ST. CLAIR CATHOLIC
DISTRICT SCHOOL BOARD
Lighting the Way ~ Rejoicing in Our Journey

ADDENDUM # 001

St. Clair Catholic District School Board

Our Lady of Fatima
545 Baldoon Rd
Chatham, ON

New Exterior Wall Assembly, Universal Washroom and In-coming Water Service
Project No. 619-CP1835

Prepared by:

Wilson Diaz Architects Inc.
280 Queens Ave, Suite 1Q
London, Ontario
N6B 1X3

May 24th. 2018

This addendum forms part of the Contract Bid Documents and amends the original drawings and specifications issued for Bid on May 18th. 2018

TABLE OF CONTENTS

PART A – GENERAL

1.1 **REVISED NOTICE OF PROJECT**

The list of qualified bidders will be released with Addendum #002, not Addendum #001.

1.2 QUESTIONS:

a. Question: This drawing is listed in the spec book but is not in the drawings: S101

Answer: S101 was issued with the drawings.

b. Question: There are no mechanical prints in the download but M101 & M102 are listed on the cover page A000; are they missing, or has it been deleted from the project?

Answer: Mechanical and Electrical drawings are included in this addendum.

PART B – SPECIFICATIONS

1. Revised Notice of Project **1 Page(s)**
The list of qualified bidders will be released with Addendum #002, not Addendum #001.

PART C – ARCHITECTURAL DRAWINGS

RESERVED

PART D – STRUCTURAL DRAWINGS

RESERVED

PART E – MECHANICAL / ELECTRICAL DRAWINGS

1. Refer to attached Tender/Addendum No. 1 issued by Chorley + Bisset

Mechanical & Electrical Specifications	182 Page(s)
Drawings E100, E200, E201, E300,	4 Page(s)
Drawings M101, M102, M201, M202, M301, M401, M501, M502	8 Page(s)

ARCHITECTURAL SKETCHES INCLUDED

ASK-001 – Demolition Section at Entrances:

1/AD400 - Existing concrete block wall, doors and frames to remain. Existing brick masonry and rigid foam insulation to be removed.

ASK-002 – Part Reflected Ceiling Demo Plan:

1/AD200 - Carefully remove & store existing L.E.D. Light fixtures in portion of ACT ceiling. Clean & reuse fixtures when ceiling work is completed.
Carefully remove & store existing ACT ceiling tiles for future use.

ASK-003 – Part Reflected Ceiling Plan:

1/A200 - Reinstall cleaned existing L.E.D. light fixtures in new ACT ceiling. Reinstall existing ACT ceiling tiles in new ACT structure.

ASK-004 – Bent Flashing Detail:

1,2,3,4/A500, 2/A501, 3/A625, 3/A650, 3,4/A675
Bent flashing between where new corrugated metal siding meets new masonry/window/door head around perimeter of school revised to 20 Gauge thickness.

ASK-005 – Finish Schedule:

2/A800 - Universal washroom walls revised to be finished with new abuse resistant gypsum wall board.

ASK-006 – Universal Washroom Plan:

1/A150 - Revised universal washroom layout; toilet moved to north corner, new grab bars and TP holder shown. Sink and mirror located in new position. Relocated accessories in new positions as shown.

ASK-007 – Universal Washroom Elevations:

1,2,3,4/A850 - Revised Elevations in universal washroom; walls to be finished with new abuse resistant gypsum wall board.

ASK-008 – Revised Sheet List:

A000 - Revised sheet list to show mechanical and electrical drawings. Sheet 502 renamed to sheet 501.

ASK-009 – Added Masonry Wall Scope:

1/AD100, 1/A100, 2/A302 - West wall along central core (between the north and south wings) will now have existing masonry and rigid insulation removed, and new shelf angle, spray foam, and masonry finish applied as is being done to the rest of the school.

END OF ADDENDUM # 001

Notice of Project
St. Clair Catholic District School Board
Our Lady of Fatima Catholic School
545 Baldoon Rd.
Chatham, Ontario

New Exterior Wall Assembly, Universal Washroom and In-Coming Water Service
Project Number: 619-CP1835

This notification is provided to inform General Contractors of a project proposed by the St. Clair Catholic District School Board and shall be considered as a supplement to the Instructions to Bidders which are included with the Bid Package for the project.

Invitation
Offers signed under seal, executed, and dated will be received **until 2:00 p.m. local time, as indicated on the time clock of the SCCDSB Reception, on Monday, June 11th, 2018, at the St Clair Catholic District School Board Catholic Education Center, 420 Creek Street, Wallaceburg, ON, N8A 4C4.**

For:

New Exterior Wall Assembly, Universal Washroom and In-Coming Water Service

Scope of Work

As described in the Drawings and Specifications, the work includes demolition of exterior masonry face brick, ceilings, window assemblies and concrete floors for underfloor services, finishes and site works. New work includes new exterior wall facing assemblies, new window systems, and parapet renovations. New Universal washroom area to be completed. Lay in Acoustic (LAT) and some ceilings will be replaced with new ceiling systems in new areas. In certain areas where ongoing above ceiling work is required for water service work, ceiling systems will be completed with new suspended track and finished with previously removed and stored existing ceiling tiles as noted on drawings. Site work to provide new underground water service to a newly created water service room are also part of the general scope of work for this project.

Site Examination and Bidders' Briefing:
Mandatory Site Examination and Bidder's Briefing scheduled is for **Tuesday May 29, 2018 beginning at 4:00pm.** All interested parties will meet at the main entrance of **Our Lady of Fatima Catholic School, 545 Baldoon Rd. Chatham, Ontario.**
All General Contractors are invited. Attendance will be taken and will form part of the tender record as issued in Addendum #2.

Document Availability
General Contractors shall obtain bid documents from the Windsor and Sarnia Construction Association, Lambton Area Builders Exchange, London & District Construction Association, Biddingo and St-Clair.net website. Documents will be available Friday, May 18th, 2018. Drawings and Specifications may be downloaded from the sites and printed at the bidders' convenience and expense.

Chorley+Bisset
CONSULTING ENGINEERS

OUR LADY OF FATIMA PHASE 2

RENEWAL REDUCED SCOPE

CHATHAM ONTARIO

ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD

CHORLEY + BISSET LTD
CONSULTING ENGINEERS
LONDON ONTARIO

FILE NO. 8391.3
MAY 2018

LONDON | 369 YORK ST, SUITE 2B | LONDON, ON N6B 3R4 | P:519-679-8660
OTTAWA | 250 CITY CENTRE AVE, SUITE 403 | OTTAWA, ON K1R 6K7 | P:613-241-0030
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OUR LADY OF FATIMA PHASE 2

RENEWAL REDUCED SCOPE

CHATHAM ONTARIO

ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD

G E N E R A L I N D E X

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PART 1 - GENERAL

PART 2 - PRODUCTS

INDEX - SECTION 15001 - continued

PART 3 - EXECUTION

DETAIL SHEETS

Detail No.	Title
1	Identification of Piping Systems
2	Typical Detail of Automatic Air Vent
3	Duct Liner Installation at Fire Damper

1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 This Section and Division 1 - General Requirements applies to and governs the work of all Sections of Division 15.

1.2 **MECHANICAL SYSTEMS COMMISSIONING**

1.2.1 The mechanical systems of this project will be thoroughly commissioned by a Third Party Commissioning Agent engaged by the Owner. Assist and cooperate with the commissioning agent as required. Include all related costs in the Base Bid.

1.3 **VISITING SITE**

1.3.1 Visit the site and be familiar with working conditions and work involved before submitting Bids. Refer to “Instructions to Bidders” regarding mandatory site visits during the bidding period. No extras will be granted due to lack of a thorough preliminary investigation of the site.

1.3.2 Remove and replace existing ceiling tile to inspect ceiling space for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras will be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces.

1.3.3 Contractors visiting for site investigation must sign in at the main office. Upon arrival, review and sign the on-site Designated Substances Report prior to site investigation.

1.4 **CONTRACT DRAWINGS**

1.4.1 Mechanical Drawings show Mechanical work only and are not intended to show Structural details, Electrical details or Architectural features. Take building dimensions and details from Architectural or Structural Drawings or from job measurements. Any dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.

1.4.2 Only the general location and route of piping and ductwork is shown. Install all piping and ductwork neatly to conserve headroom. All piping and ductwork to be installed parallel to building lines unless shown otherwise.

1.4.3 The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided notice of change is given prior to roughing-in.

1.4.4 In case of conflict between work of other trades and work of this Division, clarify the location of these items with the Consultant before roughing-in.

1.4.5 In the event of any discrepancies or ambiguity of any symbol, note, abbreviation, etc., used in this Specification or on the Contract Drawings, obtain clarification, in writing, from the Consultant prior to submitting Bid. No allowance will be made for additional costs arising from failure to obtain proper clarification of conflicting information before Bid.

1.4.6 Quantities or lengths indicated in any of the Contract Documents are approximate only and will not be held to gauge or limit the work. No adjustment to the Contract Price will be allowed to complete the work.

1.4.7 Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of equipment installation.

1.4.8 Provide labour, products and services specified, but not shown on Drawings and vice versa, and all other labour, products and services necessary for completion of the work.

1.4.9 All dimensions and sizes are in SI units. Generally, units are in millimetres. All exceptions to this are noted. Pipe sizes are in accordance with ANSI Standards. See Detail Sheet at end of this Section.

1.5 SHOP DRAWINGS

1.5.1 Submit Manufacturers' Shop Drawings, Electrical Wiring Diagrams and Control System Drawings to the Consultant. Provide title sheet for Shop Drawing submitted. Include project name, Shop Drawing item (including Specification paragraph reference) and approval stamps. The Consultant reserves the right to have samples submitted of any specified products.

1.5.2 Before submitting shop drawings, provide a complete list of shop drawings to be submitted in Microsoft Excel format. List all shop drawings and approximate date of submission.

1.5.3 Submit all shop drawings electronically in Adobe Acrobat PDF format. File attachments to an email must total no more than 5 MB and must be submitted unzipped. If multiple items are submitted in single PDF file, each individual piece of equipment must be “book marked” using equipment labels as per Design Drawings. All shop drawings submitted electronically must be checked and stamped by Contractor as specified below.

1.5.4 Catalogues, manuals or price lists will not be accepted as Shop Drawings. Before submission, check Shop Drawings, make necessary corrections, apply stamp “Checked and Certified Correct”, sign and date.

1.5.5 Submit one reviewed set of Shop Drawings with each set of Maintenance and Operating Instructions.

1.5.6 The review of Shop Drawings by Chorley + Bisset Ltd. is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Chorley + Bisset Ltd. approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor. Such review does not relieve the Contractor of his responsibility for errors or omissions in the Shop Drawings or of his responsibility for meeting all requirements of the Construction and 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.

1.5.7 The Contractor is to review each shop drawing and document the differences between the shop drawing submission and the description listed in the specification. If there are no differences listed, the Contractor implicitly declares the shop drawing meets all requirements of the Specification.

1.5.8 Ensure at least one copy of the reviewed Shop Drawings is kept on site at all times for reference.

1.5.9 Prepare all Drawings in SI units.

1.6 **FIELD DRAWINGS**

1.6.1 Submit, to the General Contractor, Drawings accurately showing all openings for ducts, pipes, etc. Drawings must include the size of openings and their locations by dimensions, including the location of the structural members framing these openings. Each trade will be responsible for detail layout of their own work.

1.6.2 Assume full responsibility for the detailed coordination of all Division 15 work. Prepare Field Drawings to determine the exact location of each service. On these Drawings, include all mechanical and electrical services, architectural features, and structural details. If a conflict becomes apparent after the installation of services, pay all costs associated with removing and reinstalling these services.

1.6.3 If the General Contractor separates the Fire Protection Sprinkler System work from the other work of Division 15, the General Contractor assumes full responsibility for this coordination work including the preparation of the Field Drawings.

1.7 **AS-BUILT DRAWINGS**

1.7.1 The Contractor will be provided with the Mechanical Drawings in AutoCAD 2010 compatible electronic format. The Contractor is to plot and print Drawings from the discs.

1.7.2 Revise and maintain the prints as work progresses. Show all revisions, relocations and changes, to scale. Use colour markings.

1.7.3 Have the marked prints on site for review by the Consultant at all times. Monthly draws will not be approved unless all changes have been shown.

1.7.4 Submit completed As Built Drawings disks in AutoCAD 2010 format and one set of Reproducible Drawings with the Operating and Maintenance Manuals.

1.7.5 For the purposes of Contract payments, marked prints of As Built Drawings will be assumed to have a value of $10,000.00. This will not be released until As Built Drawings have been accepted as complete and acceptable by the Consultant. This amount is in addition to the normal 10% holdback required by the Construction Lien Act, 1983.

1.8 **CONFLICTS AND PRECEDENCE**

1.8.1 Immediately upon discovery of any conflict, ambiguity, error or omission in the Contract Documents, request clarification in writing from Consultant prior to starting the work in questions.

1.8.2 Failure to give such written notice will constitute an irrevocable waiver and release of any claim for additional compensation or delays incurred.

1.8.3 Where work fails to conform to Contract Documents, as clarified by Consultant, promptly remove and replace such work as directed, without adjustment to Contract price.

1.9 **FIRESTOPPING**

1.9.1 Before starting any work on site, submit detailed Shop Drawings to the Consultant for review and comments. Include:

1.9.1.1 Manufacturer's technical product data and installation instructions for each specific type and location of penetration.

1.9.1.2 Certification that proposed firestopping materials and assemblies comply with CAN-ULC S115 “Standard Method of Fire Test for Firestop Systems”.

1.9.1.3 For each specific type and location of penetration, provide installation instructions from a recognized independent testing agency.

1.9.2 Mark penetration types and locations on set of white prints. At completion of project, transfer this information to As Built Drawings.

1.9.3 Comply with all requirements of Ontario Building Code Clause 3.1.9, “Building Services in Fire Separations and Fire Rated Assemblies”.

1.9.4 Submit one sample of the components of each firestop system to the Consultant for review.

1.10 **MAINTENANCE AND OPERATING INSTRUCTIONS**

1.10.1 Assemble three sets of equipment literature (cuts), operating instructions, maintenance instructions, pressure test results, certificate, other pertinent data and Letter of Warranty. Place in three ring binders, complete with index pages, indexing tabs and cover identification at front and side. Submit to Consultant for approval.

1.10.2 Make changes or submit additional information as required to obtain approval. Final Certificate of Completion will not be issued until the Consultant possesses three approved sets. Include copies of approved Shop Drawings and name and address of Spare Parts' Suppliers with manuals.

1.10.3 Provide two electronic copies of the maintenance and operating manual in Adobe Acrobat PDF format on a compact disc or DVD and submit with the final version of manuals. Provide separate files on the disc in accordance with the sections of the hard copy manuals. Divide the maintenance manuals into sections which correspond with Specification Sections.

1.10.4 The following information is to be contained within the Sections:

1.10.4.1 A list of names, addresses and telephone numbers of the Consultants, General Contractor and Mechanical Contractor. Written warranty of the Mechanical systems. A copy of the valve directory, giving number, valve location, normal valve position and purpose of valve. Copy of all natural gas fitter tags.

1.10.4.2 A copy of all pressure tests and operational tests for pumping systems. A list of names, addresses and telephone numbers of all suppliers. A copy of all approved Shop Drawings.

1.10.4.3 A complete and comprehensive lubrication, maintenance and operating instructions details D (daily), W (weekly), M (monthly), SA (semi-annually), A (annually) schedule for maintenance and lubrication.

1.10.4.4 A complete list of all air filter sizes, quantities and types, corresponding with unit designations.

1.10.4.5 Copies of warranties.

1.10.4.6 Complete control diagrams, wiring diagrams and description of control system and the functioning of the system.

1.10.4.7 Copy of the project Testing and Balancing Report.

1.11 REGULATIONS AND PERMITS

1.11.1 Carry out all work in accordance with the latest editions of applicable municipal and provincial codes, regulations, bylaws, and requirements of local Authority Having Jurisdiction. In no instance, however, is the standard established by the Drawings and Specifications to be reduced by the codes referred to above. Apply for and obtain any necessary permits. Pay any necessary fees.

1.11.2 Enforce all prevailing Provincial and local safety regulations at all times. Abide by all Owner's safety and security policies and procedures and conform to all regulations of the current Occupational Health and Safety Act.

1.11.3 Submit copies of CRN Certificates for all boilers and registered pressure vessels. Arrange and pay for TSSA certification of all boilers with a heating surface area greater than 2.78 m^2 (30 ft^2).

1.11.4 Arrange and pay for TSSA inspection and certification for all piping systems and equipment regulated by TSSA.

1.12 MATERIAL AND EQUIPMENT

1.12.1 Where an item of material or any equipment is specifically identified by a manufacturer's trade name and/or catalogue number, make no substitution except as provided for in paragraphs 3, 4 and 5 below.

1.12.2 In the case of some items of equipment, one or more additional names of acceptable equal manufacturers are listed in the Clause describing an item or a group of items. The design, layout, space allocation, connection details, etc., are based on the products named first in the description of each item. The products named first in the description of each item establish the quality of manufacture and design standards for all other manufacturers of that item. The general approval indicated by listing the names of other manufacturers is subject to final review of Shop Drawings, performance data, test reports, production samples (if required) by Consultant, and equipment shipped to site. Ensure that the products used meet the requirements specified and as shown on the Contract Drawings.

1.12.3 Suppliers wishing to submit other items of equipment for approval as an equal to those specified must apply to the Consultant at least 8 working days before Bid closing date. Requests must be accompanied by complete description and technical data on the items proposed. Approval for substitution of equipment will only be given on the understanding that all details, accessories, features and performance meet the Specifications unless otherwise stated. Deviations from the Specifications must be stated in writing at time of application for approval.

1.12.4 Include in the Bid, the equipment named in the Specifications or approved as an equal as in paragraph 3 above. This will form the Base Bid. Any number of alternative bids, as defined below, may be included in addition to the Base Bid.

1.12.5 Items of equipment by Manufacturers not named in the Specifications may be offered as alternatives to the manufacturers named in the Specifications. The alternative proposals must be accompanied by full descriptive and technical data, together with the statement of amount of addition or deduction from the Base Bid, if the alternative is accepted. Prior approval by the Consultant is not required on items submitted as alternative bids.

1.12.6 After execution of the Contract, substitution of equipment will be considered only if equipment accepted cannot be delivered in time to complete the work in proper sequence, or if the manufacturer has stopped production of the accepted item. In such cases, requests for substitution must be accompanied by proof of equality and difference in price and delivery, in the form of Certified Quotations from Suppliers of both specified and proposed equipment. Credit any decrease in price involved in substitution to the Owner by reduction of the Contract Price. The Contractor will not be reimbursed for any such increase in price.

1.12.7 Where equipment other than the equipment used as a basis for design, layout and space allocation is used, produce and submit revised layouts of equipment, pipes, ducts, etc., in the areas affected. Submit these Drawings with the Shop Drawings. Failure to produce these Drawings is indication by the Contractor that they are not required and the original space allocations are adequate for the substituted equipment.

1.12.8 Name the Subcontractors and Manufacturers in the Bid as indicated in Clause “List of Mechanical Subcontractors and Manufacturers”.

1.13 INTERPRETATION OF CONTRACT DOCUMENTS

1.13.1 The decision as to which trade provides required labour or materials rests solely with the Contractor. Extra payments will not be considered based on a difference in interpretation of the Contract Documents as to which trade involved provides materials or labour for specific items of work. The Consultant will not enter into such discussions.

1.14 SITE VISITS

1.14.1 The Mechanical Contractor shall have an office representative (not site personnel) at each site meeting and deficiency review. Attendance at these meetings is mandatory.

1.15 **PROGRESS DRAWS**

1.15.1 Mechanical Contractor shall review all supplier and subcontractor draws submitted to their office to ensure they are fair and reasonable for the amount of work completed on site to date prior to submitting to the General Contractor. Mechanical Contractor will be responsible for the validity of supplier and subcontractor draw claims.

1.16 **WARRANTY**

1.16.1 Warranty all workmanship and make good any defects for one year after Substantial Completion. Warranty material and equipment supplied by the manufacturers for one year after Substantial Completion. Make good damage caused due to defects and workmanship.

1.16.2 Where equipment specified in Sections of Division 15 to have an extended warranty period, e.g. five years, the first year of the warranty period will be governed by the terms and conditions of the warranty in the Contract Documents, and the remaining years of the warranty will be direct from the manufacturer and/or supplier to the Owner. Submit signed and dated copies of the extended warranties to the Consultant before applying for a Certificate of Substantial Performance of the Work.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Clause “Material and Equipment”.

2.2 **BACKFILL**

2.2.1 Use backfill material in accordance with the requirements of Division 2 unless specified or shown otherwise.

2.3 **CONCRETE**

2.3.1 Use concrete in accordance with the requirements of Division 3 unless specified or shown otherwise.

2.4 **SLEEVES**

2.4.1 In general, sleeves are not required through walls or floors except for penetrations through Service Room walls or floors or foundation walls.

2.4.2 For all pipes passing through foundation walls, use Link-Seal pre-engineered mechanical seals between sleeves and pipes.

2.4.3 For sleeves through mechanical room floors, use Schedule 40 steel pipes with annular fins continuously welded at midpoint.

2.4.4 For rated separation requiring a FT firestopping rating, use materials in conformance with manufacturer's recommendations.

2.5 **FIRESTOPPING**

2.5.1 Use only service penetration firestop components and assemblies tested in accordance with CAN/ULC S115 Fire Tests of Firestop Systems and listed in most recent ULC “List of Equipment and Materials” or by another recognized independent testing and certification agency acceptable to the Consultant.

2.5.2 All pipe insulation passing through the fire separation to be approved with the listing of the firestop system.

2.5.3 Pipe sleeves through fire separations requiring a rating are to be installed as per firestopping manufacturer's recommendations, as some firestopping manufacturers do not allow pipe sleeves within their approved system. Confirm pipe sleeve compatibility prior to starting work on site.

2.5.4 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

Tremco

2.6 **FIRE CLOSURES**

2.6.1 Use only fire damper assemblies tested in accordance with CAN/ULC S115 Fire Tests of Firestop Systems and listed in most recent ULC “List of Equipment and Materials” or by another recognized independent testing and certification agency acceptable to the Consultant.

2.7 **ESCUTCHEON PLATES**

2.7.1 Use chrome or nickel-plated brass, solid type, with set screws for ceiling or wall mounting.

2.8 **ACCESS DOORS**

2.8.1 Access doors to be flush to edge of frame, concealed continuous hinge with screwdriver operated cam latch. Non fire-rated door construction to be minimum 14 gauge, with 16 gauge frame. Fire-rated door construction to be a minimum 20 gauge insulated door with 16 gauge frame. Insulation thickness to provide required rating.

2.8.2 Size doors to allow adequate operating/maintenance clearance for devices. Doors to be a minimum 600 mm x 600 mm (24″ x 24″) for body entry, and 300 mm x 300 mm (12″ x 12″) for hand entry, unless noted otherwise. Use the following access doors:

Masonry Walls	-	Acudor UF-5000
Drywall Walls	-	Acudor DW-5040
Drywall Ceilings	-	Acudor BP58, match ceiling thickness
Fire-Rated	-	Acudor FW-5050/FB-5060 to match fire separation

2.8.3 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

Adam
Ancon LeHage
E. H. Price

2.9 ELECTRICAL EQUIPMENT

2.9.1 This building will be fully sprinklered. Use sprinkler proof electrical equipment in vaults and electrical rooms or shield equipment in such a way as to prevent the sprinkler system water from entering the electrical equipment and/or interfering with its operation.

2.10 ELECTRIC MOTORS

2.10.1 Provide motors of adequate size and type for intended service. Use CSA approved motors with the following characteristics:

250 watts (1/3 hp) and under	-	115 volt, 60 hertz, single phase
370 watts (1/2 hp) and over	-	60 hertz, three phase, voltage as shown on Drawings.

2.10.2 Motors are to be the voltage specified. Step down or step up transformers will not be accepted.

2.10.3 Motors 250 watts (1/3 hp) and under: Use continuously rated squirrel cage induction type with capacitor start, NEMA Design Class “B” with NEMA “N” or better starting characteristics and a minimum of Class "B" insulation, unless specified otherwise..

2.10.4 Motors 370 watts (1/2 hp) and over: Use continuously rated squirrel cage induction type NEMA Design Class “B” with NEMA “B” or better starting characteristics and a minimum of Class “B” insulation.

2.10.5 Use open drip-proof type motor with a 1.15 service factor for motors located in dry locations indoors, unless specified or required otherwise by the motor location.

2.10.6 Use totally enclosed motors outdoors and in locations subject to water spray. Totally enclosed motors must be fan cooled and have a 1.0 service factor.

2.10.7 Use totally enclosed explosion-proof (TEXP) motors where indicated to prevent ignition of external gas.

2.10.8 All enclosures shall be rolled steel band or cast iron construction. Motor nameplate shall be mounted on enclosure with stainless steel fastening pins and shall have, as a minimum, all information as described in CSA C22.2 No 100-04 (R2009).

2.10.9 Unless specified otherwise, starters for electric motors will be provided by Division 16. Where multi-speed motors are specified, ensure that motors are compatible with starters supplied under Division 16. All two speed motors to be single winding, unless specified otherwise. Provide inverter duty motors where indicated on drawings.

2.10.10 All motors 0.75 kW (1 hp) and above, use premium efficiency type motors in accordance with NEMA Premium efficiency standard.

2.11 ELECTRICAL WIRING

2.11.1 Meet all requirements of Division 16 for all wiring included in Division 15 and pre-wired equipment provided by Division 15.

2.11.2 Ensure all pre-wired electrical equipment is CSA approved. Where this is not possible, arrange and pay for special Electrical Safety Authority approval.

2.11.3 All electrical wiring, both line voltage and low voltage, for equipment supplied by Division 15 is the responsibility of Division 15. Line voltage wiring from power panels to starters and from starters to motors will be supplied and installed by Division 16.

2.12 IDENTIFICATION NAME LABELS

2.12.1 Identification name labels, directional arrows and colour bands for ductwork and piping to be plastic coated pressure sensitive “Brady” or “Westline” selfstick labels, waterproof, colourfast, dirt and grease resistant. For pipes up to and including 65 mm (2-1/2″) diameter, use markers 28 mm (1-1/8″) high. For pipes 80 mm (3″) diameter and over, and all ductwork, use markers 57 mm (2-1/4″) high. For all piping exposed to view, use Smillie McAdams Summerlin Coil - Mark pipe covers.

2.13 VALVE AND CONTROLLER TAGS

2.13.1 Use brass valve and controller tags with 32 mm (1-1/4″) stamped code lettering and numbers filled with black paint. Hang a copy of the valve chart in Mechanical Room.

2.14 EQUIPMENT NAMEPLATES

2.14.1 Use minimum size 90 mm x 40 mm x 2.4 mm (3-1/2″ x 1-1/2″ x 3/32″) thick laminated phenolic plastic nameplates with black face and white lettering. Lettering to be minimum 6 mm (1/4″) high.

2.15 BELT AND MACHINE GUARDS

2.15.1 Provide OSHA compliant expanded metal guards in steel frames to protect drives of all belt driven equipment and all equipment with exposed rotating or moving parts. Firmly bolt guards in place and make easily removable for servicing. Provide openings in metal guards to permit use of a tachometer without removing the guard.

2.16 FLASHING

2.16.1 For locations with multiple roof penetrations serving a single piece of equipment, such as for roof mounted split system condensing units, use Portals Plus, Inc. Alumi-Flash system consisting of 100 mm (4″) high, one piece spun aluminum base with deck flange and EPDM rubber cap. Use caps suitable for required number and diameter of service penetrations. Flashing is for Division 15 use only.

2.16.2 For plumbing vent roof penetrations, use Thaler SJ-38 "Stack Jack" insulated flashing consisting of 330 mm (13") high, one piece spun aluminum base with deck flange, urethane insulation line and EPDM base seal. Size seals to suit pipe diameter.

3 Execution

3.1 **GENERAL**

3.1.1 Instruct and supervise other Sections doing related work.

3.1.2 Supply the measurements of equipment to other Sections to allow for necessary openings to be left in the work of other Sections.

3.1.3 Install pipes, ducts and tubing, which are to be concealed, neatly and close to building structure so that the necessary furring can be kept as small as possible.

3.1.4 Install all ceiling components in direct accordance with reflected ceiling plans.

3.1.5 Mechanical Drawings show approximate locations for wall-mounted devices and fixtures. Clarify exact location and mounting height with Consultant prior to roughing-in.

3.1.6 All serviceable equipment installed on the roof (including boiler vents) to be installed minium 3.0 m (10'-0") from roof edge.

3.2 **DISSIMILAR METALS**

3.2.1 Separate dissimilar metals by means of gaskets or shims of approved material or use dielectric unions or flanges in order to prevent electrolytic action. Where piping of dissimilar metals is connected, use approved dielectric unions or couplings. A brass fitting or brass valve may also be used in making connections between copper and steel piping.

3.3 **STORAGE OF MATERIALS**

3.3.1 Provide proper weatherproof storage for the protection of materials and equipment on site. Blank off openings in all equipment until required for use. Consultant may require materials which are not properly stored to be discarded and removed from the site.

3.4 **EXCAVATION AND BACKFILL**

3.4.1 Be responsible for any excavation and backfill required for work of Division 15. Slope or shore all trenching in accordance with all current regulations and safety standards. Where any pipes pass under building footings, backfill under footings with lean concrete.

3.4.2 Use materials and standards of compaction for backfill in accordance with Division 2 unless specified otherwise.

3.4.3 If changes are required in locations, depth of excavating or related data, advise the Consultant in reasonable time to avoid disruption of work sequence.

3.5 **SUPPORTS AND BASES**

3.5.1 Provide structural work required for installation of equipment provided under this Division.

3.5.2 Where piping and/or equipment is to be supported by steel stud walls, use brackets and supports which attach to steel studs. Support equipment independently of wall sheathing.

3.5.3 Provide sleeves for insulated pipe large enough to permit free movement of pipe without crushing the insulation.

3.5.4 Set all floor-mounted equipment on concrete bases at least 100 mm (4″) high Provide bases, anchor bolts and any special isolation bases. Concrete bases for air handling equipment are to be sized to suit unit drain air seal requirements, but 100 mm (4″) to remain as minimum. Size concrete equipment bases to suit the equipment actually supplied and in accordance with the Shop Drawings of such equipment. Do not start concrete work until anchor bolts and other embedded parts required for the complete installation, as well as Shop Drawings, are available at the site.

3.5.5 Carry out all concrete work in accordance with requirements of Division 3. Provide wire mesh, rebar and all necessary reinforcing.

3.6 CONCRETE INSERTS

3.6.1 General

3.6.1.1 Anchors for the support of pipes, ducts and equipment from the underside of suspended structural concrete systems may be by cast-in-place inserts placed prior to the pouring of concrete or by the use of inserts placed in holes drilled after the forms are stripped. The use of inserts cast into the concrete is the preferred option.

3.6.1.2 The safe load capacity of concrete anchors is affected by a number of variables such as specific anchor type, embedment, spacing between individual anchors, edge distances, direction of loading, concrete strength and “prying action”. Refer to the manufacturer's recommendations for each specific insert proposed, including any dynamic or vibratory loads.

3.6.1.3 Be responsible for the proper selection and installation of inserts, including number, type, spacing and accurate placement to provide the necessary safe load capacity and satisfactory long term performance.

3.6.2 **Installation of Cast in Place Inserts**: Ensure that anchors are accurately placed and "fixed" in position with sufficient rigidity to maintain their position during the placement of concrete. Do not displace reinforcing to install anchors without the prior permission of the Consultant.

3.6.3 **Installation of Inserts in Hardened Concrete:**

3.6.3.1 Use inserts placed in pre-drilled holes. Do not use powder driven inserts or self-drilling inserts. Before drilling holes, accurately locate all reinforcing bars in the affected areas using an electro-magnetic locator.

3.6.3.2 Do not drill through or otherwise damage reinforcing bars. If reinforcing is encountered, the inserts must be relocated. Ensure that hole diameter, depth of penetration, spacing, etc., are in strict accordance with the insert manufacturer's recommendations for the specific insert type and load condition.

3.6.3.3 Due to the relatively close spacing of reinforcing bars in the bottom of many of the beams and girders, the preferred location of drilled-in-place anchors in beams and girders is into the sides of these members, rather than upwards into the bottom.

3.6.4 **Sleeves Embedded in Concrete**: Except as approved otherwise by the Consultant, install sleeves embedded in concrete in accordance with the following general guidelines:

3.6.4.1 Centre to centre spacing to be not less than 3 diameters of the maximum size adjacent sleeve.

3.6.4.2 Provide additional reinforcing at points of congestion as directed by the Consultant.

3.6.4.3 Sleeves through beams will be permitted only as directed by the Consultant.

3.6.4.4 The reinforcing in beams, slabs and columns must not be displaced from its intended position under any circumstances unless prior written approval is obtained from the Consultant.

3.7 SLEEVES

3.7.1 Provide sleeves for insulated pipe large enough to permit free movement of pipe without crushing the insulation.

3.7.2 Provide sheet metal framing around ducts through masonry walls in exposed areas to ensure a clean finish around ducts.

3.8 FIRESTOPPING

3.8.1 Provide a listed firestop system in accordance with the Ontario Building Code to seal around all piping, tubing, ducts, conduits, electrical wires and cables, and other similar mechanical services which penetrate part of a building assembly required to have a fire resistance rating or a fire separation. Refer to Architectural Drawings and Specifications Section “Firestopping and Smoke Seals” for building assembly and fire separation types and locations.

3.8.2 For all penetrations through fire separations required to have a fire resistance rating, use firestop systems with an F rating not less than the fire resistance rating for the fire separation. This includes the sealing of any sleeves provided for future uses. Provide an FT rating where required by the Ontario Building Code. For all penetrations through a Mechanical Room floor, provide a minimum W rating - Class 1 in addition to the fire resistance rating.

3.8.3 At each fire stopping penetrating location, provide a fire stopping identification label indicating the system number installed, products used, date installed and the installer’s name. Locate label on penetrating service at the penetration location.

3.8.4 All firestopping must be thoroughly reviewed by the Technical Representative of the systems manufacturer on site before any firestopping is concealed and submit a report of compliance with the rating requirements. Technical Representative to complete 3 destructive tests to confirm compliance with ULC listing, minimum one floor test and one wall test, third test to be Contractors choice. Contractor to replace fire stopping system after destructive test has been completed. Submit a copy of the report to the Consultant. Report to include as a minimum, confirmation fire stopping

shop drawings were used during review, locations where destructive testing was completed, confirmation all fire stopping locations were reviewed and installed systems meet the manufacturer requirements.

3.8.5 Install duct fire damper assemblies in strict accordance with manufacturer's instructions provided with each assembly.

3.9 CUTTING AND PATCHING

3.9.1 Do not cut or drill holes through floors, roof or structural members before obtaining permission from the Consultant. All cutting and patching to be done by the trade specializing in the materials to be cut.

3.9.2 For penetrations through walls not required to have a fire rating, seal all spaces between pipe or pipe and surrounding wall construction with a fire-rated foam sealant. Use 3M Fire Barrier, Metacaulk, or Dow Fire Stop UL Classified fire rated foam sealants. Do this as the work progresses, to avoid leaving inaccessible holes at completion of the job. For penetrations through parts of the building assembly required to have a fire resistance rating or acting as a fire separation, see Clause “Firestopping” in this Section.

3.9.3 Where pipes and ducts are shown on the Mechanical Drawings passing through existing walls, floors, and roof, cut and patch the necessary openings. Include the cost of all cutting and patching in the Lump Sum Contract Price for the work of Division 15. Before drilling holes through floors or roof slabs, accurately locate and note sizes for each required hole. Get approval of Consultant before any cutting is started. Electrical conduits with live wiring may be embedded in concrete floor slabs.

3.9.4 Remove and replace ceiling where necessary to complete the work of this Division unless this work is specifically included in another Division.

3.10 ELECTRICAL EQUIPMENT

3.10.1 Where electrical equipment provided by this Division is not of sprinkler proof design, provide shields to prevent the sprinkler system water from entering the electrical equipment and/or interfering with its operation.

3.11 ELECTRICAL WORK

3.11.1 Perform all electrical work included in the work of this Division in accordance with the requirements of Division 16.

3.12 PAINTING

3.12.1 Touch up minor damage to finish on equipment supplied with factory applied baked enamel finish. Completely refinish items suffering damage which, in the opinion of the Consultant, is too extensive to be remedied by touchup.

3.12.2 Paint all steel framework provided by this Division with a chromium oxide primer.

3.13 **ACCESS DOORS**

3.13.1 Supply access doors wherever equipment, valves, dampers, life safety devices, etc., are concealed behind walls or inaccessible ceilings. All devices installed requiring periodic maintenance to be made accessible. Doors will be installed by Division 9.

3.14 **IDENTIFICATION**

3.14.1 Identify all piping and ductwork using name labels. Apply labels at 7 m (24′) intervals and at all branch connections, valves, and access panel locations. Neatly stencilled labels will be acceptable above accessible ceilings on insulated piping and on ductwork.

3.14.2 Mark each pipe in a space or area less than 7 m (24′) at least once with a name label. Apply flow directional arrows beside each name label.

3.14.3 To ensure permanent bond, apply 3M Adhesive EC-1341 to the surface of the insulation or pipe material. Apply the label with its own adhesive on this surface. Remove any labels “lifting”or “peeling”. Clean the surface and repeat the procedure specified with a new label. Where labels do not adhere, use pipe banding tape spirally wrapped for full length of label. Apply label over the banding tape.

3.14.4 Provide nameplate identifying equipment type, identification number, service and area served on each piece of mechanical equipment.

3.14.5 Identify all manual and automatic control valves on all systems using brass tags attached with non-ferrous chains. Prepare a schedule of all tags for each system showing designating number, service and function. Include these schedules in the Operating and Maintenance Manuals and in the Mechanical Room.

3.14.6 Provide identification of all duct balancing dampers. Identify both support points of balancing damper and bottom of duct. Fluorescent orange spray paint is acceptable.

3.14.7 Where equipment is concealed above accessible ceilings, indicate location using coloured-coded marking devices, approved by Consultant, fastened to the ceiling components.

3.15 **PIPING**

3.15.1 **General**

3.15.1.1 Conceal all piping except in equipment rooms, unfinished areas, and where specifically noted. Unless shown otherwise, install all above ground piping parallel to building walls and partitions.

3.15.1.2 Install escutcheon plates at walls, floors and ceilings where piping is exposed. Install piping to conserve headroom.

3.15.1.3 In locations where space is provided for future or other equipment requiring connection to systems installed under this Contract, install services with shutoff valves and caps to allow connection to the system without interruption.

3.15.2 **Drain Hose Connections**: Provide drain hose connections at the base of all risers, on the suction side of all pumps and in all locations shown on Drawings.

3.15.3 **Supports and Hangers**

3.15.3.1 Provide all hangers, supports and sway braces in accordance with ANSI B31.1 and the Ontario Building Code. Support all piping in accordance with the Ontario Building Code.

3.15.3.2 Use Anvil beam clamps.

3.15.3.3 Use line size adjustable wrought steel clevis type hangers for horizontal piping 32 mm and less (1-1/4″ and less). For copper pipe, wrap pipe with tape at all hangers or use Anvil Figure CT-99C adjustable tubing ring hangers.

3.15.3.4 For piping 40 mm and over (1-1/2″ and over) use adjustable wrought steel clevis type hangers large enough for pipe insulation. See Section 15260 for insulation shields.

3.15.3.5 Where specified and/or shown on Drawings and in schedules, use spring hangers. See Drawings for details.

3.15.3.6 Unless specified otherwise, support piping at maximum spacing as shown and within 460 mm (18″) of each side of all valves and bends.

3.15.3.7 Support all plumbing piping in accordance with the Ontario Plumbing Code.

3.15.3.8 Support horizontal cast iron drainage piping at 1.5 m (5′) maximum spacing. Where the drain has successive fittings with no pipes between the fittings exceeding 800 mm (1′)in length, support the drain at intervals not exceeding 1 m (3′). Where mechanical joints are used, provide double hangers and sway bracing.

3.15.3.9 Where cast iron pipe with mechanical joints is used, support piping on both sides of horizontal joints within 460 mm (18") of joint each side, at all branch ends, and at all points where there is a change in direction. Where the pipe is 150 mm (6″) or larger in horizontal runs, brace to prevent horizontal movement at each branch or change in direction. Use braces, blocks, rodding or other suitable method recommended by the joint manufacturer. Provide Inspection Report from the manufacturer's representative certifying the installation is in accordance with their published installation data.

3.15.3.10 Do not support piping from other piping or equipment, or from metal roof decking.

3.15.3.11 **Schedule**:

Pipe Size mm	**20**	**25**	**32**	**40**	**50**	**65**	**80**	**100 to 200**	
Max. Span m	1.8	2.1	2.4	2.4	3	3.4	3.7	4.3	

3.15.4 **Anchors**: Install anchors where shown and where required. Use “U” bolts for piping 80 mm (3″) in diameter and less. For piping over 80 mm (3″) diameter, use steel fabricated anchors welded directly to pipe.

3.15.5 **Provision for Expansion**: Make proper allowance for thermal expansion and contraction whether shown on the Drawings or not. Use adequate offsets on all takeoffs to allow for expansion and contraction of mains. Weld all steel pipe forming an expansion loop regardless of size. Silver solder all copper pipe forming an expansion loop regardless of size. Use Flexonics or Anvil pipe alignment guides where shown and where required. Provide pipe guides for piping on either side of expansion loops, expansion joints and expansion compensators in accordance with "Standards of the Expansion Joint Manufacturers Association, Inc."

3.16 USE OF FANS

3.16.1 Do not use any fan supplied under this Contract for ventilation while the building is under construction. The building must be "broom clean" and all painting finished before permission will be granted for testing fans.

3.16.2 The Consultant reserves the right to use any piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same before final completion and acceptance of the work. Such tests are not to be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the equipment and/or materials due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials and/or workmanship of any kind. Supply all labour and equipment required for such tests. Trial usage will not initiate or affect in any way the warranties required for devices being tested.

3.17 INSPECTION AND TESTING

3.17.1 **General**: Inspect and test all piping. Repair any leaks and retest until satisfactory. Do not cover or close in piping until inspection and tests are completed. Thoroughly test all systems before making arrangements for the final demonstration in the presence of the Owner's staff. At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found and retest.

3.17.2 **Soil, Waste, Vent and Building Drains**: Seal all openings in section under test, then fill with water to a height of 3 m (10′) above top of section. Maintain water level for at least two hours. Test in sections as the work progresses. After all fixtures have been placed, apply a smoke test to the satisfaction of the local Plumbing Inspector.

3.17.3 **H.W. Heating - Domestic Hot and Cold Water**: Apply a hydrostatic test of 1034 kPa (150 psig) or 1-1/2 times working pressure, whichever is greater, for two hours.

3.18 PERFORMANCE VERIFICATION

3.18.1 All systems must be thoroughly tested by the Technical Representative of the system manufacturers before arrangements are made for the final demonstration in the presence of the Owner's staff.

3.18.2 At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found.

3.18.3 The manufacturer's representative must be present for the test period and submit a Certificate of Operation to the Consultant.

3.18.4 Comply with all requirements of Section 15990, “Commissioning”.

3.19 **START-UP SERVICES**

3.19.1 Provide the services of a qualified person to be on call and available to the site within one hour, for 3 weeks after work of this Contract is taken over by the Owner. Assist Owner's staff to become familiar with the system operation. Provide a similar service for one week after switchover to the opposite air conditioning cycle (heating or cooling).

3.20 **WELDING**

3.20.1 All welding is to be compliant with CSA W59-03 (for steel) or CSA W59.2-M (for aluminum). Welding is to be performed by tradesmen certified to CSA W47.1 (steel) or CSA W47.2 (aluminum). Inspectors shall be qualified to CSA W178.2. Provide proof of certification upon request.

3.20.2 For welding of stainless steel, use the provisions of the American Welding Society standard AWS D1.6/1.6M. When provisions of this standard conflict with provisions of applicable CSA standards, the CSA standards shall take precedence.

3.20.3 Welding and cutting tasks shall be carried out in accordance with CSA 117.2.

3.21 **PLACING IN OPERATION**

3.21.1 Upon completion of all work and before turning over the job, test each system for proper operation.

3.21.2 Flush through all drains and properly adjust flush valves and other fixtures.

3.21.3 Open and clean all new and existing traps, strainers and scale pockets after two weeks' operation.

3.21.4 Clean out all new and existing room heating units, terminal heating and cooling units, and all air handling equipment with a vacuum cleaner when building is completed.

3.21.5 Steam clean all existing convectors and wall-fin elements in the rooms where changes have been made. Do this after all other work has been completed.

3.21.6 For each new filter bank, provide one extra set of filters.

3.22 **COOPERATION BETWEEN TRADES**

3.22.1 Cooperate and coordinate with other trades as required for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost of extra work caused by and make up time lost as result of failure to provide necessary cooperation information or items to be fixed to or built-in, in adequate time.

3.23 **MAINTENANCE OF EXISTING SERVICES**

3.23.1 Take every precaution to locate and protect existing services so that no unscheduled interruption occurs. If any existing service is damaged due to the work of this Division, arrange and pay for repair. Bear any costs due to interruption of existing services.

3.23.2 The operation of the building by the Owner for day-to-day activities takes precedence over all construction related scope of work. The Contractor may be asked to cease work immediately in these instances and directed to work at another time. Assume all construction related activities which will impact the day-to-day operations of the facilities will be done after hours. Include all costs associated with after hours and overtime hours in the Base Bid. Additional costs related to after hours or overtime hours after Award of Contract will not be entertained.

3.23.3 Permission from the Owner is required before making any connections to or rerouting of existing services. Before any interruptions of service or restriction of use of any service, provide seven days prior written notice to the Consultant and Owner.

3.24 **PROTECTING AND MAKING GOOD**

3.24.1 Be responsible for protection of Owner's property, as well as finished and unfinished work, from damage due to execution of work under this Contract. Repair damage resulting from failure to provide such protection to the satisfaction of the Consultant, at no expense to the Owner.

3.24.2 Attach and fasten fixture and fittings in place in safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during occupancy of building, as the result of vibrating or other causes in normal use of building.

3.25 **REMOVAL OF EXISTING MATERIAL AND EQUIPMENT**

3.25.1 Remove existing material and equipment where shown or specified. Unless noted or specified otherwise, all material and equipment which is removed becomes the property of the Contractor and must be immediately removed from the site.

3.26 **ALTERNATIVE, SEPARATE, UNIT AND IDENTIFIED PRICES**

3.26.1 Refer to Division 1 Specifications.

3.27 **CASH ALLOWANCES**

3.27.1 Include in the Base Bid price, cash allowances of:

3.27.1.1 $3,000.00 to cover the cost of having the local utility supply the water meter.

3.27.1.2 $10,000.00 to cover the cost of Section 15900 “Controls” and Section 15990 “Controls Comissioning”.

3.27.1.3 $3,000.00 to cover the cost of Section 15715 “Water Treatment”.

3.27.2 Any amounts in excess of the cash allowances will be paid by the Owner. Return any unused portions of the cash allowances in full to the Owner.

3.28 **PHASING**

3.28.1 The work on this project is to be phased to enable continuous operation of the Owners facilities. See the Architectural Drawings and Specifications regarding the proposed phasing of the work. Provide for temporary services, connections, bypasses, etc. to enable the phasing as described. Carry all associated costs in the Bid.

3.29 **FIRE SAFETY IN EXISTING BUILDINGS**

3.29.1 Where temporary shutdown of sprinkler systems, standpipe systems or other fire protection systems is required, do all work in compliance with Article 1.1.1.2, Clause 2.8.2.1.1.G and Subsections 6.4.1 and 6.5.2 of the Fire Code.

3.30 **DEFICIENCY REVIEW**

3.30.1 The Mechanical Contractor shall confirm in writing that the work is complete and ready for inspection. The Consultant will schedule a site visit to review the work and provide a written deficiency list. Once deficiencies have been corrected, the Mechanical Contractor shall confirm in writing to the Consultant that all deficiencies have been corrected. The Consultant will schedule a second site visit to review the correction of noted deficiencies. Should any noted deficiencies be found to be still outstanding, the Mechanical Contractor shall correct them and again notify the Consultant in writing. Charges to the Mechanical Contractor may result from repeat visits after the second visit.

3.30.2 The Mechanical Contractor is required to complete all work above ceilings and allow time for deficiency reviews and correction of noted deficiencies in a timely manner in order to accommodate the current Construction Schedule. This includes time for reinspection as required prior to concealing (drywall enclosures, drywall ceilings and acoustic tile ceilings) of any service. The Mechanical Contractor will be responsible for uncovering any concealed services for inspection.

3.31 **TEMPORARY WATER SERVICE**

3.31.1 Provide a Reduced Pressure type backflow preventer at each temporary water service connection used for construction purposes. Completely remove all temporary facilities once permanent systems are tested and operational.

3.32 **LIST OF MECHANICAL SUBCONTRACTORS AND MANUFACTURERS**

3.32.1 In the Bid documents, name the Subcontractors and Manufacturers for the items listed below. Use only one name for each item. See Clause “Material and Equipment”. Where the name of a manufacturer is not entered on the Bid Form, the Contractor will be required to use the base specified manufacturer.

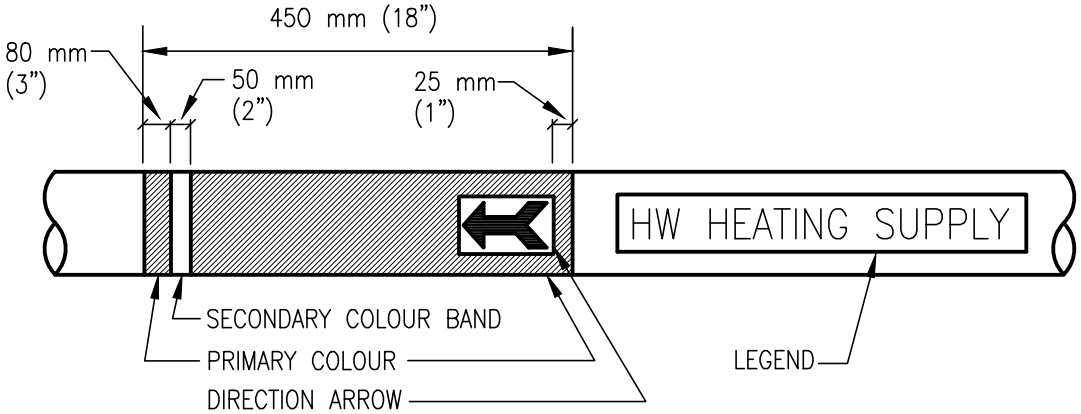
3.32.2 **Subcontractors**

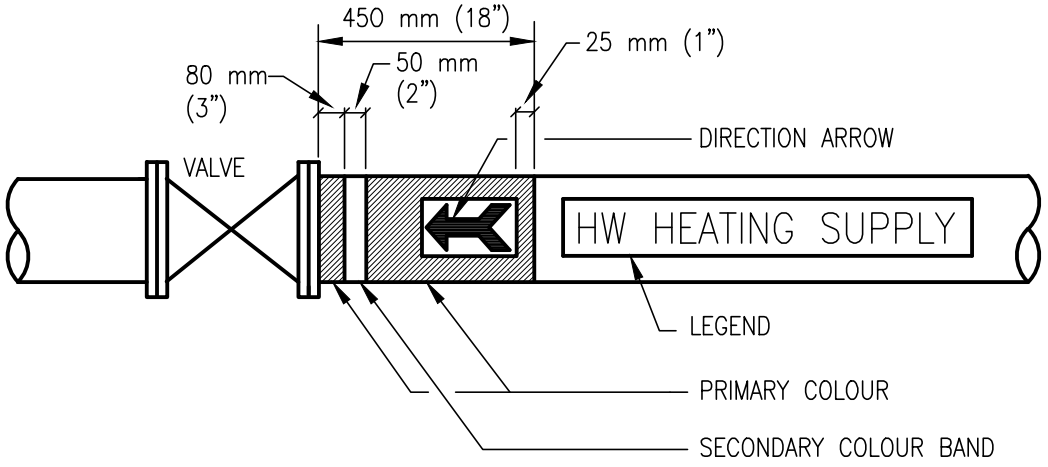
Controls
Insulation
Sheet Metal
Testing and Balancing

3.32.3 **Manufacturers**

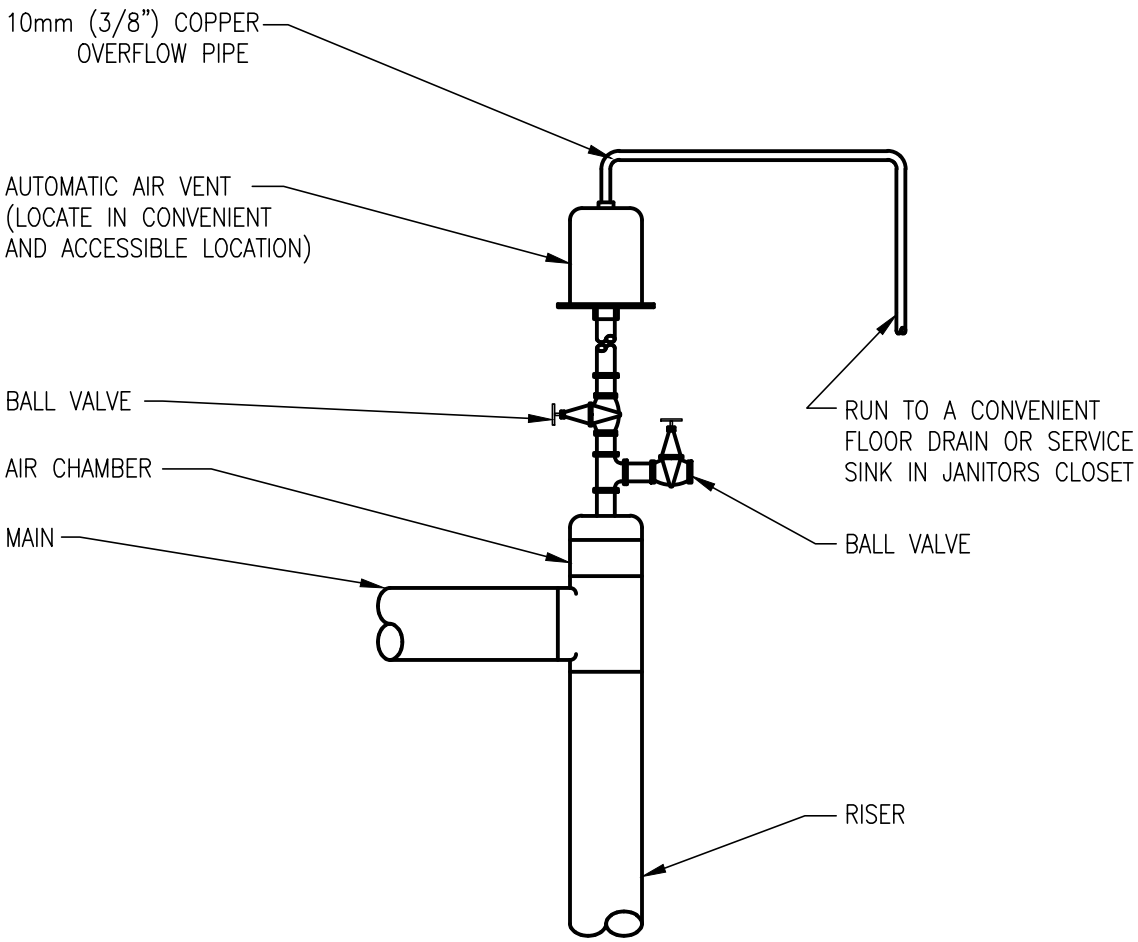
Exhaust Fans
Floor Drains
Grilles, Registers and Diffusers
Heaters
Plumbing Brass
Plumbing Fixtures

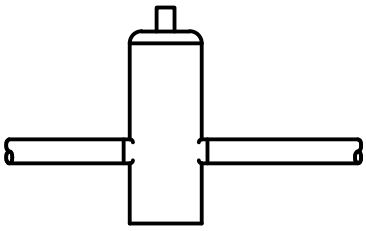
END OF SECTION





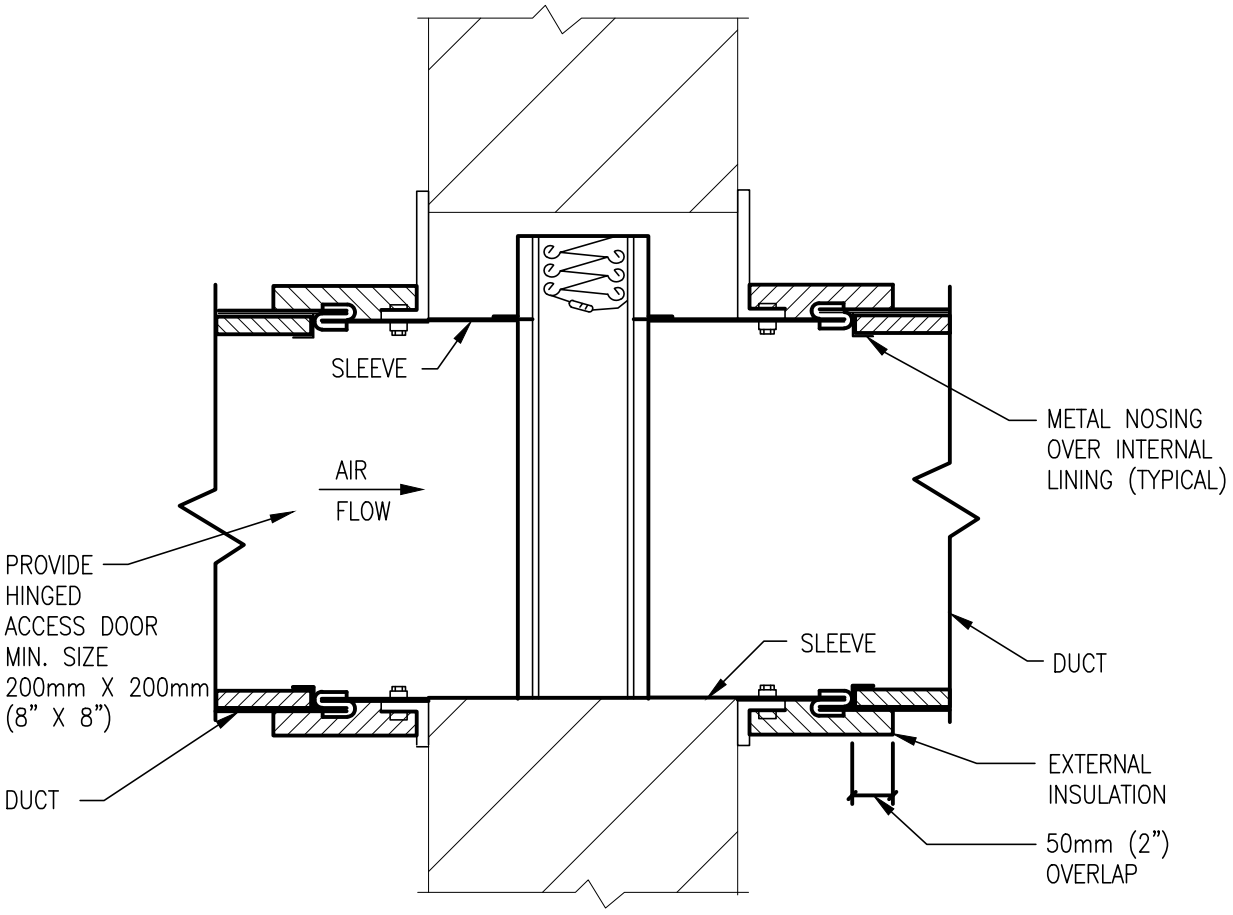
Chorley + Bisset CONSULTING ENGINEERS	TITLE IDENTIFICATION OF PIPING SYSTEMS	DETAIL NO. 001





FOR AIR VENT ON LEVEL
PIPING USE AIR CHAMBER
AS ABOVE.

Chorley + Bisset CONSULTING ENGINEERS	TITLE TYPICAL DETAIL OF AUTOMATIC AIR VENT	DETAIL NO. **002**



Chorley + Bisset CONSULTING ENGINEERS	TITLE DUCT LINER INSTALLATION AT FIRE DAMPER	DETAIL NO. 003

INDEX - SECTION 15200

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Hot Water Heating System:** The existing hot water heating system is being extended to serve new perimeter heaters.

1.2.2 **Supply Air, Return Air and Exhaust Air**: Some systems will be modified. New exhaust fan for universal washroom..

2 Products

2.1 **GENERAL**

2.1.1 Furnish all test equipment. All equipment will remain the property of the testing and balancing company. Use recently calibrated instruments. Provide verification of calibration to the Consultant when requested.

2.1.2 Approved testing and balancing companies for this project are:

Air Audit Inc.
C. J. Zettler & Associates Ltd.

2.2 **MATERIALS**

2.2.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions”, Clause “Material and Equipment”.

2.3 **DUCT ACCESS HOLE PLUGS**

2.3.1 Use Duro Dyne Type IP 4 duct access hole plugs.

3 Execution

3.1 **GENERAL**

3.1.1 Include all labour, engineering and test equipment required to adjust and balance all heating, ventilating, air conditioning and exhaust systems installed or altered under this Contract.

3.1.2 Check rotation of all fans and pumps. Advise appropriate trade if any corrections are needed. Ensure corrections are made before starting any testing or balancing.

3.1.3 Ensure that all control valves, devices and equipment interlocks are operating in the manner required for the correct performance of the systems.

3.1.4 Where existing systems are modified, rebalance the entire existing system as required.

3.1.5 Carry out testing and balancing under both extreme summer and extreme winter conditions. If you wish to simulate these conditions, obtain approval from the Consultant before beginning work.

3.2 **JOB CONDITIONS**

3.2.1 Schedule this work in cooperation with other trades involved.

3.2.2 Do not begin testing and balancing until the systems have been completely installed, tested and put in running order. Correct operation of equipment and system components and cleanliness of piping and ductwork is the responsibility of the appropriate trade.

3.3 **SUBMITTALS**

3.3.1 Record all test data and submit three copies of completed reports to the Consultant. A copy of the final report is to be included in each of the Operation and Maintenance Manuals.

3.3.2 Use data sheets which are approved by the Consultant to record measurements. Include schematic diagrams of all systems identifying branches, inlets, outlets and equipment. Submit sample sheets for review using same procedure as for Shop Drawings.

3.3.3 Provide a Deficiency List to the Contractor for all materials and installation methods which are found not to be complying with the Specifications and, where specified, quantities could not be achieved within the required tolerances. Submit copy of Deficiency List to the Consultant at the same time it is issued to the Contractor.

3.3.4 Submit electronic pdf version of report, complete with index page, indexing tabs and cover page.

3.3.5 Record all test data in SI units.

3.4 **AIR SYSTEMS**

3.4.1 Test and adjust fan speeds and dampers to deliver the required air quantities. For belt driven fans, determine size of sheaves required to properly balance systems and operate systems at minimum static pressures. Install selected sheaves. Sheaves will be supplied by fan supplier.

3.4.2 Seal duct access holes with plugs. Do not use duct tape to seal access holes.

3.4.3 Test and adjust each diffuser, grille and register to within 10% of design requirements and also adjust so as to minimize drafts in all areas.

3.4.4 Record data as specified in Clause “Balancing Data”.

3.5 **WATER SYSTEMS**

3.5.1 Prior to testing and balancing of these systems:

3.5.1.1 Verify that all strainers are clean.

3.5.1.2 Check expansion tanks and ensure that the systems are not air bound and are completely filled with water as required.

3.5.1.3 Check air vents at coils and high points of the systems to verify that all are installed and operating freely.

3.5.1.4 Position all automatic valves, hand valves, and balancing valves for full flow through coils, heat exchangers, heat pumps, individual room heating elements, etc.

3.5.2 Balance all main branches and terminal equipment where balancing devices are installed. See Piping Schematics for locations. Lock all balancing valves. This includes heat pumps, force flow units and convectors, etc. Balance to within 5% of design requirements.

3.5.3 Mark and record flow readings of balancing devices. Where flow measuring devices are not installed, balance using design temperature differences.

3.5.4 Record data as specified in Clause “Balancing Data”.

3.6 **BALANCING DATA**

3.6.1 Include the following information in the test report:

3.6.1.1 **Motors:**

Manufacturer
Model and/or Serial Number
Rated amperage and voltage
Rated kW (hp)
Rated rpm
Corrected full load amperage
Measured amperage and voltage
Calculated kW (hp)
Measured rpm
Sheave size, type and manufacturer

3.6.1.2 **Fans:**

Manufacturer
Model and/or Serial number
Rated L/s (cfm)
Rated rpm
Rated pressure rise
Measured L/s (cfm)
Measured rpm
Measured pressure rise
Pulley size, type and manufacturer
Belt size and quantity
Performance curve by manufacturer

3.6.1.3 **Air Systems (including inlets and outlets):**

Grille, register or diffuser reference number and manufacturer
Grille, register or diffuser location
Design air quantity
Effective area factor and size
Measured air quantity

3.6.1.4 **Heat Transfer Elements (Coils, Heat Exchanger etc.):**

Manufacturer and type
Design inlet and outlet temperatures (air and water side)
Design pressure drop (air and water side)
Measured inlet and outlet temperatures (air and water side)
Measured pressure drop (air and water side)
Measured flow rate (air and water side)

3.6.1.5 **Testing and Balancing Instruments:**

Types
Serial Numbers
Dates of calibration

3.7 **DUCT LEAK TESTING**

3.7.1 Perform leakage testing on representative sections, as selected by the Consultant, involving at least 25% of the duct distribution systems. Include all ductwork types (rectangular, round) and pressure classifications in the leak testing.

3.7.2 Test duct systems to the following SMACNA standards.

Pressure Class	Seal Class	Leakage Class
All	A	6

3.7.3 Refer to Section 15800, Clause “Duct Leak Testing”.

3.7.4 Test ductwork before ducts are insulated, painted or concealed.

3.7.5 Immediately advise Contractor of any defects discovered during test. Retest systems after defects have been corrected.

3.8 **FINAL INSPECTION AND ACCEPTANCE**

3.8.1 After submission of balancing report, arrange a final inspection with the Consultant.

3.8.2 At final inspection recheck points or areas selected by the Consultant.

3.8.3 For each system, if more than 10% of the measurements at the selected recheck stations deviate by 10% or more from those in the Report, then the Report for that system will be rejected as unacceptable.

3.8.4 If Report is rejected, re-balance systems deemed to be unacceptable, submit new Reports, and make reinspection at no extra cost to the Owner.

3.8.5 After acceptance of Reports by Consultant, permanently mark settings of valves, splitters, dampers and other adjustment devices so that adjustment can be restored if disturbed. Type of marking and method of application to be approved by the Consultant.

END OF SECTION

INDEX - SECTION 15260

PART 1 - GENERAL

PART 2 - PRODUCTS

PART 3 - EXECUTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.1.2 All products used must have a flame spread rating less than 25 and a smoke developed classification not more than 50 when tested in accordance with CAN/ULC-S102.

1.1.3 **Environmental Requirements*:*** Maintain ambient temperature and conditions required by manufacturers of adhesives, mastics and insulation cements.

1.1.4 **Quality Assurance*:*** Insulation materials must be manufactured at facilities certified and registered to ISO 9000 Quality Standard.

1.1.5 **Storage of Materials*:*** Protect materials from dirt, water, chemical and mechanical damage before, during and after installation. Provide and install waterproof sheeting to protect insulation in unfinished areas as required. Remove any damaged materials from the site immediately. Remove and replace at no additional cost any installed materials which are damaged.

1.1.6 **Delivery**: Deliver insulation, coverings, cements, adhesive coatings, etc., to the site in Manufacturer’s original containers with the manufacturer's stamp or label affixed showing flame and smoke ratings of the products, name of manufacturer and brand.

1.2 **DEFINITIONS**

1.2.1 In this Specification, “exposed to view” means all services within Equipment Rooms, Service Corridors, plus all other areas of the building where the services are not enclosed within ceilings or shafts. It also refers to ductwork inside horizontal and vertical architectural enclosures across the roof and down the faces of the building.

1.2.2 In this Specification, “exposed to weather” means all services located outdoors without an architectural enclosure.

1.3 **SHOP DRAWINGS**

1.3.1 Provide shop drawings which include product description, list of materials and thickness for each service and manufacturers' installation instructions.

1.3.2 Submit Shop Drawings in accordance with the Clause “Shop Drawings” in Section 15001 for the following equipment and materials:

- Duct and Piping Insulation Types, noting application for each product
- Lavatory Drain Insulation
- Pipe and Duct Coverings
- Piping Insulation Inserts

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions”, Clause “Material and Equipment”.

2.2 **PIPING INSULATION INSERTS**

2.2.1 Make rigid insulation inserts equal in thickness to the adjoining insulation. Use Johns Manville Thermo 12/Gold hydrous calcium rigid pipe insulation. Minimum width should be equal to 50% of pipe circumference. Use the following insert lengths:

Nominal Pipe Size		Insert Length	
mm	(inches)	mm	(inches)
40 - 65	(1-1/2 - 2-1/2)	250	(10)
80 - 150	(3 - 6)	300	(12)

2.3 **PIPING INSULATION INSERT SHIELDS**

2.3.1 Use minimum 18 gauge galvanized metal shields. Form shields to fit insulation and extend up to the pipe centre line. Make length 100 mm (4″) less than length of associated insert.

2.4 **LAVATORY DRAIN INSULATION**

2.4.1 Use McGuire ProWrap seamless lavatory insulation kits, manufactured of anti-microbial closed cell moulded vinyl material.

2.4.2 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Material and Equipment":

Truebro

2.5 **PIPE INSULATION**

2.5.1 **Piping**

2.5.1.1 Use Johns Manville Micro-Lok glass fibre insulation with factory applied AP-T Plus jacket. Jacket to consist of aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing.

2.5.2 **Valves and Fittings**

2.5.2.1 Insulate valves and fittings with factory precut Johns Manville Hi-Lo temp insulation inserts or Johns Manville Microlite 16 kg/m³ (1 lb/ft3) density glass fibre insulation.

2.5.3 **Pipe Thickness Schedule**

Pipe Insulation Schedule

Fluid Design Operating Temperature Range (°C)	Insulation Conductivity		Nominal Diameter (mm)				
	Conductivity Range Btu-in (hr.ft² °F)	Mean Rating Temperature (°C)	less than 25	25 to 32	40 to 80	100 & 150	200 & up
Heating System (Hot Water)							
60 - 93	0.036 - 0.042	52	40	40	50	50	50
Domestic Hot Water							
40 & greater	0.035 - 0.040	38	25	25	40	40	40
Domestic Cold Water (Sanitary, Storm and Condensate Drains)							
4 - 24	0.033 - 0.039	24	25	25	25	25	25

2.5.4 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

CertainTeed
Johns Manville
Knauf
Manson
Ottawa Fibre
Owens Corning
Roxul
Teqtix

2.6 **AIR DUCTS**

2.6.1 On all round ducts, and on rectangular ducts not exposed to view with both dimensions 610 mm (24″) and smaller, use Johns Manville Microlite Type 75 flexible blanket fibreglass insulation with FSK facing. Product must meet the requirements of ASTM C 1290, and include aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing. Maximum thermal conductivity 0.042 W/m°C (0.29 Btu-in/hr^{2}ft2°F) in accordance with ASTM C 518. Use 40 mm (1-1/2″) thickness.

2.6.2 On rectangular ducts exposed to view, and on rectangular ducts not exposed to view with one dimension 660 mm (26″) or larger, use Johns Manville Spin-Glas Type 814 rigid fibreglass insulation board, 48 kg/m3 (3 lb/ft3) density, with FSK facing. Product must meet the requirements of ASTM C 612, and include aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing. Maximum thermal conductivity 0.033 W/m°C (0.23 Btu-in/hr^{2}ft2°F) at 24°C (75°F) mean temperature. Use 40 mm (1-1/2″) thickness.

2.6.3 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

CertainTeed
Johns Manville
Knauf
Manson
Ottawa Fibre
Roxul

2.7 **PIPE INSULATION COVERING (EXPOSED TO VIEW)**

2.7.1 **Piping:** Finish with Johns Manville Zeston 2000 PVC 0.51 mm (20 mil) thickness "Cut and Curled" jacketing. Use Zeston "Perma-Weld" solvent welding adhesive to permanently seal all PVC joints. Use white covers.

2.7.2 **Valves and Fittings:** Finish with Johns Manville Zeston 2000 PVC insulated fitting covers 0.51 mm (20 mil) thickness. Use Zeston "Perma-Weld" solvent welding adhesive to permanently seal all PVC joints. Use white covers.

2.7.3 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Material and Equipment":

Proto
Walton Plastics Inc.

3 Execution

3.1 **GENERAL**

3.1.1 Install all insulation in strict accordance with manufacturer's published recommendations.

3.1.2 Install all insulation continuous through walls and sleeves.

3.1.3 Do not apply insulation until piping has been tested and approved.

3.1.4 Do not insulate unions or flanges at connections to equipment. In these locations, and in all other locations where insulation ends, finish with vapour resistant mastic.

3.1.5 Insulate ALL components of insulated systems unless specifically excluded.

3.1.6 Extend all surface finishes to protect all surfaces, ends and raw edges of insulation.

3.1.7 Patch and make good any existing insulation and covering which is damaged during the work of this Contract. Use material of the same quality as existing.

3.2 **FIRESTOPPING**

3.2.1 Where an insulated pipe passes through a fire separation, use only ULC labelled piping insulation in accordance with ULC Listed firestop system being used. See Section 15001, Clause “Firestopping”.

3.2.2 Extend ULC labelled pipe insulation through fire separation and 50 mm beyond fire separation on both sides. Tightly butt joints and wrap with approved joint tape.

3.3 **PIPING SYSTEMS**

3.3.1 **Sanitary Drainage System**: Insulate horizontal sections from combination drains, floor drains, open hub drains, water closets and urinals from fixture to point of connection with soil stacks.

3.3.2 **Other Systems**: Insulate the following piping systems in their entirety:

- Hot Water Heating
- Domestic Cold Water
- Domestic Hot Water

3.3.2.1 Use the following Mean Rating Temperatures when selecting insulation thicknesses:

Hot Water Heating : 60 - 93°C (141 - 200°F)

3.3.3 **Insulation Application**

3.3.3.1 **Hanger Points**: Provide an insulation insert and shield at each hanger point on all systems. On cold lines, vapour seal butt joints on each side of insert.

3.3.3.2 **Pipe**: Apply insulation over clean dry pipe. Butt all joints firmly together. Seal all jackets neatly in place. Wrap butt joints with a minimum 75 mm (3″) wide strip of the jacketing material. Use a vapour barrier adhesive on all "cold" lines.

3.3.3.3 **Fittings and Valves**

3.3.3.3.1 For pipe sizes 40 mm (1-1/2″) and smaller, insulate with fibreglass blanket wrapped firmly under compression (minimum 2:1) to a thickness matching adjoining insulation. Insulation ends may be mitred at elbows and sealed with tape.

3.3.3.3.2 For pipe sizes 50 mm (2″) and larger, insulate with factory precut insulation inserts or with fibreglass blanket wrapped firmly under compression (minimum 2:1) to a thickness matching adjoining insulation. Insulation ends may be mitred at elbows and sealed with tape.

3.3.3.3.3 **Cold Systems**: Provide a continuous vapour barrier on the insulation for the following systems:

- domestic cold water

3.3.3.3.4 On components which require service, fabricate easily removable and reusable insulation sections e.g. suction guides for circulating pumps and pump casings. Test ports on balancing valves to be accessible outside of insulation.

3.3.4 **Pipe Insulation Covering**: In all locations where the insulation will be exposed to view, finish with PVC insulation covering. Use solvent welding adhesive to permanently seal all PVC joints. Taping or tacking of jackets will not be accepted. Follow strictly manufacturer's installation procedures for cold and hot systems. Use white jackets.

3.4 **AIR DUCTS**

3.4.1 **General**

3.4.1.1 Seal all vapour retardant jacket seams and penetrations with UL Listed tape and adhesive.

3.4.1.2 See Section 15800, “Air Distribution”, for internal duct insulation.

3.4.1.3 Externally insulate all ductwork specifically identified on the Drawings.

3.4.1.4 Externally insulate all supply ductwork in Mechanical Rooms (including Boiler Room). Externally insulate all outside air and combustion air intake ducts.

3.4.1.5 Externally insulate fire damper sleeve assemblies where duct system is internally lined. See Detail Sheet in Section 15001.

3.4.2 **Application**

3.4.2.1 On round and oval ducts adhere insulation to ducts with a flame resistant, quick tacking adhesive. Apply adhesive in 100 mm (4″) wide strips at 200 mm (8″) centres. Butt all circumferential joints and overlap all longitudinal joints a minimum 50 mm (2″). Staple all joints on 150 mm (6″) centres. Tape all joints with minimum 76 mm (3″) wide reinforced vapour barrier tape as recommended by insulation manufacturer.

3.4.2.2 On rectangular ducts, use adhesive and impale insulation over mechanical fasteners. Provide 100% coverage of adhesive on sheet metal, all exposed insulation edges, and all transverse joints. Provide mechanical fasteners per Insulation Manufacturer's published recommendations. Insulate behind duct balancing damper operators.

3.5 **LAVATORY DRAIN INSULATION**

3.5.1 Insulate drain and supply pipes on all barrier free lavatories. Use moulded offset drain and water supplies covers.

3.6 **REMOVAL OF ASBESTOS INSULATION**

3.6.1 Remove existing pipe insulation containing asbestos fibre where shown on Drawings. Follow the Ontario Ministry of Labour's Latest Requirements. Re-insulate in accordance with this Section.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Domestic Cold Water**: Provide a new system complete with connections to fixtures and equipment requiring cold water connections as shown and/or as specified. Connect to the existing system where shown on the drawings.

1.2.2 **Domestic Hot Water**: Extend the existing system complete with connections to fixtures and equipment requiring hot water connections as shown and/or as specified.

1.2.3 **Sanitary Drainage**: Extend the existing soil and waste drainage system complete with connections to fixtures and equipment as shown and/or as specified.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, “Shop Drawings” for the following equipment and materials:

- Backflow Preventers
- Cleanouts
- Floor Drains
- Plumbing Fixtures
- Pressure Gauges
- Shock Absorbers
- Trap Seal Valves
- Vacuum Breakers
- Valves

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions” Clause “Material and Equipment”.

2.2 **PIPE AND FITTINGS**

2.2.1 Select the most economical use of the materials named below. Unless specified or shown otherwise, either material may be used or a combination of materials, whichever provides the greatest economy.

2.2.2 For all piping systems, use only solder and fluxes containing no lead.

2.2.3 **Domestic Water Piping (Hot, Cold)**

2.2.3.1 Use hard drawn copper, Type “L” to ASTM B88, with soldered or flanged joints and bronze or copper fittings.

2.2.3.2 Use Class 150 cast copper solder fittings to ANSI/ASME B16.18 or wrought copper and lead free copper alloy solder fittings to ANSI/ASME B16.22. Use Class 150 lead free cast bronze flanged fittings to ANSI/ASME B16.24.

2.2.3.3 For below grade piping only, use copper tube, soft annealed, Type “K”, to ASTM B88, or Rehau PEXa polyethlylene piping. All below grade piping to be in long lengths with no buried joints, encased in a protective PVC sleeve. No fittings to be located within sleeve.

2.2.4 **Sanitary Drainage Piping (Including Vent Piping)**: Use cast iron Class 4000 pipe and fittings to CSA B70, with mechanical joints, or seamless copper Type DWV pipe to ASTM B306 with cast or wrought copper fittings and soldered joints. Mechanical joints to be rubber compression gasket type with stainless steel clamps and hardware. For below grade piping only, use PVC pipe and fittings to CSA B181.2, with solvent weld joints.

2.3 **CLEANOUTS**

2.3.1 Use cleanouts of the same size as drainage pipe on piping up to 100 mm (4″) diameter, not less than 100 mm (4″) on size 150 mm (6″) and 200 mm (8″), and not less than 150 mm (6″) on larger size pipe. No aluminum components will be permitted.

2.3.2 For line cleanouts, use Watts CO-450-RD epoxy coated cast iron cleanout ferrule complete with countersunk threaded brass plug, stainless steel wall access cover and stainless steel vandal resistant screw.

2.3.3 For stack cleanouts, use Bibby Ste Croix cast iron Barret style stack cleanout with gasketted cast iron cover.

2.3.4 In floor with vinyl or similar finish, use Watts CO-200-T-1-34 epoxy coated cast iron floor cleanout with round adjustable nickel bronze access cover and frame, tile recess and secondary closure plug.

2.3.5 In porcelain, ceramic and other quarry tile floors, use Watts CO-200-S-1-34 epoxy coated cast iron floor cleanout with square adjustable nickel bronze access cover and frame, and secondary closure plug.

2.3.6 In concrete floors or carpeted floors, use Watts CO-200-RX-4-34 epoxy coated cast iron floor cleanout with round adjustable heavy duty ductile iron access cover and frame, and secondary closure plug.

2.3.7 In terrazzo floors use Watts CO-200-US-1-34 epoxy coated cast iron floor cleanout with square adjustable nickel bronze access cover and frame, with recess for terrazzo and secondary closure plug.

2.3.8 In floors with surface membranes, use Watts CO-100-C-RFC-7-1-34 epoxy coated cast iron cleanout with anchor flange, cast iron reversible membrane clamp, and RFC satin nickel bronze cleanout top with surface membrane clamp.

2.3.9. The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Enpoco
Jay R. Smith
Mifab
Zurn

2.4 **FLOOR DRAINS**

2.4.1 **General**: No aluminum components will be permitted. Provide flashing clamps on all drains installed in floors with membranes. Confirm membrane floor locations with Division 1.

2.4.2 **Funnel Floor Drains in Millwork (Drawing Reference FFD)**: Watts Ancon FD-200-EF-1 cast iron floor drain with adjustable heavy duty cast iron grate. Provide separate cast iron “P” trap and Type NB, 100 mm (4″) round funnel.

2.4.3 **Floor Drains in Finished Areas Not Specifically Designated (Drawing Reference FD)**: Watts FD-200-5-1 cast iron floor drain with XH, adjustable 140 mm (5-1/2″) diameter Type NB, heavy duty nickel bronze strainer with clear epoxy coating. Provide separate cast iron “P” trap.

2.4.4 **Mechanical Room (Drawing Reference FD)**: Watts FD-300-50 cast iron floor drain with adjustable 180 mm (7″) diameter CI strainer and heavy duty cast iron grate.

2.4.5 **Funnel Floor Drains in Finished Floor (Drawing Reference FFD)**: Watts FD-200-EG-1 cast iron floor drain with adjustable heavy duty cast iron grate. Provide separate cast iron “P” trap and Type NB, 100 mm x 230 mm (4″ x 9″) oval funnel.

2.4.6 **Funnel Floor Drains in Unfinished Floor (Drawing Reference FFD)**: Watts FD-300-G-50 cast iron floor drain with adjustable heavy duty cast iron grate. Provide separate cast iron “P” trap and Type CI, 100 mm x 230 mm (4″ x 9″) oval funnel.

2.4.7 In floors with surface membrane, use Watts FD-100-C-FC7-1 with strainer and surface membrane clamp.

2.4.8 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Enpoco
Jay R. Smith
Mifab
Zurn

2.5 **VALVES**

2.5.1 Use valves of same manufacturer except where approved otherwise by the Consultant.

2.5.2 Use the following valves for all piping systems provided by this Section, unless specified otherwise. Use rising stem where space permits. Use flanged, screwed or solder ends to suit pipe lines, and non-heating malleable iron handles.

2.5.3 Use only industrial class valves complying with ANSI, ASTM, ASME and applicable MSS Standards.

2.5.4 Unless otherwise specified, use valves designed for 1380 kPa (200 psig) CWP (cold working pressure) minimum. Use rising stem where space permits. Use flanged, screwed, or soldered ends to suit pipe lines, and non-heating malleable iron handles. Use valves which are repackable under pressure. Use valves with extended valve stems where piping is to be insulated.

2.5.5 All valves must have a valid and current Canadian Registry Number (CRN).

2.5.6 All new valves and fittings to be lead free to meet California Standard AB1953 for Lead Free Plumbing Fixtures with lead content below 0.25%.

2.5.7 **Domestic Water Systems**

2.5.7.1 **Ball Valves**: For sizes 50 mm (2″) and under, use 1034 kPa (150 psig) / 600 W.O.G., Brass Body to ASTM C49300 (Lead Free Brass), Full Port, PTFE Seats, Double "O" Ring or Teflon packing, TEA Plated Forged Brass C49300 Vented Solid Ball, Blowout Proof Stem, Lever Handle.

Screwed Ends - Kitz 858
Solder Ends - Kitz 859

For sizes 65 mm (2-1/2″) and over, Use Class 150 Stainless Steel A351 CF8M Body, SS Ball & Stem, PTFE packing, Hypatite or PTFE seats, locking lever operated.

Kitz 150UTBZM (Full Port)

2.5.7.2 **Check Valves**: Check Valves: For sizes 50 mm (2") and under, use 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM C89530 (Lead Free Bronze), Screwed Cap C49300 (Lead Free Brass), Integral Seat, PTFE Disk.

- Swing "Y" Pattern
- Screwed Ends - Kitz 822T
- Solder Ends - Kitz 823T

2.5.7.3 **Hose Bibbs c/w Cap & Chain** : For sizes 20 mm (3/4″) and 13 mm (1/2″) use 1034 kPa (150 psig) / 600 W.O.G. Brass Body to ASTM C49300 (Lead Free Brass), Full Port, PTFE Seats, Double "O" Ring or Teflon packing, TEA Plated Forged Brass C49300 Vented Solid Ball, Blowout Proof Stem, Lever Handle.

Hose bibb Brass fitting to ASTM C49300 (Lead Free Brass) and Cap & Chain.

- Screwed Ends - Kitz 858
- Solder Ends - Kitz 859

2.5.7.4 **Drain Hose Connections**: Use Kitz 68C bronze body ball valve, 4140 kPa (600 psig) CWP complete with brass threaded cap and chain.

2.6 PRESSURE GAUGES

2.6.1 WEISS LF4S-1 100 mm (4″) liquid filled, stainless steel case, gauge accuracy 1% middle half, ANSI B40 Grade A, brass movement, bourdon tube and socket. Use range twice the normal operating pressure of the system, so that the pointer is normally at the mid-point of the range. Provide gauges with dual unit scales.

2.6.2 WEISS TC14 “T” handle brass gauge cocks, threaded both ends, 2100 kPa (300 psig) water. Include WEISS PSN-B brass pressure snubber.

2.6.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Ashcroft
Baker
Cambridge
Taylor
Trerice
Winters

2.7 SHOCK ABSORBERS

2.7.1 Provide Watts LF15M2 Series lead free shock absorbers ahead of all solenoid valves, flush valves, or other quick-closing valves. Provide in other locations where shown on Drawings.

2.7.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jay R. Smith
P.P.P.
Zurn

2.8 BACKFLOW PREVENTERS

2.8.1 **Double Check Valve Type (DCVA)**: Watts No. 757 double check valve assembly, tested and certified under A.S.S.E. Standard 1015 and CSA B64.5, with brass or cast epoxy coated body and stainless steel working parts, strainer and primary and secondary check valves. Check valve seats and disks to be replaceable.

2.8.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Conbraco
Febco
Wilkins / Zurn

2.9 ESCUTCHEON PLATES

2.9.1 Provide one piece, brushed aluminum escutcheon plates at all points where pipes pass through walls, floors or ceilings into finished areas.

2.10 **TRAP SEAL VALVES**

2.10.1 Use only Proset trap guard drain inserts for floor drains, in lieu of priming through the use of trap seal valves.

2.11 **PRESSURE RELIEF VALVES**

2.11.1 For tanks, use Watts Series N240 A.S.M.E. temperature and pressure relief valves. Size valves to suit equipment heating rating.

2.11.2 For pipelines, use Watts Series 174A A.S.M.E. pressure relief valves. Size valves to suit equipment heating rating.

2.11.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Braukmann
Conbraco

2.12 **PLUMBING FIXTURES**

2.12.1 **General**

2.12.1.1 Provide white fixtures unless specified otherwise. Use only first quality fixtures. Warped or distorted fixtures will not be accepted. Use fixtures of a single manufacturer only where possible. Likewise use a single manufacturer for faucets, supplies and drains.

2.12.1.2 All plumbing fixtures, faucets and supplies to meet NSF 372, with lead content below 0.25%.

2.12.1.3 Provide rigid spouts in all faucets except in kitchen and staff room.

2.12.1.4 Use only new plumbing fixtures, certified by CAN/CSA-B45.0 and closet seats, fittings and trim, certified by CAN/CSA B125, and free from cracks, scratches, wrench marks, or imperfections of any kind. Replace any permanently stained, chipped or marred fixtures or connections.

2.12.1.5 Use factory chrome plated items for all visible parts of the fixture trim including faucets, escutcheons, waste, strainers, traps, supplies, stops, etc.

2.12.1.6 Unless specified otherwise, the following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

- Plumbing Fixtures - American Standard, Eljer, Kohler
- Plumbing Brass - Chicago Faucets, Delta Commercial, T&S
- Flush Valves - Sloan, Zurn
- Water Closet Seats - Beneke, Centoco, Viceroy
- Thermostatic Mixing Valves - Acorn, Bradley, Chicago Faucets, Delta Commercial, Lawler, T&S

2.12.2 **Fixture Carriers**

2.12.2.1 **Lavatories**: Watts Series 400 heavy duty carriers to support all wall hung lavatories independent of the wall.

2.12.2.2 The following manufacturers of the above equipment will be considered equal, subject to the requirements of Clause “Material and Equipment”:

Jay R. Smith
Watts
Zurn

2.12.3 **Water Closet (Drawing Reference WC1) (Wall Hung Flush Valve)**

2.12.3.1 Resevered.

2.12.4 **Water Closet (Drawing Reference WC2) (Wall Hung Barrier Free Flush Valve)**

2.12.4.1 Reserved.

2.12.5 **Water Closet (Drawing Reference WC3) (Floor Mount Barrier Free Flush Valve)**

2.12.5.1 **Bowl**: American Standard High Efficiency FloWise Madera Model 3461-128 floor mount, barrier free, 420 mm high, 4.8 litres per flush, for flush valve, vitreous china water closet with elongated syphon jet flush action bowl, fully glazed 50 mm (2") ball pass internal trapway, 254 mm x 304 mm (10″ x 12″) large water surface, 40 mm (1-1/2″) top spud. Use brass floor flange.

2.12.5.2 **Flush Valve**: Sloan “Regal” 111-1.28-YG flush valve, 4.8 litres per flush, chrome plated, factory set flow, quiet action diaphragm type with non hold open feature, vacuum breaker, back-check angle stop with extended seat bumper.

2.12.5.3 **Seat**: Centoco No. 820STS Seat, elongated, heavy duty solid plastic white open front seat with cover, reinforced stainless steel check hinges, stainless steel posts, washers and nuts.

2.12.6 **Lavatory (Drawing Reference LA1) (Counter Mount)**

2.12.6.1 Reserved.

2.12.7 **Lavatory (Drawing Reference LA2) (Wall Hung Barrier Free)**

2.12.7.1 **Lavatory**: American Standard 0954.000 Murro, barrier free vitreous china wall-hung basin with overflow, for concealed wall hanger, 100 mm (4″) centres.

2.12.7.2 **Faucet:** Chicago Faucets Ecast 802-V317XKCP faucet, chrome plated, 100 mm (4″) centres, solid cast brass lead-free body, 1/4 turn ceramic disc valve cartridges, with vandal resistant 1.9 lpm (0.5 gpm) spray aerator outlet and cast brass 100 mm (4″) blade handles. Connect tempered water to faucet using Lawler Model 516 thermostatic mixing valve with in-line check stops. Temperature range 35°C to 46°C (95°F to 115°F). Locate valve in block wall behind surface mounted access door.

2.12.7.3 **Supplies**: McGuire H170BVRB supplies, heavy pattern, chrome plated, polished, short rigid horizontal integral sweat tubes with vandalproof loose key ball valve angle stops, escutcheons and braided flexible risers.

2.12.7.4 **Drain:** McGuire 155A drain, chrome plated with open grid strainer. McGuire 8872C P Trap, 32 mm (1-1/4″), chrome plated, polished cast brass with cleanout and escutcheon.

3 Execution

3.1 **SANITARY PIPING**

3.1.1 Where pipe sizes are not shown on the Drawings and are not specified, size in accordance with the requirements of the Ontario Plumbing Code.

3.1.2 Install piping and connect to, or rough-in for, all fixtures as shown or as specified. Conceal piping in walls or ceilings in finished areas. Where sewers pass under footings, backfill with lean concrete.

3.1.3 Use the following minimum slopes on horizontal drains, unless indicated otherwise on the Drawings:

Fixture waste or drains	2%
Drains up to and including 80 mm (3″)	2%
Drains 100 mm (4″) and up to 150 mm (6″)	1%
Drains over 150 mm (6″)	0.5%

3.1.4 Use only lead free solder and fluxes.

3.2 **VENTING**

3.2.1 Vent all fixtures in accordance with local and provincial regulations. Run vents as directly as possible and grade properly to drain back to the fixture connection. Connect the bottom of all vent stacks into soil or waste stacks for drainage. Conceal vents in walls and ceilings in finished areas. Carry vent stacks through roof where shown or where required and project at least 600 mm (24″) above roof deck.

3.3 **FLASHING**

3.3.1 Carry vent, waste and soil stacks through roof where shown on Drawings or where required. Use materials specified in Section 15001 and make a watertight joint at roof. Supply all flashing materials.

3.4 **CLEANOUTS**

3.4.1 Install cleanouts behind walls so that the bolted cover on the cleanout will be within 25 mm (1″) of the finished wall.

3.4.2 Conceal cleanouts in finished walls with access doors. Wall cleanout access doors to be installed minimum 200mm (8") above finished floor. See Section 15001 “Mechanical General Provisions” for access doors.

3.4.3 Place cleanouts where shown, at end of all drainage lines, at all changes of direction greater than 45°, and at the base of all stacks.

3.4.4 Bring cleanouts up to floor level in all buried pipe and in all horizontal runs above grade where specifically shown. For all other cleanouts in horizontal runs above grade, leave with access from ceiling space. Bring cleanouts in concealed vertical pipes to a wall surface.

3.4.5 Locate floor cleanouts clear of fixed furniture and equipment. In corridors, locate cleanouts near walls but clear of base.

3.5 FLOOR DRAINS

3.5.1 Connect all floor drains, combination drains, running traps, and open hubs to trap seal valves.

3.5.2 Connect all floor drains into sanitary drainage systems unless specifically shown otherwise.

3.6 WATER PIPING

3.6.1 Use only lead free solder and fluxes.

3.6.2 Connect required service to plumbing fixtures, hose bibbs, etc., as shown or as specified.

3.6.3 After installation, thoroughly flush out complete system of water piping and remove all scale, etc.

3.6.4 Arrange with local utility for supply and installation of domestic water meter. Provide all necessary valves and piping in accordance with Utility's requirements.

3.7 VALVES

3.7.1 Install a valve at takeoff point in each main branch which takes off from main and in all locations shown.

3.7.2 Install drain valves with hose connections at all low points and at all branch valves for upfeed risers.

3.7.3 Use line size valves unless noted otherwise.

3.7.4 Use ball valves on all plumbing line 65 mm (2-1/2") and smaller. Use butterfly valves in larger lines.

3.8 PLUMBING FIXTURES

3.8.1 Provide compression type shutoff valves or ball valves at each fixture in addition to the faucets on each fixture. For countertop sinks, use ball valves.

3.8.2 Where fixture connections pass into walls, floors, or ceilings, provide proper escutcheons.

3.8.3 When installing accessories, take great care to avoid marring chrome plating. Wrench or other tool marks on the plating will be sufficient cause for rejection.

3.8.4 Unless shown otherwise, use the following sizes of hot and cold water and waste connections to fixtures:

Fixture mm (in)	Hot Water mm (in)	Cold Water mm (in)	Waste mm (in)
Lavatory	15 (1/2)	15 (1/2)	32 (1-1/4)
Water Closet (Flush Valve)	----	25 (1)	80 (3)

3.8.5 Caulk all around bases of water closets, lavatories, wash fountains and other built-in equipment. Seal all edges which abut walls and floors.

3.8.6 Mount fixtures with finished floor to rim dimensions as follows:

Drawing Reference	**Height mm (in)**
LA2	840 (33)

3.8.7 Confirm all mounting heights with Architect prior to roughing in.

3.9 **VACUUM BREAKERS AND BACKFLOW PREVENTERS**

3.9.1 Provide vacuum breakers and backflow preventers on all plumbing fixtures and equipment where required by Ontario Plumbing Code.

3.9.2 Size vacuum breaker to suit maximum design flow rates of fixture or equipment served.

3.9.3 Install backflow preventers in accordance with CAN/CSA-B64.10, Manual for the Selection, Maintenance and Field Testing of Backflow Prevention Devices, including mounting height and clearance recommendations.

3.10 **ROUGHING-IN**

3.10.1 Where shown on Drawings, rough-in hot and cold water systems, drain and vent. Cap off all piping and provide shutoff valves on hot and cold water piping.

3.11 **EXISTING SYSTEMS**

3.11.1 Maintain systems in operation throughout construction, using temporary systems where shown. Disconnect existing systems only when temporary or permanent replacement systems are operational.

3.11.2 Construct the temporary systems to the same standards of material and installation as the permanent systems.

3.12 STERILIZATION OF POTABLE WATER SYSTEMS

3.12.1 All chlorination and sampling must be completed and tested by a person holding a Water Distribution Licence Class 1 thru 4 and sampling submitted to an accredited laboratory. Provide certified reports.

3.12.2 Thoroughly flush the domestic hot and cold water piping systems using clean potable water to remove dirt and other contaminants. Remove all faucet screens prior to flushing and reinstall after completion of flushing.

3.12.3 Disinfect domestic hot and cold water piping systems using a liquid chlorine solution. Introduce the liquid chlorine to ensure the chlorine is distributed throughout the sections being tested. Apply chlorine to a achieve a minimum chlorine concentration of 10 mg/L throughout the sections being tested. Leave the 10 mg/L chlorine solution in place for 24 hours.

3.12.4 Test the chlorine residual after 24 hours. If tests show a minimum chlorine residual of 5 mg/L, flush the disinfected sections and recharge with potable water. If the chlorine residual is found to be less than 5 mg/L, repeat the disinfecting procedure until satisfactory results are obtained.

3.12.5 After the systems have been flushed and recharged with potable water, arrange and pay for bacteriological tests to be conducted by an independent testing agency. Provide certified reports. If there is evidence of contamination, repeat the disinfecting procedure until satisfactory results are obtained. Obtain the Building Inspector’s permission before placing the systems in normal operation.

END OF SECTION

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PART 1 - GENERAL

PART 2 - PRODUCTS

PART 3 - EXECUTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Hot Water Heating System:** The existing hot water heating system will be extended to serve the renovated areas of the building.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause “Shop Drawings”, for the following equipment and materials:

- Automatic Air Vents
- Combination Shutoff and Balancing Valves
- Convectors
- Valves

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions” Clause “Material and Equipment”.

2.2 **PIPING AND FITTINGS**

2.2.1 **General**

2.2.1.1 Use the following materials for all piping systems provided by this Section.

2.2.1.2 Use long radius elbows. Where the mains are 100 mm (4″) diameter or greater and where branches are smaller by two pipe sizes or more, cut-ins will be permitted. For all other branch connections, use manufactured tees.

2.2.1.3 For flanged connections use stainless steel spiral wound graphite gaskets and high tensile strength bolts, nuts and washers. Use welding neck, RF flanges.

2.2.2 **Water Piping for Sizes 50 mm (2″) and Smaller**. Use either copper or steel pipe as follows:

2.2.2.1 **Copper**

Pipe - Type L hard drawn copper
Joints - Solder (Use only lead free solder)
Fittings - Wrought copper or cast bronze
Unions - 1030 kPa (150 psig) octagon end, bronze

2.2.2.2 **Steel**

Pipe - Black steel, Schedule 40, ASTM A-53B
Joints - Screwed
Fittings - 860 kPa (125 psig) cast iron
Unions - 1030 kPa (150 psig) malleable iron, brass to iron ground joint seat

2.3 **VALVES**

2.3.1 **General**

2.3.1.1 Use the following valves for all piping systems provided by this Section, unless specified otherwise.

2.3.1.2 Use only industrial class valves complying with MSS Specification SP-80.

2.3.1.3 All valves supplied for this project shall have a current and valid Canadian Registration Number for the Province of Ontario with TSSA. Upon request, suppliers shall provide a copy of statutory declaration for valves, stamped, signed and dated by TSSA as validation of the CRN registration.

2.3.1.4 All valves to have extended locking handles complying with MSS Specification SP-80.

2.3.2 **Ball Valves**

2.3.2.1 Kitz 68/69, bronze body, full port (CGA approved) with stainless steel ball and stem. Use valves with extension stems when installed in insulated piping. Use locking lever handle where “lockable valve” is noted on the Drawings.

2.3.2.2 The following manufacturers of the above two items of equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jenkins
Kitz
Nibco

2.3.3 **Check Valves**

2.3.3.1 **Copper Pipe**: For sizes 50 mm (2″) and under use 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM B62 Y-pattern swing type disc, screw cap, bronze trim valves with solder ends. Kitz 23, Toyo 237, Jenkins 4093J..

2.3.3.2 **Steel Pipe**

2.3.3.2.1 For sizes 50 mm (2″) and under use 860 kPa (125 psig) / 200 W.O.G. bronze body to ASTM B62 Y-pattern swing type disc, screw cap, bronze trim valves with screwed ends. Kitz 22, Toyo 236, Jenkins 4092J.

2.3.3.2.2 For sizes 65 mm (2-1/2″) and over, use Class 125 / 200 W.O.G. cast iron body to ASTM A126 Class B, bronze trim, bolted cover, swing type disc, flanged. Kitz 78, Toyo 435A, Jenkins 587J.

2.3.3.3 **On Pump Discharge**

2.3.3.3.1 For sizes 50 mm (2″) and under, use 1030 kPa (150 psig) APCO or Mueller Steam Specialty spring checks.

2.3.3.3.2 For sizes 65 mm (2-1/2″) and over, use 1030 kPa (150 psig) Moygro, Mueller Steam Specialty, Duo-Check or Bell & Gossett spring checks.

2.3.4 **Combination Balancing and Shutoff Valves**

2.3.4.1 Use T&A combination balancing and shutoff valves with ANSI flanges and locking adjustment.

2.3.4.2 Balancing Valves will all be designed for flow measurement, flow balancing and positive shutoff. Size valves in accordance with manufacturer's published guidelines. Provide extended differential ports to enable access without removing insulation.

2.3.4.3 Valves to be calibrated globe style with differential ports providing flow measurement, balancing and positive shutoff. Do not exceed 910 mm (3′) head at fully open position.

2.3.5 **Drain Hose Connections**

2.3.5.1 Full port, bronze body ball valves with stainless steel stems and ball – Kitz 68 with brass hose adaptor, cap and chain.

2.3.5.2 The following manufacturers of the above item of equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jenkins
Kitz
Nibco

2.4 **GAUGE COCKS**

2.4.1 Use Trerice Type FFG No 735 needle valve of polished brass for 2100 kPa (300 psig) operating pressure, threaded both ends.

2.5 **VACUUM BREAKERS**

2.5.1 Use Spirax Sarco Type VS 15 mm (1/2″) thermostatic air vents.

2.6 **AUTOMATIC AIR VENTS**

2.6.1 Use Spirax Sarco Canada Type 13W, AWN-150, 1030 kPa (150 psig) float type air vents with semi-steel body and cap, stainless steel float, stainless steel valve seat and neoprene valve head.

2.6.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Hoffmann

2.7 WALL-FIN CONVECTORS

2.7.1 Use minimum 16 gauge steel casings complete with Series 40, 108 mm x 108 mm (4-1/4″ x 4-1/4″) aluminum fins on 32 mm (1-1/4") copper tube. Use sloped top, bottom inlet, stamped top outlet configuration. Coat casings with baked on primer and finish exterior surfaces with baked on enamel of Architect's choice from standard colour chart. See Equipment Schedule for capacities and details. Provide wall-to-wall cabinets where shown on the Drawings.

2.7.2 Provide manual air vents with all units. Chrome plate exposed vent assemblies.

2.7.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Engineered Air
Rittling
Sigma
Trane

2.8 RADIANT CEILING PANELS

2.8.1 Furnish Sigma linear radiant ceiling system consisting of panels of type, size and capacity shown on Drawings. Base panel capacities on 21°C (70°F) air temperature, 66°C (150°F) average water temperature and 71°C (160°F) entering water temperature. Use panel widths as shown on the Drawings.

2.8.2 Fabricate radiant panels from 1.52 mm (16 gauge) extruded aluminum with 12 mm (1/2″) copper tubing mechanically attached to the top of the panel. Secure the copper tubes with aluminum saddles extending minimum half way around the tubes and bond the tubes to the saddles with non-hardening heat conductive paste. Operating weight of panels is to be no more than 10.5 kg/m² (2.15 lb/ft²).

2.8.3 Factory finish with standard off-white paint.

2.8.4 Provide panel circuiting to match the end connection arrangements indicated on the floor plan Drawings. Panels to run wall to wall.

2.8.5 Furnish panels with 360° interconnecting loops and 180° return "U" bands as required to suit the arrangements shown on the Drawings.

2.8.6 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Airtex
Airtite
Frenger
Rittling

2.9 AUTOMATIC CONTROL VALVES AND OPERATORS

2.9.1 Contractor is responsible for the selection of control valves whose entire characteristics are suitable for the required application, including sizing, pressure rating, flow co-efficient, flow characteristics, close-off rating, fail position and allowable leakage factor.

2.9.2 Use only Belimo ball style control valves with stainless steel ball and stem and Teflon seals for sizes 12 mm (1/2″) through 50 mm (2″). Plug, globe or zone style control valves will not be acceptable. For larger valves, use Belimo globe style control valves. Ensure that straight-through water valves are single seated with qual percentage flow characteristics.

2.9.3 Use 3-way valves which are linear for each port giving constant total flow. On valves 50 mm (2″) and smaller, use screwed 1030 kPa (150 psig) bronze bodies. On valves 65 mm (2-1/2″) and larger, use flanged 860 kPa (125 psig) cast iron bodies. Size valves based on maximum 21 kPa (3 psi) pressure drop.

2.9.4 Use Belimo proportional action actuators. Size actuators to control valves against the maximum pump pressure or dynamic closing pressure, whichever is greater. Provide spring returns so that the valves "fail safe" in normally open or closed position as dictated by freeze, fire, or other temperature protection. Fail in place valves without spring return will be acceptable only for individual radiant ceiling panel control valves only. Spring return valves must be provided for all other services including individual convectors, etc.

2.10 **TEMPERATURE SENSORS, THERMOSTATS, FREEZESTATS AND FIRESTATS**

2.10.1 All room temperature sensors to be k OHM thermistors, with a suitable range to match the application. For hot water loop use RTD sensors. The accuracy to be ± 0.2°C maximum. All temperature sensors shall be mounted in an enclosure suitable for the application. Room temperature sensors in classrooms, offices and other regularly occupied rooms to be equipped with LCD display, limited setpoint adjustment and pushbutton for occupancy override. In change rooms, washrooms, corridors and regularly unoccupied rooms, use blank stainless steel coverplate style sensors. Sensors to be programmed not to display the room temperature.

2.10.2 Space sensors are to be located away from any direct influence from air diffusers or areas affected by drafts.

2.10.3 Sensor averaging elements are to be mounted in straight sections of duct, in serpentine fashion, equally spaced to provide adequate coverage of duct cross section to prevent stratification. Furthermore, sensor's installation must not present a safety hazard nor impede access to fan compartments.

2.10.4 All return and supply air temperatures to be sensed with duct-mounted sensors having a minimum probe length sufficient to reach the middle third of the duct space.

3 Execution

3.1 **PIPING**

3.1.1 **General**

3.1.1.1 Use flanges or unions on all piping connections to equipment.

3.1.1.2 Support all piping connected to isolated equipment with spring hanger supports for at least the first three support points.

3.1.1.3 Install all control valves, fittings, water temperature sensors and flow switches supplied by Section 15900 “Controls”.. See Section 15900 “Controls” for equipment supplied.

3.1.1.4 See Section 15001 “Mechanical General Provisions” Clause “Piping”.

3.1.2 **Water Piping**

3.1.2.1 Provide drain valves with hose connections at base of all risers, at all low points in piping distribution, and at low points on all equipment connections. Drain valves to be ball valves.

3.1.2.2 For upfeed take off top of pipe. For downfeed take off bottom of pipe.

3.2 **VALVES**

3.2.1 Unless specifically noted, shown or specified otherwise, shutoff valves may be either butterfly valves or ball valves. Do not use ball valves for sizes greater than 50 mm (2″). Where butterfly valves are required to isolate a piece of equipment, provide an extra set of flanges if necessary to allow removal or repair of equipment without disturbing valves.

3.2.2 Use line sized valves unless shown or specified otherwise.

3.3 **AIR VENTS**

3.3.1 Provide automatic air vents at all high points in piping system and at all points where piping drops to form loops.

3.3.2 Use manual air vents only where shown or specified.

3.3.3 See Detail Sheet included with Section 15001 “Mechanical General Provisions” for installation requirements.

3.4 **CONVECTORS AND RADIANT PANELS**

3.4.1 Make connections to elements with brass seated unions. Install a shutoff valve on each supply and combination shutoff and balancing valve on each return. Provide manual air vent. Provide and install 2-way control valve and temperature sensor. All wiring between control valve and sensor by Division 15. Locate control valves above accessible ceilings or behind access doors.

3.5 **ACCESS DOORS**

3.5.1 Provide access doors with quick fastening latches for access to all dampers, coils, thermostats, valves and any other concealed devices which require servicing.

3.6 **COMBINATION SHUTOFF AND BALANCING VALVES**

3.6.1 Provide water flow balancing valves and flow meters in all locations shown. Install in accordance with manufacturer's recommendations.

3.7 AIR AND WATER SYSTEM TESTING AND BALANCING

3.7.1 Cooperate with and assist the air and water testing and balancing company. See Section 15200, “Testing and Balancing”.

3.7.2 Change wire taps on individual heat pump units to allow for proper air balancing.

3.7.3 Be responsible for the initial alignment and tension of all fan pulleys and belts.

3.7.4 Provide any changes to fan drives, pulleys and belts as required to allow a proper air balance as recommended by the Testing and Balancing Company for equipment supplied under this Contract.

3.8 WATER TREATMENT SYSTEMS

3.8.1 Install all water treatment equipment as shown and in accordance with manufacturer's recommendations. Provide all necessary piping and accessories. See Section 15715, “Water Treatment”.

3.8.2 Mechanical Contractor to flush, drain, clean and refill heating system, provide bypasses, etc, as directed by Water Treatment Contractor. See Section 15001 “Mechanical General Provisions”.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 Provide pre-operational cleaning of hot water heating and heat pump loop water systems.

1.2.2 Provide chemical treatment systems for hot water heating and heat pump water systems.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause “Shop Drawings” for the following equipment and materials:

- all chemicals including MSDS (include in operations and maintenance manuals)
- pot feeders
- micron filters
- chemical feed tanks
- chemical feed pumps
- flow meters
- test cabinet

2 Products

2.1 **GENERAL**

2.1.1 Use chemicals and chemical feed equipment as supplied by Keytech Water Management, (800) 265-2772; Cell 519-630-4649, Attention Dave Denton (ddenton@keytech.ca).

2.1.2 The work of this project is to be performed only by skilled factory-trained technicians under the direction of experienced engineers, all of whom shall be properly trained and qualified for this work and who are employed directly by the firms listed above.

2.2 **PRE-OPERATIONAL CLEANING**

2.2.1 Provide an adequate quantity of cleaning solutions to thoroughly clean all new piping and associated equipment by removing sludge, oil, dirt and debris. Cleaning products to be used for cleaning and flushing of all new piping systems (excluding domestic water and drains). Cleaning and flushing procedure to be as per manufacturer's instructions and must be performed under the supervision of a manufacturer’s representative. Once cleaning is complete, provide a letter certifying that systems have been properly cleaned.

2.2.2 Ensure Mechanical Contractor provides temporary piping connections, bypasses and strainers as required for introduction of cleaning chemicals and removal of debris. Isolate boilers from cleaning chemicals.

2.3 **CLOSED WATER SYSTEMS**

2.3.1 Provide sufficient new system cleaner CSW 600 to initially clean the closed system.

2.3.2 Provide sufficient CSW 311 nitrite-based corrosion inhibitor to maintain required control levels in closed system(s) for a period of twelve (12) months after turnover. Control of system pH is critical - follow all instructions of boiler supplier.

3 Execution

3.1 **GENERAL**

3.1.1 Provide supervision and assistance during the installation, cleaning and startup procedures, and develop an appropriate water conditioning program to control corrosion, scale, algae and suspended solids. Arrange for the water conditioning company to instruct the operating personnel for a period of not less than one day duration before acceptance of the installation by the Consultant. Provide four copies of written operating instructions on the treatment dosages, control charts and test procedures.

3.1.2 Include a site visit twice a month by the treatment supplier for the first year's operation, to check operation. Conduct tests of all pertinent water treatment systems and submit a written report on same.

3.1.3 **Treatment Supplies**: Supply all chemicals required for initial cleaning and startup of the systems and a year's supply of inhibitor chemicals for normal operation.

3.2 **FLUSHING AND STERILIZATION**

3.2.1 Flush hot water heating and heat pump loops.

3.2.2 Flush water piping with water flowing at a velocity of not less than 1.8 m/sec (6 ft/sec) for a period of 15 minutes or longer as required to remove all dirt, scale, and cuttings from the entire length of the piping.

3.2.3 Thoroughly clean sections of new piping which cannot be isolated for flushing purposes, prior to fabrication, and also where possible after welding of joints, by swabbing the interior of the pipe with swabs soaked with a caustic solution to remove all loose scale, oil and dirt from the entire length of the piping.

3.2.4 Allow for all labour and chemicals for pipe flushing for each phase of construction. Coordinate all work with Piping Contractor.

3.3 **PRE-OPERATIONAL CLEANING**

3.3.1 Clean all hot water and glycol heating and heat pump piping.

3.3.2 Prior to chemical cleaning, inspect the systems to ensure removal of heavy debris and excessive oil or dirt. Install temporary strainers on the suction of each circulating pump. Where necessary, make provision for temporary connections between supply and return mains in the distribution system to permit circulation of the cleaning solution. Provide a 25 mm (1″) pipe connection on the suction side of the circulating pumps of each system for the admission of the cleaning solution.

3.3.3 Flush the systems to remove loose dirt and hydrostatically test to detect excessive water losses. Check rotation of all circulating pumps.

3.3.4 Fill the systems with water and cleaner at a 1% concentration, or as specifically recommended by the manufacturer. Circulate for 72 hours at a temperature between 21°C - 60°C (70°F - 140°F).

3.3.5 Drain systems, refill with fresh water and circulate for a minimum of four hours to flush out remaining chemical solution.

3.3.6 Following flushing, drain and refill systems with fresh, clean water. Adjust inhibitor levels to required concentrations.

3.3.7 Submit a report to the Consultant to certify that the systems are clean.

3.3.8 Allow for all labour and chemicals for pipe cleaning for each phase of construction and for final cleaning and fill. Coordinate all work with Piping Contractor.

3.4 **CLOSED WATER SYSTEMS**

3.4.1 Treat systems with corrosion inhibitor. Do this immediately after completion of pre-operational cleaning.

3.4.2 Install cartridges in the filters.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Exhaust Air Systems**: Various exhaust systems serve the building.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause “Shop Drawings” for the following equipment and materials:

- access doors
- duct sealer
- ductwork gauges, material and methods of support for each pressure type, shape (i.e. round, rectangular) and size range.
- exhaust fans
- flexible ductwork
- fire dampers
- grilles, registers and diffusers

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001 “Mechanical General Provisions”, Clause “Material and Equipment”.

2.2 **DUCTWORK**

2.2.1 **Standards**: Construct all ductwork in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Manual “HVAC Duct Construction Standards - Metal and Flexible”.

2.2.2 **Materials**: Unless specified otherwise, fabricate all ductwork from galvanized steel. Use SMACNA recommended thicknesses except where specified otherwise. Where aluminum construction is shown or specified, use utility grade aluminum.

2.2.3 **Rectangular - Low Pressure**: Use SMACNA 2″ W.G. pressure class. Use SMACNA recommended sheet metal thicknesses.

2.2.4 **Rectangular - Medium Pressure**: Fabricate according to current SMACNA standards for static pressures in duct up to 1490 Pa (6″ W.G.).

2.2.5 **Round - Medium Pressure**: Fabricate according to current SMACNA standards for static pressures in duct up to 1490 Pa (6″ W.G.). Use Alpha or Plascad spiral round ducts. Use machine formed fittings. Use conical type takeoffs. Where round ductwork is shown internally lined, use Alpha or Plascad acoustic thermal duct consisting of Alpha free-flow spiral duct lined with 50 mm fibreglass insulation and 28 gauge steel perforated interior liner.

2.2.5.1 Where round ductwork is exposed to view, a decorative grade installation is required. Arrange for special handling and shipping to avoid dents and minimize scratches.

2.2.6 **Flexible Type Round Ducts**

2.2.6.1 Where not exposed to view, use Thermaflex Type M-KC or FlexMaster equivalent insulated flexible duct with a woven fibreglass fabric core with a flame resistant coating permanently bonded to a coated wire helix. Minimum positive pressure rating of 4 kPa (16"w.g.) for sizes 100 to 250 mm (4 to 10 ″) and 2.5 kPa (10″ w.g.) for sizes 300 to 410 mm (12 to 16″). Insulate duct with minimum 40 mm (1-1/2″) thickness of 12 kg/m³ (0.75 lb/ft³) density fibreglass and bidirectional reinforced metallized film outer vapour barrier.

2.2.6.2 Flexible ductwork will not be permitted where exposed to view.

2.2.6.3 Flexible duct must bear ULC approval labels and conform to flame spread and smoke developed ratings as required by the Ontario Building Code.

2.3 **FIRE DAMPERS**

2.3.1 Use only dynamic type fire damper assemblies tested in accordance with CAN4-S112-M "Standard Method of Fire Test of Fire Damper Assemblies" and listed in most recent ULC "List of Equipment and Materials" or by another recognized independent testing and certification agency acceptance to the Consultant. Label each damper to indicate compliance with these requirements. Provide fusible links with a 70°C (158°F) rating unless noted otherwise on Drawings. Links shall comply with ULC-S505 "Standard for Fusible Links for Fire Protection Service". Fabricate all dampers from galvanized steel except in copper and aluminum duct systems. In these systems, use all stainless steel construction.

2.3.2 Provide damper assemblies whose fire protection ratings comply with Ontario Building Code requirements for the fire resistance ratings of the fire separations through which the protected openings pass. Provide an approval label, stating the fire rating, from a recognized independent testing laboratory acceptable to the Consultant, on each assembly.

2.3.3 For ducts with either face dimension of 300 mm (12″) or less, and for all medium pressure ducts, use low resistance type dampers with 100% free area.

2.3.4 Provide with each fire damper, detailed installation instructions. Include illustrations and adequate information to attain proper and safe installation of the fire damper assemblies.

2.3.5 The products of the following manufacturers will be considered equal, subject to the requirements of Clause "Material and Equipment":

Alumavent
EH Price
Nailor
Ruskin

2.4 INTERNAL DUCT LINING

2.4.1 Use Schuller/Manville “Permacote Linacoustic” fibreglass duct liner with air stream surface protected with “Permacote”, acrylic coating. Coating to be treated with anti-microbial agent so as not to support growth of fungus or bacteria as determined by ASTM G21 and G22. Liner to meet or exceed Life Safety Standards as established by NFPA 90A and 90B, have a NRC not less than 0.7, and a thermal conductivity of 0.36 W/m.K (0.0208 Btuh/ft/°F) at 23.9°C (75°F).

2.4.2 The following manufacturers of the above equipment will be considered as equal, subject to requirements of Clause “Material and Equipment”:

Knauf
Manson
Fiberglas

2.5 DUCT ACCESS DOORS

2.5.1 Use Nailor Industries Inc. 0800 Series duct access doors. For duct dimension up to 300 mm (12″) use 250 mm x 150 mm (10″ x 6″) door. For duct dimension up to 600 mm (24″), use 380 mm x 250 mm (15″ x 10″) door. For all larger ducts, use 660 mm x 510 mm (26″ x 20″) door.

2.5.2 For insulated ducts, use doors factory insulated with 25 mm (1″) thick fibreglass insulation.

2.5.3 The following manufacturer will be considered equal, subject to the requirements of Clause “Material and Equipment”:

Alumavent
Price
Nailor
Ruskin

2.6 FLEXIBLE DUCT CONNECTORS

2.6.1 Use Duro Dyne “Durolon” or Ventfabrics “Ventlon” pre-assembled flexible duct connectors with 150 mm (6″) fabric width.

2.6.2 The following manufacturer will be considered equal, subject to the requirements of Clause “Material and Equipment”:

Thorburn

2.7 GRILLES, REGISTERS AND DIFFUSERS

2.7.1 Use manufacturer of grilles, registers and diffusers shown in schedule on drawings. Provide types, accessories and finishes as noted in the Equipment Schedules. See Drawings for sizes.

2.7.2 The following manufacturers of the above equipment will be considered as equal, subject to requirements of Clause “Material and Equipment”:

Kreuger
Nailor
Price
Titus
Tuttle & Bailey

2.8 BALANCING DAMPERS

2.8.1 For ducts 930 cm² (144 in²) and less in cross sectional area, use single blade dampers with locking quadrant and pin on far side. For larger ducts use, multi-blade, opposed blade dampers with external operator and locking quadrant. Provide spacers to maintain clearance between duct and damper blades.

2.9 DUCT SEALER

2.9.1 Use Duro Dyne DSW water based high pressure duct sealer.

2.9.2 The following manufacturers of the above material will be considered as equal, subject to requirements of Clause “Material and Equipment”:

Childers
Multi-Purpose
3M Canada Inc.
United Sheet Metal

2.10 BIRDSCREENS

2.10.1 Use 12 mm x 12 mm (1/2″ x 1/2″) galvanized steel wire mesh mounted in reinforced steel frame.

2.11 EXHAUST AND TRANSFER AIR FANS

2.11.1 General

2.11.1.1 See Equipment Schedules for types, details and capacities.

2.11.1.2 Provide felt edged backdraft dampers on all systems which are not provided with automatic control dampers.

2.11.1.3 Size V-belt drives for 150% of motor nominal horsepower. Provide belt guards.

2.11.1.4 Use fixed drive pulleys on fans greater than 0.75 kW (1 hp). Use adjustable drive pulleys on fans 0.75 kW (1 hp) or less.

2.11.1.5 Use arrangement and motor location to suit fan location.

2.11.1.6 Use bearings of ball bearing type, grease lubricated. Provide extended grease fitting where required for easy access.

2.11.1.7 Use fan classification in accordance with A.M.C.A. Pressure Limitations. Use a minimum of Class I construction on all fans unless specified otherwise. Submit certified Fan Performance Curves and fan sound level ratings based on A.M.C.A. Standards to the Consultant with Shop Drawings.

2.11.2 **In-Line Fans (Drawing Reference TF)**: Use Panasonic direct-driven in-line type centrifugal fan. Use heavy gauge formed steel housing with duct mounting collars. Provide hanging brackets for spring isolators. Provide disconnect switch.

2.11.3 **Automatic Control Dampers and Operators**

2.11.3.1 Contractor is responsible for the selection of proper control dampers for the project, including sizing, pressure rating, flow co-efficient, flow characteristics, close-off rating and allowable leakage factor.

2.11.3.2 Use Tamco Series 1000 dampers. Use Series 9000 for outside air and exhaust air service. Equivalent Ruskin/Alumavent dampers will also be acceptable. Use opposed blade dampers for modulating service and parallel blade dampers for two-position service.

2.11.3.3 Blades on multi blade dampers not to exceed 200 mm (8″) in width and 1220 mm (48″) in length.

2.11.3.4 Use Belimo electronic, spring return, low voltage (24 VAC) operators with electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. Mechanical end switches or magnetic clutch to deactivate the actuator at the end of rotation are not acceptable. Provide endswitches where specified.

2.11.3.5 Proportional actuators to accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators to provide a 2 to 10 VDC position feedback signal.

2.11.3.6 Size operators to control dampers against the maximum fan pressure or dynamic closing pressure, whichever is greater. Provide spring returns so that the dampers "fail safe" in normally open or closed position as dictated by freeze, fire, or other temperature protection.

2.11.4 The following manufacturers of the above equipment will be considered as an equal, subject to requirements of Clause “Material and Equipment”:

Fan Tech

2.12 **TURNING VANES**

2.12.1 Use Rouane turning vanes as manufactured by S.E. Rozell and Sons Ltd. in all square elbows. Assemble vanes with Duro Vane Rail JVR-2 for 50 mm (2″) radius vanes spaced 38 mm (1-1/2″).

2.13 **BRICK VENT**

2.13.1 Use Greenheck, Model BVF or BVE, sizes as noted on the Drawings. Use model BVF for installation in existing walls and model BVE for installation in new walls. Construct using 40 mm (1-1/2″) deep, 45° drainable blade type louvres with storm stops. Use 3.0 mm (0.125″) louvre blades and 3.0 mm (0.125″) frames, fabricated from extruded aluminium. Provide square mesh insect screen on interior face of louvre. Architect to select colour.

2.13.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Ventex

3 Execution

3.1 **DUCTWORK**

3.1.1 **General**

3.1.1.1 Construct ALL ductwork located inside Mechanical Equipment Rooms to Medium Pressure duct standards. Unless specified otherwise, construct ALL other ductwork to Low Pressure duct standards. Construct all ducts designated on Drawings as round to Medium Pressure duct standards.

3.1.1.2 Fabricate and install ductwork in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Manual "HVAC Duct Construction Standards - Metal and Flexible".

3.1.1.3 Pay particular attention to Section 15001 “Mechanical General Provisions”, Clause “Cutting and Patching”. This will be strictly enforced on this project. Coordinate work with trades responsible for floor and wall construction to reduce difficulty of making tight seals.

3.1.1.4 Fabricate all ductwork to the clear inside dimensions shown on the Drawings. Where internal lining is specified, dimensions shown are inside insulation.

3.1.1.5 Do not suspend ducts from metal roof deck.

3.1.1.6 Make duct connections to fans and heat pumps with flexible duct connectors.

3.1.1.7 Install access doors for easy access to each damper, thermostat, coil, valve, or other concealed device which requires servicing.

3.1.1.8 Provide backdraft dampers where shown or specified.

3.1.1.9 Install fire damper assemblies in strict accordance with manufacturer's instructions provided with each fire damper. See Detail Sheet in Section 15001 for installation requirements where ducts are internally lined.

3.1.1.10 Install dampers and duct sensors as supplied by Section 15900, “Controls”.

3.1.1.11 Where ductwork has to be altered from dimensions shown due to construction conditions, use the same effective cross sectional areas, without exceeding a 4 to 1 aspect ratio. Carry out such changes at no additional cost to the Owner.

3.1.1.12 Install ductwork to maximize clear floor to ceiling heights.

3.1.1.13 Transitions are described in the direction of air flow. For converging transitions, use a maximum slope of 1 in 4 and, for diverging transitions, use a maximum slope of 1 in 7.

3.1.1.14 Paint interior of ductwork for at least 610 mm (24″) behind supply, return and exhaust grilles and registers with matte black paint so as to render ductwork invisible from occupied space. Do not paint ductwork which is internally lined.

3.1.1.15 Apply one coat zinc chromate primer over all welded surfaces.

3.1.1.16 If there is a conflict between the duct sizes shown on the floor plans and the duct sizes shown on sections, elevations or details, the floor plans will govern.

3.1.1.17 Install duct smoke detectors supplied by Division 16.

3.1.1.18 Seal all transverse joints, longitudinal seams and duct wall penetrations to SMACNA Seal Class A standards.

3.1.2 **Low Pressure - Rectangular Ductwork**

3.1.2.1 Fabricate and install according to current SMACNA standards. Use 2″ W.G. pressure class. Use SMACNA recommended sheet metal thicknesses. Fabricate with all flat surfaces wider than 450 mm (18″) either cross broken or transverse beaded, regardless of whether the duct is insulated, lined or bare.

3.1.2.2 Use elbows in the following order of preference:

3.1.2.2.1 Full radius elbows with inside radius equal to duct width.

3.1.2.2.2 Square elbows with turning vanes.

See Detail Sheets included with Section 15001 “Mechanical General Provisions”.

3.1.2.2.3 For duct takeoff to a single register, diffuser, grille or branch, use balancing dampers. Do not use splitter dampers. See Detail Drawing in Section 15001, “Mechanical General Provisions”.

3.1.2.2.4 Fabricate all duct fittings in accordance with Detail Drawings in Section 15001, “Mechanical General Provisions”. Provide all balancing dampers as shown on Details. These details apply to supply, return and exhaust air systems.

3.1.3 **Medium Pressure Ductwork**

3.1.3.1 Fabricate and install according to current SMACNA standards for 1490 Pa (6″ W.G.) pressure class.

3.1.3.2 **Round Ductwork**

3.1.3.2.1 Provide a decorative grade installation where ductwork is exposed to view, outside of Mechanical Rooms. Use satin coat finish, degreased and suitable for field painting without etching duct surfaces.

3.1.3.2.2 Make all joints in ductwork exposed to view using “Spiralmate” round duct connector system or equivalent.

3.1.3.2.3 Rotate spiral seams on duct-to-duct joints so that the seam provides a continuous helical pattern across the joint.

3.1.3.2.4 Fasten diffuser collars to duct using pop rivets. Provide a finishing filet of elastomer seal at the collar-duct junction.

3.1.3.2.5 Space hangers at equal intervals. Fasten hangers to duct system using ring collars as shown on the Drawings.

3.2 FLEXIBLE DUCTS

3.2.1 In lieu of the solid duct connections shown, flexible ducts may be used to connect diffusers to duct runouts.

3.2.2 Length of flexible duct must not exceed 1.8 m (6′) and maximum one 90º elbow will be permitted. Use hangers and supports to ensure duct does not sag. Make all duct connections using Duro-Dyne FT-2 high fibreglass tape, sheet metal screws, and Duro-Dyne S-W high pressure duct sealer. Installation to be UL Listed treatment as published by the manufacturer.

3.3 INTERNAL DUCT LINING

3.3.1 Install lining in accordance with liner manufacturer's published recommendations and SMACNA "HVAC Duct Construction Standards - Metal and Flexible". Use both adhesive and welded pin mechanical fasteners. Select pin lengths to limit insulation compression to 3 mm (1/8″). Butter butt joints with a fire resistant coating and extend 50 mm (2″) on either side of joint to stop air from lifting insulation. Repair liner surface penetrations with adhesive meeting ASTM C919. Pins must be welded to duct.

3.3.2 Internally line ducts where shown on Drawings. Use 25 mm (1″) thickness, unless designated otherwise.

3.3.3 Where plenums are not specified, internally line outside air intake ducts with 37 mm (1-1/2″) thickness. Finish with two 3 mm (1/8″) thick coats of asphalt or vinyl mastic. Apply glass reinforcing fabric between coats. Lap joints by 100 mm (4″).

3.4 GRILLES, REGISTERS AND DIFFUSERS

3.4.1 Cooperate on the job with other trades so that grilles, registers and diffusers do not conflict with lights, etc. Bring any conflict between grilles, registers and diffusers and the work of other trades to the attention of the Consultant before any ductwork is installed. See Architect's reflected ceiling plan for location of grilles, registers and diffusers.

3.4.2 Install frame for each grille, register and diffuser to suit the type of building construction.

3.5 FLEXIBLE DUCT CONNECTORS

3.5.1 Make all duct connections to fans, heat pumps and fluid cooler with preassembled duct connectors.

3.6 TESTING AND BALANCING

3.6.1 Cooperate with the Testing and Balancing trade. See Section 15200, “Testing and Balancing”. Make any changes deemed necessary by the Testing and Balancing trade to permit proper testing and balancing of the systems.

3.6.2 Provide additional balancing dampers where required by the Testing and Balancing Company.

3.6.3 Be responsible for the initial alignment and tension of all fan pulleys and belts.

3.6.4 Provide any changes to fan drives, pulleys and belts as required to allow a proper air balance as recommended by the Testing and Balancing Company for equipment supplied under this Contract.

3.7 DUCT LEAK TESTING

3.7.1 Duct leakage tests are specified in Section 15200, "Testing and Balancing".

3.7.2 Cap and seal ducts for the test sections as directed by the Testing and Balancing trade. Provide all necessary fittings and duct connections as required for the leak testing procedure.

3.7.3 Ensure all required duct access doors are installed before tests are started.

3.7.4 Immediately correct defects discovered during test and arrange for retesting until satisfactory results are obtained.

END OF SECTION

INDEX - SECTION 15900

PART 1 - GENERAL

PART 2 - PRODUCTS

PART 3 - EXECUTION

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1 General

1.1 **CASH ALLOWANCE**

1.1.1 The work of this section is included in a Cash Allowance. Conform to the requirements of Section 15001, "Mechanical General Provisions".

1.1.2 For the work of this Section, use only Durell. Contact Gary Vieira at (519) 652-5502.

1.1.3 The work of this project is to be performed only by skilled factory-trained technicians under the direction of experienced engineers, all of whom shall be properly trained and qualified for this work and who are employed directly by the firms listed above.

1.2 **SCOPE OF WORK**

1.2.1 Provide an electronic/electric, direct digital control (DDC) system to make the mechanical and electrical systems controls completely operational.

1.2.2 **General Description of System Architecture**: DDC system shall incorporate a system interface panel and primary (master) control panel to be located in the penthouse mechanical room, complete with necessary interface hardware and software to allow communication over the intranet via Web Browser using TCP/IP protocol. Provide a UPS for the interface panel and primary control panel to condition power and provide 20 minutes of uninterrupted power to avoid loss of communication during temporary power outage. The UPS shall be Power Ware Model3115 420-650-Va. The UPS and all DDC equipment shall be powered through dedicated circuit(s) from the nearest power panel. The primary panel shall communicate to field panels and terminal equipment controllers through a vendor supplied Local Area Net work(LAN). All controllers shall be capable of standalone operation on loss of communication with the primary panel and/or the interface panel. The interface panel's sole purpose shall be the conversion of controller communication to TCP/IP - no points shall reside on this panel.

1.2.3 Coordinate installation of an ethernet connection to school's server with the Owner's IT Department. This connection to be used to connect to School Board's WAN system.

1.2.4 Supply for installation by others, the following:

- Wells for temperature sensors
- Control valves
- Control dampers

1.2.5 The Controls Subcontractor is responsible for arranging, coordinating and supervising the installation of the above devices in a suitable manner and location.

1.2.6 Wire components of temperature control system in accordance with the requirements of Division 16. Include wiring between control components and electrical circuits of fans, pumps, and any other equipment or apparatus as indicated in this section or required for the proper functioning of controls as described in this section. Provide necessary transformers, relays, etc. to accomplish specified control function. All controls provided by this Section to be wired by this Section.

1.2.7 Provide a minimum of 10% spare points of the total available points, for each type of point, for future use. If each point shall necessitate an addition of a circuit card inside the panel, the necessary additional cards for the installation of these 10% of spare points shall be handed over to the Owner. These cards shall be new and exempt of any manufacturer's defects and be compatible for each type of point.

1.2.8 Controls Contractor must attend site meetings every other week.

1.2.9 Remove all redundant control systems in areas of work. Turn over existing controllers to SCCDSB.

1.2.10 Where existing systems are modified, the existing control system serving these systems should be updated to provide control of these new components to provide a fully functional and independent existing control system.

1.3 COMMISSIONING

1.3.1 Commission the entire system as described in Section 15990, "Building Control System Commissioning". Work is to be performed only by skilled factory-trained technicians under the direction of experienced engineers, all of whom shall be properly trained and qualified for this work and who are employed directly by the firms listed above.

1.4 SHOP DRAWINGS AND SUBMITTALS

1.4.1 Controls Contractor must submit a list of schedule milestones with the project shop drawings, indicating phasing of controls installation, e.g. at substantial completion of mechanical room piping, controls contractor requires X additional days for terminations, testing and commissioning, etc.

1.4.2 Direct Digital Control System Hardware

1.4.2.1 A complete bill of materials of equipment to be used indicating quality, manufacturer, model number, and other relevant technical data.

1.4.2.2 Manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for the items listed below and other relevant items not listed below:

Direct Digital Controller (Controller panels)
Transducers/Transmitters
Sensors (Including Accuracy Data)
Actuators
Control Valves
Control Dampers
Switches

1.4.2.3 Wiring Diagrams and layouts for each control panel. Show all termination numbers.

1.4.2.4 Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware.

1.4.3 **Central System Hardware and Software**

1.4.3.1 Complete Bill of material and equipment used, indicating quantity, manufacturer, model number, and other relevant technical data.

1.4.3.2 Schematic Diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers model numbers and functions. Show all interface wiring to the control system.

1.4.3.3 Riser diagrams of wiring between central control unit and all control panels.

1.4.4 **Controlled Systems**

1.4.4.1 A complete description of the operation of the control system, including sequences of operation. The description shall include a reference to the schematic diagram of the controlled system.

1.4.4.2 A point list for each system controller including both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, and the location of the I/O device. Software flag points, alarm points, etc.

1.4.5 **Maintenance Data**

1.4.5.1 In addition to requirements specified in 15001 “Mechanical General Provisions”, upon completion of the work, the control manufacturer shall provide three sets of Maintenance Data to the Mechanical Contractor for inclusion in Project Maintenance Manuals and affix a fourth, plastic coated set near or at the appropriate control panel. Maintenance Data to include the following:

1.4.5.2 Copies of the complete, approved, Shop Drawings

1.4.5.3 Copy of the Electrical Safety Final Inspection Certificate

1.4.5.4 Project Record Drawings

1.4.5.5 As-built versions of the submittal Shop Drawings

1.4.5.6 Operations Manual with procedures for operating the control systems, including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables

1.4.5.7 Licences, guarantees, and warranty documents for all equipment and systems.

1.5 **ACCEPTANCE PROCEDURES**

1.5.1 Upon completion of the system, the Controls Contractor to indicate in writing to the Consultant that the acceptance procedure can commence.

1.6 **TRAINING**

1.6.1 Provided training to the Owner's designated representatives. Training to cover the complete operation of the Building Control System. These representatives to be at the following levels of technical expertise:

- Custodian
- Maintenance Mechanical Trades
- Maintenance Controls Trade
- Central Control System Operator

1.6.2 The instruction to consist of both hands-on and classroom training at the site.

1.7 **WARRANTY**

1.7.1 All controls, equipment and material to be unconditionally warranted for a period of one years from the date of Substantial Completion. The warranty period is to commence on the date of Substantial Completion.

1.7.2 Provide warranty service at no cost to the Owner for the warranty period. This to include, but not limited to the following:

- Emergency repair service on regular working hour basis during warranty.
- Replacing defective parts and components as required.
- Servicing by factory trained and employed service representatives of system manufacturer.

1.8 **WIRING, CONDUIT AND CABINETRY**

1.8.1 All of the installation requirements, be they temporary or permanent, to comply with the Canadian Electrical Code and all local and Provincial codes.

1.8.2 For future expansion purposes, the Contractor to ensure that wires are available in all conduits to accommodate the addition of possible future points to maximum capability of panel.

1.8.3 The Contractor to supply, install and connect all conduits, boxes and wiring between the different components related to the Control System, including all required line voltage to the equipment. All power to be from appropriately sized dedicated circuits from the nearest electrical panel with space provided by the Contractor. Circuits to be identified inside each control panel and on Shop Drawings using the same code. Provide circuit breaker lock-offs and clearly mark breaker(s) with "BCS".

1.8.4 All high voltage wiring, 50 volts or more, to be a minimum of #12 gauge copper stranded TNN, run in conduit. All low voltage wiring, less than 50 volts, to be a minimum of #18 gauge copper stranded TEW-105.

1.8.5 All signal and communications wiring for the local field panels to be multi conductor, shielded twisted pairs, with ground drain wire. All drain wires to be grounded at the panel end. The other end to be protected from grounding with a dielectric material/electrical tape.

1.8.6 If wiring picks up unwanted noise, correct problem by replacing or rerouting wire at no additional expense to the Board.

1.8.7 Wiremold and/or raceway may not be used unless specifically approved by the Consultant and as specified in Division 16100.

1.8.8 FT6 wiring is to be acceptable in all rooms except Mechanical and Electrical Rooms, and exposed areas (refer to reflected ceiling plans). Wiring to be installed parallel to building lines or approved by the Consultant. In areas where cable tray or other raceway has been provided by other trades for communications, coordinate with other trade and locate wiring in raceway.

1.8.9 Use thin-walled Electrical Metallic Tubing (EMT) conduit complete with T & B 5120 Series watertight steel ring couplings and connectors in all Mechanical Rooms and Electrical Rooms, and set screw connectors and couplings in all other exposed installations in finished areas. OZ/Gedney 7000 Series/Crouse Hinds 600 Series equals.

1.8.10 Flexible conduit to be used only in areas where vibrations and/or expansion joints are present. The length of any run of flexible conduit not to exceed 2 m.

1.8.11 All conduit to be supported at least every 1.525 m, and in accordance with the Ontario Electrical Safety Code. Supports to also be located at all connectors along the length of the conduit.

1.8.12 In damp or weather exposed areas, the conduit and related equipment to be suitable for the application.

1.8.13 All conductors to be continuous from device to panel.

1.8.14 High and low voltage wire to not be run in the same conduit.

1.8.15 Sensor, power and control wiring to be run in separate conduit.

1.8.16 Where wiring penetrates fire separation, use firestop sealant to maintain fire wall ratings.

1.9 PULL BOXES AND JUNCTION BOXES

1.9.1 All boxes to comply with the Canadian Electrical Code in reference to size, capacity, etc.

1.9.2 All boxes to be fabricated of galvanized metal, unless otherwise warranted.

1.9.3 A pull box to be located every 30 m. The Contractor is responsible for the location and for obtaining any required approvals from the Consultant.

1.9.4 In suspended ceilings, all boxes to be installed on the structure.

1.9.5 All boxes to be clearly marked with "BCS" as part of the energy management system.

1.10 WIRING IDENTIFICATION

1.10.1 The two extremities of all wiring to be identified using the same code and cross referenced to the Record Drawings.

1.10.2 The terminal strips to be numbered. All Drawings to show wire identification codes and terminal numbers.

1.10.3 The identification to be done using plastic ring or band type. Paper with adhesive backing or Type C plastic labels are not acceptable.

1.10.4 The following colour code to apply to all wiring:

Power	
White	Neutral
Red, Yellow, Blue	Phase leads
Black	Switch travellers, for single pole switched circuits, the phase colour shall be carried through the switch to the outlet.

1.10.4.1 All ground wiring to be green.

1.10.4.2 All 24 VAC wiring to be brown - load side; yellow - neutral side of transformer.

1.11 **NAMEPLATES**

1.11.1 Identify each piece of equipment and panel with nameplate identifying equipment and functions in plain English, using the local naming convention.

1.11.2 Use laminated plastic nameplates of at least 75 mm x 25 mm x 3 mm (3″ x 1″ x 1/8″) with black face and white centre and 6 mm (1/4″) high engraved lettering. To be securely attached to equipment by screws. Dymo tape name tags are not acceptable. Provide black phenolic nameplates engraved with white letters for all electrical equipment, panels, disconnect switches, etc., as directed.

1.11.3 Identify motorized equipment as follows:

Pumps	Pump 301, etc.
Heat Pump Units	HP-401, etc.

1.11.4 Identify the motor, starter and branch circuit breaker and disconnecting means.

1.11.5 Index terminal strips and tag wires. Label exposed junction boxes including function and nature of service. Tag all wires within the junction boxes including purpose and nature of service.

1.11.6 Use self adhesive strip or clip on style plastic markers for wire tags. Secure tags to each individual wire at both ends.

2 Products

2.1 **CONTROL ELEMENTS**

2.1.1 **Controllers**

2.1.1.1 For each heat pump, etc. as required, provide a unitary controller module complete with mounting enclosure.

2.1.1.2 Provide individual local control panels to control fluid cooler, air handling equipment, boilers, pumps, rooftop unit and all other equipment.

2.1.2 **Relays and Contactors**

2.1.2.1 All interfacing/control relays and contactors to be sized to match the application. Low voltage coils to be used wherever possible, except where it is financially beneficial to use high voltage coils.

2.1.2.2 Mount interfacing relays in control cabinets, where possible. Do not locate relays within electrical starter enclosure. If necessary, use separate enclosure to house interface relays.

2.1.2.3 Contactors to be equipped with auxiliary contacts wherever such status indication is required.

2.1.2.4 All contactors are to be mounted in a NEMA 1 cabinet, enclosing contactor, transformer, protection, etc.

2.1.3 **Current Sensing Relays:** All equipment status monitoring to be accomplished though the use of a current monitoring sensor. This device should output a 4-20 mA or 0 - 10 V signal proportional to measured current. Provide sensors to monitor status of all new electrically driven, mechanical equipment. (Include all new unit ventilators, fans, pumps and rooftop units). Wire to the BCS.

2.1.4 **Integral Thermostatic Control Valve**: For all heating units shown on the Drawings with integral thermostat, use Tour and Andersson or Honeywell TRV, self-acting thermostatic valve. Use direct-mounted valves with locking device for high and low limit settings. Use valves with remote adjustment and capillary tube where shown on Drawings.

2.1.5 **Differential Pressure Sensors**: Use Rosemount or Veris self-contained strain gauge type sensor with reverse polarity protection, NEMA 4 enclosure, accuracy ± 0.25% of calibrated span.

3 Execution

3.1 **GENERAL**

3.1.1 Use competent tradesmen regularly employed by the manufacturer of the control equipment to install control system.

3.1.2 Unless noted otherwise, mount all room sensors and thermostats at 1200 mm (47″) above floor or in the classroom control module.

3.1.3 DDC controller to be mounted in same room as equipment being controlled. Where this is not practical, provide a communication interface at equipment location for communication to DDC panel. Provide Points List on inside of DDC panels.

3.1.4 Nomenclature in DDC programming to match Control Shop Drawing nomenclature. DDC panels to be labelled as per Shop Drawings.

3.1.5 Provide a copy of all graphical interfaces to Consultant for review at completion of programming.

3.1.6 Remove all redundant controls and return control components to the Owner.

3.2 **WIRING**

3.2.1 Conceal wiring in all finished areas.

3.2.2 Provide an installation which follows horizontal and perpendicular lines to fit into the layout of the area. Properly support and install in a neat and workmanlike manner throughout.

3.3 **NAMEPLATES**

3.3.1 Install nameplates at all duct mounted devices including transmitters, controllers, gauges, etc. Similarly label manual switches, unless they are delivered with standard nameplates.

3.4 **CONTROL PANELS**

3.4.1 Mount all equipment inside the cabinet. Mount a plasticized "as-built" control diagram for water system, complete with control piping and wiring layout, on the face of door section. Locate panels in main Mechanical Rooms. Do not locate in ceiling spaces.

3.5 **ELECTRICAL WORK**

3.5.1 Provide all wiring from power supplies to valves, dampers, thermostats, sensors, etc., and all necessary control transformers and relays required for the control system. Provide power from nearest panel.

3.5.2 Coordinate electrical requirements with the electrical trade. Arrange and pay for any modifications necessary to complete the work of this section.

3.5.3 Provide all necessary control wiring for equipment specified under Division 15.

3.5.4 Conceal all wiring. Install wiring in conduit within block walls. In unfinished areas exposed to view, install wiring in conduit. Tie-wrap fire-rated cable elsewhere. Wire in accordance with Division 16 requirements.

3.6 **DDC CONTROL SYSTEM**

3.6.1 Vendor's representatives to install complete control system providing adjustment of all controlled systems.

3.6.2 Vendor's representatives to provide full startup, calibration and commissioning of complete system. Connect all mechanical equipment in accordance with the Specifications.

3.7 **PERFORMANCE VERIFICATION**

3.7.1 Provide verification check sheets for all new control points and all associated control sequences. This work must be done, submitted and approved by the consultant prior to the commissioning agent being engaged and final payment being released. The approved reports are to be included in the maintenance manuals.

3.7.2 Verification check sheets for each piece of equipment must contain list of all control points associated with this piece of equipment. Proper operation of each sensor, actuator, terminal unit, or any other control point must be confirmed in the field by direct observation (if possible) and through the graphical user interface. Each verification sheet must be dated and signed by controls contractor.

3.7.3 Setup and verify trends for all new equipment and all control points. Provide trend verification sheets and sample sheets indicating trended points for consultant's approval

3.7.4 One month after these checks and commissioning are complete, setup a meeting with mechanical contractor, Owner and consultant to confirm the operation of all new equipment. At this meeting all trends will be reviewed and confirmed with the Owner. Prior to the meeting the Controls contractor will be required to provide trend graphs or numerical data in Excel spread sheet form, for all monitored systems for the last month of operation. If numerical data is provided the date/time data must follow Excel formatting.

3.7.5 Controls contractor will be responsible for correcting of all deficiencies found during this process and will be required to submit trends to verify operation of all equipment after making corrections.

3.8 EXISTING BUILDING CONTROL SYSTEM

3.8.1 A complete new control system is to be provided for the school. Refer to paragraph 1.2.1. All existing equipment currently connected to the BAS which is not replaced as part of this contract, must be reconnected and controlled by the new BCS in identical fashion to existing. Remove all existing redundant controls and components. This includes boilers and associated circulating pumps.

3.9 ROOFTOP MAKEUP AIR UNIT (Drawing Reference RTU-101)

3.9.1 System Description

3.9.1.1 This is a constant volume 100% outside air system which includes a rooftop air handling unit with modulating natural gas heating and modulating electric dx cooling. The unit provides tempered ventilation air to heat pumps throughout the Phase 1 area.

3.9.1.2 This air system will be enabled for operation during scheduled occupied hours.

3.9.1.3 The unit includes variable refrigerant flow DX cooling, for modulating control of cooling capacity and high cooling efficiency. Because of the increased complexity of this system, the units have limited ability to accept external control signals. Most functions will be controlled by the onboard controller, with BCS monitoring through BACnet MSTP.

3.9.2 Control Devices

3.9.2.1 Provide a dedicated unitary controller for each rooftop air handling unit. Connect to a terminal strip provided within the unit.

3.9.2.2 The following terminals will be provided by the unit manufacturer for BCS control:

- unit enable/disable digital input
- outside air damper minimum position analog input
- supply air temperature setpoint analog input

3.9.2.3 The following terminals will be provided by the unit manufacturer for BCS monitoring:

- alarm status digital output

3.9.2.4 Provide BCS supply air discharge and return air dry bulb temperature sensors and relative humidity sensors. Locate these sensors within the building in the ductwork, with the supply air temperature sensor just upstream of the first branch takeoff. These sensors are in addition to the sensors supplied with the unit and wired back to the unit controller. These points will still be displayed on the graphic in the event of loss of BACnet MSTP communications with the unit.

3.9.2.5 Provide current sensors for supply fan, energy recovery wheel motor and each of the cooling compressors. Monitor status and display on the graphic.

3.9.2.6 Each unit will be provided with a BACnet communications module. Coordinate with section 15600. Connect to it and map relevant points to the BCS for BCS monitoring. Allow for mapping of up to 80 BACnet points per unit. Consultant will provide a list of points to be mapped. Approximately 30 of these points indicate temperatures, operating modes, equipment speeds or status and are to be shown on the graphic. The remaining points are for fault indication and are to be annunciated to the BCS on activation.

3.9.2.7 A supply air temperature sensor and other sensors will be provided with the rooftop unit. Install the sensors as instructed by the rooftop unit manufacturer and connect them to the unit onboard controller.

3.9.2.8 Provide an analog differential pressure sensor for the filter rack.

3.9.3 **Schedule and Startup**

3.9.3.1 Schedule occupied/unoccupied operation of unit.

3.9.3.2 Operate the supply fan continuously during occupied hours for provision of ventilation air.

3.9.3.3 At all other times the unit is to be off.

3.9.3.4 Provide adaptive optimum start/stop sequence for each unit.

3.9.3.5 Through the graphical interface provide an individual Event Mode button to allow the Operator to override the schedule and program in events. During event mode, the system is to enable the “Occupied Day Mode” for the entire scheduled event. Return the room to occupied space temperature setpoints starting one hour (adjustable) prior to the start of the event.

3.9.4 **Occupied Mode Air Temperature Control**

3.9.4.1 Provide a 2.5°C (5°F) deadband between heating and cooling operation, as required by ASHRAE 90.1. Provide adjustable heating and cooling setpoints.

3.9.4.2 The unit will modulate the economizer dampers, VRF cooling and natural gas fired heating in sequence to maintain its supply air discharge temperature setpoint. Operate energy recovery wheel continuously during occupied mode except for during economizer operation. Provide the supply air discharge temperature setpoint to the rooftop unit controller through the terminal. The supply air discharge temperature setpoint minimum is 15°C (59°F).

3.9.4.3 Reset the supply air discharge temperature setpoint to satisfy the average space temperature sensor values. Maximum permitted supply air temperature during occupied hours is 29°C (85°F).

3.9.5 **Safeties and Miscellaneous Controls**

3.9.5.1 Use the BCS supply air discharge temperature sensor for low limit protection. Stop the fans, close the dampers and alarm to BAS if supply air temperature falls below 4°C (40°F) (adjustable from graphic).

3.9.5.2 Use the BCS return air temperature sensor to stop the supply fan if the return air temperature exceeds 57°C (135°F).

3.9.5.3 Monitor differential pressure drop across the filter bank. Display filter pressure drop on graphic and alarm when pressure drop exceeds filter change setpoint. Initial setpoint to be 250 kPa (1.0″w.c.).

3.9.6 **Graphic Display**

3.9.6.1 Provide graphic display of air handling unit and equipment internal components such as supply fan, dampers, cooling stages, temperatures, status points, energy recovery wheel, etc. Display must include all monitored and controlled functions, sensors, etc, with all alarms shown and all setpoints easily adjustable.

3.9.6.2 Include a button on the graphic which displays a unit specific summary of how the unit is controlled. This summary is to include the description of operation presented at the start of this control sequence. This summary is to be displayed on the screen beside the unit graphic, so that both can be viewed at the same time.

3.10 **HEAT PUMPS**

3.10.1 For each heat pump, provide a room temperature sensor and a unitary controller. Locate room temperature sensor in classroom control module or on wall, as shown on Drawings. Connect to occupancy sensor in room. Occupancy sensor will be provided by Division 16.

3.10.2 Provide all sensors, relays, transformers and interlocks required for operational sequences described below. Power wiring will be provided by Division 16. “Fan”, “Cool” and “Heat” digital inputs and “Alarm Status” digital outputs will be provided by the unit manufacturer on a labelled terminal strip. Provide supply air temperature sensor and supply fan current sensor for each heat pump.

3.10.3 In addition to points above, the following are to be visible from the BCS: fan status, supply air temperature, heat or cool command. Certain heat pumps have two stages of heating/cooling. Coordinate with section 15600. Alarm to BCS on high or low space temperature, fan failure, or heat pump general alarm.

3.10.4 Provide remote reset from the BCS. Coordinate with the heat pump manufacturer.

3.10.5 Program an individual operational schedule for one zoned groups of heat pumps which will enable occupied mode operation. Zones are: Classrooms. Connect each heat pump to classroom occupancy sensors provided by Division 16. Use signal from occupancy sensor to start occupied mode operation when enabled by schedule. Override schedule when temperature sensor pushbutton is activated.

3.10.6 **Occupied mode:** Operate fan continuously and cycle stages of heating and cooling to maintain occupied mode space temperature setpoint.

3.10.7 **Unoccupied mode**: For scheduled unoccupied hours or when there is no occupancy sensed, cycle the fan and stages of heating as required to maintain unoccupied mode space temperature setpoint.

3.10.8 A two position two way control valve will be provided with each heat pump by Section 15600. Control valve is to open prior to compressor operation. Connect control valve wiring harness to manufacturer's terminal strip.

3.10.9 Where supplemental perimeter heating is provided in rooms served by heat pumps, such as radiant panels or wallfin convectors, use perimeter heat as first stage of heat during occupied hours. During unoccupied hours, use heat pump to be first stage of heating.

3.11 **FLUID COOLER**

3.11.1 Provide local controller and contactors to control the operation of the fluid cooler fan motor and spray pump. Variable frequency drive will be provided by Division 16. Connect to drive and provide analog output signal for fan speed. Connect to pump starter and start and stop pump. Provide fluid cooler intake air dampers and actuators. Connect to fluid cooler exhaust air damper actuator.

3.11.2 Provide fluid cooler entering water temperature sensor and leaving water temperature sensor. Locate the leaving water temperature sensor as close to the fluid cooler outlet as practical.

3.11.3 On a fluid cooler entering water temperature rise to 32°C, open the fluid cooler inlet and discharge air dampers. On a rise to 34.5°C, start the spray pump. On a rise to 37°C, start the fan at minimum speed. Modulate the fan speed as required to maintain 37°C setpoint (adjustable) entering the cooler. On a fall in loop temperature, reverse the sequence at 2°C differential below the above specified operating points. If the cooler leaving water temperature rises above 37°C, alarm to the BCS. Ensure entering water temperature is used for cooling control, as required by the Owner.

3.11.4 When outside air temperature is below 5°C, do not enable fluid cooler spray pump operation, fluid cooler damper operation or fluid cooler fan operation. Water level controls for the sump are provided with the fluid cooler and are to be installed by this Section.

3.11.5 Provide all control wiring for chemical feed system.

3.11.6 Provide independent enable/disable schedule for fluid cooler operation.

3.12 **HEAT PUMP LOOP**

3.12.1 Provide three way control valve and actuator. Provide current sensors for pumps. Provide a flow switch for the heat pump water loop, located downstream of CP-302A+B. Provide heat pump supply water temperature sensor, located no farther than 1m from the heating injection tee.

3.12.2 Modulate the three way control valve to maintain 21°C heat pump supply water temperature setpoint (adjustable). Operate one of the heating pumps CP-303A+B whenever the control valve is open. Operate one of the heating pumps CP-304A+B constantly during the heating season, whenever the heating system is enabled. Ensure supply water temperature is used for heating control, as required by the Owner.

3.12.3 If the heat pump loop temperature drops below 13°C, as measured by any of the loop temperature sensors, alarm to the BCS.

3.13 **BOILERS**

3.13.1 The existing boiler plant is to remain. Provide all required wiring and controllers to maintain existing operation and to enable full control through building control system.

3.13.2 Provide temperature sensors, flow switches, application controller, relays, etc., for a fully operational system. Provide temperature sensors for system hot water entering and leaving temperatures and leaving water temperature for each boiler. Provide current sensor for each boiler pump and for perimeter heating pump and monitor status. Perimeter heating pump will be started and stopped manually. Boiler pumps will be started and stopped by Boiler controller. Provide supply and return temperature sensors for perimeter heating. Monitor individual boiler alarm status.

3.13.3 The heating system to be switched ON/OFF automatically by BCS or manually by the building's operator. Once enabled, the boilers to operate by direct digital control in parallel with their own operating and limit controls.

3.13.4 Boilers should be switched from lead to lag every other Tuesday at 6:30 am. Should the lead boiler fail, the next boiler in sequence will become the lead boiler. The minimum ON time for the lead boiler should be set to 10 minutes (adjustable). The boilers should be disabled by the BCS when the outside air temperature is above 18°C (adjustable).

3.13.5 When the heating is to be switched OFF, boilers should be stopped. The associated boiler’s circulation pumps through a hard wired time delay relay will remain on for five minutes after heating is no longer required.

3.13.6 When lead boiler starts from the outside air temperature setting, lock out the lag boiler for 20 minutes (adjustable). When the hot water supply temperature (HWS) is more than 2.5°C below hot water setpoint, the lead boiler to be enabled at low fire and then cycled on high fire (in accordance with manufacturer's recommended algorithm) to maintain the system HWST setpoint. When the lead boiler is on high fire, after a three minute delay, start lag boiler if the (HWST) is more than 8.5°C

(adjustable) below setpoint.

3.13.7 The lag boiler should be stopped when the hot water supply temperature (HWS) is more than 2°C (adjustable) above the setpoint. The lead boiler should be stopped if the hot water supply temperature is more than 5°C (adjustable) above the hot water setpoint.

3.13.8 The outside air temperature shall reset the heating water supply temperature setpoint (HWS-SPT) as per the following schedule:

O.A. TEMP	HOT WATER SUPPLY SETPOINT
-20°C	71°C
15°C	32°C

3.13.9 During the morning warmup period, should the heat pump loop fall more than 3°C (adjustable) below setpoint with the heat exchanger control valve open, temporarily and gradually raise the hot water supply setpoint, to a maximum of 71°C, until the heat pump loop temperature is achieved. Hold this temperature setpoint for a minimum of 30 minutes (adjustable). If heat pump loop temperature setpoint is achieved at this point and heat exchanger control valve is less than 90% open, return heating loop to normal reset schedule operation.

3.13.10 Wire all flow switches, low limits, boiler control panel, safeties, etc., required with the boilers.

3.14 PUMPS

3.14.1 Provide graphical interface indicating Start/Stop and Status points for all circulating duplex pumps. Provide status for single pumps. Schematics indicate how many of parallel pumps operate at the same time. For parallel pumps where only one pump operates, alternate pump operation on a weekly basis. Should one pump fail, alarm to BCS and start other pump.

3.14.2 Provide enable/disable for variable speed pumps CP-302A&B and CP-305A&B. Provide and install differential pressure sensors where shown on the Drawings. Coordinate control settings with Section 15200 - Testing and Balancing. Output pump speed to variable frequency drive in order to maintain differential pressure setpoint. Monitor variable frequency drive status. One pump runs at a time. Periodically alternate lead pump. Should one pump fail, alarm to BCS and start lag pump. Provide graphic display of all monitored and controlled functions, including all alarms, individual pump status, setpoint and speed.

3.15 HEAT EXCHANGER

3.15.1 Provide a water temperature sensor on supply and return piping on heated media side. Provide a water temperature sensor on supply and return piping on heating media side. Display heating media supply temperature as measured by hot water heating system supply temperature sensor.

3.16 FORCE FLOW AND UNIT HEATERS

3.16.1 Provide wall thermostat and cycle fan to maintain space temperature setpoint.

3.17 **CONVECTORS AND RADIANT PANELS**

3.17.1 Provide thermostatic control valve or space temperature sensor and two way control valve and operator. Modulate to maintain space temperature setpoint. See part 3 heat pump clause for control of units located in rooms served by heat pumps.

3.18 **DOMESTIC HOT WATER RECIRCULATING PUMP**

3.18.1 Provide start/stop and current sensor for status for recirculating pump. Schedule operating hours of pump, and link operation to the building calendar so that the pump only operates during facility operating hours. Schedule to be adjustable by Owner from graphic.

3.19 **MECHANICAL AND ELECTRICAL ROOMS**

3.19.1 Provide intake and exhaust air dampers and actuators and line voltage thermostats. Activate heater, damper and exhaust fan in sequence to maintain setpoint.

3.20 **EXHAUST FANS**

3.20.1 For all fans, provide exhaust air damper and actuator, current sensor and relay. Provide start/stop and status.

3.20.2 For fans with local wall switches by Division 16, enable fan to operate from switch during occupied hours and disable fan outside of occupied hours.

3.21 **UTILITY PHASE LOSS MONITORING**

3.21.1 Connect and monitor power meter form C output provided by Division 16 and provide “Phase Loss” alarm point monitoring. Meter is located in Electrical Room in new addition.

3.21.2 On activation of phase loss alarm, shut down all BAS controlled three phase equipment and alarm to BAS. Automatically restart equipment in zoned groups once Phase Loss alarm is cleared. Minimum stop to start time is 2 minutes (adjustable).

3.22 **CONTROL SYSTEM ACCEPTANCE**

3.22.1 A complete system check-out is required. Before starting this, provide a detailed step-by-step checkout plan.

3.22.2 Demonstrate to the Owner's satisfaction at job site, the methods, test gear and simulation equipment to be used in check-out of each part of control system. Demonstrate the actual hook-up of test gear, exercise of inputs, trouble isolation and correction technique, and final operation test of a typical remote panel. Owner may check the operation of all sensors, transducers with own equipment to ensure proper operation.

3.22.3 After completion of the check-out, make all necessary corrections and repeat the check. When the system is fully operational, demonstrate in full detail, all functions/indications to the Owner.

3.22.4 Submit a checkout list to the Owner documenting that each point has been checked and is operating satisfactorily. The check should include field wiring, relay operation and HAND/OFF/AUTO checkout.

3.23 PROGRAM START AND STOP TIMES

3.23.1 Provide optimal start and stop times programming to compensate for outside temperature. Provide morning warm up routine.

3.23.2 For all systems using hot water or heat pump loop for cooling or heating, program an individual, dedicated warm-up or cool-down cycle to bring space temperature from night setback to occupied temperature setpoint. During that cycle all outside air dampers must remain closed. Program each system individually with optimum temperature recovery time. Follow Standard ASHRAE 90.1.

3.23.3 Program various system operational times based on the normally occupied periods of the building. Program a yearly calendar to allow for daylight savings time and standard time changes. Provide separate weekly time schedules for heat pumps, exhaust fans, and each air handler.

3.23.4 Provide graphical links to fan systems including display of operating schedule, Timed Overrides and Event Mode programming. Timed override shall allow for operation of the fan systems for a 2 hour (adjustable by super user) period, mechanical cooling shall be locked out. Event mode shall allow fans to operate in normal daytime operation for a user adjustable, defined period of operation using a calendar type function. Upon entry of an Event, a report shall be generated and sent to the school board indicating the date, duration, user, and permit number. Event mode shall be linked to associated heat pumps within the building, refer to heat pump sequences above.

3.24 TREND LOGS

3.24.1 Set up trend logs to continuously monitor critical parameters for each system. Consultant will assist in determining critical parameters.

3.25 ENVIRONMENTAL ALARMS

3.25.1 Provide sensors and digital outputs to the building security alarm panel for environmental alarms. Provide individual alarms to the security system on: Low space temperature in any room (coordinate setpoint with SCCDSB, active only for ambient below 5°C), no flow in heat pump loop (monitor both flow switch and pump status), high or low heat pump water temperature, low heating system water temperature (active only for ambient below 5°C) loss of AC power to BCS, utility phase loss. Submit proposed setpoints for each alarm for Owner approval. Provide graphic displaying settings so that Owner can easily modify. Alarm outputs to be on native BCS network.

Security System Labels:

- No flow in heat pump loop “Loop Pump”
- High or low heat pump water temperature “Tower Temp”
- Low space temperature in any room “Low Space”
- Low heating system water temperature “Low Header”
- BCS power failure
- Utility phase loss monitoring “Utility Phase Loss”

END OF SECTION

INDEX - SECTION 15990

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1 General

1.1 **DESCRIPTION**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.1.2 Perform commissioning of the complete Building Control System (BCS), including every device, input and output. A Commissioning Agent (CA) will be engaged by the General Contractor to verify commissioning has been performed in accordance with the requirements of this Section.

1.1.3 Attend all commissioning meetings and perform all commissioning responsibilities assigned by the CA at those meetings.

2 Products

2.1 **TEST EQUIPMENT**

2.1.1 Provide all test equipment necessary to fulfill testing and calibration requirements of this Division. Provide two-way radios for use by CA during commissioning, if required.

3 Execution

3.1 **SUBMITTALS**

3.1.1 Provide two copies of Record Drawings and Shop Drawings for the CA's review and use. Inform CA of any differences between actual systems and systems described in Shop Drawings. On one of the Record Drawing sets, mark the locations of network panels and interconnecting wiring. Indicate wiring types on Drawings.

3.2 **TEST PROCEDURES**

3.2.1 A test form or checklist will be provided by the CA for each Mechanical and Electrical equipment item controlled or monitored by the BCS. Prior to commissioning, test and calibrate all control devices, inputs and outputs, verify correct operation of devices and controls sequences, and complete test forms. Use a skilled technician who is familiar with the building to perform this work. Submit test forms to the CA for review.

3.2.2 Test forms will generally include the following:

- Calibration of all inputs and devices
- Check of points list stored in each panel
- Operational check of all valves and dampers
- Check that all specified sequences are set up, debugged and fully operable
- Check of battery backup and power-up after power failure restart functions
- Check of trending and graphing features
- Check of global commands features
- Check of schedules and alarms
- Synchronization of workstation and field panel clock settings
- Check of field panel functionality using portable workstation
- Check that all graphic screens and value readouts are completed
- Check of setpoint changing features and functions

- Check of night setback, morning warmup operation
- Check of communications to remote sites
- Check of fire alarm interlocks
- Check of security system interlocks with environmental alarms
- Check of optimum start/stop and sequential equipment staging/alternating

3.2.3 Prior to testing, ensure all wiring connections for all voltages are properly terminated, ensure all wiring is properly identified, and ensure all wiring requirements of Section 15900, “Controls”, are met.

3.3 **COMMISSIONING**

3.3.1 When the CA is satisfied the testing is complete, commissioning will be scheduled. Commissioning will consist of verification of operation of all points, sequences and features, witnessed and directed by the CA and the Owner's representative. Commissioning to be performed by the same technician who performed the testing described in Clause 3.2.

3.3.2 Allow a minimum of five days for assisting CA during commissioning. This does not include time spent in verification and testing described in Clause 3.2 above.

3.4 **PERFORMANCE VERIFICATION**

3.4.1 Provide verification check sheets for all new control points and all associated control sequences. This work must be done, submitted and approved by the consultant prior to the commissioning agent being engaged and final payment being released. The approved reports are to be included in the maintenance manuals.

3.4.2 Verification check sheets for each piece of equipment must contain list of all control points associated with this piece of equipment. Proper operation of each sensor, actuator, terminal unit, or any other control point must be confirmed in the field by direct observation (if possible) and through the graphical user interface. Each verification sheet must be dated and signed by Controls Contractor.

3.4.3 Setup and verify trends for all new equipment and all control points. Provide trend verification sheets and sample sheets indicating trended points for consultant's approval.

3.4.4 One month after these checks and commissioning are complete, set up a meeting with Mechanical Contractor, Owner and Consultant to confirm the operation of all new equipment. At this meeting all trends will be reviewed and confirmed with the Owner. Prior to the meeting the Controls Contractor will be required to provide trend graphs or numerical data in Excel spread sheet form, for all monitored systems for the last month of operation. If numerical data is provided the date/time data must follow Excel formatting.

3.4.5 Controls Contractor will be responsible for correcting of all deficiencies found during this process and will be required to submit trends to verify operation of all equipment after making corrections.

END OF SECTION

INDEX - SECTION 16001

PART 1 - GENERAL

PART 2 - PRODUCTS

INDEX - SECTION 16001 - continued

PART 3 - EXECUTION

1 General

1.1 **GENERAL PROVISIONS**

1.1.1 This Section and Division 1 - General Requirements apply to and govern the work of all Sections of Division 16.

1.2 **VISITING SITE**

1.2.1 Visit the site and be familiar with working conditions and work involved before submitting Bids. **NO EXTRAS WILL BE GRANTED DUE TO LACK OF A THOROUGH PRELIMINARY INVESTIGATION.**

1.2.2 Remove and replace existing ceiling tiles to inspect ceiling for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras will be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces.

1.2.3 Contractors visiting for site investigation must sign in at the main office. Upon arrival, review and sign the on-site Designated Substances Report prior to site investigation.

1.3 **CONTRACT DRAWINGS**

1.3.1 Electrical Drawings show Electrical work only and are not intended to show Structural details, Mechanical details or Architectural features. Take building dimensions and details from Architectural or Structural Drawings or from job measurements only.

1.3.2 Electrical Drawings indicate only the general locations of equipment and outlets. Wiring requirements are shown diagrammatically. Responsibility for the detailed layout of equipment, outlets, raceways and wiring is part of the work of this Division. Specific outlet locations are detailed on elevations.

1.3.3 If shown, only the general location and route of conduit, cable trays and communication hooks are shown. Install all services neatly to conserve headroom. All conduit, cable trays and communication hooks are to be accessible after work by other trades is complete. Install all services parallel to building lines unless shown otherwise.

1.3.4 The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided Notice of Change is given prior to roughing-in.

1.3.5 In case of conflict between work of other trades and work of this Division, clarify the location of these items with the Consultant before roughing-in.

1.3.6 In the event of any discrepancies or ambiguity of any symbol, note, abbreviation, etc., used in this Specification or on the Contract Drawings, obtain clarification, in writing, from the Consultant prior to submitting Bid. No allowance will be made for additional costs arising from failure to obtain proper clarification of conflicting information before Bid.

1.3.7 All dimensions and sizes are in SI units, Generally units are in millimetres. All exceptions to this are noted.

CONDUIT SIZES

Imperial (Inches)	½	¾	1	1-¼	1-½	2	2-½	3	3-½	4	4-½	5	6
S.I. (metric) (mm)	16	21	27	35	41	53	63	78	91	103	116	129	155

1.4 **SHOP DRAWINGS**

1.4.1 Submit Manufacturers' Shop Drawings, Electrical Wiring Diagrams and Control System Drawings to the Consultant. Provide title sheet for Shop Drawing submitted. Include project name, Shop Drawing item (including Specification paragraph reference) and approval stamps. The Consultant reserves the right to have samples submitted of any specified products.

1.4.2 Before submitting shop drawings, provide a complete list of shop drawings to be submitted in Microsoft Excel format. List all shop drawings and approximate date of submission.

1.4.3 Submit all shop drawings electronically in Adobe® Acrobat® PDF format. File attachments to an email must total no more than 5 MB and must be submitted unzipped. If multiple items are submitted in single PDF file, each individual piece of equipment must be “book marked” using equipment labels as per Design Drawings. All shop drawings submitted electronically must be checked and stamped by Contractor as specified below.

1.4.4 Catalogues, manuals or price lists will not be accepted as Shop Drawings. Before submission, check Shop Drawings, make necessary corrections, apply stamp “Checked and Certified Correct”, sign and date.

1.4.5 Submit one reviewed set of Shop Drawings with each set of Maintenance and Operating Instructions.

1.4.6 The review of Shop Drawings by Chorley + Bisset Ltd. is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Chorley + Bisset Ltd. approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor. Such review does not relieve the Contractor of his responsibility for errors or omissions in the Shop Drawings or of his responsibility for meeting all requirements of the Construction and 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.

1.4.7 The Contractor is to review each shop drawing and document the differences between the shop drawing submission and the description listed in the specification. If there are no differences listed, the Contractor implicitly declares the shop drawing meets all requirements of the Specification.

1.4.8 Ensure at least one copy of the reviewed Shop Drawings is kept on site at all times for reference.

1.4.9 Prepare all Drawings in SI units.

1.4.10 Shop Drawings to include the following:

1.4.10.1 Indicate details of construction, dimensions, capacities, weight and electrical performance characteristics of equipment or material.

1.4.10.2 Where applicable, include wiring, single line and schematic diagram including interconnect with work of other sections.

1.4.10.3 Include manufacturer's special installation instructions where applicable.

1.5 **FIELD DRAWINGS**

1.5.1 Submit, to the General Contractor, Drawings accurately showing all openings for busducts, conduits, etc. Drawings must include the size of openings and their locations by dimensions, including the location of the structural members framing these openings. Each trade will be responsible for detail layout of their own work.

1.5.2 Assume full responsibility for the detailed coordination of all Division 16 work. Prepare Field Drawings to determine the exact location of each service. On these drawings, include all mechanical and electrical services, architectural features, and structural details. If a conflict becomes apparent after the installation of services, pay all costs associated with removing and reinstalling these services.

1.5.3 If the General Contractor separates the Communication, Security or similar work from the other work of Division 16, the General Contractor assumes full responsibility for this coordination work including the preparation of the Field Drawings.

1.6 **AS-BUILT DRAWINGS**

1.6.1 The Contractor will be provided with the Electrical Drawings in AutoCAD Version 2010 compatible electronic format. The Contractor is to plot and print Drawings from the disc.

1.6.2 Revise and maintain the prints as work progresses. Show all revisions, relocations and changes, to scale. Use colour markings.

1.6.3 Contractor shall take as-built measurements, prior to backfill, of all buried ductbanks and conduits under floor slab. Show routing, depths and dimensions from fixed points on as-built drawings.

1.6.4 Transfer information from the marked prints to AutoCAD format on a monthly basis. Have the marked prints and updated AutoCAD prints on site for review by the Consultant at all times. Monthly draws will not be approved unless all changes have been shown.

1.6.5 Prior to testing and final commissioning, complete the transfer of all information to the AutoCAD Drawings. The Drawing format is to match exactly the layering system of the Consultant. Mark Drawings “As-Built Drawings” and insert name and logo of Contractor. Bind all xrefs. Submit one set of As-Built Drawing prints for review by the Consultant. Remove Engineers Stamp. Include Contractors Name and Logo.

1.6.6 Submit completed As-Built Drawings in AutoCAD Version 2010 format and one set of Reproducible Drawings with the Operating and Maintenance Manuals.

1.6.7 For the purposes of Contract payments, As-Built Drawings will be assumed to have a value of $1,000. This will not be released until As-Built Drawings have been accepted as complete and acceptable by the Consultant. This amount is in addition to the normal 10% holdback required by the Construction Lien Act, 1983.

1.7 **SIMULTANEOUS PROJECTS**

1.7.1 Other projects may be under construction simultaneously on this site during the course of this construction project. The Owner will not be the "constructor" as defined by The Ontario Health & Safety Act & Regulations. This Contractor is to maintain a separation between this project and all other Contractors, by time or space, as defined by The Ontario Health & Safety Act & Regulations.

1.8 **CONFLICTS AND PRECEDENCE**

1.8.1 Immediately upon discovery of any conflict, ambiguity, error or omission in the Contract Documents, request clarification in writing from Consultant prior to starting the work in questions.

1.8.2 Failure to give such written notice will constitute an irrevocable waiver and release of any claim for additional compensation or delays incurred.

1.8.3 Where work fails to conform to Contract Documents, as clarified by Consultant, promptly remove and replace such work as directed, without adjustment to Contract price.

1.9 **FIRESTOPPING**

1.9.1 Before starting any work on site, submit detailed Shop Drawings to the Consultant for review and comments. Include:

1.9.1.1 Manufacturer's technical product data and installation instructions for each specific type and location of penetration.

1.9.1.2 Certification that proposed firestopping materials and assemblies comply with CAN4-115-M.

1.9.1.3 For each specific type and location of penetration, provide installation instructions from a recognized independent testing agency.

1.9.2 Mark penetration types and locations on set of white prints. At completion of project, transfer this information to As Built Drawings.

1.9.3 Comply with all requirements of Ontario Building Code Clause 3.1.9, “Building Services in Fire Separations and Fire Rating Assemblies”.

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS

1.10.1 For the Electrical Division 16 work only, assemble three sets of equipment literature (cuts), operating instructions, maintenance instructions, voltage test results, certificate, other pertinent data and Letter of Warranty. Place in three ring binders, complete with index pages, indexing tabs and cover identification at front and side. Submit to Consultant for approval.

1.10.2 Make changes or submit additional information as required to obtain approval. Final Certificate of Completion will not be issued until the Consultant possesses approved sets. Include copies of reviewed Shop Drawings and name and address of Spare Parts' Suppliers with manuals.

1.10.3 Provide two electronic copies of the maintenance and operating manual in Adobe Acrobat PDF format on a USB Drive and submit with the final version of manuals. Electronic copy of manual to be provided as one file formatted with bookmarks in accordance with the sections of the hard copy manuals. Do not include separate files in sub folders. Divide the maintenance manuals into sections which correspond with Specification Sections.

1.10.4 The following information is to be contained within the Sections:

1.10.4.1 **Section 1:** A list of names, addresses and telephone numbers of the Consultants, General Contractor and Electrical Contractor. Written warranty of the Electrical systems.

1.10.4.2 **Section 2:** Electrical Safety Authority Inspection Permit, Fire Alarm Verification Report and Certificate, Emergency Lighting Verification Letter.

1.10.4.3 **Remaining Sections - By Specification Section**

1.10.4.3.1 A list of names, addresses and telephone numbers of all suppliers. A copy of all reviewed Shop Drawings.

1.10.4.3.2 A complete and comprehensive maintenance and operating instructions details D (daily), W (weekly), M (monthly), SA (semi-annually), A (annually) for maintenance.

1.10.4.3.3 Copies of warranties.

1.10.4.3.4 Complete control diagrams, wiring diagrams and description of applicable control systems and the functioning of the system.

1.11 REGULATIONS AND PERMITS

1.11.1 Carry out the work in accordance with the latest editions of relevant codes, local bylaws, and requirements of local Authority Having Jurisdiction. Apply for and obtain permits and pay all fees. Consultant will submit Drawings to Electrical Safety Authority if required.

1.11.2 Enforce all prevailing Provincial and local safety regulations at all times. Abide by all St Clair Catholic District School Board safety and security policies and procedures and conform to all regulations of the current Occupational Health & Safety Act.

1.11.3 After completion of the work, furnish to Consultant a Certificate of Unconditional Approval from Inspecting Authorities.

1.12 **MATERIAL AND EQUIPMENT**

1.12.1 Where an item of material or any equipment is specifically identified by a manufacturer's trade name and/or catalogue number, make no substitution except as provided for in paragraphs 3, 4 and 5 below.

1.12.2 In the case of some items of equipment, one or more additional names of acceptable equal manufacturers are listed in the Clause describing an item or a group of items. The design, layout, space allocation, connection details, etc., are based on the products named first in the description of each item. The products named first in the description of each item establish the quality of manufacture and design standards for all other manufacturers of that item. The general approval indicated by listing the names of other manufacturers is subject to final review of Shop Drawings, performance data, test reports, production samples (if required) by Consultant, and equipment shipped to site. Ensure that the products used meet the requirements specified and as shown on the Contract Drawings.

1.12.3 Suppliers wishing to submit other items of equipment for approval as an equal to those specified must apply to the Consultant at least 8 working days before Bid closing date. Requests must be accompanied by complete description and technical data on the items proposed. Approval for substitution of equipment will only be given on the understanding that all details, accessories, features and performance meet the Specifications unless otherwise stated. Deviations from the Specifications must be stated in writing at time of application for approval.

1.12.4 Include in the Bid, the equipment named in the Specifications or approved as an equal as in paragraph 3 above. This will form the Base Bid. Any number of alternative bids, as defined below, may be included in addition to the Base Bid.

1.12.5 Items of equipment by Manufacturers not named in the Specifications may be offered as alternatives to the manufacturers named in the Specifications. The alternative proposals must be accompanied by full descriptive and technical data, together with the statement of amount of addition or deduction from the Base Bid, if the alternative is accepted. Prior approval by the Consultant is not required on items submitted as alternative bids.

1.12.6 After execution of the Contract, substitution of equipment will be considered only if equipment accepted cannot be delivered in time to complete the work in proper sequence, or if the manufacturer has stopped production of the accepted item. In such cases, requests for substitution must be accompanied by proof of equality and difference in price and delivery, in the form of Certified Quotations from Suppliers of both specified and proposed equipment. Credit any decrease in price involved in substitution to the Owner by reduction of the Contract Price. The Contractor will not be reimbursed for any such increase in price.

1.12.7 Where equipment other than the equipment used as a basis for design, layout and space allocation is used, produce and submit revised layouts of equipment, pipes, ducts, etc., in the areas affected. Submit these Drawings with the Shop Drawings. Failure to produce these Drawings is indication by the Contractor that they are not required and the original space allocations are adequate for the substituted equipment.

1.12.8 Name the Subcontractors and Manufacturers in the Bid as indicated in Clause “List of Electrical Subcontractors and Manufacturers”.

1.13 INTERPRETATION OF CONTRACT DOCUMENTS

1.13.1 The decision as to which trade provides required labour or materials rests solely with the Contractor. Extra payments will not be considered based on a difference in interpretation of the Contract Documents as to which trade involved provides materials or labour for specific items of work. The Consultant will not enter into such discussions.

1.14 SITE VISITS

1.14.1 The Electrical Contractor shall have an office representative (not site personnel) at each site meeting and deficiency review. Attendance at these meetings is mandatory.

1.15 PROGRESS DRAWS

1.15.1 Electrical Contractor shall review all supplier and subcontractor draws submitted to their office to ensure they are fair and reasonable for the amount of work completed on site to date prior to submitting to the General Contractor. Electrical Contractor will be responsible for the validity of supplier and subcontractor draw claims.

1.16 WARRANTY

1.16.1 Warranty all workmanship, material and equipment supplied by Division 16 for one year after Substantial Completion except where specifically specified otherwise. Make good damage caused due to defects and workmanship.

1.16.2 Where equipment specified in Sections of Division 16 to have an extended warranty period, e.g. five years, the first year of the warranty period will be governed by the terms and conditions of the warranty in the Contract Documents, and the remaining years of the warranty will be direct from the manufacturer and/or supplier to the Owner. Submit signed and dated copies of the extended warranties to the Consultant before applying for a Certificate of Substantial Performance of the Work.

1.17 DIMENSIONS AND QUANTITIES

1.17.1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.

1.17.2 Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of equipment installation.

1.17.3 Quantities or lengths indicated in any of the Contract Documents are approximate only and will not be held to gauge or limit the work. No adjustment to the Contract Price will be allowed to complete the work.

1.17.4 Provide labour, products and services specified, but not shown on Drawings and vice versa, and all other labour, products and services necessary for completion of the work.

1.17.5 Make any necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions, without adjustment to Contract price.

1.17.6 Provide work in accordance with the approved Schedule to meet completion date and specified interim Schedules.

1.18 **COOPERATION BETWEEN TRADES**

1.18.1 Cooperate and coordinate with other trades as required for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost of extra work caused by and make up time lost as result of failure to provide necessary cooperation information or items to be fixed to or built-in, in adequate time.

1.19 **COOPERATE WITH OWNER'S STAFF**

1.19.1 Maintain close cooperation with Owner's staff. The Owner will determine the times during which work may be carried out in certain areas. If the work cannot be completed in the allowed time, the Contractor may be required to clean up the area and finish the work at some future time.

1.19.2 Shutdowns will be scheduled during unoccupied times. Include any overtime wages due to conditions stipulated above in the Bid Price.

1.19.3 Provide seven day's minimum notice, in writing, prior to any interruptions of service or restriction of use of any service.

1.19.4 Provide all phase testing, as required, prior to disconnecting existing and connecting new to avoid damage to equipment.

1.19.5 The Owner's operations must take precedence over Contractors' operations at all times. Interruptions due to noise, drilling, etc., will not be allowed without Owner's prior approval.

1.19.6 Include any overtime wages due to conditions stipulated above in the Bid Price.

1.20 **EXAMINATION OF DAMAGED DEVICES**

1.20.1 Report all damaged, defective and non-functioning devices and equipment shown for reinstallation or relocation to the Consultant prior to removal and storage. All devices and equipment will be assumed to be fully functional unless reported otherwise prior to removal.

1.20.2 Devices and equipment damaged during removal, storage or reinstallation will be replaced at no cost to the Owner.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Clause “Material and Equipment”.

2.2 **SLEEVES**

2.2.1 In general, sleeves are not required through walls or floors except in service room floors and foundation walls.

2.2.2 Use Schedule 40 steel pipe sleeves through concrete structural members, walls and floor slabs. Extend sleeves minimum 1″ AFF and seal pipe to sleeve.

2.2.3 For all conduits passing through foundation walls, use Link-Seal pre-engineered mechanical seals between sleeves and pipes.

2.2.4 For rated separation requiring a FT firestopping rating, use materials in conformance with manufacturer's recommendations.

2.3 **FIRESTOPPING**

2.3.1 Use only service penetration firestop components and assemblies tested in accordance with CAN.ULC S115 “Fire Tests of Firestop Systems” and listed in most recent ULC “List of Equipment and Materials” or by another recognized independent testing and certification agency acceptable to the Consultant.

2.3.2 Pipe sleeves through fire separations requiring a rating are to be installed as per firestopping manufacturer's recommendations, as some firestopping manufacturers do not allow pipe sleeves within their approved system. Confirm pipe sleeve compatibility prior to starting work on site.

2.3.3 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause "Material and Equipment":

Hilti
Tremco

2.3.4 Where communications J hooks or cable trays are shown passing through rated walls, provide thru-wall fitting and 103 mm (4") conduit stubs. Provide quantity as required to maintain cross-sectional area of cable tray, or minimum one fitting per communication J hooks. Thru-wall fitting to be suitable for use in plenum spaces and maintain one, two, three or four hour fire rating in drywall, concrete and block penetrations. To be Legrand FlameStopper.

2.4 **SPRINKLER PROOF EQUIPMENT**

2.4.1 This building will be fully sprinklered. Use sprinkler proof electrical equipment to prevent the sprinkler system water from entering electrical equipment for all surface mounted equipment.

2.5 **IDENTIFICATION NAME LABELS**

2.5.1 Provide white lamacoid identification labels with black uppercase lettering, minimum 14 pt Arial or Helvetica typeface, for identification of all MCCs, switchboards, distribution panels, panelboards, transformers and transfer switches.

2.5.2 Submit a complete list of nameplate wording for review by Consultant prior to installation.

2.5.3 Warning plates are to be red with white letters, minimum 14 pt Arial or Helvetica typeface, as indicated on drawings.

3 Execution

3.1 **GENERAL**

3.1.1 Instruct and supervise other Sections doing related work.

3.1.2 Supply the measurements of equipment to other Sections to allow for necessary openings to be left in the work of other Sections.

3.1.3 Install conduit, which is to be concealed, neatly and close to building structure so that the necessary furring can be kept as small as possible.

3.1.4 Carry out all work in accordance with the latest regulations of the Ontario Electrical Safety Code and all applicable Municipal, Provincial and Federal Codes and Regulations. In no instance, however, is the standard established by the Drawings and Specifications, to be reduced by any of the Codes referred to above.

3.1.5 Install all ceiling components in direct accordance with reflected ceiling plans.

3.1.6 Electrical Drawings show approximate locations for wall-mounted devices. Clarify exact location and mounting height with Consultant prior to roughing-in.

3.1.7 All serviceable equipment installed on the roof (including receptacles) to be installed minium 3 m (10'-0") from roof edge unless otherwise noted on Drawings.

3.2 **STORAGE OF MATERIALS**

3.2.1 Provide proper weatherproof storage for the protection of materials and equipment on site. Blank off openings in all equipment until required for use. Consultant may require materials which are not properly stored to be discarded and removed from the site.

3.3 **SUPPORTS AND BASES**

3.3.1 Provide structural work required for installation of equipment provided under this Division.

3.3.2 Set all floor-mounted equipment on concrete bases at least 100 mm (4″) high. Size concrete equipment bases to suit the equipment actually supplied and in accordance with the Shop Drawings of such equipment. Do not start concrete work until anchor bolts and other embedded parts required for the complete installation, as well as Shop Drawings, are available at the site.

3.3.3 Extend existing concrete bases as required for replacement or new equipment. Match existing height.

3.3.4 For new concrete bases or pads on existing floors, first scrape and remove existing floor finish. Scarify existing floor so that new concrete adheres to it. Dowel new pads to new and existing floors.

3.3.5 Provide all brackets and supports required in steel stud walls. All conduits and equipment must be supported on brackets or supports attached to steel studs. Do not support materials or equipment from wall sheathing.

3.3.6 Provide independent support; brackets and unistrut structures where required to install electrical equipment; disconnect switches, splitters, panels, etc:

- in areas where the equipment is located on walls/columns that are not suitable for direct installation.
- When installation away from structural building elements is called for.
- When it is necessary to elevate the electrical equipment to ensure code compliance or ergonomical operator access.

3.3.7 For all supports of suspended or wall hung electrical equipment, provide structural drawings stamped and signed by a structural engineer holding a P.Eng. designation and registered in the Province of Ontario. This engineer is to submit proof of professional liability insurance. Equipment to be supported from the bottom.

3.3.8 Do not mount starters, VFD's, etc. on building equipment.

3.3.9 Do not suspend luminaires greater than 11.3kg (25 lbs), cable tray, conduit racks, etc from metal roof deck. Provide supports as required to suspend from roof joists.

3.3.10 Provide lintels for double-width and adjacent tubs and multiple conduits running in parallel, where located in block and poured walls.

3.4 CONCRETE INSERTS

3.4.1 General

3.4.1.1 Anchors for the support of conduits and equipment from the underside of suspended structural concrete systems may be by cast-in-place inserts placed prior to the pouring of concrete or by the use of inserts placed in holes drilled after the forms are stripped.

3.4.1.2 The safe load capacity of concrete anchors is affected by a number of variables such as specific anchor type, embedment, spacing between individual anchors, edge distances, direction of loading, concrete strength and "prying action". Refer to the manufacturer's recommendations for each specific insert proposed, including any dynamic or vibratory loads.

3.4.1.3 Be responsible for the proper selection and installation of inserts, including number, type, spacing and accurate placement to provide the necessary safe load capacity and satisfactory long term performance.

3.4.2 **Installation of Inserts in Hardened Concrete:**

3.4.2.1 Use inserts placed in pre-drilled holes. Do not use powder driven inserts or self-drilling inserts. Before drilling holes, accurately locate all reinforcing bars in the affected areas using an electro-magnetic locator.

3.4.2.2 Do not drill through or otherwise damage reinforcing bars. If reinforcing is encountered, the inserts must be relocated. Ensure that hole diameter, depth of penetration, spacing, etc., are in strict accordance with the insert manufacturer's recommendations for the specific insert type and load condition.

3.4.2.3 Due to the relatively close spacing of reinforcing bars in the bottom of many of the beams and girders, the preferred location of drilled-in-place anchors in beams and girders is into the sides of these members, rather than upwards into the bottom.

3.4.2.4 Inserts to be zinc plated female concrete anchors. Nylon or plastic anchors are not acceptable.

3.4.3 Concrete screws without anchors are not acceptable.

3.5 **SLEEVES**

3.5.1 **Sleeves Embedded in Concrete**: Except as approved otherwise by the Consultant, install sleeves embedded in concrete in accordance with the following general guidelines:

3.5.1.1 Centre to centre spacing to be not less than 3 diameters of the maximum size adjacent sleeve.

3.5.1.2 Provide additional reinforcing at points of congestion as directed by the Consultant.

3.5.1.3 Sleeves through beams will be permitted only as directed by the Consultant.

3.5.1.4 The reinforcing in beams, slabs and columns must not be displaced from its intended position under any circumstances unless prior written approval is obtained from the Consultant.

3.5.2 Provide sleeves for all conduits which pass through service room floors and foundation walls. Sleeves to extend minimum 1" above finished floor.

3.6 **FIRESTOPPING**

3.6.1 Provide a listed firestop system in accordance with the Ontario Building Code to seal around all conduits, electrical wires and cables, and other similar electrical services which penetrate part of a building assembly required to have a fire resistance rating or a fire separation. Refer to Architectural Drawings and Specifications Section “Firestopping and Smoke Seals” for building assembly and fire separation types and locations.

3.6.2 For all penetrations through fire separations required to have a fire resistance rating, use firestop systems with an F rating not less than the fire resistance rating for the fire separation. This includes the sealing of any sleeves provided for future uses. Provide an FT rating where required by the Ontario Building Code. For all penetrations through a Service Room floor, provide a minimum W rating - Class 1 in addition to the fire resistance rating.

3.6.3 All firestopping must be thoroughly reviewed by the Technical Representative of the systems manufacturer on site before any firestopping is concealed and submit a report of compliance with the rating requirements. Technical Representative to complete 3 destructive tests to confirm compliance with ULC listing, minimum one floor test and one wall test, third test to be Contractor's choice. Contractor to replace fire stopping system after destructive test has been completed. Submit a copy of the report to the Consultant. Report to include as a minimum, confirmation fire stopping shop drawings were used during review, locations where destructive testing was completed, confirmation all fire stopping locations were reviewed and installed systems meet the manufacturer requirements.

3.6.4 Provide instruction wall labels on both sides of wall for all thru-wall penetrations using FlameStopper. Locate adjacent to penetration as required to be visible from standing position.

3.7 CUTTING AND PATCHING

3.7.1 Flash holes through walls and roof to make weatherproof.

3.7.2 Do not cut or drill holes through floors, roof or structural members before obtaining permission from the Consultant.

3.7.3 For penetrations through walls not required to have a fire rating, seal all spaces between pipe or pipe and surrounding wall construction with a fire-rated foam sealant. Use 3M Fire Barrier, Metacaulk, or Dow Fire Stop UL Classified fire rated foam sealants. Do this as the work progresses, to avoid leaving inaccessible holes at completion of the job. For penetrations through parts of the building assembly required to have a fire resistance rating or acting as a fire separation, see Clause "Firestopping" in this Section.

3.7.4 Before drilling holes through floors or roof slabs, accurately locate and note sizes for each required hole. Get approval of Consultant before any cutting is started.

3.7.5 Where conduits are required to pass through existing walls, floors, and roof, cut and patch the necessary openings.

3.7.6 Where recessed electrical equipment is removed or replaced with equipment of a smaller size, patch openings to match existing wall material.

3.7.7 Where wiring devices (switches, receptacles, etc) are removed from drywall walls, remove device box and patch opening to match existing wall.

3.7.8 Where wiring devices (switches, receptacles, etc) are removed from poured concrete or block walls, remove device and provide blank coverplate.

3.7.9 Include the cost of all cutting and patching in the Lump Sum Contract Price for the work of Division 16.

3.7.10 Remove and replace ceiling where necessary to complete the work of this Division unless this work is specifically included in another Division.

3.7.11 All cutting and patching to be done by the trade specializing in the materials to be cut.

3.8 **PAINTING**

3.8.1 Touch up minor damage to finish on equipment supplied with factory applied baked enamel finish. Completely refinish items suffering damage which, in the opinion of the Consultant, is too extensive to be remedied by touchup.

3.8.2 Paint both sides and edges of plywood backboards for electrical and communications equipment before installing equipment. Use one coat fire retardant primer and two coats fire retardant paint.

3.8.3 Paint disconnect switch or breaker for fire alarm and exit light systems in red enamel. Use one coat of primer and one finish coat.

3.8.4 Where walls are cut and patched for electrical work, paint walls to match existing. For walls less than 9.3m^2 (100 sq ft), paint entire wall. For walls larger than 9.3m^2 (100 sq ft), paint area of patch. Painting to be completed by painting contractor.

3.8.5 Include the cost of all painting in the Lump Sum Contract Price for the work of Divisions 16.

3.9 **IDENTIFICATION**

3.9.1 Colour code control wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components. Match existing colour coding in use on site. Verify with Owner prior to installation.

3.9.2 All branch circuits shall be:

Phase A - red
Phase B - black
Phase C - blue

3.9.3 Identify all disconnects, starters, and other control equipment with lamacoid nameplates indicating the equipment controlled and all panels, transformers, etc identifying equipment name.

3.9.4 Lamacoid labels to be mechanically attached with self-tapping screws or rivets. Lamacoid labels attached using adhesive methods are not acceptable.

3.9.5 Identify the panel and circuit number for each wiring device with self-adhesive label on the coverplate. Use clear tape with black 14 pt Arial or Helvetica typeface. Locate labels for receptacles on front of coverplate and labels for switches on rear of coverplate.

3.9.6 Identify all pull boxes, junction boxes or octagon boxes located in the ceiling cavity with the exact use of the box, including circuits contained within. Felt pen is acceptable.

3.9.7 Where equipment is concealed above accessible ceilings, indicate location using coloured-coded marking devices, approved by Consultant, fastened to the ceiling components.

3.10 LOCKS AND KEYS

3.10.1 Where locked panelboards, control panels, terminal cabinets, etc., are specified, use a separate key pattern for each system with all locks in each system common to one key. Provide seven keys of each pattern to the Owner on a 25 mm (1″) key ring. Submit one set of keys with manuals.

3.11 TESTING

3.11.1 All systems must be thoroughly tested before arrangements are made for the final demonstration in the presence of the Owner's staff. Systems to be tested are:

1. Emergency Lighting
2. Lighting Control Systems
3. Security and Access Control Systems
4. PA / Intercom Systems

3.11.2 For the following systems, the manufacturer's Testing Representative must be present for the test period and submit a Certificate of Operation to the Consultant:

1. Fire Alarm

3.11.3 At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found.

3.12 TEMPORARY ELECTRICAL FACILITIES FOR CONSTRUCTION

3.12.1 Temporary electrical power is available at the site. Cooperate with owner for use of this power.

3.12.2 Tie in at one location only, as directed. Distribute temporary power from this location.

3.12.3 Arrange and pay for the cost of inspection of the temporary service.

3.12.4 Notify the monitoring company and Owner each and every time a part of the fire alarm system is shut down and reactivated.

3.12.5 Completely remove all temporary facilities when they are no longer required.

3.12.6 Provide fixed temporary lighting for open areas, stairwells and each enclosed room. In open areas and enclosed rooms use 150W A21 lamps, or equivalent, at spacings not exceeding 7.5m. In stairwells use one 100W A21 lamp, or equivalent, at each landing. Lighting to be on dedicated circuits.

3.12.7 Temporary lighting stipulated in this Section, do not include provisions for higher intensity lighting required for a specific operation (concrete finishing, plastering, etc.). This will be the responsibility of the specific trade requiring the higher intensity.

3.12.8 Provide minimum two 120V 20A GFCI receptacles, on dedicated circuits, per 150 m² construction area.

3.12.9 Temporary power requirements stipulated in this Section, do not include provisions for electric space heating, electric welders, or any other item of equipment which requires either a 3 phase supply or connection to a single phase circuit rated in excess of 20 amperes. Any trade using equipment which falls into above categories is to be responsible for providing additional facilities required for such equipment, including any increased sizing. This Division is responsible to see the connection to the temporary system is safe.

3.12.10 Use non-metallic sheathed cable, Type NMW-10, #12 AWG, manufactured in accordance with CSA Spec. C22.2 No. 38, for all temporary lighting branch circuit wiring.

3.12.11 **Temporary Fire Alarm Devices**

3.12.11.1 Notify the local Fire Department and Owner each and every time a part of the fire alarm system is shut down and reactivated.

3.12.11.2 Provide new temporary hard wired fire alarm detectors, pull stations and notification appliances within the construction area.

3.12.11.2.1 Provide one 135°F rate-of-rise heat detector for every 465 m² (5000 ft²) of floor area.

3.12.11.2.2 Provide smoke detectors in all temporary corridors spaced maximum 10m (30 ft).

3.12.11.2.3 Provide a manual pull station at every exit/entrance to the construction area.

3.12.11.2.4 Provide one surface mounted bell for every 560 m² (6000 ft²) of floor area.

3.12.11.3 Use #14 AWG, AC-90 cable for temporary wiring to devices.

3.12.11.4 Connect devices to dedicated fire alarm zones, grouped on a floor-by-floor basis. Provide zone cards as required to suit existing fire alarm panel.

3.12.11.5 Completely verify temporary fire alarm devices any time temporary devices are added, removed or relocated.

3.12.11.6 Once the permanent fire alarm system is operational completely remove all temporary devices and wiring. Turn devices over to the Owner.

3.13 **EQUIPMENT SCHEDULE**

3.13.1 Equipment Schedules are as shown on Drawings.

3.13.2 In general, the motor or item numbers shown in the Equipment Schedules coincide with those numbers shown for Mechanical Trades.

3.14 **GROUNDING**

3.14.1 Ground all components of the Electrical system in accordance with the requirements of Section 10 of the Ontario Electrical Safety Code latest edition and the Inspection Authority.

3.14.2 Provide a separate green ground conductor in all raceways.

3.14.3 Ground secondary neutrals of transformers to building ground conductor.

3.14.4 Where attached to equipment, conduits, cabinets, etc., use suitable approved solderless lugs, compression connectors. No soldered or split bolt type connections are to be used on grounding circuits at any point.

3.14.5 All compression connectors, lugs, etc., used in grounding circuits in any location are to have bolts, nuts, etc., of silicone bronze alloy equal to “Everdur” metal.

3.14.6 Clean all surfaces to which bus or cable are to be bolted, of all paint, rust, etc., and work to a bright, flat surface.

3.14.7 Conduit expansion joints and telescoping sections or metal raceways not thoroughly bonded otherwise, are to be provided with approved bonding jumpers or not less than #8 AWG stranded bare copper.

3.14.8 Provide a separate #14 green ground wire for all isolated ground receptacles.

3.15 START-UP SERVICES

3.15.1 Provide the services of a qualified person to be on call and available to the site within one hour, for 2 weeks after work of this Contract is taken over by the Owner. Assist Owner's staff to become familiar with the system operation.

3.16 MAINTENANCE OF EXISTING SERVICES

3.16.1 Take every precaution to locate and protect existing services so that no interruption occurs. If any existing service is damaged due to the work of this Division, arrange and pay for repair. Bear any costs due to interruption of existing services.

3.16.2 Be responsible for maintaining continuity of existing services, and for programming work so that the Owners can carry out their normal business uninterrupted, with the exception of scheduled shutdowns for connection to or rerouting of existing services, at a time agreed to by the Owners, on weekdays, over weekends or after normal working hours.

3.16.3 Permission from the Owner is required before making any connections to or rerouting of existing services. Give seven days prior notice to the Consultant and Owner.

3.17 PROTECTING AND MAKING GOOD

3.17.1 Be responsible for protection of Owner's property, as well as finished and unfinished work, from damage due to execution of work under this Contract. Repair damage resulting from failure to provide such protection to the satisfaction of the Consultant, at no expense to the Owner.

3.17.2 Attach and fasten fixture and fittings in place in safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during occupancy of building, as the result of vibrating or other causes in normal use of building.

3.17.3 Coordinate and cooperate with other trades, taking into account existing installations, to assure best arrangement of equipment in available space. For critical locations, prepare interference and installation drawing showing work of various sections as well as existing installations, for approval before commencing work.

3.17.4 All new equipment shall be delivered to site wrapped in plastic and removed only after room is thoroughly cleaned and painted, if applicable. Where existing or new equipment must be operational throughout construction in adjacent spaces, ensure door sweeps are installed and mechanical ventilation systems are fully operational. Provide filters with minimum filtration rate of 10 micron (MERV 5) on all make-up air and supply ducts. Ensure filters are regularly changed to maintain adequate airflow.

3.18 REMOVAL OF EXISTING MATERIAL AND EQUIPMENT

3.18.1 Remove existing material and equipment where shown or specified. Equipment such as Fire Alarm devices, and any other special devices are to be turned over to the Owner. Relocate these items to a designated storage site as directed by Owner. Other material and equipment which is removed becomes the property of the Contractor, and must be immediately removed from the site.

3.19 REBATES AND INCENTIVES

3.19.1 Provide all invoices and proof of purchase documentation to Owner as requested for application by Owner for rebates and incentives. All incentives will be paid to the Owner.

3.20 CASH ALLOWANCES

3.20.1 Refer to Section 01020 for cash allowances carried by the General Contractor.

3.20.2 Include in the Base Bid price, cash allowances of:

3.20.2.1 $3,000.00 to cover the cost of unforeseen electrical deficiencies. Submit Electrical Safety Authority Inspection deficiencies to the Consultant.

3.20.3 Any amounts in excess of the cash allowances will be paid by the Owner. Return any unused portions of the cash allowances in full to the Owner.

3.21 DEFICIENCY REVIEW

3.21.1 The Electrical Contractor shall confirm in writing that the work is complete and ready for inspection. The Consultant will schedule a site visit to review the work and provide a written deficiency list. Once deficiencies have been corrected, the Electrical Contractor shall confirm in writing to the Consultant that all deficiencies have been corrected. The Consultant will schedule a second site visit to review the correction of noted deficiencies. Should any noted deficiencies be found to be still outstanding, the Electrical Contractor shall correct them and again notify the Consultant in writing. Charges to the Electrical Contractor may result from repeat visits after the second visit.

3.21.2 The Electrical Contractor is required to complete all work above ceilings and allow time for deficiency reviews and correction of noted deficiencies in a timely manner in order to accommodate the current Construction Schedule. This includes time for reinspection as required prior to concealing (drywall enclosures, drywall ceilings and acoustic tile ceilings) of any service. The Electrical Contractor will be responsible for uncovering any concealed services for inspection.

3.22 LIST OF ELECTRICAL SUBCONTRACTORS AND MANUFACTURERS

3.22.1 In the Bid documents, name the Subcontractors and Manufacturers for the items listed below. Use only one name for each item. See Clause “Material and Equipment”. Where the name of a manufacturer is not entered on the Bid Form, the Contractor will be required to use the base specified manufacturer.

3.22.2 **Subcontractors**

Fire Alarm System
PA System
Security System

3.22.3 **Manufacturers**

Disconnect Switches
Emergency Lighting / Exit Signs
Fire Alarm Devices
Intercom System
Luminaires (by Type)
Occupancy Sensors
Panelboards
Wiring Devices

END OF SECTION

INDEX - SECTION 16100

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions”.

1.2 **DESCRIPTION OF SYSTEM**

1.2.1 Provide all new wiring and raceways. Where possible, conceal all wiring and raceways above ceilings, in walls and partitions. See Section 16001, “Electrical General Provisions”.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Clause “Material and Equipment”.

2.1.2 All outlet boxes, wiring devices, equipment and accessories must be C.S.A. approved and be designed for the application intended.

2.2 **RACEWAYS**

2.2.1 Use E.M.T. in concealed locations in concrete block walls, drywall partitions and for main and branch circuit wiring above corridor ceiling spaces.

2.2.2 Use minimum 1/2″ (16 mm) conduit for power wiring and 3/4″(21 mm) conduit for motor circuits.

2.2.3 Refer to Section 16700 for communication raceways.

2.2.4 Use set screw steel couplings and connectors. Use raintight steel couplings and connectors complete with “O” rings, where exposed to sprinklers.

2.2.5 Use red conduit for Fire Alarm wiring concealed above ceilings, in concrete walls and in mechanical and electrical rooms.

2.2.6 For new devices on existing block or poured concrete walls exposed in finished areas, provide metallic single compartment raceway and appropriate bases.

2.2.7 Use conduit expansion coupling for expansion joint crossing.

2.2.8 Use flexible metal conduit for all final connections to motors and other equipment subject to vibration or which has adjustable mountings. Minimum size 1/2″ (16 mm).

2.2.9 Use rigid PVC underground and in concrete floors, unless otherwise noted. Provide marking tape for underground installations in accordance with Ontario Electrical Safety Code.

2.2.10 For exterior above grade installations, use rigid aluminum conduits and fittings. All boxes and conduit bodies shall be die-cast, copper-free aluminum with aluminum covers and neoprene gaskets.

2.2.11 Fasten all raceways with approved supports. Use clamps and all mounting hardware of the same material as the conduit or compatible material to prevent galvanic corrosion.

2.3 CONDUCTORS

2.3.1 Aluminum conductors are NOT permitted on this project.

2.3.2 Use minimum copper #12 AWG RW-90XLPE **stranded** for branch circuiting and receptacle wiring.

2.3.3 Use RWU-90XLPE wire in all below grade locations.

2.3.4 Use minimum size of #14 AWG RW-90XLPE for control wiring.

2.3.5 Use RWU-90XLPE-1000 volt rated cables from Variable Frequency Drives to motors.

2.3.6 Type AC-90 cable may be used for final drops (maximum 2 m [6.5′]) to lighting fixtures and devices in accessible ceiling spaces. **DO NOT USE AS MAIN BRANCH WIRING FROM PANELBOARDS OR FOR BRANCH CIRCUIT WIRING (i.e. RECEPTACLES, ETC.).**

2.3.7 For wiring to heating equipment, recessed lighting fixtures or where body of fluorescent fixture is used as raceway, use conductors with high temperature insulation of type approved by Electrical Safety Authority.

2.3.8 Use all wire and cable insulation rated 600 volts minimum unless specified otherwise.

2.4 OUTLET BOXES

2.4.1 Use only masonry approved boxes in concrete and masonry construction.

2.4.2 Use 100 mm (4″) square or utility type boxes for surface-mounted boxes and 100 mm (4″) octagonal boxes for ceiling outlet boxes. Use multi-gang boxes for grouped devices. Use wrap-around covers for utility boxes. Use cast aluminium FS type boxes where surface mounted in finished areas.

2.4.3 Use flush-mounted boxes complete with adjustable ears, extension rings and plate rings as required. Do not use shallow or narrow boxes.

2.4.4 Provide FS type boxes c/w rain tight fittings where surface mounted in service rooms or where exposed to sprinklers.

2.5 WIRING DEVICES

2.5.1 Use specification grade wiring devices, types and ratings shown on the Drawings.

2.5.2 Switched receptacles to be black. Use red devices for receptacles\switches fed from emergency circuits.

2.5.3 Confirm colour of wiring devices and plates with Consultant prior to ordering.

2.5.4 **Receptacles**

2.5.4.1 125 volt 20 amp white U-ground Duplex Receptacle (CSA 5-20R)
Hubbell Catalogue No. HBL-5352-W

2.5.4.2 125 volt 20 amp white self-testing GFCI Duplex Receptacle (CSA 5-20R)
Hubbell Catalogue No. GFST20W

2.5.5 **Switches**

2.5.5.1 125 volt 20 amp white single pole switch
Hubbell Catalogue No. HBL-1221-W

2.5.6 **Cover Plates**

2.5.6.1 In general, use 302 stainless steel face plates for all flush-mounted devices and die-cast face plates for all surface-mounted devices.

2.5.6.2 All receptacles exposed to weather to have die-cast aluminum duplex gasketted spring door in-use covers.

2.5.7 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

Cooper
Hubbell
Leviton
Pass & Seymour

2.6 **DISCONNECT SWITCHES**

2.6.1 Unless specified otherwise, fused or unfused disconnect switches to be conditionally hp rated, heavy duty type with visible break industrial safety switches in general purpose or weatherproof enclosures as required.

2.6.2 For 120V mechanical equipment, provide Hubbell Cat. #B100 toggle switch complete with lockable cover.

2.6.3 For equipment above ceilings such as fans and heat pumps single phase and three phase 30A and below: Hubbell Cat # HBL1372 disconnect switch with aluminum housing or equivalent to be approved by Consultant.

2.6.4 For exterior roof mounted equipment single phase and three phase 30A and below: Hubbell Cat # HBL13R series NEMA 3R disconnect switch with aluminum housing. Or equivalent to be approved by Consultant.

2.6.5 The door to be mechanically interlocked with the operating handle to prevent it from being opened when the switch is in the “ON” position. The handle is to be capable of being padlocked in the “OFF” or “ON” position.

2.6.6 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

Eaton
Schneider
Siemens

2.7 **OVERCURRENT PROTECTIVE DEVICES - FUSES**

2.7.1 Provide fuses for all fusible equipment in this Contract.

2.7.2 Fuse interrupting rating is to be 200,000 amps RMS symmetrical unless otherwise noted.

2.7.3 Rated as noted on the Drawings, 600 volts AC, fuses will be CSA certified HRCI J/Class J Time Delay with dimensions and current limiting performance in accordance with CSA Specification C22.2 No. 106-05 or UL Standard 198C for Class J fuses. HRCI/JY fuses are not acceptable.

2.7.4 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Materials and Equipment”:

Cooper Bussmann
General Electric Power Controls
Littlefuse
Mersen

3 Execution

3.1 **GENERAL**

3.1.1 Unless shown otherwise, the minimum size of all raceways and conductors to be in accordance with the Ontario Electrical Safety Code.

3.2 **CONDUIT INSTALLATION**

3.2.1 Conceal all conduits except in equipment rooms, unfinished area, and where specifically noted. Flush mount all devices, starters, etc., in finished areas. Install all exposed conduits parallel to building walls and partitions.

3.2.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.2.3 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.2.4 Run parallel or perpendicular to building lines.

3.2.5 Run conduits in flanged portion of structural steel. Do not pass conduits through structural members except as indicated.

3.2.6 Group conduits wherever possible on suspended surface channels.

3.2.7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers. Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

3.2.8 Horizontal runs of conduit will not be permitted in walls unless noted otherwise.

3.2.9 In any case, horizontal runs must be located above level of door or transom frames in area.

3.2.10 Vertical conduits must be supported at each floor slab and at the top and bottom of each riser.

3.2.11 Conduits must be supported from building structure. Provide independent unistrut under obstructions such as ductwork for support as required. Support unistrut from structural members. Do not secure to underside of metal pan roof deck.

3.2.12 Conduit placement should follow the following priority:

- Below grade
- In walls or partitions
- In ceiling cavity
- Exposed

3.2.13 Maintain continuity of ground through all connection points. Use sealer lubricant on all threaded connections embedded in concrete, buried in ground or exposed outdoors.

3.2.14 Leave all conduit systems finished complete with outlet boxes, coverplates, bushings, caps, nylon fish wire, etc. Provide bushings for all sleeves.

3.3 CONDUCTORS

3.3.1 Join #8 AWG and larger conductors with compression connectors properly sized. On #10 AWG and smaller, relaxed wing-nut type connectors may be used. Ideal Industries 451, 452 or 453.

3.3.2 Size conductors for a maximum of 2% voltage drop from the supplying panel to the furthest outlet in the circuit. In calculating voltage drop, use 80% of overcurrent rating or design load where known, whichever is less.

3.3.3 Draw wiring into raceways only after all other work that may cause injury to the wire is completed. Use only wiring lubricants that do not shorten insulation life. Use continuous lengths for feeders to panels and large equipment. Do not splice without permission from Consultant.

3.4 GROUNDING

3.4.1 Ground all components of the Electrical system in accordance with the requirements of Section 10 of the Electrical Safety Code latest edition and the Inspection Authority.

3.4.2 **Provide a separate ground conductor in all raceways.**

3.4.3 Ground secondary neutrals of transformers to building ground conductor.

3.4.4 Where attached to equipment, conduits, cabinets, etc., use suitable approved solderless lugs, compression connectors. No soldered or split bolt type connections are to be used on grounding circuits at any point.

3.4.5 All compression connectors, lugs, etc., used in grounding circuits in any location are to have bolts, nuts, etc., of silicone bronze alloy equal to “Everdur” metal.

3.4.6 Clean all surfaces to which bus or cable are to be bolted, of all paint, rust, etc., and work to a bright, flat surface.

3.4.7 Conduit expansion joints and telescoping sections or metal raceways not thoroughly bonded otherwise, are to be provided with approved bonding jumpers or not less than #8 AWG stranded bare copper.

3.4.8 Provide a separate #14 green ground wire for all outlets connected to a GFCI circuit breaker.

3.5 OUTLET BOXES

3.5.1 Support all boxes independently of the conduits running to them. Use flush boxes in areas where concealed conduit is used.

3.5.2 Check the Drawings to ensure that no outlets are roughed-in at inaccessible locations, where built-in furniture, counters, etc., are to be installed. In such locations, install the outlets above and clear of the trim by approximately 100 mm (4″) unless shown otherwise on the Drawings.

3.5.3 **DO NOT INSTALL OUTLET BOXES OF ANY SYSTEM BACK TO BACK**. Offset as necessary to prevent sound transmission between areas.

3.6 WIRING DEVICES

3.6.1 Install light switches on lock jamb side of the door as finally hung. Check door swing before roughing-in. Install switches with the “ON” position up. Locate switch as close as practical to door jamb but not closer than 1″. Coordinate location with built-in and Owner supplied equipment and furnishings.

3.6.2 When two or more devices are grouped together, mount under a common coverplate unless shown otherwise.

3.6.3 Mount light switches at height as indicated on Drawings.

3.6.4 Mount duplex receptacles 25 mm (1″) above a countertop backsplash to bottom of device coverplate.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF WORK**

1.2.1 Provide panelboard circuit breakers as indicated on the drawings.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal.

2.1.2 This building will be fully sprinklered. Use sprinkler proof electrical equipment to prevent the sprinkler system water from entering electrical equipment for all surface mounted equipment.

2.1.3 Unless noted otherwise on the Drawings or in Specifications, user operated devices, display and controls shall be located between 125mm (5") and 1830mm (72") from bottom of floor mounted equipment.

2.2 **DISTRIBUTION EQUIPMENT**

2.2.1 **Distribution and Panelboard Circuit Breakers**

2.2.1.1 Unless noted otherwise on Drawings or panel schedules, circuit breakers are to be moulded case as rated below. Series rated breakers are not acceptable unless stated otherwise on the Drawings (ground fault breakers excluded).

2.2.1.2 Breakers are to be suitable for the panelboards provided. All breakers are to be bolted in place. Plug-in only type are not acceptable.

2.2.1.3 For 250V panelboards, main and branch breakers to be rated minimum 22,000 amperes RMS symmetrical at 208 or 240 volt.

2.2.1.4 For 600V panelboards, main and branch breakers to be rated minimum 22,000 amperes RMS symmetrical at 600 volt.

2.2.1.5 All circuit breakers smaller than 400A to be moulded case thermal-magnetic type providing inverse time-current tripping curves. Multi-pole breakers to have common-trip device with single handle.

2.2.1.6 All circuit breakers 400A and larger to have adjustable Long-time Short-time Instantaneous (LSI) solid state trip unit.

2.2.1.7 All 600V circuit breakers 1000A and larger, and all 208V circuit breakers 2000A and larger to have adjustable Long-time Short-time Instantaneous Ground Fault (LSIG) solid state trip unit. Each circuit breaker shall provide trip indication showing reason for trip (overload, short circuit, ground fault).

2.2.1.8 Shunt trip breakers to be 120V AC solenoid type. Electrically held shunt trip breakers are not acceptable.

2.2.1.9 Provide ground fault circuit interrupters breakers as indicated on Panel Schedules. Provide separate neutral conductors for each circuit. Unless noted otherwise, ground fault circuit interrupter breakers are Class A, Group 5mA.

2.2.1.10 Provide positive locking devices on the handles of breakers serving loads below. Trip units to remain free to function while locked in the ON position.

- exit signs
- emergency lighting and night light circuits
- Fire Alarm control panels
- Security System control panels
- door hardware

2.2.1.11 Provide quantity of spare breakers as called for on the Panel Schedules or Drawings

2.2.2 **Colour Coding**

2.2.2.1 Distribution Panelboards, panelboards and filler plates located in Electrical and Mechanical rooms are to be factory painted as follows. Paint inside of doors in finished areas.

Normal power - ASA grey

2.2.3 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

Eaton
Schneider
Siemens

3 Execution

3.1 **PANELBOARDS**

3.1.1 Provide new typewritten directories for all existing panelboards affected by work.

3.1.2 Contractor to provide updated schedules complete with room numbers. Trace out existing circuits as required.

3.1.3 Include room number and description of load for each breaker. For circuits serving mechanical equipment, indicate room number mechanical equipment serves. Coordinate on site with Division 15.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Lighting Systems**

1.2.1.1 Nominal 120 volt A.C.

1.2.1.2 Branch circuit wiring from 120/208 volt, 3 phase, 4 wire panelboards.

2 Products

2.1 **GENERAL**

2.1.1 Use materials specified herein or approved equal.

2.1.2 Use the product of only one manufacturer for each type of luminaire.

2.1.3 Refer to Luminaire Schedule on Drawings.

2.2 **LED LUMINAIRES**

2.2.1 All LED luminaires must bear an approved certification mark as per Ontario Electrical Safety Code Bulletin 2-7-29. A UL certification mark without the ‘c' is not an approved certification mark.

2.2.2 **Luminaires designed for LED lamps with integral driver** as specified below shall adhere to LED lamp manufacturer guidelines, certification programs, and test procedures for thermal management to guarantee the minimum lamp life and lumen maintenance as specified below.

2.2.3 **Luminaires designed with integrated custom LED’s.** shall be as specified on drawings or approved equal meeting the following requirements:

2.2.3.1 Only products from manufacturers that have been in the lighting manufacturing business for minimum of 10 years will be considered.

2.2.3.2 Modularity, shall be designed to allow for replacement of; driver, LED’s, without specialised tools and without removing luminaire from the ceiling.

2.2.3.3 Performance - LED luminaire with custom lamps must exceed LED lamp parameters specified below for efficacy and lumen maintenance by minimum 15%.

2.2.3.4 Lumen Maintenance - at least 70% of initial lumens for at least 50,000 hours.

2.2.3.5 Minimum luminous efficacy 50 lumens per watt (lm/W)

2.2.3.6 Warranty - Written warranty covering repair or replacement for a minimum of five (5) years from the date of purchase. Warranty must be included with maintenance manuals and have a toll-free (e.g., "800") number, or mailing address, or web site address for consumer complaint resolution and future LED replacement upgrade.

2.3 EXIT SIGNS

2.3.1 Signs to be suitable for wall and/or ceiling mounting and be provided with diffusers on the underside for down lighting and directional arrows in the face as indicated on the Drawings.

2.3.2 Signs to be green pictograms, Meeting CSA22.2 No. 141-10 with directonal pictograms and faces as shown on the drawings.

2.3.3 Provide an LED (light emitting diode) type light source, maximum 3 watts, 120/347 volt power supply.

2.3.4 Signs to meet CSA-C860-01 “Performance of Internally Lighted Exit Signs”.

2.3.5 Provide suitable clear acrylic guards as indicated on the Drawings.

2.3.6 Signs to be self-powered for 2 hours constructed from extruded, one-piece aluminum painted white, suitable for wall and/or ceiling mounting. To be Lumacell LA-3-W-S.

2.3.7 Combination exit/emergency lighting units to have die cast or extruded aluminum housing suitable for wall and/or ceiling mounting. Provide integral and remote 4W MR16 LED lamps as shown on the drawings. Unit to be 12 volt, capable of producing 50 watts for 1/2 hour at 120 volt, rated in accordance with CSA Standard C22-2-141. To be Lumancell LAC-2-W-1250-2-LD7.

2.3.8 The following manufacturers will be considered as equal subject to the requirements of Clause “Material and Equipment”:

AimLite
Beghelli Luxnet
Emergi-lite
Hubbell
Lithonia
Lumacell
Lumaid
Stanpro
Uniglo

2.4 EMERGENCY LIGHTING

2.4.1 Emergency lighting units are to be Lumacell RG12S-250-LD7 with or without two unit mounted floodlights and remote heads as shown on plans. Remote heads to be die-cast with white powder coat finish. All floodlights to be 4 watt LED MR16 type. Units to be 12 volt with an 8 year minimum battery life expectancy, capable of producing 250 watts for 1/2 hour at 120 volt, rated in accordance with CSA Standard C22-2-141.

2.4.2 Emergency lighting units located in Electrical Rooms and Generator Rooms are to be Lumacell RG12S-250-LD7 with or without two unit mounted floodlights and remote heads as shown on plans. All floodlights to be 4 watt LED MR16 type. Units to be 12 volt with an 8 year minimum battery life expectancy, capable of producing 83 watts for 2 hours at 12 volt, rated in accordance with CSA Standard C22-2-141.

2.4.3 The following manufacturers will be considered equal subject to requirements of Clause "Material and Equipment":

AimLite
Beghelli Luxnet
Emergi-lite
Hubbell
Lithonia
Lumacell
Lumaid
Stanpro
Uniglo

2.5 **LUMINAIRE NOISE**

2.5.1 All ballasted luminaires are to be manufactured to reduce noise below room ambient noise level.

2.5.2 Any luminaire or group of luminaires which can be heard above ambient noise are to be quietened or replaced at no additional cost to the Contract.

2.6 **SPARE LUMINAIRES**

2.6.1 Provide a quantity of 1% spare luminaries (minimum 1) of each type used on project and turn over to Owner at Substantial Completion.

3 Execution

3.1 **INDOOR LIGHTING**

3.1.1 Install luminaires complete with the necessary accessories, conduit supports, ball aligners, hangers, mounting yokes, etc.

3.1.2 Check the type of ceilings before placing an order for luminaires.

3.1.3 Provide independent supports from slabs or steel above hung ceilings. Luminaires are not to be supported solely by the hung ceiling. Nylon inserts are not on approved fastening method for poured concrete. Do not secure to underside of metal pan roof deck.

3.1.4 Obtain revised locations from the Consultant when pipes or ductwork interfere with the proper mounting location of recessed luminaires before roughing-in conduit.

3.1.5 Take all necessary precautions to ensure that all luminaires, diffusers and lamps are left clean at the completion of the job.

3.1.6 Ensure that all luminaires including ballasts and lamps are in good working order at the completion of the job. Replace at no extra cost any defective or burned-out lamps.

3.2 LUMINAIRES IN SUSPENDED CEILINGS

3.2.1 Provide adequate additional chain hanger supports for all luminaires in suspended ceiling systems to approval of the Consultant, and in accordance with Ontario Electrical Safety Code Bulletin No. 30-4-4.1996.

3.2.2 All existing luminaires to be removed and reinstalled are to have new chain hangers provided.

3.2.3 Coordinate with the Architect and Ceiling Contractor to determine which ceilings have been designed and constructed to carry the weight of the luminaires, so the support chains can be eliminated.

3.2.4 Ensure all luminaires are mechanically secured to the ceiling system with manufacturer approved clips.

3.3 LUMINAIRE SCHEDULE

3.3.1 Refer to Drawings for luminaire type and description.

3.4 EMERGENCY LIGHTING

3.4.1 Test emergency for 1/2 hour and verify that the entire system is working properly. Contractor is to complete the Emergency Lighting Test Form and providing a line item for each and every device. A sample copy of the form is attached in Appendix `A'. Submit a letter and the completed form indicating each device has been tested, prior to occupancy. Letter to state the following: "The emergency lighting system has been tested for 1/2 hour and is working in accordance with the Drawings and Specifications".

3.5 REPLACEMENT LUMINAIRES

3.5.1 Prior to ordering new luminaires to replace existing, Contractor to verify voltage of existing luminaires.

3.6 EXIT SIGNS

3.6.1 Locate exit signs as required to prevent obstruction from view. Mount on walls where possible.

3.6.2 Mount exit signs as required to prevent plumbing, structural supports, etc from obstructing view of exit sign. Provide pendant mounts as required for ceiling mounted signs.

END OF SECTION

A P P E N D I X “A”

Emergency Lighting Test Form

Emergency Lighting Test Form			
Project Name	XYZ Project, City		
C+B Project #	####		
Contractor Name	Your Name Electric Ltd.		
Date of Test	Day, Month, Year		
Device Type	**Device Location**	**Source (Battery # or CCT#)**	**Test Duration (min.)**

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Stand Alone Lighting Control**

1.2.1.1 Provide stand alone lighting control devices as shown on plans and specified herein.

1.3 **SUBMITTALS**

1.3.1 Submit a lighting control sequence of operation schedule with shop drawings outlining control sequence for each type of room. Group rooms with identical sequence of operation and indicate room numbers.

1.3.2 Schedule to identify number of lighting zones, zone type (switching or dimming), auto-on operation (to preset lighting level if applicable), auto-off operation, daylight harvesting, work plane height and illumination as specified herein.

2 Products

2.1 **GENERAL**

2.1.1 Use materials specified herein or approved equal.

2.1.2 In general, switches and automatic wall switches to match wiring device colour. Faceplates for low-voltage switches to match wiring device faceplates. Refer to Section 16100.

2.2 **LINE VOLTAGE OCCUPANCY SENSORS**

2.2.1 Provide a complete occupancy sensor control system in each room indicated completed with sensor, control wiring and mounting hardware as indicated and specified herein and in manufacturer installation manuals:

2.2.2 The following Sensors to be provided:

2.2.2.1 **DT-200 Dual Technology Sensor**

- 40 kHz frequency ultrasonic transmission
- Time delays: SmartSet (automatic), fixed (5, 10, 15, 20, or 30 minutes), walk-through, test-mode
- Sensitivity adjustment: SmartSet (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with trimpot
- Built-in light level sensor (DT-200) – works from 2 to 200 foot candles
- Low voltage, momentary switch input for manual operation
- DT-I relay with N/O and N/C outputs; rated for 1 Amp at 24 VDC/VAC
- 2000 sq ft of walking motion mounted at 10 ft; 1000 sq ft of desktop motion

2.2.2.2 **DT-300 Dual Technology Ceiling Sensor**

- 40 kHz frequency ultrasonic transmission
- Advanced Signal Processing automatically adjusts detection threshold
- User-adjustable DIP switch time delay and sensitivity settings
- Isolated relay allows sensor to interface with building control systems
- Omni-directional transmission (360° coverage)
- Temperature and humidity resistant receivers
- Digital DIP switch time delay (15 seconds to 30 minutes)

2.2.2.3 **DSW-100 Automatic Wall Switch**

- 100/230/277 VAC; 50/60 Hz operation
- Minor motion coverage of 15' x 15' major motion coverage of 35' x 30')
- Time delays: SmartSet (automatic), fixed (5,10,15,20,or 30 minutes), walk-through, test-mode
- Sensitivity adjustment: SmartSet (automatic) or reduced sensitivity
- Compatible with all electronic ballasts and PL lamp ballast systems
- Occupancy sensor to match wiring device colour

2.2.2.4 **DSW-200 Automatic Wall Switch**

- 100/230/277 VAC; 50/60 Hz operation
- Minor motion coverage of 15' x 15' major motion coverage of 35' x 30')
- Time delays: SmartSet (automatic), fixed (5,10,15,20,or 30 minutes), walk-through, test-mode
- Sensitivity adjustment: SmartSet (automatic) or reduced sensitivity
- Compatible with all electronic ballasts and PL lamp ballast systems
- Occupancy sensor to match wiring device colour
- 50% auto on, dual relay type

2.2.3 Unless otherwise indicated, provide the following models according to the symbol type:

Type	Symbol	Wattstopper Cat. No.	Mounting
1		DT-200	wall at ceiling
2		DT-300	ceiling
3		DSW-100/200	wall at switch height

2.2.4 Provide DT-355 dual technology line voltage ceiling sensors in storage and service rooms.

2.2.5 Provide wire guards over sensors where indicated, plated steel 5mm (1/4") wire suitable for flat wall or corner mounting.

2.2.6 All Occupancy Sensors to be from one manufacturer, UL and cUL listed and have five year warranty.

2.2.7 **Power Packs**

2.2.7.1 Power pack shall be self-contained transformer and relay module in a NEMA 1 plenum use acceptable enclosure.

2.2.7.2 Power pack shall have two isolated relays rated for 100,000 cycles capable of switching 20 amp load utilizing zero crossing circuitry to protect from effects of inrush current and increase life.

2.2.7.3 Power pack shall have a switch input for each relay output which accept three-wire momentary, two-wire momentary push-button, or maintained low voltage switches as well as 24 VDC voltage devices.

2.2.7.4 Power pack shall have 16mm thread nipple for mounting to junction boxes.

2.2.7.5 Power pack shall provide separate an independent inputs for occupancy sensor, photocell, time clock and load shed signal devices.

2.2.7.6 Power pack shall provide a 24 VDC 150 mA output, with the relay connected for powering other devices.

2.2.7.7 Power pack time input shall provide selectable control scenarios for: hold-ON, to keep lighting controlled by occupancy sensors ON during timed occupancy; ON-only, to allow switches to only turn lighting ON and not OFF during timed occupancy; auto-ON, to turn ON lighting loads at the beginning of timed occupancy; after hour shut-off, to provide local switch operation of lighting loads after hours and then shutting them off after a selectable override time period of 30 minutes, 1 hour, 2 hours, or 4 hours.

2.2.7.8 Power pack shall have a standard 5 year warranty and be UL and CUL listed.

2.2.7.9 To be Wattstopper BZ-150 or approved equal.

2.3 **ADDITIONAL SYSTEM COMPONENTS**

2.3.1 Provide auxiliary relays and other items as shown on the drawings:

3 Execution

3.1 **STAND ALONE LIGHTING CONTROL**

3.1.1 Program all occupancy sensors, where applicable, to SmartSet mode.

3.1.2 Program all occupancy sensors without SmartSet mode to a time delay of 20 minutes.

3.1.3 Demonstrate to consultant correct operation of occupancy and photo sensors.

3.1.4 Program all intelligent power packs for automatic ON operation of one circuit and manual ON operation of second circuit with automatic OFF operation for both circuits.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 The requirements of the Instructions to Bidders, the Contract Forms, the General Provisions as hereinbefore written will form a part of the following Specifications and the Contractor will consult them in detail for instructions governing the work.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Intercom System**

1.2.1.1 Provide new wiring, speakers and intercom stations as indicated on the drawings.

1.2.1.2 Extend existing intercom as indicated on the drawings.

1.2.1.3 **A copy of the PA/Intercom software must be turned over to the Owner complete with all passwords, etc., required to make programming modifications to the system. Proprietary programming software will not be acceptable.**

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal.

2.1.2 Conceal all wiring above finished suspended ceilings, except where otherwise noted.

2.1.3 **Speaker Assemblies**

2.1.3.1 **Ceilings**: Provide AEG 86-7025L-11 speaker assembly, complete with white round baffle, 25/70 volt transformer and speaker. Unit to be installed in AEG E10 backbox in ceiling tiles.

2.1.4 The following manufacturers will be considered equal :

Dukane MCS 350 TR Series
Carehawk CH-1000 Series
Telecor SL

3 Execution

3.1 **INTERCOM SYSTEM**

3.1.1 Provide a complete functioning intercom system as specified and as indicated on the Drawings.

3.1.2 Provide all conduits, outlet and wiring for a complete system. All cable to be CMP rated. CMR cable will not be permitted.

3.1.3 Cables to be colour coded to manufacturer's recommendation.

3.1.4 **Testing**

3.1.4.1 Entire system is to be installed and tested by a qualified sound technician.

3.1.4.2 Upon complete, test each station and provide a comprehensive room-by-room report to the Consultant.

3.1.4.3 Allow for a minimum of two hour's instruction of operation on two different occasions. (Total of four hours). First training session to be completed during the week before School starts, at a time suitable to the Users.

3.1.4.4 In addition to the above, provide a qualified person familiar with the operation of the system to assist the School Administration in the operation of the system between 0800 hours and 1000 hours on the first day of school.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Fire Alarm System**

1.2.1.1 Supply and install all equipment and accessories to extend the existing electrically supervised, coded, zoned fire alarm system by Edwards as described herein and as shown on plans. Fire alarm devices are to be in accordance with the Ontario Building Code and associated standards.

2 Products

2.1 **FIRE ALARM CONTROL PANEL**

2.1.1 Existing Fire Alarm Control Panel is Edwards QuickStart.

2.1.2 Consult with fire alarm manufacturer to determine accessories and wiring diagrams required to extend the existing fire alarm system. Extras will not be granted for failure to consult with fire alarm manufacturer.

2.2 **ADDRESSABLE DEVICES**

2.2.1 Provide suitable wire guards for all devices where indicated on the drawings.

2.2.2 **Photoelectric Smoke Detectors**: Addressable photoelectric smoke detectors to be Edwards SIGA-PS. Provide SIGA-SB standard sensor base, SIGA-RB sensor base with addressable supervised relay driver, or SIGA-AB4G audible base as indicated on the drawings.

2.2.3 **Automatic Heat Detectors**: Addressable fixed temperature/rate-of-rise sensing automatic heat detectors to be Edwards SIGA-HRD or SIGA-HFS with standard sensor base.

2.2.4 **Multi-Sensor Detectors**: Addressable combination photoelectric smoke detector and fixed temperature/rate-of-rise sensing automatic heat detector in one housing. To be Edwards SIGA-PHS. Provide SIGA-SB standard sensor base, SIGA-RB sensor base with addressable supervised relay driver, or SIGA-AB4G audible base as indicated on the drawings.

2.2.5 **Addressable Monitor Module**: For monitoring valves, flow switches, and conventional devices, Edwards SIGA-UM. Monitor modules shall be capable of powering 2-wire smoke detectors.

2.2.6 **Addressable Control Module:** Provide control relays to allow for various addressable control functions, Edwards SIGA-CR. Relays shall be rated for 0.5A at 120VAC. Relay to change to open state upon loss of communication.

2.2.7 **Zone Isolation Modules**: Provide isolator at zone separations, fire separations and where required by the manufacturer. Alternately provide SIGA-IB isolator bases.

2.2.8 **Power Isolation Modules**: Provide 24VDC power isolator at zone separations, fire separations and where required by the manufacturer.

2.3 **NOTIFICATION APPLIANCES**

2.3.1 Provide suitable wire guards for all devices where indicated on the drawings.

2.3.2 **Strobes (Ceiling Mounted):** Ceiling mounted strobe devices are to have white housing with red “FIRE” lettering with field selectable 15, 30, 75 or 110 candela, 1 Hz synchronized xenon high output strobe. Edwards GCF-VM.

2.3.3 Provide red adapter skirt for surface mounted devices on walls.

2.3.4 Provide tile bridge for all devices mounted in acoustic ceiling tile ceilings.

2.3.5 Provide wire guard with mounting plate where indicated on the drawings.

2.4 **PASSIVE GRAPHIC ANNUNCIATOR**

2.4.1 Provide passive graphic mounted adjacent to the main panel and annunciator panels. Graphic is to be minimum 410 mm x 410 mm (16″ x 16″) graphic outline of building, minimum five zone identification colour, mounted in a frame behind a acrylic faceplate with tamperproof screws of building identifying each zone.

2.4.2 The graphic is to be designed with each zone a different colour to the adjacent zone for easy identification. All zones are to be displayed and labelled same as annunciator. Location of fire alarm system panels to be shown on passive graphic.

2.4.3 In partially sprinklered buildings, identify areas that are sprinklered utilizing hatching.

2.4.4 Identify locations of supervised valves, flow switches and other fire suppression systems. Passive graphic, annunciator and field device identification tags must be displayed and labelled verbatim.

2.4.5 Floor plans to be shown in ‘track up’ orientation based upon location of passive graphic.

2.5 **WIRING**

2.5.1 Provide new wiring to conform with requirements of Ontario Electrical Safety Code Section 32, and applicable Codes and Standards. Size wiring in accordance with Class 2 requirements, but protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements.

2.5.2 General wiring with a floor area, conductors to be solid copper Securix II, Type 105°C PVC, 300 volt. Minimum size of any conductor: for alarm receiving circuits and remote annunciators, #16 AWG solid. Wire resistance in these circuits not to exceed 50 ohms. For audible signal circuits minimum #16 AWG solid. Voltage drop to any signal not to exceed 10%.

2.5.3 Conductors in multi-conductor cables to have allowable temperature rating of at least 105°C (200°F).

2.5.4 All conductors to be as per Ontario Electrical Safety Code and installed in metallic raceway.

2.5.5 Install conductors entirely independent of all other wiring and do not enter fixture, raceway, box or enclosure occupied by other wiring.

2.5.6 Splices will not be permitted unless otherwise indicated on the Drawings or specified. Where splices are necessary and approved by the Consultant, use approval metal contact electrical crimp type connectors.

2.5.7 All wiring must be clear of shorts, open and grounds on completion of work.

2.6 **MANUFACTURER**

2.6.1 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Materials and Equipment”:

Edwards

3 Execution

3.1 **FIRE ALARM SYSTEM INSTALLATION**

3.1.1 Fire alarm system installation to be in accordance with the latest edition of CAN/ULC S-524 “Standard for the Installation of Fire Alarm Systems”.

3.1.2 **Wiring**

3.1.2.1 Riser diagrams on drawings show general design intent. Obtain complete wiring diagrams from Fire Alarm manufacturer prior to rough-in.

3.1.2.2 Provide all wiring in conduit and in accordance with Fire Alarm equipment manufacturer's requirements.

3.1.2.3 Identify signal circuit, initiating circuit, auxiliary circuit and all other wiring at Fire Alarm control panel, annunciator, terminal boxes or elsewhere on completion of work with appropriate marking labels.

3.1.2.4 All conventional initiating wiring to be Class B.

3.1.2.5 Provide addressable loops as indicated. All addressable wiring to be Data Communications Link Style A (DCLA). Provide line isolation devices at every circuit/zone change and every fire separation crossing, per CAN/ULC-S524 which automatically opens circuit when line voltage drops to protect the rest of the loops on either side.

3.1.2.6 Addressable loops must have at least 30% spare capacity for addition of future devices. Do not exceed 140 devices total on any addressable loop.

3.1.2.7 All initiating and D.C. signal circuits extending from the fire alarm control to be current limited and protected, in accordance with Ontario Electrical Safety Code requirements.

3.1.2.8 The extended circuit wiring to each alarm receiving circuit or signal circuit is to be individually supervised with no common wiring.

3.1.2.9 Install all wiring in EMT metal conduit above ceilings, and surface in mechanical spaces, and in maintenance/storage spaces with exposed ceilings.

3.1.3 **Control Panels, Transponders and Annunciators**

3.1.3.1 Install the main control panel and annunciators as shown on the Drawings.

3.1.4 Passive graphic, annunciator and field device identification tags provided by Fire Suppression Contractor must be displayed and labelled verbatim.

3.1.4.1 Review zone identification with Fire Inspection Department prior to programming, labelling and manufacturing passive graphics.

3.1.5 **Devices**

3.1.5.1 Install detectors in accordance with CAN/ULC Standard S524 latest edition “Installation of Fire Alarm Systems”.

3.1.5.2 Location of devices shown on Drawings are approximate and must be adjusted to site conditions. If location of existing device to be replaced is not properly centred in individual rooms, adjust to suit.

3.1.6 Mount detectors on ceiling as per CAN/ULC Standard S524 standard unless otherwise specified herein, with the minimum and maximum distances as required for the respective type of detector, at the highest point where variations in ceiling height exist. Do not mount detectors on sides, on undersides, or less than 600 mm (20″) from walls, beams, joints, ducts, open web steel joists, bulkheads or any structure projecting below actual ceiling height and less than 450 mm (18″) from air handling or heating outlets.

3.1.7 Should interference from obstruction, lamp positions, air outlet or heat radiating surfaces be encountered in locating any detector where shown, locate the detector as near as possible to the indicated position, clear of obstacles, to the satisfaction of the Consultant, but maintain a clear space of 600 mm (24″) on the ceiling, below and around.

3.1.7.1 Duct detectors to be mounted in supply air ducts unless otherwise indicated on the Drawings.

3.1.7.2 Mount end of line resistors beside last device. Document location of end of line resistors and place inside fire alarm control panel and in maintenance manuals. Provide PTouch labels on end of line faceplates indicating circuits contained within.

3.1.8 Locate all addressable monitor modules adjacent to equipment being monitored.

3.1.9 Locate all addressable control modules for motors adjacent to starters/motor control centres or building automation control panels as site directed.

3.1.10 Locate all addressable control modules not controlling motors within 3' of device being controlled, where practicable.

3.1.11 **Ancillary Devices**

3.1.11.1 Provide independent addressable control modules for each ancillary device shutdown.

3.1.11.2 Verify operating voltage of door hold open devices and magnetic locks supplied by door hardware contractor for tie into new system. Provide necessary transformation or relays.

3.1.11.3 Unless specified otherwise, power door hold-open devices from nearest unswitched lighting circuit.

3.1.11.4 Shutdown of fans to occur at starter separate from building automation controls. Where single point connections are provided to mechanical equipment, connect to fire alarm shutdown contact on mechanical equipment control panel.

3.1.11.5 Door hold open devices and latch retraction hardware to be installed in accordance with Ontario Building Code clause 3.1.8.12.

3.1.11.6 Magnetic locks to be installed in accordance with Ontario Building Code clause 3.4.6.15(4).

3.2 VERIFICATION AND CERTIFICATION OF FIRE ALARM EQUIPMENT

3.2.1 The Contractor is to provide a full set of Electrical Drawings and Specifications to the fire alarm system representative prior to starting the verification of the fire alarm system. Failure to do so may require the entire fire alarm system to be reverified. Fire alarm system representative to review drawings and provide comments to Consultant prior to commencing verification.

3.2.2 All construction work must be complete before verification of fire alarm system is started. Any modifications to the fire alarm installation after the verification has been commenced will require the entire system to be reverified. Where partial occupancies occur, the fire alarm system for the area to be occupied (including control units) shall meet the requirements of this Standard. Upon system completion, those parts of the fire alarm system tested to this Standard shall be retested in accordance with the requirements of CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems, prior to the release of the Verification Report.

3.2.3 Fire alarm technician to review existing building prior to date of verification and review any existing conditions requiring repair. Submit report minimum one week before commencing verification. Consultant will review and issue appropriate instruction.

3.2.4 Where a field device is replaced, the device shall be verified in accordance with CAN/ULC-S537-04.

3.2.5 Testing of all flow switches is to be with actual water flow activation. Supervised valve switches and other supervisory zones to be tested by closing valves or replicating the abnormal condition.

3.2.6 The Contractor is to engage the services of the Fire Alarm manufacturer's representative to verify the fire alarm system in accordance with CAN/ULC-S537-04.

3.2.7 Test all voice communication systems throughout building. Adjust speaker taps as required to provide a minimum common intelligibility scale (CIS) score of 0.70. Evaluate each acoustically isolated space separately. Provide appropriate reports for review by Consultant. Reports to include room name and number, speaker tap wattage, SPL and CIS at no less than 2 locations per room.

3.2.8 During the period of inspection by the manufacturer's representative, make available to the manufacturer's representative as many electricians as designated by the manufacturer's representative to complete the verification within the specified time frame.

3.2.9 Contractor is to supply Consultant with a list of deficiencies indicating areas where installation deviates from ULC Standards or Ontario Building Code. This list will be reviewed and authorized or rejected by Consultant prior to acceptance of certificate.

3.2.10 **Inspection Certification:** On completion of the inspection and when all the above conditions have been complied with, the Contractor is to provide to the Consultant:

3.2.10.1 A verification report identical to Appendix C of CAN/ULC-S537 completed by the fire alarm manufacturer's technician. Document C1 from CAN/ULC-S537 must be signed and dated by the technician upon completion of the verification.

3.2.10.2 A certificate of verification confirming that the inspection has been completed showing the conditions upon which such inspection and certification have been rendered. Certificate must be free of conditions noted. No additional exceptions or conditions are acceptable.

3.2.10.3 Proof of liability insurance for the inspection.

3.2.10.4 A letter separate from the Verification Report stating “All door hold open devices, including latch retraction/release have been tested by the fire alarm verifier and are installed and working, in accordance with Ontario Building Code 3.1.8.12".

3.2.10.5 Provide ESA Inspection Certificate.

3.2.11 **Description of Fire Alarm System**

3.2.11.1 Upon completion of the project, provide to the Owner a copy of CAN/ULC-S536-13 Appendix E "Description of Fire Alarm System for Inspection and Test Procedures". Provide type written copy of this form and provide soft copy with maintenance manuals.

3.3 **FIRE WATCH - ALTERNATIVE MEASURES FOR OCCUPANT FIRE SAFETY**

3.3.1 In the event of any shutdown of fire protection equipment or part thereof, the Fire Department and building occupants/owner should be notified. Instructions should be posted as to alternate provisions or actions to be taken in case of an emergency. These provisions and actions should be acceptable to the Chief Fire Official and be in accordance with the accepted Fire Safety Plan.

3.3.2 An attempt to minimize the impact of inoperative equipment should be made (i.e. where portions of a sprinkler, fire alarm system and standpipe system are taken out of service, the remaining portions will be maintained). Assistance and direction for specific situations should be sought from the Fire Department and be in accordance with the accepted Fire Safety Plan.

3.3.3 Procedures to be followed in the event of shutdown of any part of a fire protection system are as follows:

3.3.3.1 Notify the Fire Department and the monitoring station. Give your name, address and a description of the work and when you expect it to be corrected. The Fire Department should be notified in writing of shutdowns longer than 24 h;

3.3.3.2 Post notices on all floors by elevators and at entrances, stating the work and when it is expected to be completed;

3.3.3.3 Unless noted otherwise in the Fire Safety Plan, have staff or other reliable person(s) patrol the affected area(s) at least once every hour; and

3.3.3.4 Notify the Fire Department, the fire signal receiving centre, and building occupants/owner when work has been completed and systems are operational.

3.4 ANCILLARY DEVICE OPERATION

3.4.1.1 All door hardware connected to fire alarm are to release upon general alarm.

3.4.1.2 Outputs to building automation system and lighting control systems to activate upon general alarm.

3.4.1.3 Connect fire alarm panel to ULC remote monitoring station. Coordinate with Owner.

3.4.1.4 Outputs to shutdown air handling equipment to activate only upon activation of <u>any</u> duct detector. General alarm is not to shut down air handling equipment.

3.5 INSPECTION COSTS

3.5.1 Include all costs involved with this inspection in the total Bid Price.

3.6 TESTING

3.6.1 Tests of the complete system in the presence of the Owner and the Consultant are to include:

3.6.1.1 Spot check of devices to ensure proper connections and supervision.

3.6.1.2 Operation of an alarm initiating device on each detection circuit is to verify the required operation of alarm devices, annunciators, etc.

3.6.1.3 Operation of all other alarm initiating devices in a convenient, silent method (buzzer, light, meter, etc.) are to ensure connection to the proper circuit and function of the device.

3.6.1.4 Live smoke or open flame are not to be used for testing.

3.6.1.5 Test each area in stages to match the Work Schedule.

3.6.1.6 Demonstrate to Consultant and Owner the operation of ancillary functions (ie maglock and door hardware release, elevator recall, etc).

3.6.2 Provide assistance to the Fire Inspection Department for testing a minimum of 25% of the installed field devices and up to 100% of sprinkler/ standpipe devices (supervised valves, flow switches, etc). Correct deficiencies and retest any devices or zones operating incorrectly as directed by the Fire Inspection Department.

3.6.3 **Integrated Systems Testing**

3.6.3.1 Provide Integrated Systems Testing as indicated in CAN/ULC-S1001-11 "Integrated Systems Testing of Fire Protection And Life Safety Systems.

3.6.3.2 Contractor to engage with Fire Alarm manufacturer at testing phase or a 3rd party commissioning type contractor to arrange for this work. In general, systems to be tested for proper integration with the fire alarm system are noted in CAN/ULC-S1001-11 and include but are not limited to elevators, cooking equipment fire suppression systems, hold-open devices, electromagnetic locks, smoke control systems, emergency generators, audio/visual and/or lighting controls, notification systems, sprinkler systems, standpipe systems, fire pumps, water supplies, water supply control valves, freeze protection systems, fixed fire suppression systems.

3.6.3.3 Contractor to provide to consultant for approval, all proposed testing procedures and proposed reports prior to commencing test.

3.6.3.4 Provide completed reports upon completion of fire alarm verification and submission of verification reports and certificate.

3.7 **TRAINING**

3.7.1 The Contractor shall provide 2 hours training for the complete operation of fire alarm system.

3.8 **SPARE PARTS**

3.8.1 Provide spare fire alarm system parts, including programming and verification, as follows (minimum of 2):

Automatic Initiation Devices	:	10% of each type installed
Manual Pull Stations	:	5% of units installed
Signal Appliances	:	5% of each type installed
Monitor Modules	:	10
Control Modules	:	10
Duct Detector Housing	:	2

3.8.2 Turn spare parts over to Owner at end of construction. Provide signed letter from Owner listing items and quantities of accessories confirming receipt, and include in electrical manuals.

END OF SECTION

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1 General

1.1 **GENERAL PROVISIONS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF WORK**

1.2.1 Provide electric hand dryers, as indicated.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal and must be CSA approved, ULC tested and listed.

2.2 **ELECTRIC HAND DRYERS**

2.2.1 Electric hand dryers to be no-touch type control, 120/208 volt single phase auto sensing, maximum 1500 watts, surface-mounted, stamped steel housing with white epoxy finish. Provide 5 year limited warranty.

2.2.2 Automatic, activated by infrared optical sensor. Operates while hands are under blower. Shut-off within 2 seconds when hands removed, or in 35 seconds if hands or other obstruction is not removed.

2.2.3 Combination Motor and Blower: vacuum type with automatic resetting thermal protector. 1/8 hp, 4800 RPM adjustable. Air velocity: 7300 LFM.

2.2.4 Heater: NiChrome resistance coil to provide an air temperature of 49°C (120°F) measured at average hand position of 102 mm (4″) below air outlet.

2.2.5 Sound level not to exceed 67 dB.

2.2.6 The following manufacturers will be considered as equal subject to the requirements of Clause “Material and Equipment”:

American Dryer Advantage AD Series

3 Execution

3.1 **ELECTRIC HAND DRYERS**

3.1.1 Mount electric dryers securely to wall, as indicated, to prevent easy removal.

3.1.2 Dryer units are not to be installed until all wall, ceiling and floor finishes are applied, and all work within the room space is completed. Any units installed and damaged will be replaced at the expense of this Contractor.

3.1.3 Mounting height and location of dryers:

3.1.3.1 In washrooms with one dryer, mount at barrier free level. In washrooms with two or more dryers, mount one at barrier free level.

3.1.3.2 Mounting heights: (from bottom edge of dryer):

Men's Washroom	1090 mm (43")
Women's Washroom	1041 mm (41")
Kindergarten Washroom	838 mm (33")
Barrier Free Washroom	889 mm (35")

3.1.3.3 Ensure a minimum clear floor space of 760mm by 1220mm (30" by 48") is provided in front of or parallel to hand dryers mounted at barrier free level.

3.1.3.4 Ensure hand dryers mounted at barrier free height are located within 610mm (24") horizontally from edge of barrier free lavatories or wash fountains. Notify Consultant prior to rough-in where hand dryer cannot be installed in this location.

3.1.3.5 Ensure a minimum of 510mm (20") is provided between adjacent hand dryers.

3.2 **TESTING AND CLEANING**

3.2.1 Inspect installation to verify secure and proper mounting. Test each dryer to verify operation, control functions, and performance. Correct deficiencies.

3.2.2 Clean surfaces and wash with mild soap.

END OF SECTION

LUMINAIRE SCHEDULE

TYPE	MANUFACTURER	MOUNTING		LAMPS	VOLTS	SYSTEM WATTS	EQUAL MANUFACTURERS	NOTES
		TYPE	HEIGHT					
B2	LITHONIA CAT # GTL4-30L-FW-EZ1-LP835 305mm x 1220mm RECESSED TROFFER, 3500K, A12 PATTERN ACRYLIC LENS, 0-10V DIMMING	RECESSED	CEILING	3000 LU LED	120	30W	CFI, COLUMBIA, METALUX, WILLIAMS, PINNACLE, PHILLIPS, STANPRO	
D2	LITHONIA CAT # ZL1N-L48-5000LM-FST-MVOLT-35K 1220mm LONG LED STRIP LIGHT, 3500K, 0-10V DIMMING	SURFACE	CEILING	5000 LU LED	120	34W	AXIS, CFI, COLUMBIA, METALUX, PHILLIPS, THOMAS, WILLIAMS	
J1	GOTHAM CAT # EVO-40/07-4AR-MD-LSS-MVOLT-EZ1 100mm APERTURE (ROUND) LED DOWNLIGHT, 4000K, 0-10V DIMMING	RECESSED	CEILING	750 LU LED	120	10.3W	CALCULITE, COOPER, ELITE LIGHTING, INTENSE LIGHTING, JUNO, LIGHTOLIER, PRESCOLITE, SALEX	CONFIRM FLANGE FINISH COLOUR AT SHOP DRAWING STAGE

NOTES:
1. REFER TO ARCHITECTURAL REFLECTED CEILING DRAWINGS TO CONFIRM LUMINAIRE MOUNTING PRIOR TO ORDERING, SUPPLY APPROPRIATE MOUNTING CLIPS AND/OR TRIMS AS REQUIRED.

MECHANICAL EQUIPMENT SCHEDULE

EQUIPMENT SUPPLIED AND INSTALLED BY DIVISION 15, WIRED BY DIVISION 16							CONTROL EQUIPMENT SUPPLIED AND INSTALLED BY DIVISION 16		BREAKER SIZE	POLES	CONDUCTOR SIZE	CONDUIT SIZE	
ITEM	DESCRIPTION	LOCATION	hp	MCA	PHASE	VOLTS	STARTER/CONTROL TYPE	FED FROM					NOTES
EF-1	EXHAUST FAN	ROOF	FHP		1	120	CON, OCC, DS	PANEL 'G'	15	1	2 #12	21mm	REFER TO EXHAUST FAN CONTROL SCHEMATIC
TF-1	TRANSFER FAN	ROOM 124	FHP		1	120	CON, DS	PANEL 'D'	15	1	2 #12	21mm	REFER TO EXHAUST FAN CONTROL SCHEMATIC

NOTES:

1. DIVISION 16 TO OBTAIN COPIES OF MECHANICAL EQUIPMENT SHOP DRAWINGS AND COORDINATE ELECTRICAL SERVICES.
2. PROVIDE LOCAL NON-FUSED DISCONNECT SWITCHES AT MOTORS IN ACCORDANCE WITH SECTION 28-604 OF THE ONTARIO ELECTRICAL SAFETY CODE.
3. UNLESS INDICATED OTHERWISE ALL CONTROL WIRING IS BY DIVISION 15.

MOTOR CONTROL ABBREVIATIONS

DC	DIRECT CONNECTION	H.O.A.	HAND OFF AUTO SELECTOR SWITCH
DS	UN-FUSED DISCONNECT SWITCH	MCA	MINIMUM CIRCUIT AMPACITY
FDS	FUSED DISCONNECT SWITCH	REC	DUPLEX RECEPTACLE
FHP	FRACTIONAL HORSE POWER	VFD	VARIABLE FREQUENCY DRIVE
FVNR	FULL VOLTAGE NON REVERSING STARTER c/w H.O.A. SWITCH	WP	WEATHER PROOF

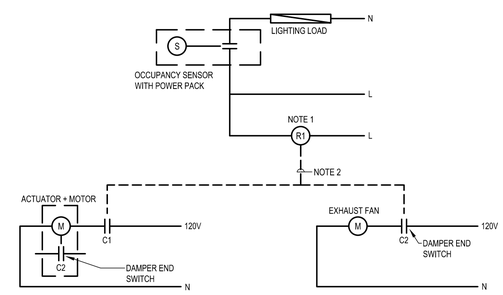
ELECTRICAL GENERAL NOTES

1. REFER TO ARCHITECTURAL AND MECHANICAL DRAWINGS, VISIT THE SITE AND BECOME THOROUGHLY FAMILIAR WITH THE EXISTING BUILDING, EQUIPMENT AND SYSTEMS TO DETERMINE THE FULL EXTENT OF DEMOLITION AND RENOVATION WORK.
2. RENOVATIONS SHALL BE MADE ON THE EXISTING BUILDING AS INDICATED ON THE DRAWINGS AND SPECIFIED HEREIN. REMOVE ALL REDUNDANT ELECTRICAL EQUIPMENT AND CONDUITS. ONLY CONDUITS AND DEVICE BOXES THAT ARE IN VERY GOOD CONDITION MAY REMAIN AND BE REUSED. ALL EQUIPMENT REMOVED AND NOT REUSED SHALL BE HANDED OVER TO THE OWNER AND/OR BE DISCARDED AT THE OWNER'S DISCRETION.
3. REMOVE, PROTECT AND REINSTALL IN THE SAME OR NEW LOCATION ON NEW SURFACES ALL EXISTING ELECTRICAL EQUIPMENT THAT WILL BE REUSED. EQUIPMENT IDENTIFIED FOR REUSE THAT IS LOST OR DAMAGED MUST BE REPLACED AT NO COST TO THE OWNER.
4. FISH FLEX CONDUIT THROUGH ALL EXISTING DRYWALL PARTITIONS, EXISTING FURRED WALLS, EXISTING DRYWALL CEILINGS AND EXISTING BLOCK WALLS FOR NEW LIGHTING, POWER AND COMMUNICATION DEVICES. IF WALLS CANNOT BE FISHED, PROVIDE V500/700 SURFACE RACEWAY AND ASSOCIATED SURFACE BOXES.

DRAWING LIST

ABBREVIATIONS

+XX	LOCATE XX ABOVE FINISHED FLOOR
AFF	ABOVE FINISHED FLOOR
C	CONDUIT
EX	EXISTING TO REMAIN
NL	NIGHT LIGHT
OC	OVER COUNTER - 230mm (9")
P	POLE
REL	IF DASHED - EXISTING TO BE RELOCATED
REL	IF SOLID - EXISTING IN NEW LOCATION
REM	EXISTING TO BE REMOVED
REP	EXISTING TO BE REPLACED WITH NEW



EXHAUST FAN CONTROL SCHEMATIC

N.T.S.

NOTES:

1. ALL RELAY COILS AND CONTACTS TO BE RATED A MINIMUM OF 30A AT 250V.
2. PROVIDE 2 #14 IN 1/2"C FROM RELAY TO OPERATE CONTACTORS FOR BOTH DAMPER AND EXHAUST FAN.
3. PROVIDE TIME DELAY OF 30 MINUTES TO OPERATE EXHAUST FAN AFTER OCCUPANCY IS LAST DETECTED.

ELECTRICAL LEGEND

SYMBOL	DESCRIPTION	MOUNTING
LIGHTING		
A	LED LUMINAIRE - NORMAL POWER	SEE LUMINAIRE SCHEDULE
A	LED LUMINAIRE - NORMAL POWER	SEE LUMINAIRE SCHEDULE
A	LED LUMINAIRE - NORMAL POWER	SEE LUMINAIRE SCHEDULE
EX	EXIT SIGN WITH OR WITHOUT DIRECTIONAL ARROWS	CEILING MOUNTED
EX	EXIT SIGN WITH OR WITHOUT DIRECTIONAL ARROWS	WALL MOUNTED AT CEILING
	EMERGENCY BATTERY PACK c/w DUAL HEADS	WALL MOUNTED
	EMERGENCY LIGHT REMOTE HEAD	SURFACE MOUNTED
	EMERGENCY LIGHT REMOTE DUAL HEAD	SURFACE MOUNTED
	OCCUPANCY SENSOR	WALL MOUNTED AT CEILING
	OCCUPANCY SENSOR	CEILING MOUNTED
$	SINGLE POLE SWITCH	1100mm (43") A.F.F.
	OCCUPANCY SENSOR SWITCH	1100mm (43") A.F.F.
POWER		
	15/20 AMP 120 VOLT 3 WIRE GROUNDED DUPLEX RECEPTACLE CSA 5-20R	460mm (18") A.F.F.
	15/20 AMP 120 VOLT 3 WIRE GROUNDED DUPLEX RECEPTACLE CSA 5-20R	ABOVE COUNTER
	TWO 15/20 AMP 120 VOLT 3 WIRE GROUNDED DUPLEX RECEPTACLE CSA 5-20R	460mm (18") A.F.F.
	DIRECT POWER	460mm (18") A.F.F.
R	50 AMP 250 VOLT 4 WIRE GROUNDED RANGE RECEPTACLE	200mm (8") A.F.F.
T	TRANSFORMER	AS NOTED
H	BARRIER FREE PUSH BUTTON	
	MOTOR	
	FUSED DISCONNECT SWITCH	
	ELECTRICAL PANEL	SEE PANEL SCHEDULE
FIRE ALARM		
	SMOKE DETECTOR	CEILING MOUNTED
	135°F RATE-OF-RISE TEMPERATURE FIRE DETECTOR	CEILING MOUNTED
F	135°F FIXED TEMPERATURE FIRE DETECTOR	CEILING MOUNTED
	SMOKE ALARM	CEILING MOUNTED
	PULL STATION	1200mm (47-1/4") A.F.F.
ST	PULL STATION c/w STI STOPPER II COVER	1200mm (47-1/4") A.F.F.
	FIRE ALARM HORN	WALL 2235mm (88") A.F.F.
	FIRE ALARM HORN c/w VISUAL SIGNAL	WALL 2235mm (88") A.F.F.
	FIRE ALARM VISUAL SIGNAL	CEILING MOUNTED
	ADDRESSABLE CONTROL MODULE	
	ADDRESSABLE MONITOR MODULE	
	MAGNETIC DOOR HOLD OPEN DEVICE BY DIVISION 16	AS NOTED
EOLR	END OF LINE RESISTOR	1800mm (70") A.F.F.
FAA	FIRE ALARM ANNUNCIATOR PANEL	1800mm (70") A.F.F. TO TOP OF UNIT
FACP	FIRE ALARM CONTROL PANEL	1800mm (70") A.F.F. TO TOP OF UNIT
UNIVERSAL WASHROOM		
ECS	EMERGENCY CALL STATION AND INDICATOR ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	1100mm (43") A.F.F.
CDL	CORRIDOR DOME LIGHT AND AUDIBLE ALARM ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	2200mm (86") A.F.F.
ADLS	AUTOMATIC DOOR LOCK SENSOR ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	1100mm (43") A.F.F.
OWL	OCCUPIED WHEN LIT ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	1100mm (43") A.F.F.
DJS	DOOR JAM DOOR STRIKE ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	
PDO	POWER DOOR OPERATOR AND INDICATOR ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	REFER TO ARCHITECTURAL DRAWINGS
PTLB	PUSH TO LOCK BUTTON ROUGH-IN ONLY (c/w BLANK COVER PLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE)	REFER TO ARCHITECTURAL DRAWINGS
SECURITY		
SSCP	SECURITY SYSTEM CONTROL PANEL	1800mm (70") A.F.F. TO TOP OF UNIT
KP	SECURITY SYSTEM ARM/DISARM KEY PAD	1195mm (47") A.F.F.
D	DOOR POSITION SWITCH - CONCEALED	DOOR FRAME
M	MOTION DETECTOR	WALL AT CEILING
COMMUNICATIONS		
	SINGLE DEVICE BOX c/w BLANK COVERPLATE AND 21mm CONDUIT TO ACCESSIBLE CEILING SPACE	460mm (18") A.F.F.
	DATA OUTLET	460mm (18") A.F.F.
	DATA AND TELEPHONE OUTLET	460mm (18") A.F.F.
IC	INTERCOM SPEAKER WITH CALL SWITCH	1100mm (43") A.F.F.
PS	PAGING SPEAKER	CEILING MOUNTED
WIRING AND CONDUIT		
	GENERAL CIRCUIT CONDUIT	

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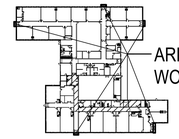
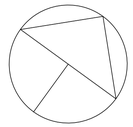


KEY PLAN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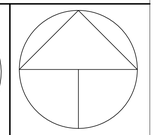
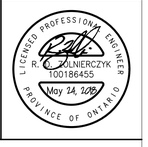

CONSTRUCTION NORTH

NOTES

LEGEND

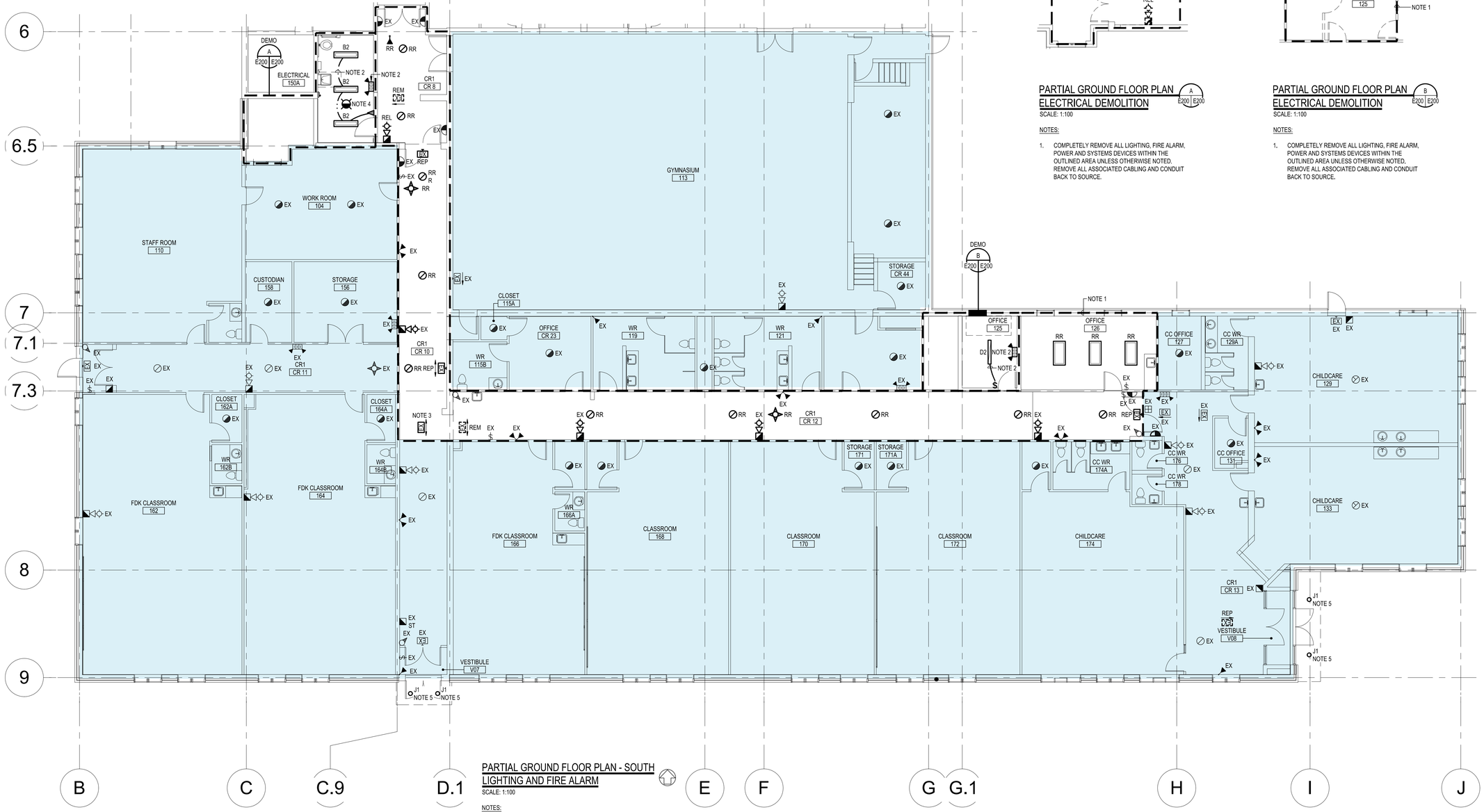
Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001



PROJECT TITLE
OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE

DRAWING TITLE
ELECTRICAL LEGEND, DRAWING LIST, SCHEDULES, ABBREVIATIONS, SITE PLAN AND ELECTRICAL GENERAL NOTES

DATE	DRAWN BY	DRAWING No.
05/23/18	ZJRL	E100
SCALE: AS NOTED	CHECKED BY: MFM	
PROJECT No.: 8391.3		

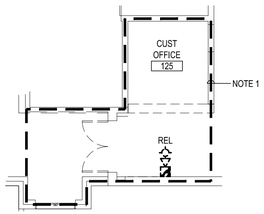


PARTIAL GROUND FLOOR PLAN - SOUTH LIGHTING AND FIRE ALARM

SCALE: 1:100

NOTES:

1. EXISTING DEVICES SHOWN FOR REFERENCE PURPOSES ONLY. UNLESS OTHERWISE NOTED, COMPLETELY REMOVE AND REINSTALL ALL CEILING MOUNTED LIGHTING AND FIRE ALARM DEVICES WITHIN THE OUTLINED AREA.
2. CONNECT TO EXISTING CORRIDOR CR-8 CIRCUIT SERVING LIGHTING IN THE AREA.
3. EXTEND/REWORK EXISTING CIRCUIT TO NEW LOCATION.
4. EXTEND/REWORK EXISTING FIRE ALARM ZONE TO INCLUDE NEW DEVICE. COORDINATE WITH FIRE ALARM MANUFACTURER (EDWARDS).
5. CONNECT TO EXISTING CIRCUIT SERVING OUTDOOR LIGHTING IN THE AREA..



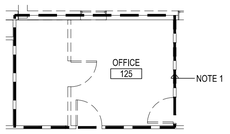
PARTIAL GROUND FLOOR PLAN ELECTRICAL DEMOLITION

A E200 E200

SCALE: 1:100

NOTES:

1. COMPLETELY REMOVE ALL LIGHTING, FIRE ALARM, POWER AND SYSTEMS DEVICES WITHIN THE OUTLINED AREA UNLESS OTHERWISE NOTED. REMOVE ALL ASSOCIATED CABLING AND CONDUIT BACK TO SOURCE.



PARTIAL GROUND FLOOR PLAN ELECTRICAL DEMOLITION

B E200 E200

SCALE: 1:100

NOTES:

1. COMPLETELY REMOVE ALL LIGHTING, FIRE ALARM, POWER AND SYSTEMS DEVICES WITHIN THE OUTLINED AREA UNLESS OTHERWISE NOTED. REMOVE ALL ASSOCIATED CABLING AND CONDUIT BACK TO SOURCE.

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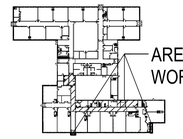

KEY PLAN

TRUE NORTH

CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
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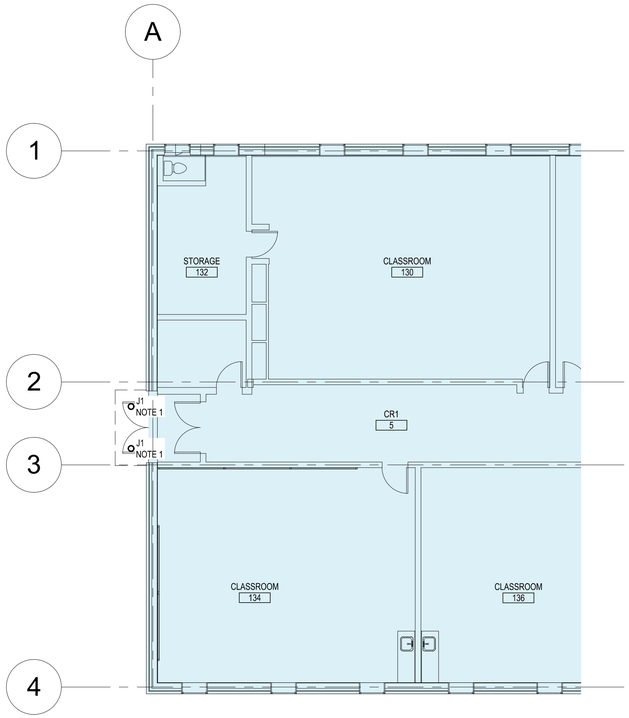
LICENSED PROFESSIONAL ENGINEER
R. D. OLNIERCZYK
100186455
May 24, 2018
PROVINCE OF ONTARIO

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
PARTIAL GROUND FLOOR PLAN - SOUTH
LIGHTING AND FIRE ALARM

DATE	DRAWN BY	DRAWING No.
05/23/18	ZJRL	E200
SCALE: AS NOTED	CHECKED BY: RDZ	
PROJECT No.: 8391.3		

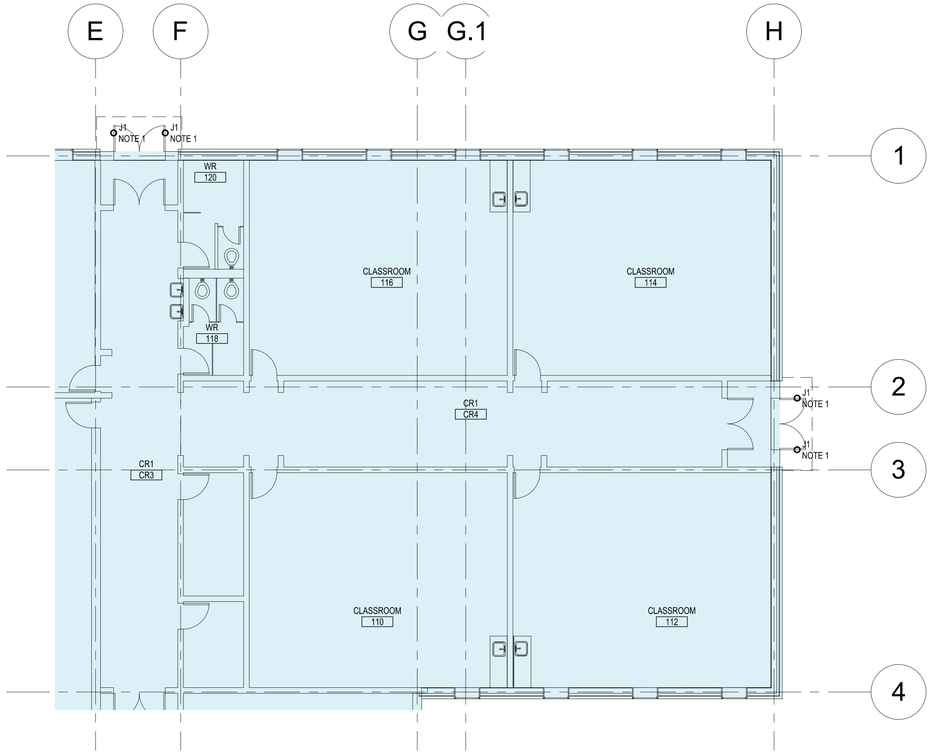


PARTIAL GROUND FLOOR PLAN - NORTH WEST - LIGHTING AND FIRE ALARM

SCALE: 1:100

NOTES:

1. CONNECT TO EXISTING CIRCUIT SERVING OUTDOOR LIGHTING IN THE AREA.



PARTIAL GROUND FLOOR PLAN - NORTH EAST - LIGHTING AND FIRE ALARM

SCALE: 1:100

NOTES:

1. CONNECT TO EXISTING CIRCUIT SERVING OUTDOOR LIGHTING IN THE AREA.

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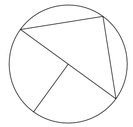
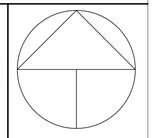
KEY PLAN



TRUE NORTH



CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
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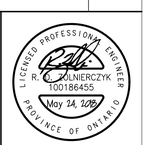


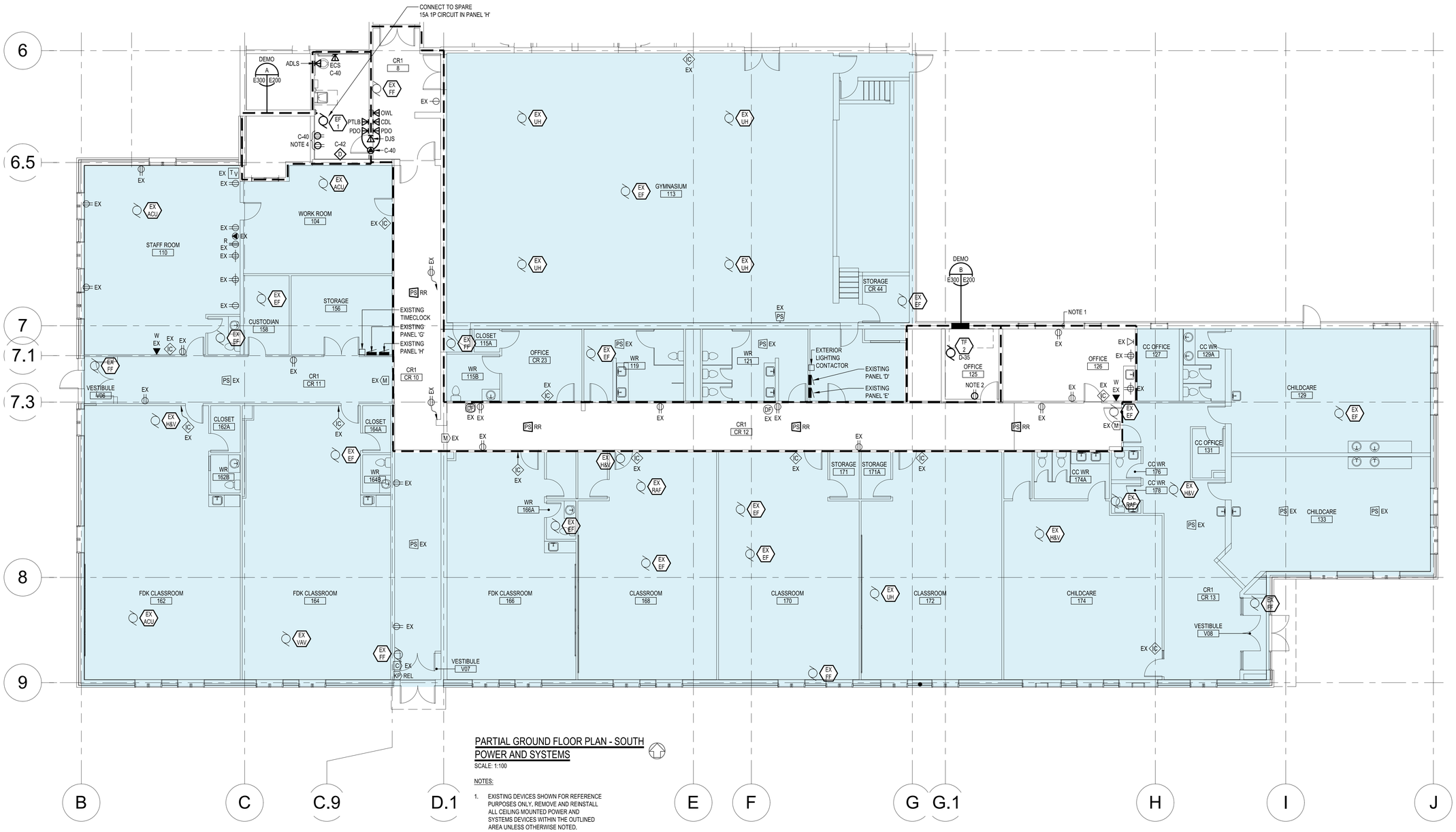
PROJECT TITLE

OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE

PARTIAL GROUND FLOOR PLANS - NORTH WEST AND NORTH EAST
LIGHTING AND FIRE ALARM

DATE	DRAWN BY	DRAWING No.
05/23/18	ZJRL	E201
SCALE: AS NOTED	CHECKED BY: RDZ	
PROJECT No.: 8391.3		



PARTIAL GROUND FLOOR PLAN - SOUTH POWER AND SYSTEMS

SCALE: 1:100

NOTES:

1. EXISTING DEVICES SHOWN FOR REFERENCE PURPOSES ONLY, REMOVE AND REINSTALL ALL CEILING MOUNTED POWER AND SYSTEMS DEVICES WITHIN THE OUTLINED AREA UNLESS OTHERWISE NOTED.
2. CONNECT TO CIRCUIT SERVING RECEPTACLES IN THE AREA.
3. PROVIDE TO NEW 1P CIRCUITS IN PANEL 'C'. PROVIDE NEW BREAKERS TO SUIT EXISTING WESTINGHOUSE PANEL AS PER BELOW:
   - 3.1. C-40 = 20A 1P
   - 3.2. C-42 = 20A 1P
   - 3.3. D-35 = 15A 1P
4. MOUNT ONE RECEPTACLE AT 280mm TO TOP OF PLATE AND ONE RECEPTACLE AT 2200mm TO TOP OF PLATE.

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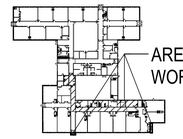
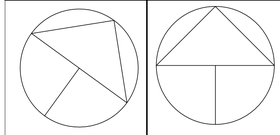


KEY PLAN



NOTES

LEGEND

Date	Description	No.
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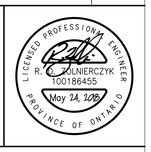

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
PARTIAL GROUND FLOOR PLAN
POWER AND SYSTEMS

DATE	DRAWN BY	DRAWING No.
05/23/18	ZJRL	E300
SCALE: AS NOTED	CHECKED BY: RDZ	
PROJECT No.: 8391.3		

MECHANICAL LEGEND

SYMBOL	DESCRIPTION
— - —	DOMESTIC COLD WATER
— - - —	DOMESTIC HOT WATER
— - - - —	DOMESTIC HOT WATER RETURN
— SAN —	SANITARY DRAIN
— ST —	STORM DRAIN
— HPWR —	HEAT PUMP WATER RETURN
— HPWS —	HEAT PUMP WATER SUPPLY
— HWR —	HOT WATER HEATING RETURN
— HWS —	HOT WATER HEATING SUPPLY
— G —	NATURAL GAS
—NAME(E)—	EXISTING PIPING TO REMAIN
-x-NAME(E)-x-	EXISTING PIPING TO BE REMOVED
— — NAME — —	PIPING BELOW FLOOR OR GRADE
	SHUT OFF VALVE
	CHECK VALVE
	COMBINATION SHUT-OFF, BALANCE & CHECK VALVE
	PRESSURE REDUCING VALVE
	TWO-WAY CONTROL VALVE
	THREE-WAY CONTROL VALVE
TPV	TEMPERATURE-PRESSURE RELIEF VALVE (TPV) OR PRESSURE RELIEF VALVE (RV)
	BALL VALVE
	BALANCING VALVE
FCV	FLOW CONTROL VALVE
	COMBINATION SHUT-OFF & BALANCING VALVE
	PRESSURE GAUGE COCK

SYMBOL	DESCRIPTION
	DRAIN WITH HOSE CONNECTION
	UNION
	PIPE ANCHOR
CO	CLEANOUT IN WALL
CO	CLEANOUT PLUG
CO	CLEANOUT IN FLOOR
	CONCENTRIC REDUCER
	STRAINER
	STRAINER C/W BLOW OFF
	PIPE ALIGNMENT GUIDE
	AIR SEPARATOR
	FLEXIBLE CONNECTOR
EJ	EXPANSION JOINT (EJ) OR EXPANSION COMPENSATOR (EC)
RT	RUNNING TRAP
	CAP
AV	AUTOMATIC AIR VENT
MV	MANUAL AIR VENT
FD	FLOOR DRAIN
OH	OPEN HUB DRAIN
FFD	FUNNEL FLOOR DRAIN
SCD	SCUPPER DRAIN
RD	ROOF DRAIN
PSD	PUMP SUCTION DIFFUSER
	BACK FLOW PREVENTOR
	COLD WATER MAKE-UP STATION
	FLANGES
	PUMP

SYMBOL	DESCRIPTION
G M	GAS METER
W M	WATER METER
	THERMOMETER
	PRESSURE GAUGE
T	TEMPERATURE SENSOR
H	HUMIDITY SENSOR
P	PRESSURE SENSOR
T	THERMOSTAT
	CONCEALED SPRINKLER HEAD C/W GUARD
	UPRIGHT SPRINKLER HEAD C/W GUARD
FEX	FIRE EXTINGUISHER - SURFACE MOUNTED
FEX	FIRE EXTINGUISHER - RECESSED
	FIRE DEPARTMENT CONNECTION
	EXISTING DUCTWORK TO REMAIN - SINGLE LINE
	EXISTING DUCTWORK TO BE REMOVED - SINGLE LINE
	NEW DUCTWORK - SINGLE LINE
	EXISTING DUCTWORK TO REMAIN
	EXISTING DUCTWORK TO BE REMOVED
	NEW DUCTWORK
	FLAT OVAL DUCTWORK
	FLEXIBLE DUCTWORK

SYMBOL	DESCRIPTION
	INTERNALLY INSULATED DUCTWORK
BD	BALANCING DAMPER
FD	FIRE DAMPER
	OPPOSED BLADE DAMPER - AUTOMATIC OPERATOR
	ACCESS DOOR
AD	ACCESS DOOR ON SIDE OF DUCTWORK
	HEAT PUMP UNIT
	UNIT HEATER
	WALL-FIN ENCLOSURE AND ELEMENT
	FORCE FLOW HEATER OR FAN COIL UNIT
	SUPPLY DIFFUSER/GRILLE/REGISTER
	RETURN GRILLE/REGISTER
	EXHAUST GRILLE/REGISTER
A1	PLUMBING FIXTURE TAG DESIGNATION
③	HEATING ELEMENT WITH THREE WAY CONTROL VALVE
0.00 GPM	VALVE FLOW RATE
EF-1 / EF 201	MECHANICAL EQUIPMENT TAG
A-1 / 24	TYPE; ELEMENT LENGTH (INCHES OR MM) — WALL-FIN/CONVECTOR DESIGNATOR
HP / 420	TYPE; DESIGNATOR — HEATING EQUIPMENT DESIGNATOR (TYPE- HP HEAT PUMP; UH UNIT HEATER; FF FORCE FLOW UNIT)
SD-1 / 100	TYPE; AIR QUANTITY (L/S) — DIFFUSER/REGISTER/GRILLE DESIGNATOR
BAL / 100	TYPE; AIR QUANTITY (L/S) — BALANCE EXISTING DIFFUSER/REGISTER/GRILLE DESIGNATOR

FANS

DRAWING REFERENCE	LOCATION	SERVICE	MANUFACTURER	MODEL	AIR VOLUME (L/s)	STATIC PRESSURE (Pa)	FAN RPM	BRAKE HP	MOTOR HP	ELECTRICAL V/Ph/Hz	INTEL SOUND POWER LEVELS (10^{-12} WATTS)							REMARKS
											1	2	3	4	5	6	7	8	
EF-1	MECH 150B	ROOM 152	PANASONIC	FV-10NLF1	25	75	1,590	-	FHP	120/1/60	34	35	29	33	35	36	32	25	
TF-2	ROOM 124	ABANDONED SPACE	PANASONIC	FV-30NLF1	160	50	1,247	-	FHP	120/1/60	-	-	-	-	-	-	-	-	

HEATING UNITS

DRAWING REFERENCE	MANUFACTURER	MODEL	SIZE (LENGTH X HEIGHT X DEPTH (mm))	CAPACITY (W)	ELECTRICAL (V/Ph/Hz)	MOTOR HP	REMARKS
A-1	SIGMA	SWE-18S	AS PER DRAWING TAG	910 W/m	-	-	ENCLOSURE LENGTH AS SHOWN ON DRAWINGS, 1 ROW
A-2	SIGMA	SWE-24S	AS PER DRAWING TAG	1,315 W/m	-	-	ENCLOSURE LENGTH AS SHOWN ON DRAWINGS, 2 ROW

GRILLES, REGISTERS AND DIFFUSERS

DRAWING REFERENCE	MANUFACTURER	MODEL	PANEL SIZE (mm)	NECK SIZE (mm)	AIR VOLUME (L/s)	REMARKS
SD-1	PRICE	SPD/31/B12	610x610	200Ø	66-110	STEEL CONSTRUCTION SQUARE PLAQUE DIFFUSER, EQUALIZING GRID, WHITE FINISH
SG-1	PRICE	520D/F/L/B15	-	300x200	0-160	STEEL CONSTRUCTION, DOUBLE DEFLECTION, CONCEALED FASTENING, VOLUME DAMPER, ALUMINUM FINISH
RG-1	PRICE	PDDR/3/B12	610x610	560x560	0-790	STEEL CONSTRUCTION PERFORATED FACE GRILLE, HINGED FACE, WHITE FINISH
EG-1	PRICE	80/F/B12	250x250	250x250	0-140	EXTRUDED ALUMINUM CONSTRUCTION EGG CRATE GRILLE, ALUMINUM GRID CORE, FLAT BORDER, WHITE FINISH

MECHANICAL DRAWING LIST

ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR
AHU	AIR HANDLING UNIT
APPROX	APPROXIMATE
COND	CONDENSER
CTE	CONNECT TO EXISTING
DB	DECIBEL
D.B.	DRY-BULB TEMPERATURE
E.A.T.	ENTERING AIR TEMPERATURE
EA	EXHAUST AIR
EF	EXHAUST FAN
EG	EXHAUST AIR GRILLE
EST.	ESTIMATED
ET	EXPANSION TANK
E.W.T.	ENTERING WATER TEMPERATURE
F	FAHRENHEIT
FA	FACE AREA
FHP	FRACTIONAL HORSEPOWER

HP	HEAT PUMP
HP	HORSEPOWER
HR	HOURS
HWRT	DOMESTIC HOT WATER RETURN
HX	HEAT EXCHANGER
KW	KILOWATT
L/S	LITRES PER SECOND
L.A.T.	LEAVING AIR TEMPERATURE
L.W.T.	LEAVING WATER TEMPERATURE
MAX	MAXIMUM
MCA	MINIMUM CIRCUIT AMPACITY
MIN	MINIMUM
M/S	METRES PER SECOND
NC	NORMALLY CLOSED
NO	NORMALLY OPEN

NO	NUMBER
NTS	NOT TO SCALE
O/A	OUTSIDE AIR
Pa	PASCALS
RA	RETURN AIR
RG	RETURN AIR GRILLE
RH	RELATIVE HUMIDITY
RPM	REVOLUTIONS PER MINUTE
RR	RETURN AIR REGISTER
SA	SUPPLY AIR
SD	SUPPLY AIR DIFFUSER
SENS	SENSIBLE
SG	SUPPLY AIR GRILLE
SP	STATIC PRESSURE
W.B.	WET-BULB

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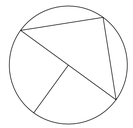
OTTAWA ON, K1R 6K7

KEY PLAN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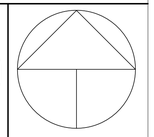

CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

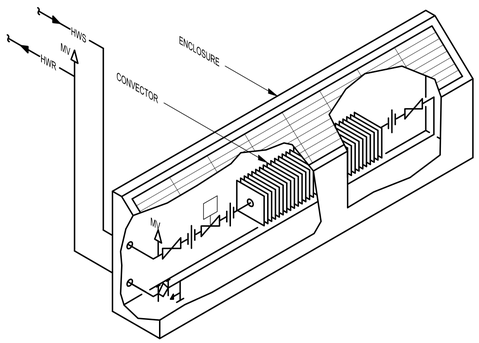
8391.3

LICENSED PROFESSIONAL ENGINEER
JOHN DAVID FOSTER
100148736
MAY 23, 2018
PROVINCE OF ONTARIO

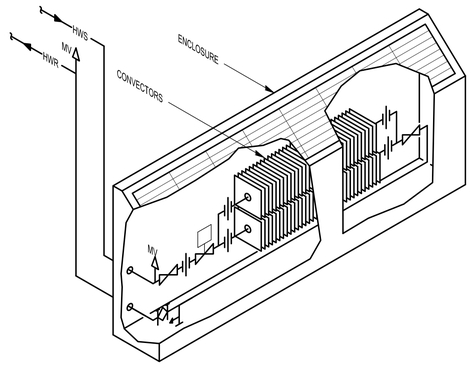
PROJECT TITLE
OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE

DRAWING TITLE
MECHANICAL LEGEND, ABBREVIATIONS, SCHEDULES & DRAWING LIST

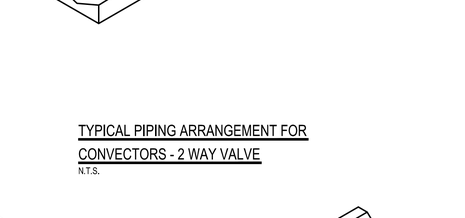
DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M101
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



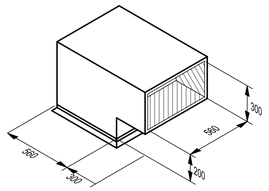
TYPICAL PIPING ARRANGEMENT FOR CONVECTORS - 2 WAY VALVE
N.T.S.



TYPICAL PIPING ARRANGEMENT FOR CONVECTORS W/ 2 ROWS - 2 WAY VALVE
N.T.S.



TYPICAL RUNOUT TO SUPPLY DIFFUSER
N.T.S.

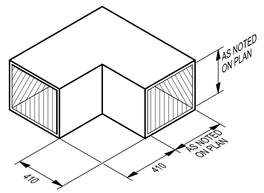


RG-1

CEILING RETURN GRILLE & BOOT DETAIL
N.T.S.

NOTE:

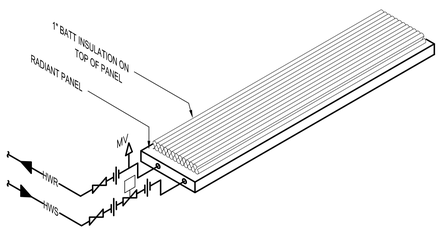
1. INTERNALLY LINE DUCTWORK.



TRANSFER DUCT DETAIL
N.T.S.

NOTE:

1. INTERNALLY LINE DUCTWORK.



TYPICAL PIPING ARRANGEMENT FOR RADIANT PANELS - 2 WAY VALVE
N.T.S.

NOTE:

1. PROVIDE MEMORY STOP ON HWR BALL VALVE FOR BALANCING PURPOSES.

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LONDON ON, N6B 3R4

250 CITY CENTRE AVE., SUITE 403
OTTAWA ON, K1R 6K7

KEY PLAN

TRUE NORTH

CONSTRUCTION NORTH

NOTES

LEGEND

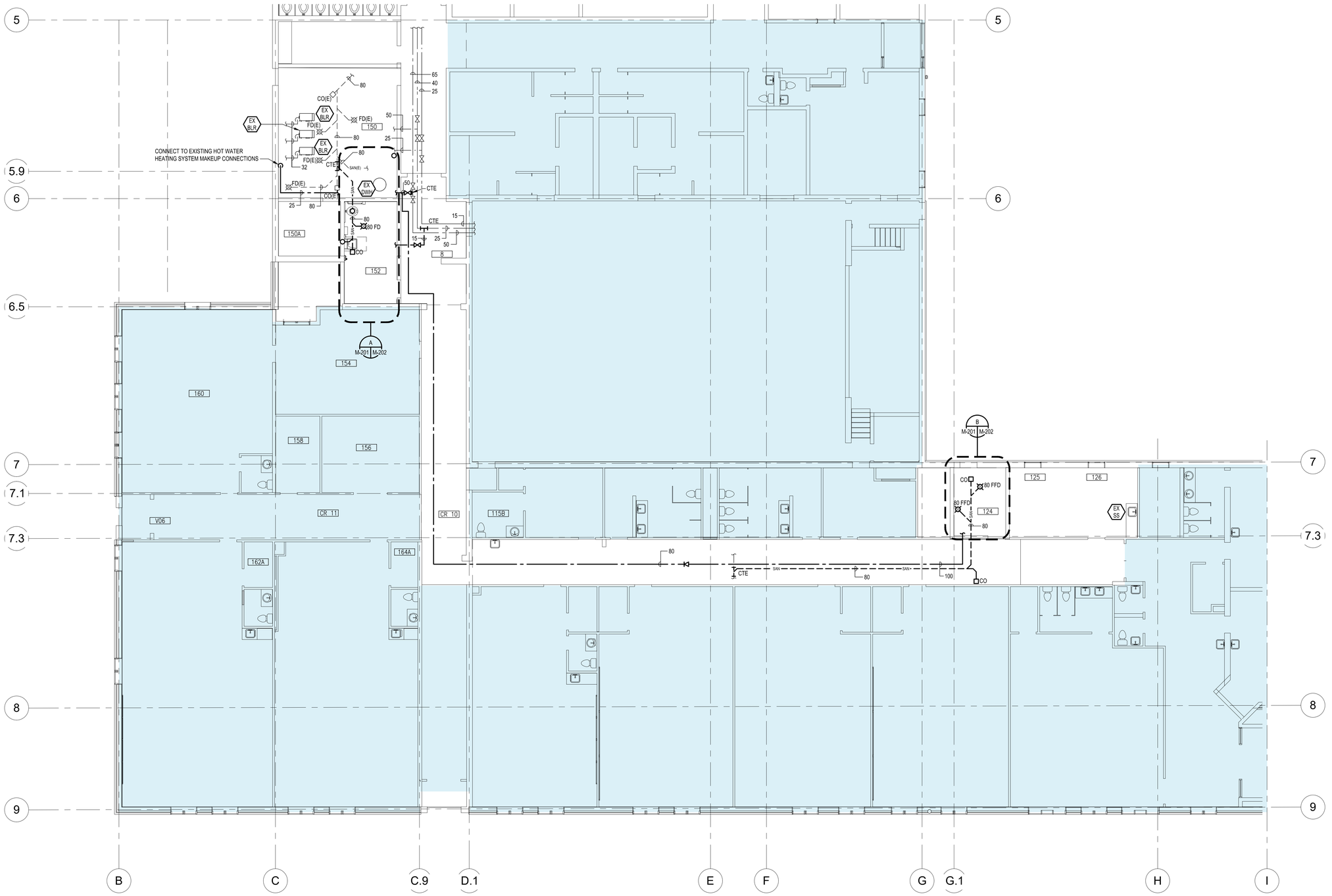
Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

8391.3
LICENSED PROFESSIONAL ENGINEER
JDF FOSTER
100148736
MAY 23, 2018
PROVINCE OF ONTARIO

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE

DRAWING TITLE
MECHANICAL DETAILS

DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M102
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



GROUND FLOOR PLAN PLUMBING

SCALE: 1:100

NOTES:

1. MINIMUM SANITARY BELOW GRADE PIPE SIZE IS 80MM.
2. SCAN/LOCATE ALL EXISTING BELOW GRADE SERVICES BEFORE EXCAVATION/CUTTING.
3. GENERALLY, NEW PIPING INSTALLED WITHIN CEILING SPACE IS TO BE INSTALLED AS HIGH AS POSSIBLE AND THROUGH EXISTING OWSJ WEBBING.

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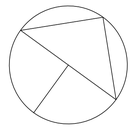
LONDON ON, N6B 3R4

250 CITY CENTRE AVE., SUITE 403
OTTAWA ON, K1R 6K7

KEY PLAN



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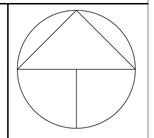


CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

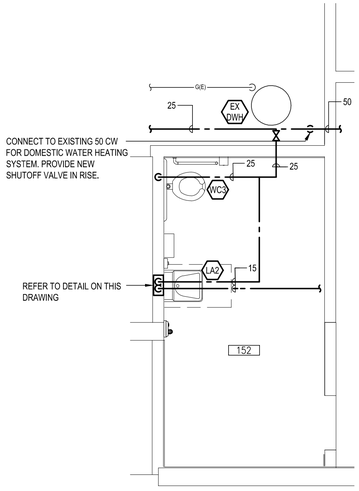
8391.3

LICENSED PROFESSIONAL ENGINEER
J.D. FOSTER
100148736
MAY 23,2018
PROVINCE OF ONTARIO

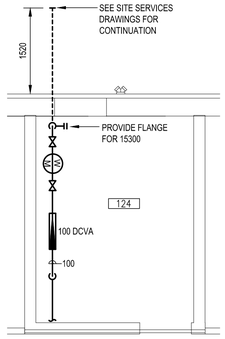
PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
GROUND FLOOR PLAN
PLUMBING

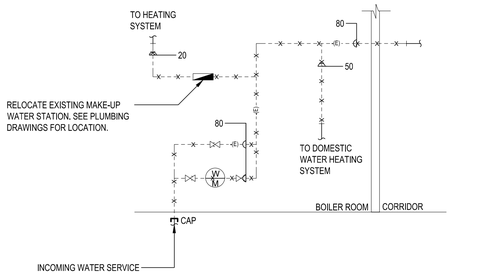
DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M201
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



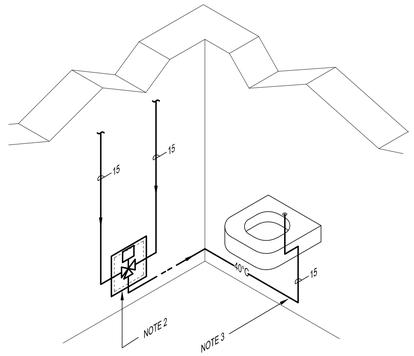
DETAIL
SCALE: 1:50
A M-201 M-202



DETAIL
SCALE: 1:50
B M-201 M-202



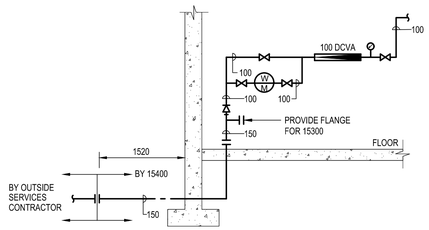
DOMESTIC WATER SUPPLY SCHEMATIC - DEMOLITION
N.T.S.



LAVATORY MIXING VALVE DETAIL
N.T.S.

NOTES:

1. REFER TO SPECIFICATIONS FOR ALL FIXTURE MOUNTING HEIGHTS.
2. CONCEAL MIXING VALVE WITHIN BLOCK WALL. PROVIDE ACCESS DOOR AS SPECIFIED. MOUNT AT 150mm ABOVE FINISHED FLOOR.
3. RUN TEMPERED WATER HORIZONTALLY WITHIN WALL CAVITY.



DOMESTIC WATER SUPPLY SCHEMATIC
N.T.S.

NOTES:

1. MOUNT BACKFLOW PREVENTER BETWEEN 750mm AND 1500mm ABOVE FINISHED FLOOR.

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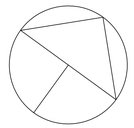
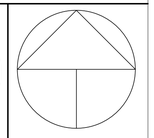
KEY PLAN


TRUE NORTH


CONSTRUCTION NORTH

NOTES

LEGEND

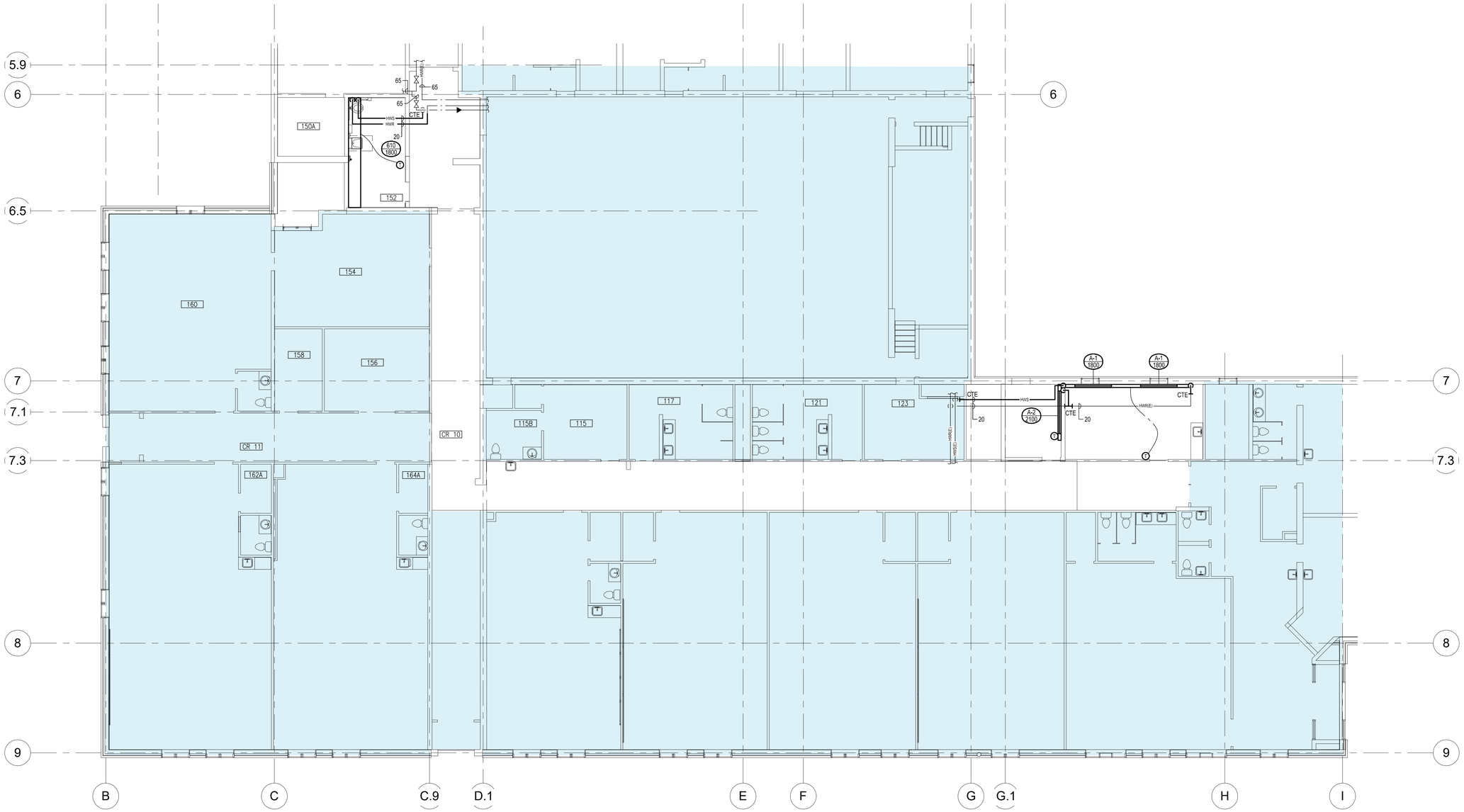
Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

8391.3
LICENSED PROFESSIONAL ENGINEER
JOHN DOUGLAS FOSTER
100148736
MAY 23, 2018
PROVINCE OF ONTARIO

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
PLUMBING
DETAILS & SCHEMATIC

DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M202
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



GROUND FLOOR PLAN - HEATING

SCALE: 1:100

NOTES:

1. CAP AND ABANDON EXISTING HEATING PIPING SERVING WALLFIN CONVECTORS IN CLASSROOM.
2. MINIMUM HEATING PIPE SIZE IS 20MM.
3. GENERALLY, ALL NEW PIPING INSTALLED WITHIN CEILING SPACE IS TO BE INSTALLED AS HIGH AS POSSIBLE & THROUGH EXISTING OWSJ WEBBING.

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KEY PLAN

TRUE NORTH

CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

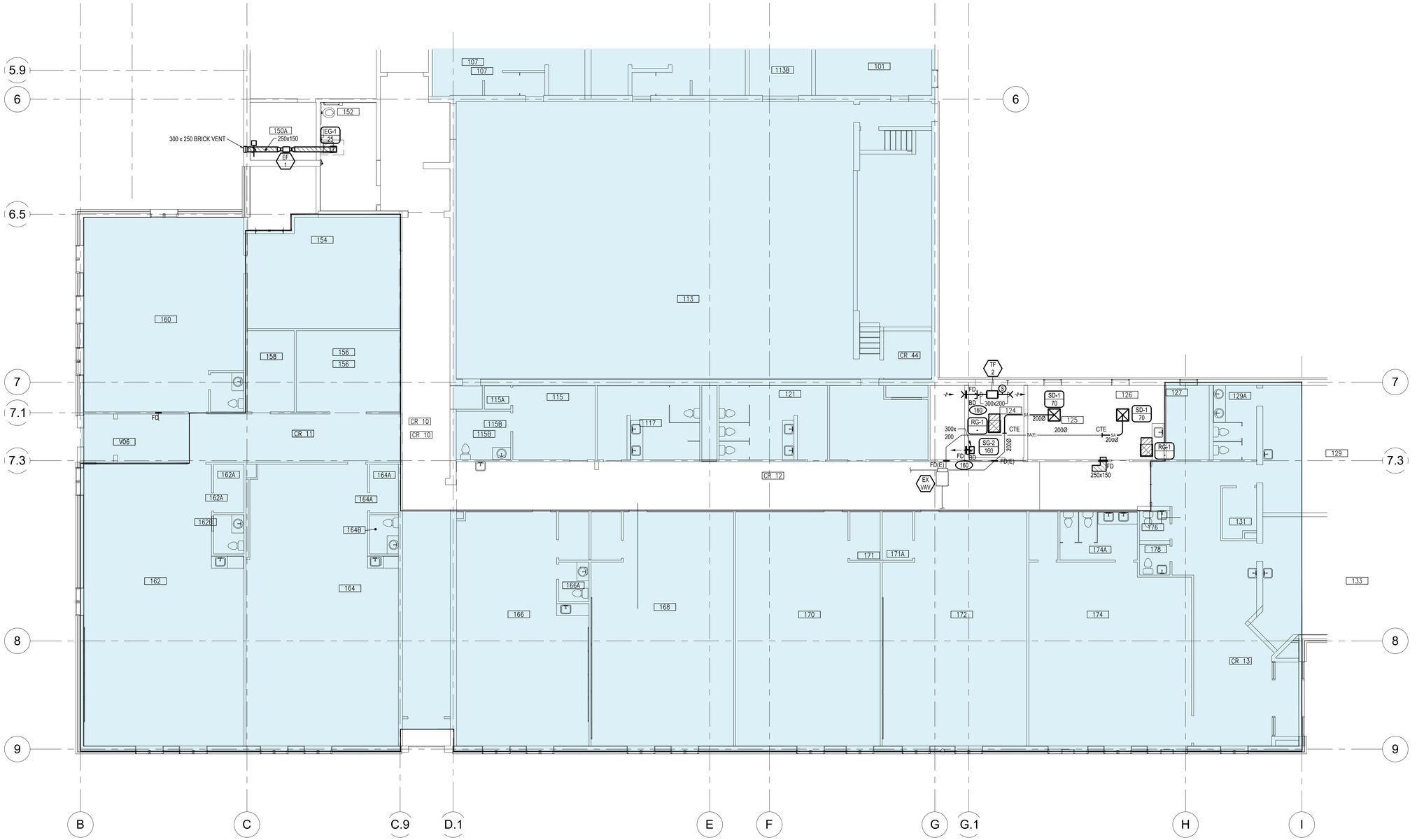
8391.3

LICENSED PROFESSIONAL ENGINEER
JOHN DAVID FOSTER
100148736
MAY 23, 2018
PROVINCE OF ONTARIO

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
GROUND FLOOR PLAN
HEATING

DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M301
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



GROUND FLOOR PLAN - AIR DISTRIBUTION

SCALE: 1:100

NOTES:

1. GENERALLY RUN DUCTWORK THROUGH OWSJ.
2. PROVIDE BALANCING DAMPERS WHERE SHOWN OR SPECIFIED, NOT ALL REQUIRED BALANCING DAMPERS ARE SHOWN ON DRAWINGS.
3. ALLOW FOR REMOVAL AND REPLACEMENT OF 15m (50FT) OF 250 mm (10") INSULATED ROUND DUCTWORK IN CR12 TO ALLOW FOR INSTALLATION OF NEW DOMESTIC WATER PIPING WITHIN OWSJ WEBBING. INSTALL NEW DUCTWORK BELOW EXISTING OWSJ.

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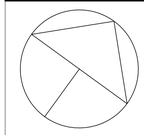
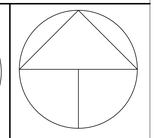
KEY PLAN



TRUE NORTH



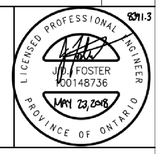
CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

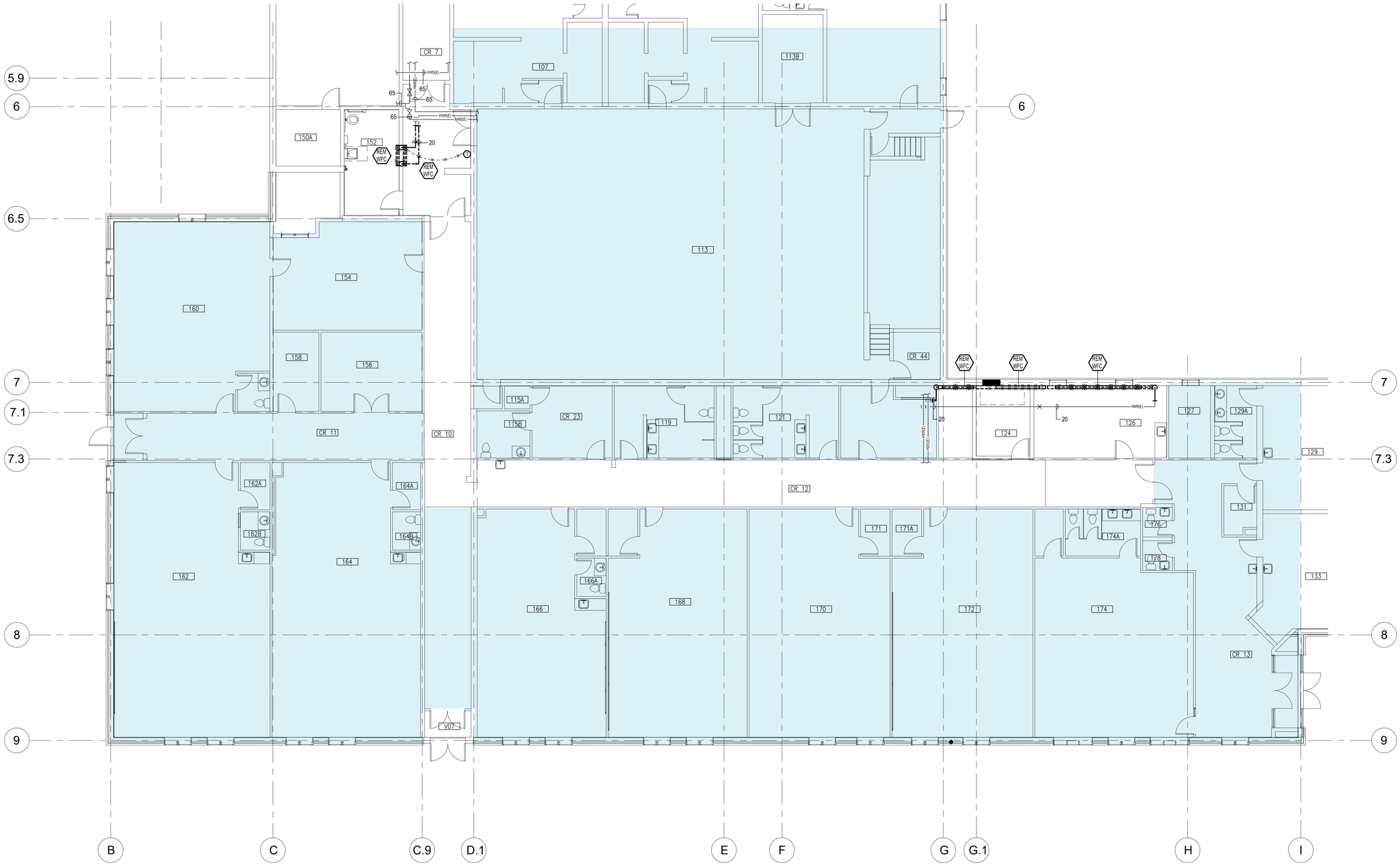
8391.3



PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
GROUND FLOOR PLAN
AIR DISTRIBUTION

DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M401
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



GROUND FLOOR PLAN - HEATING DEMOLITION

SCALE: 1:100

NOTES:

1. WHERE EXISTING HEATERS ARE SHOWN BEING REMOVED, REMOVE ALL ASSOCIATED CONTROLS.

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LONDON ON, N6B 3R4

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OTTAWA ON, K1R 6K7

KEY PLAN

TRUE NORTH

CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

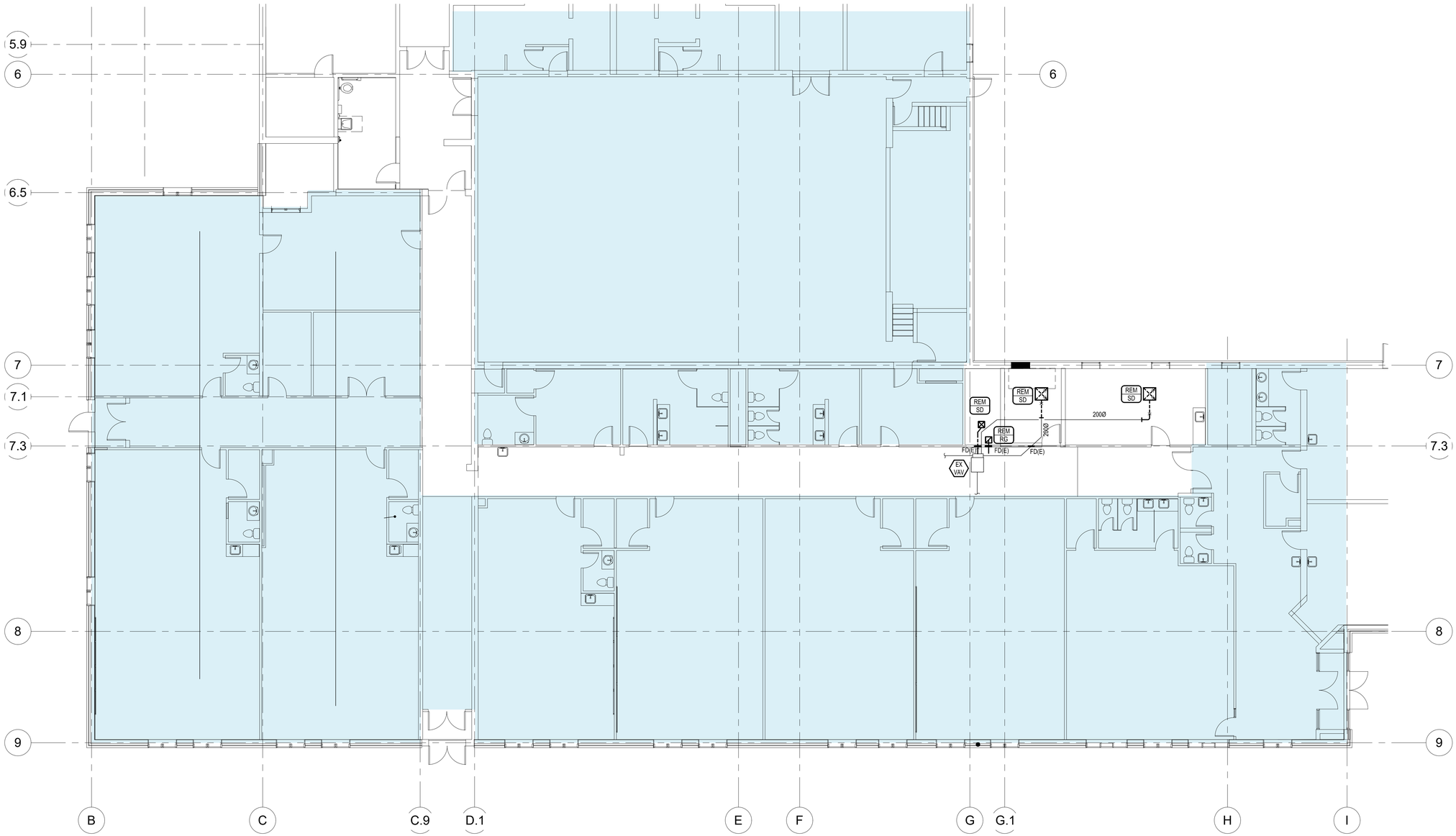
8391.3

LICENSED PROFESSIONAL ENGINEER
JOHN D. FOSTER
100148736
MAY 23, 2018
PROVINCE OF ONTARIO

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

DRAWING TITLE
GROUND FLOOR PLAN
HEATING DEMOLITION

DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M501
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



GROUND FLOOR PLAN - AIR DISTRIBUTION DEMOLITION

SCALE: 1:100

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KEY PLAN

TRUE NORTH

CONSTRUCTION NORTH

NOTES

LEGEND

Date	Description	No.
05/23/2018	ISSUED FOR TENDER/ADDENDUM #1	001

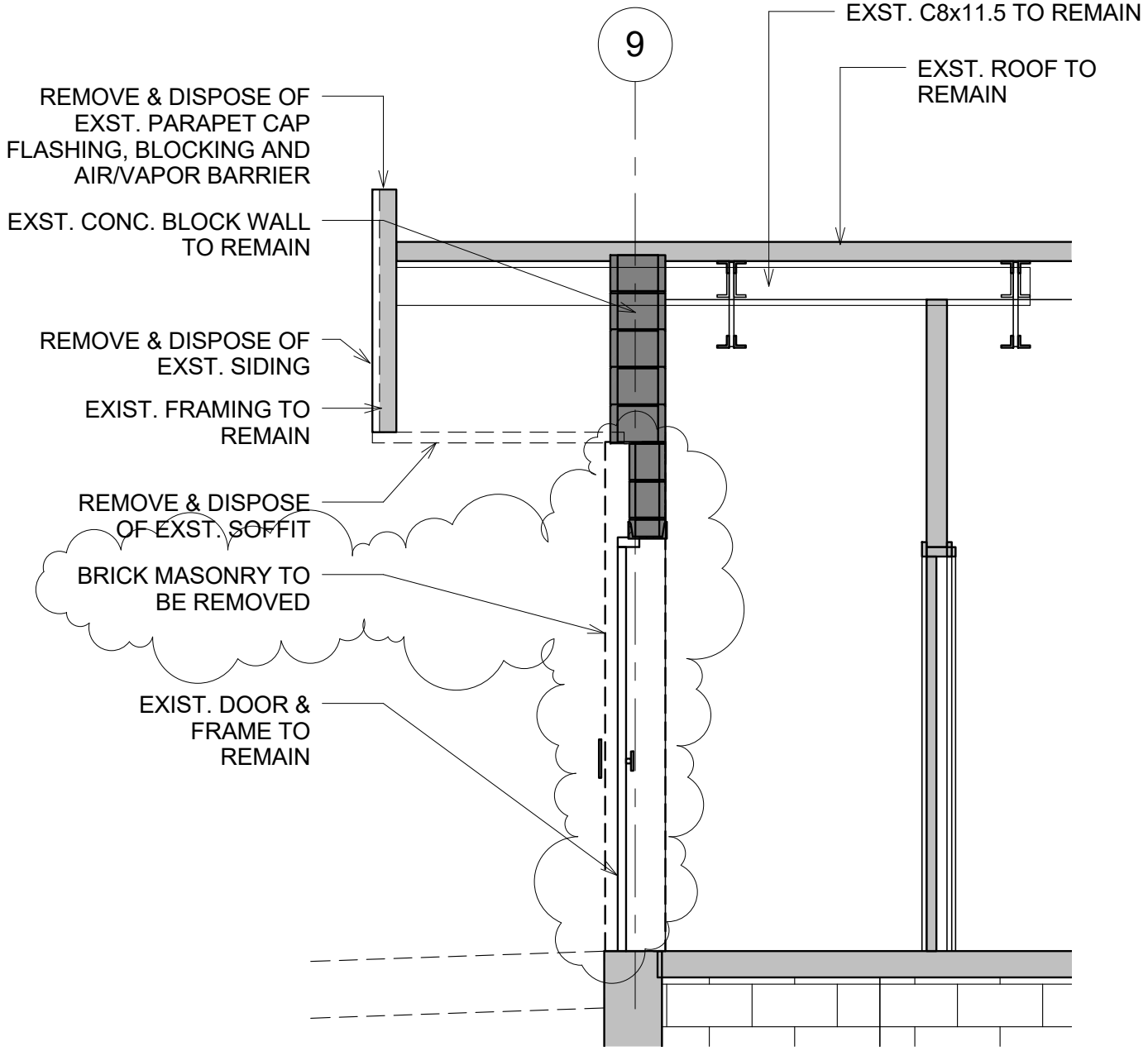
8391.3

LICENSED PROFESSIONAL ENGINEER
JDF FOSTER
100148736
MAY 23,2018
PROVINCE OF ONTARIO

PROJECT TITLE
OUR LADY OF FATIMA PHASE 2
RENEWAL REDUCED SCOPE

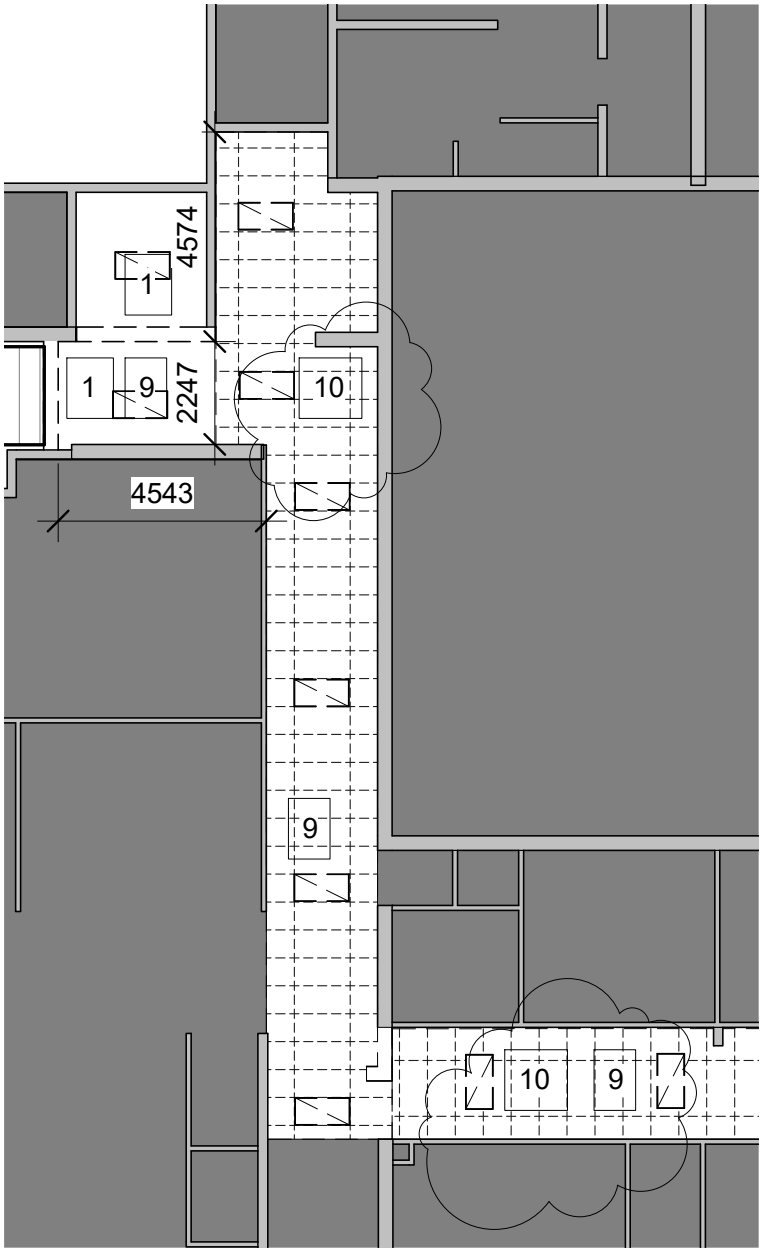
DRAWING TITLE
GROUND FLOOR PLAN
AIR DISTRIBUTION DEMOLITION

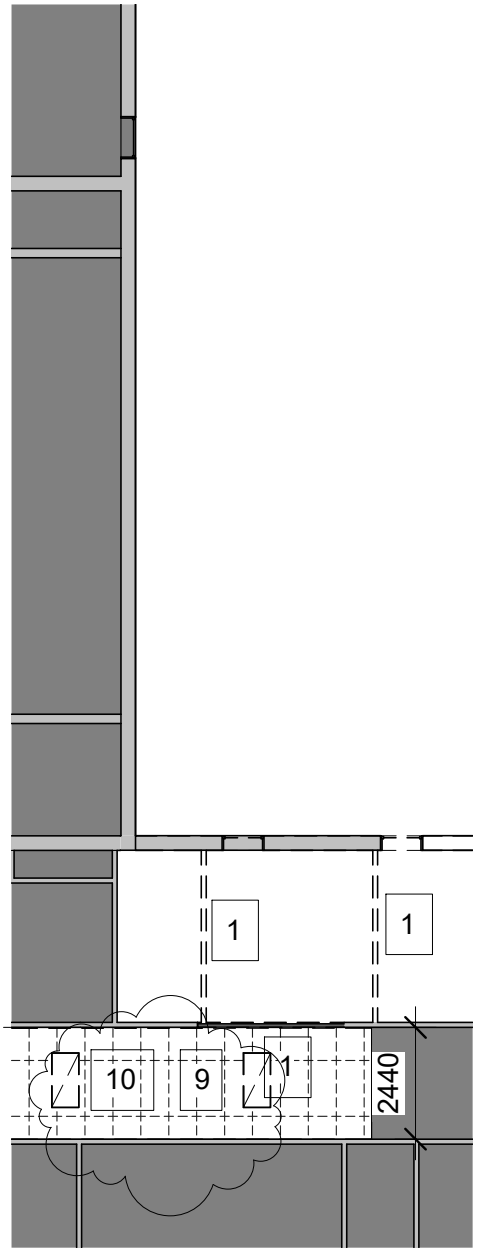
DATE	DRAWN BY	DRAWING No.
05/23/18	BMD	M502
SCALE: AS NOTED	CHECKED BY: JDF	
PROJECT No.: 8391.3		



WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE DEMOLITION SECTION @ ENTRANCES
SCALE 1 : 30	DRAWN BY SH	CHECKED BY RW	Reference Page No. 1/AD400
DATE 5/22/2018	PROJECT No. 1724		DRAWING No. ASK-001



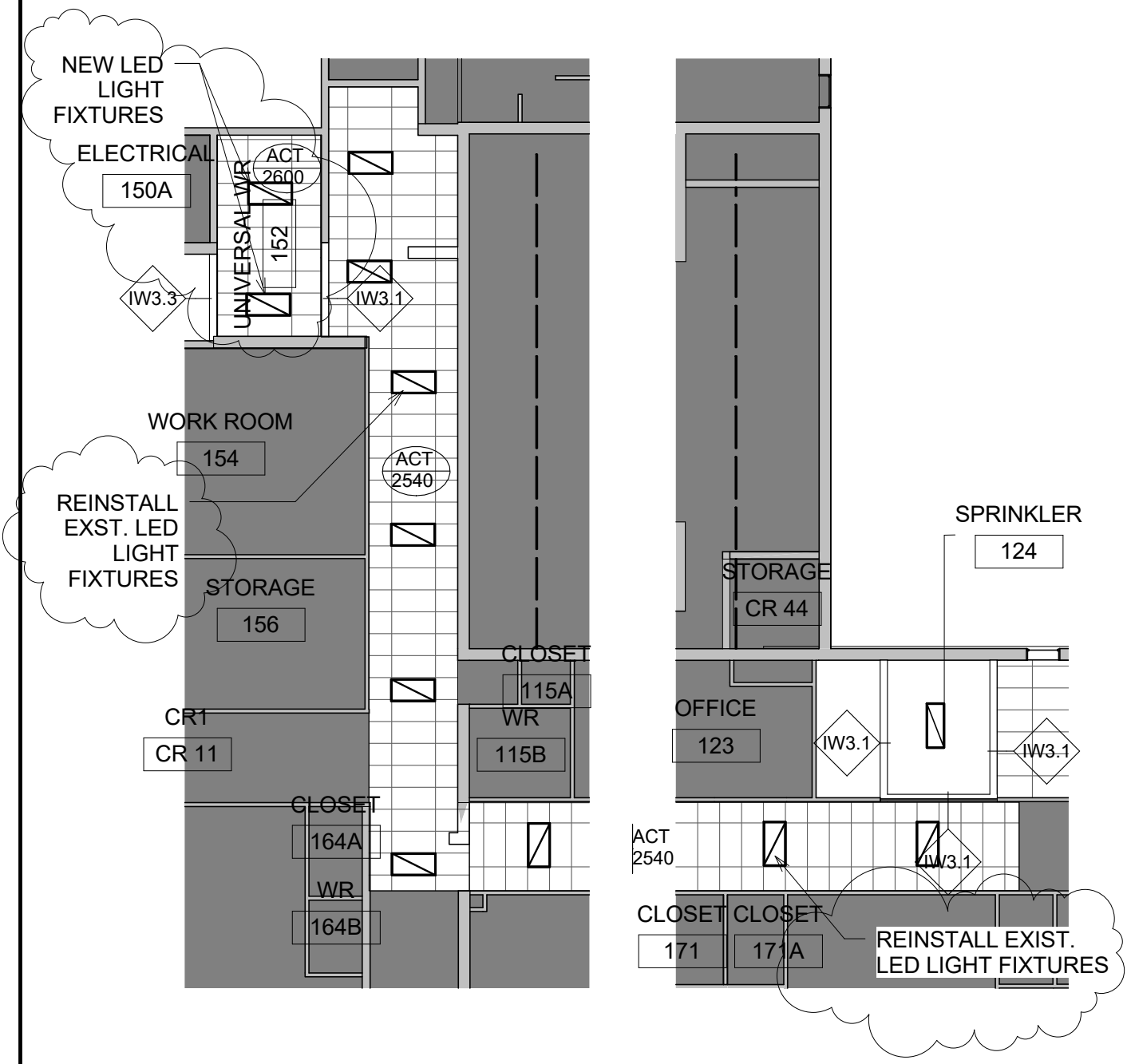


DEMOLITION NOTES:

10	CAREFULLY REMOVE & STORE EXISTING L.E.D. LIGHT FIXTURES IN A SAFE LOCATION. CLEAN & REUSE FIXTURES WHEN ABOVE CEILING WORK IS COMPLETED. REFER TO M&E DWGS.

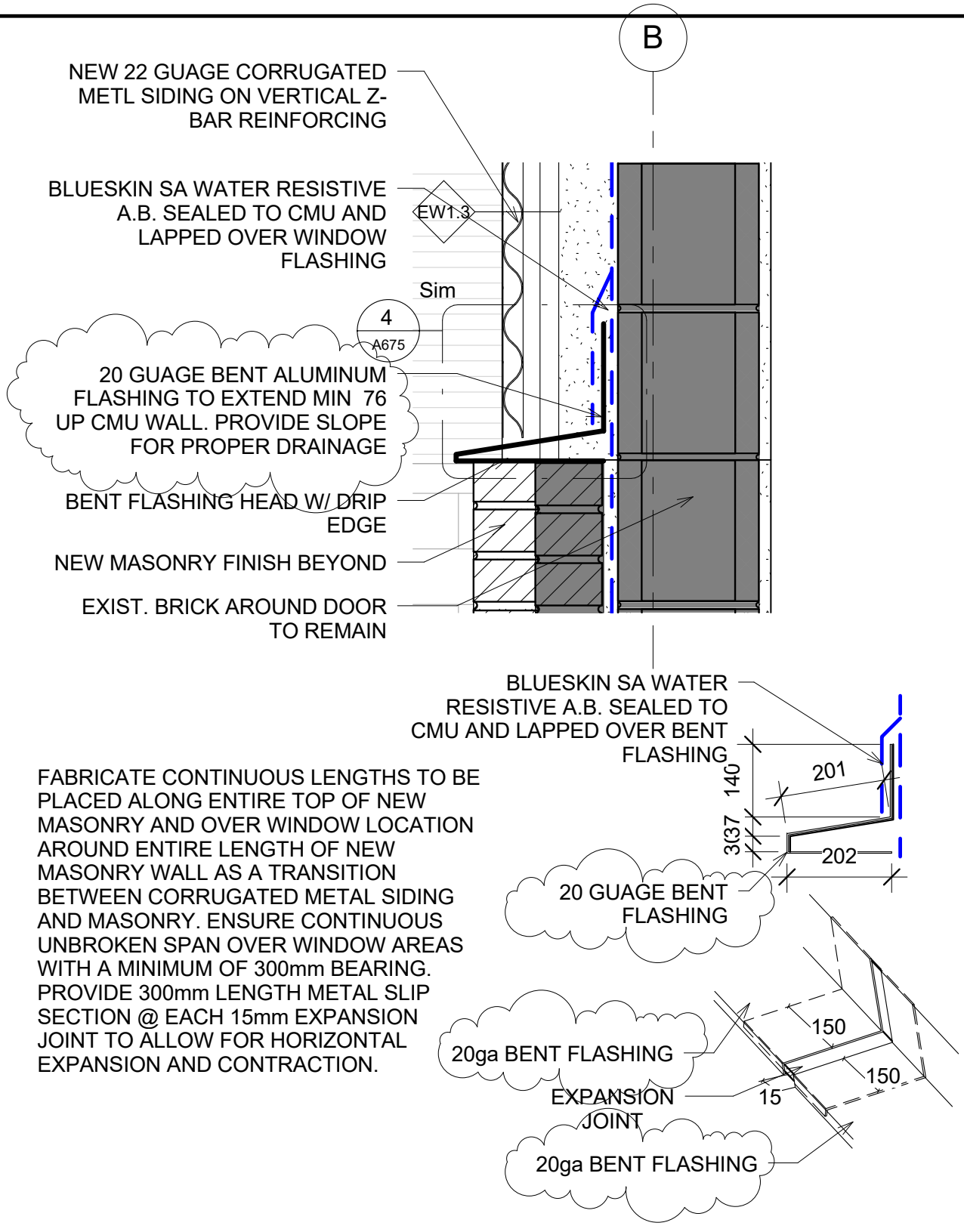
WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE PART REFLECTED CEIL.DEMO PLAN
SCALE 1 : 150	DRAWN BY SH	CHECKED BY RW	Reference Page No. 1/AD200
DATE 5/22/2018	PROJECT No. 1724		DRAWING No. ASK-002



WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE PART REF. CEIL. PLAN
SCALE 1 : 150	DRAWN BY SH	CHECKED BY RW	Reference Page No. 1/A200
DATE 5/22/2018	PROJECT No. 1724		DRAWING No. ASK-003



FABRICATE CONTINUOUS LENGTHS TO BE PLACED ALONG ENTIRE TOP OF NEW MASONRY AND OVER WINDOW LOCATION AROUND ENTIRE LENGTH OF NEW MASONRY WALL AS A TRANSITION BETWEEN CORRUGATED METAL SIDING AND MASONRY. ENSURE CONTINUOUS UNBROKEN SPAN OVER WINDOW AREAS WITH A MINIMUM OF 300mm BEARING. PROVIDE 300mm LENGTH METAL SLIP SECTION @ EACH 15mm EXPANSION JOINT TO ALLOW FOR HORIZONTAL EXPANSION AND CONTRACTION.

WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE: OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE: BENT FLASHING DETAIL
SCALE: As indicated	DRAWN BY: SH	CHECKED BY: RW	Reference Page No. 1,2,3,4/A500, 2/A501, 3/A625, 3/A650, 3,4/A675
DATE: 5/22/2018	PROJECT No.: 1724		DRAWING No.: ASK-004

ROOM FINISH SCHEDULE WDAI - 1724

Our Lady of Fatima - Chatham - Phase II

CHANGES ARE HIGHLIGHTED, BOLD & ITALICIZED

Wilson Diaz Architects Incorporated

Abbreviations

ACT	Acoustic Ceiling Tile	**EP.PT.**	Epoxy Paint	**GLZ**	Glazing	**OPEN**	Open to adjacent room	**SRTC**	Service Room Traffic Coating
Anod	Anodized Alum Frames	**EPF**	Epoxy Flooring	**GSW**	Glass System Wall	**PCT**	Porcelain Tile	**STO**	Stone
CF	Clear Finish Strain	**EPW**	Epoxy Wall Coating	**GYP**	Gypsum Board	**PT**	Paint	**TER**	Terrazzo
CMU	Concrete Masonry Unit	**EX**	Existing	**HW**	Hardwood	**RES**	Resilient Sht. Flooring/Base	**QT**	Quartz Tile
COVE	Cove Base	**EXP**	Exposed Structure	**IP**	Intumescent Paint	**RUB**	Rubber Flooring/Base	**WB**	Wood base finish to match floor
CSH	Cushon Flooring	**GB**	Gypsum Board	**LIN**	Linoleum	**SB**	Stone Base	**WC**	Wallcovering (# indicates wallcovering type)
CT	Ceramic Tile	**GLB**	Glass Block	**N/A**	Not Applicable	**SPR**	Spartacote	**WD**	Woodwork

Room No.	Room Name	Floor			North		East		South		West		Ceiling			Remarks
		Material	Finish	Base	Mat'l	Finish	Mat'l	Finish	Mat'l	Finish	Mat'l	Finish	Mat'l	Finish	Height	
152	Universal Washroom	PCT	-	PCT	GWB	PT	GWB	PT	GWB	PT	GWB	PT	ACT	-	2600	Refer to elevations in A820 for ceramic tile finish.
124	Sprinkler	EX	EX	RUB									-	-	-	
125	Office	EX	EX	EX	PT		PT		PT		PT		ACT	-	2600	

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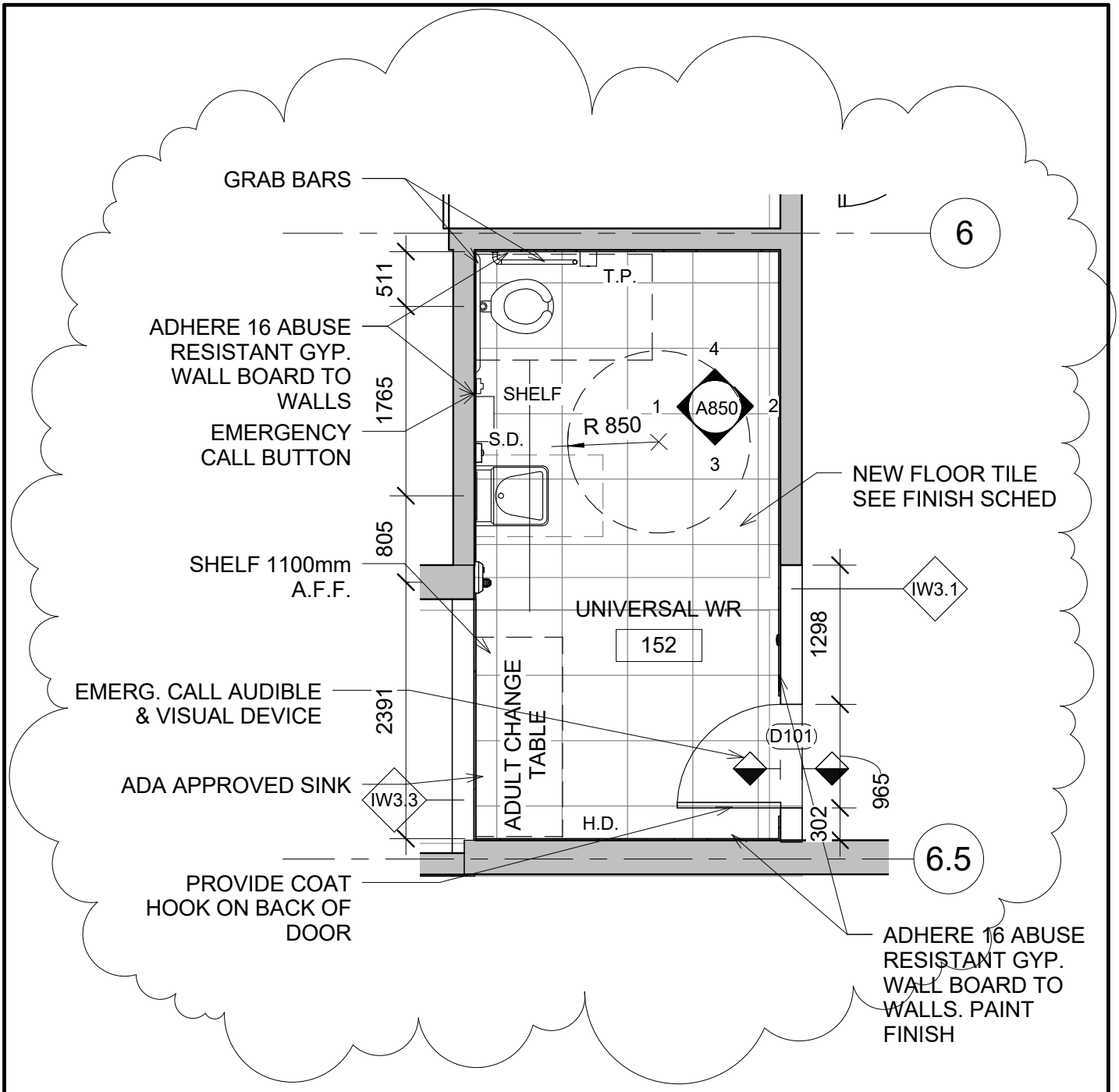
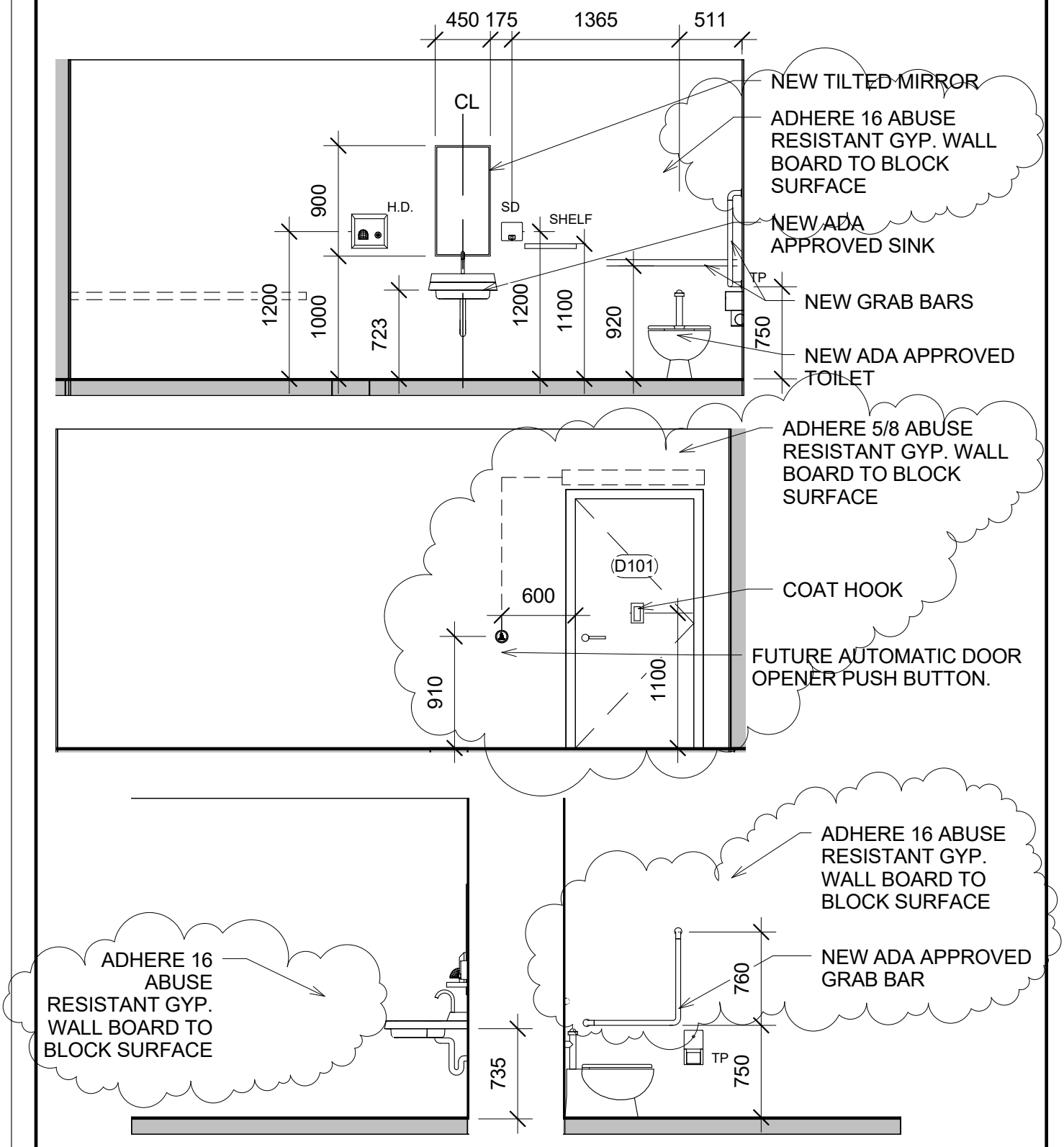
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE: OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE: FINISH SCHEDULE
SCALE: 1 : 40	DRAWN BY: SH	CHECKED BY: RW	Reference Page No.: 2/A800
DATE: 5/22/2018	PROJECT No.: 1724		DRAWING No.: ASK-005



WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE: OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE: UNIVERSAL WASHROOM PLAN
SCALE: 1 : 50	DRAWN BY: SH	CHECKED BY: RW	Reference Page No.: 1/A150
DATE: 5/22/2018	PROJECT No.: 1724		DRAWING No.: ASK-006



WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE: OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE: UNIVERSAL WASHROOM ELEVATIONS
SCALE: 1 : 40	DRAWN BY: Author	CHECKED BY: Checker	Reference Page No.: 1,2,3,4/A850
DATE: 5/22/2018	PROJECT No.: 1724		DRAWING No.: ASK-007

SHEET LIST	
Sheet Number	Sheet Name

01 ARCHITECTURAL

A000	COVER PAGE
A010	LIFE SAFTEY PLAN
A050	GENERAL NOTES
AD100	DEMOLITION PLAN
AD200	REFLECTED CEIL. DEMO PLAN
AD400	DEMOLITION SECTIONS
A100	CONSTRUCTION FLOOR PLAN
A150	ENLARGED FLOOR PLANS
A200	REFLECTED CEILING PLAN
A300	EXTERIOR ELEVATIONS
A301	EXTERIOR ELEVATIONS
A500	WALL SECTIONS
A501	WALL SECTIONS
A600	PLAN DETAILS
A625	WINDOW DETAILS
A650	SECTION DETAILS
A675	SECTION DETAILS
A800	FINISHING PLAN
A850	INTERIOR ELEVATIONS
A1000	SCHEDULES

02 STRUCTURAL

S101	STRUCTURAL DRAWINGS

03 CIVIL

SE1	SITE SERVICING & GRADING PLAN

SHEET LIST	
Sheet Number	Sheet Name

SE2	NOTES AND DETAILS

04 ELECTRICAL

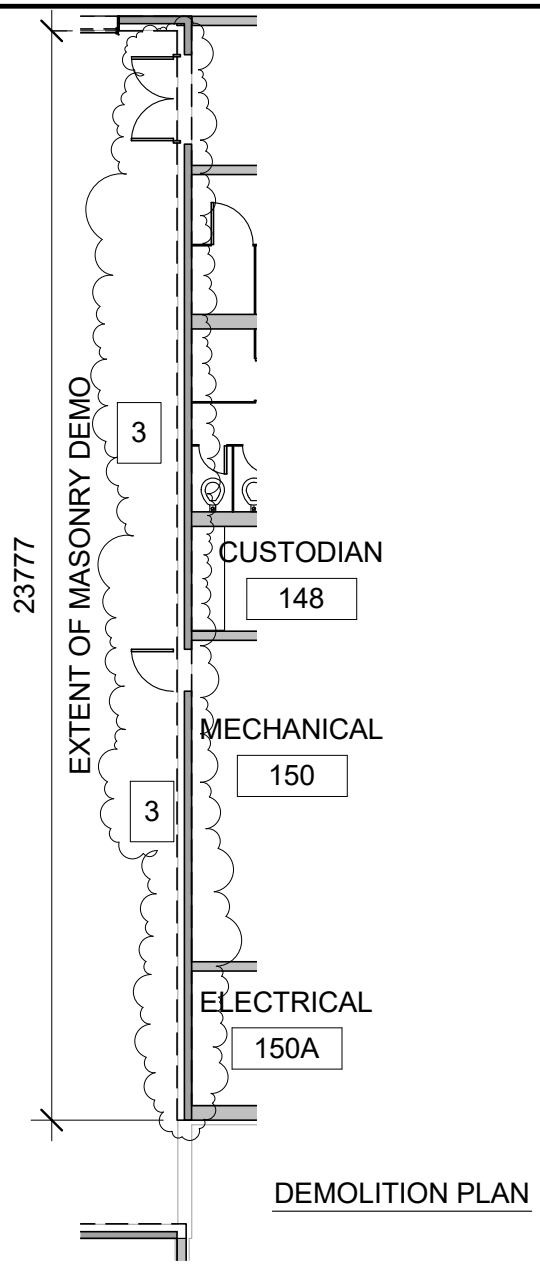
E100	ELEC. LEGEND, DWG LIST, SCHEDULES, NOTES
E200	PARTIAL GROUND FLOOR PLAN - SOUTH LIGHTING & FIRE ALARM
E201	PARTIAL GROUND FLOOR PLANS - NORTH WEST & NORTH EAST LIGHTING & FIRE ALARM
E300	PARTIAL GROUND FLOOR PLAN POWER & SYSTEMS

05 MECHANICAL

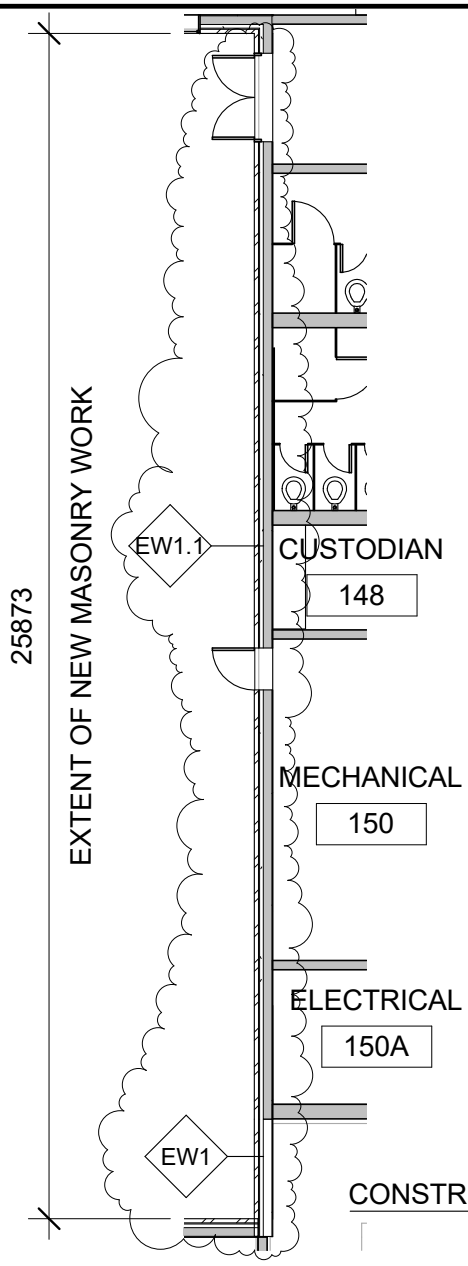
M101	MECHANICAL LEGEND, SCHEDULES, DWG LIST
M102	MECHANICAL DETAILS
M201	GROUND FLOOR PLAN PLUMBING
M202	PLUMBING DETAILS & SCHEMATIC
M301	GROUND FLOOR PLAN HEATING
M401	GROUND FLOOR PLAN AIR DISTRIBUTION
M501	GROUND FLOOR PLAN HEATING DEMOLITION
M502	GROUND FLOOR PLAN AIR DISTRIBUTION DEMOLITION

WILSON DIAZ ARCHITECTS INCORPORATED
WDA
260 QUEENS AVENUE, SUITE 1Q2
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5942
wda@wilsondiaz.ca
www.wilsondiaz.ca

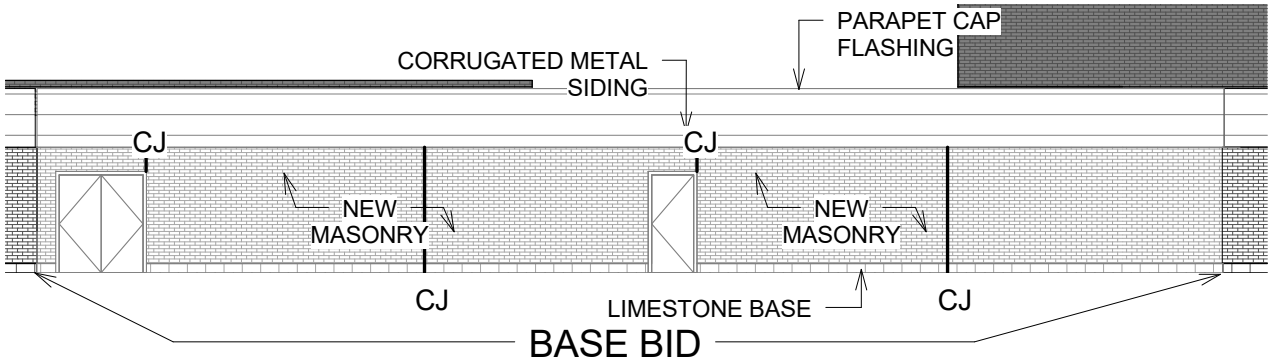
PROJECT TITLE: OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE: REVISED SHEET LIST
SCALE	DRAWN BY: SH	CHECKED BY: RW	Reference Page No.: A000
DATE: 5/22/2018	PROJECT No.: 1724		DRAWING No.: ASK-008



DEMOLITION PLAN



CONSTRUCTION PLAN



BASE BID

WILSON DIAZ ARCHITECTS INCORPORATED
280 QUEENS AVENUE, SUITE 1Q
LONDON, ONTARIO N6B 1X3
t. 519.439.0611
f. 519.438.5962
wda@wilsondiaz.ca
www.wilsondiaz.ca

PROJECT TITLE OUR LADY OF FATIMA PHASE 2 RENEWAL REDUCED SCOPE			DRAWING TITLE NEW MASONRY WALL SCOPE
SCALE 1 : 150	DRAWN BY Author	CHECKED BY Checker	Reference Page No. 1/AD100, 1/A100, 2/A302
DATE 5/22/2018	PROJECT No. 1724		DRAWING No. ASK-009