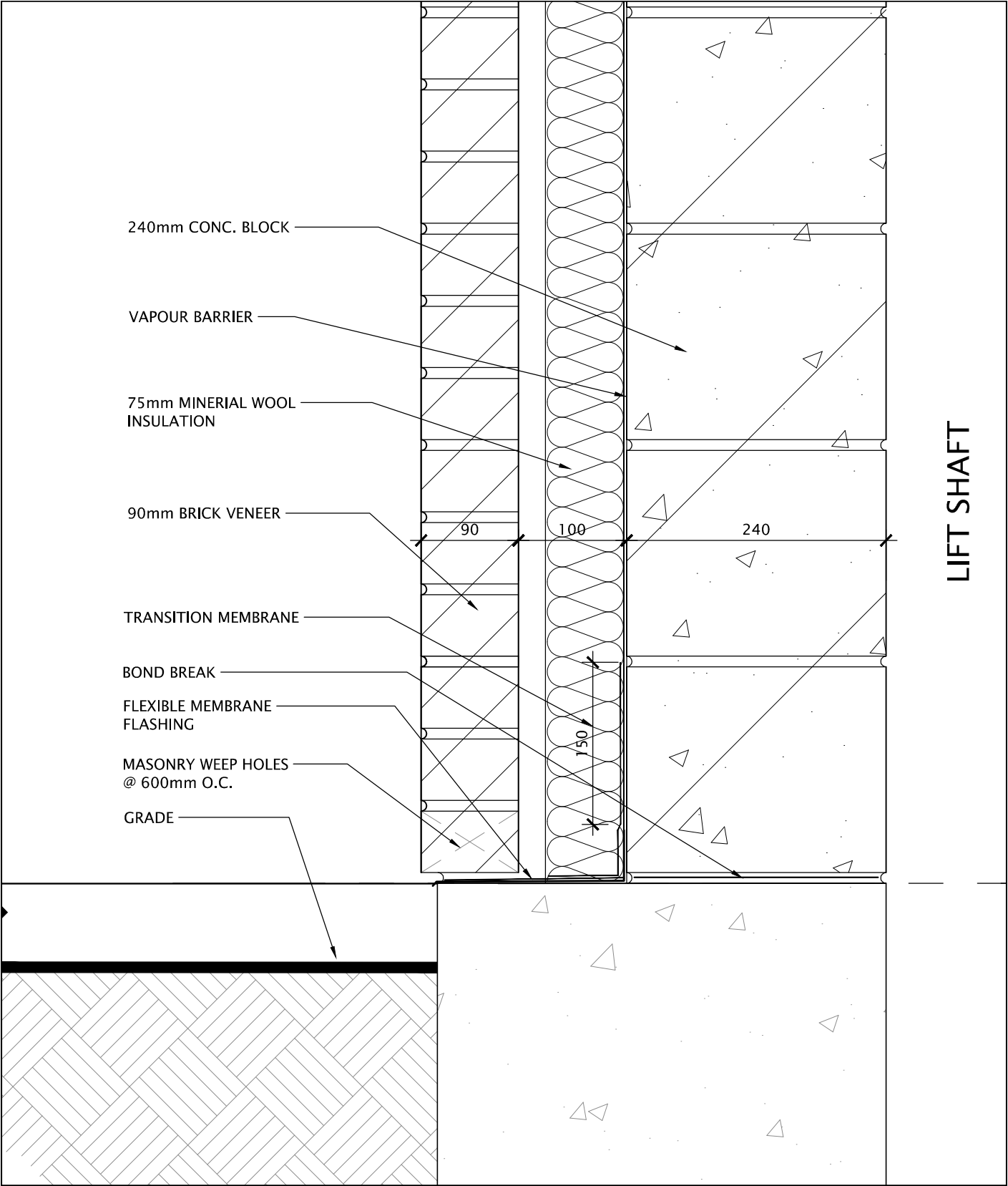
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			K+	7-504	



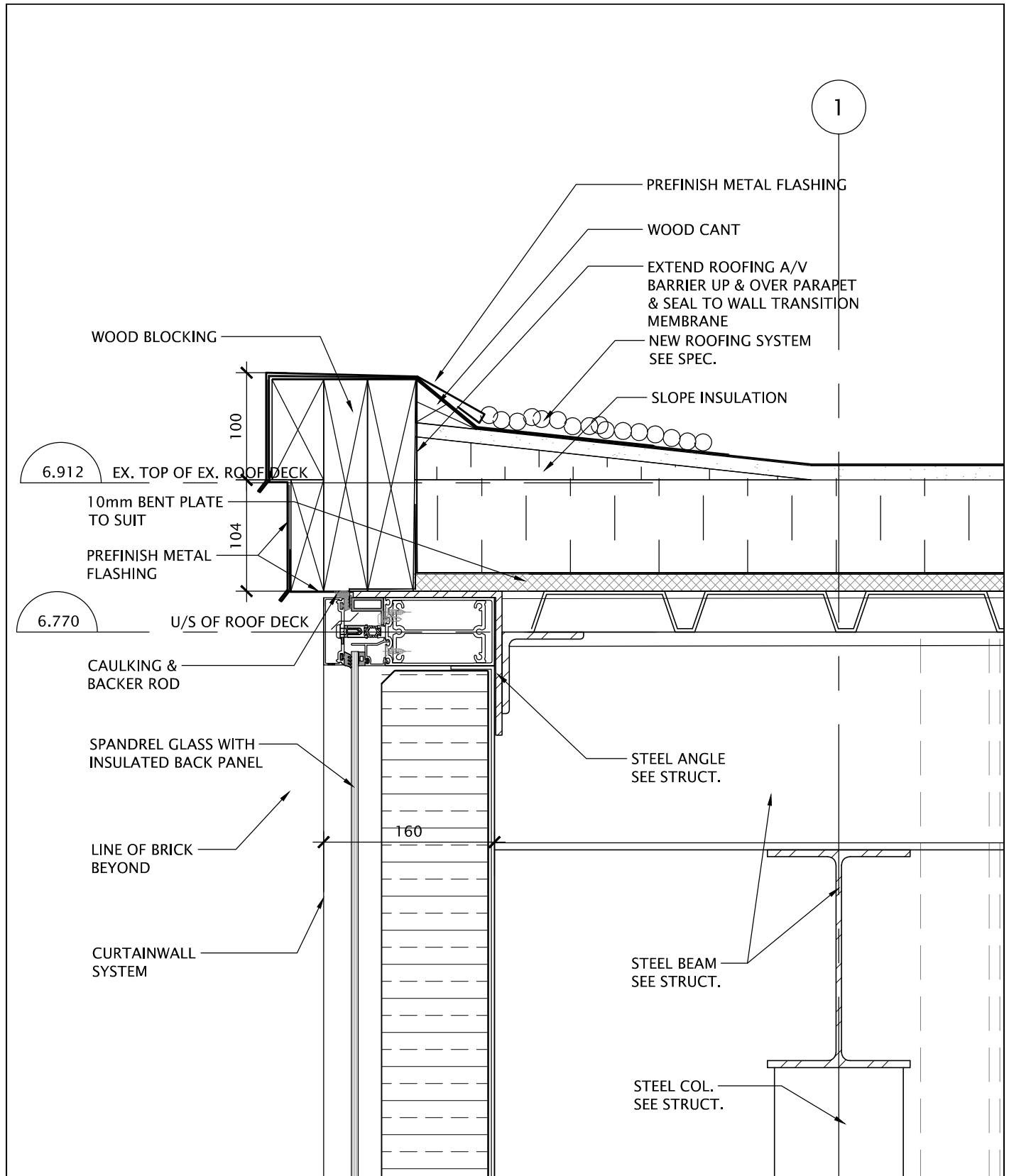
<div><div>Kingsland + ARCHITECTS INC.</div><div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div></div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
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		PROJECT NAME:	DRAWN:	PROJECT NO:	
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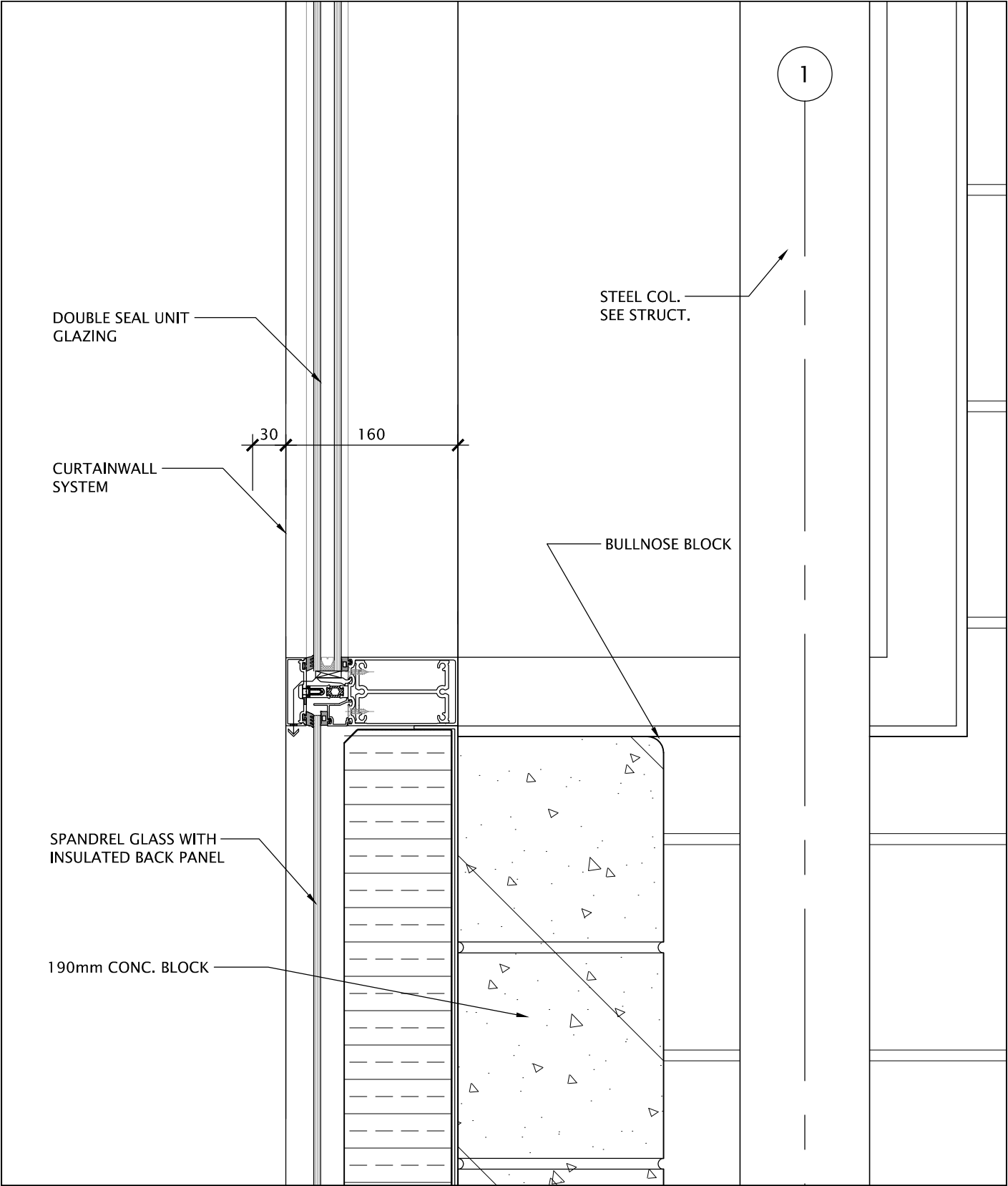
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KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		William G Miller—Bundle 5	K+	A25006	
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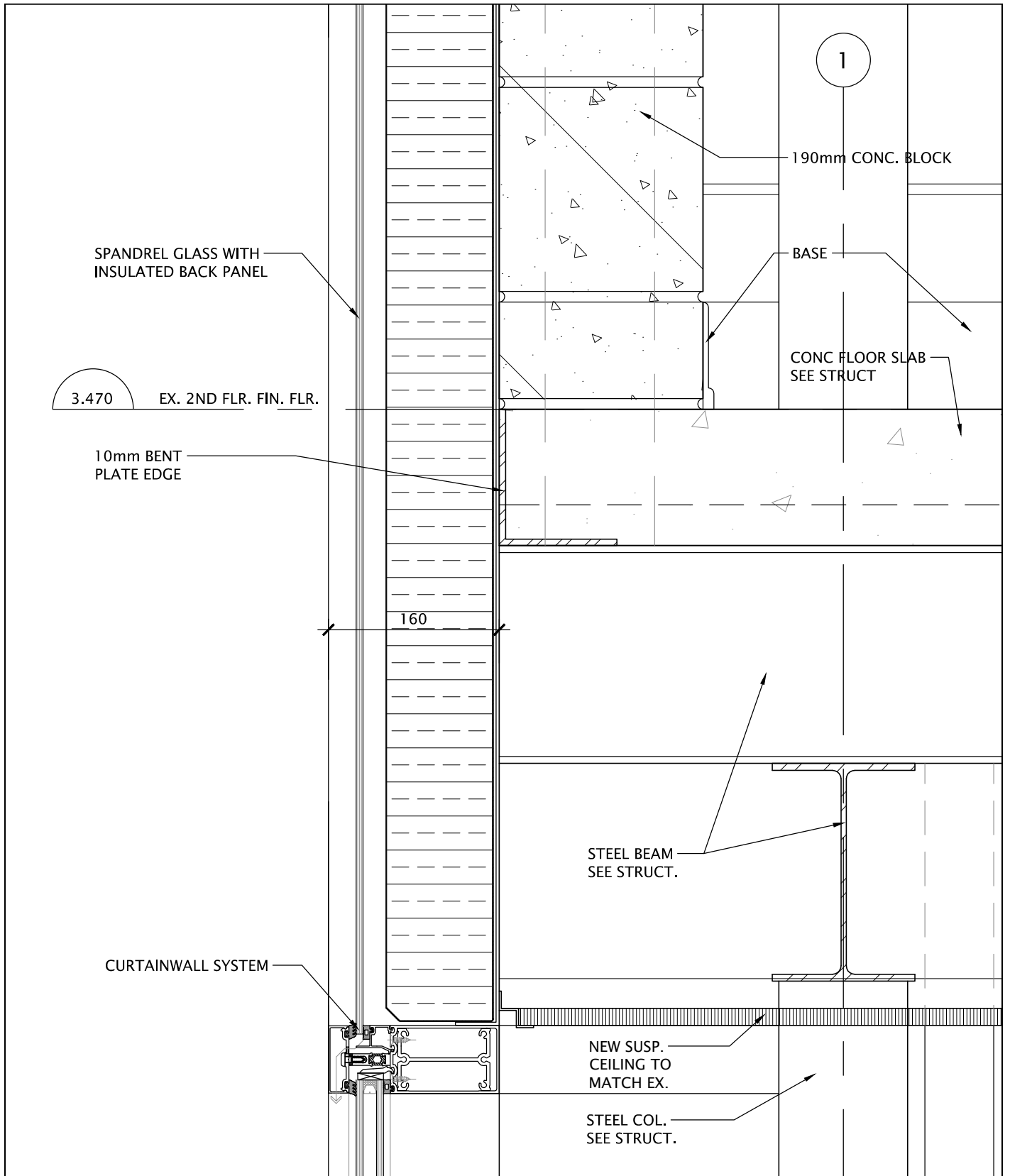
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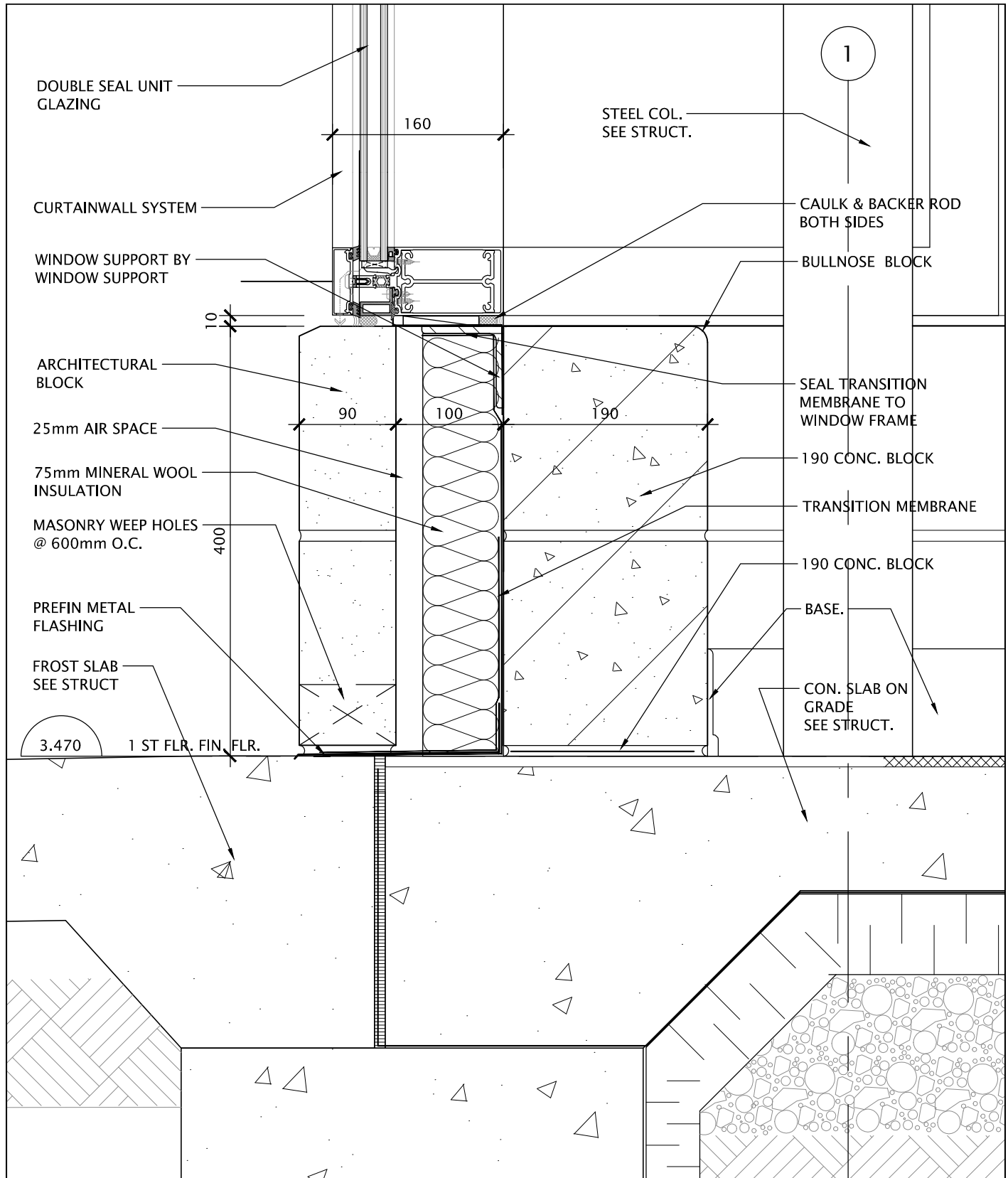
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KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+		DWG NO: 7-507	REV.



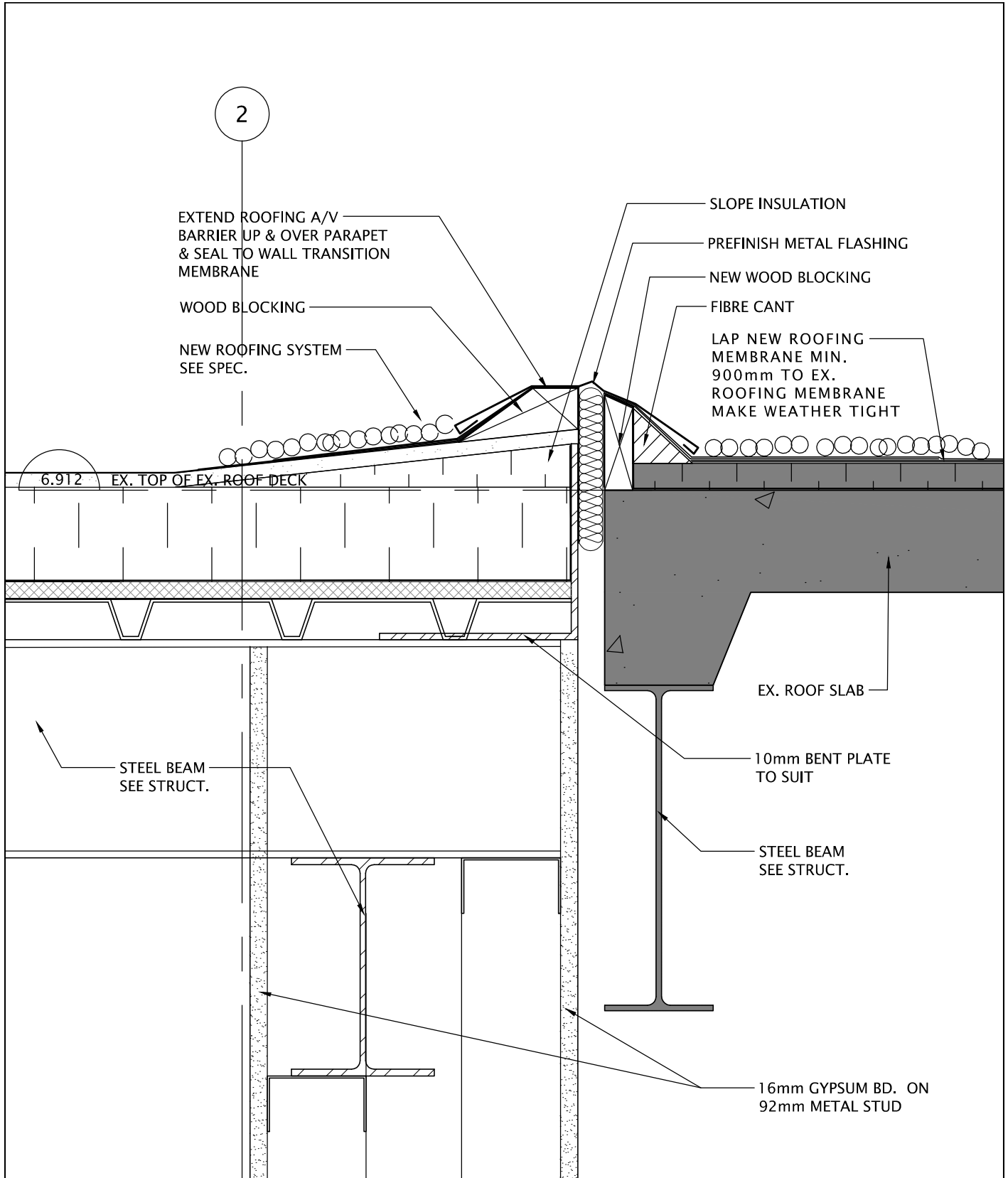
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KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		William G Miller—Bundle 5	K+	A25006	
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			K+	7-508	



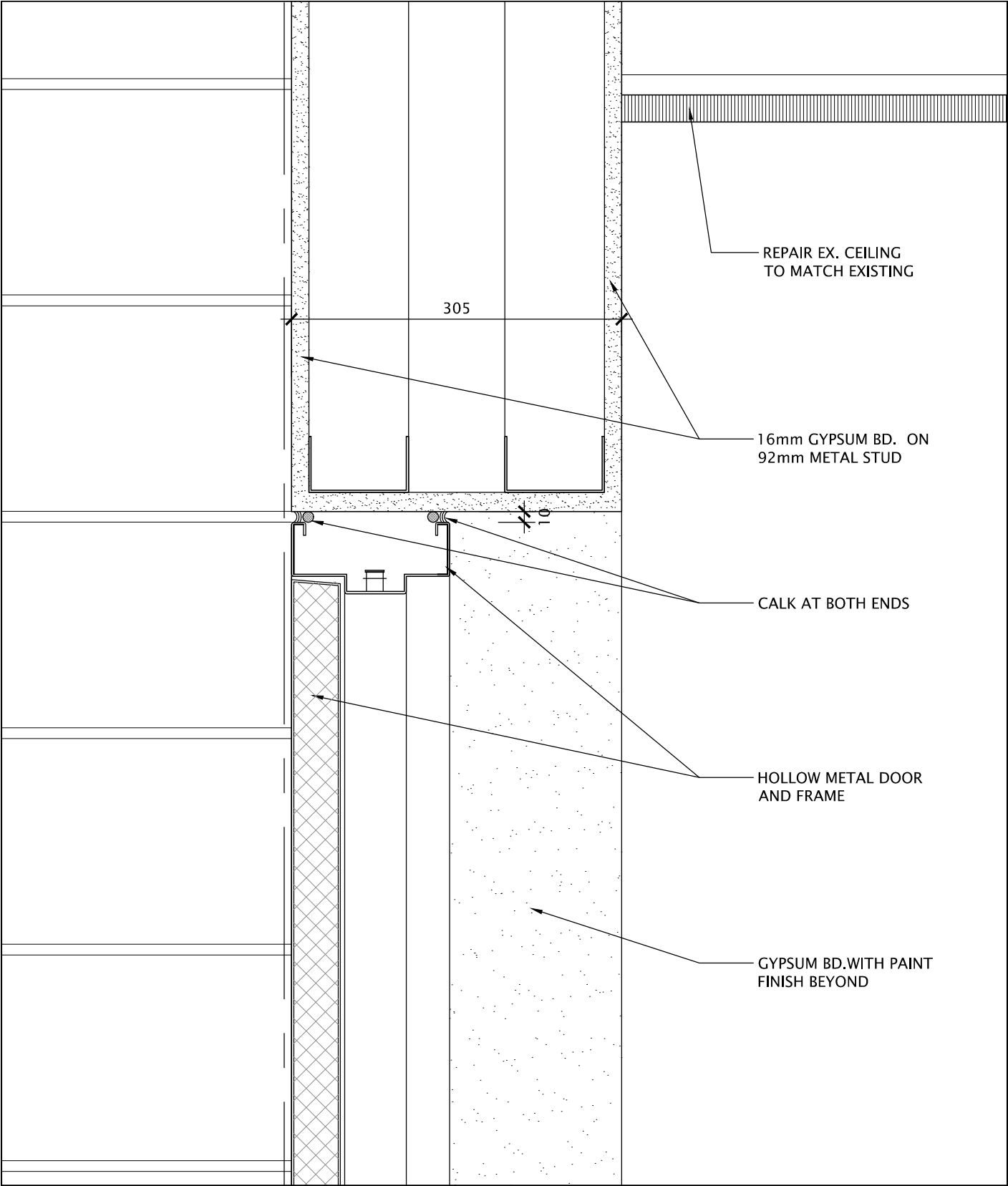
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		SECTION DETAIL AT 2ND FLOOR LEVEL	MAR 2026	1:5	
<div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div>		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller—Bundle 5	K+	A25006	
		CHECKED:	DWG NO:	REV.	
		K+	7-509		



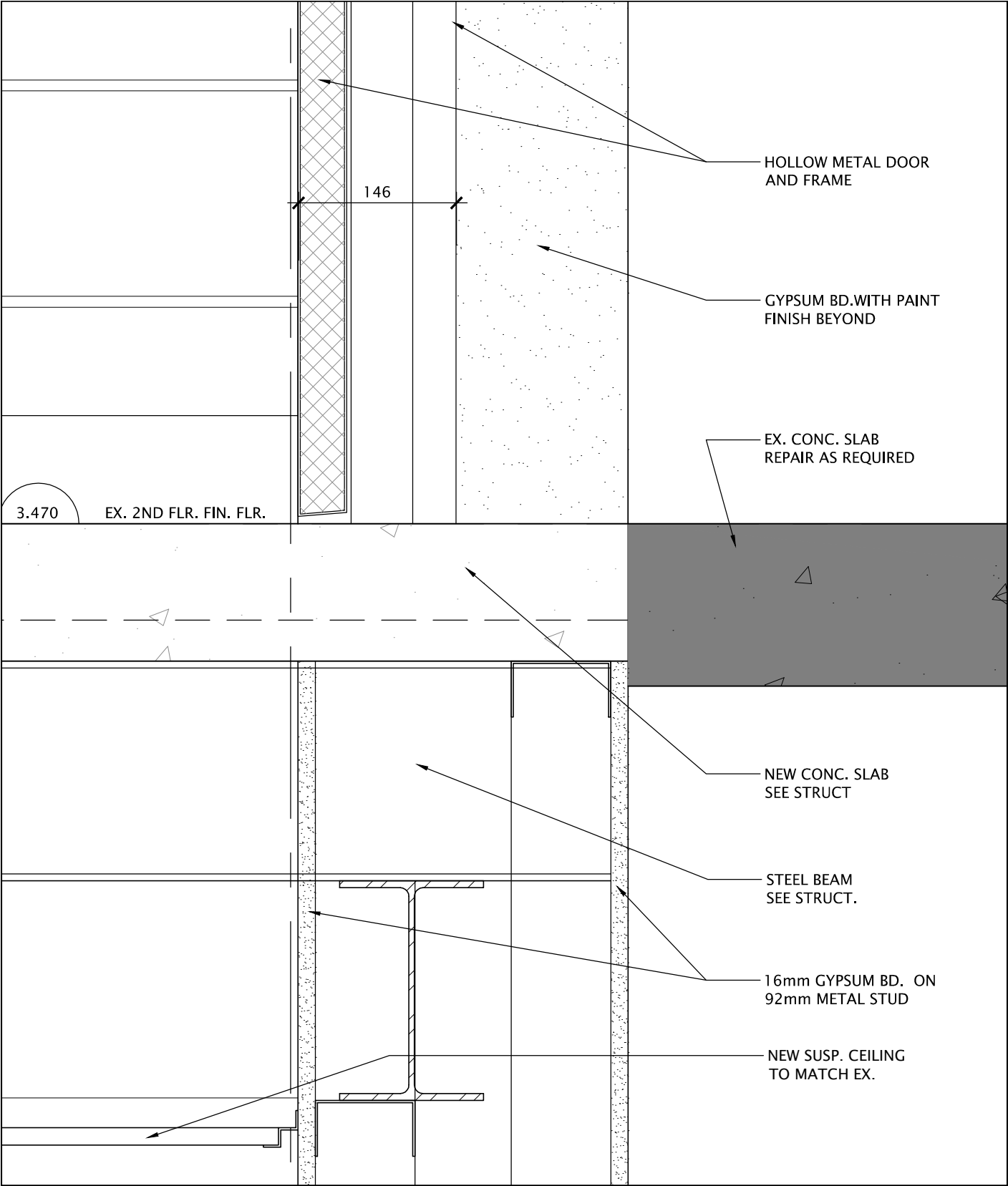
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KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	DRAWN:	PROJECT NO:	
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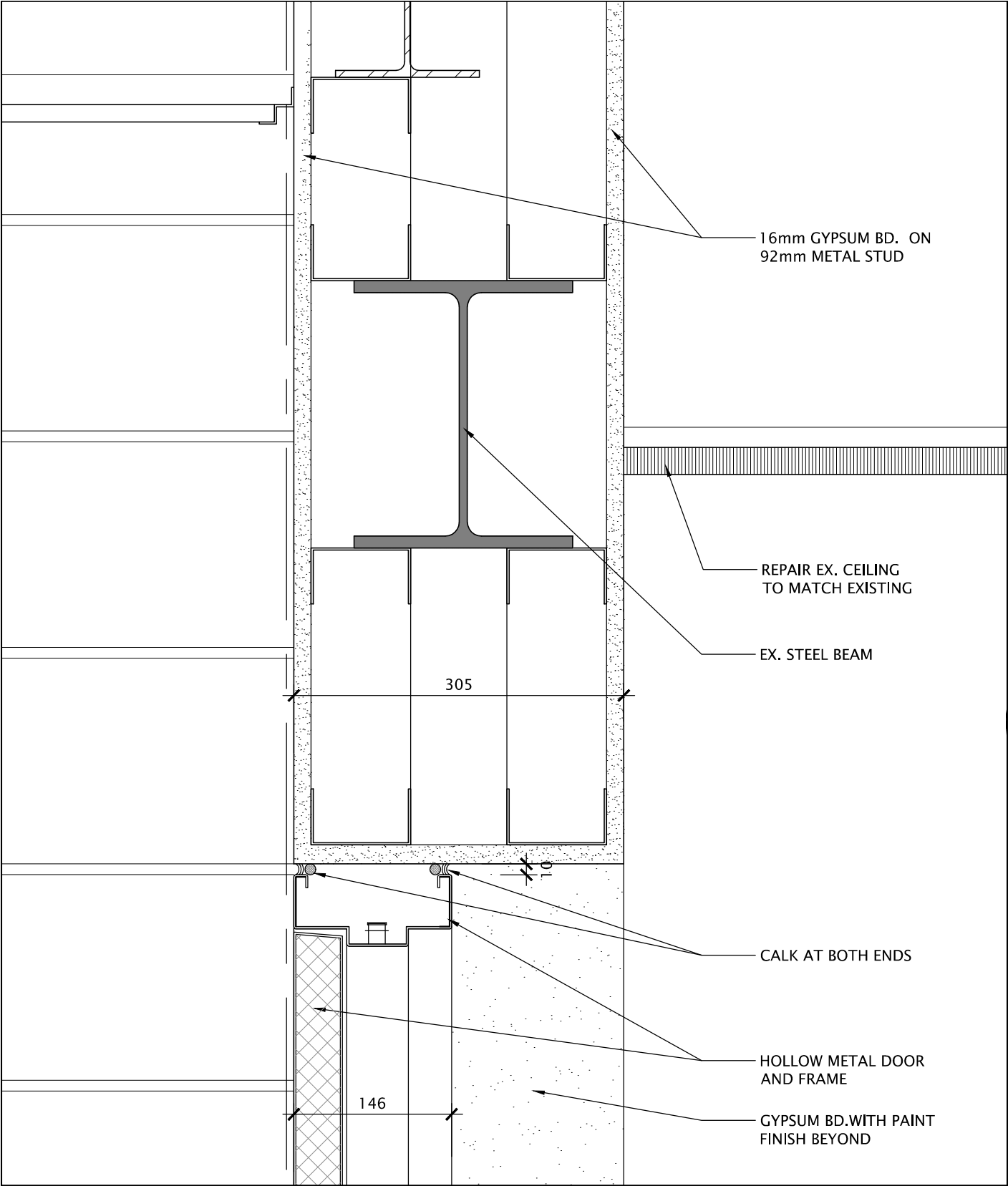
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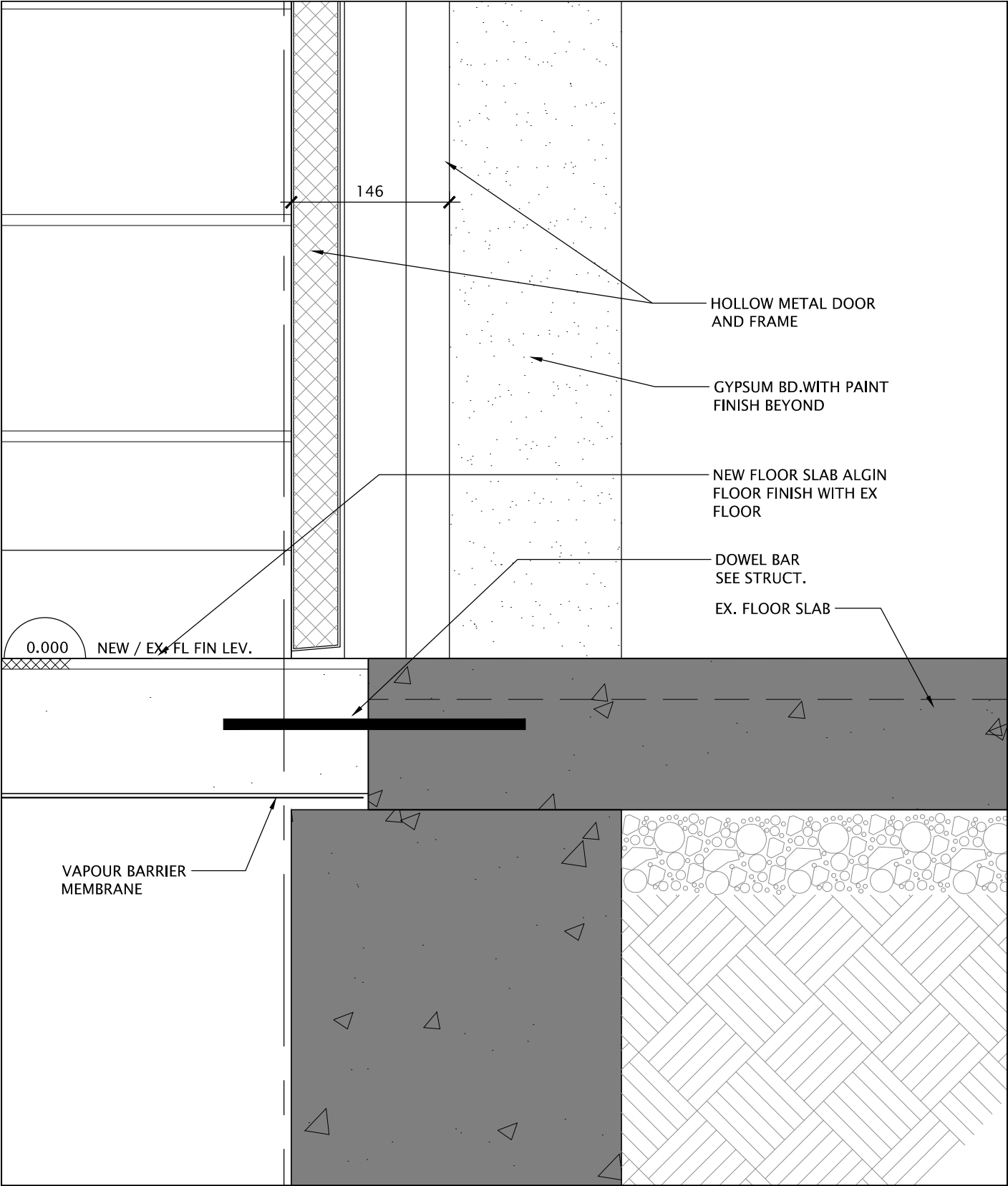
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		SECTION DETAIL AT DOOR HEAD	MAR 2026	1:5	
		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller—Bundle 5	K+	A25006	
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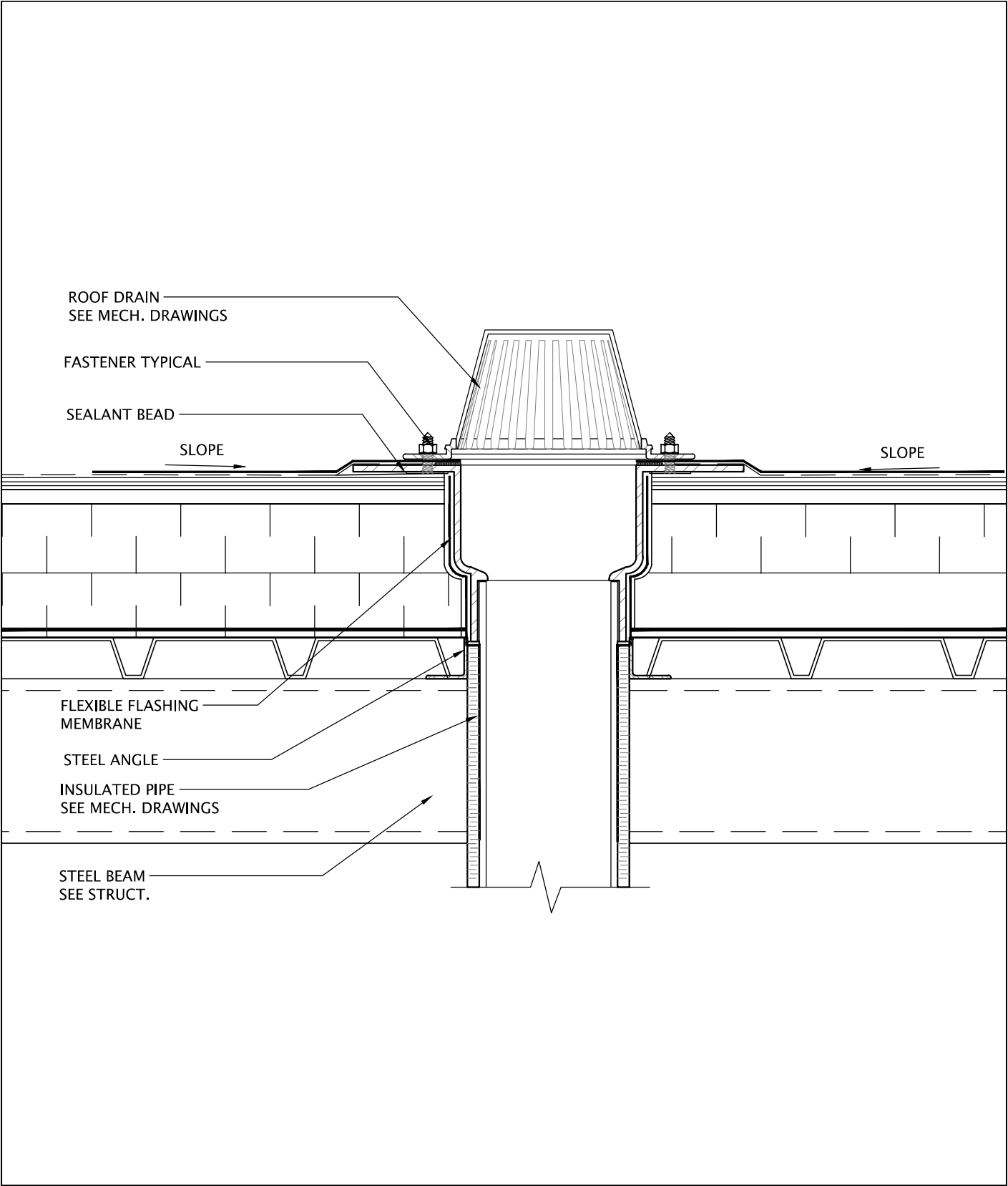
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		SECTION DETAIL AT 2nd FLOOR LEVEL	MAR 2026	1:5	
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		William G Miller—Bundle 5	K+	A25006	
			CHECKED:	DWG NO:	REV.
			K+	7-513	



<div><div>Kingsland + ARCHITECTS INC.</div><div></div></div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		SECTION DETAIL	MAR 2026	1:5	
		AT DOOR HEAD	DRAWN:	PROJECT NO:	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	CHECKED:	DWG NO:	REV.
		William G Miller—Bundle 5	K+	7–514	



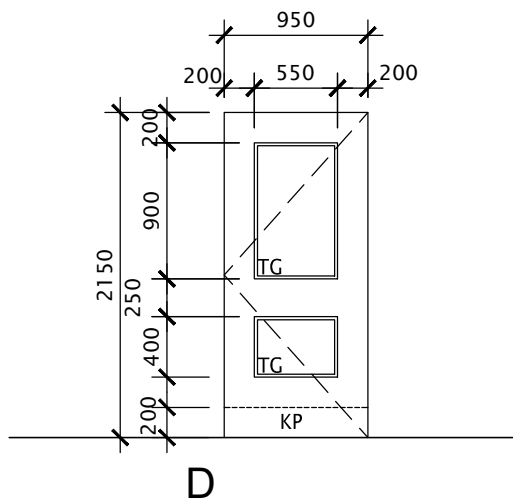
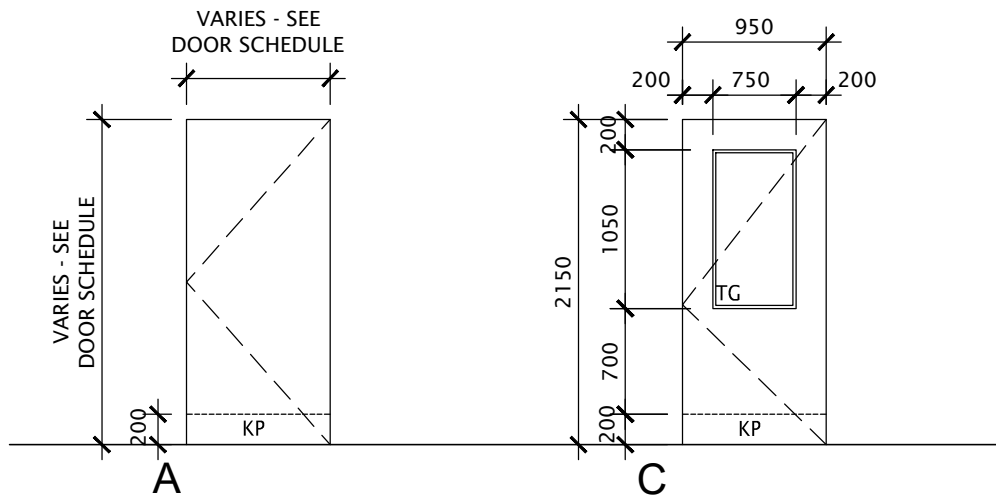
<div><div>Kingsland + ARCHITECTS INC.</div><div>KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763</div></div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
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			K+	7-515	



<div><div>Kingsland + ARCHITECTS INC.</div><div></div></div>	ISSUED:	DRAWING NAME: ROOF DRAIN DETAIL @ VESTIBULE		DATE: MAR 2026	SCALE: 1:5	
		PROJECT NAME: William G Miller—Bundle 5		DRAWN: K+	PROJECT NO: A25006	
				CHECKED: K+	DWG NO: 7–516	REV.

LEGEND:

TG - TEMPERED GLASS / FRR
TEMPERED GLASS
KP - KICK PLATE



Kingsland +
ARCHITECTS INC.

KINGSLAND + ARCHITECTS INC
110 Cumberland Street, Suite 262
Toronto, Ontario M5R 3V5
ph 416.203.7799
fax 416.203.7763

ISSUED:

DRAWING NAME:

DOOR TYPES

PROJECT NAME:

William G Miller—Bundle 5

DATE:

MAR 2026

DRAWN:

K+

CHECKED:

K+

SCALE:

1:50

PROJECT NO:

A25006

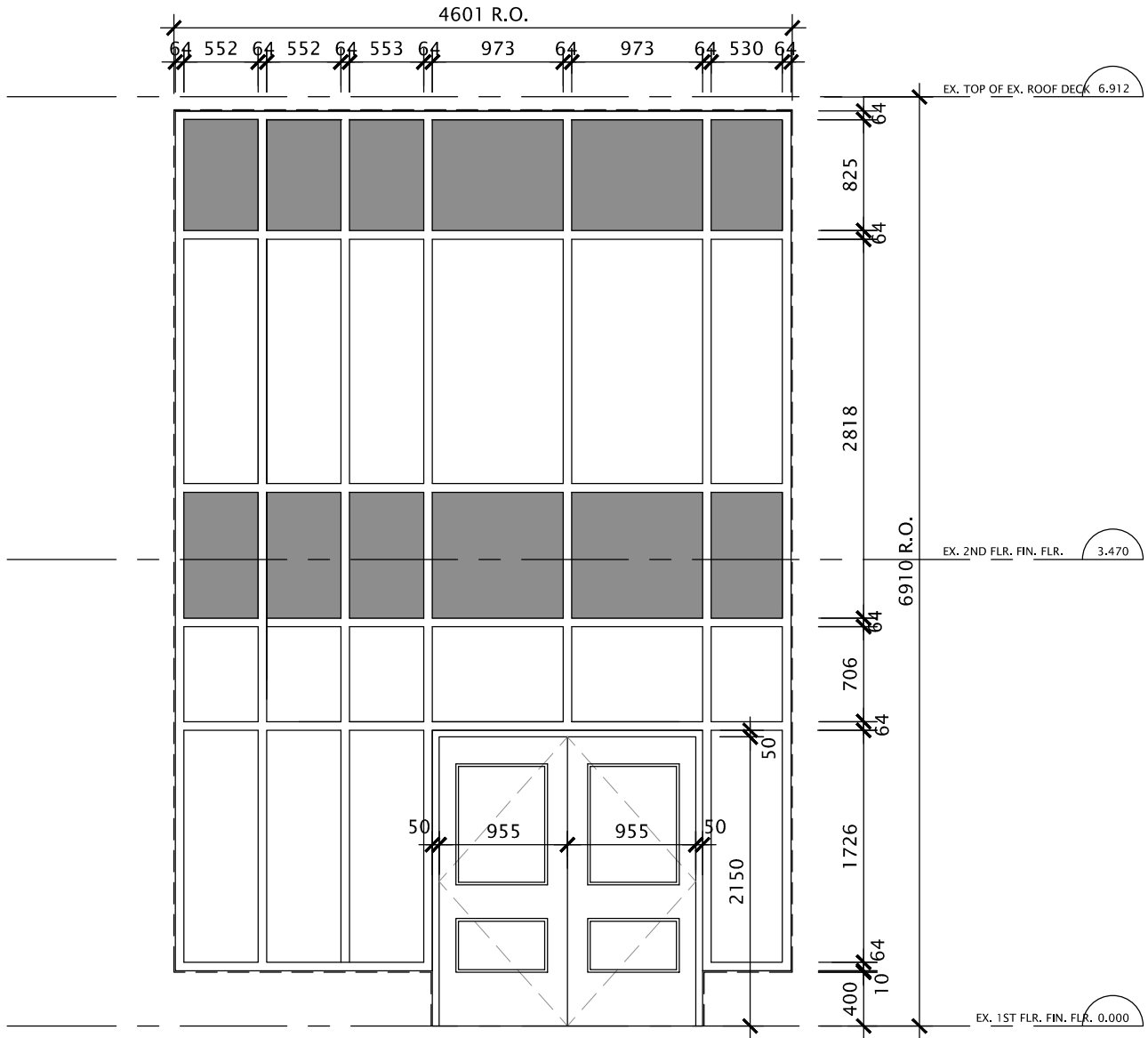
DWG NO:

8-401

REV.

LEGEND:

 - SPANDREL GLASS



W1

CURTAINWALL WITH INSUL. PREFIN. ALUM. DOOR
PREFIN. ALUM. THERMALLY BROKEN FRAMES W/
INSULATED GLAZED UNITS
SPANDREL INSULATED GLASS PANELS

QUANTITY: 1
DOOR AND FRAME ATTACHED
TO CURTAINWALL SYSTEM

Kingsland +
ARCHITECTS INC.

KINGSLAND + ARCHITECTS INC
110 Cumberland Street, Suite 262
Toronto, Ontario M5R 3V5
ph 416.203.7799
fax 416.203.7763

ISSUED:

DRAWING NAME:

WINDOW SCHEDULE

PROJECT NAME:

William G Miller—Bundle 5

DATE:

MAR 2026

DRAWN:

K+

CHECKED:

K+

SCALE:

1:50

PROJECT NO:

A25006

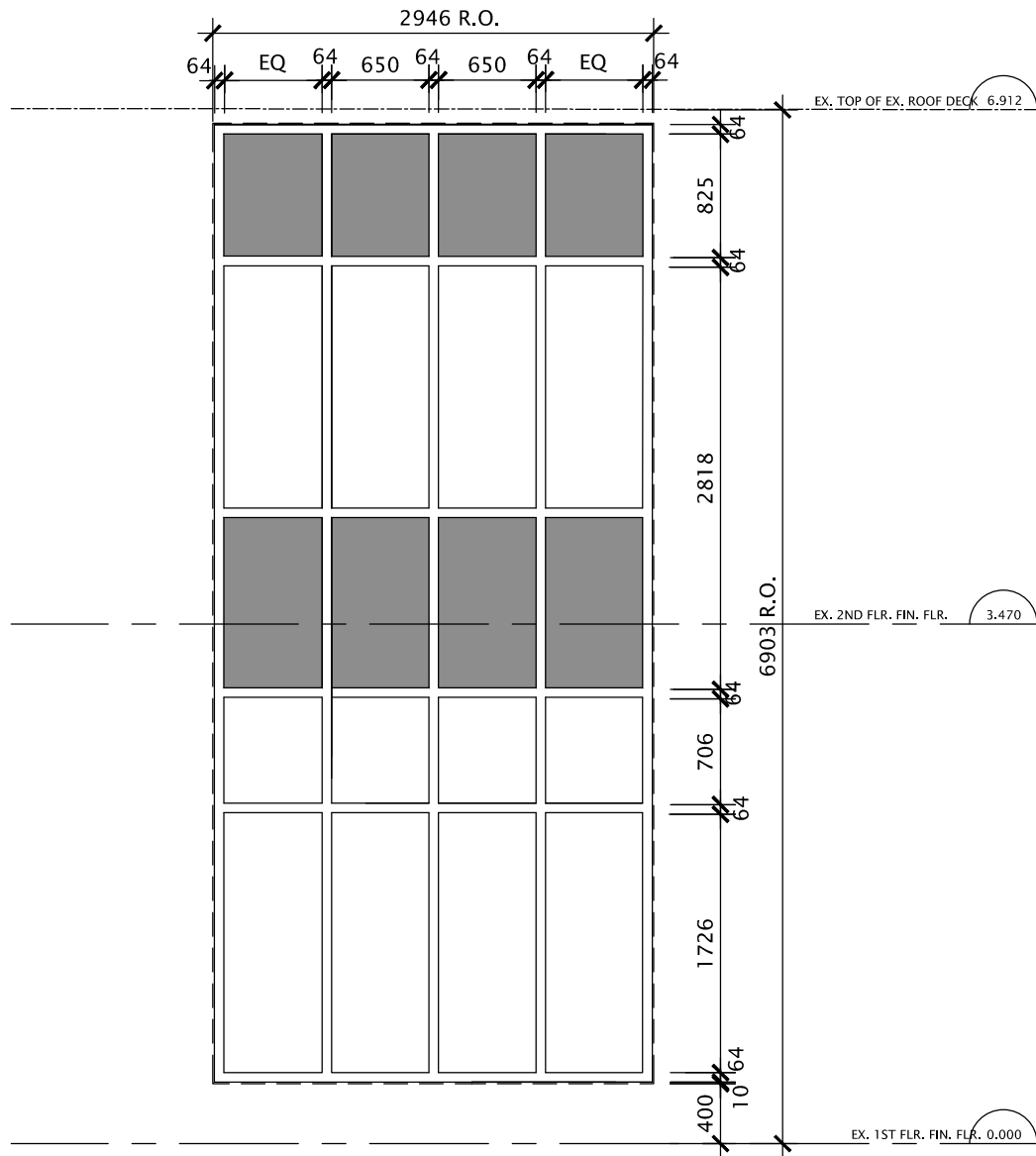
DWG NO:

8-402

REV.

LEGEND:

■ - SPANDREL GLASS



W2

CURTAINWALL WITH INSUL. PREFIN. ALUM. DOOR
PREFIN. ALUM. THERMALLY BROKEN FRAMES W/
INSULATED GLAZED UNITS
SPANDREL INSULATED GLASS PANELS

QUANTITY: 1

Kingsland +
ARCHITECTS INC.

KINGSLAND + ARCHITECTS INC
110 Cumberland Street, Suite 262
Toronto, Ontario M5R 3V5
ph 416.203.7799
fax 416.203.7763

ISSUED:

DRAWING NAME:

WINDOW SCHEDULE

PROJECT NAME:

William G Miller—Bundle 5

DATE:

MAR 2026

DRAWN:

K+

CHECKED:

K+

SCALE:

1:50

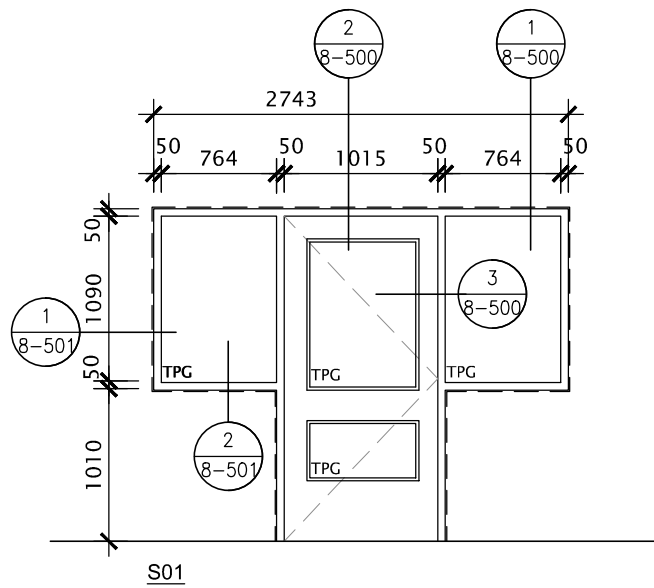
PROJECT NO:

A25006

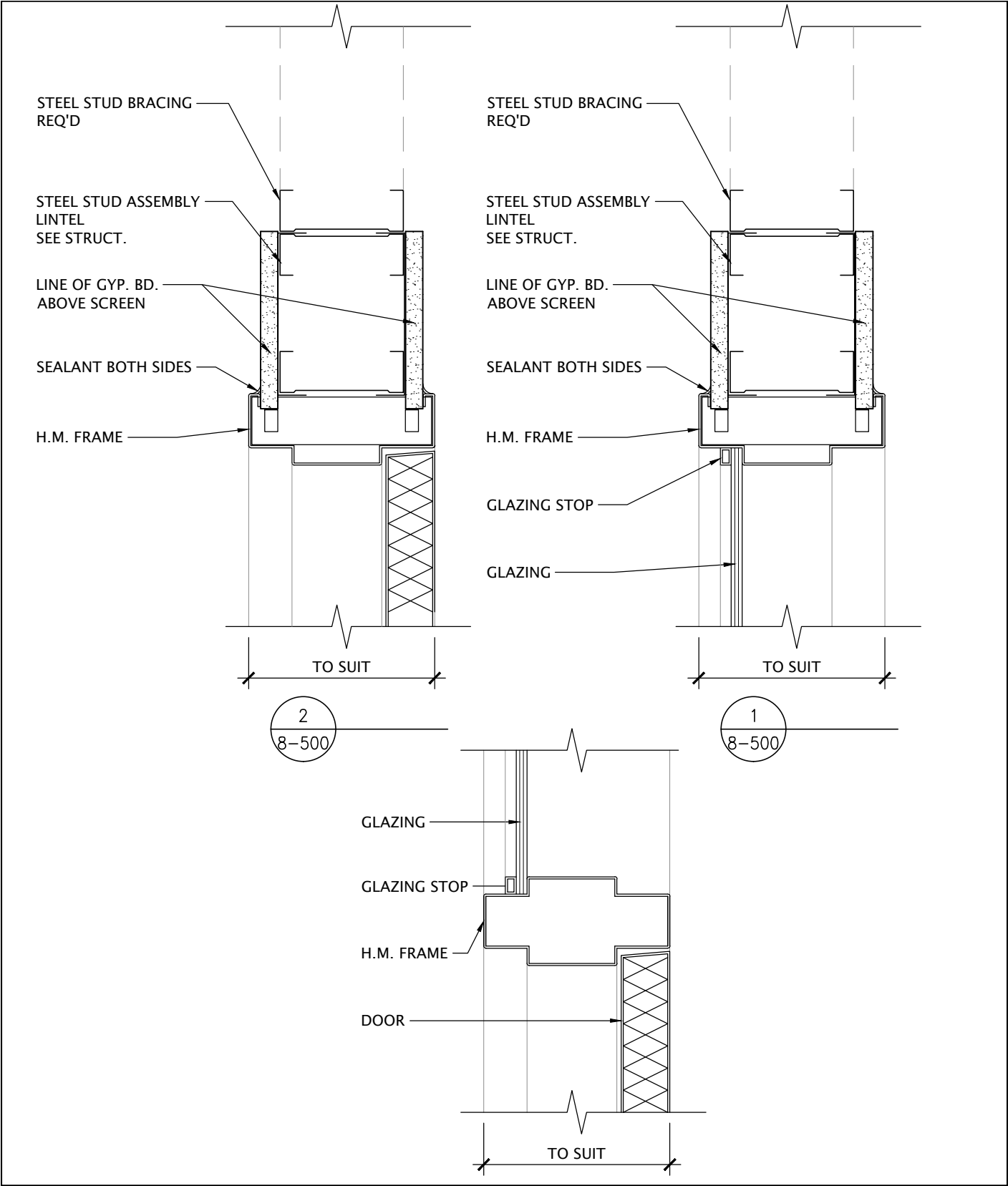
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8-403

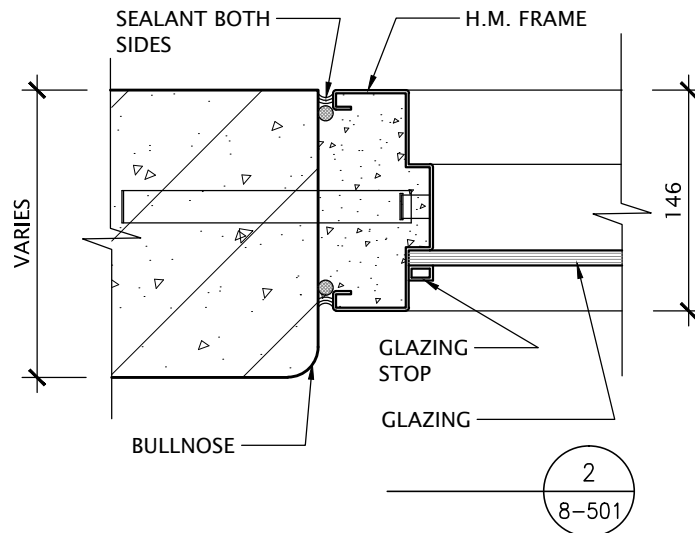
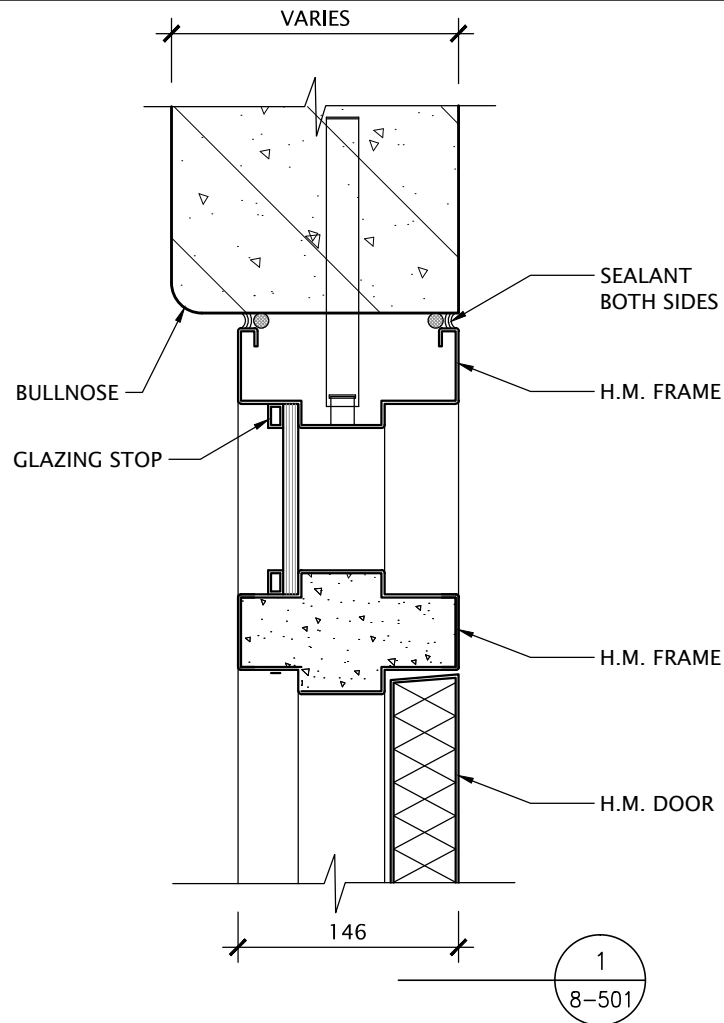
REV.



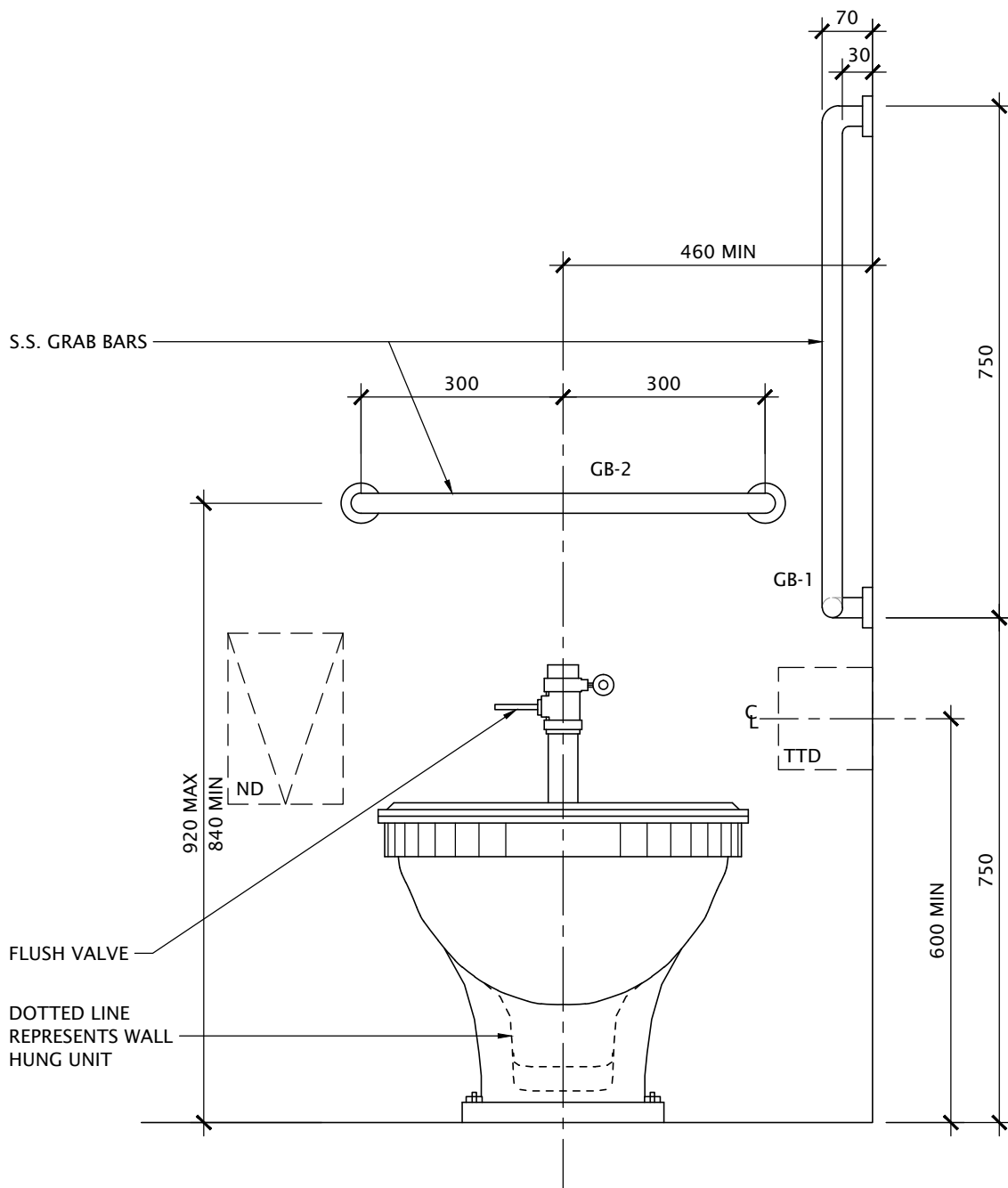
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KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+		DWG NO: 8-404	REV.



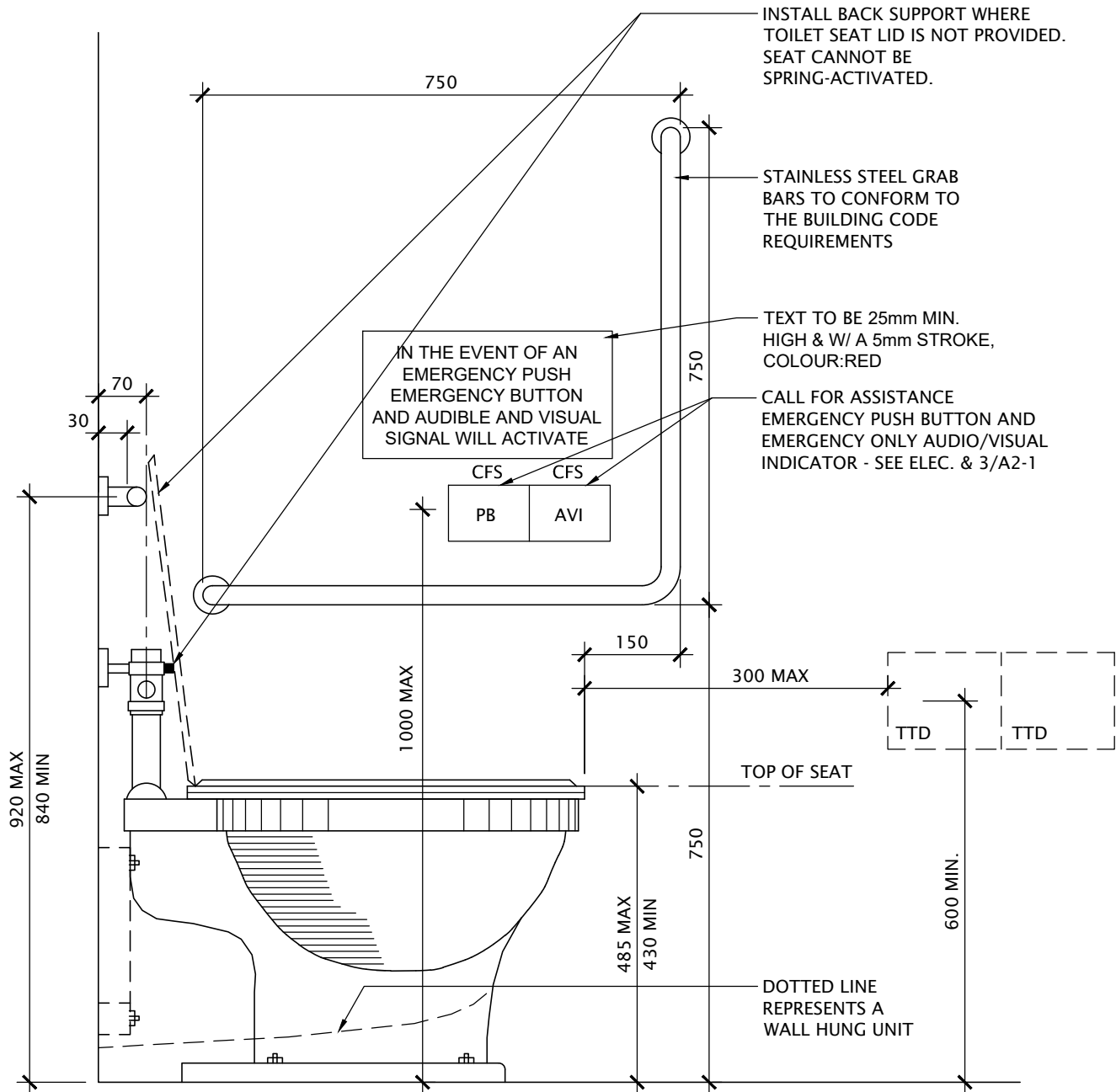
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			PROJECT NAME:	DRAWN:	PROJECT NO:
William G Miller—Bundle 5	K+	A25006			
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763			CHECKED:	DWG NO:	REV.
			K+	8-500	



<div>Kingsland + ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME:	DATE:	SCALE:	
		HOLLOW METAL FRAME DETAILS	MAR 2026	1:5	
PROJECT NAME:			DRAWN:	PROJECT NO:	
	William G Miller—Bundle 5	K+	A25006		
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763			CHECKED:	DWG NO:	REV.
			K+	8-501	



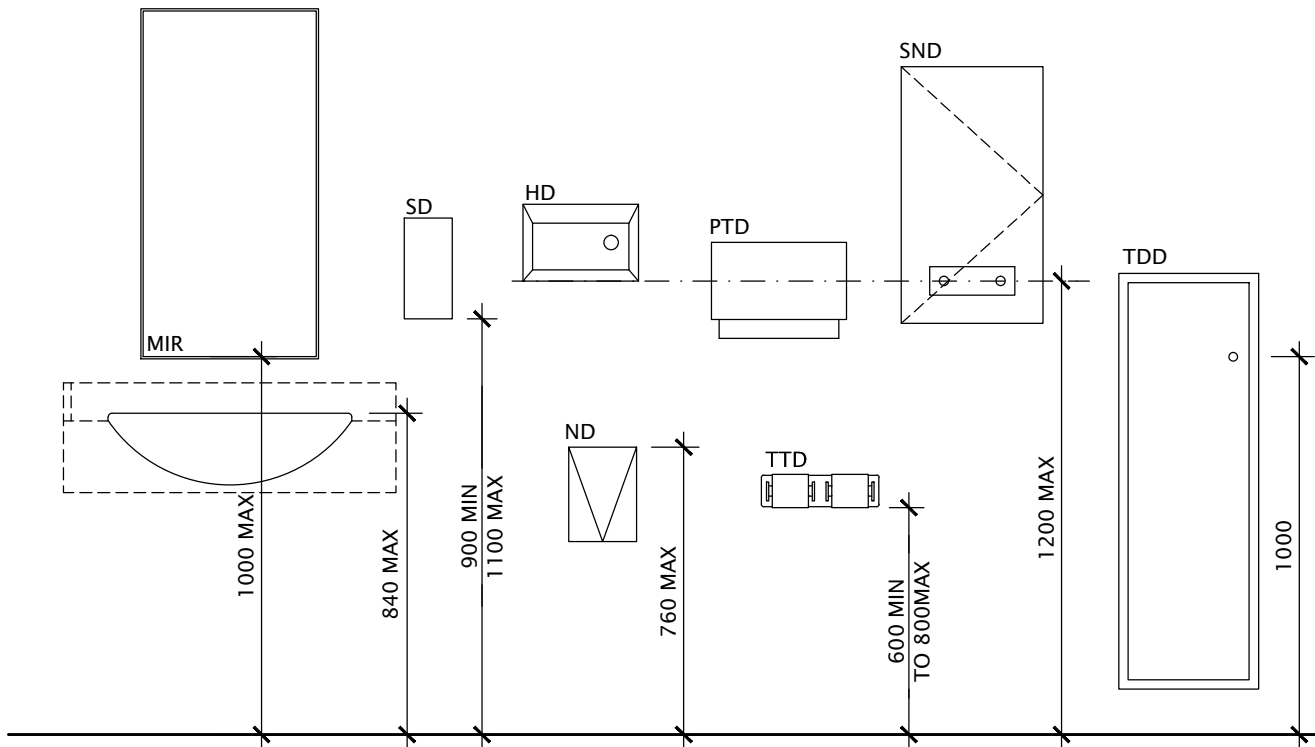
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KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME:	DRAWN:	PROJECT NO:	
		William G Miller-Bundle 5	K+	A25006	
			CHECKED:	DWG NO:	REV.
			K+	10-100	0



NOTE:
 INSTALLATION OF GRAB BARS, WASHROOM ACCESSORIES & W.C. TO CONFORM TO BUILDING CODE REQUIREMENTS (FOR ONTARIO - O.B.C. SECTION 3.8 BARRIER FREE DESIGN.
 SEE FLOOR PLANS FOR LOCATION OF WASHROOM ACCESSORIES.

Kingsland + ARCHITECTS INC.	ISSUED:	DRAWING NAME: BARRIER-FREE WASHROOM SIDE ELEVATION	DATE: MAR 2026		SCALE: 1:10	
			DRAWN: K+		PROJECT NO: A25006	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+		DWG NO: 10-101	REV. 0

LEGEND - NEW			
AVI	CFS EMERGENCY AUDIO/VISUAL INDICATOR	RUB	RUBBER BASE
CFS	CALL FOR ASSISTANCE SYSTEM- SEE ELEC.	MOS	MOSAIC WALL TILES TO MATCH EX.
HD	HAND DRYER-SEE ELEC.	OI	OCCUPANCY INDICATOR
LPS	LOW PROFILE SINK - SEE MECH. & SPECS	PL	PUSH TO LOCK BUTTON
MIR	TILTED MIRROR	PB	CFS PUSH BUTTON
MOS	MOSAIC WALL TILES TO MATCH EX.	PT	PAINT FINISH
ND	NAPKIN DISPOSAL	PTD	PAPER TOWEL DISPENSER
PT	PAINT FINISH	POR	PORCELAIN FLOORING TILES /BASE TO MATCH EX.
POR	PORCELAIN FLOORING TILES /BASE TO MATCH EX.	RUB	RUBBER BASE
		SND	SANITARY NAPKIN DISEPNSER
		SD	SOAP DISPENSER
		TTD	TOILET TISSUE DISPENSER
			WALL FINISH
			FLOOR FINISH




NOTES:

INSTALLATION OF WASHROOM ACCESSORIES TO CONFORM TO THE BUILDING CODE REQUIREMENTS FOR BARRIER FREE DESIGN.

A COAT HOOK MUST BE MOUNTED WITHIN THE STALL ON THE SIDE WALL NOT MORE THAN 1100 MM ABOVE THE FLOOR AND EXTENDING NOT MORE THAN 50 MM OUT FROM WALL.

IN UNIVERSAL TOILET ROOMS PROVIDE A SHELF LOCATED NOT MORE THAN 1100 MM ABOVE THE FLOOR. SEE FLOOR PLANS FOR LOCATION OF WASHROOM ACCESSORIES.

REFER TO MANUFACTURES SPECIFICATIONS FOR MOUNTING DETAILS OF SPECIFIED ACCESSORIES.

<div>Kingsland </div> <div>ARCHITECTS INC.</div>	ISSUED:	DRAWING NAME: BARRIER-FREE ACCESSORY INSTALLATION	DATE: MAR 2026		SCALE: 1:20	
			DRAWN: K+		PROJECT NO: A25006	
KINGSLAND + ARCHITECTS INC 110 Cumberland Street, Suite 262 Toronto, Ontario M5R 3V5 ph 416.203.7799 fax 416.203.7763		PROJECT NAME: William G Miller—Bundle 5	CHECKED: K+		DWG NO: 10-102	REV. 0

APPENDIX 'B' - REPORTS



Geomaple Geotechnics Inc.

**GEOTECHNICAL INVESTIGATION REPORT
PROPOSED ACCESSIBILITY IMPROVEMENT
WILLIAM G. MILLER PUBLIC SCHOOL
60 BENNETT ROAD,
SCARBOROUGH, ONTARIO**

Prepared for: Toronto District School Board
Facility Services
15 Oakburn Crescent
Toronto, Ontario
M2N 2T5

Prepared by: Geomaple Geotechnics Inc.
60 Green Lane, Unit 12A
Thornhill, Ontario
L3T 7P5

Date: March 13, 2026

Project No.: 2026-10-107

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APPENDICES

Appendix A	Figures
Appendix B	Borehole Logs
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1 INTRODUCTION

Geomaple Geotechnics Inc. (GGI) was retained by Toronto District School Board (Client) to conduct a geotechnical investigation for the proposed accessibility improvement at William G. Miller Public School located at 60 Bennett Road, Scarborough, Ontario.

This report presents results of the geotechnical investigation conducted at the subject site to determine the prevailing subsurface soil and groundwater conditions, and based on this information, provides pertinent geotechnical engineering and design recommendations for the proposed accessibility improvements.

2 SITE AND PROJECT DESCRIPTION

The subject site is located at the southeast quadrant of the intersection of Lawrence Avenue East and Morningside Avenue, in the City of Toronto, Ontario. The general location of the site is shown on Figure 1 in Appendix A.

Based on the information provided by the client, we understand that the proposed accessibility improvements include the installation of an elevator and the construction of a new sidewalk, accessible pathway, and accessible parking space on the north side of the existing building. The site plan illustrating the proposed improvements was provided by the client and is presented as Figure 2 in Appendix A.

3 PROCEDURE

The field investigation of the site was conducted on February 17, 2026, which consisted of drilling and sampling of four (4) boreholes extending to a depth of about 5.0 m, and excavation of one (1) test pit to a depth of about 1.3 m below grade.

The approximate borehole and test pit locations are shown on Figure 2 in Appendix A. The results of the boreholes are recorded in detail on the Borehole Logs in Appendix B.

The borehole and test pit surface elevations are provided only for relating borehole soil stratigraphy and should not be used or relied on for other purposes.

The borings were drilled by specialist drilling subcontractor using a track mounted drill rig power auger with solid stem augers and were sampled with conventional 25 mm diameter split barrel samplers when the Standard Penetration Test (SPT) was carried out (ASTM D1586). The field work (drilling, sampling, and testing) was observed and recorded by a member of our engineering staff, who logged the bores and examined the samples as they were obtained.

All samples obtained during the investigation were sealed into clean plastic bags and transported

to our office for detailed inspection and testing. The samples were examined (tactile) in detail by our staff and classified according to visual and index properties.

The geotechnical laboratory testing consisted of water content determination, Sieve and Hydrometer Analysis on selected sample(s). The laboratory test results of individual sample(s) are plotted on the Borehole Logs at respective sampling depth, and presented in Appendix C.

Analytical sampling was conducted on selected soil samples obtained from the boreholes to assess the chemical quality of the site soils for the purpose of excess soil management and potential off-site disposal. The samples were analyzed in accordance with O. Reg. 406/19 – On-Site and Excess Soil Management, and the analytical results were compared to the applicable Excess Soil Quality Standards table under the regulation. The laboratory results are presented in Appendix D.

Unstabilized groundwater levels were measured in the boreholes upon completion of drilling. Monitoring well installation was not included in the scope of this assignment. The results of the groundwater level measurements are summarized in Section 4.2 of this report.

4 SUBSURFACE CONDITIONS

It should be noted that soil and groundwater conditions are confirmed at the borehole locations only and may vary at other locations. The stratigraphic boundaries as shown on the Borehole Logs represent an inferred transition between various strata, rather than a precise plane of geologic change.

4.1 Stratigraphy

The borehole results are summarized below and recorded on the accompanying Borehole Logs. This summary is intended to correlate this data to assist in the interpretation of the subsurface conditions at the site.

In summary, the boreholes encountered a surficial layer of pavement structure at the ground surface underlain by earth fill materials overlying undisturbed native soil deposit extending to the full depth of investigation.

4.1.1 Earth Fill

Below the pavement structure, the boreholes encountered a layer of earth fill material extending to about 0.7 to 1.2 m below grade. The earth fill comprised of a sandy matrix with some silt, and trace amounts of clay and gravel.

The samples obtained from the earth fill were loose to compact with Standard Penetration Test

results ('N' Values) of 9 to 30 blows per 300 mm of penetration.

4.1.2 Glacial Till

Below the earth fill material, undisturbed native glacial till deposit was encountered extending to the full depth of investigation. The composition of the glacial till varied from sandy silt to silty sand with trace to some clay and trace amounts of gravel.

The samples obtained from the native glacial till and sand layers were loose to very dense with Standard Penetration Test results ('N' Values) of 16 to 84 blows per 300 mm of penetration.

It should be noted that the glacial till deposit is likely to contain larger particles (cobbles and boulders) that are not specifically identified in the borehole. The size and distribution of such obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples for particles of this size.

4.2 Groundwater

Groundwater was not encountered in any of the boreholes upon completion of drilling. Installation of monitoring wells was not part of the scope of this assignment.

It should be noted that the groundwater levels may fluctuate seasonally depending on the amount of precipitation and surface runoff. Wet soils may be encountered to about 0.6 m above the groundwater level in the cohesionless silt/sand deposits.

5 FOOTING OF THE EXISTING BUILDING

A test pit investigation was conducted to determine the depth, thickness and projection of the footing of the existing building at the site. The investigation included excavation of one (1) test pit adjacent to the north wall of the building near the footprint of the proposed elevator. The test pit location is shown on Figure 2 in Appendix A.

The results of the test pits are summarized in the following table.

Test Pit No.	Groundwater Depth (m)	Under Side of Footing Depth (m)	Footing Thickness (m)	Footing Projection (m)
TP1	NA	1.24	0.20	0.15

6 SOIL CHEMISTRY ANALYSIS

Three (3) soil samples (BH1 SS1, BH2 SS3, and BH4 SS2) were selected for analytical testing and submitted to a certified environmental laboratory (Eurofins) retained by GGI. The samples were analyzed for the following parameters:

- Metals and Inorganics
- Volatile Organic Compounds (VOCs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Petroleum Hydrocarbons (PHCs F1–F4)
- BTEX (Benzene, Toluene, Ethylbenzene, Xylenes)

The analytical results were compared with the O. Reg. 406/19 – Excess Soil Quality Standards for Full Depth – Residential/Parkland/Institutional/Industrial/Commercial (Table 1). The Certificate of Analysis and Chain of Custody are provided in Appendix D.

Based on the analytical results, all tested parameters met the applicable Table 1 Excess Soil Quality Standards, with the exception of Sodium Adsorption Ratio (SAR) and Electrical Conductivity (EC). Elevated SAR and EC values were observed in all three tested samples.

It should be noted that the analytical results apply only to the soil samples collected from the borehole locations tested. Soil conditions may vary between and beyond the sampled locations. Accordingly, soil materials to be excavated and transported off-site should be monitored for any visual or olfactory indications of contamination, and additional chemical testing may be required depending on the requirements of the receiving site and the applicable regulatory framework.

The soil chemistry analysis carried out as part of this investigation was intended to provide preliminary information regarding the chemical quality of the site soils for excess soil management purposes. This work does not constitute a Phase II Environmental Site Assessment and is not intended to support the filing of a Record of Site Condition (RSC) under the Environmental Protection Act. Additional environmental investigation may be required if an RSC is to be submitted.

6.1 Off-Site Soil Disposal

As previously noted, the objective of the soil chemistry analysis carried out on selected borehole soil samples was to obtain preliminary information regarding the chemical quality of the site soils for the purpose of excess soil management.

Based on the analytical results obtained from the tested soil samples, all analyzed parameters meet the applicable Excess Soil Quality Standards under O. Reg. 406/19 – On-Site and Excess Soil Management (Table 1 – Full Depth – Residential/ Parkland/ Institutional/ Industrial/

Commercial), with the exception of Sodium Adsorption Ratio (SAR) and Electrical Conductivity (EC), which exceeded the applicable standard in the tested samples.

It should be noted that elevated SAR and EC values are relatively common in natural soils and are typically associated with the natural mineral composition of the soil rather than anthropogenic contamination. SAR and EC is primarily an indicator of soil sodicity and may affect soil structure and permeability under certain conditions, but it does not generally represent a contamination concern. The exceedance observed in the tested samples is therefore considered to be likely related to natural soil conditions.

It should also be noted that the analytical results apply only to the soil samples collected from the borehole locations tested. Soil conditions may vary between and beyond the sampled locations. Accordingly, additional sampling and analysis may be required during construction to further characterize the soils to be excavated and determine appropriate soil management and disposal options.

It is recommended that a Soil Management Plan be prepared and implemented during construction to further characterize the site soils and assess soil reuse and disposal options in accordance with O. Reg. 406/19 requirements. This plan may include stockpiling and sorting of excavated soils under appropriate supervision, followed by re-sampling and laboratory analysis of representative stockpile samples to confirm soil quality prior to off-site transportation or potential on-site reuse.

If any soils exhibiting unusual staining, hydrocarbon or solvent odours, or containing rubble, debris, cinders, or other visual evidence of potential impact are encountered during excavation, such materials should be segregated and temporarily stockpiled on-site. These soils should not be transported off-site until further assessment and analytical testing has been completed to determine appropriate handling and disposal requirements.

7 DISCUSSION AND RECOMMENDATIONS

The following discussion and recommendations are based on the factual data obtained from this investigation and are intended for use of the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding construction methods and scheduling.

This report is provided based on these terms of reference and the assumption that the design features relevant to the geotechnical analyses will be in accordance with applicable codes, standards, and guidelines of practice. The pertinent sections of Ontario Building Code may require additional considerations above and beyond the recommendations provided in this report. If there are any changes to the site development features, or there is any additional information relevant to the interpretations made of the subsurface information with respect to the geotechnical analyses or other recommendations, then Geomape should be retained to review the implications of these changes with respect to the contents of this report.

7.1 Foundations

Based on the borehole data the site is underlain by undisturbed native glacial till deposit which is competent to support the proposed foundations.

Groundwater was not encountered in the boreholes and test pit at the time of drilling and excavation. However, groundwater levels may rise during wetter periods of the year. Therefore, conservatively, any below-grade elements such as the elevator pit may be designed assuming the potential presence of groundwater. Appropriate waterproofing (tanking) measures should be incorporated into the foundation design to prevent water ingress and to ensure the long-term performance of the structure.

A net geotechnical reaction of 200 kPa at Serviceability Limit States (SLS), and a factored geotechnical resistance of 300 kPa at Ultimate Limit States (ULS), may be used for the design of conventional spread footing foundations (for vertical and concentric loads) supported on the glacial till deposit at a depth of 1.5 m below grade or lower.

For structural design purposes, a modulus of subgrade reaction of 30,000 kN/m³ may be assumed for slabs or foundations bearing on the recommended native glacial till or engineered fill compacted to 98% Standard Proctor Maximum Dry Density (SPMDD).

All foundations must be designed to bear at least a minimum of 0.3 m into the undisturbed native soil strata. The founding depth noted above accounts for this embedment.

The minimum width of continuous strip footings should be 600 mm, and the minimum size of isolated footings should be 1000 mm x 1000 mm in conjunction with the above bearing pressures

regardless of loading considerations. The footing sizes for institutional buildings are stipulated in the Ontario Building Code (2024), and must be followed.

7.1.1 Placement of Footings

Prior to placing foundation concrete, the foundation subgrade should be stripped of all deleterious materials, including topsoil, fill, softened, disturbed, or caved soils, as well as any standing water. If construction proceeds during freezing weather conditions, adequate temporary frost protection should be provided for both the foundation subgrade and the concrete.

It is recommended that the foundation subgrade be inspected by Geomape or a qualified geotechnical representative to confirm that the soils exposed at the base of excavation are consistent with the soil conditions assumed in the design and are capable of supporting the specified bearing pressures.

All exterior foundations, or foundations located in unheated areas exposed to freezing temperatures (such as footings for fence posts or basketball posts), should be provided with a minimum soil cover of 1.2 m for frost protection, or alternatively be protected with equivalent frost insulation measures.

It should also be noted that the native soils encountered at the site may weather and soften upon prolonged exposure to the atmosphere or surface water. Therefore, if foundation excavations remain open for an extended period, the exposed subgrade should be protected, for example by placing a skim coat of lean concrete, to prevent deterioration prior to construction.

7.2 Excavation and Groundwater Control

Excavations must be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

The earth fill can be considered Type 3 Soil above and Type 4 Soil below the groundwater level, while the glacial till encountered in the boreholes is considered Type 2 Soil under these regulations.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The regulation stipulates steepest slopes of excavation by soil type, as follows:

Soil Type	Base of Slope	Maximum Slope Inclination
Type 1	within 1.2 m of bottom of trench	1 horizontal to 1 vertical
Type 2	within 1.2 m of bottom of trench	1 horizontal to 1 vertical
Type 3	from bottom of trench	1 horizontal to 1 vertical
Type 4	from bottom of trench	3 horizontal to 1 vertical

Minimum support system requirements for steeper excavations are stipulated in the Occupational Health and Safety Act and Regulations for Construction Projects, and include provisions for timbering, shoring and movable trench boxes.

Groundwater was not encountered within the boreholes. However, perched groundwater may be present within the earth fill material above the native till layer.

The excavation for the foundations would be above the water table, however, the groundwater seepage may emanate from the perched groundwater generally present in the earth fill materials. Based on the above, the groundwater seepage during the construction for the basement excavation would not be significant (less than 50,000 L/day) which can be controlled by pumping from filtered sumps at the base of the excavation.

7.3 Earth Pressure Design Parameters

Walls or bracings subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K [\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where:

P = the horizontal pressure at depth, h (m)

K = the earth pressure coefficient,

h_w = the depth below the groundwater level (m),

γ = the bulk unit weight of soil, (kN/m³)

γ' = the submerged unit weight of the exterior soil, (9.81 kN/m³)

q = the complete surcharge loading (kPa)

Where the wall backfill can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

$$P = K [\gamma h + q]$$

This equation assumes that free-draining granular backfill is used and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

Resistance to sliding of earth retaining structures is developed by friction between the base of the footing and the soil. This friction (R) depends on the normal load on the soil contact (N) and the frictional resistance of the soil ($\tan \phi$) expressed as: $R = N \tan \phi$. The factored resistance at ULS is $0.8R$.

Passive earth pressure resistance is generally not considered a resisting force against sliding for conventional retaining structure design since a structure must deflect significantly to develop the full passive resistance.

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows:

<u>Parameter</u>	<u>Definition</u>	<u>Units</u>
ϕ	internal angle of friction	degrees
γ	bulk unit weight of soil	kN/m ³
K_a	active earth pressure coefficient (Rankin)	dimensionless
K_o	at-rest earth pressure coefficient (Rankin)	dimensionless
K_p	passive earth pressure coefficient (Rankin)	dimensionless

Stratum/Parameter	ϕ	γ	K_a	K_o	K_p
Earth Fill	30	20	0.33	0.50	3.00
Silty Sand to Sandy Silt Till	36	21	0.26	0.41	3.85
Granular Backfill	32	21	0.31	0.47	3.25

The values of the earth pressure coefficients noted above are for the horizontal retained grade. The earth pressure coefficients for inclined grade will vary based on the inclination of the retained ground surface.

7.4 Backfill

The earth fill and native soils encountered at the site may be reused as backfill, provided they are free of excessive organic matter, debris, or other deleterious materials. The selection and

placement of suitable backfill materials should be carried out under the supervision of a geotechnical engineer or qualified representative. Soils containing excessive organic material should not be used as structural backfill but may be stockpiled and reused for landscaping purposes, where appropriate.

The earth fill may be considered suitable for backfill if the moisture content is within approximately ± 3 percent of the optimum moisture content. It should be noted that native soils located below the groundwater table are expected to have elevated moisture content and may be too wet for effective compaction. Soils with in-situ moisture content exceeding the optimum moisture content by approximately 3 percent or more should be aerated or tilled to reduce the moisture content prior to compaction. Alternatively, excessively wet materials may need to be removed and replaced with imported granular materials that can be readily compacted.

In settlement-sensitive areas, such as beneath floor slabs, backfill should consist of clean, approved fill materials placed in maximum 150 mm thick lifts and compacted to a minimum of 98 percent of the Standard Proctor Maximum Dry Density (SPMDD) at a moisture content close to optimum.

It should also be noted that the native glacial till encountered at the site is not free-draining and may become difficult to handle and compact if exposed to additional moisture from precipitation or groundwater seepage. As a result, earthworks may be more challenging during wet periods of the year, particularly during the spring and fall seasons.

7.5 Pavement

The proposed work may include the construction of a new concrete sidewalk, accessible pathway, and accessible parking space as part of the accessibility improvements.

Based on the anticipated subgrade conditions, a subgrade modulus of resilience of approximately 12,000 kPa/m may be assumed for design purposes. The following flexible pavement structure is recommended for a typical design life of approximately 15 to 20 years under normal parking and light vehicular loading conditions.

Pavement Layer	Compaction Requirements	Thickness
Surface Course - Asphaltic Concrete HL3 (OPSS 1150 and Pertinent City Specifications)	as per OPSS 310	40 mm
Base Course - Asphaltic Concrete HL8 (OPSS 1150 and Pertinent City Specifications)	as per OPSS 310	50 mm
Base Course: Granular 'A' or 19 mm Crusher Run Limestone (OPSS 1010 and Pertinent City Specifications)	98% Standard Proctor Maximum Dry Density (ASTM-D698)	150 mm
Subbase Course: Granular 'B' Type II, or 50 mm Crusher Run Limestone (OPSS 1010 and Pertinent City Specifications)	98% Standard Proctor Maximum Dry Density (ASTM-D698)	200 mm

The existing granular base materials encountered at the site may be reused for engineered fill or pavement subgrade preparation provided they are free of excessive organic matter and other deleterious materials and their in-situ moisture content is within approximately 3 percent of the optimum moisture content. The selection and reuse of these materials should be carried out under the supervision of a geotechnical engineer. The pavement subgrade and granular materials should be compacted to a minimum of 98 percent Standard Proctor Maximum Dry Density (SPMDD).

Prior to placement of new pavement materials, the exposed subgrade should be proof rolled using a heavy rubber-tired vehicle. Any loose, soft, wet, or unstable areas identified during proof rolling should be sub-excavated and replaced with suitable granular fill placed in lifts not exceeding 150 mm and compacted to a minimum of 98 percent SPMDD.

The long-term performance of the pavement structure is highly dependent on the quality and uniformity of the subgrade. Therefore, care should be taken during construction to maintain consistent moisture and density conditions and to avoid disturbance of the prepared subgrade.

7.6 Drainage

Proper drainage is essential for satisfactory pavement performance. The pavement subgrade should be graded to promote positive drainage and should be free of depressions that may trap water. Where feasible, pavement subdrains should be installed along the edges of the parking area and connected to nearby catch basins to facilitate drainage of the subgrade and granular layers. The subdrain invert should be maintained at least 0.3 m below the pavement subgrade.

For the proposed sidewalk and accessible pathway, the granular base beneath concrete walkways should extend to provide a continuous drainage path toward the pavement subdrains to facilitate subgrade drainage and reduce the potential for slab heaving. Concrete sidewalk and entrance slabs should be supported on a minimum of 1.2 m of non-frost-susceptible material (Granular 'A' and 'B', OPSS 1010) with provision of a subdrain with a positive outlet to minimize frost-related heave. Where achieving this depth is impractical, installation of a frost-protected slab system should be considered.

Regular inspection and testing during construction are recommended to confirm material quality, layer thicknesses, and adequate compaction.

7.7 Earthquake Design Parameters

The Ontario Building Code (2024) outlines the requirements for earthquake design analysis in Division B, Section 4.1.8. The type of seismic analysis required depends on the importance category of the structure, the spectral response acceleration values, and the seismic site classification.

The parameters for determining the Seismic Site Classification are provided in Table 4.1.8.4.A of the Ontario Building Code (2024). The site classification is primarily based on the average shear wave velocity (V_s) within the upper 30 m of the site stratigraphy where shear wave velocity measurements are available. Alternatively, the classification may be estimated based on a rational assessment of the undrained shear strength (S_u) of cohesive soils or Standard Penetration Test (SPT) N-values obtained during the geotechnical investigation.

Based on the borehole data obtained during the investigation (to a maximum explored depth of approximately 5.0 m below existing grade), the subsurface conditions at the site consist of undisturbed native glacial till deposits of typically very dense relative density. Assuming that the deeper stratigraphy is at least as competent as the lowest proven strata encountered in the boreholes, the weighted average SPT N-value for seismic design purposes may conservatively be taken as greater than 50 blows per 300 mm.

Based on the above considerations, the preliminary seismic site classification for the site is Site Class C, in accordance with Table 4.1.8.4.A of the Ontario Building Code (2024). The corresponding acceleration-based and velocity-based site coefficients for seismic design are provided in Tables 4.1.8.4.B and 4.1.8.4.C of the same code.

Site Class	Values of F_a (acceleration-based site coefficient)				
	$S_a(0.2) \leq 0.25$	$S_a(0.2) \leq 0.5$	$S_a(0.2) \leq 0.75$	$S_a(0.2) \leq 1.00$	$S_a(0.2) \leq 1.25$
C	1.0	1.0	1.0	1.0	1.0

Site Class	Values of F_v (velocity-based site coefficient)				
	$S_a(1.0) \leq 0.1$	$S_a(1.0) \leq 0.2$	$S_a(1.0) \leq 0.3$	$S_a(1.0) \leq 0.4$	$S_a(1.0) \leq 0.5$
C	1.0	1.0	1.0	1.0	1.0

It should be noted that the above site seismic designation is estimated based on rational analysis of the limited penetration resistance (N-Values) information obtained from the boreholes advanced at the site to a maximum depth of about 20 m below grade, and with assumed 'N-Values' for the soil stratigraphy beneath the investigation depth.

Alternatively, a site-specific Multichannel Analysis of Surface Waves (MASW) may be conducted to determine the average shear wave velocity within the upper 30 m of the site stratigraphy. GGI can provide this service if required. The results of this analysis may allow for a more refined seismic site classification and could potentially lead to more favourable seismic design parameters compared to those associated with a Site Class C designation, which may in turn reduce structural design requirements.

8 LIMITATIONS AND USE OF REPORT

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. A comprehensive sampling and testing program implemented in strict accordance with the most stringent level of care may fail to detect certain conditions. Geomape has assumed for the purpose of providing advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Geomape has interpreted to exist between sampling points can differ from those that exist. It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions.

The discussion and recommendations provided here are based on the factual data obtained from the investigation and are intended for use by the owner and its retained designers in the design phase of the project. Since the project is still in the design stage, all aspects of the project relative to the subsurface conditions cannot be anticipated. Geomape should review the design drawings and specifications prior to the construction of this work. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant to the revised project scope. Geomape should be retained to review the implications of these changes with respect to the contents of this report.

The investigation at this site was conceived and executed to provide information for the slope stability study and the geotechnical design. It may not be possible to drill a sufficient number of boreholes, or samples and report them in a way that would provide all the subsurface information that could influence construction costs, techniques, equipment, and scheduling. Contractors bidding on or undertaking work on this project should therefore, in this light, be directed to decide on their own investigations, as well as their own interpretations of the factual investigation results. They should be cognizant of the risks implicit in subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was prepared for the express use of Toronto District School Board and its retained design consultants. It is not for use by others. This report is copyright of Geomape Geotechnics Inc., and no part of this report may be reproduced by any means, in any form, without the prior written permission of Geomape Geotechnics Inc. and Toronto District School Board, who are the authorized users.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statutes, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

9 CLOSURE

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,

Geomaple Geotechnics Inc.

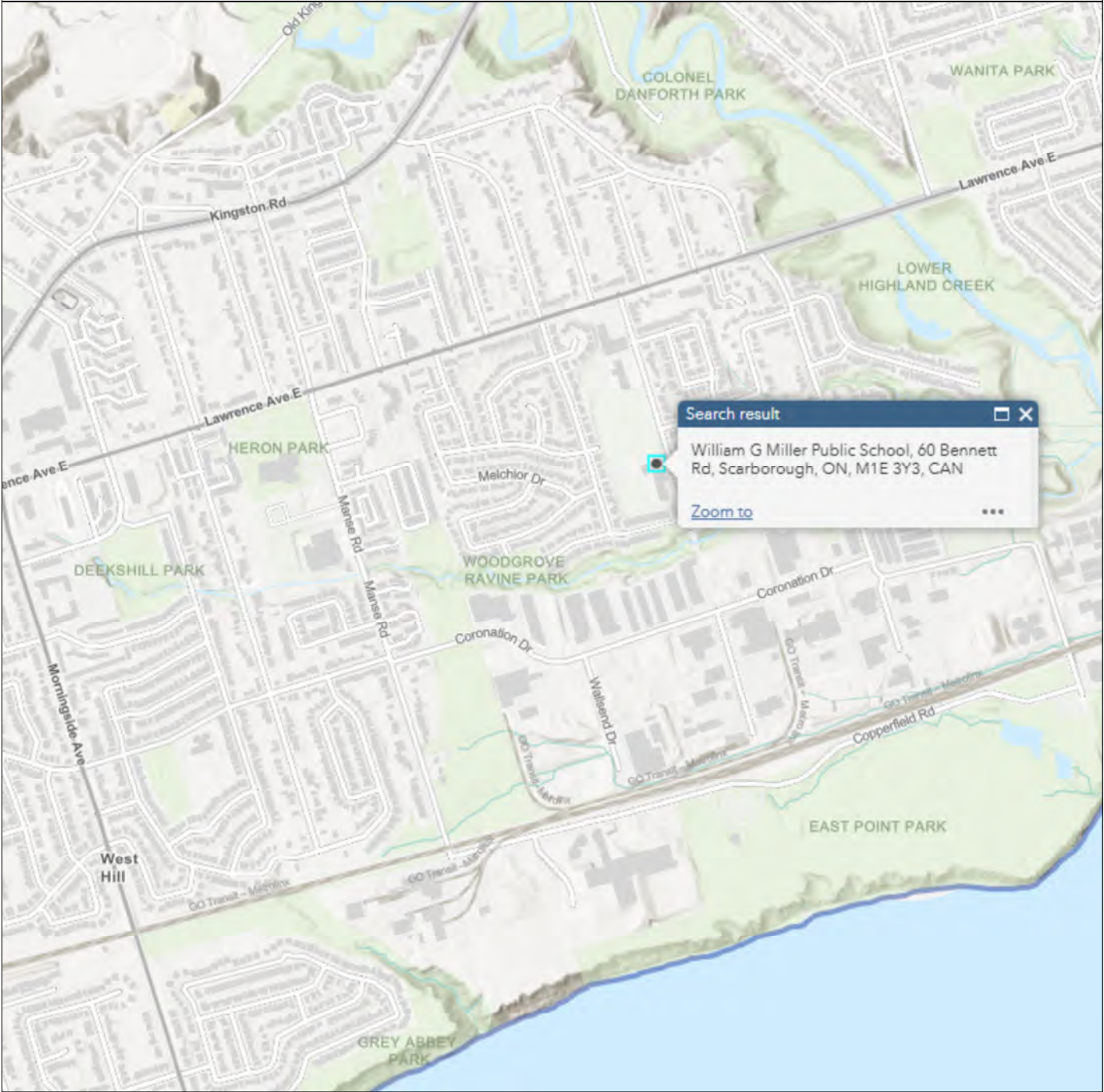



Navid Hatami, M.Eng, P.Eng
Senior Engineer

APPENDICES

APPENDIX A

FIGURES



 Geomaple Geotechnics Inc.	60 Green Lane, Unit 12A Thornhill, Ontario L3T 7P5 Phone: (416) 444 1200 Fax: (416) 444 1200	No.	Revision	Date		William G. Miller Public School
			Site Location Plan			
			Project No.:	2026-10-107		
			Date:	March 2026		
			Drawn by:	EL		
			Checked by:	NH		
			Figure 1			
			Scale:	NA		



Phone: (416) 444 1200
Fax: (416) 444 1200

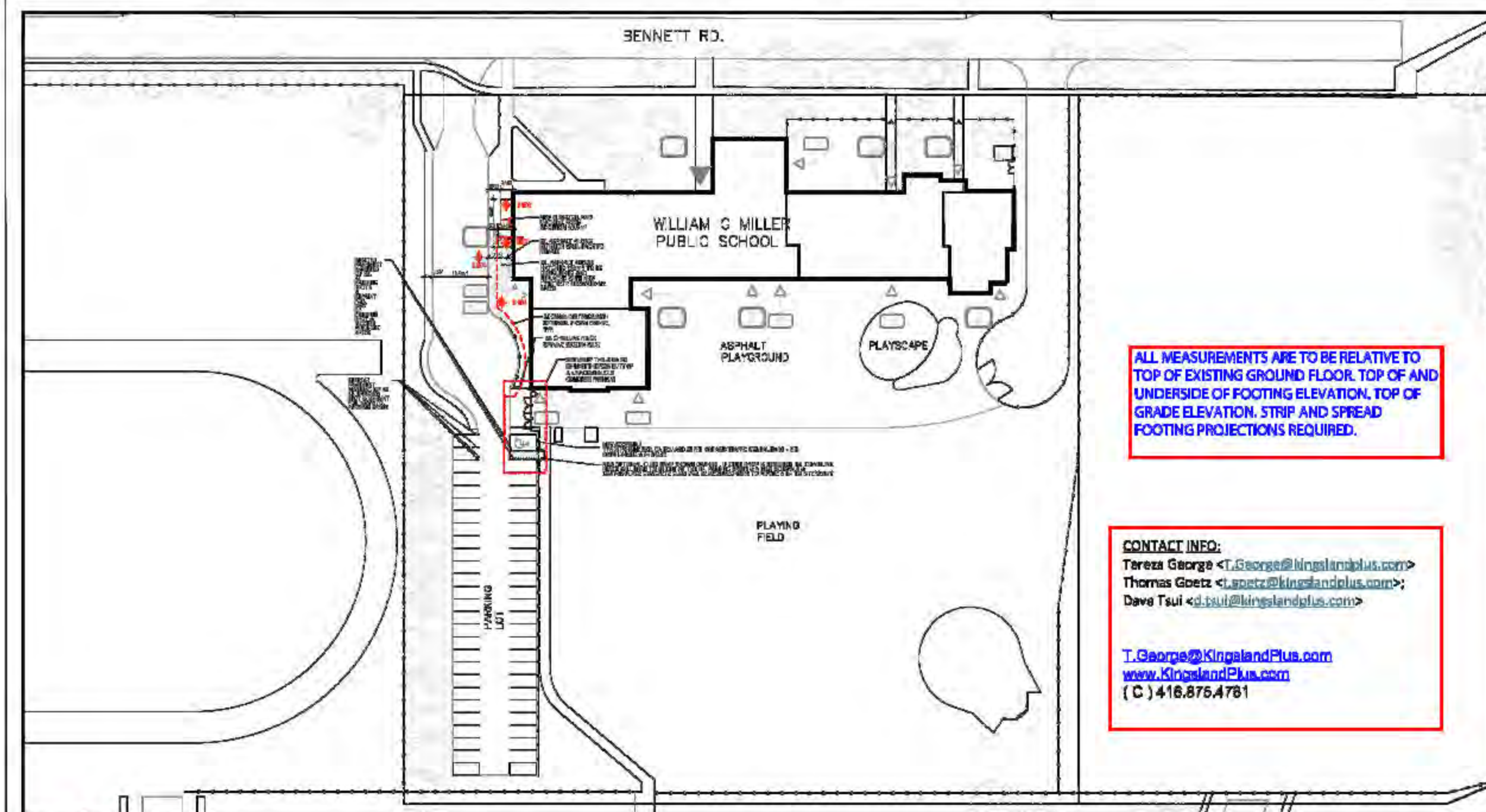
Legend:

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William G. Miller
Public School

Project Number	2026-10-107
Date	March 2026
Drawn By	EL
Checked By	NH

Scale As Shown



ALL MEASUREMENTS ARE TO BE RELATIVE TO TOP OF EXISTING GROUND FLOOR, TOP OF AND UNDERSIDE OF FOOTING ELEVATION, TOP OF GRADE ELEVATION, STRIP AND SPREAD FOOTING PROJECTIONS REQUIRED.

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William G Miller PS
OVERALL SITE PLAN W/BH & TP LOCATIONS

PROJECT: A25006 **DATE:** January 26 2026
SCALE: 1:750

KINGSLAND + ARCHITECTS INC.
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Kingsland +
ARCHITECTS INC.

APPENDIX B

BOREHOLE LOGS



RECORD OF BOREHOLE 1

PAGE 1 OF 1

PROJECT: William G. Miller Public School
LOCATION: 60 Bennett Road, Toronto, Ontario
PROJECT NO: 2026-10-107

CLIENT: Toronto Distict School Board
DRILLING DATE: 2/17/2026

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _P	W	W _L		
100.0								20	40	60	80	100		
99.9	ASPHALT 150 mm							20	40	60	80	100		
99.7	GRANULAR BASE 180 mm							20	40	60	80	100		
0.3	EARTH FILL sand, some silt, trace to some gravel, loose to compact, brown, moist.		1	SS	18			20	40	60	80	100		
98.8			2	SS	9			20	40	60	80	100		
1.2	SILTY SAND TO SANDY SILT TILL trace to some clay, some gravel, dense to very dense, brown, moist.		3	SS	47			20	40	60	80	100		
			4	SS	65			20	40	60	80	100		
			5	SS	71			20	40	60	80	100		
	... sand lense		6	SS	88/ 270mm			20	40	60	80	100		
95.0	END OF BOREHOLE							20	40	60	80	100		
5.0	The borehole was open and dry upon completion of drilling.							20	40	60	80	100		







RECORD OF BOREHOLE 2

PAGE 1 OF 1

PROJECT: William G. Miller Public School
LOCATION: 60 Bennett Road, Toronto, Ontario
PROJECT NO: 2026-10-107

CLIENT: Toronto Distict School Board
DRILLING DATE: 2/17/2026

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		w _p	w	w _L		
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	WATER CONTENT (%)					
100.0								20 40 60 80 100						GR SA SI CL
99.9	ASPHALT 150 mm													
99.7	GRANULAR BASE 180 mm													
0.3	EARTH FILL sand, some silt, trace to some gravel, compact, brown, moist.		1	SS	20									
99.2														
0.8	SILTY SAND TO SANDY SILT TILL trace to some clay, some gravel, compact to very dense, brown, moist.		2	SS	24		99							
			3	SS	51		98							
			4	SS	84									12 54 30 4
			5	SS	87		97							
							96							
	... sand lense		6	SS	84									
95.0							95							
5.0	END OF BOREHOLE													
	The borehole was open and dry upon completion of drilling.													

ONTARIO MOT 2026-10-107 WILLIAM PS - BH LOG.GPJ ONTARIO MOT.GDT 2/26/26



RECORD OF BOREHOLE 3

PAGE 1 OF 1

PROJECT: William G. Miller Public School
LOCATION: 60 Bennett Road, Toronto, Ontario
PROJECT NO: 2026-10-107

CLIENT: Toronto Distict School Board
DRILLING DATE: 2/17/2026

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST▲ RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W _p W W _L				
100.0								○ UNCONFINED	+ FIELD VANE	WATER CONTENT (%)				
99.9	CONCRETE SLAB 100 mm							● QUICK TRIAXIAL	× LAB VANE					
99.8	GRANULAR BASE 120 mm													
0.2	EARTH FILL sand, some silt, trace to some gravel, compact, brown, moist.		1	SS	16									
99.3	SILTY SAND TO SANDY SILT TILL trace to some clay, some gravel, dense to very dense, brown, moist.		2	SS	36		99							22 30 37 11
0.7			3	SS	54		98							
			4	SS	61		97							
			5	SS	92/ 210mm		96							
			6	SS	80/ 230mm									
95.1	... sand lense													
5.0	END OF BOREHOLE													
	The borehole was open and dry upon completion of drilling.													

ONTARIO MOT 2026-10-107 WILLIAM PS - BH LOG.GPJ ONTARIO MOT.GDT 2/26/26



RECORD OF BOREHOLE 4

PAGE 1 OF 1

PROJECT: William G. Miller Public School
LOCATION: 60 Bennett Road, Toronto, Ontario
PROJECT NO: 2026-10-107

CLIENT: Toronto Distict School Board
DRILLING DATE: 2/17/2026

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	STANDARD PENETRATION TEST ▲ RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
100.0								20 40 60 80 100		10 20 30				
99.9	ASPHALT 150 mm													
99.7	GRANULAR BASE 180 mm													
0.3	EARTH FILL sand, some silt, trace to some gravel, compact, brown, moist.		1	SS	30									
99.2														
0.8	SILTY SAND TO SANDY SILT TILL trace to some clay, some gravel, dense to very dense, brown, moist.		2	SS	39		99							
			3	SS	71/ 290mm		98							
			4	SS	63									
			5	SS	50		97							
							96							
	... sand lense		6	SS	80/ 290mm		95							
95.0														
5.0	END OF BOREHOLE													
	The borehole was open and dry upon completion of drilling.													

ONTARIO MOT 2026-10-107 WILLIAM PS - BH LOG.GPJ ONTARIO MOT.GDT 2/26/26

APPENDIX C

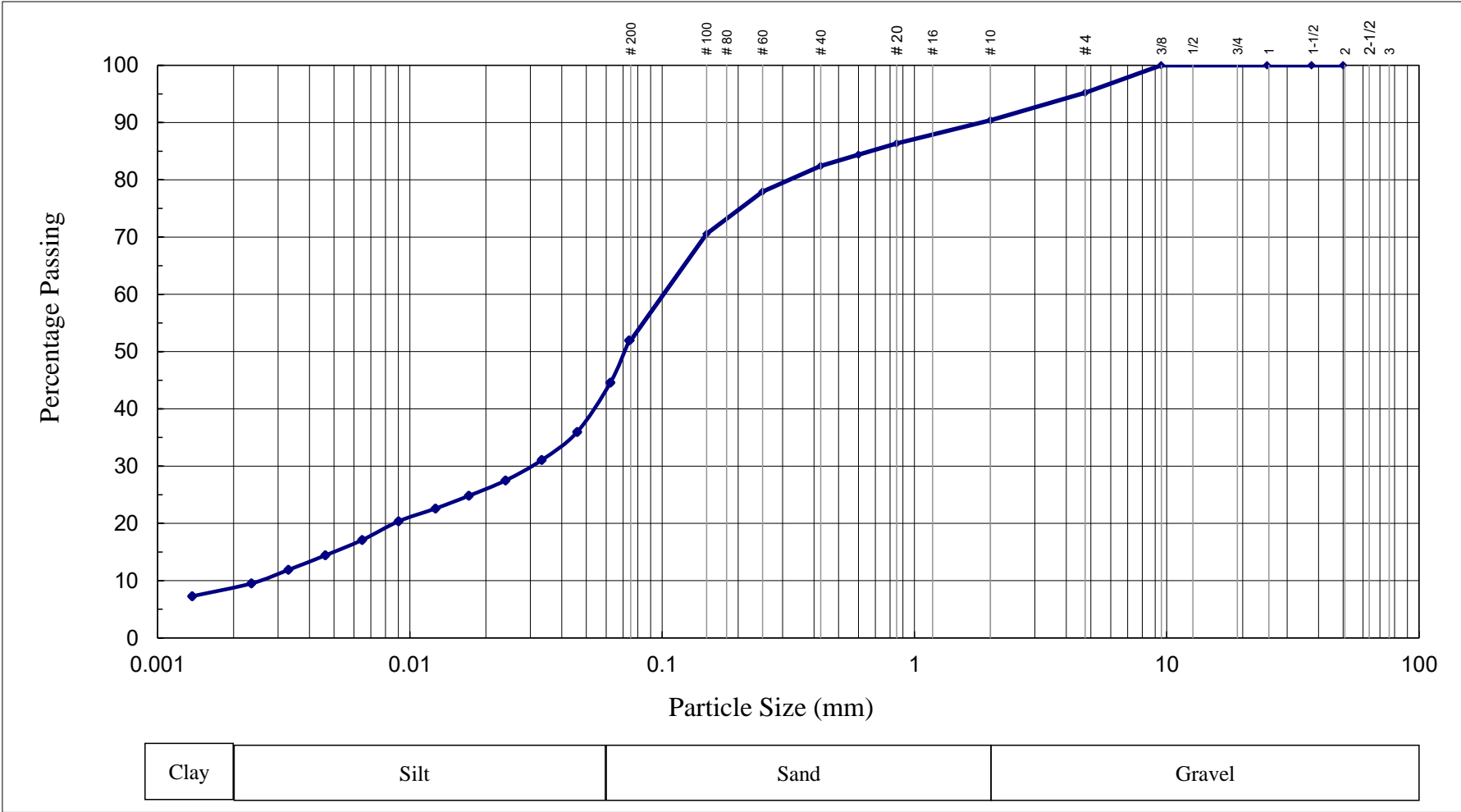
GEOTECHNICAL LABORATORY TEST RESULTS



Sieve & Hydrometer Analysis

Lab#: 100994

Project Name: William G Miller PS		Project No: 2026-10-107	
Order No:	Test Date: February 24, 2026	Client:	TDSB
Borehole No: BH1	Borehole Location: Figure2	Lead Consultant:	
Sample No: SS3	Sample Depth: 1.75	moisture content: 8.8%	



Clay:

9

Silt:

34

Sand:

47

Gravel:

10

LL:

PL:

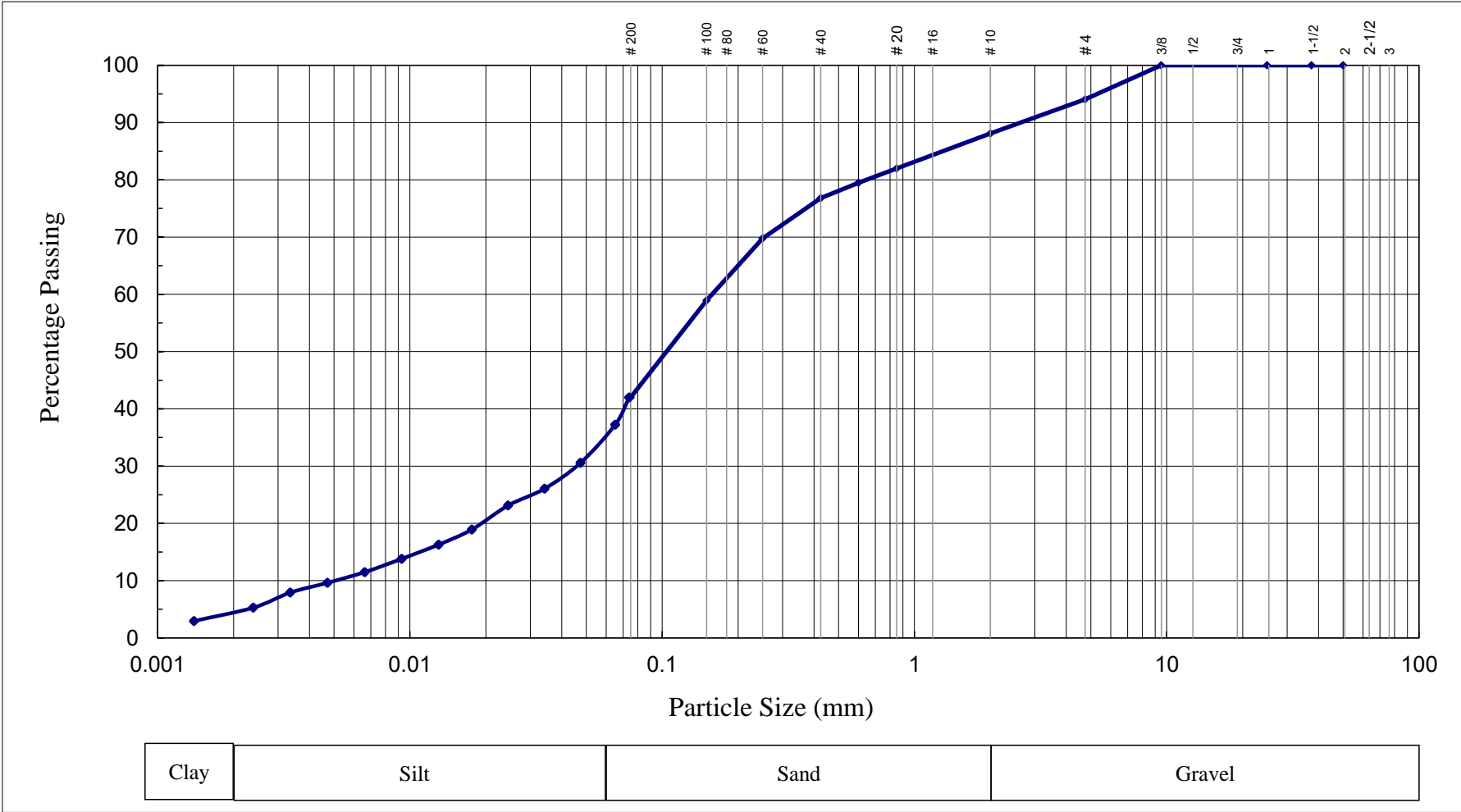
PI:

Sieve & Hydrometer Analysis



Lab#: 100995

Project Name: William G Miller PS		Project No: 2026-10-107	
Order No:	Test Date: February 24, 2026	Client:	TDSB
Borehole No: BH2	Borehole Location: Figure2	Lead Consultant:	
Sample No: SS4	Sample Depth: 2.52	moisture content: 6.4%	



Clay:

4

Silt:

30

Sand:

54

Gravel:

12

LL:

PL:

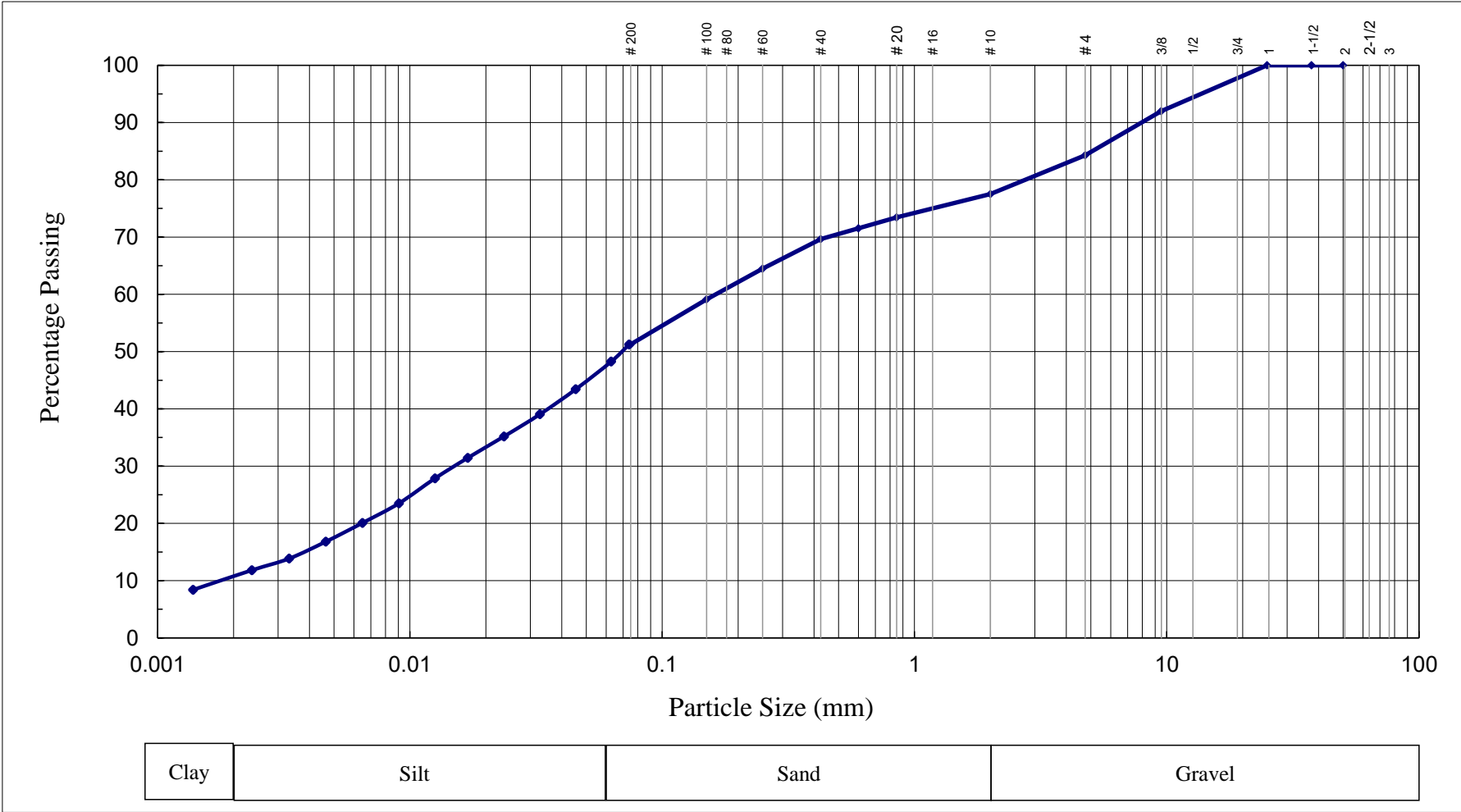
PI:

Sieve & Hydrometer Analysis



Lab#: 100996

Project Name: William G Miller PS		Project No: 2026-10-107	
Order No:	Test Date: February 24, 2026	Client:	TDSB
Borehole No: BH3	Borehole Location: Figure2	Lead Consultant:	
Sample No: SS2	Sample Depth: 0.99	moisture content: 7.4%	



Clay:

11

Silt:

37

Sand:

30

Gravel:

22

LL:

PL:

PI:

APPENDIX D

Analytical Test Results

OFFICIAL CERTIFICATE OF ANALYSIS : 4616033
WORK REQUEST : 100416099
Report Date : 2026-02-26
Geomaple Geotechnics

60 Green Lane, Unit 12A

Thornhill, Ontario

L3T 7P5

Attention : Navid Hatami

Reception Date : 2026-02-19

Project : William G Miller PS

Sampler : NA

PO Number : Not Applicable

Temperature : 10 °C

Analysis	Quantity	External Method
Boron, HWS (Soil, OES)	3	Modified from MECP E3470 and Gupta, 1967.
Chromium, Hexavalent (Soil, FAA)	3	Modified from EPA 3060A, USGS I-1232-85
Conductivity (Soil, Manual Meter)	3	Modified from MECP E3530
Cyanide, Free (Soil, Colorimetry)	3	Modified from MECP E3015
Hexavalent Chromium (Soil, IC)	3	Modified from SM 3500-CR C and EPA 3060A
Metals Scan (Soil, ICP/MS)	3	Modified from EPA 3050, EPA 200.8
Moisture (Soil, Gravimetric)	3	Modified from ASTM D2216
PAH, O. Reg. 153/04 (Soil, GC/MS)	3	Modified from EPA 8270
pH (Soil, 1:2 CaCl ₂ , Manual Meter)	3	Modified from MECP E3530
PHC F1-BTEX (Soil, Calculation)	3	CCME Petroleum Hydrocarbons in Soil, Tier 1 Method
PHCs F1 (Soil, GC-FID)	3	CCME Petroleum Hydrocarbons in Soil, Tier 1 Method
PHCs F2-F4 (Soil, GC-FID)	3	CCME Petroleum Hydrocarbons in Soil, Tier 1 Method
SAR (Calculation, Soil)	3	O.Reg. 153/04, Analytical Protocol
VOCs, O.Reg. 153/04 (Soil, GC/MS)	3	Modified from EPA 8260

Criteria :
A : O. Reg 406/19 - Excess Soil - Full Depth - Res/Park/Ins/Ind/Comm - Table 1

Sample status upon receipt :

9429115 9429116 9429117

Compliant
Certificate Comments :

9429115 9429116 9429117

Bromomethane spike recovery is outside of acceptable range.
Notes :

- All analysis is completed at Eurofins Environment Testing Canada Inc. (Ottawa, Ontario) unless otherwise stated.
- Eurofins Environment Testing Canada Inc. is accredited by CALA, Canadian Association for Laboratory Accreditation to ISO/IEC 17025 for tests which appear on the scope of accreditation. The scope is available at <https://directory.cala.ca/>
- Please note: Field data, where presented on the report, has been provided by the client and is presented for informational purposes only. Guideline or regulatory limits listed on this report are provided for ease of use (informational purposes) only. Eurofins recommends consulting the official guideline or regulation as required. Unless otherwise stated, measurement uncertainty is not taken into account when determining guideline or regulatory exceedances.

Legend :

RL : Reporting limit

N/A : Not applicable

* : Analysis conducted by external subcontracting

QC : Reference material (QC)

1 : Results in annex

^ : Analysis not accredited

OFFICIAL CERTIFICATE OF ANALYSIS - EXCEEDENCE SUMMARY

Client : Geomape Geotechnics

Project : William G Miller PS

Reception Date : 2026-02-19

Eurofins Sample No	Client Sample Identification	Analyte	Result	Units	Exceeded Criteria		
					A	B	C
Conductivity (Soil, Manual Meter)							
9429115	BH4-SS2	Electrical Conductivity	1.37	mS/cm	0.57		
9429116	BH2-SS3	Electrical Conductivity	1.44	mS/cm	0.57		
9429117	BH1-SS1	Electrical Conductivity	1.34	mS/cm	0.57		
SAR (Calculation, Soil)							
9429115	BH4-SS2	Sodium Absorption Ratio (SAR)^	25.0		2.4		
9429116	BH2-SS3	Sodium Absorption Ratio (SAR)^	19.7		2.4		
9429117	BH1-SS1	Sodium Absorption Ratio (SAR)^	29.9		2.4		

OFFICIAL CERTIFICATE OF ANALYSIS - RESULTS

Client : Geomaple Geotechnics
Project : William G Miller PS

Reception Date: 2026-02-19

Eurofins Sample No :				9429115	9429116	9429117		
Matrix :				Soil 153	Soil 153	Soil 153		
Sampling Date :				2026-02-17	2026-02-17	2026-02-17		
Client Sample Identification :				BH4-SS2	BH2-SS3	BH1-SS1		
General Chemistry	RL	Unit	Criteria					
			A	B	C			
Boron (Hot Water Soluble)	0.25	ug/g				<0.25	<0.25	0.26
Electrical Conductivity	0.05	mS/cm	0.57			1.37	1.44	1.34
Cyanide (Free)	0.005	ug/g	0.051			<0.005	<0.005	<0.005
pH (1:2 CaCl2)	1					8.02	8.05	8.05
Sodium Absorption Ratio (SAR)^	0.01		2.4			25.0	19.7	29.9

Eurofins Sample No :				9429115	9429116	9429117		
Matrix :				Soil 153	Soil 153	Soil 153		
Sampling Date :				2026-02-17	2026-02-17	2026-02-17		
Client Sample Identification :				BH4-SS2	BH2-SS3	BH1-SS1		
Metals	RL	Unit	Criteria					
			A	B	C			
Hexavalent Chromium	0.2	ug/g	0.66			0.55	0.26	<0.20
Metals Scan (Soil, ICP/MS)								
Antimony	1	ug/g	1.3			<1	<1	<1
Arsenic	1	ug/g	18			3	3	2
Barium	1	ug/g	220			38	37	26
Beryllium	1	ug/g	2.5			<1	<1	<1
Boron	5	ug/g	36			6	<5	<5
Cadmium	0.4	ug/g	1.2			<0.4	<0.4	<0.4
Chromium	1	ug/g	70			15	14	14
Cobalt	1	ug/g	21			7	7	2
Copper	1	ug/g	92			16	16	5
Lead	1	ug/g	120			9	9	8
Mercury	0.1	ug/g	0.27			<0.1	<0.1	<0.1
Molybdenum	1	ug/g	2			<1	<1	<1
Nickel	1	ug/g	82			17	16	8
Selenium	0.5	ug/g	1.5			<0.5	<0.5	<0.5
Silver	0.2	ug/g	0.5			<0.2	<0.2	<0.2
Thallium	1	ug/g	1			<1	<1	<1
Uranium	0.5	ug/g	2.5			0.5	0.5	<0.5
Vanadium	2	ug/g	86			23	23	17
Zinc	2	ug/g	290			57	28	30

OFFICIAL CERTIFICATE OF ANALYSIS - RESULTS

Client : Geomaple Geotechnics
Project : William G Miller PS

Reception Date: 2026-02-19

Eurofins Sample No :				9429115	9429116	9429117		
Matrix :				Soil 153	Soil 153	Soil 153		
Sampling Date :				2026-02-17	2026-02-17	2026-02-17		
Client Sample Identification :				BH4-SS2	BH2-SS3	BH1-SS1		
Petroleum Hydrocarbons	RL	Unit	Criteria					
			A	B	C			
F1 minus BTEX	10	ug/g	25			<10	<10	<10
F1 (C6 to C10)	10	ug/g	25			<10	<10	<10
PHCs F2-F4 (Soil, GC-FID)								
F2 (C10 to C16)	2	ug/g	10			2	<2	<2
F3 (C16 to C34)	20	ug/g	240			<20	<20	<20
F4 (C34 to C50)	20	ug/g	120			<20	<20	<20
5-alpha-Androstane (surrogate)	1	%				87	84	70

Eurofins Sample No :			9429115	9429116	9429117				
Matrix :			Soil 153	Soil 153	Soil 153				
Sampling Date :			2026-02-17	2026-02-17	2026-02-17				
Client Sample Identification :			BH4-SS2	BH2-SS3	BH1-SS1				
Sample Preparation		RL	Unit						
Moisture		0.1	%	8.8	7.7	8.0			

Eurofins Sample No :						9429115	9429116	9429117		
Matrix :						Soil 153	Soil 153	Soil 153		
Sampling Date :						2026-02-17	2026-02-17	2026-02-17		
Client Sample Identification :						BH4-SS2	BH2-SS3	BH1-SS1		
Semivolatile Organic Compounds	RL	Unit	Criteria							
			A	B	C					
PAH, O. Reg. 153/04 (Soil, GC/MS)										
1 + 2-Methylnaphthalene	0.05	ug/g	0.59			<0.05	<0.05	<0.05		
1-Methylnaphthalene	0.05	ug/g				<0.05	<0.05	<0.05		
2-Methylnaphthalene	0.05	ug/g				<0.05	<0.05	<0.05		
Acenaphthene	0.05	ug/g	0.072			<0.05	<0.05	<0.05		
Acenaphthylene	0.05	ug/g	0.093			<0.05	<0.05	<0.05		
Anthracene	0.05	ug/g	0.16			<0.05	<0.05	<0.05		
Benzo(a)anthracene	0.05	ug/g	0.36			<0.05	<0.05	<0.05		
Benzo(a)pyrene	0.05	ug/g	0.3			<0.05	<0.05	<0.05		
Benzo(b)fluoranthene	0.05	ug/g	0.47			<0.05	<0.05	<0.05		
Benzo(g,h,i)perylene	0.05	ug/g	0.68			<0.05	<0.05	<0.05		
Benzo(k)fluoranthene	0.05	ug/g	0.48			<0.05	<0.05	<0.05		
Chrysene	0.05	ug/g	2.8			<0.05	<0.05	<0.05		
Dibenzo(a,h)anthracene	0.05	ug/g	0.1			<0.05	<0.05	<0.05		
Fluoranthene	0.05	ug/g	0.56			<0.05	<0.05	<0.05		
Fluorene	0.05	ug/g	0.12			<0.05	<0.05	<0.05		
Indeno(1,2,3-c,d)pyrene	0.05	ug/g	0.23			<0.05	<0.05	<0.05		
Naphthalene	0.013	ug/g	0.09			<0.013	<0.013	<0.013		
Phenanthrene	0.05	ug/g	0.69			<0.05	<0.05	<0.05		
Pyrene	0.05	ug/g	1			<0.05	<0.05	<0.05		
p-Terphenyl-d14 (surrogate)	0	%				113	104	111		

OFFICIAL CERTIFICATE OF ANALYSIS - RESULTS

Client : Geomaple Geotechnics
Project : William G Miller PS

Reception Date: 2026-02-19

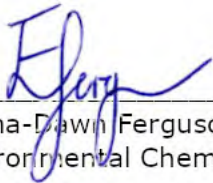
Eurofins Sample No : Matrix : Sampling Date : Client Sample Identification :						9429115	9429116	9429117		
Volatile Organic Compounds	RL	Unit	Criteria							
			A	B	C					
VOCs, O.Reg. 153/04 (Soil, GC/MS)										
1,1,1,2-Tetrachloroethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,1,1-Trichloroethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,1,2,2-Tetrachloroethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,1,2-Trichloroethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,1-Dichloroethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,1-Dichloroethylene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,2-Dibromoethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,2-Dichlorobenzene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,2-Dichloroethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,2-Dichloropropane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,3-Dichlorobenzene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,3-Dichloropropene, cis + trans	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,4-Dichlorobenzene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Acetone	0.5	ug/g	0.5			<0.5	<0.5	<0.5		
Benzene	0.0068	ug/g	0.02			<0.0068	<0.0068	<0.0068		
Bromodichloromethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Bromoform	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Bromomethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Carbon tetrachloride	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Chloroform	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
cis-1,2-Dichloroethene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
cis-1,3-Dichloropropene	0.05	ug/g				<0.05	<0.05	<0.05		
Dibromochloromethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Dichlorodifluoromethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Dichloromethane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Ethylbenzene	0.018	ug/g	0.05			<0.018	<0.018	<0.018		
Hexane	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
m/p-Xylene	0.05	ug/g				<0.05	<0.05	<0.05		
Methyl ethyl ketone (MEK)	0.5	ug/g	0.5			<0.5	<0.5	<0.5		
Methyl isobutyl ketone (MIBK)	0.5	ug/g	0.5			<0.5	<0.5	<0.5		
Methyl tert-butyl ether (MTBE)	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Monochlorobenzene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
o-Xylene	0.05	ug/g				<0.05	<0.05	<0.05		
Styrene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Tetrachloroethylene (PCE)	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
Toluene	0.08	ug/g	0.2			<0.08	<0.08	<0.08		
trans-1,2-Dichloroethene	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
trans-1,3-Dichloropropene	0.05	ug/g				<0.05	<0.05	<0.05		
Trichloroethylene (TCE)	0.01	ug/g	0.05			<0.01	<0.01	<0.01		
Trichlorofluoromethane	0.05	ug/g	0.25			<0.05	<0.05	<0.05		
Vinyl chloride	0.02	ug/g	0.02			<0.02	<0.02	<0.02		
Xylene (Total)	0.05	ug/g	0.05			<0.05	<0.05	<0.05		
1,2-dichloroethane-d4 (surrogate)	0	%				130	128	128		
4-bromofluorobenzene (surrogate)	0	%				77	80	75		
Toluene-d8 (surrogate)	0	%				81	88	91		

OFFICIAL CERTIFICATE OF ANALYSIS - RESULTS

Client : Geomaple Geotechnics
Project : William G Miller PS

Reception Date: 2026-02-19

Approved by :


Emma-Dawn Ferguson, M.Sc.
Environmental Chemist

OFFICIAL CERTIFICATE OF ANALYSIS - QUALITY CONTROL

Client : Geomape Geotechnics

Project : William G Miller PS

Reception Date: 2026-02-19

Parameter	Unit	RL	Blank	QC		Matrix Spike		Duplicate	
				Recovery %	Range %	Recovery %	Range %	RPD %	Range %
Boron, HWS (Soil, OES)									
Method : Boron, hot water soluble (Soil, ICP/OES). Internal method: AMEBORE2.									
Boron (Hot Water Soluble)	ug/g	0.25	<0.25	112	43-157	106	70-130	-	0-40
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-23 Analysis Date: 2026-02-26	
Conductivity (Soil, Manual Meter)									
Method : Conductivity (soil, manual meter). Internal method: AMPHCNX2.									
Electrical Conductivity	mS/cm	0.05	<0.05	102	70-130			17	0-40
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-24 Analysis Date: 2026-02-24	
Cyanide, Free (Soil, Colorimetry)									
Method : Cyanide (Soil, Colorimetry). Internal method: OTT-I-CN-WI46209.									
Cyanide (Free)	ug/g	0.005	<0.005	84	77-122	100	70-130	-	0-20
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-22 Analysis Date: 2026-02-23	
Hexavalent Chromium (Soil, IC)									
Method : Chromium, Hexavalent (Solids, IC). Internal method: OTT-I-IC-WI69883.									
Hexavalent Chromium	ug/g	0.2	<0.20	64	60-140	77	70-130	-	0-35
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-22 Analysis Date: 2026-02-25	
Metals Scan (Soil, ICP/MS)									
Method : Metals (Soil, Digested, ICP/MS). Internal method: OTT-I-MET-WI48349.									
Antimony	ug/g	1	<1	171	20-203	120	70-130	-	0-30
Arsenic	ug/g	1	<1	102	70-130	100	70-130	-	0-30
Barium	ug/g	1	<1	116	71-130	100	70-130	1	0-30
Beryllium	ug/g	1	<1	96	70-130	100	70-130	-	0-30
Boron	ug/g	5	<5	93	70-130	120	70-130	-	0-30
Cadmium	ug/g	0.4	<0.4	119	70-130	116	70-130	-	0-30
Chromium	ug/g	1	<1	117	70-130	120	70-130	0	0-30
Cobalt	ug/g	1	<1	112	70-130	110	70-130	0	0-30
Copper	ug/g	1	<1	113	70-130	90	70-130	5	0-30
Lead	ug/g	1	<1	103	70-130	110	70-130	0	0-30
Mercury	ug/g	0.1	<0.1	93	70-130	110	70-130	-	0-30
Molybdenum	ug/g	1	<1	114	70-130	120	70-130	-	0-30
Nickel	ug/g	1	<1	114	70-130	100	70-130	0	0-30
Selenium	ug/g	0.5	<0.5	115	70-130	104	70-130	-	0-30
Silver	ug/g	0.2	<0.2	102	70-130	100	70-130	-	0-30
Thallium	ug/g	1	<1	103	70-130	110	70-130	-	0-30
Uranium	ug/g	0.5	<0.5	99	70-130	113	70-130	-	0-30
Vanadium	ug/g	2	<2	115	70-130	130	70-130	0	0-30
Zinc	ug/g	2	<2	112	70-130	80	70-130	0	0-30
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-25 Analysis Date: 2026-02-25	

OFFICIAL CERTIFICATE OF ANALYSIS - QUALITY CONTROL

Client : Geomape Geotechnics

Project : William G Miller PS

Reception Date: 2026-02-19

Parameter	Unit	RL	Blank	QC		Matrix Spike		Duplicate	
				Recovery %	Range %	Recovery %	Range %	RPD %	Range %
PAH, O. Reg. 153/04 (Soil, GC/MS)									
Method : Semi-volatile organic compounds (Soil, GC/MS). Internal method: OTT-O-SEMI-WI45239.									
1 + 2-Methylnaphthalene	ug/g	0.05	<0.05	99	50-140		-	-	0-50
1-Methylnaphthalene	ug/g	0.05	<0.05	86	50-140	56	50-140	-	0-50
2-Methylnaphthalene	ug/g	0.05	<0.05	111	50-140	54	50-140	-	0-50
Acenaphthene	ug/g	0.05	<0.05	95	50-140	63	50-140	-	0-50
Acenaphthylene	ug/g	0.05	<0.05	91	50-140	53	50-140	-	0-50
Anthracene	ug/g	0.05	<0.05	93	50-140	58	50-140	-	0-50
Benzo(a)anthracene	ug/g	0.05	<0.05	93	50-140	57	50-140	-	0-50
Benzo(a)pyrene	ug/g	0.05	<0.05	85	50-140	54	50-140	-	0-50
Benzo(b)fluoranthene	ug/g	0.05	<0.05	92	50-140	68	50-140	-	0-50
Benzo(g,h,i)perylene	ug/g	0.05	<0.05	85	50-140	52	50-140	-	0-50
Benzo(k)fluoranthene	ug/g	0.05	<0.05	99	50-140	57	50-140	-	0-50
Chrysene	ug/g	0.05	<0.05	99	50-140	69	50-140	-	0-50
Dibenzo(a,h)anthracene	ug/g	0.05	<0.05	78	50-140	55	50-140	-	0-50
Fluoranthene	ug/g	0.05	<0.05	96	50-140	54	50-140	-	0-50
Fluorene	ug/g	0.05	<0.05	87	50-140	51	50-140	-	0-50
Indeno(1,2,3-c,d)pyrene	ug/g	0.05	<0.05	81	50-140	53	50-140	-	0-50
Naphthalene	ug/g	0.013	<0.013	93	50-140	63	50-140	-	0-50
Phenanthrene	ug/g	0.05	<0.05	96	50-140	66	50-140	-	0-50
Pyrene	ug/g	0.05	<0.05	95	50-140	57	50-140	-	0-50
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-24 Analysis Date: 2026-02-26	
pH (Soil, 1:2 CaCl2, Manual Meter)									
Method : pH (soil, 1:2 CaCl2, Manual meter). Internal method: AMPHCNX2.									
pH (1:2 CaCl2)		1	6.97	100	98-101			0	0-40
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-23 Analysis Date: 2026-02-24	
PHCs F1 (Soil, GC-FID)									
Method : Petroleum Hydrocarbons (Soil, GC-FID). Internal method: OTT-O-PHC-WI45386.									
F1 (C6 to C10)	ug/g	10	<10	116	70-130	103	70-130	-	0-30
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-22 Analysis Date: 2026-02-24	
PHCs F2-F4 (Soil, GC-FID)									
Method : Petroleum Hydrocarbons (Soil, GC-FID). Internal method: OTT-O-PHC-WI45386.									
F2 (C10 to C16)	ug/g	2	<2	110	80-120	78	60-140	-	0-30
F3 (C16 to C34)	ug/g	20	<20	110	80-120	78	60-140	-	0-30
F4 (C34 to C50)	ug/g	20	<20	110	80-120	78	60-140	-	0-30
Associated Samples : 9429115, 9429116, 9429117								Prep Date: 2026-02-24 Analysis Date: 2026-02-26	

OFFICIAL CERTIFICATE OF ANALYSIS - QUALITY CONTROL

Client : Geomape Geotechnics

Project : William G Miller PS

Reception Date: 2026-02-19

Parameter	Unit	RL	Blank	QC		Matrix Spike		Duplicate	
				Recovery %	Range %	Recovery %	Range %	RPD %	Range %
VOCs, O.Reg. 153/04 (Soil, GC/MS)									
Method : Volatile Organic Compounds (Soil, GC/MS). Internal method: AMVOMSE8.									
1,1,1,2-Tetrachloroethane	ug/g	0.05	<0.05	129	60-130	121	50-140	-	0-30
1,1,1-Trichloroethane	ug/g	0.05	<0.05	103	60-130	99	50-140	-	0-30
1,1,2,2-Tetrachloroethane	ug/g	0.05	<0.05	114	60-130	119	50-140	-	0-30
1,1,2-Trichloroethane	ug/g	0.05	<0.05	126	60-130	126	50-140	-	0-30
1,1-Dichloroethane	ug/g	0.05	<0.05	118	60-130	118	50-140	-	0-30
1,1-Dichloroethylene	ug/g	0.05	<0.05	102	60-130	92	50-140	-	0-30
1,2-Dibromoethane	ug/g	0.05	<0.05	118	60-130	121	50-140	-	0-30
1,2-Dichlorobenzene	ug/g	0.05	<0.05	108	60-130	111	50-140	-	0-30
1,2-Dichloroethane	ug/g	0.05	<0.05	130	60-130	126	50-140	-	0-30
1,2-Dichloropropane	ug/g	0.05	<0.05	110	60-130	115	50-140	-	0-30
1,3-Dichlorobenzene	ug/g	0.05	<0.05	114	60-130	116	50-140	-	0-30
1,3-Dichloropropene, cis + trans	ug/g	0.05	<0.05				-		-
1,4-Dichlorobenzene	ug/g	0.05	<0.05	116	60-130	121	50-140	-	0-30
Acetone	ug/g	0.5	<0.5	127	50-140	122	50-140	-	0-30
Benzene	ug/g	0.0068	<0.0068	119	60-130	120	50-140	-	0-30
Bromodichloromethane	ug/g	0.05	<0.05	98	60-130	95	50-140	-	0-30
Bromoform	ug/g	0.05	<0.05	95	60-130	86	50-140	-	0-30
Bromomethane	ug/g	0.05	<0.05	123	60-130	37	50-140	-	0-30
Carbon tetrachloride	ug/g	0.05	<0.05	105	60-130	98	50-140	-	0-30
Chloroform	ug/g	0.05	<0.05	118	60-130	117	50-140	-	0-30
cis-1,2-Dichloroethene	ug/g	0.05	<0.05	113	60-130	118	50-140	-	0-30
cis-1,3-Dichloropropene	ug/g	0.05	<0.05	74	60-130	77	50-140	-	0-30
Dibromochloromethane	ug/g	0.05	<0.05	104	60-130	96	50-140	-	0-30
Dichlorodifluoromethane	ug/g	0.05	<0.05	82	60-130	77	50-140	-	0-30
Dichloromethane	ug/g	0.05	<0.05	125	60-130	99	50-140	-	0-30
Ethylbenzene	ug/g	0.018	<0.018	119	60-130	119	50-140	-	0-30
Hexane	ug/g	0.05	<0.05	105	60-130	103	50-140	-	0-30
m/p-Xylene	ug/g	0.05	<0.05	124	60-130	124	50-140	-	0-30
Methyl ethyl ketone (MEK)	ug/g	0.5	<0.5	107	50-140	127	50-140	-	0-30
Methyl isobutyl ketone (MIBK)	ug/g	0.5	<0.5	108	50-140	102	50-140	-	0-30
Methyl tert-butyl ether (MTBE)	ug/g	0.05	<0.05	95	60-130	99	50-140	-	0-30
Monochlorobenzene	ug/g	0.05	<0.05	129	60-130	130	50-140	-	0-30
o-Xylene	ug/g	0.05	<0.05	115	60-130	119	50-140	-	0-30
Styrene	ug/g	0.05	<0.05	114	60-130	115	50-140	-	0-30
Tetrachloroethylene (PCE)	ug/g	0.05	<0.05	110	60-130	105	50-140	-	0-30
Toluene	ug/g	0.08	<0.08	117	60-130	118	50-140	-	0-30
trans-1,2-Dichloroethene	ug/g	0.05	<0.05	118	60-130	117	50-140	-	0-30
trans-1,3-Dichloropropene	ug/g	0.05	<0.05	78	60-130	79	50-140	-	0-30
Trichloroethylene (TCE)	ug/g	0.01	<0.01	103	60-130	102	50-140	-	0-30
Trichlorofluoromethane	ug/g	0.05	<0.05	123	60-130	95	50-140	-	0-30
Vinyl chloride	ug/g	0.02	<0.02	98	60-130	110	50-140	-	0-30
Xylene (Total)	ug/g	0.05	<0.05				-		-
Associated Samples : 9429115, 9429116, 9429117									
Prep Date: 2026-02-22 Analysis Date: 2026-02-24									

Where RPD % is reported as "-" the calculation is not available because one or both of the duplicates is within 5 times the RL.

Notes:

- 1) The laboratory method complies with CCME Tier 1 reference method for PHC in soil. It is validated for laboratory use.
- 2) Where the F1 fraction (C6 to C10) and BTEX are both measured, F1-BTEX is reported.
- 3) Where the F2 fraction (C10 to C16) and naphthalene are both measured, F2-naphthalene is reported.
- 4) Where the F3 fraction (C16 to C34) and PAHs* are both measured, F3-PAH is reported.
- 5) F4G is analyzed if the chromatogram does not descend to baseline before C50. Where F4 (C34 to C50) and F4G are both reported, the higher result is compared to the standard.
- 6) Unless otherwise stated in the sample comments, the following criteria have been met where applicable:
 - nC6 and nC10 response factors within 30% of response factor for toluene;
 - nC10, nC16, and nC34 response factors within 10% of each other;
 - C50 response factors within 70% of nC10 + nC16 + nC34 average; and,
 - Linearity is within 15%.
- 7) Unless otherwise stated in the sample comments, sampling requirements and analytical holding times have been met.
- 8) Gravimetric heavy hydrocarbons (F4G) cannot be added to the C6 and C50 hydrocarbons.
- 9) *PAHs = phenanthrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene and pyrene.
- 10) Where F4G-sg is reported, the F4G extract has been cleaned with silica gel.

CLIENT INFORMATION

Company:	Geomaple Geotechnics Inc.
Contact:	David Hataw
Address:	60 Green Lane, Unit 12A, Thornhill, ON
Telephone:	647 897 3820
Cell:	
Email:	#1: e.lavi@geomaple.ca
Email:	#2: geotechnics@geomaple.ca
Project:	William & Miller PS
Quote #:	

TURN-AROUND TIME (Business Days)

☐ 1 Day* (100%) ☐ 2 Day** (50%) ☐ 3-5 Days (25%) ☒ 5-7 Days (Standard)

Please contact Lab in advance to determine rush availability. *For results reported after rush due date, surcharges will apply: before 12:00 - 100%, after 12:00 - 50%. **For results reported after rush due date, surcharges will apply: before 12:00 - 50%, after 12:00 - 25%.

TCLP, SPLP, PFAS, and NP/NPE the rush surcharges are 100% (3 day) and 50% (4 day). For farm soils the rush surcharge is 100% (3-5 days). Regular TAT is 10 days.

The optimal temperature conditions during transport is 4 - 10°C. Sample(s) cannot be frozen, unless otherwise indicated or agreed upon with the Laboratory. This COC must not be used for drinking water samples. The COC must be complete upon submission of the samples, there will be a \$25 surcharge if required information is missing (required fields are shaded in grey).

Occasionally, situations arise in which Eurofins Environment Testing Canada (Ottawa) is unable to process a sample after receipt. By signing this chain-of-custody form, the client agrees that Eurofins Environment Testing Canada (Ottawa) may subcontract samples to a laboratory that is similarly accredited. This subcontracted laboratory will perform the same analysis using the same or similar methodology. Agreements made in advance to subcontract to a specific laboratory will be honored.

Sample ID	Date/Time Collected
-----------	---------------------

BH4-SS2	Feb 17, 2026
BH2-SS3	Feb 17, 2026
BH1-SS1	Feb 17, 2026

Sample Details

Field Filtered -->

O.Reg.153/04 parameters

Sample Matrix	# of Containers	PHC F1 - F4	BTEX	VOCs	PAHs	PCBs	Metals + Inorganics	Metals only
---------------	-----------------	-------------	------	------	------	------	---------------------	-------------

		✓	✓	✓	✓		✓	
		✓	✓	✓	✓		✓	
		✓	✓	✓	✓		✓	

100416099



Printed On : 2026-02-19 13:21:44

INFORMATION: YES ☒ NO ☐

INVOICE

Company:

Contact:

Address:

Telephone:

PO #:

REGULATION/GUIDELINE REQUIRED

- ☐ Sanitary Sewer, City: _____
- ☐ Storm Sewer, City: _____
- ☐ ODWSOG (Use DW COC if samples are for human consumption)
- ☐ PWQO
- ☐ O.Reg. 347 (TCLP)
- ☐ Other: _____

☐ O. Reg. 153/04

The sample results from this submission will form part of a formal Record of Site Condition (RSC) under O.Reg. 153/04. Analysis of full parameter list only

Table # _____ Coarse / Fine, Surface / subsurface
Type: Com-Ind / Res-Park / Agri / GW / All Other / Sediment

Yes ☐ No ☐

☒ O. Reg. 406 Excess Soils

Table # 1 Full depth/Strat/Ceiling/mSPLP Leachate
Type: Com-Ind / Res-Park / Agri / All Other
Category: Surface / Subsurface

RN#
(Lab Use Only)9429115
16
17

PRINT NAME	LOCATION	SIGN	DATE/TIME	TEMP (°C)
Sampled By: Ali Kauran				
Relinquished By: Victor Gallant			02/19/26 11:48 AM	9.7°C
Received By:				
Received By:				

FOR INTERNAL LAB USE ONLY

CUSTODY SEAL: ☐ YES ☒ NO ☐ Ice packs submit ☒ Yes ☐ No

DESIGNATED SUBSTANCES AND HAZARDOUS BUILDING MATERIALS ASSESSMENT REPORT

**Accessibility Upgrades Project
William G Miller Public School
60 Bennett Road
Scarborough, Ontario
M1E 3Y3**

***Prepared for:*
Sandra Chen
Architectural Design Coordinator**

**Toronto District School Board
15 Oakburn Crescent
Toronto, Ontario
M2N 2T5**

***Prepared by:*
Safetech Environmental Limited**

A handwritten signature in black ink, appearing to read "Dan Whittal".

**Dan Whittal
Occupational Health and Safety Technician**

Reviewed by:

A handwritten signature in black ink, appearing to read "Daniel D'Aloisio".

**Daniel D'Aloisio, B.Sc., A.M.R.T
Project Manager**

Safetech Project Number: 1-3260231

**Date of Site Work: March 10, 2026
Date of Issue: March 20, 2026**

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Appendix A: Summary of ACM Occurrences

Appendix B: Site Drawings

Appendix C: Laboratory Certificate of Analysis – Asbestos

Appendix D: Laboratory Certificate of Analysis – Lead

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EXECUTIVE SUMMARY

Safetech Environmental Limited (Safetech) was commissioned by Toronto District School Board to conduct a designated substances and hazardous materials assessment in project specific locations of William G. Millar Public School, 60 Bennett Road, Scarborough, Ontario.

The objective of the assessment was to determine the presence, location, condition and quantities of designated substances and other hazardous materials that have the potential to be disturbed as part of planned construction activities (i.e. Accessibility Upgrades Project) so that appropriate control measures can be implemented to protect workers during the work.

A summary of the assessment results and general recommendations based on our findings are provided in the following table. This table should be considered a summary only. Please refer to the Results (Section 2.0), Conclusions and Recommendations (Section 3.0), Summary of ACM Occurrences (Appendix A) and Site Drawings (Appendix B) of our report for additional details.

Table 1: Summary of Hazardous Materials and Designated Substances

Designated Substance	Findings	Recommendations
Asbestos	No asbestos-containing materials were identified in the areas assessed that would be impacted during the project.	No action required.
Lead	<p>Cream and green paints were confirmed to be low-level lead-containing paint ($\leq 0.1\%$ lead content).</p> <p>The following materials are assumed to be lead-containing:</p> <ul style="list-style-type: none"> - paints and surface coatings (not sampled) - solder in copper pipe fittings - solder in electrical components 	Disturbance of lead-containing materials must be conducted in accordance with the Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD) <i>Lead on Construction Projects</i> guideline (2011) and/or the Environmental Abatement Council of Canada (EACC) <i>Lead Guideline</i> (October 2014). For additional details, refer to Section 2.1.2 (Results) and Section 3.1.2 (Conclusions and Recommendations). Lead-containing wastes should be recycled if practicable or handled and disposed of according to R.R.O. 1990, Regulation 347, <i>General- Waste Management</i> .

Mercury	Sources of mercury were observed in the subject area and include the following: - vapour in fluorescent lamps	If required, handle lamps with care and keep intact. All waste lamps are recommended to be sent to a lamp recycling facility.
Silica	Building materials identified that are suspected to contain crystalline silica and may be disturbed as part of the planned construction project include: - drywall walls/drywall joint compound - concrete - mortar	Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the Ontario MLITSD "Silica on Construction Projects" guideline. For additional information, refer to Section 2.1.4 (Results) and Section 3.1.4 (Conclusions and Recommendations).
Other Designated Substances	No other designated substances are expected to be present in any significant quantities or in a form that would represent an exposure concern.	No protective measures or procedures specific to acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.
Other Hazardous Materials	Findings	Recommendations
Urea Formaldehyde Foam Insulation	No UFFI was identified or is suspected in the subject area.	No action required.
Mould Contamination	No suspect mould contamination was observed on building finishes in the subject area.	No action required.
Pest Infestation	No pest infestations were observed in the areas assessed.	No action required.
Polychlorinated Biphenyls	Fluorescent light ballasts are assumed to contain PCB's.	PCB-containing ballasts should be removed, separated from other waste and disposed of as PCB waste at an authorized destruction facility.
Ozone Depleting and Global Warming Substances	No equipment was observed that is suspected to contain ozone depleting and/or global warming substances	No action required.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statutes of Ontario 1990, as amended.

Should you have any questions regarding the information contained in the report, please contact our office.

Safetech Environmental Limited



Dan Whittal
OH&S Technician

March 20, 2026

Toronto District School Board
15 Oakburn Crescent
Toronto, Ontario
M2N 2T5

Attention: Sandra Chen
Architectural Design Coordinator

**RE: Designated Substances and Hazardous Materials Assessment
Accessibility Upgrades Project
William G Miller Public School
60 Bennett Road, Scarborough, Ontario**

1.0 INTRODUCTION

1.1 Background and Objectives

Safetech Environmental Limited (Safetech) was commissioned by Toronto District School Board to conduct a designated substances and hazardous materials assessment in project specific locations at William G. Millar Public School, 60 Bennett Road, Scarborough, Ontario (project specific areas). The objective of the assessment was to determine the presence, location, condition and quantities of designated substances and other hazardous materials in the project specific areas that have the potential to be disturbed as part of planned construction activities (i.e. Accessibility Upgrades Project) so that appropriate control measures can be implemented to protect workers during the work.

This assessment satisfies the Owner's requirements under Section 30 of the Ontario Occupational Health and Safety Act (OHSA), Revised Statutes of Ontario 1990, as amended. Section 30(1) requires a building owner to determine if there are any designated substances present at a project site prior to construction or demolition activities. Sections 30(2), (3) and (4) require the Owner and constructors for a project to provide the findings in this report as part of the tendering information for any tendered project or to prospective contractors (and subcontractors) of a project before entering into a binding contract.

This report documents findings of our on-site inspection that was conducted on March 10, 2026 and provides conclusions and recommendations based on our findings and knowledge of the planned construction project.

1.2 Scope of Work

In accordance with our fee proposal document, our scope of work included the following activities:

- A review of existing documents, including renovation documents and drawings, floor plans and existing environmental assessment reports, etc., where available;
- A visual assessment of accessible area(s) in the project specific areas to identify the presence, location, condition and quantities of designated substances and other hazardous materials;
- Collection, analysis and interpretation of representative bulk samples of suspect asbestos-containing building materials for the determination of asbestos content and material classification;
- Collection, analysis and interpretation of representative paint chip samples for the determination of lead content; and
- Preparation of a report to document findings and provide recommendations regarding control measures and/or special handling procedures for designated substances or specific hazardous materials that may be disturbed as part of planned construction activities.

Documents reviewed to aid in the assessment included the following:

- *“Asbestos Building Materials Reassessment Survey – William G Miller Junior Public School”* dated May 2020 as prepared by ECOH Management Inc.
- William G Miller Public School, Project Floor Plans

This assessment only identified designated substances and hazardous materials that were deemed to be part of the building or somehow otherwise incorporated into the building structure and its finishes. **The following items were not included in our scope of work:**

- Assessing occupant items such as stored products, furnishings, items and materials used or produced as part of a manufacturing process;
- Investigating underground materials or equipment (vessels, drums, underground storage tanks, duct-banks, pipes, or cables);
- Assessing enclosed wall or ceiling cavities; and
- Assessing risers, pipe chases or elevator shafts.

1.3 Description of Area(s) Assessed

The area(s) investigated included all accessible locations of the project specific areas. The extent of the area investigated is indicated on the floor plan(s) provided in Appendix B.

2.0 RESULTS

Results of our visual assessment and bulk sample analytical findings are summarized in the sections below.

2.1 Designated Substances

2.1.1 Asbestos

Results of bulk sample analysis for the determination of asbestos content are summarized in the following table. Materials have been classified as “ACM”, “Non-ACM”, “Suspected ACM” or “Presumed Non-ACM” based on analytical results. Materials classified as Suspected ACM or Presumed Non-ACM may require further analysis (depending on site-specific conditions) to verify whether the material should be classified as ACM or Non-ACM. Please refer to the Limitations section of this report (Section 4.0) for additional details. The Laboratory Certificate of Analysis is included in Appendix C.

Table 2: Bulk Sample Analytical Results for Determination of Asbestos Content

Sample No.	Material Description	Sample Location	Asbestos Content	Material Classification
1a	Drywall Joint Compound	Stage Door 2 (31280)	None Detected	NON-ACM
1b	Drywall Joint Compound	Stage Door 2 (31280)	None Detected	NON-ACM
1c	Drywall Joint Compound	Level 2 Corridor, Adjacent Classroom 37 (139864)	None Detected	NON-ACM
2a	1'x1' Fissure & Pinhole Glue on Ceiling Tile	Level 1 Corridor, Adjacent Stage Door 2 (31254)	None Detected	NON-ACM
2b	1'x1' Fissure & Pinhole Glue on Ceiling Tile	Level 1 Corridor, Adjacent Stage Door 2 (31254)	None Detected	NON-ACM
2c	1'x1' Fissure & Pinhole Glue on Ceiling Tile	Level 1 Corridor, Adjacent Stage Door 2 (31254)	None Detected	NON-ACM
3a	Cream with White Speck Vinyl Floor Tile	Level 1 Corridor, Adjacent Gymnasium (139844)	None Detected	NON-ACM
3b	Cream with White Speck Vinyl Floor Tile	Level 1 Corridor, Adjacent Gymnasium (139844)	None Detected	NON-ACM


Sample No.	Material Description	Sample Location	Asbestos Content	Material Classification
3c	Cream with White Speck Vinyl Floor Tile	Level 1 Corridor, Adjacent Gymnasium (139844)	None Detected	NON-ACM
4a	Concrete Block Mortar – Block Fill	Stage Door 2 (31280)	None Detected	NON-ACM
	Mortar 1		None Detected	NON-ACM
	Mortar 2		None Detected	NON-ACM
4b	Concrete Block Mortar – Block Fill	Stage Door 2 (31280)	None Detected	NON-ACM
	Mortar 1		None Detected	NON-ACM
	Mortar 2		None Detected	NON-ACM
4c	Concrete Block Mortar – Block Fill	Level 1 Corridor, Adjacent Gymnasium (139844)	None Detected	NON-ACM
	Mortar		None Detected	NON-ACM
5a	Brick Mortar 1	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
	Mortar 2		None Detected	NON-ACM
5b	Brick Mortar 1	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
	Mortar 2		None Detected	NON-ACM
5c	Brick Mortar	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
6a	Grey Caulking on Flashing	Roof (31311)	None Detected	NON-ACM
6b	Grey Caulking on Flashing	Roof (31311)	None Detected	NON-ACM
6c	Grey Caulking on Flashing	Roof (31311)	None Detected	NON-ACM
7a	White Caulking on Flashing	Roof (31311)	None Detected	NON-ACM
7b	White Caulking on Flashing	Roof (31311)	None Detected	NON-ACM
7c	White Caulking on Flashing	Roof (31311)	None Detected	NON-ACM
8a	Grey Window Frame Caulking	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
8b	Grey Window Frame Caulking	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
8c	Grey Window Frame Caulking	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
9a	Brown Door Frame Caulking	Exterior, Door 7 (31311-1)	<0.25% Chrysotile	NON-ACM
9b	Brown Door Frame Caulking	Exterior, Door 7 (31311-1)	<0.25% Chrysotile	NON-ACM
9c	Brown Door Frame Caulking	Exterior, Door 7 (31311-1)	<0.25% Chrysotile	NON-ACM
10a	Black Interior Door Frame Caulking	Exit Door 7 (31265-1)	None Detected	NON-ACM
10b	Black Interior Door Frame Caulking	Exit Door 7 (31265-1)	None Detected	NON-ACM

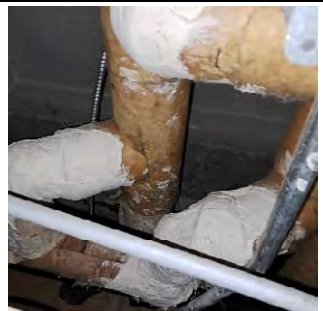
Sample No.	Material Description	Sample Location	Asbestos Content	Material Classification
10c	Black Interior Door Frame Caulking	Exit Door 7 (31265-1)	None Detected	NON-ACM
11a	New Window Glazing	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
11b	New Window Glazing 1	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
	Glazing 2		None Detected	NON-ACM
11c	New Window Glazing	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
12a	Old Window Glazing	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
12b	Old Window Glazing	Exterior, Door 7 (31311-1)	None Detected	NON-ACM
12c	Old Window Glazing	Exterior, Door 7 (31311-1)	None Detected	NON-ACM

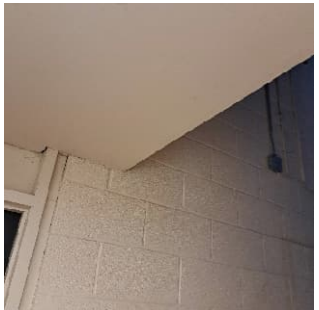



As per O.Reg. 278/05, ACM contains $\geq 0.5\%$ asbestos by dry weight.

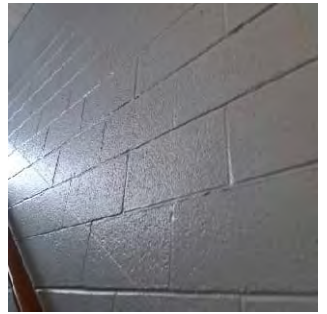

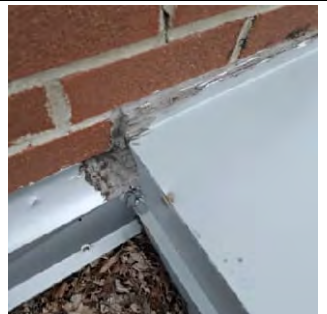

Materials assessed for asbestos content are summarized in the following table based on the type/use of the material.




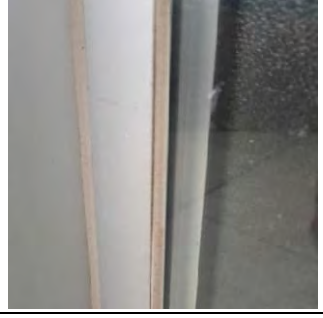

Table 3: Results of Assessment for Asbestos-Containing Materials

Sprayed and Loose Fill Insulating Materials	Location/Description	
Sprayed Fireproofing	None identified in project specific areas.	
Sprayed Insulation	None identified in project specific areas.	
Loose Fill / Vermiculite Insulation	None identified in project specific areas. Interior portions of concrete block walls could not be assessed. However, it is not expected that these walls are insulated with loose fill or vermiculite insulation	
Thermal System Insulation	Location/Description	
Mechanical Pipe Insulation – Straights	Pipes were observed to be insulated with fiberglass which is known to be not asbestos-containing.	

Mechanical Pipe Insulation – Straights	<p>According to the 2020 ECOH report, aircell pipe insulation was previously observed in the subject building. Results of analysis confirmed this material to contain 75% Chrysotile asbestos.</p> <p>This building material is not expected to be affected by the accessibility upgrade project.</p>	
Mechanical Pipe Insulation – Fittings (elbows, valves, tees, hangars, etc.)	Pipe fittings were observed to be insulated with fiberglass which is known to be not asbestos-containing.	
	<p>According to the 2020 ECOH report, parging cement on fittings was previously observed in the subject building. Results of analysis confirmed this material to contain 50% Chrysotile asbestos.</p> <p>This building material is not expected to be affected by the accessibility upgrade project.</p>	
HVAC Duct Insulation	None identified in project specific areas.	
Breeching / Exhaust Insulation	None identified in project specific areas.	
Tank Insulation	None identified in project specific areas.	
Boiler Insulation	None identified in project specific areas.	
Other Mechanical Equipment Insulation	None identified in project specific areas.	
Architectural Finishes & Finishing Materials	Location/Description	
Sprayed Texture / Stucco Finishes	None identified in project specific areas.	
Plaster Finishes	None identified in project specific areas.	

Drywall Joint Compound	Drywall joint compound was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 1 in Table 2.	
Ceiling Tiles	Location/Description	
Lay-in Acoustic Ceiling Tiles	2x4 small pinhole lay-in ceiling tiles were observed in the project specific areas. This building material was noted to contain a manufacturer's date stamp following the year 2000 and therefore is not suspected to contain asbestos.	
Glued-on Acoustic Ceiling Tiles	1x1 Fissure & pinhole glued-on acoustical ceiling tiles were observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 2 in Table 2.	
Cement Ceiling Panels	None identified in project specific areas.	
Flooring	Location/Description	
Vinyl Floor Tiles	Cream with white speck vinyl floor tiles were observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 3 in Table 2.	
Vinyl Sheet Flooring	None identified in project specific areas.	
Mastic	None identified in project specific areas.	
Asbestos Cement Products	Location/Description	
Piping	None identified in subject area.	

Roofing, Siding, Wallboard	None identified in project specific areas.	
Mortar	Concrete block mortar was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 4 in Table 2.	
	Brick mortar was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 5 in Table 2.	
Exterior Building Materials	Location/Description	
Caulking	Grey caulking on flashing was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 6 in Table 2.	
	White caulking on flashing was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 7 in Table 2.	

Caulking	<p>Grey window frame caulking was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 8 in Table 2.</p>	
	<p>Brown door frame caulking was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 9 in Table 2.</p>	
	<p>Black interior door frame caulking was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 10 in Table 2.</p>	
Glazing	<p>New window glazing was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 11 in Table 2.</p>	
	<p>Old window glazing was observed in the project specific areas. Bulk samples were collected during the assessment and results of analysis confirmed that this building material is not asbestos-containing. Refer to sample set 12 in Table 2.</p>	
Shingles	None identified in project specific areas.	

2.1.2 Lead

Laboratory analytical results for paints tested to determine lead content are summarized in the following table. The Laboratory Certificate of Analysis is included in Appendix D. Refer to Section 3.1.2 of this report for recommended lead abatement procedures (if any) that correspond to the type of proposed construction, renovation, or demolition work.

Table 4: Results of Paint Condition and Lead Content Assessment

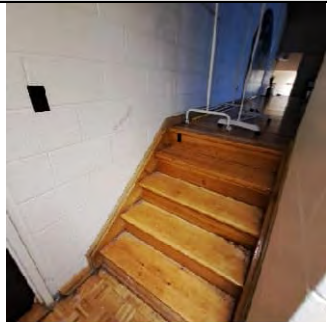
Sample No.	Location	Surface	Paint Colour	Condition	Lead Conc. (% by wt.)	Material Classification
L1	Stage Door 2 (31280)	Concrete Block Wall	Cream	Good	0.011%	LLLP
L2	Stage Door 2 (31280)	Wood Door	Green	Good	0.018%	LLLP
L3	Exterior, Door 7 (31311-1)	Metal Door	Brown	Good	<0.0064%	NLC



LCP: Lead-Containing Paint (>0.1% Lead Content); LLLP: Low-Level Lead Paint (≤0.1% Lead Content)

Suspect lead-containing materials observed in the project specific areas included the following:

- paints and surface coatings (not sampled)
- solder in copper pipe fittings
- solder in electrical components

Table 5: Results of Assessment for Lead-Containing Materials

Location/Description	Picture
Cream paint associated with concrete block wall at stage door 2 (31280) was sampled during our investigation. Results of analysis indicated the presence of 0.011% concentrations of lead. Therefore, the cream paint is considered to be low-level lead paint. Refer to sample L1 in Table 4.	

Location/Description	Picture
<p>Green paint associated with wood door at stage door 2 (31280) was sampled during our investigation. Results of analysis indicated the presence of 0.018% concentrations of lead. Therefore, the green paint is considered to be low-level lead paint. Refer to sample L2 in Table 4.</p>	
<p>Brown paint associated with exterior door 7 (31311-1) was sampled during our investigation. Results of analysis did not indicate the presence of any detectable concentrations of lead. Therefore, the brown paint is not considered to be lead-containing. Refer to sample L3 in Table 4.</p>	

2.1.3 Mercury

Mercury is present in the project specific areas in the form of:

- vapour in fluorescent lamps

2.1.4 Silica

A number of building materials were identified in the project specific areas that are ***suspected to contain crystalline silica***. This includes the following materials:

- drywall walls/drywall joint compound
- concrete
- mortar

2.1.5 Other Designated Substances

Acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride were not included in the assessment as these substances are not expected to be a significant component of building materials or present in a form that would represent an exposure concern. Additionally, no specific information regarding their use was provided to us.

2.2 Other Hazardous Materials

2.2.1 Chemical Hazards

No visible evidence of UFFI installation (i.e. injection openings) or overspray of foam insulation at wall/ceiling joints was identified in the project specific areas.

2.2.2 Biological Hazards

2.2.2.1 Mould Contamination

There was no visible evidence of obvious mould growth on building finishes in the project specific areas at the time of the assessment. In addition, there was no visible evidence of any significant water staining or discolouration to building finishes in the project specific areas that would suggest the potential for hidden mould growth behind these finishes.

2.2.2.2 Pest Infestation

There was no visible evidence of a pest infestation in the project specific areas.

2.2.3 Environmental Hazards

2.2.3.1 Polychlorinated Biphenyls (PCBs)

Fluorescent light ballasts are assumed to contain PCB's.

2.2.3.2 Ozone Depleting and Global Warming Substances

No fixed equipment suspected to contain ODS/GWS was observed in the project specific areas.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 Designated Substances

3.1.1 Asbestos

As results summarized in Table 2 indicate, no asbestos was detected in any of the bulk samples retrieved for analysis. Therefore, these building materials are considered to be Non-ACM and there are no requirements for management, disturbance or removal of these materials under O. Reg. 278/05. No other suspect asbestos-containing materials were observed in the subject area.

3.1.2 Lead

Results of paint chip analysis for the determination of lead content indicated that cream paint associated with concrete block wall and green paint associated with wood door at stage door 2 (31280) are considered a 'low-level lead paint' ($\leq 0.1\%$ based on requirements of the Environmental Abatement Council of Canada (EACC) Lead Guideline

(2014)). If the 'low-level lead paint' is disturbed in a non-aggressive manner (no use of power tools/abrasive blasting, grinding, welding, heating, etc.), then respirators are not considered necessary. However, Class 1 measures and procedures should still be implemented during the non-aggressive disturbance of 'low-level lead paints', including, but not limited to, no smoking, eating, drinking and chewing gum in the work area; dust suppression methods must be implemented; and facilities must be made available so that workers can wash their hands and face.

Paints and surface coatings not sampled are assumed to be lead-containing (>0.1% lead content) in the subject area.

Additional suspect lead-containing products includes solder on pipe fittings and electrical components. Future testing of these materials and specific handling/disposal requirements may be necessary if/when these materials are to be disturbed.

Any disturbance of the lead-containing materials should be conducted in accordance with the procedures outlined in the Environmental Abatement Council of Canada (EACC) "Lead Guideline" (October 2014) and/or the Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD) "Lead on Construction Projects" guideline (April 2011). The extent of procedures required depends on the type of work to be conducted.

At this time the method of disturbance, if any, of lead-containing materials is unknown. It is recommended that any contractor whose work requires lead-containing materials to be disturbed consult the EACC or Ontario MLITSD guidelines prior to the start of work to determine the Class/Type of operation(s) and the corresponding control measures (engineering controls, work/hygiene practices, protective clothing and equipment and worker training) necessary to conduct the work in a manner that will prevent worker overexposure to lead. The following table outlines the classification of lead disturbance based on the EACC guideline.

Operation	Description
Class 1	<ol style="list-style-type: none"> 1. Removal of lead-containing or lead-based paints and surface coatings with a chemical gel/stripper or paste; 2. Application of lead-containing or lead-based paints and surface coatings with a brush, roller or sponge. 3. Installation or removal of lead sheeting or flashing. 4. Installation or removal of lead-containing packing, babbitt, caulking, gasket or similar material. 5. Removal of materials coated with lead-containing or lead-based paints and surface coatings, using non-powered hand tools, where the material remains chiefly intact and is not crumbled, pulverized or powdered. 6. Operating construction or demolition equipment (e.g. excavator, bulldozer) during building renovation or demolition where lead-based paints or surface coatings are present on building materials and are being disturbed. 7. Soldering with lead solder. 8. Removing lead-containing or lead-based paints or surface coatings with a heat gun. 9. Removing lead-containing and lead-based paints and surface coatings using a high-pressure water jet (e.g. pressure washer).
Class 2a	<ol style="list-style-type: none"> 1. Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool that has an effective dust collection system equipped with a HEPA filter*. 2. Welding, torching or high temperature cutting of lead-containing materials indoors when using an effective fume collector or smoke eater that filters and exhausts lead fume and expels it directly outdoors (away from occupants, entrances, walkways, rest areas, etc.). Fume collector or smoke eater must have effective source control and capture velocity, minimum of 0.5 metres per second (100 feet per minute) at the work surface. 3. Welding, torching or high temperature cutting of lead-containing and lead-based paints and surface coatings or lead-containing materials outdoors. 4. Removal of lead-containing mortar using handheld non-powered tools. 5. Removal of lead-containing and lead-based paints and surface coatings or lead-containing materials by scraping or sanding (including wet sanding) using non-powered hand tools. 6. Demolition of plaster or building components that crumble, pulverize or powder and are covered with lead-containing or lead-based paints or surface coatings. 7. Clean up and removal of a significant amount of lead-containing dust and debris (that can be made easily airborne) using wet methods or HEPA vacuums.
Class 2b	<ol style="list-style-type: none"> 1. Spray application of lead-containing paints and surface coatings

Operation	Description
Class 3a	<ol style="list-style-type: none"> 1. Removal of lead-containing or lead-based paints and surface coatings or lead-containing materials using a power tool without an effective dust collection system equipped with a HEPA filter. 2. Welding, torching or high temperature cutting of lead-containing materials indoors or in a confined space (e.g. within a ditch or pit). 3. Removal of lead-containing mortar using a powered cutting device. 4. Burning of a material containing lead. 5. Removal, cleaning or repair of a ventilation system or ductwork used for controlling lead exposure. 6. Spray application of lead-based paints and surface coatings. 7. In the absence of an exposure assessment: <ol style="list-style-type: none"> a. demolition or cleanup of a facility where lead-containing products were manufactured and significant dust and debris, which can be made easily airborne, is present. b. cleanup of dust and debris down range of a firing station in an indoor firing range. an operation that may expose a worker to lead dust, fume or mist that is not a Class 1, Class 2, or Class 3B operation.
Class 3b	<ol style="list-style-type: none"> 1. Abrasive blasting of lead-containing and lead-based paints and surface coatings or lead-containing materials (including wet, slurry and dry abrasive blasting and dry-ice blasting).

* Effective implies that the dust collection system should be capable of controlling airborne lead concentration levels to below 0.05 mg/m³. Employers should follow manufacturer's recommendations and maintenance specifications for optimal function.

If practicable, all bulk lead waste materials should be separated from other wastes and sent to a recycling facility. If not practicable, lead-containing waste should be handled and disposed of according to R.R.O. 1990, Regulation 347, *General - Waste Management* (Reg. 347) made under the Environmental Protection Act. Under this regulation (and depending on the quantity of waste generated) the waste may be subject to analysis following the Toxicity Characteristic Leaching Procedure (TCLP) to determine if it is a "leachate toxic waste" based on the leachate quality criteria provided in Schedule 4 of the regulation. Such wastes must meet specific treatment requirements (Schedule 5) or undergo alternative treatment for hazardous debris (Schedule 8) prior to land disposal.

3.1.3 Mercury

Fluorescent and HID lamps that require removal should be handled with care and kept intact to avoid potential exposure to mercury vapour present within the lamps. To prevent the release of mercury into the environment, Safetech recommends that all waste lamps be sent to a lamp recycling facility and not disposed of in landfill.

Although no mercury was visibly identified in other equipment, dismantling of equipment was not conducted to verify the presence/absence of mercury. It is cautioned that thermometers, barometers and other measuring devices (pressure gauges/sensors, vacuum gauges, manometers, etc.), thermostats and a variety of other electrical switches (temperature sensitive, tilt switches, float switches, etc.) may contain mercury that may not be visible without dismantling the equipment. Such devices should be assumed to contain mercury until proven otherwise and similar precautions to those outlined above

should be taken if any of these items are to be disturbed or taken out of service in the future.

3.1.4 Silica

Suspect silica-containing materials were identified to be present in the project specific areas. In their current state, building materials containing silica do not represent a risk to building occupants or construction workers. Risks associated with exposure to silica arise during demolition activities that cause silica dust to be created (particularly grinding, drilling or cutting operations and during major demolition), resulting in a crystalline silica inhalation hazard.

If any materials suspected to contain silica are to be removed or otherwise disturbed as a result of renovation/demolition activities it is recommended that procedures be put in place to control the generation of dust (such as routine water misting) and thus reduce the potential for worker exposure. Workers that have the potential to be exposed to airborne silica should also wear appropriate protective clothing and respiratory protection. Any work involving the disturbance of silica-containing materials should follow the procedures outlined in the Ontario MLITSD “Silica on Construction Projects” guideline (April 2011). The appropriate engineering controls, work practices, hygiene practices, personal protective measures and training necessary to conduct the work in a safe manner are provided in this guideline. The general measures and procedures (or Type of operation) necessary depends on the type of work to be conducted. The following table outlines the classification of silica disturbance based on the Ontario MLITSD guideline.

Operation	Description
Type 1	<ol style="list-style-type: none"> 1. The drilling of holes in concrete or rock that is not part of a tunneling operation or road construction. 2. Milling of asphalt from concrete highway pavement 3. Charging mixers and hoppers with silica sand (sand consisting of at least 95% silica) or silica flour (finely ground sand consisting of at least 95% silica) 4. Any other operation at a project that requires the handling of silica-containing material in a way that may results in a worker being exposed to airborne silica. 5. Entry into a dry mortar removal or abrasive blasting area while airborne dust is visible for less than 15 minutes for inspection and/or sampling. 6. Working within 25 metres of an area where compressed air is being used to remove silica-containing dust outdoors.
Type 2	<ol style="list-style-type: none"> 1. Removal of silica containing refractory materials with a jackhammer 2. The drilling of holes in concrete or rock that is part of a tunneling or road construction. 3. The use of a power tool to cut, grind, or polish concrete, masonry, terrazzo or refractory materials. 4. The use of a power tool to remove silica containing materials. 5. Tunneling (operation of the tunnel boring machine, tunnel drilling, and tunnel mesh installation). 6. Tuckpoint and surface grinding 7. Dry mortar removal with an electric or pneumatic cutting device 8. Dry method dust cleanup from abrasive blasting operations 9. The use of compress air outdoors for removing silica dust 10. Entry into area where abrasive blasting is being carried out for more than 15 minutes

Operation	Description
Type 3	<ol style="list-style-type: none"> 1. Abrasive blasting with an abrasive that contains >1% silica 2. Abrasive blasting of a material that contains >1% silica

3.1.5 Other Designated Substances

No other designated substances are expected to be a component of building materials in the project specific areas in a form that would represent an exposure concern. Therefore, no protective measures or procedures specific to acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride are considered necessary.

3.2 Other Hazardous Materials

3.2.1 Chemical Hazards

As no UFFI was identified or is suspected to be present in the project specific areas, no further action is required. However, given that no destructive testing was conducted, there is a remote possibility that UFFI could be hidden within locations such as exterior wall cavities. If suspect foam insulation is identified during renovation/demolition activities work should be stopped and the area should be re-assessed to evaluate conditions and determine appropriate control measures and worker protection, if necessary.

3.2.2 Biological Hazards

3.2.2.1 Mould Contamination

No mould contamination was identified in the project specific areas and no further action is required at this time. Although no obvious mould contamination or evidence to suggest possible hidden mould contamination was identified in the project specific areas, there is still a potential for hidden mould growth to exist behind or underneath building finishes. Should suspect mould growth be discovered during the course of renovation or demolition work, Safetech recommends that all work stop so that the area can be assessed to evaluate proper control measures and remediation protocols in order to avoid worker exposure to mould and possible contamination of adjacent areas.

3.2.2.2 Pest Infestation

No visual evidence of any significant pest infestation was observed in the project specific areas. Therefore, no additional precautionary measures are deemed necessary for protection against biological contaminants potentially associated with pest infestation.

3.2.3 Environmental Hazards

3.2.3.1 Polychlorinated Biphenyls (PCBs)

The federal government has set strict regulations for the handling, storage and disposal of PCBs. The PCB Regulations (SOR/2008-273) came into effect on September 5th, 2008 and consolidates and replaces the Chlorobiphenyls Regulations (SOR/91-152) and the

Storage of PCB Material Regulations (SOR/92-507). The purpose of the PCB Regulations is to improve the protection of Canada's environment and the health of Canadians by minimizing the risks posed by the use, storage and release of PCBs by accelerating the elimination of these substances.

As of December 31, 2009 all current PCB storage sites are to have been eliminated and there should no longer be any electrical capacitors, electrical transformers, electromagnets, heat transfer equipment or any other equipment in service that contains PCBs at a concentration greater than 500 mg/kg (500 ppm). As of this time, all of this equipment should have been removed from service and sent for destruction. Furthermore, the PCB Regulations restricts the use of equipment containing PCBs (other than light ballasts or pole-top electrical transformers) at concentrations exceeding 50 mg/kg (50 ppm) in sensitive areas (such as drinking water treatment plants, schools, hospitals and senior citizen care facilities) by the same date. All other locations have until December 31, 2025 to decommission equipment containing 50 ppm to 500 ppm PCBs. The assessment confirmed that some of the existing fluorescent light ballasts contain PCB's.

Existing fluorescent light ballasts are assumed to contain PCBs. When light fixtures are to be decommissioned, all ballasts should be verified at this time by determining the date of manufacture and other pertinent information by referring to the Environment Canada document entitled "Identification of Lamp Ballasts Containing PCBs" (Report EPS 2/CC/2 (revised) August 1991) to aid in identification. Any ballasts that meet the criteria outlined in this document must be treated as PCB containing.

When PCB-containing equipment is taken out of service, jurisdiction falls under provincial regulations. As per R.R.O 1990, Regulation 347, *General - Waste Management*, the land disposal of PCB waste is prohibited. PCB wastes in Ontario are regulated under R.R.O 1990, Regulation 362, *Waste Management – PCBs* (Reg. 362), made under the Environmental Protection Act. Under this regulation, PCB waste is defined as any waste material containing PCBs at a concentration of more than fifty (50) parts per million by weight (i.e. >50mg/kg), with the exception of an electrical capacitor that has never contained over 1 kg of PCB's. Any PCB-containing equipment taken out of service should be properly handled and disposed of at an authorized destruction facility in accordance with the requirements of Federal Regulation SOR/2008-273 and Reg. 362.

3.2.3.2 Ozone Depleting and Global Warming Substances

No equipment was identified in the project specific areas that is expected to contain ozone depleting or global warming substances. As such, no recommendations are considered necessary at this time.

4.0 LIMITATIONS

The information and recommendations detailed in this report were carried out by trained professional and technical staff in accordance with generally accepted environmental and

industrial hygiene work practices and procedures. Recommendations provided in this report have been generated in accordance with accepted industry guidelines and practices. These guidelines and practices are considered acceptable as of the date of this report.

In preparation of this report, Safetech relied on information supplied by others, including without limitation, information pertaining to the history and operation of the site, test results and reports of other consultants and testing services provided by independent laboratories. Except as expressly set out in this report, Safetech has not made any independent verification of information provided by independent entities.

The collection of samples at the location noted was consistent with the scope of work agreed-upon with the person or entity to whom this report is addressed and the information obtained concerning prior site investigations. As conditions between samples may vary, the potential remains for the presence of unknown additional contaminants for which there were no known indicators.

The analytical method used for determination of asbestos content meets the requirements of O. Reg. 278/05. However, small asbestos fibres may be missed by PLM due to resolution limitations of the optical microscope. Interfering binder/matrix and/or low asbestos content may also hinder positive identification by PLM. These conditions are common for vermiculite attic insulation (VAI) and non-friable organically bound (NOB) materials such as vinyl floor tiles, roofing materials, mastics and caulking and can lead to “false negative” results. If PLM analytical results for these types of materials indicate no asbestos detected they have been reported as “Presumed Non-ACM”. Due to limitations of the analytical method we cannot confirm that low quantities of asbestos are not present in these samples using solely PLM analysis. Additional analytical procedures should be considered for such materials to rule out false negative results.

Conclusions are based on site conditions at the time of inspection and can only be extrapolated to an undefined limited area around inspected locations. The extent of the limited area depends on building construction and conditions. Building materials that are not detailed within this survey due to inaccessibility during the time of survey and/or are uncovered during renovation/demolition activities should be properly assessed by a qualified person prior to their disturbance. Safetech cannot warrant against undiscovered environmental liabilities. If any information becomes available that differs from the findings in this report, we request that we be notified immediately to reassess the conclusions provided herein.

No other person or entity is entitled to use or rely upon this report without the express written consent of Safetech and the person or entity to who it is addressed. Any use that a third party makes of this report, or any reliance based on conclusions and recommendations made, are the responsibility of such third parties. Safetech accepts no responsibility for damages suffered by third parties as a result of actions based on this report.

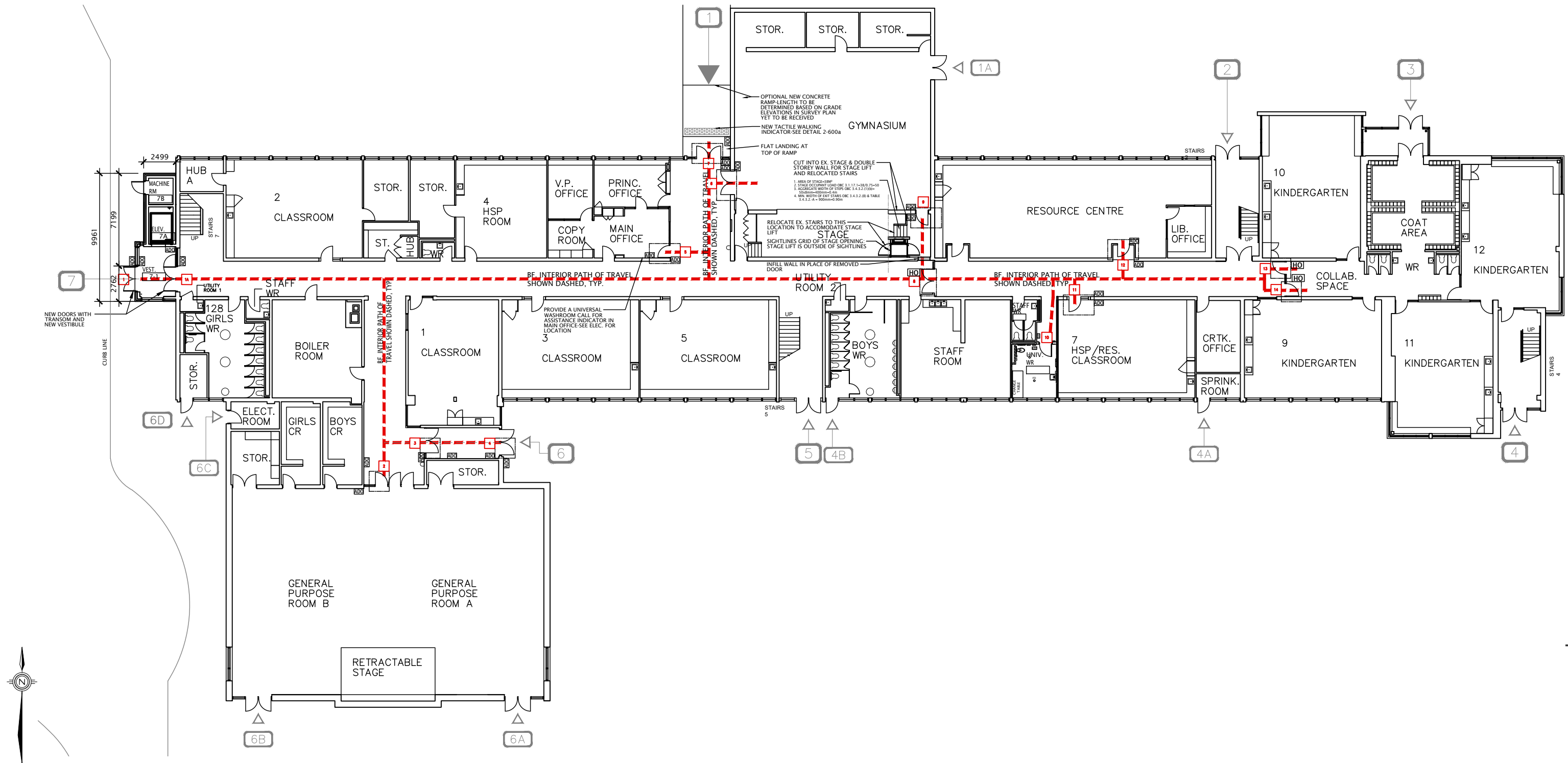
Appendix A: Summary of ACM Occurrences

Floor	Room No.	Room Description	System	Material	Description	Classification	Friable/ Non-Friable	Condition	Est. Quantity	Unit	Access	Action
No sources of asbestos were observed in the project specific areas												

Appendix B: Site Drawings

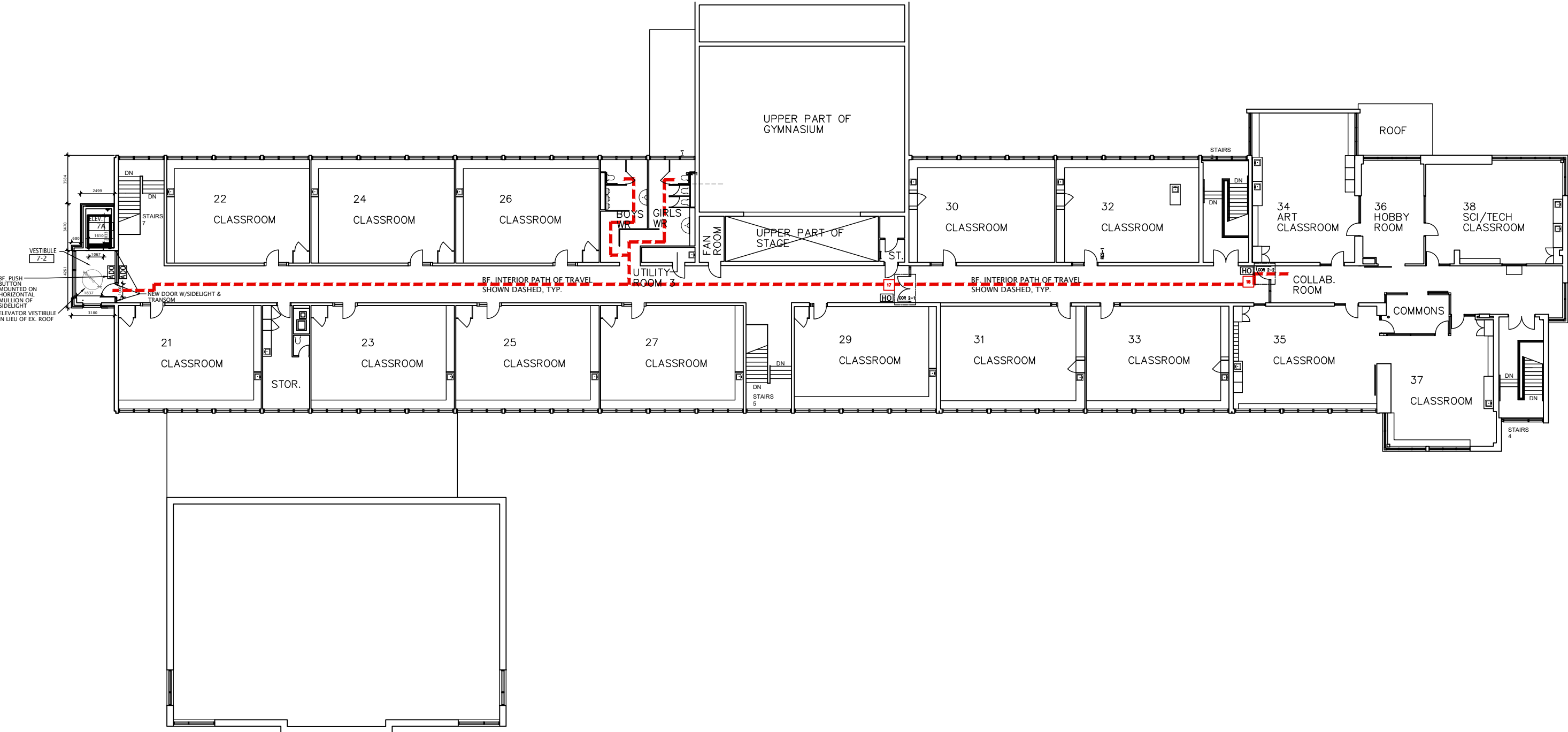
LEGEND

AREAS ASSESSED



LEGEND

AREAS ASSESSED



1) THIS FLOOR PLAN MUST BE READ IN CONJUNCTION WITH THE DESIGNATED SUBSTANCE AND HAZARDOUS MATERIALS ASSESSMENT REPORT.
2) NOT ALL ASBESTOS-CONTAINING MATERIALS ARE INDICATED IN THE FLOOR PLAN. REFER TO THE DESIGNATED SUBSTANCE AND HAZARDOUS MATERIALS REPORT FOR FURTHER DETAILS.
3) REMOVAL OR DISTURBANCE OF ASBESTOS-CONTAINING BUILDING MATERIALS MUST BE CONDUCTED IN ACCORDANCE WITH ONTARIO REGULATION 278/05 "DESIGNATED SUBSTANCE - ASBESTOS ON CONSTRUCTION PROJECTS AND IN BUILDINGS AND REPAIR OPERATIONS".

LEVEL 2

ACCESSIBILITY UPGRADE PROJECT

WILLIAM G MILLER PS

DRAWING NO.

DS-2

DATE: MARCH 10, 2026

SAFETECH PROJECT NO.
1-3260231



3045 SOUTHCREEK RD, UNIT 14
MISSISSAUGA, ONTARIO
L4X 2X7

Appendix C: Laboratory Certificate of Analysis – Asbestos



EMSL Canada Inc.

2756 Slough Street Mississauga, ON L4T 1G3
Phone/Fax: (289) 997-4602 / (289) 997-4607
<http://www.EMSL.com> / torontolab@emsl.com

EMSL Canada Order 552604879
Customer ID: 55SELI62
Customer PO: 1-3260231
Project ID:

Attn: Dan Whittall
Safetech Environmental Limited
3045 Southcreek Road
Unit 14
Mississauga, ON L4X 2X7
Phone: (905) 624-2722
Fax: (905) 624-4306
Collected:
Received: 3/11/2026
Analyzed: 3/16/2026
Proj: 1-3260231 - William G Miller PS, Scarborough, ON

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 1a **Lab Sample ID:** 552604879-0001

Sample Description: Stage Door 2 (31280)/Drywall Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 1b **Lab Sample ID:** 552604879-0002

Sample Description: Stage Door 2 (31280)/Drywall Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 1c **Lab Sample ID:** 552604879-0003

Sample Description: Level 2 Corridor, Adjacent Classroom 37 (139864)/Drywall Joint Compound

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 2a **Lab Sample ID:** 552604879-0004

Sample Description: Level 1 Corridor, Adjacent Stage Door 2 (31254)/1'x1' Fissure & Pinhole Glue on Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	80.0%	20.0%	None Detected	

Client Sample ID: 2b **Lab Sample ID:** 552604879-0005

Sample Description: Level 1 Corridor, Adjacent Stage Door 2 (31254)/1'x1' Fissure & Pinhole Glue on Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	80.0%	20.0%	None Detected	

Client Sample ID: 2c **Lab Sample ID:** 552604879-0006

Sample Description: Level 1 Corridor, Adjacent Stage Door 2 (31254)/1'x1' Fissure & Pinhole Glue on Ceiling Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Brown/Gray	80.0%	20.0%	None Detected	

Client Sample ID: 3a **Lab Sample ID:** 552604879-0007

Sample Description: Level 1 Corridor, Adjacent Gymnasium (139844)/Cream with White Speck Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Beige	0.0%	100.0%	None Detected	



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EMSL Canada Order 552604879
Customer ID: 55SELI62
Customer PO: 1-3260231
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 3b **Lab Sample ID:** 552604879-0008

Sample Description: Level 1 Corridor, Adjacent Gymnasium (139844)/Cream with White Speck Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Beige	0.0%	100.0%	None Detected	

Client Sample ID: 3c **Lab Sample ID:** 552604879-0009

Sample Description: Level 1 Corridor, Adjacent Gymnasium (139844)/Cream with White Speck Vinyl Floor Tile

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 4a-Block Fill **Lab Sample ID:** 552604879-0010

Sample Description: Stage Door 2 (31280)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 4a-Mortar 1 **Lab Sample ID:** 552604879-0010A

Sample Description: Stage Door 2 (31280)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 4a-Mortar 2 **Lab Sample ID:** 552604879-0010B

Sample Description: Stage Door 2 (31280)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 4b-Block Fill **Lab Sample ID:** 552604879-0011

Sample Description: Stage Door 2 (31280)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 4b-Mortar 1 **Lab Sample ID:** 552604879-0011A

Sample Description: Stage Door 2 (31280)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 4b-Mortar 2 **Lab Sample ID:** 552604879-0011B

Sample Description: Stage Door 2 (31280)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	



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EMSL Canada Order 552604879
Customer ID: 55SELI62
Customer PO: 1-3260231
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 4c-Block Fill

Lab Sample ID: 552604879-0012

Sample Description: Level 1 Corridor, Adjacent Gymnasium (139844)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: 4c-Mortar

Lab Sample ID: 552604879-0012A

Sample Description: Level 1 Corridor, Adjacent Gymnasium (139844)/Concrete Block Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 5a-Mortar 1

Lab Sample ID: 552604879-0013

Sample Description: Exterior, Door 7 (31311-1)/Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 5a-Mortar 2

Lab Sample ID: 552604879-0013A

Sample Description: Exterior, Door 7 (31311-1)/Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 5b-Mortar 1

Lab Sample ID: 552604879-0014

Sample Description: Exterior, Door 7 (31311-1)/Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 5b-Mortar 2

Lab Sample ID: 552604879-0014A

Sample Description: Exterior, Door 7 (31311-1)/Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 5c

Lab Sample ID: 552604879-0015

Sample Description: Exterior, Door 7 (31311-1)/Brick Mortar

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 6a

Lab Sample ID: 552604879-0016

Sample Description: Roof (31311)/Grey Caulking on Flashing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black	0.0%	100%	None Detected	



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Customer ID: 55SELI62
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Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 6b

Lab Sample ID: 552604879-0017

Sample Description: Roof (31311)/Grey Caulking on Flashing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black	0.0%	100%	None Detected	

Client Sample ID: 6c

Lab Sample ID: 552604879-0018

Sample Description: Roof (31311)/Grey Caulking on Flashing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black	0.0%	100%	None Detected	

Client Sample ID: 7a

Lab Sample ID: 552604879-0019

Sample Description: Roof (31311)/White Caulking on Flashing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	White/Beige	0.0%	100%	None Detected	

Client Sample ID: 7b

Lab Sample ID: 552604879-0020

Sample Description: Roof (31311)/White Caulking on Flashing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Beige	0.0%	100%	None Detected	

Client Sample ID: 7c

Lab Sample ID: 552604879-0021

Sample Description: Roof (31311)/White Caulking on Flashing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Gray/Beige	0.0%	100%	None Detected	

Client Sample ID: 8a

Lab Sample ID: 552604879-0022

Sample Description: Exterior, Door 7 (31311-1)/Grey Window Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Gray	0.0%	100%	None Detected	

Client Sample ID: 8b

Lab Sample ID: 552604879-0023

Sample Description: Exterior, Door 7 (31311-1)/Grey Window Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Gray	0.0%	100%	None Detected	

Client Sample ID: 8c

Lab Sample ID: 552604879-0024

Sample Description: Exterior, Door 7 (31311-1)/Grey Window Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Gray	0.0%	100%	None Detected	



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EMSL Canada Order 552604879
Customer ID: 55SELI62
Customer PO: 1-3260231
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 9a **Lab Sample ID:** 552604879-0025

Sample Description: Exterior, Door 7 (31311-1)/Brown Door Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black	0.0%	100%	<0.25% Chrysotile	

Client Sample ID: 9b **Lab Sample ID:** 552604879-0026

Sample Description: Exterior, Door 7 (31311-1)/Brown Door Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black	0.0%	100%	<0.25% Chrysotile	

Client Sample ID: 9c **Lab Sample ID:** 552604879-0027

Sample Description: Exterior, Door 7 (31311-1)/Brown Door Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black	0.0%	100%	<0.25% Chrysotile	

Client Sample ID: 10a **Lab Sample ID:** 552604879-0028

Sample Description: Exit Door 7 (31265-1)/Black Interior Door Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black/Blue	0.0%	100%	None Detected	

Client Sample ID: 10b **Lab Sample ID:** 552604879-0029

Sample Description: Exit Door 7 (31265-1)/Black Interior Door Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black/Blue	0.0%	100%	None Detected	

Client Sample ID: 10c **Lab Sample ID:** 552604879-0030

Sample Description: Exit Door 7 (31265-1)/Black Interior Door Frame Caulking

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	3/16/2026	Black/Blue	0.0%	100%	None Detected	

Client Sample ID: 11a **Lab Sample ID:** 552604879-0031

Sample Description: Exterior, Door 7 (31311-1)/New Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 11b-Glazing 1 **Lab Sample ID:** 552604879-0032

Sample Description: Exterior, Door 7 (31311-1)/New Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	



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Customer ID: 55SELI62
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Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Client Sample ID: 11b-Glazing 2

Lab Sample ID: 552604879-0032A

Sample Description: Exterior, Door 7 (31311-1)/New Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 11c

Lab Sample ID: 552604879-0033

Sample Description: Exterior, Door 7 (31311-1)/New Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 12a

Lab Sample ID: 552604879-0034

Sample Description: Exterior, Door 7 (31311-1)/Old Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 12b

Lab Sample ID: 552604879-0035

Sample Description: Exterior, Door 7 (31311-1)/Old Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray	0.0%	100.0%	None Detected	

Client Sample ID: 12c

Lab Sample ID: 552604879-0036

Sample Description: Exterior, Door 7 (31311-1)/Old Glazing

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	3/14/2026	Gray/Black	0.0%	100.0%	None Detected	



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Customer ID: 55SELI62
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Project ID:

Summary Test Report for Asbestos Analysis of Bulk Materials for Ontario Regulation 278/05

Analyst(s):

Antonio Peluso PLM Grav. Reduction (5)
Ashley Brito PLM (21)
Nickesh Mistry PLM Grav. Reduction (10)
Olivia Zeppieri PLM (8)

Reviewed and approved by:

Matthew Davis or other approved signatory
or Other Approved Signatory

None Detected = <0.1%. EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON NVLAP Lab Code 200877-0

Initial report from: 03/16/2026 16:23:31

School Name:	William G Miller PS									
Date:	10-Mar-26									
Floor	Location		Sample No	Lab Results	Material	System	Quantity		Access	Notes
	Location Name	Monument No					Condition	Total		
1	Stage Door 2	31280	1A	None Detected	Drywall Joint Compound	Wall	Good		A	
1	Stage Door 2	31280	1B	None Detected	Drywall Joint Compound	Wall	Good		A	
2	Level 2 Corridor, Adjacent Classroom 37	139864	1C	None Detected	Drywall Joint Compound	Wall	Good		A	
1	Level 1 Corridor, Adjacent Stage Door 2	31254	2A	None Detected	1'x1' Fissure & Pinhole Glue on Ceiling Tile	Ceiling	Good		C	
1	Level 1 Corridor, Adjacent Stage Door 2	31254	2B	None Detected	1'x1' Fissure & Pinhole Glue on Ceiling Tile	Ceiling	Good		C	
1	Level 1 Corridor, Adjacent Stage Door 2	31254	2C	None Detected	1'x1' Fissure & Pinhole Glue on Ceiling Tile	Ceiling	Good		C	
1	Level 1 Corridor, Adjacent Gymnasium	139844	3A	None Detected	Cream with White Speck Vinyl Floor Tile	Floor	Good		A	
1	Level 1 Corridor, Adjacent Gymnasium	139844	3B	None Detected	Cream with White Speck Vinyl Floor Tile	Floor	Good		A	
1	Level 1 Corridor, Adjacent Gymnasium	139844	3C	None Detected	Cream with White Speck Vinyl Floor Tile	Floor	Good		A	
1	Stage Door 2	31280	4A	None Detected	Concrete Block Mortar	Wall	Good		A	
1	Stage Door 2	31280	4B	None Detected	Concrete Block Mortar	Wall	Good		A	
1	Level 1 Corridor, Adjacent Gymnasium	139844	4C	None Detected	Concrete Block Mortar	Wall	Good		A	
1	Exterior, Door 7	31311-1	5A	None Detected	Brick Mortar	Wall	Good		A	
1	Exterior, Door 7	31311-1	5B	None Detected	Brick Mortar	Wall	Good		A	
1	Exterior, Door 7	31311-1	5C	None Detected	Brick Mortar	Wall	Good		A	
2	Roof	31311	6A	None Detected	Grey Caulking on Flashing	Flashing	Good		B	
2	Roof	31311	6B	None Detected	Grey Caulking on Flashing	Flashing	Good		B	
2	Roof	31311	6C	None Detected	Grey Caulking on Flashing	Flashing	Good		B	
2	Roof	31311	7A	None Detected	White Caulking on Flashing	Flashing	Good		B	
2	Roof	31311	7B	None Detected	White Caulking on Flashing	Flashing	Good		B	
2	Roof	31311	7C	None Detected	White Caulking on Flashing	Flashing	Good		B	
1	Exterior, Door 7	31311-1	8A	None Detected	Grey Window Frame Caulking	Windows	Good		A	
1	Exterior, Door 7	31311-1	8B	None Detected	Grey Window Frame Caulking	Windows	Good		A	
1	Exterior, Door 7	31311-1	8C	None Detected	Grey Window Frame Caulking	Windows	Good		A	
1	Exterior, Door 7	31311-1	9A	None Detected	Brown Door Frame Caulking	Door	Good		A	
1	Exterior, Door 7	31311-1	9B	None Detected	Brown Door Frame Caulking	Door	Good		A	
1	Exterior, Door 7	31311-1	9C	None Detected	Brown Door Frame Caulking	Door	Good		A	
1	Exit Door 7	31265-1	10A	None Detected	Black Interior Door Frame Caulking	Door	Good		A	
1	Exit Door 7	31265-1	10B	None Detected	Black Interior Door Frame Caulking	Door	Good		A	
1	Exit Door 7	31265-1	10C	None Detected	Black Interior Door Frame Caulking	Door	Good		A	
1	Exterior, Door 7	31311-1	11A	None Detected	New Glazing	Windows	Good		A	
1	Exterior, Door 7	31311-1	11B	None Detected	New Glazing	Windows	Good		A	
1	Exterior, Door 7	31311-1	11C	None Detected	New Glazing	Windows	Good		A	
1	Exterior, Door 7	31311-1	12A	None Detected	Old Glazing	Windows	Good		A	
1	Exterior, Door 7	31311-1	12B	None Detected	Old Glazing	Windows	Good		A	
1	Exterior, Door 7	31311-1	12C	None Detected	Old Glazing	Windows	Good		A	

Appendix D: Laboratory Certificate of Analysis – Lead

**EMSL Canada Inc.**

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Received: 3/11/2026 03:52 PM
Collected:

Project: 1-3260231 - William G Miller PS, Scarborough, ON

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

<i>Client Sample</i>	<i>Description</i>	<i>Collected</i>	<i>Analyzed</i>	<i>Weight</i>	<i>RDL</i>	<i>Lead Concentration</i>
L1 552604877-0001	Site: Cream Paint - Stage Door 2 (31280) - Concrete Block Wall		3/12/2026	0.2583 g	0.0064 % wt	0.011 % wt
L2 552604877-0002	Site: Green Paint - Stage Door 2 (31280) - Wood Door		3/12/2026	0.2507 g	0.0064 % wt	0.018 % wt
L3 552604877-0003	Site: Brown Paint - Exterior, Door 7 (31311-1) - Metal Door		3/12/2026	0.2532 g	0.0064 % wt	<0.0064 % wt

Rowena Fanto, Lead Supervisor
or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. * Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.0064% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Canada Inc. Mississauga, ON AIHA LAP, LLC-ELLAP Accredited #196142

Initial report from 03/16/2026 09:51:28

Appendix E: Methodology

A. METHODOLOGY

The presence of hazardous materials was assessed by visual inspection. For the purpose of this assessment and this document, hazardous materials include designated substances as well as other chemical, biological and environmental hazards as defined below:

- Designated Substances (as prescribed by Ontario Regulation 490/09):
 - Acrylonitrile, Arsenic, Asbestos, Benzene, Coke Oven Emissions, Ethylene Oxide, Isocyanates, Lead, Mercury, Silica and Vinyl Chloride.
- Other Hazardous Materials:
 - **Chemical Hazards** – Urea Formaldehyde Foam Insulation (UFFI)
 - **Biological Hazards** – Mould Contamination and Pest Infestation
 - **Environmental Hazards** – Polychlorinated Biphenyls (PCBs) and Ozone Depleting & Global Warming Substances

Concealed locations such as above solid plaster or drywall ceilings, within plaster or drywall wall cavities, enclosed mechanical/pipe shafts and bulkheads, etc. were not investigated, unless otherwise stated in Section 1.3. Similarly, motors, blowers, electrical panels, etc., were not de-energized or disassembled to examine concealed conditions. Building materials that are not detailed within this assessment due to inaccessibility at the time of our site visit and/or uncovered during renovation/demolition activities should be assessed by a qualified person prior to their disturbance.

Bulk sampling followed by laboratory analysis was also conducted to confirm the presence/absence of select hazardous materials. Bulk sampling was limited to asbestos in building materials and lead in paint on building finishes (if flaking paint was present). All other hazardous materials were identified by visual inspection only. Where possible, observations regarding the location, quantity and condition of the hazardous materials identified were made in order to determine the potential for exposure and provide appropriate recommendations for remedial action, if necessary. Specific methodology for each individual hazardous material assessed is further detailed below.

A.1 Designated Substances

A.1.1 Asbestos

A visual inspection for the presence of both friable and non-friable asbestos-containing material (ACM) was performed in the subject area.

If an existing asbestos survey was available for review, Safetech relied on the information present. Building materials that were visually similar to materials previously tested and that were confirmed to be either ACM or non-ACM were considered to have consistent content and were not re-sampled. Additional sampling was only conducted where the investigator believed a need existed.

Bulk samples of building materials suspected to contain asbestos were retrieved by Safetech only for materials that were deemed to have a potential to be disturbed as part

of the construction project. Some suspect materials may not have been sampled during our investigation. Bulk samples were retrieved in accordance with Section 3 and Table 1 of Ontario Regulation 278/05, "Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations". The number of samples collected for each material was based on the type and quantity of the material present in the subject area. Each individual sample was placed in a labeled zip-lock bag for transportation to an independent laboratory (EMSL). EMSL is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos fiber analysis.

Analysis for asbestos content was performed by the independent laboratory in accordance with the U.S. Environmental Protection Agency (EPA) Test Method *EPA/600/R-93-116: Method for the Determination of Asbestos in Bulk Building Materials (June 1993)*. This method identifies the asbestos fibre content of building materials using polarized light microscopy (PLM) analytical techniques, with confirmation of presence and type of asbestos made by dispersion staining optical microscopy. This analytical method meets the requirements set forth in Section 3 of O. Reg. 278/05.

In accordance with O. Reg. 278/05, an asbestos-containing material is defined as material that contains 0.5 per cent or more asbestos by dry weight. The laboratory was instructed to conduct "stop-positive" analysis for all materials. If a sample was found to be asbestos-containing no further analysis was conducted for samples taken from the same homogeneous material.

Locations where ACM have been identified are detailed in this report. Recommendations pertaining to ACM were made based on the friability, accessibility and condition of the material in conjunction with the potential for the planned renovation work to disturb the ACM.

A.1.2 Assessment of Asbestos-Containing Building Materials

Accessibility, Condition and Action (Priority) ratings for individual items, or defined areas were developed by Safetech to determine remedial action plans specific to the facility's needs.

A.1.2.1 Accessibility

Accessibility has been assessed as: (A) Accessible to all non-maintenance occupants of the building; (B) Accessible to maintenance staff without a ladder; (C) Accessible to maintenance staff with a ladder and exposed to view without moving a building component; (D) Accessible to maintenance staff with a ladder and concealed from view due to a building component; (E) Not accessible without demolition or removal of fixed building components or building systems

A.1.2.2 Condition

The condition of asbestos-containing materials identified in the subject area was assessed as Good (G), Fair (F) or Poor (P). The assessment criteria used to determine condition is dependent on material characteristics, such as friability. The following table summarizes the criteria used by Safetech to evaluate the condition of ACM.

Sprayed Fireproofing, Sprayed Insulation and Sprayed Texture Finishes	
Good	<ul style="list-style-type: none"> Surface shows no significant signs of damage, deterioration, or delamination (i.e. <1%). Unencapsulated or unpainted fireproofing or texture finishes, where no delamination or damage is observed. Encapsulated fireproofing or texture finishes where encapsulation applied after damage or fallout.
Fair	<ul style="list-style-type: none"> Not utilized as part of condition assessment for these materials.
Poor	<ul style="list-style-type: none"> Greater than 1% damage, delamination, or deterioration to surface.
In areas where damage exists in isolated locations, both Good and Poor may be applicable.	
Mechanical Insulation (boilers, breeching, ductwork, piping, tanks, equipment, etc.)	
Good	<ul style="list-style-type: none"> Insulation completely covered in jacketing and exhibits no evidence of damage or deterioration. Jacketing may have minor damage (i.e. scuffs or stains), but is not penetrated.
Fair	<ul style="list-style-type: none"> Minor penetrating damage to jacketed insulation (cuts, tears, nicks, deterioration or delamination). Undamaged insulation that had never been jacketed. Insulation is exposed but not showing surface disintegration. Extent of missing insulation ranges from minor to none. Damage that can be repaired.
Poor	<ul style="list-style-type: none"> Original insulation jacket is missing, damaged, deteriorated, or delaminated. Insulation is exposed and significant areas have been dislodged. Damage that cannot be easily repaired.
Non-Friable and Potentially Friable Materials (includes materials such as plaster finishes, drywall compound, ceiling tiles, asbestos cement products, vinyl asbestos tile and asbestos paper backed vinyl sheet flooring, etc., which have the potential to become friable when handled)	
Good	<ul style="list-style-type: none"> No significant damage. Material may be cracked or broken but is stable and not likely to become friable upon casual contact. No friable debris present
Fair	<ul style="list-style-type: none"> Not utilized as part of condition assessment for these materials.
Poor	<ul style="list-style-type: none"> Material is severely damaged. Debris is present or binder has disintegrated to the point where the material has become friable.
Asbestos-Containing Debris (noted separately from the presumed source material)	
Poor	<ul style="list-style-type: none"> Debris is always considered to be in Poor condition.

A.1.2.3 Action

Recommended ACTION for compliance and for management of identified asbestos-containing materials has been provided for each condition and component outlined in the above table. Recommendations have been classified under the following 8 ACTIONS:

1. Action dealing with the immediate clean-up of fallen ACM likely to be disturbed.

2. Action dealing with the need to use Type 2 asbestos procedures to enter an area (other than a ceiling space).
3. Action dealing with performing asbestos removal for compliance with regulations.
4. Action dealing with Type 2 asbestos procedures for ceiling entry where friable ACM debris is present on the top side of a ceiling system.
5. Action dealing with the removal of asbestos that goes beyond compliance requirements but simplifies the asbestos management.
6. Action dealing with the repair of asbestos.
7. Action dealing with ACM surveillance requirements of the regulation.
8. Action for dealing with material that may contain asbestos but was not conclusively identified in the survey.

A.1.2.4 Quantity

The approximate quantity and the units of measure related to the quantity (i.e.: linear feet (LF), square feet (SF) or each (EACH) as appropriate to the item) have only been provided for materials requiring remedial or corrective action (i.e. materials in Fair or Poor condition). In such circumstances any quantities provided should be considered rough estimates only and should not be solely relied upon for bidding purposes. It is the responsibility of the selected Contractor to obtain actual quantities.

A.2 Lead

If paint samples were collected, they would be collected by scraping the paint down to the base material substrate to ensure collection of all layers of paint. Care would be taken to avoid collection of the underlying substrate to reduce analytical substrate matrix interference.

If collected, paint samples would be submitted to an independent laboratory for the determination of lead content. The laboratory would participate in and accredited by the EPA (U.S. Environmental Protection Agency) for analysis of lead in paint chips through the American Industrial Hygiene Association (AIHA) Environmental Lead Laboratory Accreditation Program (ELLAP). Analysis would be conducted by the laboratory following the EPA "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846), Method 7000B "Flame Atomic Absorption Spectrophotometry". Result of analysis would be reported by the laboratory as the percentage of lead by weight of the total sample (% by wt.).

The presence of lead in other materials, such as lead sheeting, pigmented mortar, lead piping, lead solder, etc. would be noted where observed but not sampled to verify lead content. Lead can be present in these materials to varying degrees, depending on their age of application and should be considered lead-containing until proven otherwise.

A.3 Mercury

The type, quantity and location of mercury-containing equipment and devices in the subject area were determined by visual inspection based on appearance, age and knowledge of historical uses. Sampling for mercury-containing building materials and dismantling of suspect mercury-containing equipment was not performed. Where possible, attempts were made to verify the presence/absence of mercury by gathering additional information such as equipment model number, serial number, etc.

A.4 Silica

The presence of crystalline silica in building materials was determined through visual inspection of building materials only, based on knowledge of the historic use of silica-containing materials in certain building materials. Sampling to verify the presence/absence of silica in building materials was not performed.

A.5 Other Designated Substances

Other designated substances (i.e. acrylonitrile, arsenic, benzene, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride) are typically not expected to be encountered in building materials as significant constituents or in a form that would represent an exposure concern. These substances were not included in the assessment unless specific information regarding their use (e.g. in a manufacturing process) was provided to us. No sampling for these designated substances was performed.

A.6 Other Hazardous Materials

A.6.1 Chemical Hazards

A.6.1.1 Urea Formaldehyde Foam Insulation (UFFI)

A visual inspection to evaluate the possible presence of Urea Formaldehyde Foam Insulation (UFFI) was conducted in the subject area. Our visual inspection was limited to identifying evidence of possible UFFI installation (i.e. repaired nozzle holes in walls) and overspray at wall/ceiling joints, etc. No destructive testing or material sampling was conducted as part of the assessment.

A.7 Biological Hazards

A.7.1.1 Mould Contamination

A visual inspection to determine the possibility of mould growth was conducted in the subject area. The assessment was limited to identifying evidence of mould growth and water damage (staining, material deterioration, efflorescence, etc.) on the surface of building materials, which may be an indicator of hidden mould growth. No moisture content readings of building materials were taken to determine their current condition. Additionally, destructive testing to confirm the presence/absence of hidden mould growth and material sampling to verify the presence/absence of mould on suspect surfaces was beyond the scope of this assessment.

A.7.1.2 Pest Infestation

The presence and extent of pest infestation in the subject area was based on visually inspecting for evidence of significant pest activity, including signs of nesting, droppings/fecal accumulation, dead insects/carcass accumulation, etc. Evidence of minor pest presence was not considered to be indicative of pest infestation.

A.8 Environmental Hazards

A.8.1 Polychlorinated Biphenyls (PCBs)

The presence of PCB-containing electrical equipment in the subject area was identified through visual inspection and knowledge of the timeline of historical use.

For stand-alone transformers and capacitors, information from the manufacturer nameplate (such as the date of manufacture, dielectric fluid trade name or “Type Number”, etc.) was gathered, where possible, to further evaluate if the equipment may contain PCBs. This information was then compared to the information provided in the Environment Canada document entitled “Handbook on PCB’s in Electrical Equipment” (Third Edition, April 1988) to aid in identification. Transformers and capacitors confirmed to be manufactured after 1979 were assumed to not contain PCBs. If appropriate information could not be obtained it was assumed that the transformer or capacitor contained PCBs.

For fluorescent light ballasts, a representative number of fixtures were inspected, if possible, for assessment areas that were constructed prior to 1980 and where there was no history or evidence of a complete lighting retrofit. The light fixtures were examined by removing any lenses and ballast covers to expose the ballast and identify information such as ballast make, model number, serial number, and date code. This information was then compared to the information provided in the Environment Canada document entitled “Identification of Lamp Ballasts Containing PCBs” (Report EPS 2/CC/2 (revised) August 1991) to aid in identification. Ballasts that could not be confirmed Non-PCB-containing were assumed to contain PCBs. The light fixtures were not de-energized and ballasts were not removed to obtain manufacturer information that may be on the back of the ballast. If visual confirmation of ballast type could not be made it was assumed that light fixtures in areas constructed prior to 1980 that have not undergone a complete lighting retrofit have PCB-containing ballasts until proven otherwise.

No sampling of materials or fluids within equipment was conducted to verify the presence/absence of PCBs. Inspection and testing of other materials for PCB content, including (but not limited to) caulking, asphalt, oil-based paint, plastics, switches, electric cables and hydraulic fluids was beyond the scope of the assessment.

A.8.2 Ozone Depleting and Global Warming Substances

The presence of fixed equipment likely to contain ozone-depleting substances (ODS) and/or global-warming substances (GWS) was identified through visual inspection and

knowledge of the timeline of historical use. This included equipment such as chillers, air-conditioners, walk-in refrigeration and freezer units and fixed dry-chemical fire extinguishers, where chemicals such as hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) or halons may be present. Where possible, information regarding the type and quantity of refrigerant present was obtained from the manufacturer nameplate. Our visual assessment was limited to fixed equipment in the subject area and did not include portable equipment such as stand-alone refrigerators, freezers, water coolers, air-conditioners and fire extinguishers, etc.