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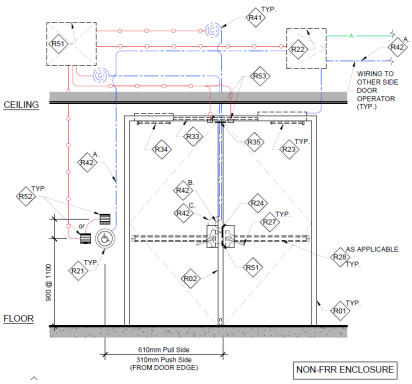
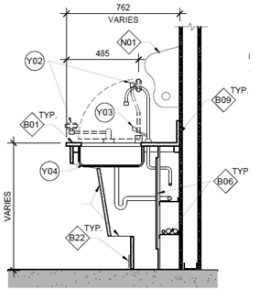
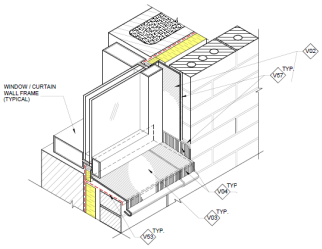
Immeubles
Facilities

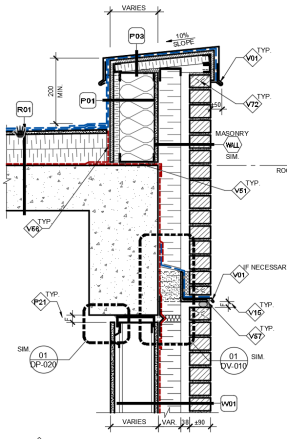










DESIGN and CONSTRUCTION GUIDELINES

Last revision: 2024-12-01

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1.0 GENERAL

1.1 Overview

.1 The following are main information implicated in the current Guidelines. For full contact information, visit **UofO** web site.

1.2 Definition, References and Contact info:

.1 General:

AODA: Accessibility for Ontarians with Disabilities Act
CFI: Canadian Foundation for Innovation
DCG: **UofO** Design and Construction Guidelines
ECA: Environmental Compliance Approval
OEPA: Ontario Environmental and Protection Act
Facilities: Physical Resources Services of the **UofO**, located at:
141 Louis Pasteur,
Ottawa, Ontario, K1N 6N5
GC: General Contractor (including all sub-contractors), and all individual Contractors
MECP: Ministry of the Environment and Climate Change (Ontario)
OBC: Ontario Building Code
OFC: Ontario Fire Code
OWRA: Ontario Water Resource Act
TSSA: Technical Standard & Safety authority
UofO: University of Ottawa, duly constituted and having a place of business at:
550 Cumberland,
Ottawa, Ontario, K1N 6N5.

.2 **Facilities** and **UofO** Service departments:

ACVS: Animal Care & Veterinary Services
Contact: Holly Meredith Orlando – Email: horlando@uottawa.ca

ARCH: Architecture, Building Code & Technical Expertise Services
Contact: Charles Albert Azar – Cell.: 613-797-7469 – Email: cazar@uottawa.ca

BAS: Building Automation Systems
Contact: To be confirmed

CSS: Cleaning and Sanitary Services
Contact: Suzanne Vincent – Email : svincent@uottawa.ca
Brigitte Morin – Email : bmorin@uottawa.ca

DES: Interior Design & Furniture Services
Contact: Nathalie Charron – Cell.: 613-286-6514 – Email: ncharron@uottawa.ca

FPS: Fire Protection Services
Contact: Richard Sincennes – Cell.: 343-998-8975 – Email : rsincen2@uottawa.ca

DHS: Designated and Hazardous Substances
Contact: Martine Bergeron – Email: mberger8@uottawa.ca

HS: Housing Services
Contact: Jérémie Génier – Email: jgenier@uottawa.ca

ITS: IT Services
Contact: Eric Rivard – Email: erivard@uottawa.ca

KCS: Keying and Cylinder systems
Contact: Maxime Bigras – Email: mbigra2@uottawa.ca

LGS: Landscaping, Grounds, Snow removal & Ancillary Services
Contact: Pierre-Yves Leroux – Cell.: 613-697-0100 - Email: plerou2@uottawa.ca

M&E: Mechanical and Electrical services
Contact: Peter Chan – Email: pchan2@uottawa.ca

OPST: Office of Parking and Sustainable Transportation
(Also responsible for the approval of the fire prevention department)
Contact: Francine Faubert – Email: ffaubert@uottawa.ca

OCRO: Office of the Chief Risk Officer (Previously: **O**ffice of **R**isk **M**anagement)
Environment, Radiation and Biosafety
Contact: Pascal Simard – psimar2@uOttawa.ca

Occupational Health and Safety
Contact: Catherine Bernard - cbernar6@uOttawa.ca

Insurances
Contact: John Darragh - jdarragh@uOttawa.ca

PRO: Protection
Contact: Roger Morin – Email: rmorin@uottawa.ca
Olivier Cousineau – Email: Olivier.Cousineau@uottawa.ca

SAGO: Support, Architectural and Grounds Operations
Contact: Ludric Burelle – Email : lburelle@uottawa.ca

SME: Subject Matter Experts
Refer to **ARCH, DES, M&E** & **SRS**

SPS: Security and Protection Services - alarms & card reader systems
General
Contact: Luc Nadon – nadon@uottawa.ca

Installation
Contact: Constantin Serban Cosmin – Email: cserban@uottawa.ca

SRW: Signage, Room numbering & Wayfinding Services
Contact: Jordan Labelle – Cell.: 613-291-1341 – Email: sign@uottawa.ca

TERR: Terrain
Contact: Pierre –Yves Leroux – Email: pierre-yves.leroux@uottawa.ca
Frédéric Desjardins – Email: fdesjar2@uottawa.ca

TLSS: Teaching and Learning support Service – A/V components
Contact: Xavier Erdmer – Email: xerdmer@uottawa.ca

1.0 GENERAL

1.1 Overview

.1 This document was prepared by **Facilities** to act as a standard reference applicable on all renovation or construction projects at the **UofO**. Establishing standards ensures a required minimal quality for physical installations and facilitates their maintenance.

.2 We realize that existing situations on renovation projects may challenge the application of these standards. In which case, we will aim to attain the highest level possible to comply with them.

.3 These Guidelines are not meant to replace any regulation or standard issued by proper authorities. If in any case a standard described in this document contravenes with an effective regulation, that regulation overrides the standard. In which case, **Facilities** needs to be notified promptly.

.4 All design and execution work shall conform with the latest version of all applicable Codes, Acts, Regulations and Municipal Bylaws including – but not limited to **AODA**, **EPA**, **OBC**, **OFC,** NFPA and **TSSA**.

.5 **Comments or recommendations to improve this document and its application are welcomed**.

1.2 Document structure

.1 **VOLUME I – SPACE & DESIGN STANDARDS**

Categorizes the General Guidelines for different spaces or Services, including Areas, design, schedules, quantities, and similar information generally necessary for preliminary design information.

.2 **VOLUME II – CONTRACT GENERAL CONDITIONS**

Categorizes the Guidelines related to General and supplementary conditions and all similar information related to Contracts.

.3 **VOLUME III, IV & V – CONSTRUCTION STANDARD**

Regroups precise or performance specifications, classified by the National Master Specification (**NMS**) sections which every Consultant needs to incorporate to their respective specifications and documents at advanced design stages.

.4 VOLUME VI - APPENDIX

Consist of Notes, Details, Sketches, or Diagrams showing depict standard guidelines for designing high performance assemblies or components, intended to reflect "best practice" options applied in previous projects, and are based on several industry standards. They reflect the detailing level and quality to expect in any project.

They are complementary to the notes and guidelines listed elsewhere in the other sections of this document. **In case of discrepancies, the later shall prevail**.

They are to be validated and adapted to the specifics of the project, as applicable. Any variations shall be with equivalent materials, to be approved by **Facilities**.

1.3 Overall Design and Building Code information

.1 Code related issues:

.1 General: Unless rare exceptions, Campus new buildings or alterations to existing shall be classified according to **OBC** Major Occupancies definition as follow (contact SME Arch for more details):

- "A-2 – Institutional", for all buildings.
- "C – Residential", for building dedicated to house students or dormitories.

All other occupancies, ("F" - Laboratories, "D" - Offices, and similar) shall be considered subsidiary occupancies to the main ones. This approach allows the **UofO** to easily modify the space occupancies and the introduction of student or teaching spaces anywhere on Campus without resorting to complex building reclassification processes or the addition of unnecessary fire separations.

.2 Corridors:

.1 In new or additions to existing Buildings: Design layout shall allow flexibility for future alteration into open spaces without the need for corridors. Exits shall be strategically located to avoid the creation of any rated fire-separation in the corridors used by public. Except in circulation areas, travel distances – as defined by **OBC** shall be measured on a perpendicular path line toward the Exits.

.2 Alteration to existing Buildings: Some of the corridors used by public in the existing buildings are fire-rated, others are not. The alteration shall be directed toward the objective of waiving those fire-rated corridors where possible. Contact **SME Arch** at **Facilities** for any further information.

.3 Occupant Load:

.1 In new or additions to existing Buildings: Occupant Load shall be based on the **most stringent** number among the following factors listed by **OBC**:

.1 Per design:

- The number of seats in spaces with fixed seats, or
- The number of persons for which the area is designed if there is no known furniture in the space.

.2 Per **OBC** Table factor:

- As per the designated occupancy in the user's requirement, or
- Using the "classrooms" factor for shell spaces with unknown designation dedicated for future occupancy designation.

.2 Alteration to existing Buildings: Occupant Load may be restricted by the existing parameters (Exit widths, washroom numbers, High Building status or similar), and shall be verified with **SME Arch** at **Facilities**.

.4 Washroom count:

.1 Unless otherwise noted, Washroom count shall be based on OBC 3.7.4.3.(15) (college buildings), that attributes one fixture for each 100 males and one fixture for each 75 females. Nevertheless, any additional number of fixtures is encouraged. Also Refer to section "**VOLUME I - I. Washrooms**".

.2 Heritage Buildings:

.1 All work done to the buildings with historical values shall be performed in accordance with the principles listed in The Standards and Guidelines for the Conservation of Historic Places in Canada.

1.0 GENERAL

1.1 Overview

.1 **UofO** follows a particular drawing standard for presentation, drawings, specifications and other similar production standards. However, those standards are not mandatory for external Consultants, unless they are mandated as sub-consultants for one of **Facilities**' internal projects, where their drawings will be required to be integrated.

2.0 REQUIRMENTS

2.1 Drawings generalities

The following requirements are strongly recommended to be followed by the external consultants for their drawings; to ease **Facilities**', follow up and review process, to minimize errors, and save time and cost in the event of modifications:

.1 Drawing organization:

- .1 Organize sheets in sequences or series for plans, elevations, sections, details, etc. in order to ease the addition or withdrawal of sheets, without undermining the whole numbering system.
- .2 Product specifications, brand names, etc. should not be described on the drawings, but in a separate specification document. For very small projects, such specifications could be part of the drawings, but preferably on separate sheets dedicated only for this purpose.
- .3 Keep specifications as generic as possible. Keep free from quantities, legends, components schedules, or any space detailed information specifics to the drawings.
- .4 Show in the title sheet the following:
  - .1 Name of all the Main Consultants involved.
  - .2 **UofO** Project number.
  - .3 **UofO** Logo.

.2 Drawing methodology:

- .1 Components schedules: To be used as often as possible and referred on the drawings with Tags, for the different components such as:
  - .1 Partition & Ceiling types showing the support system and substrate layers.
  - .2 External wall, roof and window types.
  - .3 Doors, screen schedule and similar.
- .2 Keynotes & legends:
  - .1 For all repeated information, Key notes to be used and referred on the drawings as the best option and referred on the drawings instead of written texts.
  - .2 Keynote numbers should be kept consistent on all series of drawings. Different numbers attributed to the same note leads to confusion. Use prefix if necessary to distinguish between the different keynote types on the different pages (e.g.: "D" for demolition notes, "P" for partition notes, and similar).
  - .3 In alteration projects, avoid using the term "New". Use only "Existing" for elements to remain to remove. Everything else is deemed new.

.3 Duplication of information: To be avoided as possible, especially:

.1 Between similar detail types. Use multi-references instead.

.2 Between the source drawing and the blow-up portion. If the info is in the blow-up portion or detail, remove it from the source.

.3 Between Components schedules and the drawings: If the info is shown in the schedule, do not repeat it on the drawings. The reference Tag should be enough.

.4 Clarity: Insure clarity of information, especially for the following:

.1 Elevations: Show hierarchy in the lines: Use dark lines for close object, and light lines as objects fades back.

.2 Nomenclature: Shall be with the appropriate sizes suitable for each scale. Avoid oversize or very small illegible sizes.

.5 Redundancies: Avoid unnecessary drawings, such as:

.1 Several internal Elevations, Plans or Details showing the same information for different - but similar- types of spaces or conditions. Use multi-reference instead.

2.2 Documents deliverables

The following may be superseded by particular requests or detailed checklist, depending on project's complexities and contract specifics:

.1 Architectural drawings should show at minimum – **As applicable**:

.1 Preliminary & Schematic Concept Design:

.1 Schematic design documents to illustrate the scale and character of the Project and how the parts of the Project functionally relate to each other including as appropriate.

.2 Applicable codes summary.

.3 Site Plan.

.4 Spatial Relationship diagrams.

.5 Schematic Floor Plans.

.6 Schematic Elevations & Sections.

.7 Outline Specifications

.2 Design Brief (to be included with every submittal):

.1 Executive Summary & Introduction.

.2 Applicable codes and standards.

.3 Brief analysis of Project's requirements.

.4 Sketches and/or Schematics of proposed concept, reflecting current site conditions.

.5 Appendices as required.

.3 At 33% stage:
- .1 Code Matrix analysis.
- .2 Building main envelope system descriptions (exterior walls, roofs, parapets, soffits, internal partitions, and similar).
- .3 Site plans, Floor plans showing main layouts.
- .4 Elevations and sections.

.4 At 66% stage. At minimum:
- .1 Fire safety drawings.
- .2 Site, Roof & Floor plans showing the different wall and partition types.
- .3 Reflected Ceiling plans showing the different compositions.
- .4 Wall sections identifying main components.
- .5 External elevations with identified materials.
- .6 Typical main envelope details.
- .7 Preliminary detailed spec sections.
- .8 Preliminary door and finish schedules.

.5 At 99% stage:
- .1 All the previous stage items fully developed, identified and dimensioned.
- .2 Interior elevations as applicable.
- .3 Finished colored pattern (at least % of accent items).
- .4 Location of internal partition control joints and patterns.
- .5 Location of external masonry control joints and patterns.

.6 Fire-Safety drawings submitted to the City:
- .1 A summary description of the scope.
- .2 For new construction or Extensive Renovation (**OBC**) projects:
  - .1 A matrix summarizing the basic building information: Area, year of construction, type, number of stories, applicable Codes, major fire-rated components for floors, and similar.
  - .2 Fire-separations on all partitions on the entire floor area.
  - .3 Show Fire-spatial separations (floors, shafts, etc.), if the layout include Mezzanines or other complex spatial components.
  - .4 Critical travel distances to the exits covering the entire floor area.
- .3 For Basic Renovation (**OBC)** projects: Where information may not be available for the rest of the space:
  - .1 The matrix provided by **Facilities** which summarize the basic building information and a justification for the assessment of the fire-resistance ratings of spaces.
  - .2 Fire-separations on partitions only in the affected area.
  - .3 Travel distances **only** from the affected area to the exits.

.4 ULC, cUL or OBC SB-3 reference test number (or any approved equivalent) on all proposed fire-resistance or sound rated assemblies.

.2 Mechanical, Electrical, Plumbing drawings should show at minimum - **As applicable**:

In addition, also, refer to the relevant Deliverable & Testing requirements in the relevant **M&E** Divisions in this **DCG** document.

.1 I&R & Schematic Design:

.1 As a minimum the I&R report shall include sections to cover the following topics:

- Introduction.
- Executive summary.
- Project background.
- Applicable codes and standards.
- Existing conditions.
- Analysis of project's requirements.
- Validation and/or deviation along with recommendation(s).
- Energy consumption and O&M cost impact.
- Appendices as necessary.

.2 In addition, detailed I&R report to include:

.1 An overview of the project.

.2 Narratives to describe the existing mechanical, electrical, controls, life and safety systems, and related elements including their condition, deficiencies and life expectancy.

.3 Report on existing mechanical, electrical, controls and life and safety systems and related elements.

.4 Narratives to determine all applicable codes, regulation, standards and authorities having jurisdiction and outlined requirements related to the project.

.5 Graphical floor plans and schematics for all mechanical and electrical system to clearly demonstrate proposed options proposed in the report being recommended along with description how the new equipment/systems will impact existing installations.

.6 Sequencing of project deliverables and phasing based on priority and/or constructability. Identify short/medium/long term requirements.

.7 Project impact on existing spaces which may need to remain operational during construction; identify project impact on spaces that fall outside of the project boundary taking into account all project phases.

.8 Regardless of whether existing infrastructure is being utilized or not, investigate how other areas of the building may be negatively affected due to shutdowns, etc. Also provide recommendations to alleviate any building system capacity issues that may arise due to the project.

.9 Long delivery items which have impact on project schedule and/or phasing of construction. Equipment with long delivery time will require to be purchased in advance.

.10 Life Cycle Cost Analysis (LCCA) of mechanical and electrical systems for preferred option and/or recommendation(s). LCCA shall consider the total life cycle cost of the project. LCCA shall include the initial or first cost plus the overall operating cost and equipment replacement costs when applicable over the life of the project.

.11 Breakdown cost estimate for recommended options and other options pertain to all mechanical and electrical systems related to the project.

.2 Design Brief / Basis of Design (BOD):

.1 Executive Summary & Introduction.

.2 Applicable codes and standards.

.3 Brief analysis of Project's requirements.

.4 Narratives to describe all the existing and proposed new and/or modified mechanical systems. For controls systems provide narratives to describe the integration with other building systems including lighting controls, fire alarm, security, energy monitoring and verification.

.5 Narratives to describe all the existing and the proposed new and/or modified electrical systems. Narratives to include total connected normal load, maximum demand and diversity factors for normal load, total connected emergency load and capacity of base building emergency generator (where applicable), short-circuit requirements and calculations showing the ratings of equipment used.

.6 Approximate size of the required base building equipment/systems along with cut-sheet of preliminary selections.

.7 Analysis of selected equipment and calculations sufficient to justify the economy of the selected equipment.

.8 Sketches and/or Schematics of proposed concept, reflecting current site conditions.

.9 Appendices as required. Cutsheet of process equipment / systems with impact on base building design shall be included in the appendix.

.3 At 33% stage:

.1 Single line diagrams of all mechanical system including but not limited to HVAC, plumbing, fire protection and process systems indicating the equipment tags, preliminary system sizing, flow rates and directions, equipment capacities and all control valves, isolating valves, strainers, gauges, dampers, louvers, etc. Single line to demonstrate all the spaces affected by the project and modification(s) to existing systems.

.2 Mechanical controls schematics complete with sequences of operations and comprehensive list of control points.

.3 Floor plans showing the preliminary sizing, physical dimensions and require service areas of all major equipment complete with their locations and layouts (Equipment on floor plans must reflect the proper location within the system on both this drawing and the single line diagrams).

.4 Floor plans showing the zoning of thermal, ventilation and lighting systems.

.5 Equipment schedule including preliminary selection of all major mechanical and electrical equipment.

.6 Floor plans showing the applicable occupancy classification for fire protection systems.

.7 Site Plan showing service entrances for mechanical and electrical systems and connections to utility services including all key elevations.

.8 Single line diagram of the electrical power distribution circuits with their metering and protection, including rating of equipment, ratios and connections of current transformer and power transformer, description of relays (when used, maximum short circuit levels on which design is based. identification and size of services, connected load and estimated maximum demand on each load center.

.9 Riser diagrams for lighting, power and telecommunication cable systems, fire alarm and other systems.

.10 Preliminary control diagrams for each system.

.11 Schedule for motors and controls.

.12 Panel boards schedule with loadings for each panel.

.4 At 66% stage:

.1 Revised design brief as required.

.2 Revised single line diagrams of systems as required.

.3 Schedule for motor and controls.

.4 Floor plans of mechanical systems showing routing and sizing of major lines and location of all equipment.

.5 Floor plans of power distribution indicating all conduit and wire sizes except for minimum sizes (minimum sizes should be given in the specification).

.5 At 99% stage:

.1 Revised design brief as required.

.2 Revised single line diagrams of systems as required.

.3 Complete working drawings.

.4 Class A cost estimate (Highlight changes from previous cost estimate).

.5 Preliminary Coordination, Short Circuit, Device Evaluation, and Arc Flash study.

.6 ESA Plans Approval Response.

.7 Electrical drawings as a minimum must show the following:

- Single line diagram of the electrical power distribution circuits with their metering and protection, including Complete rating of equipment, Ratios and connections of Current Transformer (CT's) and Power Transformer (PT's), Description of relays when used, Maximum short circuit levels on which design is based, Identification and size of services and Connected load and estimated maximum demand on each load center.
- Electrical plans with: Circuit numbers at outlets and control switching identified. All conduit and wire sizes except for minimum sizes which should be given in the specification and IT, AV and Security conduits system layout for ceiling/floor distribution.

- For electrical layout and schedule provide the following data:
- Total connected normal load.
- Maximum demand and diversity factors for normal load.
- Total connected emergency load.
- Maximum demand and diversity factors for emergency load.
- Capacity of base building emergency generator.
- Sizing of standby load.
- Short-circuit requirements and calculations showing the ratings of equipment used.

.3 Specifications:

.1 Specifications produced by the external consultants, shall follow the National Master Specification (NMS) format in a separate document. For very small projects, the specifications could be incorporated to the drawings on separate sheets dedicated for this purpose, following the same NMS format.

.4 Cost Estimates:

.1 In general, and depending on Project specifics, to be as follow:

- Preliminary Concept, schematic, I&R, and similar: Class D.
- 33% Stage: Class C.
- 66% Stage: Class B.
- 99% Stage: Class A.

.5 Closeouts:

- Updated & Record Drawings.
- Updated & Record Specifications.
- Contractor's Documentation at Completion, including Warranties, Test reports, Owner Manuals, Shop Drawings Samples, and similar.
- Updated Code reports, if done by external Consultants.
- Final Commissioning Reports and related data.
- Drawing electronic format. Refer to "**VOLUME I - 4a. Drafting.**
- Any other as listed in the project specific requirements.

3.1 Procedures

.1 Reviews:

.1 Coordination: At early design stages, coordination between the different Consultants, the users and Facilities is imperative toward the realization of the design objectives. Special attention should be given to the equipment and clearances for maintenance and easy access. Design developments, Construction drawings, Reports, and all other similar documents shall be reviewed by **SME**'s during the different project phases as established and agreed with the Project Manager.

.2 **SME**'s will overview the documents to ensure they are conforming to the established **UofO DCG** and will highlight any issues to Consultants a.s.a.p. (typically, allow 5 working days). Consultant shall incorporate review comments into the next submission stage and provide written responses as necessary.

.3 Unless otherwise noted, Consultants to provide written responses to all comments received from the **UofO**, Comments shall be incorporated in the next submission as required.

.4 During the review process by **SME**'s, the Consultant shall keep working in parallel to develop their documents for the next phase, **unless specifically requested to stop** by **UofO**. Depending on the project's complexities, Consultants may be requested to obtain authorization before proceeding to the following stage.

.5 **UofO** review does not relieve the Consultants from their responsibilities and/or liabilities. The Consultants are solely responsible for integrity of design and shall ensure project requirements and **DCG** have been included in design.

.2 Room Numbering:

.1 It is imperative to consult **UofO, SRW** department to establish the proper Room numbering **prior to the beginning of every project. Room numbering done without such consultation will not be accepted.** Refer to contact information at the beginning of this document.

.3 Color & Samples:

.1 Color & Finish Sample patterns, shall be ready - ideally by 99% phase and submitted to **UofO** for review.

.4 Shop Drawings (SD):

.1 SD's shall be submitted to Consultant and **UofO** in parallel.

.2 If specific input is required, Consultant to highlight to **UofO**, and vice versa.

.3 **UofO** will not necessarily review all SD's, but in some case may do so. **UofO** will inform Consultants about any new pressing issues – if applicable.

.4 Once reviewed by Consultant, SD's electronic copy to be sent to contractor and **UofO**.

.4 Construction Documents:

.1 Consultants to issue fully stamped/sealed construction sets by all consultants.

.2 If exceptions present themselves, **UofO** must formally agree to release without stamps.

1.0 GENERAL

1.1 Overview

.1 This document comprises the **Facilities** Computer Aided Drafting and Design (CADD) & other related drafting Standard.

.2 This document forms a legal part of project deliverables. It is to be applied both internally and by any Consultant providing external Drafting**,** or on Project delivery services for **UofO**.

2.0 REQUIRMENTS

2.1 Production

.1 Consultants working Medium:

- .1 BIM (Revit or similar 3D) modeling Software: Shall be used in:
  - .1 New Buildings.
  - .2 New addition to existing buildings.
  - .3 Alteration / renovation to newly constructed buildings after 2015 (ARC, CRX & STEM).
  - .4 Major Renovation projects inside older buildings (generally where project area exceeds 50% of floor).
- .2 CADD Software:
  - .1 Can be used in all other conditions not listed above, which include generally minor renovations, roof renewal, landscape projects, etc.
  - .2 Refer to the Related document and Sample drawing / Blocks / Layering & Attributes on **UofO** Web Site.

2.2 Deliverable

.1 Timeline:

- .1 At all project phases; drawings, or other requested files as per agreements, shall be delivered to **Facilities**.
- .2 In addition, As Built Record drawings to be delivered as follow:
  - .1 Architecture: 30 days at most after the project close-out.
  - .2 M&E, Structure and other disciplines: 60 days at most after the project close-out.

.2 Format:

- .1 Pdfs:
  - .1 To be delivered in electronic tabled (indexed) format.
  - .2 Paper format is optional, depending on the project size.
- .2 CADD software:
  - .1 Refer to the Related "**Cad Standards**" document on **UofO** Web Site.
  - .2 At final closeout or last closet delivery, Layer structure, Blocks, Symbols, and other similar components shall conform to **UofO's** standards, published on the Web Site.

.3 BIM (Revit or similar 3D) modeling Software:

.1 To be delivered in both Revit and CADD format.

.2 At final closeout or last closet delivery, BIM Model shall be converted into CADD drawings, based on the same CADD parameters highlighted above.

.3 Not accepted: Overlapping partition lines (resulting from 3D flattening process).

1.0 GENERAL

1.1 Overview

.1 Unless otherwise noted, the measures indicated below shall to be applied by the **GC**, depending on project complexities, scope, and duration.

2.0 REQUIRMENTS

.1 Access:

.1 Provide access to building and Employees' Parking Area at all times. Arrange access points with Owner.

.2 Provide and maintain road access and egress from / to property fronting, except where other means of road access exist that meet approval by **Facilities**.

.2 Traffic Control:

.1 Provide traffic control mechanisms for all areas surrounding the buildings for extended or prolonged Construction periods. **PRO** may take very limited and short periods in charge. To be confirmed with every scope.

.2 Traffic control Measures shall be based on “Ontario Traffic Manual, Book 7 - Temporary Conditions”, mainly:

.1 Through competent and trained flag personnel.

.2 By continually maintain traffic control devices in use.

.3 By maintaining and providing signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project.

.3 Waste containers:

.1 All applications for projects waste containers on campuses shall be approved by the **OPST** and by the **Facilities TERR** department.

.2 Once the application is approved, the **GC** must respect the demands laid upon approval. E.g.: Install boards under the waste container to protect asphalt or terrain, observe the established distances around trees, and similar.

.3 All waste containers must be enclosed (fenced in) in order to minimize the chances of people getting injured trying to get inside, or that other people use the container without project approval. E.g.: To throw dangerous products or material that cannot usually be thrown in the waste.

.4 A poster with the name and contact of the **UofO** Project Manager and the **GC** shall be installed on the fences surrounding the waste container.

.5 The **GC** must comply with the dates initially established, as there could be other projects requesting this specific space. If there are no other requests, a new date could be established.

.6 The **GC** is responsible to establish the space to its originally state before the waste container installation. E.g.: re-installation of grass or damaged plants.

.7 The **GC** shall pay for parking that was blocked by the waste container to the tariff established in the initial meeting (as applicable.

.8 For all additional info, contact **PRO**, or **TERR**.

1.0 GENERAL

1.1 Overview

.1 Student spaces vary based on project and design specifics.

1.2 Design

.1 Definitions:

.1 Master or PHD student spaces:

.1 Enclosed study spaces to accommodate several students applying for their Master Studies.

.2 Design permitted, shall have direct access to natural lighting or indirectly through vision panels.

.2 Student Association offices:

.1 Enclosed office to hold common activity by several Student associations.

.2 Design permitted, shall have direct access to natural lighting or indirectly through vision panels.

.3 Student Lounge / Focus room: Refer to Public spaces section.

.4 Quiet Study Space / Workstation:

.1 Open or closed spaces to accommodate several students, in a quit individual environment for studying.

1.3 Accessories

.1 *Coat Hook Strip **(10 28 10)**:* To be installed in every closed office, behind door.

2.0 SERVICES

2.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

2.2 Power and Data outlets

.1 In Student lounge / focus room spaces, trailing wires connected to wall-mount outlets constitutes a Health safety hazard. Special consideration shall be taking while designing the outlets through integrating them into furniture or by other means.

1.0 GENERAL

1.1 Overview

.1 Administrative spaces vary considerably based upon major users such as the Registrar or a Faculty, and project specific.

1.2 Design

.1 Definitions:

.1 Closed (Private) Offices:

.1 Sizes vary based on the users and their hierarchy. To include but not limited to: Dean, Chair, Professor, Directors Assistant directors, Admin CAO, and similar.

.2 Design permitted, shall have direct access to natural lighting, or indirectly through vision panels.

.2 Open Office spaces:

.1 Open spaces for admin personnel, to be organized in a way to preserve a semi-privacy factor, with enough circulating and gathering spaces.

.2 Shall have direct access to natural lighting, or indirectly through skylights.

.3 Meeting Rooms:

.1 Design shall accommodate reasonable number of people based on design requirements, with a versatile design.

.2 Shall be located at strategic places, ideally at intersection of main corridors, to facilitate its sharing between different groups.

.4 Reception Areas:

.1 Space to accommodate several persons depending on design parameters with enough support space for electronic equipment.

.2 Consider in the design additional space for lineups or waiting seated area, which do not impede on the main corridors or circulation.

.5 Staff & Professor Lounge:

.1 Closed spaces for common social, gaming and reading activities.

.2 Could be used as lunchroom with a small kitchenette space with sink, which can accommodate basic appliances such as microwave and fridge.

.6 Support Spaces:

.1 Include all related support administrative spaces include but not limited to:

.1 Reprographics.

.2 Storage for students' Records.

.2 General:

.1 For privacy and acoustical issues, avoid locating office and meeting room doors face to face in double loaded corridors.

1.3 Accessories

.1 *Coat Hook Strip **(10 28 10)**:* To be installed in the following locations:

.1 In every closed office, behind door.

.2 In every Meeting room behind door, and common office space, closed to every workstation.

2.0 SERVICES

2.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

2.2 Power and Data outlets

.1 In new buildings, and depending on size and design imperatives in existing ones, Power and Data outlets shall be located in a Monument type on the floor, with possibilities of extension to the meeting table.

1.0 GENERAL

1.1 Overview

.1 Classrooms and their specific requirements vary considerably based upon major users such as the Registrar or a Faculty.

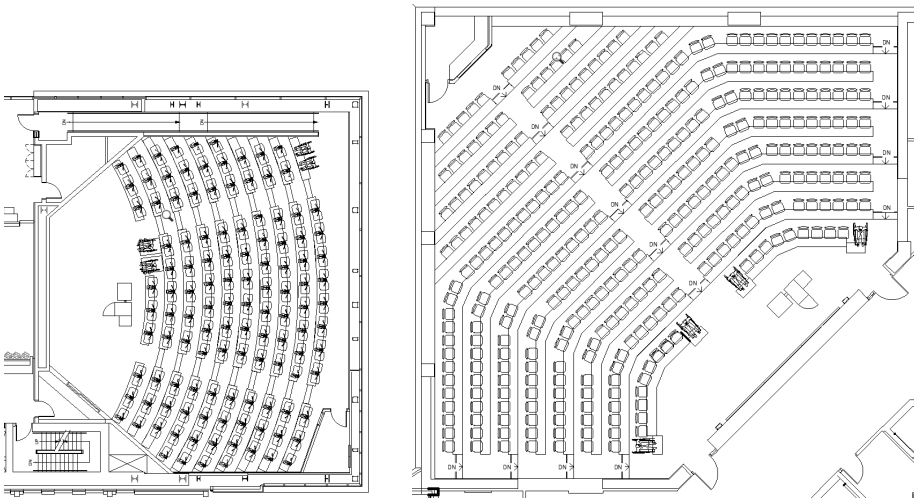
1.2 Design

.1 Definitions:

.1 Amphitheater / Auditorium:

.1 Design generally accommodates more than 80 seats, with different teaching accessories.

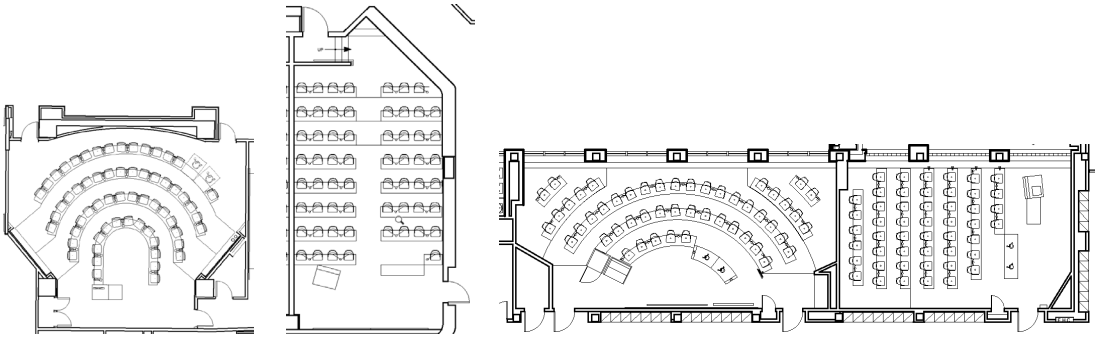
.2 Shall be designed as Auditorium style, multilevel or tired.



.2 Lecture / Regular Classroom:

.1 Design generally accommodates 40 to 80 places, with different teaching accessories.

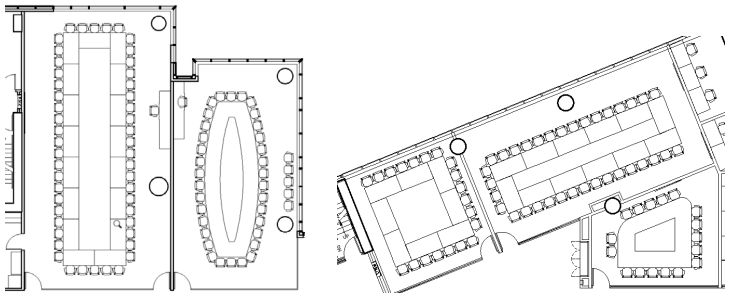
.2 Aisles to be preferably designed as large arrow, single or multi-level configuration. Design options shall minimize or eliminate the need for a tired system as possible.



.3 Seminar Room:

.1 Design accommodates generally 20 to 50 places, with different teaching accessories.

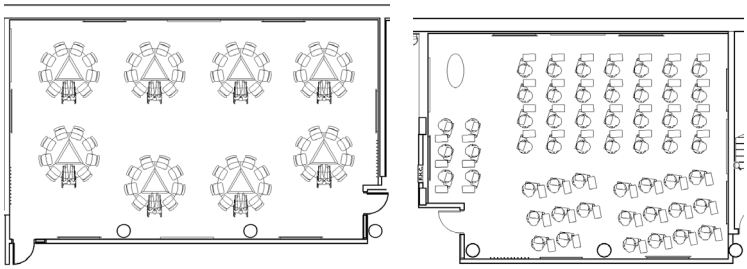
.2 Shall be designed for an interactive teaching environment, single tire, with aisles generally set-up in rectangular fashion.



.4 Computer Classroom:

.1 Depending on the parameters, design shall accommodate variable number of students, and other teaching accessories.

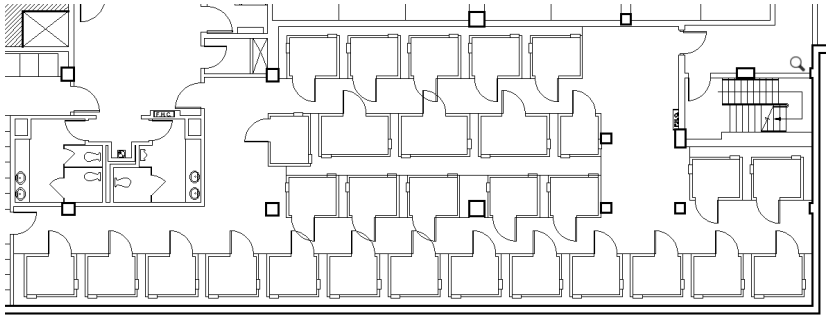
.2 Design shall be versatile, to accommodate different student's or **TLSS** groups.



.5 Music (acoustic) Room:

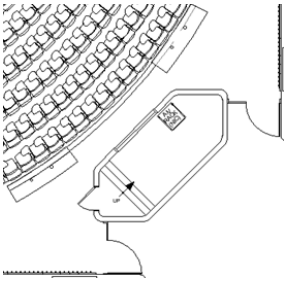
.1 Closed room or space designated for students to play different musical instruments. Sizes vary based on the number of instrument enclosed.

.2 Design options could include insulated prefabricated booth.



.6 A/V Control Room:

.1 Is generally required is required when a fixed podium is being installed and not required with the A/V rack. The door entrance of this room shall be located outside of the classroom.



.2 General:

.1 Spaces widths to depth ratio is absolutely critical to functional well. Avoid 1:1 ratio (square) or long and narrow room layout these are acoustically bad and not recommended. Recommended classroom proportions are to be 1/3 of front of room for instructor's station and remaining 2/3 for students.

.2 Depending on the room width, a single center aisle is generally the most efficient – losing space to the center aisle is often best to having two side aisles. Ideally, students should not have to cross more than 5 other seats to reach the middle seats in that row – this often dictates the placement of aisles.

.3 Preferred entrance to be located at the low level in the front of the room as it provides better access and locations to disabled persons in wheelchair.

.4 Design site lines and angle of vision in a way that no seat shall be outside of 45 deg. off the classroom centerline on either side, within 90 deg. horizontally and 15 deg. vertically.

.5 In general, Classrooms do not require a vestibule, except for very large and Amphitheater type Classrooms where a vestibule may be considered.

.6 Where tired seating is introduced, each two rows shall share the same level to encourage collaborative and interaction context.

.7 Not permitted: Built-in heavy structured tires for Classrooms. Floor shall be flat; tires & steps shall be built in light structure elements, easily removable for more design flexibility in the future.

1.3 Accessories

.1 *Coat Hook Strip **(10 28 10)***: To be installed in every Classroom (quantity to equal 50% of seating capacity), up to 60 hooks maximum per space, to be confirmed by **Facilities**.

.2 Seats: Free standing or fixed models, depends on space configuration. Other than amphitheatres, all seat options shall have the ability for 360degress rotation for shared learning experience.

2.0 MULTIMEDIA TECHNOLOGIES PRESENTATION TOOLS

2.1 Overview

.1 This is a very specialized and essential component of classroom design. Requirements and technologies are in constant evolution. Coordination with **TLSS** Multimedia Section is mandatory.

2.2 Typical Multimedia video conference technologies

.1 *Podium Desk **(12 50 00)**:*

.1 General:

.1 Designed to house all the electronics and computer teaching equipment and is linked to the classroom light controls, ceiling projectors and screens and other stuff.

.2 This is a prefabricated unit with a fixed non-adjustable component and an electrically adjustable component designed to meet barrier free requirements.

.3 To be provided and installed by **GC**.

.4 Refer to furniture standard for more details on **UofO** Web site.

.2 *Podium Desk Control **(26 50 00)***:

.1 One dedicated telephone line to be located on the *Podium desk* or at the front of the room adjacent to professors teaching station. This is required in the event of an emergency or a technology malfunction.

.2 Control design shall be similar to the following sketch. Refer to Xxxxxxx.

.2 Multi-Media Rack: A fixed unit containing A/V equipment and is used in smaller type classrooms where fixed podiums will not fit and are not used. This unit is supplied and installed by **TLSS**.

.3 Computers: Supplied and installed by **TLSS.**

.4 Projectors, (overhead, ceiling mounted) and sound systems: Supplied and installed by **TLSS**.

.5 Projection Screens, (manual and/or motorized)**:**

.1 Are supplied by **TLSS** and installed by the Contractor.

.2 A/V screens to be concealed within the ceiling space or using gypsum board bulkheads.

.6 *Visual Display Boards – Writing Surfaces **(10 11 00)**,* Bulletin Boards and Tack Strips:

.1 Shall be included in the **GC** responsibilities to supply and install. As a general rule mounting heights for chalkboards and whiteboards to be 36” above finished floor.

.2 Chalk boxes are always required. These are specially designed units by **UofO** and installed by **GC**. Request installation with **Facilities**, Custodial section.

.3 White boards are not allowed in Registrar classrooms, chalkboards to be installed.

.7 Flat screen Monitor: Supplied and installed by **TLSS**.

.8 *Clocks **(12 50 00)***:

.1 To install a minimum of one Clock per room located so that is visible to both students and teachers.

.2 Where possible, Clock type shall be integrated with the building master clock system, c/w battery backup.

.3 No battery-operated Clocks are permitted.

3.0 SERVICES

3.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

3.2 Electrical

.1 *Electrical Panel **(26 00 00)***:

.1 Each new Classroom shall have an Electrical Panel, to be located outside the Technical Support room and the Classroom to permit electricians' access.

.2 Lighting Controls:

.1 General:

.1 All lighting controls shall be located in the A/V room and be accessible.

.2 A plasticized lighting zones plan shall be affixed inside A/V Control room and on the wall, including zone numbers and electrical circuit numbers.

.2 *Motorized Projection Screen Control **(26 00 00)***:

.1 Must be installed inside the A/V Control room.

.1 Are supplied by **TLSS** and installed by the Contractor.

.3 *Multimedia* & Data *Conduits **(26 00 00)***: Provide an additional EMT conduit for lighting control wiring between the main lighting controller, switches, interfaces and scene selectors at the podium.

3.3 Power and Data outlets

.1 Data:

.1 Data port required at *Podium Desk (**12 50 00**)* or media rack.

.2 Data outlets or wireless system requirement to be confirmed on an individual project basis.

.2 *Seats with Retractable Tablet Outlets **(26 00 00)*** and *similar fixed*:

.1 Design shall allow for a maximum of eight laptops per 15 amp, 1110 volt circuit or 1.5 amp draw per electrical outlet.

.2 Electric raceway systems and top table power pack shall be approved by the **UofO** and authority having jurisdiction.

.3 To install one power outlet (2 plugs) at:

.1 Every *Seat with Retractable Tablet **(12 50 00)***.

.2 Every *Fixed Table **(12 50 00)*** for each 2 *Seats **(12 50 00)***.

1.0 GENERAL

1.1 Overview

.1 Laboratories vary from very large to smaller, more precise specific areas. Each of these Labs types have their own specific requirements and the functional programs associated with these spaces must be clearly defined early in the design process since size and weight of materials being handled will affect both the structural aspects as well as location and proximity to major loading areas, some specific equipment may generate excessive noise or heat or require large amount of chilled water or domestic water. **It is very important to work with the users** to define their needs and confirm with **Facilities** & **OCRO**, for elements such as:

- .1 Natures of operations they are conducting, including hazardous materials, chemicals and similar.
- .2 Type of Labs they operate.
- .3 Furniture configuration, material, accessories and hardware.
- .4 Equipment & Fume Hood types, sizes, weights, locations, and similar info.
- .5 All requested or necessary services.

1.2 Design

.1 Definitions:

- .1 Laboratories: Spaces designated in general for testing, teaching or experimental activities requesting specialized equipment, furniture and related M&E features. They include:
  - .1 Categories:
    - .1 Animal Care / Vivarium Facilities: Labs where experiments are performed on animals, fishes and similar that requires special architectural and HVAC confined environment. May also request to be confined, if dealing with hazardous experiments as defined by Health Agency of Canada's.
    - .2 Clean Rooms (ISO 1 – ISO 9): Labs mainly dealing with non-hazardous pathogens that require special architectural and HVAC confined environment as defined in ISO Standards (formally known as Class 1, Class 100,000, etc.).
    - .3 Classified (Bio containment level CL2(Basic), CL2-Ag, CL2-P, CL3): Labs mainly dealing with hazardous pathogens that require special architectural and HVAC confined environment as defined by Health Agency of Canada's. They include generally the following types:
      - .1 Wet (Chemical / Biological): Generally, where drugs, chemicals, and other types of biological matter can be analyzed and tested by using various liquids or flammable products, with plumbing services. They often require special architectural and HVAC environment.
      - .2 Dry (Analytical & Support): Generally, focuses more on applied or computational or electronic mathematical analyses via the creation of computer-generated models or simulations, without plumbing services. They may require humidity and temperature control, or dust control.

    Note: Unless otherwise noted, **UofO** Wet (Chemical) Labs shall be designed based on the CL2(Basic) principles.

.4 Non-classified: Labs mainly dealing with chemicals requiring special power, humidity and cooling control systems, or particular safety and health requirements, in a non-confined environment.

.5 Engineering: Labs dealing with machinery, industrial experiment, or similar. They may require proper HVAC or dedicated power systems.

.2 Other:

.1 Lab offices: Spaces that are generally daily used by the same personnel who will be operating the Laboratory. While they could be integrated to the same confined Lab area, it is recommended by **OCRO** to keep them separate, depending on design parameters.

.2 Cloakrooms: Design permitted, consider an open separated space located adjacent to a Lab zone, for personal's students' belongings such as coats, bags, water & coffee bottles, and similar belongings not allowed inside the Labs.

.3 Computer Classrooms: Spaces with large number of computers generally dedicated for students use, that are not considered Labs as described in this section. They may require proper HVAC or dedicated power systems.

.4 High Hazard Spaces:

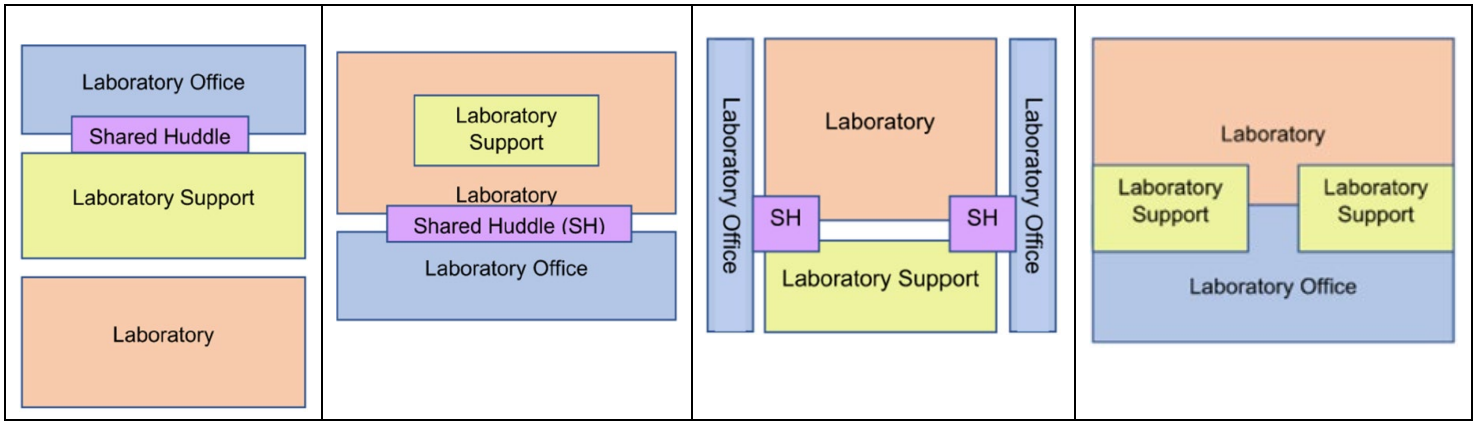
.1 Hazardous Waste Spaces: To be implemented in every building containing Labs, for the use of **OCRO** and external contractors), for the flammable, compressed gas, combustible liquid, radioactive, and similar hazardous waste material storage.

.2 Hazardous Storage Spaces: To be implemented in every building containing Labs, dedicated for the flammable, compressed gas, combustible liquid, radioactive, and similar hazardous material storage.

.3 Hazardous Dispensing Spaces: To be implemented in every building containing Labs, dedicated for the flammable or combustible liquid dispensing for cylinders or containers exceeding the permitted sizes in a typical Lab.

.2 General Concepts:

.1 Depending on Project's specifics, several options could be implemented for a combination of Large open Labs, Support Labs & related Offices, as per the following illustrations (courtesy of Parkin Architects Ltd Report, 2020):



.2 Labs with lots of Fume-Hoods should be located at top floor levels.

.3 Windowsills must be above the bench height, with enough space for backsplash.

.4 Labs should not be installed against exterior windows. Space adjacent to exterior windows should be used for circulation corridors to allow for providing temperature and humidity to be easily Controllable in the Labs. If Labs are installed against exterior windows, avoid installing Lab benches lengthwise against exterior windows as it limits the shelving potential and interferes with proper ventilation around windows. Instead, they should be installed butt-end to the windows.

.5 In an open Lab concept, ideal layout is island benches repeated on a 3000mm - 3200mm pattern, to leave 1550mm - 1650mm clear circulation. Additional circulation space should be given if benches are located parallel to exit path of travel.

.6 Unless few exceptions in existing buildings, Labs with Class I liquids which requires handling shall not be installed in the basement levels or any building, according to **OFC**.

.3 Safety Measures (in case of conflict between any of the codes, standards and regulations, the most stringent standard shall apply):

.1 Laboratories Handling Pathogen agents or Animal Care facilities: To follow:

.1 Public Health Agency of Canada's Laboratory Biosafety Guidelines.
http://www.phac-aspc.gc.ca/Lab-bio/index-eng.php

.2 Canadian Food Inspection Agency's Containment Standards for Veterinary Facilities.

.3 Canadian Council on Animal Care in science.

.4 Animals for Research Act.
http://www.ontario.ca/laws/regulation/900024

.5 Occupation Health & Safety Act & Regulations.

.6 **OCRO** Laboratory Design Guidelines.

.2 Laboratories handling chemicals, flammable or combustible material: Depending on the sizes, and hazardous quantities, Fire-Rated boundaries or compartments can include a single or serval contiguous Labs.

.1 NFPA 45 (latest edition) - Standard on Fire Protection for Laboratories Using Chemicals

.2 NFPA 55 (latest edition), Compressed Gases and Cryogenic Fluids Code.

.3 NFPA 91 (latest edition), Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, And Particulate Solids.

.4 **OFC** (latest edition).

.5 **OCRO** Hazardous material & waste directives.

.3 Specific Measures:

.1 First-aids and other safety equipment: Shall be located next to entrance within the Lab, and generally supplied and installed by **UofO**.

.2 Spill kits: Supplied by **OCRO**, shall be installed in every Lab dealing with chemical or hazardous materials, shall be highly visible, and hooked on walls.

.3 In Contained spaces: All electro-mechanical fixtures and associated penetrations on ceilings and walls, shall be air-tight and sealed around their perimeter, with compressible gaskets and appropriate sealants.

.4 Depending on hazardous material type, quantities, and applicable codes for hazardous spaces, electrical equipment may need to be explosion proof.

.5 Purge Exhaust: All wet Labs to be designed with 12 ACH purge exhaust. For building where this is not possible consult wit OCRO.

.6 Fixed Atmospheric Sensors: Refer to OCRO guidelines. Alarms shall go to protection.

.7 Emergency Shut-off: Gas shut-off valves shall be located near the door of the Laboratory (path of egress)

1.3 Accessories & Furniture

.1 Refer to "**VOLUME VI – Appendix – DB. Lab Furniture Details**" Series and related notes for proposed configurations.

.2 Accessories:

.1 For a typical Lab, at every Sink:

- *Drying Rack **(12 35 00)***. Note not to dispense water into the Sink, but in a dedicated adjacent container. Verify with **OCRO** for best location & practice.
- *Paper Towel Dispenser, Surface Mounted **(12 28 10)***
- *Soap Dispenser **(12 28 10)***
- *Hand Sanitizer **(12 28 10)***
- Integrated waste bins: Only in classified Labs, where no exposure is allowed.
- All other **M&E** accessories as per design imperative

.2 For a Cloakroom, or a Lab:

- *Coat Hook Strip: **(10 28 10)***: Quantity to equal 50% of space capacity, to be confirmed by **Facilities**.

.3 *Lab Furniture **(12 35 00)***: Unless there is any special condition or design specific:

.1 Existing Lab extensions or modifications: Shall follow the existing configuration and materials, unless otherwise indicated by **Facilities**.

.2 New Labs:

.1 System: Units shall be *Fixed Countertop Units* for Labs requiring plumbing and complex services, and *Mobile Countertop Units*, serviced from ceiling for Labs requiring few services, depending on design imperatives.

.2 Dimensions: Countertop unit width: 762mm. Shelves and wall units: 305mm.

.3 Materials: Refer to the following Schedule which represents a preferred finish or varieties of finish options covering the different possible areas. The Designer may submit an alternative for approval depending on the scope and budget.

	COUNTERTOPS ***(12 35 00)***						*CASEWORK* ***(12 35 00)***						Exposed and interior *SHELVES* ***(12 35 00)***								*SUPPORT FRAME, BACK PANELS, CHASE* ***(12 35 00)***			*SINK & CUP SINKS* ***(22 42 01)***		*DRYING RACKS* ***(12 35 00)***		
	Stainless Steel	Plastic Laminate Facing Acid Resistant	Plastic Laminate Facing	Solid Phenolic Resin (Solid pl. Laminate)	Epoxy Resin - Acid & Heat Resistant		Stainless Steel	Prepainted Steel	Wood - Plastic Laminate Facing	Wood – Wood Veneer Facing	Wood -Thermally Fused melamine (TFM)	Catalyzed Vinyl Finish	Stainless Steel	Prepainted Steel	Plastic Laminate Facing Resistant to acid	Wood – wood Veneer Facing	Wood -Thermally Fused melamine (TFM)	Catalyzed Vinyl Finish	Same as Countertop		Stainless Steel	Prepainted Steel		Stainless Steel	Epoxy Resin	Stainless Steel	Solid Phenolic Resin (Solid pl. Laminate)	Notes
Animal Care Lab	X			X	X		X	X					X	X							X	X		X	X	X	X	
Classified – CL3	X				X		X						X								X			X		X		
Clsfd' – CL2-Ag, P	X			X	X			X			X	X			X	X	X		X			X		X	X	X	X	
Glassified-CL2 (Basic)				X	X			X	X	X	X	X		X	X	X	X	X	X			X			X		X	
General, non-clsfd				X				X	X	X	X	X		X	X	X	X	X	X			X			X		X	
Engineering		X	X					X				X		X								X					X	
Hazardous Spaces	X			X	X		X	X					X	X							X	X		X	X	X	X	

Notes:

.1 Most common combination for Labs ***(12 35 00)***,:

- .1 Frame assembly: Mobile system, mounted on *Open Leg Frame Assembly*, with interchangeable *Suspended Base Cabinets* for general use, and fixed *Floor-mount Base Cabinets* for *Sinks* ***(22 42 01)***, and other plumbing units.
- .2 *Fixed floor-mount* units shall have movable *Service panels in prepainted steel* to cover all exposed piping and conduits underneath the *Countertops*, or between the *Countertops* and the ceiling, or elsewhere.
- .3 *Countertop* work surfaces & reagent shelves: *Solid Phenolic resin (Solid plastic Laminate)*, with 100 or 150mm backlash on all Units adjacent to walls.
- .4 Exposed shelves materials: In *Solid Phenolic resin (Solid plastic Laminate)*, and *Prepainted steel* gable supports.
- .5 *Casework* materials: Completely in *Prepainted Steel*, or *Thermally Fused Melamine (TFM)*, or a combination of both for sides & faces. *Catalyzed Vinyl Finish* to be considered for teaching and high abuse Labs.
- .6 *Base Cabinet Doors*: Swinging, same finish as body.
- .7 *Upper Cabinet Doors*: Sliding, in glass.

2.0 CANOPIES, BIOLOGICAL SAFETY CABINETS & FUME HOODS

2.1 Design

.1 Class I and Class II biological safety cabinets:

- .1 Shall follow NSF/ANSI 49, "Biosafety Cabinetry: Design, Construction, Performance and Field Certification".

.2 *Storage Cabinets for Corrosive (Acids and Bases) & Flammable **(12 35 00)***:

.1 Shall follow UL/NFPA standards (in particular NFPA standard 45 and the OFC.

.2 Cabinets shall be generally installed underneath the Fume Hoods and properly ventilated.

.3 Corrosion resistant-storage cabinets shall be used. Acids and bases shall be stored separately.

.4 The cabinet shall be provided with a removable, corrosion-resistant, liquid-tight pan that can hold 50 mm (2 in) of liquid.

.5 All Labs shall have dedicated areas for chemical transfer and hazardous waste storage. Chemical transfer and hazardous waste storage areas shall be designed to protect the users, the environment and prevent spilled material to access the plumbing system.

.2 *Fume Hoods **(12 35 00)***:

.1 Shall follow CSA Standard Z316.5 (latest edition) “Fume Hoods and Associated Exhaust Systems” and NFPA 91 (latest edition) “Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, And Particulate Solids”.

.2 Fume Hood’s exhaust system design and installation must meet all requirements of Ministry of the Environment, Conservation and Parks (MECP) and related regulations.

.3 For every space requiring Fume Hoods, the attached “Fume Hood Data Sheet” shall be thoroughly and accurately filled out in consultation with corresponding end users and be included with the related room data sheets.

.4 Measures shall be taken to ensure sufficient number and right type of Fume Hoods are installed. When selecting Fume Hoods, user needs, type of use and type of sash shall be considered. A complete and thorough review of the chemicals used and experiments to be conducted shall be carried out generally by a qualified industrial hygienist. In all cases, consideration shall be given to the use of low volume Fume Hoods.

.5 Variable volume Fume Hoods shall be used.

.6 In buildings that do not have a neutralizing system, sinks shall not be located in the Fume Hood. Consult with **Facilities** in such cases.

.7 For “Acid Digestion Fume Hoods”, the following requirements shall apply:

.1 Hoods and exhaust ductwork shall be constructed of acid-resistant, nonreactive impervious material.

.2. All ductwork seams and joints shall be welded and watertight.

.3 Ductwork shall be installed in the shortest and straightest vertical path to the building exterior.

.4 Positive drainage back to the hood shall be provided.

.5 Signage shall be installed on the Fume Hood in both French and English indicating: **Acid Digestion Fume Hood (Not For Perchloric Acid Use)**.

.6 Should Hydrofluoric Acid (HF) be used, additional information shall be specified on the signage.

.8 For “Perchloric Acid Fume Hoods”, the following requirements shall apply:

.1 Hoods and exhaust ductwork shall be constructed of acid-resistant, nonreactive impervious material.

.2 All ductwork seams and joints shall be welded and watertight.

.3 Ductwork shall be installed in the shortest and straightest vertical path to the outside.

.4 Positive drainage back to the hood shall be provided.

.5 Controls shall be provided so that the user can easily wash down the system.

.6 Hoods shall have a DI water spray system to wash down the entire exhaust system from the hood interior behind the baffle, through the fan, and up to the roofline.

.7 The hood work surface shall be watertight with a minimum depression at the front and sides.

.8 An integral trough shall be provided at the rear of the hood to collect wash down water and direct it to a drain.

.9 The baffle shall be removable for cleaning.

.10 Signage shall be installed on the Fume Hood in both French and English indicating: **Perchloric Acid Fume Hood (Wash Down Often)**.

.11 A fixed signage shall be installed on the exhaust fan in the penthouse and on the discharge stack above the roof that states in French and English: "**ATTENTION: EXPLOSION HAZARD Perchloric Acid Exhaust System**".

.9 Fume Hood ductwork material shall be selected to accommodate the chemicals being exhausted. Examples of ductwork materials are vinyl / Teflon or coated carbon steel or galvanized sheet metal, Fiberglass Reinforced Plastic (FRP) and Polyvinyl Chloride (PVC). In FRP and PVC ductwork, sprinklers may be required. Applicable codes shall be applied, and design shall be completed by Laboratory specialist.

.10 All Fume Hood duct work to be pressure tested.

.11 The placement of the Fume Hoods shall allow alternate routes of egress so that Laboratory personnel do not pass in front of the hood's face in emergency situations and shall not be placed too close to each other and not in front of each other.

.12 All Fume Hoods shall be equipped with an audible and visual alarm for indicating that the face velocity has fallen below the recommended set point.

.13 The Fume Hoods shall be designed to contain any spills inside and not to discharge into plumbing or sewage systems. Spill tray shall be sized based on chemical quantities to be used in the Fume Hood. Discuss required size of spill tray with Facilities.

.14 The design shall prevent turbulent air flow patterns in the occupied space and Fume Hood exhaust system. This incorporates the following factors:

.1 Diffuser type and location.

.2 Furniture location and room obstructions.

.3 Fume Hood configuration and sash positions.

.4 Exhaust duct & fan configuration/selection.

.15 The airflow shall meet the manufacturer recommendation for minimum and maximum FPM.

.16 Fume Hoods shall be equipped with emergency controls capable of increasing the ventilation in a case of a spill.

.17 Fume Hoods shall be provided with an airflow sensing, monitoring and alarm device. Airflow sensor shall be of direct measurement type e.g. velocity sensing. The system shall be integrated with Lab room's main air supply/exhaust control system.

.18 Ductless and portable Fume Hoods shall not be utilized, unless approved by **Facilities**.

.19 In general, consideration shall be given to using high efficiency low air volume Fume Hoods. Where the required velocity can be obtained by partly closing the sash, the sash and/or jamb shall be marked to show the maximum opening at which the hood face velocity will meet the requirements.

.20 Automatic fire dampers shall not be used in Hood exhaust systems.

.21 Canopy hoods (e.g. overhead hoods), shall only be intended to vent heat or local processes (e.g. autoclaves) and shall not be designed as a personal workstation. Where work involves manual manipulation or release of volatile materials, a chemical Fume Hood shall be utilized.

.22 Fume Hood sash shall have a lockable feature when in use.

.23 For maintenance lockout procedures refer to “Fume Hood and System Maintenance Program”.

4.0 EMERGENCY EQUIPMENT

2.1 General

.1 This section shall be used in parallel with **OCRO** Guidelines. **Where this section is in conflict, the latter shall prevail.**

4.1 Design

.1 *Eye/Face Wash **(12 35 00)***:

.1 Shall be installed in all areas using hazardous material within 10 seconds of the hazard and with unobstructed travel path. When using corrosive materials, however, they shall be immediately accessible and much closer to the hazard (target is 3 m (10 ft)).

.2 Electrical outlets shall not be located underneath or nearby an emergency eye/face wash or emergency shower.

.3 Shall be hard plumbed, with Lab grade plumbing.

.4 Shall be identified with a highly visible sign.

.5 Shall be in a well-lit area.

.1 Consider video surveillance coverage for all stations located in classrooms, laboratories, high hazard areas and those in public hallways. Consult with **PRO**.

.2 *Emergency Showers & Eye Wash **(22 42 01)***:

.1 Shall be installed in all areas that utilize hazardous materials within 10 seconds of the hazard and with unobstructed travel path. If using strong acid or base or very hazardous chemical, they shall be installed immediately adjacent to the hazard. They shall be accessed by a maximum of one door to go through, door swinging toward the shower location.

.2 Where possible, shall be installed in corridors and away from path of egress to avoid further exposure of the exposed individuals.

.3 Electrical outlets shall not be located underneath or nearby an emergency eye/face wash or emergency shower.

.4 Shall be hard plumbed with Lab grade plumbing and have a water basin with the following characteristics:

.2 Shall be installed immediately underneath the safety shower with no slope in the floor, with sufficient size to collect the water.

.3 Shall be covered with a grid or other material that will resist corrosion.

.4 Shall have provision for floor drain.

.5 Emergency safety showers shall have remote alarm (to “Protection Services”), triggered by a water flow switch when the shower is activated.

.6 Shall be identified with a highly visible sign.

.7 Shall be in a well-lit area.

.8 Consider video surveillance coverage for all stations located in classrooms, laboratories, high hazard areas and those in public hallways. Consult with **PRO**.

.3 Gas Detection System:

.1 The “Fixed Atmospheric Sensors” shall be compatible with gas(s) being detected for each application. Specific Lab requirements to be reviewed and gas detection devices shall be provided.

.2 Refer to and follow the requirements indicated in the attached “Fixed Atmospheric Sensors” Document / Guideline.

.3 In addition to the annunciator panel, the signal from Fixed Atmospheric Sensors shall be relayed to the intrusion detection system.

.2 Purge Activation Button:

.1 Shall be installed in:

.1 Each Laboratory that has a fume hood

.2 Areas where there is a potential for a hazardous atmosphere (accidental release from activity and/or product. This includes oxygen deficiencies, chemical releases that can interfere with the human body’s ability to transport and utilize oxygen, or that have negative toxicological effects).

.3 Locations deemed required by **OCRO**.

.3 Purge Activation System:

.1 Shall have the following functions and features:

.1 Increase the general ventilation from its current flow rate of 6.2 ACH to the higher flow rate of 12 ACH.

.2 Be intrinsically safe where required.

.3 Be locally activated and deactivated.

.4 Be remotely activated and deactivated (Either by Power Plant or BAS, to be checked internally).

.5 Local alarm to be audible and visual.

.6 Be located near the door leading to the exit so the user can press it on his/her way out.

.7 Be Labelled: ”**Purge Button, when activated call “Protection Services” at 613 562-5411.**

.8 Send an alarm to **SPS**, and provide them information on the location (building and room number), and on the common panel located in the building.

.9 When a gas detector/sensor is activated, it shall automatically activate the purge button. The gas detector/sensor shall also send an alarm signal to “Protection Services” and to the building common panel. It shall provide information on the

location (building and room number) and type of gas detector/sensor activated (to be checked internally).

.10 Purge button or gas detection system shall not return the fan to normal operation. It shall be of manual release type once the site has been inspected for safe use.

5.0 SERVICES (as applicable)

5.1 General

.1 For each laboratory space as well as high hazard areas such as but not limited to Chemical Waste Storage rooms, the Designer shall complete University of Ottawa's "Laboratory Design Review Checklist"

.2 Wet Labs requiring positive pressure to the adjacent corridor shall have an anteroom.

.3 All incoming electrical and mechanical services to each lab shall be able to be isolated separately to allow for independent shut-down (for maintenance and repair) without affecting other building areas and adjacent laboratories.

.4 Acid digestion, and perchloric acid fume hoods and fume hoods that require dedicated exhaust shall be located at top floor levels.

.5 Base Building Systems: Generally, base building systems are the systems that provide heating, cooling, ventilation, domestic water and power to the various spaces in a building. Laboratory specific equipment including but not limited to fume hoods, process cooling units, and other similar process related equipment are not considered base building systems. The University defines the following systems as base building systems:

.1 Ventilation Systems: Any and all parts of the system that provides outdoor air to a space. This can include AHUs, MAUs, their respective ductwork, terminal units and all controls associated with the system.

.2 Space Heating Systems: The system providing direct heat to a space, including the heating plant and the terminal units.

.3 Space Cooling Systems: The system providing direct cooling to a space, including the cooling plant and the terminal units.

.4 Domestic Water Systems: The system providing potable cold and hot water to the various non-lab related spaces.

.5 Laboratory Domestic Water Systems: The system providing non-potable cold and hot water to the various laboratories. This excludes laboratory chilled water systems.

.6 Laboratory General Exhaust: The fans and ductwork associated with laboratory general exhaust.

.6 Any new centralized laboratory process systems (compressed air, vacuum, purified water, process chilled water, lab gases, equipment specific transformers, UPS, etc.) requires a discussion with Facilities on ownership and maintenance and shall not be located in any facilities mechanical electrical spaces without permission from Facilities.

5.1 Ventilation

1 The minimum ventilation rate within wet Labs shall be 6.2 Air Changes per Hour (ACH) as per **OCRO**. Any deviation shall be approved by **Facilities** and **OCRO**.

.2 Wet Lab and high hazard areas shall always be maintained at proper negative pressurization. The design shall consider drawing class 1 air (as per air classification indicated in ASHRAE

62.1) from suitable dry spaces such as offices or classrooms to satisfy air containment and ventilation requirements of wet Lab spaces or high hazard areas.

.3 Demand Controlled Ventilation (DCV) shall not be utilized in Labs.

.4 For all Labs the room shall have “purge” capability. Refer to Section 4.2 below.

.5 Airflow in front of fume hoods shall not cause a turbulence that will affect the operation of the hood. Supply diffusers shall be selected such that airflow in vicinity of bio safety hoods is laminar. Computational Fluid Dynamics (CFD) simulations shall be carried out to demonstrate that proper airflow and circulation patterns are achieved. The CFD simulations shall be completed prior to design completion.

.6 The Lab exhaust system shall incorporate a heat recovery as per ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016) system.

.7 Acceptable heat recovery system are as follows: Heat wheels, Reverse return, run-around loop. Heat wheels are preferred pending cross contamination requirements. Heat recovery coils shall have filters with a minimum MERV 8 rating.

.8 Run-around loop units shall have by-pass for full flow.

.9 High plume type exhaust fans shall be used to address exhaust velocity requirements of 15.2 m/s (3000 fpm). Cone type reducers shall not be used. Exhaust duct may be reduced but design shall include ductwork to be of sufficient length to allow the air movement to return to a linear pattern.

.10 Exhaust fans serving wet Labs and high hazard areas (i.e., chemical waste storage rooms) shall be spark-proof and constructed of materials or coated with corrosion resistant materials for the chemicals being transported. V-belt drives shall be conductive.

.11 Fume hood venting shall be dedicated, separated from all other building exhaust systems.

.12 No terminal units such as FCUs and VAV boxes shall be installed inside the Lab rooms to allow for maintenance and repair without entering the Lab space. Provisions shall be made to install these units over head at corridor spaces.

.13 Laboratory ventilation (make-up) and exhaust systems as well as all other associated HVAC systems shall incorporate N+1 redundancy and have 20% extra capacity for future expansion.

.14 Laboratory supply air shall be adjusted based on exhaust air flow rate to meet the minimum ACH required for wet Laboratory spaces as outlined in this section. Supply air could be the combination of outdoor and clean transfer dry air from dry spaces in accordance with air classification of ASHRAE 62.1.

.15 Based on the above item, make-up air system shall modulate independent of exhaust air system. The turndown of the make-up air unit during the unoccupied period shall not be a fixed percentage. It shall be determined based on the calculation of ventilation and exhaust volumes of all spaces, which shall include the 20% spare capacity safety factor identified in the HVAC section of this guideline.

5.2 Heating/Cooling/Humidity Control

.1 Hydronic heating should be designed to heat the space in order to allow the outdoor air ventilation system to be turned off/down in these Labs during unoccupied hours, but never –in any case- below the minimal ACH value indicated above.

.2 Where applicable main outdoor air supply unit shall be equipped with additional heating coils to allow for use of chill water return to preheat air during colder seasonal weather.

.3 Humidity control shall be provided where 100% outdoor air is supplied. Minimum 18% RH shall be provided during the dry winter periods, maximum 55% shall be maintained during the wetter summer periods. More stringent humidity control ranges mat be required for certain applications (animal care areas).

5.3 Exhaust Fans

.1 *Laboratory Exhaust Fans (**23 00 00**)*, and heat recovery coil arrangement shall follow the following guidelines:

.1 The system shall be capable of monitoring and measuring the velocity of discharge air and verifying velocity data against corresponding fan curves published by the manufacturer.

.2 Shall be capable of accommodating the installation of one extra fan unit and additional heat recovery and associated components for future expansion.

.3 To be vertical or angled type. Horizontally mounted coils are not acceptable.

.4 The design of Lab exhaust system shall be such that it can achieve the minimum 15.2 m/s (3000 FPM) fan discharge rate at the minimum and maximum demand conditions without the need to open the by-pass dampers. Exhaust fan motors shall be located outside of the airstream at lower level for easy maintenance access without cranes. Where this is not possible permanent crane and I-beam system shall be provided.

.5 Shall not be fed from a single MCC panel but rather spread out amongst several panels in an optimum manner to allow maintenance on certain systems without shutting down the entire building. Review the MCC distribution with **Facilities.**

5.4 Process Systems

.1 Pure Water piping shall be welded / socket fusion fittings and not mechanical (threaded).

.2 Natural Gas: Provide emergency master shutoff valve in each Lab. Shutoff valve shall be located in a 1 ft x 1 ft stainless steel recessed cabinet with a glass panel near the Lab exit door.

.3 Consult with **Facilities** for the preferred Compressed Air turret type.

.4 Power Plant provides compressed air at a nominal 621 – 634 kPa (90 – 92 psi), oilless, 97% dry and filtered air (not HEPA filtered). Consultant shall confirm with Power Plant. Any requirements above this, Faculty must provide their own air compressor and they are responsible to maintain.

.5 Provide a master shutoff valve for compressed air and vacuum at each Lab. Shall be located in the ceiling space outside the Lab entrance with tag on ceiling.

.6 High Pressure Vacuum: For buildings that do not have a central high-pressure vacuum system consultant with **Facilities** to determine if dedicated vacuum ejectors (i.e. Piab) utilizing the Building's compressed air can be used.

.7 Walk-In Fridges/Freezers/CTE's: Consult with **Facilities** on the preferred type of unit, and any requirements for City Water back-up.

.8 The use of air-cooled process chillers is not permitted. Exceptions may be made when the process chilled water infrastructure in unavailable or for manufacturers that do not provide water cooled chillers. Exceptions must be approved by **Facilities**. Consult with **Facilities** on the requirements for City Water back-up for emergencies.

.9 All water-cooled process equipment shall be connected to the building **process** chilled water system, and not the main Campus chilled water system or building chilled water system. Process chilled water loops shall have N+1 redundancy.

.10 Process Chilled Water systems (main components) shall not be located in Corridors or General access areas. They shall also not be located within the ceiling space, except within a Lab. Preferred location is in a Service Closet near the Lab(s) with access from the Corridor.

.11 Provide a valve, cap and chain for all service drops to process equipment (excluding Fume Hoods), unless otherwise directed.

5.5 Plumbing

.1 Each Lab shall have accessible shut off valves located inside the ceiling space within the corridor area.

.2 All piping serving Labs shall be routed through horizontal pipe chases, integrated within cabinet benches and easily accessible through removable panels.

.3 A separate dedicated drainage system shall be provided for Lab fixtures such as but not limited to: Lab sinks, fume hood cup sinks, emergency showers, eye wash stations, Lab floor drains, etc. The Lab drainage system to be combined with the building sanitary system immediately after exiting the building. Test points / ports shall be provided at Lab and building sanitary networks before existing the building (before the combination point) and also outside the building (after the combination point).

.4 Installation and support of Lab sanitary piping, fittings and fire stops shall be in accordance with manufacturer's recommendations.

.5 The domestic hot and cold water as well as hot water recirculation network serving all wet Labs and high hazard areas shall be dedicated and shall be separated from the main domestic hot and cold-water network serving the rest of the building. The Lab domestic water loop shall be protected with back flow preventers. Back flow preventers shall be installed no higher than 5ft AFF within a mechanical room, service closet or in an accessible stainless-steel cabinet within the Lab. Lab sink aspirators are not permitted.

.6 Piping system and jointing methods shall resist spills and illicit discharges of corrosive chemicals.

.7 Drying racks shall not drain into the sewer system.

.8 Also, refer to section "**VOLUME I - W. Plumbing**" for other requirements.

5.6 Power and Data outlets

.1 All receptacles/circuits within a Lab shall not be shared with another adjacent Labs. Each Lab receptacles/circuits shall be separated.

.2 Discuss the need for UPS in the design with **Facilities.**

.3 Lab lighting shall not be controlled by occupancy sensors.

.4 Lab emergency power requirements to be discussed/coordinated with **Facilities.**

5.7 Other

.1 Refer to relevant related information sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

1.0 GENERAL

1.1 Overview

.1 Public spaces vary considerably based upon design parameters and project or building specifics.

.2 Spaces are very valuable to **UofO**. General circulation and open Public spaces shall have reasonable proportions, but not to be overdesigned.

1.2 Design

.1 Definitions:

.1 Cafeterias:

.1 Design shall include:

.1 Seating area, versatile to accommodate eating as well as common activities.

.2 Check-in counter space, and all related accessories.

.3 Kitchen area, accommodating service and all related catering equipment and services.

.2 Shall have direct access to exterior light, through windows or skylight.

.2 Corridors, Atrium Hall and Vestibule spaces:

.1 Shall be designed with reasonable proportions between widths and heights, in order to minimize the “tunnel effect”.

.2 Design permitted, Vestibules to be designed with enough dimensions, to accommodate ***Foot Grilles (12 48 00)***: with a minimum depth of 1600mm.

.3 *Elevators **(14 20 00)***:

.1 Sizes to accommodate a stretcher.

.2 At least one freight elevator shall be included in every new building.

.4 Libraries:

.1 Design shall include:

.1 Reading areas. To be organized to insure a quite environment as possible.

.2 Book storing aisles.

.3 Reception area, with related security gates and service spaces.

.2 Aisles to be designed in order to ease the circulation and increase the security. Avoid exposing bookshelves to direct sun contact.

.5 Locker spaces:

.1 Depending on project requirements, spaces could be left open with no entrance doors, located adjacent to corridors.

.2 Shall take in consideration enough circulation space around ***Lockers (10 51 00)*** with no dead end corridors.

.3 Avoid placing ***Lockers (10 51 00)*** within corridors or main circulation areas.

.6 Lounge spaces:

.1 Open spaces designated for general public. Shall have appealing and versatile design, which could be converted to accommodate different activities.

.2 Design permitted, shall be located adjacent to public corridors, in a manner to ease movement without impeding main traffic areas.

.7 Stairs:

.1 Exit stairs: Design and finishes shall be limited to the minimum Code requirements.

.2 Internal communication / feature and exterior stairs: Use durable, easy to clean materials. Shall not be overdesigned. Step sizes shall be:

.1 Risers: 152mm minimum, up to 177mm maximum.

.2 Treads: 300mm approximate.

.2 General:

.1 Avoid placing Cafeterias, Lounge and other noisy spaces close to classrooms laboratory or similar study spaces.

.2 Avoid installing showers for public use in new buildings – unless specifically requested for operational or health and safety purposes. Confirm with **Facilities** before proceeding.

2.0 SERVICES

2.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

2.1 Mechanical

.1 *Water Fountains **(22 42 03)***: To install minimum 1 per floor in visible locations. Not inside Washrooms or any similar closed spaces.

.2 Vestibules located on top of occupied basements shall be equipped with corrosive resistant drains & appropriate *PVC Rated **(22 42 02)** piping*.

2.2 Electrical

.1 In Stairwell, light fixture should be installed on walls or in the ceiling of the landing area, avoid installing fixtures above the stairs, for ease of maintenance.

2.3 Power and Data outlets

.1 Electrical outlets in stand-up counters, trailing wires connected to wall-mount outlets constitutes a Health safety hazard. Special consideration shall be taking while designing the outlets through integrating them into furniture or by other means.

.2 As a general rule, consideration should be given to the use wireless internet and data connections. Verify with **TLSS**.

1.0 GENERAL

1.1 Overview

.1 Residences and their specific requirements vary considerably based upon number of users and design specifics. Layout, amenities services, furnishings and similar shall be coordinated with **HS**. They are generally split into 2 categories:

.1 Suite style Residences: Described in this section.

.2 Dormitory style Residences: With common or public services and amenities. Shall follow similar Guidelines described in other sections.

.2 Users are mainly Students who rent the places during learning season. In summer time, some units are also rented to the public (hotel style).

.3 These spaces are subject to high abuse; construction and finished materials should be easy to maintain and resistant to high-abuse.

1.2 Design

.1 Definitions:

.1 Common Spaces:

.1 Corridors, Halls, Vestibules and service areas: Refer to Public spaces section.

.2 Laundry facilities:

.1 Not to be located inside of Suites, but as Common closed space which accommodate sufficient Laundry equipment.

.2 Design permitted, to be located on each floor.

.3 Lounge spaces:

.1 Closed Shared spaces for common social, gaming and reading activities.

.2 Design permitted, shall be located on every floor, with direct access to natural lights and terraces, if applicable.

.2 Suite spaces:

.1 In-suite Bathrooms:

.1 Design to accommodate practical functioning. Not oversized or too squeezed.

.2 In-suite Bedroom:

.1 Sizes shall accommodate a sleeping area and a study area.

.2 Built-in closets are highly not recommended, for maintenance issues.

.3 Shall have direct access to natural light and ventilation, as per Codes.

.3 In-suite Kitchens:

.1 Shall be designed as an open concept, without doors.

.2 Shall accommodate the typical appliances, such as stove, microwave, fridge and similar, except dishwashers.

.4 In-suite Living room:
.1 Shall have appropriate proportions to allow common activity, without the narrow-corridor feeling proportions.
.2 Sizes shall accommodate a sleeping area and a study area.

.2 General:
.1 Design shall include common Garbage chute.
.2 Design or project specific permitted, common Terraces to be included in the general layout.

1.3 Accessories

.1 *Mirror, Framed **(08 80 00)***: Shall be installed on top of all Sink counter surface, at 150mm height at least, except for *handicapped mirror* in accessible area.

.2 In-suite *W.C. Accessories **(10 28 10)***: Types and quantities to be:
- Stainless sheet plate 610mm wide on each side of the Stove (Kitchen countertops)
- 1 *Tissue dispenser*.
- 1 Towel racks.
- All necessary Toilet accessories, for Accessible W.C. (Refer to the related section).

.3 *Coat Hook Strip **(10 28 10)***: To be installed in the following locations:
.1 In every Bathroom.
.2 In every Bedroom (behind doors).

.4 *Stainless Steel Plates*: Shall be installed on the kitchen countertop, extended 300mm at each side of the stove.

2.0 SERVICES

2.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".
.2 Unless approved by **Facilities**, all Mechanical electrical services on the ceilings including sprinkler heads to be recessed.

2.2 Mechanical

.1 No ceiling hung pipes or conduits shall be left exposed inside Residential Suites.
.2 In the In-Suite bathrooms, Shower & bathtub shall be prefabricated units.

2.3 Electrical

.1 Public Electrical panels should be in locked vandal proof enclosures.
.2 *Exit Light **(26 50 00)*** to be mounted on the walls.

2.4 Power and Data outlets

.1 Considerations should be given for installation of power outlets for hair dryers.

.2 Every residential room should have a minimum of two outlets.

1.0 GENERAL

1.1 Overview

.1 Service rooms vary considerably based upon design parameters and project or building specifics.

.2 Size, number and location of Service spaces, especially **M&E** rooms as well as lay-out of mechanical equipment inside the mechanical rooms shall be considered at the early stage of design process. Adequate space shall be considered to provide safe distance and sufficient work space around and in front of electrical components and equipment to satisfy code requirements and for maintenance work.

.3 Lay-out of **M&E** rooms shall show the equipment service area(s) to demonstrate component and equipment clearances for code, maintenance and service purposes have been respected.

1.2 Design

.1 Definitions:

.1 Janitor rooms:

.1 Shall have appropriate sizes to accommodate cleaning carts, ladders and all other specified cleaning accessories.

.2 Shall be located as close as possible to washrooms - but not inside, to ease maintenance personnel access.

.2 Loading Docks:

.1 Design permit, Loading Platform shall be located indoor at the building perimeter - not outdoor, using integrated *Loading Dock Levellers, Hydraulic **(11 13 00)***.

.2 *Overhead Dock Doors, Motorized **(11 13 00)*** to be installed on exterior walls, with appropriate sizes to fit the Loading Dock operations. Protective Bollards to be added as necessary for full-height doors.

.3 Not Acceptable: Scissor lifts or any other similar lifting mechanism.

.3 Mechanical & Electrical rooms:

.1 Unless otherwise noted, **M&E** rooms shall be enclosed spaces, accessible from the inside of the building. Wherever impossible or in existing buildings, a special attention shall be given for adequate maintenance access, generally through marine ladders or similar.

.2 Location of transformer rooms shall be close to service entrance of building. Main transformer rooms / Vaults shall be accessible from outside of buildings and free of other systems not associated with electrical distribution systems.

.3 Design to take in consideration easy access for maintenance and personnel evacuation. Lay-out of **M&E** rooms shall show the equipment to demonstrate sufficient work space around equipment for work, safety, and routine maintenance. Following clearances shall be provided as a minimum:

.1 For fans bearing/belts/motors repair/replacement: 75 cm (3 ft.).

.2 Around pumps and compressors: 75 cm (3 ft.).

.3 For coil removal, filter replacement, tube bundle replacement and VAV boxes: As per manufacturer's recommendation.

.4 Installation of equipment from ceiling are not preferred and shall be approved by **Facilities**.

.5 Air handling unit shall be installed high enough to ensure adequate trapping and condensate pitch.

.6 All penthouse mechanical rooms shall have elevator rooftop access for removal/replacement of equipment.

.7 Penthouse elevators shall have rooftop access for removal/replacement of equipment.

.8 Basements are considered as preferred location for heating equipment.

.9 All equipment or part of equipment which imped on minimum clearances of travel of exits shall be highlighted with distinguished colors.

.10 Where project budget permits it is preferred to provide separate room for switch gear and main distribution panels.

.11 Electrical rooms for power distribution shall be enclosed and dedicated spaces and accessible from the inside of the building.

.12 Minimum one electrical room shall be provided per floor.

.13 All floor mounted transformers, switch gears, large power distribution panels, MCCs and mechanical equipment shall be installed on concrete housekeeping pad minimum 100mm (4 in.) high with rounded or steel angle protected edges.

.14 Critical **M&E** components and equipment shall be protected from water and fire damage.

.15 Whenever replacing or adding any equipment in existing spaces, consideration shall be given to refurbish the surrounding walls / floors / ceilings - budget permitted. To be discussed with **Facilities**.

.5 Workshop:

.1 Design to accommodate different repair or maintenance activities.

.2 To take in consideration all regulation and safety requirements related to the nature of work, including welding, grinding, and similar.

.6 Storage rooms:

.1 Design shall have sufficient space to store extra replacement materials for each finish product, as indicated in the related sections.

.2 Design shall optimize the space, while easing the circulation flow with enough manoeuvring space for transportation equipment such as pump lifts and similar.

.2 Ideally to have a single entrance point for security reasons.

.2 General:

.1 Design permitted, avoid locating the Service spaces close to areas with high sensitivity to vibration or noise, such as Classrooms and Laboratories.

1.3 Accessories

.1 Mop suspensions: To be installed in Janitor rooms, to fit 6 mops.

.2 Shelves: To be considered for Janitor spaces, Workshops & Storage rooms.

.2 *Loading Dock Equipment **(11 13 00)***: Budget permitted, design to include:

.1 *Loading Dock Levelers, Hydraulic*.
.2 *Dock bumpers*.
.3 *Dock door seals*.
.4 *Vehicle Restraint system, Wheel chocks, Chains and Signage*.
.5 Any other as necessary or requested.

2.0 SERVICES

2.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

2.1 Mechanical

.1 General: Special consideration shall be given to the heating system in mechanical rooms, loading dock spaces, Workshops or similar spaces, when delivery overhead doors are kept open for prolonged periods of time.

.2 Janitor rooms:

.1 Where Janitor rooms serving floor cleaning machines floor drains or *Slop Sink **(22 42 01)*** shall be equipped with sediment interceptors.

.2 *Slop Sink **(22 42 01)*** shall be installed in all Janitor rooms.

.3 *Eye/Face Wash (**22 42 01)*** shall be installed in every Janitor room with dispensing and/or chemical diluting activities.

.3 Loading Docks:

.1 Where loading dock is subject to excessive soiling, hot and cold water shall be included in design.

.2 Where there is risk of freezing from continuous open overhead doors, fire protection shall be dry type sprinkler system.

.3 Requirements of refrigerated waste room on the loading dock shall be reviewed with **Faculties** when loading dock serves food services.

.4 Mechanical & Electrical rooms:

.1 In each mechanical room one hose bib shall be provided.

.2 All penetration sleeves shall extend to a minimum of 25mm (1 in.) above slab.

.3 Workshop:

.1 Ventilation system shall be capable of accommodating the nature of work, including welding, grinding, and similar.

.2 A separate dedicated drainage system shall be provided for drains, *Sinks **(22 42 01)***, and other similar fixtures, and merged with the Sanitary Lab system, if applicable.

.4 Storage rooms:

.1 Ventilation system design shall be capable of providing tempered outdoor air to storage rooms as a minimum.

.2 Mechanical systems such as piping, ductwork shall be installed in such maintaining maximum headroom outlined in project requirement.

.3 Sprinklers shall be upright pendant with wire cage.

2.2 Electrical

.1 Janitor rooms:

.1 A minimum of one 20A/102V duplex normal power receptacle shall be provided in each janitor room.

.2 Mechanical & Electrical rooms:

.1 One campus phone line for emergency shall be provided in main switch gear and/or electrical room.

.2 Minimum one emergency power receptacle shall be provided in main mechanical rooms.

.3 At least one emergency light shall be provided in **M&E** rooms.

.4 Adequate conduits shall be provided for spare circuits. Spare conduits shall be extended to above ceiling and shall be boxed or troughed at the end.

.5 Power distribution panels in **M&E** rooms shall be surface mount (recessed in finished areas).

.6 All penetration sleeves shall extend to a minimum of 25mm (1 in.) above slab.

.3 Storage rooms:

.1 Lighting fixtures shall be guarded against damage due to moving objects in the storage rooms.

1.0 GENERAL

1.1 Overview

.1 Sports rooms vary considerably based upon design parameters and project or building specifics.

1.2 Design

.1 Definitions:

.1 Change room:

.1 Design to accommodate *Locker **(10 51 00)*** spaces with *Benches **(10 51 00)***.

.2 Avoid dead end corridors within the space.

.2 Entrance and exit doors shall be located separately, or separated by rails, in order to ease people's flow, especially in rush hours.

.2 Exercise room:

.1 Design to accommodate:

.1 Check point entrance space; which could accommodate several persons, with related service spaces, including Turnstiles or similar security gates.

.3 Exercise space; which should take in consideration training machine sizes and secure circulation spaces around.

.2 Shall have direct access to natural lighting, or indirectly through skylights.

.3 Gymnasium:

.1 Design shall accommodate different sport activities as well as major gathering events.

.2 Shall be built in durable materials to withstand high abuse from.

.4 Shower spaces:

.1 Shall include *Toilet compartments **(10 21 00)*** between showers. Doors ore curtain are optional. Design imperative and ceiling height permitted, shall be Ceiling hung.

.2 Shower space design shall prevent water spread to adjacent spaces, by curbs or other means installed at every booth, or at the entrance level of the area.

.3 Spaces to include Washrooms (refer to related section).

.2 General:

.1 Design permitted, Gymnasiums and Exercise rooms, to have direct connection with change rooms, without the need to travel through main corridors.

1.3 Accessories

.1 *Mirrors, Framed **(08 80 00)***: Shall be installed on Exercise room perimeter, up to 7000mm, installed directly above floor base.

2.0 SERVICES

2.1 General

.1 Refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

1.0 GENERAL

1.1 Overview

.1 Washrooms to be strategically located – generally on high traffic paths, in order to minimize user's displacements and unnecessary lineups.

1.2 Design

.1 Definitions:

.1 Barrier-Free Compartment: Located within Common Washrooms, to be sized and adapted as per **OBC** requirements.

.2 Common Washroom:

.1 Includes several Toilets to be segregated by standard height ***Toilet compartments (10 21 00)***. Unless otherwise requested, no Compartment to be installed between Urinals.

.2 Where space permits, Common washrooms should be barrier free labyrinth type entrance, with no entrance doors.

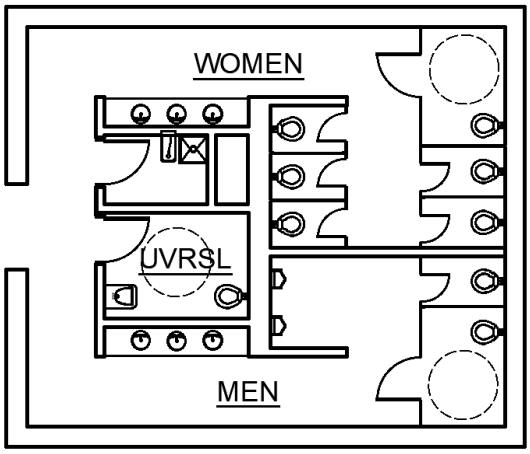
.3 Universal Washroom: For the use of one person at a time, as defined by **OBC**. To be located on every floor, in addition to the Barrier-Free Compartments located within the Common Washrooms

.2 Showers: Spaces permitted, to be placed in Common Washrooms, adjacent to Laboratories: One for males, and one for females.

.2 General:

.1 In new buildings, or extensive renovation projects, all Washrooms to be regrouped in the same vicinity with a common entrance based on the multi-stall gendered model. Additional Individual or independent Washrooms (Universal) may be added elsewhere, if necessary.

.2 The ***Toilet Compartment System (10 21 00)*** to be set at the traditional height (with open bottoms and ups); to benefit from the common lighting and HVAC system of the space.



.2 Washroom flooring to have a positive 1% slope toward the drains. In the existing installations, where a slope is difficult, a barrier-free threshold to be installed at the entrance.

1.3 Accessories

.1 Mirrors:

.1 *Mirror, Famed **(08 80 00)***: Continuous, in one piece, to be installed at 150mm over the top of counter.

.2 *Mirror, Accessible **(10 28 10)***: To be installed in every Washroom, to accommodate Barrier-Free dedicated *Lavatory Sinks **(22 42 01)***, depending on the design.

.2 *Washroom. Accessories **(10 28 10)***: Quantities and types to be:

.1 In all Washrooms, as applicable:

- One *Tissue Dispenser, Surface Mounted* for each Toilet.
- One *Heavy Duty Shelf* in each Toilet, to be mounted at 200 mm on top of *Tissue dispenser*.
- One *Soap Dispenser* per 2 *Lavatory Sinks **(22 42 01)***.
- One *Waste bin* per 4 *Lavatory Sinks **(22 42 01)***.
- One *Sanitary Napkins Receptacle* for each female Toilet.
- One *Individual Hook* for each cubicle.

.2 Additional, for Barrier-Free Toilets:

- One *P.T. Hinged Offset Rail **(10 28 10)***, to be installed on the opposite wall space of the grab bars.
- *One Adult Change Table **(10 28 10)***, to be installed at least in one Universal Washroom of every new Building.
- One *Portable Ceiling Lift Device **(11 14 00)***, to be installed at least in one Universal Washroom of every new Building.
- Any other as per related Codes (Grab bars and similar).

.3 Not acceptable:

- Recessed Accessories.
- *Paper Towel Dispenser **(10 28 10)***, *in any Washroom* accessible by public.

2.0 SERVICES

2.1 General

.1 In addition to what listed below, refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

2.2 Mechanical

.1 *Washroom Fixtures (**22 42 01**)*: Installation criteria to be confirmed by **Facilities.** In general:

- *Water Closet:*
  - *Manual Lever Operated* for small renovated Washrooms with one Toilet.

- *Sensor Activated* for Common Washrooms with several Toilets.
- *Urinals*:
  - *Manual Lever Operated* For small renovated Washrooms with one Urinal.
  - *Sensor Activated* for Common Washrooms with several Urinals.
- *Water Closet Seat* for every Toilet.
- *Lavatory Sinks*:
  - *Manual Lever Operated* for small renovated Washrooms with one *Lavatory Sink*.
  - *Sensor Activated Faucet* for Common washrooms with several *Lavatory Sinks*.

2.3 Electrical

.1 *Washroom Fixtures **(26 00 00)***: Installation criteria to be:

.1 One *Electric jet towel hand dryer* per 2 *Lavatory Sinks **(22 42 01)***, to be installed in every Washroom.

.2 Not acceptable: Sensor occupancy mechanism.

.3 Universal Washrooms door & security operating mechanism:

.1 Emergency strobe system and exterior sign to be installed as per **OBC**, and to also be linked to the central security dispatch on Campus. Reduce strobe DB levels to the necessary minimum, to avoid panic among occupants.

.2 Interior *Actuator Switch **(08 70 00)*** must always unlock the door at any time.

.3 “Push to lock” lit button to be installed beside the interior *Actuator* to deactivate the exterior *Actuator* while occupied and lock / unlock the door.

.4 Interior door *Lever **(08 70 00)*** to be always operational (never locked). Door can be manually unlocked and should reactivate the exterior *Actuator* through a door contact.

.5 Outside door *Lever **(08 70 00)*** to be always locked with a cylinder key. Outside *Door Operator Electrical strike **(08 70 00)*** to not function unless the Washroom is not occupied.

.6 Outside *Actuator Switch **(08 70 00)*** to be equipped with perimeter lit – or additional lit sign, to indicate when Washroom is occupied.

1.0 GENERAL

1.1 Overview

.1 Barrier free design should follow **OBC** requirements, Canadian Standards Barrie-free design, Accessibility Standards (CAN/CSA-B651) for the Built Environment, all other regulations and special owner or users request specifics to the project. **AODA** part IV.1 & IV.2 is currently applicable for all exterior pathways, routes, ramps, and similar; and public customer services spaces (e.g.: service counters). In case of contradiction, the most stringent shall prevail.

.2 Always verify with users and **Facilities**, the extent and applicability of such Codes into the specifics of each project.

1.2 Design

.1 Spaces: Design to take in consideration the following:

.1 Rooms dedicated to general public, such as Public spaces, Classrooms, Laboratories, Administration spaces, and similar, shall have barrier-free accommodations. (number to vary based on OBC requirements).Refer to related sections for special requirements.

.2 Free manoeuvering spaces in front of accessible cubicles in W.C., in order not to interfere with other occupants' activities.

.3 Exceptions:

.1 Spaces which contain hazardous materials that require highly trained persons, or special procedures, such as classified Labs, Animal care and similar facilities may be exempted from barrier-free requirements However, this issue should be approved by **UofO's** users and accepted by the City.

.2 Maintenance spaces that require qualified personnel, such **M&E** spaces, Janitor, and similar, do not require barrier-free accommodations.

.2 Pathways:

.1 Avoid Wall or furniture projections or special design features in barrier-free paths of travel.

.2 Exterior ramps to be concrete heated and have a canopy.

1.3 Furniture & Accessories

.1 General Accessories' height shall conform with barrier-free requirements in the designated areas.

.2 *Coat hooks **(10 28 10)***: Shall be installed at accessible heights (three minimum), where several units are required in the space.

.3 *Portable Ceiling lift Device **(11 14 00)***: Shall be installed in a total enclosed and acoustically insulated environment in special accessible W.C. designated by **Facilities**.

.4 Reception Counter desks: Shall accommodate at least one disabled receptionist and a visitor in wheelchair.

.5 *Accessible Table, Adjustable & Motorized* ***(12 50 00)***: Shall be provided in all Classroom and similar spaces with fixed tables. Quantity as prescribed by Codes, size as necessary, but not less than 750mm x 480mm clear space underneath, with 1100mm preferred space on the back.

.6 *Millwork* ***(06 10 00)*** *Stand*-up Counters: Shall be provided with a barrier-free section.

.7 Lab areas:

.1 Unless deemed hazardous or highly specialized, each Lab space shall include accommodations for people with disabilities, including at least one *Lab furniture countertop units* ***(12 35 00)***, *Emergency showers and eye wash*, *Laboratory Sinks* ***(22 42 01)***, and other related accessories and features.

.2 Accessible *Fume hoods* ***(12 35 00)***, shall be provided in each Lab space, if deemed important to the operations for every user. To be discussed with **Facilities**.

.8 *Motorized* systems or open pathways: Building Codes & Regulations permitted, doorways in the following location are to be kept open or doors to be provided with *Door Operators* ***(08 70 00)***:

.1 Within main corridors, leading to general public spaces.

.2 At floor entrances, vestibules, and washrooms.

.3 At large classrooms and auditoriums, where the number of occupants exceeds 60 persons.

.4 Where the clearances do not meet **OBC** accessibility requirements.

.9 Universal Barrier-Free Washroom or Accessible stall accessories:

.1 Refer to "**VOLUME I – I. Washroom**".

.10 Door sizes:

.1 Refer to "**VOLUME I – O. Door Schedule**".

2.0 SERVICES

2.1 General

.1 Height of Electrical and data, controls outlets, Mechanical services (water fountains, and similar) shall conform with barrier-free requirements in the designated areas.

1.0 GENERAL

1.1 Overview

.1 The **UofO** advocates matching the built surrounding environment, best practices, City bylaws or any other particular or specific parameters based on the existing conditions or project specifics. Descriptions in this section have been developed to outline the general requirements for the structural system for the project.

.2 Any design loads recommended in this narrative are a minimum. It remains the responsibility of the Project Structural Engineer of Record to confirm all loading requirements with the Building Code and to ensure the structural design meets the indicative design intent and building code.

1.2 Design

.1 Unless otherwise noted, the Importance Category for new buildings to be designated as Normal.

.2 In new Buildings, structural systems shall allow flexibility for future alteration, by prioritizing flat concrete structural slabs & shear walls, that do not require any special fire-protection coating systems which may be damaged during space alterations. Budget permitting, if built in steel, structural elements to be protected by ***Intumescent Coating (07 80 00)***.

.3 Provide concrete retaining walls for all exterior landscape elements were indicated by the Landscape consultant. Provide heavy duty slabs on grade where required for heavy loading from vehicular traffic or heavy equipment.

.4 Superimposed Dead Loads: The design of the structure shall specifically account for vertical loads imposed on the building by systems or elements that do not act as part of the primary structural system. The design shall also include anticipated superimposed dead loads in any seismic load combinations.

2.0 TECHNICAL NOTES

2.1 Vibration Mitigation

.1 Design and construction are to mitigate vibration – especially caused by mechanical equipment.

.2 Unless project specifics, vibration sensors shall be installed within buildings adjacent to the new construction site, to monitor construction vibration activity. Vibrations due to rock excavation shall be kept to a minimum to allow existing vibration sensitive research facilities to remain fully functional during construction.

2.2 Deflection Limitations

.1 Unless project specifics, limit Roof assembly deflection due to specified live load to L/360 of span. Limit Floor assembly deflection as follow:

.1 Live Load Deflection = L/360.

.2 Long-Term Deflection = L/480.

.3 Specified Total Load = L/240.

2.3 Loading

.1 Live Loads: Shall conform to the minimum standards for use and occupancy of the **OBC**, or to project specifics, whichever is greater. The design live loads shall be indicated on plan.

.2 Dead Loads: The building shall be designed to support the actual weight of all materials, finishes, ceilings, partitions, shielding, piping, and ductwork. Assumed weights shall be indicated on the design documents.

.3 Useless project specifics, below are the recommended loading conditions for the building. Higher gravity loads may be required depending on the exact use.

.1 Corridors, lobbies and aisles: 4.8 kPa
.2 Equipment areas and service rooms: 3.6 kPa
.3 Exits and fire escapes: 4.8 kPa
.4 Footbridges: 4.8 kPa
.5 Office areas above the first storey: 2.4 kPa
.6 Offices at and below the first storey: 4.8 kPa
.7 Operating rooms and laboratories: 3.6 kPa
.8 Classrooms, Cafeteria and similar: 4.8 kPa
.9 Roofs: 1.0 kPa minimum. Base snow loads plus drift per **OBC**, with IS (ULS) = 1.15 and IS (SLS) = 0.9
.10 Green roofs: 7.2 kPa (to be verified with proposed landscaping)
.11 Seismic per **OBC** at a minimum, however **NBCC** is recommended. IE (ULS) = 1.3

1.0 GENERAL

1.1 Overview

.1 **UofO** advocates matching the surrounding built environment, best practices, City bylaws or any other particular or specific parameters based on the existing conditions or project specifics.

2.0 TECHNICAL AND OTHER CRITERIA

2.1 Aspect

.1 Cladding materials for walls and high sloped roofs shall be durable, easy to maintain and to clean. At grade levels and all similar accessible areas, to be abuse resistant.

.2 Special consideration shall be taken on designing entrances, to include canopies or other means of protection from weather conditions.

.3 Building overhead pop-outs shall be avoided over pedestrian circulating areas, unless designed in a way to prevent roof snow avalanche.

.4 Special consideration shall be taken for traffic protection - especially at loading docks, by the means of bollards, corner guards and similar.

2.2 Building Envelope performance

.1 Achieve total thermal insulation of the building envelope by ensuring continuity of insulating products from the foundation walls up to the roof, minimizing thermal bridging. Exterior wall assemblies to be designed as complete cavity insulated assemblies with all required thermal values installed on exterior face of air and vapour barriers. Thermally broken anchors, supports and clips shall be used to secure cladding to structure. Thermal break shall be located within the continuous insulating layer.

.2 Achieve complete, uninterrupted moisture and Air/Vapour tightness of the building envelope, ensuring continuity from foundation walls up to and including the roof, covering all surfaces, also ensuring continuity with existing surfaces. Building enclosure elements shall prevent condensation on exposed/concealed interior surfaces caused by water vapour diffusion or air leakage, by maintaining temperatures above the dew point, using Air/Vapour membrane seal on the warm side of the insulation.

.3 Not acceptable:

.1 Hybrid systems consisting of adding *Flexible Insulation **(07 20 00)*** within the stud cavity - except in concealed difficult- to-reach conditions. To be approved by **Facilities**.

.2 Any type of *Insulation **(07 20 00)*** located on the warm side of the Vapor Barrier membrane line, except for *Sprayed Polyurethane Insulation **(07 20 00)*** in very specific locations; or as an added insulating value (for an average thickness of ± 25mm) – where the proportion of overall RSI value of the insulation system is at least 80% on the cold side, and 20% on the warm side. To be approved by **Facilities**.

.3 Using a Vapor Retarder (Semi-Impermeable) material as a substitute of Vapor Barrier (Impermeable) material, unless approved by **Facilities** and subject to low level moisture conditions.

.4 Face sealed systems, relying on the exterior wall cladding to be the sole and principal weather shield.

Permeance ng/s•m²•Pa (perm)	Term	Class
< 5.72 (< 0.1)	Vapour impermeable	Class I Vapour Retarder (or Vapour Barrier)
5.72 – 572 (0.1 – 1.0)	Semi-impermeable	Class II Vapour Retarder
572 – 5721 (1 - 10)	Semi-permeable	Class III Vapour Retarder
> 5721 (10)	Vapour permeable	

Image 1 of 4 - Figure 1: Classification of materials according to their vapour permeance referenced from a Building Science paper by J. Lstiburek.

2.3 Drainage

.1 The exterior wall systems shall follow the Rain Screen principles, with design pressure-equalization airspace, vented and drained to the exterior, within the wall construction. All cladding elements to be designed to evacuate water from back cavities with an adequate pressure-equalized continuous drainage cavity outside of exterior wall structural.

.2 Lower cladding drainage line to be installed at 150mm in height minimum over grade level.

.3 Provide ***Insect Screens (07 40 00)*** in exterior cladding systems, whenever gaps exceed 6mm.

.4 Not acceptable:

.1 Drainage line from one building components through another. e.g. Wall cavity cladding through Curtain Wall Mullion cap.

2.4 Compatibility

.1 All installed components to be compatible with each other. Including, but not limited to:

.1 Non-compatible materials EDM, PVC, TPO, asphalt or bituminous materials shall be separated using felt membranes, prefinished metal sheets or other similar features.

.2 The junctions or interfaces of dissimilar metals shall have an electrolytic separation device or appropriate membrane, to prevent electrolytic corrosion and metal degradation.

2.5 Compartmentalization

.1 Provide Wind compartmentalization in cladding cavity wall systems, applied vertically @ 9000mm o/c average (±1000mm from building corners).

.2 If exterior cavity exceeds 25mm, and a combustible or foam plastic insulation is used in the cavity with a flame spread exceeding 25, provide fire compartmentalization (metal sheets or similar) distanced 20m horizontally / 3m vertically in walls, and 20m in soffits, as per **OBC**2024, 3.1.11.2; and 2012, 3.1.11.5(2).

2.6 Structural

.1 Refer to section "**VOLUME I - N. Interior Work**".

2.7 Protection

.1 Apply ***Anti-Graffiti Shield (09 96 00)*** on all exterior rough surfaces susceptible to be vandalized on new buildings. Protected surfaces –up to 3000m higher than any accessible level, to include walls and high sloped roofs at the following locations:

.1 Perimeter at grade level.

.2 Perimeter at roof levels accessible to public, patios, terraces, and similar.

.3 Any similar, as per project specifics.

2.8 Bird Friendly Design

.1 Bird friendly Design parameters shall be considered – generally on the first 12m of a building (tree canopy height):

.1 To follow as a minimum the CSA A460-19 Bird-Friendly Building Design Standards.

.2 Design well-articulated buildings where structures are easily distinguishable from the natural environment.

.3 Avoid parallel glass.

.4 Avoid at grade glass rails.

.5 Ensure ground level ventilation grates have a porosity of less than 20mm X 20mm (or 40 mm x 10 mm).

.6 Ensure lighting is 'Dark Sky' compliant. Lower lighting angles.

.7 Plant lush landscape immediately adjacent to windows.

.8 Incorporate features that reduce or break-up reflections or transparency of glass: overhangs, louvers, window treatments, awnings, external screens, lattice or grillwork.

.9 Use ***Bird Friendly Glass (08 80 00)*** treatments (fritting, etching, film, frosting and similar), located on the outside of the glass, visible in all light conditions, as per the above-mentioned standard.

2.9 Green Roofs:

.1 Design permitted; avoid plant material in the following locations:

.1 Underneath roof lines unless there is built in irrigation.

.2 Within 2 feet of south or west facing walls, unless irrigated weekly (during growing season), as reflected light will cause excessive loss of soil moisture.

.3 Underneath downspouts and drip lines.

.4 In corners where snow tends to drift during winter.

.5 In shady areas, those that get less than 3 hours of direct sunlight per day—too shady for sedums.

.6 Locations with constricted air movement.

.7 Areas where there is reflected light from white membrane, glass and skylights, unless there is a built-in irrigation system and access to water at least once per week.

.8 Areas where there is excessive heat below roof deck, such as from steam or hot water pipes. Use pavers or stone ballast in such areas.

.9 Any area where water pools on the roof.

.10 Within 10 feet of the leeward side of wind screens unless they extend to the ground. If there is a gap, the wind will blow under it, accelerate, and dry out the plants.

.11 Under landscape lighting that is close enough to plant material to throw heat onto the plant material.

.2 Depending on vegetation type, to take into consideration ANSI/SPRI VF-1 external Fire Design Standard for Vegetated roofs leaving buffer zones (vegetation free) at:

.1 Building elevated facades,

.2 Between vegetated areas.

.3 Around mechanical and other penetrations.

2.9 Energy

.1 Refer to section "**VOLUME I - S. Energy and Sustainably**".

3.0 SYSTEMS

3.1 Systems Assemblies

.1 Refer to **"VOLUME VI – Appendix – DV. Building Envelope Details"** Series and related notes for proposed connection details.

.2 All building envelope components are subject to **Facilities'** approval. **Facilities** reserves the right to request Hygrothermal or any other analysis, for any assembly or configuration that differ from the examples or indicated systems.

.3 Unless otherwise noted, all listed assemblies apply for new buildings. Repairs or alterations to existing buildings to match adjacencies – depending on conditions and availability. Glazing types may be upgraded, depending on project and design specifics.

.4 Notes:

.1 Depending on the type of plants, all Green roofs shall be provided with non-freezing Hose Bibs. To be confirmed by **Facilities**.

.2 Soffits to be vented to the exterior or heated to the interior.

.5 Not acceptable:

.1 EIFS (Exterior Insulation Finish System) wall systems.

.2 PVC cladding system.

.3 Ceramic cladding system.

.4 Thin brick "light" cladding systems.

.5 Window wall systems.

.6 Curtain wall systems over blind walls (e.g. Concrete sheer walls).

.7 Shadow boxes (deep spandrel panels) in curtain wall assemblies.

.8 Single unit *Glazing **(08 80 00)*** units in new buildings.

.9 PVC window frames.

.6 Insulation thickness, Frames, Glazing types or other similar, to depend on the Energy targets set for the building.

.7 Unless otherwise noted, exterior doors to be as follow:

.1 Exits:

- *Pressed Steel Frames For Exterior Doors, Insulated **(08 11 00)***.
- *Hollow Metal Exterior Doors, Insulated **(08 11 00)***, with *Sealed Glazed Vision Units **(08 80 00)***.

.2 Entrances:

- *Frames In Aluminum, Tubular Extrusions For Curtain Wall, Windows And Exterior Doors, Regular Or With S.S.G., Anodized Or Prepainted **(08 40 00)**; Or Frames In Aluminum, Tubular Extrusions For Curtain Wall, Windows And Exterior Doors, With High Thermal Resistance, Regular And For S.S.G. Anodized Or Prepainted **(08 40 00)**; Or Frames In Aluminum, Tubular Extrusions For Light Curtain Wall, Windows And Exterior Doors. Anodized Or Prepainted (08 40 00)*; Or *Frames In Aluminum, Tubular Extrusions For Exterior Doors And Vision Panels Anodized Or Prepainted, Storefront **(08 40 00)***.
- *Aluminum Exterior Swinging Glazed Doors, Insulated Anodized Or Prepainted **(08 80 00)***, with *Sealed Glazed Vision Units **(08 80 00)***.

3.2 Typical Assemblies

.1 Glazing & Openings:

C01 – Strip window, Curtain Wall & Glazing (for large Glazed surfaces, Atriums and similar – and for Strip or Punch windows in Institutional Buildings and similar).

+ *Frames In Aluminum, Tubular Extrusions For Curtain Wall, Windows And Exterior Doors, Regular Or With S.S.G., Anodized Or Prepainted **(08 40 00)***; Or *Frames In Aluminum, Tubular Extrusions For Curtain Wall, Windows And Exterior Doors, With High Thermal Resistance, Regular And For S.S.G. Anodized Or Prepainted **(08 40 00)***; Or *Frames In Aluminum, Tubular Extrusions For Light Curtain Wall, Windows And Exterior Doors. Anodized Or Prepainted **(08 40 00)***.
+ *Aluminum Curtain Wall Frame Covers, Anodized Or Prepainted **(08 40 00)***; Or *Sun Control Screens, Aluminum, Anodized Or Prepainted **(08 40 00)*** - On chosen locations; Or *Structural Silicone Adhesive Sealant **(08 80 00)*** - With S.S.G. frames.
+ *Sealed Glazed Vision Units, Regular Or With S.S.G **(08 80 00)***; Or *Insulated Sandwich Panels In Aluminum, Anodized Or Prepainted **(08 40 00)***; Or similar.

C02 – Spandrel Panel (for large Glazed surfaces, Atriums and similar).

+ *Opaque Glass For Spandrel Panels (08 80 00); Or Sealed Unit With Ceramic Frit (08 80 **00)***; Or *Cladding Panels In Aluminum, Anodized Or Prepainted **(08 40 00)***; Or similar.
+ *Mineral Fiber Semi-Rigid Board Insulation For Curtain Wall **(07 20 00)***.
+ *Cold Formed Galvanized Steel, Air/Vapour Barrier Pans **(08 40 00)***.

C03 – Skylight (for general use, depending on project and design specifics).

+ *Frames In Aluminum, Tubular Extrusions For Skylight, Anodized or Prepainted **(08 40 00)***.
+ *Aluminum Skylight Frame Covers, Anodized or Prepainted **(08 40 00)***.
+ *Sealed Glazed Vision Units, Tempered & Laminated **(08 80 00)***.

C04 – Sectional Window (for Residential Buildings and similar).

+ *Windows In Aluminum, Anodized or Prepainted Extruded Sections, With High Thermal Resistance **(08 40 00)***.
+ *Sealed glazed vision units, regular or with S.S.G **(08 80 00)***; Or *Insulated sandwich panels in aluminum, anodized or prepainted **(08 40 00)***; Or similar.

.2 Decks & Slabs:

D01 – Slab on grade (for general use, depending on project and design specifics).

+ Concrete Slab-On-Grade (Struct.).
+ *Polyolefin Vapour Barrier Membrane **(07 10 00)***.
+ Granular Fill (Stone Dust) (Struct.).

D02 – Grating (for general use, depending on project and design specifics).

+ *Foot Grill **(12 48 00)** + Drainage Pan (As Necessary)*.
+ *Elastomeric Waterproofing Membrane*; Or *Cementitious Waterproofing **(07 10 00)***.
+ Concrete Slab (Struct.).

.3 Foundation Walls:

F01 – Composite (for general use, depending on project and design specifics).

+ *Extruded Expanded Polystyrene Board Wall Insulation With Modified Concrete Facing* ***(07 20 00)*** - on above grade exposed foundations 200mm or higher, and 150mm below grade.
+ *Drainage Board* ***(07 10 00)*** - on underground exposed membrane and insulation).
+ *Bituminous Damp Proofing Membrane* ***(07 10 00)*** - on total height of foundation walls; Or *Hot Applied Asphalt Waterproofing Membrane* ***(07 10 00)*** - on total height of foundation walls; Or *Cementitious Waterproofing (07 10 00)* - on total height of foundation walls, with high exposure to water - elevator pits, or similar; Or *Elastomeric Waterproofing Membrane* ***(07 10 00)*** - on total height of foundation walls, with high exposure to water, on concrete surface subject to cracks or shear movements; Or *Self-Adhering Waterproofing Membrane* ***(07 10 00)*** - on total height of foundation walls, with high hydrostatic pressure, elevator pits, or similar.
+ Concrete Foundation Wall (Struct.).

F02 – Plaster (in less exposed and non-traffic areas).

+ *Plaster System for Foundation Walls* ***(07 20 00)*** - up to 150mm below grade.
+ *Lightweight Concrete Board* ***(05 40 00)*** - attached to metal furring, on above grade exposed foundations 200mmor higher, and 150mm below grade.
+ *Insulation, Waterproofing*, etc., similar to "**F01**" composition.

.4 Parapets:

P01 - Vertical Framed Surface (for general use, depending on project and design specifics).

+ *Modified Bitumen Two-Ply Exposed Flashing Membrane, Granule Surfaced* ***(07 50 00)*** and *Metal flashing and coping, galvanized or pre-painted* ***(07 40 00)*** - only if wood Substrate is used.
+ *Glass Fiber Mat Faced, Silicone Core, Gypsum Exterior Wall Sheathing Board* ***(05 40 00)***; Or *Lightweight concrete board* ***(05 40 00)***; Or *Plywood panel, pressure treated, water-resistant* ***(07 50 00)***.
+ *Extruded Expanded Polystyrene Board Wall Insulation* ***(07 20 00)*** - to prevent the thermal bridges over studs.
+ *Exterior Structural Steel Stud System, Galvanized* ***(05 40 00)***.
+ *Glass Fiber Flexible Insulation* ***(07 20 00)*** - to fill cavities within parapets supporting systems.

P02 - Vertical Solid Surface (for general use, depending on project and design specifics).

+ *Modified Bitumen Two-Ply Exposed Flashing Membrane, Granule Surfaced* ***(07 50 00)*** and *Metal flashing and coping, galvanized or pre-painted* ***(07 40 00)*** - only if wood Substrate is used.
+ *Glass Fiber Mat Faced, Silicone Core, Gypsum Exterior Wall Sheathing Board* ***(05 40 00)***; Or *Lightweight Concrete Board* ***(05 40 00)***; Or *Plywood panel, pressure treated, water-resistant* ***(07 50 00)***.
+ *Extruded Expanded Polystyrene Board Wall Insulation* ***(07 20 00)*** - to prevent the thermal bridges over studs, and *Metal Furring, For Application With Rigid Insulation* ***(07 20 00)***.
+ *Interconnecting Air/Vapor Barrier Membrane* ***(07 50 00)***, Or *Vapor Barrier Membrane* ***(07 50 00)***.
+ *Concrete* Masonry Units (04 80 00) - vertically and horizontally reinforced.

P03 – Parapet's Tops (for general use, depending on project and design specifics).

+ *Metal Flashing And Coping, Galvanized Or Pre-Painted **(07 40 00)**;* Or *Flashing and Coping In Aluminum, Anodized **(07 40 00)**;* Or *Aluminum Flashing and Coping, Prepainted **(07 40 00)**;* Or similar.
+ *Modified Bitumen Sub-Layer Flashing Membrane **(07 50 00)**.*
+ *Glass Fiber Mat Faced, Silicone Core, Gypsum Exterior Wall Sheathing Board **(05 40 00)***; Or *Lightweight Concrete Board **(05 40 00)***; Or *Plywood Panel, Pressure Treated, Water-Resistant **(07 50 00)***.
+ *Exterior Structural Steel Stud System, Galvanized **(05 40 00)***
+ *Extruded Expanded Polystyrene Board Wall Insulation **(07 20 00)***; and *Glass Fiber Flexible Insulation **(07 20 00)*** (To fill cavities within supporting systems).

.5 Roofs:

R01 – Conventional (for general use and roofs filled with Mechanical and other equipment – and in renovation projects, where the current structural capacity is inadequate to sustain any additional load).

+ *Modified Bitumen Two-Ply Exposed Roofing Membrane, Granule Surfaced (07 50 00)* - Glued or torched.
+ *Fiberboard Panels, Regular **(07 50 00)**;* Or *Perlite Panels, Regular and Sloped **(07 50 00)*** - Glued.
+ *Expanded Polystyrene Board Roof Insulation, With Laminated Fiberboard **(07 50 00)**;* Or *Expanded Polystyrene Board Roof Insulation, Sloped **(07 50 00)**;* Or *Expanded Polystyrene Board Roof Insulation, W/ Sloped Laminated Fiberboard **(07 50 00)**;* Or *Polyisocyanurate Board Roof Insulation, Regular And Sloped **(07 50 00)*** - Glued.
+ *Organic Felt Reinforced Two-Ply Asphalt Roofing Membrane **(07 50 00)**;* Or *Asphalt Laminated Kraft Paper Vapour Barrier **(07 50 00)**;* Or *Vapour Barrier Membrane, Asphalt or Adhesive Applied **(07 50 00)**;* Or *Modified Bitumen One-Ply Vapour Barrier Membrane, Self-Adhesive, Torch or Adhesive Applied **(07 50 00)*** - Glued Or Torched.
+ *Glass Fibre Mat Faced, Silicone Core Gypsum Roof Sheathing Board, Regular and Primed **(07 50 00)***
+ Concrete slab (Struct.); Or *Glass Fiber Mat Faced, Silicone Core Gypsum Roof Sheathing Board*; Or *Lightweight Concrete Board **(05 40 00)*** - mechanically fastened to steel deck (Struct.).

R02 – Inverted (for terraces or occupied roofing areas).

+ *Gravel Ballast **(07 50 00)**;* Or Concrete Walking Pads.
+ *Woven Fabric Membrane **(07 50 00)**.*
+ *Extruded Expanded Polystyrene Board Roof Insulation **(07 50 00)*** – Loose-laid.
+ *Roof Drainage Board **(07 50 00)*** – Loose-laid.
+ *Polyethylene Film Separation Membrane **(07 50 00)**.*
+ *Modified Bitumen Two-Ply Protected Roofing Membrane **(07 50 00)*** - Glued or Torched; Or *Hot Applied Modified Asphalt Protected Roofing Membrane **(07 50 00)**.*
+ *Concrete* Slab (Struct.); Or *Glass Fiber Mat Faced, Silicone Core Gypsum Roof Sheathing Board*; Or *Lightweight Concrete Board **(05 40 00)*** - Mechanically fastened to Steel Deck (Struct.).

R03 – Extensive (Light) Green system (for general use, depending on project imperatives, especially on low-level roofs which could be seen from higher floors, or large exposed surfaces – and for renovation projects, where the current structural capacity is adequate to sustain the additional load).

+ *Tray Vegetated System **(07 50 00)***.
+ *Anti-Root Barrier **(07 50 00)***.
+ *Roof Drainage Board **(07 50 00)***.
+ Membrane, Insulation, etc.: Same as "**R01 – Conventional**".

R04 – Intensive (Heavy) Green system (for low level terraces, depending on project depending on project imperatives).

+ *Growing Medium **(07 50 00)***.
+ *Anti-Root Barrier **(07 50 00)***.
+ *Roof Drainage Board **(07 50 00)***.
+ Membrane, Insulation, etc.: Same as "**R02 – Inverted**" - without ballast.

R05 – Shingles (for replacement of similar systems).

+ *Asphalt Shingles **(07 30 00)*** - On Sloped Roofs; Or Similar.
+ *Roofing Felt Underlayment **(07 30 00)***
+ *Glass Fiber Reinforced Modified Bitumen Waterproofing Membrane for Roofing **(07 30 00)*** - for leaves -1500mm min. wide, ridges and valleys around openings.
+ *Wood* Deck; Or similar (Struct.).

.6 Soffits:

S01 – Metal (for general use, depending on project and design specifics).

+ *Cladding Panel System In Aluminum, Anodized Or Prepainted **(07 40 00)*** - With *Galvanized Steel Sub-Girt System for Walls **(07 40 00)***.
+ Brackets, insulation & substrates: Similar to exterior walls "**W**" – Series.

.7 Exterior Walls:

W01 – Masonry Veneer (for general use, depending on project and design specifics).

+ *Clay Brick*; Or *Concrete Masonry Units **(04 80 00)***; Or *Manufactured Stone Masonry Units **(04 80 00)***; Or *Natural Stone Masonry **(04 80 00)***; Or similar.
+ Air Space 38mm Min.
+ *Mineral Fiber Semi-Rigid Board Cavity Wall Insulation **(07 20 00)**; Or Polyisocyanurate Board Wall Insulation **(07 20 00)***; Or *Sprayed Polyurethane Insulation **(07 20 00)***.
+ *Modified Bitumen, Air/Vapour Barrier Sheet Membrane, Self-Adhesive **(07 10 00)*** - For General Use And Transition); Or *Liquid Emulsion Air And Vapour Barrier Membrane **(07 10 00)*** - For General Use; Or *Modified Bitumen Air/Vapour Barrier Sheet Membrane, Thermofusible Grade **(07 10 00)*** - At High moisture conditions.
+ *Concrete Masonry Units **(04 80 00)*** - Vertically and horizontally reinforced; Or structural concrete elements; Or *Glass Mat Exterior Gypsum Wall Sheathing Board **(05 40 00)*** & *Exterior Structural Steel Stud System, Galvanized **(05 40 00)***.

W02 – Cladding (for general use, depending on project and design specifics).

+ *Cladding Panel System in Aluminum, Prepainted* ***(08 40 00)***; Or *Glass Fiber Reinforced Concrete Cladding Panels* ***(07 40 00)***, with Trim joint reveals; Or Similar; with *Galvanized Steel Sub-Girt System For Walls* ***(07 40 00)***,
+ Air Space 25mm or 38mm (within the system).
+ *Galvanized Steel Sub-Girt System For Walls* ***(07 40 00)*** *– vertically & horizontally,* with *Thermal Breaks* ***(07 40 00)***; Or *Thermally Broken Sub- Spacers (****07 40 00)***.
+ *Insulation*, substrate, etc.: Similar to "**W01**" System.

W03 – Corrugated Metal (for facades hidden from public view, or for Mechanical penthouses and similar).

+ *Exterior Metal Siding Panels, Galvanized* ***(07 40 00)*** - Galvalum Plus; Or *Exterior Metal Siding Panels, Prepainted* ***(07 40 00)***.
+ *Air Space 25mm (Within The System).*
+ *Galvanized Steel Sub-Girt System for Walls* ***(07 40 00)*** *– Vertically & Horizontally,* With *Thermal Breaks* ***(07 40 00)***; Or *Thermally Broken Sub- Spacers (****07 40 00)***.
+ *Mineral Fiber Semi-Rigid Board Siding Wall Insulation, Medium Density* ***(07 20 00)***.
+ *Interior Metal Liner Panels, Prepainted* ***(07 40 00)*** - applied against structural steel girts.
+ *Steel*, Primed, Structural Sections (Struct.).

W04 – Precast Concrete (for general use, depending on project and design specifics).

+ *Precast Concrete Insulated Sandwich Panels* ***(03 45 00)*** - Exterior and interior skin.
+ *Polyisocyanurate Board Wall Insulation* ***(07 20 00)*** - Between Concrete Panels.
+ *Modified Bitumen, Air/Vapour Barrier Sheet And Thru-Wall Flashing Membranes, Self-Adhesive* ***(07 10 00)*** - around sandwich panels perimeter, extended 200mm.

W10 – Blocking of openings (for blocking exiting openings or similar).

+ *Gypsum Board, Regular* ***(09 20 00)*** - 16mm.
+ *Metal Furring, Galvanized* ***(09 20 00)*** - 22mm @ 400mm O/C.
+ *Modified Bitumen, Air/Vapour Barrier Sheet Membrane, Self-Adhesive* ***(07 10 00)***.
+ *Extruded Expanded Polystyrene Board Wall Insulation* ***(07 20 00)*** - 25mm.
+ *Exterior Structural Steel Stud System, Galvanized* ***(05 40 00)*** - 42mm @ 400mm O/C.
+ *Cavity Space Filled With Glass Fiber Flexible Insulation* ***(07 20 00)***.
+ Existing window frame to remain.
+ *Lightweight Concrete Board* (05 40 00) - with sealed edges.
+ *Galvanized Steel Sub-Girt System For Walls* ***(07 40 00)*** - Vertical, 25mm @ 400mm O/C.
+ *Glass Fiber Reinforced Concrete Cladding Panels* ***(07 40 00)***.

1.0 GENERAL

1.1 Overview

.1 Non withstand the cases where Building Code allows combustible constructions, only non-combustible partition construction should be used, unless applied to repair or match existing combustible conditions.

2.0 TECHNICAL AND OTHER CRITERIA

2.1 Height

.1 In general, partitions to be full height in the following locations:

- .1 Corridors, Halls, and similar common spaces.
- .2 Classrooms, Teaching labs, Meeting room other similar spaces.
- .3 Wherever there is a special acoustical necessity.

.2 In spaces places where sound attenuation is not an issue, or whenever sound tests allows it, partitions may stop at 150mm above ceiling height.

.3 Avoid terminating partitions under ceiling height, unless working in an existing –difficult to reach area, or in flexible design spaces.

.4 Notes:

- .1 Unless any particular necessity, in non-Fire-Rated full-height Gypsum board partitions, substitute all Gypsum board types above ceiling level, with *Regular Gypsum Board* ***(09 20 00)***, same thickness.

2.2 Thicknesses

.1 As necessary by design specifics, but not less than:

- .1 16mm for *Board Material* ***(09 20 00)***.
- .2 92mm for *Steel Stud System* ***(09 20 00)***.
- .3 150mm for *Concrete Masonry Units* ***(04 80 00)***.

2.3 Structural

.1 Provide slot connection and gaps as necessary to accommodate structural deflection, which includes, but is not limited to:

- .1 Exterior cladding support ("z" sub-girts, hat channels, or other).
- .2 Curtain wall mullions, window support.
- .3 Masonry, Glazing or Drywall's partition systems, using double tracks, moldings or similar approved.

.2 Maximum deflections: L/360th of span (ceilings), L/240th of span (partitions).

.2 All Walls, Partitions and Glazed partitions to comply with **OBC**, section 4, (Loads on walls acting as guards), for all walls where the floor elevation on one side (including around a shaft) is more than 600mm higher than the elevation of the floor or ground on the other side.

3.0 SYSTEMS

3.1 Systems criteria

.1 General Application Location:

.1 *Gypsum Board, Regular Or Fire-Resistant **(09 20 00)***: General use for walls and ceilings.

.2 *Mould and Moisture Resistant Gypsum Board, Regular or Fire-Resistant **(09 20 00)***: High moisture spaces and similar.

.3 *Glass Mat Water Resistant Gypsum Board, Regular Or Fire-Resistant **(09 20 00)***: Or *Llightweight Concrete Board **(05 40 00)***: High humid exposed spaces, showers, and all surfaces under ceramic, porcelain, thin brick cladding, Porcelain tiles and similar.

.4 *Abuse Resistant Gypsum Board, Regular or Fire-Resistant **(09 20 00)***: Corridors, high traffic and all similar spaces.

.5 *High Impact Resistant Gypsum Board, Regular or Fire-Resistant **(09 20 00)***: Corridors, Halls, and all common spaces in Residencies and all similar high abuse spaces.

.6 *Acoustical Gypsum Board **(09 20 00)*****:** Spaces with particular requests for sound attenuation.

.7 *Concrete Masonry Units **(04 80 00)***: Stairwells, Elevator shafts, Garbage chutes, Mechanical, Machine shops, and all similar and high abuse spaces.

.8 *Demountable Partitions **(10 22 00)***, with *Glass Fibre Flexible Acoustical Buffer **(07 20 00)***: Generally in office spaces, Classrooms, temporary spaces or at any location requiring flexibility in design.

3.2 Systems Assemblies

.1 All partition components shall be approved by **Facilities**.

.2 Refer to **"VOLUME VI – Appendix – DP. Partition Details"** Series and related notes for proposed connection details – especially related to Fire-Rated systems.

.3 Suggested Assemblies:

Number of layers, gauge, thickness to General Application Locations, Fire-Separation, Acoustical parameters and Structural Criteria, using *Steel Stud System, Regular, Galvanized **(09 20 00)*** or *Concrete Masonry Units **(04 80 00)*** as substrates.

4.0 ACOUSTICAL PERFORMANCE

4.1 Sound attenuation

.1 *Mineral Fibre Acoustical Bat Insulation **(07 20 00)***: To fill cavities in acoustical rated partitions, as well as in the following or similar conditions:

.1 On top of folding panel partitions.

.2 In door / vision panel / window frame cavities or similar if partition containing these elements is filled with acoustic insulation.

.3 In all concealed voids between partitions and exterior window mullions and other similar adjacent spaces.

.4 In the flute metal decks, on top of the partition, if sound insulated.

.2 Where partitions with acoustical characteristic cannot extend full-height, acoustical integrity to be maintained by one of the following or similar methods:

.1 Adding *Glass Fiber Flexible Acoustic Liner* ***(07 20 00)*** over suspended ceilings, extended 1220mm on both sides of partition.

.2 Suspending *Flexible Acoustical Buffer,* or *Semi-Rigid Acoustical Buffer* ***(07 20 00)*** in plenums over the partitions.

4.2 Parameters

.1 To ensure that the required STC ratings are achieved, strict adherence to the construction details during installation is critical, including sealing all penetrations and partition perimeters. Leaks or gaps in the walls, or vibrating equipment improperly mounted to the main structure will become sources of unwanted noise and defeat any sound insulation being provided by the walls and doors.

.2 Reverberation time of 0.8 to 1.0 seconds to be considered (by adding surface Architectural treatment absorptive materials):

.1 In large spaces, such as Classrooms and similar spaces.

.2 In open ceiling spaces.

.3 Consideration to be given to exterior outside noise intrusion (ex: vehicle traffic).

.4 In Amphitheaters, Classrooms, and other similar spaces, the following should be considered:

.1 In general, the walls, floor, and ceiling can be finished with acoustically reflective materials, such as wood sheathing, paneling or gypsum board. Concave walls should be avoided to eliminate sound focusing and walls that might produce echoes should be "broken up" with a series of splays or undulations of sufficient scale to scatter the sound.

.2 Side walls should provide some lateral reflections to the audience over a broad frequency range. The rear walls should provide reflections to the rear and centre of the rooms. Ceiling reflectors can be used to provide proper sound dispersion around the room.

.3 Acoustical sound absorbing panels installed at human height shall be in abuse resistive materials.

4.2 Sound Transmission Class (STC) ratings

.1 Specific requirements are relative to the type of each space, existing locations, conditions and particular specifics of every space, including those of the OBC.

.2 STC rated components shall be based on OBC SB-3 or any approved equivalent tested assemblies.

.3 Existing spaces: Existing partitions upgrades to be dealt with on a case-by-case basis, depending on the situation and the budget.

.4 New or renovated spaces: The STC Rating performance schedule indicated in the last page is to be applied in new partitions.

4.2 Mechanical & Electrical related

.1 General:

.1 Mechanical system design shall incorporate all necessary sound attenuation features (flexible connections, duct acoustic lining, mufflers, low velocity diffusers, etc…) to assure the required room acoustic performance.

.2 Isolate the ventilating equipment from floors, walls and ceilings using rubber isolators.

.3 Use large fan blades and ducts operating at the low speed to keep the air velocity as low as possible. (below 500 fpm at the supply register and 600 fpm at the return grille).

.4 Apply absorptive treatment in the duct system and in the mechanical rooms. The discharge duct of the fan in the mechanical room should be connected to subsequent ductwork through a flexible coupling to reduce transmitted vibration and the first 1-2 m. of ductwork (including a 90 deg. angle) should be fitted with absorptive material to minimize transmitted sound.

.5 Mechanical equipment having rotating parts should not have any direct physical contact with the walls or ceilings. Isolate the ventilating equipment from floors, walls and ceilings using rubber isolators.

.6 Layout supply air ductwork and registers to have equivalent duct lengths between diffusers and the fan.

.7 Do not locate air-moving devices in the ceiling plenum directly above the studio theatre or classrooms. This includes heat pumps, fan powered boxes, variable air volume boxes (VAV), fan coil units (FCU), exhaust fans, and air handlers (AHU)

.8 Consideration could also be given to the use of stanchion supports on the roof. Noise from the air-handler is transmitted in two ways: direct transmission of rumble through the building structure, and airborne noise through the ducted air. If air-handlers have to be mounted on the roof, extend the ducting as far as possible before a downturn to reduce airborne noise.

.9 All air handlers and projector exhaust fans must be vibration isolated.

.10 Review supply air diffuser selections and specify an NC rating five points less than required.

.11 Lampers should never be located directly behind the face of the air distribution device.

.12 Provide a clearance between pipes and gypsum board or other finish surfaces. Do not allow pipes to make rigid metal-to-metal contact between ceiling hanger wires, supports, framing, or other structure to which finishes are attached.

.13 Ducts penetrating the sound rated wall or floor/ceiling construction should be in an insulated sleeve packed with 25mm thick non-combustible mineral wool and sealed on both sides using backer rod and acoustical sealant. Piping penetrations less than three inches in diameter should be sealed using acoustic sealant filling a 1/4-inch clearance. Larger pipes should be treated similar to ducts.

.14 Avoid any back-to-back penetrations, such as electrical panel boards, junction boxes or fire extinguisher cabinets. Offset penetrations two stud cavities.

.2 Amphitheaters, Classrooms and similar teaching spaces:

.1 Avoid locating plumbing and rainwater leaders in the walls or ceiling spaces.

.2 Avoid locating Air Handling Units devices on the roof directly on top.

.3 Isolate the ventilation ducts from noise pickup in adjacent rooms to the Auditoriums and Classrooms. These ducts should be enclosed in a sealed wall (STC 45).

.1 Any piping located in the walls or ceiling should be attached with resilient mountings.

.3 Audiovisual Control rooms:

.1 Special consideration shall be given to eliminate sound transmission from A/V Control rooms located within spaces, particularly concerning ventilation systems.

STC Ratings**

A. Student spaces	STC		B. Admin Spaces	STC		C. Classrooms	STC
Closed Office	45*		Open office space	35		Amphitheatre /	58
Student Lounge	50		Closed office	45*		A/V Control Room	50
Quiet Study space	50		Meeting, Conference	50		Computer Classroom	52
			Lounge	50		Lecture Room	55
			Support (Repro, etc.)	45		Music (Acoustic) Rooms	55
						Seminar Room	52
D. Laboratories			**E. Public Spaces**			**F. Residences**	
Animal Care Lab	55		Atrium Halls, stores	45		Corridors	45
Clean Room (ISO)	50		Cafeteria	55		Laundry	50
Classified – CL2, CL3	50		Corridor (main)	45		Lounge	55
Engineering	50		Corridor (secondary)	40		In-Suite Bedrooms	50
General, non-clssfd’	50		Elevators / shaft walls	60			
Cloakroom	45		Library	55			
Offices	45*		Locker Space	45			
			Lounge	45			
			Parking (Indoor)	55			
			Stairwell (Exit)	55			
			Vestibules	-			
G. Service Spaces			**H. Sports Facilities**			**I. Washrooms**	
Janitor Room	45		Change room	45		Individual W.C.	45
Loading Dock	45		Exercise room	50		Common W.C.	50
M&E Room	60		Gymnasium	55			
Storage Room	45		Shower spaces	45			

Notes:

* When confidentiality is required.

** Data extracted from RWDI Design Brief Report prepared for FHS Building in 2020.

1.0 GENERAL

1.1 Overview

.1 The following Schedule represents a preferred ***Door types (08 11 00)*** or varieties of Door options covering the different possible areas. Materials may vary to match existing conditions. The Consultant may submit an alternative for approval depending on the scope and budget.

	DOORS										**FRAMES**					**SIDE VSN PANELS**		**FINISH**[10]						***ACCESSORIES & HARDWARE (08 70 00)***[9]							
	Plywood Faced Prtclbrd ***(08 11 00)***[8]	*Hollow Metal* ***(08 11 00)***[8]	*Hollow Metal, Sanitary* ***(08 11 00)***	*Plywood faced Prtclbrd, Acoustical* ***(08 11 00)***	*Hollow Metal, Acoustical* ***(08 11 00)***	*Aluminum* ***(08 40 00)***[8]	*Glass* ***(08 80 00)***	*In-door Glazing* ***(08 80 00)***[3]	Stainless Steel		*Pressed steel* ***(08 11 00)***	*Pressed Steel, Sanitary* ***(08 11 00)***	*Aluminum* ***(08 40 00)***[8]	Stainless Steel		Side lights, same Frame & Glass types[4]		*Latex 100% Acrylic H. Perf.* ***(09 91 00)***	*Light industrial Acrylic or Epoxy*[10] ***(09 91 00)***	*Stain and Varnish* ***(09 91 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Anodized or Prefinished* ***(08 80 00)***	*Abuse-resistant p.laminate sheet* ***(06 10 00)***	*Door Closer*[3,4]	*Door Operator*[6]	*Kick plates*	*Emergency Button*	*Sound Attenuation Kit*	*Frosted Films* ***(08 80 00)***[3,4, 3.5]		Notes
A. Student spaces:																														
Closed Office	X	X				X		X			X		X			X		X		X		X	X						X		
Student Lounge	X	X				X		X			X		X			X		X		X		X	X		X				X		
Quiet Study spaces	X	X				X		X			X		X			X		X		X		X	X						X		
B. Admin Spaces:																														
Closed office	X	X				X		X			X		X			X		X		X		X	X						X		
Open office space	X	X				X		X			X		X			X		X		X		X	X						X		
Meeting, Conference Rm	X	X				X	X	X			X		X			X		X		X		X	X					X	X		3
Lounge	X	X				X		X			X		X			X		X		X		X	X						X		
C. Classrooms:																														
Amphitheatre	X	X				X		X			X		X			X		X				X	X	X	X	X		X	X		5
A/V Control Room	X	X				X					X							X				X	X					X			
Computer Classroom	X	X				X		X			X		X			X		X				X	X	X	X	X					
Lecture / Regular	X	X				X		X			X		X			X		X				X	X	X	X	X					5
Music (Acoustic) Rooms				X	X						X		X			X		X		X		X	X	X		X		X	X		5
Seminar Room	X	X				X		X			X		X			X		X		X		X	X	X		X					5
D. Laboratories:																														
Animal Care Lab		X	X		X						X	X							X		X			X	X	X					
Clean Room (ISO)			X					X				X							X		X			X		X					

	DOORS										**FRAMES**					**SIDE VSN PANELS**		**FINISH**[10]						**ACCESSORIES & HARDWARE (08 70 00)** [9]							
	Plywood Faced Prtclbrd ***(08 11 00)*** [8]	*Hollow Metal* ***(08 11 00)*** [8]	*Hollow Metal, Sanitary* ***(08 11 00)***	*Plywood faced Prtclbrd, Acoustical* ***(08 11 00)***	*Hollow Metal, Acoustical* ***(08 11 00)***	*Aluminum* ***(08 40 00)*** [8]	*Glass* ***(08 80 00)***	*In-door Glazing* ***(08 80 00)*** [3]	Stainless Steel		*Pressed steel* ***(08 11 00)***	*Pressed Steel, Sanitary* ***(08 11 00)***	*Aluminum* ***(08 40 00)*** [8]	Stainless Steel		Side lights, same Frame & Glass types[4]		*Latex 100% Acrylic H. Perf.* ***(09 91 00)***	*Light industrial Acrylic or Epoxy*[10] ***(09 91 00)***	*Stain and Varnish* ***(09 91 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Anodized or Prefinished* ***(08 80 00)***	*Abuse-resistant p.laminate sheet* ***(06 10 00)***	*Door Closer*[9,4]	*Door Operator*[6]	*Kick plates*	*Emergency Button*	*Sound Attenuation Kit*	*Frosted Films* ***(08 80 00)*** [3,4, 3,5]		Notes
Classified – CL3			X					X				X									X			X	X	X					
Clsfd' – CL2-Ag		X	X					X			X	X						X	X		X			X	X	X					
Classified – CL2 (Basic)		X						X			X							X	X					X	X	X					
General, non-classified		X				X		X			X							X						X	X	X					
Engineering		X				X		X			X								X					X	X	X					
High Hazard Spaces		X									X							X						X		X					
Emergency Showers, Fridges, Freezer rooms		X						X			X							X													
E. Public Spaces:																																
Cafeteria		X				X	X	X			X		X			X		X				X		X	X	X					
Elevators (Passenger)									X					X																	
Elevators (Freight)		X						X			X								X												
Library		X				X	X	X			X		X			X		X				X		X	X	X					5
Stairwell (Exit)		X						X			X							X						X		X					
Store						X	X	X			X		X			X						X									
Vestibule (interior)						X	X	X					X			X						X		X	X						
F. Residences:																																
Laundry		X						X			X							X						X		X		X			
Lounge		X						X			X					X		X						X				X			
In-suite Bathroom	X										X							X					X								
In-suite Bedrooms	X										X							X					X								
In-suite Living room		X									X							X						X							
G. Service Spaces:																																
Janitor Room		X									X							X						X		X					
Loading Dock		X									X							X													

	DOORS										**FRAMES**					**SIDE VSN PANELS**		**FINISH**[10]						**ACCESSORIES & HARDWARE (08 70 00)** [9]							
	Plywood Faced Prtclbrd ***(08 11 00)*** [8]	*Hollow Metal* ***(08 11 00)*** [8]	*Hollow Metal, Sanitary* ***(08 11 00)***	*Plywood faced Prtclbrd, Acoustical* ***(08 11 00)***	*Hollow Metal, Acoustical* ***(08 11 00)***	*Aluminum* ***(08 40 00)*** [8]	*Glass* ***(08 80 00)***	*In-door Glazing* ***(08 80 00)*** [3]	Stainless Steel		*Pressed steel* ***(08 11 00)***	*Pressed Steel, Sanitary* ***(08 11 00)***	*Aluminum* ***(08 40 00)*** [8]	Stainless Steel		Side lights, same Frame & Glass types[4]		*Latex 100% Acrylic H. Perf.* ***(09 91 00)***	*Light industrial Acrylic or Epoxy*[10] ***(09 91 00)***	*Stain and Varnish* ***(09 91 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Anodized or Prefinished* ***(08 80 00)***	*Abuse-resistant p.laminate sheet* ***(06 10 00)***	*Door Closer*[9,4]	*Door Operator*[6]	*Kick plates*	*Emergency Button*	*Sound Attenuation Kit*	*Frosted Films* ***(08 80 00)*** [3,4, 3,5]		Notes
M&E Room		X									X							X						X		X					
Workshop		X									X							X						X		X					
Storage Room		X									X							X								X					
Garbage Room		X									X							X								X					
H. Sports Facilities:																															
Change room		X									X							X						X	X						
Exercise room		X						X			X					X		X													
Gymnasium		X						X			X					X			X												
Shower spaces		X									X								X												
I. Washrooms:																															
Individual W.C.		X									X							X						X	X	X	X				7
Common W.C.		X									X							X						X	X	X					7

Notes (whenever applicable – whether indicated in the table or not):

.1 Not accepted:

- .1 Hollow core wood doors.
- .2 Wood frames.

.2 Meeting room doors to preserve a semi-privacy factor: Users shall be able to keep confidentiality, while outsiders shall be able to observe if the room is occupied or free.

.3 Vision Panels or glazed partitions:

- .1 If installed in doors, ideal dimension (Code permitted) is within 200mm from door edge.
- .2 A fire-rated Glass, or *Georgian Wired polished glass* ***(08 80 00)*** to be only used in Fire-rated vision panels. It will not be acceptable in non-Fire-rated vision panels.
- .3 Only *Tempered Glass* ***(08 80 00)*** or other abuse-resistant glass shall be acceptable in non-Fire-rated vision panels.
- .4 Architectural *Frosted Film* ***(08 80 00)*** for Glass may be applied anywhere, to cover the whole surface, leaving 25mm perimeter gap.
- .5 Where the glass is covering the whole height (glazed partition) may be confused with an opening, a *Frosted Film* ***(08 80 00)*** pattern shall be installed on full width, at guard height.

.4 Depending on the different design features, Side visual panels shall not be combined with in-door *Glazing* ***(08 80 00)***.

	DOORS										FRAMES					SIDE VSN PANELS		FINISH[10]						ACCESSORIES & HARDWARE (08 70 00)[9]							
	Plywood Faced Prtclbrd ***(08 11 00)***[8]	*Hollow Metal* ***(08 11 00)***[8]	*Hollow Metal, Sanitary* ***(08 11 00)***	*Plywood faced Prtclbrd, Acoustical* ***(08 11 00)***	*Hollow Metal, Acoustical* ***(08 11 00)***	*Aluminum* ***(08 40 00)***[8]	*Glass* ***(08 80 00)***	*In-door Glazing* ***(08 80 00)***[3]	Stainless Steel		*Pressed steel* ***(08 11 00)***	*Pressed Steel, Sanitary* ***(08 11 00)***	*Aluminum* ***(08 40 00)***[8]	Stainless Steel		Side lights, same Frame & Glass types[4]		*Latex 100% Acrylic H. Perf.* ***(09 91 00)***	*Light industrial Acrylic or Epoxy*[10] ***(09 91 00)***	*Stain and Varnish* ***(09 91 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Anodized or Prefinished* ***(08 80 00)***	*Abuse-resistant p.laminate sheet* ***(06 10 00)***	*Door Closer*[9,4]	*Door Operator*[6]	*Kick plates*	*Emergency Button*	*Sound Attenuation Kit*	*Frosted Films* ***(08 80 00)***[3,4, 3,5]		Notes

.5 *Acoustical Parameters*: In spaces with highly efficient acoustical partitions (STC 55 and over) and other special acoustical requirements, *Hollow Metal* ***(08 11 00)*** doors to be acoustically insulated. *Solid Wood Core* ***(08 11 00)*** doors to be also considered. with the exceptions of Universal Washroom or any independent similar public room, where ventilation Grill should be installed on the door to permit hearing an emergency call for help.

.6 *Door Operator* ***(08 70 00)***:

- .1 To be installed where required by **OBC** or indicated.
- .2 Only one to be installed in each designated space with several entry doors.
- .3 Required only in the labs where teaching activity is to take place.
- .4 Required on all doors falling within main circulation corridors.

.7 Install accessible threshold at doorstep in washrooms if no positive slope is provided to the drains.

.8 Unless otherwise noted, Aluminum, Wood doors and Aluminum frames shall be a component of the *Demountable Partitions* ***(10 22 00)*****,** only if such system is used in he adjacent partitions.

.9 *Door Hardware* ***(08 71 10)***:

- .1 Install all typical necessary Hardware as per **UofO** Standard and **OBC** or other design imperative requirements.
- .2 Coordinate with **SPS** for Access Cards and other similar security features necessary on doors in key locations.
- .3 *Kick plates* ***(08 07 00)*** shall be installed on all doors that have *Closers* ***(08 07 00)***.
- .4 *Closers* ***(08 07 00)*** to be installed on all FRR and / or, Secured doors or as per any other ventilation or Project parameters.
- .5 Astragals to e installed on any double FRR doors.
- .6 For electronic hardware and wiring connections, refer to "**VOLUME VI – Appendix – DR. Doors & Hardware**" Series and related notes.

.10 Epoxy Paint (09 91 00) to be applied only in spaces frequently cleaned with chemicals or similar. To be approved by Facilities.

.11 *Finishes* shall be read in conjunction with section **"VOLUME I - P. Finish Schedule**".

1.2 Design

.1 *Aspects **(08 11 00)***:

.1 Sliding doors:

.1 Sliding doors are permitted in some particular cases, provided not being on a corridor used by public, or having a secondary egress or break-away system.

.2 With the exception listed in **OBC**2012 3.3.1.10 & 3.3.1.11, Sliding doors not having a break-away function are permitted to serve as egress doors in office layouts or small meeting rooms and similar ancillary areas such as photocopy rooms, with the following conditions, as per City of Ottawa Guidelines (based on NFPA 101):

.1 The room served contains an occupant load of 10 persons or less.

.2 The room is contained in an office type use or similar occupancy (i.e. kitchenettes, photocopy rooms, small "quiet" rooms in schools or libraries, offices in retail units, etc.).

.3 The door has no locking hardware or special latching devices of any kind, (i.e. readily openable at all times).

.4 An arrow or sign clearly indicating the direction of door opening is visible from inside the room when approaching the door.

.5 The door is openable with a force of 67 N (15 lbf) or less.

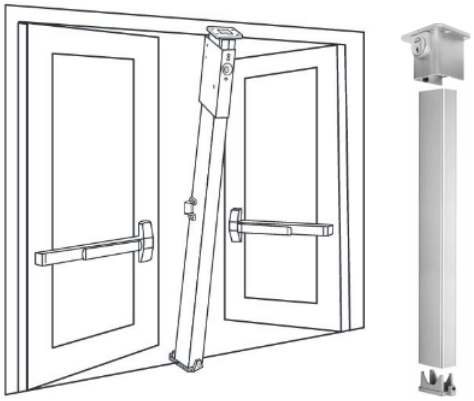
.6 The door is not located in a fire separation (whether fire rated or not).

.7 The area of the room is limited to 20 m2 (215 ft2) or less.

.2 Double doors that carries Exit devices (panic bars) shall have intermediate mullion. Such mullion to be movable in the following conditions:

.1 At least at one Building entrances, unless otherwise approved by **Facilities**.

.2 At main corridors, or elsewhere, when there is large equipment susceptible to be transferred through doors.

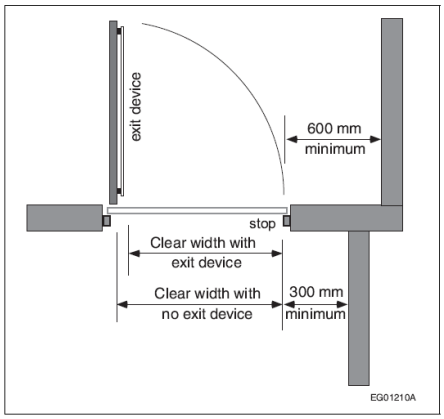


.4 Dimensions:

.1 .2Particular considerations shall be given to spaces with large equipment, such as laboratories, where a single 1067mm wide door or 2 leaf doors (965mm + 610mm) could be the optimum solution, depending on design parameters.

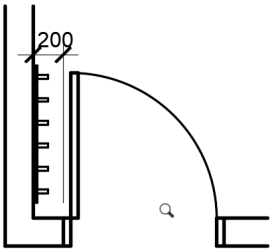
.2 In general, a double door of 915mm leaf should be installed on Electrical, Mechanical, or Workshops and all similar technical spaces.

.3 Door dimensions shall suit projects' specific requirements. Generally, for Basic Renovation (**OBC**) projects, all door dimensions to match existing. For Extensive Renovation (**OBC**) projects, the latest **OBC** edition shall be applied, taking in consideration hardware projection (e.g. panic bar); unless the door can open to more than 90 degrees.



.5 Location:

.1 In general, entrance door frame should be located at 200mm distance minimum from the perpendicular partition to accommodate ***Coat Hook Strip (10 28 10)*** as requested.



1.0 GENERAL

1.1 Overview

.1 The following Schedule represents a preferred finish or varieties of finish options covering the different possible areas. Materials may vary to match existing conditions. The Consultant may submit an alternative for approval depending on the scope and budget. To be coordinated with users and **DES**.

	FLOORS										**BASES**				**WALLS**								**CEILINGS**[1]								
	Epoxy Quartz System or MMA[25] ***(09 67 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 67 00)***	*Clear Sealer* ***(09 67 00)***	*VCT / LVT / or Rubber Tiles* ***(09 20 00)***[18]	*Homogenous Vinyl or Rubber Sheet* ***(09 65 00)***	*Linoleum Sheet* ***(09 65 00)***[12]	*Porcelain Tile* ***(09 30 00)***[12]	*Synth. Carpet / Hybrid Resil. Tiles or Sheets* ***(09 65 00)***	*Rubber Sheet Flooring* ***(09 20 00)***	Other[17]	Rubber / Vinyl ***(09 65 00)***	Same as Flooring	Integral with flooring (cove)	Other[17]	*Paint* ***(09 91 00)***			*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Ceramic / Porcelain Tiles* ***(09 30 00)***	Ornamental finishes[21]	*Homogeneous Vinyl Wall Covering* ***(10 26 00)***	Other	*Paint and\or on Gypsum*								Notes
															Latex 100% Acrylic H. Perf.	Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]						Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Acoustical tiles, Regular* ***(09 50 00)***[2]	*Acoustical tiles, Ornamental* ***(09 50 00)***[2]	*Acoustical tiles, soil Resist. Film* ***(09 50 00)***[2]	Exposed	Other	
A. Student spaces:																															
Closed Office				X		X			X		X					X							X			X					
Student Lounge				X		X			X		X				X								X			X				X	
Study spaces				X		X			X		X				X								X			X					
B. Admin Spaces:																															
Closed office				X		X			X		X					X										X					
Open office space				X		X			X		X					X										X					
Meeting, Conference Room				X		X			X		X					X				X			X			X	X				
Reception Areas				X		X			X		X					X				X			X			X	X				
Lounge				X		X			X		X					X							X			X				X	
Support (Reprographics, etc.)				X		X			X		X					X							X			X				X	
C. Classrooms:																															
Amphitheatre		X		X		X		X	X		X		X		X								X				X		X	X	
A/V Control Room				X		X			X		X				X											X					
Computer Classroom				X		X			X		X				X											X					
Lecture / Regular				X		X		X	X		X				X											X					
Music (Acoustic) room								X	X		X	X			X											X					
Seminar Room				X		X			X		X				X											X					

	FLOORS										BASES				WALLS								CEILINGS[1]								
	Epoxy Quartz System or MMA[25] ***(09 67 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 67 00)***	*Clear Sealer* ***(09 67 00)***	*VCT / LVT / or Rubber Tiles* ***(09 20 00)***[18]	*Homogenous Vinyl or Rubber Sheet* ***(09 65 00)***	*Linoleum Sheet* ***(09 65 00)***[12]	*Porcelain Tile* ***(09 30 00)***[12]	*Synth. Carpet / Hybrid Resil. Tiles or Sheets* ***(09 65 00)***	*Rubber Sheet Flooring* ***(09 20 00)***	Other[17]	Rubber / Vinyl ***(09 65 00)***	Same as Flooring	Integral with flooring (cove)	Other[17]	*Paint* ***(09 91 00)***			*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Ceramic / Porcelain Tiles* ***(09 30 00)***	Ornamental finishes[21]	*Homogeneous Vinyl Wall Covering* ***(10 26 00)***	Other	*Paint and\or on Gypsum*								
															Latex 100% Acrylic H. Perf.	Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]								Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Acoustical tiles, Regular* ***(09 50 00)***[2]	*Acoustical tiles, Ornamental* ***(09 50 00)***[2]	*Acoustical tiles, soil Resist. Film* ***(09 50 00)***[2]	Exposed	Other	Notes
D. Laboratories:																															
Animal Care Lab	X												X				X	X			X			X	X			X			4, 26
Clean Room (ISO)	X				X	X			X				X					X			X			X							4, 26
Classified – CL3	X												X					X			X			X							4, 26
Clsfd' – CL2-Ag[15]		X			X	X			X				X		X		X	X					X	X	X			X			4
Classified – CL2 (Basic)		X		X	X	X			X		X	X	X		X								X					X			4
General, non-classified				X	X	X			X		X				X								X			X		X		X	4
Engineering		X	X	X		X			X		X	X		X			X						X			X			X	X	4
Cloakrooms				X	X	X			X		X				X	X										X					
Lab Offices			X	X	X	X			X		X	X	X		X	X	X	X					X	X	X	X		X	X	X	22
High Hazard Spaces	X	X										X	X				X	X						X		X			X		
Emergency Showers, Fridge, Freezer rooms	X				X	X	X					X	X						X							X					11
E. Public Spaces:																															
Atrium Halls	X						X			X			X		X					X			X				X		X	X	
Cafeteria						X	X		X	X	X	X			X								X			X	X		X	X	
Corridor (main)		X			X		X		X	X	X	X			X					X			X				X		X	X	
Corridor (secondary)					X	X			X		X	X			X								X			X			X	X	
Elevators (Passenger)					X	X	X		X	X		X		X								X								X	19
Elevators (Freight)										X				X								X								X	19
Library						X		X	X		X				X											X	X			X	
Locker Space		X		X		X	X		X		X				X								X			X					
Lounge (Public)						X	X		X	X	X	X			X								X			X	X		X		
Parking (Indoor)			X												X														X		
Stairwell (Exit)		X	X								X				X								X						X		9
Stair (Atrium)							X			X				X						X			X						X	X	20
Store for public					X	X				X	X	X			X							X	X			X	X		X	X	

	FLOORS										BASES				WALLS							CEILINGS[1]								
	Epoxy Quartz System or MMA[25] ***(09 67 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 67 00)***	*Clear Sealer* ***(09 67 00)***	*VCT / LVT / or Rubber Tiles* ***(09 20 00)***[18]	*Homogenous Vinyl or Rubber Sheet* ***(09 65 00)***	*Linoleum Sheet* ***(09 65 00)***[12]	*Porcelain Tile* ***(09 30 00)***[12]	*Synth. Carpet / Hybrid Resil. Tiles or Sheets* ***(09 65 00)***	*Rubber Sheet Flooring* ***(09 20 00)***	Other[17]	Rubber / Vinyl ***(09 65 00)***	Same as Flooring	Integral with flooring (cove)	Other[17]	*Paint* ***(09 91 00)***			*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Ceramic / Porcelain Tiles* ***(09 30 00)***	Ornamental finishes[21]	*Homogeneous Vinyl Wall Covering* ***(10 26 00)***	Other	*Paint and\or on Gypsum*								Notes
															Latex 100% Acrylic H. Perf.	Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]							Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]	*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Acoustical tiles, Regular* ***(09 50 00)***[2]	*Acoustical tiles, Ornamental* ***(09 50 00)***[2]	*Acoustical tiles, soil Resist. Film* ***(09 50 00)***[2]	Exposed	Other	
Vestibule	X	X						X		X		X	X		X							X							X	
F. Residences:																															
Corridors		X			X	X			X	X	X				X							X			X			X		10
Laundry		X			X		X		X			X	X				X						X							
Lounge				X	X	X			X		X				X							X						X		
In-Suite Bathroom		X			X	X	X		X		X	X	X				X						X							13
In-Suite Bedroom				X	X	X			X		X				X							X						X		13
In-Suite Kitchen				X	X	X			X		X				X							X						X		13
In-Suite Living room				X	X	X			X		X				X							X						X		13
G. Service Spaces:																															
Janitor Room		X		X					X				X				X								X					16
Loading Dock		X	X								X				X													X		
M&E Room		X									X				X													X		14, 16
Workshop		X	X								X				X													X		14
Storage Room			X	X					X		X				X										X					
Garbage Room			X								X				X													X		
H. Sports Facilities:																															
Change room				X	X				X		X		X		X							X								
Exercise room				X	X	X			X	X	X				X							X			X			X	X	
Gymnasium				X					X	X	X			X			X											X	X	6
Shower spaces	X						X					X	X						X				X							16
I. Washrooms:																															
Individual W.C.							X					X			X				X			X								7
Common W.C.							X					X							X			X								

	FLOORS										BASES				WALLS							CEILINGS[1]								
	Epoxy Quartz System or MMA[25] ***(09 67 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 67 00)***	*Clear Sealer* ***(09 67 00)***	*VCT / LVT / or Rubber Tiles* ***(09 20 00)***[18]	*Homogenous Vinyl or Rubber Sheet* ***(09 65 00)***	*Linoleum Sheet* ***(09 65 00)***[12]	*Porcelain Tile* ***(09 30 00)***[12]	*Synth. Carpet / Hybrid Resil. Tiles or Sheets* ***(09 65 00)***	*Rubber Sheet Flooring* ***(09 20 00)***	Other[17]	Rubber / Vinyl ***(09 65 00)***	Same as Flooring	Integral with flooring (cove)	Other[17]	*Paint* ***(09 91 00)***		*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Ceramic / Porcelain Tiles* ***(09 30 00)***	Ornamental finishes[21]	*Homogeneous Vinyl Wall Covering* ***(10 26 00)***	Other	*Paint and\or on Gypsum*		*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Acoustical tiles, Regular* ***(09 50 00)***[2]	*Acoustical tiles, Ornamental* ***(09 50 00)***[2]	*Acoustical tiles, soil Resist. Film* ***(09 50 00)***[2]	Exposed	Other	Notes
															Latex 100% Acrylic H. Perf.	Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]					Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]							

Notes (whenever applicable – whether indicated in the table or not):

.1 Ceiling heights to be proportional to space sizes. Access shall be taken into consideration if placing equipment in the dead space above. Preferred heights shall not be less than:

.1 2450mm (8'-0") in small or medium size rooms.

.2 2750mm (9'-0") or more in large size rooms or spaces.

.2 Acoustical Tiles:

.1 To be selected from the manufacturer's standard from 610 x 610 or 1220 mm (24"x24" or 48") sizes range. Not accepted: 610mm or 762 x 1525mm (24" or 30" x 60") or any similar non-standard Tile sizes.

.2. Acoustical tile configuration in Labs shall account for furniture direction and configuration. Optimal size for movable furniture: 610mm x 610mm.

.3 For maintenance purposes, use acoustic tiles wherever possible.

.4 In all the spaces with laboratory furniture, floor, wall finishes and bases to be installed in the entire area, prior to installation of furniture.

.5 Install a finish base similar to what used for the room, on all Millwork and Lab furniture cabinet's bases.

.6 Bases in Gymnasiums to be made of min. 100x100mm angles, anchored only to the walls, to cover the shrinking gaps on wood floor perimeter.

.7 In individual W.C., ceramic tile could be installed only on the lower portion of the wall.

.8 Unless otherwise noted, *Shading Systems (**12 20 00**)* to be installed at all openings – except Atrium Halls, Lobbies and similar open gathering areas.

.9 If stairwell not used frequently, apply sealant to Concrete flooring. If used frequently, apply Epoxy or similar coating.

.10 In corridor's residences, Acoustical Tiles choice in corridors is to be confirmed by **Facilities** because of the vandalism risk it represents.

.11 Design permitted, indicated finishes around *Emergency Showers **(22 42 01)*** to be in dimensions of 1200mm x 1200mm x 2400mm High.

.12 Where sound transmission is a concern, install *Cork Underlayment **(09 65 00)***, or any similar, under the finished floor.

.13 All ceiling hung pipes, conduits or similar shall be encased in prefinished metal or Gypsum board bulkheads.

.14 In M&E & Workshop rooms, install 1220mm high fire treated plywood panels on all wall perimeters, mounted at 915mm high.

.15 Unless otherwise noted, Tissue Culture room to be considered Classified – CL2-Ag Labs.

16 In M&E and other technical spaces where water leak could be an issue, a *Pigmented Urethane Floor Coating **(09 67 00)**, with Underlayer Waterproof Membrane (**09 61 00*** shall be considered.

.17 Other types of finishes may include Polished Concrete surfaces, Composite, or similar as indicated.

.18 LVT and other similar non-waxed Tiles are not recommended in High Chemical Labs, as waxing help sealing the seams between joints.

	FLOORS										BASES				WALLS							CEILINGS[1]								
	Epoxy Quartz System or MMA[25] ***(09 67 00)***	*Coating (Epoxy, Urethane & sim)* ***(09 67 00)***	*Clear Sealer* ***(09 67 00)***	*VCT / LVT / or Rubber Tiles* ***(09 20 00)***[18]	*Homogenous Vinyl or Rubber Sheet* ***(09 65 00)***	*Linoleum Sheet* ***(09 65 00)***[12]	*Porcelain Tile* ***(09 30 00)***[12]	*Synth. Carpet / Hybrid Resil. Tiles or Sheets* ***(09 65 00)***	*Rubber Sheet Flooring* ***(09 20 00)***	Other[17]	Rubber / Vinyl ***(09 65 00)***	Same as Flooring	Integral with flooring (cove)	Other[17]	*Paint* ***(09 91 00)***		*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Ceramic / Porcelain Tiles* ***(09 30 00)***	Ornamental finishes[21]	*Homogeneous Vinyl Wall Covering* ***(10 26 00)***	Other	*Paint and\or on Gypsum*		*Coating (Epoxy, Urethane & sim)* ***(09 96 00)***	*Acoustical tiles, Regular* ***(09 50 00)***[2]	*Acoustical tiles, Ornamental* ***(09 50 00)***[2]	*Acoustical tiles, soil Resist. Film* ***(09 50 00)***[2]	Exposed	Other	Notes
															Latex 100% Acrylic H. Perf.	Latex 100% Acrylic						Latex 100% Acrylic	Light industrial Acrylic orEpoxy[24]							

.19 Elevators recommended finishes are as follow:

.1 Passenger elevators:

- Floor: General use: *Linoleum Sheet* ***(09 65 00)***. Consider *Porcelain Tiles* ***(09 30 00)*** (small sizes) over compressible membrane such as Ditra or similar (to neutralizes movement and stresses) in high end locations.
- Bases: Stainless Steel. 316L grade.
- Lower partitions: Stainless Steel, 316L grade.
- Upper partitions: *Plastic Laminate* or other similar.
- Guard: Stainless Steel.
- Ceiling: Decorative metallic light weight framed system - accessible, from Elevator manufacturer selection.

.2 Freight elevators:

- Floor: Checkered plate Stainless Steel 316L grade, over sub floor made of two layer of 19 mm plywood or more rugged as required for class of loading, and 38mm thick rubber isolation pads.
- Bases: Stainless Steel. 316L grade.
- Partitions: 14 gau. powder coated (prepainted steel).
- Bumper rails: Stainless Steel 316L grade, flat surfaced at a height of 100mm and 500mm.
- Ceiling: 22 gau. powder coated (prepainted steel).

.20 Handrail & Balustrades in *Glazing* ***(08 80 00)*** or other decorative materials shall be designed to prevent dust, dirt or debris in difficult to access surfaces.

.21 Ornamental finishes could include Acoustical Panels, Wooden slats, Metal Perforated Panels or similar.

.22 Lab Offices finishes to be depending on their location and shall generally be same if located within the contained Lab area.

.23 Wall Protection elements, to be as follows:

- *Stainless Steel Corner Guards (10 26 00)*: In Student Spaces, Classrooms, Laboratories, Public Spaces, Service spaces, Sports facilities, and Washrooms.
- *Aluminum Corner Guards* ***(10 26 00)***: In Admin spaces.
- *Vinyl Corner Guards* ***(10 26 00)***: In Residential spaces inside Student Residence Suites or dormitories.
- *Crash Rail Wall Bumpers* ***(10 26 00)***: In Storage spaces, Shipping Receiving, Loading Docks and similar spaces.
- *Homogeneous Vinyl Wall Covering*, or *Stainless Steel Wall Covering* ***(10 26 00)***: On perimeter (up to 800mm high): Janitor room, Animal care Labs.

.24 *Epoxy Paint* ***(09 91 00)*** to be applied only in spaces frequently cleaned with chemicals or similar. To be approved by **Facilities**.

.25 *MMA Flooring Systems* ***(09 67 00)*** to be used in limited situations on existing concrete where limited time is a factor.

.26 Coved corners on walls and ceilings to be considered in Clean Rooms, sterile environment, and similar spaces with elevated water content.

1.2 Design

.1 General applications for Paints & Coatings:

.1 *Paint & Varnish **(09 91 00)*** types: As indicated in the above table. Also refer to to "**VOLUME I – O. Door Schedule**" for relevant openings finishes.

.2 Colors, textures and sizes:

1. **UofO** has no standards or specific colors or patterns, except in existing buildings or conditions where the new shall match the existing.
2. Apply different colors for Doors, Frames and Walls in order to facilitate the public circulation. Washrooms, Stairwells and Service room's doors shall have different colors from Administrative, Classrooms, Laboratory's doors on a same floor.
3. Wherever possible, in main circulation areas, floor finish pattern shall be designed to include signage directions to main spaces.
4. Grout color for Porcelain or ceramic tiles, shall be selected within a range of colors which reduce the staining or dirt effect.
5. Not acceptable:
   - .1 Sophisticated patterns, or complicated installation systems for wall or ceiling panels, difficult to replace or to open for maintenance.
   - .2 Non-standard sizes for floor or acoustical ceiling tiles.
   - .3 End-of-series or out-of-standard finish materials.
   - .4 Extreme clear or dark colors in high circulation area floorings, such as in Atrium Halls, Communication stairs, Main corridors and similar.

1.0 GENERAL

1.1 Overview

.1 The following Schedule represents preferred furniture or varieties of furniture options covering the different possible areas. Materials may vary to match existing conditions. Scope of work and responsibilities of external Consultants may vary depending on project specifics. Whether included or not, all furniture to be taken in consideration and coordinated throughout the design. To be coordinated with users and **DES**.

	Standing Offer furniture										**lab**		**M. Media**				***Millwork (06 10 00)***					**Misc. furn**				**Specialized furniture**							**Users furniture**					
	Workstation	Filing & Storage Cabinet	Meeting table	Panels	Storage Cabinet / Shelves	Various Chairs	Training tTable	Wardrobe			*Lab Furniture* ***(12 35 00)***		General (Refer to related sections)	*Podium desk* ***(12 50 00)***	A/V Rack	Computer cabinet	Sink Countertop	Counter / Cabinet / shelves	Stand-up counter[2]	Waste recycling station[3]		Sofas	Modular Counter	Modular Counter		*Seats with retractable tablet* ***(12 50 00)***	*Fixed tables systems* ***(12 50 00)***[1]	*Accessible Table* ***(12 50 00)***	Prefabricated Racks / Shelves	Bookshelves	*Prefabricated Benches* ***(10 51 00)***	*Lockers* ***(10 51 00)***	Bed + side tables + dresser + wardrobe[5]	Study Desk	Chairs	Couches	Equipment Racks	Notes
A. Student Spaces:																																						
Closed Office	X		X			X																																
Association office	X					X																X																
Student Lounge						X							X				X	X				X	X															
Study spaces					X																			X														
B. Admin Spcs:																																						
Closed office	X	X	X			X																																
Open office space	X	X		X	X	X		X																														
Meeting Rm			X			X							X			X																						
Reception Areas		X			X	X																X		X														
Lounge						X							X				X	X				X	X															
Support (Repro)																		X																				
C. Classrooms:																																						
Amphitheatre													X	X											X	X	X											
A/V Control Rm													X																									
Computer Clsrm						X	X						X	X										X														
Lecture Rm													X	X												X	X											
Music Rm						X							X																									
Seminar Rm						X	X				X				X																							
D. Laboratories:																																						
Animal Care Lab											X																								X			

	Standing Offer furniture										**lab**		**M. Media**				**Millwork (06 10 00)**					**Misc. furn**				**Specialized furniture**								**Users furniture**					
	Workstation	Filing & Storage Cabinet	Meeting table	Panels	Storage Cabinet / Shelves	Various Chairs	Training tTable	Wardrobe			*Lab Furniture* ***(12 35 00)***		General (Refer to related sections)	*Podium desk* ***(12 50 00)***	A/V Rack	Computer cabinet	Sink Countertop	Counter / Cabinet / shelves	Stand-up counter[2]	Waste recycling station[3]		Sofas	Modular Counter	Modular Counter		*Seats with retractable tablet* ***(12 50 00)***	*Fixed tables systems* ***(12 50 00)***[1]	*Accessible Table* ***(12 50 00)***	Prefabricated Racks / Shelves	Bookshelves	*Prefabricated Benches* ***(10 51 00)***	*Lockers* ***(10 51 00)***	Bed + side tables + dresser + wardrobe[5]	Study Desk	Chairs	Couches	Equipment Racks	Notes
Classified – CL3											X																								X				
Clean Room (ISO)											X																								X				
Classified – CL2-Ag											X																								X				
Classified – CL2											X																								X				
General, non-classified											X																								X				
Engineering											X						X	X																	X				
Cloakrooms																		X																					
Hazardous Spaces											X																												
E. Public Spcs:																																							
Atrium Halls																			X			X																	
Cafeteria						X											X	X	X				X																
Corridor (main)																				X																			
Corridor (scd)																				X																			
Library					X	X							X										X																
Locker Spce																																							
Lounge (Public)						X							X						X	X		X	X																
Store for public																		X																					
F. Residences:																																							
Laundry																	X																			X				
Lounge																		X																		X	X		
In-Suite Bathroom																	X	X																					4
In-Suite Bedroom																																			X	X	X			
In-Suite Kitchen																		X																					4
In-Suite Living Rm																																					X	X		
G. Service Spaces:																																							
Janitor Rm																																							
Loading Dock																																							
Workshop						X												X																					

	Standing Offer furniture										**lab**		**M. Media**				***Millwork (06 10 00)***					**Misc. furn**				**Specialized furniture**							**Users furniture**						
	Workstation	Filing & Storage Cabinet	Meeting table	Panels	Storage Cabinet / Shelves	Various Chairs	Training tTable	Wardrobe			*Lab Furniture* ***(12 35 00)***		General (Refer to related sections)	*Podium desk* ***(12 50 00)***	A/V Rack	Computer cabinet	Sink Countertop	Counter / Cabinet / shelves	Stand-up counter[2]	Waste recycling station[3]		Sofas	Modular Counter	Modular Counter		*Seats with retractable tablet* ***(12 50 00)***	*Fixed tables systems* ***(12 50 00)***[1]	*Accessible Table* ***(12 50 00)***	Prefabricated Racks / Shelves	Bookshelves	*Prefabricated Benches* ***(10 51 00)***	*Lockers* ***(10 51 00)***	Bed + side tables + dresser + wardrobe[5]	Study Desk	Chairs	Couches	Equipment Racks	Notes
Storage Rm																		X											X										
H. Sports:																																							
Change Rm																																X	X						
Exercise Rm					X	X												X					X									X						
Gymnasium																																							
I. Washrooms:																																							
Individual W.C.																	X																						7
Common W.C.																	X																						7

Notes (whenever applicable – whether indicated in the table or not):

.1 *Fixed tables Systems* ***(12 50 00)***:

.1 Tables: Shall be minimum 510 mm (20") deep with modesty panels, with 610mm minimum clear (face to back). Spacing shall increase proportionally with the number of the seats.

.2 *Millwork* ***(06 10 00)*** *Stand-up Counter*: To be designed with modesty panel if installed against glazed partitions.

.3 *Millwork* ***(06 10 00)*** *Waste Recycling Station*:

.1 At least one recycling station shall be installed per floor. Location to be coordinated with **Facilities** Custodial Services, but generally located on the outside of classrooms, and to be considered with large and amphitheater classroom.

4 Private (In-suites) Residence Kitchen and W.C. *Millwork* ***(06 10 00)*** *Sink Countertop*:

.1 To be made of *Regular or Abuse-Resistant Plastic Laminate* on *Plywood Wood Panel* c/w backlash of 100mm of height. *MDF Fiberboard Medium Density core* will not be accepted.

.2 No gap between the back counter and wall will be acceptable.

.5 Residences Beds: To be double size (Twins).

.6 Minimum distance between furniture: Shall take into consideration all related accessibility and access to egress parameters as requested by Codes. However, ideal distances are recommended to be 900mm free between fixed furniture, below waste level, whenever located at mean path of egress way.

.7 Public Kitchen and W.C. *Millwork* ***(06 10 00)*** Sink Countertop:

.1 Shall be made of Solid Homogeneous Panel, with 100mm min. solid backsplash.

.2 No gap between the back counter and wall will be acceptable.

.3 Not acceptable: Trough design lavatory sinks. Individual *Lavatories* ***(22 42 01)*** are mandatory.

.4 Design to incorporate Built-in *Lavatory* ***(22 42 01)*** or Wall-mount *Lavatory* ***(22 42 01)***, in an approved concept by Facilities.

1.2 Design

.1 Main furniture categories (also refer to other related sections):

.1 *Standing Offer furniture*: Indicate furniture used generally in Administrative and similar spaces. To be provided and installed by **UofO** specialized firm, as per Standing Offer agreement with **UofO**. **GC** to coordinate location, installation, and provide all infrastructure (electric outlets, data, etc.).

.2 *Lab Furniture **(12 35 00)***: Indicate special furniture generally installed in Laboratory and similar spaces. To be provided and installed by **GC**. Refer to related section.

.3 *Multi-Media Furniture*: Indicate furniture dedicated for A/V equipment, generally installed in Classrooms and similar spaces. Refer to related sections. **GC** to coordinate location, installation, and provide all infrastructure (electric outlets, data, etc.).

.4 *Miscellaneous Furniture*: Indicate all types of fixed and non-fixed furniture, to be provided and installed by **UofO** specialized firms. **GC** to coordinate location, installation, and provide all infrastructure (electric outlets, data, etc.).

.5 *Specialized Furniture*: Indicate pre-manufactured furniture described in different locations. Shall be provided and installed by **GC**.

.6 *Users Supplied Furniture*: Indicate furniture to be provided and installed by different users, faculty or services. Shall be coordinated and approved by Faculty managers to ensure there is no risk of injury to others. Location must be approved by **Facilities** to ensure they do not impede into path of travel or Exit minimums, in conformity with Code and Security parameters.

.2 Keying: Furniture master key shall **not** be handled to users, but only to Faculty managers or **Facilities**.

3 References:

.1 Refer to **"VOLUME VI – Appendix – DM. Millwork Details"** Series and related notes for proposed configurations.

.2 Refer to **"VOLUME VI – Appendix – DB. Lab Furniture Details"** Series and related notes for proposed configurations.

General Notes:

1. **Indicated areas are approximate and represent the maximum values - for reference use only. Areas may vary depending on the project specifics or**
2. Dedicated for the use of **Facilities.**
3. Non indicated areas are to be determined (TBD) depending on activity
4. Side-by-side seated spaces shall be 750mm O/C minimum.

	Type of Space	m2[1]	Unit	No[2]	Total m2[2]	Notes
A.	**Student spaces:**					
Graduate Students						
1	Master student spaces	3.00	/ pers.	0	0.00	Up to 50% Full time students with thesis
2	PHD student spaces	4.00	/ pers.	0	0.00	Between 2/3 up to 1 per Full time Student depending on faculty, Note: some have their ws in the research labs or centers
Undergraduate Students						
3	Student Association office	9.00	Total	0	0.00	Max. one per department (sometimes one per sevaral units) based on No of Students
4	Student Lounge	10.00	Total	0	0.00	A minimum allocation of 0.1 m2/per Full time Student for the first 500 students, with additional 0.05m2 per additonal student
5	Quiet Study Space / workstation	2.00	/ pers.	0	0.00	6 to 10 pers. (up to 12 m2 if confinded in a closed office). Study space as chair or small desk computer.
	Total[2]:				0.00	
B.	**Admin spaces:**					
Teaching Staff						
1	Private Office - Dean	25.00	/ pers.	0	0.00	Maximum
2	Private Office - Chair	15.00	/ pers.	0	0.00	
3	Private Office - V.R. Assistant	15.00	/ pers.	0	0.00	
4	Private Office - Professor	11.00	/ pers.	0	0.00	
5	Workstation	6.00	/ pers.	0	0.00	Post Docs, Invited profs, Full time Research assignments,
Support Staff						
6	Private Office - Admin CAO	12.00	/ pers.	0	0.00	
7	Private Office - Director of Services	12.00	/ pers.	0	0.00	
8	Private Office Assistant to Director of Services	9.00	/ pers.	0	0.00	
9	Private Office - Administration	8.00	/ pers.	0	0.00	Class 12 and/or justification (To be confirmed by Space committee)
10	Workstation - Administration	4.00	/ pers.	0	0.00	A more likely number is in the range of 2.5m2 to 3.5m2 per person
11	Workstation - COOP Student	3.00	/ pers.	0	0.00	1/3 to 1/2 of asvailable spaces as full time only during summer
Meeting rooms						
12	Up to 20 people	2.20	/ pers.	0	0.00	
13	Up to 50 people	2.00	/ pers.	0	0.00	
Lounge						
14	Staff Lounge	15.00	Sum	0	0.00	Max 20 m2
15	Professor Lounge	15.00	Sum	0	0.00	A minimum allocation of 0.2 m2/per Full time Stdents & Profs for the first 200 persons, with additional 0.1m2 per additonal person (Student or Prof) - Based on Full time Students & Profs number. TBD[3]
Reception						
16	Reception or Service Counter	10.00	Sum	0	0.00	Depending on no of students to attend secretariat
Support Space						
17	Reproduction - Courrier "Business Center" Mail - Reprographics	9.00	Sum	0	0.00	
18	Storage - Student Records	9.00	Sum	0	0.00	
	Total[2]:				0.00	

General Notes:

1. **Indicated areas are approximate and represent the maximum values - for reference use only. Areas may vary depending on the project specifics or**
2. Dedicated for the use of **Facilities.**
3. Non indicated areas are to be determined (TBD) depending on activity
4. Side-by-side seated spaces shall be 750mm O/C minimum.

	Type of Space	m2[1]	Unit	No[2]	Total m2[2]	Notes
C.	**Classrooms[4]:**					
Classrooms, Seminar rooms						
1	Up to 20 people	2.20	/ pers.	0	0.00	
2	Up to 50 people	2.00	/ pers.	0	0.00	
3	Above 50 bellow 100	1.90	/ pers.	0	0.00	
4	more than 100	1.00	/ pers.	0	0.00	
	Total[2]:				0.00	
D.	**Laboratories:**					
Hotelling office environment for Research, Part time Profs, Invited Profs, PDF's						
1	Workstations @ 4 to 6 NASM	6.00		0	0.00	1 w.s. per five part time professor
2	Interview space	7.00		0	0.00	for 2 to 3 people
Research allocations						
3	General - Non Classified	40.00	Total	0	0.00	Max., TBD[3] when design is based on equipment and no of RA's
4	Wet research (Typical)	75.00	Total	0	0.00	Up to 75 NASM to be determined when design is based on equipment and number of Research Assistants and full time Staff
5	(Dry) Research allocation per full time Profs	5.00	/ pers.	0	0.00	Council of Ontario's Universities gives 1 NASM more per office + 1 NASM for research per prof and is under evaluation
6	(Wet) Research allocation per full time Profs	10.00	/ pers.	0	0.00	Allocation, to be evaluated depending on department and Faculty, equipment info and type of research
7	Research Centers		/ pers.	0	0.00	TBD[3]
8	Cloakrooms		/ pers.	0	0.00	TBD[3]
	Total[2]:				0.00	
E.	**Public Spaces: (N/A)**					
1	Library	0.00	/ pers.	0	0.00	TBD[3]
2	Locker Space	0.00	/ pers.	0	0.00	TBD[3]
3	Lounge	0.00	/ pers.	0	0.00	TBD[3]
4	Cafeteria	0.00	/ pers.	0	0.00	TBD[3]
5	Circulation, Corridors / Elevators, Halls, Stairs, etc.	0.00	Sum	0	0.00	Percentage of all other occupancies
	Total[2]:				0.00	
F.	**Residences:**					
1	Laundry	0.00	/ pers.	0	0.00	TBD[3]
2	Lounge	0.00	/ pers.	0	0.00	TBD[3]
3	In-Suite Bathroom	0.00	/ pers.	0	0.00	TBD[3]
4	In-Suite Bedrooms	12.00	/ pers.	0	0.00	TBD[3]
5	In-Suite Kitchen	0.00	/ pers.	0	0.00	TBD[3]
6	In-Suite Living room	1.00	/ pers.	0	0.00	TBD[3]

General Notes:

1. **Indicated areas are approximate and represent the maximum values - for reference use only. Areas may vary depending on the project specifics or**
2. Dedicated for the use of **Facilities.**
3. Non indicated areas are to be determined (TBD) depending on activity
4. Side-by-side seated spaces shall be 750mm O/C minimum.

	Type of Space	m2[1]	Unit	No[2]	Total m2[2]	Notes
7	Circulation & services, Corridors / Elevators, Halls, Stairs, etc.	0.00	Sum	0	0.00	Percentage of all other occupancies
	Total[2]:				0.00	
G.	**Service Spaces: (N/A)**					
1	M & E Rooms, Janitor, Machine, etc.	0.00	Sum	0	0.00	As necessary
2	Storage rooms	0.00	Sum	0	0.00	TBD[3]
	Total[2]:				0.00	
H.	**Sports Facilities:**					
1	Change room	0.00	/ pers.	1	0.00	TBD[3]
2	Exercise room	0.00	Sum	0	0.00	TBD[3]
3	Gymnasium	0.00	Sum	0	0.00	TBD[3]
4	Shower spaces	0.00	Sum	0	0.00	TBD[3]
	Total[2]:				0.00	
I.	**Washrooms:**					
1	W.C.	0.00	/ pers.	1	0.00	As per Codes
	Total[2]:				0.00	
J.	**Other:**					
	TBD[3]	0.00	/ pers.	1	0.00	TBD[3]
	Total[2]:				0.00	
	GRAND TOTAL N.A.S.M.:				**0.00**	

1.0 GENERAL

1.1 Overview

.1 The following section has been prepared to provide consultants with a general overview of the energy and sustainability requirements for both new construction and extensive renovation projects. For all related systems, consultation with other sections of this guideline and/or **Facilities** shall be carried out to determine the specific scope of requirements suitable to the Laboratory system under consideration. All designs shall be reviewed by **Facilities**.

.2 The **UofO** is committed to sustainable campus development. One of the objectives is to reduce carbon emissions, therefore improving buildings energy efficiency is a major objective.

.3 Energy performance, analysis and reporting requirements including identification of Energy Efficiency Measures (EEMs), building simulation, building envelope, daylighting design and Measurement and Verification (M&V) for all new construction and major renovation projects are outlined in this section.

.4 In order to achieve environmental objectives and contribute to the overall sustainability of the campus, all new construction projects are required to achieve LEED Gold rating as a minimum. Formal certification is required.

.5 Where requirements outlined in this section are not feasible and/or in contradiction with applicable codes and standards, deviation shall be reviewed with **Facilities.** Similarly, when innovative technologies or solutions may not meet the requirements of this section, consultants shall consult with **Facilities.**

.6 To ensure sustainable approach is undertaken for the project under review IBD methodology shall apply in all projects. The following shall be included in the process:

- .1 Kick-off meeting shall be held to introduce the project team. Project team comprises of **UofO** Project Manager (PM); **SME**, **UofO**'s operational representatives and sustainability team; Design Team and stakeholders (end-user representatives). At this meeting and throughout the design process Design Team must collaborate to ensure that an environmentally sustainable project is delivered.
- .2 At the beginning of design concept stage a design charrette meeting shall be held. At this meeting the Project Team will establish goals and objectives with respect to sustainable metrics including energy target outlined earlier in this section.
- .3 At trade's bidding debriefing meeting **UofO**'s PM and Design Team will present sustainability objective to the bidders. Objectives shall be reviewed with the construction team again at the construction kick-off meeting.

.7 The requested studies, tests or reports indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 An Integrated Building Design (IBD) methodology shall be followed in all projects.

.2 The following steps shall be considered in the IBD process:

- .1 Building Load Optimization
- .2 High Efficiency Equipment Utilization
- .3 Operation Optimization

.3 Construction projects shall achieve a minimum of 50% reduction in total energy consumption as compared to the AHSRAE 90.1.

.4 Design of mechanical and electrical systems for all new construction and major renovations shall comply with the requirements outlined in ASHARE 90.1 for prescriptive approach and **OBC** whichever is more stringent.

.5 The guidance provided in ASHARE 50% Advanced Energy Design Guides (AEDG50) shall be followed.

.6 For Laboratories the design of mechanical and electrical systems shall comply with the I2SL Best Practice Guide series for Design of Laboratories.

.7 Where requirements outlined in this section are not feasible and/or in contradiction with applicable codes, deviation shall be reviewed with **Facilities**.

.8 Curtain wall systems shall not be designed nor installed on blind walls, unless their components are part of the OWR upon approval by **Facilities.**

2.2 Building Load Optimization

.1 The following features shall be considered for building load optimization:

.1 In new construction projects, the building envelope design shall achieve the highest feasible thermal performance as high levels of insulation are an implicit requirement for energy efficient new construction. The design shall consider placement of the insulation as a continuous layer on the exterior of the wall as opposed to the stud cavity to minimize thermal bridging. Nominal thermal performance (R-value) of the wall shall not be used in energy models and load calculations. Based on wall construction details, effective thermal performance (R-value) of the wall shall be applied. Building envelope design shall meet or exceed the prescriptive requirements of ASHRAE 90.1 (2016).

.2 For new buildings, the effective U-value of walls, taking into account thermal bridging, shall not exceed 0.284 W/m².K (0.05 Btu/ft².°F).

.3 For new buildings, Windows to Wall Ratio (WWR) shall be minimized. It is strongly recommended to maintain a maximum WWR of 30%. Minimization of WWR shall be combined with daylighting control strategy. Concepts such as utilization of windows with high Visible Transmittance (VT) and high placement of windows to simulate a clerestory shall be considered. Building orientation as discussed earlier plays a strategic role in effective daylighting.

.4 In new construction projects and major renovations where replacement of windows is under review, Solar Heat Gain Coefficient (SHGC) of glass shall be minimized. Use of glass with high SHGC will provide additional savings in building energy use during winter via an increase in the winter solar heat gain offsetting the space heating energy use, but at the expense of an increase in the cooling load and the size of cooling system.

.5 In new construction projects, the effect of external shading elements such as utilization of recessed windows shall be considered. External shading elements can reduce the solar heat gain and cooling load. The reduction in solar heat gain during summer and winter seasons shall be compared to evaluate the effects of shading element on the overall building energy performance. The following are recommended means to reduce the solar heat gain:

.1 Vertical fins for west and east facades

.2 Overhangs for south facade

.3 North facade does not require any shading element, however, consider including clerestory windows to contribute to daylighting.

.6 In Laboratories, air handling equipment overall coil and air handling units to be

selected for low-pressure-drops with coils velocities of 1.5 m/s (300 fpm) following the I2SL Best Practice Guide: Low-Pressure-Drop HVAC Design for Laboratories.

.7 The design of laboratory exhaust systems shall follow the I2SL Best Practice Guide: Designing and Operating Sustainable Laboratory Exhaust Systems and Manifolding Laboratory Exhaust Systems

.8 For new construction and major renovations consideration shall be given to efficient lighting design that will exhibit low lighting power densities (LPD). High illuminance level with LED fixtures shall be utilized which would allow the design to attain LPD of 0.7 W/m2 (0.65 W/Ft2) as a minimum, where “fixture density” of 4.5 - 6.5 m2 / Fixtures (50 – 70 Ft2 / Fixtures) is utilized.

.9 For new construction and major renovations where daylighting via continuous dimming control strategy is deemed feasible care shall be given to selection of dimming LED fixtures to ensure same input power and efficacy is achieved compare to non-dimming LED fixtures.

2.3 High Efficiency Equipment Utilization

.1 For all projects regardless of the size and type:

.1 Fan system power shall meet or exceeds the requirements outlined in article 6.5.3.1 of ASHRAE 90.1 (2016) (Refer to table 6.5.3.1-1).

.2 Energy efficiency of HVAC equipment shall meet or exceed the requirements outlined in subsection 6.8 of ASHRAE 90.1 (2016) (Refer to tables 6.8.1-1 to 13).

2.4 Operation Optimization

.1 For all projects regardless of the size and type:

.1 Optimum control strategies such as reset control loops for chilled water, condenser water, hot water, supply air temperatures and ductwork pressurization shall comply with the requirements outlined in ASHRAE 90.1 (2016) subsection 6.5.

.2 Optimal start-stop strategies and operating schedules shall be included in the control systems sequences of operation to ensure that equipment only operates when needed.

.3 For cooling and heating seasons, occupied and unoccupied periods space temperature set points shall be included in design.

3.0 SUSTAINABILITY

3.1 General

.1 Life Cycle Cost Analysis (LCCA) and Energy Modeling are main tools of sustainable approach. LCCA assist **UofO** to make informed decisions.

.2 For Laboratories, LCCA shall guide design decisions as described in the I2SL Best Practice Guide: An introduction to Low-Energy Laboratory Design

3.2 Life Cycle Cost Analysis

.1 LCCA shall be applied to projects as an effective decision-making tool that will consider the total life cycle cost of the project. This LCCA will include the initial or first cost plus the overall operating cost over the life of the project. This is in contrast to more traditional financial performance evaluations that are based on only the first cost. Thus, an option with a higher first cost, but significantly lower operating cost, over the life of the facility may display an overall lower LCC compared to the option with the lowest first cost, but much higher

operating cost.

.2 LCCA is applicable to all projects regardless of their size. **UofO**'s Project Manager may waive the requirements of LCCA for small size projects.

.3 LCCA shall be prepared to compare two or more options.

.4 As a minimum building envelope, mechanical and electrical, as well as water and energy systems shall be included in LCCA.

.5 LCCA will require the initial or first cost plus the operating costs of the facility or system including energy costs, O&M and equipment replacement costs when applicable.

.6 LCCA shall be prepared in accordance with Standard Practice for Life-Cycle Costs of Buildings and Building Systems, ASTM E917-05 (2010). LCCA shall be completed over 35 years.

.7 In order to ensure consistency of LCCA across all the UofO's projects data required to render LCCA shall be included as follow:

.1 Project area (Gross square feet) based on the design by the design team.

.2 Invested cost (First cost) based on cost estimate at each stage by the design team.

.3 Energy usage from energy model at each stage by design team.

.4 Utility cost by Facilities Operation department.

.5 Operation & Maintenance (O&M) by Facilities Operation department.

.6 Building component useful life as a minimum based on Table 4, Chapter 37, ASHARE Handbook – Application (2011).

.7 Replacement/Renewal cost based on building component useful life by the design team.

.8 Financing cost by will be provided **Facilities**.

.9 Discount and Escalation rate will be provided by **Facilities**.

.10 Inflation will be provided by **Facilities** department.

.11 Service date based on forecast of substantial completion date from project schedule.

.12 Base date based on start of the project.

.8 Energy model for energy consumption shall be based on acceptable industry standard modeling software (IES VE). All data input and configuration files shall be delivered to allow the **UofO** to execute the model using identical modeling software to support internal and external third-party QA/QC review.

3.3 Energy Modeling/Simulation, Calculation of HVAC Loads & Equipment Sizing

.1 Energy modeling/simulation is a key method for the design of energy efficiency buildings and an essential tool to demonstrate the energy consumption of the proposed design. Energy simulation is also an essential tool to aid in the design of high performance buildings beyond code compliance.

.2 Calculation of heating and cooling loads and equipment sizing is equally important or more important, as design optimization is driven by the sustainable consultant who is the professional best suited to perform load calculations.

.3 The energy modeling program shall be used for load calculations, equipment sizing and energy performance modeling. The energy modeling tasks shall follow the guidelines of ASHRAE Standard 209-2018 Energy Simulation Aided Design for Buildings Except Low-Rise Residential Buildings. This standard outlines eleven energy modeling cycles: including: load reduction modeling; HVAC system selection modeling and design integration and optimization as three cycles that are part of the HVAC load calculations and equipment

sizing.

.4 A preliminary energy model shall be prepared in pre-design stage. This energy model will serve as a conceptual design model that explores the building's form and architecture, as well as, identifying the largest end-uses.

.5 The energy model shall refine and be revised at each stage of the design process. Final energy model shall be performed prior to issuance of construction documents.

.6 Cost of electric power due to CO_2 emissions reduction legislation (cap and trade system) shall be included in the energy model to account for anticipated costs.

.7 Energy modeling shall be carried out for all major renovations and new construction projects. For small size projects the **UofO** may request the design team to prepare and submit the energy model.

.8 Energy model shall be established in accordance with procedures and guidance outlined in section 11 and Appendix G of the ASHRAE 90.1 (2016).

.9 The **UofO** has aggressive energy performance targets including a Thermal Energy Demand Intensity (TEDI) of 38 ekWh/m².yr.

.10 The UofO's goal is to meet realistic energy performance targets. Thus, the energy model shall be developed and calibrated so that the reported energy use is realistic. The **UofO**'s desire is to see savings that are close to actual energy savings as opposed to speculative results that are not consistent or in line with typical energy benchmark data (academic buildings: less than 450 MJ/m2 and research buildings less than 1000 MJ/m2). Design methodology, equipment selection and how to apply their efficiency in energy models shall be reviewed and discussed with **Facilities**.

.11 Acceptable energy model to simultaneously perform load calculations, equipment sizing and energy simulation is IES VE. IES VE is an energy model capable of performing HVAC load calculations for equipment sizing, as well as, annual energy use simulations.

4.0 MANDATES AND DELIVERABLES

4.1 Required Energy Model Outputs and Reports

.1 The following list of IES VE outputs shall be provided to **Facilities** at the appropriate stage of the design. All output files shall be submitted in a searchable format:

.1 A heating and cooling summary report: A summary report outlining the procedure followed to calculate the cooling and heating loads, including but not limited to major inputs into the energy model, all assumptions made, zoning diagram, and results in table format. The following IES VE output report shall be submitted with the heating and cooling summary report:

.1 Heating and Cooling Load Sizing report in excel format.

.2 An energy modeling report: A summary report in the style and rigor of a LEED EAp2 and EAc2 submission, including but not limited to a project summary and background, Input summary table, zoning diagram, narrative of all assumptions and modeling workarounds, a results section including narrative and table. The following IES VE output reports shall be submitted with the energy modeling report:

.1 BPRM Report.

.2 ASHRAE 62.1 Report.

4.2 Scope

.1 Scope of work and deliverables at each stage of project are identified as per the following:

Milestone		Scope of Service	Deliverables
Concept Design (CD)		For Each Option: .1 Identify Project's Energy Target **.2** Identify Energy Efficiency Measures and Review with **UofO** **.3** Identify Design Concept of Building Envelope Design Concept and Review with **UofO** .4 Demonstrate the Perspective Compliance of Building Envelope Concept .5 Perform Glazing (Daylighting) and Thermal Performance Calculation of Building Envelope .6 Perform Life Cycle Cost Analysis (LCCA)	Submit Report to Include: .1 Summarizing Energy Target, Energy Efficiency Measures and Building Envelope Concept for Each Option .2 Preliminary energy Model for Each Option .3 Input / Output Spreadsheet and Zoning Diagram for Each Option .4 Summarizing the Result of Glazing (Daylighting) and Thermal Performance Calculations for Each Option .5 Preliminary Life Cycle Cost Analysis for Each Option
Design Concept (DD)	**33% DD**	For selected option: .1 Develop Energy Efficiency Measures and Building Envelope Concept .2 Perform preliminary selection of major equipment .3 Develop the first Energy Model .4 Revise Input / Output Spreadsheet and Zoning Diagrams .5 Revise result of Glazing (Daylighting) and Thermal Performance calculations .6 Revise Life Cycle Cost Analysis (LCCA)	Based on selected option from Concept Design stage, submit design brief to Include: .1 Narratives for Energy Target, Energy Efficiency Measures and Building Envelope Concept .2 Cut sheet of the preliminary selection of major equipment .3 Revised Energy Model .4 Revised Input / Output Spreadsheet and Zoning Diagrams .5 Revised result of Glazing (Daylighting) and Thermal Performance calculations .6 Revised Life Cycle Cost Analysis (LCCA)
	66% DD	.1 Revise Energy Efficiency Measures and Building Envelope Concept as required .2 Perform final selection of major equipment .3 Revise the first Energy Model to reflect development from 33% DD .4 Revise Input / Output Spreadsheet and Zoning Diagrams to reflect development from 33% DD .5 Revise result of Glazing (Daylighting) and Thermal	Submit revised design brief to reflect the development from 33% DD to Include: .1 Narratives for Energy Efficiency Measures and Building Envelope Concept .2 Cut sheet of the final selection of major equipment .3 Revised Energy Model .4 Revised Input / Output Spreadsheet and Zoning Diagrams
		Performance calculations to reflect development from 33% DD .6 Revise Life Cycle Cost Analysis (LCCA) to reflect development from 33% DD	.5 Revised result of Glazing (Daylighting) and Thermal Performance calculations .6 Revised Life Cycle Cost Analysis (LCCA)
	99% DD	.1 Finalize Energy Efficiency Measures and Building Envelope Concept .2 Finalize Energy Mode .3 Finalize Input / Output Spreadsheet and Zoning Diagrams .4 Finalize result of Glazing (Daylighting) and Thermal Performance calculations .5 Finalize Life Cycle Cost Analysis (LCCA) to reflect changes from 66% DD	Submit: .6 Cut sheet of the final selection of major equipment .7 Revised Energy Model to reflect development from 66% DD .8 Revised Input / Output Spreadsheet and Zoning Diagrams to reflect development from 66% DD .9 Revised result of Glazing (Daylighting) and Thermal Performance calculations to reflect development from 66% DD .10 Revised Life Cycle Cost Analysis (LCCA) to reflect development from 66% DD

1.0 GENERAL

1.1 Overview

.1 This section has been prepared to provide consultants with a general overview of HVAC systems design requirements for new buildings and renovations in existing building. For all related systems, consultation with other sections of this guideline and/or **Facilities** shall be carried out to determine the specific scope of requirements suitable to the HVAC system under consideration. All designs shall be reviewed by **Facilities**.

.2 In many instances **UofO** undertakes short term planning and long-term master planning to address economic and practical inefficacies associated with renovations in existing building, therefore consultants shall always review project requirements. In all cases consultation with **Facilities** will be required to determine the specific scope of work and requirements suitable to the project under review. All systems shall be reviewed by **Facilities**.

.3 Design and installation of HVAC systems must be implemented in compliance with section 9 of **EPA**, where applicable. To be coordinated with **OCRO.**

.4 Where requirements outlined in this section are not feasible and/or in contradiction with applicable codes and standards, deviation shall be reviewed with **Facilities**. Similarly, when innovative technologies or solutions may not meet the requirements of this section, consultants shall consult with **Facilities.**

.5 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

.6 This section should be used in parallel with section "**VOLUME I - U. Utilities**".

2.0 DESIGN

2.1 General

.1 Outdoor design conditions:

.1 Summer: Above Ontario Building Code, 32°C (89.6°F) dry bulb and 24.4°C (76°F) wet bulb temperature.

.2 Winter: To Ontario Building Code, Supplementary Standard SB-1 for Ottawa, Ontario, -27°C (-16.6 °F) dry bulb temperature (1% design temperature).

.2 Indoor design conditions: System capacity shall be capable of maintaining 23.5 °C (74.3°F) in summer and 22 °C (71.6 °F) in winter. Indoor relative humidity shall be maintained within ASHRAE 55 Thermal Environmental Conditions for Human Occupancy (2013) recommend thermal comfort zone with a maximum RH of 55% RH in summer and 40% RH in winter, low limit shall be adjustable. For Laboratories, the consultant shall review the functional program requirements and Room Data Sheets (RDSs) and consult **Facilities**.

.3 Type of humidification systems must be approved by **Facilities**.

.4 For modifications to existing systems verify systems parameters with **Facilities** prior to commencement of design. Integrated domestic and hydronic systems shall not be used, including in residences.

.5 Design of HVAC systems shall provide an acceptable level of indoor air quality and comfort by following ASHRAE 55 while minimizing energy use by following ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016).

.6 Design of HVAC systems and selection of respective equipment shall meet or exceed the ASHRAE and/or BOMA Equipment Service Life whichever is longer.

.7 Unless otherwise instructed all buildings shall be metered for all utilities including electricity, gas, water, domestic hot water, steam, steam condensate, chilled and heating hot water.

.8 The feasibility of heat/energy recovery unit for building exhaust system shall be examined. Use of heat/energy recovery unit shall be based on Life Cycle Cost Analysis. Type and selection of heat/energy recovery unit shall cause less than 5% cross contamination and to recover sensible/latent heat/energy from the exhaust air stream with efficiency above 75% for non-labs. The feasibility of utilizing heat recovery systems (used particularly on wet lab or high hazard space exhaust systems) shall be examined. Use of heat recovery unit shall be based on Life Cycle Cost Analysis and energy modelling. For labs refer to Section D2.

.9 For new construction with large internal loads, consideration shall be given to the use of heat recovery ***Chillers (23 00 00)***, based on stringent analysis of loads to ensure balanced heating-cooling loads as well as life cycle cost analysis. Type and selection of heat recovery chiller shall be reviewed with Facilities. Consideration shall be made to use the waste heat from the heat recovery chiller(s) to serve the pre-heat coils and/or reheat terminal units and/or domestic hot water pre-heat.

.10 For heat recovery systems, if loads and system configuration permit, consideration shall be made to export the excess heat to central heating loops in shoulder seasons (outdoor air temperatures from 8 to 15°C).

.11 Where humidification is required type and application of humidifiers shall be reviewed with **Facilities**.

.12 Mechanical and electrical system design shall comply with ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Buildings (2016) mandatory and prescriptive path (Refer to Sustainability and Energy Section S).

.13 HVAC systems design shall reflect the differing thermal zones and exposure of building. The following shall be considered where HVAC systems serve multiple thermal zones:

- .1 Each board/meeting room and classroom shall be treated as an individual thermal zone. They shall be provided with separate space thermostat and/or sensor.
- .2 Offices with similar load profile (maximum of three), i.e. on the same exposure and/or floor may be considered as common thermal zone as they shall be controlled by a combination of all active space thermostat and/or sensors.
- .3 Corner offices shall be treated as a separate thermal zone. In the case that perimeter heating is used, provide a control valve for each individual room. It should be controlled via a connection to BAS and the room temperature sensor.
- .4 In residences each suite shall be thermally controlled as a separate zone.
- .5 HVAC design shall follow ASHRAE 55 (latest edition) for occupant comfort.
- .6 Furniture layouts shall be coordinated with HVAC design to prevent interference with perimeter heating, cooling and ventilation. It is recommended to not place furniture immediately adjacent to the exterior wall and/or windows.

.14 All space thermostats or temperature sensing shall not be located on: exterior walls, in direct sunlight, in the way of any obstructions and in the path of supply air, away from all equipment generating heat. Preference to be located below room air return.

.15 Mechanical ventilation shall be provided to all occupied spaces, as per ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality (OBC applicable version).

.16 Operable windows shall not be used.

.17 For new construction projects, the design of hydronic piping system shall consider direct return configuration with pressure independent control valves. Reverse return piping distribution strategy shall not be used. For existing buildings, the design shall match the existing system.

.18 HVAC systems, shall include 20% extra capacity in the main air duct and piping distribution systems. HVAC systems and components including but not limited to: boilers, ***Chillers (23 00 00)***, *Cooling Towers (23 00 00)*, pumps, heat exchangers and all associated hydronic piping

(main distribution lines including risers and main horizontal distribution systems) shall be sized, designed, and constructed for 20% extra capacity. Any new connections to an existing main or riser shall have capped future valved connections for future expansion. Confirm sizing with **Facilities**.

.19 For new construction mechanical room and branch connections at each floor from the riser shall have future valved capped connections.

.20 For new construction, air handling units and make-up air units plus associated ductwork serving the main building and dry spaces shall be sized, selected, designed, and constructed for 150% of minimum code requirements for outside / ventilation air capacity. Make-up air units and associated ductwork serving the wet lab spaces and high hazard areas shall be sized, selected, designed, and constructed for 120% of minimum code requirements for outside / ventilation air capacity. Oversizing ventilation allows for future expansion and changes of spaces.

.21 The heating and chilled water system design shall incorporate a primary and a secondary loop. The number of *Chillers **(23 00 00)*** and, *Cooling Towers **(23 00 00)*** as well as boilers shall be justified by detailed Life Cycle Cost Analysis (35 years) and energy modelling.

.22 For heating loops with condensing boilers the design shall use variable primary and variable secondary loops.

.23 For projects on the campus steam/hot water loop, energy transfer systems shall be used to isolate the building from the campus loop as a secondary tertiary loop.

.24 For projects on the campus chilled water loop, energy transfer systems shall be used to isolate the building from the campus loop as a secondary tertiary loop.

.25 Terminal coils shall be sized for a delta T of 11.1°C (20°F) for heating, and 6.7°C (12°F) for cooling. In existing building to follow existing conditions, consultant shall verify existing delta T.

.26 Heating and chilled water system design shall be based on mechanical equipment following lead/lag/standby operation to address part load conditions effectively and efficiently. Where lead/lag/standby is not possible duty/standby with rotational hours is required.

.27 Include N+1 redundancy in HVAC systems for major equipment such as boilers, *Chillers **(23 00 00)***, pumps, *Cooling Towers **(23 00 00)***, associated pumps, general and laboratory make-up air, as well as lab exhaust systems. Redundant equipment shall be physically redundant.

.28 Hydronic control valves shall be selected in such they can provide control with system design pressure differentials at maximum and minimum flows.

.29 To prevent quick, sudden system pressure fluctuation automatic relief valves shall not be oversized.

.30 Heat pump terminal units shall not be used.

.31 New glycol systems shall be 35% propylene glycol (35% PG) pre-mixed. Glycol systems shall be clearly labeled following labeling standard. For existing systems match existing concentration and type, consultant to verify on site the existing concentration and type.

.32 In new buildings ceiling mounted hydronic radiant panels shall not be used.

.33 Where applicable, a screening level numerical exhaust dispersion and environmental and odor assessment of the preliminary HVAC design shall be completed as per ASHRAE / NPC, to include:

.1 The applicability of the proposed exhaust system locations in the context of the surrounding buildings and environment.

.2 If necessary – recommendations to address any concerns related to air and noise emissions & odors.

2.2 Ventilation and Air Distribution Systems

.1 Ventilation rate shall be minimized; however, minimum fresh air supply shall not be less than the values required by ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality (OBC applicable version). Except in Laboratories (refer to Section D.2).

.2 Ventilation system fans and distribution systems shall be capable of providing 100% outside air intake and relief for air economizer operation (air-side free cooling) when conditions permit.

.3 Ventilation systems with heat recovery shall have the ability to by-pass heat recovery when outdoor air temperatures permit.

.4 Room carbon dioxide levels shall be limited to 700 ppm above outside conditions (420 ppm) under normal circumstances in accordance with ASHARE 62.1 Ventilation for Acceptable Indoor Air Quality as per **OBC**.

.5 Design of medium and high-pressure air distribution system for new buildings is not permitted. Air distribution system shall be deigned to low pressure as per AHSRAE and SMACNA guidelines. For existing buildings where major renovation is under review and if applicable, consideration shall be given to conversion of the medium/high pressure air distributing system to low pressure.

.6 Design of new systems with dual duct (hot deck, cold deck) configuration is not permitted.

.7 Supply ductwork shall be sized with a static pressure drop less than 20 Pa per 30 linear metres (0.08 in. per 100 linear feet) of the duct run.

.8 Return ductwork shall be sized with a static pressure drop less than 10 Pa per 30 linear metres (0.04 in. per 100 linear feet) of the duct run.

.9 Diffusers and registers shall be selected with a static pressure drop on less than 20 Pa (0.08 in).

.10 Locate fresh air intakes to prevent contamination by external sources such as road traffic, smoke stacks or exhaust outlets and shall also be located to prevent snow infiltration.

.11 Where variable volume systems are used provide VFD for fan control. Selection of fan motor shall match the VFD. VFDs shall not operate (or be designed to operate) higher than 60 Hz at any condition.

.12 All VFDs to be specified with the correct enclosure for the application (NEMA 2, NEMA 3R, etc). VFDs shall be installed indoors or in a heated service corridor as part of the packaged unit.

.13 In addition to meeting the design operating pressure/flow, fan selection shall be based on fan efficiency at the expected normal operating conditions. Fan system power limitation at fan system design conditions shall not exceed the allowable fan system nameplate hp or fan system bhp as per Table 6.5.3.1.1A of ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Buildings (2016).

.14 In General, duct design shall maintain maximum NC 35 except as specified in project requirements.

.15 Intake louvers shall be sized to maximum 2.3 m/s (450 FPM) through free area.

.16 Exhaust louvers shall be sized to maximum 3.6 m/s (700 FPM) through free area.

.17 Face velocity of hydronic and refrigerant cooling coils shall be maintained between 1.5 – 2.0 m/s (300 – 400 FPM).

.18 Face velocity of pre-heating and heating coils shall be maintained between 1.5 and 2.0 m/s (300 and 400 FPM).

.19 All air intake and exhaust ducts shall be insulated to protect building interiors from frost and moisture damage. The air distribution ductwork shall be leakage tested before insulation or concealment of systems in accordance with SMACNA 016 (latest edition).

.20 Air distribution ductwork shall be cleaned after construction is complete and prior to building or project handover.

.21 Specialty system exhaust shall be cleaned after construction is complete and prior to building or project handover.

.22 For feasibility of heat recovery chiller(s) both building cooling profile and process cooling demand shall be considered. Where use of heat recovery chiller(s) is feasible, consideration shall be made to use the waste heat from the heat recovery chiller(s) to serve the pre-heat coils and/or reheat terminal units and/or domestic hot water pre-heat. The analysis of the feasibility to employ a heat recovery chiller shall ensure balanced heating-cooling loads.

.23 Include heat recovery on ventilation air and recover heat from cooling systems as useful heat when loads permit. Consider exporting excess heat to central heating loops in shoulder seasons (Outdoor air temperatures from 8 - 15 °C).

2.3 Campus Connected Cooling Systems

.1 Campus chilled water distribution system consist of a chiller plant with three centrifugal electric driven ***Chillers (23 00 00)*** and associated pumps and chemical treatment equipment. Use of campus chilled water is the preferred method for cooling and dehumidification throughout the campus.

.2 Available differential pressure of the campus chilled water system varies from 48.3 to 75.8 kPa (7 to 11 psi) at end of line (Simard). Consult Facilities for the pressure differentials across the campus.

.3 Chilled water is supplied between 4 – 10°C (39 – 50°F) depending on outdoor air temperature. Sizing of cooling coils for winter operation shall be sized on the upper limit of 10°C.

.4 The campus chilled water system is based on 10°C (18°F) temperature difference (delta T).

.5 Each building shall be evaluated based on the trend data of the building chilled water loop which differs from the campus loop delta T. New construction shall incorporate a plate type heat exchanger to isolate building from campus loop.

2.4 Standalone Cooling Systems

.1 Use of all electrically driven ***Chillers (23 00 00)*** and/or refrigeration units shall be reviewed with Facilities Flush and clean all systems before handover. Chilled water system design shall be based on 6.67°C (12°F) temperature difference (delta T).

.2 Chillers (23 00 00) shall be water cooled. Use of air-cooled cooling system can be used for shoulder season cooling. Air-cooled ***Chillers (23 00 00)*** shall have an economizer, low ambient package, and use a higher design outdoor air temperature of 35°C (95°F) for equipment sizing.

.3 CFC and HCFC refrigerant shall not be used.

.4 Cooling equipment shall be ARI rated.

.5 Use of cooling tower(s) for summer operation are preferred however, utilization of evaporative and dry coolers shall be evaluated based on Life Cycle Cost Analysis, energy modelling, manufacturer's recommendations, and project site requirements.

.6 *Cooling Towers **(23 00 00)*** shall be designed with ability to drain the towers in a period 24 hrs (50 mm (2 in) or larger drain} to the SANITARY Sewer system. Cooling tower draining SHALL NOT be routed to STORM Sewers

.7 Discharge from Evaporative *Cooling Towers **(23 00 00)*** shall be located away from any HVAC Exhaust or Air Intake (**OBC** 6.2.3.12 recommends 7.6 m).

.8 Operation of standalone cooling systems during the wintertime requiring a winterized cooling tower is prohibited. However, the cooling tower design shall include ability to use it in the winter for emergency purposes. Review all cooling tower design with **Facilities.**

.9 Acceptable type of compressors are as follows:

.1 Up to 280 kW (80 tons): Screw and Scroll

.2 281 to 703 kW (80 to 200 tons): Screw and Centrifugal

.3 703 kW (200 tons) and above: Centrifugal

.4 All sizes: To the extent possible, the compressor to be oil free, magnetic bearing type

.10 The design of ventilation and refrigeration monitoring systems shall meet the requirements of CAN/CSA-B52

.11 IT room and specialty loads shall be rated for full capacity of the cooling load year-round. Design and selection of systems and equipment shall include 20% extra capacity as a minimum.

.12 In general, variable refrigerant flow (VRF) and Direct Expansion (DX) systems are not preferred. Depending on location of building services LCCA shall be provided for **Facilities** review.

.13 Where the use of water-cooled Direct Expansion (DX) system is required for kitchen equipment (such as but not limited to walking coolers and freezers) and/or laboratory equipment (such as but not limited to CTEs), heat shall be rejected to building chilled water loop using process chilled water distribution system.

.14 Minimum performance of the water cooled and Direct Expansion (DX) systems and equipment (in specific applications) shall meet or exceed the requirements outlined in ASHARE 90.1 Energy Standard for Buildings Except Low-Rise Buildings (2016).

.15 Kitchen refrigeration equipment shall not be provided with redundancy. Design of kitchen refrigeration systems shall include local audio and visual temperature alarm and an alarm via dry contact to the BAS.

.16 Design of ***Cooling Towers (23 00 00)*** and evaporative coolers shall not be designed to be operated in the winter. However, they shall be equipped with heater and condenser water pipes shall be heat traced. Their design, including of evaporative coolers, fluid coolers shall be such that cooling requirements can be satisfied without circulating water to the outdoors when the ambient temperature is less than 5°C.

.17 Systems with control valves either modulating or two position shall be designed for variable flow using pump VFDs capable of reducing flow to 30% or more based on system predicated part load requirements. Consult chiller manufacturer or **Facilities** for minimum flow requirement.

.18 Piping system design shall be sized between friction rate of 0.46 – 1.22 m/100 m (1.5 - 4 ft/100 ft) of pipe (average friction rate of 0.46 m/100 m (1.5 ft/100 ft) of pipe is preferred). Velocity shall be limited to 1.8 m/s (6 FPS) in occupied areas and 2.7 m/s (8 FPS) in unoccupied areas such as mechanical rooms. Under part load condition velocity shall not be less than 0.4 m/s (1.5 FPS). Selection of pumps shall be compliant and coordinated with piping system design to ensure requirements outlined in Sustainability and Energy section are met. Certain Laboratories have requirements for chilled water for water cooling the research equipment. Type of system, i.e. open vs. close, local vs. central shall be reviewed with Facilities, and end user (corresponding research group). Characteristics of the required chilled water such as but not limited to tight chilled water temperature range, high or low operating pressure, special chilled water filtration, use of specific piping material, user's controllability/adjustability, and chemical treatment shall be reviewed with **Facilities**, the facility manager and researcher. If a central process chilled water system is required, include 20% extra capacity in the central process chilled water system and associated distribution system for future expansions.

2.5 Campus Connected Heating Systems

.1 Steam produced in the Central Heating Plant (CHP) is supplied at 103 – 276 kPa (15 – 40 psig) (saturated) at the plant wall based on outside air temperature. For most of the buildings located at the South end of the main campus the steam is used in the buildings to produce hot water for

heating purposes heat exchangers for the South are located behind the Power Plant. North end campus buildings are directly supplied building heating water produced via a large heat exchanger located in the Lamoureux basement. The heating water supply temperature varies between 35 – 80°C (95 – 176 °F).

2.6 Standalone Heating Systems (not connected to campus)

.1 In new buildings, the heating system shall be designed for a maximum of 54°C (130°F) supply water at winter design conditions.

.2 Heating hot water system shall be based on 11°C (20°F) temperature difference (delta T).

.3 In general, new system designs shall consider glycol only for pre-heat coils or in areas subject to freezing. Refer to item 2.1.31. above for type and concentration of glycol.

.4 Systems with control valves either modulating or two position shall be designed for variable flow using VFD capable of reducing flow to 30% or more based on part load requirement. Consult boiler manufacturer or **Facilities** for minimum flow requirement. VFDs shall not operate (or be designed to operate) higher than 60 Hz at any condition. The boiler manufacturer shall be consulted for minimum flow requirements.

.5 Piping system design shall be sized between friction rate of 0.46 – 1.22 m/100 m (1.5 - 4 ft/100 ft) of pipe (average friction rate of (1.5 ft/100 ft) of pipe is preferred). Velocity shall be limited to 1.8 m/s (6 FPS) in occupied areas and 2.7 m/s (8 FPS) in unoccupied areas such as mechanical rooms. Under part load condition velocity shall not be less than 0.4 m/s (1.5 FPS). Selection of pumps shall be compliant and coordinated with piping system design to ensure requirements outlined in Sustainability and Energy section are met.

.6 Perimeter heating zones shall be served by an independent heating source from the interior zones and include their own thermostat.

.7 Perimeter heating design shall follow the table below:

Perimeter Heating Table

Exterior Wall Heat Loss W / linear m of external wall (Btu/ linear ft of external wall)	Permissible Perimeter Heating Location
<73 (<250)	- Under window - Base of Wall - Overhead (adjustable linear diffuser only)
≥73 and <132 (≥250 and <450)	- Under window - Base of Wall - Overhead (adjustable linear diffusers only and must discharge air directly over the wall or window)
≥132 (≥450)	- Under window - Base of Wall

.8 In lobbies and vestibules, heating systems shall be designed to suit the recovery rate. Vestibule heating systems shall maintain a minimum temperature of 15°C (59°F).

.9 Heating plant system design and infrastructure shall be capable of conversion from natural gas to electric power.

3.0 IMPLEMENTATION AND MAINTENANCE

3.1 General

.1 All major air handling equipment shall be installed in a mechanical room accessible from the inside of the building. Roof-top air-handling units shall not be utilized.

.2 Special attention shall be given early in the design process to provide for sufficient and safe

access space for maintenance of mechanical systems. Sufficient space implies the capability to replace major components with minor impact to the building. This includes the space between pumps, design shall consider how the equipment will be maintained and provide adequate space.

.3 Operations shall be consulted during design to review equipment placement and clearances.

.4 Mechanical room locations shall take into account how large equipment can be moved in and out to/from the building to accommodate the initial installation and future installation due to maintenance, repair and replacement.

.5 Equipment shall be designed to be accessible and maintainable from floor level whenever possible. When not possible, permanent structures shall be designed to minimize the necessity of such tools as ladders, hoists and portable lighting (i.e.: platforms and permanent ladders for overhead work, rail systems for removal of pumps in pits, adequate permanent lighting, etc.). This must also be reviewed by **OCRO**.

.6 Provide minimum 90 cm (36 in) clearance around heat exchangers. Where shell and tube heat exchangers are used provide minimum clearance for tube pull-out (generally equal to the length of the heat exchanger) for servicing and cleaning as per manufacture's recommendation.

.7 For main air handling units visual and BAS connected pressure gages are required across all filter banks (filter and pre-filter separate). Filter pressure drop status shall be monitored and alarmed on BAS with pressure setpoints based on consultation with filter vendor.

.8 Floor drain (shall be installed wherever there is a need for maintenance and cleaning of coils and manifolds. (i.e., in mechanical rooms).

.9 In hydronic systems differential pressure control valves shall not be installed in pump discharge bypasses.

.10 When differential pressure control strategy is utilized desirable differential pressure shall not be accomplished at the pump. Pressure bypass shall be provided at the end of the system or at the end of subsystem regardless of whether system utilizes bypass flow system or VFD. Where bypass flow is utilized flow should not exceed 20% of the pump design flow.

.11 Use of pipe less than 19 mm (3/4 in) diameter is not acceptable and shall not be used.

.12 Branch take-offs (supply and return) from the main hydronic pipes towards the terminal devices shall not be installed at the bottom of the main to prevent routing debris and sediments to the terminal devices.

.13 Hydronic circuits including glycol, chilled and heating water loops shall be equipped with air and dirt separators.

.14 Provisions shall be provided to facilitate cleaning, and to ensure adequate flushing of hydronic piping systems. Adequate clearances shall be provided for the removal of Tube bundles of all heat exchanges.

.15 Air vents and drains shall be installed at high and low points in the hydronic systems respectively. Air vents and drains shall be piped to a safe location within 15 cm (6 in) of the floor preferably over a funnel drain.

.16 Automatic air vent shall be provided on chemical feed tanks.

.17 Visual thermometer and BAS connected temperature sensors shall be installed at both supply and return piping for all coils, ***Chillers (23 00 00)***, boilers, heat exchangers.

.18 Where major return streams are mixed provide thermometer (Visual and BAS) downstream and upstream of mixing points.

.19 Water make-up and blowdown water lines shall be monitored by BAS for both status (valve open/close position) and cumulative flow rate.

.20 Sound and vibration isolation systems shall be provided to minimize structural, system and

airborne noise to acceptable level as outlined in this section or as per project requirements.

.21 In mechanical rooms where valves are installed above 2.1 m (7 ft) chain wheel operator shall be provided.

.22 Circuit Balancing Valves shall be eliminated in locations where Pressure Independent Control Valves (PICVs) are used.

.23 Where balancing valves are installed, they shall be provided with position indicator and maximum adjustable stops.

.24 Hydronic and condensate drainage piping and / or any wet pipe shall not be installed within the IT rooms/closets as well as electrical rooms and within partitions.

.25 Access doors to vertical pipe chases shall be provided at each floor level.

.26 Where service shafts are deep and where future access to the pipes are limited, maintenance platform shall be designed and built withing the service shafts.

.27 Piping shall be installed straight and parallel with building structure/guidelines/walls.

.28 When joining pipes and fittings with dissimilar metals, di-electric couplings shall be used.

.29 For new installations, all branches shall be terminated with valves and capped connections.

.30 Efforts shall be made to group piping at common elevations.

.31 Where feasible, avoid joints in piping below the grade.

.32 Connections to equipment shall be made with unions or flanges. Where flanges are used, appropriate gaskets shall be provided.

.33 HVAC Pumps:

.1 In-line circulators: Shall be installed as indicated by the flow arrows and be supported at inlet and outlet flanges or unions. Install with bearing lubrication points accessible. The motor shall be installed in orientation that is recommended by the manufacturer.

.2 Pumps with integrated VFDs shall not be used.

.3 Base mounted pumps: Templates shall be supplied for anchor bolt placement. All anchor bolts shall be furnished with sleeves. Couplings shall be aligned in accordance with manufacturer's recommended tolerances.

.4 Location and size of base mounted pumps shall be reviewed to determine if base mounted pumps require vibration isolation concrete pad/springs.

.5 Pump body shall not support piping or equipment. Stanchions or hangers shall be utilized for this purpose. Manufacturer's installation instructions shall be consulted for details.

.6 To review with **Facilities** if pump requires pip flex connectors to permit ease of replacement (depends on pump size).

.7 Volute venting pet cocks shall be installed in accessible locations.

.8 Ball valves shall be installed on pump suction & discharge tap-ins for pressure gauges.

.9 For measuring pump differential pressure, a single pressure gauge piped across the pump inlet and discharge with inlet and discharge isolation valves is preferred.

.10 Review with facilities if pump seal requires a pump seal cyclone separator to extend pump seal life (certain systems accumulate sediment in the pump location).

3.2 Ventilation and Air Distribution Systems

.1 Provide minimum clearance for air handling units' coil pull-out (generally equal to the width of the air handling unit) per manufacturer's recommendation. Where it is not feasible provide minimum 60 cm (24 in) on non-service side and 90 cm (36 in) on service side clearance around air handling units and similar equipment or as per manufacturer's recommendation.

.2 In order to simplify duct fabrication and reduce the cost of duct work consider changing only one duct dimension at a time.

.3 Duct taps shall be at least 50 mm (2 in) smaller than main duct.

.4 Duct size shall be 50 mm (2 in) wider than diffusers, register and grilles.

.5 90° square elbows shall be provided with double radius turning vanes.

.6 Where rectangular duct taps are used, they shall be shoe fittings (45° fittings). Splitter dampers and extractors are not acceptable.

.7 Where items which require service and inspection are installed such as but not limited to: fire dampers, smoke detectors, humidifiers and coils, access doors shall be provided. (Refer to arch section Volume III, Division 05 Metals, Section 2.2 Accessories)

.8 In dishwasher, kitchen and laundry exhaust systems where elbows are required, elbows shall be smooth radius construction. Use of vane in these applications are not permitted. It is recommended to construct the elbows with the radius equal to 1-1/2 times width of duct.

.9 Flexible ducts shall be 1.5 m (5 ft) maximum in length.

.10 Operable intake and exhaust louvers are not permitted. (The louvre and damper are to be separate components).

.11 In open ceiling spaces with high visibility (entrances, offices, and similar), exposed mechanical ductwork shall be finished from their inside faces, to form clean and smooth visible joints.

.12 Where flow measuring stations are installed they shall be accessible in a distance recommended by the manufacturer.

.13 In exhaust systems serving wet Laboratories or high hazard areas, ductwork and plenums, material shall be selected to accommodate the chemicals being exhausted (chemical composition of the air stream). Acceptable examples of ductwork and plenum materials are vinyl coated carbon steel, 304/316 stainless steel and Polyvinyl Chloride (PVC) coated galvanized steel. Preferred material is PVC coated galvanized steel.

.14 Horizontal laboratory exhaust ductwork shall be slopped a minimum of 1/8” per foot with a drain provided at the low point. Drain shall be piped to the appropriate waste system.

.15 HVAC ductwork considerations:

- .1 All air intake and exhaust ducts shall be insulated to protect building interiors from frost and moisture damage.
- .2 Pitot tube openings, complete with spring-loaded caps, shall be provided on all supply, return and exhaust systems around major equipment. Adequate provision shall be made where insulation is encountered.
- .3 Flexible duct connections shall be made from anti-bacterial material.
- .4 Balancing dampers shall be made from quality hardware to facilitate the balancing operation and to ensure positive locking of the damper. They shall meet or exceed the requirements highlighted in Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA) and Air Movement and Control Association (AMCA).

.16 *Fan Coil Units (FCUs)* ***(23 00 00)*** shall be counter flow type, cleanable and drainable. The tubes shall be readily accessible without having the need to disconnect piping.

.17 Air handling and distribution systems including re-circulation systems serving high traffic areas and public assembly spaces (such as but not limited to classrooms, meeting rooms, lounges, atriums, main entrances…) or other areas / spaces with occupant density of 0.4 person/area [#/m^2] and higher, shall be equipped with active and passive air purification measures including but not limited to Bipolar Ionization Hydroperoxide UV systems for protection against airborne and surface contamination, germs, and pollutants. The system design shall explore the following characteristics:

.1 To be mercury free and be zero-ozone compliant

.2 The system to be designed for easy installation and be accessible for maintenance and repair

.3 The system to have unlimited cycling capacity and be designed to be turned ON and OFF with the HVAC system

.4 UV lamp placement and orientation not to impact and deteriorate any system component such as but not limited to air filters

.5 The system to be designed to have minimal impact on air flow pattern and pressure drop

.6 For any related design solutions, the project team to seek University of Ottawa's approval during tender process

3.3 Cooling Systems

.1 Use of satellite *Chillers **(23 00 00)*** and refrigeration units shall be reviewed by **Facilities** as it is not a preferred solution.

.2 Satellite *Chillers **(23 00 00)*** and refrigeration units shall not be used.

.3 When process refrigeration system is required, use of chilled water cooling with city water back-up is the preferred option monitored and controlled by BAS.

.4 All *Cooling Towers **(23 00 00)*** shall be tested under actual operating conditions in accordance with CTI 105-ATC for performance verification.

3.4 Heating Systems:

.1 Ceiling mounted heating radiant panels shall not be used.

.2 Natural gas fired installations to be installed in accordance with CSA B149.1 (latest edition).

4.0 M&E ACOUSTICAL CONSIDERATIONS

4.1 General

.1 Sound and vibration isolation systems shall be provided to minimize structural, system and airborne noise to an acceptable level as outlined in this guideline or as per project requirements.

.2 Mechanical system design shall incorporate all necessary sound attenuation features (flexible connections, duct acoustic lining, mufflers, low velocity diffusers, duct mounted acoustic silencers and etc.) to assure the required room acoustic performance is achieved.

.3 Mechanical and electrical equipment and components shall be isolated from floors, walls and ceilings using rubber or spring type vibration isolators.

.4 Fan selection and duct sizing strategy shall be carried out in accordance with recommendations from ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Buildings (2016) to achieve optimum performance and noise level results. Where implementation of these strategies could still result in unfavorable noise levels, noise attenuation components as outlined in item 1 shall be utilized.

.5 Absorptive material shall be applied in the duct system and in the mechanical rooms (where required). The discharge duct of the fan in the mechanical room shall be connected to the subsequent ductwork through a flexible connection in order to reduce the transmitted vibration and the first 12 m. of ductwork (including a 90° angle) shall be fitted with absorptive material to minimize sound transmittal.

.6 Fan powered air-moving devices shall not be located in the ceiling plenum directly above dry and wet Laboratories, studio theatres or classrooms. These include heat pumps, fan powered boxes, *Fan Coil Units (FCUs) **(23 00 00)***, exhaust fans, and Air Handling Units (AHUs).

.7 Consideration shall be given to the use of stanchion mounting supports on the roof. Noise from Air Handling Units (AHUs) is transmitted in two ways: direct transmission of rumble through the building structure, and airborne noise through the ducted air stream. If an Air Handling Unit (AHU) has to be mounted on the roof, duct mounted acoustic silencer and/or extended ducting (as long as possible) before a downturn, shall be utilized to reduce airborne noise.

.8 Installation of all mechanical and electrical equipment and components shall comply with the applicable standards and/or guidelines and/or best practice and/or project requirements whichever is most stringent from vibration and acoustic standpoint.

.9 Supply air diffuser selections and design and construction of air distribution systems shall be reviewed by the consultant to ensure the NC ratings outlined for spaces are met.

.10 In general, duct design shall maintain maximum sound level of NC 35 except as specified in project requirements.

.11 Supply air ductwork and registers shall be laid out to have the recommended equivalent duct lengths between diffusers and between mechanical components to minimize the acoustic impact within the spaces.

.12 A clearance shall be provided between pipes, ductworks and gypsum board or other finished surfaces. Pipes and ductworks shall not make rigid metal-to-metal contact with ceiling hanger wires, supports, framing, or other structures to which finishes are attached.

.13 Ducts penetrating the sound rated wall or floor/ceiling construction shall be in an insulated sleeve packed with sound and fireproofing material and sealed on both sides using backer rod and acoustical sealant. Piping penetrations less than 75 mm (3 in) in diameter shall be sealed using acoustic sealant filling a 6 mm (1/4 in) clearance. Larger pipes shall be treated similar to ducts.

.14 Back-to-back penetrations shall be avoided, such as electrical panel boards, junction boxes or fire extinguisher cabinets. Penetrations shall be offset by two stud cavities.

4.2 Amphitheaters, Classrooms and Similar Teaching Spaces

.1 Plumbing and rainwater leaders shall not be located in the walls or ceiling spaces.

.2 Air Handling and Make-up Air units shall not be placed on the roof directly on top the amphitheaters, classrooms, and similar teaching spaces.

.3 Ventilation ducts shall be isolated from noise pickup in adjacent rooms enroute to the auditoriums and classrooms. These ducts shall be enclosed in a sealed wall.

.4 Any piping located in the walls or ceiling shall be attached with resilient mountings.

4.3 Audio/Visual (A/V) Control Rooms

.1 Special consideration shall be given to eliminate sound transmission from A/V control rooms located within spaces, particularly concerning ventilation systems.

5.0 IDENTIFICATION

5.1 General

.1 All piping and ductwork in exposed locations such as equipment rooms, pipe service chases, ceiling spaces, etc., shall be clearly labelled and identified with flow arrows and wording. For pipes over 75 mm (3 in) in diameter and all ducts, the lettering shall be 50 mm (2 in) high.

.2 Marking system shall be standardized with black lettering on yellow, blue and green backgrounds (colour of the pipe, duct, etc.) and with white lettering on the red background. Factory printed self-sticking labels shall be used.

.3 Identification shall be applied:

.1 Where view is not obstructed.

.2 At each valve and where pipes leave or enter a room.

.3 No more than 7.6 m (25 ft) apart on long runs.

.4 Where label will not stick to a surface, the pipe shall be wrapped continuously with the pipe tape to provide a suitable surface.

.4 For identification of ductwork use 50 mm (2 in) high black stenciled letters easily seen from floor. Markers shall be provided on the underside of ceilings to locate boxes.

.5 For identification of valves and controllers use laminated plastic tags with 19 mm (3/4 in) engraved lettering.

.6 Lamacoid nameplates shall also be fastened on all equipment, starters and panels.

6.0 HVAC COMPONENTNS

6.1 General

.1 *Heating Boilers **(23 00 00)***

.1 All related systems and equipment shall be installed in accordance with ASME Boiler and Pressure Vessel Code, Section IV, as well as regulations set out by Authority Having Jurisdiction and as per manufacturers' recommendations.

.2 *Chillers **(23 00 00)***:

.1 The main Chillers shall be water cooled with minimum two independent oil-free, "magnetic bearing type", variable speed, two-stage, hermetically or semi-hermetically sealed, centrifugal compressors equipped with internal flow and stepped control load balancing valves for capacity control and for optimization of the Chillers' part load efficiency. Inlet guide vanes are not acceptable unless used with compressors deployed in a mixed arrangement.

.3 *Cooling Towers **(23 00 00)***:

.1 Towers shall be seismically designed (stamped by a Professional Engineer in Ontario) with multiple spring type isolators with top and bottom rails pre-drilled for anchor bolts and static deflection of 50 mm. Isolators shall run continuous along the long dimension front and back of all units. Rust inhibiting coating shall be factory applied. All steel components shall be hot dip galvanized.

.2 Towers with combined cells and multiple fans are not acceptable as redundant equipment.

.3 Maintenance Access:

.1 Fan Section: Access door shall be hinged and located in the upper casing for fan drive and water distribution system access.

.2 Basin Section: Framed removable louver panels shall be on all four sides of the unit for pan and sump access.

.3 Internal Working Platform: Internal working platform shall provide for easy access to the fans, belts, motors, sheaves, bearings, all mechanical equipment, and complete water distribution system.

.4 External Working Platform: Each cooling tower shall be provided with full OSHA/OBC compliant handrail system around the unit and shall have walkways to access other existing towers. Structural frame below towers and perimeter platforms shall be provided. Guard rails and platforms round the top of the tower

shall be provided. This railing shall provide access to the top of the fan grille protective screen and shall allow the maintenance staff to inspect the fan. All guard rails and platforms shall be hot dipped galvanized.

.5 Design to include any OSHA compliant ladders to access the platform and step over platforms that are required in order to properly access the tower without stepping on top of insulated piping.

.6 Motor Davit with Base: Each cooling tower shall be provided with mechanical jib-boom assembly that can facilitate the removal of large fan section components. Davit arm shall be constructed of aluminum and base shall be galvanized steel.

.7 Design to include review of condenser water filtration options such as sidestream (slipstream) filtration vs basin filtration with basin sweepers/nozzles.

.8 Condenser water filtering method to review use of sand filter capable of filtering 98% of particles larger than 10 microns.

.4 *Fan Coil Units (FCUs)* ***(23 00 00)***:

.1 FCUs shall be either of 2 pipe chilled water or 4 pipe heating water & chilled water type.

.5 *Energy Recovery Make Up Air Units* ***(23 00 00)***:

.1 Provide instrument test ports in each section to allow measurement of static pressures after each damper, filters, coil, etc.

.2 All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle shall be degreased, and steam cleaned (in direction of airflow) to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

.3 Coils shall be installed such that headers and return bends are enclosed by unit casing to ensure that if condensate is formed on the header or return bends, it is captured by the drain pan under the coil. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

.6 *Humidifiers* ***(23 00 00)***:

.1 Humidifiers to be either “Isothermal” type (gas fired or electric option) or “Adiabatic” type with stainless steel construction, cleanable design and modulating control and sealed combustion (if applicable). Unit to be CSA certified and **ULC** listed.

.2 Choice of “Isothermal” type (gas fired or electric option) or “Adiabatic” type shall be based on detailed Life Cycle Cost Analysis (LCCA) and consideration of other energy efficiency measures (i.e., the need to include RO water for adiabatic type humidifiers).

1.0 GENERAL

1.1 Overview

.1 This section has been prepared to provide consultants with a general overview of Refrigeration systems requirements for new buildings and renovations in existing building. For all related systems, consultation with other sections of this guideline and/or **Facilities** shall be carried out to determine the specific scope of requirements suitable to the system under consideration. All designs shall be reviewed by **Facilities**.

.2 Where requirements outlined in this section are not feasible and/or in contradiction with applicable codes and standards, deviation shall be reviewed with **Facilities**. Similarly, when innovative technologies or solutions may not meet the requirements of this section, consultants shall consult with **Facilities.**

.3 This Section shall be used in parallel with Section "**VOLUME I - T. HVAC**".

2.0 DESIGN

2.1 Valves

.1 Shut-off valves shall be located on each floor level.

.2 Each laboratory shall be provided with separate isolation valves for all incoming services to allow for independent shut-down (for maintenance and repair) without affecting other building areas.

.3 Valve products from Toyo shall not be utilized.

.4 Ball valves shall not be utilized on steam services. The preference is for globe steam valves.

.5 All sinks and flush valves shall be provided with 1/4 turn shut off ball valves.

.6 Ball valves shall be used in sizes up to 50 mm (2 in.) and be designed for minimum 862 kPa (125 psig) (WOG) bubble-tight working pressures. Valve seals shall be designed for 232°C (450°F) maximum temperature.

.7 Globe valve shall be used for sizes between 50 mm and 100 mm (2 in and 4 in)

.8 Butterfly valves shall be used for sizes 100 mm (4 in) and above. All butterfly valves shall have manual gear operators. Valve bodies shall be of one piece design, zinc electroplated in accordance with ASTM A164, and cast ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47. Valve discs shall be of ductile iron conforming to ASTM A-536 65-45-12 and plated with nickel chromium. Valve operator hubs shall be cast malleable iron conforming to ASTM A47. Infinitely variable, extending lever handles shall be electroplated carbon steel.

.9 For new installations, all main branches shall be terminated with valves and capped flanged connections.

.10 Isolation valves shall be located:

- .1 At supply and return piping to and from the HVAC equipment
- .2 At pipe branch take-offs (supply and return) and vertical risers
- .3 In accessible locations to facilitate maintenance

.11 Connections to equipment shall be made with unions or flanges. Where flanges are used, appropriate gaskets shall be provided.

.12 Piping shall be in parallel to walls.

.13 Efforts shall be made to group piping at common elevations.

.14 Drain valves shall be installed:

- .1 Near the main shut-off valves

.2 At base of vertical raisers

.3 At the bottom of equipment and

.15 At low points of piping systems

.16 Isolation valves shall be used on main risers connecting to central mechanical room for cooling and heating systems in the following locations:

.1 "Vanessa Triple Offset Valves (Series 30,000)" by Pentair/Emerson

.2 "Butterfly Valves (US made)" by Demco (second preference)

.17 The following air vent valves shall be used across Campus:

.1 "13WS or 13WHS" by Spirax Sarco (for main risers)

.2 "27 series radiator air vent valve" by Apollo Conbraco

.3 "No. 4V coin operated air vent valve" by Bell and Gossett

.4 "FV-4M1 series automatic air vent valve" by Watts

.18 For any alternatives, consult with **Facilities** during design.

2.2 Chilled Water

.1 Victaulic joints and couplings as well as compression (press) and grooved fittings shall not be used for cooling systems.

.2 Chilled water pipe joints shall be by weld. Use of flange connections for pipe joints shall be prohibited.

2.3 Hot Water

.1 Victaulic joints and couplings as well as compression (press) and grooved fittings shall not be used for heating systems.

.2 Heating water and glycol pipe joints shall be by weld. Use of flange connections for pipe joints shall be prohibited.

.3 Hot water relief valves shall be piped to the nearest drain.

2.4 Refrigeration

.1 New glycol systems shall be 35% propylene glycol (35% PG) pre-mixed. Glycol systems shall be clearly labeled following labeling standard. For existing systems match existing concentration and type, consultant to verify on site the existing concentration and type.

.2 Design of kitchen refrigeration system shall not send temperature alarm to BAS.

2.5 Natural Gas Piping

.1 Natural gas may be required for laboratory or process use. All efforts should be made to use electricity in place of natural gas, where applicable.

.2 Avoid the running of gas piping underground.

.3 Do not route natural gas piping through electrical rooms, or other potential sources of combustion.

.4 Design laboratory natural gas systems to provide a pressure of approximately 1,750 Pa at each laboratory outlet unless other requirements are indicated.

.5 Each Laboratory to have natural gas emergency isolation valves, located in a clearly identified valve box or complete with a valve tag reading, "EMERGENCY GAS SHUT-OFF".

2.6 Compressed Air

.1 Compressed Air Quality Parameters shall be consistent with ISO 8573-1 Compressed Air Specifications.

.2 Consult **Facilities** to discuss the following requirements:

.1 Compressor shall be sized with 20% extra capacity for future growth.

.2 Compressor shall have N+1 redundancy.

.3 Design and operating pressure of compressed air system. Complete a study to evaluate the lab air outlet locations and their frequency of use. The report should validate the use of central distribution systems as opposed to local storage bottles. Consider point-of-use bottle storage for low usage systems to save power and minimize the maintenance on air compressors.

.4 Compressed air quality shall be determined by equipment requirements and determined during the programming stage of a project.

.5 Evaluate the end user dryness requirements in the selection of an appropriate drier.

.6 Provide an air quality monitor where high purity air is required.

.7 Pressure-reducing valves should be installed after the storage tanks to control distribution pressure. Discharge pressure shall be set lower than the minimum supply pressure of the air compressor so that the air compressor maintains pressure in the storage tank.

.8 Storage tanks should be fitted with automatic drains to verify that there is no water buildup in the tank.

2.7 Water Treatment

.1 Chemical treatment is required for heating water, chilled water, and condenser water. The University has retained WMC as the campus wide water treatment specialists, and they shall be consulted on all projects requiring water treatment.

.2 Heating water and chilled water treatment design shall include filters, pot feeders, conductivity meters, pH sensors as well as air and dirt separators.

.3 Condenser water treatment shall include filters and pot feeders, and automatic chemical injection.

2.8 Cooling Tower Water Treatment

.1 Provide complete water treatment and chemical feed systems including but not limited to chemical feed piping and pumps, conductivity control stations and filtration for both open and closed hydronic systems, by a reputable vendor (e.g.: WMC).

2.9 Vacuum

.1 Complete a study to evaluate the lab vacuum fitting locations and their frequency of use. The report should validate the use of central distribution systems as opposed to local vacuum pumps. Centralized laboratory vacuum systems and distribution are preferred over local systems, with the main benefit being simplified maintenance.

.2 Consult with **Facilities** on the following requirements:

.1 Vacuum shall be sized with 20% extra capacity for future growth.

.2 Vacuum shall have N+1 redundancy.

.3 Vacuum piping shall be 316 stainless steel.

.3 Animal surgical vacuum systems should use liquid ring pump design of stainless-steel construction with corrosion-resistant seals and bushings.

.4 Vacuum systems for highly corrosive, toxic, or explosive hazards should use local vacuum pumps. Other vacuum system scenarios should consist of a central vacuum pump with distribution piping to the point of use.

.5 Central system should operate under constant pressure at all points of use. Points of use that require different operating pressures should use a separate system to prevent vaporization problems.

.6 Locate the central vacuum systems exhaust discharge to the outdoors. The exhaust should be terminated at a minimum of 3 m above the roof where the vacuum exhaust is located, and a minimum horizontal distance of 15 m from any air intake. The exhaust vent should include vermin screens.

2.10 Medical Gas

.1 Design and construction of Medical Gas Systems shall follow requirements of NFPA 45, NFPA 99, CSA Z7396, and CGA M-1: Standard for Medical Gas Supply Systems at Health Care Facilities.

.2 A study shall be done to evaluate lab gas outlet locations and their frequency of use, to validate the use of local storage bottles, as opposed to central distribution systems.

.3 Gas generators should be considered for large systems, as opposed to a bottle manifold system.

.4 Point-of-use bottle storage for low usage systems to minimize the maintenance costs on purified distribution piping.

.5 All piping should be certified for medical gas applications and be cleaned and purged.

.6 Bottle manifold systems should use automatic switchover manifolds for the purpose of redundancy.

.7 A minimum of a two-stage pressure reduction process should be employed for bottled systems.

.8 For gas generators, pressure reducing valves should be installed after storage tanks to control the distribution pressure.

2.0 Reverse-Osmosis (RO) Water Systems

.1 RO water piping system shall be designed and installed with a recirculation loop.

.2 RO water piping shall be new and made from non-pigmented Polypropylene. Pipe joints shall be of socket fusion weld type. No mechanical joints and butt-weld shall be used.

.3 The system shall be cleaned/sanitized using 5% hydrogen peroxide solution.

.4 Water Quality Parameters shall be consistent with ISO 3696:1987 Water for analytical laboratory use – Specification and test methods.

.5 Where a central purification plant is required an assessment of the site potable water service for hardness and impurities shall be complete and confirmed with the RO equipment vendor. A pre-treatment method of feedwater, like a water softening process should be considered prior to treatment through the central RO Water purification plant.

.6 All new and updated central RO Water plants shall include a filter system with multiple membrane filters, with flow meters for each filter, to verify equal flow across all filter membranes.

.7 Storage tanks shall be specified with non-leaching and non-contaminating materials with an opacity that allows the view of the liquid level. Preferred materials are polyethylene or polyethylene lined.

.8 Protect any vents from the storage tanks of the purified water system with a 0.2-micron filter to

prevent contamination of the purified water.

.9 Provide ultraviolet lights in central distribution RO systems and all wetted components of the system to control microbial growth.

.10 Where Grade/Type 2 or Grade/Type 1 Water (Ultrapure Water) is required point-of-use polishing systems shall be provided.

3.0 IMPLEMENTATION AND MAINTENANCE

3.1 General

.1 For building that have a shoulder season cooling system, Cooling towers and evaporative coolers shall be equipped with water heater for water sump to protect equipment during the shoulder season.

.2 Cooling towers shall have a dedicated sanitary drain for each tower.

.3 Cooling towers shall include mezzanine inside towers for access to fan and motor. Alternative means of fan and motor access shall be discussed with **Facilities**.

.4 Cooling Towers and Evaporative Coolers shall not be equipped for operation below 5°C (41°F). The University drains all cooling towers and evaporative coolers in early October, and the design shall accommodate this operational requirement.

.5 IT room cooling and specialty loads shall be satisfied by chilled water. DX systems shall not be utilized. (Chilled water-cooling using DX systems is not preferred.)

.6 Removal, discharge, handling and disposal process of refrigerants that contain Ozone substances and other hydrocarbon such as CFC's, HCFC's, HFC's shall be coordinated with OCRO.

.7 All refrigeration installations (including piping) will conform to applicable codes (CSA B52, ASME B31.5 refrigerant Piping and Heat Transfer Components) and meet the requirements of the regulatory body therein (TSSA, CSA)

.8 The use of copper tubing in ammonia service is strictly prohibited.

.9 All installations shall be pressure tested as per **UofO DCG** (or ASME):

.1 Initial pressure test of no more than 172 kPa (25 psi) shall be applied to look for leaks (ASME B31.5 Sec 538.4 Field Testing Requirements)

.2 Pneumatic pressure test shall be 110% design pressure, and no more than 130% design pressure of any component in the system.

.3 The use of water or aqueous solutions shall not be used to test refrigerant piping

.10 All lines shall be flushed and clean after installation and prior to pressure testing.

.11 All branch connections in piping shall be suitably supported. Recommend Gusset all connections 25 mm (1 in) or less.

.12 Chemical injection points for condensing water/cooling towers shall be installed to provide uniform dispersion.

.13 *Hydronic Piping **(22 42 02)*** Shall be used for all work related to this Division as relevant.

1.0 GENERAL

1.1 Overview

.1 This section has been prepared to provide consultants with a general overview of Controls systems design requirements for new buildings and renovations in existing building. For all related systems, consultation with other sections of this guideline and **Facilities** shall be carried out to determine the specific scope of requirements suitable to the Instrumentation and Controls system under consideration. All designs shall be reviewed by **Facilities**.

.2 **UofO** undertakes short term planning and long-term planning to address requirements of controls systems in existing building, therefore consultants shall always review project requirements and consult with **Facilities** to determine the specific scope of work and requirements suitable to the project under review. All systems shall be reviewed by **Facilities**.

.3 **Facilities** maintains a control center at 141 Louis Pasteur for the monitoring and control of most campus buildings mechanical systems. The level of control within systems varies with age and type of installed systems and equipment.

.4 The campus control network allows **UofO** to manage buildings environmental conditions and energy consumption through web access.

.5 It is the goal of **UofO** to employ sever based Direct Digital Controls (DDC) systems for all systems and equipment through the campus network.

.6 **UofO** has a variety of automatic control devices. Over the years through renovations and upgrades hybrid combinations of pneumatic and DDC systems have come into existence. Renovation projects shall convert existing pneumatic systems over to DDC and new construction shall implement DDC.

.7 In certain applications where high pressure is required for durability and compressed air is readily available, the application of pneumatics shall be reviewed with **Facilities**' Instrumentation group.

.8 New HVAC systems and equipment shall have electronic application and zone controllers. The zone controllers in occupied spaces are typically electronically actuated DDC with adjustable zone sensors for the occupants.

.9 DDC product from Delta is the standard for all future projects. No proprietary controllers shall be permitted on HVAC systems or equipment. In cases of specialized systems or equipment where proprietary controllers are required, full access, licensing, and training shall be provided to **Facilities**. For these cases, the options shall be reviewed with **Facilities**.

.10 The current Building Automation Systems (BAS) consists of DDC panels that communicate back to the central control systems utilizing campus BACnet / IP protocol. All new DDC panels shall be connected to University's network infrastructure via MQTT protocol. Consult with the Universities IT department and Facilities for all projects.

.11 Where requirements outlined in this section are not feasible, practical and/or in contradiction with applicable codes and standards, deviation shall be reviewed with **Facilities**. Similarly, when innovative technologies, solutions, or alternatives solutions may not meet the requirements of this section, consultants shall consult with **Facilities.**

.12 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 Control systems design shall be based of Delta Controls and UDO II standards and guidelines with an enteliWEB front end user interface.

.2 Hardware and software design of control system shall include point database, graphical system, and network interface to main control system enteliWEB front end and at the power plant 720 King Edward.

.3 As a minimum hardware and software design shall include 20% spare capacity for

future expansion.

.4 Control systems use different control modes to accomplish their purposes. Each control mode is applicable to a process with certain characteristic. Following table lists control modes and applications which shall be used in the campus.

Application	Mode
Space Temperature Control	Proportional + Integral
Coil Discharge Temperature Control	Proportional + Integral
Chilled Water Supply Temperature (Chillers)	Proportional + Integral
Supply Hot Water Temperature (Heat Exchangers)	Proportional + Integral
Air Flow	Proportional + Integral
Fan Static Pressure	Proportional + Integral
+Humidity Control	Proportional + Integral
Dew Point Temperature Control	Proportional + Integral
PI: Proportional + Integral	

.5 All actuators shall be brushless DC motors. Standard of acceptance: Belimo or approved alternative. Consult with **Facilities** for alternatives.

2.2 Control Applications and Graphics

.1 Graphics shall be suited to uOttawa requirements.

.2 Graphic display with real time dynamic data shall be provided to monitor and/or control all system design characteristics including but not limited to CO_2 levels, airflows, air temperatures, fluid flows, fluid temperatures, differential pressure, static pressure, pump/compressor status, filter status, drain pan alarm, etc.

.3 Where system operates manually, all temperature high/low limit, fire and pressure safeties shall be hard wired. Where BAS monitoring is included, the safeties shall also be monitored by the BAS.

.4 Any safety system shall be hard wired. DDC controller and BAS will be used for monitoring only.

.5 Alarm monitoring shall follow the uOttawa standards for program prioritization protocols. Consult with **Facilities** for the requirements. Refer to *Annex V-1*.

.6 BAS shall be capable of showing equipment actual capacity L/s, kW (CFM, GPM, MBH…) versus set-point, in addition to percentage of operational value.

.7 BAS graphic shall be capable of showing the Air Change Rate (Air Change per Hour - ACH) for all spaces based on both supply and exhaust airflow.

.8 Graphics of floorplan to be updated to reflect the AS BUILT project architectural drawings that shows all new rooms, walls, and door openings.

.9 ASHRAE Guideline 36, “High-Performance Sequences of Operation for HVAC Systems” shall be referenced for all sequences of operation, shall also be coordinated with **Facilities**.

.10 The implementation of control strategies shall meet the requirements of ASHRAE 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings, Section 6.4.3.10 Direct Digital Control (DDC) Requirements.

.11 In non-lab spaces with occupancies of 8 people or more, outdoor (ventilation) air shall be provided using Demand Control Ventilation (DCV) strategy. The DCV design shall meet the ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality (OBC applicable version) requirements, for providing and maintaining the minimum outdoor air requirements in the breathing zone.

2.3 Building Pressurization

.1 HVAC systems shall be designed to achieve building pressurization of 5 Pa differential

between the lobby and outdoors. The outdoor reference shall be the average of at least four sensors located on different sides of the building, each facing a different cardinal direction; the indoor sensor shall be in the building front lobby. HVAC system design shall consider the change in static pressure difference between the interior and exterior of a building. Control strategy for building pressurization shall include these parameters for proper compartmentalization/segregation of HVAC system to achieve the proper building pressurization year-round. During the heating season, to avoid exfiltration of humid air through the building envelope consider maintaining positive building pressurization (5 Pa)

.2 Volume of supply and return/exhaust shall be controlled such that the supply fan volume to be slightly higher than return/exhaust volume.

.3 Building pressure control shall not be implemented without the return fan modulation.

.4 Proper air distribution and zone pressurization shall be maintained to ensure that minimum and maximum airflows are provided.

.5 Include envelope leakage when determining the amount of outdoor air required to maintain the building pressurization.

2.4 Air Handling Units

.1 For precise control of outdoor air, outdoor air volume shall be controlled utilizing enthalpy of outdoor air. The quantity of outdoor air shall be overridden to satisfy CO_2 conditions when CO_2 sensors are included in the system.

.2 Control of outdoor air described above shall be combined with maintaining a constant negative static pressure in the mixing air via referencing the pressure across the outdoor air damper to maintain the variable minimum position until the airside free cooling (economizer mode) is triggered.

.3 As per ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016), Section 6.5.3.2.2 VAV Setpoint Reset, VAV systems shall be equipped with a static pressure reset based on the zone requiring the most pressure (the setpoint is reset lower until one zone damper is nearly wide open). The controls shall monitor damper position of all VAV boxes, automatically detect zones that may be driven the reset with alarm generation and readily allow the operator to remove these zones from the reset algorithm.

.4 AHU systems with multiple zones must be equipped with supply air reset controls consistent with ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016), Section 6.5.3.5 Supply Air Temperature Reset Controls. Exception is the SAT shall be reset based on RAT or worst zone. OAT reset is not acceptable.

.5 Pressure-drop sensing and alarming shall be implemented for all filters for maintenance purposes.

.6 Fan flow measurements by fan-inlet Pitot tube is preferred. Other means shall be consulted by the Facilities for approval.

.7 Drain pans shall be positively sloped to drain.

.8 Control valves for coils shall be two-way modulating and pressure independent if applicable. When Dual Purpose coils are used, twined valves (six–way valves) sharing an actuator assembly shall be used to eliminate the risk of cross-over. Consult with **Facilities** for more details.

2.5 Hot and Chilled Water Systems

.1 Chillers' control strategy shall include supply water temperature reset based on return water or outdoor air temperature. For systems with cooling capacity of greater than 50 Tons control strategy of condenser water reset shall also be included.

.2 Cooling Towers and Evaporative Coolers controls strategy shall include capacity control and provision for free cooling.

.3 Pump configurations that are connected to BAS shall be controlled by the BAS system and not by a proprietary pump vendor algorithm. Note that pump safety algorithms such as

motor overheating, etc. are to still be controlled by the pump vendor but the basic functionality such as start/stop/duty/standby operation are to be controlled by BAS.

2.6 Air Terminal Units

.1 In variable air volume (VAV) systems all air terminal units shall be pressure independent. Pressure independent air terminal units deliver the required airflow to the space regardless of the supply static pressure.

.2 Single Duct Variable Air Volume Air Terminal Units:

.1 Pressure independent air terminal units shall be programmed to change the airflow delivered to the space based on the operating mode.

.2 Where single duct variable air volume air terminal unit is used the amount of air delivered to the space shall be controlled by the space temperature via PI loop. Flow sensor at the air terminal unit modulates the damper actuator of the air terminal unit. A space temperature sensor / thermostat /O3 Edge sensor resets the airflow setpoint as the space load changes. The airflow control loop shall be set to maintain the minimum airflow at part load conditions. Maximum airflow shall be set to limit flow to meet design conditions.

.3 Where single duct variable air volume air terminal unit is equipped with heating coil, the amount of air delivered to the space shall be controlled by the space temperature via PID loop. The amount of air delivered to the space varies from maximum to minimum as the cooling load drops to maintain setpoint. If the cooling load drops more the space temperature drops through dead band until is controlled to maintain the heating setpoint. Heating capacity is controlled either by modulating the two-way control valve or by staging the SCR heating coil where hydronic heating coil or electric heating coil are used respectively.

.3 Dual Duct Air Terminal Units:

.1 Pressure independent air terminal units shall be programmed to change the airflow delivered to the space based on the operating mode.

.2 Consideration shall be made to temperature load reset in duct systems to minimize energy use.

.3 Sequences of operation of dual duct air terminal unit shall be consulted with the **Facilities**.

.4 Each office shall be equipped with a temperature sensing device.

.4 Radiant Panels:

.1 Radiant panels shall not be used.

.2 For existing buildings that have radiant panels, the space temperature sensor / thermostat shall reset the control valve(s) based on outdoor temperature. As hot water circulates the radiant panel and space temperature rises, the controller to reposition the control valve to respond to the changes.

.3 For existing buildings that have ceiling radiant panels, ceiling panel's surface temperature shall not exceed 46°C (115 °F). Where hot water temperature exceeds these settings a high limit sensor shall reset the circulating water temperature.

.5 Radiant Floors:

.1 Radiant floors shall not be used.

.2 For existing buildings that have radiant floors, the space temperature sensor / thermostat shall reset the control valve(s) based on outdoor temperature. As hot water circulates the radiant floor and space temperature rises, the controller to

reposition the control valve to respond to the changes.

.3 For existing buildings that have radiant floors, the floors surface temperature shall not exceed 30°C (86°F). Where hot water temperature exceeds these settings a high limit sensor shall reset the circulating water temperature.

.6 Unit Heaters:

.1 Unit heaters shall be used only for loading docks and mechanical rooms.

.2 Only hot water unit heaters are accepted. Electric or gas unit heaters shall not be used.

.3 Hydronic unit heaters shall use pressure independent modulating two-way control valves. The heating hot water shall be modulated in proportion to changes in space temperature. Fan operates continuously to prevent air stagnation. As the space temperature falls the space temperature sensor / thermostat sends a signal to reposition the control valve. When the control valve is closed and coil cools down, the low-limit control turns off the fan.

.4 Low-limit control for night or summer shut down when the heating system is off via sensing the water temperature shall be provided. This control strategy also shall prevent fan from blowing cold air when the heating system fails.

.5 Where down blow unit heaters are used two space temperature sensors / thermostats shall be utilized. One shall be installed in occupied area and the other close to the ceiling. The space temperature sensor / thermostat controls the control valve and cycles the fan. As the ceiling temperature rises above ceiling temperature setpoint it overrides the control and starts the fan. Fan runs until the ceiling setpoint is met.

.7 Unit Ventilators:

.1 In new construction projects, unit ventilators shall not be used.

.8 Fan Coil Units (FCU):

.1 Use of two pipe heating/cooling FCUs are not permitted.

.2 Use of two pipe heating (for heating only), two pipe cooling (for cooling only) and four pipe heating/cooling FCUs are acceptable.

.3 All FUCs shall be equipped with Electronically Commutated Motors (ECMs).

.4 Control valves for FCUs shall be two-way modulating and pressure independent. FCU control valves to be installed at the return leg.

.5 The room temperature sensor / thermostat / O3 Edge sensor regulates the control valve(s) while the fan moves air across the coil(s). Fan run continuously, cycled on/off as scheduled by the room temperature sensor / thermostat. Use of multi speed fans shall not be used. FCUs fans shall be equipped with ECM. ECM motors shall be controlled by duct static pressure and supply air temperature.

.9 *Fume Hoods **(12 35 00)'*** (FH) controls and *Venturi Air Valves **(23 00 00)***:

.1 Control shall be based on face velocity. Sash position control is not permitted.

.2 Controllers shall be TSI or Delta controllers These controllers are standalone, and they monitor and control the FH operation.

.3 BAS shall not control the FHs. Exhaust flow shall be monitored through BAS. All Fume hoods shall be equipped with local alarm. The system shall also send an alarm to Protection Services.

.4 New FH shall be standard efficiency low volume system with minimum FH face velocity 0.51 m/s (100 FPM) at 46 cm (18 in) sash height. Consult with Facilities.

.5 If the face velocity of the FH falls below 0.41 m/s (80 FPM) or exceeds 0.61 m/s (120 FPM) a local alarm shall make an audible sound. Discuss with **Facilities** if the Alarm

should also be sent to **PRO**.

.6 Where existing constant volume system is used, average face velocities at FH sashes shall not be less than 0.51 m/s (100 FPM) at all sash positions.

.7 For all variable volume systems, consult manufacturer for minimum FH face velocity. Variable volume FH minimum air flow rate shall be not less than 24 L/s (50 CFM) per linear foot of FH.

.8 BAS shall control room differential pressure and make-up air while maintaining a minimum of 6.2 ACH for wet laboratories and high hazard areas in normal condition and 12.4 ACH during purge mode operation. Both the room differential pressure and ACH shall be discussed and confirmed with end users and **Facilities**.

.9 Laboratory pressurization shall achieve ±10 Pa differential between the laboratory and the corridors. The amount of pressurization may vary depending on the lab type and application. Consultation with both end users and **Facilities** is required.

.10 Control Valves:

.1 Control valves shall not be oversized.

.2 Control valves shall be positioned properly upon HVAC system shutdown and/or upon loss of power. Below outlines desirable actuator positioning on system shutdown and/or loss of power.

Valves	System Shutdown	Loss of Power
AHU Chilled Water	Closed	No Change
AHU Steam Heating	Closed	Closed
AHU Hot Water	Closed	No Change
Steam Humidifier	Closed	Closed
Terminal Reheat	Closed	No Change
OA Preheat Below 2°C (36°F)	Opened	Opened
OA Preheat Above 2°C (36°F)	Closed	Opened

.3 Where hot water pump is provided for freeze protection, hot water valve should be positioned 25% open when low temperature loop senses freezing condition.

.4 For chilled water coils it is preferable to close the valve shutdown to prevent excessive condensation around duct and coil and to save pumping energy. This may be accomplished with normally closed valves.

.5 Heat exchanger control valve shall be normally closed, and outdoor air preheat valves shall be normally open.

.6 For tight shut-off consider using single seated valves and for pressure by-pass lines double seated valves.

.7 When the control valve is fully open, pressure drop across the valve shall be adequate to allow the valve to have precise controllability.

.8 When the control valve is closed, pressure drop across the valve shall not exceed valve and actuator close-off rating.

.9 All two-way modulating valves shall be of Pressure Independent Characterized Control Valve (PICCV) type.

.10 The following control valve products shall be used:

.1 Belimo PIQCV type valve for use in heating & cooling terminal units and perimeter heating applications for sizes up to 19 mm (3/4 in) and pressure drops of minimum 17.2 kPa (2.5 psi) If potential for pressure control problems, then utilize Belimo QCV type valve as indicated below

.2 Belimo QCV type valve with adjustable Cv, for use in heating & cooling terminal units and perimeter heating for sizes up to 19 mm (3/4 in) Shall be utilized with no

or low differential pressure drops across system loop

.3 Belimo ePIV type valve suitable for horizontal and vertical installations on major hydronic and ventilation equipment for pipe sizes from 25 to 150 mm (1 to 6 in) The valve inlet shall be installed a minimum of 5 pipe diameter distance from the nearest obstacle (elbow, valve, etc.)

.11 Combined performance of two-way control valve and coil shall be linear.

.12 Three-way valves shall not be used to the extent possible. Where use of three-way valves is not avoidable consider the use of mixing type as opposed to diverting type.

.13 Frost pumps complete with two-way valves and check valves shall be used to prevent coils from freezing. Frost pumps shall be monitored by the BAS for status and start-stop.

.11 Dampers:

.1 Where size of damper is over 1.5 m^2 (16.1 ft^2), use of single damper is not permitted, and it shall be divided in multiple sections. In this case multiple sections shall be all linked together in vertical and horizontal stacks. All sections shall be linked together with multiple actuators with the same operating range, torque and stroke.

.2 The use of gravity type back draft dampers shall not be used.

.3 Safety Factor of 2 on damper actuator torque spec shall be applied.

.4 Outdoor air dampers shall include:

.1 Thermally insulated damper with severe cold silicone option

.2 Upgraded damper linkages suitable for saltwater vapour exposure

.3 No double stacking of damper actuators shall be accepted. Actuators must be easily serviceable and outside of the ductwork.

.4 Damper bearings shall have no metal-to-metal or metal-to-plastic contact.

.5 No “oillite” type bearings are acceptable.

.5 Dampers shall be provided by mechanical contractor, actuators shall be provided by controls contractor and sized for damper configuration and layout.

.6 The following table outlines desirable actuator positioning on system shutdown and/or loss of power. Self-closing feature shall be spring return or capacitor return.

Dampers	Damper Position Upon System Shutdown	Damper Position Upon Loss of Power
Outdoor Air (OA)	Closed	Closed
Relief Air	Closed	Closed
Return Air (RA)	Opened	Opened
VAV Box	Based on Space Req’s	Based on Space Req’s
Multi Zone Hot Deck (Cold Spaces)	Opened	Opened
Multi Zone Cold Deck (Hot Spaces)	Closed	Closed

.7 RA damper should not be spring return to ensure the fan does not work with both OA and RA dampers closed.

2.7 Metering

.1 **UofO** has strategized metering in addition to service metering of utility providers (City, hydro and gas).

.2 Metering and monitoring shall meet the requirements of ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016) Section 8.4.3, Electrical Energy Monitoring and Section 10.4.5, Whole-Building Energy Monitoring. The intention is to achieve the following goals:

.1 Provide energy/emissions reports for the local, provincial, and national jurisdictions required by law.

.2 Measuring Building Energy Performance Index (BEPI).
.3 Benchmark energy-related baselines and determine potential case studies for energy retrofits and audits.
.4 Discontinue manual readings and engage Operations Staff to monitor energy use in real- time.
.5 Support revenue grade billing.
.6 Energy tracking for ESCo performance bonus and government/utility provider incentives.
.7 Provide data to Ministry of Environment & Climate Change (MOECC) for Cap & Trade Program.

.3 The metering information shall reside in the enteliWEB Energy Management Module with the capability to record and report information as outlined in ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016) Section 8.4.3.2 and Section 10.4.5.2, Recording and Reporting. An exception is that data shall be able to be archived for a minimum of 5 years.

.4 All metering points shall be configured and communicated over BACnet/IP protocol subscribable by University of Ottawa's data center hosted applications including the enteliWEB Energy. Management Module, Influx database, as well as cloud hosted Meterconnex.

.5 The metering strategy is divided into two groups:
.1 Building Metering: University metering shall be installed at main building services, downstream to utility service metering. This applies to new construction, additions, and Extensive Renovations as defined by **OBC**.
.2 Sub-Metering: Applies to service branches that can include switchboards (600V, 120/208V), smart MCCs that monitor demand and electrical consumption of each load, panel-boards, other end-uses as defined in ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (2016), Sections 8.4.3.1 and 10.4.5.1, as well as University services and/or 3rd party tenants including but not limited to: Food Services, and Student Federation Offices.

.6 Electrical meters shall have the following met criterion:
.1 Shall be Revenue-Grade meters.
.2 Measurement Canada certified.
.3 Shall be ULC approved.
.4 Shall have a pulse output capable of communicating with an Ethernet connection c/w device MAC address.
.5 Associated current transformers (CTs) shall be solid core. Split core CTs are not acceptable as a permanent metering solution.
.6 Real-time capability with maximum 5-minute delay on data transmission.
.7 Phase Transformers (PTs), CTs, electrical meter, and associated metering devices shall be mounted on a fire-rated plywood panel.
.8 Meter tag and proper identification (lamacoid or P-Touch is acceptable for labelling).
.9 Network drops shall be added within 0.9 m (3 Ft) of the metering device.

.7 Mechanical meters (Magnetic Flow, Vortex, and Turbine) shall have the following criterion:
.1 4-20mA or 0-10 VDC signal output.
.2 "Industrial-Grade" meters for power plant and preferred for all campus locations. "Commercial-Grade" is acceptable for all other facilities.
.3 Shall have flanged connections complete with full-port isolation ball valves.
.4 Digital head display, or digital remote head for inaccessible areas.
.5 Intelligent meter with diagnostic mode.
.6 Meter body and flanges to be thermally insulated.
.7 Shall have meter tag and proper identification (lamacoid or P-Touch is acceptable for labelling).

.8 Measurement Canada certified.
.9 Drinking water flow meters shall meet or exceed ANSI/NSF 61
.10 Steam meters to be temperature and pressure compensated.
.11 Insertion type flow meters shall not be used.

.8 Energy shall meet the following criterion:
.1 Installed in a NEMA 4 enclosure.
.2 Thermal Energy (Btu) meters to meet or exceed CAN/CSA-C900-13 Heat meters.
.3 Data loggers (pulse collectors) shall be installed in a NEMA 4 enclosure c/w Duplex receptacle (with data network drop within 0.9 m (3 Ft) distance from the enclosure).

.9 Varity of Building Meters are as follows:
.1 Electricity: Consumption (kWh), Power (kW), demand (KVa), reactive power (kVar), voltage (V), amps (A), frequency and power factor. Shall be installed on the 600V or 208V side.
.2 Heating water: Demand (GJ/h), consumption (GJ), peak demand (date/time). Shall be a full port magnetic flowmeter. Flanged connection complete with full-port isolation ball valves. to be installed on supply c/w thermowell and RTD thermometer (on both system supply and return lines) and energy calculator. Remote head display is required for meters installed in elevated or hard-to-reach areas. Meters shall have a 4-20mA pulse out-put and report to a data logger capable of communicating with an Ethernet connection c/w MAC address.
.3 Chilled water: Demand (GJ/h), consumption (GJ), peak demand (date/time). Shall be a full port magnetic flowmeter. Flanged connection complete with full-port isolation ball valves. to be installed on supply c/w thermowell and RTD thermometer (on both system supply and return lines) and energy calculator. Remote head display is required for meters installed in elevated or hard-to-reach areas. Meters shall have a 4-20mA pulse out-put and report to a data logger capable of communicating with an Ethernet connection c/w MAC address.
.4 Domestic cold water (if permitted by the city): demand in (L/s, m^3/h). Shall be a magnetic flowmeter. Flanged connection complete with full-port isolation ball valves to be installed on supply line. Remote head display is required for meters installed in elevated or hard-to-reach areas. Meters shall have a 4-20mA pulse out-put and report to a data logger capable of communicating with an Ethernet connection c/w MAC address.
.5 Domestic Hot water: Demand (GJ/h), consumption (GJ), peak demand (date/time. Shall be a magnetic flowmeter. Flanged connection complete with full-port isolation ball valves. to be installed on supply c/w with thermowell and RTD thermometer (on both supply and return lines if applicable) and energy calculator. Remote head display is required for meters installed in elevated or hard- to-reach areas. Meters shall have a 4-20mA pulse out-put and report to a data logger capable of communicating with an Ethernet connection c/w MAC address.
.6 Natural Gas: Consumption (m^3), demand (m^3/h); Shall tie into existing Enbridge meter complete with Zener Barrier and data logger capable of communicating with Ethernet connection and c/w MAC address (where digital meter head exists).
.7 Steam: Consumption (lb.), energy (GJ). Shall be a vortex flowmeter Flanged connection complete with full-port isolation ball valves. to be installed on supply c/w pressure sensor rated for associated line pressure, and a jet turbine type flowmeter to be installed on condensate, c/w thermowell and RTD thermometer and energy calculator. Remote head display is required for meters installed in elevated or hard-to-reach areas. Meters shall have a 4-20mA pulse out-put and report to a data logger capable of communicating with an Ethernet connection c/w MAC address.

.8 Building usage to be monitored and tracked through enteliWEB and all metering devices shall be compatible with this system.

.10 Design and installation purposes of proposed sub-metering wich shall be considered:
- .1 Mechanical installation of new instrumentation and sensors shall be carried out by competent and qualified subcontractor and shall conform to all applicable codes and standards. The re-use of any existing instruments shall be coordinated with **Facilities**.
- .2 Modification to existing piping to meet project requirements shall be included in the design package.
- .3 Where existing thermal insulation is removed for installation of new instruments, proper thermal insulation shall be provided and installed. The insulation shall match the existing except where ultrasonic meters have been installed. For chilled water systems, Armaflex and for heating water systems, Canvas Wrap shall be provided, respectively. The insulation shall not interfere with the maintenance and operation of any instrumentation and/or equipment.
- .4 Where retrofits apply, all the removed equipment and instrumentation shall be delivered back to the client at each location.
- .5 Electrical panel, piping and conduit layout, shall be organized in a matter that the sub- metering strategies can be implemented. This include but not limited to:
  - .1 Provide adequate space for the meters to be installed and service. The inside of electrical panel shall be organized in a matter that enough space is allocated for CT's to be installed on power supply and on branch circuits. Wall-mount electrical metering devices shall be installed on fire rated plywood.
  - .2 Provide data outlet per metering devices or data logging device.
  - .3 Group similar load per panel such as lighting panel, plug load panel, HVAC equipment panel and shall be reviewed by the campus utilities department for approval.
  - .4 Revenue base services and tenant's utility services to be a single point of entry before being distributed throughout their space.
  - .5 Metering equipment specific connection guidelines shall be utilized to tie-in to other panels and/or instrumentation.

2.8 Metering Equipment and Instrumentation

- .1 Ultrasonic strap-on flowmeters shall not be utilized.
- .2 Electromagnetic flowmeters are acceptable for use in all liquid systems and shall have the following criteria:
  - .1 HART communications
  - .2 Bi-directional flow capability
  - .3 4-20 mA signal output
  - .4 Self-cleaning electrode circuitry
  - .5 Liner and electrodes rated for hot water application (maximum 85°C and 572 kPa (80 psig).
  - .6 Pulse output of unit volume.
  - .7 120 VAC or loop powered.
  - .8 Process connection to be NPT female (existing piping to be modified to fit)
  - .9 All meters to have line sized gate valves and unions installed before and after the meter for isolation and removal (piping to conform to manufacturer's stated straight pipe requirement before and after the meter).
  - .10 Accuracy of 0.2% or better.
  - .11 Industrial-Grade meters shall be utilized for power plant and certain campus locations. Commercial-Grade is acceptable for all other facilities. Consult with

Facilities.
.12 Flanged connections, complete with full-port isolation ball valves.
.13 Digital head display, or digital remote head for inaccessible areas.
.14 Intelligent meter with diagnostic mode.
.15 Meter body and flanges to be thermally insulated.
.16 Shal have proper meter tag and identification (lamacoid or P-Touch is acceptable for labelling).

.3 Jet Turbine flowmeters are acceptable for use in steam condensate applications and shall have the following features:
.1 Local totalizer of volumetric flow in cubic meters.
.2 4-20 mA signal output.
.3 Pulse output of unit volume.
.4 Dry form A and solid-state form A compatible.
.5 Internal 3.3 V pull up.
.6 Maximum frequency: 10 Hz.
.7 Minimum pulse width: 20 ms.
.8 Process connection to be NPT female (existing piping to be modified to fit).
.9 All meters to have line sized gate and unions installed before and after the meter for isolation and removal (piping to conform to manufacturer's stated straight pipe requirement before and after the meter).
.10 Industrial-Grade meters shall be utilized for power plant and certain campus locations. Commercial-Grade is acceptable for all other facilities. Consult with **Facilities**.
.11 Flanged connections, complete with full-port isolation ball valves.
.12 Digital head display, or digital remote head for inaccessible areas.
.13 Intelligent meter with diagnostic mode.
.14 Meter body and flanges to be thermally insulated.
.15 Shall have proper meter tag and identification (lamacoid or P-Touch is acceptable for labelling).
.16 Manufacturer options for pulse values to be presented in submittal for client selection.

.4 Vortex flowmeters are acceptable for use in steam applications and shall have the following criteria:
.1 HART communications.
.2 4-20 mA signal output.
.3 Pulse output of unit volume.
.4 Low Pressure (LP) steam application (maximum 827 kPa (120 psig)).
.5 120 VAC or loop powered.
.6 Flanged connections, complete with full-port isolation ball valves.
.7 Piping to conform to manufacturer's stated straight pipe requirement before and after the meter.
.8 Accuracy of 1% or better.
.9 All designs shall be reviewed by / registered with Technical Standards and Safety Authority (TSSA). All field weldments shall be either die-pan or X-ray tested and shall comply with TSSA regulations. Canadian Registration Number(s) (CRN) shall be provided to the **UofO**.
.10 Industrial-Grade meters shall be utilized for power plant and certain campus locations. Commercial-Grade is acceptable for all other facilities. Consult with **Facilities**.
.11 Digital head display, or digital remote head for inaccessible areas.
.12 Intelligent meter with diagnostic mode.

.13 Meter body and flanges to be thermally insulated.
.14 Shall have proper meter tag and identification (lamacoid or P-Touch is acceptable for labelling).

.5 Energy meters shall have the following features:
.1 Shall be mounted in NEMA 12 panel, hinged door and lockable at two mechanical points (screw fasteners).
.2 Display (HMI) shall be mounted on the front door.
.3 HMI shall be able to display the meter operational parameters and to be used to configure the unit.
.4 Software and cable to be supplied to interface with PC to configure, monitor and generate full documentation.
.5 Data loggers (pulse collectors) shall be installed in a NEMA 12 enclosure c/w duplex receptacle (with data network drop within 3 Ft. distance from the enclosure)
.6 Each energy meter to be able to perform up to three independent energy calculations simultaneously.
.7 Calculation shall conform to IAWPS-IF97 standard (Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam)
.8 120 VAC power supply.
.9 Input: 4-20 mA signal (Pulse Frequency Modulation (PFM)). RTD to be PT100 or 1000 (2, 3 or 4 wire).
.10 Output: 4-20 mA pulse. Relay and solid-state pulse with adjustable parameters
.11 Accuracy for calculations and hardware (combined) shall be 1.5% or better.
.12 Shall have saturated steam condensate alarm functionality.
.13 The required energy calculation types are:
.1 Water heat, water heat differential.
.2 Steam mass/quantity of heat.
.3 Steam heat differential.

.6 Pressure transmitters shall have the following features:
.1 HART communication.
.2 4-20 mA signal output.
.3 Low Pressure (LP) steam application (maximum 103 kPa (15 psi)).
.4 Loop powered, 24 VDC.
.5 Where existing process piping need to be modified to fit in the new installation, hot tap of 13 mm (1/2 in) NPT female coupling to be installed.
.6 Reference accuracy shall be 0.075% or better.
.7 Appropriate rated “block and bleed” manifold shall be installed between process coupling and the new pressure transmitter for future service.

.7 Zener Barriers for Enbridge natural gas meters shall have the following features:
.1 Existing Enbridge meter shall have pulse output. If not available, meter shall be indicated as “needing replacement” to be changed by Enbridge.
.2 Specific connection cable from utility company for each individual meter shall be supplied.
.3 Cable to be connected to a lockable NEMA 4 panel containing Zener Barriers and required terminal blocks to connect signal to the Delta system. Panel to be installed a minimum of 1500 mm from any pressure regulating vent.
.4 All components and interconnections shall comply with code requirements and utility provider’s written instructions.
.5 Pulse output of unit volume to have solid state output and shall comply with enteliWEB system.

.8 Temperature sensors shall have the following features:
- .1 New temperature probes shall be 3 wire thin film PT-100 RTDs.
- .2 RTDs shall be fitted in low mass thermowells with 13 mm (1/2 in) NPT process connection.
- .3 Probe head shall have terminal connection blocks for re-transmission wiring to the energy meter.
- .4 Thermowells shall be mounted with tip at 25% depth of pipe diameter.
- .5 Welded coupling shall be installed to accept 13 mm (1/2 in) . NPT male thermowell connection.

.9 General notes:
- .1 All signal wiring to be shielded #18 twisted pairs. Shield connected at panel (one end only) and the other end shall be insulated.
- .2 All signal wiring shall be run in EMT conduit. TEK cabling is acceptable for distances less the 1500 mm from equipment/instrumentation connection point. Junction boxes or appropriate couplings shall be provided at transitions.
- .3 Ultrasonic meters are acceptable for critical systems where the allowable downtime is not sufficient for use of magnetic flowmeters. Ultrasonic sensor cables shall be run in separate conduit from signal cabling. Sensor wiring shall not be run inside thermal insulation.

2.9 Testing, Commissioning and Training

.1 Following procedures shall be incorporated and conducted in commissioning process of all projects:
- .1 Instrumentation and metering equipment shall be commissioned by the manufacturer or factory trained technician only. Factory training documentation shall be submitted prior to commissioning work.
- .2 All supplied equipment shall be CSA or ULC certified.
- .3 All work/construction areas pertaining to metering devices shall be kept clean and free from dust and debris.
- .4 Selective verification of installation and functionality of supervisory equipment, pathway, wiring and individual component (by Controls Contractors).
- .5 Verification of signal and device response by conducting comprehensive control point functionality (by Controls Contractors).
- .6 Validation of the sequences of operation of control systems after review and acceptance of TAB report (by **CxA**).
- .7 Review and validation of the functionality of control systems in different modes such as but limited to heating, cooling, fire, smoke, occupancy/un-occupancy, start-up, warm-up and cool-down.

.2 All FHs shall be tested at a maximum room supply air volume at 13°C (55°F) and minimum exhaust air volume at 13°C (55°F) and maximum exhaust air volume.

.3 Commissioning of FHs shall be done by a third party **CxA**. FHs shall be certified by an independent qualified/certified third party. Commissioning and certification as per CSA Z316.2 Fume hoods and associated exhaust systems (latest edition) and ASHRAE 110 Laboratory Fume Hoods Performance Testing (latest edition) under the certification procedure. The commissioning and certification process shall be reviewed by **Facilities.**

.4 For variable air volume FHs sash movement effect test must be conducted. Once face velocity and smoke test has been passed, the five-minute average test result for the tracer gas testing shall be less than or equal to 0.1 PPM for all operating conditions tested.

2.10 Maintenance

.1 Pressure gauges shall be stainless steel and shall be suitable for vibration and working temperature and pressure. The dial reading shall be in the two-thirds range.

.2 For differential pressure control strategy of heating hot water and chilled water loops consult **Facilities**' Instrumentation group.

ANNEX V (Frensh)

Séquence des opérations des alarmes sur le campus

- *Séquence campus alarme*
  - ✓ *Si la température d'eau refroidie intégré est plus grande ou égale à 12 °C et que la pression différentiel a Tabaret est – 5 Psi du point de consigne (10 Psi). (Campus Cooling flag en alarme)*
  - ✓ *Si la pression de steam intégré est plus petite 120 Psi. (Campus heating flag en alarme)*
  - ✓ *Si la génératrice est en marche… (Campus Power flag en alarme)*
  - ✓ *Si la pression d'air comprimé est plus petite que 70 PSI.(Campus Comp air flag en alarme)*
  - ✓ *Si Campus Cooling en alarme, Campus heating en alarme, Campus Power ou Campus comp Air flag est en alarme… (Campus flag en alarme)*

- *Séquence building alarme*
  - ✓ *Vérifier si la pression de vapeur intégré est <8 Psi au secondaire de la PRV ou si la température est < 20 °C de la courbe à Lamoureux. (Building heating flag en alarme)*
  - ✓ *Vérifier si le différentiel de pression intégré de l'eau refroidi est < 5 Psi de son point de consigne et que la température eau a l'entré du bâtiment est + 5 °C de la central… (Building Cooling flag en alarme)*
  - ✓ *Si la génératrice fonctionne dans le bâtiment… (Building Power flag en alarme)*

- *Séquence alarme pour boucle de chauffage (échangeur)*
  - ✓ *Vérifier s'il n'y pas d'alarme a la central (Campus flag) et s'il a de l'électricité dans le bâtiment (Building Power flag)*
  - ✓ *Vérifier s'il y a une source d'eau chaude dans le bâtiment (Building Heating flag)*
  - ✓ *Vérifier si la pompe n'est pas en alarme … (Pompe alarme)*
  - ✓ *Vérifier si la pompe fonctionne bien … (status de la pompe)*
  - ✓ *Vérifier que la température de l'eau intégré ne dépasse pas + ou - 20 °C du point de consigne… (Température alarme)*

- *Séquence alarme pour eau refroidit (échangeur)*
  - ✓ *Vérifier s'il n'y pas d'alarme a la central (Campus flag) et s'il a de l'électricité dans le bâtiment (Building Power flag)*
  - ✓ *Vérifier s'il y a une source d'eau froide dans le bâtiment (Building Cooling flag)*
  - ✓ *Vérifier que la température de l'eau froide intégré ne dépasse pas + ou - 5 °C du point de consigne… (Température alarme)*

- *Séquence alarme pour ventilation*
  - ✓ *Vérifier s'il n'y pas d'alarme a la central (Campus flag) et s'il a de l'électricité dans le bâtiment (Building Power flag)*
  - ✓ *Vérifier si la fan n'est pas en alarme (comparaison du statu avec la comment de la fan)*
  - ✓ *Vérifier si la ventilation fonctionne déjà depuis un Demi-heure. (status de la fan ON)*
  - ✓ *Vérifier s'il y a une source d'eau refroidie et d'eau chaude disponible pour cette ventilation… (Building Cooling flag, Building Heating flag ou échangeur approprier)*
  - ✓ *Vérifier la température d'alimentation intégré pour quel ne dépasse pas + ou - 5 °C du point de consigne… (Température d'alimentation en alarme)*
  - ✓ *Vérifier pression statique intégré pour quel ne dépasse pas + ou – 50% du point de consigne… (Pression statique en alarme)*

- *Séquence alarme pièce*
  - ✓ *Vérifier s'il n'y a pas d'alarme approprier a la ventilation (Vent flag)*

ANNEX V (English)

Sequence of alarm operations on campus

- *Campus alarm sequence*
  - ✓ *If the integrated chilled water temperature is greater than or equal to 12 ° C and the differential pressure at Tabaret is - 5 Psi from the set point (10 Psi). (Campus Cooling flag in alarm)*
  - ✓ *If the built-in steam pressure is smaller than 120 Psi. (Campus heating flag in alarm)*
  - ✓ *If the generator is running ... (Campus Power flag in alarm)*
  - ✓ *If the compressed air pressure is smaller than 70 PSI (Campus Comp air flag in alarm)*
  - ✓ *If Campus Cooling in alarm, Campus heating in alarm, Campus Power or Campus comp Air flag is in alarm ... (Campus flag in alarm)*

- *Building alarm sequence*
  - ✓ *Verify that the built-in vapor pressure is <8 Psi at the secondary level of the PRV or if the temperature is <20 ° C of the Lamoureux curve. (Building heating flag in alarm)*
  - ✓ *Check that the built-in pressure differential of the chilled water is <5 Psi from its set point and that the water temperature at the building inlet is + 5 ° C from the central ... (Building Cooling flag in alarm)*
  - ✓ *If the generator works in the building ... (Building Power flag in alarm)*

- *Alarm sequence for heating loop (exchanger)*
  - ✓ *Check if there is no alarm at the central (Campus flag) and if it has electricity in the building (Building Power flag)*
  - ✓ *Check if there is a hot water source in the building (Building Heating flag)*
  - ✓ *Check if the pump is not in alarm ... (Alarm pump)*
  - ✓ *Check if the pump works well ... (pump status)*
  - ✓ *Check that the integrated water temperature does not exceed + or - 20 ° C from the set point ... (Alarm temperature)*

- *Alarm sequence for chilled water (exchanger)*
  - ✓ *Check if there is no alarm at the central (Campus flag) and if it has electricity in the building (Building Power flag)*
  - ✓ *Check if there is a source of cold water in the building (Building Cooling flag)*
  - ✓ *Check that the temperature of the integrated cold water does not exceed + or - 5 ° C from the set point ... (Alarm temperature)*

- *Alarm sequence for ventilation*
  - ✓ *Check if there is no alarm at the central office (Campus flag) and if there is electricity in the building (Building Power flag). If both flags have been Normal for 30 mins, proceed :*
  - ✓ *Check if the fan is not in alarm (comparison of the status with the how of the fan)*
  - ✓ *Check if the ventilation has been working already for half an hour. (status of the ON fan)*
  - ✓ *Check whether there is a source of chilled water and hot water available for this ventilation ... (Building Cooling flag, Building Heating flag)*
  - ✓ *Check the integrated supply temperature for which does not exceed + or - 5 ° C of the set point ... (Supply temperature in alarm)*
  - ✓ *Check integrated static pressure for not more than + or - 50% of set point ... (Static pressure in alarm)*

- *Alarm Sequence for Rooms*
  - ✓ *Check if there is no alarm appropriate to the ventilation (Wind flag)*

1.0 GENERAL

1.1 Overview

.1 This following has been prepared to provide consultants with a general overview of plumbing system requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

.2 Design and installation of storm sewer systems must be implemented in compliance with section 53 of the Ontario Water Resources Act (**OWRA)**, where applicable. To be coordinated with **OCRO**

.3 Where requirements outlined in this section are not feasible and/or in contradiction with applicable codes and standards, deviation shall be reviewed **Facilities**. Similarly, when innovative technologies or solutions may not meet the requirements of this section, consultants shall consult with **Facilities.**

.4 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN & MAINTENANCE

2.1 General

.1 Piping shall be installed straight and parallel with building structure/guidelines.

.2 Di-electric couplings for joining pipes of dissimilar metals shall be used.

.3 Where noise in an application is a concern drainage and water systems shall be avoided if feasible. Where passage of these systems is not avoidable design shall include acoustic treatment.

.4 At the completion of all piping work, all piping shall be tested in accordance with the following schedule and Ontario Building Code whichever is stringent:

Service	Duration	Testing Pressure
Domestic Hot and Cold Water	Four (4) hours	690 Kpa (100 psig)
Sanitary Sewage	One (1) hour	30 Kpa (4 psi or 10 ft. wc)

.5 Pressure testing shall be witness and approved by either Third Party CxA or Design Team as per requirements outlined in commissioning section of UofO Design and Construction Requirements.

.6 Testing procedure shall be in accordance with Pre-Functional and Functional testing as outlined in project commissioning specification.

2.2 Pumps

.1 Avoid the use of flexible rubber connectors.

.2 Pumps shall be direct drive where possible.

.3 Pumps with motors greater than 0.75 kW (1 HP) shall be equipped with Variable Speed Drive (VSD). VSD shall not be integrated with pump.

.4 Gauges and gauge ports shall be provided across pumps.

.5 All pumps shall be provided with upstream strainers, completed with isolating and drain ***Valve (22 42 01)***.

.6 For pumps that are not flanged provide a union on both sides of the pump (between isolation Valves).

2.3 Valves

.1 Shut-off Valves shall be located on each floor level.

.2 Each laboratory shall be provided with separate isolation Valves for all incoming services to allow for independent shut-down (for maintenance and repair) without affecting other building areas.

.3 Ball Valves shall not be utilized on steam services. The preference is for globe steam Valves.

.4 All sinks and flush Valves shall be provided with 1/4 turn shut off Ball Valves.

.5 Ball Valves shall be used in sizes up to 50 mm (2 in) and be designed for minimum 862 kPa (125 psig) (WOG) bubble-tight working pressures. Valve seals shall be designed for 232°C (450°F) maximum temperature.

.6 All butterfly Valves in sizes 63 mm and above (2.5 in and above) shall have manual gear operators. Valve bodies shall be of one piece design, zinc electroplated in accordance with ASTM A164, and cast ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47. Valve discs shall be of ductile iron conforming to ASTM A-536 65-45-12 and plated with nickel chromium. Valve operator hubs shall be cast malleable iron conforming to ASTM A47. Infinitely variable, extending lever handles shall be electroplated carbon steel.

2.1 Domestic Hot and Cold-Water Systems

.1 Design of water entry at building entrance shall comply with City of Ottawa by-laws.

.2 Domestic hot water is generated centrally on campus from waste heat. Wherever is feasible, use this system for generation of domestic hot water.

.3 For energy and water usage, design of domestic hot and cold-water systems shall meet or exceed the requirements outlined in **OBC** and section 7 of ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.

.4 Back flow prevention devices shall be included in accordance with **OBC** and City of Ottawa by-laws.

.5 For new construction projects, design of domestic hot and cold water shall include allowance for future expansions. Branches shall be sized to accommodate 20% additional flow in addition to design flow for future renovation projects.

.6 Any new connections to an existing main or riser shall have capped future Valved connections for future expansion. Confirm sizing with **Facilities**.

.7 For new construction provide Valved and capped connections at each floor and at each mechanical room for future expansion.

.8 Design of domestic hot and cold-water systems shall be in accordance with the minimum pressure available at the municipal main.

.9 Water pressure at any outlets after the main water entry back flow preventor shall be maintained at a minimum of 210 KPa (30 psi) residual and between 300 and 500 KPa (44 and 73 psi) static for all conditions.

.10 Maximum water velocity shall be maintained at 1.2 m/s (4 FPS).

.11 Hot and cold-water thermal insulation shall meet all applicable codes, as well as design temperature and to prevent condensation and significant heat loss.

.12 For maintenance purposes, hose bibs and compressed air outlet shall be included in design for all mechanical rooms.

.13 Where for domestic cold water system booster pump is required down-feed system is

preferred. Booster pump shall be designed for N+1 redundancy. Booster pump shall be equipped with VSD and control panel capable of displaying inlet and outlet pressure, flow, totalized flow, pump status and to communicate with BAS.

.14 The following equipment shall be connected to the emergency power:

.1 Sump pumps.

.2 Domestic booster pumps.

All of above systems shall be redundant N+1, shall be packaged pre-wired pump alternator controller with liquid level controls, control panel (to cut in second pump when liquid level rises or first pump fails), level control for high alarm and contacts to BAS for remote alarm high level. Local control panel shall be completed with audio and visual alarm.

.15 Pump configurations that are connected to BAS shall be controlled by the BAS system and not by a proprietary pump vendor algorithm. Note that pump safety algorithms such as motor overheating, etc. are to still be controlled by the pump vendor but the basic functionality such as start/stop/duty/standby operation are to be controlled by BAS.

.16 Compression fittings shall not be utilized in general.

.17 Use of PEX tubing are not permitted in the Campus.

.18 All new water piping shall be flushed to remove foreign material.

.19 All exterior hose bibs shall be keyed, frost proof and equipped with vacuum breaker.

.20 Water piping systems including potable water, hydronic, sanitary and storm drainage shall not be permitted within the IT rooms/closets and electrical rooms including within the partitions.

.21 Hydronic piping to be steel pipe to ASTM A53 Grade B:-1 to 6" (150 mm), Schedule 40, 8" to 10" (200 mm to 250mm), Schedule 30, 12" (300 mm) and over, 3/8" (10 mm) wall thickness or copper tube piping, hard drawn, type L to ASTM B88M-99.

.22 Backflow preventer devices with body materials dissimilar to the connected piping shall be installed with a dielectric kit as per manufacturer's recommendation.

.23 Backflow Preventers shall not be located in Corridors or General Access areas. They shall be located in a Mechanical Room or Closet within the required height as per CSA B64.

.24 For domestic cold water piping, continuous vapor barrier shall be applied to prevent condensation.

.25 For new construction projects all main branches shall be terminated with Valve and capped connections.

.26 Isolation Valves shall be ball Valve (for piping less than 50 mm (2 in) in diameter) and be located:

.1 At supply piping to fixtures or group of fixtures and equipment.

.2 At branch take-offs and vertical risers.

.3 In accessible locations to facilitate maintenance.

.27 Connections to equipment and main branches shall be made with unions or flanges. Where flanges are used, gaskets shall be provided.

.28 Piping shall be in parallel to walls.

.29 Efforts shall be made to group piping at common elevations.

.30 Where feasible, avoid joints in piping below grade.

.31 Drain Valve shall be located:

.1 Near the main shut-off Valve.

.2 At base of vertical raisers.

.3 At the equipment.

.4 At low points of piping systems.

.32 Victaulic piping system for plumbing shall not be used, except in fire protection piping.

.33 Design shall consider power pipe type heat recovery to preheat domestic hot water make-up in residences.

.34 Pipes and fittings must conform to North American standards.

.35 Pure water piping:

.1 Shall be designed and installed with a recirculation loop.

.2 Shall be new, unpigmented Polypropylene to schedule 80, IPS dimensions. Joints shall be shock welded or Rionite mechanical joints.

.36 Layout- Vertical piping chase:

.1 On each floor, access to vertical piping chase shall be made easy by means of access doors.

.2 Piping should be layout in a manner that future connections will be easy to make.

.3 Shut off valve should be located on each floor.

2.3 Identification

.1 All piping and ductwork in exposed locations such as equipment rooms, pipe service chases, ceiling spaces, etc., shall be clearly labelled and identified with flow arrows and wording. For pipes over 75 mm (3 in) in diameter and all ducts, the lettering shall be 50 mm (2 in) high.

.2 Marking system shall be standardized with black lettering on yellow, blue and green backgrounds (colour of the pipe, duct, etc.) and with white lettering on the red background. Factory printed self-sticking labels shall be used.

.3 Identification shall be applied:

.1 Where view is not obstructed.

.2 At each Valve and where pipes leave or enter a room.

.3 No more than 7.6 m (25 ft) apart on long runs.

.4 Where label will not stick to a surface, the pipe shall be wrapped continuously with the pipe tape to provide a suitable surface.

.4 For identification of ductwork use 50 mm (2 in) high black stenciled letters easily seen from floor. Markers shall be provided on the underside of ceilings to locate boxes.

.5 For identification of Valve and controllers use laminated plastic tags with 19 mm (3/4 in) engraved lettering.

.6 Lamacoid nameplates shall also be fastened on all equipment, starters, and panels.

2.4 Tennant Domestic Hot Water

.1 All revenue generating services and base-building shall be sub-metered. Sub-metering system shall be capable of connecting to BAS and logged for monitoring and billing purposes.

.2 Local domestic heaters are discouraged. Any justifications for local domestic heaters shall be reviewed by Facilities.

.3 Design of domestic hot water services shall include recirculation system to provide 49°C (120°F) in 10 seconds or less at any domestic hot water outlet. In applications such as food services where domestic hot water in excess of 49°C (120°F) is required, local booster heater shall be provided. Legionella prevention requires storage at 60°C (140°F) distribution can be at 49°C (120°F).

2.5 Green Roof Irrigation

.1 In projects where green roof is proposed – and depending on the type of plants, water supply for initial watering or care of green roof shall be provided in accordance with the requirements outlined in LEED® guidelines. Where use of treated grey water or harvested rainwater is feasible, water supply for green roof shall be supplied from these systems. Verify with **Facilities**.

3.6 Sanitary Sewage and Storm Drainage Systems

.1 For sump pumps, dry contacts to communicate with BAS on level controls shall be included. Pump control panel to include: power to panel light, pump running light, manual pump start/stop button, alarm silence. Lights shall be located on the outside of the panel and not internally.

.2 Sump pit covers shall be stainless steel complete with hydraulic lift assist.

.3 Drainage piping shall be made from the following:

.1 For laboratories or any other fixtures (e.g. Urinals) dealing with high corrosive materials, high chemical corrosive resistance piping to be used such as: ***Polypropylene Piping (22 42 02)*** (with fused sockets).

.2 Copper piping is not acceptable for ***Urinals (22 42 01)*****.**

.3 For vestibules or entrances dealing with salty conditions, or where the pipes are penetrating through fire separation, ***Uncoated PVC Rated (22 42 02)*** piping to be used (with appropriate / compatible fire-sealing around the penetrations). Design shall include drain, interceptor and primer.

.4 Sanitary Sewage and Storm Drainage Systems:

.5 Clean-outs shall be extended to finished floor or wall surface.

.6 Provide enough clearance at clean-outs for rodding of drainage systems.

.7 Clean-outs in wet areas shall be completed with membrane clamp.

.8 Where electric trap seal primer is used, controls and flow activated bronze body shall be located in an accessible location within a service area. Where flow activated bronze body is located in a public area, it shall be concealed with access door.

.9 All drain pans of fan coil units shall be piped to drain. Pipe sizes shall be 19 mm as a minimum.

.10 For sanitary equipment, sewer clean-out shall be installed above rim level, in order to prevent the rejection of waste during cleaning process.

3.7 Plumbing Fixtures

.1 All public and residence private washrooms, mechanical rooms, garbage rooms, commercial kitchen, laundry rooms and loading docks shall be completed with *Floor Drains (**22 42 01**)*.

.2 Design shall include trap seal primers (pressure drop activated type) to floor drains as per the requirements outlined in **OBC**. Washroom floor drains shall be provided with flush Valve type trap seal primer. In locations where it is not possible or feasible to connect the drain with a flush Valve trap seal primer, a trap guard seal may be used instead. To verify with Facilities.

.3 Where floor drains and/or janitor sinks serve the floor cleaning machine or an area where there is a potential for soiling, sediment interceptors shall be provided.

.4 Grease traps shall be provided in all commercial food services and shall be accessible for maintenance.

1.1 GENERAL

1.2 Overview

.1 This following has been prepared to provide consultants with a general overview of Fire Protection system requirements in existing and new building. For all projects consultation with other sections of this guideline and/or Facilities will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities.**

.2 Where requirements outlined in this section are not feasible and/or in contradiction with applicable standards, deviation shall be reviewed with **Facilities.** Similarly, when innovative technologies or solutions may not meet the requirements of this section, consultants shall consult with **Facilities.**

2.1 DESIGN

2.2 Fire Protection Systems

.1 Design of Fire protection system design shall be based on volume and pressure of incoming water data derived from latest closest hydrant testing provided from **Facilities.**

.2 Where available flow and pressure is not sufficient, fire pump shall be provided and evaluated by a fire protection engineer. Design of fire pump system shall meet the requirements outlined in NFPA 20 based on the edition referenced in OBC (latest edition).

.3 Fire protection systems shall be interlocked with fire alarm system.

.4 Design and lay-out of fire protection system shall conform with OBC and referenced edition of NFPA in **OBC**.

.5 In areas where there is a risk of freezing (e.g. loading docks, walk-in freezers, and public vestibules), the fire protection system design shall be a dry pipe system. Where coverage area is limited to a small area, the use of listed dry pipe fire protection heads from a wet pipe system is permitted. For alternative designs consult with **Facilities**.

.6 Fire protection system design shall be based on hydraulic calculation method and not the schedule method, unless otherwise is permitted by applicable codes.

.7 Unless is required by the applicable code or approved by the authority having jurisdiction, standpipe and fire protection systems shall be separated.

.8 Consult with **Facilities** on the use of fire hose cabinets.

.9 Where fire pump and fire hose cabinets are installed to ensure the required pressure at the fire hose cabinet, pressure reducing valve and/or orifices shall be installed.

.10 Design of fire protection system including fire pump and piping shall include 20% extra capacity for future expansion.

3.1 INSTALATION AND MAINTENANCE

3.2 Fire Protection System:

.1 All fire protection risers shall be protected with adequate posts and guards to prevent physical damage.

.2 Horizontal piping shall be sloped to allow for drainage.

.3 For system repair, alteration of fire protection system shall be designed so that the system can be drained entirely. Piping to drain points shall be provided.

.4 Piping shall be parallel to building structure/gridlines.

.5 Piping shall be hung from structural elements. Piping shall not be hung from ductwork or

bottom chord of open web steel joists.

.6 Where fire pump is required, it shall be listed packaged factory assembled equipped with controller and accessories as required.

.7 For foam type and pre-action fire suppression system consult with both users and **Facilities**.

3.3 Fire Extinguishers

.1 Mounting height for Fire extinguishers shall follow NFPA.

.2 Preference is for fire extinguisher cabinet to be recessed.

1.0 GENERAL

1.1 Definition

.1 For the purpose of this section (see also other Definitions in the beginning of this document):

Cx: Commissioning.
CxA: Commissioning Authority.
DT: Design Team, including its internal (in-house) and/or external resources (Consultants).
ITP: Independent Third Party.
OPR: Owner Project Requirement.

1.2 Overview

.1 **UofO** is committed to **Cx** of all projects to ensure the systems meet the project requirements and are operated and calibrated as required to deliver functional and efficient performance in accordance with the project objectives. The objective of **Cx** described in this section is to provide documented confirmation for such a purpose, and that training is provided to **UofO's** operation personnel.

.2 To achieve the objectives of **Cx**, it is necessary to verify and document the **UofO OPR** for systems function, performance, and maintainability. as well as, to verify and document compliance with these criteria throughout he different design and construction phases.

.3 **Cx** of a building ensure that when the building is handed over to operational personnel it meets all requirements as described in **OPR**. It shall be followed and requires coordinated efforts from all Project Team members, including Planning, Design and Construction Teams.

.4 The **Cx** topics elaborated in this section deals mainly with **M&E** issues, with few Architectural.

.5 Refer to Volume II, "Inspection & testing" for additional information which may be required.

.6 The **Cx** Process is encompassed of three stages as follows:

.1 During Design Phase.
.1 During Construction Phase.
.3 During Occupancy and Operation Phase.

2.0 DESIGN

2.1 Models types

.1 Depending on the size and type of the projects, **Cx** services will be implemented in the following different models:

.1 **CxA**: The **DT** with its internal (in-house) and/or external resources (Consultants) will be responsible of **Cx** of the project on behalf of the **UofO**. This model generally applies to the project with construction budget of the mechanical and electrical services less than or equals $250,000. To be confirmed by **Facilities**.

.2 **ITP CxA**: **UofO** will retain Independent **Cx** services of an **ITP CxA**, which will be responsible for the project **Cx** in collaboration with Design and Construction Teams and will report to **UofO**. This model generally applies to the project with construction budget of the mechanical and electrical services more than $250,000. To be confirmed by **Facilities**.

2.2 Model description

.1 **CxA** Model:

.1 The **DT** shall develop the **Cx** plan, specifications, schedule and forms, develop training plan, witness and certifies installation and performance of building systems, organizes and monitors all **Cx** activities during construction and perform warranty period tasks.

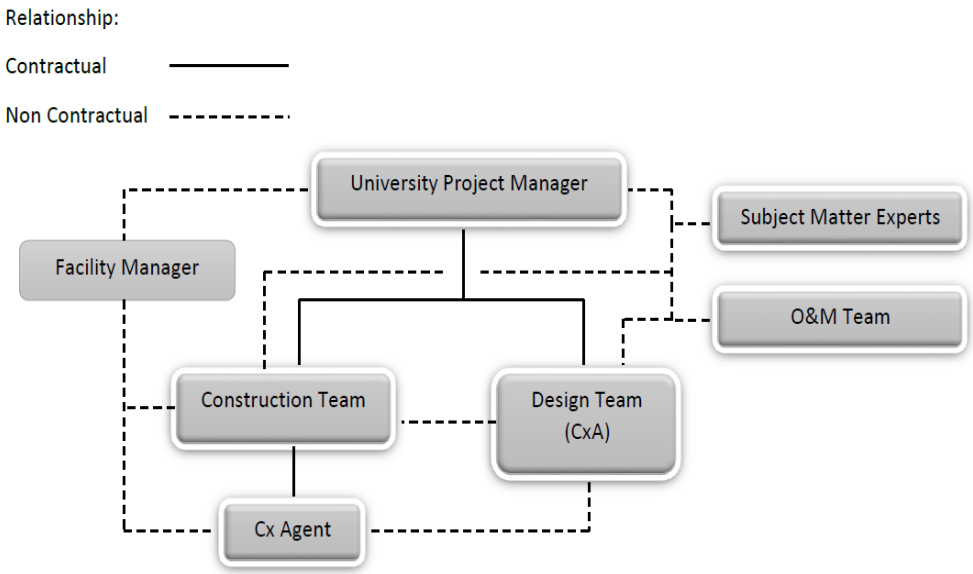
.2 At the start of the project, the **DT** provides design intent/brief (in lieUofO**PR**), **Cx** plan and develop **Cx** specifications:

.1 The design brief becomes the document to be reviewed/edited and ultimately approved before moving to the detailed design.

.2 The design brief clearly outlines the proposed **M&E** systems options, preferred approach, code issues, layout, maintenance & access issues with a discussion on life cycle costs.

.3 During the construction phase, the Contractor (or his **Cx** Agent) are responsible to carry out the start-ups and performance verifications activities, demonstrate the acceptance of test procedures, acts as a coordinator in all **Cx** process and collaborate with **CxA** in accordance with construction documents.

.4 Below the organization chart demonstrates relationships among Project Team & main topics at a glance:



Design Phase	Prepare and Submit **Cx** Specifications Including **Cx** Forms
	Prepare **Cx** plan
Construction Phase	Develop and Distribute the **Cx** Schedule
	Review and Verify Systems Installation and Performance
	Provide Objective Reporting with **Cx** Based Observations with Recommendations
	Develop, Organize and Supervise the Training Program
	Complete and Submit the Final Commissioning Process Manual
Occupancy and Operation Phase	Schedule and Verify Deferred and Seasonal Testing
	Provide Final Testing Documentation for the **Cx** Record
	Conduct Warranty Period Review
	Develop and Submit Reports on Outstanding Problems

.2 **CxA** Scope:

.1 **CxA** During Design Phase**:**

.1 Identify scope for the commissioning process.

.2 Develop a commissioning plan encompassing the design, construction, occupancy and operations phases.

.3 Develop the basis of design to meet project requirements.

.4 Develop full commissioning specifications for all commissioned equipment. The specifications shall follow **M&E** portions in ASHRAE Guideline 0-005: The Commissioning Process.

.5 Determine the commissioning requirements and activities to include in the construction documents.

.6 Prepare **Cx** plan.

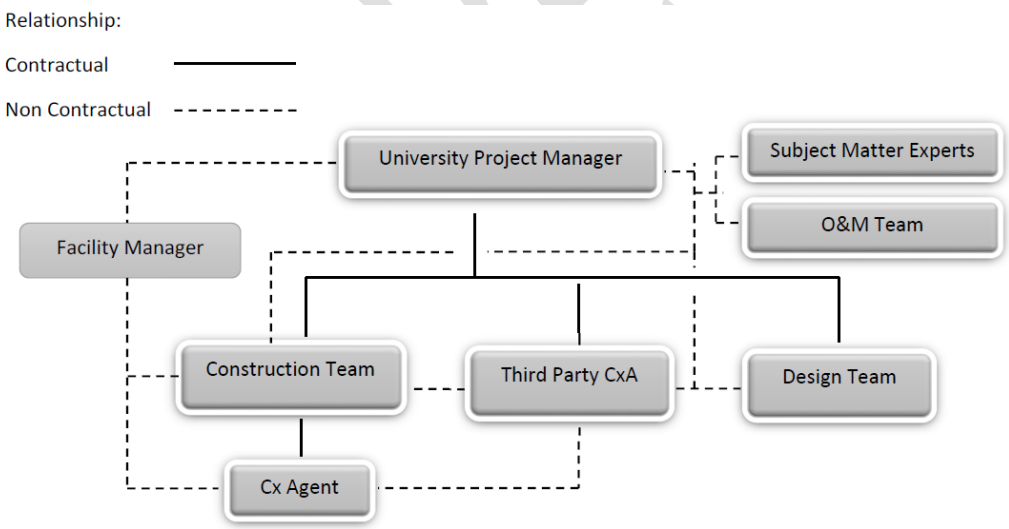
.2 **CxA** During Construction Phase:

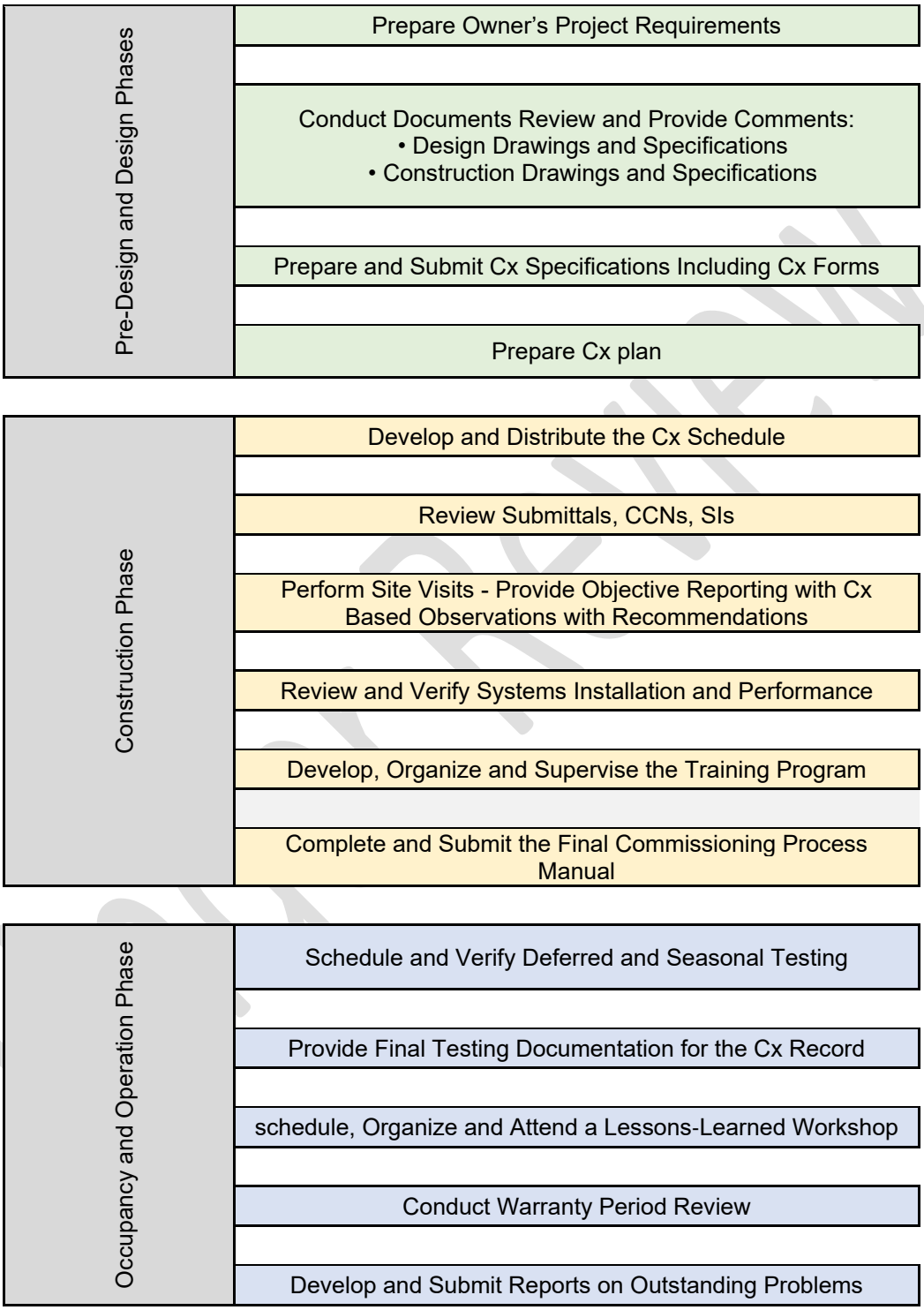
.1 Organize and conduct periodic commissioning team meetings.
.2 Develop and distribute the **Cx** schedule.
.3 Develop the Operations/Systems Manual for use in assessing performance and desired operational parameters.
.4 Coordinate and direct commissioning activities in a logical, sequential and efficient manner.
.5 Witness systems pressure testing, cleaning and flushing to ensure that proper procedures are followed.
.6 Develop and distribute pre-functional checklists and detailed functional performance test procedures and checklist for all commissioned systems and equipment.
.7 Coordinate and document functional performance testing performed by installing contractors.
.8 Review mechanical and electrical controls systems with performance testing and verification.
.9 Work with contractors in completing construction checklists and tracking of checklist completion.
.10 Review and approve systems start-up by reviewing the reports and by selected site observation.
.11 With necessary assistance and review from installing contractors, write the test procedures.
.12 Coordinate witness and recommend approval of test procedure performed by installing contractors.
.13 Maintain a master issues log and a separate testing record and submit written progress reports and test results with recommended actions.
.14 Document the correction and retesting of non-compliance items by the contractors.
.15 Develop, organize and supervise the training program conducted by construction team and **DT**.
.16 Complete and submit the final Commissioning Process Manual. As the minimum following shall be included in the **Cx** Process Manual:

- Basis of Design.
- **Cx** Plan.
- Schematic Design Review.
- Construction Documents Review.
- **Cx** Specifications.
- Equipment Installation and Performance Verification.
- Completed Equipment Installation and Performance Verification Forms.
- Submissions and Changes during Construction.
- **CX** Schedule.
- **Cx** Tracking Logs and Status of Completeness.
- Operations/Systems Manual.
- Training Program.
- Warranty Period Activities.
- Occupancy Issues.

.3 **CxA** During Occupancy and Operation Phase:
- .1 Schedule and verify deferred and seasonal testing by the contractors.
- .2 Provide Final Testing Documentation for the Cx Record.
- .3 Conduct Warranty Period Review.
- .4 Develop and Submit Reports on Outstanding Problems.
- .5 Schedule, organize, and attend a lessons learned workshop.
- .6 Return to the site at 10 months into the 12 month warranty period.

.2 **ITP CxA** Model:
- .1 A professional services of **ITP CxA** are retained at the beginning of either concept design or planning (when desirable) phase to ensure implementation of **Cx** process and to ensure **OPR** and **UofO's** Guidelines are met and followed. This model requires the participation of the **UofO's Facilities** team, End-users, **DT, ITP CxA** and Construction Team (where applicable).
- .2 All **Cx** related activities shall be coordinated with **ITP CxA,** who shall develop and coordinate the execution of **Cx** process to ensure systems ae functioning in accordance with **OPR**, construction documents and **UofO's** Guidelines.
- .4 Below the organization chart demonstrates relationships among Project Team & main topics & main topics at a glance:




Pre-Design and Design Phases
Prepare Owner's Project Requirements
Conduct Documents Review and Provide Comments:
• Design Drawings and Specifications
• Construction Drawings and Specifications
Prepare and Submit Cx Specifications Including Cx Forms
Prepare Cx plan
Construction Phase
Develop and Distribute the Cx Schedule
Review Submittals, CCNs, SIs
Perform Site Visits - Provide Objective Reporting with Cx Based Observations with Recommendations
Review and Verify Systems Installation and Performance
Develop, Organize and Supervise the Training Program
Complete and Submit the Final Commissioning Process Manual
Occupancy and Operation Phase
Schedule and Verify Deferred and Seasonal Testing
Provide Final Testing Documentation for the Cx Record
schedule, Organize and Attend a Lessons-Learned Workshop
Conduct Warranty Period Review
Develop and Submit Reports on Outstanding Problems

.2 **ITP CxA** Scope:

.1 **ITP CxA** During Design Phase**:**

.1 Develop the **OPR**.
.2 Identify scope for the commissioning process.
.3 Develop the initial commissioning plan.
.4 Collaborate with the **DT** in documenting the basis of design.
.5 Verify the basis of design in regard to the **OPR**.
.6 Attend design reviews and value engineering meetings and/or discussions.
.7 Participate in discussions to evaluate technologies and design methods to meet **OPR**.
.8 Perform review of the design documents at the end of each design phase and submit review comments.
.9 Develop full commissioning specifications for all commissioned equipment. The specifications shall follow ASHRAE Guideline 0-2005: The Commissioning Process.
.10 Develop and finalize the commissioning plan encompassing the design, construction, occupancy and operations phases.
.11 Determine the commissioning requirements and activities to include in the construction documents.
.12 Prepare **Cx** plan.

.2 **ITP CxA** During Construction Phase:

.1 Organize and conduct the commissioning pre-construction meeting.
.2 Develop and distribute the **Cx** schedule.
.3 Develop the Operations/Systems Manual for use in assessing performance and desired operational parameters
.4 Coordinate and direct commissioning activities in a logical, sequential and efficient manner.
.5 Perform site visits, as necessary, to observe component and system installations followed by reports with suggested direction.
.6 Attend selected planning and job-site meetings to obtain information on construction progress.
.7 Conduct periodic on-Site observations during construction and submit observation report.
.8 Witness systems pressure testing, cleaning and flushing to ensure that proper procedures are followed.
.9 Develop and distribute pre-functional checklists and detailed functional performance test procedures and checklist for all commissioned systems and equipment.
.10 Coordinate and document functional performance testing performed by installing contractors.
.11 Review mechanical and electrical controls systems with performance testing and verification.
.12 Organize and conduct periodic commissioning team meetings.
.13 Review submittals concurrent with the **DT**'s review, including shop drawings, Site instructions, and similar.

.14 Work with contractors in completing construction checklists and tracking of checklist completion.
.15 Review and approve systems startup by reviewing the reports and by selected site observation.
.16 With necessary assistance and review from installing contractors, write the test procedures.
.17 Coordinate, witness and recommend approval of test procedure performed by installing contractors.
.18 Recommend approval of air and water systems balancing by reviewing the report and through field verification.
.19 Maintain a master issues log and a separate testing record and submit written progress reports and test results with recommended actions.
.20 Document the correction and retesting of non-compliance items by the contractors.
.21 Reviews the systems manual for achieving the OPR.
.22 Develop, organize and supervise the training program conducted by construction team and **DT**.
.23 Video tape the training sessions.
.24 Complete and submit the final Commissioning Process Manual. As the minimum following shall be included in the Commissioning Process Manual:

- **OPR.**
- Basis of Design.
- **Cx** Plan.
- Schematic Design Review.
- Construction Documents Review.
- **Cx** Specifications.
- Equipment Installation and Performance Verification.
- Completed Equipment Installation and Performance Verification Forms.
- Submissions and Changes during Construction.
- **Cx** Schedule.
- **Cx** Tracking Logs and Status of Completeness.
- Operations Manual.
- Training Program.
- Warranty Period Activities.
- Occupancy Issues.
- Re-**Cx.**

.3 **ITP CxA** During Occupancy and Operation Phase:
.1 Schedule and verify deferred and seasonal testing by the contractors.
.2 Verify continuing training.
.3 Schedule, organize, and attend a lessons-learned workshop.
.4 Assist in the development of a preventative maintenance plan.
.5 Return to the site after six month of substantial completion of project to coordinate and supervise required seasonal or deferred testing and deficiency corrections.
.6 Return to the site at 10 months into the 12 month warranty period to assess warranty issues and summarize any outstanding issues.

2.3 Process

.1 **OPR** description:

.1 The **OPR** describes the criteria that the **UofO** considers key and important to the project. This documents primarily conveys the **UofO's** objective and wishes to the Project Team. As the minimum following sections shall be included:

.1 Project Background: Describe the project in general including the purpose of project, usage.

.2 Objectives: To include the following, but not limited to:

.1 Budget: Describe budget limitations, expectations and/or constrains

.2 Functional Uses: Describe and document occupancy information such as number of occupants, hours of operation, etc.

.3 Life: Describe expected life of the building systems and/or components

.4 Expansion: Describe **UofO's** plans to occupy the facility, and how services growth would be accommodated in future, i.e. describe general requirements for future expansion.

.5 Building Envelope: Provide the following descriptions and/or requirements:

.1 Building Vision: Orientation, compatibility with adjacent buildings, image and aesthetic, maintenance and renewal expectations and durability.

.2 Exterior Walls: Assemblies, cladding types, life expectancy and any exclusion.

.3 Roofs: Assemblies, types, reflection and color, anchors, life expectancy and any exclusion.

.4 Windows: Maximum percentage of glazing, window sizes, style of window, level of occupant control, conflict of size vs thermal comfort, number of panes, frame type, coatings, views to the outside and daylighting, control of glare & solar gain, need for barred windows, safe break glass.

.6 Structure: Describe any required or preferred structural system such as materials, spans, foundations, etc.

.7 Interior Partitions and Finishes: Describe any specific needs and/or requirements for typical construction and interior finishes.

.8 Accessibility: Provide narratives for any extra-ordinary requirements for building accessibility components such as doors openers, fixtures, etc.

.9 Noise and Vibration: Describe any specific acoustic requirements for spaces and the facility.

.10 Energy Efficiency: Provide overall energy efficiency goal by comparison to MNECCB or ASHRAE 90.1 or by required LEED energy credit points. Also provide narratives for any eligibility for incentives or, requirements to utilize specific technologies in 3rd party financing of energy efficient equipment or systems.

.11 **Cx**: Define scope, systems to be commissioned, i.e. M&E systems, envelope, miscellaneous architectural). Also describe any specific tests such as Envelope Thermographs, indoor air quality or sound, the UofO would like to conduct.

.12 Existing Buildings and Systems: For Extensive Renovations (**OBC**) and/or addition to existing buildings, describe requirements for all building systems and components. Specific requirements should be added to the pertinent

section, e.g. for existing building Extensive Renovation (**OBC**) **Cx** requirements such as Re-**Cx** of existing major mechanical systems should be included in **Cx** section.

.13 HVAC Systems: Provide following descriptions and/or requirements:
- .1 System Types: Any preferred systems and/or approaches and/or "permitted/Not permitted" systems.
- .2 Equipment Materials and Locations: Any preferred equipment type and/or "permitted/Not permitted" equipment and particular requirements for major equipment locations.
- .3 Environmental Conditions: Any environmental conditions such as set points, ventilation rates, etc. Ensure compliance with all terms and conditions stated in section 9 of **ECA**.
- .4 Controls: Any specific control requirements such as type of control systems, control vender, etc.

.14 Plumbing Systems: Provide following descriptions and/or requirements:
- .1 Systems and Equipment: Any system/equipment requirements or preferences such as central or local, storage or instantaneous, grey water or recycling.
- .2 Material: Any material requirements or exclusions.
- .3 Fixtures: Any fixture requirements.
- .4 Storm sewer system: Ensure compliance with all terms and conditions stated in section 53 of **ECA**.

.15 Fire Protection Systems: Describe any specific or extraordinary requirements for Fire Protection systems

.16 Power Distribution Systems: Describe any specific extraordinary requirements such as motors efficiency, transformers energy rating, compatibility with existing systems.

.17 Emergency Power System: Describe any specific requirements such as systems require to be connected to emergency power, and **ECA** requirements.

.18 Lighting Systems: Describe any specific lighting levels and/or design approaches and/or control strategy and/or lighting fixtures/system

.19 Security: Describe any specific requirements for building access, intrusion alarms, CCTV, duress alarms.

.20 IT and Communication: Describe any specific requirements and for telephone, computer networks.

.2 **Cx** Plan:
- .1 Commissioning Plan is the main document for project **Cx**. It is addressed to all Project Team, provides an overview and objectives of the commissioning, and describes all elements and methodologies to make the **Cx** process successful.
- .2 The purpose is to informs the **Cx** Team about their roles and responsibilities and to set out the scope, standards of **Cx** and deliverables. It also identify the systems that are to be commissioned. It shall be prepared at the early stage of design phase. It can be revised and as necessary as the design phase proceeds.
- .4 Preparation of **Cx** plan is primarily the responsibility of **CxA** however its production is joint effort between **UofO's** Project Manager, **DT** and **CxA**. Other Project Team

members such as end-users, Operational personnel, Facility Manager and Subject Matter Experts can be involved.

.5 As a minimum, the following sections shall be included in the **Cx** Plan:
- .1 Overview and Design Stage Activities: This section to include, but not limited to:
  - .1 Project Summary.
  - .2 Purpose of **Cx**.
  - .3 Definitions.
  - .4 **Cx** Process.
  - .5 Roles and Responsibilities (including Organizational Chart).
  - .6 **OPR.**
  - .7 Design Review.
  - .8 Construction Specifications.
- .2 Installation and Performance Verification: This section to include, but not limited to:
  - .1 General Requirements.
  - .2 Installation Verification.
  - .3 Performance Verification.
  - .4 Water and Air Balancing.
  - .5 Systems Testing.
  - .6 Post Occupancy Testing.
  - .7 Selective Testing.
  - .8 Manufacturer's Involvement.
  - .9 Witnessing of Testing.
  - .10 **Cx** Forms.
- .3 **Cx** Process: This section to include, but not limited to:
  - .1 **Cx** Schedule.
  - .2 **Cx** Meetings.
  - .3 **Cx** Protocols.
  - .4 **Cx** Notes.
  - .5 **Cx** Forms During Construction.
- .4 Close-Out Process: This section to include, but not limited to:
  - .1 Pre-Occupancy Checks.
  - .2 Operation Manual.
  - .3 As-Built Drawings.
  - .4 Maintenance.
  - .5 Training.
  - .6 **Cx** Report.
- .5 Warranty Period: This section to include, but not limited to:
  - .1 General.
  - .2 Seasonal Testing.
  - .3 Scheduled Maintenance.
  - .4 Users and Operational Issues.
  - .5 **Cx** Close-out.

.3 Systems to be **Cx**'nd, to include, but not limited to:

Systems or Equipment	Sampling Rate / Observation and Testing
HVAC Systems	
Chillers	100%
Heat Exchangers	100%
Pumps	100%
Air Handling Units	100%
Various Exhaust Fans	100%
Variable Frequency Drives	100%
Fan coil Units	25%
Unit Heaters	25%
Dual Duct Terminal units	25%
Energy Recovery Units	100%
Kitchen Hood System including Controls	100%
Air and Water Balancing	25%
Building Automation Systems	
Temperature/Humidity Sensors	100%
Pressure Sensors and Controllers	100%
Airflow Stations	100%
Damper/Valve Actuators	100%
Meters and Sub-Meters* - Gas (Main and Kitchen) , Domestic Cold Water, Chilled Water, Heating Hot Water	100%
Sequence of Operation including graphics	100%
Occupancy Sensors (Lighting, BAS Schedule…)	25%
Plumbing	
Plumbing Equipment	25%
Plumbing Fixtures	25%

Plumbing Piping Systems	25%
Back Flow Preventer	100%
Booster Pumps	100%
Pressure Reducing Valves	100%
Sump Pumps	100%
Grease Interceptor	100%
Fire, Life and Safety Systems	
Fire Pumps	100%
Fire Suppression Systems (Kitchen Hoods)	100%
Smoke Evacuation Exhaust Fan	100%
Fire Alarm	100%
Egress Pressurization	100%
Exit Signs and Emergency Lighting System	100%
Fire and Smoke Dampers	100%
Electrical Systems	
Normal Power Electrical Systems (Power Quality, Grounding, Transformers, 600V and 208V Distribution and Panels, Circuit Panels, Motor	50%
Emergency Power Systems (Emergency Generator, automatic transfer switches, Distribution, Circuits…)	100%
Lighting Systems (Fixtures, and Controls including daylight and dimming systems).	25%
Miscellaneous Systems	
Fuel Oil Systems including Safety Controls	100%
Vertical Transport	100%

1.1 GENERAL

1.2 OVERVIEW

.1 This following has been prepared to provide consultants with a general overview of general electrical requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

.2 The requested studies or tests indicated in this section, applies only for new buildings or major electrical service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 The electrical systems to be designed based on **OBC**, Ontario Electrical Safety Code (OESC), Canadian Standards Association (CSA) and Institute of Electrical and Electronics Engineers (IEEE) – standards related to the Equipment and infrastructure being installed.

.2 The electrical systems will be designed with the intent and approach to delivering a safe, flexible, energy efficient, expandable, maintainable, and straightforward configuration.

.3 New electrical equipment provided will be of new materials certified by CSA or ULC and is compliant with applicable codes and standards. The equipment will be of a quality and grade suited for the intended application and environment, installed with good workmanship standard practices, as per the stipulations of CSA or ULC certification requirements and other regulatory bodies.

.4 The design of electrical systems shall be flexible, maintainable and expandable without significant modifications to the system infrastructure.

.5 All mechanical Equipment and controls will be arranged on the various distribution buses in such a way that the failure of one bus will not affect the building operation.

.6 For future expansion requirements, design of subpanel distribution system shall minimize the distance between. The electrical rooms containing distribution equipment at each voltage level will have space allocated for future growth.

.7 Mechanical Equipment sized larger than 100HP but smaller than 500HP will be powered from the 600V. All motors sized 20HP and larger shall come with a thermistor monitored by the VFD for temperature and the VFD will act in the event the temperature exceeds a set value.

.8 Electrical Equipment and/or components shall meet or exceed the energy efficiency requirements outline in *ASHERAE 90.1-2013 and SB-10.*

.9 Design of Electrical Systems shall include the lowest life cycle maintenance cost and long service life.

.10 All floor mounted electrical Equipment shall be mounted on 100 mm thick concrete housekeeping pads and housekeeping pads shall extend 100 mm beyond electrical Equipment all the way around. To include housekeeping pad for switch gears and ***MCC (26 00 00)***'s.

.11 Electrical rooms shall be ventilated without mechanical cooling and shall not exceed a temperature of 40 degrees Celsius. Review the electrical rooms cooling system with **Facilities** when mechanical cooling is deemed necessary.

.12 Locations of normal and emergency panels/subpanels shall be reviewed with **Facilities**.

.13 Battery powered Equipment and devices (with the exception of UPS and inverters) including emergency/exit lighting are **not** permitted except for electrical room and ***Generators (26 00 00)*** room.

.14 Aluminum bus bar and cables are **not** permitted.

.15 The proponent shall practise load balance during the design and report shall be submitted. Amperage shall be listed at the panel boards. Updated/as-built panel schedule shall be provided in MS Excel format.

.16 Motors of 1 hp and above shall be 3-phase. Use of single-phase motor for fraction hp motors

such as Fan Coil units are acceptable.

.17 3 Phase motors shall be premium efficiency to meet or exceed requirements outlined in *ASHRAE 90.1-2013*.
All magnetic starters shall be equipped with Hand-Off-Auto controls, light test switches, running lights, reset buttons, auxiliary contacts and controls ***Transformers (26 00 00)***. For protection motor circuit breaker shall be used, fuses are **not** permitted.

.18 The following considerations shall be incorporated into the design process in consultation with **Facilities** to reduce harmonics:
- .1 A study shall be performed before equipment installation and at the time of Equipment commissioning.
- .2 The maximum voltage and current distortion limits at the Point of Common Coupling (PCC) shall meet the requirements of the latest IEEE 519 Standard.
- .3 Voltage total harmonic distortion will be limited to 5% based on the utility voltage of 13.2kV and current total demand distortion will be limited to 8% based on short circuit levels of 20<50kA at the PCC.
- .4 Throughout the design process harmonics will be addressed to ensure compliance, if the building power factor is below 0.95):
  - .1 Where high rated transforms are required consider sizing high the neutral.
  - .2 For loads with significant third harmonic content neutral shall be doubled;
  - .3 For all circuit provide separate neutral conductor. Avoid sharing neutral in design.

.19 VFDs shall be equipped with low harmonic technology. Bypass capability, adjustable for critical applications, shall be provided alongside Harmonic filters. If the VFD is installed inside the control panel, the LCD must be visible from outside enclosure. No matter of mechanical equipment location, the VFD must locate inside the room.

.20 The VFD shall be rated to operate from 3-phase power at 525 to 690 VAC (600 VAC, ULc and CSA) +/-10%. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.

.21 All VFD ranging from 25 HP to 125 HP shall be equipped with passive harmonic mitigation equipment to prevent power system problems resulting from high levels of harmonic distortion. Harmonic mitigation shall be by passive inductor/capacitor network.

.22 The harmonic mitigation equipment shall treat all of the characteristic low frequency harmonics generated by a 3-phase, diode bridge rectifier load (5th, 7th, 11th, 13th, etc.)

.23 Power factor shall be minimum 0.95 in operating range from 30% to full load.

.24 The full load efficiency of the harmonic mitigation equipment / VFD combination shall be greater than 96%. The harmonic mitigation equipment itself shall have efficiency no less than 99%.

.25 Anti-vibration pads shall be used between the reactor or ***Transformers (26 00 00)*** core and the harmonic mitigation equipment enclosure.

.26 Where a main distribution panel is not used or available, ***MCC (26 00 00)*** shall be used for distribution centers.

.27 Where elevators are fed from ***MCC (26 00 00)***, it shall have only breakers and **not** starters.

.28 For GHG reduction purposes building service loading estimation/calculation shall include the prevision of the natural gas equipment electrification, such as electric boiler, electric humidifier and another equipment's specified by mechanical division. The prevision of the service can be categorized as fully electrification and natural gas plus electric hybrid. The electrification equipment must coordinate and confirm final load calculation by **Facilities.**

.29 The medium voltage service entrance shall be modeled within OSI ETAP software from the **UofO** or Utility supply point and the ***Generators (26 00 00)*** supply point down to the main service entrance (***MV switchgear (26 00 00)*** and the feeders directly off the main switchgear. The consultant to use the ETAP software with the Harmonic module to produce several scenarios to evaluate harmonics during normal and emergency operation, as well as normal and emergency operations with maximum harmonic generation based on anticipated

loads.

.30 The ETAP as-built power study software modelling files and library used to complete this study shall be submitted to University of Ottawa in native ETAP format at the end of the project.

.31 Protective system devices have been selected such that protection is adequate and good coordination is possible, however, since differences do exist between manufacturers, some changes in trip ratings or relay settings may be necessary and are to be carried out. Obtain Hydro Ottawa information on their protective devices and include requirements as necessary.

.32 A list of Equipment requiring protective devices to be used in distribution system shall be obtained from other manufacturers, to prepare coordination curves as soon as possible - ensuring that proper control and protective devices are selected such that they coordinate with protective devices.

.33 Flash protection boundary and incident energy shall be calculated at significant locations in electrical distribution system (switchboards, switchgear, motor-control centres, panel boards, busway and splitters) where work could be performed on energized parts.

.34 Ground resistivity testing of soil shall be performed to determine measurement expressed in ohm-meters as defined by IEEE 80-2000 - IEEE Guide For Safety In A.C. Substation Grounding. Use 4-point method with Model 4610 or Model 4500 Ground Tester or approved equal, and insertion of four equally spaced and in-line electrodes into test area.

.35 Water piping systems including potable water, hydronic, sanitary and storm drainage shall **not** be installed within electrical rooms, IT rooms/closets and within partitions.

.36 Provide cable trays and/or conduits c/w pull strings to allow for installation for IT and control cabling. Refer to IT and control specifications, drawings and details. Provide pull boxes and back boxes in walls. Minimum conduit size shall be ¾" (21mm). Provide larger diameter size conduits as indicated in IT and control specifications.

.37 Provide cable trays and/or conduits c/w pull strings to allow for installation of security cabling. Refer to security specifications, drawings and details. Provide pull boxes and back boxes in walls. Minimum conduit size shall be ¾" (21mm). Provide larger diameter size conduits as indicated in security specifications.

.38 Provide 120V wiring in minimum 1" (27mm) conduit for Emergency Code Blue Stations and connection. Provide additional 1" (27mm) conduit c/w pull string for Emergency Code Blue Stations for security and communication wiring. Refer to Security Specifications, Drawings and Details for detailed information.

.39 Provide all cable trays, conduits c/w pull strings and devices for fully functioning special systems including elevators.

.40 Conduits, complete with a pull string for the future installation of UTP cabling shall be installed to support mass notification devices. The pathway shall be from the rough-in location back to the nearest network switch enclosure. <u>The rough in locations shall be the following location for all floors above the first floor</u>:

- .1 Entrances to stairwell and elevators.
- .2 Social Space (CS1).

.41 The conduits shall be finished into outlet boxes in the spaces listed above at a height of 1.20m (48") to accommodate mass notification devices as per specification 28 47 00. The outlet boxes are to be finished with solid faceplates.

.42 For spaces with requirements for annunciator panels provide empty conduit (min 21 mm) local audio/video and alarm to annunciator.

.43 A minimum 21 mm conduits c/w pull string and outlet box for master clock system shall be installed <u>in the following spaces</u>:

- .1 Classrooms
- .2 Teaching Labs.
- .3 Waiting areas in corridors (by the classrooms).
- .4 By the elevator on each floor.

.44 Conduit color coding:

System Type	Prime	SECONDARY
Fire Alarm	RED	
Normal power up to 250V	WHITE	
Normal power 250 to 600V	BLACK	
Normal power 600V to 15KV	BLUE	
Emergency power Life-safety (LS) 250 to 600V	YELLOW	BLACK
Emergency power Life-safety up to 250V	YELLOW	RED
Emergency power Non Life-safety (NLS) 250 to 600V	YELLOW	WHITE
Emergency power Non Life-safety up to 250V	YELLOW	
CONTROLS/DC	ORANGE	
BAS Data	ORANGE	WHITE
BAS normal	ORANGE	BLACK
BAS Emergency LS	ORANGE	RED
BAS Emergency NLS	ORANGE	YELLOW
Lighting Control	ORANGE	Green
Data/Comm	Brown	
Clock	Brown	WHITE
Security	Brown	BLACK
A/V	Brown	YELLOW
BESS	Green	BLACK
PV	Green	

.45 LV Electrical distribution equipment:

.1 Low voltage *Switchgear, Switchboard & CDP* ***(26 00 00)*** will be divided into separate buses, one bus for each incoming feed. The buses will be arranged into a main-tie - main configuration for bus redundancy.

.2 *Switchgear, Switchboard, CDP* & *MCC* ***(26 00 00)*** shall be 3-phase 3-wire. If 347/600V or 120/208V is required a separate 4-wire *Transformers* ***(26 00 00)*** and distribution will be provided.

.3 A Surge Protection Device (SPD) shall be provided on all *Switchgear, Switchboard & CDP* ***(26 00 00)***.

.4 Branch panel shall equal to Eaton EZ Box and EZ Trim or approval alternative.

.5 More details refer to Power Distribution section.

.46 Wiring and Cabling:

.1 All conductors, including grounding shall be copper. Stranded copper shall be used for #10AWG and larger, and any load with high vibration. Minimum conductor size for power and lighting circuits to be #12AWG. Solid copper is acceptable for #12AWG except for supply loads with high vibration. Aluminum cables are **not** permitted.

Conduits smaller than 21mm are **not** permitted.

.2 Branch circuit wiring in accessible ceiling spaces and within stud wall construction consisting of drops down to luminaries and drops down stud walls to devices and in furniture systems - AC90 flexible armoured cable ("BX") (maximum 6m (20') run permitted)

.3 VFD rated cable shall be used for variable frequency drives.

.4 In applications where multiple conductors in conduit are being run, provide trapeze configuration of Unistrut type metal C-channels and threaded rod hangers to support cable/conduit from ceiling slab. Wall mounted cable/conduit brackets and ring type conduit hangers are **not** permitted.

.5 The following table indicates the type of cables and installation method that will be used based on application:

Categories of space	**Equipment's to be connected**	**Type of conductors**	**Method of cabling**
Occupancy areas (offices, classroom, labs, kitchens, washrooms, etc. including corridors and staircases)	All electrical devices.	RW90	Concealed in EMT
		AC90 (BX) for last drop	Concealed
Service rooms such as M/E rooms and workshops.	Lighting fixtures, receptacles, small Equipment	RW90	Surface EMT
Outdoor areas	Electrical and Mechanical Equipment	RWU90	Concealed Rigid Galvanized Steel, Liquid Tight Flexible Conduit for final connection (max 1m)
M/E rooms	*Switchgears, Switchboards, Panelboards*, *MCC, Transformers* ***(26 00 00)***, *Automatic Transfer Switches* ***(26 00 00)***, chillers, boilers, compressors, pumps, VFDs.	RW90	Surface EMT, Flexible conduit for final connection (max 1m)
		Teck90	Cable Tray
		VFD rated cables	Cable Tray
Hydro Switch Room MV Transformation Room (MV Room)	MV equipment	15KV TRXLPE 15KV Teck	Cable Tray
General Areas	Emergency system	MI	Surface/Cable Tray

.6 Separated medium voltage, low voltage and control cable trays will be sized for 25% spare cable capacity, based on the largest initial cable installed or the medium voltage cables will be oversized to include the 25% spare capacity.

.7 Cable trays will be aluminium ventilated ladder tray, with a height of a minimum of

25mm more than the largest cable.

.47 Wiring Devices:
- .1 Line voltage receptacles and switches will be heavy duty industrial grade. Receptacles in service area will be surface mounted in aluminum cast boxes with stainless steel face plates. Receptacles in occupied areas such as offices and meeting rooms will be recessed standard boxes with white face plates.
- .2 Outdoor and housekeeping receptacles shall be 20A Ground Fault Circuit Interrupter (GFI) and mounted in aluminum cast boxes.
- .3 A/V equipment receptacle shall have surge protection device protection.
- .4 Power/date outlet shall coordinate with **TLSS** requirement.
- .5 Security post (Code Blue) shall coordinate with **PRO** requirement.
- .6 Drinking fountain shall require GFI receptacle.
- .7 Receptacles located in electrical rooms, near outdoor electrical Equipment, in telecommunication rooms and in locations required to maintain the building operation during a utility blackout will be on emergency backup power.
- .8 Rooftop receptacles and receptacles in hallways and corridors shall be on their own branch circuits and **not** be powered from room branch circuits.
- .9 The convenience receptacles, such as, maintenance, housekeeping, personal mobile device/Equipment, one 15A circuit shall connect to maximum six (6) receptacles. However, the receptacles for stationary equipment/devices, such as, lab equipment, AV/IT/Security equipment, microwave, coffee maker and photo copier, shall **not** share the circuits with other equipment/devices. They **must** have the dedicate circuit to service the equipment/device solely.

2.2 Studies

- .1 A ground potential rise (GPR) study shall be performed to ensure that ground system complies with requirements of local governing electrical code, for protection of personnel and Equipment.
- .2 A coordination study, short circuit calculations (available fault currents) and equipment evaluation study of system shall be done, according to local standards' authorities, including ESA and CSA Standards.
- .3 An Arc Flash Hazard analysis shall be done, according to IEEE 1584 equations that are presented in NFPA70E, Annex D. Cap maximum clearing time at 2 seconds based on section B.1.2. To be based on actual overcurrent protective device clearing time. Such study to include:
  - .1 Electrical equipment rated between utility voltage down to 208 volts.
  - .2 Calculations for maximum and minimum contributions of fault current magnitude. Minimum calculation to assume that utility contribution is at a minimum and a minimum motor load. Conversely, maximum calculation to assume a maximum contribution from utility and motors to be operating under full-load conditions. Other switching scenarios are to be included as necessitated by power system design and layout.
  - .3 Both line and load side of main breaker calculations, where necessary.
  - .4 All Equipment requiring Arc Flash study shall receive a permanent, durable Arc Flash Protection label as per code. All electrical Equipment shall be equipped with arc flash labels identifying the name of the electrical Equipment, the working distance, the incident energy, the system voltage, and arc flash boundary. For public facing panels labels shall be located inside the panel door near panel label.
- .4 A harmonics study for the electrical distribution system to be provided, to verify that the specified and supplied Equipment shall operate properly when correctly installed in the system and shall not adversely impact the operation of other Equipment, whether existing or new and comply with ANSI/IEEE 519. To include:
  - .1 All portions of the electrical distribution system, from the normal and emergency

sources of power down to each load shown on the single line diagram.

.2 To consider operation during normal conditions, alternate operational configurations, emergency power conditions and any other operations which could result in harmonic distortion exceeding proscribed standards.

.3 Analysis of the harmonic voltages and currents which are likely to be produced on the power distribution system by operation of plant equipment.

.4 The “worst case” situation that is likely to be produced. The worst case is defined as that combination of Equipment which is deemed most likely to create the highest level of total harmonic voltage distortion and total current demand distortion at a given point.

.5 Arc Flash, Short Circuit study and Coordination study shall be completed during design phase. All new builds shall have power system studies completed during the design and construction phase. The project for existing building shall completed all applicable studies. To include:

.1 Short-circuit study.
.2 Device evaluation study.
.3 Coordination study.
.4 Arc-flash hazard study.
.5 Harmonic-analysis study. (must apply to the line side and load side).

.6 A Lightning protection risk assessment shall be conducted in accordance with CAN/CSA-B72-M87 (R2013), and provide the recommendations accordingly. If a lightning protection system is required, it shall meet the requirements of CAN/CSA-B72-M87 (R2013) – Installation Code for Lightning Protection Systems.

3.0 GROUNDING AND BONDING

.1 Grounding and bonding will meet at a minimum the requirements of the Ontario Electrical Safety Code (OESC) and TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications when concerning telecommunications.

.2 A 50mm x 6mm copper grounding bus bar, mounted on 25mm insulators will be installed around the perimeter of all new MV and LV electrical rooms including the doors and frame, bonded to the main ground grid.

.3 All conduits and duct banks will include an insulated ground copper conductor run with the feeders.

.4 All cable tray runs will include a bare #2/0 AWG copper conductor for bonding of the cable tray sections. This is in addition to the bonding conductor run with feeders.

.5 Grounding system shall be star configuration. Loop configuration is **not** acceptable.

4.0 IMPLEMENTAITON AND MAINTENANCE

4.1 General

.1 Provide adequate space for servicing, replacement and addition (for future projects to be consulted with **Facilities**) where Equipment are installed in service rooms.

.2 Electrical and communication equipment and/or components shall **not** be installed in mechanical service rooms unless required to service mechanical equipment.

.3 Where electrical panels are installed in electrical rooms, closets and/or load centers, design and installation shall allow space for two additional panel boards for future projects/expansion.

.4 Warning Signs shall be decal and minimum 175 X 250 mm.

.5 Wiring lugs, terminals, screws used for termination of wiring shall be suitable for copper conductors.

.6 Equipment identification:

.1 Nameplates shall be Lamicoid 3 mm thick plastic engraving sheet, blackface for normal power and red face for Emergency power, white core, mechanically rivetted for electrical panels or double way tape as below. For existing buildings match existing labelling.

.2 Self-adhesive plastic labels with 6 mm high letters should be applied to all terminal

devices.

.3 Average of 25 letters shall be allowed per nameplate and label.

.4 Nameplate of terminal cabinets and junction boxes shall indicate system and/or voltage characteristics.

.5 Distribution equipment shall be identified by the nameplates.

.6 Nameplate of ***Transformers (26 00 00)*** shall indicate the capacity, power source, primary and secondary voltage.

.7 Disconnects, starters and contactors: indicate Equipment being controlled and voltage.

.8 Nameplate of distribution equipment shall indicate the identification/tag, voltage, phase and upstream Equipment.

.9 All nameplates, signs and label shall be in English.

.7 Main ceiling mounted Equipment, devices, sensors and components requiring readily service access and/or periodic maintenance and/or inspection shall be located, where possible in service rooms or and not over corridors. However, the ceiling mounted Equipment for labs shall be installed in the corridor ceiling space.

.8 Ceiling mounted Equipment, devices, sensors and components requiring periodic maintenance and/or inspection shall be installed in such the installation provides ease of servicing access. The required maintenance and/or inspection work shall not jeopardize the health and safety of University's operational staff and/or service contractors. They shall be accessible from the floor or a permanent service or access platform or walkway.

.9 Wirings shall be identified with numbers on both ends of phase conductors of feeders and branch circuit wiring.

.10 Wiring of controls, fire alarms and communication systems shall be colour coded and matched throughout in accordance with University's standards.

.11 Where conduits and/or cables penetrate walls, ceiling and floor, they shall be coded with plastic tape or paint at 3 m interval.

.12 Breakers, disconnects, starters and contactors shall be labelled indicating Equipment being controlled and its voltage.

.13 Mounting height (from finished floor to centerline of component) of the electrical components shall follow below, in accordance with ADA regulations and relevant code requirements:

Switches	1,100 mm
Receptacles:	
General	300 mm
Over counters	175 mm
In service rooms, workshops, laboratories	1,200 mm
Panels (as per code or as indicated below):	
	1,800 m from the top of the panel
	Where multiple panels are installed; align tops. Highest panel determines the height.
Voice and Data Outlets	300 mm
Phone outlets	1,400 mm
Fire alarm pull stations	1,400 mm
Fire alarm bells, horns, strobes	2,300 mm
Speakers	2,100 mm
Time switches, lighting contractors	1,400 mm
Starters	
	1,500 mm from top
	Where multiple starters are installed; align tops. Highest starter determines the height.

.14 Receptacles shall be labelled indicating power source and circuit number.

.15 Conceal conduits in finished areas.
.16 Exposed conduits shall be run parallel to building gridlines. Maintain maximum headroom.
.17 Sleeves through concrete coordinate with mechanical design guidelines for details.
.18 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.
.19 Outlets shall **not** be installed back to back where they are in the same wall or partition.
.20 Minimum 150 mm horizontal distance shall be maintained between electrical boxes where they are in the same wall or partition.
.21 Light switches shall be located on latch side of doors.
.22 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.
.23 All ground conductors shall be installed with non-metallic or non-continuous metallic hardware.
.24 All ground bus connections shall be bolted lug type with double bolt.

4.2 Tests (at time of completion)

.1 Tests shall be conducted at time of completion and acceptance of work and reported to **UofO**'s Commissioning Service Provider (ESA) and Commissioning Service. To include:
  .1 Polarity, control and switches test circuits for correct operation of devices, switches and controls.
  .2 Test voltage at last outlet of each circuit. Voltage drop shall **not** exceed the maximum allowance per Ontario Electrical Safety Code.
  .3 Measure load on each phase at switchboards, splitters, distribution panels, lighting and power panels. Where necessary phase connections shall be rearranged to balance load on each phase. Loads shall be measured after rearrangement to confirm the load balance.
  .4 Line voltage of each phase at load terminals shall be of main breakers shall be measured. Test shall be performed when majority of electrical Equipment are in use.
  .5 Line current of each phase of motors when motor is under load shall be measured.
  .6 Insulation resistance (Megger) test for circuits, feeders and Equipment shall be performed.
  .7 Continuity of grounding and bonding conductors shall be verified.
  .8 Power distribution and generation system including phasing, voltage, grounding and load balancing.
  .9 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  .10 High and low voltage equipment.
  .11 Start-up of emergency power supply and load transfer.
  .12 Lighting controls and emergency lighting.
  .13 Fire alarm system.
  .14 Security access and intrusion alarm operation during power outage.
  .15 UPS system.
  .16 Communication system.

1.0 GENERAL

1.1 Overview

.1 This following has been prepared to provide consultants with a general overview of the Power Distribution requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

.2 Warranty period shall be as follow:

- .1 Low Voltage Transformers – Minimum 5 years.
- .2 Low Voltage Switchgear and Switchboards – Minimum 5 years.
- .3 Low Voltage Distribution and Branch Panelboards – Minimum 5 years.
- .4 Variable Frequency Drives (VFD's), Harmonic Filters – Minimum 5 years.

.3 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 Electrical rooms shall be located in such to maximize the flexibility of the power distribution system and ease of access to the floor area served.

.2 The configuration of electrical rooms shall be laid out in such a way as to allow for safe and easy maintenance and the straightforward removal and replacement of failed or end-of-life equipment. Openings in the structure, ramps and gantries will be provided as required to facilitate the transportation of equipment in and out of the building and electrical rooms.

.3 Any mechanical plumbing and piping containing liquid shall not be installed in or pass through electrical vaults and electrical rooms, except for fire protection piping. However, sprinkler piping may pass through the room, provided it does not traverse over switchgears, MCCs, or panels.

.4 The power distribution system shall be designed to provide flexibility and adaptability when a change of spaces is required. Also, ease of access to electrical panels shall be considered in the design to facilitate the addition of new feeds are required.

.5 Switchboard and switchgear shall have a mimic diagram.

.6 Central distribution panels, such as distribution panels and MCCs, shall be located close to load centers, such as mechanical/electrical rooms.

.7 Routing of distribution feeders shall be through common areas. Routing of distribution feeders between adjacent spaces which are subject to change is not acceptable.

.8 Consideration shall be given to controlling the noise of electromagnetic fields in the design of a power system for noise-sensitive areas. Electrical transformers shall not be located inside and/or adjacent to these areas.

.9 All outdoor electrical cables shall be properly rated copper cables in an underground duct bank complete with full-sized neutral.

.10 Where UPS system is used:

- .1 UPS panel shall be completed with an isolated ground bus.
- .2 UPS panel shall be located in the same UPS room.

.11 All motors over 1/3HP shall operate through VFD and reduced voltage soft start starter except indicated by mechanical otherwise.

.12 All magnetic starters shall be equipped with Hand-Off-Auto controls, light test switches, running lights, reset buttons, auxiliary contacts and controls transformers.

.13 For the purpose of protecting motors from loss/reversal or over/under current situations, all three phase motors shall be equipped with phase protection devices.

.14 Motor starters shall be operated by the building automation system.

.15 For motors, 1/2 hp and larger, single-phase protection shall be provided.

.16 Design of electrical power distribution system (normal and emergency) shall include the subdivision of the following categories:
- .1 Lighting.
- .2 HVAC.
- .3 Mechanical equipment (motors, pumps, boilers etc.).
- .4 Electrical equipment.
- .5 Communication system.
- .6 AV and security system.
- .7 User equipment/devices (fixed and mobile)
- .8 Building maintenance and housekeeping equipment/device

.17 Wirings connecting to power distribution system equipment shall be RW90 XLPE copper conductors in rigid steel conduits and EMT. All feeders shall have the same ratings or larger than their over-current protection device. Refer to Electrical general requirement for details.

.18 Electrical equipment located in areas with sprinkler systems shall be provided with drip-proof enclose/protection against water from sprinklers.

.19 Seismic restraint requirements shall apply to all power distribution equipment installations.

.20 Distribution equipment such as switchgear, switchboard, panelboard, VFD and MCC shall be supplied by the same manufacturer and/or supplier.

.21 Design of main electrical distribution equipment, such as distribution panels and MCCs, shall include 25% spare space for additional circuits. The spare circuits for branch panels shall be 20%.

.22 Each functional space, such as laboratories and classrooms, shall have dedicated power branch panel, including normal & emergency power, which shall feed all lighting, equipment and receptacles in the corridor near the space.

.23 Electrical system including all voltage levels, Low Voltage (LV) 600V & 120V the electrical distribution and associated controls will be provided with redundancy for future growth. Minimum spare capacity shall be provided as per the following:

600V Switchgear	Provide sufficient space within electrical rooms on one side of the switchgear to install a future cell.
Switchboard/Distribution Panels (600V and 208V)	All panelboards, switchboards and distribution panels shall have space to accommodate the installation of 20% more spare breakers required for each panel.
Motor Control Centers (MCC)	All MCCs shall be sized to accommodate 25% future loading. All MCCs shall be supplied with the capacity to install additional starters.
All Distribution Transformers	All step-down transformers shall be sized to accommodate an additional 25% future loading while accounting for the redundancy N+1 requirements. Future loading requirements can be achieved with transformer fan ratings.
Automatic Transfer Switches	All automatic transfer switches shall accommodate 25% future load growth.

2.2 Low Voltage Transformer

.1 Indoor transformers shall be dry type and copper windings

.2 Class "H", 220°C class, coil insulation, such that winding temperature rise to not exceed 150C°(270F°) and enclosure temperature rise not exceed 65C°(117F°) under full load in a 40°C (104°F) ambient temperature.

.3 Core construction consists of stacked laminations of high permeability silicon steel.

.4 Vacuum impregnated polyester or epoxy resin.

.5 Lugs or pressure type terminals to suit primary and secondary conductors

.6 Transformer size up to 15 kVA shall have two - 5% full capacity taps; one above normal and one below normal; taps located on the primary winding.

.7 Transformer size greater than 15 kVA shall have four - 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on the primary winding.

.8 An integral vibration dampening system with anti-vibration pads used between coil and core and enclosure. Noise control measures shall apply to office areas and laboratories. Otherwise, the requirement shall be provided by the Facilities Operations Team.

.9 Transformers shall be energy efficient, meeting or exceeding the requirements outlined in CSA C802.2 upgraded to Natural Resources Canada, Energy Efficiency Regulations.

.10 Transformer servicing communication/AV/IT/security system shall be harmonic mitigation type.

.11 The nameplate shall include impedance rating, weight, connection diagram, style and serial number, riveted to the front of the enclosure.

.12 Transformer installed inside the electrical room: minimum NEMA 2 ventilated enclosure with rigid end frame, removable plates, terminal compartment.

.13 Transformer installed outside the electrical room: minimum NEMA 12 non-ventilated, dust-tight enclosure with rigid end frame, removable plates, terminal compartment.

.14 The transformer shall have top mounted factory painted drip shield, where sprinklers are installed, and bottom mounted drip tray for wall/ceiling mounted.

.15 The finish shall consist of a coat of gray (ANSI-61), thermosetting, and polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have a corrosion resistance of 600 hours to 5% salt spray.

2.3 Motor Control Center (Mcc)

.1 For new construction and equipment replacement MCC shall not be used.

.2 Where three or more starters are needed, MCC shall be provided.

.3 MCC shall include smart technology features.

.4 600 V, 60Hz, delta connected, 3 phase, 3-wire, grounded.

.5 Compartmentalized vertical sections with common power busbars.

.6 Floor mounting, free-standing, enclosed dead front.

.7 Indoor NEMA 3R enclosure, front mounting.

.8 Acceptable manufacturers: Schneider Electric, Eaton Corporation, General Electric.

.9 The warranty period for Motor Control Centers (MCC) shall be a minimum of five years from the date of substantial completion.

2.4 Switchboards

.1 The main switchboard shall be double-ended with 100% redundancy (N+1) and consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide means of ventilation within the enclosure (ie. grill or louver). Main switchboard shall have window for scanning purposes.

.2 All sections of the switchboard shall align front and rear with depth. All protective devices

shall be compartmentalized with line and load bus connections. Devices shall be front removable and load connections rear accessible. Insulated rigid copper bus connections shall extend from the load side of over-current feeder devices into rear compartment where outgoing cable connections may be made without reaching into or near the main horizontal or vertical buses. Distribution sections shall be sectionalized to provide a front device section, an intermediate bus section and a rear feeder cable section. There shall be a vertical barrier of glass polyester between the device compartment and the bus compartment.

.3 Provide a rear compartment vertical insulating barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.

.4 All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

.5 Provide a full capacity neutral bus.

.6 A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

.7 Power circuit breakers shall be low-voltage power circuit breakers. All frame sizes shall have a common height and depth. All breakers shall be ULc or CSA listed for application in their intended enclosures for 100% of their continuous ampere rating.

.8 Breakers shall be manually operated (MO) and electrically operated (EO). Electrically operated breakers shall be complete with close/open pushbuttons, plus red and green indicating lights to indicate breaker contact position.

.9 The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and ULc or CSA listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

.10 Each power circuit breaker shall be equipped with a true RMS sensing, solid-state tripping system consisting of three current sensors, a microprocessor-based trip device and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.

.11 Circuit breaker above 225A shall have electronic trip units with an LCD display panel.

.12 All power circuit breakers shall include an Arc Flash reduction features.

.13 All branch circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism.

.14 Circuit breakers 225-ampere frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.

.15 Provided tie breaker c/w kirk-key locks.

2.5 Low Voltage Switchgear

.1 The switchgear shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. Cable compartment access shall be provided by hinged rear doors, complete with captive hardware shall be provided.

.2 Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by

means of steel barriers to the maximum extent possible. It shall be equipped with draw-out rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where is shown on the plans, shall be located within the appropriate breaker cells and be front accessible, removable, and provided with shorting terminal blocks in the front wireway. Circuit breaker doors shall not be ventilated.

.3 The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for draw-out application. It shall have four positions, “connected,” “test,” “disconnected,” and “removed.” The breaker draw-out element shall contain a worm gear levering “in” and “out” mechanism with a removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering “in” or “out” of the cell. Interlocking that trips the breaker will not be accepted. The breaker cell shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering. Breaker shall be ready to accept connection of remote racking device without modification of breaker, cell or door.

.4 Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

.5 Provide a rear compartment barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars. Barrier shall be solid grounded steel.

.6 Provide a safety shutter in the cell when the circuit breaker is withdrawn, which automatically covers the line and load stabs and protects against incidental contact. Provide pad-lockable breaker door to prevent access to shutter when breaker is removed from cell.

.7 All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

.8 A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short-time withstand rating shall meet that of the largest circuit breaker within the assembly. The ground bus plating shall match main bus plating.

.9 Breakers shall be provided in drawout configuration. All breaker cell sizes shall have a common height and depth. Breaker frames of the same size shall be fully interchangeable.

.10 Breakers shall be manually operated (MO) and/or electrically operated (EO).

.11 The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and ULc or CSA listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

.12 A position indicator shall be located on the faceplate of the breaker.

.13 Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip.

.14 Trip units shall be provided with a LCD display panel.

.15 All circuit breakers shall include an Arc Flash reduction features.

.16 All circuit breaker shall have the adjustability of an LSI trip unit.

2.6 Panelboards

.1 All panelboards shall be factory assembled dead front industrial grade panelboards.

.2 Circuit breaker type distribution panelboards to be single or double row as required and

complete with moulded case, bolt-on circuit breakers calibrated for 40°C (104°F) ambient temperature.

.3 Switch and fuse type distribution panelboards are **not** permitted.

.4 Distribution panelboards of rating greater than 1200 amperes rating to be switchboard type.

.5 Floor mounted distribution panelboard enclosures to be free-standing type, reinforced as required to provide with adequate strength.

.6 Distribution panelboards shall be minimum NEMA 1 or NEMA 2. Surface mounted panelboards to be complete with drip shield. Ventilation louvres to be designed to prevent penetration of water spray onto live components. Conduit entries to be sealed watertight.

.7 Lockable hinged doors, latches, and keyed alike locks.

.8 All panelboard shall have copper neutral bars and solidly bond equipment copper ground bar.

.9 Circuit breakers of frame size 200 amperes and greater shall equip with adjustable solid state trip units.

.10 Design of 208/120V lighting panels shall include six, 15A/120V spare breakers as minimum.

.11 Design of 600/347V power panels shall include two, 3 pole spare breakers as a minimum.

2.7 Implementation

.1 Conduits shall be grouped on channels.

.2 Cables shall be run in conduits, ducts or wire ways.

.3 Dry mount transformers shall be mounted on concrete pad with adequate clearance for ventilation.

.4 At least one general purpose duplex receptacle shall be provided in electrical closets. In electrical rooms two duplex receptacles shall be provided as a minimum.

.5 Motors with ½ hp and larger shall be three phase.

.6 In order to obtain better lagging power factor (better than 0.95) automatic power factor correction equipment shall be provided.

.7 Single pole breakers with handle ties shall not be used in lieu of multiple breakers.

.8 Recessed panels shall have two spare conduits from the panel to the ceiling for future use.

.9 Ensure adequate clearance is provided as required for access for operation and maintenance.

.10 Ensure that there is adequate ventilation for transformers to operate as specified and that there is no transfer of heat to adjacent surfaces or equipment.

.11 Secure transformers 75 KVA and larger to a concrete housekeeping pad.

.12 Secure transformers smaller than 75 KVA in place on an angle wall mounting bracket support assembly located approximately 300 mm (12") below ceiling. Provide support assembly and adequately secure to wall and/or ceiling construction.

.13 When transformer installation is complete, test and check secondary voltages. Make all required adjustments and submit the test report indicating secondary voltage readings and any adjustments made to achieve proper voltages. Furthermore, when building is in normal use, re-check voltages and make any required adjustments.

.14 Set and secure motor control centre in place on housekeeping pad, and square to building floor and wall.

2.8 Field Quality Control

.1 The following tests shall be conducted on:

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 Insulation resistance testing shall be conducted of the following:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.4 Carry out tests in presence of design Engineer.

.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.6 Submit test results for design Engineer's review.

.7 Hot spot testing shall be conducted on the following:

.1 After 24 hours of operation under full load, perform infrared tests on all cable terminations and connections and all transformer, panel and breaker connections, to ensure the integrity of the system.

.2 Tests to be carried out by using an infrared camera.

.8 Terminations and/or connections failing tests shall be replaced immediately as part of the contract.

1.1 GENERAL

1.2 Overview

.1 This following has been prepared to provide consultants with a general overview of MV Power distribution requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

.2 Warranty period shall be for 5 years for Medium Voltage Switchgear / Panels and Medium Voltage Dry Type Transformers.

.3 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 Any mechanical plumbing and piping containing liquid shall not be installed in or pass through electrical vaults and electrical rooms, except for fire protection piping. However, sprinkler piping may pass through the room, provided it does not traverse over switchgears, MCCs, or panels.

.2 The switchgear described in this specification shall be designed for operation on a 13.8kV, three-phase, 3-wire, solidly grounded, 60-hertz system.

.3 Medium voltage switchgear will be arc resistant with type 2B accessibility. Designed to allow for interrupters operation, including racking and un-racking of the interrupters, without having to open the inner compartment doors. Arc flash events will be directed up through top venting which will be at least 2300mm above the finished floor.

.4 Switchgear room/electrical room shall include a human machine interface (HMI) wall mounted outside of the arc-flash zone of the switchgear. This HMI shall allow for remote operation and monitoring of the breakers and metering, with remote breaker opening/closing and remote draw-out breaker racking in/out. The HMI control system shall come with redundancy.

.5 Medium voltage switchgear shall be divided into separate buses, one bus for each incoming Hydro Ottawa service line. The power distribution shall be arranged into a double-end main-tie-main configuration for bus redundancy N+1.

.6 Switchgear enclosure shall provide protection against internal arcing faults at the front, sides, and rear as designated by accessibility Type 2 under ANSI test guide C37.20.2, and Type B designated under EEMAC test guide G14-1.

.7 Enclosures shall be constructed per IEEE/ANSI C37.20.3 indoor specifications. (Meets or exceeds NEMA 1.) Each vertical section shall be ventilated at the top and bottom, both front and rear, to allow airflow to provide cooling and to help prevent buildup of moisture within the structure.

.8 All phase bus conductors shall be silver-plated copper.

.9 Ground bus shall be silver-plated copper and be directly fastened to a galvanized metal surface of each vertical section and be of a size sufficient to carry the rated current of the switchgear assembly.

.10 The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

2.2 MV Dry-type Transformer

.1 Type "ANN/ANF," indoor. Transformer to be dry type, designed, manufactured, and complete with accessories in accordance with requirements herein specified and as per listed codes and standards.

.2 Transformers to be capable of additional 33% capacity output with three fan cooling.

.3 Continuous self-cooled rating when operating on any tap with a temperature rise, by resistance, not more than 150C° (270F°) over a maximum ambient of 40°C (104°F).

.4 Overall transformer efficiency not less than 98.5%;

.5 Insulation to be Class 220°C rated.

.6 Primary and secondary windings to be copper.

.7 Transformer and windings vacuum impregnated with polyester resin.

.8 Winding temperature alarm components consisting of thermistors, measuring devices and control unit to monitor winding temperature and provide alert and alarm signals upon rising and high temperatures.

.9 Fan cooling: fans with protective screens; thermometer with 3-stage alarm type "C" contacts; first stage operates fans, second stage actuates an alert signal, and third stage actuates an alarm; control cabinet with controls, transformers, contacts, integral to transformer power supply, and devices to allow for operation of fans.

.10 Maximum sound level with fans of 68 dB rating.

.11 Factory installed neoprene anti-vibration pads eliminating a minimum of 95% sound transmission between core/coil and supporting structure; mount pads between core/coil assembly and bottom support members in enclosure; provide stiffening members on enclosure panels as may be required to eliminate diaphragm noise amplification.

.12 Provide spring isolation type anti-vibration mountings between I-beam base and concrete floor pad, to isolate not less than 90% of disturbing vibrations.

.13 Integral R-C snubber series combination resistor, capacitor, and dedicated fuse element for dampening of high frequency switching transients; include snubber monitor circuit consisting of current transformers, Red/Green LEDs and relays that monitor snubber components and indicates condition by colored LED activation.

.14 The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

2.3 Metal enclosed MV Switchgear

.1 The metal-enclosed load interrupter switchgear shall consist of dead-front, completely metal-enclosed vertical sections containing load interrupter switches and fuses.

.2 On every vertical section containing a three-pole, two-position open-closed switch, the following features shall be supplied:

- .1 High impact viewing window that permits a full view of the position of all three switchblades through the closed door.
- .2 The door shall be interlocked with the switch so that:
  - .1 The switch must be opened before the door can be opened.
  - .2 The door must be closed before the switch can be closed.

.3 A hinged grounded metal barrier that is bolted closed in front of every switch to prevent inadvertent contact with any live part and allows for a full-view inspection on the switchblade position.

.4 Provision for padlocking the switch in the open or closed position.

.5 Green OPEN, Red CLOSED switch position indicators with the words “Open” and “Closed” in French, and English.

.6 A hinged cover with over the switch operating mechanism to discourage casual tampering.

.7 Vertical section construction shall be of the universal frame type using die-formed and bolted parts. All enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3. To facilitate the installation and maintenance of cables and buses in each vertical section, a removable top cover and split removable rear covers with rustproof nylon handles shall be provided.

.8 Each vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with two (2) rotary latch-type pad-lockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full-length door.

.9 The switchgear assembly shall be of arc-resistant construction that provides Type-2B accessibility around the perimeter (front, sides, and rear) of the line-up plus arc-resistant in front of the instrument/control compartment with instrument/control compartment door opened.

.10 Each load interrupter switch shall have the following features:

- .1 Three-pole gang-operated mechanism.
- .2 Manual quick-make, quick-break over-toggle-type mechanism that does not require the use of a chain or a cable for operation and utilizes a heavy-duty coil spring to provide opening and closing energy.
- .3 The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position under normal operation.
- .4 Separate main and break contacts to provide maximum endurance for fault close and load interrupting duty.
- .5 Insulating barriers between each phase and between the outer phases and the enclosure.
- .6 A maintenance provision for slow closing the switch to check switchblade engagement and slow opening the switch to check the operation of the arc interrupting contacts.

.11 Fault protection shall be provided by fuses with continuous ratings, as shown in the contract documents. Any fuse/switch integrated momentary and fault-close ratings specified shall have been verified by test and UL and CSA certified.

.12 The equipment must be provided with spare fuses for each applicable size.

.13 Switchgear shall have mimic diagram.

3.0 IMPLEMENTAITON AND MAINTENANCE

3.1 General

.1 MV Dry Type Transformers:

- .1 Secure *MV Transformer (**26 00 00**)* to bases using spring type isolation pads with minimum 13 mm (1/2") deflection, and additional seismic restraints requirements to suit local governing codes and authorities. Where connecting conduits are used, utilize liquid type flexible metallic conduits.
- .2 Provide alarm circuits. Include for provision of conduits, boxes and control/signal wiring for interconnection to switchgear control system. Properly identify wiring and junction box.

.3 Make necessary incoming and outgoing power cable connections to equipment in strict accordance with equipment and cable manufacturer's recommendations. Ensure connections, stress cones and terminations are suitable for specific incoming and outgoing cables. Where applicable, obtain bus duct flange from bust duct manufacturer and install to connect to bus duct, as required.

.4 Ground and bond equipment to ground electrode grids.

.5 Test power transformers before placing in regular service. Testing work to include voltage ratio test, phase angle test, insulation resistance, verification and any testing as required by ESA.

.6 Transformers with fans are to be protected.

.2 MV Switchgears:

.1 Secure *MV Switchgear **(26 00 00)*** each assembly to concrete bases. Fasten to concrete pad using 13 mm (1/2") threaded studs embedded in concrete,13 mm (1/2") nuts and clamps provided with switchgear.

.2 Connect incoming cables. Torque bus joint bolts and properly interlock and connect roof of assembly to produce a watertight roof. Interconnect split arrangements with bus duct and/or cable in conduit as required. Connect power and ground bussing. Connect ground bus to grounding rods.

.3 Provide distribution system coordination study to switchgear.

.4 Install controls and metering displays at height of between 1200 mm (4') to 1800 mm (6') above finished floor level.

.5 Arrange for inspection and approval of completed switchgear installation by Hydro Ottawa prior to energization. Also, arrange and coordinate required primary cable connections and metering requirements with Hydro Ottawa.

.6 Ground and bond equipment to ground electrode grids.

.7 Provide alarm circuits. Include for provision of conduits, boxes and control/signal wiring for interconnection to switchgear control system. Properly identify wiring and junction box.

3.2 Field quality control

.1 To operate load interrupter closing and tripping mechanisms, to verify correct functioning.

.2 To check insulation of switchgear assembly with DC Hi-Pot tester. If values are not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Consultant.

.3 To check insulation of switchgear assembly with 1000V megger. If values not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Consultant.

.4 To check phase rotation of each feeder.

.5 To place primary switchgear in service and check wattmeter, voltmeter, power factor meter, and ammeter readings to ensure proper functioning of instruments and satisfactory phase balance and power factor of loads.

.6 To check for grounding and neutral continuity between station ground and system neutral.

1.1 GENERAL

1.2 Overview

.1 This following has been prepared to provide consultants with a general overview of Lighting requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

.2 The requested studies or tests indicated in this section, applies only for new buildings or major electrical upgrade and similar projects.

2.0 GENERAL

2.1 General Requirements for Luminaires and Components

.1 Only LED fixtures shall be specified in the project and luminaires efficacy in Lumens per Watt (L/W) shall be greater than 110 L/W.

.2 Average Lighting power density (LPD) shall not be greater than 0.56 W/sq. ft. Include all requirement of energy efficiency as identified in Ontario Building Code.

.3 Lighting system shall be designed to meet functional requirement of each specific space.

.4 Light level requirement shall meet IESNA.

.5 Exterior lighting shall be controlled through photocell and building system.

.6 DMX lighting shall be included in some interior spaces and the location will be coordinated with **UofO**. Color changing lighting control shall be available for exterior space and the scope will be cooperated with **UofO**.

.7 A detailed photometric lighting study shall be prepared, using the AGI 32 software, and the calculations shall follow IESNA procedures. Calculation results to include maximum, minimum, and average illumination levels along with the appropriate uniformity ratios.

.8 Lighting controls and luminaires when integrated together for control purposes must be 100% compatible with each other. Coordinate with manufacturers of applicable ***Drivers (26 50 00)*** /LEDs, sensors, switches, panels and other controls, to ensure that components are compatible with each other and that interconnections do not adversely affect performance or end-of-life expectancies or invalidate any warranties.

.9 Design of lighting systems shall provide ease of maintenance and replacement. Design of lighting systems for ceiling heights over 4.5 m (15 Ft.) shall be reviewed by Facilities.

.10 Design of lighting system shall be done in such that illumination is directed to desired location with minimal direct glare and reflection.

.11 New lighting and controls will meet at a minimum the requirements of ASHRAE 90.1 -2013 Energy Standard for Buildings, National Energy code 2017 and OBC- SB10, the light level recommendations of Illuminating Engineering Society (IES).

.12 Lighting design shall meet LEED Platinum requirement.

.13 Adjustable luminaires shall have positive locking devices to fix aiming angle. Luminaires shall be capable of without adjusting aiming angle.

.14 Each luminaire that has an array with a beam pattern or a spread lens that defines beam orientation shall contain locking devices to ensure the orientation is not disturbed during array replacement or cleaning.

.15 All luminaires and ***Drivers (26 50 00)*** shall operate within the temperature limits of their design and as specified by ULC in the applications and mounting conditions specified.

.16 Luminaires shall hold LED arrays securely against normal vibration and maintenance handling.

2.2 Interior Luminaires

.1 ***Interior Luminaires (26 50 00)*** shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such

luminaires shall not exceed 0.5 watts when in the off state.

.2 *Interior Luminaires **(26 50 00)*** shall be fully accessible from below ceiling plane for changing *Drivers **(26 50 00)***, power supplies and arrays.

.3 Lighting fixture lay-out within drop ceilings shall allow relocation of lighting fixture by one ceiling tile in either direction.

.4 Where connected to dimmers, be 100% compatible with connected dimmer controls to provide dimming down to 1%. Coordinate with dimming controls vendors to ensure that technical operations of dimmers (i.e. forward phase, reverse phase, etc.) match LED/ driver technology.

2.3 Exterior Luminaires

.1 *Exterior Luminaires **(26 50 00)*** lighting design will enrich the residents, users and visitors' experiences while promoting environmentally friendly, responsible lighting practice while providing Safety and visual comfort. The lighting shall be incorporated within the architectural and landscape elements.

.2 All lighting-level calculations shall be performed for all exterior spaces in conjunction with architectural and/or landscaping design. The point-by-point method utilizing computer-generated calculations shall be used to validate adequate illumination levels and boundaries.

.3 Lighting levels will define and differentiate between parking, pedestrian walkways, seating/rest areas, benches, &, etc. Lighting shall be designed to minimize glare and provide uniform distribution. Luminaires shall be selected, located, and aimed to accomplish their primary purpose while producing a minimum of objectionable glare and/or interference with neighboring areas.

.4 The selection of *Exterior Luminaires **(26 50 00)*** shall be simple, elegant, and contemporary, consisting of state-of-the-art LED, combined with lighting controls.

.5 The lighting shall act as wayfinding and define feature elements such as the stairs, ramps and rest areas. Lighting equipment shall be vandal-resistant where accessible to the general public.

.6 *Exterior Luminaires **(26 50 00)*** that emit light above the horizontal plane shall be avoided in the exterior design unless luminaires are located under overhangs or other architectural features shielding the sky from upward light. Luminaires shall be provided with full cut-off optics and, if necessary external shielding to minimize light spill-over onto adjacent properties.

.7 The pole height of the exterior lighting fixture shall be suitable for area they illuminate; shorter (4m) pedestrian style pole is recommended for all path way lights; longer pole (7m) is used for parking area. All post shall be black. Except for, red post will only be for the main walkway, and blue post for security and CCTV camera.

.8 Bollard style light fixtures shall be provided for landscape and student seating area.

.9 Up lights shall be provided for building high lights and accent.

.10 Additional 15% light fixtures with integrated chips and *Drivers **(26 50 00)*** (excluding poles) shall be provided as spare parts. A minimum of two of each fixture type.

2.4 Interior Lighting Control

.1 Lighting controls shall be minimizing the building lighting system energy use.

.2 Lighting controls shall be readily accessible to occupants.

.3 All control devices shall be low voltage operation.

.4 Lighting control system shall be able to communicate to university of Ottawa BAS.

.5 For multi-zone spaces lighting system design shall consider controlled dimming system.

.6 For the purpose of energy conservation, lighting system design shall include occupancy sensors as a control point, manual control switches for multi-level lighting, daylight harvesting sensors.

.7 *Occupancy Sensors **(26 50 00)*** not to be used I the following locations:

.1 Laboratories.

.2 Washrooms.
.3 Mechanical/electrical room and other service/Utility rooms.

.8 *Occupancy Sensors **(26 50 00)*** to be used in the following locations:
.1 Offices.
.2 Meeting rooms.
.3 Functional spaces/rooms.
.4 Study rooms.
.5 Public gathering space.
.6 Classroom.
.7 Food service space.

.9 Dimming shall be provided for the following spaces:
.1 Classrooms.
.2 Meeting rooms.
.3 AV spaces.
.4 Large gathering spaces such as dining halls.
.5 Laboratories based on the user request.

.10 For enclosed area lighting controls system shall include one control point for each task location or each group of task locations within an area of 45 sq. m. or less

.11 In design of lighting system of large open space where must be used as a whole, lighting control for shall be controlled by a lesser number of controls but not less than one control point per 1500 W (120 VAC) of connected lighting power or a total of three control points whichever is greater.

.12 Where daylight harvesting sensors are provided, lights shall dim, turn off when daylight is available.

.13 Security night lights shall be provided in areas to left ON at all times for safety or CCTV cameras.

.14 Design of lighting controls system shall include low voltage lighting control system capable of communicating with the BAS for either manual or automatic lighting controls.

.15 With the exception of main electrical and generator rooms, battery pack type emergency lighting fixtures are not permitted.

.16 Emergency lighting in main electrical and generator rooms shall consist of battery pack emergency lighting and emergency circuit lighting. The battery pack emergency lighting shall be fed from the emergency lighting circuit from the same space and only turns on due to the emergency power outage.

2.5 Exterior Lighting Controls

.1 Lighting will turn off when sufficient daylight is available.

.2 Parking lot and outdoor space lighting shall be controlled through BAS controls to automatically reduce the power of each luminaire by a minimum of 50% when no activity has been detected in the area illuminated by the controlled luminaires for a time of no longer than 15 minutes.

1.0 GENERAL

1.1 Overview

.1 This following has been prepared to provide consultants with a general overview of Fire-Alarm system requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

.2 Fire Alarm products shall come from reputable and single manufacturers (e.g.: Chubb Edwards or Simplex for Equipment and Accessories; Notifier or Viking for suppression panels).

.3 Warranty period for complete Fire Alarm Panels & System c/w all accessories and wiring shall be minimum 3 years.

.4 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 All fire alarm initiating and signaling devices installed in the public space must have bilingual label.

.2 CSA approved and ULC listed and labelled components for a fully electrically supervised, addressable, microprocessor based, single stage, zoned, modular, fire alarm system.

.3 Design of fire alarm system shall include the following components:

- .1 Main control panel with liquid crystal display (LCD) and integral light emitting diode (LED) annunciator and system software; capacity for required schedule of zones, system points plus minimum additional spare 25% zones and points.
- .2 Remote annunciators
- .3 Alarm initiating devices.
- .4 Alarm signalling devices.
- .5 Batteries and battery chargers, end-of-line devices and required ancillary devices.
- .6 Wiring in conduit

.4 Design of fire alarm system shall be integrated with building automation system.

.5 All devices must be accessible for annual testing and further replacement. Aspiration detectors (VESDA) are acceptable options.

.6 Fire alarm system must be demonstrated in an integrated format to display suitable protection and alarm with other systems such as:

- .1 HVAC.
- .2 Elevators.
- .3 Emergency generator.
- .4 Security access.
- .5 BAS.
- .6 Central monitoring pint and U of O Central Plant.

1.2 Components

.1 Control panel shall have solid-state microprocessor-based technology with LCD and integral LED annunciator with alarm and trouble LED’s for each scheduled zone.

.2 Control panel shall be dead front, modular cabinet assembly with trim, a hinged door with full glazing, a lock, and keys; door provides access to operator controls, but does not expose live electrical connections; controls, indicators, and operating instructions clearly visible through a viewing window; electrical connections are front access through a removable inner protective cover.

.3 Control panel LCD indicates alarms, supervisory service conditions and troubles. Panel includes but is not limited to following:

.1 Minimum 8''(20cm) color touch Screen LCD/LED display.

.2 Up to 2500 addressable point capacity.

.3 Minimum 15 hardwired circuit capacity.

.4 Capable of logging and storing minimum 300 events in an alarm log and minimum 300 events in a trouble log.

.5 Displays must proper function at temperatures near 0 degree.

.4 System provides communication with addressable initiating devices. These devices are annunciated on control panel's main LCD/LED display. Annunciation includes following conditions for each point:

.1 Zone/Device Location.

.2 Type of Device.

.3 Detector Status (Normal/Alarm/Trouble).

.4 Device Missing/Failed.

.5 Fire alarm system shall be capable of servicing the following ancillary devices:

.1 Magnetic door holders to release.

.2 Signal to the elevator controller, security and IT systems.

.3 Signal to BAS.

.4 All designated fans to shut down as per **OBC**.

.5 Signal to the AV for classroom.

.6 Emergency generator.

.6 Remote Annunciators:

.1 Alarm LED for each fire zone.

.2 supervisory LED for each sprinkler and standpipe zone.

.3 Multi-coloured passive graphic display indicating address of device in alarm and details of system operating conditions.

.4 trouble buzzer.

.5 tamper resistant mounting hardware.

.6 Displays must properly function at temperatures near 0 degrees.

.7 Manual Pull Stations:

.1 Manual pull stations to be addressable, single stage, single action, non-coded, semi-flush mounted type. Pull stations are of die cast metal construction with red enamel finish with bilingual lettering. Stations include front break-glass rod, tamper proof reset function, and one set of N/O contacts. Contacts close when handle is pulled down with single action, breaking glass rod and activating fire alarm condition.

.2 Addressable pull station electronics including diagnostic LEDs are mounted on station and distinct address is set on station at time of installation.

.3 Include plaster cover for semi–flush mounting and suitable back box. Where surface mounted include for compatible surface mounted style red box. Include additional

auxiliary set of contacts where required for interconnection to other building systems.

.4 Pull stations located in areas of high abuse or where designated to be complete with guard, with STI type, ULC listed and labelled, hinged clear Lexan cove. Where specified or where required by code or local fire authority, include integral audible alarm to sound when cover is opened.

.8 Heat Detectors:

.1 Detector to be complete with a base plate for mounting to a standard 4" (100 mm) outlet box and cast guards for detectors. Where required, provide an additional alarm relay (Form C, SPDT), normally open contact, for auxiliary functions.

.2 Low silhouette design and twist-lock mounting to base.

.3 Integral microprocessor with non-volatile memory, automatic device mapping, electronic addressing, self-diagnostics and history log.

.4 LED status indication.

.5 Field configurable mounting mechanism to prevent unauthorized removal.

.6 Combination 135°F (57°C) fixed temperature and 15°F (9°C) rate-of-rise type.

.7 135°F (57°C) fixed temperature type.

.9 Photoelectric type and addressable Smoke Detectors:

.1 Sensitivity range from 0.6% to 1.9% per foot.

.2 Identification of dirty or defective detectors.

.3 Each detector to be complete with a base plate equipped with wiring terminals, for mounting to a standard 4" (100 mm) octagon box. Provide cast guards for detectors where identified on drawings. Where required, provide an additional alarm relay (Form C, SPDT), normally open contact, for auxiliary functions.

.10 Duct type smoke detector shall be addressable photoelectric.

.11 Aspirating Smoke Detection shall be provided in the elevator shaft and the space with high-rise ceiling. Acceptable product, VESDA and Simplex XAD. Selection of Aspirating Smoke Detector shall not include single use filters, and design and placement of unit shall take into consideration ease of access and maintenance.

.12 Addressable Interface Module: Addressable interface module: to interface non-addressable devices to the addressable loop including each sprinkler alarm and supervisory device, actuated as a distinct and separate address for each sprinkler supervisory device.

.13 Intelligent Input/Output module: Automatic device mapping, electronic addressing, ground fault detection by address and self-restoring.

.14 Audible/Visual Devices:

.1 Devices include horns, strobes and combination units.

.2 Audibility levels and candela levels of devices to be field selectable and adjustable.

.3 Devices mounted exterior to be complete with "weatherproof" box.

.4 Minimum 94 dBA @ 3 m (10') at low setting.

.5 Strobe to be complete with Lexan lens, field changeable "FIRE" markings and candela output intensity as approved by local fire authority (range from 15 cd to 110 cd).

.15 CSA approved and ULC listed wire and cable, approved for alarm circuits; with colour coded, insulated, solid Copper conductors.

.16 Mineral Insulated (MI) type ULC listed and labelled, and 2-hour fire rated, mineral insulated, Copper sheathed, Copper conductors for power wiring to and between each transponder/control panel and applications.

1.3 Implementation And Testing

.1 Fire alarm annunciator shall be connected to 120 VAC emergency power.

.2 Fire alarm system shall fully supervise the sprinkler system with indication on flow, pressure loss and tamper condition as a minimum.

.3 Fire pump shall fully supervise the fire pump with indication on status, phase reversal and loss, alternate power and trouble.

.4 Fire alarm annunciator shall be located at main entrance to building.

.5 Fire alarm annunciator and fire department connection shall be located in same general area of building.

.6 Wiring shall be CSA approved and ULC listed wire and cable, approved for fire alarm circuits; with colour coded, insulated solid copper conductors, fire rating as per Ontario Building Code.

.7 Fire alarm system shall be provided grounding and bonding.

.8 Building design shall consider device locations to facilitate replacement and testing.

.9 EOL shall install on walls with special test covers, not inside dampers, fire pumps, generators or above ductwork.

.10 Sprinkler ITV shall be accessible and piped to a drain.

.11 For detectors in ceiling tiles, cut tiles in half to have an access tile to hold box while inserting the detector.

.12 Proper labeling on the base of every detector and horn strobes identified (zone#). Labels shall be self-adhesive plastic labels with 6 mm high letters.

.13 Wiring for notifying devices, such as, speaker/horns, shall be max 14 awg.

.14 For larger building, maximum 50 devices per loop.

.15 The location of alarm initiating devices must be readily accessible and maintainable without any obstructions for testing.

.16 Building Fire Alarm panel shall be connected to an external monitoring center chosen by the University of Ottawa, rather than to the central monitoring panel at 720 King Edward Ave.

.17 Update addressable messages to reflect modified room numbers and spaces.

.18 In addition to wiring connections to fire alarm system components, extend control wiring in conduit to (where applicable):

- .1 Fire protection system piping supervised valves and flow switches for alarm initiation.
- .2 Fire protection system piping supervised valves and flow switches for trouble indication.
- .3 Fire protection piping pressure sensors for loss of pressure trouble indication.
- .4 Fan equipment starters.
- .5 Fire pump.
- .6 Fire dampers.
- .7 Door holders/releases and electromagnetic locks master release/reset;
- .8 Telephone system key switch for connection to offsite central monitoring station;
- .9 Elevators.
- .10 Security systems.
- .11 BAS system.
- .12 Emergency system.

.19 Fire alarm panel will be installed to meet CAN/ULC S524 inspected and tested to meet CAN/ULC S536 and verified to CAN/ULC S537. Integrated Systems Testing CAN/ULC S1001 must be included, therefore, tender scope with testing shall include the following, but not

limited to:

.1 Sprinkler monitoring devices.

.2 Mechanical equipment, such as AHU.

.3 Elevator recall.

.4 Security/access control interaction.

.5 Generator and fire pump monitoring.

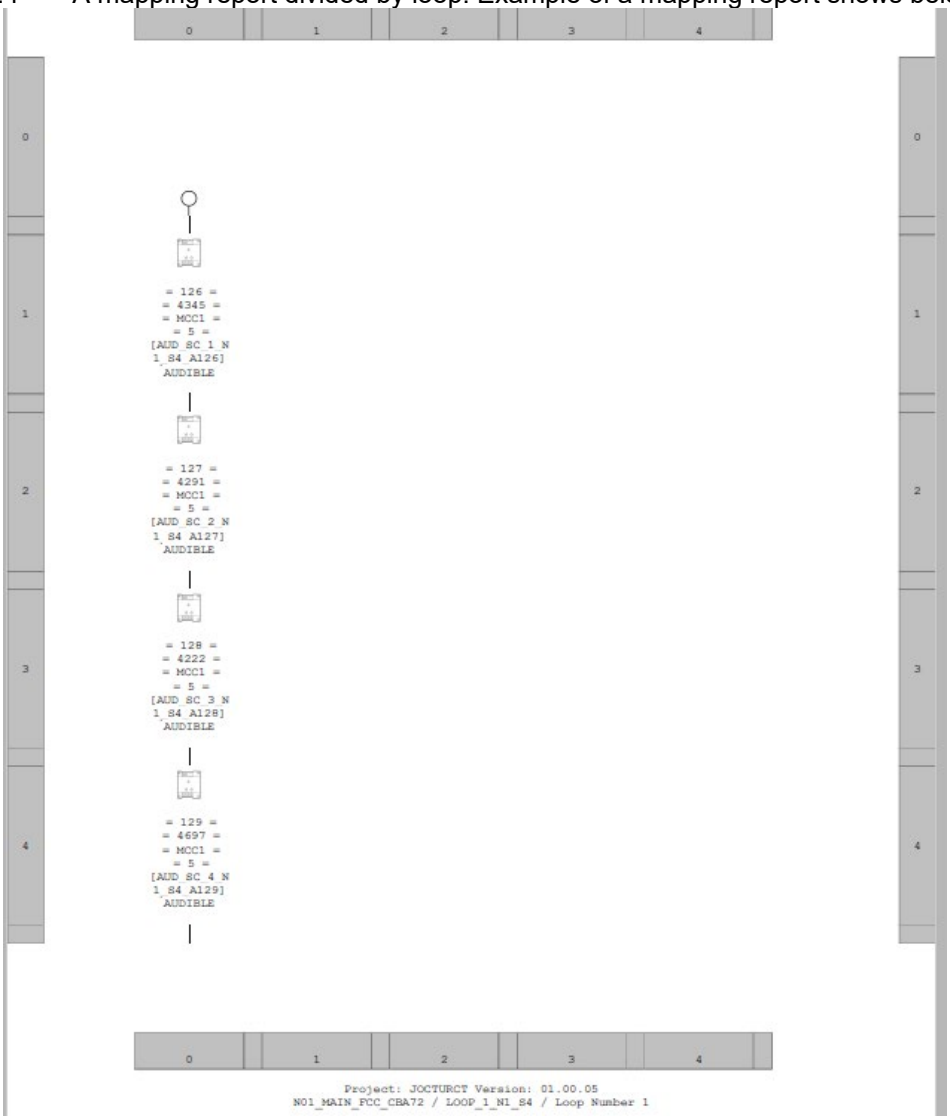
.20 The following reports (new and updated) shall be provided in pdf and pap format (to be installed, in a Large enough cabinet to hold these documents - Usually a small fire panel tub approx. 18x24in with same key as fire panel, near the fire panel):

.1 F/A electrical plan, F/A VI report.

.2 Sequence of operation (for smoke control, suppression system). Parts list and manuals.

.3 Integrated Systems, Testing reports.

.4 A mapping report divided by loop. Example of a mapping report shows below:



1.0 GENERAL

1.1 Overview

.1 This section has been prepared to provide consultants with a general overview of Emergency Power systems design requirements for new buildings and renovations in existing building. For all related systems, consultation with other sections of this guideline and/or **Facilities** shall be carried out to determine the specific scope of requirements suitable under consideration. All designs shall be reviewed by **Facilities**.

.2 The requested studies or tests indicated in this section, applies only for new buildings or major service upgrade and similar projects.

2.0 DESIGN

2.1 General

.1 Emergency generator sizing shall be based on demand calculation rather than on the entire load operating simultaneously. The diversity factor shall be based on the existing building operation, NOT from other projects or standards.

.2 The acoustic study shall be completed and submitted at the design stage.

.3 Design of EPS shall include connection to a 100% rated resistive loadbank.

.4 Design of EPS shall operate at 600V, 3 phase, 60 Hz and capable of handling 20% total harmonic distortion as a minimum.

.5 Prevision of mobile generator and loadbank connections is required.

.6 Emergency generator shall be sized capable of handling the following loads plus 20% additional load:

- .1 Life Safety Systems: Including but not limited to:
  - .1 Emergency egress lighting.
  - .2 Egress signage.
  - .3 Communications systems.
  - .4 Fire alarm systems.
  - .5 Self-contained, battery-powered lighting at generator set location.
  - .6 Fire suppression systems (fire pumps, compressors, valves, etc.).
  - .7 Security, intrusion detection and access control systems.
  - .8 Automatic doors used for egress.
  - .9 Elevators.
  - .10 Generator day tank pump.
- .2 Base Building Systems:
  - .1 All major HVAC equipment including,not limited to chillers, boilers, cooling tower, domestic water heaters, make-up air system, lab exhaust fans, biosafety equipment/devices.
  - .2 The following duplex pumps (if applicable). For each equipment, only one to be operational during loss of normal power:
    - .1 Sewage ejectors
    - .2 Storm sump pumps
    - .3 Elevator sump pumps
    - .4 Domestic booster pumps
  - .3 Pumps, components and all devices associated with fuel stored in large storage tanks serving the emergency generator
  - .4 Lighting provided at the generator.
  - .5 One elevator per bank of elevators. All elevators shall be on emergency power with only one elevator per each bank of elevators to run at a given time. The lock-out of the elevators shall be provided by the elevator controller.
  - .6 One light fixture per module per laboratory (minimum).
  - .7 Laboratory equipment alarm monitoring system.

.8 I.T. Infrastructure / Backup system Computer room.
.9 Building Automation System (B.A.S.)
.10 Medical / Scientific Equipment/Systems: (not apply to all buildings, requirement is from end-user)
.11 High-value specimen refrigerators (4°C Refrigerators), freezers (-80°C and -20°C), cold rooms, warm rooms and Controlled Temperature Environmental (C.T.E.) Rooms equipment.

.7 Ventilation and heating system of Emergency Generator room shall be designed in such to operate as follow:
.1 Air intake and outlet dampers are closed when the engine is not in operation;
.2 On engine start air intake damper opens (minimum position of air intake damper shall be set by manual potentiometer);
.3 Generator room thermostat modulates the air intake and outlet dampers to maintain room setpoint;
.4 Ventilation fan starts when air intake damper is 90% open;
.5 Heating system maintains the room temperature at above 18°C.

2.2 System details

.1 Generating system consists of followings and shall meet CSA 282-2019 and comply with T.S.S.A. oil burning Appliance requirements:
.1 Diesel engine, suitable for Diesel.
.2 Alternator.
.3 Generator control panel and remote HMI
.4 Automatic transfer equipment.
.5 Battery charger and battery.
.6 Automatic engine room ventilation system
.7 Fuel supply system suitable for Diesel and Bio-diesel fuel.
.8 Exhaust system silencer and flex connection.
.9 Steel mounting base.
.10 Synchronizing panel and associated controls.
.11 Manual by-pass switch.
.12 Electronic fuel level indicator to be provided with output to B.A.S.
.13 Engine controller to be BACnet and must be able to interface with DELTA BAS for
.14 Fuel level.
.15 Engine run status.
.16 Engine alarms.

.2 System designed to operate as an emergency standby system.

2.3 Automatic Transfer Switch

.1 Automatic load transfer equipment to include:
.1 LED display
.2 Monitor voltage on all phases of normal power supply.
.3 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below pre-set adjustable limits for an adjustable period of time.
.4 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
.5 Transfer load from standby unit to the normal power supply when normal power restored, confirmed by sensing of voltage on all phases above the adjustable pre-set limit for the adjustable time period.
.6 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

.2 Contactor Type Transfer Equipment:

.1 Two-3 phase contactors mounted on a common frame, in double throw arrangement, mechanically and electrically interlocked, solenoid operated, with C.S.A. 1 enclosure.
.2 Rated: 600/347 V, 60 Hz, 4-wire, solid neutral. Ampere rating to be determined by consultant during the design stage.
.3 Main contacts: silver surfaced, protected by arc disruption means.
.4 Switch and relay contacts, coils, and spring and control elements accessible for inspection and maintenance from the front of the panel without removal of the switch panel or disconnection of drive linkages and power conductors.
.5 Auxiliary contact: silver plated to initiate emergency generator start-up on the failure of normal power.
.6 Fault withstand rating: kAIC rating shall conform with the short circuit study.
.7 A lever to operate the switch manually when the switch is isolated.
.8 Solid neutral bar, 100% rating.

.3 Controls:
.1 Selector switch - four position "Test", "Auto", "Manual", "Engine start".
.2 Test position - Normal power failure simulated. The engine starts, and transfer takes place. Return switch to "Auto" to stop the engine.
.3 Auto position - Normal operation of transfer switch on the failure of normal power; retransfers on return of normal voltage and shuts down the engine.
.4 Manual position - The transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
.5 Engine start position - Engine starts but unit will not transfer unless normal power supply fails.
.6 Switch must be returned to "Auto" to stop engine.

.4 Control transformers:
.1 Dry type with 120 V secondary to isolate control circuits from:
.2 Normal power supply.
.3 Emergency power supply.

.5 Relays:
.1 Continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
.2 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and overvoltage protection.
.3 Time delay: normal power to standby, adjustable solid state, 0 to 60 s.
.4 Time delay on engine starting to override momentary power outages or dips, adjustable solid state, 0 to 60 s delay.
.5 Time delay on retransfer from standby to normal power, adjustable 20 s to 30 min.
.6 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 20 s intervals to 10 min.
.7 Time delay during transfer to stop transfer action in neutral position to prevent fast transfer, adjustable, 5 s intervals to 180 s.
.8 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches pre-set adjustable values (set to 100%).
.9 Solid state electronic in-phase monitor, or programmed neutral delay is acceptable.
.10 Provide 3 sets of S.P.D.T. contacts on both normal and emergency supply contactors or breakers and provide interlock wiring to motorized dampers.
.11 Provide manual bypass switch for purpose of maintaining auto bypass switch.

.6 Accessories:
.1 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.
.2 Plant exerciser: 168 h timer to start standby unit once each week for selected interval

but does not transfer load from normal supply. Timer adjustable 0-168 h in 15 min intervals.

.3 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.

.4 Overlapping neutral contacts.

.5 Acceptable material: Consultant shall confirm with University Operation team.

2.4 Installation

.1 Emergency powered receptacles shall have distinctive color or mark (be coloured red).

.2 The emergency generator shall be capable of starting and attaining settled voltage and frequency limits and to accept full rated load to steady state bands within 10 seconds of the loss of normal power within the specified operating temperatures.

.3 Exhaust stack shall be completed with rain shield cap. Exhaust stack shall comply with thee T.S.S.A. requirement.

.4 Any hot surface including exhaust pipe and silencer exceeding 60°C (140°F) shall be insulated.

.5 Generator shall be installed on heavy duty fabricated steel base plate and on concrete housekeeping pad. Base shall be supported on spring type high efficiency isolators complete with leveling bolts, adjustable oil proof snubbers and minimum 6 mm sound pads. Isolators shall be located to carry equal proportion of weight.

.6 Fuel system shall be sized capable to run the emergency generator at full load for at least 24 hours.

.7 Non-metallic fuel hoses shall be steel reinforced rubber type with crimped and swaged end fittings. Non-metallic fuel hoses shall meet T.T.S.A. requirement.

.8 Vent and fill pipes shall be extended to the outside of generator room.

.9 Vent pipe shall be equipped with fill cap and whistle. Electronic fill alarm is not acceptable.

.10 Vent discharge shall be located away from air intake louvers and above the room.

.11 Generators shall be provided with the following least minimums:

- .1 Five fuel filter elements for each type of fuel filter and water separator.
- .2 Five lubrication oil filter elements.
- .3 Three air cleaner elements.

.12 Panels to have:

- .1 One spare control circuit breaker per rating
- .2 One spare control relays and socket per rating and contact arrangement;

.13 One spare contactor operating coil.

.14 The permanent loadbank connection must be installed at ground level and/or shall be readily accessible from the exterior. Otherwise, a permanent loadbank is required beside the generator.

.15 Provide test loadbank access consisting of flexible boots over cable openings behind a hinged insulated door for routing of test bank conductors in enclosure and direct connection to loadbank breaker.

.16 Provide loadbank test breaker c/w shunt trip, interfaced with main breaker. Provide cam lock connectors in weather proof lockable splitter box and locate exterior to generator room. Mount 750mm above finished grade.

.17 Provide indoor L.E.D. luminaires.

.18 Duplex receptacles to be extra heavy duty, specification grade. Switches to be industrial grade with illuminated handles. Devices to be complete with stainless steel faceplates.

.19 Interior conduits to be E.M.T., surface mounted. Final connections to vibrating equipment such as motors and transformers to be liquid type flexible conduits. Surface mounted boxes to be cast FS/FD type boxes with threaded openings and mounting ears.

.20 Exterior surface mounted conduits to be of rigid galvanized steel. Exterior boxes to be weatherproof and corrosion resistant FS/FD type boxes.

.21 Provide ventilation system for genset combustion air-cooling and ventilation. Combustion

air operation must comply with T.S.S.A. requirements or a variance needs to be applied by the manufacturer.

.22 Provide leak detection system for main fuel system.

.23 The fuel fill point must be equipped with a visual and audible stop fill notification.

.24 Provide complete grounding and bonding conductor system, complete with ground bar in enclosure for common connection of grounding and bonding conductors from equipment and exterior ground rods or for connection to main building grounding system.

1.1 GENERAL

1.2 OVERVIEW

.1 This following has been prepared to provide consultants with a general overview of Electric Vehicle (EV) Charging Equipment requirements in existing and new building installations. For all projects consultation with other sections of this guideline and/or **Facilities** will be required to determine the specific scope of requirements suitable to the project under review. All designs shall be reviewed by **Facilities**.

2.0 DESIGN

2.1 General

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

.2 Comply with NFPA 70.

.3 ADA compliant.

.4 Metering: +/- 2 percent from 2 percent to full scale of output (30 A).

.5 EV Charging Equipment Mounting: Bollard mount.

.6 Enclosures:

- .1 Rated for environmental conditions at installed location.
- .2 Water-resistant, thermoplastic and vandal-proof enclosure.
- .3 Outdoor Locations: NEMA 250, Type 3R.
- .4 Aluminum and UV-resistant plastic.
- .5 Paint and Anodized.
- .6 Charging components protected by security screws.
- .7 Charging connectors in locking holsters.
- .8 Meter, modem, and CPU, tamper resistant.

.7 EV Cable and Connectors:

- .1 SAE J1772 NEMA Type 3S connector.
- .2 One connector with locking holster.
- .3 Minimum 25-foot (7.62m) cable with cable management system.
- .4 Heavy duty impact resistant thermoplastic cable management hook with mounting hardware to suit installation.

.8 Electrical Protection:

- .1 Overcurrent, Undervoltage, over voltage, residual current, surge protection, short circuit, over temperature and ground fault.

.9 Status Indicators:

- .1 LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.

.10 Display Screen:

- .1 VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.
- .2 Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.

.11 Networking:

- .1 WAN Communications: Cellular GSM/GPRS and CDMA.
- .2 LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.
- .3 Capable of remote configuration, diagnostics and reporting.
- .4 Capable of remote software updates (future proof).

.12 Payment System:

- .1 RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.
- .2 PCI (Payment Card Industry) compliant.
- .3 Capable of remote control and authorization including mobile phone application or toll free phone number.

.13 Charging Network: Compatible with the EV charging network.
- .1 Multiple units shall independently connect to charging network.
- .2 Multiple units shall have one unit designated as a master unit that is configured as a gateway unit between the EV charging equipment and the charging network.
- .3 Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

.14 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

.15 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

.16 Integrated On/Off switch to minimize standby power.

.17 Operating Temperature: -30^{0}C to + 50^{0}C (-22^{0}F to +122^{0}F).

2.2 Description of system

.1 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

.2 Surge Withstand: 6 kV at 3000 A.

.3 Integral GFCI.

.4 Auto-GFCI fault retry.

.5 Input Power:
- .1 30A/40 A, 208/240-V ac, 60 Hz, single phase per charger.
- .2 Dual circuits do not need to be interlocked.

.6 EV Charging Levels:
- .1 Dual vehicles, AC Level 2 at up to 7.2 kW (CT4000) or up to 7.7 kW (CPF25) per vehicle.
- .2 Multiple vehicles simultaneously charging at a site using Automatic Power Load Management may be charged up to 7.2 kW (CT4000) or up to 7.7 kw (CPF25) per vehicle.

2.3 Mounting

.1 Comply with NECA 1 and NECA 413.

.2 Concrete Base Mounting:
- .1 Install EV charging equipment on 6-inch (150-mm) nominal-thickness concrete base. Base should be 24-inch (600 mm) diameter or square (minimum 12-inch (300 mm) from the center located conduit stub-up).
- .2 Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
- .3 For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
- .4 Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- .5 Install anchor bolts to elevations required for proper attachment to supported equipment.
- .6 Secure EV charging equipment to concrete base according to manufacturer's written instructions.
- .7 Provide signs and labels at each bollard. Signage requirement shall be University of Ottawa guide lines.
- .8 Pedestal Mounting Pole and Base: Accommodate up to 2 charging stations enabling charging to two parking spots; with charge connector docking bracket and stainless steel hardware; constructed of durable powder coated steel with weather-resistant and corrosion resistant finish.

.3 Bollard Mounting:
  .1 Allow a minimum of 24 inches (600 mm) of clearance around EV charging equipment.
  .2 EV charging equipment receptacles or holders shall be not less than 24 inches (600 mm) and not more than 4 feet (1.2 m) above finished grade.
  .3 Mount EV charging equipment plumb and rigid without distortion of enclosure.
  .4 Secure EV charging equipment according to manufacturer's written instructions.
.4 Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.
.5 Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
.6 Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
.7 Secure covers to enclosure.
.8 Warranty period for electric vehicle chargers shall be minimum 3 years from date of substantial completion.

2.4 Identification

.1 Identify system components, wiring, cabling, and terminals.
.2 Tests and Inspections:
  .1 For each unit of EV charging equipment, perform the following tests and inspections:
    .1 Unit self-test.
    .2 Operation test with load bank.
    .3 Operation test with EV.
    .4 Network communications test.
.3 EV charging equipment will be considered defective if it does not pass tests and inspections.

1.0 GENERAL

1.1 Overview

.1 This following has been prepared to provide Designers with a general overview of **SPS** requirements in new building installations. In all cases further consultation with **UofO SPS** will be required to determine the specific scope of requirements suitable to the project under review. A full security Audit is to be executed with the client representatives of the space to fully understand the needs.

1.2 Design

.1 General: Unless otherwise noted, the building security systems may provide for some or all of the following features:

- .1 Segregates the administrative areas and public / teaching areas, so that the Administrative areas can easily be secured after certain hours.
- .2 May include electronic access control to the exterior doors of the building which will limit access after certain hours and holidays. Main access points may have CCTV coverage which will be digitally recorded and viewable live at Protection Services dispatch center.
- .3 Access control at strategic locations, requirements to be identified by the clients/tenants during security audit.
- .4 Registrars controlled classrooms are typically secured with access control as per the Multimedia standard system, now in place across campus.
- .5 Emergency Code Blue type Emergency telephones may be required at strategic locations within the public locations. These will all have a Pan Tilt Zoom camera associated to them.
- .6 ATM banking machines are to have a PTZ camera associated.
- .7 All 24 Hr computer labs will have fixed cameras installed covering the labs activity as a safety feature.
- .8 Where applicable elevators will be equipped with access control readers to restrict access to floors as required, All cabs will be equipped with a CCTV cameras and emergency call boxes.
- .9 Where applicable, exterior Pan Tilt Zoom (PTZ) camera will be installed on the exterior wall(s).
- .10 Panic alarms to Protection Services that handle cash require a dedicated CCTV camera.
- .11 Emergency buttons shall be installed in every Individual / Universal Washroom, or totally enclosed stall within a Common washroom. Signal to interface with **UofO** Security Network.

.2 Conduits / cable trays:

- .1 Security system cabling is generally installed using a combination of conduit, cable tray and free air.
- .2 Multimedia Classrooms design should generally provide conduits for related security cabling requirements.
- .3 To minimize costs free air cabling can be used in concealed ceiling space or cable trays where available.

.4 No more than two 3/16" cables are typically required to any classroom or card reader location.

.5 When running conduits up to 8 card readers can be daisy chained form one reader location to the next.

.3 Elevators:

.1 A 25mm conduit for CCTV interface and access control with the elevators must be provided into elevator machine rooms from the cable tray system or from the main riser.

.2 Elevator specifications shall be written so as to indicate that the elevator supplier and subcontractors are to coordinate works with **SPS** to interface all CCTV equipment and access control equipment related to elevator security (Floor and camera control).

.3 Each cab travelling cable must have 3 twisted pairs for camera operation, and 4 twisted pair for the card reader system (2X18 AWG).

.4 Elevator control system shall be designed such that **SPS** will be automatically advised when either of cab emergency phones (we generally interface to telephone line and monitor for line loop activation at machine room; we need an individual line activation per cab. Protection has no other requirement as to fire alarm with respect to the elevator).

.4 University communication closets:

.1 **UofO** communication closets shall be designed with approximately 1m2 floor space to install security system controllers. One dedicated four-inch conduit risers shall also be provided between vertical closets for security system requirements. This requirement may vary as per number of security devices required.

.2 **UofO** communication closets shall be provided with one 110 V emergency powered duplex circuit dedicated to security system. In general, all secured doors driven by security controllers will operate with 24 V electrical devices at the doors. Certain doors may nevertheless require 110V /24 V power supply. Controllers are hard wired to 110 V emergency circuits.

.3 Design team shall co-ordinate with **ITS** for the allocation to Security Services of dedicated fiber optic cable links back to 141 Louis Pasteur and Network ports as required by project.

.5 **UofO** Security services requirements:

.1 **ITS** may require CCTV front end equipment additions and Basic Renovations (**OBC**) to accommodate additional CCTV Cameras and digital video recorders. The costs to provide this infrastructure shall be included in the construction project.

1.3 Connections

.1 All building envelope components shall be approved by **SPS**.

.2 Refer to section "**VOLUME III – Division 8. 08 70 00 Finish Hardware**", for all other information related to electrified hardware.

.3 Refer to **"VOLUME VI – Appendix – DR. Doors & Hardware"** Series and related notes for proposed wiring connection details.

1.0 GENERAL

1.1 Overview

.1 This section has been prepared to provide Consultants with a general overview of Environmental requirements for new buildings and renovations in existing buildings.

.2 Environmental considerations are part of all activities and operations within the **UofO**. All Contractors & Consultants must understand their Environmental responsibilities conforming to all related laws and regulations, including, but not limited to, **UofO** related policies, directives, procedures and Guidelines, especially Environmental and Sustainability Policy (Policy 72) on **UofO** Web Site, which contains the following key commitments:

.1 Continual Environmental Performance Improvement.

.2 Pollution Prevention.

.3 Regulatory Compliance.

.3 All obligation, procedures and policies described in this section shall be depending on the project size and design context. Consultants shall review project requirements with **Facilities** - including **ORM** to determine other related required services when the project or any part of the work involves the following, but not limited to:

.1 Excavations greater than $5m^2$ and 15cm deep.

.2 Demolition.

.3 Laboratory and workshop renovations, upgrades, relocation or decommissioning.

.4 Hazardous waste management.

.5 Installation, modification, replacement and decommissioning (or any other work outside regular maintenance), in parts or in whole, for:

- HVAC systems, Boilers & Chillers.
- Fume hoods, canopy hoods and paint booths.
- Exhaust fans, rooftop and wall mounted.
- Stacks.
- Emergency generators and associated fuel systems.
- Storm, sanitary and combined sewer systems.

2.0 ENVIRONMENTAL MANAGEMENT

2.1 Construction Environmental Management Plan (CEMP)

.1 CEMP specific requirements are defined as follow:

.1 Complies with all applicable requirements in the Environmental scope.

.2 Identifies the roles and provides detailed descriptions of the responsibilities and communication protocols of the members of the **GC**'s Environmental team and the **UofO**.

.3 Identifies and provides detailed descriptions of monitoring and reporting requirements.

.4 Sets out the initial list of the sensitive Environmental issues and compliance requirements, in connection with which the **GC** shall prepare Environmental Work Plans described below.

.5 Includes the Component Plans listed below.

.6 Complies with all of the **GC**'s and the **UofO**'s Environmental obligations and policies, listed in this document.

.2 CEMP Component Plans: As applicable and to address the various phases of the work, shall consist, of the following components (as minimum):

.1 Communications Plan: Describing the approach for communicating and collaborating on the project, including all internal and external members of the project team and relevant management stakeholders, the information to be communicated and the methods used. Shall be regularly updated on different phases.

.2 Construction Schedule: Including the schedule for obtaining Environmental studies, permits, authorizations and/or approvals, Environmental tasks towards mitigation and/or compliance measures and, if required, work restrictions planned during the overall project Schedule.

.3 Contaminated Sites Management Plan (CSMP): Identifying additional Environmental studies requirements, areas of soil and/or groundwater contamination and extent of remediation requirements, mitigation options, excess soil management options, and procedures for which the **GC** is responsible and describes the contingency plan for remediation and/or disposal procedures in the event that new or additional contamination is encountered in the course of the project or an accidental release results in soil and/or groundwater contamination. Must also include requirements for long-term monitoring, if applicable.

.4 Air Quality and Dust Control Management Plan (AQDCMP): Describing the measures to be used to control dust during construction and the program that will be implemented to monitor nuisance dust concentrations, ambient particulate matter (PM10 and PM2.5), and ambient air quality.

.5 Surface Erosion Prevention and Sediment Control Plan (SEPCP): Identifying areas and activities that are prone to generate elevated amount of sediments, describe general and Site-specific measures that will be applied to mitigate soil erosion and shallow slope movement, to control sediment-laden flows, and to prevent sediment from entering sanitary and storm sewer systems and adjacent water courses. Shall include a description of the monitoring program that will be implemented on the proposed Site specific measures.

.6 Construction Site Dewatering Plan (CSDP): Identifying measures necessary to plan and manage dewatering operations in compliance with federal, provincial and municipal regulations both prior to and during construction activities. It must describe the general steps and roles and responsibilities with respect to assessment requirements, permits, authorizations and approvals, construction dewatering and disposal procedures, management of construction Site run-off, melt water run-off and sediment control. It shall also include the measures that will be implemented to manage and remove snow from the Site in a timely and efficient manner with considerations for contaminated sediments.

.7 Noise and Vibration Management Plan (NVMP): Describing Site-specific schedule pertaining to noise and vibration-generating activities, procedures and Best Management Practices to control Construction noise emissions including target noise emission levels of equipment, equipment maintenance, management and education, **UofO** community communication, and noise monitoring. The goal is to minimize impacts and allowing the **UofO** Community and **GC** enough time for implementing appropriate identified measures

towards achieving acceptance of unavoidable noise and/or vibration.

.8 Fuels, Chemicals and Materials Storage and Handling Management Plan (FCMSHMP): Describing procedures and Best Management Practices for the transport, inventory and storage of Hazardous Substances, servicing of equipment and equipment operations in Environmentally sensitive areas, including but not limited to, near sewer manholes.

.9 Spill Prevention and Emergency Response Plan (SPERP): Identifying potential spills, list the spill abatement materials and equipment to be stored on the Site, responsible work personnel and external contacts, training procedures, recovery procedures including communications, containment, clean-up, debriefing and follow-up reporting.

.10 Solid and Liquid Waste Management Plan (SLWMP): Describing measures that will be implemented to reduce, reuse and recycle solid waste, as well as the disposal plan for solid, non-hazardous waste.

.11 Water Taking Plan and Discharge Plan - produced by a Qualified Person (QP): As per Ontario regulation 153/04 which estimates the dewatering efforts required, analyze potential impacts and, if required, identify where the water can be discharged. The QP will also need to develop a Discharge Plan if there is any discharge of water to occur.

2.2 Environmental Work Plans (EWP)

.1 General:

.1 EWP demonstrate the measures which the **GC** will implement and follow to protect the Environment and to ensure regulatory compliance. Such compliance requirements to include areas that are defined or referenced in permits, authorizations or approvals which relate to or are required under Environmental laws in connection with the work.

.2 The information shall be clear and concise as to enable the **GC**, any Subcontractor of any tier or any other person engaged or involved in the performance of the work, and their respective representatives, agents, employees and Contractors, to effectively use and understand the EWP in connection with the performance of the work.

.2 EWP specific requirements shall include the following:

.1 A description of the Site, or portion thereof applicable to the work described in the EWP, the part of the work that is to be carried out at such part of the Site, the schedule and duration of such part of the work.

.2 A description (including maps and drawings, as appropriate) of the Environmental issues or requirements at the Site or portion thereof, and adjacent lands, applicable to the work described in the EWP, including regular maintenance activities.

.3 A specification of the applicable sections, terms, conditions and commitments of the CEMP, permits, authorizations and approvals relevant to the specified portion of the Site, the described part of the work, and the described mitigation measures, as applicable.

.4 A description of the expected and scheduled timing of internal Environmental inspections, including full time, daily, and as required inspections, as applicable, and the specific reporting procedures that will apply.

.5 A description of the emergency procedures and relevant 24/7 **GC** complete contact

information, specific to the applicable portion of the Site.

3.0 ENVIRONMENTAL OBLIGATIONS

3.1 Procedure

.1 All Environmental procedures shall be done through the Assistant Director (AD), who is **UofO**'s representative for all Environmental matters at the **ORM**, and is the signing authority for all Environmental approvals, authorizations and permits. He is ensuring:

.1 The Final approval and defined authority on the **GC**'s Environmental strategies.

.2 The applicable **UofO**'s policies, directives, procedures and guidelines are respected or alternative approaches are proposed and approved.

.3 The Environmental issues are mitigated and that all applicable legislative requirements are fulfilled.

3.2 GC's obligations

.1 Depending on the scope, the **GC** Shall:

.1 Perform its duties and obligations in accordance with Best Management Practices with regards to Environmental compliance and sustainability laws and regulations.

.2 Manage, identify, plan and coordinate all Environmental obligations and their potential impacts on the project with the **UofO**'s Environmental Management department at the **ORM**.

.3 Observe, comply with, and perform all of its duties and obligations, and cause all persons for whom the **GC** is in law responsible to observe, comply with and perform such duties and obligations.

.4 Notify of any circumstance that may require the **UofO** to provide notice to Federal, Provincial or Municipal authorities, including regional conservation authorities, in accordance with regulatory requirements.

.5 Obtain on behalf of the **UofO** all approvals, authorizations and permits, including amendments to existing approvals (except in relation to existing Environmental compliance approvals), authorizations and permits, which relate to or are required under Federal, Provincial and Municipal legislation in connection with the project or any part of the work in his contractual obligations.

.6 Maintain copies of all documents, reports, plans, figures, analytical data sets, inspections, emission results, procedures and any other relevant records in connection with the project and the performance of the work relating to Environmental matters.

.7 Obtain the authorization of the **UofO**'s AD prior to provide any type of documents or information to any Environmental authority or other stakeholder in connection with the project and the performance of the work relating to Environmental matters.

.8 Submit to the AD for acceptance the preliminary CEMP prior to implementing it and/or submitting to any appropriate Environmental authority or other stakeholder,

.9 Reports:

.1 Promptly forward to the **UofO**'s AD - upon request - a copy of any report, submission, application or other document that is produced or otherwise obtained relating to Environmental matters affecting the work, the Site or any aspect of the project.

.2 Develop, implement, maintain and update CEMP plans and reports (include updates and supplements to reflect all changes) described above.

.3 Prepare monthly Environmental management reports that outline the design and construction activities undertaken and projected, key Environmental issues, summaries of weekly inspection activities, mitigation measures (successes and failures), resolutions to Environmental impacts and compliance with all applicable permits, authorizations and approvals. Shall include all Environmental sub-Consultant reports, Environmental incident reports, specific mitigation plans and sediment and drainage plans.

3.3 Specialists

.1 Depending on the scope:

.1 The **GC** will have available, at all times until the Substantial Completion date, a multi-disciplinary team of qualified Environmental specialists and thereafter shall have available such a team to the extent relevant to the **GC**'s obligations that continue after the Substantial Completion date until the expiry of the Warranty Period.

.2 The multi-disciplinary team of qualified Environmental specialists shall ensure the day-to-day implementation of the **GC**'s CEMP.

.3 The job specification and responsibilities of such a team shall include the following:

.1 Identification, planning and management of all Environmental issues and compliance requirements associated with all aspects of the Work on a day-to-day basis.

.2 Complete internal audits on the performance of the CEMP.

.3 Prepare and submit to the **UofO**'s Assistant Director all reports required under the CEMP and all other documentation and information required.

3.4 Contaminated Sites

.1 Contaminants include, but not limited to:

.1 Any groundwater, surface water, soil, building material or other material on the Site which contains any hazardous substance which exceeds the **MECP** background standards or the standards permitted for use at the Site under applicable Environmental Laws and Regulations, including the Records of Site Condition regulation 153/04 under the Environmental Protection Act (Ontario).

.2 If the **GC** is in law responsible excavates, disturbs, moves, manipulates, treats, pumps, transports or otherwise handles or deals with, or is required to do any of the foregoing for the purposes of the work for any Contaminant on the Site (whether such contamination is existing, foreseeable, non-foreseeable or subsequent), the **GC** shall:

.1 Obtain from an independent and qualified Environmental Consultant, accepted by the **UofO**'s AD, the required Environmental Site assessment studies for the Site.

.2 Initiate and complete any assessment, remedial, by removal and disposal, such Contaminant as the case may be (unless an alternative method of contamination management is accepted).

.3 Ensure that neither the **GC** nor any person for whom the **GC** is in law responsible contributes to or exacerbates, or causes the leaching or migration of, any contamination on the Site or onto any adjacent properties, including the sewer systems, land, water or air.

.3 Notifications:

.1 The **GC** shall promptly notify the **ORM** of:

.1 Any release of a hazardous substance or any other occurrence or condition involving hazardous substances at or affecting the **UofO** property.

.2 Any release that may subject the **GC**, sub-contractors or the **UofO** of any fines, penalties, orders, investigations or other proceedings under any Environmental Laws.

.3 The identification of any contamination uncovered in the course of a project which was not disclosed previously.

.4 All charges, orders, investigations or notices of violation or non-compliance issued against the **GC** or relating to the performance of work completed at a **UofO** property under any Environmental law.

.5 Any notice, claim, action or other proceeding by any person against the **GC** or relating to the performance of work completed at a **UofO** property concerning the release or alleged release of any Contaminant.

.2 The **GC** shall immediately notify the relevant Environmental authorities of any release of any hazardous substance at or from a **UofO** property as required pursuant to and in accordance with Environmental laws. In the event of a failure from the **GC** to provide such a notice, the **UofO** may notify the relevant Environmental authorities of such occurrence.

SECTION 01 75 00 – INSPECTION & TESTING

1.0 GENERAL

1.1 Responsibilities

.1 Inspections and Testing done by independent agencies do not, in any way, limit the **GC**'s responsibility for ensuring that products and execution of the work meet contract requirements.

.2 Upon receipt of reports of inspections and tests, **UofO**, in consultation with the Consultants, will decide upon any action that may be required.

1.2 Third party required inspections and testing

.1 General:

.1 Inspections and Testing may be required by jurisdictional authorities, or by the Contract. Companies engaged for Inspections and Testing may be hired by the **UofO**, the **GC**, its Sub-Contractor, or the Consultant, depending on the scope and budget, and shall be determined at the beginning of every project.

.2 Building Envelope Components: Depending on the scale of the Project, scope may include - but not limited to:

.1 Field Testing of Vertical Envelope Components:

.1 Opening's connections (to include sealed chambers as applicable):

.1 Smoke/fog Air Leakage testing as per ASTM E1186 standard entitled "Standard practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems".

.2 Air Leakage testing as per ASTM E783 standard entitled "Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows, Curtain walls or similar".

.3 Resistance to water penetration test as per ASTM E1105 standard entitled "Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls or similar, by Uniform or Cyclic Static Air Pressure Difference".

.4 Opening's connections test to be performed as follow:

.1 One test per different opening type unit (e.g.: curtain wall, window, and similar).

.2 One test per different envelope component intersection with opening unit.

.2 Building Elevations (to be undertaken after the completion of air barrier assemblies, or wall assemblies – as suitable):

.1 Infrared Thermographic surveys as per ASTM C1060 standard entitled "Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings" and CAN/CGSB 149-GP-2MP:

.1 Conducted from outside on all exterior elevations from ground level. All accessible areas will be scanned and recorded on tape.

.2 Conducted from inside on all suspect areas that were identified during the exterior survey.

.2 Overall Smoke/fog Air Leakage testing as per ASTM E1186-17: Exterior & Interior, using smoke or tracer gasses to qualitatively detect or quantify sources of air leakage through building envelope or air barrier assemblies, projected by calibrated fans or permanent building mechanical systems to create negative and positive air pressure differentials in accordance with ASTM E779-19.

.3 Overall thermal performance: Exterior thermographic inspection to locate possible water penetration from exterior sources and of moisture accumulation from interior sources using portable calibrated fans or permanent building mechanical systems to create negative and positive air pressure differentials in accordance with ASTM E799-19.

.4 Standard cut tests of applied self-adhesive membranes at random locations, which involve making a small "V" cut and making a subjective determination of the quality of the adhesion between the membrane and the substrate. As necessary, alongside with the On-Site inspection.

.3 Other:

.1 Concrete Relative humidity as per ASTM F2170 standard entitled "Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs".

.2 Moisture Vapor Emission as per ASTM F1869 standard entitled "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".

.3 Ground Penetrating Radar as per ASTM D6432 standard entitled "Surface Ground Penetrating Radar Method for Subsurface Investigation".

.3 Roofs: To be performed over the completed roof membrane (to be performed *before* the spaces underneath are fully occupied to limit the amount of potential damage). One test per Roof level or area. To pick from one of the followings methods:

.1 24 hour flooded test and review the water tightness of the membrane at the conclusion.

.2 Electrical Capacitance (Impedance) Testing.

.3 Nuclear Moisture Testing.

.4 Electric Field Vector Mapping Testing (EFVM).

.5 Electronic Leak Detection Testing (ELD).

.6 Infrared imaging (ASTM C1153) and CAN/CGSB 149 GP 2MP.

.3 Fire and Smoke Protection Assemblies**:** Depending on City's requirements**,** scope shall include - but not limited to:

.1 Sampling and checking the thickness of fireproofing, confirming the integrity of each firestopping assembly and its installation in conformity with specification design parameters, and as per City's requests. One Test for each different component.

.4 Acoustical Performances: Acoustical performance testing shall confirm the integrity of the different components in accordance with specification design parameters. Generally, an Acoustical performance Testing is required in the following conditions:

.1 Existing renovated Amphitheaters before and after the work.

.2 When an acoustical consultant is requested for particular projects such as musical rooms, Spectacle rooms, Amphitheaters and similar).

.3 In projects including Folding Panels. One Test for each different component.

.5 M&E Components: Refer to relevant related information in sections "**VOLUME I - S. Energy and Sustainability**" through "**VOLUME I - Z10. Environment**".

End of Section

SECTION 01 95 00 – PRODUCTS & QUALITY REQUIREMENTS

1.0 GENERAL

1.1 Design Criteria and Notes

.1 The execution and installed materials shall be conforming with all applicable codes and regulations including **ULC**, **UL** or **cUL** listed tests, and all other norms according to the most recent version.

1.2 Notes

.1 Abandoned equipment: When equipment, wiring, piping, telecommunications cable, etc. is disconnected or "abandoned", it must be physically removed back to source of origin, made safe and disposed of as part of the project.

.2 Structural verification: All issues of shop drawing of elements which deals with structural loads and other supporting systems shall be signed and stamped by a professional Engineer registered in the province. Particularly but not limited to the following:

- .1 Stairs, Ladders, Balustrades and handrails.
- .2 Catwalks, Platforms.
- .3 Support for operable partitions, *Demountable Partitions **(10 22 00)***, *Portable Ceiling lift Devices **(11 14 00)***, ceiling hung projectors and other hung elements.
- .4 Bent plate frames for specialty doors, or wide openings.
- .5 Wall bumpers, Bollards.
- .6 Wall-hung Counter supports.
- .7 Loose lintels, shelf angles and similar masonry supports
- .8 Partitions or Glazing acting like guards, structural steel studs, load-bearing partitions, free standing partitions, framed (self-supported) ceilings.
- .9 Ceilings with resistances to seismic forces.
- .10 All-Glass partitions.
- .11 Exterior wall framing or cladding supporting components, Curtain wall and similar systems.

2.0 PRODUCTS

.1 Definition:

- .1 Materials specified as "Suggested (or equivalent) product", bearing manufacturer's name, are given as reference only, as an indication for the minimum acceptable quality of physical and chemical properties, visual characteristics, texture, performance, etc. The Consultant can submit products as per his choice with similar or higher quality, for **Facilities** approval.
- .2 Materials specified as "**UofO** Standard Product", bearing manufacturer's name, are the minimum required. No alternative submittal will be acceptable.

.2 Provision: Unless otherwise noted, all materials and product listed in the **DCG** are to be supplied and installed by the qualified contractors.

End of Section

SECTION 02 41 00 – DEMOLITION

1.0 GENERAL

1.1 Design Criteria and Notes

.1 General:

- .1 Notify the users and **Facilities** at least five (5) working days in advance before proceeding with demolition work.

.2 Protection and prevention:

- .1 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .2 Notify and obtain approval of utility companies before starting demolition.
- .3 Immediately notify **UofO**, and the utility company concerned in case of damage to any utility or service, designated to remain in place and await instruction regarding remedial action.
- .4 Confirm by a structural engineer before demolishing any structural elements.
- .5 Provide scanning of concrete floor slab, walls and block walls, whenever coring, drilling or bolting is required. to be confirmed by **Facilities**.
- .6 Core drilling shall be done before 8:00 am or after working hours.
- .7 Take all necessary steps to prevent movement, settlement or damage of adjacent areas and services. Provide bracing, shoring and underpinning as required.
- .8 Provide protection for new and existing work, for material, equipment, fixtures and accessories which must remain undamaged for whatever reason.

.3 Demolition work:

- .1 Plan and execute each operation in a secure way and with the objective of minimum disturbance, noise and vibration to the users of the existing services.
- .2 Demolish in a manner to minimize or eliminate dust. All cutting through Concrete, Stone, Masonry elements or similar shall be done through wet cutting methods.

.4 Openings in existing Building Envelope:

- .1 Ensure that demolition work involving exterior walls is performed adequately to always provide continuous protection against water infiltration. Repair and finish with same materials as existing, or as indicated. Provide continuous air/vapour/ waterproofing membranes as well as of thermal insulation at the end of each working day to prevent inside condensation and excessive heat loss.
- .2 Make necessary cuttings, holes and penetrations in the existing walls and roof to provide passageways for mechanical/electrical services or special equipment, or for other reasons.
- .3 Cut existing membrane, insulation and vapour barriers properly and execute with precision the holes or penetrations through the roof deck or the wall materials.
- .4 After installation of services or other elements, build required curbs on roof and make necessary repairs to the vapour barrier, insulation and membrane, including flashings, flexible flashings, and caulking to seal perfectly around these elements and ensure their continuity.
- .5 Ensure continuity of air/vapour barriers and insulation of walls affected.

.6 Do not perforate steel deck or interior metal liner panels.

.7 Repair and make good any parts of the roofing or walls that have been affected by the work of this Section or any other Section.

.8 Provide weathertight safety enclosures if openings in the building envelope shall remain open for construction work.

.5 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling or dispose in accordance with the related section **"VOLUME I – Z10. Environment"**.

End of Section

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE & STEEL DECK

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Concrete:

.1 Concrete floors to be designed in accordance with CAN/CSA-A23.1 – 27.3.

.2 Exposed concrete:

.1 Architectural concrete finishing to be approved by **UofO**.

.2 Ensure that exposed concrete surfaces are dense, even, uniform in color, texture, and distribution of exposed aggregates, free from defects such as honeycombing, voids, loss of fines, visible flow lines, cold joints, excessive bug holes, inadequate cover to reinforcement and incorrect tie holes, spacers, reglets, formwork joints or construction joints.

.3 Ensure that exposed concrete members have sharp accurate definitions of corners, reglets, etc. and are free from chips and spalls.

.4 Failure to meet all the above requirements shall be cause for rejection at the discretion of **UofO**.

.3 Only use corrosion coated Materials on reinforcement.

.4 For exposed prefabricated concrete units, on site patching for Concrete is not permitted without approval of **UofO**.

.5 Slab-on-grade:

.1 Unless otherwise noted with project specifics, the at-grade slabs are expected to be composed of a minimum 150 mm concrete on compacted granular sub-base base and shall be in agreement with recommendations by the geotechnical engineer.

.2 Slab on grade control joints may be created by saw cuts. Construction joints to be spaced at a maximum of 30 m, control joints to be located at a maximum of 30 times the slab thickness, but not more than 5m. Extensive cracking with cracks more than 3mm in width shall be cause for rejection by the University of Ottawa. Floor flatness shall be in accordance with CSA A23.1 with a floor flatness class of A.

03 Extensive cracking or cracks in excess of 3mm in width shall be cause for rejection at the discretion of **UofO**.

.6 Sustainability

.1 To reduce the embodied carbon of structural materials, the usage of Portland Limestone Cement shall be specified for all general use concrete work.

.2 The usage of fly ash or slag for all poured concrete shall be maximized as much as possible.

.2 Steel:

.1 Structural steel floors to be designed in accordance with CAN/CSA-S136.

.2 Provide flashing at columns and points of discontinuity to prevent leakage of mortar when concrete is placed over deck.

.3 Provide edge forming for concrete slabs over deck.

.4 Exercise particular care in erection of exposed deck. Sections which are dented, damaged or perforated by welding will not be accepted.

.5 Where deck slopes steeply, fasteners may be substituted for welding of deck to support.

End of Section

SECTION 03 45 00 – ARCHITECTURAL PRECAST CONCRETE

1.0 GENERAL

1.1 Extended Warranty

.1 Precast architectural elements shall be guaranteed from sapling or show visible evidence of cracking or any deterioration and shall meet the design criteria and protect the building against air and water infiltration for a period of 5 years.

1.2 Design Criteria and Notes

.1 Panels to be sealed by double caulking lines with vented cavity, drained to the exterior with tubular vents.

.2 Anchors for Precast elements to be generally in hot dipped Galvanized steel. Use Stainless steel polished Finish #2B (Grade 316) for below grade use.

2.0 PRODUCTS

2.1 Precast Panels

.1 *Precast Concrete Insulated Sandwich Panels:*

.1 Composed of an outer skin of 125 mm (5") thickness and inner skin of 76 mm or 102 mm (3" or 4") thickness, and 76 mm (3") thick or more rigid *Polyisocyanurate Board Wall Insulation* ***(07 20 00)*** in between, with interior joints and exposed ends of insulation board sealed.

.2 The two concrete skins to be held together by means of stainless steel ties.

.3 On the perimeter of sandwich panels, provide 200 mm (8") extension of vapour barrier on rear of insulation using *Modified bitumen, air/vapour barrier sheet (**07 10 00**)*, turn and glue it to the insulation and concrete surfaces.

- Suggested (or equivalent) Product:

.1 Permacon Group Inc.

2.2 Accessories

.1 *Tube Vent:* Tube in UV stabilized polypropylene, used in the mortar joints of block or brick wall for allowing water to flow from behind the substrate.

- Suggested (or equivalent) Product, as manufactured by:

.1 Hohmann & Barnard (Dur-o-wal) Limited.

.2 Muphco Ltmited.

End of Section

SECTION 04 80 00 – MASONRY & STONEWORK

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Do not select a masonry or stone of unit face design, colour, size or shape that will be difficult or impractical to duplicate at a later date, for renovations or future additions.

.2 Do not sandblast exterior masonry as a restoration process.

.3 Install movement joints of 16mm as by best recommended practices, and:

.1 At all junctions with structural columns or elements.

.2 At connection between existing and new partitions.

.3 At intersection between main & intersecting partitions.

.4 At intervals @ ±7620 mm o/c, and as recommended.

.4 Top course of Concrete Masonry partitions or walls, to be 100% solid or filled with mortar.

.5 Exposed Concrete Masonry units used as internal partitions shall have rounded corners at intersections.

.6 Allow tolerances for structural deflection on top of non-load-bearing partitions, to prevent transmission of structural loads to studs. Coordinate with Structure.

.7 Fasteners, ties and support for masonry, stone cladding or similar to be in hot dipped Galvanized steel. Use Stainless steel polished Finish #2B (Grade 316) for popping-out supports below or at grade levels.

.8 Jointing of exterior cladding masonry units to be Concave, Flush, Vee or Weathered. No Beaded, Extruded, Racked, or Struck joints will be acceptable.

2.0 PRODUCTS

2.1 Masonry & Stone Units

.1 *Manufactured Stone Masonry Units*: As per CSA A165, of modular metric.

- Suggested (or equivalent) Product: As manufactured by by Permacon.

.2 *Natural Stone Masonry*: As per ASTM C615, Granite, 32 mm (1¼") thick slabs, square edges.

- Suggested (or equivalent) Product: As manufactured by Milestone Marble & Granite

.3 *Clay Brick*: As per CAN/CSA-A82.1, of modular metric.

- Suggested (or equivalent) Products, as manufactured by:
  .1 Belden Brick .2 Canada Brick

.4 *Concrete Masonry Units*: Regular or reinforced conforming to CSA A165, or ASTM C90 Type 1, grade N-1, heavy or lightweight, cured with low pressure steam curing, with the following characteristics:

.1 Hollow concrete block: Type H/15/A/M.

.2 Solid concrete block: Type S/25/A/M.

- Suggested (or equivalent) Products, as manufactured by (in Ontario):
  .1 Permacon .2 Boehmers
  .3 Atlas Block .4 Niagara Block Inc.

2.2 Mortar and Grout

.1 *Mortar Type "N" (for exterior Masonry)*: Natural color of ingredients.

- Suggested (or equivalent) Product: "Betomix Plus" by Daubois Inc.

.2 *Mortar Type "S" (for interior Masonry)*: Natural colour of the ingredients.

- Suggested (or equivalent) Product: "Blocmix" by Daubois Inc.

.3 *Mortar Type "O" (for restoration and historical buildings)*: Natural colour of the ingredients.

- Suggested (or equivalent) Product: "Blocmix" by Daubois Inc.

2.3 Accessories

.1 *Cavity Drainage Material*: Free-draining mesh made from polymer strands or extruded polypropylene formed cavity units to suit cavity depth, that will not degrade within the wall cavity.

- Suggested (or equivalent) Products:
  - .1 "Mortar Break" by Advanced Building Products Inc.
  - .2 "Mortar Net" by Mortar Net USA, Ltd.

.2 *Compartmentalization Dividers*: Formed 28 gauge Type 304 stainless steel sheet metal. Sealant: one component elastomeric chemical curing.

.3 *Prefabricated Weep Holes & Vents:* Full height of masonry unit, custom lip brick profile, designed to keep weep hole open for passage of air and water, UV stabilized polypropylene.

- Suggested (or equivalent) Products:
  - .1 "Cell-Vent" by Blok-Lok Limited.
  - .2 "343 Weep Hole" by Blok-Lok Limited.

.4 *Brick Masonry Ties*: Hot dip galvanized, adjustable wall ties, rectangular type, double pinned, to tie brick or exterior block work to substrate wall.

- Suggested (or equivalent) Product: "HB-200/DA-213-HS " by Hohmann & Barnard, Inc.

.5 *Cavity Drainage Mat:* Fluid conducting, non-absorbent, mold and mildew resistant polymer mesh consisting of 100% recycled plastic with binder to be a non-woven textile product in random pattern and have voids no greater than 6mm in diameter.

- Suggested (or equivalent) Product: As manufactured by Cav Clear.

End of Section

SECTION 05 40 00 – EXTERIOR METAL FRAMING WALLS, PARAPETS AND SOFFITS

1.0 GENERAL

1.2 Design Criteria and Notes

.1 The maximum deflection allowed shall be L/720 for the stud system.

2.0 PRODUCTS

2.1 Support system

.1 *Exterior Structural Steel Stud System, Galvanized*: Cold rolled steel studs as per CSA S136-01, fabricated from Galvanized zinc coated steel. Depth and thickness as per structural calculations, including Stud top and bottom tracks, Metal furring and similar.

- Suggested (or equivalent) Product: As manufactured by Bailey (BMP) Ltd.

2.2 Sheathing

.1 *Glass Mat Exterior Gypsum Wall Sheathing Board*: 12.7 mm (1/2") or 15.8 mm (5/8") thick as necessary, ends square cut.

- Suggested (or equivalent) Products:
  - .1 "Dens-Glass Gold Gypsum Sheathing" and "Dens-Glass Gold Fireguard Gypsum Sheathing" by Georgia-Pacific.
  - .2 “GlasRoc Exterior Sheathing”, by CertainTeed Canada.

.2 *Lightweight Concrete Board*: Exterior grade cement board, 12.7 mm (1/2") or 15.8 mm (5/8") thick as necessary, manufactured with a lightweight polymer modified cement core and fully embedded alkali resistant fiber glass facings, with tapered edges and square butt ends.

- Suggested (or equivalent) Product: "Permabase" by Unifix.

End of Section

SECTION 05 50 00 - METAL WORK

1.0 GENERAL

1.2 Design Criteria and Notes

.1 Detail and fabricate balustrades / handrails as per National Association of Architectural Metal Manufacturers (NAAMM) Metal Stairs Manual. Design Load criteria shall be as per **OBC** part 4.

.2 Work shall be true to detail, clean, straight, with sharp profile and smooth finish surfaces. No material containing plugged or filled holes permitted.

.3 Use hot dipped galvanized fasteners and anchors for galvanized items, and Stainless Steel fasteners and anchors for stainless steel and aluminum items.

.4 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws and Countersunk exposed fastenings, cut off bolts flush with nuts for exposed item.

.5 Install support at hang-on Countertops perimeter with miscellaneous steel 'C' or 'L' channel, minimum 76mm (H) X 51mm (W) structurally anchored to the walls.

.6 Grind welds smooth and flat, and fill flush with filler compatible with finish coating system, where exposed to view.

.7 Allow for differential movements with assemblies and at junctions of assemblies with surrounding of work.

.8 Insulate between dissimilar metals or between metal and masonry and concrete with bituminous paint to prevent electrolytic action.

.9 Finishes:

Elements: Handrails, guardrails, treads, stairs and similar, or as indicated.	S.S., Grade316L		S.S., Grade 304	Prepainted		Hot dipped Galvanized	Primed steel	FRP	Anodised or Prepainted Aluminum
	Polished Finish #2B	Fine Satin Finish #4		Zinc Powder coating & Polyester Powder coated	Hot dipped Galvanized & Polyester Powder coated				
• High corrosive areas. • CL3 classified Laboratories.	X							X	
• *Countertops and Sinks* (***22 42 01***).	X								
• Exterior or interior elements in contact with exterior grade or on ground floor level close to entrance Lobbies.		X		X	X				X
• Mechanical spaces.							X	X	
• Elsewhere exterior, roofs and similar.						X		X	
• Elsewhere interior.			X				X	X	X
• Elsewhere interior – hidden.							X		

.10 Refer to **"VOLUME VI – Appendix – DL. Miscellaneous Steel Details"** Series and related notes for proposed details configurations.

2.0 PRODUCTS

2.1 Grating, stairs & Ladders

.1 *Steel Grating, Treads & Landings, Antiskid*: Composed of bars 38 mm x 5 mm (1½" x 3/16") and rods, smooth or serrated (antiskid) surface, regular mesh.

- Suggested (or equivalent) Product: "Type 19-W-4" by Russel Metals Inc.

.2 *Fiber Reinforced Polymer (FRP) Grating, Treads, Landings, Anti-Skid*: In moulded gratings, 38mm thick mesh pattern, c/w anti-skid nosing.

- Suggested (or equivalent) Product: "Duragrate Stair tread" by Fiberman Inc.

.3 *Steel Safety Ladder Rungs*: In cold formed steel, 2.28 mm (0.09" / 13 ga) thick, 40 mm (15/8") wide and 28 mm (11/8") high, with 3 holes.

- Suggested (or equivalent) Product: as manufactured by Fisher and Ludlow (Harris Steel Group Inc.).

.4 *Steel Checker Plates, Anti-Skid*: In cold formed steel, 3 mm (.13" / 11 ga) thick, sizes as indicated, with diamond shape anti-ski surface, folded to suit.

- Suggested (or equivalent) Product: as manufactured by Mascot Steel + Tools.

2.2 Accessories

.1 *Access Panels, Primed Steel, Regular Or Fire Resistant*: Cold rolled steel access doors and panels with continuous piano hinges, with manual locks, primed, with galvanized steel corners, regular or fire rated and insulated.

- Suggested (or equivalent) Products: as manufactured by Cendrex:
  - .1 "AHD" model (regular), for masonry walls.
  - .2 "AHD GYP" model (flush), for gypsum walls and ceilings (metal faced).
  - .3 "AHA GYP" model (recessed), for gypsum walls and ceilings (gypsum or tile faced).
  - .4 "PFI" model (fire rated and insulated).
  - .5 "PFN" model (fire rated non-insulated).

.2 *Tactile Walking Surface Indicators, in Iron*: In Iron - with asphalt dip. Cast-in place, or inserted.

- Suggested (or equivalent) Product: As manufactured by Duralast.

.3 *Tactile Walking Surface Indicators, in Polymer*: In engineered polymer composites - reinforced with fiberglass, and integral colour. Cast-in place, or inserted.

- Suggested (or equivalent) Product: As manufactured by Kinesik Engineered Products.

.4 *Carborundum Anti-Skid Strips*: Inserted, manufactured from a choice of 1.6mm galvanised metal, Stainless Steel or Aluminium, coated with a mix of two-part acrylic polyurethane and an aluminium oxide granule.

- Suggested (or equivalent) Product: As manufactured by Floorsafe Inc.

End of Section

SECTION 06 10 00 – WOOD AND PLASTIC WORK

1.0 GENERAL

1.1 Extended Warranty

.1 Panel material with laminated plastics wood veneers shall be guaranteed against warp of delaminate for a period of 2 years.

1.2 Design Criteria and Notes

.1 Criteria:

.1 Do finish carpentry as per Architectural Woodwork Manufacturers Association of Canada (AWMAC) quality standards, Premium Grade; and the finishing of the finish per Architectural Woodwork Institute AWI quality standards.

.2 Fabrication of laminated elements: Comply with National Electrical Manufacturers Association (NEMA): ANSI/NEMA LD3 and Decorative. Laminate Products Association (DLPA) Standards.

.3 Wood for laminated work to be FSC (Forest stewardship Council) certified.

.2 Application: Use the following Materials, as suitable:

.1 Counter tops:

.1 *Particleboard Panel, or Plywood Panel,* or *Medium Density Fibreboard MDF Panel* 19mm, covered with *Regular or Abuse resistant plastic laminate*.

.2 *Solid Homogeneous Panel*.

.2 Exposed Casework surfaces, Doors, etc.:

.1 *Particleboard Panel* or *Medium Density Fibreboard MDF Panel* 19mm, covered with *Plastic laminate* or *Wood veneer facing*.

.3 Non-exposed surfaces, backs, etc.:

.1 *Particleboard Wood Panel, covered with Melamine* 16mm or 19mm.

.4 Thicknesses:

.a Casework: 19mm.

.b Shelves (adjustable): 19mm @ 915mm long max., and 25mm up to 1220mm long).

.c Doors & Drawers: 16mm.

2.0 PRODUCTS

2.1 Panels & Lumbers

.1 *Plywood Panel:* Douglas fir plywood, as per CSA O121 and CSA O325.0, exterior grade, standard construction, with maximum moisture content of 8% at time of manufacture. Flame spread maximum 150, class III, with the following types:

.1 Good two sides, for finish carpentry and interior work.

.2 Good one side, for rough carpentry and exterior work.

.2 *Particleboard Wood Panel*: Interior mat-formed particleboard, minimum density of 720 kg/m^3 (45 lb/ft^3), sanded faces (grit 120), Type 1, Grade "M2" (industrial).

- Suggested (or equivalent) Products, as manufactured by:
  .1 Tafisa. .2 Uniboard Canada Inc.

.3 *Medium Density Fibreboard MDF Panel*: Density of 770 kg/m, formaldehyde free, smooth faces.

- Suggested (or equivalent) Products:
  .1 "Norbord MDF" by Norbord Industries Inc.
  .2 "Medite II" by Medite Co.
  .3 "Panfibre Excel MDF" by Uniboard Canada Inc.

.10 *Particleboard Wood Panel, covered with Melamine*: Similar to *Particleboard Wood panel*, covered with Melamine resin impregnated decorative sheet thermally fused to both faces of particleboard core, grade M3.

- Suggested (or equivalent) Products, as manufactured by:
  .1 Tafisa. .2 Uniboard Canada Inc.

.11 *Wood Veneer Facing*: 0.508 mm (0.02") or 0.75 mm (1/32") thick rift cut, with edges in solid hardwood, same species as face veneer, or veneer, without hardwood.

2.2 Plastic Laminate

.1 *Regular Plastic Laminate Sheet*: Grade GP (general purpose), and grade PF (post forming). Regular 1.15 mm (0.045") thick, or light duty 0.75 mm (0.030") thick, depending on the use.

.2 *Abuse-Resistant Plastic Laminate Sheet*: A homogeneous non-porous high density composed of paper impregnated with thermosetting resin, with Nanotechnology anti-scratch characteristic.

- Suggested (or equivalent) Products: “Fenix NTM”, by Arpa.

2.3 Solid Composite

.1 *Solid Homogeneous Panel*: Non-porous, homogeneous filled acrylic composite, smooth finished, resistant to marking.

- Suggested (or equivalent) Products: as manufactured by:
  .1 Corian. .2 Hanex

2.4 **Accessories**

.1 *Wall Mount Shelve Adjustable Brackets and Racks:* In steel, ultra-robust, double slot Wall Standards 16-gauge, with double flange brackets 16-gauge (8", 10", and 12" brackets) or 14-gauge (14"-24" brackets), adjustable in 1” (25mm) increments, sizes and configuration as indicated, colour in prepainted white or zinc plated.

- Suggested (or equivalent) Products: “85 & 185 Series”, as manufactured by Knape & Vogt.

End of Section

SECTION 07 10 00 – AIR / MOISTURE / WATER PROTECTION

1.0 GENERAL

1.1 Extended Warranty

.1 The work of the whole moisture, air/vapour protection system shall be guaranteed against failure of performance, by the manufacturers and by the Subcontractor, for a period of 5 years for labour and 10 years for Materials.

.2 Manufacturer representative shall be present at all construction phases to ensure adequate quality control on the installation.

1.2 Design Criteria and Notes

.1 All Air barrier/Vapour retarder membranes at connections with curtain wall mullions, door or window frames and at deflection joints or similar, shall be supported by *Metal Flashing and Coping, Galvanized or Pre-Painted* **(07 40 00)** 26 ga. min. (bent and folded to suit), or similar, where the unsupported gap exceeds 13mm. Otherwise, apply *Silicone Sealant Transitional Membrane*, or similar at those locations.

.2 Exterior door thresholds to be imbibed in a continuous bed of *Exterior Sealant* ***(07 90 00)***.

.3 *Membranes* to be duplicated over irregular or dented shape supports.

2.0 PRODUCTS

2.1 Water proofing Membranes

.1 *Hot Applied Asphalt Waterproofing Membrane*: Hot applied, rubberized asphalt membrane composed of specially selected blend of refined asphalts, synthetic rubber and mineral stabilizers, solids content: 100%; thickness: 5 mm (3/16") average (dry film), with fabric reinforcement; water vapour permeance: 0.6 ng/Pa.m2.s (0.01 perm) for 3 mm (1/8") wet film.

- Suggested (or equivalent) Products:
  - .1 "Elasto-Seal 790-11" by Henry.
  - .2 "6125" by Hydrotech.
  - .3 "PQ 6100" by Permaquik.

-With Fabric Reinforcing System: spun polyester fabric, min. 0.2 mm (8 mils) thick.

- Suggested (or equivalent) Products:
  - .1 "Polyester fabric" by Henry.
  - .2 "Reemay 2016" by Hydrotech.
  - .3 "PQ 2016" by Parmaquik.

.2 *Bituminous Damp Proofing Membrane*: Premium quality, medium consistency, solvent type damp proofing compound of selected asphalts and fibres, with a water vapour permeance at 3 mm (1/8") wet film of 2.9 ng/Pa.m².s (0.05 perms).

- Suggested (or equivalent) Product: "710-11" by Henry.

.3 *Cementitious Waterproofing*: A special formulation powder containing organic and inorganic cementitious material, used as a slurry coating, with dry film thickness 1.5 mm (1/16") for Base coat and 1.5 mm (1/16") for Wear coat.

- Suggested (or equivalent) Product: "Krystol T1" (base coat) + "Krystol T2" (wear coat) by Poly-Tech MP Inc.

.4 *Elastomeric Waterproofing Membrane*: A modified asphalt emulsion seamless monolithic membrane using formulated polymers providing elastomeric performance.

- Suggested (or equivalent) Products:
  - .1 "Roller/Brush Rubber " by Cantex, distributed by Krytex Poly-Tech MP Inc.
  - .2 “MasterSeal® HLM 5000” by BASF.

.5 *Self-Adhering Waterproofing Membrane*: A high-performance waterproofing barrier, SBS rubberized asphalt compound, 60 mils (1.5 mm) thick, with hydrostatic head pressures of 231 feet.

- Suggested (or equivalent) Product: "Blueskin WP 200" by Henry.

.6 *Aluminized Polyurethane Coating Waterproofing Membrane* (over Metallic surfaces): Liquid-applied, single-component, heavy duty, with have high tensile strength, tear strength and elongation, all in a viscosity grade that can be used horizontally and vertically.

- Suggested (or equivalent) Product: “Vulkem 801”, by Tremco.

2.2 Air barrier Membranes

.1 *Modified Bitumen, Air Barrier Sheet*: A self-adhered vapour permeable, water resistive air barrier membrane consisting of an engineered film and a patented, permeable adhesive technology with split-back poly-release film, with 1914 ng/Pa.s.m² (33 Perms) water Vapour permeance.

- Suggested (or equivalent) Product: "Blueskin VP160" by Henry.

2.3 Air barrier/Vapour retarder Products

.1 *Polyolefin Vapour Barrier Membrane* (for use under concrete slab on grade): A highly durable polyolefin sheet and a non-tacky adhesive coating, with maximum 1.7 ng/Pa.s.m2 (0.03 perms) water vapour permeance.

- Suggested (or equivalent) Product: "FlorprufeTM 120" by Grace.

.2 *Modified Bitumen, Air/Vapour Barrier Sheet and Thru-Wall Flashing Membranes, Self-Adhesive* (for general use and transition points with adjacent surfaces membrane and through-wall flashing at bottom of masonry walls or at shelf angles, and at bottom of manufactured siding walls):

Self-adhered, SBS modified bitumen membrane reinforced with proprietary glass scrim, or integrally laminated to a cross-laminated polyethylene film (thru-wall), minimum 1.0 mm (40 mil) thick, with maximum 5 ng/Pa.s.m2 (0.08 perms – Method B) water vapour permeance.

- Suggested (or equivalent) Products for general membrane:
  - .1 "Blueskin SA" and "Lo-Temp Blueskin SA" by Henry.
  - .2 "Sopraseal Stick 1100T" by Soprema.
- Suggested (or equivalent) Products for thru-wall membrane:
  - .1 "Blueskin TWF" by Henry.

.3 *Polyethylene Vapour Barrier Membrane, Fire Retardant*: A highly durable polyethylene sheet 10 mills, with 1.7 ng/Pa.s.m2 (0.03 perms) water vapour permeance.

- Suggested (or equivalent) Product: As manufactured by Uline Inc.

.4 *Liquid Emulsion Air and Vapour Barrier Membrane*: One component, liquid applied, elastomeric membrane, cold applied by trowel or spray, with maximum 5 ng/Pa.s.m2 (0.08 perms) water vapour permeance.

- Suggested (or equivalent) Product: "Air-Bloc 32" by Henry.

.5 *Modified Bitumen Air/Vapour Barrier Sheet Membrane, Thermofusible Grade*: Thermofusible, SBS modified bitumen membrane reinforced with proprietary glass scrim, 2.5 mm (100 mils) thick, with maximum 0.2 ng/Pa.m^2.s (0.003 perms) water vapour permeance.

- Suggested (or equivalent) Products:
  - .1 "Blueskin TG" by Henry.
  - .2 "Aquabarrier TG" by IKO.
  - .3 "Sopraseal 60" by Soprema.

.6 *Latex Moisture Vapor Retarder Paint*: Interior Latex combining a primer and finish in a single, fast drying coat, can be topcoated, with any compatible interior latex or alkyd product, 2.4 mils total thickness, with maximum 60.0 ng/Pa.m2.s (1.0 perms) water vapour permeance.

- Suggested (or equivalent) Product: "Moisture Vapor Barrier" by Sherwin-Williams.

2.4 Accessories

.1 *Geo-Drain*: Geo-drain with a dimple core of high-density polyethylene with a non-woven needle-punched filler fabric.

- Suggested (or equivalent) Product:
  - .1 "Hydro-drain 400" by Hydro-tech (vertical surfaces).
  - .2 "Hydro-drain 700" by Hydro-tech (horizontal surfaces)

.2 *Drainage Board*: A polypropylene Three-dimensional polymeric core drain board with a non-woven geotextile fabric fully bonded to the top dimples of the core.

- Suggested (or equivalent) Product: “Henry DB” Series by Henry.

.3 *Silicone Sealant Transitional Membrane*: Self-supportive transitional membrane in preformed silicone elastomer extrusion set in silicone bed.

- Suggested (or equivalent) Product:
  - .1 “123 Silicone Seal Series” and “795 Silicone Building Sealant” by Dow Corning.
  - .2 “Proglaze ETA System” by Tremco.

.4 *Expansion Joint – Pre-Compressible*: Exposed or hidden Preformed, self-expanding foam, sealant system with Silicone pre- coated surface.

- Suggested (or equivalent) Product: As manufactured by EMSEAL Inc.

End of Section

SECTION 07 20 00 – THERMAL INSULATION

1.0 GENERAL

1.2 Design Criteria and Notes

.1 Butt joints tightly and offset vertical joints to form an unbroken thermal barrier. Use largest possible dimensions to reduce number of joints.

2.0 PRODUCTS

2.1 Rigid Insulation

.1 *Extruded Expanded Polystyrene Board Roof Insulation*: Type 4, with shiplapped edges, and joints staggered, RSI = 0.88 / 25 mm (R = 5.00 / 1"), of 240 kPa (35 psi) compressive strength.

- Suggested (or equivalent) Products:
  - .1 "Celfort 350" by Owens Corning.
  - .2 "Roofmate" by Dow Chemical.

.2 *Extruded Expanded Polystyrene Board Wall Insulation*: Type 4, ship lapped edges, RSI = 0.88 / 25 mm (R = 5 / 1"), minimum compressive strength of 210 kPa (30 psi). Provide appropriate grooves where *Metal furring for application with rigid insulation* are used.

- Suggested (or equivalent) Products:
  - .1 "Celfort 300" by Owens Corning.
  - .2 "Styrofoam SM" by Dow Chemical.
  - .3 "Styrofoam XPS" by Dupont.

.3 *Extruded Expanded Polystyrene Board Wall Insulation with Modified Concrete Facing*: Type 4, thickness as indicated, ship lapped edges, RSI = 0.88 / 25 mm (R = 5 / 1"), minimum compressive strength of 210 KPA (30 psi); with 6 mm (1/4") modified concrete facing.

- Suggested (or equivalent) Product: "Tech-Crete" by CFI.

.4 *Polyisocyanurate Board Wall Insulation with Foil Facer*: Type 1, rigid, closed cell insulation, integrally laminated to tri-laminate foil/kraft/foil facers, outside face non-reflective, inside face non perforated, without CFC, with thermal resistance: RSI value of 1.27 / 25 mm (R = 7.2 / 1"); density: 32 kg/m^3 (2 lb/ft^3); compressive strength: 140 KPA (20 lb/in^2).

- Suggested (or equivalent) Product: "AP Foil-Faced" by Johns Manville.

2.2 Sprayed Insulation

.1 *Sprayed Polyurethane Insulation*: Foam Class 1, RSI = 1.05 / 25 mm (R = 6.00 / 1").

- Suggested (or equivalent) Products:
  - .1 "Airmetic 0223-A100" ("Heatlok 0240") by Demilec.
  - .2 "Airmetic 0223F/A100" by Demilec (for cold weather applications).

.2 *Sprayed or Injected Polyurethane Insulation, Portable System* (in structural members' cavities or similar): Two components, without CFCs, having a density of 28 kg/m^3 (1.75 lbs/ft^3), in a portable dispensing system (not in cans).

- Suggested (or equivalent) Product: "Froth-Pak" by Dow Chemical.

.3 *Polyurethane Foam Adhesive Sealant* (to to fill spaces between frames and adjacent walls): Polymeric insulating sealant, without CFC's single component, low density.

- Suggested (or equivalent) Product: "CF 812" by Hilti

2.3 Semi-Rigid Insulation

.1 *Mineral Fibre Semi-Rigid Board Siding Wall Insulation, Medium Density* (for metal siding panels): Stone wool, Type 1, Class 1, RSI = 0.71 / 25 mm (R = 4.0 / 1"), 32 kg/m^3 (2 lb/ft^3) minimum density.

- Suggested (or equivalent) Product: "Roxul Plus MB" by Roxul.

.2 *Mineral Fibre Semi-Rigid Board Cavity Wall Insulation*: Made of stone wool, Type 2, Class 4, RSI = 0.76 / 25 mm (R = 4.3 / 1"), 72 kg/m^3 (4.5 lb/ft^3) minimum density.

- Suggested (or equivalent) Product: "CavityRock DD" by Roxul.

.3 *Mineral Fibre Semi-Rigid Board Insulation for Curtain Wall*: Made of stone wool, Type 2, Class 4, RSI = 0.75 / 25 mm (R = 4.2 / 1"), 56 kg/m^3 (3.5 lb/ft^3) minimum density.

- Suggested (or equivalent) Product: "CurtainRock" by Roxul.

.4 *Glass Fibre Semi-Rigid Board Insulation with Foil Facer:* Semi-rigid insulation laminated to FSK Vapor-retarder facer. Type 2, Class 4, RSI = 0.76 / 25 mm (R = 4.3 / 1"), 48 kg/m3 minimum density.

- Suggested (or equivalent) Product: "I/S 300 – FSK Faced" by Johns Manville.

2.4 Batt & Flexible Insulation

.1 *Mineral Fibre Flexible Insulation* (for deflection joints): Made of stone wool, RSI = 0.68 / 25 mm (R = 3.86 / 1"), 32 kg/m^3 (2 lb/ft^3) minimum density.

- Suggested (or equivalent) Products:
  - .1 For wood studs: "ComfortBatt" by Roxul.
  - .2 For steel studs: "Roxul Plus" by Roxul.

.2 *Glass Fibre Flexible Insulation* (within metal studs): RSI = 0.70 / 25 mm (R = 4.00 / 1"), of 12.58 kg/m³ (0.79 lb/ft³) density.

- Suggested (or equivalent) Product: "Fiberglas Pink Insulation" by Owens-Corning.

.3 *Mineral Fibre Acoustical Batt Insulation*: Friction fit type insulation, 40 kg/m^3 (2.5 lb/ft^3) minimum density.

- Suggested (or equivalent) Product: "Acoustical Fire Batts (AFB)" by Roxul.

.4 *High Thermal Resistance Blanket* (for thermal bridging points): Thin-profile (starting at 10mm), flexible semi-rigid insulation. RSI = 1.72 / 25mm (R = 9.8) compressive strength 10 psi.

- Suggested (or equivalent) Product:
  - .1 "Spaceloft" by Aspen/Aerogels.
  - .2 "HPI-1000" by Dow Corning.

2.5 Plenum Insulation

.1 *Glass Fibre Flexible Acoustical Liner* (over bulkheads & ceiling tiles): Made of fibreglass bonded with thermosetting resin.

- Suggested (or equivalent) Product: “Permacote Linacoustic Standard" by Johns Manville.

.2 *Flexible Acoustical Buffer* (suspended in plenums): Made of fiberglass, faced with fiberglass cloth and backed with a flame-proof foil (50mm thick), secured with metal track.

- Suggested (or equivalent) Products: “Plenum Barrier Quilt”, by Insul-Quilts.

.3 *Semi-Rigid Acoustical Buffer* (suspended in plenums): Made of mineral wool, faced with a flame-proof foil (50mm thick), secured with metal track.

- Suggested (or equivalent) Products: “Rockfon Plenum Barrier Board”, by Rockfon.

2.6 Polymer & Acrylic Systems

.1 *Plaster System for Foundation Walls*: High performance, polymer-modified, two-component, fast-setting, non-sag cementitious mortar. Thickness from 5 mm (3/16") to 25mm (1").

- Suggested (or equivalent) Product: “SikaTop-123 Plus” by Sika.

.2 *Plaster System, on Insulation or Lightweight Concrete Boards:*

.1 Base coat: of 5 mm (3/16") thickness (on Insulation), or 1.6 mm (1/16") thickness (on *Lightweight concrete board* **(05 40 00)**, composed of 2 parts by mass of 100% acrylic product and 1 part of Type 10 Portland cement, having after 28 days an impact resistance greater than 3.5 MPa, a compression resistance of 37.6 MPa, a tension resistance of 3.6 MPa and a bending strength of 9.3 Mpa, with joint tape at the transition points (starter mesh), and Glass Fibre reinforcing on the total surface.

.2 Finish coat: alkali, humidity and mildew resistant, ready mixes, 100% acrylic polymer based coating, standard light sand texture, natural grey.

- Suggested (or equivalent) Products:
  - .1 For Insulation system:"Adex-HC" by Adex Systems Inc. (Groupe BAO)
  - .2 For concrete board system: “Unifix System" by Unifix Inc.

2.6 Accessories

.1 *Sound Barrier Sheet* (In the Studs or though Drywall Layers): A mass loaded vinyl (MLV), to increase STC ratings of walls, floors & ceilings. Can be used in new construction and also to correct noise problems in existing spaces, 3mm or 6mm thick.

- Suggested (or equivalent) Product: “Audioseal Sound Barrier” by Acoustical Solutions.

.2 *Metal Furrings, for Application With Rigid Insulation*: "U" or "L" shaped, min. 0.38 mm (28 ga) thick, galvanized, for drywall installation. Use custom fabricated 0.91mm (20 ga) thick furrings of bent plate, and of similar shape for the soffit application.

- Suggested (or equivalent) Products: As manufactured by:
  - .1 Owens Corning.
  - .2 Dow Chemical.

.2 *Insulation Fasteners*: Soft washer and pin type, direct fasten type: polyethylene washer, corrosion resistant fastener.

- Suggested (or equivalent) Product: “X-SW 60 Pins” by Hilti.

End of Section

SECTION 07 30 00 – SHINGLES, ROOF TILES AND COVERING

1.0 GENERAL

1.1 Extended Warranty

.1 The work of the whole shingle roofing system shall be guaranteed against failure of performance, by the manufacturer and by the Contractor, for a period of 20 years for labor and qualified life period for the shingles.

2.0 PRODUCTS

2.1 Shingles

.1 *Asphalt Shingles*: Architectural shingles, with rectangular pattern, and auto adhesive back strips. Weight / square: 350 lbs approximate.

- Suggested (or equivalent) Products:
  - .1 As manufactured by GAF Inc.
  - .2 As manufactured by CertainTeed Inc.

2.2 Underlayment:

.1 *Roofing Felt Underlayment*: Asphalt saturated 15, non-perforated.

- Suggested (or equivalent) Product: as manufactured by BP Shingle.

.2 *Glass Fiber Reinforced Modified Bitumen Waterproofing Membrane for Roofing*: 1.5 mm (60 mils) thick, with mineral granules surface; self-adhesive.

- Suggested (or equivalent) Product: "Gripgard" by BP Shingle.

End of Section

SECTION 07 40 00 – MANUFACTURED SIDING AND CLADDING PANELS

1.0 GENERAL

1.1 Extended Warranty

.1 Metal siding products furnished and installed shall be guaranteed against all defects of fabrication, installation and shall be air and watertight for a period of 5 years.

1.2 Design Criteria and Notes

.1 Metal-to-metal fastenings and accessories shall be fabricated of the same metal, or of a metal which will not set up electrolytic action causing damage to fastenings or components, or both, under most conditions.

.2 All fasteners for aluminum or Composite Panels work shall be stainless steel, as per manufacturer's recommendations and as per ASME B18.6.4-1999.

.3 All exposed screws to have a neoprene washer and be painted same colour as siding.

.4 Fasteners to be self-tapping.

.6 In siding Aluminum panels or similar, provide weepholes to control condensation, including proper inclusion of seals, and provision for breathing, venting and drainage. Do all drilling (for weepholes, etc.) in shop, not on site. (6mm min. @ 600mm o/c).

.7 All *Flashings* to be continuous with same type cleats and concealed fasteners.

2.0 PRODUCTS

2.1 Metallic Exterior Panels

.1 *Exterior Metal Siding Panels, Prepainted*: as per CAN/CGSB-93.4, in galvanized prepainted steel, installed vertically, with smooth surface and interlocking edges, in metal sandwich walls or on other substrates, 0.76 mm (0.03" / 22 ga) thick or as necessary.

- Suggested (or equivalent) Product: As manufactured by VicWest.

.2 *Exterior Metal Siding Panels, Galvanized*: as per CAN/CGSB-93.4, in hot dipped galvanized steel, with overlapping edges, in metal sandwich walls or on other substrates, 0.76 mm (0.03" / 22 ga) min. or as necessary, with Zinc coating in Glavalum Plus.

- Suggested (or equivalent) Product: "$2^{2}/_{3}$" x 7/8" Corrugated", by VicWest.

2.2 Composite Panels

.1 *Glass Fiber Reinforced Concrete Cladding Panels*: composed of inorganic fibre with natural stone and cement, with glass fibre reinforcements.

- Suggested (or equivalent) Product: As manufactured by Synstone.

2.3 Sub-Girts

.1 *Galvanized Steel Sub-Girt System for Walls:* Double or triple system, in galvanized steel "Z", "L" or "U" elements, of thickness as necessary, min. 1.2 mm (cal. 18), to comply to design load specified. Interior and exterior surfaces insulated by means of polyethylene *Insulating strip for metal work, self-adhesive*.

2.4 Interior Air barrier/Vapour retarder Panels

.1 *Interior Metal Liner Panels, Galvanized Or Prepainted*: in galvanized or prepainted steel, installed vertically in metal sandwich walls, with interlocking edges, 0.60 mm (0.02" / 24 ga) min. or as necessary.

- Suggested (or equivalent) Product: "L-800R" or "L-800SR" by VicWest.

2.5 Finishes for Prepainted Aluminum work

.1 *Prepainted Fluoropolymer Coating Finish for Aluminum Surfaces*: a fluoropolymer resin thermosetting coating, treated with and applied in plant, in three coats, of a total dry film thickness of 50.8 microns (2.0 mils), including primer, base coat and transparent finish coat.

- Suggested (or equivalent) Product: "Duranar XL" by PPG.

2.6 Accessories

.1 *Aluminium Flashing And Coping, Anodized*: including all accessories such as alignment bars, brackets, clips, inserts, shims, trims, fillers, sills, gutters as required, AA-5005-H14 alloy and temper, "stretcher level" quality, flat or profiled, minimum 0.81 mm (0.032" /20 ga) min., or as necessary.

.2 *Aluminum Flashing and Coping, Prepainted*: Alloy AA-5005-H14, "stretcher level" quality, minimum 0.81 mm (0.032"/20 ga) min., or as necessary, prepainted.

.3 *Metal Flashing And Coping, Galvanized or Pre-Painted*: Hot dipped galvanized or powder coated, including all accessories such as alignment bars, brackets, clips, inserts, shims, trims, flashings, fillers, sills, gutters, as required, base metal minimum 0.61 mm (24 ga) min., or as necessary, same material, galvanization.

.4 *Insect Screens, Galvanized Steel* (for all gaps bigger than 4mm): Hot dipped galvanized, 0.3 mm (0.012") diameter wire 18 x 14 mesh with 60% free area, secured to the bird-screen frame.

.5 *Insect Screens, Aluminium* (for all gaps bigger than 4mm): 0.3 mm (0.012") diameter aluminum wire, with a stitch of 7.1 x 6.3 / cm^2 (18 x 16 / in^2) and 44% free area, secured to aluminum frame.

.6 *Thermal Breaks*: (Thermal or electrolytic break and/or water-tightness), Insulating strip for metal work, self-adhesive, in cross-linked waterproof polyethylene EVA strip with adhesive on one or both faces, depending on location and required use, 3 mm (1/8") thick.

- Suggested (or equivalent) Product: "Polyethylene #2720" by Jacobs and Thomson (RCR International Inc.).

.7 *Cross-Linked Butyl Preformed Sealant* (at joints between metal liners and sub girts): Of 100% solids, cross-linked butyl rubber.

- Suggested (or equivalent) Product: "440 II Tape" by Tremco.

.8 *Polyethylene Foam EVA Closure Blocking* (for compartmentalization): matching the siding profile, in cross-linked waterproof polyethylene (EVA).

- Suggested (or equivalent) Product: As manufactured by Jacobs and Thompson (RCR International Inc.).

.9 *Thermally Broken Sub-Spacers:* In ceramic, Aluminum composite, or similar, engineered to meet structural requirements.

- Suggested (or equivalent) Products:
  - .1 “TCLIP” by Engineering Assemblies.
  - .2 “TAC Thermal Spacer” by ETG.
  - .3 “Cascadia Clip” by Cascadia Windows & doors.
  - .4 “Iso Clip”, by Northern Facades.

.10 *Synthetic Rubber Based Industrial Sealant* (concealed between overlapping panels): non-skinning.

- Suggested (or equivalent) Product: "JS-773" by Tremco.

End of Section

SECTION 07 50 00 – MEMBRANE ROOFING & PARAPETS

1.0 GENERAL

1.1 Extended Warranty

.1 The work of the full roofing system (including, sheathing, membranes and other) shall be guaranteed against failure of performance by the Contractor for a period of 2 years, and by the Manufacturer for a period of 10 years – non-prorated - for labor and Materials.

1.2 Design Criteria and Notes

.1 For conventional systems, roofing components shall be fully adhered, with the deck sheathing board fastened to the steel supporting structure underneath. Fully mechanically through fastened roofing membrane systems are not acceptable.

.2 Unless cases with particular energy saving concerns, or building specifics, the use of reflective white surfaces should not be considered in the roofing system choice.

.3 In new Buildings, structural decks shall be designed to slope toward the drains to minimize the amount of sloped insulation.

.4 Only non-combustible supporting systems (steel studs, masonry or similar) are allowed in non-combustible buildings for parapets. Plywood is allowed as nailer substrate, provided it doesn't exceed 600mm height, and the Parapet Flashing Membrane is covered by a metal flashing (**OBC** 2024, 3.1.5.3.3 & 4).

.5 For new constructions, Roofs to be designed to have positive slopes of 2% to the drains. Parapets to be designed with tops offering 10% slopes to the roof sides.

.6 On steel deck, fasteners for Support boards shall be anchored against upper flute ribs. The apparent portion shall not exceed the rib depths.

.7 Work shall be carried out in accordance with good Roofing practice and Canadian Roofing Contractors' Association (CRCA).

.8 Install *Lightweight concrete board* ***(05 40 00)*** 300mm deep cement board, same thickness as adjacent described deck sheathing board on the roof perimeter of steel deck, around openings and under all curbs or accessories, for structural consolidation.

.9 Perimeter parapets to be elevated 200mm minimum from the surface. Where the height exceeds 900mm approximate, or wherever handrails are supported on parapets, a structural reinforcement shall be provided within the supporting stud system.

.10 Roof *Vapor Barrier* membrane shall be upturned against parapet framing.

.11 All Roof penetrations to be wrapped in insulated curbs, elevated 200mm minimum from the surface.

.12 Access:

- .1 All Roof Hatches need to be installed at least 2 meters away from perimeter; otherwise, a guard rail should be installed.
- .2 Always provide access to the different roof levels with appropriate means, taking in consideration the size and type of the maintenance elements for equipment.
- .3 Protect roofing system from foot traffic damage at roof access doors, access hatches, around roof mounted mechanical and electrical equipment, and other facilities requiring maintenance access using appropriate *Traffic Elements*.
- .4 Roof anchors shall be considered in the following conditions (to be confirmed by **Facilities**):
  - .1 High roofs or where facades are not easily accessible from grade level.

.2 If an equipment or other similar maintenance access is required on a roof with no guard protection.

2.0 PRODUCTS

2.1 Roof Membranes

.1 *Modified Bitumen Two-Ply Exposed Roofing Membrane, Granule Surfaced*:

.1 Base sheet: SBS polymer modified bitumen roofing membrane, minimum 2.2 mm (90 mils) thick, with a 180 g/m^2 non-woven polyester reinforcement, sanded lower surface for application with mopped asphalt or adhesive, and thermofusible polyethylene covered upper surface for torch application.

- Suggested (or equivalent) Products: mopping asphalt or adhesive applied:
  - .1 "Modified Plus NP180 p/s" by Henry.
  - .2 "Modiflex MP-180-FS-Base" by IKO.
  - .3 "Elastophene 180 PS" by Soprema Inc.

.2 Top sheet: SBS minimum 4 mm (160 mils) thick, with a non-woven polyester reinforcement, thermofusible polyethylene covered back face for torch application and granular finish front face.

- Suggested (or equivalent) Products, torch applied:
  - .1 "Modified Plus NP 250gT4" by Henry.
  - .2 "Torchflex TP-250-Cap" by IKO.
  - .3 "Sopralene Flam 250gr" by Soprema Inc.

.2 *Modified Bitumen Two-Ply Protected Roofing Membrane*:

.1 Base sheet: SBS polymer modified bitumen roofing membrane, minimum 2.2 mm or 3 mm (90 mils or 120 mils) thick, with a non-woven 180 g/m^2 polyester reinforcement, both faces thermofusible polyethylene covered for torch application, or bottom face sanded for mopped asphalt application, and top face with thermofusible polyethylene.

- Suggested (or equivalent) Products:

  Torch applied:
  - .1 "Modified Plus NP180 p/p" by Henry.
  - .2 "Torchflex TP-180-FF-Base" by IKO.
  - .3 "Sopralene Flam 180" by Soprema Inc.

  Mopping asphalt or adhesive applied:
  - .1 "Modified Plus NP180 p/s" by Henry.
  - .2 "Modiflex MP-180-FS-Base" by IKO.
  - .3 "Elastophene 180 PS" by Soprema Inc.

.2 Top Sheet: similar to base sheet, both faces thermofusible polyethylene covered.

- Suggested (or equivalent) Products, torch applied:
  - .1 "Modified Plus NP180 p/p" by Henry.
  - .2 "Torchflex TP-180-FF-Base" by IKO.
  - .3 "Sopralene Flam 180" by Soprema Inc.

.3 *Hot Applied Modified Asphalt Roofing Membrane*: A specially selected blend of refined asphalts, synthetic rubber and mineral stabilizers, with additives for better adhesion and low temperature flexibility, with Polyester Reinforcing sheet fabric, 0.2 mm to 0.25 mm (8-10 mils) thick.

- Suggested (or equivalent) Products:
  - .1 Membrane "Elasto-Seal 790-11" with "Polyester Fabric" by Monsey Henry.
  - .2 Membrane “6125" with "Reemay 2016" by Hydrotech

2.2 Parapet flashing Membrane:

.1 *Modified Bitumen Two-Ply Sheet Flashing Membrane, Granule Surfaced*: (on parapets, curbs, other vertical exposed surfaces):

.1 Base sheet: SBS polymer modified bitumen roofing membrane, minimum 2.5 or 3 mm (100 mils or 120 mils) thick, with a non-woven polyester (or polyester and glass) reinforcement, self-adhesive, with a thermofusible polyethylene covered upper face for torch application.

- Suggested (or equivalent) Products: self-adhesive:
  - .1 "Modified Plus NP180 Tack sheet" by Henry.
  - .2 "Armourbond 180" by IKO.
  - .3 "Sopralene Flam Stick" by Soprema Inc.

.2 Top Sheet: SBS minimum 4 mm (160 mils) thick, with a non-woven polyester reinforcement, thermofusible polyethylene covered back face for torch application and granular finish front face.

- Suggested (or equivalent) Products: Torch applied:
  - .1 "Modified Plus NP 250gT4" or “NP250TUW (white)” by Henry.
  - .2 "Torchflex TP-250-Cap" by IKO.
  - .3 "Sopralene Flam 250gr" by Soprema Inc.

.2 *Liquid Flashing Membrane*: For difficult to adhere situations. One-component polyurethane / bitumen resin membrane.

- Suggested (or equivalent) Product: "Alsan Flashing" (imbibed in granule, for UV protection), by Soprema Inc.,

2.3 Support Boards

.1 *Fibreboard Panels, Regular*: With square edges, asphalt coated on both faces and all edges, 12.7 mm (1/2") min. thick or as necessary.

- Suggested (or equivalent) Products:
  - .1 "Esgard High Strength" by BP Shingles (EMCO).
  - .2 "Cascades II haute performance HP" by Matériaux Cascades Inc.
  - .3 "Xpress Board HD" by Soprema

.2 *Fibreboard Panels, Sloped*: high performance, with square/shiplapped edges, tapered, thickness as necessary.

- Suggested (or equivalent) Products:
  - .1 "Esgard" by BP Shingles (EMCO).
  - .2 As manufactured by Matériaux Cascades Inc.

.3 *Perlite Panels, Regular and Sloped*, Homogeneous, expanded perlite, blended with selected binders and fibers, with waterproof top face, 25 mm (1") thick or as necessary.

- Suggested (or equivalent) Product: "Fesco" by Johns Manville.

2.4 Insulations and Related Products

.1 *Expanded Polystyrene Board Roof Insulation, with Laminated Fibreboard*: Incorporating a fire retardant agent, Type II, RSI = 0.70 / 25 mm (R = 4.0 / 1"), with shiplapped edges, factory laminated by asphalt to 12.7 mm (½") fibreboard panels, Type I, RSI = 0.5/25 mm (R = 2.8/1").

- Suggested (or equivalent) Product: "Izofibre" by Fransyl.

.2 *Expanded Polystyrene Board Roof Insulation, Sloped*: Incorporating a fire retardant agent, Type II, RSI = 0.70 / 25 mm (R = 4.0 / 1"), having a compressive strength of 125.2 kPa (18.21 lbs/in^2), with square edges.

- Suggested (or equivalent) Product: "Bizolon" by Fransyl.

.3 *Expanded Polystyrene Board Roof Insulation, with Sloped Laminated Fibreboard*: Incorporating a fire-retardant agent, Type II, RSI = 0.70 / 25 mm (R = 4.0 / 1"), with square edges, factory laminated by asphalt to 12.7 mm (½") fibreboard panels, RSI = 0.5 / 25 mm (R = 2.8 / 1").

- Suggested (or equivalent) Product: "Bizofibre" by Fransyl.

.4 *Polyisocyanurate Board Roof Insulation Regular and Sloped*: Type III class 2, rigid, closed cell, inorganic/organic felt facing, with ecological expansion agent; RSI = 1.01 / 25 mm (R = 5.7 / 1"). density: 32 kg/m^3 (2 lb/ft^3) ; compressive strength: 158 kPa (23 lb/in^2); edges: square; flame spread/smoke developed values: less than 25. Use two layers where more than 51 mm or 63.7 mm (2" or 2½") is required.

- Suggested (or equivalent) Product: "E'NRG'Y 3" by NRG Polyiso (Johns Manville).

.5 *Extruded Expanded Polystyrene Board Roof Insulation*: Type 4, thickness as shown, with shiplapped edges, and joints staggered, RSI = 0.88 / 25 mm (R = 5.00 / 1"), of 240 kPa (35 psi) compressive strength; with drainage grooves on the underside where required.

- Suggested (or equivalent) Products:
  - .1 "Celfort 350" by Celfortec.
  - .2 "Roofmate" by Dow Chemical.

2.5 Air Barrier/Vapour Retarder Membrane

.1 *Asphalt Laminated Kraft Paper Vapour Barrier*: Asphalt laminated double kraft paper vapour retarder, with glass fibre yarn reinforced edges, Type 2.

- Suggested (or equivalent) Products:

.1 "Vapour Bloc" by Henry. .2 "Roof Retarder" by Tremco.
.3 "Armourgard" by Iko.

.2 *Organic Felt Reinforced Two-Ply Asphalt Roofing Membrane*: Organic roofing felts, asphalt saturated, perforated, No. 15 organic felts, in 5 layers (3 and 2), with Regular mopping or Modified elastomeric mopping asphalt.

- Suggested (or equivalent) Product: "No.15 Asphalt Felt Perforated" by IKO Industries Ltd.

.3 *Interconnecting Vapour Barrier Membrane, Asphalt Or Adhesive Applied*: Minimum 2.2 mm (90 mils) thick, with a non-woven 180 g/m^2 polyester reinforcement, with sanded faces.

- Suggested (or equivalent) Products:
  .1 "Modified Plus NP180 s/s" by Henry.
  .2 "Modiflex MP-180-SS-Base" by IKO.
  .3 "Elastophene 180 SS" by Soprema Inc.

.4 *Modified Bitumen One-Ply Vapour Barrier Membrane, Self-Adhesive, Torch or Adhesive Applied*: (for connection between roof and wall Air/vapour-barriers membranes under parapets): to serve also as of minimum 3 mm (120 mils) thick, with a non-woven 180 g/m^2 polyester or 160 g/m^2 non-woven polyester and glass scrim reinforcement, self-adhesive, or with thermofusible polyethylene covered faces.

- Suggested (or equivalent) Products: self-adhesive:
  .1 "Modified Plus NP180 Tack Sheet" (3 mm/120 mils) by Henry.
  .2 "Armourbond 180" (3 mm/120 mils) by IKO.
  .3 "Sopralene Flam Stick" (2.5 mm/100 mils) by Soprema Inc.

- Suggested (or equivalent) Products: Torch applied:
  .1 "Modified Plus NP180 p/p" by Henry.
  .2 "Modiflex MP-180-FF-Base" by IKO.
  .3 "Sopralene Flam 180" by Soprema Inc.

2.6 Deck Sheathing

.1 *Glass Fibre Mat Faced, Silicone Core Gypsum Roof Sheathing Board*: A core of silicone treated gypsum, with inorganic glass mat surfaces, and non-asphaltic surface treatment of the face (primed type), 12.7 mm (1/2") min. thick or as necessary, square edges.

- Suggested (or equivalent) Product: "Dens-Deck" and "Dens-Deck Prime Roof Guard" by Georgia-Pacific.

.2 *Gypsum-Fiber Roof Board*: A high-performance, versatile board with advanced fiber-reinforced technology 9.5 mm (3/8”) min. thickness or as necessary, square edges.

- Suggested (or equivalent) Product: " Securock" by CGC.

2.7 Traffic Elements:

.1 *Concrete Paving Slabs*: Plain face, 610 mm x 610 mm (24" x 24") paver size, 50 mm (2")

thick, natural colour, with prefabricated high density polyethylene grid-type pedestals, integral with spacer ribs, or on a layer of laminated insulation.

- Suggested (or equivalent) Product: "Izodalle" by Fransyl Ltée.

.2 *Modified Bitumen Protection And Traffic Pads*: Precut pieces of the top layer of *Modified bitumen SBS Roofing Membrane*, 915 mm (36") wide by 457 mm (18"), in contrasting colour.

2.8 Accessories

.1 *Chemical Curb System*: 50 mm (2") pourable urethane rubber seal, with precast curb components of fireproof polymer cement or black structural urethane, as necessary.

- Suggested (or equivalent) Product:
  - .1 "ChemCurb" by Chem Link.
  - .2 "Interclip system" by Duomastic.

.2 *Gravel Ballast*: Nonporous material, washed, free from fines, ice, snow or long splinters: well graded, well rounded, Standard Size No.3, as per ASTM D 448, 25 mm to 51 mm (1" to 2"), well graded, having a density of approximately 2643 kg/m^3 (165 lb/ft^3), moisture content not exceeding 0.5%, as per ASTM D 1863, or as per FM Global requirements.

.3 *Polyethylene Film Separation Membrane*: Min. 100 micron (4 mil) thick, Type 2.

- Suggested (or equivalent) Product: as manufactured by W. Ralston.

.4 *Woven Fabric Membrane*: Woven polyolefin or polyethylene fabric, UV stabilized, water permeable.

- Suggested (or equivalent) Products:
  - .1 "Fabrene V.I.E." by Dow Chemical. .2 "Fabroc 400" by Hydrotech.

.5 *Expansion Joint Trim For Roofing* (at exposed joints): A combination of flexible rubber membranes supported by a closed cell foam to form flexible bellows, with two metal flanges.

- Suggested (or equivalent) Product: "Expand-O-Flash" by Johns Manville.

.6 *Expansion Joint Waterproof Membrane* (with high exposure to water): Exposed or hidden elastomeric expansion waterproofing joint membrane, with asphaltic based medium, glued or torched.

.7 *Butyl Flexible Membrane, Reinforced* (for connection between roof and wall Air/vapour-barriers membranes where structural or expansion movement is expected): Flexible flashing membrane composed of a combination of butyl and EPDM polymers, and reinforced with polyester fabric, 1.2 mm (47 mils) thick.

- Suggested (or equivalent) Product: "990-26" by Henry.

.8 *Plywood Panel, Pressure Treated, Water Resistant*: as per CSA O121 and CSA O325.0, exterior grade, standard construction, with maximum moisture content of 8% at time of manufacture, pressure treated with copper alkaline quaternary, in a closed cylinder, in vacuum, to obtain a retention of 6.4 kg/cm^3 of wood.

- Suggested (or equivalent) Product: "NW100" by Timber Specialties (Goodfellow Inc.).

.9 *Roof Accessories & Post supports*: In aluminium or as indicated, complete with the corresponding 2 mm (0.08") thick flashing assemblies and seals.

- Suggested (or equivalent) Products: As manufactured by Thaler.

.10 *Roof Edge Safety Railing Systems*: Modular system, with no penetration to roofing, for flat or up to 3 degrees slope roofs.

- Suggested (or equivalent) Products:
  - .1 “KeeGuard” by KeeSafety.
  - .2 As manufactured by Skyline Group.

.11 *Growing Medium*: Mix of organic and inorganic materials, to retain water, and support and maintain long term life and healthy growth of plant material.

- Suggested (or equivalent) Products: “Rooftop Biomix” by Landsource Organix Ltd.

.12 *Roof Drainage Board*: A polypropylene Three-dimensional polyethylene core drain board with a factory laminated geotextile fabric fully bonded to the top dimples of the core.

- Suggested (or equivalent) Product: “Sopradrain” by Soprema.

.13 *Anti-Root barrier*: A woven and micro-perforated polyethylene fabric.

- Suggested (or equivalent) Product: “Microfab” by Soprema.

.14 *Tray Vegetated System*: Modular tray system c/w planters and growing medium, variable depths from 75mm to 200mm.

- Suggested (or equivalent) Product: “Hybrid modular system” by Liveroof.

.15 *Roof Hatches*: with thermally broken cover and curb, polyisocyanurate insulation (R-20+), and special EPDM gasketing.

- Suggested (or equivalent) Product: “S-50TB” by Bilco.

End of Section

SECTION 07 80 00 - FIRE AND SMOKE PROTECTION

1.0 GENERAL

1.1 Extended Warranty

.1 Caulking work shall be guaranteed against failure for a period of 3 years.

.2 Include coverage of repair or replacement of Firestopping materials, which fail to achieve a smoke tight or watertight seal, exhibits loss of adhesion or cohesion, or do not cure. Sealants that crack, crumble, melt, shrink, run, or stain adjacent surfaces will be considered failed.

1.2 Design Criteria and Notes

.1 All applications of fire and smoke protection assemblies shall be as per tested assemblies UL, ULC, cUL or OBC SB-3. For assemblies not tested and rated, submit proposals based on related designs using accepted design criteria.

.2 A particular attention shall be given to the structural deflection on top of partitions, taking in consideration the compressibility of the fire-rated stopping materials. On head of partitions, compress FRR components (Insulation and / or sealant) with maximum 30% compression to allow structural deflection above.

.3 Pipe & ducts penetrations should be done in accordance with the Engineers specifications.

- Suggested (or equivalent) Systems including but not limited to:

  cUL HW-D-0002, cUL HW-D-0060, HW-D-0061, cUL HW-D-0091, cUL HW-D-0092, cUL HW-D-0330, cUL HW-D-0291, cUL HW-D-0264, cUL HW-D-0538, cUL HW-D-1049, , ULC O504. Hilti Top Track Seal CFS-TTS

  http://www.tremcosealants.com/technical-resources/fire-systems/fire-systems-canada/fire-systems-search-results-canada.aspx#p0000-bo-cw

.4 A certificate, confirming the integrity of each firestopping assembly and its installation in conformity with drawings and specification standards shall be submitted.

.5 Wherever Fire Resistant Rated (FRR) partition meets an Exterior wall or any other non-FRR Partitions, this partition shall penetrate through the core of the other Wall or Partition.

.6 Patch damage to fireproofing caused by testing or by other trades before fireproofing is concealed, or if exposed, before final inspection.

.7 FRR sealants and caulking products shall be in contrasting colors (preferably red) comparing to other sealants in order to facilitate the identification and inspection between rated and non-rated components (partitions, slabs, etc.).

2.0 PRODUCTS

2.1 Insulation

.1 *Mineral Fibre Fire Resistant Batt Insulation*: Stone wool, Type 2, of 72 kg/m3 (4.5 lbs/ft3) density and 6.9 kPa (144 lbs/ft2) compressive strength, compressed at least 25%, of required thickness; flame spread: 0; smoke developed: 5.

- Suggested (or equivalent) Products:

  .1 "Roxul-Safe" by Roxul Inc. .2 "Safing Insulation" by Fibrex.

  .3 "Firebarrier" by A/D.

.2 *Mineral Fibre Fire Resistant Pre-Cut Insulation for steel deck ribs*: For top of wall with metal deck use mineral wool cut to flute configuration to perfectly fit without gaps or voids.

- Suggested (or equivalent) Product: "Speed plugs CP 777" by Hilti.

.3 *Intumescent Coating*: Fireproofing system, interior grade application, with topcoat as necessary for colour coding.

- Suggested (or equivalent) Products:
  - .1 For steel work:
    - .1 "A/D Firefilm" by A/D Fire Protection Systems Inc.
    - .2 "SprayFilm WB3" by Cafco.
    - .3 "Carboline Nullifier S607" by StonCor.
  - .2 For polyurethane or plastic insulation and similar:
    - .1 "Flame Seal TB-C" by FSP.
    - .2 "Monokote Z3306", by Grace.

.4 *Cementitious Fireproofing Coating*: Spray-applied material, without asbestos or mineral wool, providing high fire resistance with fast reliable application. single component. It shall have a bond strength of 16.2 kPa (339 psf) minimum, a compressive strength at 10% deformation of 68.9 kPa (1440 psf) minimum, a dry density of 240 kg/m3 (15 pcf) minimum, a flame spread of 0 and smoke development of 0, for 25 mm (1") thickness.

- Suggested (or equivalent) Products:
  - .1 "Monokote Type MK-6 or Type MK-6/HY" by Grace.
  - .2 "Cafco 400" by Cafco.

.5 *Fire Stop Bricks*: With present dimensions, In Polyurethane Foam, fire and smoke resistant, for temporary or permanent sealing of cables, cable trays and pipes in wall and floor openings.

- Suggested (or equivalent) Product: "CFS-BL", by Hilti.

.6 *Fire Stop Flute Deck Blocks*: In high density rockwool stone wool, in as trapezoidal, square cut, rectangular or round sections. Could include with intumescent smoke seal facing as necessary.

- Suggested (or equivalent) Product: As manufactured by AIM.

2.2 Sealants & Seals

.1 *Silicone Sealant, Fire Resistant,* or *Modified acrylic latex elastomer sealant, fire resistant (*for sealing openings around metal conduits, pipes, and ductwork, and at wall/ceiling junctions, and similar): High performance silicone or modified latex elastomer.

- Suggested (or equivalent) Products: As manufactured by:
  - .1 Tremco. .2 3M Canada. .3 Hilti.

.2 *Intumescent Acrylic Sealant* (for sealing openings around non-metal conduits, pipes and similar): Single-component, water-based firestop sealant that will expand to fill the voids left when combustible materials burn and deteriorate in a fire.

- Suggested (or equivalent) Products: "TREMstop IA+" by Tremco.

.3 *Prefabricated Collar* (for sealing openings around non-metal odd pipe sizes and similar): With a hose clamp sealing system for securing the device around the penetrating items.

- Suggested (or equivalent) Products: “TREMstop D+” by Tremco.

.4 *Firestop Top Track Seal*: A pre-formed firestop device in wrapped polyurethane foam.

- Suggested (or equivalent) Products: “CFS-TTS” by Hilti.

.5 *Penetrable Cable Sleeve*: A Re-penetrable sleeve penetrations for single and bundled cables, with resealing capacity.

- Suggested (or equivalent) Products: “CP 653 BA” by Hilti.

2.3 Mortars

.1 *Fire-Rated Mortar* (as a complete Firestop system or to close down annular spaces making penetrations easier to treat with other products): one-part, fast setting, fire resistive micro silica compound, with thermal insulation and high impact resistance.

- Suggested (or equivalent) Products: “Fire Mortar” by Tremco

2.4 Wraps

.1 *Duct Wrap* (for wrapping ducts where shaft walls or Fire-dampers are difficult to install): A flexible fire-resistant wrap, inorganic fiber blanket encapsulated with a scrim-reinforced foil. 1-1/2" thick, 6 pcf density.

- Suggested (or equivalent) Products: “Duct Wrap 614+” by 3M.

End of Section

SECTION 07 90 00 - SEALANTS

1.0 GENERAL

1.1 Extended Warranty

.1 All caulking and sealant shall be guaranteed against leak, crack, crumble, melt, shrink, run, lose adhesion or stain adjacent surfaces, for a period of 3 years for labour and Material.

1.2 Design Criteria and Notes

.1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of back-up materials and sealants: i.e. depth of joint = 2 times the width of joint (min. 3 mm (1/8"), max. 25 mm (1") width). Install backing rod to achieve correct joint depth and shape, with approximately 30% compression, where the joint width exceed 3mm.

.2 Apply *Sealant* after painting and coating work is completed. Do not paint over sealants not manufactured to be painted.

.3 Apply *Sealant* on the perimeter of the new door or vision panel frames where they come to contact with adjacent surfaces; and on existing frames, if the adjacent surfaces' finishes (walls, floors) have been modified or replaced.

.4 Install *Backing rods* to support sealants where joint gaps exceed 3mm.

2.0 PRODUCTS

2.1 Exterior Sealants

.1 *Epoxidized Polyurethane Terpolymer Sealant*: Non-sag, for general application for joints on Building Envelope components.

- Suggested (or equivalent) Products:
  - .1 "Dymeric 240" by Tremco
  - .2 "Sikaflex-2c NS/SL" by Sika

.2 *Multi Cable Sleeves and Sealant*: Combined thermoplastic sleeve and rubberised sealant system.

- Suggested (or equivalent) Product: "Riswat" by BEELE Eng.

2.2 Interior Sealants

.1 *Siliconized Acrylic Latex Sealant*: Paintable, around interior work in general.

- Suggested (or equivalent) Products: "Tremflex 834" by Tremco.

.2 *Silicone Building and Glazing Sealant*: Not paintable, for Classified Labs, Clean rooms and similar spaces.

- Suggested (or equivalent) Products:
  - .1 "999-A" by Dow Corning
  - .2 "Contractors SCS1800" by GE Silicones
  - .3 "Tremsil 200" by Tremco

.3 *Silicone Sealant, Mildew Resistant*: Not paintable, around W.C. accessories and similar items.

- Suggested (or equivalent) Products:
  - .1 "786" by Dow Corning
  - .2 "Sanitary SCS1700" by GE Silicones

.4 *Cellular Foam and Silicone Sealant*: Foam component + Silicone Sealant for expansion, dynamic joints or wide joints exceeding 25mm wide.

- Suggested (or equivalent) Products: “Colorseal” by Emseal

.5 *Smoke and Acoustic Top Track seal*: A pre-formed device in wrapped polyurethane foam.

- Suggested (or equivalent) Products: “CS-TTS SA” by Hilti.

2.3 Accessories

.1 *Polyethylene Closed Cell Foam Backing Rod:* compressible and resilient, oversized 30 to 50%.

- Suggested (or equivalent) Products:
  - .1 "Ethafoam 220 Round" by Dow Chemical Co.
  - .2 "HBR" by Tremco.

End of Section

SECTION 08 11 00 - DOORS AND FRAMES

1.0 GENERAL

1.1 Extended Warranty

.1 Steel doors and frames, shall be guaranteed for a period of 3 years.

.2 Wood doors shall be guaranteed against warp, twist, show core lines, split, delaminate, or sag, for a period of 3 years.

1.2 Design Criteria and Notes

.1 General:

.1 Fabricate steel doors and frames in accordance with Canadian Steel Door and Frame Manufacturers Association (CSDMA), for hollow steel and honeycomb core construction, except where specified otherwise.

.2 Fabricate wood doors and frames doors in accordance with AWI/AWAAC Section 1300, Window and Door Manufacturers Association (WDMA) Series I.S.1-A-97 and CAN/CSA-O132.2 Series 90.

.3 Fabricate fire resisting doors and frames as per CAN4-S104 and CAN-S105 and label and list by an organization accredited by Standards Council of Canada; provide certification for oversized doors and frames.

.4 Install labelled fire-rated frames and doors according to NFPA 80 requirements.

.5 Reinforce head of frames wider than 1220 mm.

.6 Make allowance for deflection to ensure structural loads are not transmitted to frames. Provide flexible connections on head of frames if the head of the partition at underside of structural are not equipped with deflection joints.

.7 Paint all faces, edges, tops, and bottoms of doors.

.8 Fill frames with acoustic insulation, if partition is filled with insulation.

.9 Cut mitres and joints accurately and weld continuously on inside of frame profile.

.10 On site modifications will be accepted on fire rated doors and frames.

.11 Frame sizes, profiles, and installation to match adjacent existing. For new frames, width to be 50mm min. for for adequate installation of electrified hardware.

.12 Unless in FRR separation or similar special conditions, steel frames shall not be filled with mortar in masonry partitions.

2.0 PRODUCTS

2.1 Steel Frames

.1 *Pressed Steel Frames For Interior Doors And Vision Panel, Standard or Fire-Rated*: In Cold formed galvanized steel sheets, shall be labelled if Fire-Rated, with the following thicknesses:

.1 1.6 mm (0.060" / 16 ga) min. base thickness for vision panel frames and for openings up to 2440 mm (8'- 0") wide and up to 2440 mm (8'- 0") high, or not larger than 1930mm (6'- 4") and up to 3050 mm (10'- 0") high.

.2 1.9 mm (0.075" / 14 ga) min. base thickness for openings wider than the values previously mentioned.

- Suggested (or equivalent) Products: as manufactured by:

.1 Doormasters of Ottawa Inc. .2 Fleming Steel Doors and Frames.

.2 *Pressed Steel Frames For Interior Doors And Vision Panels, Sanitary*: Similar to *Pressed steel frames*, with sanitary chamfered stops, and flush bottom at 150mm high, with smooth welded edges.

.3 *Pressed Steel Frames For Exterior Doors, Insulated*: Similar to *Pressed steel frames*, with galvannealed finish, PVC thermal break, adequately reinforced against twisting, filled with *insulation*.

2.2 Steel Doors

.1 *Hollow Metal Interior Doors, Standard or Fire-Rated*: In Cold formed galvanized steel, Structural honeycomb core, 45 mm (1¾"), face sheets thickness of 1.2 mm (0.047" / 18 ga), and 1.6 mm (0.060" / 16 ga) for doors over 3048 mm (10'-0") high. Shall be Labelled if Fire-Rated.

- Suggested (or equivalent) Products: As manufactured by:
  .1 Doormasters of Ottawa Inc .2 Fleming Steel Doors and Frames.

.2 *Hollow Metal Interior Doors, Sanitary*: Similar to *Hollow Metal doors*, with inverted top and bottom, and smooth welded edges.

.3 *Hollow Metal Exterior Doors, Insulated:* Similar to *Hollow Metal doors*, with galvannealed finish, 1.6 mm (0.060" / 16 ga), filled with insulation and covered with continuous metallic filler channel, welded to the metal sheets, filled with metallic paste filler, ground and sanded to uniform smooth finish.

.4 *Hollow Metal Interior Doors, Acoustical*: With STC ratings from 43 to 57, with related integrated soundproof gaskets and seals.

- Suggested (or equivalent) Products: As manufactured by Overly Inc.

2.3 Wood doors

.1 *Plywood Faced Solid Particleboard Doors*: Standard flush doors, 5 ply or 7 ply having the following characteristics:

.1 Core: Particleboard, industrial brand, of minimum 0.45 g/cm^3 (28 lb/cu.ft) density, with sanded faces (120 grit), bonded to stiles and rails.

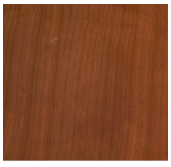
.2 Edges: Stiles and rails in laminated low-density wood or structural composite lumber, stiles with hardwood edges, matching the face veneer.

.3 Faces:

.1 3 mm (1/8") plywood, or composite crossband, with veneer, to be varnished, painted, or covered with *Abuse-resistant plastic laminate sheet (**06 10 00**)*. Total thickness: 44 mm (1¾").

- For general doors, suggested (or equivalent) Products:
  .1 "Series 8500" by Baillargeon.
  .2 "5-PC-ME" or "7-PC-ME series" by Lambton.

.2 For FSS building: Cherry veneer face, Quarter cut (AWI), to be varnished clear finish.



.3 For Roger Guindon building: Plastic laminate bonded on a mill option composite crossband.

- **UofO** Standard product: "557 Winter Oak" by Uniboard.

.2 *Plywood Faced Solid Particleboard Doors, Fire-Rated*: Standard flush doors, 5 ply or 7 ply, with non-combustible mineral core, face of 3 mm (1/8") plywood, or composite crossband, with veneer, to be varnished, or painted; for a Total thickness: 44 mm (1¾").

- For general doors, suggested (or equivalent) Products:
  .1 " 5-FD45-EBE" or " 5-FD60-EBE" by Lambton.

.3 *Plywood Faced Solid Particleboard Doors, Acoustic*: With STC ratings from 43 to 57, with related integrated soundproof gaskets and seals.

- Suggested (or equivalent) Products: As manufactured by Overly Inc.

End of Section

SECTION 08 40 00 – CURTAIN WALL AND GLAZED METAL WORK

1.0 GENERAL

1.1 Extended Warranty

.1 The work included in this Section shall be guaranteed against all defects, including glazing sealed units, deterioration, texture and colour modification, for a period of 10 years for labour and Material.

1.2 Design Criteria and Notes

.1 Curtain wall and glazed metal to comply with or surpass requirements of **OBC**, **AAMA** and CAN/CSA-A440-00/A440.1 standards.

.2 The design of the curtain wall and skylight shall be based on the "Rain Screen" principle. Behind the curtain wall or windows or at other points where rain may penetrate to the building interior, the rainwater must be drained quickly to the exterior of the screen by means of flashings or waterproof membranes to drip openings provided for this eventuality.

.3 No condensation shall form on any interior surfaces of the Aluminum members or glazing before any of the exposed area of sealed units reaches the dew point temperature.

.4 The structural performance shall be based on CAN3-S157 and ASTM E330 and deflection of mullions shall be limited to L/175 of clear span, or a maximum of 19 mm (3/4"), perpendicular to the panel, and to L/360 or a maximum of 3 mm (1/8") parallel to the panel plane, with full recovery of glazing materials.

.5 Mitre all joints between Aluminum elements meeting at angles, unless otherwise designed.

.6 Cavities between curtain wall supporting mullions and adjacent walls, shall not be obstructed, or filled with insulation. In addition, at parapet levels, one or several of the following method (or similar) shall be used to limit condensation within the vertical mullions' components:

- Decks shall be pushed back from mullions 100mm approximate to allow warm air to heat their inside surfaces. Distance to be directly proportionate to parapet's heights.
- Vertical mullions shall be separated by distinct sections at deck level.
- Spandrel panels connections shall be designed in a "V" shape to allow warm air to heat the mullions inside surface.

.7 Fabricate the *Air/Vapour Barrier Metal Pans* in such a manner as to leave 6 mm (1/4") space between their lateral faces and the adjacent mullions, to allow these to be conditioned to the ambient temperature.

.8 As necessary, install *Mineral Fibre Semi-Rigid Board Insulation for Curtain Wall* ***(07 20 00)*** (100mm long min.) on perimeter of spandrel panel cavities, with drip holes 25mm that matches the pressure plates.

.9 Spandrel panels shall be able to be replaced with other panels in a simple operation by mechanical means only from the exterior of the building.

.10 Adhere, seal and mechanically fasten connection membrane to mullions' throat, with adjacent walls.

.11 Glazing details shall permit Glass replacement after initial construction, the reuse of original gaskets, and replacement Glass of the same nominal size as original Glass. Silicone supported vision Glass shall be replaceable from the exterior and/or interior.

.12 Closures to be installed at top or bottom edges of vertical mullions and caps, if exposed, or serve to support membranes.

.13 Screws, lag screws, and other attachments shall be non-corrosive and of types and sizes required. They shall be concealed as much as possible and those impossible to conceal shall be finished to match adjacent surfaces.

.14 Manufacturer's name plates on Aluminum work are not permitted.

.15 Unless otherwise indicated, on the interior sides, windowsills to be built in *Aluminum panels*.

2.0 PRODUCTS

2.1 Curtain wall and curtain wall type window frames

.1 *Frames in Aluminum, Tubular Extrusions for Curtain wall, windows and exterior doors, regular or with S.S.G., anodized or prepainted*: Application with double sealed Glass units. For horizontal and vertical members, 65 mm ($2^1/_2$") wide. High Performance Series highly recommended.

- Suggested (or equivalent) Products:
  - .1 "1600UT System 1/System 2" by Kawneer.
  - .2 "Series 3400HP" (High Performance) by A. & D. Prévost Inc.

.2 *Frames in Aluminum, Tubular Extrusions for Curtain Wall, Windows and Exterior Doors, Regular and For S.S.G. Anodized or Prepainted, with High Thermal Resistance*: Application with triple sealed Glass units. For vertical and horizontal framing members, 65 mm ($2^1/_2$") wide.

- Suggested (or equivalent) Products:
  - .1 "G450GEE/S" by Gamma.
  - .2 "7525" by Kawneer.
  - .3 "Series 3400 HPT" by A. & D. Prevost Inc.

.3 *Frames in Aluminium, Tubular Extrusions for Light Curtain Wall, Windows and Exterior Doors. Anodized or Prepainted*: For horizontal and vertical members, 51 mm (2") wide.

- Suggested (or equivalent) Products:
  - .1 "1620" by Kawneer.

.4 *Aluminum Curtain Wall Frame Covers, Anodized or Prepainted*: Extruded Aluminum, of the compatible alloy and temper.

- Suggested (or equivalent) Products: as manufactured by:
  - .1 Gamma.
  - .2 Kawneer.
  - .3 A. & D. Prevost.

.5 *Sun Control Screens, Aluminium, Anodized or Prepainted*: Aluminum extrusions, aerofoil fin type fixed blades.

- Suggested (or equivalent) Products, as manufactured by:
  - .1 Nysan Shading System Ltd.
  - .2 Arc Structures Inc.
  - .3 Kawneer

2.2 Storefront entries

.1 *Frames in Aluminum, Tubular Extrusions for Exterior Doors And Vision Panels Anodized or Prepainted, Storefront*: With thermal break, 51 mm (2") wide.

- Suggested (or equivalent) Product: "Trifab 451UT" Series by Kawneer.

2.3 Windows

.1 *Windows in Aluminum, Anodized or Prepainted Extruded Sections, with High Thermal Resistance*: Depth as necessary, with inserted insulation.

- Suggested (or equivalent) Products:
  - .1 "Series 1300/1300 HPT" by A. & D. Prévost.
  - .2 “562”, “5525” by Kawneer.

2.4 Skylights

.1 *Frames in Aluminum, Tubular Extrusions for Skylight, Regular or With S.S.G., Anodized or Prepainted*: 65 mm ($2^1/_2$") wide, with drainage gutters incorporated.

- Suggested (or equivalent) products:
  - .1 "500" by Gamma.
  - .2 "2000" by Kawneer.
  - .3 "Series 3700" by A. & D. Prevost.

.2 *Aluminum Skylight Frame Covers, Anodized or Prepainted*: Extruded Aluminum, of the compatible alloy and temper.

- Suggested (or equivalent) Products: "216-103" & “822-031 (snap-on cover)” by Kawneer.

2.5 Interior vision panel & vestibule frames

.1 *Frames in Aluminum, Tubular Extrusions for Interior Doors And Vision Panels Anodized or Prepainted*: 44.5 mm (1¾") or 51 mm (2") wide.

- Suggested (or equivalent) Products:
  - .1 "Trifab VG450" Series by Kawneer.
  - .2 "Series 65", by A. & D. Prévost.

2.6 Panels

.1 *Panels in Aluminum, anodized or Prepainted*: In AA-6063-T5 alloy and temper Aluminum, 3 mm (1/8") minimum thickness.

.2 *Insulated Sandwich Panels in Aluminum, Anodized or Prepainted*: Composed of an exterior panel in AA-6063-T5 alloy and temper Aluminum , 1.2 mm (18 ga) thick, with Polyisocyanurate insulation, all laminated and prefinished in plant, with sealed edges.

.3 *Cold Formed Galvanized Steel Air/Vapour Barrier Pans*: Min. 0.9 mm (0.036") thick, or more as per the structural requirements, in galvanized steel, to be fabricated in one piece, with tapered sides and sealed corners, used in conjunction with Aluminum or glazed spandrel panels.

2.7 Cladding panel system

.1 *Cladding Panel System in Aluminum, Anodized or Prepainted*: Exterior Aluminum cladding system in sheets or bent plates, complete with supporting system, 3 mm (1/8") minimum for plates, and 2 mm (3/32") minimum for extrusions.

- Suggested (or equivalent) Products:
  - .1 "Series 4400" by A. & D. Prevost.
  - .2 "Almura, Series G-2100" by Gamma.
  - .3 "Ultima Type 5" by VicWest.
  - .4 As manufactured by Alucobond

2.8 Doors & Architectural railing systems

.1 *Aluminum Interior Swinging Glazed Doors, Anodized or Prepainted*: Strongly built, glazed swinging doors with wide stiles, min. 44.5 mm (1¾") thick, Aluminum extrusions, with minimum wall thickness of 3.2 mm (0.126") and mechanically joined, reinforced corners.

- Suggested (or equivalent) Products:
  - .1 "350" or "500" by Kawneer.
  - .2 "2200" or "2700" by A. & D. Prevost.

.2 *Aluminum Exterior Swinging Glazed Doors, Insulated Anodized or Prepainted*: Heavy duty insulated glazed swing doors, min. 51 mm (2") thick, Aluminum extrusions with minimum wall thickness of 3.2 mm (0.126"), with thermal break and mechanically joined, reinforced corners.

- Suggested (or equivalent) Products:
  - .1 "360" or "560" "Insulclad" Series, by Kawneer.
  - .2 "2250" or "2750" by A. & D. Prévost.

.3 *Glass Doors, Swinging: All Glass,* single, swinging, or double, including all gaskets, shoes, mouldings, supports, and other related accessories.

- Acceptable (or equivalent) products: "Prel-Gard Entrances" by Prelco Inc.

.4 *Railing & Handrail systems in Anodized, prepainted Aluminum, or Stainless steel*: Including all gaskets, shoes, mouldings, supports, and other related accessories.

- Suggested (or equivalent) Product: As manufactured by C.R. Laurence of Canada.

2.9 Accessories

.1 *Strip and Pad for Metals Work, Self-Adhesive*: For thermal or electrolytic isolation between steel surfaces and Aluminum: 3 mm (1/8") closed cell polyethylene (EVA) tape and pad, with adhesive on one or two faces, as necessary.

- Suggested (or equivalent) Product: As manufactured by Jacobs and Thompson.

2.10 Finishes

.1 *Anodized Finish*: Clear or colored anodic oxide treatment, 18 microns (0.7 mil) thick, on surfaces treated with a caustic etch. Execute preparation and anodization after assembling and welding Aluminum elements.

- Suggested (or equivalent) Product: "Permanodic" by Kawneer.

.2 *Prepainted Coating Finish for Aluminum Surfaces*: A caustic etch, a fluoropolymer resin thermosetting coating, treated with and applied in plant, in three coats of a total dry film thickness of 50.8 microns (2.0 mils).

- Suggested (or equivalent) Product: "Duranar XL" by PPG.
- Not Acceptable Product: Prepainted acrylic coating "Duracron" by PPG.

.3 *Stainless Steel*: As per section **05 50 00**.

End of Section

SECTION 08 70 00 – FINISH HARDWARE

1.0 GENERAL

1.1 Extended Warranty

.1 The following items shall be guaranteed:

- .1 Door closers for a period of 10 years.
- .2 Locksets for a period of 5 years.
- .3 Exit devices for a period of 3 years.
- .4 Automatic door operators, compressors & control boxes for a period of 3 years.
- .5 Electric strikes for a period of 3 years.
- .6 Electrical Power Transfers and Loops for a period of 3 years.

1.2 Design Criteria and Notes

.1 General:

- .1 Provide a hardware schedule indicating the type of lockset or exit device recommended and the type cylinder required. **UofO - ATS** will consult the potential occupying faculties or departments in order to establish their individual needs and develop a basic master-keying plan to meet these needs. The building shall be assigned to a zone which has Great Grand Master Key (GGMK) space to include it. The master key plan shall then be submitted to “Medeco Canada” keying records management for comments and approval.
- .2 A “take-off” sheet, as part of the keying list, shall be prepared by **UofO** - **ATS** and submitted to “Medeco” indicating the number of different cylinders, and to whom the MK’s must be sent. When received, the cylinder order should be checked by **UofO - ATS** to ensure the appropriate number is received. Upon approval, the keying list shall be submitted to the Associate Director, Project Management, **Facilities** or his representative for process of purchase orders and a letter of authorization for the contractor to purchase the required cylinders from “Medeco” on the University’s behalf.
- .3 The following products shall be avoided as much as possible:
  - .1 Maglock installations.
- .4 All hardware items to be provided and installed by the **GC**, with the exception of the following; which will be provided by **UofO** and installed by the **GC**:
  - .1 Non-Electronic Door Hardware - less than 5.
  - .2 Door Cylinders and keys – less than 50.

.2 Application:

- .1 Only hardware items satisfying standards CAN/CGSB-69 series and ANSI/BHMA A156 series are acceptable for use, except otherwise indicated. Use hardware approved by ULC or authorities for fire-rated-doors.
- .2 All hardware to match make of existing unless requested otherwise.

.3 Keying & Cylinders:

- .1 If provided by **GC** (see above):
  - .1 All cylinders to be master-keyed on existing master key system as per Owner’s requirements, using keying **Facilities** schedule standards.

.2 Supply the following:
- .1 One key cabinet with the required capacity plus 10%, such as made by Lund.
- .2 Number of keys per lock: 3.
- .3 Number of master keys per system: 10.
- .4 Construction keys as required.
- .5 Extractor keys as required.

.3 Supply keys directly to Owner, in properly identified envelopes.

.2 If provided by **UofO** (see above):
- .1 Two (2) keys shall be supplied with each cylinder. Individual additional keys must be requested from the Coordinator, **Facilities** (2222). These requests must be made in advance of their perceived need in order for the locksmith to complete the additional work load. When received, the cylinder order should be checked by **UofO ATS** to ensure the appropriate number is received.
- .2 When installing the Medeco cylinders, the contractor shall use the accompanying change key to verify the cylinders are functional. Contractor shall then return the key to its original container which is returned to the university locksmith staff when the installation is complete.

.3 Combination locks:
- .1 “Ilco Unican” push button locks L1021-M have been used at strategic areas on campus where it was not feasible to issue keys to numerous authorized persons. “Medeco” grand master keys must be allowed to by-pass the combination key code. The preferred combination lock is “King Cobra” which has proven to be less expensive, more flexible and almost maintenance free.

.4 Key functions:
- .1 Circuit Entry: Can be unlocked for periods of time but can also be locked on a personal basis.
- .2 Classroom: Can be unlocked to give access to groups of people.
- .3 Storage: Always remains on the lock position – key use is essential.
- .4 Passage: No cylinder.
- .5 Privacy: No cylinder

.4 Fastenings:
- .1 Use fasteners compatible with the materials they penetrate. Exposed fastening devices to match finish of hardware. Stainless steel hardware to be fastened with stainless steel fasteners.
- .2 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .3 Use cross recessed countersunk flat mushroom head screws for attachment of kickplates, pushplates, and similar devices.

.5 Electrified hardware:

.1 General:

.1 All proposed electrified hardware must be submitted to both the Manager of **UofO** Security, as well as the lead **UofO** locksmith for approval.

.2 Classroom function is required on locksets at all electronically secured doors.

.3 Wiring schematics detailing all electrical components for each door opening to be prepared by the hardware manufacturer at the request and with the support of the hardware supplier.

.4 Fail safe position during power outage shall be in unlock position. Fail secure position during power outage shall be in locked position.

.5 A 19mm conduit is required at each Door Card Reader location, Door Strike location, and Door Contact location. The strike and reader conduit may be combined if done as per the configuration below.

.6 In general all secured doors driven by security controllers will operate with 24 V electrical devices at the doors. Certain doors may nevertheless require 110V /24 V power supply.

.7 Several wiring sharing the same routing, can be gathered in the same conduit, with appropriate size fitting.

.8 Refer to "**VOLUME VI – Appendix – DR. Doors & Hardware**" Series and related notes for proposed wiring connection details.

.2 Installation and wiring:

.1 All access-controlled doors to have door closers supplied and adjusted at time of installation.

.2 All access control hardware to installed by qualified tradesman competent in the installation of finishing hardware with minimum of (5) years' experience shall be used. The installer shall adjust, clean and make good all installation of Finishing hardware to the satisfaction of the Universities Security manager or hardware consultant.

.3 Final inspection to be carried out by the Hardware Supplier consultant whose name is written on the cover sheet and Product representative. Representative to provide written certification that hardware has been installed and adjusted as intended. Once written documentation is provided that the access-controlled opening is functioning 100%, **Facilities** will dedicate the necessary resources to complete and commission the system at that door Above and beyond manufactures specifications, the door needs to be tested that:

.1 It closes form any position in its swing including from a position resting on the latch.

.2 That all door pins fit securely in receptacles.

.3 No excessive play of latch in strike.

.4 No preload exerted on electrified hardware.

.5 Door does not rub on floor or any part of frame.

.6 Door closer is adjusted properly, (not over tightened to make up for other door deficiencies.)

.7 No excessive gaps under, above or between twin doors.

.3 Low Voltage Wiring for Electrified Hardware: All wiring to be stranded, FT6 rated (exposed) or FT4 rated (totally enclosed in a non-combustible raceway): EMT conduit or as indicated on drawings. Use as specified, 18 AWG 2 conductor wires, stranded; 22 AWG foil shielded 4 conductor wires, stranded; and 22 AWG foil shielded 6 conductor wires, stranded.

- **UofO** Standard Products: For Security Wiring:
  - White & Green Conductors are reserved for:
  - Latch Bolt Monitor (Electric Strike).
  - Exit to Request (Electrified Mortise).
  - Door Contact.
  - Red & Black Conductors, 22 AWG, are reserved to provide power to:
    - Electric Strike.
    - Electrified Mortise.

.4 Pneumatic tubing: To be rated plenum.

.5 Automatic Door Closer Delay Timing:

Delay: Unless otherwise requested, operation required delays to be:

.1 5 seconds after actuator is pushed before the door closer is activated.

.2 12 seconds when door is full opened before closing.

.6 Actuators:

Actuators, whether wired or wireless, to be connected individually to the door closers control box.

Run an additional 6 Conductor Wires 22 AWG to actuator for eventual card reader installation, on corridor side.

.7 Electric Strikes:

.1 Door frames to adapt to sizes of specified electric strikes.

.2 To install a Classroom function lock to permit locking the door if electric strike is out of order.

.3 Doors controlled by these means shall have a “Medeco” cylinder keyed to the “E” GGMK only.

.4 Power to be connected to the Red or White and Black Conductor wires.

.5 Latch Bolt Monitor to be connected to Green & White Conductor wires.

.8 Connection:

.1 If a scheduled Card-Reader or similar security system is to be connected to Fire-Rated door, *Electrified Levers* and *Power Transfer* or similar electrified hardware should be installed - **not** *Electrical Strikes*, in order to maintain a positive latch all the time, as requested by **OBC**.

.2 In Fire-rated doors, *Door Operators* to be connected to *Electrical Strikes*, and Card Readers to be connected to *Electrified Levers*.

.9 Control Boxes: Generally, to be installed wall mounted or in ceiling spaces with vibration isolators in corridors, A/V rooms or storage rooms. Never install in Classroom ceiling space. Final location to be coordinated with **UofO**.

.6 Security: Refer to section "**VOLUME I – Z7. Security Systems**".

2.0 PRODUCTS

2.1 Hardware Items

.1 Some of the listed products are shown as different choices, to adapt to different situations a necessary. Coordination with **Facilities** personnel is mandatory.

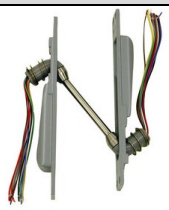
- **UofO** Standard Products: Refer to following page.

DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
Actuator Switches:					
Actuator Switch	4-1/2" (114mm) x 2" (50mm) Rectangular 	Camden Door Controls	CM-35	SS	Wired Wheelchair symbol, blue **Limited use only**
		LCN	8310-818S	SS	
	6" (152mm) round 	Camden Door Controls	CM-60/2	SS	Wired Wheelchair symbol, blue
		LCN	8310-852	SS	
	Wireless Transmitter	Camden Door Controls	CM-TX-9	n/a	Wireless Transmitter **Limited use only**
Flush Box	1 1/2" (38mm) x 4 3/4" (121mm)	LCN	8310-819F	Black Plastic	Rectangular
	4 1/2" (114mm) Actuator Switch	LCN	8310-868F	Black Plastic	
	6" (152mm) Actuator Switch	LCN	8310-869F	Black Plastic	Cannot be used in FRR partitions according to **OBC**
Escutcheon	For 4 1/2" (114mm) Actuator Switch	Camden Door Controls	CM-59S	SS	Tapered edge CM-49A is Semi-recessed into wall
			CM-49A	ABS	
		Camden (wireless receiver)	8310-874	SS	
	For 6" (152mm) Actuator Switch	Camden Door Controls	CM-RX90	SS	Tapered edge **Preferred option**
		LCN	8310-876	SS	Tapered edge
Surface Box	1 1/2" (38mm) x 4 3/4" (121mm) rectangular	Camden Door Controls	CM-23	ABS	**Limited use only**
		LCN	8310-819S	Black Plastic	

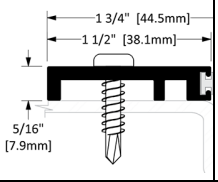
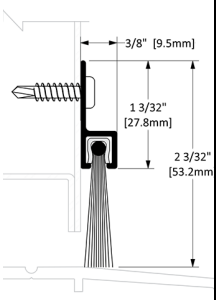
DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
	4 1/2" (114mm) round	Camden Door Controls	n/a	ABS	**Limited use only**
		LCN	8310-868S	Black Plastic	
	6" round	Camden Door Controls	n/a	ABS	Used at CBY Building **Limited use only**
		LCN	8310-869S	Black Plastic	
Flush Box	1 1/2" (38mm) x 4 3/4" (121mm)	LCN	8310-819F	Black Plastic	Rectangular
	4 1/2" (114mm) Actuator Switch	LCN	8310-868F	Black Plastic	
	6" (152mm) Actuator Switch	LCN	8310-869F	Black Plastic	Cannot be used in FRR partitions according to **OBC**
Closers:					
Automatic Door Operators	Pneumatic 	LCN	4810 c/w 925 tubing	689	Pull side
			4820 c/w 925 tubing	689	Push side
	Electrical 	Hunter Automatics	HA8-HD HA9	689	No closer adjustments **Preferred option**
	Electromechanical	LCN 4600 Series	4631 / 4642	689	Pull / Push Side (Closer adjustments) **Limited use only**
Control Boxes	With or without Compressor	LCN	7981		One door operation
			7982		Two door operation
Controls	Barrier free	DCI Glyn Johnson			
Closers	Surface Mount 	LCN	1461 Narrow styles	689	Acceptable for all doors except exterior stairwells and corridors
			4040XP		Acceptable for all doors
Overhead Stop	Concealed	Glynn-Johnson	100 series	US32D (alum)	
Key Switch		Camden Control	CM Series	US32D (alum)	Override / Lock door operator

DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
Coordinator					
Door Coordinator	Carry Bar	IR Security & Safety	COR32, 42, 52, 60,72		Model to suit conditions
Cylinders & Locks					
Coded locks	Cylindrical Mortise	Schlage	C0-100	26D	
	Mailbox	Weiser, Riopel			
Locks	Deadlock latch paddle	Adams Rite	MS 1850 series 4710 X 4590	Match door	For Exterior Aluminium Framed Glass Doors
Cylinders	Interior or Exterior	Medeco	To suit lock type	626	
Dead locks	Mortise	Schlage Sargent	L460 series 4870 series	626 26D	
Patiobolt	Deadlock	Abloy	MC82	Satin Chrome	Surface-mount, for sliding and bi-fold doors
Electrical Strikes:					To include LBM and LCM monitoring and be configured for 24Vdc operation
Electric Strikes	Control	RCI	AS65-LMKM	630	
	Frame surface Mounted 	HES	Rim-9600 Series		
Electric Strikes With Fire Rating (Fixed panel mounted)		HES	HES 4500	630	C/W LBM
			HES 1006 LBM	630	For Mortise lock c/w latch monitor – 6 wires
			HES 8500 Series	630	For narrow Panels 1-1/4" (32mm) W x 4/7/8" (124mm)H (Face Plate) x1-5/16" (33mm) D c/w latch monitor – 6 wires
Power Supply	Electric Strikes	Von Duprin			
Exit Devices:					
Standard Panic Bar Exit Device	Rim 	Von Duprin	996L with 98EO or 99EO	626	To be configured "Store Room NL" (Key override in FRR conditions).

DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
Electrified / Retractable Panic Bar Exit Device	Electrified Rim 	Von Duprin	996L with 98EO or 99EO	626	With Von Duprin Quiet Electric Latch Retraction QEL 98/99, 94/95 and 33/35A series exit devices. To be configured "Store Room NL" (Key override in FRR conditions. C/W "Request to Exit" switch.
Electrified Breakaway Lever Trim		Von Duprin	M996L or E996L	626	
Request to Exit Switch		Von Duprin	Exit Switch for card Access System		Compatible only with Von Duprin RIM RX-S1
Power Supply for Panic Bars / Maglocks		Von Duprin	Power Supply PS902 – 2Amp PS904 – 4Amp PS906 – 6Amp		
Fire Alarm Input Board		Von Duprin	900-FA Fire Alarm Input		
Input/Output Board		Von Duprin	900-2RL BOARD (2 zones) 900-4RL BOARD (4 zones)		Single Power Supply controlling multiple zones / door leaves
Hinges:					
Hinges	Butt* 	Hager	BB1168	26D	
		McKinney	TA2714, T4A3786	26D	
		Stanley	FBB179, FBB168	26D	
	Continuous 	Select	SL11HD (alum) SL24HD (HMD)	CLA	**Preferred option**
		Roton	780 112 HD(alum) 780 224 HD (HMD)	CLA	
***Note**: Consider using offset hinges in order to accommodate the latest **OBC** recommended minimum Accessibility door clearances.					
Latch Guard:					
Latch Guard	Outswing	MAG Security	Mag 8849-AL 11-3/4"	AL	
Power Transfer					
Electric Power Transfer (Connections for Electric Strikes / Electrified	Electric Power Transfer (EPT) – Recessed	Von Duprin	EPT10	AL	**Preferred option for new installations**

DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
Mortise or Other)	Heavy Duty				
	Power Transfer Loop (PTL) – Surface-Mount Heavy Duty, 18 Gau.	RCI Rutherford Controls	9509-18S Flex Loops 	SS	**Preferred options in retrofit**
	Electric Power Transfer & Loop (PT) Heavy Duty	American Lockset	SDC PT-5 	SS	
	ETH Hinges	Command Access	Model to suit	SS	**Limited use only**
Kick plates:					
Kick Plates				Al	3mm thick, with rounded edges
Levers:					
Electrified Lever & Mortise	Electrified Mortise Functions: Classroom 	Command Access Technologies Schlage	ML170 w/ 03B or L909x Series	626	To be Fail secure in FRR partition application, With "Req. to Exit" option. C/W "Request to Exit" switch.
Electrified Latch Device		Von Duprin	E996L with 98EO	628	With "Req. to Exit" option RX-S1
Electrified Lock & Handle		Schlage	AD-300	628	Network Wired Lock. REX & DPS built in.

DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
Cylindrical Locks	Mortise Functions: Office Storeroom Classroom	Schlage	ND Series RHO ND+TLR	626	
Mortise & Lever	Mortise Functions : Classroom Storeroom Passage with Levers	Schlage	L9000 series 03B	626	Unless otherwise advised, Office function (e.g. L9050) is prohibited. 
		Corbin	ML 2000 series LWA	630	
		Sargent	8200 LNB	626	
Patch Fittings for All Glass Doors/ Walls:					
Patch Fittings for Mortise on Glass Door		CRL	6" x 10" LH Center Lock	SS	(Ref. to Mortise & Levers for types)
Patch Fittings for Electric Strike on Glass Door			LH/RHR Center Lock Glass Keeper	SS	(Ref. to Electric Strikes for types)
Pull / Pushes / Stops:					
Flatware – Pulls-Bolts, and similar	Kick plate Push plate Flush bolts	Gallery Specialty	GSH80A (Screwed) GSH81AA (Screwed) GSH401	32D	
		Hager	Alternate	32D	
		Standard Metal	Alternate		
		CBH	Alternate		
Doorstops	Floor mount	Gallery specialities	GSH 218	SS	
Magnetic Catch	Triple Magnetic catch	Hardware Hut	AME-BP9798AW	AL	
Weather stripping:					
Sound-Dampening & Weather-Stripping	Weather stripping	K N Crowder	W-20N W20P	AL Neoprene Pile	Heavy Duty

DEVICE	TYPE	MANUFACTURER/ SUPPLIER	PRODUCT	FINISH	NOTES
					
	Door sweep		W24S	AL	
	Threshold		CT 11 / 12 / 32 	AL	
	Threshold stop		CT40P 	AL	
	Automatic Door Bottoms		CT-52	AL	Surface mount preferred for simpler maintenance
	Sound Trap & stripping	Zero International	#870 (Head & Jamb) #365 (Aut. Door bottom) #566A (Threshold)	AL	Based on 49 STC Sealing system
	Weather Stripping	Pemko	Series 306		

End of Section

SECTION 08 80 00 – GLAZING

1.0 GENERAL

1.1 Extended Warranty

.1 Mirrors shall be guaranteed against silvering defects, for a period of 10 years.

.2 Double-glazed sealed units shall be guaranteed for a period of 10 years.

.3 Fire-rated glazing shall be guaranteed for a period of 5 years.

1.2 Design Criteria and Notes

.1 Notwithstanding **OBC** Supplementary Standard **SB-13**, all interior Glazing located at floor openings, stairs or similar where difference in level is exceeding 600mm shall be *Laminated*.

.2 All sealed glazed units to be manufactured as per CAN/CGSB-12.8, and by a manufacturer who has certified these units in accordance with the Insulating Glass Certification Council (IGCC) Certification Program.

.3 All *Tempered Glass* must be produced by the horizontal roller hearth method and bear a discrete mark of being so treated.

.4 All interior glazing for openings, visual panels, doors and similar, shall be made of *Tempered Glass* units or stronger / equivalent.

.5 Not acceptable: *Georgian Wired Polished Glass* in non-Fire-rated installations.

.6 All Glazing for skylight shall be *Sealed, Laminated, Tempered Glass* and Tinted units, with all additional necessary films or colors.

.7 *Georgian Wired Polished Glass* or *Fire-Rated Glass* sizes in doors or windows shall be as per the maximum allowed per OBC, ULC or any other accredited tests for single pans, with or without intermediate mullions.

.8 All Glazing for exterior openings shall be *Sealed*, and *Laminated* or *Tempered Glass* units, with all additional necessary films or colors.

.9 All exterior sealed Glazing units to be at least argon filled with Low Emissivity soft coating, with the following minimal performances (triple glazed units and other may also be accepted as per the design and Energy Modelling imperatives):

.1 *Clear Double-Glazed Sealed Units, With Low-E Soft Coating, (on face #2), Argon Filled*:

.1 Thermal resistance (in winter), at centre of vision panel: RSI = 0.73 (R = 4.17); or more.

.2 Solar heat gain coefficient: 0.39 or less.

.3 Light transmission: 70 % or more.

.4 Shading coefficient: 0.45 or less.

.2 *Tinted Double Glazed Sealed Units, With Low-E Soft Coating, (on face #3), Argon Filled*:

.1 Thermal resistance (in winter), at centre of vision panel: RSI = 0.73 (R = 4.17), or more.

.2 Solar heat coefficient gain: 0.32 or less.

.3 Light transmission: 42% or more.

.4 Shading coefficient: 0.37 or less.

- Suggested (or equivalent) manufacturers:

.1 AFGD. .2 Industries April Inc. .3 Prelco (Thermalite).

2.0 PRODUCTS

2.1 Single Glass Units

.1 *Tempered Glass*: Clear safety Glass, as per CAN/CGSB-12.1, 6 mm (1/4") min., or as necessary.

.2 *Laminated Glass*: Safety Glass, as per CAN/CGSB-12.1, 2 x 3 mm (1/8") (regular) and 2 x 6 mm or 5 or as necessary, with clear *PVB Glass lamination film* interlayer 1.5 mm (0.060") thick.

.3 *Georgian Wired Polished Glass* (for fire-rated openings): As per CAN/CGSB-12.11, with 12.7 mm x 12.7 mm (1/2" x 1/2") wire mesh square design, 6 mm (1/4") thick min.

.4 *Polycarbonate Glazing*: Clear, 6 mm (1/4") thick min., as per CAN/CGSB-12.12, abrasion resistant.

- Suggested (or equivalent) Products:
  - .1 As manufactured by Plastique Alto Inc.
  - .2 As manufactured by GE Plastics (General Electric).

5 *Opaque Glass for Spandrel Panels*: as per CAN/CGSB-12.9, 6 mm (1/4") thick min., heat strengthened Glass, with ceramic frit opacifier on the back, or with silicone-based paint on the back.

- Suggested (or equivalent) Products:
  - .1 With "Ceramic Frit" by Ferro.
  - .2 With "Opaci-Coat 300" paint by Industrial Control Development Inc.

.6 *Heat Soaked Thermally Toughened Glass*: as per DIN EN 14179-1 (Heat soaked thermally toughened soda lime silicate safety Glass).

.7 *Fire-Rated Glass Ceramic*: 8 mm thick, Premium Grade-Ground and polished on both sides, with Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent. Glass panels that exceed 1,393 sq. inches for 90-minute ratings shall be glazed with fire-rated glazing tape supplied by manufacturer.

- Suggested (or equivalent) Product: “FireLite Plus”, manufactured by Nippon Electric Glass Company, Ltd., and distributed by Technical Glass Products Canada.

.8 *Mirror, Silvered, Framed:* as per CAN/CGSB-12.5, tempered, 6 mm (1/4") thick, dimensions as shown, in stainless steel frame, with shelf, or without shelf, as indicated, square corner type, and vandal proof concealed mounting.

.9 *Acrylic Glazing (Plexiglas):* As per CAN/CGSB.12.12, extruded grade, clear, or matt, 6 mm (1/4") thick min..

- Suggested (or equivalent) product:
  - .1 As manufactured by Plastique Alto Inc.
  - .2 As manufactured by 3 Form Inc.

.10 *Polyethylene Terephthalate Glycol Glazing (PETG):* As per CAN/CGSB.12.12, clear or frosted, 6 mm (1/4") thick min..

- Suggested (or equivalent) product: As manufactured by Humanscale Inc.

2.3 **Sealed Double-Glazed Units**

.1 *Sealed Glazed Vision Units Regular or With S.S.G.*: 25 mm (1") total thickness min., warm-edge, double-sealed with polyisobutylene and polyurethane sealants (regular), and with polyisobutylene and silicone sealants, compatible with structural sealant (with S.S.G.), with Low-E coating on surface #2 or #3 as necessary, composed of:

.1 Exterior pane & interior pans:

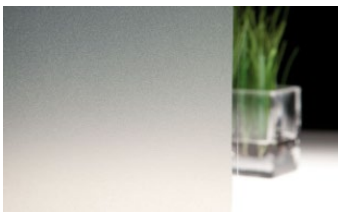
6 mm (1/4") min. clear, tinted, or colored, and Heat strengthened, *Tempered* or *Laminated* units, as necessary.

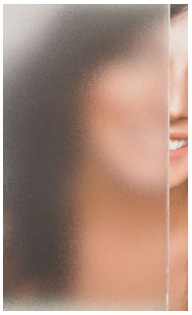
.2 Air space:

12.7 mm (1/2") min., with *Black polycarbonate* or *Thermoplastic Glazing spacer*, argon filled.

2.4 **Accessories**

.1 *Frosted Films:* Special effects film: 3 mills Polycarbonate translucent film for acid-etched look.





- **UofO** standard Products:
  - .1 "6900 Frosted" by CGI.
  - .2 "Matte Crystal 2, SH2MACRX2" by 3M Fasara.
  - .3 "7725SE-314 Dusted Crystal", by 3M.
  - .4 "Solyx-SX-1301 Clear Frost" by Decorative Films.

.2 *PVB Glass Lamination Film*: Clear, 0.75 mm (0.030") or 1.5 mm (0.060") respectively.

- Suggested (or equivalent) Products: As manufactured by:
  - .1 Dupont.
  - .2 Prelco.
  - .3 Saflex

.3 *Opaque Film*: White colored film to block-out 100% light, facing the exterior.

- Suggested (or equivalent) Product: "3635-22b" as manufactured by 3M.

.4 *Glazing Spacer, Thermoplastic*: made of a butyl based thermoplastic material, UV stable, with integrated desiccant, with a thermal conductivity of 0.20 W/m.K or less.

- Suggested (or equivalent) Product: "TPS" by Oldcastle Glass.

.5 *Low-E Coating, (on face #2)*: Low emissivity soft coating.

- Suggested (or equivalent) Product:
  - .1 "LoE2-172" by Cardinal.
  - .2 "SN-68" by Guardian.

.3 "Solarban 60" by P.P.G.

.6 *Low-E coating, (on face #3)*: Low emissivity soft coating.
- Suggested (or equivalent) Products:
  .1 "LoE-178" by Cardinal. .2 "Performance Plus" by Guardian.
  .3 "Sungate 100" by P.P.G.

.7 *Low Emissivity Film (on inside glazing face)*: To limit heat transfer on existing windows.
- Suggested (or equivalent) Product: "Prestige" series by 3M.

.8 *Structural Silicone Adhesive Sealant*: One-part silicone sealant
- Suggested (or equivalent) Products:
  .1 "795" by Dow Corning. .2 "SilPruf SCS2000" by GE Silicones.
  .3 "Spectrem 2" by Tremco.

.9 *Glazing Spacer, Black Polycarbonate, Reinforced*: with steel foil, with a thermal conductivity of 0.19 W/m.K or less.
- Suggested (or equivalent) Product: "R-Max" by Thermalite.

.10 *Bird-Friendly Glass*: Treatment located on the outer Glass surface, to combine with other Glass types depending on use.
- Suggested (or equivalent) Products:
  .1 "Decorative Acid-Etched", as manufactured by Vitro Architectural Glass.
  .2 "Feather Friendly Window Markers", by 3M.

End of Section

SECTION 09 20 00 - DRYWALL WORK

1.0 GENERAL

1.1 Extended Warranty

.1 Drywall board shall be guaranteed from defect, including fissures, cracking, surface deterioration or other defects of appearance or for a period of 3 years for labour and Material.

1.2 Design Criteria and Notes

.1 Structural criteria's:

- .1 Partitions in Laboratory areas should be designed to carry a load of 195kg/m2 (40 lb/ft2) - or as prescribed loads, uniformly distributed, for wall mounted cabinets and shelves.
- .2 Cavity shaft wall systems to withstand a min. positive and negative pressure of 10psf.
- .3 Partitions in office or similar areas shall be designed to support shelves or any other wall mount indicated loads.
- .4 Provide adequate stiffeners, furring channels and/or plates, and sheet reinforcing secured between studs for installation of:
  - .1 A/V and similar feature
  - .2 M&E and A/V features or fixtures
  - .3 Handrails
  - .4 Shelving and cabinets
  - .5 Any other similar.
- .5 No wood blocking is permitted within the following locations:
  - .1 Classified Laboratory spaces
  - .2 Animal care facilities
  - .3 High moisture spaces
- .6 Carry out additional *Regular Steel Stud, Structural Steel Stud* or miscellaneous steel reinforcement for vertical posts and lintels, as necessary in the following:
  - .1 For all openings wider than 1800mm.
  - .2 All free-standing partitions.
- .7 Use a min. 20 ga thick for Steel Stud supporting the following:
  - .1 *Board material* finished with ceramic, porcelain or thin brick cladding.
  - .2 *Fibre reinforced or High impact gypsum board* or similar.
- .8 Double the studs at each side of door openings and all openings 915 mm (3'- 0") or wider.
- .9 On the perimeter of all board ceilings, install continuous galvanized "L" shape frame 50mm x necessary height x ±16 Gauge.
- .10 Resistance to seismic forces shall be as required by codes in retrofit or new installation projects.

.2 Notes:

- .1 Install 250 mm (10") long joint tape at 45 degrees, perpendicular to the diagonals, at all corners of openings (doors, windows, inserted items of more than 100 mm x 100 mm (4"x 4") and at all changes of width or depth and take all other measures necessary to avoid cracking.

.2 Install control joint as by best recommended practices, and at:

.1 Maximum 9 m (30'-0") apart on walls horizontally and vertically, and 5 m (16'-0") apart on walls to receive ceramic, porcelain, or thin brick cladding.

.2 Maximum 9 m (30'-0") apart on ceilings without perimeter relief, in both directions.

.3 Maximum 1.5 m (50'-0") apart in ceilings with perimeter relief, in both directions.

.4 Maximum 5 m (16'-0") apart on walls to receive ceramic, porcelain or thin brick cladding.

.3 Install *Insulating strip for drywall, self-adhesive* under floor track and above top track.

2.0 PRODUCTS

2.1 Board Material

.1 *Gypsum Board, Regular or Fire-Resistant*: Ends square cut, edges tapered.

- Suggested (or equivalent) products:
  - .1 "Sheetrock" and "Sheetrock Firecode", regular, type X or type C, by CGC Inc.
  - .2 "ToughRock" and "ToughRock Fireguard", regular, type X or type C, by Georgia-Pacific Canada.
  - .3 “Easy-Lite”, regular, type X or type C, by CertainTeed Canada.

.2 *Mould and Moisture Resistant Gypsum Board, Regular or Fire-Resistant*: Composed of a blend of gypsum and cellulose fibre, ends square cut, edges tapered.

- Suggested (or equivalent) products:
  - .1 "Fiberock AquaTough”, regular, type X or type C, Interior panels by CGC Inc.
  - .2 “M2Tech”, regular, type X or type C, by CertainTeed.
  - .3 “Dens Armor Plus”, regular, type X or type C, by Georgia Pacific.

.3 *Glass Mat Water Resistant Gypsum Board, Regular or Fire-Resistant:* Composed of a blend of gypsum inorganic fiberglass mat surfacing on both sides, ends and edges square cut.

- Suggested (or equivalent) products:
  - .1 "Dens-Shield" and "Dens-Shield Fire-Guard”, regular, type X or type C, by Georgia-Pacific.
  - .2 “DiamondBack Glasroc”, regular, type X or type C, by CertainTeed.

.4 *Abuse Resistant Gypsum Board, Regular or Fire-resistant:* Composed of a core and faces of a blend of gypsum and cellulose fibre, ends square cut, edges tapered.

- Suggested (or equivalent) product:
  - .1 "Fiberock Abuse Resistant" by CGC Inc.
  - .2 “Extreme Abuse” by CertainTeed Canada.

.5 *High Impact Resistant Gypsum Board, Regular or Fire-Resistant*: Composed of a core of a blend of gypsum and cellulose fibre, with embedded glass fibre mesh scrim at the back, ends square cut, edges tapered.

- Suggested (or equivalent) product:
  - .1 "Fiberock VHI" by CGC Inc.
  - .2 “Extreme Impact” by CertainTeed Canada.

.6 *Acoustical Gypsum Board, Regular or Fire-Resistant*: Sound damping gypsum panel without paper or metal in the core, with tapered edges, cuts and installs similar to regular gypsum panel products.

- Suggested (or equivalent) products:
  - .1 "QuietRock ES" by QuietRock Inc.
  - .2 “SilentFX QuickCut” by CertainTeed Canada.

2.2 Steel stud systems

.1 *Steel Stud System, Regular, Galvanized:* Channel Stud Framing in "U","ST": Roll formed from cold-formed galvanized steel sheets, of min. 0.455 mm (0.0179") (26 ga.) base metal thickness or more, as necessary; hot-dipped galvanized, for screw attachment of gypsum boards, with Top and bottom channel tracks in widths to suit stud sizes.

- Suggested (or equivalent) product: As manufactured by by CGC Inc.

.2 *Interior Structural Steel Stud and Open-Web Heavy Duty Joist System, Galvanized*: Channel stud framing and joists: as per ASTM A653/A653M, studs of 152 mm (6") or 92 mm (3⅝") depth.

- Suggested (or equivalent) product: As manufactured by Baily Inc.

2.3 Accessories

.1 *Insulating Strip for Drywall, Self-Adhesive*: Rubberized, moisture resistant 3 mm (1/8") thick closed cell neoprene composition strip, 19 mm (3/4") wide or full width, with self-sticking permanent adhesive on one face.

- Suggested (or equivalent) products: "Permastik 1220" by Jacobs and Thompson Inc. (RCR International Inc.).

.2 *Deflection Joint Trim for Walls:* Pre-assembled joint trim composed of two 76 mm (3") wide, 0.66 mm (24 ga) thick galvanized metal strips joined by a 150 mm (6") wide, 1320 g/m2 (39 oz/yd2) glass fibre fabric coated with neoprene.

- Suggested (or equivalent) products: "Super Metal-Fab", by Duro Dyne Canada Inc.

.3 *Steel Deck Flute Closures in Galvanized Steel*: In cold formed galvanized steel, at least 0.76 mm (22 ga) thick, with galvanized finish.

- Suggested (or equivalent) products: As manufactured by Canam Inc.

.4 *Control Joint Trim for Gypsum Board*: made of zinc sheet, 44 mm x 13 mm (13/4" x 1/2").

- Suggested (or equivalent) products: "Zinc # 093" by CGC Inc.

End of Section

SECTION 09 30 00 - TILE WORK

1.0 GENERAL

1.1 Extended Warranty

.1 All Tile work shall be guaranteed against all defects including cracking, crazing, surface deterioration or any other defects detrimental to the appearance or strength of the finishes, for a period of 3 years for labour and Materials.

.2 Manufacturer representative shall be present at all construction phases to ensure adequate quality control of the installation.

1.2 Design Criteria and Notes

.1 Maintain air temperature and structural base temperature at installation area above 12°C for 72 hours before, during and 72 hours after installation.

.2 Install tile in accordance with recommendations of Terrazzo Tile & Marble Association of Canada (TTMAC) and manufacturers' instructions.

.3 Do not bridge saw-cuts or control-joints. Install backer rod and apply sealant or mouldings.

.4 Terminate tiles at adjacent dissimilar finishes with transition or finishing trims at unprotected edges.

1.2 Extra Material

.1 Deliver 3% of each type and colour of different finish Products to Owner, for maintenance use.

2.0 PRODUCTS

2.1 Tiles

.1 *Porcelain Tiles*: Tiles for floors and walls, single-fired, 8mm (0.32") thick, square edges, slip resistant surface (matte) or polished, through body, colored base, colored body or double pressed tile. Thin set application.

.2 *Unglazed Ceramic (Quarry) Tile:* Tiles mainly for floors, unglazed, single fired, usual thickness from 8mm to 12mm, square edges, slip resistant matte finish, uniform texture and colored all the way through. Thin set application.

.3 *Glazed Ceramic Tile*: Wall application only, vitreous natural clay or semi-vitrified glazed, 7 to 10mm thick, square edges, glossy surface and uniform texture. Multipurpose adhesive. Tiles larger than 4x16 require thin set method.

2.2 Mortars, Grouts and Membranes

.1 *Grout for Floor Tiles*: Pre-mixed urethane based sanded that is stain resistant, single-part product, pigment free, color uniformity, low shrinkage and high crack resistance; colors to be selected by Consultants.

- Suggested (or equivalent) product: "Colour Max Plus" by Flextile Ltd.

.2 *Grout for Wall Tiles*: Portland cement base, polymer additives with high adherence and resistance, mildew resistant, for mixing with water; colours to be selected by Consultants.

- Suggested (or equivalent) product: "Flextile 500 Series" by Flextile Ltd

End of Section

SECTION 09 50 00 - ACOUSTICAL CEILINGS

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Design criteria's:

.1 All services must be supported independently from the ceiling system, except of grid, panel or tile, light fixtures, and air terminals.

.2 Resistances to seismic forces shall be as required by codes in retrofit or new installation projects.

.2 Notes:

.1 Not accepted: ULC assembly rated systems, unless specifically approved by **Facilities**, for very special conditions.

1.2 Extra Material

.1 Deliver 3% of each type and colour of different finish Products to Owner, for maintenance use.

2.0 PRODUCTS

2.1 Acoustical Tiles

.1 *Mineral Fibre Acoustical Tiles, Regular*: made of acoustically efficient non-combustible wet-formed mineral fibre, with Square edge, latex paint face, white colour.

- Suggested (or equivalent) product: "Radar Clima Plus" by USC/CGC Inc.

.2 *Mineral Fibre Acoustical Tiles, Fire-Rated*: made of acoustically efficient non-combustible wet-formed mineral fibre, with Square edge, UL approved.

- Suggested (or equivalent) product:
  .1 "Radar Clima Plus Firecode" by USG/CGC Inc
  .2 "Performa Baroque", by CertainTeed.

.3 *Mineral Fibre Acoustical Tiles, Ornamental*: made of acoustically efficient non-combustible wet-formed mineral fibre, with Tegular edge, latex paint face, white colour.

- Suggested (or equivalent) products:
  .1 "Cortega Second Look II" by Armstrong.
  .2 "Radar Illusion Two/24" by CGC Inc.
  .3 "Performa Baroque", by CertainTeed.

.4 *Mineral Fibre Acoustical Tiles, with Vinyl Soil-Resistant Film*: made of acoustically efficient non-combustible wet-formed mineral fibre, with soil-resistant finish, with square, sealed, coated edge when cut, vinyl film face, adhered to entire surface, white colour.

- Suggested (or equivalent) products:
  .1 "Clean Room VL & VL", by Armstrong.
  .2 "Clean Room Class 100", by CGC Inc.
  .3 "Vinylshield A,C", by CertainTeed.

2.2 Suspension System

.1 *Suspension System, Standard, for Acoustical Ceilings, Regular:* Intermediate duty system, non-fire-rated, commercial quality, corrosion resistant. Components die cut. Tee with double web, rectangular bulb and 24 mm (15/16") rolled cap on exposed face.

- Suggested (or equivalent) products:
  - .1 "Prelude XL", by Armstrong.
  - .2 "DX", by CGC Inc.
  - .3 “15/16 Classic Stab System”, by CertainTeed.

.2 *Suspension System, Narrow Faced, for Acoustical Ceilings, Regular*: Similar to *Standard Suspension system*, but with 14.3 mm (9/16") face.

- Suggested (or equivalent) products:
  - .1 "Suprafine XL", by Armstrong.
  - .2 "Centricitee DXT", by CGC Inc.
  - .3 “9/16 Elite Narrow Stab System”, by CertainTeed.

.3 *Suspension System, Standard, for Acoustical Ceilings, Fire-Rated:* Intermediate duty system, commercial quality, corrosion resistant. Components die cut. Tee with double web, rectangular bulb and 24 mm (15/16") rolled cap on exposed face, UL approved.

- Suggested (or equivalent) products:
  - .1 "DX/DXL", by CGC Inc.
  - .2 “15/16 FireSecure Stab System”, by CertainTeed.

End of Section

SECTION 09 61 00 – SURFACE PREPARATION

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Prepare floor using grinding, Blastrac system, acid etching (as a last resort), or by other means, to remove all surface gloss and laitance and produce a level surface, as recommended by the manufacturer. Do not use sand shot blasting without **Facilities** approval.

.2 Scarify narrow cracks to 12.7 mm (1/2), then fill depressions and cracks, as well as holes, and other defects and crevices in the substrate with appropriate types of mortar.

.3 Do not fill saw-cuts, expansion and construction joints with mortar or grout.

.4 Remove all surface contamination by washing with an appropriate cleaner such as "TSP" (Trisodium Phosphate). Rinse thoroughly and allow drying. Do not use hydrocarbon solvents for cleaning. Existing peeled or checked paint should be scraped and sanded to a sound surface. Glossy surfaces should be sanded dull. Stains from water, smoke, ink, pencil, grease, etc. should be sealed with the appropriate primer/sealer.

.5 For extreme conditions, prepare existing painted metal surfaces as per The Society for Protective Coatings (SSPC-SP1 & SSPC-SP6) solvent & commercial blast cleaning specifications, to remove existing or cracked paint, rust or other contaminants and render surface rough.

2.0 PRODUCTS

2.1 Flooring filliers

.1 *Crack Filler and Repair Mortar*: Two-component multi-purpose, non-shrink, solvent-free and moisture- insensitive epoxy and binder.

- Suggested (or equivalent) product: "Planibond EBA" by Mapei.

.2 *Patching Compound, Over Existing Finishes* (up to 3mm): A fast-setting mix of Portland cement blended with inner fillers and synthetic dry polymer resins for conditioning concrete and patching and filling of minor cracks cracks and depressions over properly prepared wood underlayments, vinyl or cermaic tiles.

- Suggested (or equivalent) product: "Plani/Patch" with "Plani/Patch Plus", “Novoplan 2 Plus” by Mapei.

.3 *Modified Cementitious Mortar for Concrete Repairs and Slopes* (for toppings of 1.5mm to 40mm): A self-levelling & tapered blend of Portland cement and other hydraulic cements; for interior use only.

- Suggested (or equivalent) product: "Ardex K13" by Ardex.

.4 *Modified Cementitious Mortar for Concrete Fill* (for toppings of 10mm to 100mm): One-component, shrinkage crack free, fast-setting and drying polymer-modified cementitious mortar consisting of special hydraulic binders, selected aggregates, special additives and polymeric resin, for interior or exterior use.

- Suggested (or equivalent) product: "Mapecem 100" by Mapei.

.5 *Epoxy Based Grout for Concrete Repairs and Slopes Fast Drying*: A three-component, fast-setting, trowelable, epoxy based grout designed for permanent horizontal repairs to concrete foundations, decks, floors and structural surfaces, with high strength and excellent chemical resistance, for interior use.

- Suggested (or equivalent) product: "Stonset TG5" by Stonhard.

.6 *Levelling and Repairing Compound, High Compressive*: A high compressive strength cementitious, rapid hardening premixed self-levelling underlayment compound for levelling and repairing substrate up to 12 mm (½") in depth, with compressive strength attaining more than 29.5 MPa and linear shrinkage not more than 0.05% after 28 days cure.

- Suggested (or equivalent) product: "Ultra/Plan" by Mapei.

.7 *Modified Cementitious Mortar for Concrete Repair, High Resistance, Low Permeable* (for toppings of 6mm to 50mm): A preblended two-component, shrinkage crack free, fast-setting polymer-modified cementitious mortar consisting of high strength hydraulic binders, selected aggregates, and special additives; high wear resistant, for interior and exterior use.

- Suggested (or equivalent) product: "Mapecem 202" by Mapei.

.8 *Pedestrian Polyurethane Waterproofing Mortar, Textured* (for toppings up to 25mm): Single-component topping, with recommended aggregate.

- Suggested (or equivalent) Product: "Vulkem 350/351", by Tremco.

.9 *Portland Cement Terrazzo*: Underbed and topping, to comply with NTMA's (Terrazzo Specifications and Design Guide) for terrazzo system indicated for component proportions and mixing, with the following characteristics:

.1 Portland Cement: As per ASTM C 150, Type 1.

.2 Water: Potable.

.3 Sand: As per ASTM C 33/C 33M.

.4 Aggregates: Contain no deleterious or foreign matter.

a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.

b. 24-Hour Absorption Rate: Less than 0.75 percent.

c. Dust Content: Less than 1.0 percent by weight.

.5 Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.

.6 Bonding Agent: Neat Portland Cement, or epoxy or acrylic bonding agents formulated for use with topping indicated.

.7 Underbed Reinforcement: Galvanized welded-wire reinforcement, wire 2 by 2 inches (51 by 51 mm) by 0.062 inch (1.57 mm) in diameter, complying with ASTM A 185/A 185M and ASTM A 82/A 82M, except for minimum wire size.

.8 Isolation Membrane (if necessary): Polyethylene sheeting, ASTM D 2103, Type 13300, 4 mils (0.1 mm) thick; or unperforated asphalt felt, ASTM D 226, Type I (No. 15).

.9 Mix Color and Pattern: To match existing.

2.2 Accessories

.1 *Underlayer Waterproof Membrane*: For interior use, a Waterproof & Crack Isolation Membrane, for use below bond coat, under all ceramic tile and stone installation where a waterproof surface is required. Exceeds ANSI A118.10 and ANSI A118.12 standards.

- Suggested (or equivalent) product: “WP-900”, with “WP980 fabric”, by Flextile Ltd.

End of Section

SECTION 09 65 00 - RESILIENT & SYNTHETIC FLOORING

1.0 GENERAL

1.1 Extended Warranty

.1 Resilient sheet flooring shall be guaranteed to be free of defects and not to wear through the colour/pattern for a period of 3 years for labour and Materials.

.2 Manufacturer representative shall be present at all construction phases to ensure adequate quality control of the installation.

1.2 Design Criteria and Notes

.1 Maintain minimum 20°C air temperature at flooring installation area for 3 days before, during and for 48 hours after installation.

.2 Install transition or finishing trims, or reduction strips where necessary at termination of flooring.

.3 Hard nosing to be installed on the steps or tiers, with contrasting colours.

.4 Seal and Waxing:

.1 No wax or other floor finish shall be applied on pre-protected Linoleum surfaces and other non-waxed resilient products.

.2 Waxing procedures:

.1 Decap / clean existing surface Resilient finishes.

.2 Application of Sealer coat product, recommended by Resilient finish manufacturer, followed by three coats of wax.

.3 Sealing and waxing on **UofO** Campus to be performed by one of the pre-approved contractors – depending on the building location. Verify with **CSS** for the list of eligible contractors.

1.3 Extra Material

.1 Deliver 3% of each type and colour of different finish Products to Owner, for maintenance use.

2.0 PRODUCTS

2.1 Resilient finishes

.1 *Vinyl Composition Tiles (VCT) or Luxury Vinyl Tiles (LVT)*: Through pattern, asbestos-free, 3 mm (1/8") thick, precision cut, with colour and pattern extending through the full thickness of the tile, and chemical and abrasive resistance to suit.

.2 *Homogeneous Vinyl Sheet Flooring*: Wax-free, homogeneous sheet vinyl flooring having nominal thickness of 2 mm (0.08"). Colour and pattern shall be dispersed uniformly throughout the thickness of the product, with a polyurethane coating, and chemical and abrasive resistance to suit.

.3 *Linoleum Sheet Flooring*: Made of natural ingredients, consisting of oxidized linseed oil combined with resins, wood flour, inorganic filler material, chalk, natural pigments and cork, mixed and calendared to a jute backing.

.4 *Rubber Sheet Flooring or Tiles*: Made of thermoset or vulcanized rubber, 3mm (1/8") thick rolls with integral base and welded seams.

- Suggested (or equivalent) products:
  - .1 As manufactured by Mondo.
  - .2 As manufactured by Mannington Commercial.

2.2 Synthetic finishes

.1 *Synthetic Carpet Tiles*: Flocked high performance broadloom carpet with a 100% nylon type 6.6 wear layer with an intermediate fiberglass layer and a recycled closed cell vinyl cushioned backing.

- Suggested (or equivalent) product: "Flotex modular Seagrass" series, by Forbo.

.2 *Hybrid Resilient Tiles or Sheets* (glued, or layed down on top of existing flooring finishes): Made of heterogeneous construction of nylon and closed-cell cushion, fused together through heat and pressure.

- Suggested (or equivalent) products:
  - .1 "Powerbond", by Tarkett.
  - .2 "Coral Series", by Forbo Inc.

2.3 Accessories

.1 *Cork underlayment:* In rolls or sheets, made of natural Cork, 6mm or 12mm as necessary.

- Suggested (or equivalent) product: As manufactured by QEP.

.2 *Sound Reducing Underlayment Sheet*: Dual Sheet, 10mm Thick free floating, dry leveling, sound reducing.

- Suggested (Or Equivalent) Products:
  - .1 "Jumpax Waterprrof", By Impacta.
  - .2 "Forbo NR 99", by Forbo.

.3 *Floating Floor Underlayment Sheet: 1.8mm thick.*

- Suggested (or equivalent) product*: "floexpro", by xtrafloor.*

.4 *Stair Tread with Integrated Riser, in Rubber*: Ant-skid, in homogeneous composition of 100% synthetic rubber, integral with constrasting nosing patterns.

- Suggested (or equivalent) Product: "Angle Fit" by Tarket.

.5 *Tactile Walking Surface Indicators, in Rubber*: In homogeneous composition of 100% synthetic rubber, high quality additives – for interior applications only.

- Suggested (or equivalent) Product: "Tactile Walking Surface" by Tarket.

End of Section

SECTION 09 67 00 - SPECIAL FLOORING

1.0 GENERAL

1.1 Extended Warranty

.1 All special flooring shall be guaranteed against all defects including cracking, crazing, surface deterioration or any other defects detrimental to the appearance or strength of the finishes, for a period of 3 years for labour and Materials.

.2 Manufacturer representative shall be present at all construction phases to ensure adequate quality control of the installation.

1.2 Design Criteria and Notes

.1 Maintain surfaces and ambient air temperature between 13°C and 28°C for a minimum of 72 hours before, during and after application, and ambient relative humidity below 80% during application. Ensure moisture content in the substrate is within the limits prescribed by the manufacturer.

.2 Do adherence test before beginning the work to ensure compatibility between new and existing floorings and coatings. Also, do a test of the cleaning process to ensure sufficient adhesion of new coating.

.3 Separate with a clean cut existing and new surfaces.

.4 Do not cover expansion joints. For flooring with considerable thickness, at saw cuts and construction joints, install a 150 mm (6") *Glass fiber Reinforcing fabric tape* ***(09 96 00)***, attaching with epoxy adhesive on both sides to the concrete slab surfaces, but leaving unadhered over the caulking. Only at construction joints install also "L" shaped divider strips, back to back, without attaching them together and ensuring that each one has at least 6 mm (1/4") adherence to the slab.

.5 Obtain from **UofO**'s users the approval of degree of slip resistance.

2.0 PRODUCTS

2.1 Flooring systems

.1 *Clear Acrylic Floor Sealer*: Acrylic resin based polymer sealer-curing film. Minimum two coats, 50-75 microns (2-3 mils) of dry film per coat.

- Suggested (or equivalent) product: "Sikafloor CureHard-24" by Sika (Duochem).

.2 *Pigmented Urethane Floor Coating:* Two component glossy polyester resin and aliphatic polyurethane hardener coating, with an antiskid agent. Minimum two coats, 87.5 microns (3.5 mils) of dry film per coat.

- Suggested (or equivalent) product: “942” system by Sika (Duochem).

.3 *Pigmented Urethane Floor Coating, with Waterproof Membrane*: Two components Glossy polyester resin and aliphatic polyurethane hardener coating, with an antiskid agent and with polyurethane based elastomeric membrane. Minimum 1 mm (40 mils) of dry film, and 850 microns (34 mils) of membrane and 125 microns (5 mils) of finish coating.

- Suggested (or equivalent) products: “SikaFloor 304W, by Sika (Duochem).

.4 *Epoxy Floor Coating, Glossy*: Two-component heavy duty, catalyzed, water borne, polyamide epoxy floor coating, chemical resistant Primer: 150 microns (6 mils) dry film same resin.

Finish coats: two coats of 50 &10 microns (2 & 0.5 mils) per coat.

- Suggested (or equivalent) products:
  - .1 "Armorseal floor-plex 7100 WB", with anti-slip additives, by Sherwin Williams.
  - .2 "Atonkote GS4", with anti-slip additives, by Stonehard.

.5 *Epoxy Quartz Flooring System*: Seamless, trowel applied epoxy quartz mortar flooring, with a multi-colored ceramic granular aggregate, with antiskid finish and a clear urethane protective coat. Minimum 3 mm (1/8") – up to 5mm (3/8”), including primer coat, grout coat, and two epoxy finish coats of 125 microns (5 mils) dry film each. In addition, a protective urethane coat of 87.5 microns (3.5 mils) of dry film.

- Suggested (or equivalent) products:
  - .1 "9200/902" system by Sika (Duochem).
  - .2 “Stonblend GSI-G” by Stonehard.

.6 *Methyl Methacrylate (MMA) Flooring System* (fast curing, for existing, unconditioned or cold environments): Low VOC, with chemical, stain and slip resistance, self levelled or troweled, 3 mm (1/8") – up to 5mm (3/8”).

- Suggested (or equivalent) products:
  - .1 "Stonclad SL Xpress” or “Stonclad TR Xpress” by Stonhard.

End of Section

SECTION 09 91 00 - PAINTING

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Notes:

- .1 The temperature of the room, the substrate and the paint should be at a minimum of 7°C. Relative humidity should be less than 85%. If the temperature falls below the minimum prescribed limits during the 24 hours preceding paint application, install heating equipment to obtain the minimum specified temperature.
- .2 Paint walls and ceilings before new mechanical and electrical equipment is installed; do the necessary repairs to the painted surfaces after the installation of the latter.
- .3 Apply paint of similar properties and matching the existing in at least two finishing coats on existing painted surfaces.
- .4 All paint should be lead free.

.2 Systems:

- .1 System paintings to be one primer coat, minimum one undercoat, and two finished coats, as per industry standards, to suit all surfaces and conditions.

2.0 PRODUCTS

.1 Paint surfaces in accordance with the following MPI (Master Painter Institute) Manual requirements:

- Suggested (or equivalent) products: As manufactured by:
  - .1 Benjamin-Moore.
  - .2 Dulux.
  - .3 Sherwin-Williams.
  - .4 SICO.

GENERAL APPLICATION[1]	LOCATION	PAINT TYPE					MPI CODE NUMBER									
							PRIMER ON SUBSTRATE					FINISH COAT SHEEN[2]				
		Latex 100% Acrylic H. Perf.	Latex 100% Acrylic	Light Industrial Acrylic	Varnish & Lacquers	Epoxy	Concrete	Masonry	Gypsum wall board	Galvanized steel	Wood	Level 1 (Flat)	Level 3 (Eggshell)	Level 5 (Semi-gloss)	Level 6 (Gloss)	Notes
Walls:																
General application	Interior		X				4	3	50				52			
Public, high traffic and average abuse spaces	Interior	X					4	3	50				139			
High abuse or High moisture & sim.	Interior			X			4	3	50					153		
Frequently cleaned with chemicals	Interior					X			50					215		
Ceilings:																
General application	Interior		X				4		50			53				
High abuse or High moisture & similar spaces	Interior			X			4		50					153		
Frequently cleaned with chemicals	Interior					X			50					215		
Door, window frames, Balustrades, handrails, decks, and all miscellaneous surfaces:																
General application – metallic surfaces	Interior	X								134				153		
	Exterior			X						134					164	
High abuse or High moisture & similar spaces – metallic surfaces	Interior			X						134				153		
Frequently cleaned with chemicals	Interior					X				50				215		
General application – Wooden surfaces	Interior	X									6			141		
	Interior				X										56	
	Exterior	X									6				164	

Notes:

.1 Refer to "**VOLUME I – P. Finish**" for relevant for detailed information about finishes applications. Refer to other related Sections for **Special coatings** finishes.

.2 MPI Sheen levels:

Level 1: Gloss at 60 degrees – Max. 5 units; Sheen at 85 degrees – Max. 10 units.

Level 3: Gloss at 60 degrees – 10-25 units; Sheen at 85 degrees – 10-35 units.

Level 5: Gloss at 60 degrees – 35-70 units.

Level 6: Gloss at 60 degrees – 70-85 units.

Note: Subject to **Facility** approvals, Sheen levels could be maintained as existing adjacent in case of limited renovation projects.

.3 In general, for new surfaces, to apply 1 primer coating & 2 finish coats. Primer coating could be skipped for existing painted surfaces.

End of Section

SECTION 09 96 00 - SPECIAL COATING

1.0 GENERAL

1.1 Extended Warranty

.1 All special coating shall be guaranteed against all defects including cracking, crazing, surface deterioration or any other defects detrimental to the appearance or strength of the finishes, for a period of 3 years for labour and Materials.

.2 Manufacturer representative shall be present at all construction phases to ensure adequate quality control of the installation.

1.2 Design Criteria and Notes

.1 Maintain surfaces and ambient air temperature between 13oC and 28oC for a minimum of 72 hours before, during and after application, and ambient relative humidity below 80% during application. Ensure moisture content in the substrate is within the limits prescribed by the manufacturer.

.2 Do not apply coatings on sealants, unless they are compatible.

.3 Protect adequately or remove all prefinished adjacent elements, such as apparatus, equipment or accessories, using canvases, masking tape or other appropriate means.

2.0 PRODUCTS

2.1 Coating systems

.1 *High Performance Pigmented Epoxy Wall Coating, High Gloss:* Two-component high performance epoxy coating, high gloss finish, with a water borne epoxy finish coat. System includes recommended Primers with minimum Two coats of 200 microns (8 mils) dry film thickness per coat and One coat of water borne epoxy of 50-75 microns (2-3 mils) dry film thickness.

- Suggested (or equivalent) products: As manufactured by Sika (Duochem):
  - .1 "Cor-Pro 470" (primer for metal surface).
  - .2 "Sika (Duochem) 265" (primer for gypsum surfaces).
  - .3 "Sika (Duochem) VA" (filler for concrete block surfaces).
  - .4 "Duroplast 100" (coating).
  - .5 "Duroplast 150" (finish coat).

.2 *Pigmented Epoxy Wall Coating, with Polyurethane finish, High-Gloss*: Two-component, high performance, high solids, epoxy base layer, with a high performance, UV resistant, Polyurethane finish. System includes recommended Primers with minimum One coat applied at 5 to 7 mil/125 to 180 microns, and Two coats of 2 to 4 mils/50 to 100 microns dry film thickness.

- Suggested (or equivalent) product: “Stonglaze VSR” system by Stonehard.
  - .1 As recommended (Primer).
  - .2 “Stonglaze Topcoat EPX” (Base coat).
  - .3 “Stonglaze URE” (Topcoat).

.3 *High Performance Pigmented Epoxy Wall Coating, High Gloss, Partially Reinforced*: Two-component high performance epoxy coating, high gloss finish, with a water borne epoxy finish

coat, partially reinforced at junctions of dissimilar materials and at rounded corners with *Glass Fiber Reinforcing Fabric Tape*. System includes recommended Primers with minimum Two coats of 200 microns (8 mils) dry film thickness per coat and One coat of water borne epoxy of 50-75 microns (2-3 mils) dry film thickness.

- Suggested (or equivalent) products: As manufactured by Sika (Duochem):
  - .1 "Cor-Pro 470", primer for metal surfaces.
  - .2 "Sika (Duochem) 265", primer for gypsum surfaces.
  - .3 "Sika (Duochem) VA" filler for concrete block surfaces.
  - .4 "Duroplast 100" coating.
  - .5 "Duroplast 150" finish coat.

.4 *High Performance Pigmented Epoxy Wall Coating, High Gloss, Totally Reinforced*: Two-component high performance epoxy coating, high gloss finish, with a water borne epoxy finish coat, reinforced on entire surface with *Glass fiber Reinforcing fabric tape*. System includes recommended Primers with minimum Two coats of 200 microns (8 mils) dry film thickness per coat and One coat of water borne epoxy of 50-75 microns (2-3 mils) dry film thickness.

- Suggested (or equivalent) products: As manufactured by Sika (Duochem):
  - .1 "Cor-Pro 470", primer for metal surfaces.
  - .2 "Sika (Duochem) 265", primer for gypsum surfaces.
  - .3 "Sika (Duochem) VA" filler for concrete block surfaces.
  - .4 "Duroplast 100" coating.
  - .5 "Duroplast 150" finish coat.

2.3 Accessories

.1 *Glass Fiber Reinforcing Fabric Tape:* Min. 100 mm (4") wide tape, simple weave, 194 g/m^2 (5.7 oz/yd^2), 0.20 mm (0.008") thick.

- Suggested (or equivalent) product: "Style 7521" by Bay Mills.

.2 *Anti-Graffiti Shield:* VOC compliant, clear, water-based sacrificial coating for control of graffiti on most building surfaces, preventing spray paints, crayons and ink from penetrating and staining the underlying surface. To be reapplied after every graffiti removal.

- Suggested (or equivalent) Product: “Defacer Eraser Sacrificial Coating SC-1” by Prosco.

End of Section

SECTION 10 11 00 - VISUAL DISPLAY BOARDS

1.0 GENERAL

1.1 Extended Warranty

.1 Visual display boards shall be guaranteed for a period of 10 to 50 years, as per university of Ottawa open agreement with manufacturer (see below).

2.0 PRODUCTS

2.1 Visual display boards

.1 *Visual Display Boards – Writing Surfaces (Whiteboards, Green Chalkboards, Natural Cork Tack boards or Linoleum Cork Takboards)*: Distributed by (as per **UofO** Standing Offer No.: 2017067-RFQ):

Compagnie Canadienne de Tableaux Noirs Ltée (CCTN).
30 Montee des Bouleaux
Saint-Constant, Qc, J5A 1B6
Tel: 450-632-1660, Fax: 450-632-5449

End of Section

SECTION 10 21 00 - TOILET COMPARTMENTS

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Equip each door with hinges, latch set, and each compartment with coat hook mounted on door to standard mounting heights. Adjust and align hardware for proper functioning.

.2 Set door open position at 30E from closed position.

.3 Equip out swinging doors with door pulls.

2.0 PRODUCTS

2.1 Compartments

.1 *Polymer Toilet Compartment System, Floor mount*: Made from high density Polyethylene (HDPE) resins with homogeneous color, and Aluminum heat sunk strip for bottom edge of doors and panels.

- Suggested (or equivalent) product: “Global Polymer”, as manufactured by Global Partitions.

.2 *Phenolic Compartment System, Floor Mount*: Made from resin impregnated raft paper core with homogeneous color.

- Suggested (or equivalent) products:
  - .1 “Global Phenolic”, as manufactured by Global Partitions.
  - .2 “Series 1080”, by Bobrick

2.2 Accessories

.1 *Pilaster Shoes and Sleeves*: In stainless steel sheet metal, with brushed finish, 1.2 mm (0.05") thick for plastic laminate compartments.

.2 *Fasteners for Toilet Compartments*: stainless steel screws and bolts, tamperproof, "male-female" type bolts, through-type, identical on both sides.

End of Section

SECTION 10 22 00 - DEMOUNTABLE PARTITIONS

1.0 GENERAL

1.1 Extended Warranty

.1 Demountable Partitions components, including doors, door frames, door hardware, electrical, communications and plumbing accommodations shall be guaranteed for a period of 10 years.

1.2 Design Criteria and Notes

.1 Partition system to be fully demountable and reloadable, non-progressive, extend in four directions at posts without disturbing other panels, accommodate floor/ceiling height variations of 25 mm (1").

.2 Components to be non-combustible, distortion free, uniform in dimension, construction and appearance.

.3 Partition system to accommodate electrical outlets on posts or base, and wiring in posts, base and cap.

.4 Carry out additional *Regular Steel Stud*, *Structural Steel Stud* ***(09 20 00)***, miscellaneous steel or any similar reinforcement as necessary at head of partitions to provide adequate structural resistances.

2.0 PRODUCTS

2.1 Partitions

.1 *Demountable Partitions:* Modular insulated panels made of thin, anodized or prepainted Aluminium posts, with vertical and horizontal reveals, including:

.1 Solid Fascia in Laminate or Veneer.

.2 Acoustic and Fabric Fascias with sound-absorbing and sound-blocking properties

.3 *Tempered or Laminated Glass, Clear or Frosted* ***(08 80 00)*** Fascias, Double-Sided or Single-Centred.

- Suggested (or equivalent) products:

.1 “Altos” by Teknion.

.2 “Dirtt Systems” by Dirtt.

End of Section

SECTION 10 26 00 – WALL AND CORNER PROTECTION

1.0 GENERAL

1.2 Design Criteria and Notes

.1 For Metallic elements, refer to Metal work related Section.

.2 For plastic elements:

.1 Fire Performance Characteristics: Comply with specified requirements of ASTM D 256 for impact resistance and ASTM E 84 for the following:

.1 Flame Spread: 25 or less.

.2 Smoke Developed: 450 or less.

2.0 PRODUCTS

2.1 Corner Guards

.1 *Stainless Steel Corner Guards:* In *Satin Finish*, surface mounted, 1.5 mm thick (16 gauge) min., 3-1/2" (89mm) wing, with bevelled edges.

- Suggested (or equivalent) products:

.1 "SCO-8 Series" by Construction Specialities Inc.

.2 “Stainless steel Corner Guard GS series” by Korogard.

.2 *Aluminum Corner Guards*: In anodized Aluminum in satin finish, 4mm thick, 1/2" x 1/2" (12.7mm x 12.7mm), with a standard 90° angle.

- Suggested (or equivalent) product: “Anodized Corner Guard” by Korogard.

.3 *Vinyl corner Guards*: In Extruded acrylic modified vinyl plastic sheets, 078" (1.98mm) thick vinyl or 2-1/2" (63.5mm) wing, mounted over extruded plastic retainer.

- Suggested (or equivalent) product: "IPC Series" BY INPRO CORP.

2.2 Wall Bumpers

.1 *Crash Rail Bumper Extrusion*: Made of Extruded, rigid, impact-resistant plastic, nominal 0.078 inch (1.9 mm) thick or Stainless steel type 304 with #4 Satin finish, 16 gauge, or Aluminum, .250 inch (6.4 mm) thick, 5052-H32 with powder-coated finish, mounted over continuous Aluminum retainer and two continuous vinyl bumper cushions. Sizes as indicated.

- Suggested (or equivalent) product:

.1 "Crash Rail C series" by Korogard.

.2 "Acrovyn" by Construction Specialities Inc.

2.3 Protective Wall Coverings

.1 *Homogeneous Vinyl Wall Covering*: Vinyl/Acrylic: Rigid sheet should be high impact, nominal .040" (1.02mm) minimum thickness. With color-matched vinyl/acrylic trim as needed for joint/transitions.

- Suggested (or equivalent) products:

.1 “korogard sheets” by Koroseal. .2 "Prism Wall Series" by INPRO Corp.

.2 *Stainless Steel Wall Covering*: Type 304 with #4 Satin finish, 1.5mm thick, with countersunk screws and perimeter Caulking.

- Suggested (or equivalent) product: “Wall Guard Xlerator”, by Grainger.

End of Section

SECTION 10 28 10 - WASHROOM AND OTHER ACCESSORIES

1.0 GENERAL

1.1 Design Criteria and Notes

.1 All lockable accessories shall be keyed alike.

.2 Use tamper proof theft proof stainless steel screws/bolts for exposed fasteners, and corrosion resistant type for concealed fasteners.

.3 Apply *Sealant **(07 90 00)*** around all accessories.

.4 Do not use wood for the installation of the accessories.

.5 Not acceptable:

.1 Manufacturer's or brand names on face of units.

.2 Wall recessed or semi-recessed Accessories or features. Only surface mount.

.3 Stainless Steel, Alumium or any shiny metallic surface difficult to clean.

2.0 PRODUCTS

2.1 Accessories

.1 *Soap Dispenser, Surface Mounted*: 900ml, colour white.

- **UofO** Standard product: “JH438”, distributed by Tenaquip.

.2 *Sanitary Napkin Receptacle, Surface Mounted*: Color white.

- **UofO** Standard product: ”6140”, by Rubbermaid.

.3 *Tissue Dispenser, Surface Mounted*: Smoke color.

- **UofO** Standard products:

.1 General: “56TR (double roll)”, by Tork.

.2 For single washrooms and tight locations: “66TR(single roll)”, by Tork.

.4 *Paper Towel Dispenser, Surface Mounted*: Smoke color.

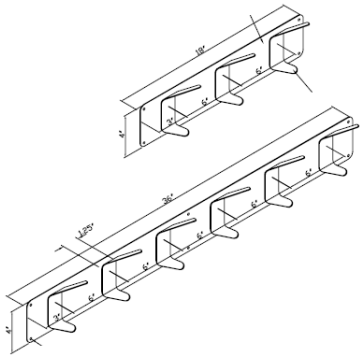
- **UofO** Standard product: “84TR”, by Tork.

.5 *Hand Sanitizer, Surface Mounted*: Foam dispenser, 1200 mL capacity. Color white.

- **UofO** Standard product: “Purell FMX”, by Wood Wyant Inc.

.6 *Coat Hook Strip, 3 or 6 Series*: In stainless Steel.

- UofO Standard product: “3CH/18-4SS and / or “6CH/36-4SS”, by Ridalco Industries Inc.



.7 *Waste Bin*: Container without lid. Up to 10 gallons maximum capacity.

- Suggested (or equivalent) products:
  - .1 Under counter: “FG295600GRAY”, by Rubbermaid.
  - .2 Exposed: “Spectrum Series”, by Bush Systems.

. 8 *Individual Hook*: In stainless steel with bumper, integral with partition. Single or double head.

- Suggested (or equivalent) product: “01-9402”, by Sunglow.

.9 *Mirror, Accessible*: Tilt model, in stainless Steel.

- Suggested (or equivalent) product: “B-293 1630”, by Bobrick.

.10 *P.T. Hinged Offset Rail*: In stainless Steel, (810mm x 150mm offset), c/w free standing post (for retrofit projects).

- Suggested (or equivalent) products:
  - .1 “B-4998(.99 for peened gripping surface)”, by Bobrick.
  - .2 “P.T.Rail Floor Mast” by Healthcraft.

.11 *Adult Change Table, Surface Mounted*:

- Suggested (or equivalent) product: “Pressalit Care 1000” by Max-Ability.

.12 *Heavy Duty Shelf*: In brushed stainless steel, 22 gau, 450mm x 150mm.

- Suggested (or equivalent) product: “950-18”, by Frost.

.13 *Toilet Backrest*: In brushed stainless steel tube & 16mm solid plastic laminate Backrest.

- Suggested (or equivalent) product: “1028”, by Frost.

.14 *Recycle Bin*: Container without lid. Up to 10 gallons maximum capacity.

- Suggested (or equivalent) product: “H-1859BLU”, by Rubbermaid.

End of Section

SECTION 10 51 00 - LOCKERS

1.0 GENERAL

.1 Design Criteria and Notes

.1 Install filler panels above or beside lockers & finished end panels to exposed surfaces of locker banks.

.2 Shall be sitting on concrete base or steel base if concrete not possible.

.3 Apply *Sealant **(07 90 00)*** at joints between lockers and adjoining surfaces.

2.0 PRODUCTS

2.1 Lockers

.1 *Institutional Type Lockers*: Sizes as necessary, 305 mm (12") wide maximum, in High Density Polyethylene. Single or double tier, space permitted.

- Suggested (or equivalent) products:
  - .1 As manufactured by Royal Plastic Lockers.
  - .2 As manufactured by Tufftec HDPE Lockers.

.2 *Clean Room Type Lockers*: Similar to *Institutional type lockers* in Brush Satin vertical grain Finish #4 (Grade 304).

- Suggested (or equivalent) product: As manufactured by Famous Lockers.

2.2 Prefabricated Benches

.1 *Prefabricated Benches, Wood Top* (for general use): Solid maple tops, corners rounded and sanded; with a clear urethane finish, 460mm wide minimum, mounted on prepainted steel pedestals consisting of single diameter tubing.

- Suggested (or equivalent) product: “20B72-12” by Prefix.

.2 *Prefabricated Benches, Stainless Steel* (for clean rooms): Brush Satin vertical grain Finish #4 (Grade 304), solid top; 460mm wide minimum.

- Suggested (or equivalent) product: "Pedestal Gowning Bench" by Pearce Stainless.

End of Section

SECTION 11 13 00 – LOADING DOCK EQUIPMENT & OVERHEAD DOORS

1.0 GENERAL

1.1 Extended Warranty

.1 The following elements shall be guaranteed as follow:

.1 *Loading Dock Levellers*: 10 year general warranty (all components).

.2 *Dock Bumpers*: 2 year performance warranty. 1 year for labour and Materials.

.3 *Dock Door Seals*: 1 year performance warranty. 1 year for labour and Materials.

1.2 Design Criteria and Notes

.1 Coordinate with transport companies for the exact dimensions and locations of the bumpers and seals.

2.0 PRODUCTS

.1 *Loading Dock Levellers, Hydraulic*:

.1 Unless otherwise requested, Dock levellers minimum capacity of moving or rollover live load shall be of 11340 kg (25,000 lb) and static load of 22,680 kg (50,000 lb), to be installed in a dry pit.

.2 Pit will be built with full length structural steel "C" channels and "I" beams. Formed-steel moulds are not accepted.

.3 Sides of platform will be equipped with protective full range steel sheet plates to provide toe guards for platform in raised position.

.4 Deck to be thoroughly thermally insulated, with Weatherseals on all 3, with an easily replaceable flexible part fitted into a steel section welded to the leveller or curb angle.

- Suggested (or equivalent) product: "RHH 5000", by Rite-Hite.

.2 *Dock Bumpers, High Impact Resistant*: Completely enclosed box construction with 12.7 mm (1/2") high-carbon steel face cap, 6 mm (1/4") steel body and rubber slats, 610 mm x 267 mm x 102 mm (24" x 10½" x 4").

- Suggested (or equivalent) product: "Docksaver" by Rite-Hite.

.3 *Dock Door Seals:* Construct dock shelter seal of 100 mm (4") tapered projection pads, 305 mm to 405 mm x 305 mm (12" - 16" x 12") high density polyurethane foam, continuously bonded to 50 mm (2") thick kiln-dried pressurized wood frames and a galvanized steel base, with a non-flammable elastic adhesive, and covered with waterproof high performance " fabric, and one full width touch and hold velcro adjustable split curtain, complete with "wiper" pad.

- Acceptable (or equivalent) product: "S-600" with "S-900 DD Dry Dock" by Serco Corporation.

.4 *Vehicle Restraint System, Wheel Chocks, Chains and Signage*: Heavy duty industrial grade, to provide a fully functional Loading Dock.

- Acceptable (or equivalent) product: As manufactured by Serco Corporation.

.5 *Overhead Dock Doors, Motorized*: To be industrial grade with heavy duty hardware, rails and integrated visions panels, with the following characteristics:

.1 Made of pre-painted galvanised G-60 metal sheet to ASTM A653.

.2 Commercial aluminium extrusions 6063 T5.

.3 Insulation: foamed in place polyurethane, 2.56 lbs/ft3 (41.0 kg/m3) minimum density to CGSB 51-GP-21M.

.4 To be equipped with electric operators, push button control stations, motion detectors, safety edges and utility switches.

- Suggested (or equivalent) product: "Energex, model Mark III-266 (26ga, steel, R-32)" by Thermostop.

End of Section

SECTION 11 14 00 – HOSPITALITY EQUIPMENT

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Mounting method shall be ceiling hung (from structure above) application.

3.0 PRODUCTS

.1 *Portable Ceiling Lift Device*: Lift device composed of aluminium rail, suspension system, rods, straps, and all similar installation features with following characteristics:

.1 Operation system: Battery operation. Capacity as recommended by manufacturer.

.2 Capacity: 440 lb (200 kg)

.3 Noise level: 60.5 dB.

.4 Accessories: Trolley Track, Extension strap, Reacher, Portable lift carry bag, Pivoting adaptor, Swivel Trolley, Non-slip feet that provide stability and protection when put on the table.

.5 Power Supply: At disconnect switches.

- **UofO** Standard product: "V3 (MAXISKY 440)" by BHM Medical.

End of Section

SECTION 12 20 00 - WINDOW TREATMENT

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Secure aluminium components with non-corrosive metal fasteners for installation, concealed in final assembly.

.2 When installed on multi-mullion windows, any joint between two fabric pieces shall occur only at center line of an intermediate mullion.

.3 Design brake to stop and hold blinds in any position.

.4 In general:

.1 *Motorized Shading Systems* to be used in areas that are hard to reach or in rooms where there is a large span of windows where the shades would always have to be drawn up or down at the same time (Classrooms, Laboratories, and similar).

.2 *Manual Shading Systems* to be used in public spaces, with a mechanism that can be controlled by chain but also pulled down manually, as it does not jam if a student pull on the shade.

2.0 PRODUCTS

.1 *Shading Systems, Manual or Motorized*: Chain operated and sprocket roller shading system with infinite positioning, or with motor. Fabric in Shade cloths woven of .018 opaque, vinyl coated polyester yarn consisting of approximately 79% vinyl and 21% 500 denier polyester core yarn. Percentage of openness: 3%, 1% and 0%.

- Suggested (or equivalent) products:

.1 "Sheerweave 2410” (3%), "Sheerweave 2500” (1%), "Sheerweave 7500” (0%), as manufactured by SOL-R:

.2 Spring Assistant models (for large, high or big units), as manufactured by Sun Project.

End of Section

SECTION 12 35 00 - LABORATORY FURNITURE

1.0 GENERAL

1.1 Extended Warranty

.1 All lab furniture and related accessories shall be guaranteed against all defects in design, Material fabrication and installation for a period of 3 years.

1.2 Design Criteria and Notes

.1 Criteria: Comply with all standards is this specification, unless more stringent requirements are given herein. Work shall conform also to the following:

- .1 Safety Guide for Laboratory Operations, Chapter 5.1, Treasury Board Manual, Occupational Safety and Health.
- .2 Health Canada, Office of Laboratory Security, The Laboratory Bio-Safety Guidelines.
- .3 ANSI/AIHA Z9.5 - American National Standard, Laboratory Ventilation
- .4 ANSI/NFPA 30 - Flammable and Combustible Liquids Code.
- .5 NFPA 45 – Fire Protection for Laboratories Using Chemicals.
- .6 SEFA-2.3 – Installation of Scientific Laboratory Furniture and Equipment, Recommended Practices
- .7 SEFA-3 – Work surfaces
- .8 SEFA-5.1 – Scope of Work
- .9 SEFA-7 – Laboratory and Hospital Fixtures
- .10 SEFA-8 – Laboratory Furniture Casework, Shelving and Tables, Recommended Practices
- .11 SEFA 10 - Adaptable Laboratory Furniture Systems
- .12 OSHA applicable standards.
- .13 EEMAC standards.
- .14 Ontario Electrical Safety Code.
- .15 CSA C22.1-02 - Canadian Electrical Code.
- .16 "Quality Standards for Architecural WoodWork", for wood casework.
- .17 AWI and CSA quality standards for finish carpentry and Plywood identification to be by grade mark.

.2 Notes:

- .1 An operational HVAC system that maintains temperature and humidity at occupancy levels must be in place. Relative humidity must be between 25% and 55% before product is brought on site.
- .2 Permissible variation is 1.5 mm in 3 meters (1/16" in 10'-0"). Bolt together casework, in such a way that joints between them shall not be wider than 1 mm (0.04").
- .3 Integrate existing cabinets into the new furniture (if applicable) and make necessary repairs.
- .4 Use non-corrosive screws and bolts for concealed fastenings.
- .5 No oils or waxes are to be used on finished installation.

2.0 PRODUCTS

1.0 General

.1 The Contractor / Manufacturer shall be a member of SEFA & AWI/AWMAC.

- **UofO** standard products: As manufactured by:

.1	Bedcolab Inc	.2	CIF Lab Solutions
.3	Mottlab Inc	.4	Duralab Equipment Corp.
.5	Fisher-Hamilton	.6	ICI Inc.
.7	Symbiote Inc.	.8	CSI Inc.
.9	Microzone Inc.		

2.2 Countertops, Tabletop (work surfaces) & Shelves

.1 General:

.1 Tops shall be fabricated in as long a length as possible to minimize the number of joints. All joints shall be butt type and factory fitted to provide proper alignment on site.

.2 Exposed edges and *Laboratory Sink **(22 42 01)*** openings surfaces shall be finished in same manner as specified for working surface of countertop material and faces shall have a drip groove on the underside.

.2 *Countertops - Plastic Laminate Facing with Resistance to Acid:*

.1 To be fabricated from wood panel particleboard 28.6 mm (1-1/8") thick overall, with chamfered edges, covered with plastic laminate with Acid resistance or with High resistance to acids, 1.2 mm (0.047") thick material on the exposed / open / underneath faces.

.2 Splash backs of the same material shall be part of the counter, with a 3 mm (1/8") pencil radius at the intersection of counter. Lateral splashbacks shall be fixed mechanically to the counter and joints sealed.

.3 Solid PVC finishing edge strip 3mm shall be applied by electro-pressure to the exposed edges of the countertop.

- Suggested (or equivalent) products:
  - .1 "Arborite flex 4", finish "CA" or "Diamond", by Arborite.
  - .2 "Panelab" by Panelyte.
- Suggested (or equivalent) products for High Acid resistant plastic Laminate:
  - .1 "Arbochem", by Arborite.
  - .2 "Laboratory grade 840/LGP", black colour, finish "58" or "42", by Formica.

.3 *Countertops - Solid Phenolic Resin (Solid plastic Laminate) – Acid resistant:*

.1 Shall be 19 mm (1") minimum overall thickness or more – depending on support spacing, with chamfered edges.

.2 Splashbacks of the same material shall be mechanically fastened to the counter and the resultant joints shall be sealed.

- Suggested (or equivalent) products:
  - .1 "Arborite laboratory grade solid phenolic core", finish "CA" or "Diamond",

by Arborite.

.2 "Trespa TopLab Plus" by Formica.

.3 "Chemical resistant SPC" by Durcon.

.4 *Countertops – Epoxy Resin - Acid and Heat Resistant:*

.1 Moulded, homogeneous, 100% modified epoxy resin boards, completely cured in processing, with at least 1.25 mm (0.05") thick (dry film) coating, very smooth finish, non-glazing, non-reflecting, without surface defects.

.2 Of 25 mm (1") overall thickness or more, with bevelled edges, and with 32 mm (1¼") marine edges in fume hoods, extremities rounded 6.4 mm.

.3 Joints shall be welded with identical material.

- Suggested (or equivalent) product: As manufactured by Chemtops.

.5 *Countertops - Stainless Steel:*

.1 Shall be of 1.5 mm (16 ga) with closed edges and reinforced with 1.5 mm (16 ga) thick hat-shaped channels spaced 400 mm (16") o.c. maximum, and welded to the underside to avoid twisting or buckling with sound deadening. With integral splashbacks, and milled to match the Stainless Steel counter tops, with a cove, at the junction with the countertop and shall have a total thickness of 19 mm (¾").

.2 The front edges and all other exposed or open ends of such tops shall have a raised rim or marine edge 25 mm (1") wide. From the extreme inward edge of the rim, a slope downwards of 30o shall be provided with a vertical drop of 6 mm (1/4"). Exposed edge shall be of 25 mm (1") total height.

2.3 Casework

2.3.1 General

.1 Units: Shall be interchangeable, rigid and self-supporting.

.2 Suspended Cabinets or on Casters:

.1 To be provided with steel hanging rails to match correspondent Framing system.

.2 To be provided with finished backs and bottoms made of similar materials.

.3 Suspended cabinets shall have dust cover to enclose the top, made of similar materials, and units on Casters shall have a finished countertop surface, with similar construction as the fixed countertops.

.4 Depending on the number, shall be provided with 2 cabinet transfer carts that will allow for installation, removal and relocation of suspended cabinets without tools or removal of contents of cabinets.

.3 Additional notes for Stainless Steel units

.1 Shall be of similar construction to that of Prepainted Steel furniture.

.2 All base cabinets and other furniture, including those with drawers and with sinks, shall be sealed units.

.3 Joints in exposed Stainless Steel cabinet surfaces shall be ground and polished to the same finish as the rest of the surfaces. All Stainless Steel nuts, screws, bolts, rivets, etc., shall be of the same type stainless as in the sheet material.

.4 All Stainless Steel welding material shall be of type similar to the sheet material, by the argon arc process. To be continuous, crevice-free, ground and polished to the original finish of the surface. Fillers, solders or spot welding will not be permitted.

2.3.2 Base cabinets, wall cabinets or floor cabinets

.1 *Units in Prepainted Steel or Stainless Steel:*

.1 Casework:

.1 Each unit shall be a completely welded structure. Under hood base cabinets must be capable of supporting the weight of the fume hoods and their contents.

.2 All metal surfaces shall be isolated from direct contact with dissimilar metals, concrete and masonry.

.3 No exposed horizontal structural cabinet members between doors and drawers shall be accepted.

.2 Internal shelves:

.1 Shelves shall be mild Steel of similar finish to the cabinets, with edges turned down on all four (4) sides 19 mm and shall return under on the front and back 16 mm (5/8"). Shelves shall be adjustable on 16 mm (5/8") increments and shall be full depth and width of interior. A minimum of four (4) zinc plated shelf clips per shelf shall be provided.

.3 Doors:

.1 Hinged doors shall be double-wall telescoping construction 19 mm (3/4") thick, with front panel and inner liner formed on four sides. All interior surfaces shall be painted before assembly. Doors shall be sound-deadened on interior.

.2 Sliding doors:

.1 To be easily removable, without having to remove shelving, and bumpered.

.2 Frameless sliding Glass doors shall be with "H" shaped extruded aluminum shoes fixed to and running the full width of door bottom.

.3 Sliding doors, with or without glazing, shall have a hollow metal frame 19 mm x 32 mm. same finish as adjacent.

.4 Drawers:

.1 Drawer bodies shall be reinforced and spot-welded to the inner drawer front and back panel. Fronts shall be 19 mm (3/4") double pan construction sound deadened, consisting of two telescoping metal panels (painted inside and out). All interior surfaces shall be painted before assembly.

.5 Basic thicknesses: In general, metal used in the construction of cases shall be of the following minimum gauges:

.1 Front support rail: 3 mm.

.2 Case ends, bottoms, tops, vertical posts, uprights, filler panels, shelves, door

panels, glazed door frames and top rear corner gussets, back rails, intermediate horizontal rails: 1.2 mm (18 gauge / 0.048").

.3 Exposed case tops, drawer suspensions, door and case hinge and front corner reinforcement, and levelling device brackets: 1.5 mm (16 gauge / 0.059").

.4 Drawer bodies and cabinet backs: 0.91 mm (20 gauge / 0.036").

.2 *Units in wood:*

.1 Casework:

.1 Wood Core Material shall be in Medium density fibreboard (MDF) of 700-745 kg/m3 density, minimum grade 130, FSC certified, minimum 75% recycled material content, free of added formaldehyde. Finish to be one (or a combination) of the following:

.1 *Catalysed Vinyl Finish*: Color to be selected from the manufacturer standard.

- Suggested (or equivalent) products: As manufactured by CIF

.2 *Wood Veneer Facing* with *Catalysed Vinyl Finish*: 0.508 mm (0.02") thick rift cut, Book match pattern, clear Vinyl finish or stained, in Grade AA (with modifications to grade), White Maple (Plain Sliced), Grade A Birch (Rotary cut), European Steamed Beech (Plain Sliced) or Cherry (Plain sliced).

.3 *Thermally Fused Melamine (TFM):* High wear resistant Resin Impregnated decorative sheet thermally fused to both faces of wood core. Colour to be selected by Consultants.

- Suggested (or equivalent) products: Flakeboard Thermally Fused Melamine

.4 *Plastic Laminate Facing with Resistance to Acid*: Similar to material used for Countertops.

.5 *Plastic Laminate Facing*: Plastic laminate sheet: regular grade (GPR), 1.15 mm (0.045") thick, colour as per Consultant's choice.

- Suggested (or equivalent) products: As manufactured by:
  - .1 Arborite
  - .2 Abet Laminati
  - .3 Wilsonart
  - .4 Formica

.2 Edging shall be in 3mm solid PVC for *Plastic Laminate Facing*, Catalysed *Vinyl, TFM* units, or Solid wood, same type for *Wood veneer Facing* units.

.3 All Cabinet work shall be Full Flush overlay Modular Construction, factory assembled, using dowel construction. Overall thickness shall be as follow:

.1 Sides: 19mm with 1mm solid edging on 4 edges

.2 Back: 19mm

.3 Bottom: 19mm with 1mm solid edging

.4 Floor mounted cabinets to have an integral fir waterproof veneer core base.

.2 Internal shelves:

.1 Refer to *Exposed Shelving* articles.

.3 Doors:

.1 *Swinging*:

.1 In *Wood Veneer Facing*, *Catalysed Vinyl*, *TFM* or *Plastic Laminate Facing*, with a MDF core, or as indicated of same construction, thickness and finishes as Casework, and 3mm similar solid edging on perimeter.

.2 *Sliding*:

.1 Shall be easily removable, without having to remove shelving.

.2 Sliding doors, with or without glazing, shall have a wood frame, same composition as casework frame 19 mm x 32 mm. Or, Frameless sliding Glass doors shall be with ground, polished edges and door pull.

.4 Drawers:

.1 Faces: In *Wood Veneer Facing*, *Catalysed Vinyl*, *TFM* or *Plastic Laminate Facing*, with a MDF core, thickness and finishes as Casework, and 3mm similar solid edging on perimeter.

.2 System: Shall be in *Plastic Laminate Facing* with MDF core, Fully dovetailed drawer box, with 12mm *TFM* bottoms, or in *Prepainted Steel*.

2.3.3 System & Frame assemblies

.1 *Fixed Countertop Units*:

.1 *Post or Open Leg frame assembly, in Prepainted Steel or Stainless Steel:*Consisting of special tubular frame system (50mm x 50 mm approx.) with prolonged posts (uprights) for shelf support, with hangers to accommodate *Suspended Cabinets*, with the following minimum gauges:

.1 Leg frames, uprights and ddifferent supports and connections: 2 mm (14 ga).

.2 Front and rear cabinet hangar rails: 2.7mm (12ga).

.3 Toe kick Plate: 1.5mm (16ga).

.4 Modesty panels (if applicable): 1.2 mm (18 ga).

.5 Wall and Isle Pilasters: 1.5mm (16ga), double slotted.

.2 *Service panels in Prepainted Steel or Stainless Steel*: To be flanged on all four sides and reinforced, 1.2 mm (18 ga) thick. Completely or partially removable, without the use of tools and shall be bumpered to prevent rattling. To be part of the removable or on caster base cabinets. To be also provided for base cabinets in peninsular or split island benches, with or without electrical outlets.

.3 *Aprons for knee space, in Prepainted Steel or Stainless Steel*: Unless otherwise noted, aprons, with or without drawers, to be 64 mm high maximum, to match adjacent units in material, design and finish.

.4 *Gable legs*: Unless otherwise noted, shall be with same composition as the *Casework*. To be provided for exposed end *Aprons*.

.5 *Suspended Base Cabinets*: Modular and interchangeable.

.6 *Floor-mount Base Cabinets*: Modular, with continuous base.

- Suggested (or equivalent) products:
  - .1 "Chorus" by Bedcolab In.
  - .2 "Sigma Flex" by MottLab Inc.

.2 *Mobile Countertop Units*:

.1 Similar to *Fixed Countertop Units*, with adjustable legs or pads, and upper Sleeves for shelves and *Suspended cabinets*, serviced by the ceiling, with integrates services.

- Suggested (or equivalent) products:
  - .1 "Symphony" by Bedcolab In.
  - .2 "Sigma Carts" by MottLab Inc.
  - .3 "Ascent Series Tables" by CIF Lab Solutions

.3 *Upper Units*:

.1 *Wall-mount Brackets in Prepainted Steel or Stainless Steel*: Consisting of special adjustable tubular frame system (13mm x 50mm approx.) for shelf support, wall-mount cabinets, with hangers to accommodate wall-mount Cabinets, 2 mm (14 ga).

.2 *Wall-Mount Cabinets*: Adjustable heights, mount on *Wall-mount Brackets*, or on *Post or Open Leg frame*, with *Sliding doors*.

2.3.4 Exposed shelving

.1 *Reagent Shelving*:

.1 Reagent shelves shall be of *Plastic Laminate*, provided with a 3mm solid PVC edges, or in *Epoxy Resin*, thickness and finishes as *Countertops.* Underside to be finished to match top, provided with Stainless Steel edges and trims.

.2 Vertical Supports shall be of the same material, 32 mm (1¼") thick.

.2 *Exposed Adjustable Shelving*:

.1 In *Wood Veneer Facing*, *Catalysed Vinyl*, *TFM* or *Plastic Laminate Facing,* with a MDF core. Shall be of same construction, thickness and finishes as *Casework* (19mm min.), and 3mm similar solid edging on perimeter. Shelves exceeding 914mm shall have 25mm thickness min.

.2 In *Epoxy Resin*, or *Solid Phenolic Resin*: Underside to be finished to match top,

provided with Stainless Steel edges and trims. Thickness, finishes and compositions as described for Countertops.

- Suggested (or equivalent) product: “Vario system” by CIF.

.3 *Adjustable Prepainted Steel or Stainless Shelving:* Shall be of similar construction and finishes as the cabinets, reinforced, to avoid deflection, supported on the slotted tubular Steel uprights.

2.3.5 Cabinets for Storage of Chemical Products & Fume Hoods

.1 *Storage Cabinets for Corrosive (Acids and Bases) Storage*: Shall be enamelled Prepainted Steel or wood finish, except the whole of the interior shall be lined with 6 mm (¼") thick chemical-resistant panel liners, with Stainless Steel drainage basins, on the shelf and on the cabinet floor, with a 2" rim all around.

.2 *Storage Base Cabinets, for Flammable (Solvent)*: Cabinets shall be of the same construction and appearance as the corrosive storage cabinets. Cabinets shall also comply with NFPA's flammable and combustible liquids Code 30 and have ULC or Factory Mutual approvals and/or certification, lockable.

.3 *Fume Hoods*: Body shall be of the same construction and appearance as the adjacent Casework. To be constructed as per CSA Z316.5, NFPA 45 as well as NFPA 91 (latest editions), and performance tested and certified to ASHRAE 110 (latest edition) for sash height of 46 cm (18 inches).

.4 Also, refer to section “**VOLUME I - D. Laboratories & Support”** for any additional requirements.

2.4 Cabinet Hardware

.1 *Nuts, Bolts and Washers*: Shall be Stainless Steel.

.2 *Drawer and Door Pulls*: Shall be recess mounted and shall be 100 mm (4") extruded anodized aluminum for baked enamel furniture, Stainless Steel for Stainless Steel furniture, and Nickel plated for wood furniture.

.3 *Door Hinges*:

.1 For Metal furniture: 5 knuckle, removable, institutional type, semi-concealed, with unequal wings, Stainless Steel. Hinges shall be attached to doors and case with cadmium plated flathead machine screws.

.2 For wood furniture: 3 knuckle, self-Closing type, Nickel-plated finish, casework hinges with mounting plates to provide overlay and height adjustment. minimum 170 deg.

.3 Quantity: Provide 3 hinges for doors 800 mm to 1300 mm high. 4 hinges for doors 1300 mm to 1800 mm high, and 5 hinges for doors 1800 mm to 2400 mm high.

.4 *Adjustable Shelf Supports*:

.1 For Internal Steel Shelves: Seismic type, shall be cadmium or chrome plated Steel for cabinets with baked enamel finish, and Stainless Steel for cabinets in Stainless Steel,

or shall be gloss nickel finish, as recommended by Lab Manufacturer.

.2 For Internal Wood Shelves: Seismic type, Double Pin Polycarbonate locking shelf clip.

.3 For External shelves assemblies: Seismic type, Gables shall be 16ga with mounting pins, with finish to match supporting system leg frames or brackets.

2.5 General Accessories

.1 Drying Racks:

.1 *Drying Racks in Solid Phenolic Resin (Solid plastic Laminate):* To be with a wall hanger bracket, and Pegs of 10 mm x 125 mm (3/8" x 5"). Pegs shall not be bonded into board, but shall be held securely by mechanical design, with horizontal trough at bottom of rack to catch drips, pitched to drain directly into sinks, in Stainless Steel, c/w drain basket accessories.

- Suggested (or equivalent) product: As manufactured by InterDyne Systems.

.2 *Drying Racks in Stainless Steel:* To be with a wall hanger bracket and integral drip through. Pegs shall be 12 mm x 150 mm (1/2" x 6"), with interchangeable bases with horizontal trough at bottom of rack to catch drips, pitched to drain directly into sinks, c/w drain basket accessories.

- Suggested (or equivalent) product: As manufactured by InterDyne Systems.

2.6 Service Chases and Air Returns

.1 *Service Chases and Air Returns in Prepainted Steel or Stainless Steel:*

.1 To have at least 1.5 mm (0.059") thick with reinforcing and accessories as necessary, with Stainless Steel bases (sleeves) and access panels and be easily demountable to allow access to the services.

.2 *Ceiling Service Tiles*: In Powder coated steel, fits acoustical tile size (610mm x 610mm or 1220mm), providing connection to gas services, electric and data from the ceiling to your flexible workstation solutions configured below.

Note: Refer to Mechanical & Electrical sections for more details.

- Suggested (or equivalent) product: As manufactured by CIF.

2.7 Support frames for mechanical services

.1 *Mechanical Support Frame in Steel:*

.1 To be of adequate thickness, of cold rolled Galvanized or Prepainted Steel box channel Construction, spaced a maximum of 1220 mm (48") o.c. at all standard wall benches, for service piping.

- Suggested (or equivalent) product: As manufactured by Unistrut.

2.8 Plumbing Service & Fixtures & Fume Hoods

.1 Refer to Mechanical section for more details.

2.09 Electrical Accessories

.1 Refer to Electrical section for more details.

2.10 Finishes

.1 *Wood Veneer Facing Catalysed Vinyl, TFM or Plastic Laminate Facing*: (As indicated).

.2 *Stainless Steel Elements*: Unless otherwise indicated:

.1 To be in Polished Finish #2B (Grade 316L) for the *Countertops, Sinks, Cup sinks* and Electrical *Monument boxes*.

.2 To be in Brush Satin vertical grain finish #4 (Grade 304) for all other elements.

.3 *Prepainted Steel Elements*: Finish shall be a high-grade laboratory furniture quality, chemically resistant polyester baked enamel, baked in a controlled high heat. Surfaces exposed to view (interior or exterior) shall receive one coat pigmented primer applied over carefully sanded surfaces followed by two coats of enamel. Surfaces not exposed to view shall have one coat of primer and one of enamel. Completed finish shall be highly resistant to acids, alkalis, salts and solvents.

End of Section

SECTION 12 48 00 – FOOT GRILLES

1.0 GENERAL

1.1 Design Criteria and Notes

.1 The grilles shall withstand a force of 4.300 kN (966 lb/ft2) or 2.260 kN (508 lb/ft2), at a maximum span of 610 mm (2'- 0"), with a deflection not exceeding 1/190th of the span.

.2 Grille assemblies to pass successfully salt fog test at 1000 hours as per ASTM B117.

.3 Foot grilles drainage basin to be coated with an *Elastomeric Waterproofing Membrane* ***(07 10 00)***, or *Cementitious Waterproofing* ***(07 10 00)***. For special cases, and upon **Facilities**' approval, a recessed Drainage Pans with bituminous coating can be provided only if poured within the concrete. *Aluminized Polyurethane Coating Waterproofing Membrane* ***(07 10 00)*** may also be applied over existing Drainage Pans.

1.0 PRODUCTS

.1 *Foot Grilles* (over Drainage Pans): In Aluminum extrusions, with Self-cleaning grilles, anti-slip, with 1.05 coefficient of friction, and concealed supports. Sections to be mounted on hidden Stainless Steel hinges and have stainless steel lock notches and lifting hooks, with flush mounted inverted "T" frame, supplied with anchoring hooks and Sound gaskets, factory installed. Including:

.1 Drainage Pan: In Aluminium 1.52 mm (16 ga) with 2 coats of bituminous paint on all surfaces in contact with the concrete, or Stainless Steel Polished finish #2b (Grade 316) as per AISI specifications.

- Suggested (or equivalent) products:

.1 One-Directional Pattern: "C040" of "Design Line", with "VV" frame and "GB-46" lock, by Grillage Bolar Canada Inc.

.2 Two-Directional Pattern: "BSA-1", with "TT" frame, by Grillage Bolar Canada Inc.

.2 *Foot Plank Grilles* (without Drainage Pans): Patented Aluminum click-in profile system, combined with synthetic carpet, 11 mm thick closed construction, with transition and or edge pieces. Surface-Mount or Recessed.

- Suggested (or equivalent) product: "OBEX Bar", by Millken Inc.

End of Section

SECTION 12 50 00 - FURNITURE AND ACCESSORIES SYSTEMS

1.0 GENERAL

1.1 Extended Warranty

.1 Furniture shall be guaranteed to perform without defect for a period of 10 years.

1.2 Design Criteria and Notes

.1 For full information, refer to Furniture Standards document on **UofO** web site.

2.0 PRODUCTS

2.1 Seats

.1 *Seats With Retractable Tablet*: With the following characteristics:

.1 Load Criteria: Seats shall be designed at minimum to withstand the following loads in addition to their own weight:

.1 Seat: Shall wisthand an evenly distributed static load of 275lb.
.2 Seat back: Shall withstand an evenly distributed front or rear static load 275lb.
.3 Retractable tablet: Shall wisthand an evenly distributed static load of 150lb.

.2 Seats:

.1 Backrest: Shall be fabricated to accommodate a range of seat spacing from 19" – 24" on center. Shall fit a riser of 37 inches in depth.
.2 Armrest: To be located on each seat side and shared between seats.
.3 End Panels: Plastic or metal end panels shall be included at the end of each row to conceal seat structure.
.4 Seat numbers: Seat numbers shall be recessed on the front of the seat shroud and be numbered in a clear and visible manner.
.5 Fabric: Shall be polyester and meet or exceed performance guidelines outlined by the Association for Contract Textiles for Heavy Duty Upholstery.

.3 Retractable Tablet:

.1 Shall be self-storing underneath or between seats without interfering with the seat, in one single motion and have anti-panic release movement.
.2 Writing surface shall be minimum 18mm thick Birch plywood core c/w high-pressure laminate on face and High pressure laminate backer sheet or phenolic polyurethane board. Dimensions shall be minimum 13 ¼" wide by 10 ½" deep (159 sq. in) and capable of supporting a laptop computer.

.4 Power:

.1 Lights shall be installed on every seat edge adjacent to circulation isles.
.2 Refer to Elect. For other information.

.5 Finish: As per Consultant's choice.

- Suggested (or equivalent) products:

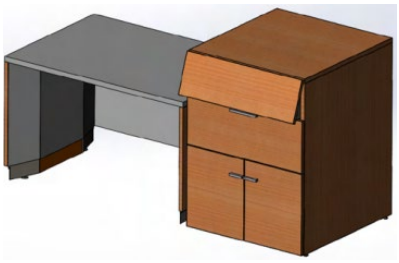
.1 "Concerto" Auditorium Seating" by KI.

2.2 Tables

.1 *Fixed or Mobile Tables Systems*: With the following characteristics:

- .1 Tabletop: Continuous in ***Abuse-resistant plastic laminate sheet (06 10 00)***, continuous no less than 1-3/8" finished thickness with ¼" radiuses corners.
- .2 Edges: Extruded "T" vinyl moulding or 3mm PVC edging, colour to be selected by consultant.
- .3 Modesty Panels: 305mm high and continuous, finished to match Tabletops.
- .4 Upholstery: Not required.
- .5 Power: Refer to Elect.
- .6 Finish: As per Consultant's choice.
- .7 Design: Refer to Furniture Standards document on **UofO** web site.
- \- **UofO** Standard Product: As supplied by CMG Office interiors.

2.3 Podium Desks



.1 *Podium Desk:* Made up of one fixed unit and one height adjustable unit. To be secured to the floor and be modified on Site to accommodate 2 D-boxes and Motor cut-out. To relocate ventilation openings and grills to opposite side of the unit, with the following characteristics:

- .1 High pressure laminate: Teknion foundation laminate.
- .2 Low pressure laminate: Teknion source laminate.
- .3 Metal: Teknion mica.
- .4 Power: Refer to Elect.
- .6 Finish: As per Consultant's choice.
- .7 Design: Refer to Furniture Standards document on **UofO** web site.
- \- **UofO** Standard Product: As supplied by CMG Office interiors.

2.4 Accessible Tables

.1 *Accessible Table, Adjustable & Motorized*: Floor mounted height adjustable tables for barrier free access w/ modesty panel and electrical sphere, with the following characteristics:

- .1 Table base: T-shape metal height adjustable legs to be anchored to floor. Anchoring bolts to be finished to match table legs or concealed with a screw cap. leg to be installed on centreline of short side of table top.
- .2 Table top: 25.4" thick core c/w high pressure laminate on all exposed surfaces and 3mm thick PVC edge, to match surface.
- .3 Modesty panel: Embossed metal to run full length of table.
- .4 Height adjustments: Electric control height adjustment at front of table c/w manual override mechanism. Table height to range between 750mm and 100mm.
- .5 Power: Refer to Elect.

.6 Finish: As per Consultant's choice.

.7 Design: Refer to Furniture Standards document on **UofO** web site.

- Suggested (or equivalent) product: As supplied by CMG Office interiors.

2.5 Accessories

.1 *Clock*: Digital, wall-mount, connected to the existing IT network, synchronized via Ethernet.

- **UofO** Standard Product: "POE / OneVue Sync" by Primex Inc.

End of Section

SECTION 14 20 00 - ELEVATORS

1.0 GENERAL

1.1 Extended Warranty

.1 All proper functioning of the elevators, including the doors, the accessory equipment and all hardware shall be guaranteed against all defects, Material fabrication and installation for a period of 2 years.

1.2 Design Criteria and Notes

.1 Performance:

- .1 Operate Elevators with smooth acceleration and provide a comfortable and agreeable ride to the passengers.
- .2 Adjust typical acceleration rate to 0.92 g. Provide car speed to within 10% of 0.15m/s in both directions.
- .3 Provide adjustable dwell times and independent dwell settings for car and hall calls.
- .4 Set door detector interrupt and nudging time to 20 seconds.
- .5 Adjust door opening and closing times to suit handicapped users.
- .6 Door noise level increase above ambient shall not exceed 6 dBa, as measured inside the elevator cab during a full door cycle;
- .7 Car running noise level increase above ambient shall not exceed 4 dBa, as measured inside the elevator cab when travelling bottom to top of the hoistway;
- .8 Machine room noise level will not exceed 75 dBa, as measured when the elevator is running in either direction.

.2 Systems:

- .1 Provide machine within minimum 85% efficiency.
- .2 Install machine on high performance insulating pads.

.3 Drive System:

- .1 The compatibility of the drive and motor shall have been tested successfully on five other comparable installations.
- .2 The unit response shall be instantaneous and noiseless.
- .3 Provide filters to limit electrical noises to 5 percent of nominal signal.
- .4 Mount all drive components on insulating pads so that any vibration is not transmitted to the building structure.

.4 Position Transducer:

- .1 Provide a device to transmit position of the car to the controller.
- .2 Install automatic levelling device for smooth deceleration at floor in both directions.
- .3 Provide on top of the car, a position reader to count number of tape perforations.
- .4 Ensure position readings every floor as a minimum.
- .5 Stroboscopic and dual tachometers devices are permitted.
- .6 Do not use stepper switches.

.5 Notes:

.1 Elevator design must meet ASME A17.1/CSA-B44, OBC, OFC and TSSA codes.

.2 All buttons and signage are to meet the needs of visually impaired and mobile impaired users, and to be vandal proof.

.3 Elevators are to come with moving blankets.

.4 Provide a clear cab interior height of 2743 mm (9'-0") to the underside of the fixed ceiling.

.5 Paint all non-machined metal surfaces.

.6 Finishes: Refer to **"VOLUME I – P. Finish Schedule**" for relevant information.

.7 Control Panel:

.1 To be bilingual, French first.

.2 To include braille.

.3 Level numbering to reflect the way it is on plans: Using numbers to indicate levels (no use of "lobby" or "ground", etc).

End of Section

SECTION 22 42 01 – PLUMBING FIXTURES

1.0 GENERAL

1.2 Design Criteria and Notes

.1 Valves:

.1 Valve products from Toyo shall not be utilized.

.2 Refer to section "**VOLUME I – W. Plumbing**".

2.0 PRODUCTS

2.1 Water Closets

.1 *Water Closet*: With the following characteristics:

.1 High efficiency, Low consumption.

.2 Operating in a range of 4.2Lpf to 6.0 Lpf (1.1 gpf to 1.6 gpf).

.3 Wall hung.

.4 Vitreous china.

.5 Elongated bowl.

.6 Antimicrobial surface.

.7 Direct-fed siphon jet action.

.8 Top inlet spud (1-1/2'' diam.) (Back spud - conceal application- is not acceptable).

.9 Color: White.

- Suggested (or equivalent) Product: "3351.101" by American Standard.

.2 *Manual Lever Operated Water Closet Flush Valve*: With the following characteristics:

.1 Exposed flush valve with manual lever.

.2 High efficiency (1.28gpf/4.8Lpf).

.3 Chloramine resistant diaphragm.

.4 Brass construction with Polished chrome plated finish.

.5 1'' IPS Screwdriver Back-check angle stop.

.6 Vandal resistant stop cap.

.7 Chrome plated vacuum breaker tube.

.8 Spud coupling and flange for 1-1/2'' top spud.

.9 Trap primer connection to flush valve shall be considered where new floor drain is required.

.10 ADA & ASSE1037 compliant.

- Suggested (or equivalent) Products:

.1 "111-1.28" by SLOAN (Manual Lever).

.2 "81T201-48", by DELTA (Manual Lever).

.2 *Sensor Activated Water Closet Flush Valve*: With the following characteristics:

.1 Exposed hardwired flush valve with integral solenoid (concealed flush valve is not allowed).

.2 High efficiency (1.28gpf/4.8Lpf).

.3 Brass construction with polished chrome plated finish.
.4 Chloramine resistant diaphragm.
.5 1'' IPS Screwdriver Back-check angle stop.
.6 Vandal resistant stop cap.
.7 Chrome plated vacuum breaker tube (concealed vacuum breaker is not allowed).
.8 Spud coupling and flange for 1-1/2'' top spud.
.9 Chrome plated wire covering tube.
.10 Hardwired infrared sensor, to be recessed in wall.
.11 Valve top mounted infrared sensor also acceptable.
.12 Sensor range shall be field adjustable.
.13 Electronic manual override button or true mechanical override.
.14 Vandal resistant chrome plated or stainless steel cover plates with vandal resistant screws (cover plates using hidden/invisible fastener such as set crews are not acceptable).
.15 Trap primer connection to flush valve shall be considered where new floor drain is required.
.16 ADA & ASSE1037 compliant.
.17 ASSE 1037 compliant
.18 Low voltage transformers shall be in an accessible space and hardwired to electrical circuit. Plug-in transformers shall not be utilized in "public space" areas

- Suggested (or equivalent) Products:
  .1 As manufactured by SLOAN (wall mounted sensor with override button).
  .2 As manufactured by MOEN.
  .3 As manufactured by DELTA (wall mounted sensor with override button).
  .4 As manufactured by DELTA (valve-top mounted sensor with override button).

.4 *Water Closet Seat*: With the following characteristics:
  .1 Commercial high strength impact resistant thermoplastic.
  .2 Heavy duty.
  .3 Corrosion free hardware.
  .4 Open front elongated bowl seat, without cover.
  .5 Stainless steel check hinges, nuts and lock washers.
  .6 Withstanding strong chemicals.
  .7 Color: Black.
  - Suggested (or equivalent) Product: "500STSCC" by Centoco.

2.2 Urinals

.1 *Urinals*: With the following characteristics:
  .1 Washout wall hung urinal with integral extended shields.
  .2 Ultra-High efficiency, Low consumption.
  .3 Operating in a range of 0.5 Lpf to 3.8 Lpf (0.125 gpf to 1.0 gpf).
  .4 Vitreous china.

.5 Top inlet spud (3/4'' diam.) (Back spud - conceal application - is not acceptable).
.6 Color: White.
.7 ADA Compliant.
- Suggested (or equivalent) Products:
  .1 "6590.001" by American Standard.
  .2 "Z5758", by ZURN.

.2 *Manual Lever Operated Urinal Flush Valve*: With the following characteristics:
.1 Exposed flush valve with manual lever.
.2 High efficiency (0.125 gpf/0.5 Lpf).
.3 Chloramine resistant diaphragm.
.4 Brass construction with Polished chrome plated finish.
.5 3/4'' IPS Screwdriver Back-check angle stop.
.6 Vandal resistant stop cap.
.7 Chrome plated vacuum breaker tube.
.8 Spud coupling and flange for ¾'' top spud.
.9 Trap primer connection to flush valve shall be considered where new floor drain is required.
- Suggested (or equivalent) Products:
  .1 "186-0.125 DBP" by SLOAN (Manual Lever)
  .2 "81T231-05", by DELTA (Manual Lever)

.3 *Sensor Activated Urinal Flush Valve*: With the following characteristics:
.1 Exposed hardwired flush valve with integral solenoid (concealed flush valve is not allowed).
.2 High efficiency (0.125 gpf/0.5 Lpf).
.3 Brass construction with Polished chrome plated finish.
.4 Chloramine resistant diaphragm.
.5 3/4'' IPS Screwdriver Back-check angle stop.
.6 Vandal resistant stop cap.
.7 Chrome plated Vacuum breaker tube (concealed vacuum breaker is not allowed).
.8 Spud coupling and flange for 3/4'' top spud.
.9 Chrome plated wire covering tube.
.10 Hardwired infrared sensor, to be recessed in wall.
.11 Valve top mounted infrared sensor is also acceptable.
.12 Sensor range shall be field adjustable.
.13 No manual override button for urinals.
.14 Vandal resistant chrome plated or stainless-steel cover plates with vandal resistant screws (cover plates using hidden/invisible fastener such as set crews are not acceptable).
.15 Trap primer connection to flush valve shall be considered where new floor drain is required.

.16 ADA & ASSE1037 compliant.

.17 ASSE 1037 compliant

.18 Low voltage transformers shall be in an accessible space and hardwired to electrical circuit. Plug-in transformers shall not be utilized in "public space" areas

- Suggested (or equivalent) Products:
  - .1 As manufactured by SLOAN (wall mounted sensor with override button).
  - .2 As manufactured by MOEN.
  - .3 As manufactured by DELTA (wall mounted sensor with override button), or (valve-top mounted sensor with override button).

2.3 General Lavatories & Sinks

.1 *Wall-Mount Lavatory*: Commercial sink, vitreous China, with recessed self-draining deck, and rear overflow.

- Suggested (or equivalent) Products: "Murro 0955.000", by American Standard.

.2 *Manual Lever Lavatory Faucet*: 4" trim plate, 0.5 usgpm vandal resistant aerator, brass body, Faucet height 5 ¾" max, ADA compliant.

.3 *Sensor Activated Lavatory Faucet*: With the following characteristics:

- .1 Waterproof sensor and control module.
- .2 Hardwire, 4" trim plate,
- .3 0.5 usgpm vandal resistant aerator.
- .4 Brass body, adjustable sensing distance and auto-shutoff.
- .5 Faucet height 5 ¾" max.
- .6 Mixing valve shall compensate for inlet water temperature fluctuations (Mechanical mixing valves - with thermostatic limit stop are not acceptable).
- .7 ADA compliant.
- Suggested (or equivalent) products: "ETF-600 Optima" by SLOAN, c/w "120v/24v" transformer and thermostatic mixing valve and ¼ turn mini ball valves by Dahl.

.4 *Slop (Mop) Sink:* Terrazzo 6" drop front slop sink, 36"x36"x12", c/w Stainless Steel caps and drain. Trim to be service-sink faucet.

- Suggested (or equivalent) Product: "TSB 3002" by Crane with "830-AA" Faucet by Fiat.
-

.5 *Kitchen Sink:* Size as per design parameters, with the following characteristics:

- .1 In Stainless steel, type 304 (18/10), No. 4 satin finished.
- .2 Single compartment, self-rimming drop sink with faucet ledge.
- .3 Material thickness: 18 gauge (1.2 mm).
- .4 No overflow.
- .5 One Faucet hole.
- .6 Undercoated to reduce condensation and resonance.
- .7 3 ½'' cup strainer and 1 ½'' brass tailpiece.
- Suggested (or equivalent) product: "LBS6808P-1" by Franke.

.6 *Faucet Kitchen Sink:* With the following characteristics:
- .1 Single hole, single lever.
- .2 Chrome plated.
- .3 9 ½'' center to center integral cast brass spout.
- .4 1.5 GPM (5.7 L/s) max., non-aerating outlet.
- .5 Ceramic Cartridge.
- .6 User adjustable temperature control mixer.
- .7 Temperature limiter.
- .8 Rated operating pressure: 20-125 psi.
- .9 Rated operating temperature: 40-140°F.
- .10 ADA compliant.

- Suggested (or equivalent) product:
  - .1 As manufactured by SLOAN (wall mounted sensor with override button).
  - .2 As manufactured by MOEN.

.7 *Water Fountains*: With the following characteristics:
- .1 Refrigerated.
- .2 Sanitary touchless activated bottle filler.
- .3 Condensate to be piped to sanitary drainage.
- .4 Easy-touch front and side push bar controls.
- .5 Integrated silver ion anti-microbial protection in key areas.
- .6 Stainless steel basin with integral drain.
- .7 Quick fill rate of 0.07 L/s (1.1 GPM).
- .8 No filter type.
- .9 No gooseneck type.
- .10 Stainless steel cooler cabinet / panels.
- .11 Flexi-guard safety bubbler (not vandal resistant type).
- .12 Plug-in type (shall not have direct power connection).
- .13 ADA compliant

- .Suggested (or equivalent) Products:
  - .1 "EZSTL8WS Versatile Bi-Level EZ Cooler" by ELKAY.
  - .2 "EZSTLG8WS High-Efficiency Green Spec Versatile Bi-Level Cooler" by ELKAY.
  - .3 "EZS8WS Single EZ Cooler" by ELKAY.
  - .4 "EZSG8WS High-Efficiency Green Spec Single Cooler" by ELKAY.

2.4 Laboratory Fixtures, & Sinks

.1 General:
- .1 Equip sinks and with tailpieces, cross strainer, plug and removable overflow. Standing removable overflow, when in position, should be 25 mm (1") below flood level of sink. Include perforated overflow guard with top 12.7 (1/2") below flood level.

.1 Laboratory Sinks:
- .1 *Stainless Steel Sinks:*

.1 Shall be of 1.2 mm (18 Ga.) thickness overall, seamless, drawn in one piece with rounded edges and corners.

.2 Integrated sinks with within the counters must be fabricated with the same Stainless Steel as the counters, with integrated drainboards if indicated.

.3 Drainage connections shall be in non-corrosive materials.

.2 *Epoxy Resin Sinks*: Shall be molded one piece, with 38 mm (1½") coved corners, sloped 16 mm (5/8") thick bottoms, 12.7 mm (1/2") thick walls, with corner drain and overflow, welded in place with epoxy cement, with integral epoxy drain board tops, if indicated.

- Suggested (or equivalent) product: “DropIn Sink” by Durcon.

.3 *Cup Sink*: Made of same gauge and Stainless Steel type as the Stainless Steel countertops, with Stainless Steel funnel (two per cup sink), or in Epoxy Resign.

.2 Laboratory Faucets:

.1 *Cold water/Hot water*: One hole mixer with ADA blade handles, with detachable nozzle and 200mm min. swing gooseneck and accessible wrist handles.

- Suggested (or equivalent) product: “L424-9VB” by WaterSaver.

.2 *Vacuum Breaker*: With 200mm min. swing gooseneck.

- Suggested (or equivalent) product: “L424-9VB” by WaterSaver.

.3 *Purified Water Faucet*: Made from high purity PVDF, in either weld or sanitary clamp connections, with simple heat flaring tools for leak-proof, and minimum crevice connections between components.

- Suggested (or equivalent) product: “Georg Fischer 530” by Aquatap.

.4 *Needle Valve*: With inlet shank shall be of a 3/8’’ NPS – ¼” NPT, single, 90 degrees double, 3-way or 4-ways, as indicated.

- Suggested (or equivalent) product: “L2880-WSA” series by WaterSaver.

2.5 Mixing valves

.1 *Mixing Valve*: With the following characteristics:

.1 To be thermostatic type (not mechanical)

.2 For utilization at point of use or master controlled fixtures

.3 Compliance with ASSE 1070 and CAN/CSA B125.3

.4 Suggested or Equivalent Products:

- Suggested (or equivalent) product: As manufactured by Lawler.

2.6 Emergency fixtures

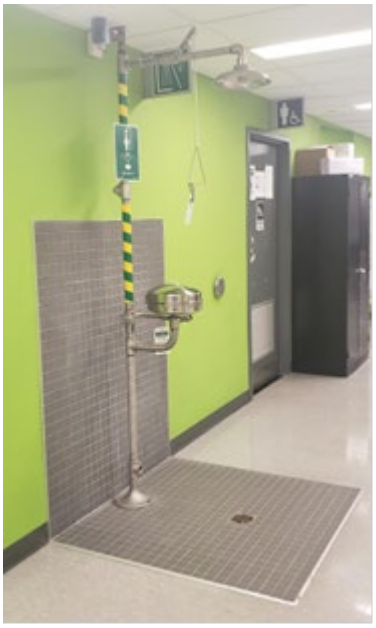
.1 *Eye/Face Wash*: Barrier-free emergency countertop mount: To meet or exceed the requirements of the latest ANSI Z358.1. In Polished chrome brass single action pull-down valve body, with universal sign, 1.3 cm O.D. slip joint inlet, activated with pull-down, with full continuous flow of water, inverted directional laminar flow to sweep contaminants away from the nasal cavity, zero vertical velocity supplied by an integral flow control. C/w *Mixing Valve*.

- **UofO** Standard product(s):
  - .1 Front mount: “7611” by Haws.
  - .2 Back mount (shall be installed no deeper than 610mm from the front of the counter, with no interference with *Drying Racks*): “7610” by Haws.

.2 *Emergency Shower & Eye Wash*: Combination shower and eye/face wash shall include:

- .1 11" (27.9 cm) Stainless steel round bowl.
- .2 Axion MSR™ eye wash head that supplies an inverted directional laminar flow which achieves zero vertical velocity supplied by an integral flow control.
- .3 Dust cover, 50 x 50 mesh water strainer.
- .4 Stay-open shower and eyewash ball valves.
- .5 Cast 9" (22.9 cm) diameter floor flange.
- .6 High visibility safety colors.
- .7 1-1/4" ips supply.
- .8 ADA & ANSI Z358.1 compliant.

- Suggested (or equivalent) Products:
  - .1 Surface mount:
    - “8309WC” by Haws.
    - “GBF1909” by Hadrian.
  - .2 Recessed: “8355WCC” by Haws.



2.7 Drains

.1 *Floor Drain*: With the following characteristics:

.1 Inside: Made from cast iron and include round bronze strainer, 100 mm (4 in) throat, and reversible membrane clamp.

.2 Area/roof drains: Made from epoxy coated cast iron, 200 mm by 200 mm (8 in by 8 in) and include adjustable top, standard outlet c/w body collar with weep holes and anchor flanges.

End of Section

SECTION 22 42 02 – PIPING

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Refer to section "**VOLUME I – W. Plumbing**".

2.0 PRODUCTS

.1 *Floor Drain*: Floor drain with round bronze strainer, cast iron, 4" throat, and reversible membrane clamp.

- Suggested (or equivalent) Product: "FD-100-C-A" by Watts.

.2 *Area Drain*: Epoxy coated cast iron, 8"x8", adjustable top, standard outlet c/w body collar with weep holes and anchor flanges.

- Suggested (or equivalent) Product: "FD-330" by Watts.

.3 *Trap Seal Primer* (for Washroom/kitchen Area Drains): To be provided with Flush Valve Trap Seal Primer. In location where it is impossible or too costly to connect the drain with a Flush Valve Trap Seal Primer, a Trap Guard seal may be used instead.

- Suggested (or equivalent) Product:
  - .1 "MI-702" by MiFab.
  - .2 "VBF-72-A1" by Sloan.

.4 *Polypropylene Piping*: Schedule 40, certified to CAN/CSA B1800-02.

- Suggested (or equivalent) Product: "Blueline" by Orion.

.5 *Polyvinylidene Fluoride (PVDF) piping*:

- Suggested (or equivalent) Product: "Pegas Superblue" by Corix.

.6 *Uncoated PVC Rated*: Made of tough, impact resistant PVC, high moisture, salts, soils and acid resistant. With fire-retardant properties that eliminate flame spread and reduce the volume of smoke generated. To apply with related fire stopping products.

- Suggested (or equivalent) Product: "System 15 XFR" by IPEX.

.7 *Hydronic Piping*:

- .1 Steel piping conforming to ASTM A53 Grade B: 63 to 150 mm (2.5 to 6 in) schedule 40, 200 to 250 mm (8 to 10 in) schedule 30, 300 mm (12 in) and over, 9 mm (3/8 in) wall thickness
- .2 Copper piping conforming to ASTM B88M for 50 mm (2 in) and below

End of Section

SECTION 23 00 00 – GENERAL WORKS

1.0 GENERAL

1.1 Extended Warranty

.1 All HVAC items listed in this section shall be guaranteed from defect - labour and materials for the main component and associated package equipment, for 5 years.

1.2 Design Criteria and Notes

.1 Any equipment shall be provided with all special tools and spare parts required by the manufacturer.

.2 Refer to section "**VOLUME I – T. HVAC**".

2.0 PRODUCTS

.1 *Filters*: Shall be for two-stage air filtration at AHUs. Pre-Filter to be 50 mm (2 in) pleated, high capacity, MERV 8. Final Filter shall be 30 cm (12 in) pleated, V style, high-capacity MERV 13.

.2 *Intake and Exhaust Louvers*: In pre-painted or anodized Aluminum extrusions. To be equipped with bird screen and insect screen, easily removed from the interior of the duct shaft.

.3 *Laboratory Exhaust Fans*: Dual stack up blast fan with high plume velocity c/w plenum, bypass damper, heat recovery coil, integrated flow velocity transducer and be connected to BAS. C/W:

- .1 Chemical Resistant Gasket.
- .2 316 Stainless Steel Hardware.
- .3 Internal Drain System.
- .4 Fan Inlet Safety Screen.

- Suggested (or equivalent) Product: As manufactured by Cook Fans.

.4 *Heating Boilers*: With the following characteristics:

- .1 Gas fired, high efficiency "condensing type".
- .2 All components including combustion chamber, heat exchanger and condensate collector shall be made from high-grade stainless steel and titanium alloy.
- .3 Vent system shall meet Category IV venting requirements. The vent material shall be UL/ULC/CSA listed for Category IV and made from stainless steel or CPVC and shall be water and gas tight.
- .4 Condensate water shall be piped (using CPVC piping) to the neutralizing kit and to the nearest floor drain.
- .5 Control shall be able to operate independently and shall be able to integrate with BAS with BACnet/IP communication protocol.

- Suggested (or equivalent) Product: As manufactured by Viessmann Boilers.

.5 *Chillers*: With the following characteristics:

- .1 To have factory installed brazed plate refrigerant to refrigerant sub- cooler/economizer to maximize chiller capacity and efficiency.
- .2 Evaporator, condenser, and electronic expansion valves shall be common to all compressors.
- .3 To stage compressor(s) without drastically unloading compressors on-line or creating check valve chatter on staged compressors. All unloaded capacity values shall be achieved without the use of traditional hot gas bypass or load balance valves.
- .4 Unit acoustic testing shall be carried out in accordance with AHRI 575. Chiller sound performance shall be measured at the highest level recorded at all load points.

.5 Shall feature single-point power connection not utilizing adjoining power cabinets as pull boxes.
.6 Fully operate with one refrigerant circuit.
.7 Each compressor shall be capable of coming to a controlled safe stop in the event of a power outage.
.8 Compressors shall be capable of auto restart in the event of a power outage, once power has been restored.
.9 All compressors shall be mechanically and electrically isolated to facilitate proper maintenance, service, and / or removal. Design shall include a water box (with appropriate clearances) to allow for easier maintenance of the chiller.
.10 All heat exchangers to be built in accordance with ASME BPVC VIII and carry a manufacturer's nameplate certifying ASME compliance.
.11 Both the condenser and evaporator compartments shall have shell and tube design with single shell construction
.12 Heat Exchangers shall feature enhanced and rifled individual tubes. Tubes shall be individually replaceable. Tubes shall be mechanically rolled into steel tube sheets and sealed. Tubes shall be supported by intermediate tube supports at a maximum spacing of 46 cm (18 in) apart. Heat exchangers to be equipped with dished heads with drain and vent ports.
.13 Piping connections to be flange only and Victaulic is not acceptable. The first valves after the chiller shall not be Victaulic.
.14 Evaporator to be of flooded type with refrigerant surrounding the tubes and water passing through the tubes. Tubes to be enhanced and rifled. Evaporator, water boxes, suction piping, and any other component subject to condensate shall be insulated with a UL listed closed cell insulation. All joints and seams to be sealed.
.15 Condenser to be water cooled type with refrigerant surrounding the tubes and water passing through the tubes. Tubes to be enhanced and rifled. The condensers shall have pressure relief tree with isolation valves, water drain and vents. Pressure relief tree to be equipped with isolation/transfer valve to prevent the loss of refrigerant when relief is removed for testing and or replacement. Rupture disks are not acceptable. Condenser heads and tube sheets shall be epoxy coated to prevent corrosion.
.16 The condenser and evaporator compartments shall be designed for a minimum and maximum tube velocities of 0.01 and 0.05 m/s (2 and 9 FPS), respectively.
.17 Both condenser and evaporator compartments shall be equipped with factory mounted & wired thermal dispersion switch for flow safety. Both the condenser and evaporator compartments shall be able to individually hold the entire unit charge as required for machine service. Condenser and evaporator compartments shall be cable of 45 percent rate of change per minute on water side and maintain stable operation without dropping compressors off-line.
.18 To be equipped with multiple variable frequency drives (VFDs). The variable frequency drive to utilize Insulated Gate Bi-Polar Transistors (IGBT). Variable frequency drive shall be compatible with the motor supplied voltage at all operating modes and to create its own simulated AC voltage for the motor connected to it. Refer to Section Z1 and Z2.1 for additional requirements for VFDs.
.19 Each compressor with its integrated drive shall have a line reactor and circuit breaker.
.20 Control shall be able to operate independently and shall be able to integrate with BAS with BACnet/IP compatibility.
.21 Control panel to have a USB port and capable of downloading all operating data to a memory stick.

- Suggested (or equivalent) Product:
  .1 As manufactured by Daikin WMC.
  .2 As manufactured by York WMC.
  .3 As manufactured by Trane.

.6 *Cooling Towers*: With the following characteristics:

.1 To be factory assembled induced draft vertical discharge open circuit type.

.2 Water to be entering at 35°C (95°F) and leaving at 29°C (85°F) at a design wet bulb of 24.4°C (76.0°F) with an additional 20% excess/reserve capacity.

.3 To be certified in accordance with CTI STD-201 RS. Cooling equipment shall be AHRI rated.

.4 Fan motor loads shall not exceed 12.7 W/kW (0.06 HP/ton) of chiller capacity. Reduced condenser water temperatures should be utilized when possible to reduce the chiller electrical consumption.

.5 Casing section including channels and angle supports, shall be constructed of type 304 stainless steel. Fan cowl and guard shall be constructed of type 304 stainless steel. “Series 300” stainless steel or galvanized steel shall not be acceptable as equivalent to type 304 stainless steel.

.6 All cold-water basin components including vertical supports, air inlet louver frames and panels up to rigging seam shall be constructed of type 304 stainless steel (thickness of 11 gauge sheet metal). “Series 300” stainless steel or galvanized steel shall not be acceptable as equivalent to type 304 stainless steel.

.7 Cold water basin shall be self-draining with fill, drain, overflow, and cleanout connections, anti-vortexing device, pan strainer, as well as electronic water level control.

.8 Pan strainers shall be constructed of type 316 stainless steel and have large area, removable, perforated screens.

.9 Cold water basin shall be provided with external connections to equalized basin water levels at the bottom. Cold water basin shall be provided with bypass connection(s), sized to accommodate full flow bypass, complete with diffuser.

.10 Water distribution shall be by either gravity feed or by means of a pressurized spray header. Distribution boxes, spray branch piping and metering devices shall be entirely corrosion-free and made from PVC or stainless steel. Each cooling tower and/or cooling tower cells shall have a single inlet connection.

.11 Fill shall be comprised of PVC vertical sheets or chevron configuration. Eliminators shall be multi-pass PVC. Louvres shall be sight tight, PVC. Towers not otherwise equipped shall have air inlet screens which shall serve to keep debris from entering the fill pack/basin area. Air inlet screens shall be made of corrosion-free materials (PVC or stainless steel).

.12 Unit shall be provided with ultra-low sound fan. Fan shall be high efficiency axial propeller type with non-corrosive fiber reinforced polyester (FRP) blade construction. Fan(s) shall be heavy duty and utilize a forward swept blade design for superior sound reduction. Each fan shall be dynamically balanced and installed in a closely fitted fan cowl with venturi air inlet for maximum efficiency.

.13 Unit shall be provided with electronic Vibration Cut-out Switch, operating on 120VAC feed, to protect the fan and drive assembly from damage in the event of excess vibration.

.14 Fan motor(s) shall be totally enclosed, ball bearing type, electric motor(s) suitable for moist air service. Motor(s) shall be premium efficient, Class F insulated, with 1.15 service factor design. Inverter(s) shall be rated per NEMA MG1 Part 31.4.4.2 and shall be suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives.

.15 Fan motor(s) shall include stripe-type space heaters with separate leads brought to the motor conduit box. Motor(s) shall include VFD shaft grounding rings.

.16 Provide one spare set of belts (each) and one spare replacement motor for cooling towers.

- Suggested (or equivalent) Product:
.1 As manufactured by Evapco.
.2 As manufactured by BAC.
.3 As manufactured by Marley.

.7 *Fan Coil Units (FCUs)*: With the following characteristics:
.1 Supply fan to be double inlet, forward curved, statically, and dynamically balanced, direct driven fan. The motor shall be EMC variable speed type with internal overload protection and sealed bearings. An unfused service disconnect switch shall be included and mounted inside the unit. The switch shall be rated in accordance with the electrical load. Consultant design to provide direction to contractor to review disconnect location relative to the installation and confirm that there is adequate electrical service space. If adequate electrical service space does not exist for a unit mounted disconnect, then the disconnect to be located within 3 m (10 ft) of the unit.
.2 Plenums and casings shall be constructed from galvanized steel, reinforced, and braced for rigidity. Internal surfaces shall be furnished with acoustic insulation. Enamel finish shall be applied to all exposed areas. Plenums, casings, access doors, pipe and other penetration shall be rendered airtight at all joints and connections as per SMACNA recommendations.
.3 Heating and cooling coils shall be counter flow type and installed according to manufacturer's specifications.
.4 Heating and cooling coils shall be cleanable and drainable. The tubes shall be readily accessible without having the need to disconnect piping. For plate and spiral wound fin types, tubes to be mechanically bonded to fins. All non-ferrous tubes and headers to be brazed assembly. Coils to be factory tested with air under water and AHRI certified performance rating.
.5 Condensate drain pans shall be constructed from stainless steel with rounded corners and shall be insulated. Drain connection to be in the bottom at low point. Drain piping shall be sloped without sag to ensure no standing water at any time or at any point. Condensate drainage pipe sizes shall be 19 mm (3/4 in.) as a minimum and connected with a union to permit drain line to be removed for cleaning without having to turn the drain piping.
.6 The piping package shall include full port ball type shut off valves at the coil supply and return c/w stainless steel braided flexible hose kit. It shall also include a 2-way modulating control valve, strainer and for sensitive locations, a condensate overflow level switch to shutdown unit when water level is at unsafe level.

.8 *Energy Recovery Make Up Air Units*: With the following characteristics:
.1 Energy Recovery Make up Air Units shall consist of fan and motor assemblies (supply and exhaust), heat transfer core, all necessary dampers, hoods, plenums, filters, drain pans, wiring and controls. Units shall have full-flow by-pass to allow for free cooling. All equipment shall be factory tested prior to shipment.
.2 Prewired air handling units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code, Part 2 (Canada). All components shall be factory tested and checked for proper function.
.3 To include a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors, and terminals for the connection of external control devices or relays. Unit control shall be able to integrate with BAS with BACnet/IP compatibility.
.4 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.
.5 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and humidifiers/wet cells,

electrical control panels and if applicable burner compartments and compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels shall not be accepted.

.6 To include hinged access doors in welded steel frames. Doors shall be fully lined with closed cell bulb gasket and lever lock handles, operable from both sides. Wherever possible, hinged access doors to areas with negative pressure shall open out, and to areas with positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label shall be affixed.

.7 Unit casing shall be of minimum 16 (1.6 mm) gauge galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.8 Casings shall be supported on formed galvanized steel channel or structural channel supports, designed, and welded for low deflections. Integral lifting lugs shall be provided for hoisting.

.9 All units shall be internally insulated with minimum 50 mm (2 in) thick thermal insulation. Insulation shall be secured to metal panels with a fire-retardant adhesive and welded steel pins.

.10 The energy transfer (recovery) cassettes shall be made from pure aluminum plates of 1100 alloy to offer excellent corrosion resistance. The structural frames and storm louvers to be constructed of 16 (1.6 mm) gauge 304 type stainless steel. Energy transfer cassettes shall be easily accessible individually. They shall be removable and cleanable with a pressure washer.

.11 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.12 Fans shall be Backward Inclined Airfoil Fans (BI-AF) type and shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings. Drives shall be adjustable on fans with motors 3.73 kW (5 HP) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating.

.13 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension. Standard belt guards shall be provided on all units with walk in sections over 1,524 mm (60 in) height.

.14 Fan-motor assemblies to include vibration isolators. Isolators shall be bolted to steel channels that are welded to the unit floor, which is welded to the structural frame of the unit. The isolators shall be vertical spring type isolators with levelling bolts, bridge bearing waffled pads designed to achieve high isolation efficiency.

.15 To include seismic restraint type isolators containing compressed spring. Use of separate bumper or snubber is not acceptable.

.16 To be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable.

.17 End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

.18 Cooling coil drain pans shall be fabricated of stainless steel and shall be an integral part of the floor paneling with a minimum of 50 mm (2 in) depth and welded corners.

Drain pans shall extend a minimum of 150 mm (6 in) downstream of coil face and be provided with a 38 mm (1.5 in) stainless steel drain connection. Drain pans shall have a fast pan and shall be sloped and pitched such that there is no standing water. Intermediate fast pans shall be provided between cooling coils where required for effective moisture removal.

.19 When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed to be of sufficient size to collect all condensation that are produced from the coil and be sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the section's primary drain pan.

.20 To include single extended grease line from far side to access side bearing. Fan motors shall be Open Drip Proof (ODP) type with super high efficiency.

.21 To include a discharge air low limit switch equipped with an automatic by-pass time delay to allow for cold weather start-up. On a heating system failure, this device shall shut down the fan and close the outdoor air damper. This device shall require resetting by interrupting the electrical circuit.

.22 To include one spare set of belts for all motors and drive types associated with air handling units and exhaust fans (general exhaust and kitchen applications). Provide one full set of replacement filters at turn-over of air handling equipment and fan coil units and one full set of spare replacement filters for all air handling equipment and fan coil units. Provide one spare motor for motors with less than 2.7 kW (2 HP) capacity used in air handling equipment including fan coil units and exhaust fans (general exhaust and kitchen applications).

- Suggested (or equivalent) Product:
  - .1 As manufactured by Tempeff.
  - .2 As manufactured by Regent Eco (bkm REVERSE FLOW).

.9 *Humidifiers*: With the following characteristics:

- .1 All components shall be housed in factory fabricated cabinets with thermal insulation c/w finished.
- .2 Indoor cover (painted or anodized aluminum) and floor stand.
- .3 Steam dispersion header shall be designed for absorption within 457 mm (18 in.) with condensate drain and insulated supply hose, sized to suit air volumes and ductwork size.
- .4 Condensate water shall be piped to a neutralizing kit and to the nearest floor drain. Drain connection shall have water tempering valve to temper humidifier drain water during drain cycle to meet OBC maximum discharge water temperature limits c/w all additional piping and accessories as necessary.
- .5 Control shall be able to operate independently and shall be able to integrate with BAS with BACnet/IP compatibility.

- Suggested (or equivalent) Product:
  - .1 As manufactured by Neptronic.
  - .2 As manufactured by DriSteem.
  - .3 As manufactured by Condair

.10 *HVAC Pumps*: Engineered for exceptional performance and rugged durability, designed for easy maintenance and to be highly energy efficient.

- Suggested (or equivalent) Product:
  - .4 As manufactured by ITT Bell & Gossett.
  - .5 As manufactured by Armstrong.
  - .6 As manufactured by Taco.

.11 *Venturi Air Valves*: In aluminum or 316 Stainless Steel for environments with highly corrosive or dangerous chemicals in the air stream.
- Suggested (or equivalent) Product: As manufactured by Rosemex, Phoenix.

End of Section

26 00 00 – GENERAL WORKS

1.0 GENERAL

1.1 Design Criteria and Notes

.1 Wiring and cabling to include all power wiring of Equipment which is provided and installed by Division 26. All power and control wiring over 50V for Equipment is supplied by manufacturer, Division 26 will be responsible for installation. Division 23 and/or 25 will be responsible for control wiring final connection. Coordinate with the Integrated Automation contractor (Division 23 and/or 25) for exact requirements. All control wiring 50V and less for Equipment supplied by Division 25, Division 26 shall provide the empty conduit with pull string; the wiring shall be done by Division 23 and/or 25.

.2 Refer to section "**VOLUME I – Z1. Electrical General Requirements**", "**VOLUME 1 - Z2.1. Power Distribution**", and "**VOLUME 1 - Z2.2. MV Power Distribution**".

2.0 PRODUCTS

2.1 General fixtures

.1 *Hallway Service Receptacles:* Shall be of the industrial grade "T" slot type suitable for 120 volt, 20 amp circuits (housekeeping services).

.2 *GFI Receptacles*: CSA approved, ULC listed, Class A, c/w Test/Reset feature and Green/Red pilot lights, c/w stainless steel cover plate, white finish.

- Suggested (or equivalent) Product: "GFST15W" (15 Amp circuit), & "GFST20W" (20 amp circuit).

.3 *Electrical Panel*: With the following characteristics:

.1 To keep a total of 20% available circuits (spare breakers and blank spaces) for future use.

.2 Provide around 10% of 15 amps spare breakers for future use.

- Suggested (or equivalent) Product: "EZ box, PRL-1a", including Bolt-on breakers, by Cuttler Hammer, with identification label "Lamicoid." White letters on black label.

.4 *Motorized Projection Screen Control*: Projection screen motor shall be manual motor starter switch installed at proximities and capable of cutting both power up and power down.

.5 *Podium Desk Control*: With the following characteristics:

.1 Podium-mounted momentary contact switch for projection screen shall be 20A – 120V, spring load three-position, single pole, double throw, center OFF, including stainless steel cover plate.

.2 All podium Electric Outlet shall be equivalent to the surge suppression duplex receptacles indicated.

.3 Lighting scenes shall be identified on the scene selector located on the podium lip.

.6 *A/V Electric Outlet*: 120 Volt, surge suppression duplex receptacles, 15A-125V, "Commercial Specification" grade minimum, with stainless steel cover plates.

- Suggested (or equivalent) Product: "HBL5260S" blue colour with stainless steel cover plate by Hubble.

.7 *Seats with Retractable Tablet Outlets*: The electrical distribution system shall be integrated in the design of the seating, to accommodate the requirements of laptop computers. The receptacle shall not interfere with the seat and tablet return. All wires and components shall be concealed with covers. The receptacle module shall be constructed of a vandal proof material and be both visible and accessible from a seated position.

.8 *Multimedia & Data Conduits*: With the following characteristics:

.1 All Multi-Media wiring shall be inside EMT conduits.

.2 Only EMT conduits should be used.

.3 EMT conduits should incorporate ¼" diam. pull cord and be terminated at ends with a coupling and a plastic bushing.

.09 *Electric Jet Towel Hand Dryer, surface mounted*: White color c/w new 15A-120V ground fault circuit interrupter breaker.

- **UofO** Standard product: "JT-SB116JH2", by Mitsubishi.

.10 *MV Switchgear*: Reliable switching and fault protection, designed for applications where high duty cycle operation is not needed, with metal-enclosed assembly switch, bus and fuses.

- Suggested (or equivalent) Products:
  - .1 As manufactured by Eaton.
  - .2 As manufactured by ABB.
  - .3 As manufactured by Schneider.
  - .4 As manufactured by S&C.

.14 *MV Transformers*: Dry type for indoor use, With the following characteristics:

.1 To meet at a minimum the requirements of standards CSA C22.2, CSA C9-M1981, CSA C802.2 Minimum Efficiency Values for Dry Type, and OBC SB-10 Energy Efficiency Requirements.

.2 To have copper windings, will be Delta-Wye configuration and include 25% spare capacity. The 25% spare capacity will be provided with fan cooling for all the main distribution.

- Suggested (or equivalent) Product: As manufactured by HPS, Eaton, ABB.
  - .1 As manufactured by Eaton.
  - .2 As manufactured by ABB.
  - .3 As manufactured by HPS.

.16 *MCC (Motor Control Centers)*: Built to the UL845 standard, with reinforced cabinet door latches, designed with an optimal compact footprint and flexible construction, and easy to move and replace starters and feeders as load requirements change.

- Suggested (or equivalent) Products:
  - .1 As manufactured by Eaton.
  - .2 As manufactured by ABB.
  - .3 As manufactured by Schneider.
  - .4 As manufactured by Siemens.

.5 As manufactured by General Electric (GE).

.15 *LV Switchgear, Switchboard & CDP (Central Distribution Panels)*: Low voltage, pre-assembled kits with ease of access for wiring during installation.

- Suggested (or equivalent) Products:
  - .1 As manufactured by Eaton.
  - .3 As manufactured by Schneider.
  - .4 As manufactured by Siemens.
  - .5 As manufactured by General Electric (GE).

.17 *Generators*: For standby or prime power provide efficiency, low fuel consumption and emissions compliance.

- Suggested (or equivalent) Products:
  - .1 As manufactured by CAT.
  - .2 As manufactured by Kohler.
  - .3 As manufactured by Cummins.
  - .4 As manufactured by Total Power.

.18 *Automatic Transfer Switch*: Advanced supervision, monitoring and control, comprehensive diagnostics, simple user interface.

- Suggested (or equivalent) Products:
  - .1 As manufactured by Eaton.
  - .2 As manufactured by ASCO.
  - .3 As manufactured by ABB.

2.2 Laboratory fixtures

.1 Monuments:

.1 *Monument boxes in Stainless steel*: For electrical outlets, in Stainless Steel, 1.2 mm (18 ga) thick, delivered with galvanized rods, connectors, threaded nut washers, grounding rods and Stainless Steel receptacle covers.

- Suggested (or equivalent) products: As manufactured by CIF:
  - .1 “SE004”, double face, single gang. Outlet to be supplied with duplex 20A receptacle with "T" slot.
  - .2 “SE006”, double face, Quadplex (double gang), with 20A receptacle.

.2 *Monument boxes in Coated Aluminum*: For electrical outlets, in epoxy powder coated finish, 6 mm thick, delivered with galvanized rods, connectors, threaded nut washers, grounding rods and Stainless Steel receptacle covers.

- Suggested (or equivalent) products: As manufactured by CIF:
  - .1 “E300WS” or “E400WS”, single or double face as indicated, single gang. Outlet to be supplied with duplex 20A receptacle with "T" slot.
  - .2 “E500WS” or “E600WS”, single or double face as indicated, Quadplex (double gang), with 20A receptacle.

End of Section

SECTION 26 50 00 – LIGHTING

1.0 GENERAL

1.1 Extended Warranty

.1 Exterior Lighting system shall be guaranteed from defect for a period of 3 years for labour and Material.

.2 Refer to section "**VOLUME I – Z3. Lighting**".

1.2 Design Criteria and Notes

.1 Sufficient cable length and/or access panels shall be provided to provide access to wiring connections in hard ceiling areas, to the inspection authorities requirements.

.2 Connect fixtures to indicated circuits.

.3 Special consideration shall be given to the access and maintenance where design and location of fixtures shall be such as to eliminate the usage of scaffolding when changing lamps. In particular:

- .1 In high ceiling or Auditorium applications, consideration shall be given to provide cat walk above the light fixture;
- .2 In Stairwell, lighting fixture should be installed on walls or in the ceiling of the landing area. Avoid installing fixtures above the stairs.

.4 For ease of maintenance for high volume and high ceilings consider utilization of remote ballasts.

.5 Confirm with luminaire manufacturers that luminaires have been tested at factory with integrated LEDs and drivers to ensure 100% compatibility of operation.

.6 Ensure that each dimmer is properly sized to suit the connected load.

.7 Providing, locating, and aiming appropriate sensors in the correct location required for complete and proper volumetric coverage within a range of coverage(s) of controlled areas per manufacturer's recommendations. Rooms to have 90-100% coverage to completely cover controlled area to accommodate occupancy habits of single or multiple occupants at any location within room(s). Where the locations and quantities of sensors are shown and/or noted in the Design-Build package they are for illustrations only and should only be used as guidelines. Provide additional sensors if required to properly and completely cover respective room.

.8 Additional 3% Light Fixtures of each type excluding architectural specialty light fixtures shall be provided as spare parts.

2.0 PRODUCTS

.1 *UoO Light Pedestals*: In prepainted steel, with UofO graved logos, mounted on bases, with the following features:

- .1 Poles must have an adjustable base-plate in order to level complete assembly.
- .2 Bases are made from Central Precast, with the molds for the concrete.
- .3 Lamp post c/w single fixture head, burgundy with glazed glass to match exiting fixtures. The Multi-Voltage is 120-347 c/w fuse holders (Ferraz #atm-5A).
- .4 Lamps are LED-8029E42C post top multi-voltage, 24w, 4200K c/w E26 Edison base and socket. Socket must be installed in head of lamp post.
- - **UofO** Standard product: "2372-PS01" by Eclairage SDL Inc., as manufactured by Molcast inc.

.2 *Interior Luminaires*: With the following characteristics:

.1 Recessed types to comply with NEMA LE 4.

.2 The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.

.3 Housing shall be minimum cold gauge steel construction painted after fabrication with high reflectance white paint unless otherwise indicated.

.4 Shielding shall adhere to the following criteria:

.1 Flat frosted diffuser shall be 100% virgin acrylic, pattern #12, and shall have matte finish on exterior side. Diffuser shall be of sufficient density to completely obscure LED image.

.2 Flat clear lenses shall be injection molded 100% virgin acrylic.

.3 Clear patterned lenses shall be injection molded 100% virgin acrylic, pattern #12.

.4 Clear patterned lenses shall be polycarbonate, pattern #12.

.5 Minimum thickness shall not be less than 0.125” with a minimum weight of 8 ounces per square foot.

.6 Doorframes shall be supplied with concealed hinges and latches. Provide mitered corners with no gaps or light leaks.

.7 Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.

.8 Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.

.9 Comply with In-Situ testing for more reliable results.

.10 LED’s shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

.11 Indoor light fixtures shall be LED 120V, dimmable, 3500 Kelvin, CRI >85, at a minimum a lumen maintenance of L90 at 50,000-70,000 hours and within a housing designed for the environment (dry, damp, wet) it is intended for. However acceptable colour temperature shall be based on user.

.12 Acrylic Lighting Diffusers: 100% virgin acrylic plastic. UV stabilized high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation, 0.125 inch thick, with uniform brightness throughout the entire visible area without LED pixilation.

.13 To include wire guards on all open strip type luminaires in unfinished service rooms spaces.

.14 Components to be in Steel to prevent warping and sagging.

.15 For steel and aluminum luminaires, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel.

.16 Doors, Frames, and Other Internal Access to be smooth operating, free of light leakage under operating conditions, and designed to permit maintenance without use of tools. Safety devices shall be detachable if necessary and shall not interfere with luminaire performance, maintenance or the seating of any luminaire element, not visible during normal luminaire performance.

.17 For weatherproof or vapor-tight installations, finishes of luminaires and accessories shall be a premium 5 stage TGIC polyester powder coat paint minimum 2.5 mils thick, applied to factory assembled and -tested luminaires before shipping, so that the entire assembly is completely corrosion resistant for the service intended. Exterior finishes shall have an outdoor life expectancy of not less than 20 years without any visible rust or corrosion. Where aluminum parts come in contact with bronze or steel parts, apply a coating material to both surfaces to prevent corrosion.

.3 *Exterior Luminaires*: With the following characteristics:

.1 Consist of pole mounted, size and height of the pole shall meet IESNA guidelines and bollard style fixture shall be provided for low level landscape lighting.

.2 LED, dark sky compliant, bird friendly and meet municipal, ASHRAE 90.1-2013, OBC, IDEA-IESNA MLO 2011, IESNA RP-33, Addendum A for TM-07-15 and IESNA guidelines, 347V, 3000K, CRI >80, at minimum lumen maintenance of L70 at 50,000 hours, and within a housing designated for wet environment (min IP65).

.3 Luminaires in areas designated as damp locations shall be suitable gasketed to prevent the entrance of moisture, with approved wire mesh screens for ventilation openings.

.3 *Occupancy Sensor*: Shall be connected to a contact closure interface controlling the *Lighting Controller*, dual technology ceiling mount occupancy sensor.

- Suggested (or equivalent) Product: “O3 HUB” by Delta control.

.4 *Photoluminescent Exit Signs*: Depending on electrical parameters and minimal lighting Codes requirements: Pictogram sign, Photoluminescent system, Zero energy consumption, surface ceiling or flag mount.

- Suggested (or equivalent) Product: “Ecolo Exit Signs” Series by Kinesik.

.5 *Exit Lights*: With the following characteristics:

.1 Conform to CSA C22.2 No. 141 and CSA C860.
.2 Housing: extruded aluminum, brushed aluminum finish.
.3 Face and back plates: extruded aluminum.
.4 Lamps: LED with 25-year rated life.
.5 Pictogram: aluminum frame, opal diffuser panel, pictogram panel with multiple films for direction selection, and clear protective panel. Pictogram panel shall consist of green pictogram and white graphic symbol meeting the visibility specifications referred to in ISO 3864-1, and conform to the dimensions indicated in ISO 7010.
.6 Suitable for 120V normal power supply. Battery is **NOT permitted.**
.7 Die cast mounting bracket for wall, ceiling, or end mounting as indicated.
.8 To be provided with circuit labels.

.6 *Drivers*: With the following characteristics:

.1 Operate from 60 Hz input source of 120/347 VAC with sustained variations of ± 10% (voltage and frequency) with no damage to driver.
.2 Output regulated to ±5% across load range.
.3 Power factor greater than 0.90.
.4 Total harmonic distortion less than 20%.
.5 Class A sound rating.

.7 *Wiring:* System cable data line connected to *Controller* shall be separate from line voltage wiring by at least ¼” (7mm), to avoid functioning problems.

.8 *Task Light*: Mid-powered LEDs spaced uniformly for even distribution on the task plane: Even glow diffuser, minimize shadow effects, easy to clean, 3500K colour temperature, with individual dimming to off on each luminaire, 565mm, 62.2 lumens per watt efficacy, 380 lumens light output, 6.1w power consumption, 60w power supplies to provide power up to 4

luminaires , 87 color rendering index, rated for 100 000 hours at 90% initial lumens, power cable from power supply to first luminaire, patch cables for daisy chaining luminaires (length according to furniture layout without excessive lengths), splitter cable for two rows of lights at the island, and extension cables as necessary. Can be used as stand also unit or daisy chained.

- Suggested (or equivalent) products: “UC-E-22-S-PS-60W” by Finelite.

End of Section

SECTION 31 10 00 – SITE PREPARATION & HARD LANDSCAPING

1.0 GENERAL

1.1 Design Criteria and Notes

.1 General:

.1 All earth work to be planned and coordinated with and approved by **LGS** and **ORM**.

.2 Grading:

.1 Slope rough grade away from building 1:100 minimum, and towards catch basins and drainage points, or as necessary to adapt to site conditions.

.3 Backfilling:

.1 Areas to be backfilled to be free from debris, snow, ice, water or frozen ground.

.2 Do not use backfill material which is frozen or contains ice, snow or debris.

.3 Do not backfill around or overcast-in-place concrete within 3 days after placing the concrete.

.4 Asphalt:

.1 Do not apply primer or tack coat, nor commence laying of asphalt base or binder courses until base surfaces are dry and at least at 2°C, and the ambient temperature is above 5°C.

.2 Commence laying of asphalt surface courses only when base or binder course surfaces are completely dry, when atmospheric temperature in shade is at least 10°C and rising, or above 15°C if falling, and the weather is not foggy or rainy.

.3 Suspend paving operations two hours before it rains, if temperature drops below specified minimums, and if the surfaces become wet or humid.

.4 Provide access to building and Employees' Parking Area at all times. Arrange access points with Owner.

.5 Do paving operations only when other dust producing operations are completed or stopped and truck movements are not scheduled adjacent to area of installation.

.6 Finished surfaces should not have a variation of more than 5 mm (3/16") under a 3 m (10'-0") long straightedge in any direction.

.5 Protection:

.1 Reduce environmental impacts during construction by limiting topsoil removal, stockpiling existing topsoil on site and exposing smallest area of soil at any time during development.

.2 Maintain access roads to prevent accumulation of mud.

.3 Integrate finish grading to waste management plan.

.4 Cut off unsound branches and cut down trees that could endanger the area to be cleared.

.5 Prevent damage and protect existing fencing, landscaping, existing structures, benchmarks, buildings, pavement, surface, or underground utility lines which are to remain.

1.2 Preserving trees

.1 General:

.1 The Trees and Natural Areas Protection By-law (No. 2020-350) applies to all vendors working for a public or private utility.

.2 Critical root zone (CRZ) of a tree:

.1 CRZ is established as being 10 centimeters from the trunk of a tree for every centimeter of trunk diameter. The trunk diameter is measured at a height of 1.2 meters for trees of 15 centimeters diameter and greater and at a height of 0.3 meters for trees of less than 15 centimeters diameter.

.2 D = diameter of trunk in centimeters D x 10cm = Critical Root Zone (radius).

.3 Working around trees:

.1 Soil compaction and vibrations from construction equipment can cause root damage. To prevent this:

.1 A Snow fence or Moduloc-type fence shall be erected at the CRZ of trees, without any material or equipment within the CRZ of the tree.

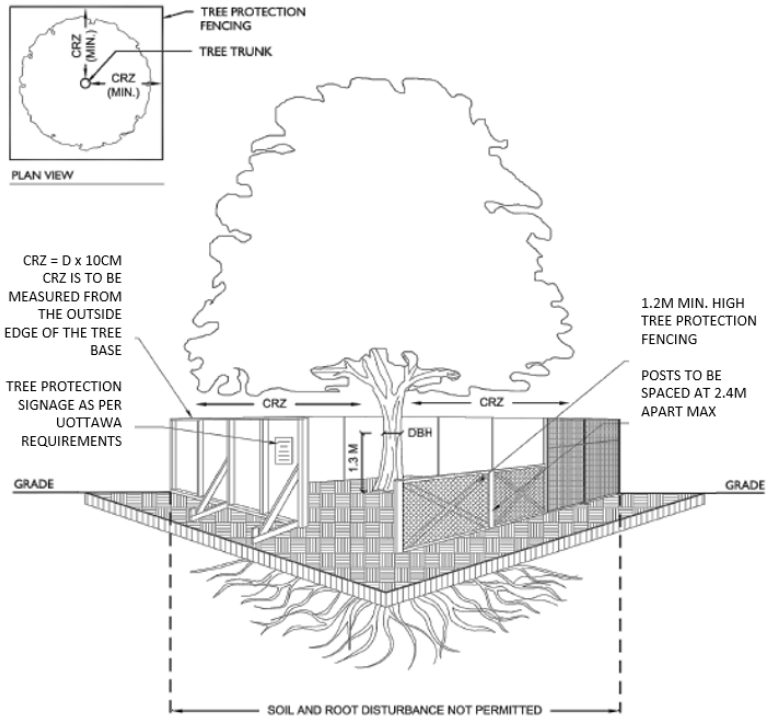
.2 Not to attach any signs, notices, or posters to any tree.

.3 Not to raise or lower the existing grade within the CRZ of a tree without approval of the Grounds Department.

.4 Not to tunnel or bore when digging within the CRZ of any tree.

.5 Not to damage the root system, trunk, or branches of any tree.

.6 Ensure that exhaust fumes from all equipment are not directed towards any tree's canopy.



.4 If trees are damaged and/or require removal:

.1 Repair work shall be done at no cost for **UofO**. Either by:

.1 Paying the value of the tree removed or;

.2 Paying the cost of a replacement tree and its installation.

1.3 Reinstating turf

.1 When working on turf areas:

.1 Turf areas are often used for staging zones and waste containers during construction projects. This can cause extensive damage to the lawn. The needed Turf area must be approved by **LGS**. Once completed:

.1 The existing sod to be removed from said area.

.2 Screened, residential grade topsoil to be used to cap and re-level.

.3 Nursery sod to be installed.

.4 Turf to be rolled and fine raked.

.5 Initial watering to be performed.

.6 Stakes to be added around area.

.2 If damage is minimal, top dress may be done rather than lay sod (to be approved by **LGS**). In such a case:

.1 25mm of screened, residential grade, topsoil to be applied.

.2 The existing lawn covering whole area to be brushed.

2.0 PRODUCTS

.1 *Granular Fill Material*: Clean, angular, crusher run natural stone, free from shale, clay, friable materials, roots and vegetable matter.

.2 *French Drains*: High density polyethylene resine ringed tubes of 100 mm (4") diameter, or larger, as per ASTM D1248, Type III, category 4 or 5, grade P33 or P34, Class C.

- Suggested (or equivalent) product: "Big-O" by Big-O Inc.

.3 *Geotextile*: Non-woven rootproof polyester fabric non-biodegradable, with a mass of 300 g/m2.

- Suggested (or equivalent) product: "7609" by Texel (Solmax).

End of Section

SECTION 32 30 00 – SITE IMPROVEMENTS AND AMENITIES

1.0 GENERAL

1.1 Extended Warranty

.1 All work in this section, including Fence materials, and proper functioning of gates, shall be guaranteed for a period of 5 years for labour and Materials.

1.2 Design Criteria and Notes

.1 To come.

2.0 PRODUCTS

2.1 Fences

.1 *Chain Link Fence*:

- .1 Wire mesh: 4.9 mm (6 ga), hot dipped galvanized high strength steel.
- .2 Pipes: For posts and rails in Galvanized steel, End posts: 89 mm (3½"), 3.42 kg / 300 mm (7.55 lbs / 12"). Intermediate posts: 60 mm ($2^{3}/_{8}$"), 1.66 kg / 300 mm (3.65 lbs / 12"). Rails, bracings: 43 mm ($1^{11}/_{16}$").
- .3 Bottom tension wire: 5 mm (3/16") diameter, single strand, hot dipped galvanized steel.
- .4 Tension bar: 5 mm x 19 mm (3/16" x 3/4") minimum hot dipped galvanized steel.
- .5 Tension bar bands: 3 mm x 19 mm (1/8" x 3/4") minimum hot dipped galvanized steel.
- .6 Finish: In Vinyl coated for mesh, and powder electro-color for other components, black color.
  - Suggested (or equivalent) product: As manufactured by:
    .1 Frosst Fences. .2 Medallion Fence Ltd

.2 *Metal Security Fence in Rectangular Mesh (Ornemental)*:

- .1 Wire mesh, for rectangular fence fabric: manufactured of 4.9 mm (6 ga) hot dipped galvanized steel wire, with 150 g/m^2 (0.5 oz/ft^2)
- .2 Hot dipped galvanized steel HSS sections, for line and end posts, 76 m x 76 mm (3" x 3"), at 2490 mm (8'- 2") c.c., or as necessary, with a zinc coating inside and out.
- .3 Finish: In powder electro-color, black color.
  - Suggested (or equivalent) product: "Omega II" by Omega Fence Systems Inc.

2.2 Roadway Guardrail

.1 *Removable or Fixed Guardrails*: Heavy duty roadway guardrail, with undulating cross section, to withstand slow moving vehicular impact, complete with HSS supports and bolts and Concrete bases.

2.3 Protection

.1 *Fixed Bollard*: Made up of concrete, various heights, with 1/8" thick High-Density Polyethylene (HDPE) protection sheet and reflective strips.

- **UofO** Standard product: As manufactured by Sureguard. Inc.

.2 *Removable Bollard*: Made up of concrete, 960mm or 1220mm high.
- **UofO** Standard product: "6432" or “6433”, with “6439” base (optional) by Central Precast Inc.

.3 *Conical Bollard*: Made up of concrete, 1425mm high.
- **UofO** Standard product: "6431" by Central Precast Inc.

.4 Parking Lot Divider: Made up of concrete.
- **UofO** Standard product: "6437" by Central Precast Inc.

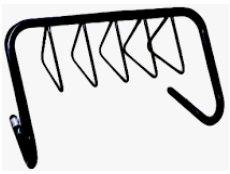
.5 *Parking Post*: Made up of galv. Steel post on concrete base, 1370mm or 1830mm high.
- **UofO** Standard product: "6436" or “6435” by Central Precast Inc.

2.4 Site Furnishing and amenities

.1 *Recycle Bins*: 1702mm x 610mm x 1143mm, triple stream front load waste, in PVC, Color Black Grey. With (3) engraved identifiers: "WASTE", "GLASS", "PLASTIC", or "CANS". Includes liners and hinged doors. Capacity 45 + 45 + 45 Gal (67"w x 24"d x 45"h), SKU # 030 470 045
- **UofO** Standard product: “Halston”, by Max-R.

.2 *Park Benches*: 1778mm x 762mm, with two end arms, legs painted black, gloss collection, wood grain texture High Density Polyethylene or IPE Wood. To be bolted.
- **UofO** Standard product: “100 Series Backed Benches”, by Maglin.

.3 *Bicycle Rack*: Capacity 6 to 8. 1473mm x 864mm x 864mm. In Stainless Steel. To be blotted.
- **UofO Standard product**: “Expo series W5808”, by Bicycle Cora.



.4 *Picnic Tables with Seating*: 1473mm x 1372mm x 762mm, with hole for parasol, woodgrain domestic modified sourced, Thermally Modified Ash Matte, black low sheen designer palette, wheelchair accessible at end of table can add length for better accessibility. To be bolted.
- **UofO** Standard product: “Gretchen Picnic Table”, by Landscapeforms.

.5 *Table, Cluster Seating*: 2388mm x 838mm, 3 seat backed backrest, prepainted steel, various colors. To be bolted. Allowing space for wheelchair accessibility
- **UofO** Standard product: “Carousel”, by Arno Yurk.

.6 *Table, Exterior Round*: 762mm dia x 762mm, in prepainted steel, various colors. Designed by John Rizzi.
- **UofO** Standard product: “Park Center Table”, by Landscapeforms.

.7 *Table, Exterior Square*: 711mm sq. x 762mm, in prepainted steel, various colors. Designed by John Rizzi.
- UofO Standard product: “Park Center Table”, by Landscapeforms.

.8 *Chair, Exterior, with Armrests*: 762mm x 584mm x 1092mm, in prepainted steel, various colors. Designed by John Rizzi.
- UofO Standard product: “Park Center Armchair”, by Landscapeforms.

.9 *Chair, Exterior, without Armrests*: 534mm x 483mm x 838mm, in prepainted steel, various colors. Designed by John Rizzi.
- UofO Standard product: “Park Center”, by Landscapeforms.

.10 *Ottoman, Exterior*: 457mm x 508mm x 432mm, in prepainted steel, various colors. Designed by John Rizzi.
- UofO Standard product: “Ottoman”, by Landscapeforms.

.11 *Chair, Exterior Lounge*: 711mm x 1575mm x 838mm, moulded polyethylene with surface mounting plate, various colors.
- UofO Standard product: “Chill Chaise Lounge”, by Landscapeforms.

.12 *Planters*: In Prefabricated concrete, with exposed aggregate finish. Different sizes to suit.
- **UofO** Standard product: "6100” series or “6210” series by Central Precast Inc.

.13 *Ash Trays*: Prefabricated Antitheft, in prepainted steel. Bolted from the inside to a concrete paver.
- **UofO** Standard product: As manufactured by Ikwit - Urban Ashtray & Furniture.

2.5 Accessories and Finishes

.1 *Aluminum Edging*: 140 mm (5½") deep, 4.8 mm (3/16") thick, mill finish aluminum edging, in AA-6063-T6 alloy and temper, complete with interlocking stakes 305 mm (12") long.
- Suggested (or equivalent) product: "Permaloc Cleanline" by Permaloc Corporation.

.2 *Aluminum Edging, Structural*: L-shaped, 55 mm (2¼") deep, 4.8 mm (3/16") thick, mill finish, structural aluminum edging, in AA-6063-T6 alloy and temper, complete with up to 305 mm (12") long, spikes and stakes as required.

- Suggested (or equivalent) product: "Permaloc StructurEdge" by Permaloc Corporation.

.3 *Recycled Plastic Edging*: synthetic lumber, made of recycled plastic, impervious to moisture, insects, rotting, mildew and graffiti.

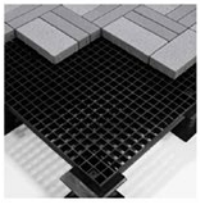
- Suggested (or equivalent) product: "Polyex" by Plastival.

.4 *Plastic Edging*: made of black extruded PVC, "Commercial" type, 140 mm (5½") deep.

- Suggested (or equivalent) product: as manufactured by D.C.N. Plastiques.

.5 *Wood Decking*: In EPI or Thermally Modified Ash Matte wood with snap clips and Terragrid system on pedestals.





.6 *Wood Edging*: In IPE wood inserts.

.7 *Tactile Walking Surface Indicators, in Concrete*: In pressed concrete pavers, engineered, with integral colour. Cast-in place.

- Suggested (or equivalent) Product: “H or V series, as manufactured by Wausau Tile.

End of Section

SECTION 32 80 00 – IRRIGATION SYSTEM

1.0 GENERAL

1.1 Extended Warranty

.1 The specified system shall carry a 3 year warranty. This is to include 1 year winterization in the fall and 1 year reactivation in the following spring.

1.2 Design Criteria and Notes

.1 Excavation and Trenching:

.1 Minimum depth of trenches shall be 450 mm (18") below finished grade with sufficient slope to allow drainage of the system or as detailed or indicated on drawing(s). Width of trench at bottom shall be minimum 100 mm (4") greater than the outside diameter of pipe it contains and keep free from rocks and all other material that may damage pipe.

.2 Piping, and zone valves:

.1 Snake pipe from side to side of trench bottom to allow for expansion and contraction.

.2 Where possible, main supply lines may occupy the same trench as sprinkler lines provided a minimum horizontal clearance of 150 mm (6") is maintained.

.3 Thoroughly flush out all water lines before installing heads, valves and other hydrants.

.4 Control wires under walks or paving to be sleeved with PVC Class 160 pipe or galvanized heavy wall steel conduit. Wires to the controller(s) in pump house to be sleeved in conduit.

.5 All splices to be made watertight using appropriate connectors.

.6 Group valves together where practical. Place valves no closer than 300 mm (12") to walk edges, buildings and/or walls. All valves shall be located in approved heavy duty high impact plastic valve boxes.

.7 Valve boxes shall have adequate space for proper operation of each component within. Install minimum 150 mm (6") depth of pea gravel below valve boxes for drainage.

.8 Quick coupling valves to be installed perpendicular to and flush with finished grade.

.3 Testing After Completion:

.1 Test the entire system for leaks, blockages, operation of sprinklers, valves and controller(s) in the presence of **SAS**. Continue to make adjustments and repairs and re-test, as required, until the entire system has been approved.

.3 Carry out pressure testing of the entire mainline system at full line pressure plus one hundred percent (100%) for a three (3) hour duration. During this time, the pressure shall not drop more than ten percent (10%) of the total initial pressure.

End of Section

SECTION 32 90 00 – PLANTING AND SOFT LANDSCAPING

1.0 GENERAL

1.1 Extended Warranty

.1 All work in this section shall be guaranteed against defects for a period of 2 growing seasons years.

.2 During warranty period, remove from site any plant material that has died or failed to grow satisfactorily. Replace plant material in the next planting season. Extend warranty on replacement plant material for a period equal to the original warranty period. Continue such replacement and warranty until plant material is acceptable

1.2 Design Criteria and Notes

.1 Planter supply source, should be member of the Canadian Nursey Association.

.2 Plants approved at the supply source may be rejected before or after planting. Imported plants must be submitted with all required permits.

.3 Contractor is responsible for soil analysis and shall determine the need for soil amendments, so that soil meets prescribed formulation.

.4 Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the breaking of buds in their original location and heeled-in, in a protected area until conditions suitable for planting.

. 5 Use trees and shrubs with strong fibrous root system free of disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.

.6 Large trees must have been half root pruned during each of two successive growing seasons, the latter at least one growing season prior to arrival on site.

.7 Plant material that has come out of dormant stage and is too far advanced will not be accepted unless prior approval obtained.

2.0 PRODUCTS

2.1 Trees and Shrubs

.1 *Source of Plant Material*: grown in compatible zone in accordance with Agriculture Canada Plant Hardiness Zone Map. Use trees and shrubs of No.1 grade.

.2 *Plant Material*: free of disease, insects, defects or injuries and structurally sound with strong fibrous root system; root pruned regularly, but not later than one growing season prior to arrival on site.

.3 *Trees*: with straight trunks, well and characteristically branched for species except where specified otherwise.

.4 *Bare Root Stock*: nursery grown, in dormant stage, not balled and burlapped or container grown.

.5 *Collected Stock*: maximum 40 mm (1½") in caliper, with well-developed crowns and characteristically branched; no more than 40% of overall height may be free of branches.

End of Section

GENERAL NOTES:

"G" SUFFIX

LEGENDS, NOTES & SYMBOLS:

A01 THE NOTES, DETAILS, SKETCHES, DIAGRAMS OR ANY OTHER IN THE CURRENT **VOLUME**, DEPICT STANDARD GUIDELINES FOR DESIGNING HIGH PERFORMANCE CONNECTION ASSEMBLIES, AND REFLECT "BEST PRACTICE" SCENARIO OPTIONS APPLIED IN PREVIOUS PROJECTS.
THEY ARE COMPLEMENTARY TO THE NOTES AND GUIDELINES LISTED ELSEWHERE IN THIS DOCUMENT.
LICENSED PROFESSIONALS & CONSULTANTS TO VALIDATE AND ADAPT TO SUIT THE SPECIFICS OF EACH PROJECT. ANY VARIATIONS SHALL BE WITH WITH EQUIVALENT MATERIALS - SUBJECT TO **FACILITIES**'S APPROVAL.
THE CONCEPT IS BASED ON SEVERAL INDUSTRY STANDARDS; INCLUDING, BUT NOT LIMITED TO:

- SEVERAL ULC, UL & cUL TESTS.
- ARCHITECTURAL DETAILS FOR INSULATED BUILDING, BY RONALD BRAND.
- NATIONAL INSTITUTE OF BUILDING SCIENCE (WBDG).
- REPUTABLE MANUFACTURER`S INFORMATION.
- VARIOUS PUBLICATIONS OF:
  - BUILDING ENVELOPE COUNCIL OTTAWA REGION (BECOR).
  - ONTARIO ASSOCIATION OF ARCHITECTS (OAA).
  - CANADA MORTGAGE & HOUSING CORPORATION (CMHC).
  - "LE CONSEIL DE L'ENVELOPPE DE BATIMENT DU QUEBEC" (CEBQ).
  - "L'ASSOCIATION DES MAITRES COUVREURS DU QUEBEC" (AMCQ).
  - "L'ASSOCIATION DE REVETEMENT METALLIQUE DU QUEBEC" (ARMQ).
  - "L'ASSOCIATION DES MANUFACTURIERS DE MACONNERIE DE BETON" (AmmB).

A02 DESCRIBED ASSEMBLIES ARE FOR GENERAL INFORMATION ONLY. CONSULTANTS MAY USE EQUIVALENT DIFFERENT MATERIALS OR MIXED ASSEMBLIES DEPENDING ON THE PROJECT NATURES AND SPECIFICS - SUBJECT TO **FACILITY**'S APPROVAL. MATERIALS' THICKNESS SHALL BE AS NECESSARY TO SUIT THE DIFFERENT CONDITIONS. ALSO REFER TO "BUILDING ENVELOPE" & "PARTITIONS & ACOUSTICAL ASSEMBLIES" SECTIONS IN THE OTHER **VOLUMES**.

A03 WHETHER INDICATED OR NOT, NOTES AND LEGENDS ARE INTERCHANGEABLE, AND SHALL APPLY INTEGRALLY TO ALL DETAILS, WHEREVER APPLICABLE.

GENERAL ABBREVIATIONS LIST:

ACT	ACOUSTICAL TILE
AFF	ABOVE FINISHED FLOOR
APPROX.	APPROXIMATE(LY)
C/L	CENTER LINE
C/W	COMPLETE WITH
C/C	CENTER TO CENTER
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
D	DEEP, DEPTH UofO DESIGN
DCG	CONSTRUCTION GUIDELINES
DIM.	DIMENSION
EQ.	EQUAL
EX.	EXISTING
EXT.	EXTERIOR
FRR	FIRE-RESISTANT RATED
FHC	FIRE HOSE CABINET
GA	GAUGE
GMP	GOOD MANUFACTURING PRACTICE
GWB	GYPSUM WALL BOARD
INT.	INTERIOR
LIN.	LINEAR
MAX.	MAXIMUM
MIN.	MINIMUM
MISC.	MISCELLANEOUS
MSN	MASONRY
NBC	NATIONAL BUILDING CODE, OR APPLICABLE PROVINCIAL CODES
NFC	NATIONAL FIRE CODE OR APPLICABLE PROVINCIAL CODES
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
O/C	ON CENTER
OBC	ONTARIO BUILDING CODE
PP	PERPENDICULAR
SIM.	SIMILAR
TBD	TO BE DETERMINED
TVS	TO BE VERIFIED ON SITE OR CHECKED W/ SUPPLIER OR SUB-TRADE
TYP.	TYPICAL
UL	UNDERWRITERS' LABORATORIES
ULC/cUL	UNDERWRITERS' LABORATORIES OF CANADA OR ANY APPROVED/CERTIFIED LISTINGS FOR CANADA
UON	UNLESS OTHERWISE NOTED
U/S	UNDERSIDE OF
VAR.	VARIABLE

LEGEND - LAB FURNITURE

SUFFIX "B"

LEGEND:

SYSTEMS AND FRAME ASSEMBLIES ***(12 35 00)***:

TO BE INSTALLED AS INDICATED OR NECESSARY:

B01 *FIXED COUNTERTOP UNITS*, FOR LABS REQUIRING MULTIPLE SERVICES, SUCH AS SINK UNITS OR SIMILAR.

B02 *MOBILE COUNTERTOP UNITS*, SERVICED FROM CEILING FOR LABS REQUIRING FEW SERVICES.

B03 *FLOOR-MOUNT UNITS*, WITH CONTINUOUS BASE, FOR SINK UNITS REQUIRING PLUMBING.

B04 *POST OR OPEN LEG FRAME ASSEMBLY*, WITH HANGERS TO ACCOMMODATE SUSPENDED BASE CABINETS.

B05 **ADJUSTABLE** *WALL-MOUNT BRACKET*, FOR UPPER *WALL-MOUNT CABINETS*.

B06 *SERVICE PANELS* COMPLETELY OR PARTIALLY REMOVABLE TO COVER ALL EXPOSED PIPING AND CONDUITS UNDERNEATH THE COUNTERTOPS, IN *FIXED UNITS*, WITH APPROPRIATE BRACKETS AND STIFFENERS.

B07 ADJUSTABLE LEGS TO BE PROVIDED IN ALL *MOBILE UNITS*.

B08 UON, *SHELVES* TO BE ADJUSTABLE. A SHELF SHALL BE PROVIDED FOR EVERY 305mm OF AVAILABLE SPACE.

B09 BACK SPLASH TO BE INSTALLED ON ALL CONNECTIONS BETWEEN *COUNTERTOPS* AND VERTICAL SURFACES, ON *FIXED UNITS*.

B10 *GABLE LEGS*, AT EXPOSED ENDS, ON *FIXED UNITS*.

B11 *SLIDING DOORS* FOR UPPER *WALL-MOUNT CABINETS*.

B12 *APRONS FOR KNEE SPACES* NO MORE THAN 64mm HEIGHT.

B13 *SERVICE CHASE* COMPLETELY OR PARTIALLY REMOVABLE TO COVER ALL EXPOSED PIPING AND CONDUITS BETWEEN THE COUNTERTOPS AND THE CEILING, IN *FIXED UNITS*, WITH APPROPRIATE BRACKETS AND STIFFENERS.

DETAILING AND FINISHES:

B21 *COUNTERTOPS* TO EXTEND BEYOND THE BASE CABINET AND HAVE A DRIP GROOVE TO THE UNDERSIDE OF PROJECTING FRONT EDGE (5 mm), 13mm BACK FROM THE FRONT EDGE AND EXPOSED GABLES. A SOLID FINISHING EDGE STRIP SHALL BE APPLIED IN PLASTIC LAMINATE OR VENEER WOOD FINISHED COUNTERTOPS.

B22 FLOOR BASES TO BE INSTALLED ON ALL *BASE CABINETS* , ON FLOOR *SERVICE PANELS* AND ALL VISIBLE SURFACES.

B23 FLOOR FINISHES TO EXTEND ALL THE WAY UP TO THE PARTITIONS, UNDER THE FIXED LAB CASEWORK UNITS. IF APPLICABLE, INTEGRAL FLOOR BASES TO BE INSTALLED ALIKE UP TO THE PARTITIONS.

ACCESSORIES & SERVICES:

TO BE INSTALLED AS INDICATED OR NECESSARY:

B31 *DRYING RACKS **(12 35 00)***, WITH CATCH DRIP.

LEGEND - MISCELLANEOUS STEEL:

SUFFIX "L"

LEGEND:

COMPONENTS:

TO BE INSTALLED AS INDICATED (SIZES AS INDICATED OR NECESSARY):

L01 *STEEL PLATES*.

L02 *STEEL CHECKERED PLATES, ANTISKID **(05 50 00)***

L03 *STEEL* OR *FIBER REINFORCED POLYMER (FRP) GRATING, TREADS & LANDINGS, ANTI-SKID **(05 50 00)***.

L04 CONCRETE FILL-IN TOPPING

L05 STEEL OR FIBER REINFORCED POLYMER (FRP) STRINGER.

L06 STEEL SHAPES ("L", "C", OR SIMILAR).

L07 STEEL BARS.

L08 STEEL PIPES, TUBES OR RODS.

L09 *CARBORUNDUM ANTI-SKID STRIPS **(05 50 00)***.

L10 STEEL CHAIN (MOVABLE, WITH APPROPRIATE HOOKS).

L11 STEEL CAST-IN SLEEVE, SIZE TO ADAPT TO BALUSTRADE / POST.

L12 *TACTILE WALKING SURFACE INDICATORS, IN IRON OR POLYMER **(05 50 00)***, SURFACE MOUNT (IN EXISTING CONSTRUCTION) OR CAST-IN (IN NEW CONSTRUCTION).

INSTALLATION:

L21 INSTALL ALL STIFFENERS, SUPPORTS AND REINFORCEMENTS AS NECESSARY TO ENSURE STRUCTURAL STABILITY OF UNITS.

L22 UON, STEEL ELEMENTS TO BE WELDED TOGETHER AND GRINDED SMOOTHLY.

L23 UON, STEEL ELEMENTS TO BE ANCHORED TO OTHER ELEMENTS USING COUNTERSUNK FASTENER BOLTS (IF EXPOSED), OR ANY OTHER APPROPRIATE BOLTS AS RECOMMENDED.

L24 ALL HANDRAILS EXTENSIONS SHALL BE TERMINATED (TURNED) IN A SMOOTH WAY, IN ORDER NOT TO CONSTITUTE A HAZARD TO THE USERS.

L25 IN NON-INUSTRIAL STAIRS: BALUSTRADES SHALL PREVENT THE PASSAGE OF A 100mm DIAMETER SPHERE.

LEGEND - MILLWORK

SUFFIX "M"

LEGEND:

COMPONENTS:

TO BE INSTALLED AS INDICATED OR NECESSARY:

M01 COUNTER TOP:
A) *PLYWOOD PANELS* ***(06 10 00)*** OR *PREMOLDED PARTICLE BOARD* ***(06 10 00)*** 19mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)***
B) NATURAL STONE 19mm
C) *SOLID HOMOGENEOUS PANEL* ***(06 10 00)*** 19mm

M02 BACKSPLASHES:
PLYWOOD PANELS ***(06 10 00)*** 19mm, COVERED *WITH PLASTIC LAMINATE* ***(06 10 00)*** OR V*ENEER WOOD* ***(06 10 00)*** .
FOR RECYCLING COUNTER: TO BE DOUBLE (2 X 19mm), SECURED ONLY TO THE COUNTER WITH ADEQUATE METAL FITTING PLATE OR BRACKET.

M03 STIFFENERS:
PLYWOOD PANELS ***(06 10 00)*** 19mm, @ 1220mm O/C, COVERED *WITH PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***(06 10 00)***.

M04 BODY / SIDES:
PARTICLE BOARD WOOD ***(06 10 00)*** 19mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***(06 10 00)***.

M05 BACK PANEL:
PARTICLE BOARD WOOD 13mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***06 10 00)***.

M06 DOORS:
PARTICLE BOARD WOOD ***(06 10 00)*** 16mm, COVERED *WITH PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***(06 10 00)***.

M07 CABINET BASES:
PLYWOOD PANELS ***(06 10 00)*** 19mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***(06 10 00)*** OR *WALL BASE FINISH* ***(06 10 00)***.

M08 DRAWERS:
-FACES: *PARTICLE BOARD WOOD* ***(06 10 00)*** 16mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD(* ***06 10 00)***.
-BACKS AND SIDES: *PARTICLE BOARD WOOD* ***(06 10 00)*** 13mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)***.

M09 SHELVES (ADJUSTABLE):
PARTICLE BOARD WOOD ***(06 10 00)*** (19mm @ 915mm LONG MAX., AND 25mm @ 1220mm LONG), COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***(06 10 00)***.

M10 DECORATIVE PANELS / FASCIAS:
PARTICLE BOARD WOOD ***(06 10 00)*** 19mm, COVERED WITH *PLASTIC LAMINATE* ***(06 10 00)*** OR *VENEER WOOD* ***(06 10 00)*** .

M11 INSERTS:
IN SAME MATERIAL AS THE PANEL. TO BE SECURED AT ALL SIDES (2 PER SIDE) WITH METAL FITTING PLATE OR BRACKETS.

LEGEND - MILLWORK

SUFFIX "M"

LEGEND:

ACCESSORIES:

TO BE INSTALLED AS INDICATED OR NECESSARY:

M21 HANDLES: CHROMED STEEL, SS, PR PVC.
FOR RECYCLING COUNTER: CONTINUOUS: "RICHELIEU #3182".

M22 SLIDES: CHROMES, WITH EXTRA EXTENSION

M23 HINGES: CONCEALED, CHROMES, WITH SLOW RETURN TYPE 'BLUM".

M24 GROMMETS: PRE FABRICATED IN PVC

M25 MOULDINGS: ANODIZED ALUMINUM TRIMS "L" SHAPE ON PERIMETER & "T" SHAPE INSIDE(3/4")

M26 COAT RACKS: S.S. TUBE Ø 41mm.

M27 *WALL MOUNT SHELVE ADJUSTABLE BRACKETS AND RACKS **(06 10 00)***: IN PRE-PAINTED STEEL, ULTRA-ROBUST (DOUBLE SLOT WITH DOUBLE FLANGE BRACKETS), TO ADAPT TO SHELVE SIZES.

M28 TRIMS: STAINLESS STEEL RING Ø 152mm.

M29 LIQUID DRAIN TROUGH: STAINLESS STEEL DRAIN TROUGH COMPLETE WITH 13mm STAINLESS STEEL EDGE AND HINGED GRATE. RECESSED 13mm. TO BE CONNECTED AND SECURED TO APPROPRIATE FLEX TUBING IDENTICAL TO SIMILAR INSTALLATIONS ON EXISTING **UOFO** RECYCLING COUNTERS. ANY ALTERNATIVE TO BE APPROVED.

M30 WASTE DEFLECTORS: STAINLESS STEEL, SECURELY FIXED TO INSIDE OF DOOR AT ALL 4 RECTANGULAR OPENINGS.

M31 WASTE AND RECYCLE CONTAINERS (N.I.C.): PROVIDED BY OWNER

M32 LIQUID DRAIN CONTAINERS (N.I.C.): PROVIDED BY OWNER.

NOTES:

M41 ALL EXPOSED EDGES TO BE COVERED WITH PLASTIC LAMINATE EDGING TO MATCH ADJACENT.

M42 INSTALL ALL WOOD BLOCKING OR OTHER STIFFENERS OR SUPPORTS NECESSARY TO ENSURE STRUCTURAL STABILITY OF UNITS.

M43 ALL NECESSARY CUTS FOR ELECTRICAL RECEPTACLES OR OTHER SIMILAR FEATURES, TO BE CARRIED OUT AS PER ELECTRICAL FEATURES.

PLASTIC LAMINATE FINISHES:

UON, THE FOLLOWING ARE THE FINISHES TO BE USED:

PL1 FOR BACK SIGNAGE PANEL:
FORMICA, 909-58, BLACK, MATTE FINISH.

PL2 ALL EXPOSED EXTERIOR FINISHES (EXCEPT BACK SIGNAGE PANEL).
FORMICA, 7012-58, AMBER MAPLE, MATTE FINISH.

PL3 ALL EXPOSED INTERIOR SURFACES:
WHITE MELAMINE, MATTE FINISH.

LEGEND - WASHROOMS ACCESSORIES & INSTALLATIONS

SUFFIX "N"

LEGEND:

ACCESSORIES **(10 28 10)**:

TO BE INSTALLED AS INDICATED OR NECESSARY:

N01 *PAPER TOWEL DISPENSER, SURFACE MOUNTED **(10 28 10).***
MOUNTING OPERATING HEIGHT: 1100mm AFF.

N02 *SOAP DISPENSER, SURFACE MOUNTED **(10 28 10)***.
MOUNTING OPERATING HEIGHT: 1100mm AFF.

LEGEND - PARTITION / INTERNAL WORK

SUFFIX "P"

LEGEND:

INTEGRITY:

P01 ALL MECH./ELECT./STRUCT. PENETRATIONS N FULL HEIGHT SOUND RATED OR IN FRR ASSEMBLIES, TO BE SEALED OR FIREPROOFED.

P02 PARTITIONS IN FIRE RATED OR SOUND RATED OR FULL-HEIGHT PARTITION ASSEMBLIES TO BE SEALED ON PERIMETER.

P03 SEALANT & CAULKING MATERIAL THICKNESS TO TAKE IN CONSIDERATION THE COMPRESSIBLE PERCENTAGE FACTOR INDICATED ON THE TEST, IN CONJUNCTION WITH THE STRUCTURAL DEFLECTION OF THE MEMBERS.

P04 IN MASONRY PARTITIONS, TOP COURSE TO BE 100% FILLED WITH MORTAR.

P05 FRR OR ACOUSTICAL PARTITIONS TO PENETRATE THROUGH THE CORE OF THE OTHER WALL OR PARTITION WHEREVER IT MEETS AN EXTERIOR WALL OR ANY OTHER NON-FRR PARTITIONS.

P06 *POLYETHYLENE FOAM EVA CLOSURE BLOCKING* ***(07 40 00)*** TO SEAL METAL CLADDING PARTITIONS BETWEEN PANELS (HORIZONTALLY AND VERTICALLY) IF PARTITION IS SMOKE SEALED.

P07 RECESSED ELECTRIC BOXES TO BE STAGGER AT OPPOSITE SIDES OF SOUND RATED PARTITIONS @ MIN. 600mm O/C.

ACOUSTIC INSULATION:

P11 *GLASS FIBER FLEXIBLE ACOUSTIC LINER* ***(07 20 00)*** TO BE INSTALLED OVER CEILING, EXTENDED 1220mm ON BOTH SIDES OF PARTITION, IN EXISTING CONDITIONS WHERE IT IS IMPOSSIBLE TO EXTEND SOUND PARTITIONS FULL HEIGHT.

P12 *MINERAL FIBER ACOUSTIC BATT INSULATION* ***(07 20 00)*** TO BE INSTALLED IN ANY OF THE FOLLOWING CONDITIONS AS APPLICABLE:

- ON TOP OF FOLDING PANEL PARTITIONS.
- IN DOOR / VISION PANEL / WINDOW FRAME CAVITIES OR SIMILAR IF PARTITION CONTAINING THESE ELEMENTS IS FILLED WITH ACOUSTIC INSULATION
- IN ALL CONCEALED VOIDS BETWEEN PARTITIONS AND EXTERIOR WINDOW MULLIONS AND OTHER SIMILAR ADJACENT SPACES
- IN THE FLUTE METAL DECKS, ON TOP OF THE PARTITION, IF SOUND INSULATED
- ALL ADJACENT SPACES TO SOUND INSULATED PARTITIONS
- ALL OTHER SPACES, AS INDICATED

P13 *FLEXIBLE ACOUSTICAL BUFFER, OR SEMI-RIGID ACOUSTICAL BUFFER* ***(07 20 00)*** TO BE SUSPENDED IN PLENUMS, TO ENSURE THE SOUND INTEGRITY IN HIDDEN PLACES WHERE SOUNDPROOF PARTITIONS DO NOT EXTEND FULL HEIGHT (SLAB TO SLAB).

LEGEND - PARTITION / INTERNAL WORK

SUFFIX "P"

STRUCTURAL STABILITY:

P21 DEFLECTION GAP TO BE CARRIED AT THE HEAD OF ALL PARTITIONS (MASONRY AND / OR STUDS) USING DOUBLE TRACK OR SIMILAR APPROVED SYSTEM TO ALLOW FOR FLEXIBLE STRUCTURAL DEFLECTION ABOVE.
F: STRUCTURAL DEFLECTION AS RECOmmENDED BY STRUCTURAL ENGINEER. = 20mm MIN. RECOmmENDED

P22 STUDS TO BE DOUBLED AT ALL OPENINGS, DOOR OR WINDOW FRAMES IN DRY WALL PARTITIONS.

P23 ADDITIONAL STUD, ALUMINUM EXTRUSIONS OR MISCELLANEOUS STEEL REINFORCEMENT TO BE ADDED FOR VERTICAL POSTS AND LINTELS, AS NECESSARY IN THE FOLLOWING:
- DRY WALL PARTITIONS, FOR ALL OPENINGS WIDER THAN 1800mm.
- ALL FREE STANDING PARTITIONS, WHERE NECESSARY TO SUPPORT THE DESCRIBED DIMENSIONS.

P24 "L" SHAPE, CHANNEL, OR SIMILAR MISCELLANEOUS STEEL REINFORCEMENT TO BE INSTALLED AS NECESSARY AS REINFORCEMENT FOR THE FOLLOWING:
- VANITY SUPPORT
- CEILING HUNG PARTITIONS

P25 CONTINUOUS STEEL PLATE ±16 GAUGE X APPROPRIATE WIDTH OR SIMILAR TO BE INSTALLED AS NECESSARY FOR THE SUPPORT AND/OR REINFORCEMENT OF PARTITION STUDS UNDER WASHROOM ACCESSORIES, ELECTRO/ MECHANICAL ITEMS, SUSPENDED FURNITURE, OR SIMILAR.

P26 UON, ADDITIONAL CROSS BRACING @ 1500mm O/C MAX TO ATTACH DOUBLE STUD PARTITIONS.

P27 CONCRETE OR STEEL LINTELS TO BE INSTALLED OVER OPENINGS, DOORS, MECHANICAL / ELECTRICAL SERVICE OR EQUIPMENT PENETRATIONS IN MASONRY PARTITIONS. REFER TO STRUCTURAL AS NECESSARY.

P28 CONTINUOUS GALVANIZED "L" SHAPE FRAME 50mm x NECESSARY HEIGHT x ±16 GA., TO BE INSTALLED ON THE PERIMETER OF ALL BOARD CEILINGS.

P29 *STEEL STUD SYSTEM **(09 20 00)*** (SAME GAUGE AND STUD SPACING AS ADJACENT) TO BE INSTALLED AS NECESSARY FOR BRACING & REINFORCEMENTS OF BULKHEAD FACES, PARTITION HEADS, SUSPENSIONS OR SIMILAR.

P30 ADDITIONAL FRAMING TO BE INSTALLED IN CEILINGS AS NECESSARY TO ACCOmmODATE ALL ELECTRICAL / MECHANICAL FEATURES SUCH AS FUME HOOD COVER PANELS, LIGHTING, DUCTS, PIPES, OR SIMILAR.

P31 UON, UNDER STEEL DECK COMPONENTS, ALL CEILING HUNG ELEMENTS TO BE ANCHORED TO THE STRUCTURAL SUPPORTING ELEMENTS OR LOWER PORTIONS OF THE FLUTES, AND NOT TO THE UPPER PORTIONS.

LEGEND - PARTITION / INTERNAL WORK

SUFFIX "P"

DRY WALL PARTITION CONSTRUCTION:

P41 BOARD MATERIAL OF SAME TYPE AND THICKNESS AND LAYER NUMBER TO BE INSTALLED AS INDICATED TO COVER PARTITION GAPS.

P42 BOARD MATERIAL TO BE SCREWED TO VERTICAL STUDS AND NOT TO TOP TRACK.

P43 GALV. TOP TRACKS AT PARTITION HEADS TO BE COMPOSED OF ONE FIXED TOP AND ONE LOOSE BOTTOM CHANNEL, OR SLOTTED HEAD SYSTEM.

P44 DEFLECTION GAP TO BE CARRIED OUT WHERE MECHANICAL / ELECT. PENETRATIONS (PIPES, CONDUITS, OR SIMILAR) PENETRATES DRY WALL PARTITIONS, TO PREVENT STRUCTURAL DEFLECTION, UNLESS SUPPORTING STUDS BELOW ARE DESIGNED TO CARRY THE LOAD OF THESE PENETRANTS.

P45 FLEXIBLE (LOOSE) CONNECTION BETWEEN BOARD MATERIALS TO BE DONE, AT ALL LOCATIONS WHERE THERE IS ANTICIPATED DEFLECTION / MOVEMENT.

P46 *PREFABRICATED DEFLECTION JOINT TRIMS* ***(09 20 00)*** WITH SEALED EDGES, TO BE INSTALLED ON TOP OF PARTITIONS, IF DESIGNATED AS PRESSURIZED AIR SEAL.

P47 *STEEL DECK FLUTE CLOSURES* ***(09 20 00)*** IN GALVANIZED STEEL, SAME GA. AS STRUCT. METAL DECK (20 MIN.), TO BE INSTALLED ON TOP OF FULL-HEIGHT PARTITIONS AS INDICATED.

P48 GALVANIZED SHEET, 20 GA, 64mm x 64mm MIN. TO BE INSTALLED TO FIX LOOSE PARTITION BOARDS TO THE STRUCTURE ABOVE.

P49 UON, WOOD BLOCKING IS NOT PERMITTED WITHIN THE FOLLOWING LOCATIONS:
-LAB SPACES, CLEAN ROOM SPACES, HIGH MOISTURE SPACES, AND SIMILAR.

FIRE RATED PROTECTION:

P51 *MINERAL FIBER FRR BATT INSULATION* ***(07 80 00)*** TO BE INSTALLED IN ALL CAVITY CONNECTIONS OF FRR PARTITIONS OR SIMILAR, AS INDICATED, OR *FIRE STOP FLUTE DECK* ***(07 80 00)***.

P52 *FRR SEALANTS* ***(07 80 00)*** OR *SPRAYS MODIFIED ACRYLIC LATEX ELASTOMER SEALANT* ***(07 80 00)*** , OR *SILICONE SEALANT* , TO BE INSTALLED AS MANUFACTURERS RECOmmENDATIONS DEPENDING ON SITE CONDITIONS, APPLICABILITY, LOCATION, WALL FINISHES TO MEET ULC/cUL REQUIREMENTS OR AS INDICATED.

P53 STRUCTURAL STEEL ELEMENTS (COLUMNS, BEAMS, OR SIMILAR) PENETRATION FRR PARTITIONS OR CARRYING LOADS, TO BE BE PROTECTED WITH *INTUMESCENT COATING* ***(07 80 00)*** OR OTHER ULC APPROVED MEANS.

P54 PIPE INSULATION OR P.V.C. COVERS THAT PENETRATE FIRE RATED SEPARATIONS TO BE IN CONFORMANCE WITH ULC/cUL APPROVED TESTS.

P55 REFER TO MECH. / ELECT. NOTES FOR GENERAL INFORMATION ABOUT SEALING AND FIRE STOPPING AROUND MECHANICAL / ELECTRICAL PENETRATION.

P56 *FIRESTOP TOP TRACK SEAL* ***(07 80 00)*** , TO BE INSERTED BETWEEN TOP TRACK AND STRUCTURE, WITH PROVISION FOR DEFLECTION.

LEGEND - PARTITION / INTERNAL WORK

SUFFIX "P"

MOULDING & FINISHES:

TO BE INSTALLED AS INDICATED OR NECESSARY:

P61 *"V" MOULDING FOR DRYWALL CONTROL JOINTS, PLASTERED **(09 20 00)***.

P62 CONCEALED "J" TRIM, PLASTERED, AND / OR FINISHED.

P63 DRYWALL METAL REVEAL TRIM "Z" SHAPE, PLASTERED.

P64 DRYWALL PLASTER.

P65 CONTROL JOINT TRIM FOR DRYWALL.

P66 NEOPRENE GASKET ±8mm.

P67 EXPOSED ALUMINUM FASCIA, "U", "J" OR "Z" TRIM OR STRIPS, SAME FINISH AS ADJACENT ALUMINUM ELEMENTS.

SEALANTS & GASKETS:

TO BE INSTALLED AS INDICATED OR NECESSARY:

P71 INTERIOR *SEALANT* + *BACKER ROD **(07 90 00)*** (BACKING ROD ONLY FOR ALL GAPS EXCEEDING 3mm).

P72 *INSULATING STRIP FOR DRYWALL, SELF-ADHESIVE **(09 20 00)*** BETWEEN THE TOP OR BOTTOM TRACK AND STRUCTURAL ELEMENTS.

P73 *EXPANSION JOINT PRE-COMPRESSIBLE **(07 10 00)*** COMPONENT INTEGRATED WITH A SILICONE SEALANT EDGES.

P74 *SMOKE AND ACOUSTIC TOP TRACK SEAL **(07 90 00)*** , TO BE INSERTED BETWEEN TOP TRACK AND STRUCTURE, WITH PROVISION FOR DEFLECTION.

EXISTING CONDITIONS OR EXTERIOR WALLS:

P81 UON, PARTITIONS NO TO BE ATTACHED DIRECTLY ON EXISTING ELEMENTS AT JUNCTIONS BETWEEN NEW AND EXISTING CONSTRUCTION, OR IF IT IS SUPPORTED ON FLOATING SLAB-ON GRADES WITH EXPANSION JOINTS.

P82 METAL STUDS TO TO BE INSTALLED ON THE CURTAIN WALL MULLIONS IF NECESSARY, BUT NOT TO THE SPANDREL PANELS (VAPOR-BARRIER).

P83 PARTITION ELEMENTS SUPPORTED ON FLOATING SLABS, SHALL NOT LEAN DIRECTLY ON ANY ELEMENT OF THE EXTERIOR WALL OR SURROUNDING PARTITIONS.

LEGEND - DOOR & HARDWARE

SUFFIX "R"

LEGEND:

DOORS & FRAMES:

R01 U.O.N, FRAME THROAT SIZE TO ADAPT TO PARTITION TYPE. FOR ALL WALLS OR PARTITIONS WIDTHS, REFER TO CONSTRUCTION PLANS AND PARTITION TYPES. VERIFY WIDTHS OF ALL EXISTING WALLS ON SITE. DOOR FRAMES TO BE AT LEAST 50mm WIDE FOR ADEQUATE INSTALLATION OF SPECIFIED ELECTRIC STRIKES.

R02 U.O.N., DOUBLE DOORS THAT CARRIES *EXIT DEVISE **(08 70 00)*** ((PANIC BARS) SHALL HAVE INTERMEDIATE MULLION FRAMES (TO BE REMOVABLE IN MAIN CORRIDORS OR ENTRANCES, UON) .

HARDWARE & CONNECTIONS:

TO BE INSTALLED AS INDICATED OR NECESSARY:

R21 *ACTUATOR SWITCH* AND *ESCUTCHEON **(08 70 00)*** (AS APPLICABLE) FOR AUTOMATIC DOOR OPERATOR, TO BE INDIVIDUALLY WIRED, OR WIRELESSLY CONNECTED. U.O.N., TO BE AUTOMATICALLY DEACTIVATED (NOT OPERATIONAL) IN CASE OF FIRE-ALARM SIGNAL, IN FRR PARTITION'S DOORS. INSTALLED ON BOTH SIDES, TAKING IN CONSIDERATION ACCESSIBILITY & CIRCULATION CLEARANCES.

R22 DOOR OPERATOR'S *CONTROL BOX **(08 70 00)***. U.O.N., TO BE INSTALLED WALL MOUNTED OR IN CEILING SPACES WITH VIBRATION ISOLATORS IN CORRIDORS, A/V ROOMS OR STORAGE ROOMS. NEVER INSTALL IN CLASSROOM CEILING SPACE. FINAL LOCATION TO BE COORDINATED WITH **UofO**.
NOTE: DEVISE COULD ALSO BE INTEGRATED TO THE *AUTOMATIC DOOR OPERATOR CLOSER*.

R23 *AUTOMATIC DOOR OPERATOR CLOSER **(08 70 00)***, TO BE GENERALLY INSTALLED ON FRAME. UON, DELAY TIME:
- 5 SECONDS AFTER ACTUATOR IS PUSHED.
- 12 SECONDS WHEN DOOR IS FULLY OPENED.

R24 *ELECTRIFIED LATCH DEVICE **(08 70 00)*** (ELECTRICAL STRIKE), TO BE MOUNTED ON FRAME.

R25 ELECTRIFIED MAGLOCK.

R26 DOOR COORDINATOR, TO BE INSTALLED ON ALL FRR DOUBLE DOORS.

R27 STANDARD *MORTISE & LEVER **(08 70 00)***.

R28 *STANDARD PANIC BAR EXIT DEVICE **(08 70 00)***.

R29 *ELECTRIFIED MORTISE & LEVER **(08 70 00)***.

R30 *ELECTRIFIED / RETRACTABLE PANIC BAR EXIT DEVICE **(08 70 00)***.

R31 *ELECTRIC POWER TRANSFER **(08 70 00)***, INSTALLED IN FRAME.

R32 FLUSH BOLT, ON TOP AND BOTTOM.

R33 *DOOR COORDINATOR **(08 70 00)***.

R34 MANUAL *DOOR CLOSER **(08 70 00)***, TO BE GENERALLY INSTALLED ON FRAME. UON, DELAY TIME:
- 3 SECONDS WHEN THE DOOR IS IN AN OPEN POSITION OF 70°.

R35 ELECTRICAL CONNECTION (WHERE APPLICABLE WITH MOVABLE MULLIONS).

R36 KEY SWITCH, TO SHUNT / BYPASS THE *ACTUATOR SWITCH*.

R37 ASTRAGAL. TO BE INSTALLED ON ALL F.R.R. DOUBLE DOORS.

R38 MANUAL FIRE ALARM PULL STATION (ON THE EGRESS SIDE).

R39 PULL-BAR & PUSH-PLATE.

R40 POWER SUPPLY BOX.

R41 PUSH TO RELEASE BUTTON (ON EGRESS / EXIT SIDE ONLY).

R42 *ELECTRONIC LOCK & HANDLE **(08 70 00)***.

LEGEND - DOOR & HARDWARE

SUFFIX "R"

LEGEND:

HARDWARE WIRING, CONDUITS AND CONNECTIONS:

TO BE INSTALLED BY GENERAL CONTRACTOR AS INDICATED OR NECESSARY.

ELECTRIFIED WIRING AND CONDUIT SYSTEM.

A — 12.5mm COPPER COMPRESSED AIR, TO TAP INTO BUILDING COMPRESSED AIR SYSTEM (IF APPLICABLE).

CONDUITS ONLY. TO BE REGROUPED AS NECESSARY.

SECURITY:

TO BE INSTALLED BY **UofO** INSTRUMENTATION TEAM (N.I.C.):

WIRING & CONNECTIONS.

R51 CONTROLLER BOX:
- TO BE STURDY, SPECIFICALLY TAILORED FOR ACCESS CONTROL SYSTEM, EQUIPPED WITH KEY-LOCK, AND TAMPER.
- TO BE INSTALLED ON SECURED SIDE (OPPOSITE TO CARD READER).
- TO BE DOUBLED, IF SECURED IN / OUT.
- MOUNTED JUST ABOVE CEILING HEIGHT, PREFERABLY HIDDEN IN CEILING SPACE, OR ON THE WALL HEIGHT 3.5m TO 4m AFF.
- TO HAVE SPACE TO HOUSE THE NECESSARY HARDWARE, PRE-DRILLED OR KNOCK-OUT HOLES FOR CABLE MANAGEMENT.
- SURFACE-MOUNTED OPTION WITH SECURE ANCHORING POINTS TO PREVENT UNAUTHORIZED REMOVAL.

R52 *CARD READER* TO BE INSTALLED IN WALL, WITH PLASTER RING ON, IN SECURED SIDE.
NOTE: TO BE INSTALLED ON BOTH SIDES, IF SECURED IN / OUT.

R53 DOOR CONTACT.

R61 1m FT6 WIRE COIL(S) C/W CLEAR LABELS IDENTIFYING DESTINATION OF EACH WIRE PAIR (LABEL: BLACK MARKER ON BEIGE MASKING TAPE). JUNCTION BOX & MULTIPLE COILS TO BE GROUPED TOGETHER IN ONE AREA, IN CEILING SPACE ABOVE DOOR ON PROTECTED SIDE, NEAR CARD READER CONTROLLER BOX WHERE POSSIBLE.

R62 WIRING TO BE AS INDICATED ON ILLUSTRATION AND BELOW:
A. 2 CONDUCTORS.
B. 2 CONDUCTORS 18 AWG STRANDED CABLE.
C. 2 X 4 CONDUCTORS.
D. 4 CONDUCTORS 22 AWG STRANDED SHIELDED CABLE.
E. 6 CONDUCTORS 22 AWG COPPER STANDARD SHIELDED CABLE.
F. 4 CONDUCTORS 22 AWG STRANDED SHIELDED CABLE.
G. 4 CONDUCTORS 24AWG STRANDED SHIELDED CABLE.

NOTES:

1. SEVERAL WIRING SHARING THE SAME ROUTING, CAN BE GATHERED IN THE SAME CONDUIT, WITH APPROPRIATE SIZE FITTING.
2. ALL SYSTEMS, COMPONENTS AND DIAGRAMS TO BE APPROVED BY **FACILITIES**.
3. WIRING AND CONDUITS TO BE PRIMARILY INSTALLED IN WALLS, UNLESS OBSTRUCTED BY TRANSOM PANELS, ACTIVE OR PASSIVE LEAVES, ETC.
4. ALL CABLES TO BE PLENUM RATED TYPE.
5. ALL HARDWARE ITEMS TO BE FIRE RATED, WHERE APPLICABLE.
6. REFER OTHER ELECTRICAL NOTES IN OTHER SECTION OF THIS DOCUMENT, AS APPLICABLE FOR WIRING, CONNECTIONS & CONDUITS.

LEGEND - EXTERIOR ENVELOPE

SUFFIX "V"

LEGEND:

FLASHING, MOLDING & PANELS:

V01 *METAL OR ALUMINUM FLASHING & CLOSURES, PREPAINTED* ***(07 40 00)*** TO BE CONTINUOUS WITH SAME TYPE CLEATS & CONCEALED FASTENERS, IF NECESSARY.

V02 *PANELS, TRIMS, SILLS OR CLOSURES IN ALUMINUM* ***(08 40 00)***, TO BE FASTENED WITH CONCEALED CLIPS, SAME FINISHES TO ADJACENT WINDOW OR CURTAIN WALL ELEMENTS.

V03 ALUMINUM SILLS, TO BE SLOPED 10% TO THE EXTERIOR, WITH CONCEALED CLIPS AND SIMILAR FINISHES TO ADJACENT WINDOW OR CURTAIN WALL ELEMENTS.

V04 FLASHING, SILLS, AND RELATED MEMBRANES, TO BE UPTURNED TO THE SIDES (END DAM) FOR AN AVERAGE OF 100mm HIGH.

REINFORCEMENT:

TO BE INSTALLED AS INDICATED OR NECESSARY:

V11 SUPPORT FOR CURTAIN WALL COMPONENTS, OR OTHER SIMILAR, AS NECESSARY.

V12 RESERVED.

V13 RESERVED.

V14 300mm DEEP *LIGHT WEIGHT CONCRETE BOARD* ***(05 45 00)***, SAME THICKNESS AS ADJACENT DESCRIBED BOARD ON THE ROOF PERIMETER OF STEEL DECK, AROUND OPENINGS AND UNDER ALL CURBS OR ACCESSORIES.

V15 SLOT CONNECTION TO ACCOmmODATE STRUCTURAL DEFLECTION, GENERALLY AT EVERY FLOOR LEVEL. APPLIED MATERIAL TO TAKE IN CONSIDERATION ITS COMPRESSIBLE PERCENTAGE FACTOR .

V16 *GALVANIZED STEEL SUB-GIRT SYSTEM FOR WALLS* ***(07 40 00)***, SAME GAUGE AS FOR THE RELATED WALL SYSTEM.

V17 *PLYWOOD PANEL, PRESSURE TREATED, WATER-RESISTANT* ***(07 50 00)***, THICKNESS AS NECESSARY.

V18 S.S. COLLAR AND CLAMP, ON ALL OPEN END MEMBRANES, OR SIMILAR CONNECTIONS.

COMPARTMENTALIZATION:

V21 *COMPARTMENTALIZATION DIVIDERS* ***(04 80 00)*** WITH APPROPRIATE DIMENSIONS AND *THERMAL BREAKS* ***(07 40 00)***, TO BE APPLIED VERTICALLY @ CONTROL JOINTS ADJACENT TO CHANGE IN DIRECTION IN WALL (±1000mm FROM BUILDING CORNERS) FOR WIND COMPARTMENTALIZATION IN THE BRICK VENEER CLADDING.

V22 *POLYETHYLENE FOAM EVA CLOSURE BLOCKING* ***(07 40 00)*** WITH APPROPRIATE DIMENSIONS, FOR WIND COMPARTMENTALIZATION IN THE METAL OR PANEL CLADDING SYSTEM, TO BE APPLIED VERTICALLY @ 9000mm C/C MAX. (±1000mm FROM BUILDING EDGE), INSERTED BETWEEN THE EXTERNAL INSULATION FACE AND THE EXTERNAL CLADDING.

LEGEND - EXTERIOR ENVELOPE

SUFFIX "V"

CURTAIN WALL:

V31 THE CAVITIES BETWEEN CURTAIN WALL MULLIONS AND ADJACENT WALLS, OR CAVITIES BEHIND PARAPETS, NOT TO BE OBSTRUCTED OR FILLED WITH INSULATION (TO INSURE WARM AIR CIRCULATION).

V32 TRANSITION MEMBRANES BETWEEN MULLIONS' THROATS AND ADJACENT WALLS TO BE ADHERED, SEALED AND MECHANICALLY FASTENED. MULLION'S VERTICAL LIP SHALL BE CUT IF INTERFERING.

V33 PVC OR ALUMINUM CLOSURES TO BE INSTALLED AT TOP OR BOTTOM EDGES OF VERTICAL MULLIONS AND CAPS, IF EXPOSED, OR TO SUPPORT MEMBRANES.

V34 *MINERAL FIBRE SEMI-RIGID BOARD INSULATION FOR CURTAIN WALL **(70 20 00)*** (100mm LONG MIN.) TO BE INSTALLED ON PERIMETER OF SPANDREL PANEL CAVITIES, WITH DRIP HOLES 25mm THAT MATCHES THE PRESSURE PLATES, AS NECESSARY.

V35 VERTICAL MULLIONS TO BE EXTENDED AS NECESSARY TO SUIT DIFFERENT CONSTRUCTION AND SUPPORT CONDITIONS.

V36 HORIZONTAL MULLION'S CAPS & PRESSURE PLATES TO INCLUDE DRAINAGE WITH VENT & WIPE HOLES SLOTS

COMPATIBILITY:

V41 NON-COMPATIBLE MATERIALS EDM, PVC, TPO, ASPHALT OR BITUMINOUS MATERIALS TO BE SEPARATED USING FELT MEMBRANES, PREFINISHED METAL SHEETS OR OTHER SIMILAR FEATURES.

V42 JUNCTIONS OR INTERFACES OF DISSIMILAR METALS TO HAVE AN ELECTROLYTIC SEPARATION DEVICE OR APPROPRIATE MEMBRANE, TO PREVENT ELECTROLYTIC CORROSION AND METAL DEGRADATION.

WATERPROOF & SEALANTS:

TO BE INSTALLED AS INDICATED OR NECESSARY:

V51 *INTER CONNECTING AIR/VAPOR BARRIER MEMBRANE **(07 50 00)**,* OR DOUBLE LAYERS OF *VAPOR BARRIER MEMBRANE **(07 50 00)***.

V52 *EXPANSION JOINT WATERPROOF MEMBRANE **(07 50 00)*** OR *EXPANSION JOINT TRIM FOR ROOFING **(07 50 00)***.

V53 *THROUGH-WALL FLASHING MEMBRANE **(07 10 00)***, SELF ADHESIVE. TO BE DUPLICATED OVER IRREGULAR OR DENTED SHAPE SUPPORTS.
NOTE: IF LOCATED OVER SOFT INSULATION, A 26 GA. GALV. METAL SHEET SHALL BE INSTALLED UNDERNEATH FOR SUPPORT, FOLDED TO SUIT.

V54 *MODIFIED BITUMEN, AIR/VAPOUR BARRIER **(07 10 00)***.

V55 *SILICONE SEALANT TRANSITIONAL MEMBRANE **(07 10 00)***,
Or *MODIFIED BITUMEN, AIR/VAPOUR BARRIER **(07 10 00)***, SELF-ADHESIVE, OVER:
- 26 GA. GALV. METAL SHEET BENT AND FOLDED TO SUIT,
- Or *BACKER ROD **(07 90 00)***, WHENEVER POSSIBLE,
- Or INVERTED *MODIFIED BITUMEN MEMBRANE* STRIP, LOOPED TO SUIT.

V56 ROOF *VAPOR BARRIER MEMBRANE **(07 50 00)***, OR *MODIFIED BITUMEN BASE-PLY FLASHING MEMBRANE **(07 50 00)*** UPTURNED AGAINST PARAPET FRAMING.

V57 EXTERIOR *SEALANT* + *BACKER ROD **(07 90 00)*** (BACKER ROD ONLY FOR ALL GAPS EXCEEDING 3mm).

V58 *CROSS-LINKED BUTYL PREFORMED SEALANT **(07 40 00)*** AT CONNECTION BETWEEN METAL LINERS AND SUB-GIRTS.

V59 *CHEMICAL CURB SYSTEM **(07 40 00)*** AT ROOF PENETRATIONS.

V59a *LIQUID FLASHING MEMBRANE **(07 40 00)*** FOR DIFFICULT TO ADHERE SITUATIONS.

LEGEND - EXTERIOR ENVELOPE

SUFFIX "V"

INSULATION:

TO BE INSTALLED AS INDICATED OR NECESSARY:

V61 *POLYURETHANE FOAM ADHESIVE SEALANT* ***(07 20 00)*** INSULATION, LOW DENSITY.

V62 *BATT* OR *SEMI-RIGID INSULATION* ***(07 20 00)***, FLEXIBLE.

V63 *EXTRUDED EXPANDED POLYSTYRENE BOARD INSULATION* ***(07 20 00)***, LAMINATED TO PRE-PAINTED ALUMINUM SHEET, IF EXPOSED.

V64 *SPRAYED OR INJECTED POLYURETHANE INSULATION, PORTABLE SYSTEM* ***(07 20 00)***.

V65 SAME INSULATION TYPE AS ADJACENT.

V66 *HIGH THERMAL RESISTANCE BLANKET* ***(07 20 00)***, IN TIGHT SPACES, TO ENSURE THE CONTINUITY OF INSULATION.

V67 *SPRAYED POLYURETHANE INSULATION* ***(07 20 00)***,
NOTE: TO BE PROTECTED WITH FIRE BARRIER AS PER **OBC**, IF EXPOSED FROM INSIDE.

DRAINAGE & VENTS:

TO BE INSTALLED AS INDICATED OR NECESSARY:

V71 *PREFABRICATED (RECTANGULAR) WEEP HOLES* ***(04 80 00)*** IN MASONRY CLADDING, OR *TUBE VENTS* ***(03 45 00)*** IN CONCRETE SILLS @ 600mm O/C AND A CONTINUOUS MORTAR MESH CONTROL IN THE BACK CAVITY.

V72 PREFABRICATED *WEEP VENTS* ***(04 80 00)*** AT MASONRY CLADDING, TOP @ 600mm O/C.

V73 CONTINUOUS DRAINAGE SPACE (@ 6mm to 8mm OR AS INDICATED) BETWEEN THE BOTTOM OF THE PANELS AND THE METAL FLASHING.

V74 WEEP HOLES WITH APPROPRIATE DIMENSION (6mm MIN. @ 600mm O/C OR AS INDICATED) FOR THE PREFABRICATED ALUMINUM OR SIMILAR CLADDING.

V75 CONTINUOUS *INSECT SCREEN* ***(07 40 00)*** VENT STRIP (PERFORATED MESH) , WHENEVER GAPS EXCEED 4mm.

V76 CONTINUOUS GROOVE GUTTER STRIP.

LEGEND - EXTERIOR ENVELOPE

XXX

TYPICAL ASSEMBLIES:

FOR DETAILED INFORMATION, REFER TO "**VOLUME I - BUILDING ENVELOPE"** SECTION.

CURTAIN WALL & SKYLIGHTS:

- C01
- C02
- C03
- C04

FOUNDATION WALLS:

- F01
- F02

PARAPETS:

- P01
- P02
- P03

ROOFS:

- R01
- R02
- R03
- R04
- R05

SOFFITS:

- S01

EXTERIOR WALLS:

- W01
- W02
- W03
- W04
- W10

LEGEND - MECHANICAL / ELECTRICAL / CONTROL

SUFFIX (Y)

LEGEND:

MECHANICAL:

TO BE INSTALLED AS INDICATED OR NECESSARY:

(Y01) MECHANICAL CONDUITS, TO BE PROPERLY FINISHED IF EXPOSED IN OCCUPIED SPACES.

(Y02) *EYE WASH* ***(22 42 01)***:
- FRONT MOUNT (WITHOUT INTERFERENCE WITH EQUIPMENTS.
- BACK MOUNT (WITHOUT INTERFERENCE WITH *DRYING RACKS*).

(Y03) *WATER FAUCET* ***(22 42 01)***, TO TAKE INTO CONSIDERATIONS ACCESSIBILITY PARAMETERS.

(Y04) *SINKS* ***(22 42 01)***, TO TAKE INTO CONSIDERATIONS ACCESSIBILITY PARAMETERS.

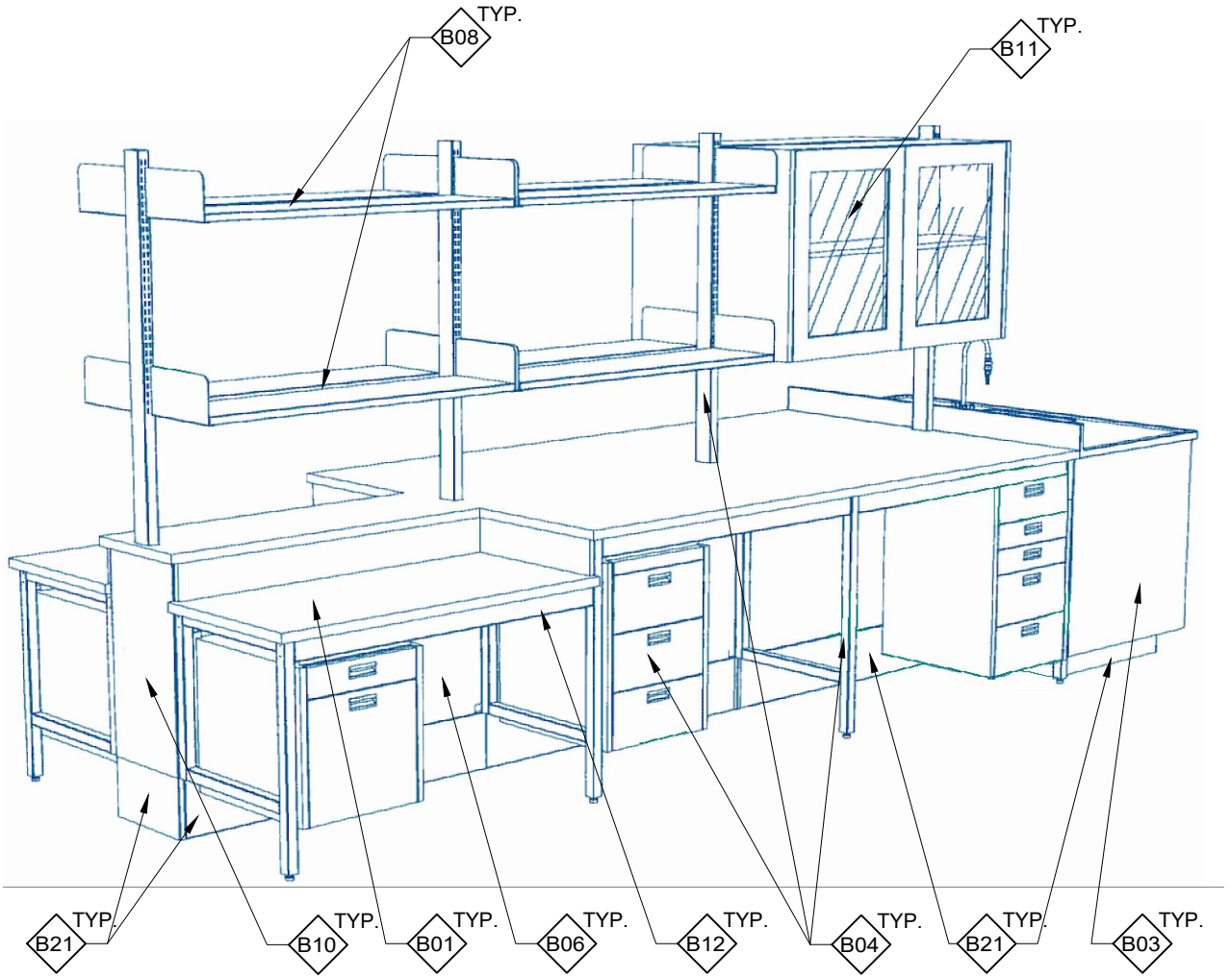
ELECTRICAL:

TO BE INSTALLED AS INDICATED OR NECESSARY:

(Y20) *TASK LIGHTS* ***(26 50 00)***.

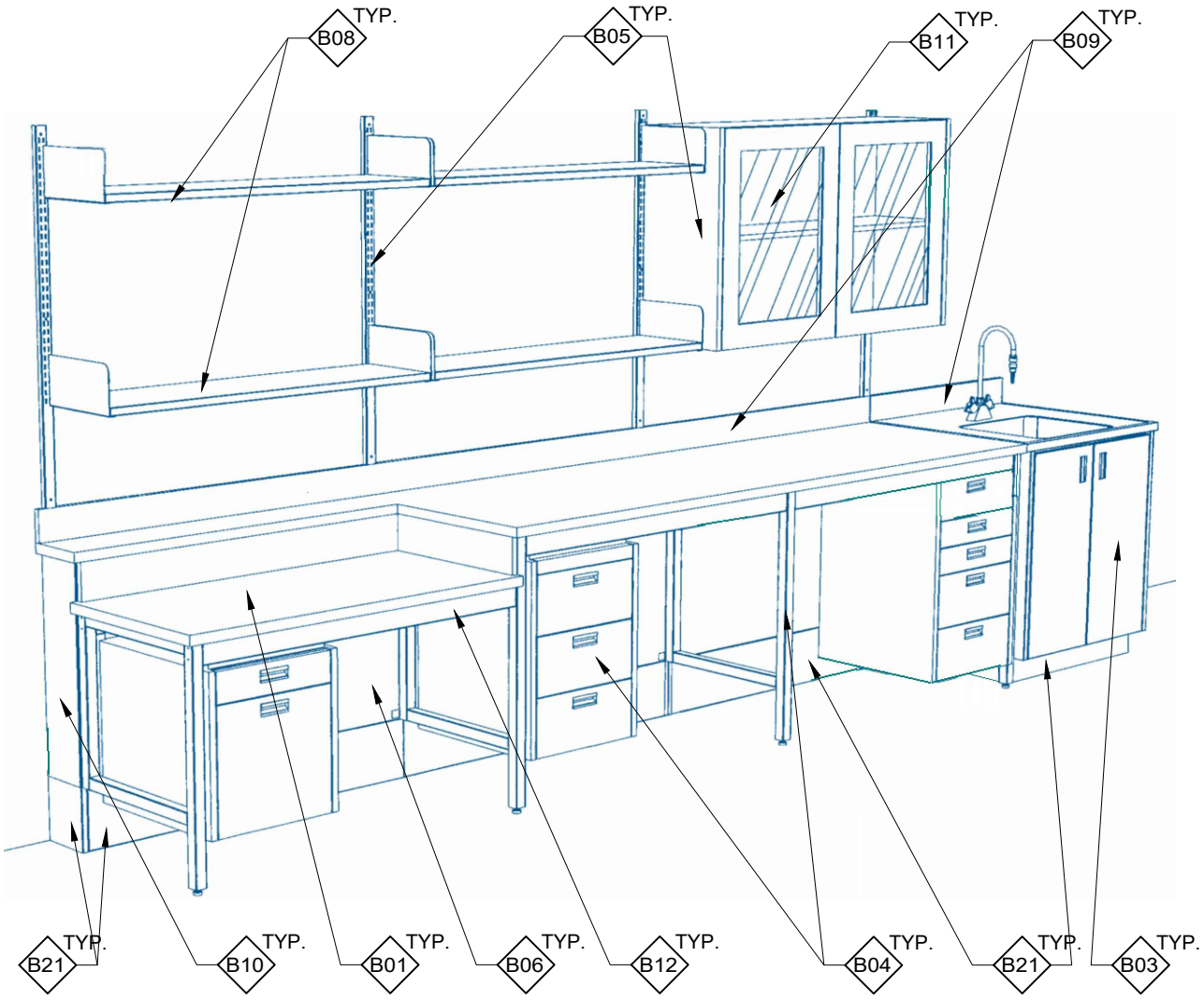
(Y21) *ELECTRICAL MONUMENT* ***(26 00 00)***, TO BE INSTALLED ON COUNTERTOPS WHERE WALL RACEWAY WOULD BE DIFFICULT OR UNNECESSARY.

(Y22) ELECTRICAL AND OTHER SUSPENDED FEEDINGS AND PLATES.



*THE SHOWN PERSPECTIVE IS A COURTESY FROM "BEDCOLAB INC.", AS EXAMPLE ILLUSTRATION ONLY, AND NOT LIMITED OR EXCLUSIVE TO ANY PARTICULAR MODEL OR MANUFACTURER.

A01
1
DB-010
FIXED COUNTERTOP - ISLAND UNITS*
PERSPECTIVE VIEW (TYPICAL)
SCALE: NTS



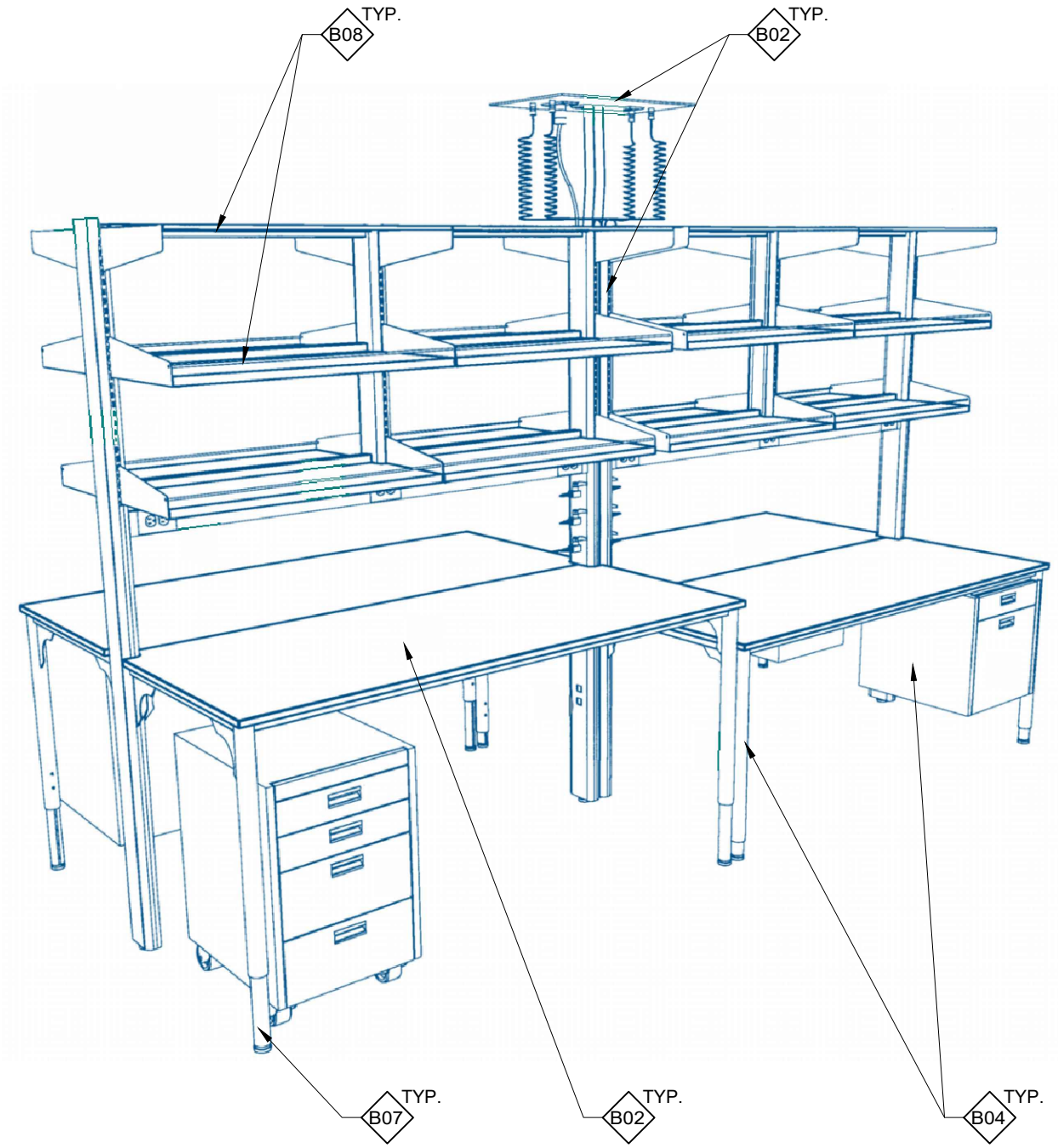
*THE SHOWN PERSPECTIVE IS A COURTESY FROM "BEDCOLAB INC.", AS EXAMPLE ILLUSTRATION ONLY, AND NOT LIMITED OR EXCLUSIVE TO ANY PARTICULAR MODEL OR MANUFACTURER.

A01

1 / DB-011 FIXED COUNTERTOP - WALL UNITS*
PERSPECTIVE VIEW (TYPICAL)

SCALE: NTS

A01
1
DB-012
FIXED COUNTERTOP
PICTURES (ARC Building)
SCALE: NTS

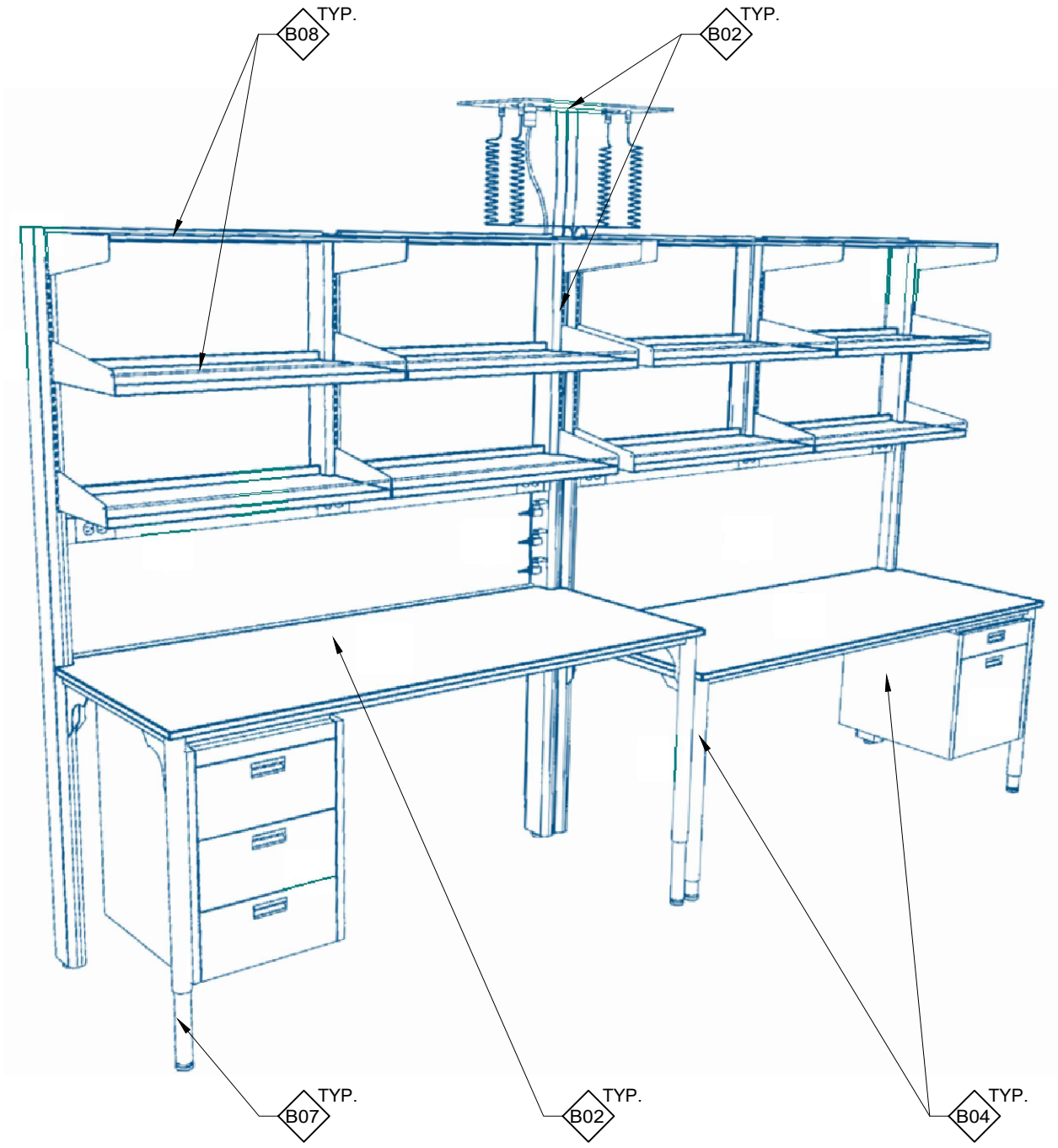


*THE SHOWN PERSPECTIVE IS A COURTESY FROM "BEDCOLAB INC.", AS EXAMPLE ILLUSTRATION ONLY, AND NOT LIMITED OR EXCLUSIVE TO ANY PARTICULAR MODEL OR MANUFACTURER.

A01
1
DB-013

MOBILE COUNTERTOP - ISLAND UNITS*
PERSPECTIVE VIEW (TYPICAL)

SCALE: NTS



*THE SHOWN PERSPECTIVE IS A COURTESY FROM "BEDCOLAB INC.", AS EXAMPLE ILLUSTRATION ONLY, AND NOT LIMITED OR EXCLUSIVE TO ANY PARTICULAR MODEL OR MANUFACTURER.

A01
1
DB-014

MOBILE COUNTERTOP - WALL UNITS*
PERSPECTIVE VIEW (TYPICAL)

SCALE: NTS

* THE SHOWN PICTURE IS A COURTESY FROM "MOTTLAB INC.", AS EXAMPLE ILLUSTRATION ONLY, AND NOT LIMITED OR EXCLUSIVE TO ANY PARTICULAR MODEL OR MANUFACTURER.

FROM ROGER GUINDON BUILDING:

A01
1
DB-015

MOBILE COUNTERTOP - ISLAND UNITS
PICTURES (RGN Building)

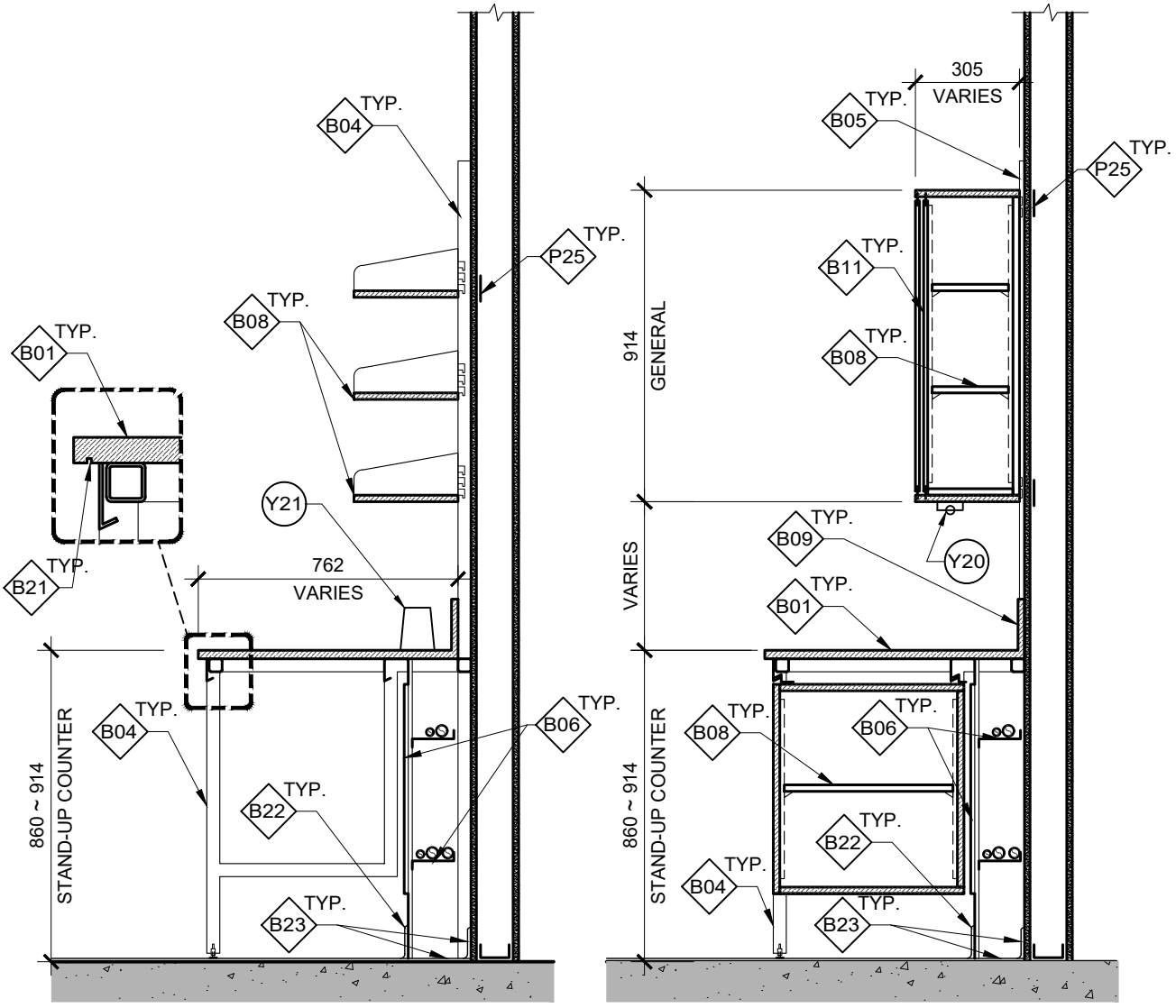
SCALE: NTS

A01

1
DB-016

MOBILE COUNTERTOP - WALL UNITS W/ FIXED ACCESSIBLE UNITS
PICTURES (STEM Building)

SCALE: NTS



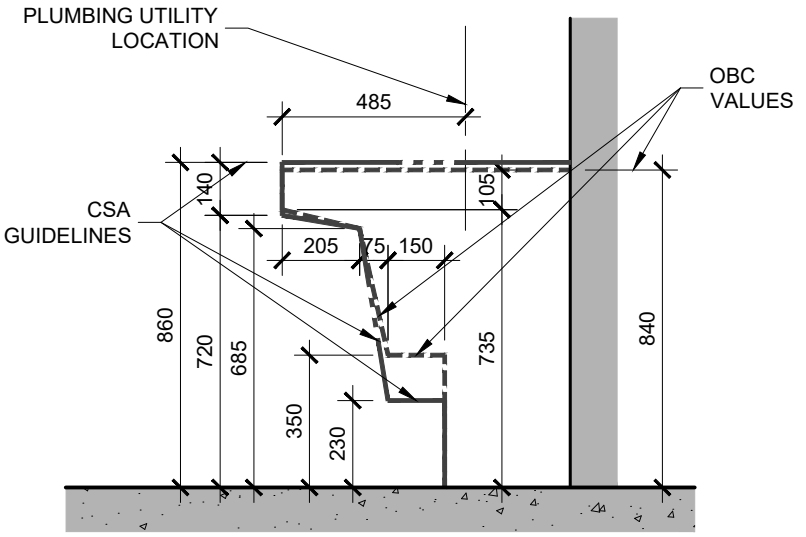
KNEE SPACE

SUSPENDED CABINET

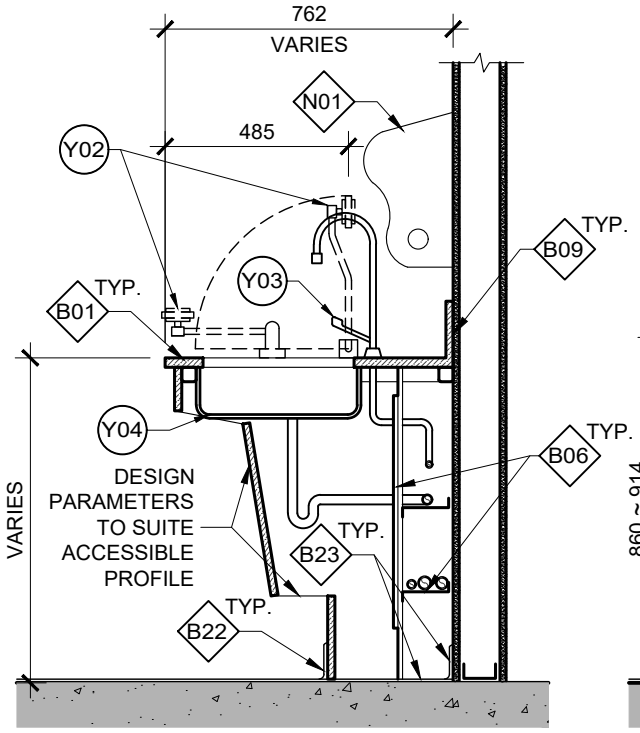
A01
1
DB-020

FIXED COUNTERTOP - WALL UNITS SECTION (TYPICAL)

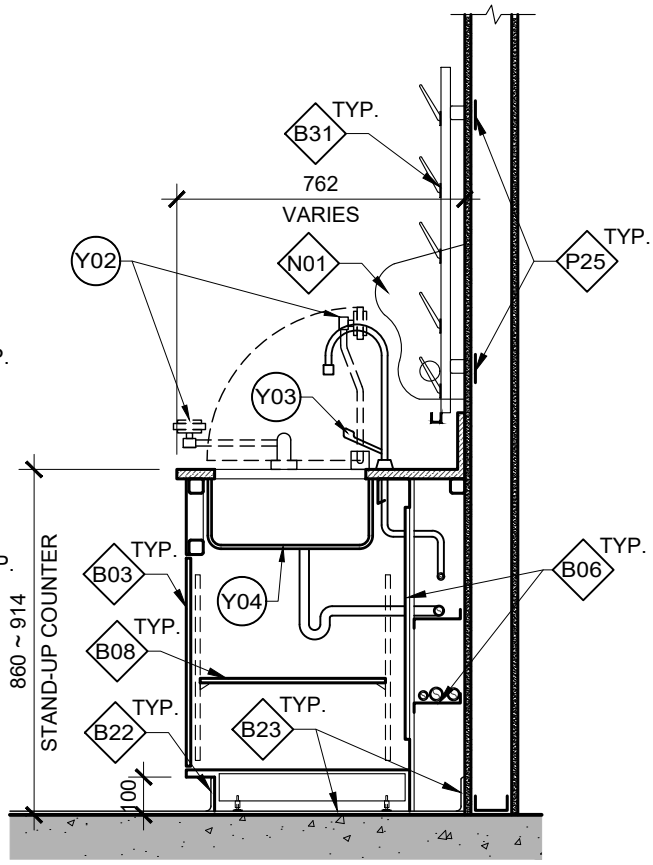
SCALE: 1:20



ACCESSIBLE DESIGN PARAMETERS

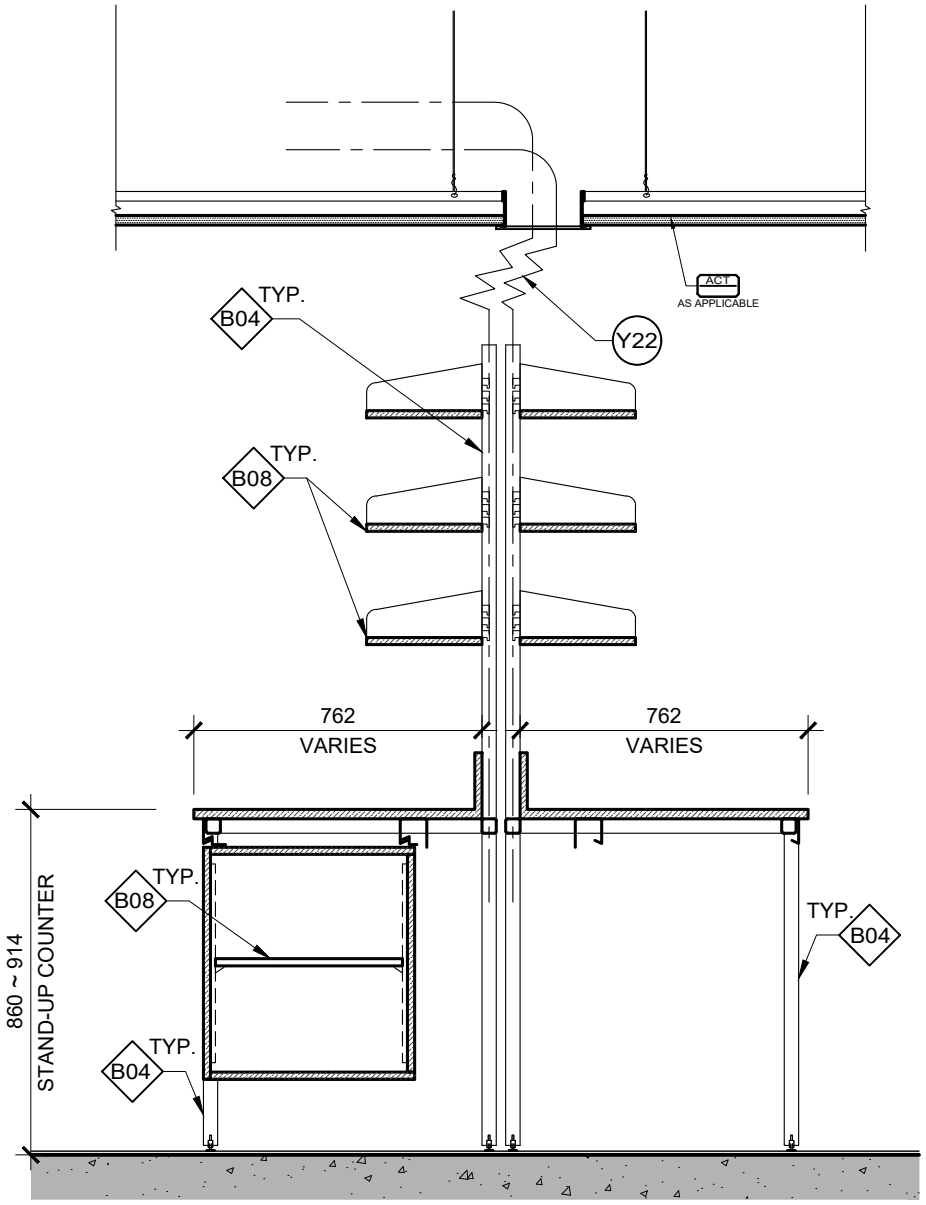


ACCESSIBLE FIXED UNIT

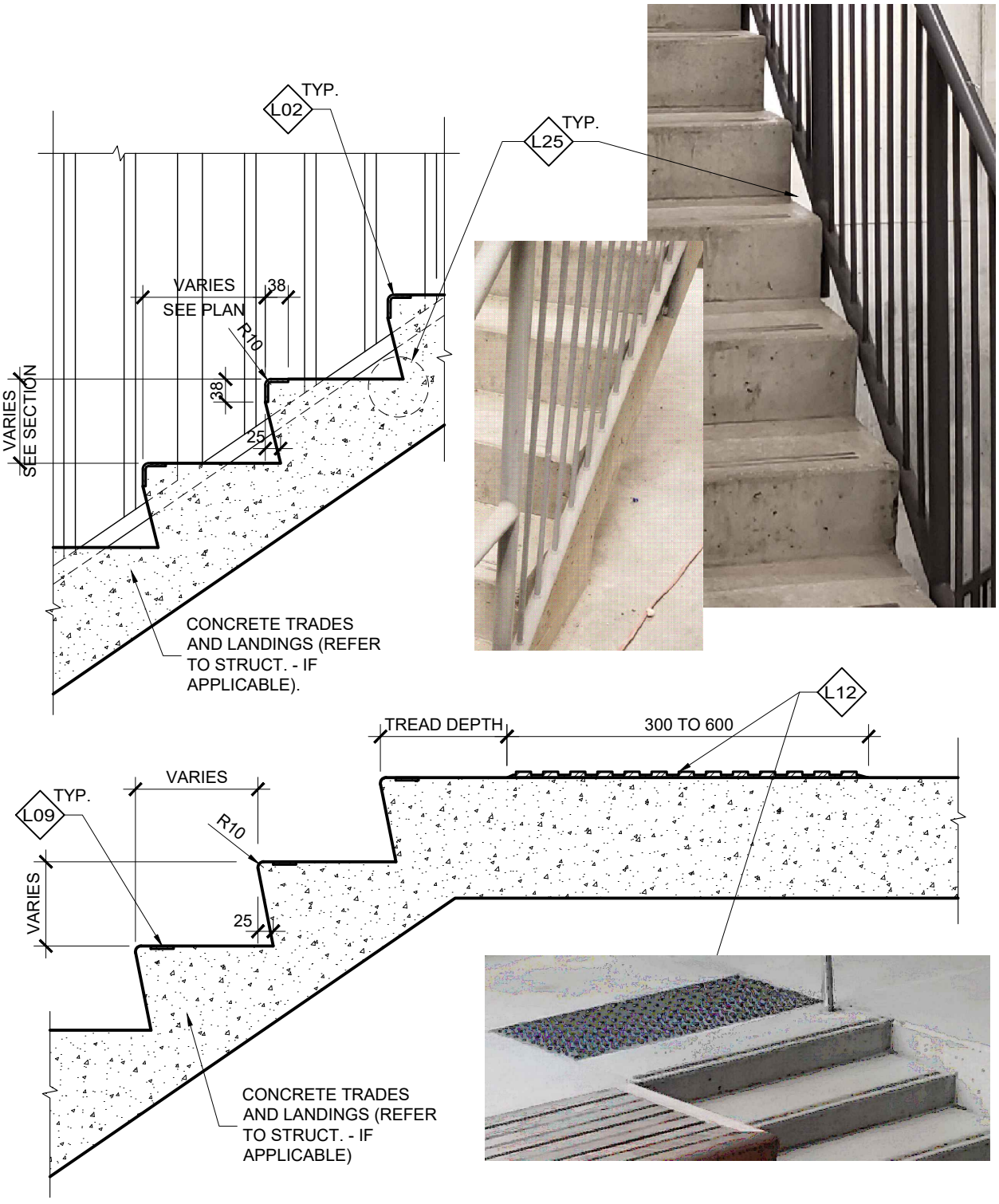


CONVENTIONAL FIXED UNIT

A01
1 / DB-021
COUNTER SINK UNIT SECTION DETAIL (TYPICAL)
SCALE: 1:20



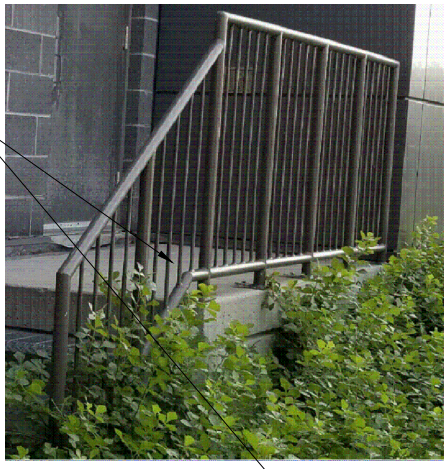
A01
1
DB-022
MOVABLE COUNTERTOP - ISLAND UNITS
SECTION (TYPICAL)
SCALE: 1:20

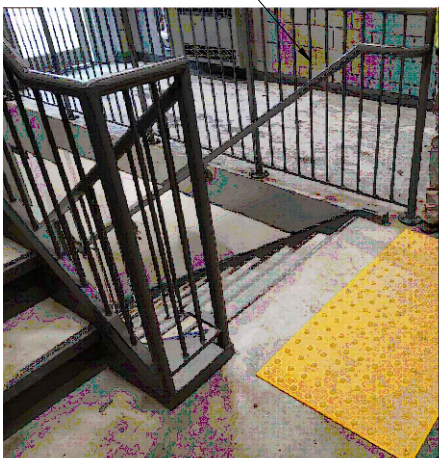


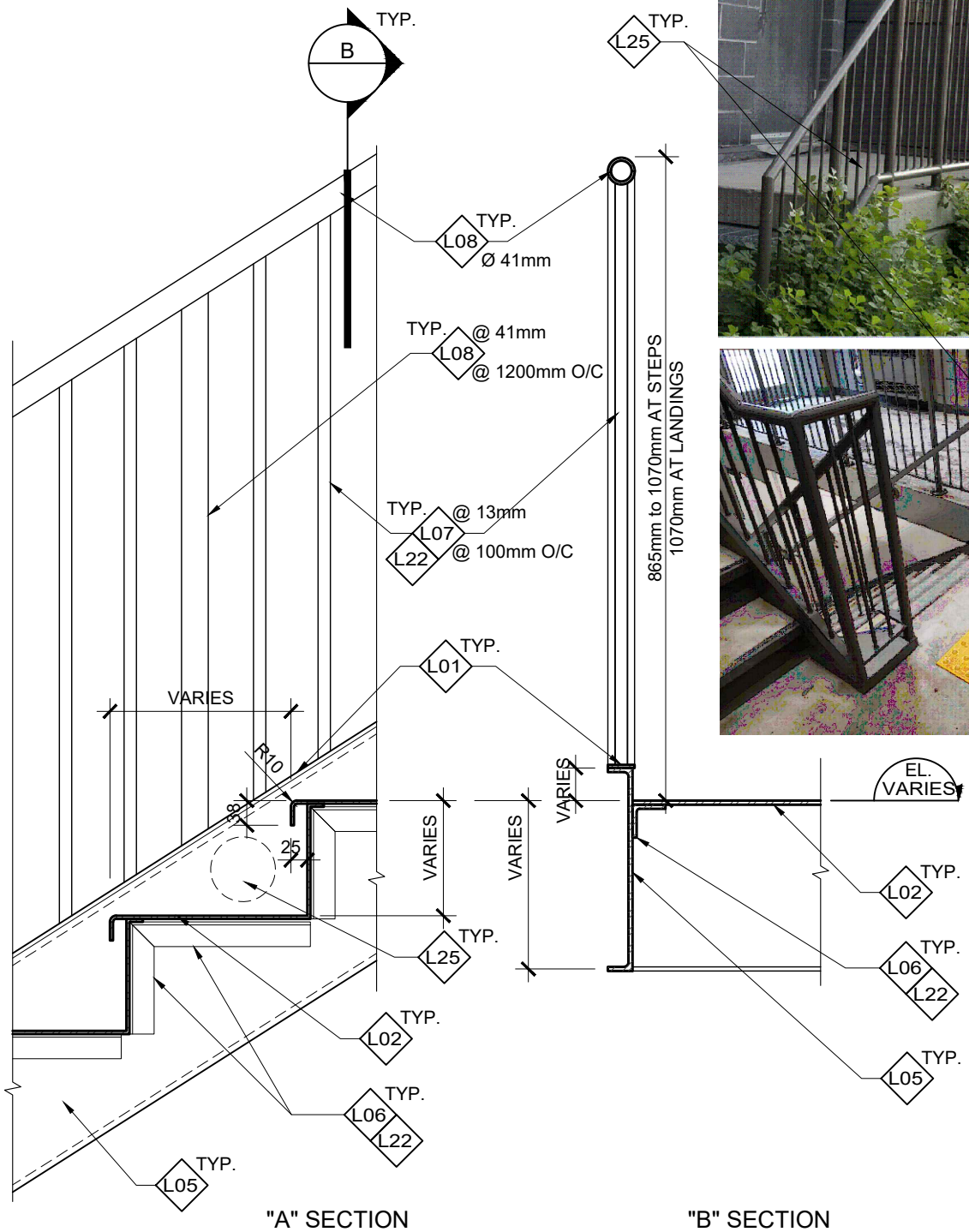
A01
1
DL-010

NON-IDUSTRIAL CONCRETE RISERS & HANDRAIL / BALUSTRADE SECTION DETAIL (TYPICAL)

SCALE: 1:10



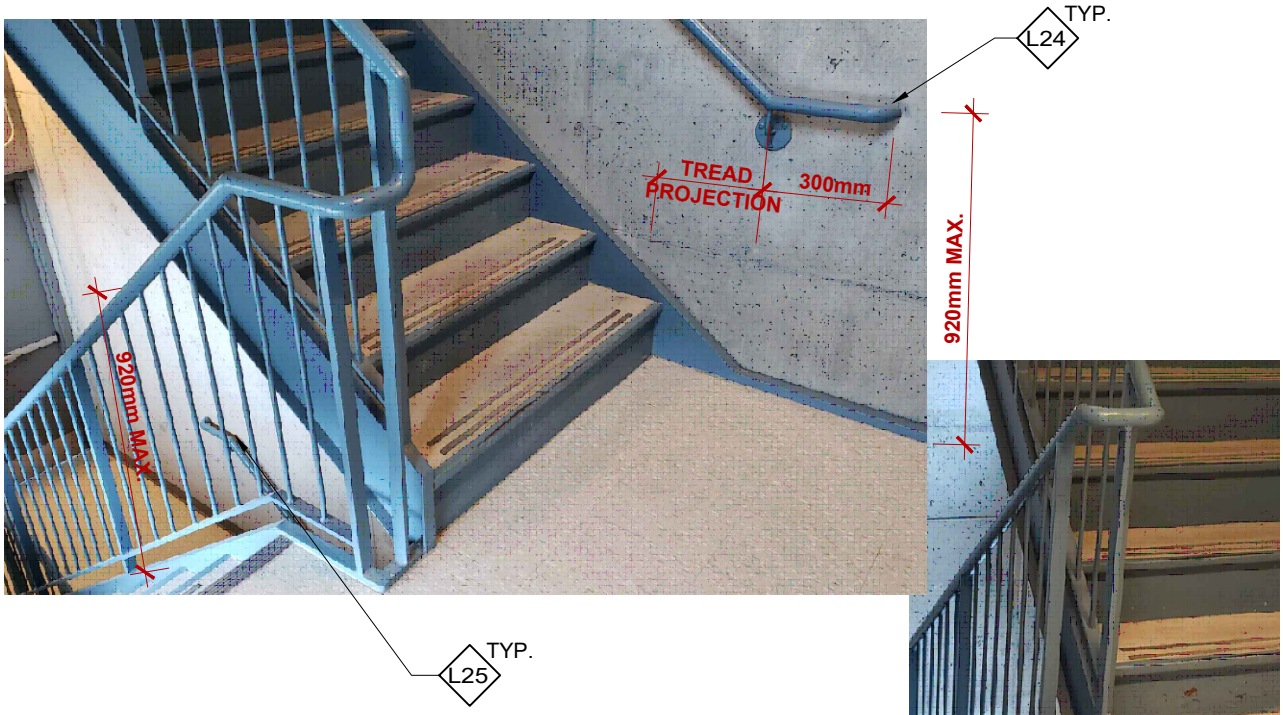


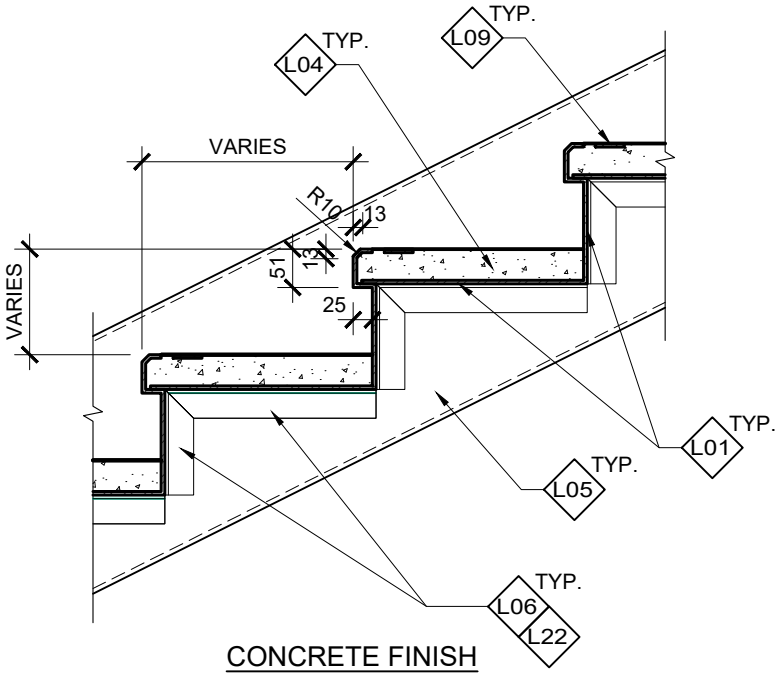


A01
1
DL-011

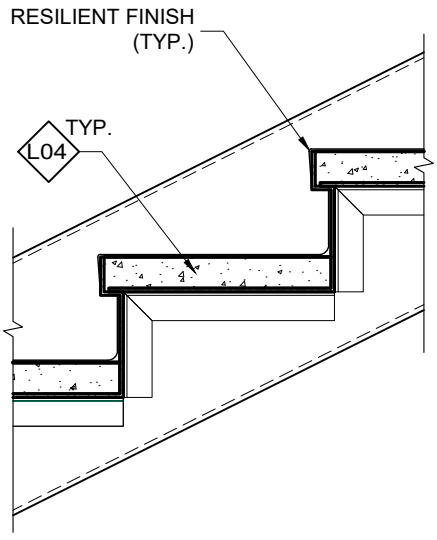
NON-INDUSTRIAL CLOSED RISER & HANDRAIL / BALUSTRADE SECTION DETAIL (TYP.)

SCALE: 1:10





CONCRETE FINISH

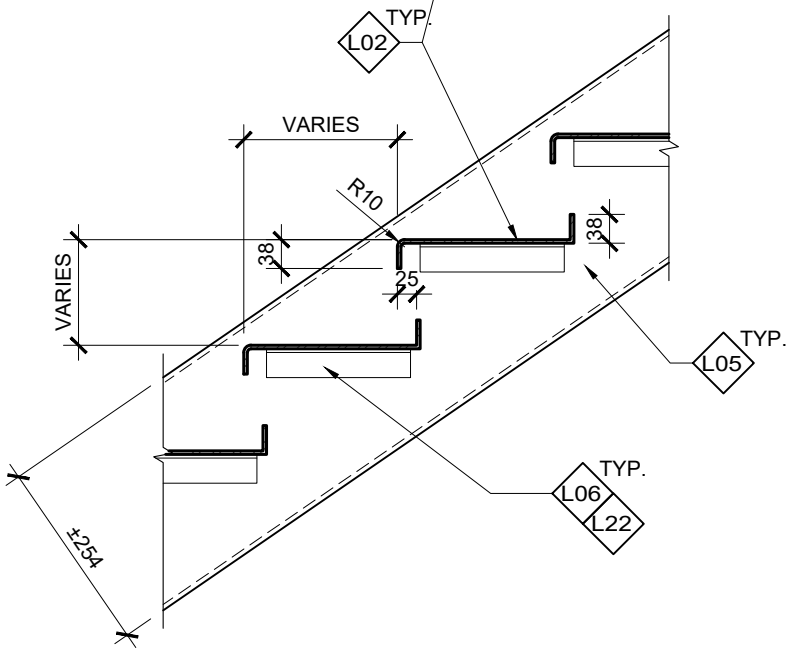


RESILIENT FINISH

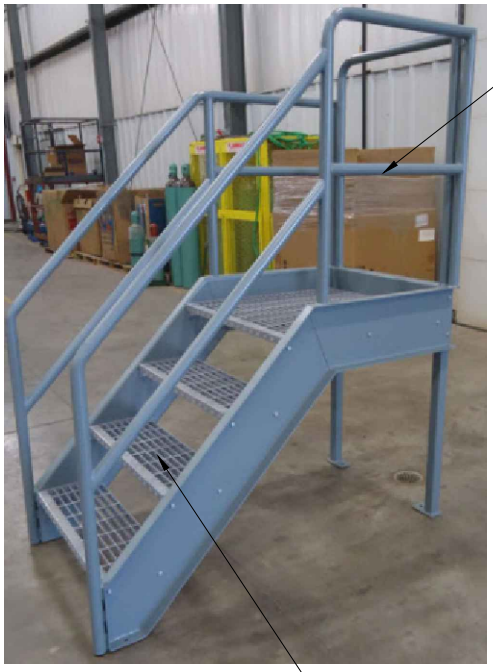
A01
1
DL-012

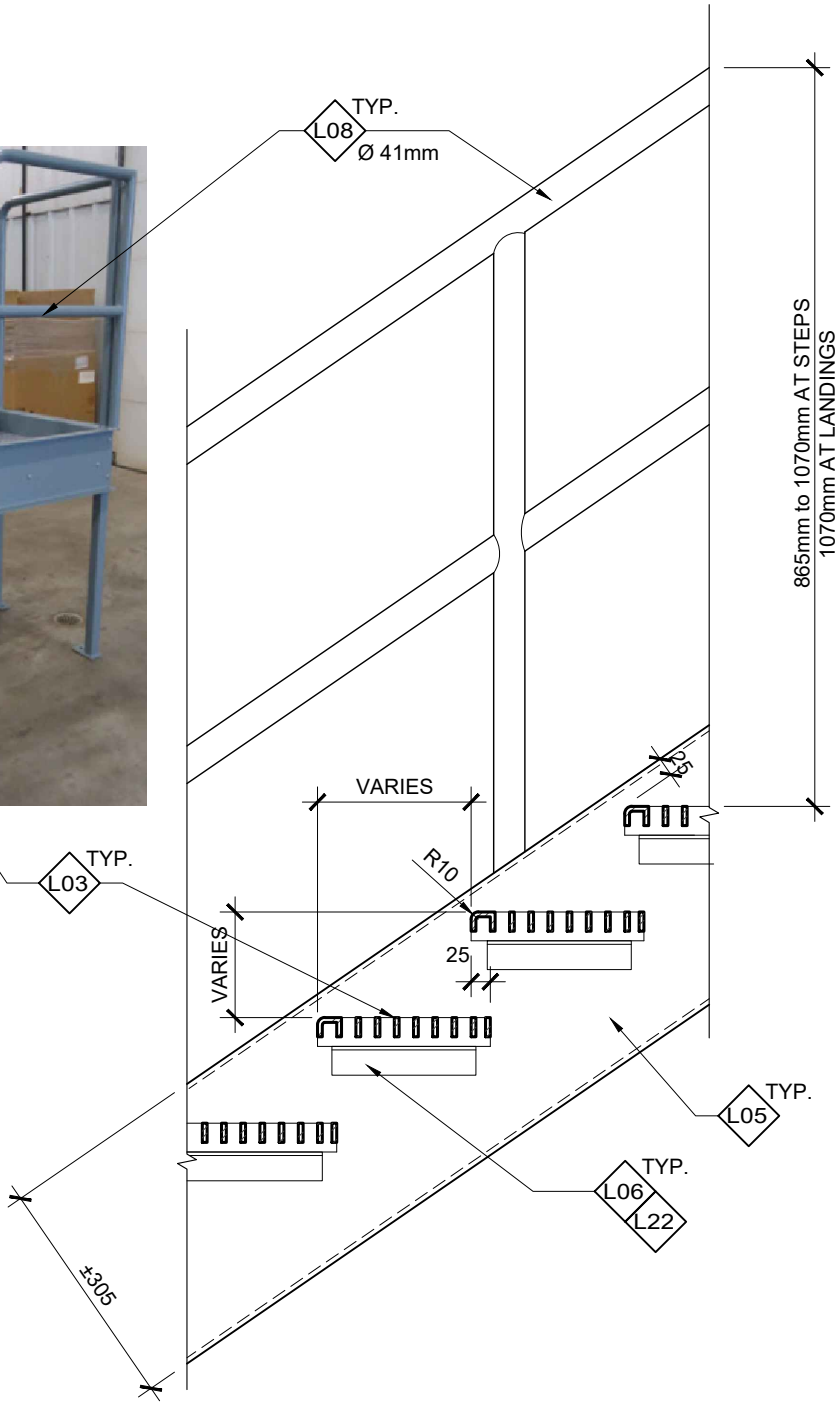
NON-INDUSTRIAL CLOSED RISERS & HANDRAIL / BALUSTRADE SECTION DETAIL (TYPICAL)

SCALE: 1:10

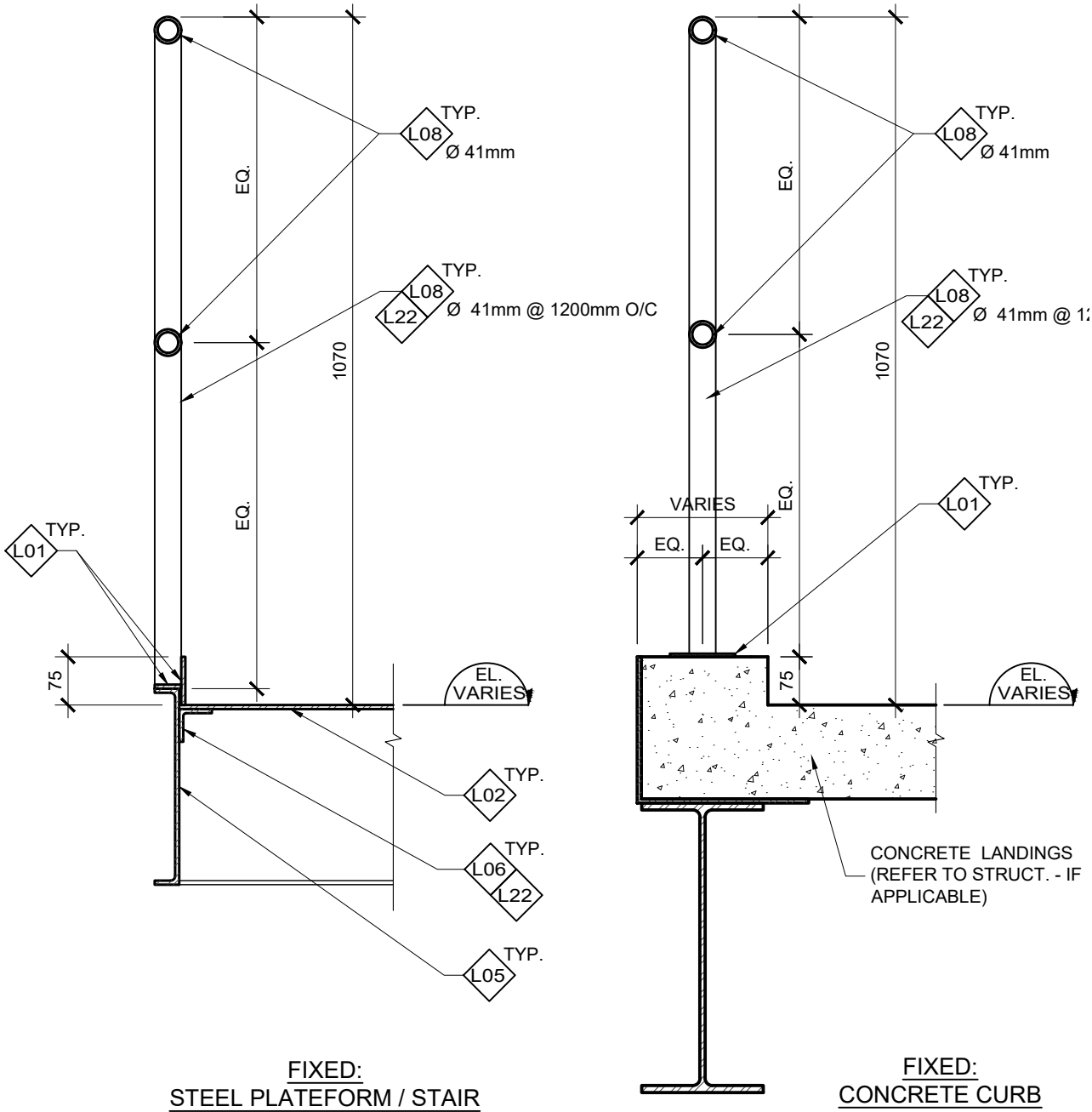


A01
1
DL-013
NON-INDUSTRIAL OPEN RISERS & HANDRAIL / BALUSTRADE
SECTION DETAIL (TYPICAL)
SCALE: 1:10





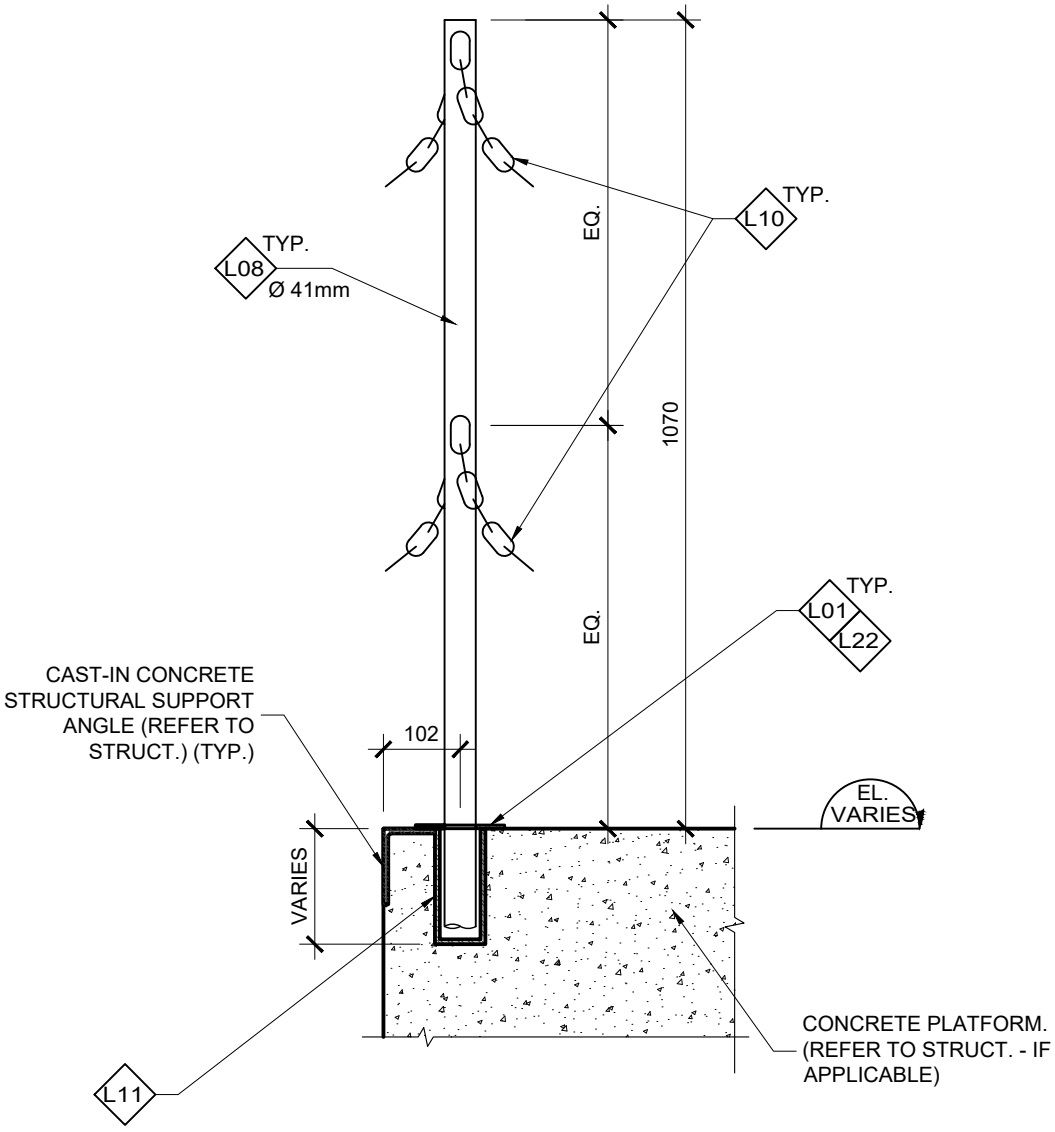
A01
1
DL-020
IDUSTRIAL FIXED BALUSTRADE
SECTION DETAIL (TYP.)
SCALE: 1:10



FIXED:
STEEL PLATEFORM / STAIR

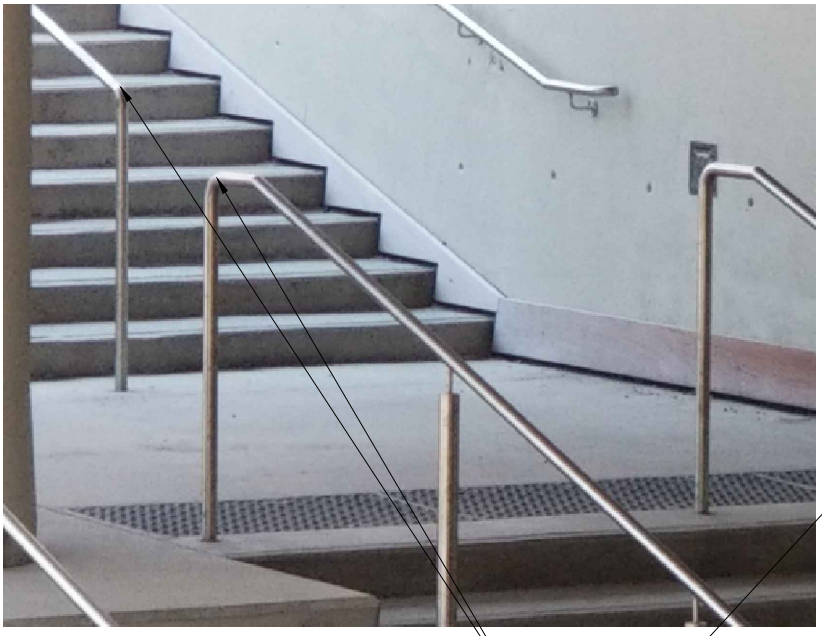
FIXED:
CONCRETE CURB

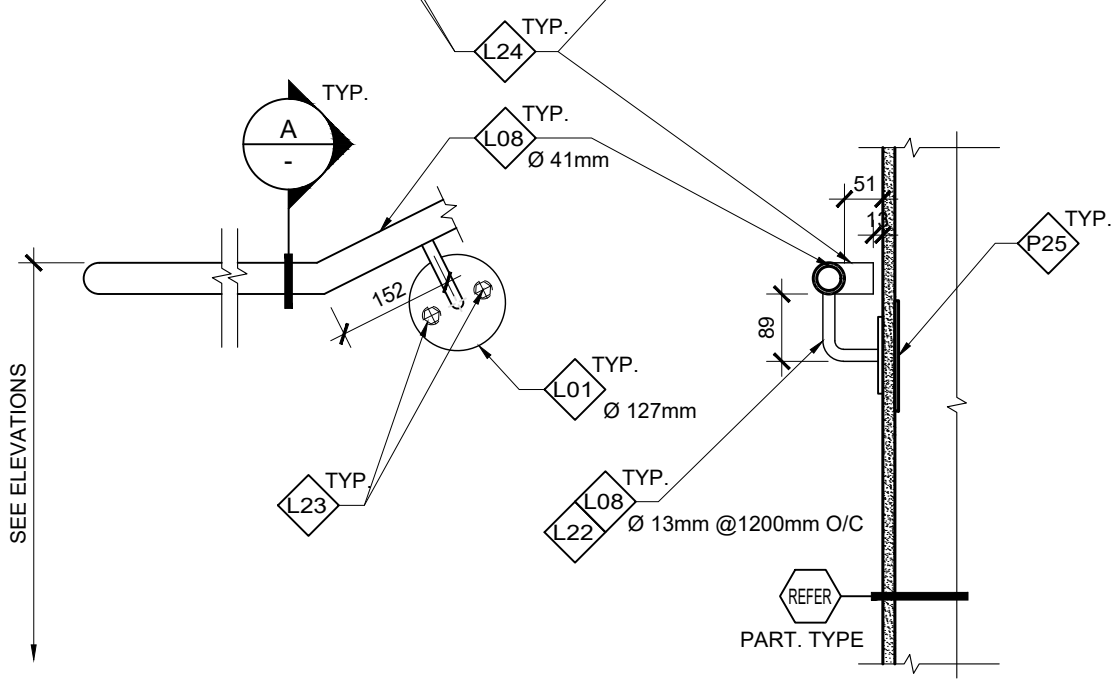
A01
1
DL-021
IDUSTRIAL FIXED BALUSTRADE
SECTION DETAIL (TYP.)
SCALE: 1:10



MOVABLE POST AND CHAIN:
CONCRETE CURB PLATFORM

A01
1
DL-022
INDUSTRIAL BALUSTRADE
SECTION DETAIL (TYP.)
SCALE: 1:10

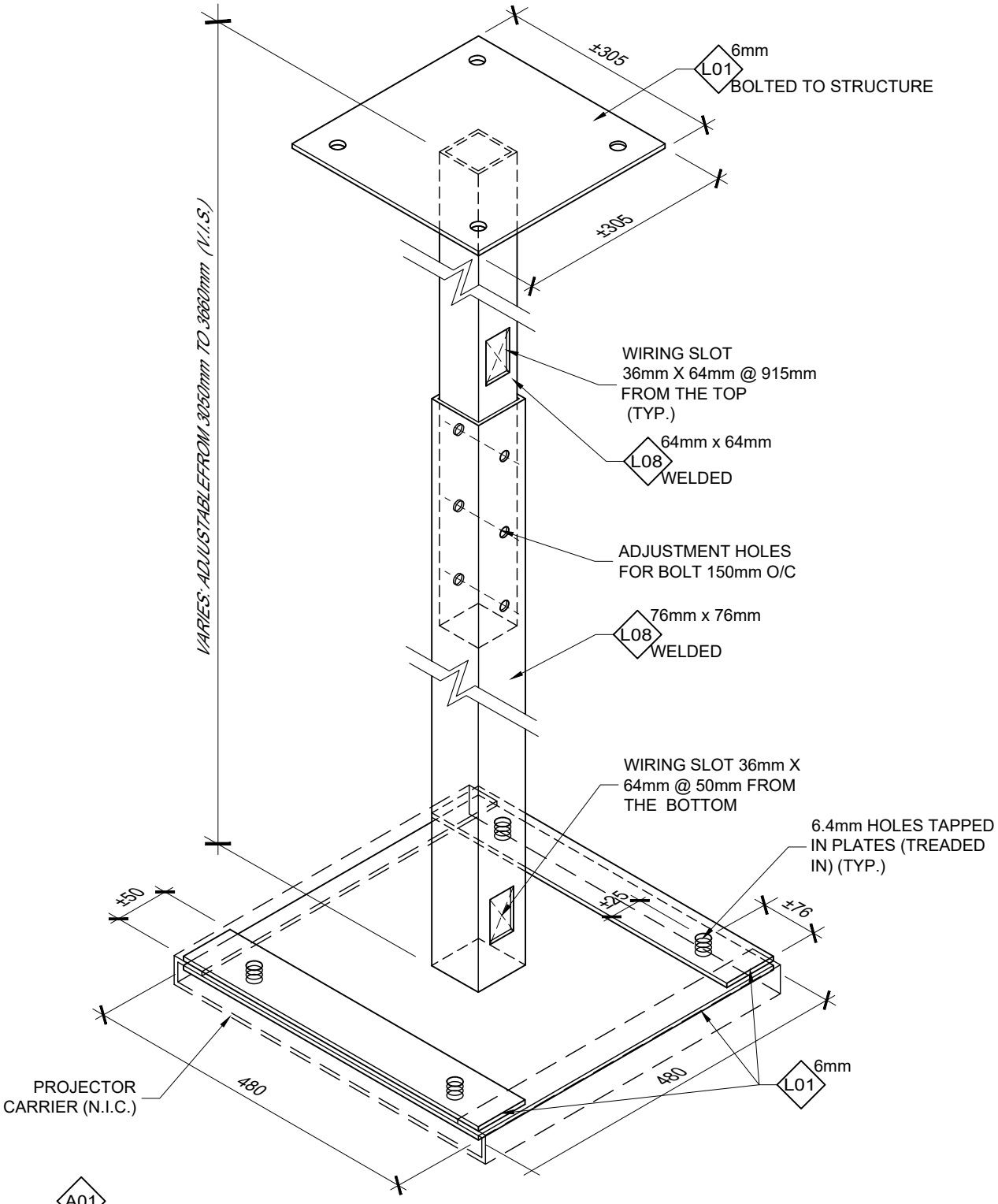




ELEVATION "B"

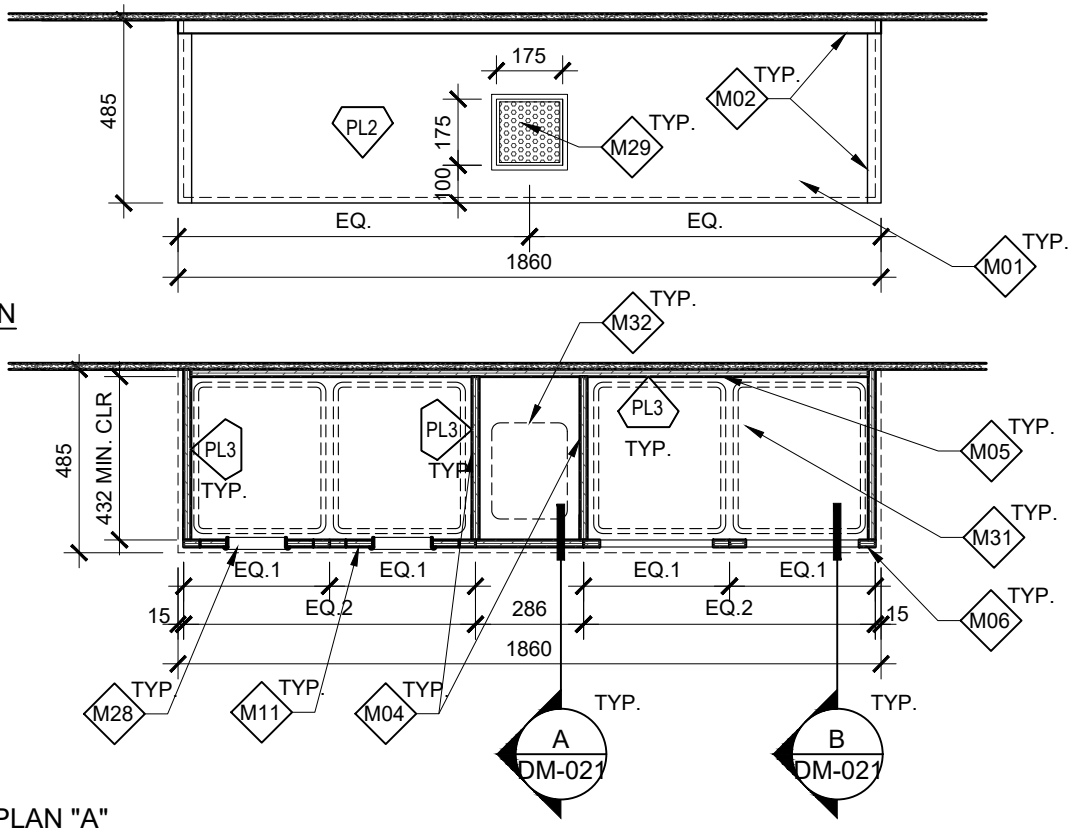
SECTION "A"

A01
1
DL-023
HANDRAILS
SECTION DETAIL (TYP.)
SCALE: 1:10



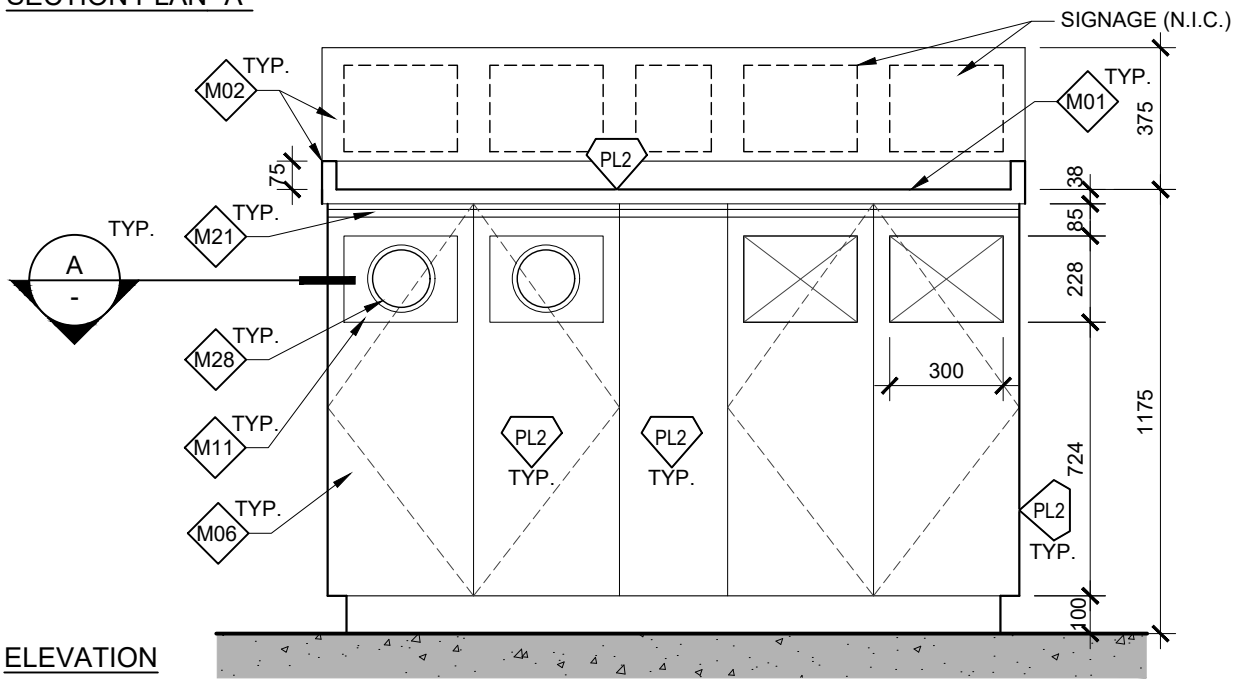
A01
1
DL-030
PROJECTOR SUPPORT BRACKET
ISOMETRIC DETAIL (TYP.)
SCALE: 1:10

A01
1
DM-010
WASTE RECYCLING STATION
PERSPECTIVE VIEW (TYPICAL)
SCALE: NTS



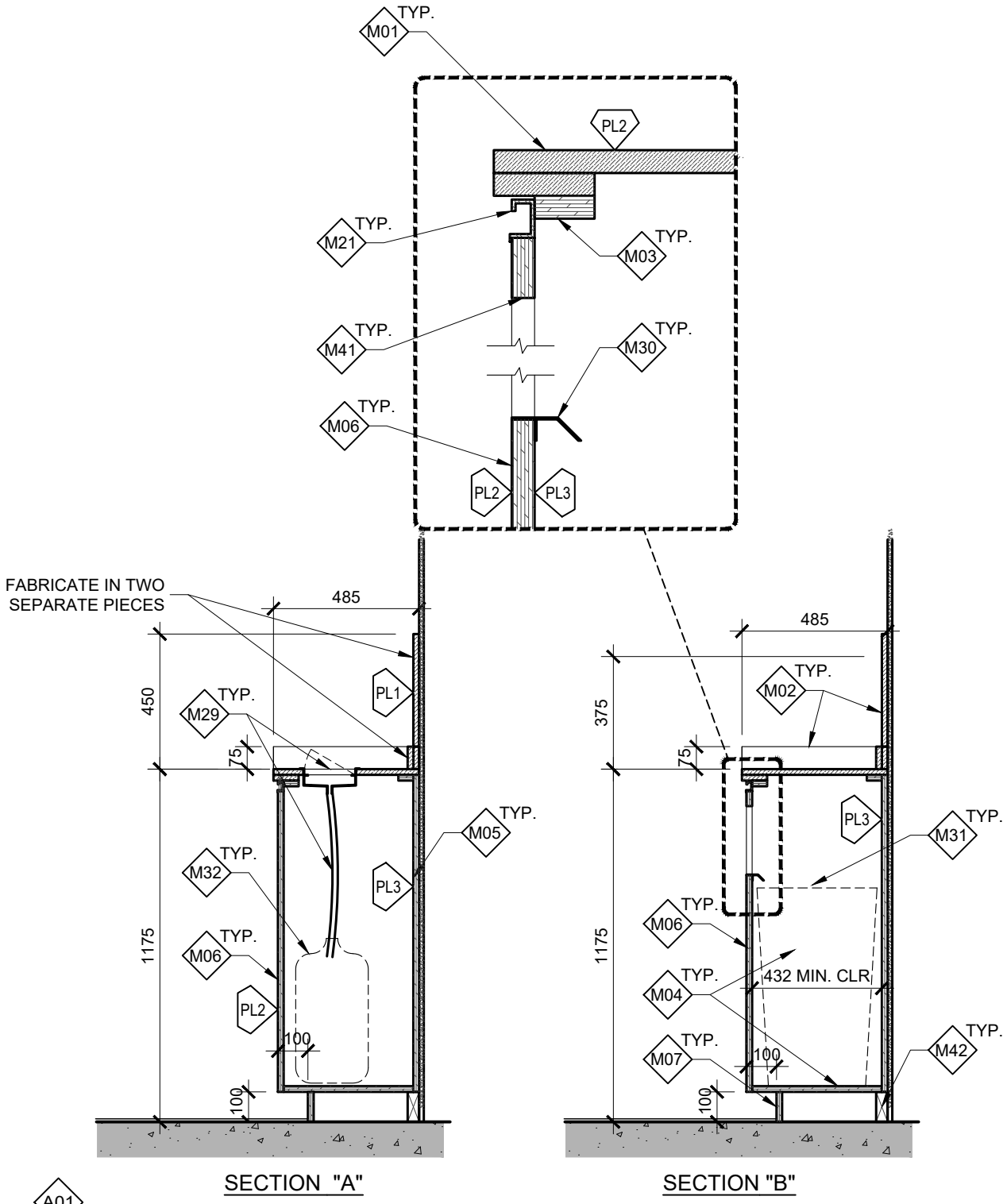
ELEVATION

SECTION PLAN "A"



ELEVATION

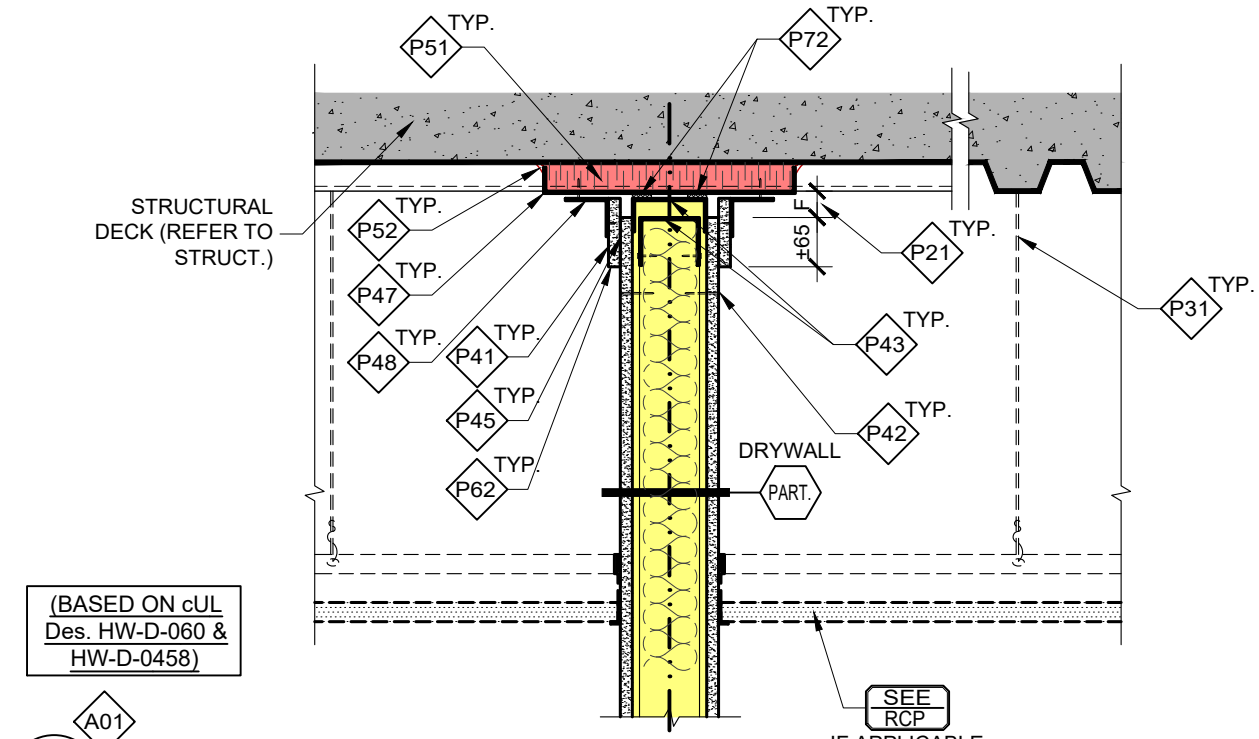
A01
1
DM-020
WASTE RECYCLING STATION
OVERALL VIEW (TYPICAL)
SCALE: 1:20



A01
1
DM-021

WASTE RECYCLING STATION SECTION DETAILS (TYPICAL)

SCALE: 1:20

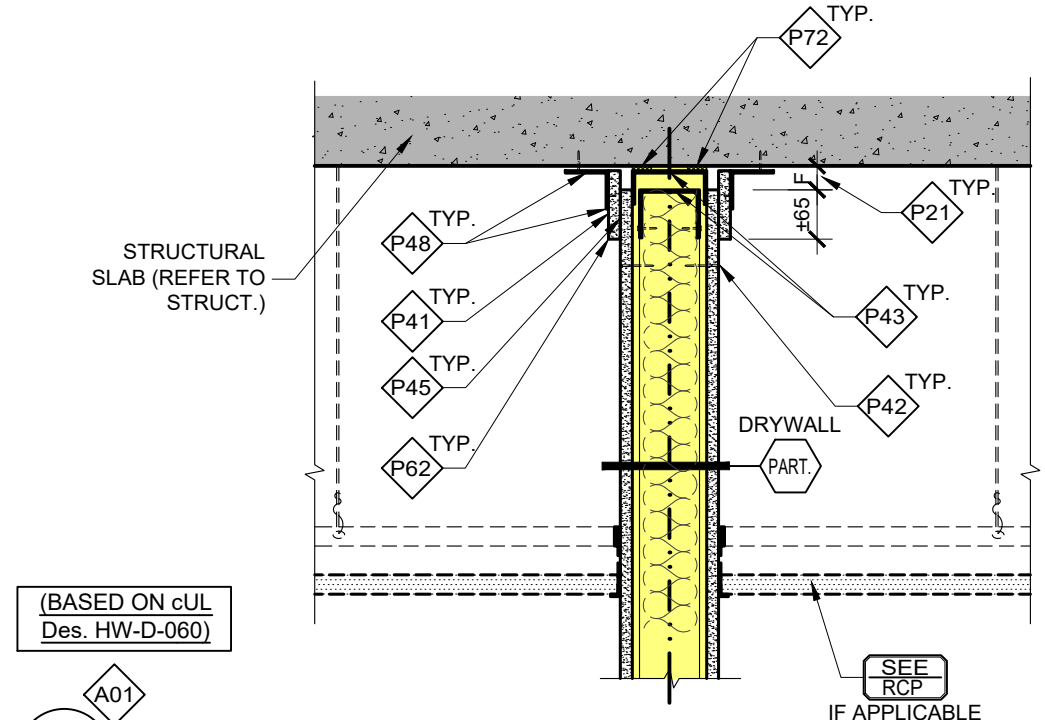


(BASED ON cUL Des. HW-D-060 & HW-D-0458)

A01
1
DP-010

FRR PARTITION HEAD - DRY WALL SECTION DETAIL (TYPICAL)

SCALE: 1:10

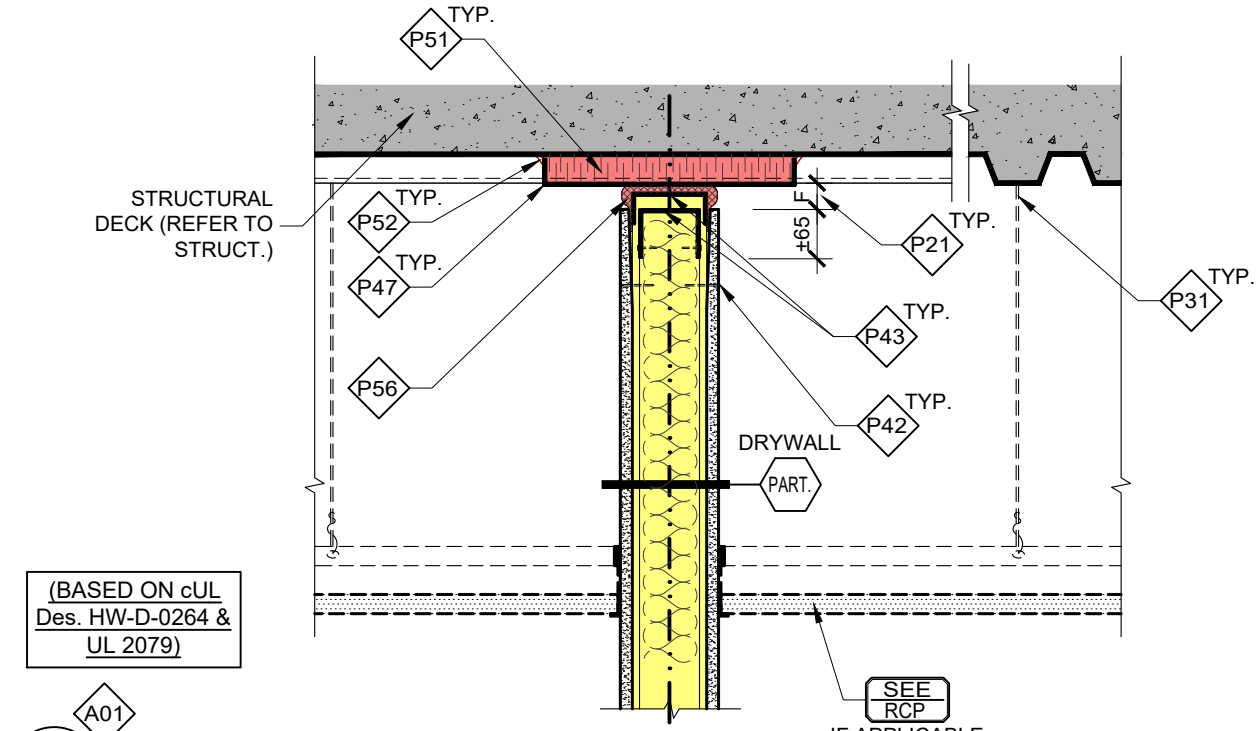


(BASED ON cUL Des. HW-D-060)

A01
2
DP-010

FRR PARTITION HEAD - DRY WALL SECTION DETAIL (TYPICAL)

SCALE: 1:10

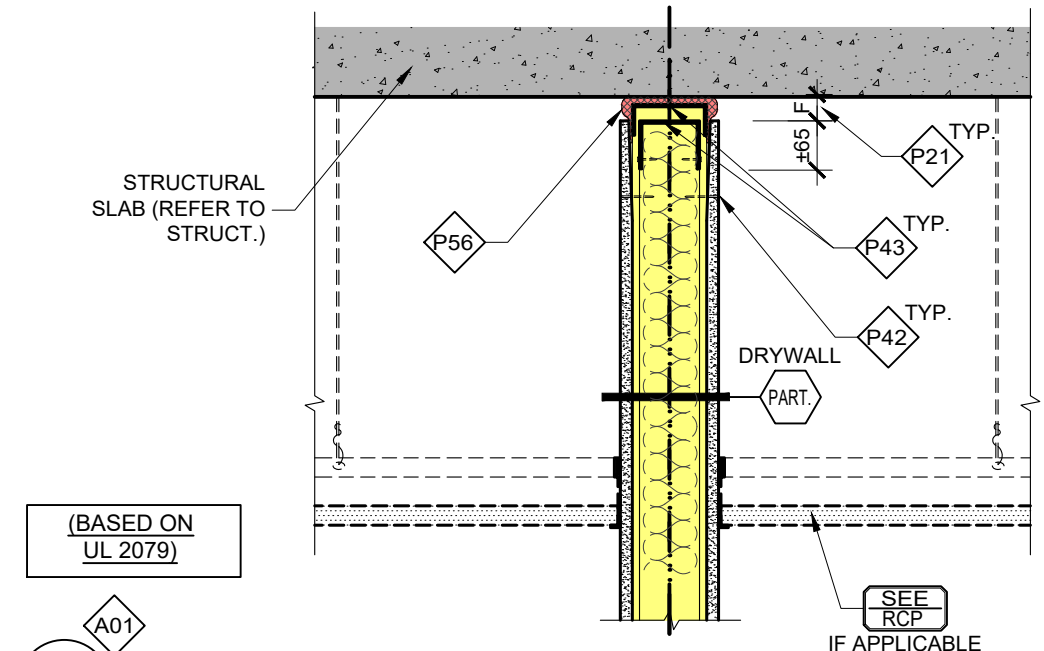


(BASED ON cUL Des. HW-D-0264 & UL 2079)

A01
1
DP-011

FRR PARTITION HEAD - DRY WALL SECTION DETAIL (TYPICAL)

SCALE: 1:10

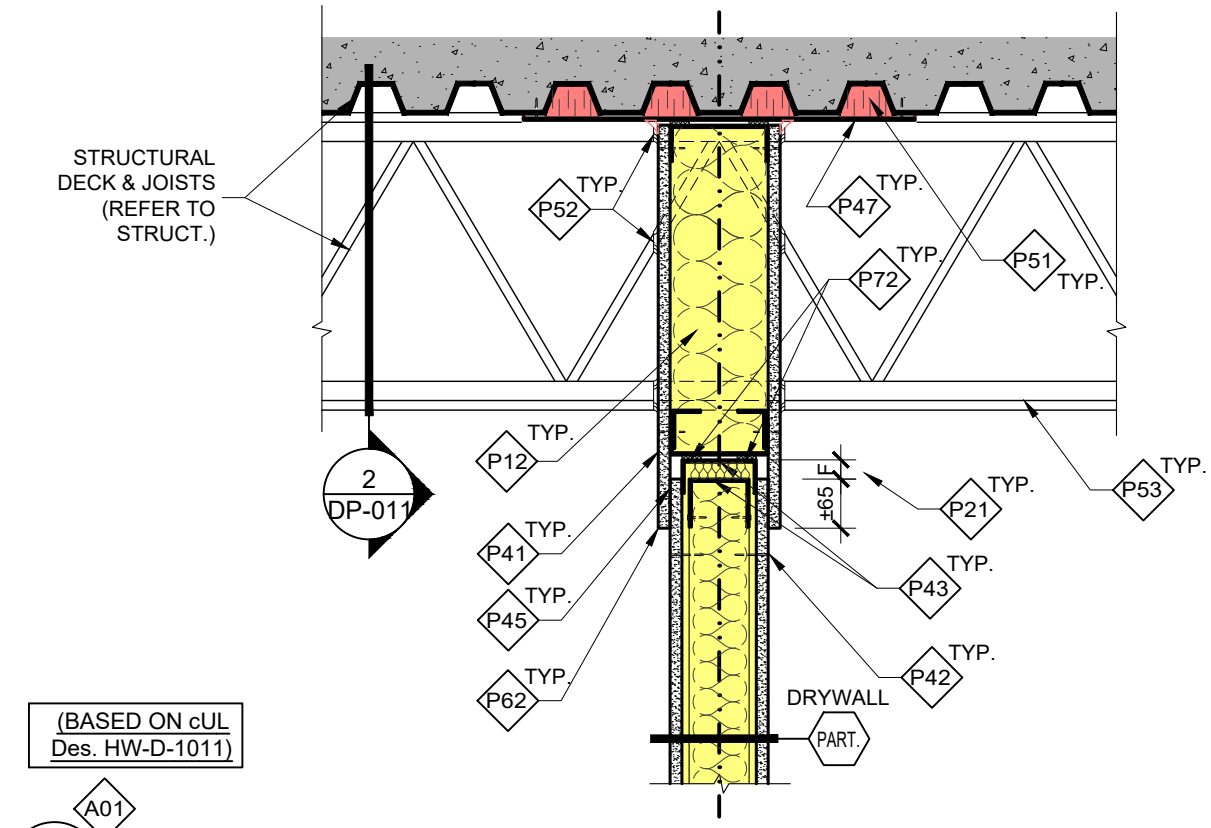


(BASED ON UL 2079)

A01
2
DP-011

FRR PARTITION HEAD - DRY WALL SECTION DETAIL (TYPICAL)

SCALE: 1:10

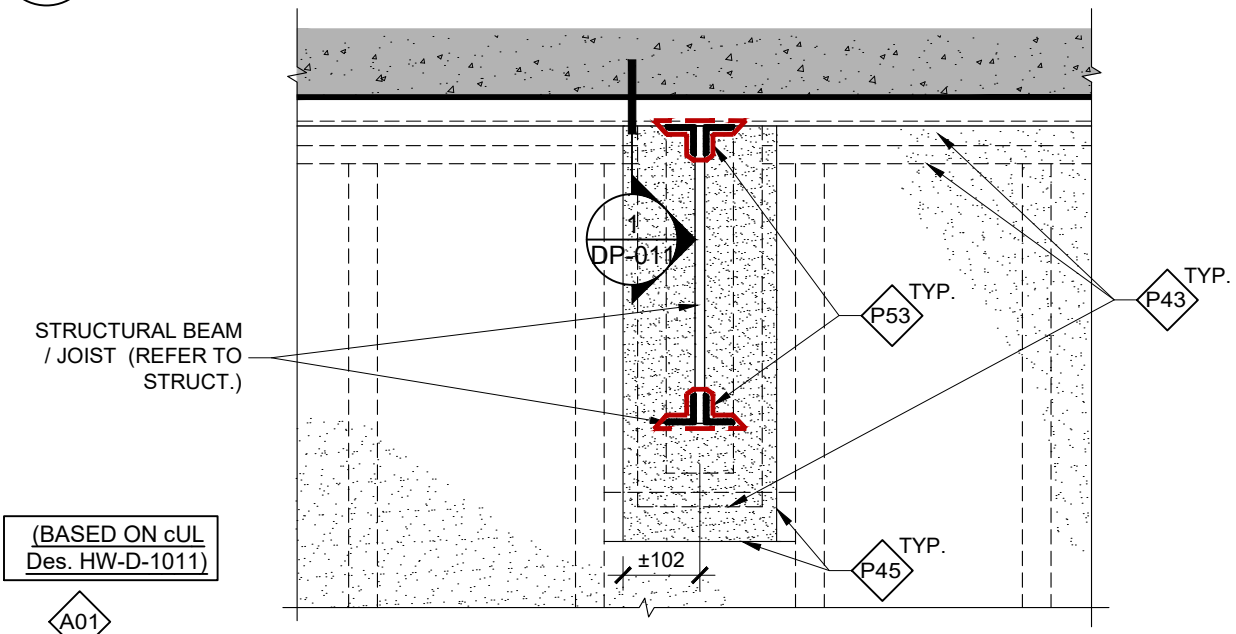


(BASED ON cUL Des. HW-D-1011)

A01
1
DP-012

FULL HEIGHT PARTITION HEAD U/S JOIST - DRY WALL SECTION DETAIL (TYPICAL)

SCALE: 1:10

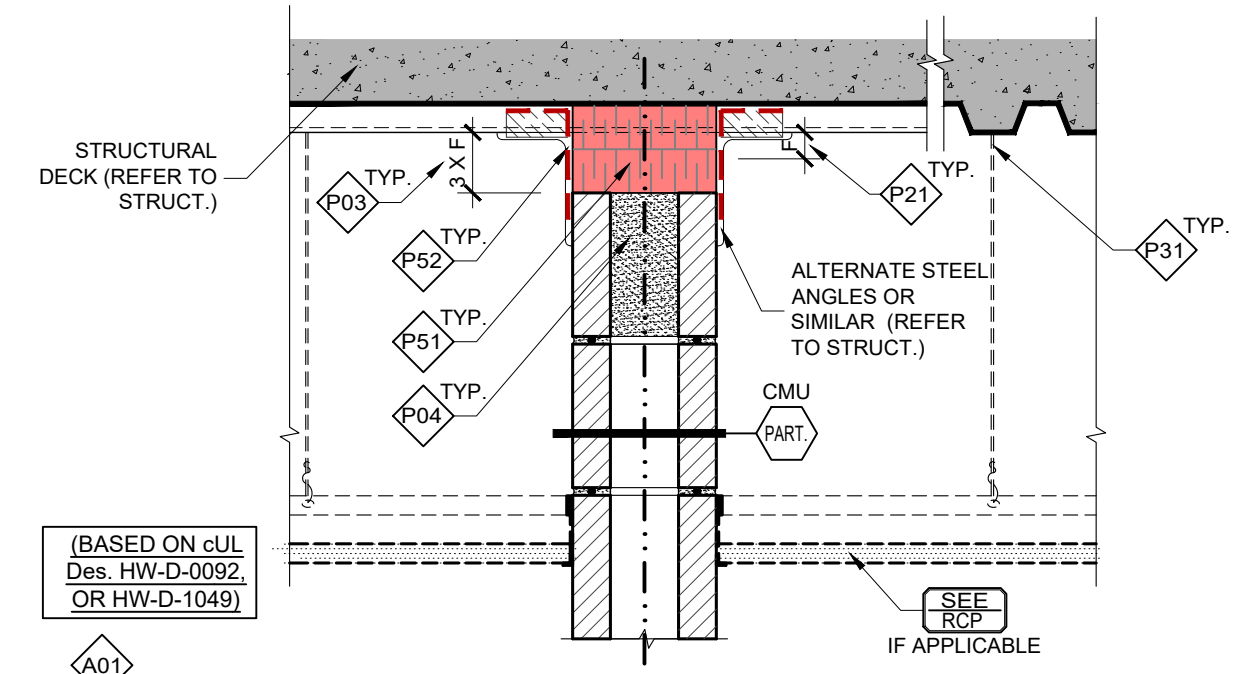


(BASED ON cUL Des. HW-D-1011)

A01
2
DP-012

FULL HEIGHT PARTITION HEAD U/S JOIST - DRY WALL SECTION DETAIL (TYPICAL)

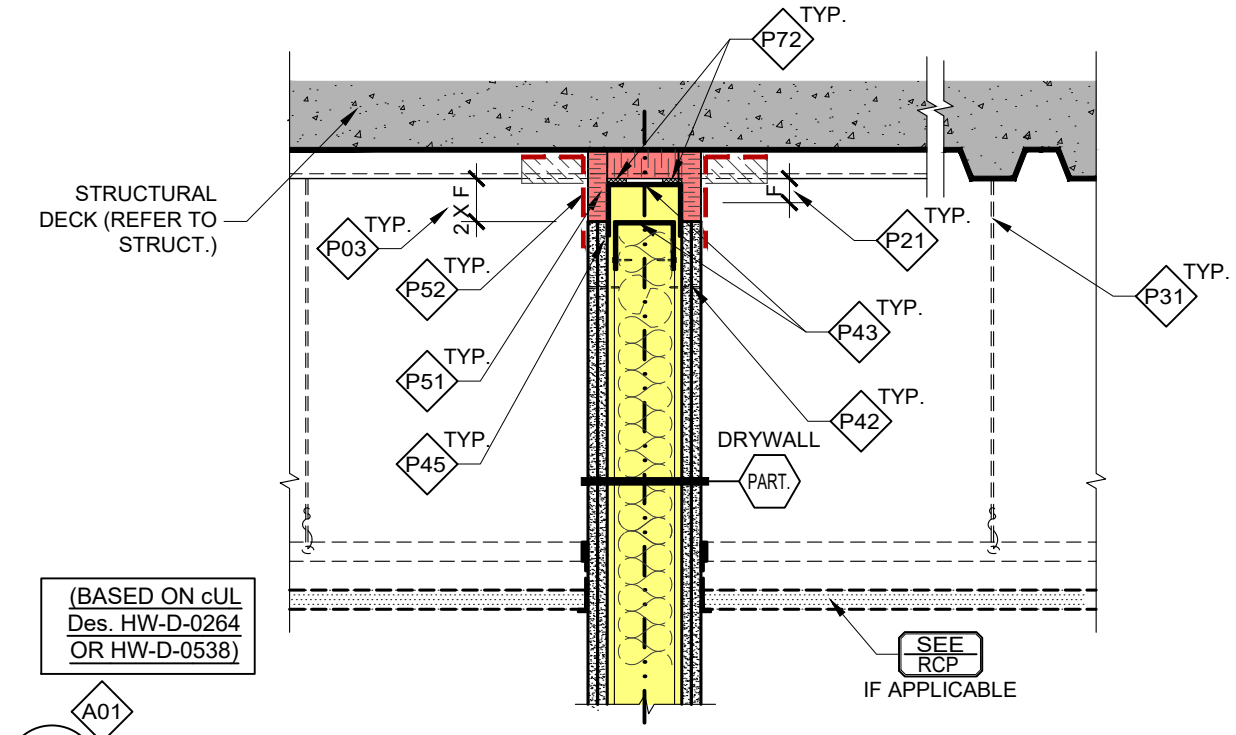
SCALE: 1:10



A01
1
DP-013

FRR PARTITION HEAD - MASONRY W/ FRR SPRAY SECTION DETAIL (TYPICAL)

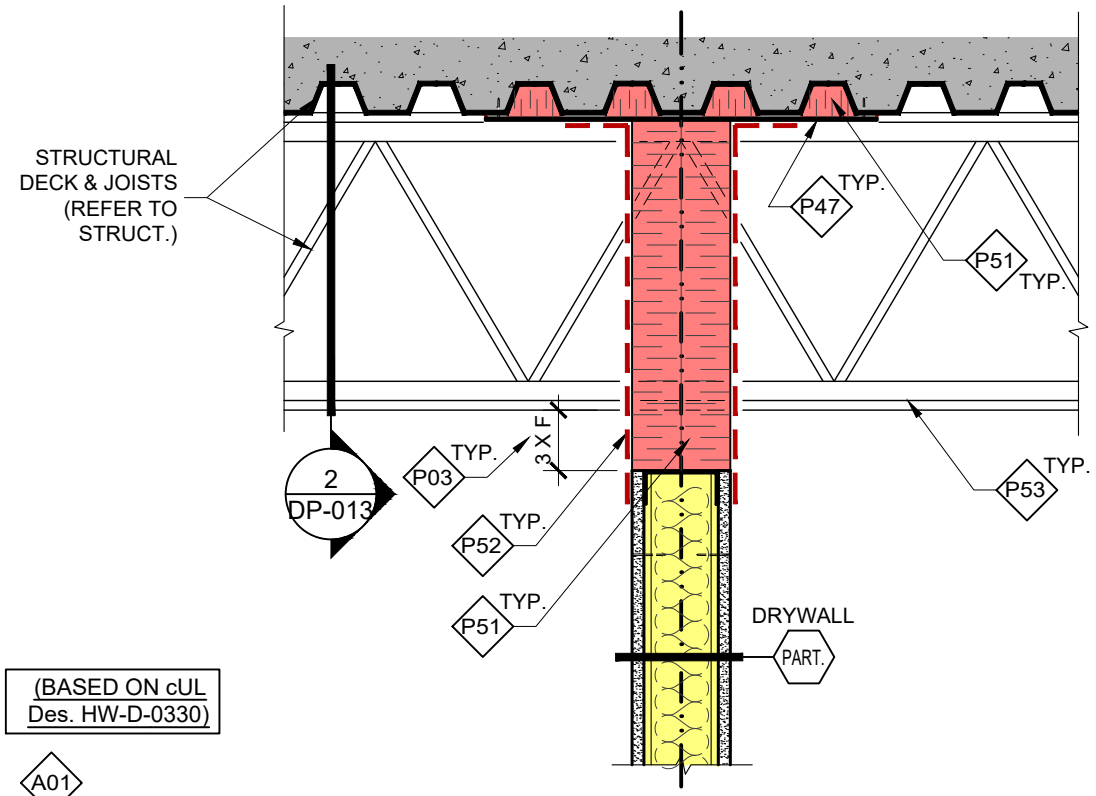
SCALE: 1:10



A01
2
DP-013

FRR PARTITION HEAD - DRY WALL W/ FRR SPRAY SECTION DETAIL (TYPICAL)

SCALE: 1:10

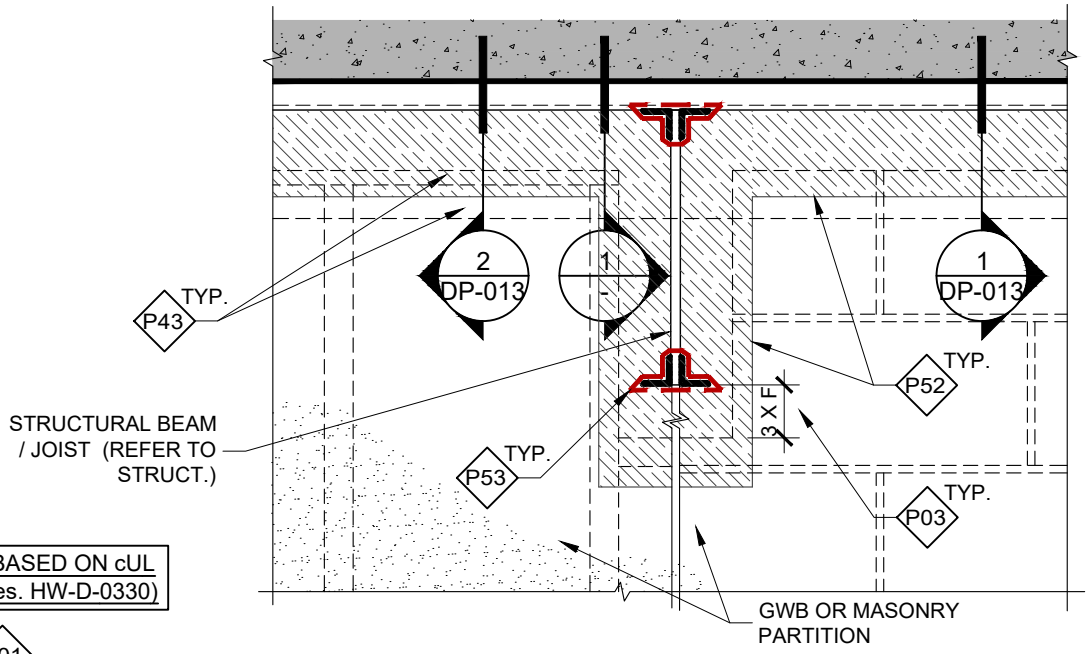


(BASED ON cUL Des. HW-D-0330)

A01
1
DP-014

FULL HEIGHT PARTITION HEAD U/S JOIST - DRY WALL W/ FRR SPRAY SECTION DETAIL (TYPICAL)

SCALE: 1:10

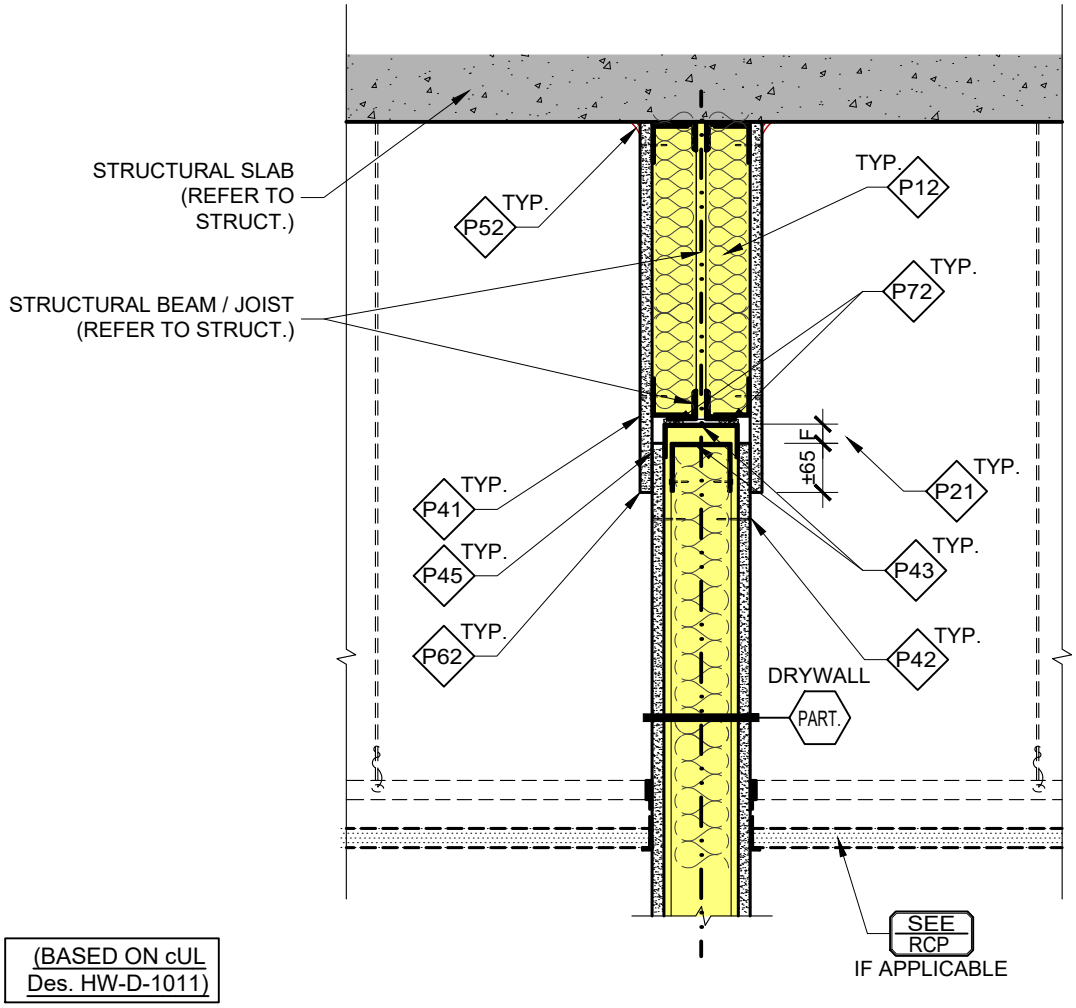


(BASED ON cUL Des. HW-D-0330)

A01
2
DP-014

FULL HEIGHT PARTITION HEAD U/S JOIST - W/ FRR SPRAY SECTION DETAIL (TYPICAL)

SCALE: 1:10

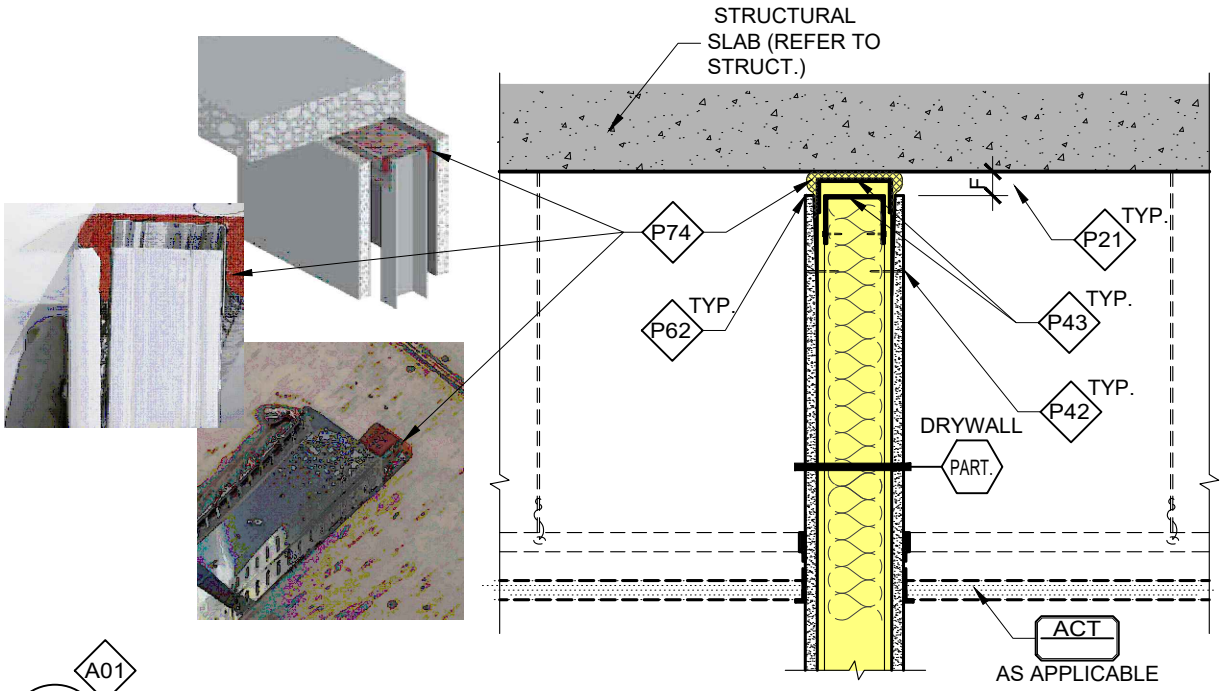


(BASED ON cUL
Des. HW-D-1011)

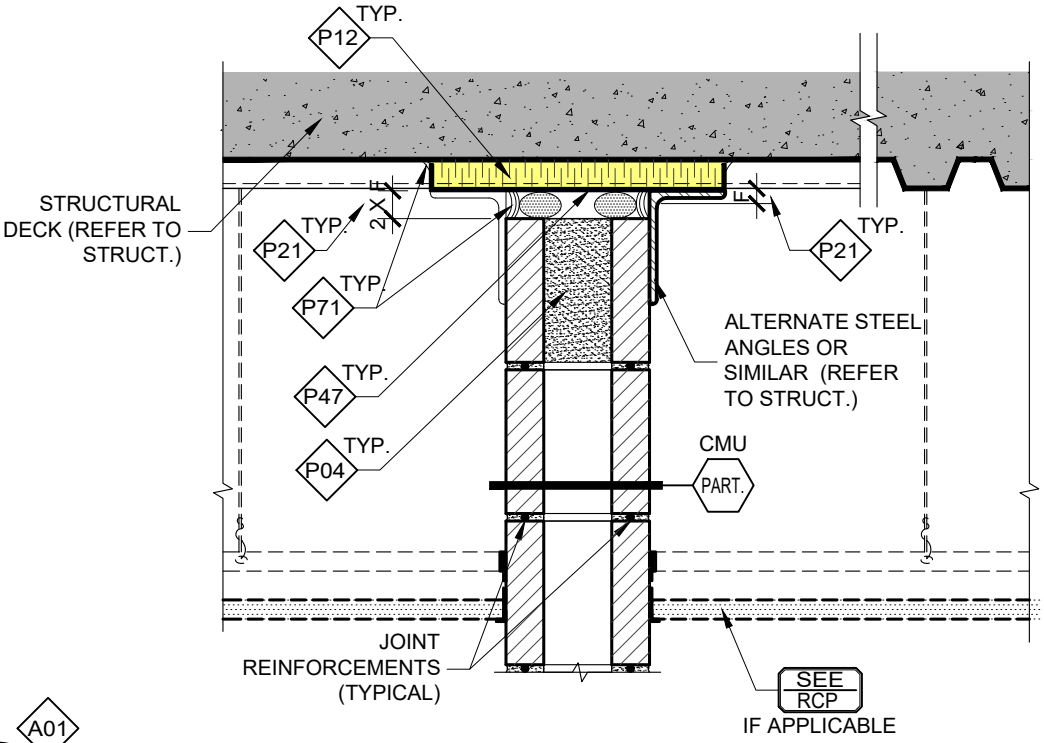
A01
1
DP-015

FULL HEIGHT PARTITION HEAD U/S JOIST - DRY WALL SECTION DETAIL (TYPICAL)

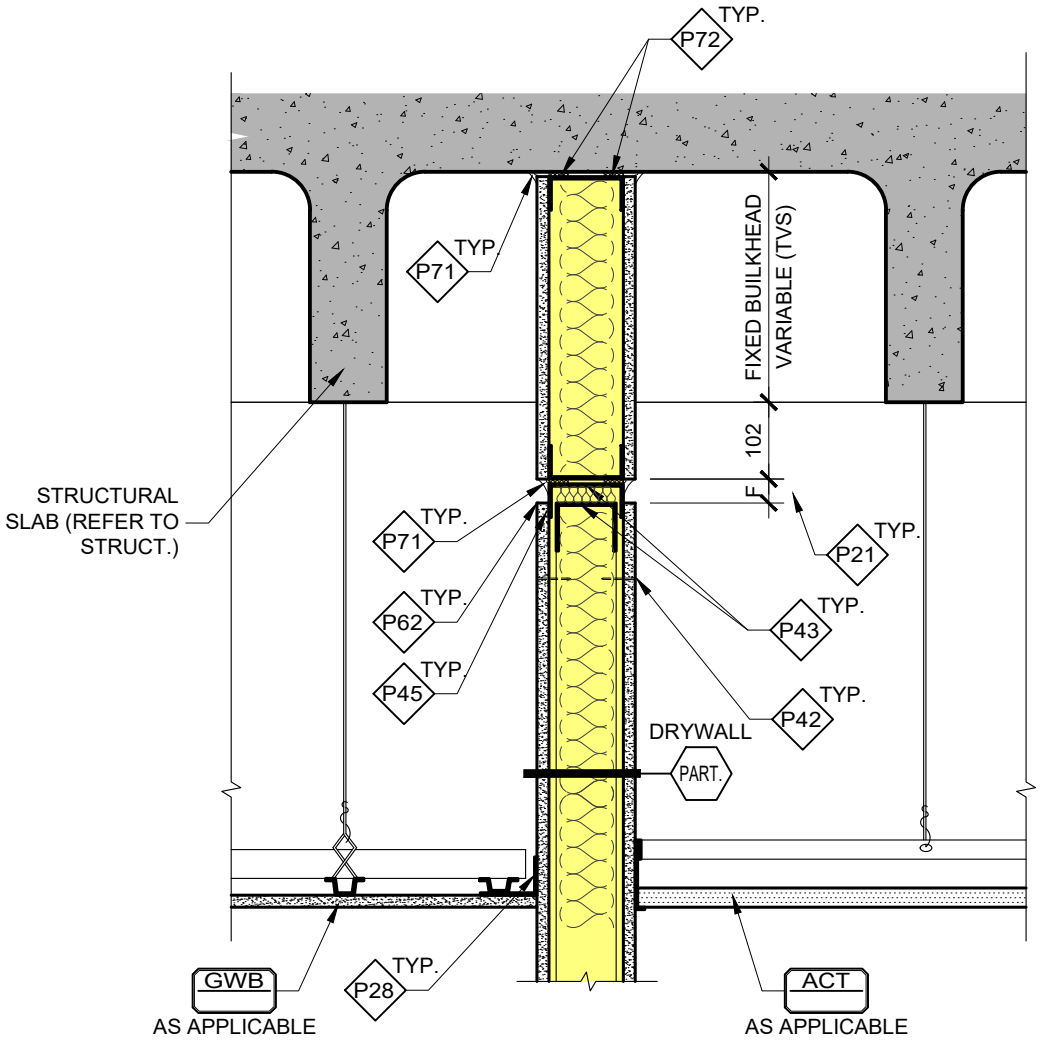
SCALE: 1:10



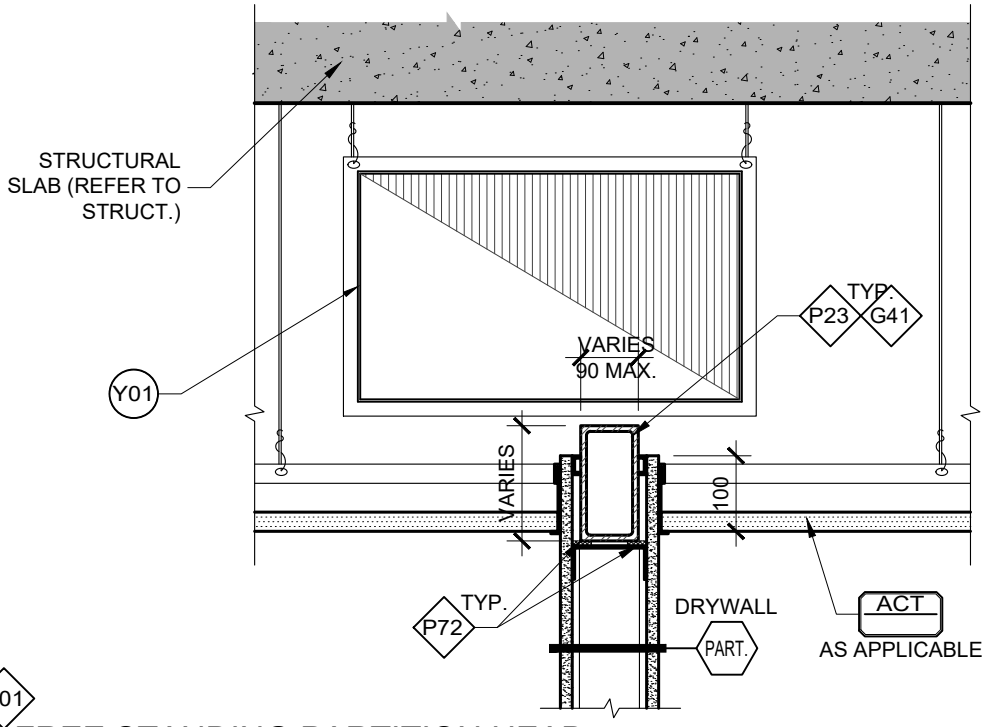
A01
1 / DP-020
FULL HEIGHT PARTITION HEAD U/S SLAB - DRY WALL SECTION DETAIL (TYPICAL)
SCALE: 1:10



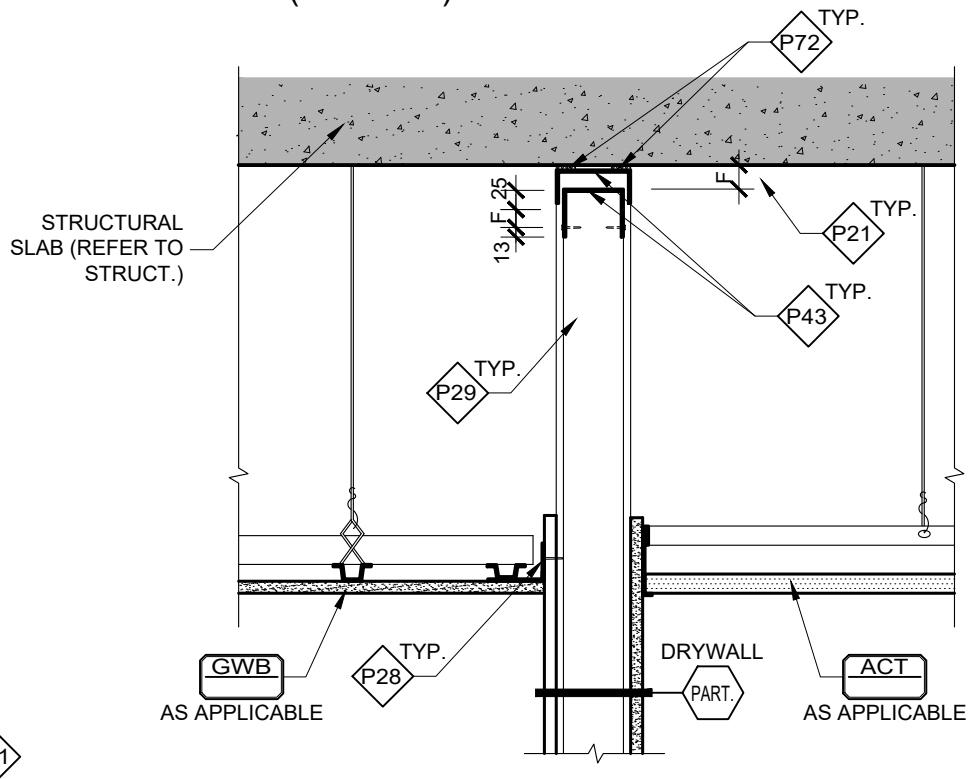
A01
2 / DP-020
PARTITION HEAD - MASONRY SECTION DETAIL (TYPICAL)
SCALE: 1:10



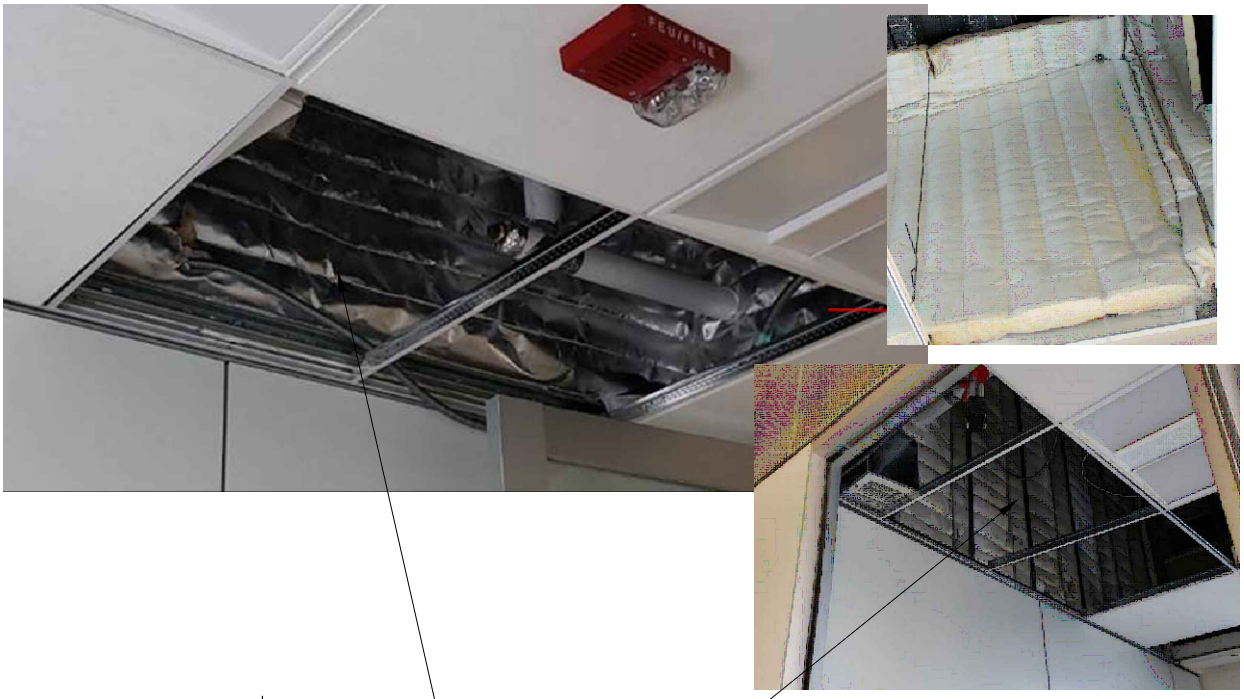
A01
1
DP-021
FULL HEIGHT PARTITION HEAD U/S SLAB - DRY WALL
SECTION DETAIL (TYPICAL)
SCALE: 1:10



A01 / 1 / DP-022 FREE STANDING PARTITION HEAD SECTION DETAIL (TYPICAL) SCALE: 1:10



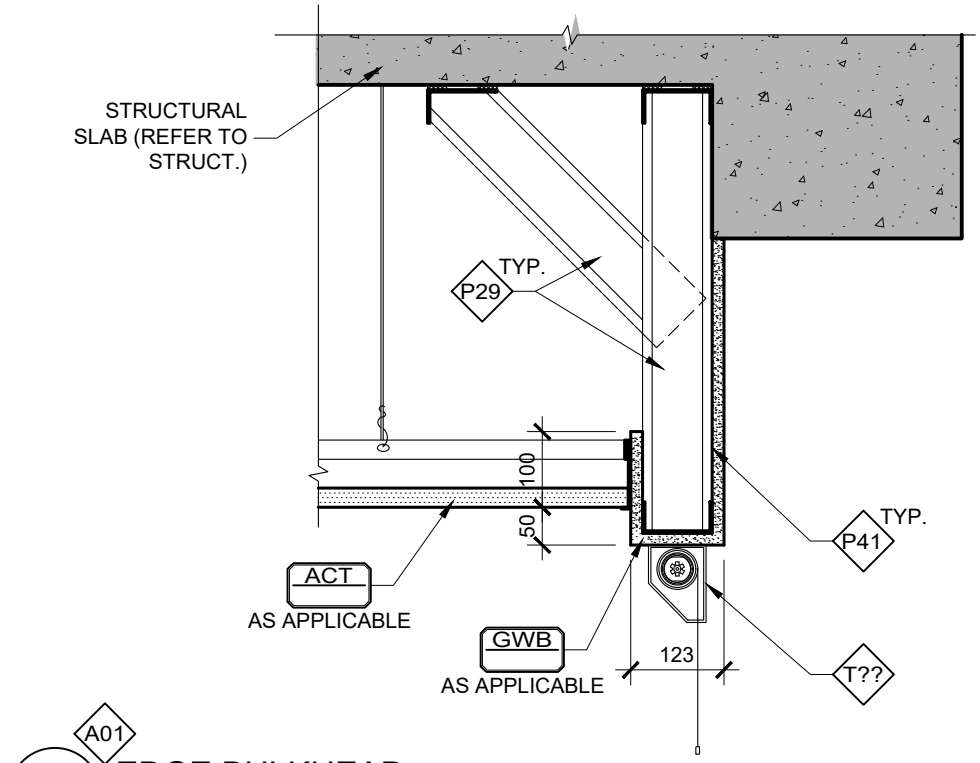
A01 / 2 / DP-022 NON FULL-HEIGHT PARTITION HEAD - DRY WALL SECTION DETAIL (TYPICAL) SCALE: 1:10



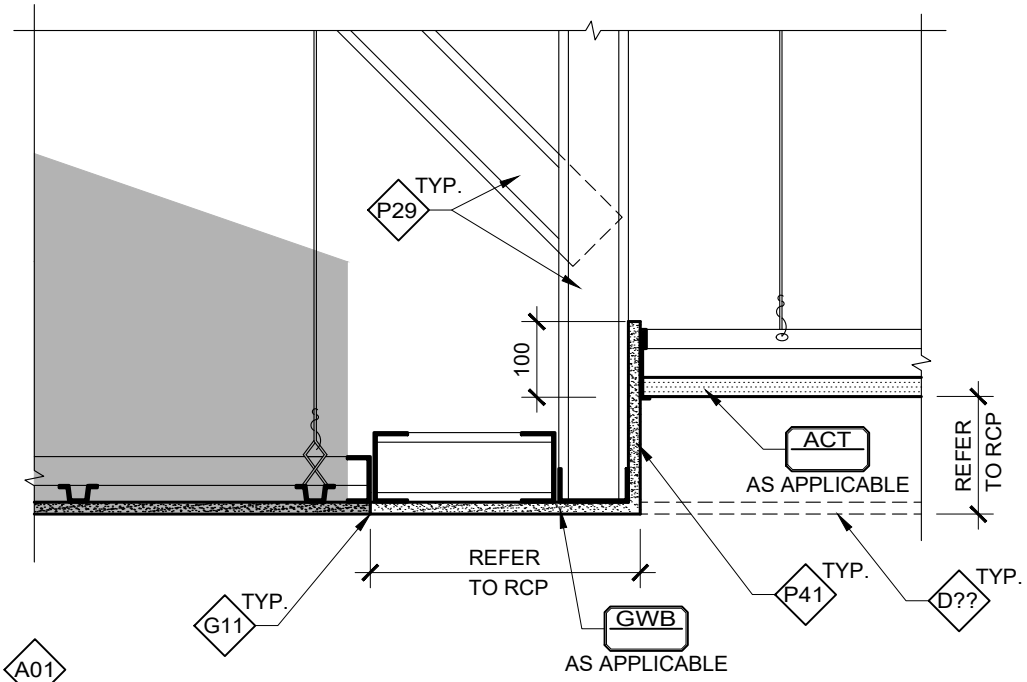
A01
1
DP-023

NON FULL-HEIGHT PARTITION HEAD - DEMOUNTABLE
SECTION DETAIL (TYPICAL)

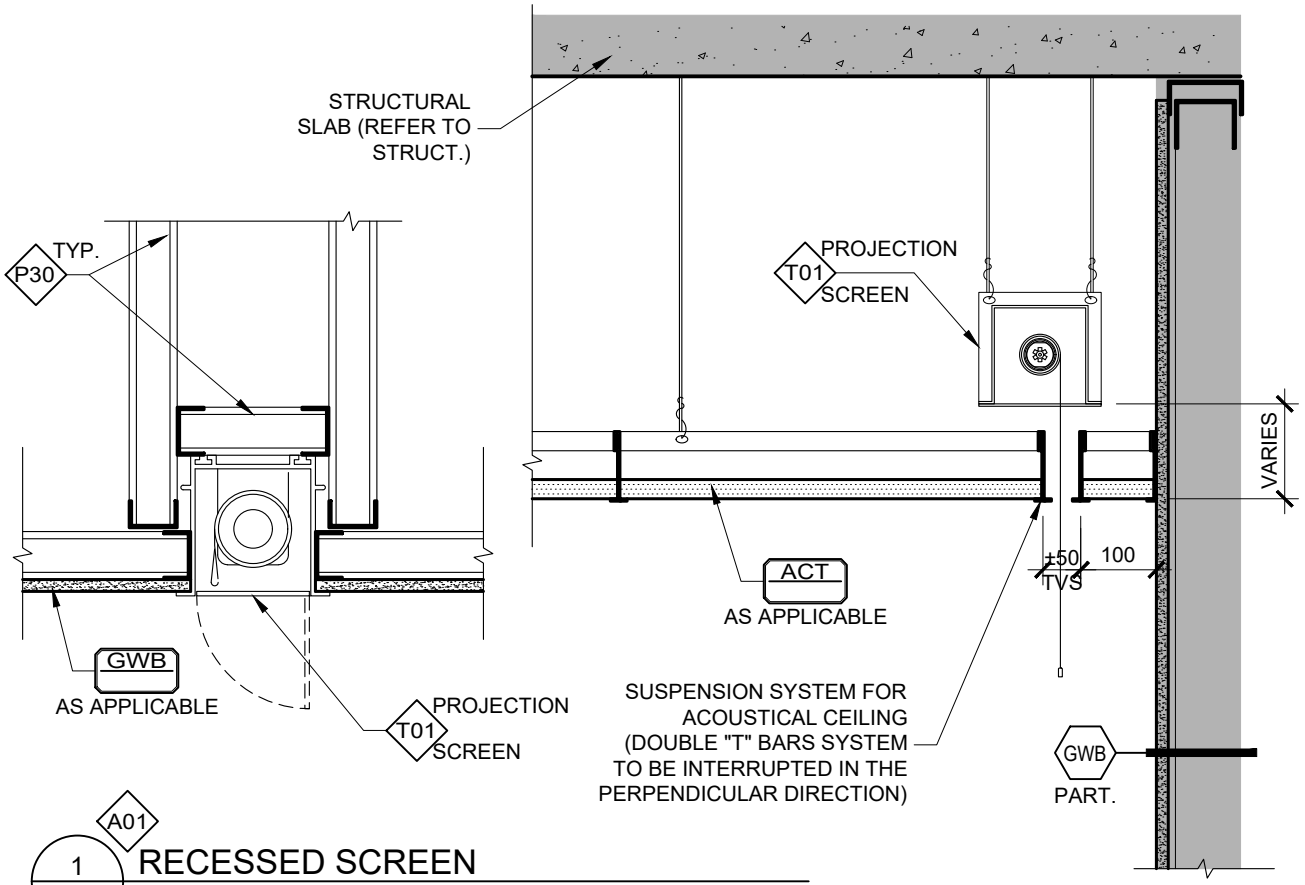
SCALE: 1:10



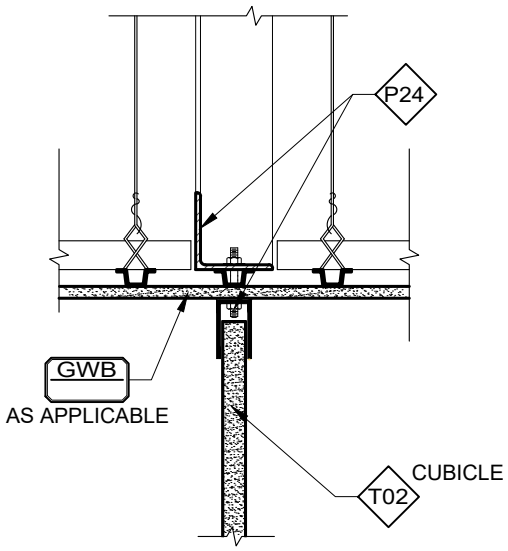
A01
1 / DP-030 EDGE BULKHEAD SECTION DETAIL (TYPICAL)
SCALE: 1:10



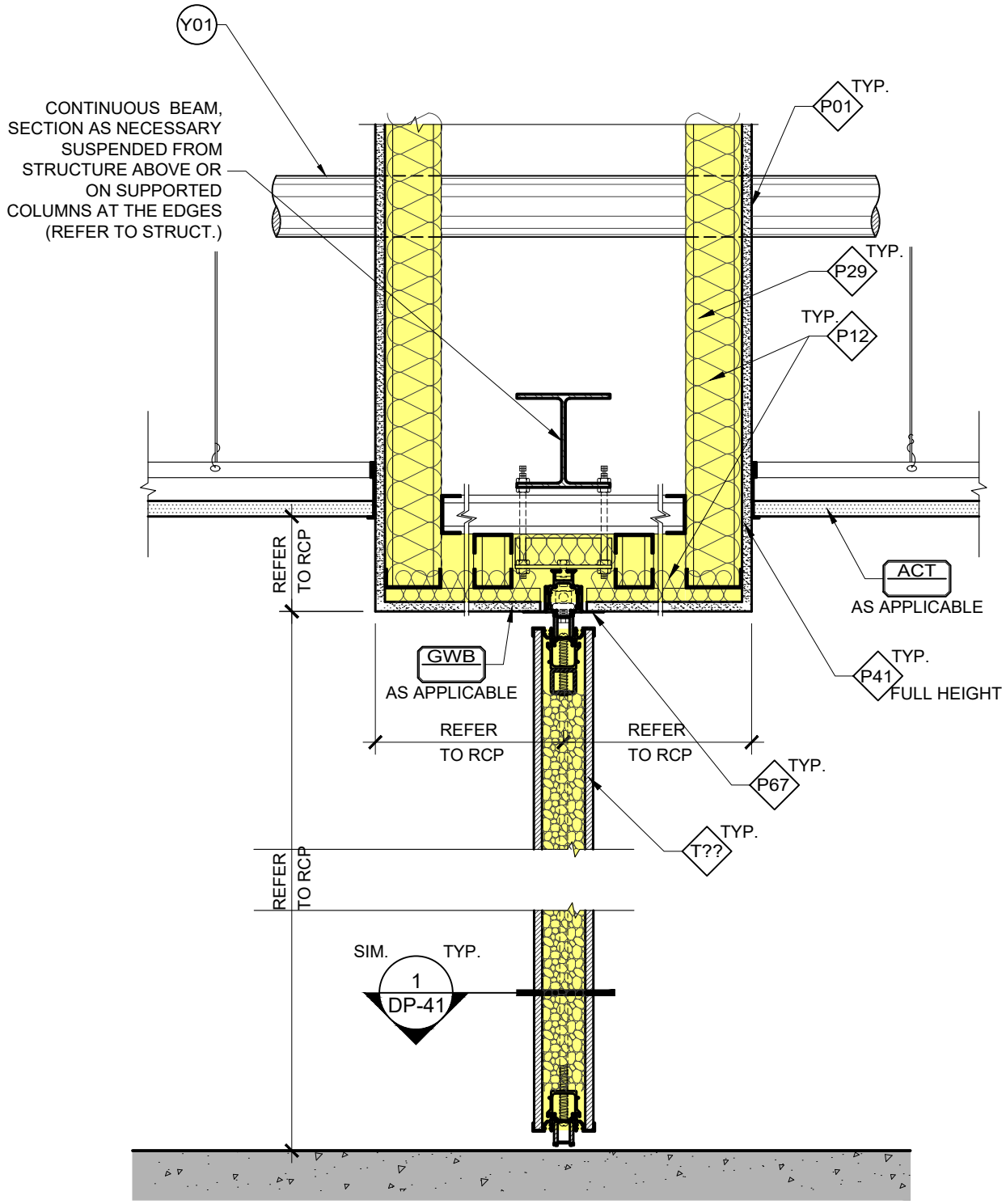
A01
2 / DP-030 EDGE BULKHEAD SECTION DETAIL (TYPICAL)
SCALE: 1:10



A01
1 DP-031 RECESSED SCREEN SECTION DETAIL (TYPICAL)
SCALE: 1:10

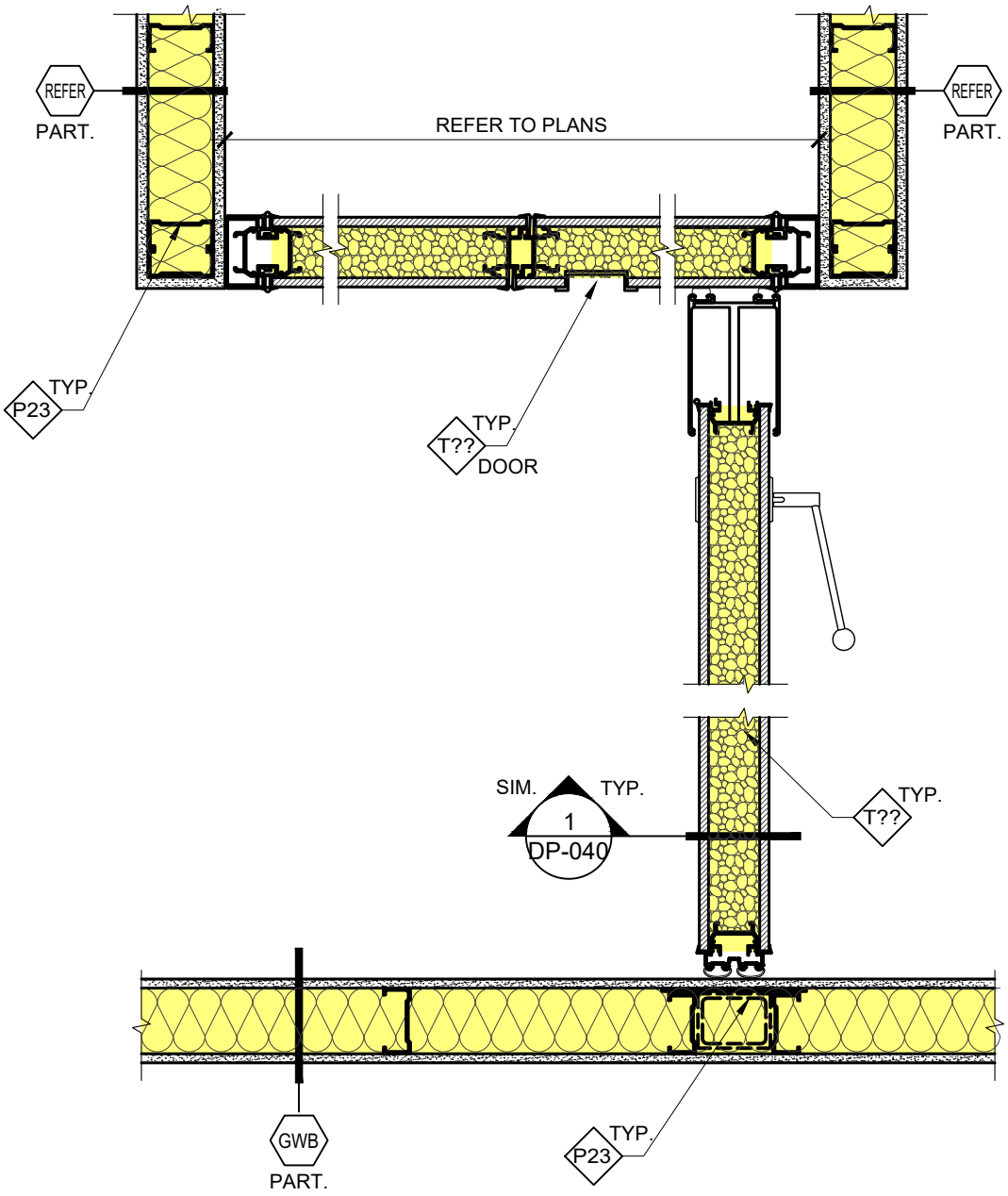


A01
2 DP-031 CUBICLE SUPPORT SECTION DETAIL (TYPICAL)
SCALE: 1:10

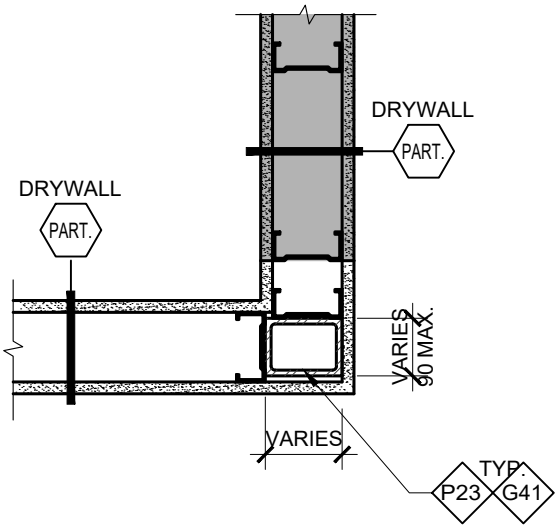


A01
1 / DP-040 MOVABLE PARTITION SECTION DETAIL (TYPICAL)

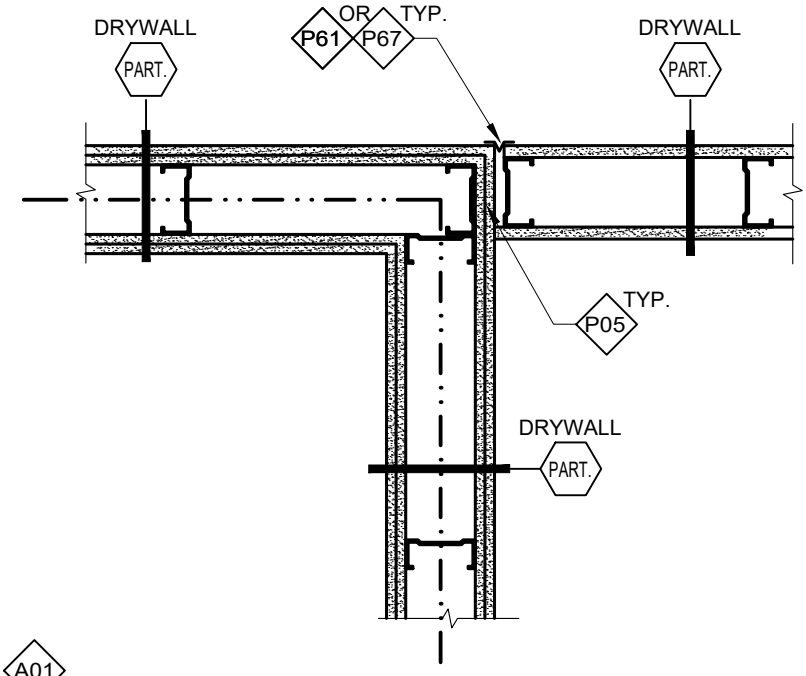
SCALE: 1:10



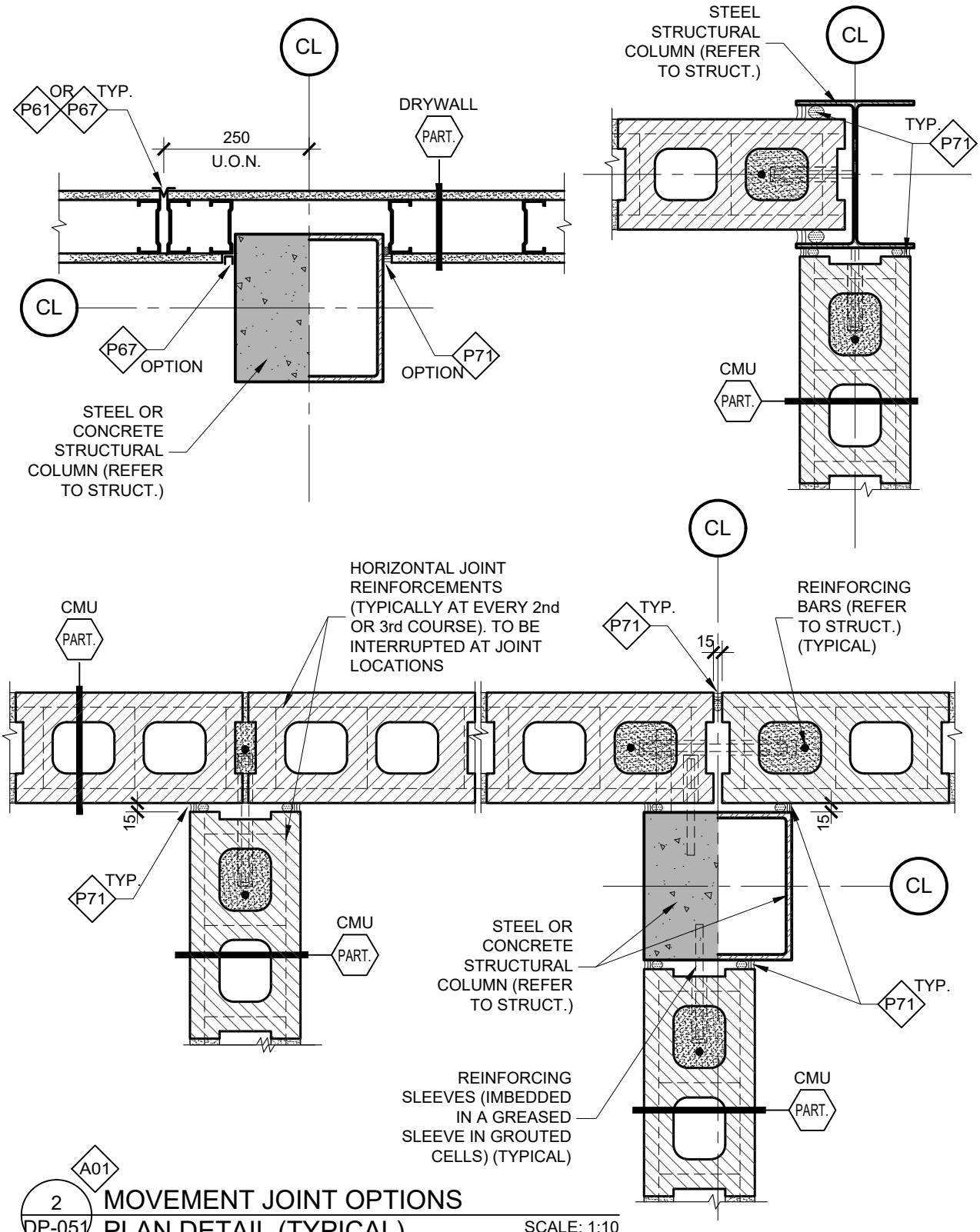
A01
1
DP-041
MOVABLE PARTITION
PLAN DETAIL (TYPICAL)
SCALE: 1:10



A01
1
DP-050
FREE STANDING PARTITION
PLAN DETAIL (TYPICAL)
SCALE: 1:10



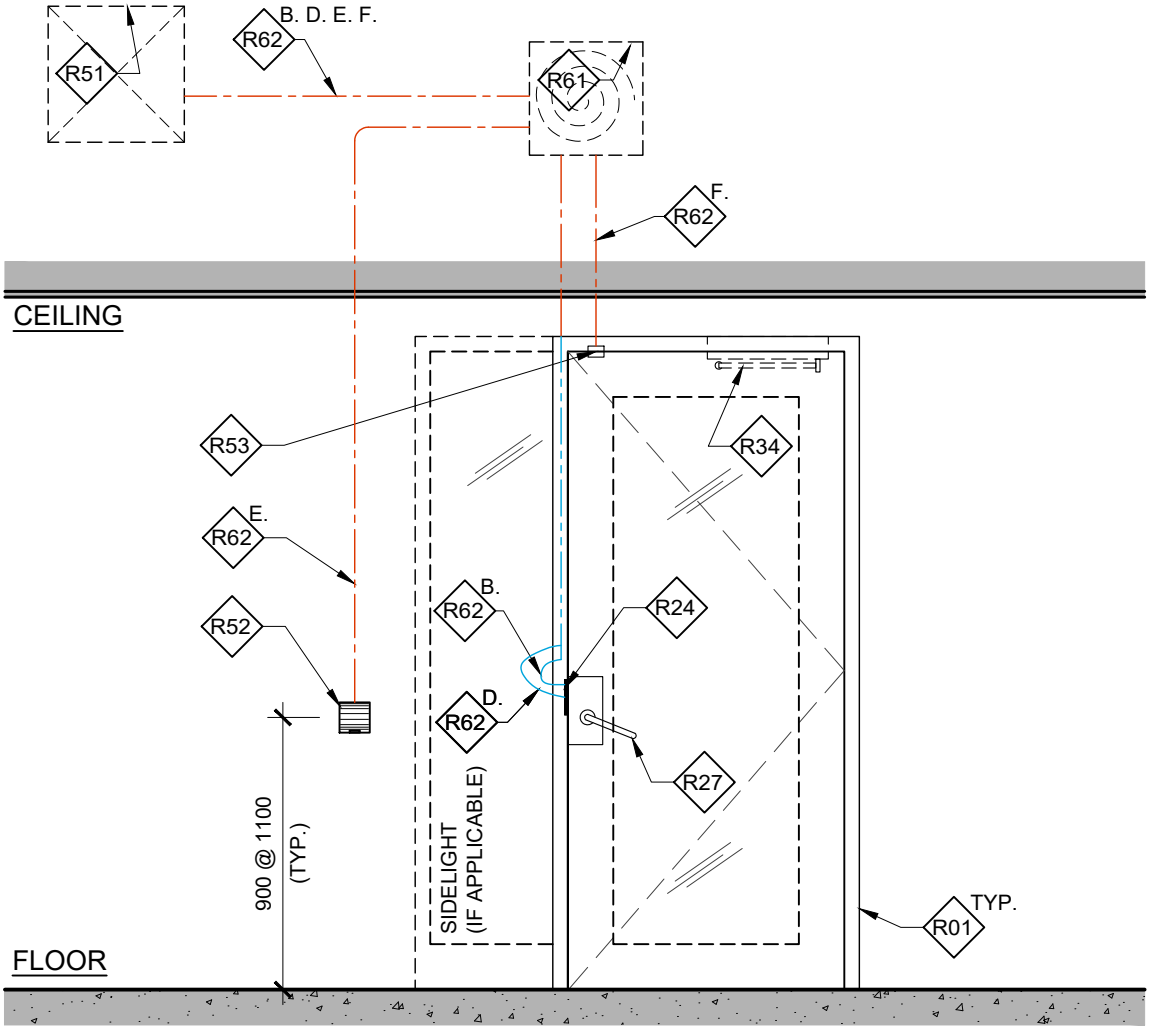
A01
2
DP-050
CONNECTION WITH FRR PARTITION
PLAN DETAIL (TYPICAL)
SCALE: 1:10



A01
2
DP-051

MOVEMENT JOINT OPTIONS
PLAN DETAIL (TYPICAL)

SCALE: 1:10



FEATURES:

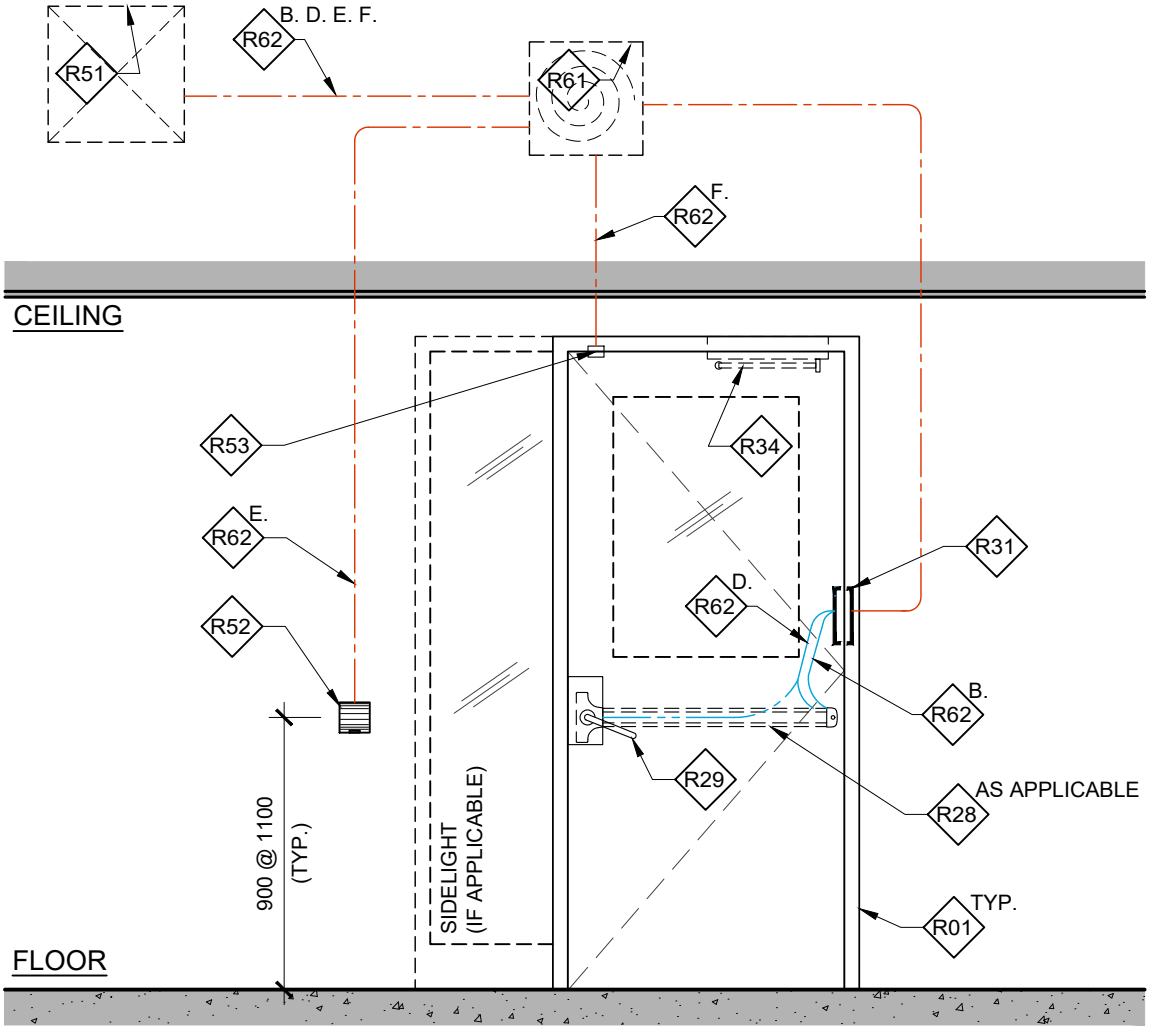
	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-010

SINGLE DOOR WITH / WITHOUT SIDELIGHT

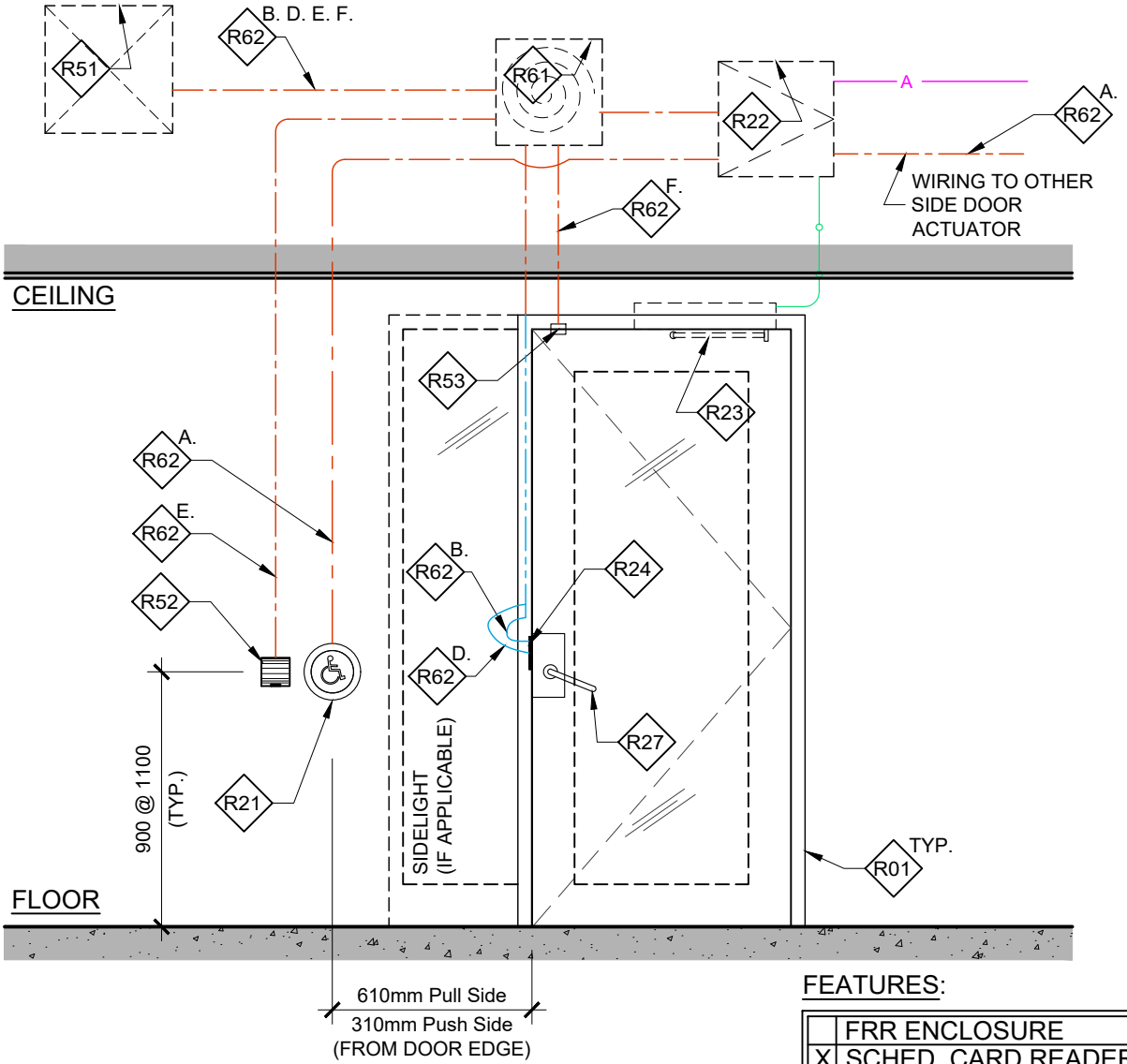
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-011
SINGLE DOOR WITH / WITHOUT SIDELIGHT
SCALE: 1:25



FEATURES:

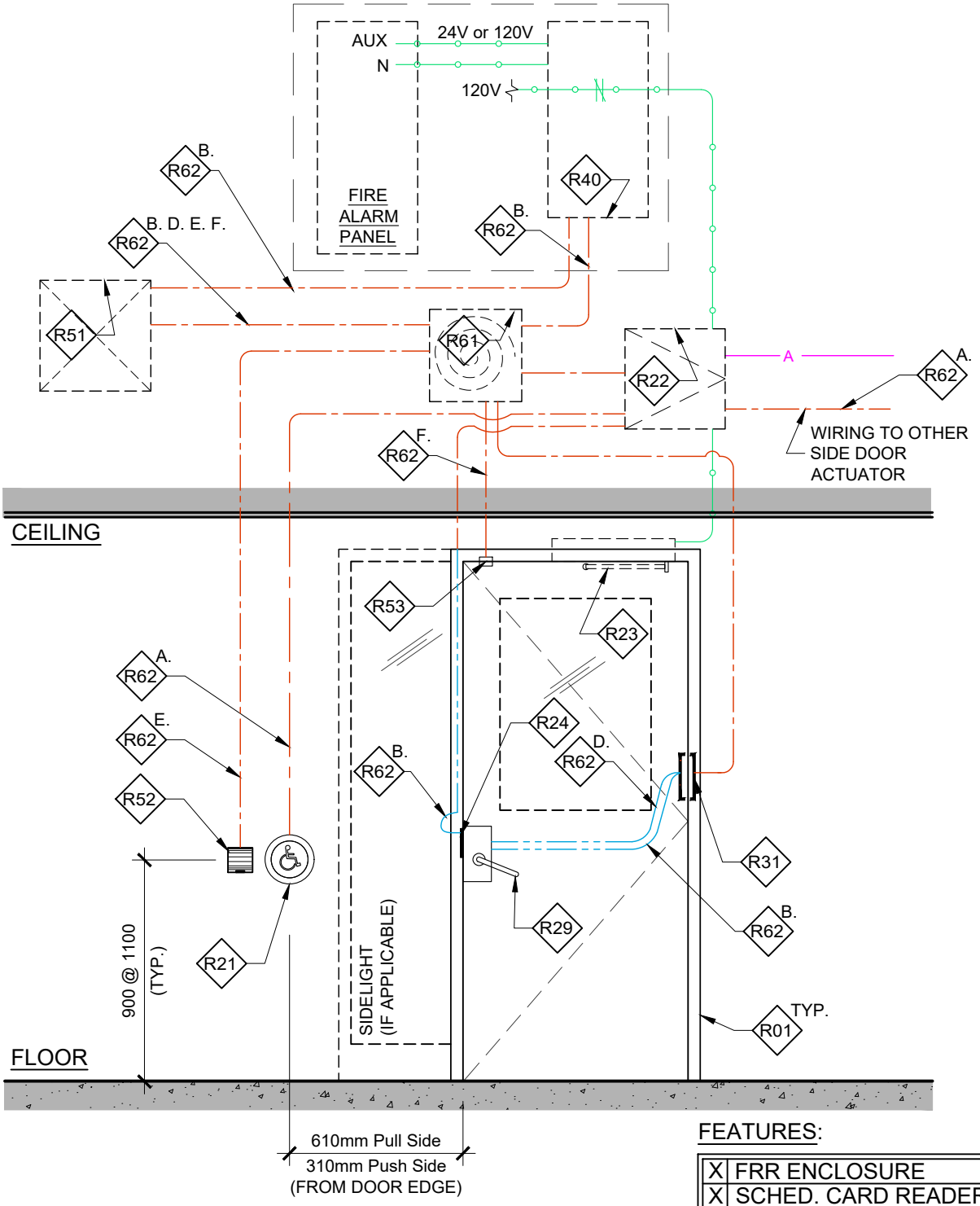
	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-012

SINGLE DOOR WITH / WITHOUT SIDELIGHT

SCALE: 1:25



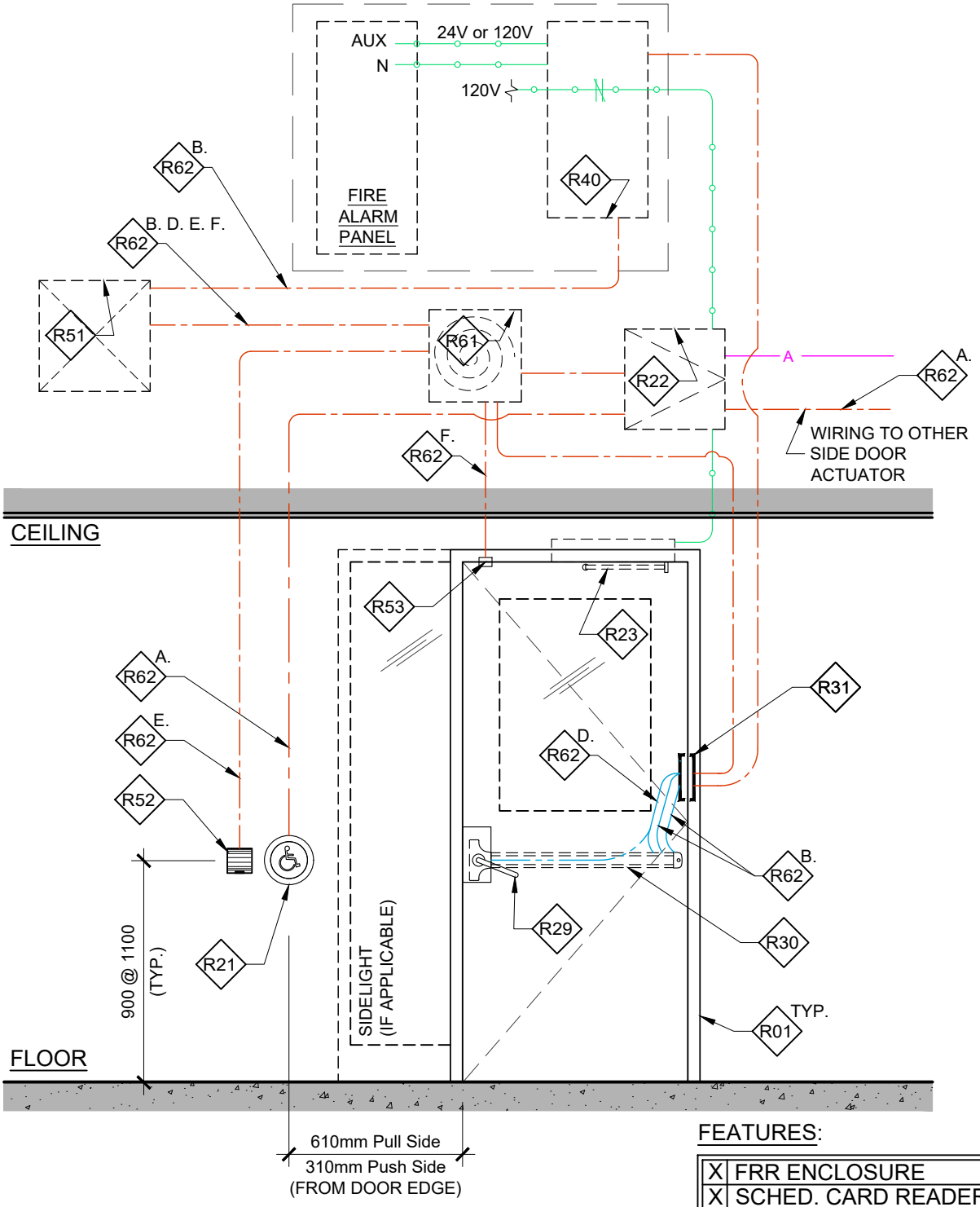
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-013

SINGLE DOOR WITH / WITHOUT SIDELIGHT

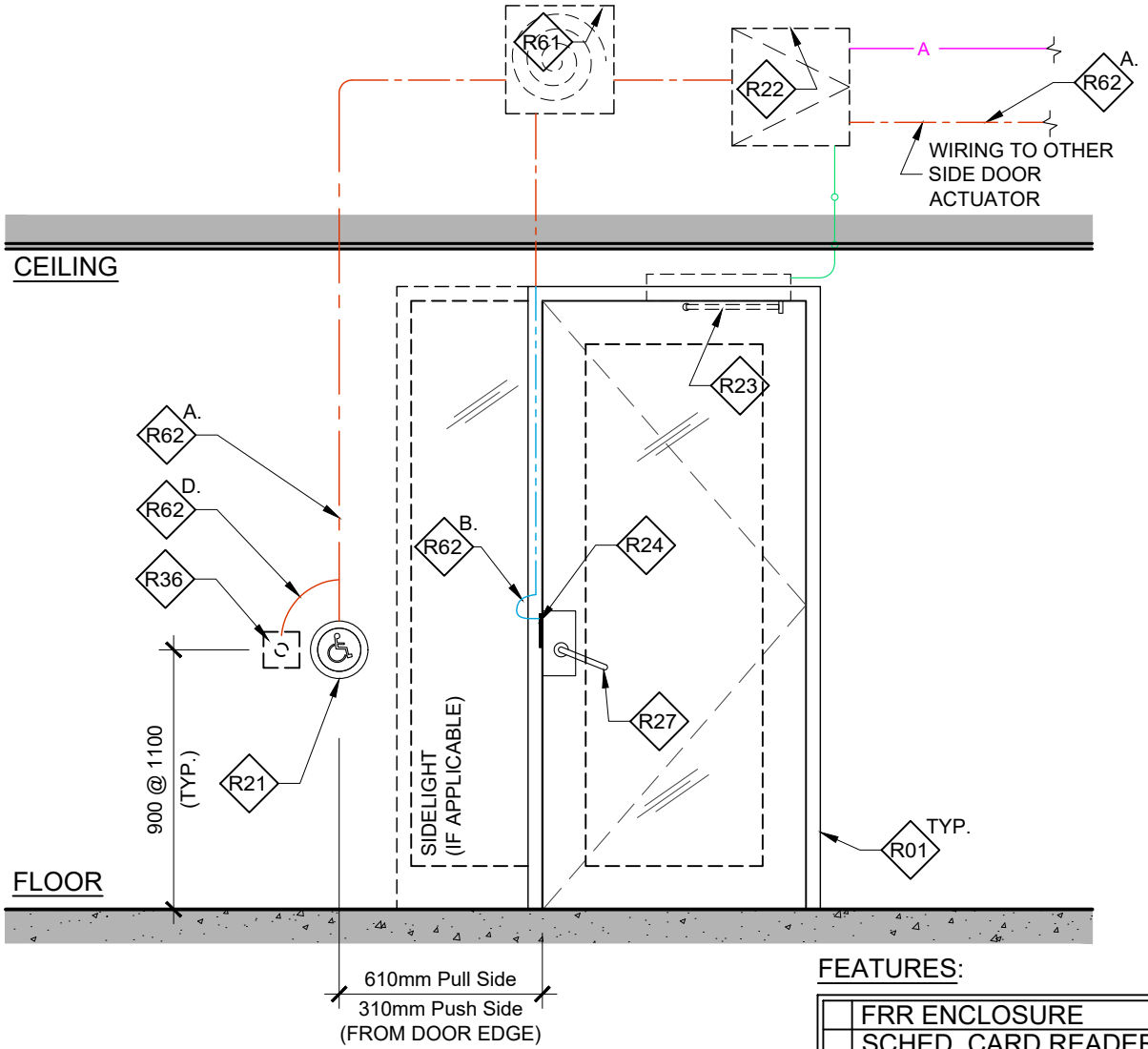
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-014
SINGLE DOOR WITH / WITHOUT SIDELIGHT
SCALE: 1:25



FEATURES:

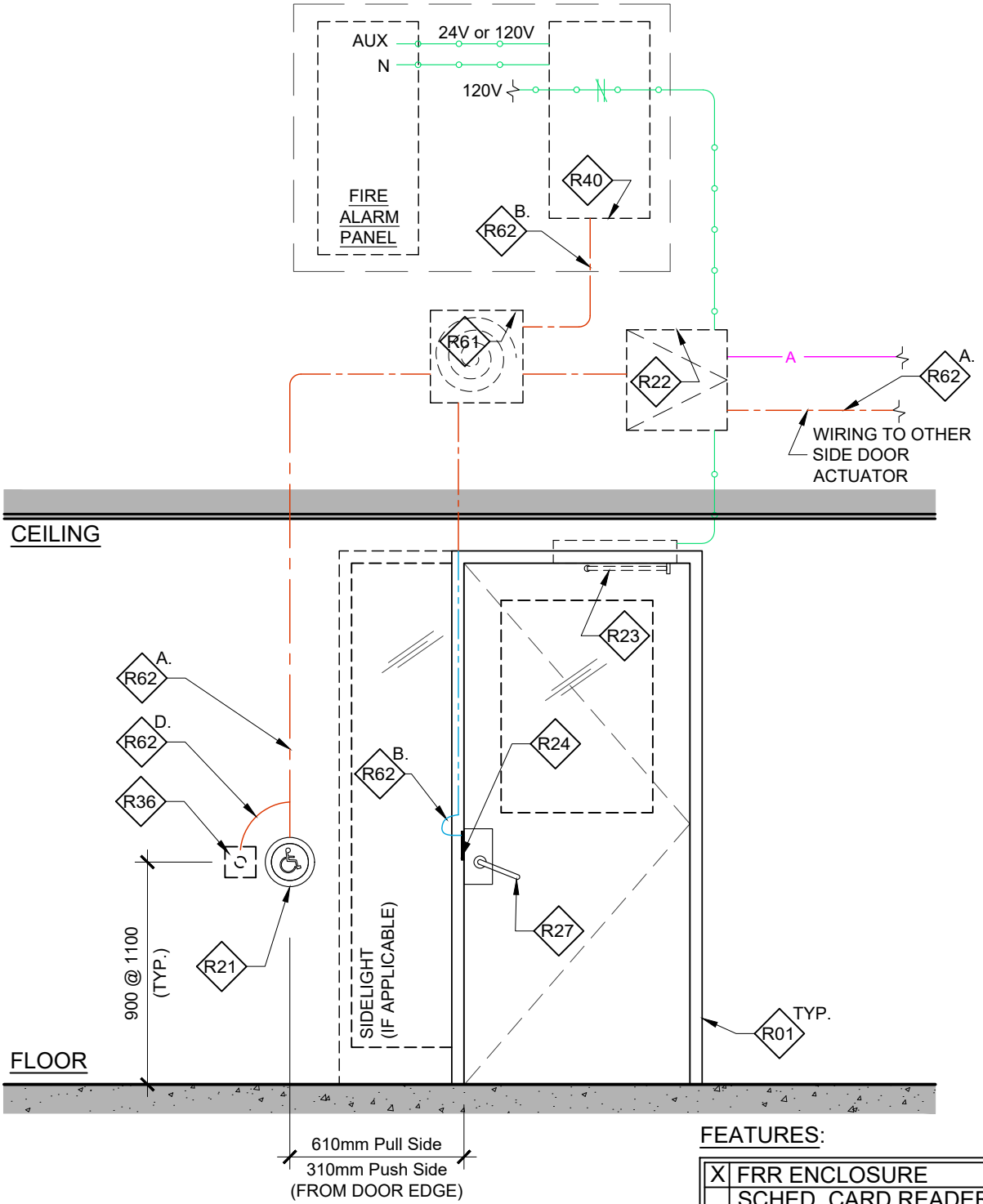
	FRR ENCLOSURE
	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
X	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-015

SINGLE DOOR WITH / WITHOUT SIDELIGHT

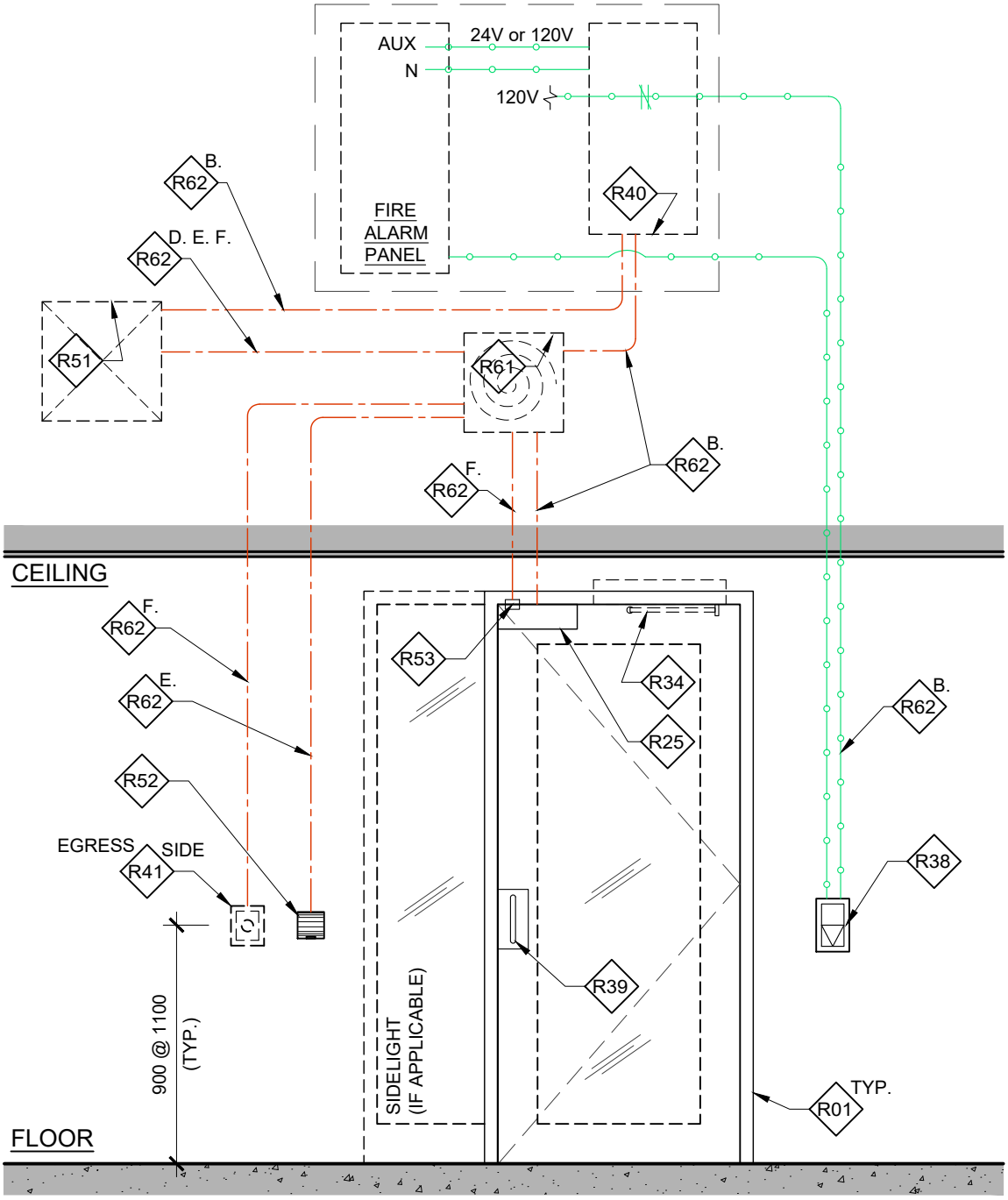
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
X	KEY SWITCH

A01
1
DR-016
SINGLE DOOR WITH / WITHOUT SIDELIGHT
SCALE: 1:25



FEATURES:

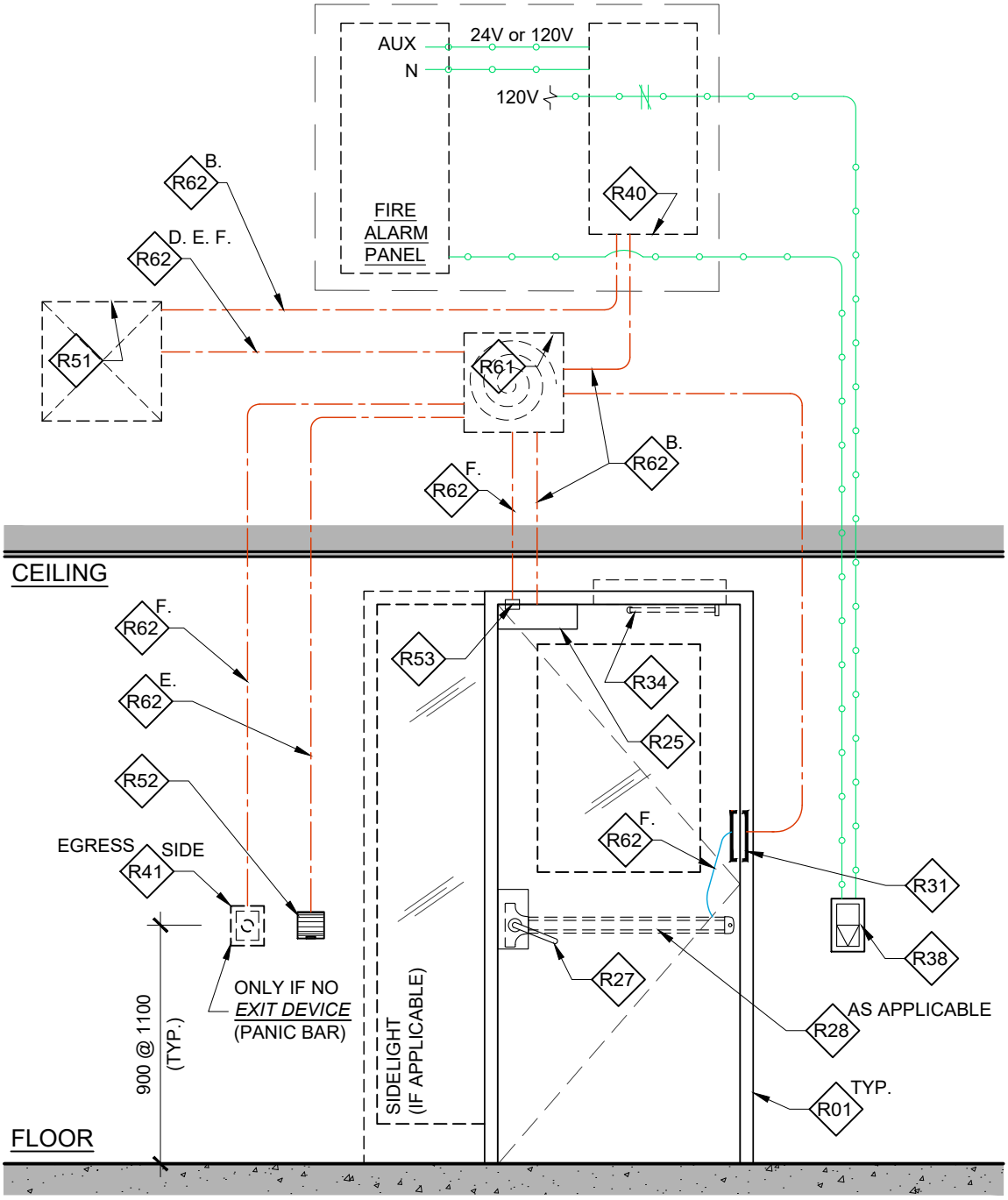
	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-017

SINGLE DOOR WITH / WITHOUT SIDELIGHT

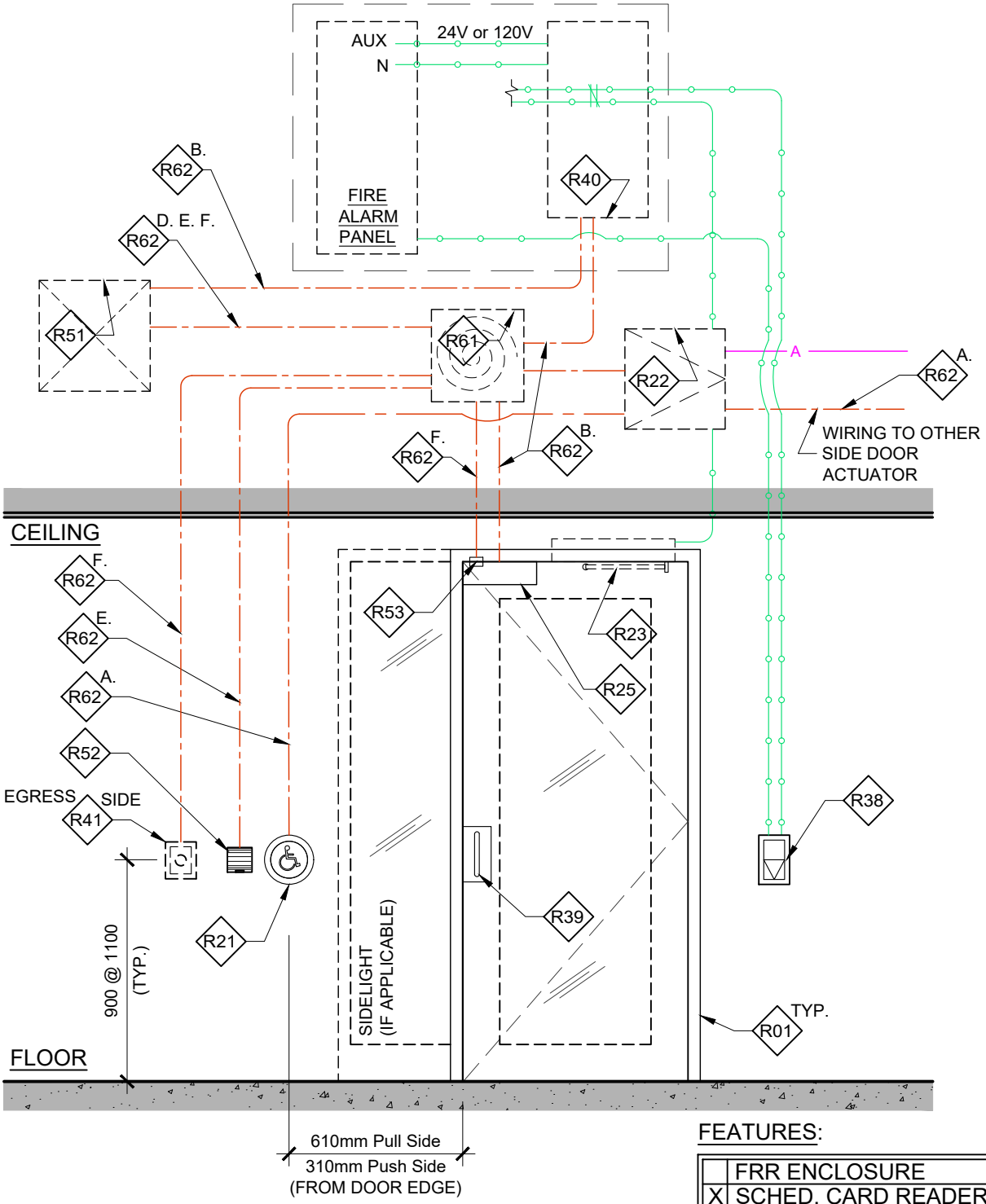
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

A01
1
DR-018
SINGLE DOOR WITH / WITHOUT SIDELIGHT
SCALE: 1:25



FEATURES:

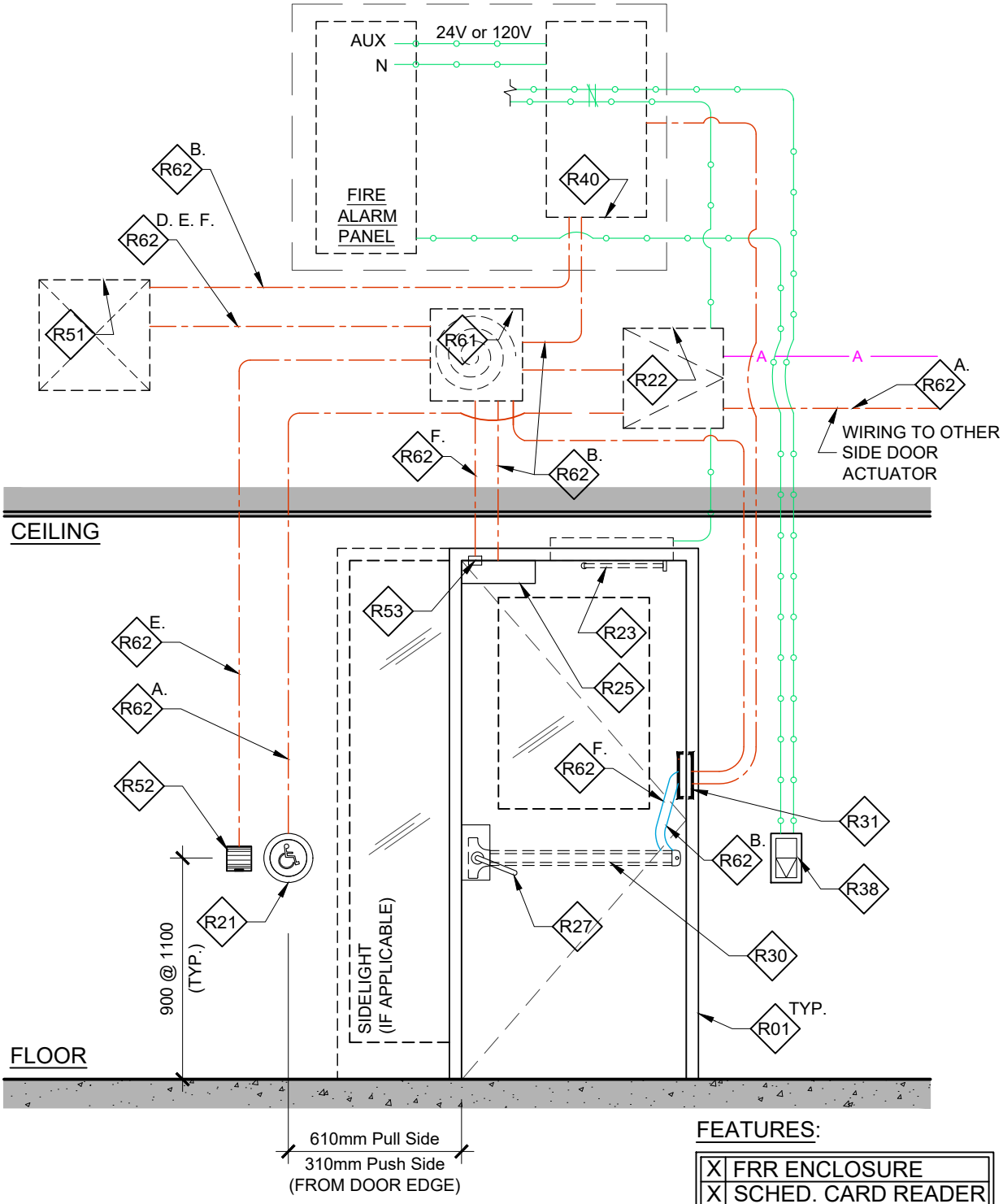
	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-019

SINGLE DOOR WITH / WITHOUT SIDELIGHT

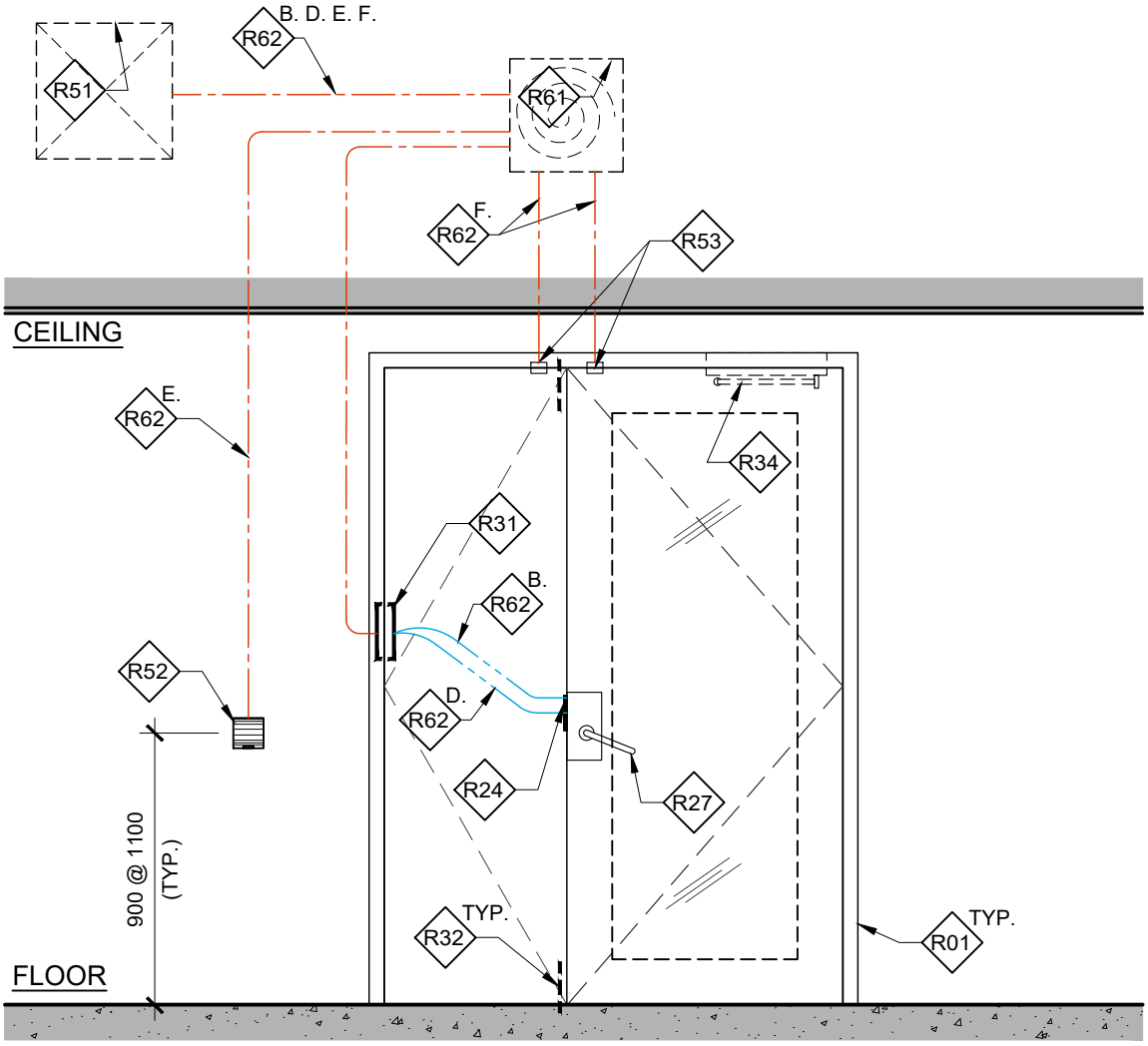
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

A01
1
DR-020
SINGLE DOOR WITH / WITHOUT SIDELIGHT
SCALE: 1:25

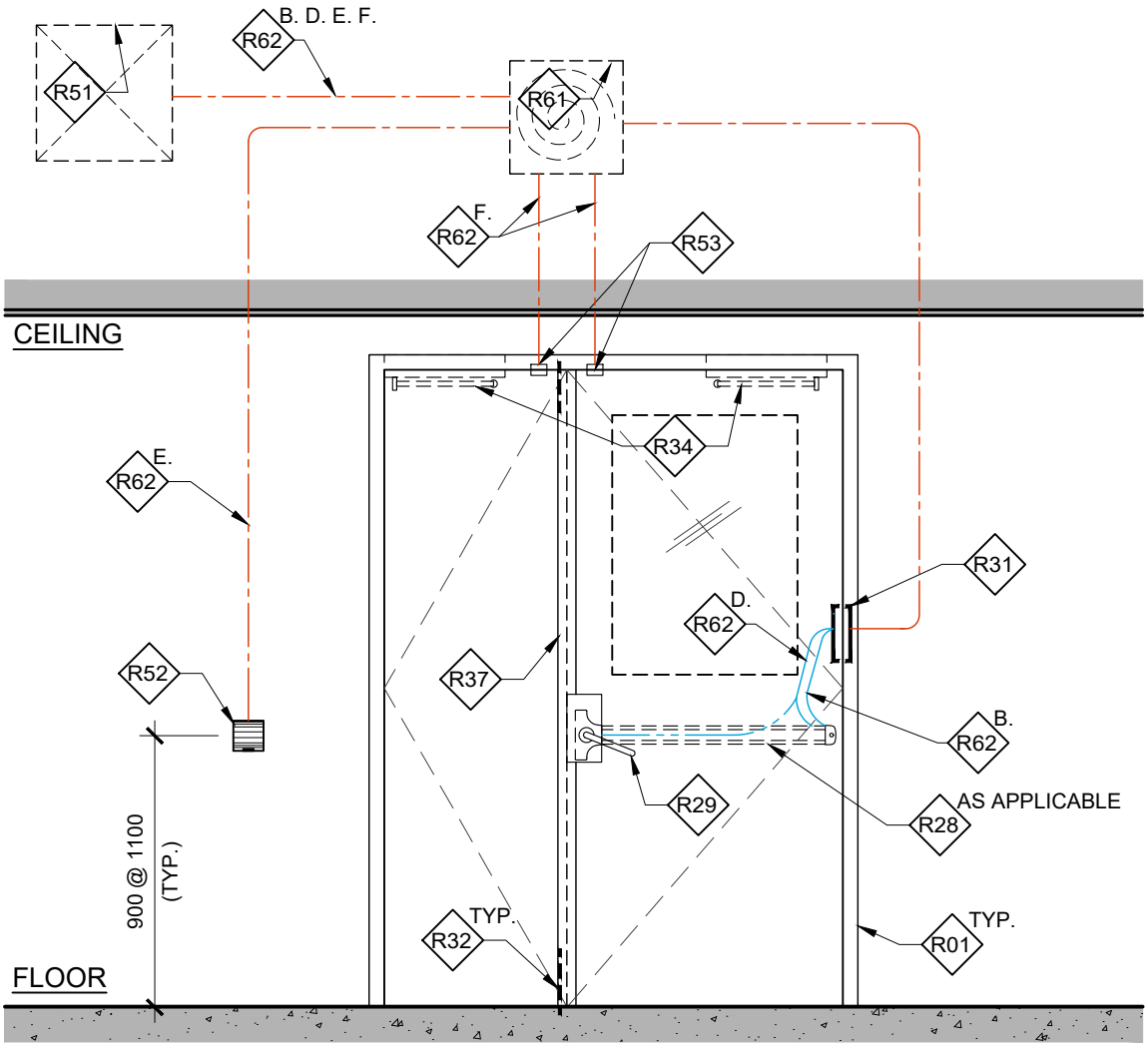


FEATURES:

	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

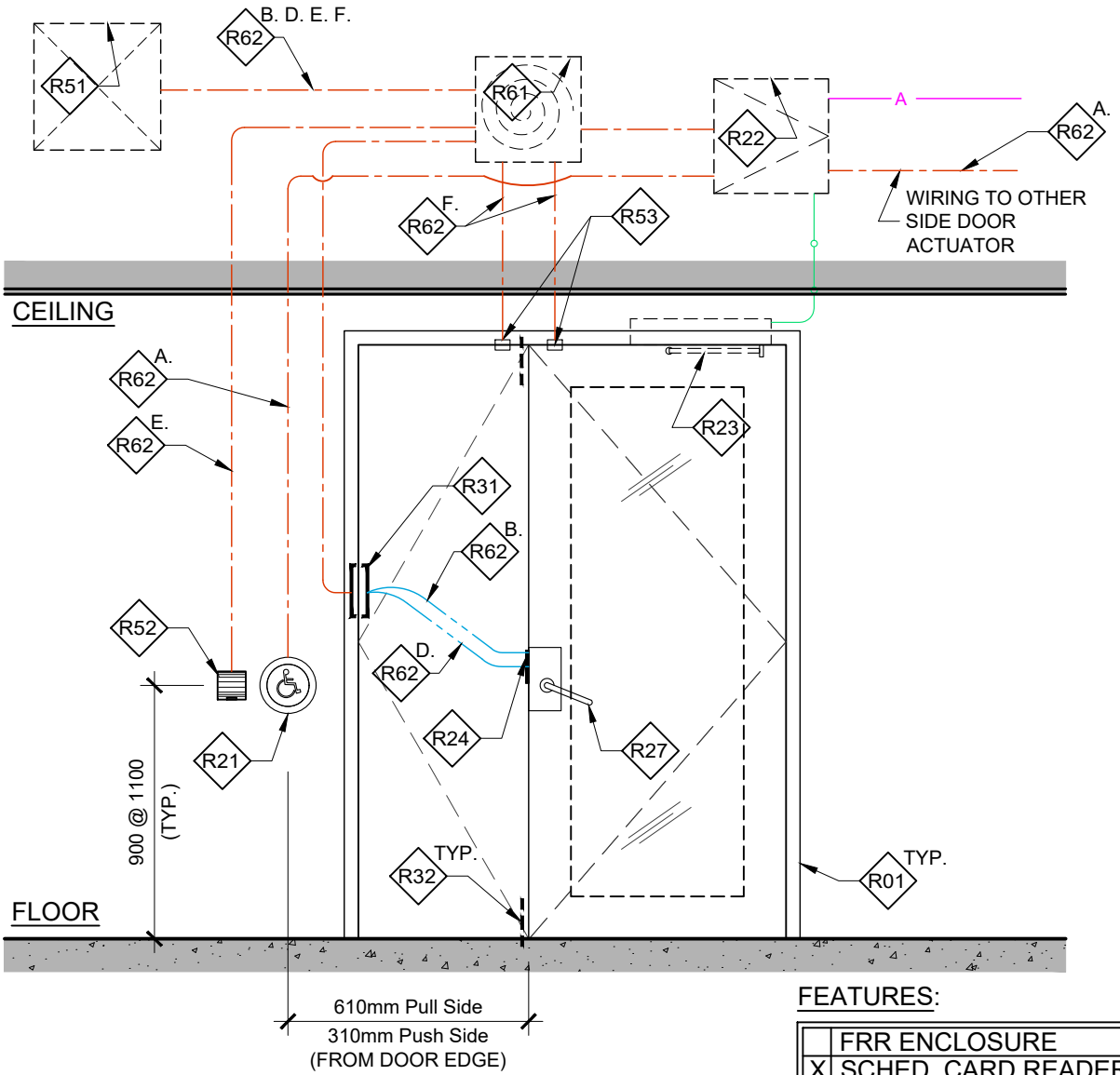
A01
1
DR-030
DOUBLE DOOR / ONE ACTIVE LEAF
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-031
DOUBLE DOOR / ONE ACTIVE LEAF
SCALE: 1:25

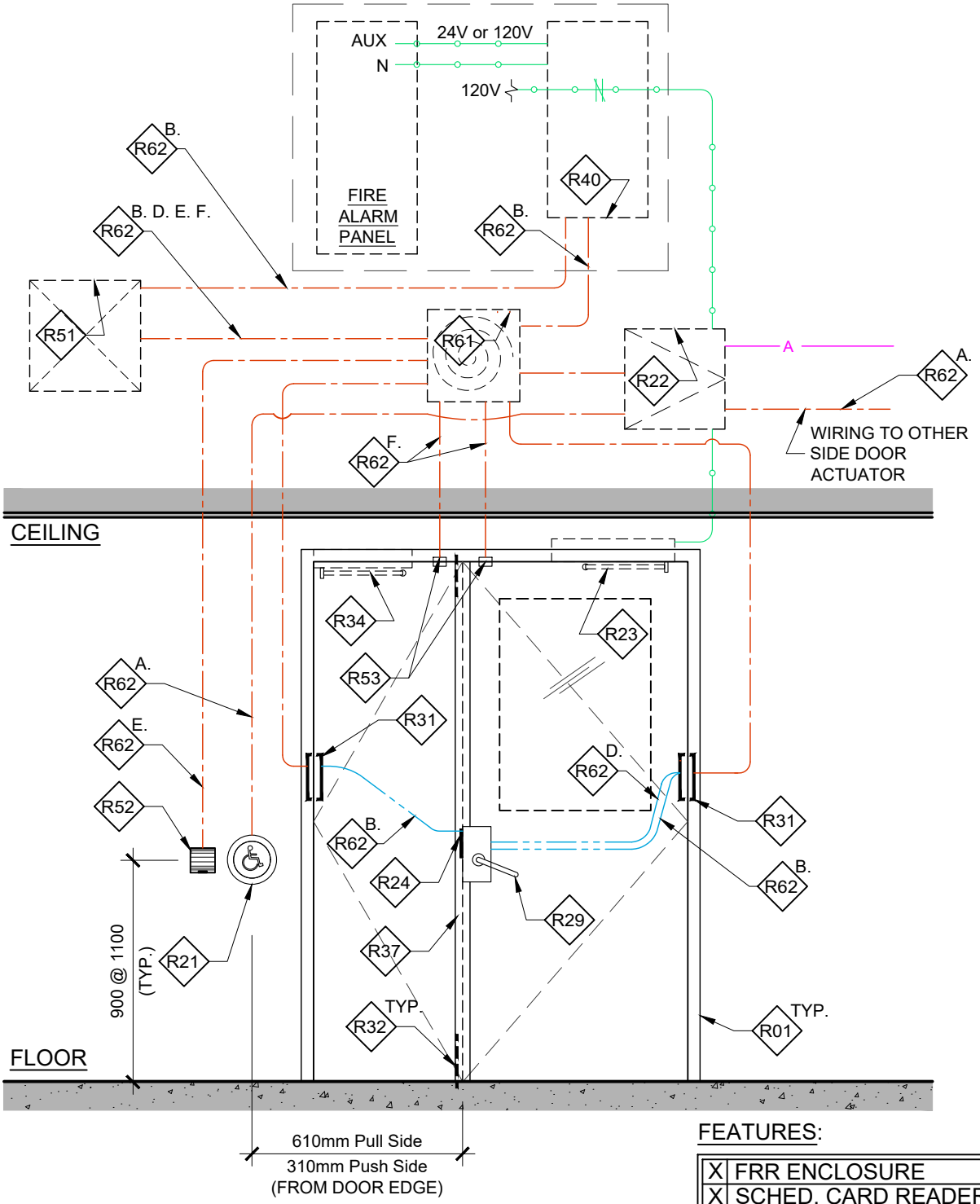


FEATURES:

	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-032
DOUBLE DOOR / ONE ACTIVE LEAF
SCALE: 1:25



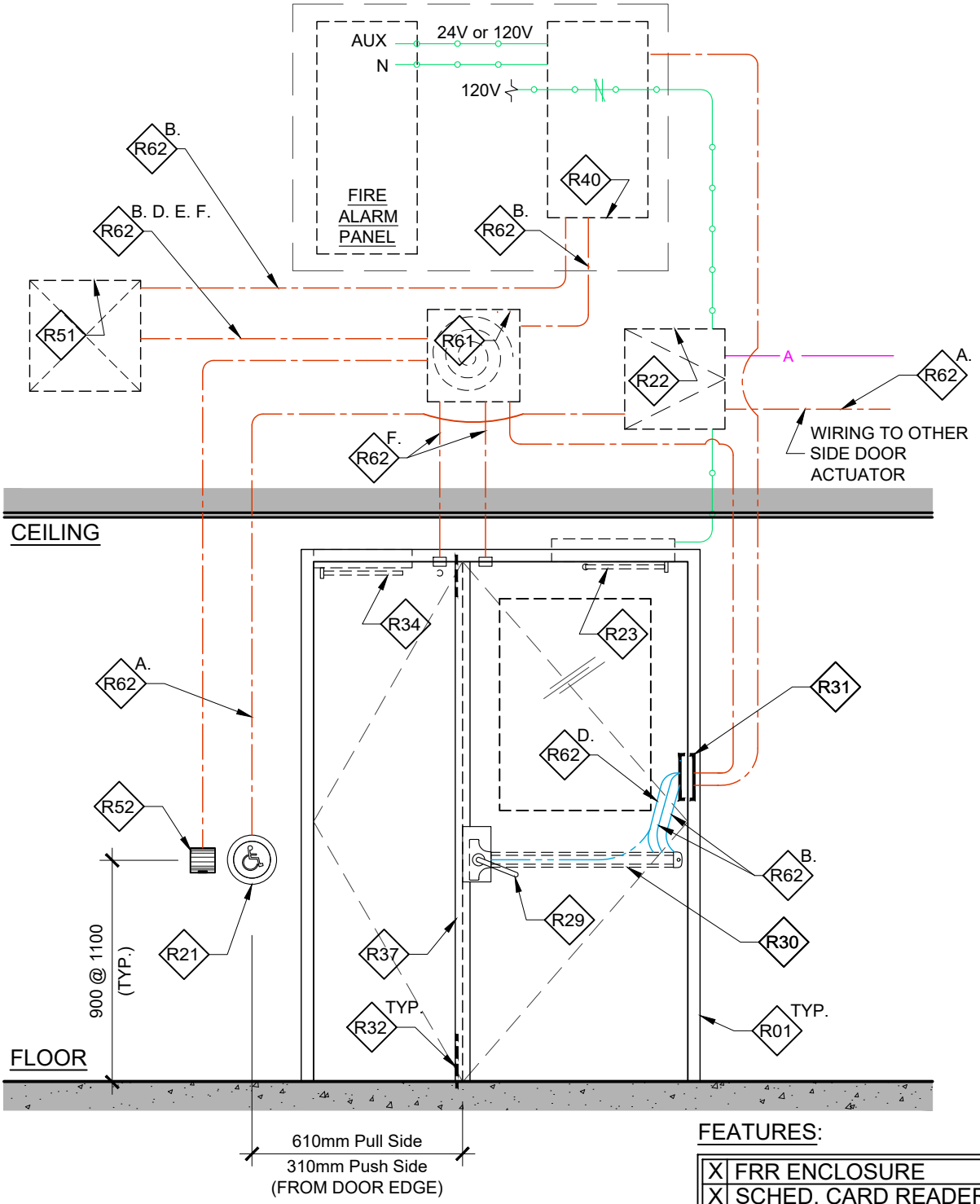
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-033

DOUBLE DOOR / ONE ACTIVE LEAF

SCALE: 1:25



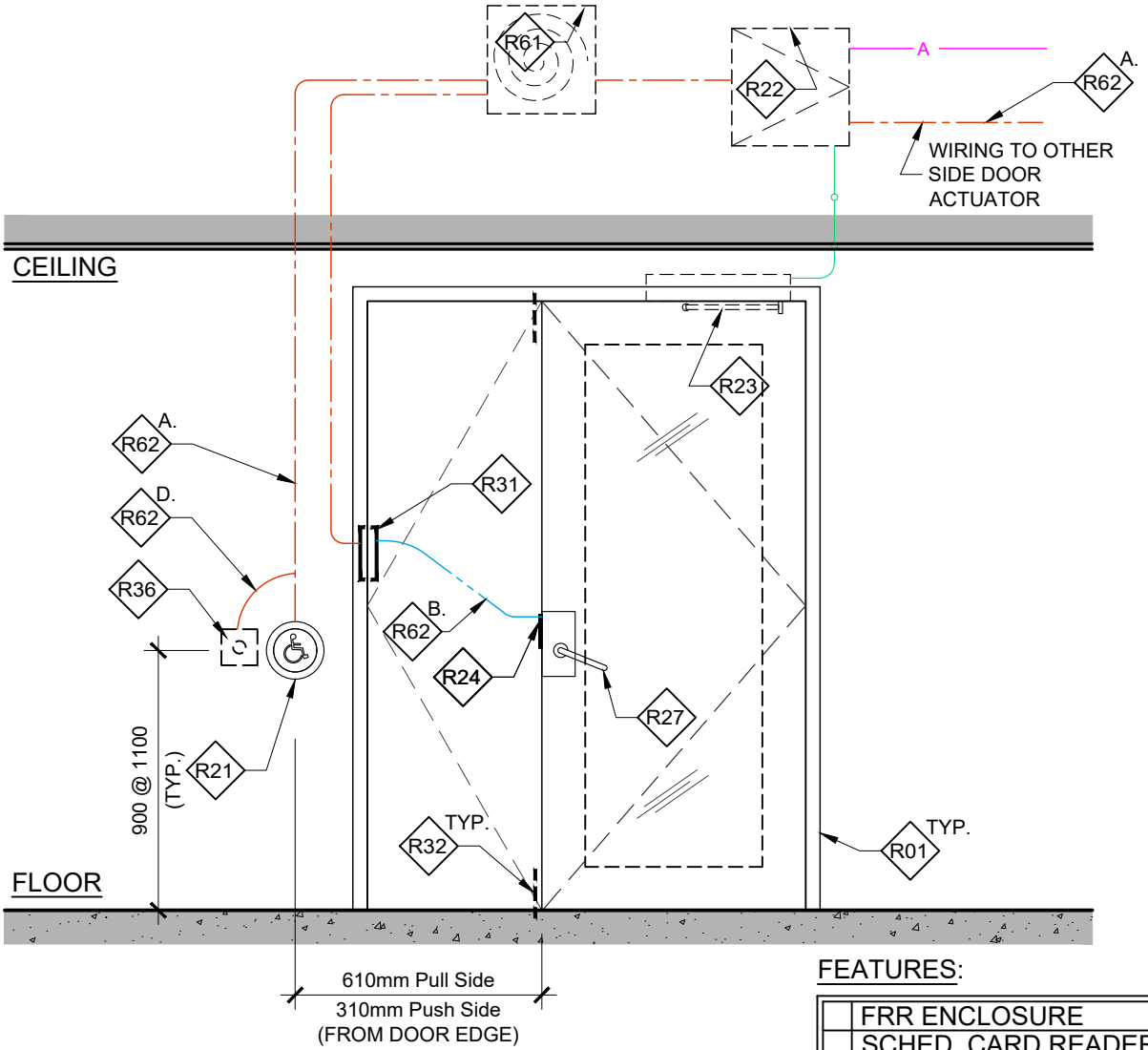
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-034

DOUBLE DOOR / ONE ACTIVE LEAF

SCALE: 1:25



FEATURES:

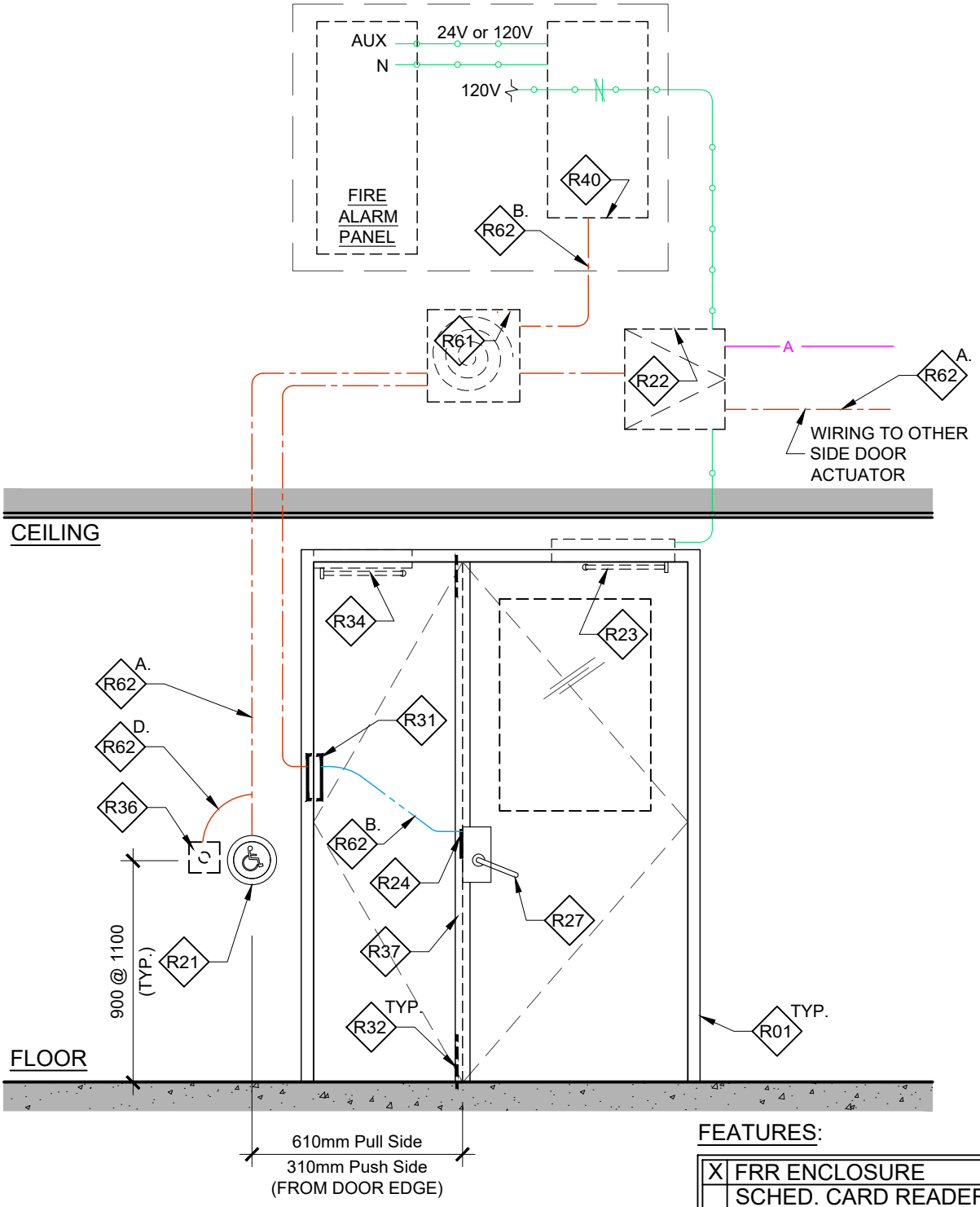
	FRR ENCLOSURE
	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
X	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-035

DOUBLE DOOR / ONE ACTIVE LEAF

SCALE: 1:25



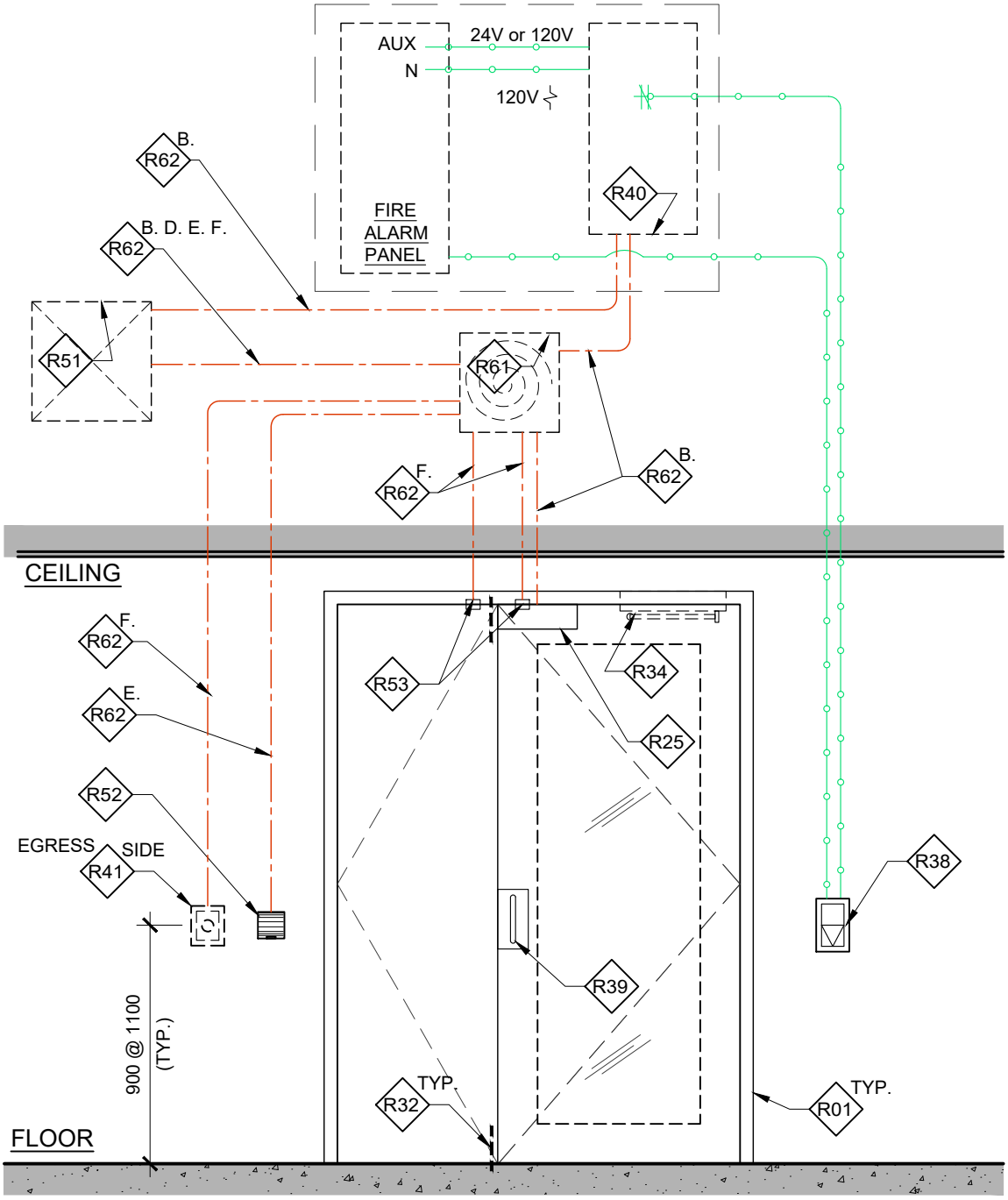
FEATURES:

X	FRR ENCLOSURE
	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
X	KEY SWITCH

A01
1
DR-036

DOUBLE DOOR / ONE ACTIVE LEAF

SCALE: 1:25

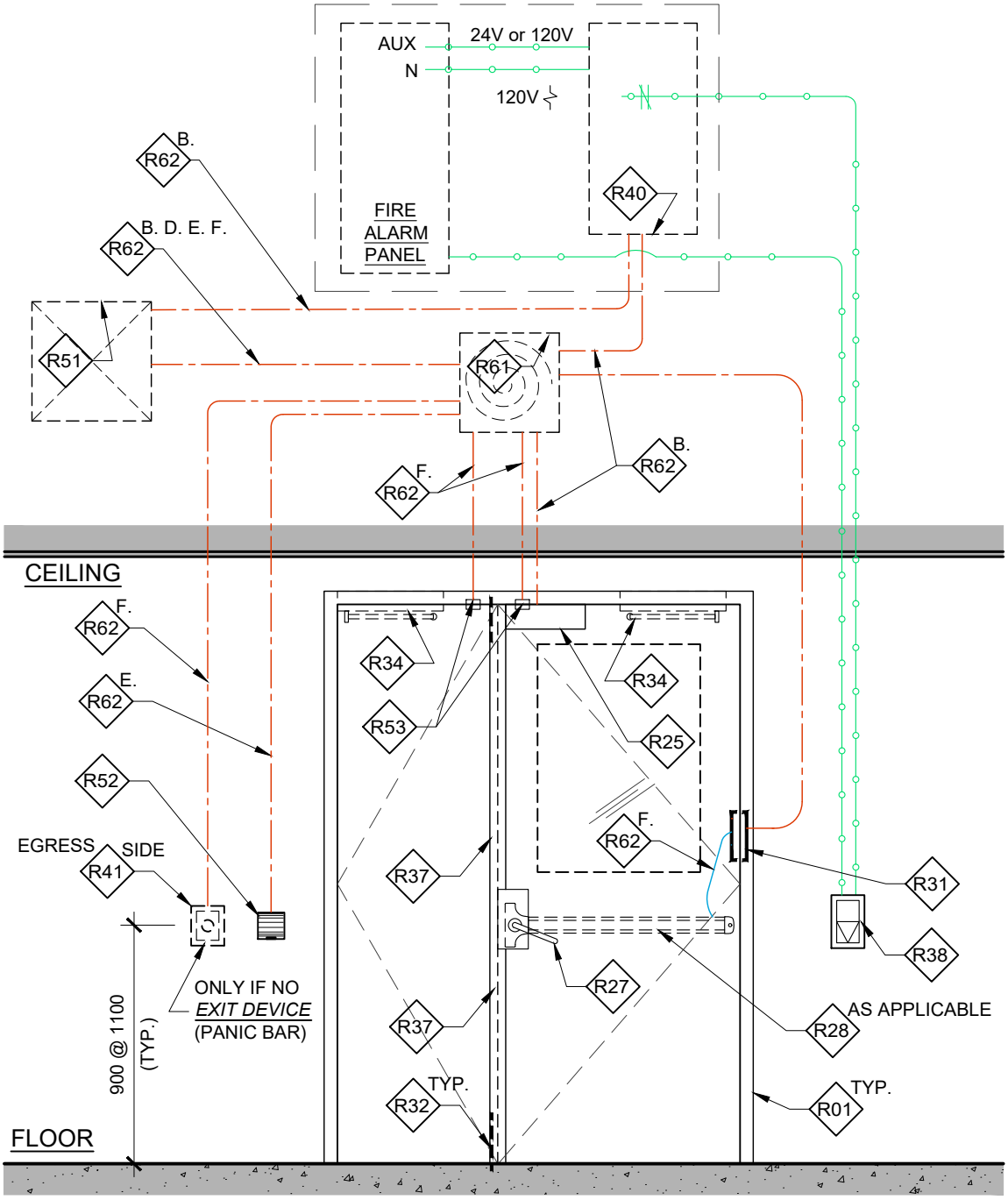


FEATURES:

	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-037
DOUBLE DOOR / ONE ACTIVE LEAF
SCALE: 1:25



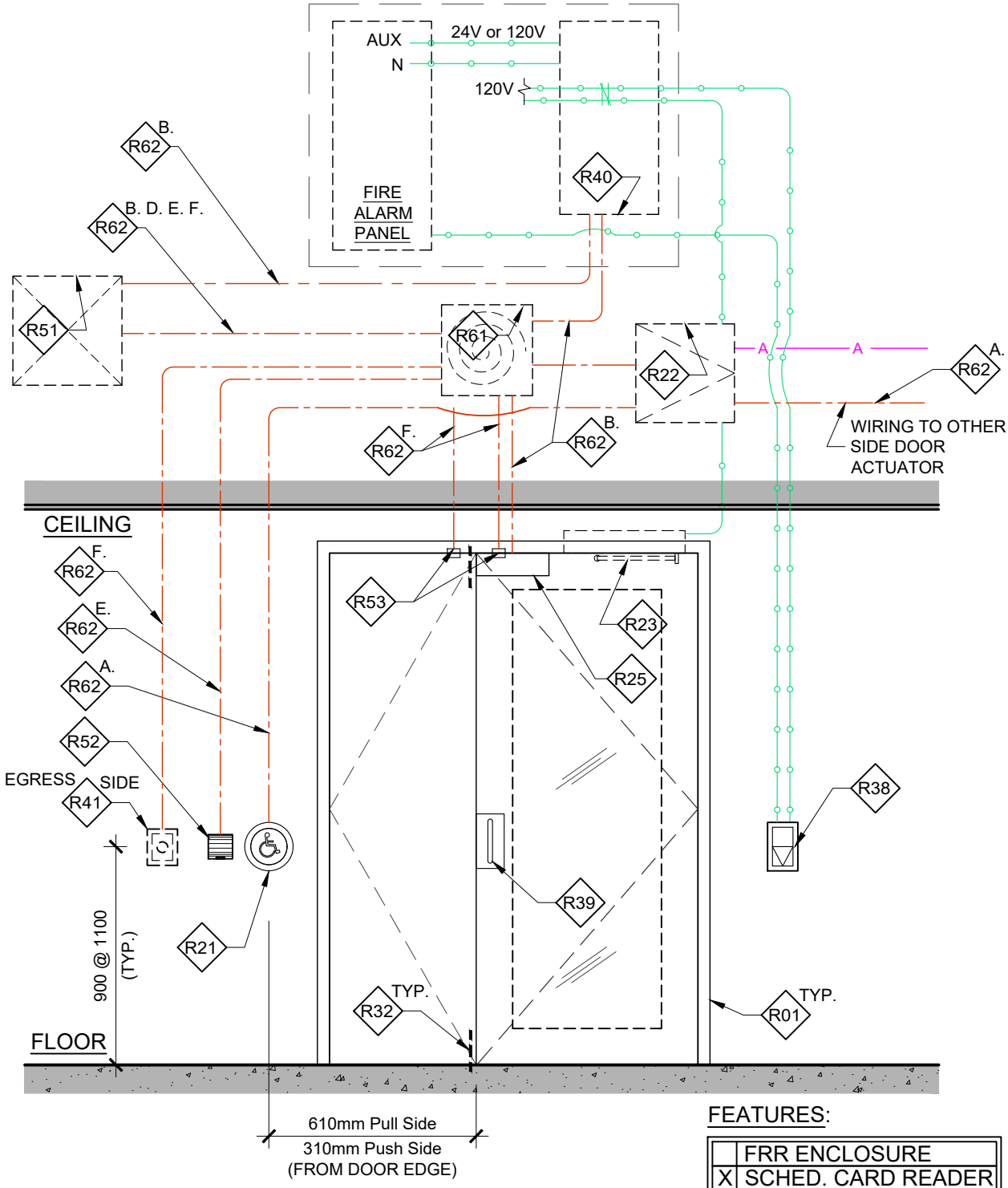
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

A01
1
DR-038

DOUBLE DOOR / ONE ACTIVE LEAF

SCALE: 1:25



FEATURES:

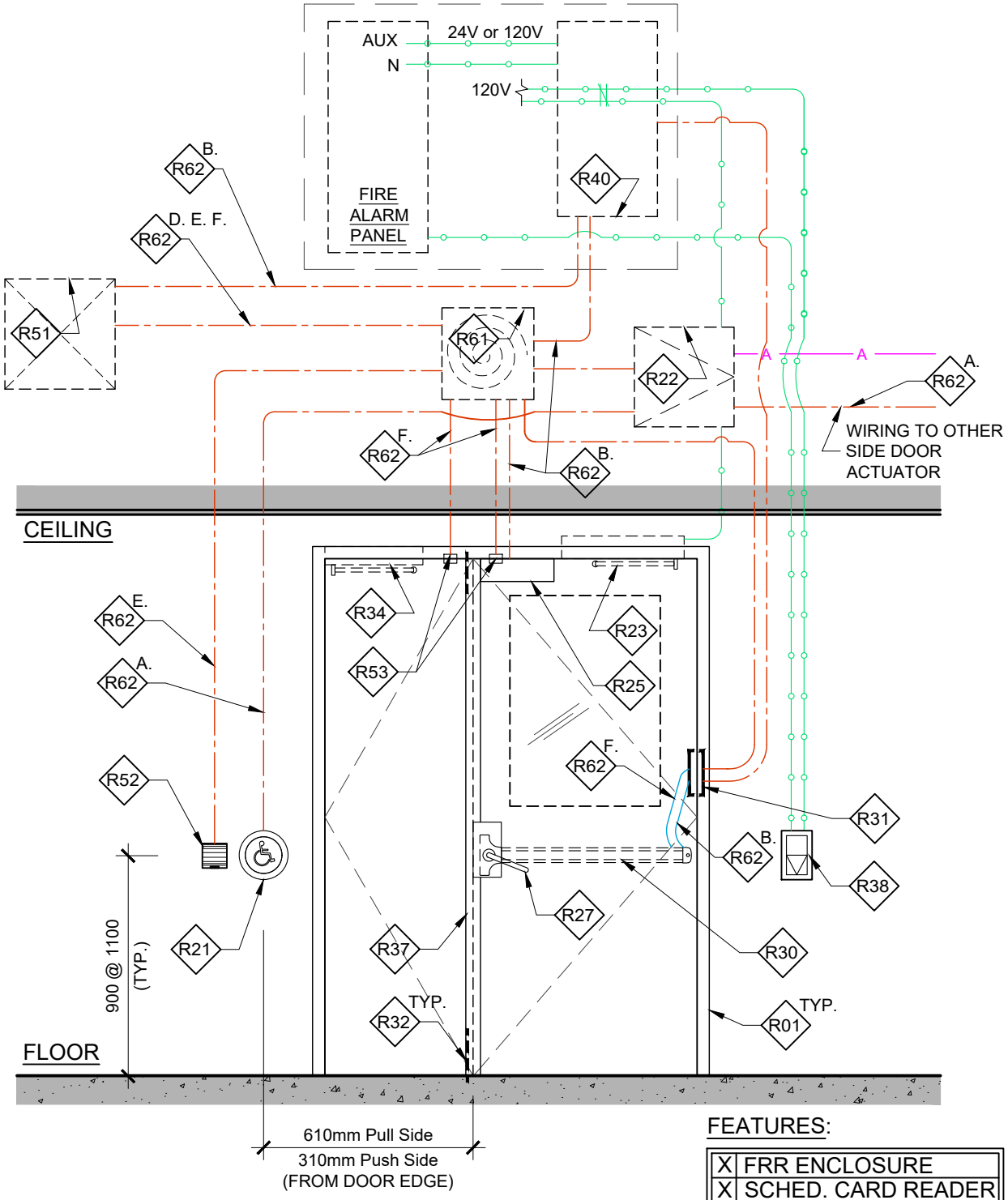
	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-039

DOUBLE DOOR / ONE ACTIVE LEAF

SCALE: 1:25



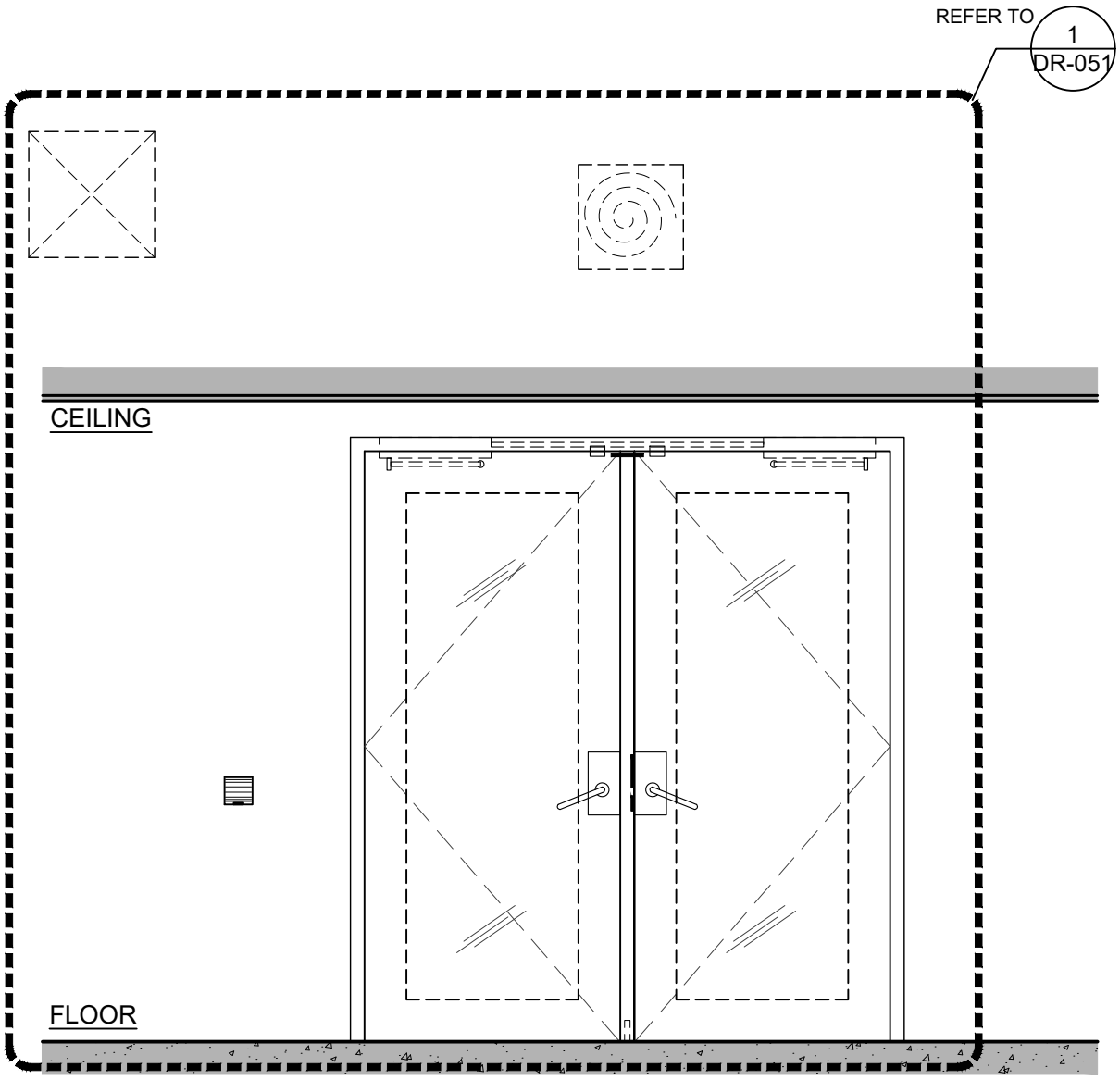
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

A01
1
DR-040

DOUBLE DOOR / ONE ACTIVE LEAF

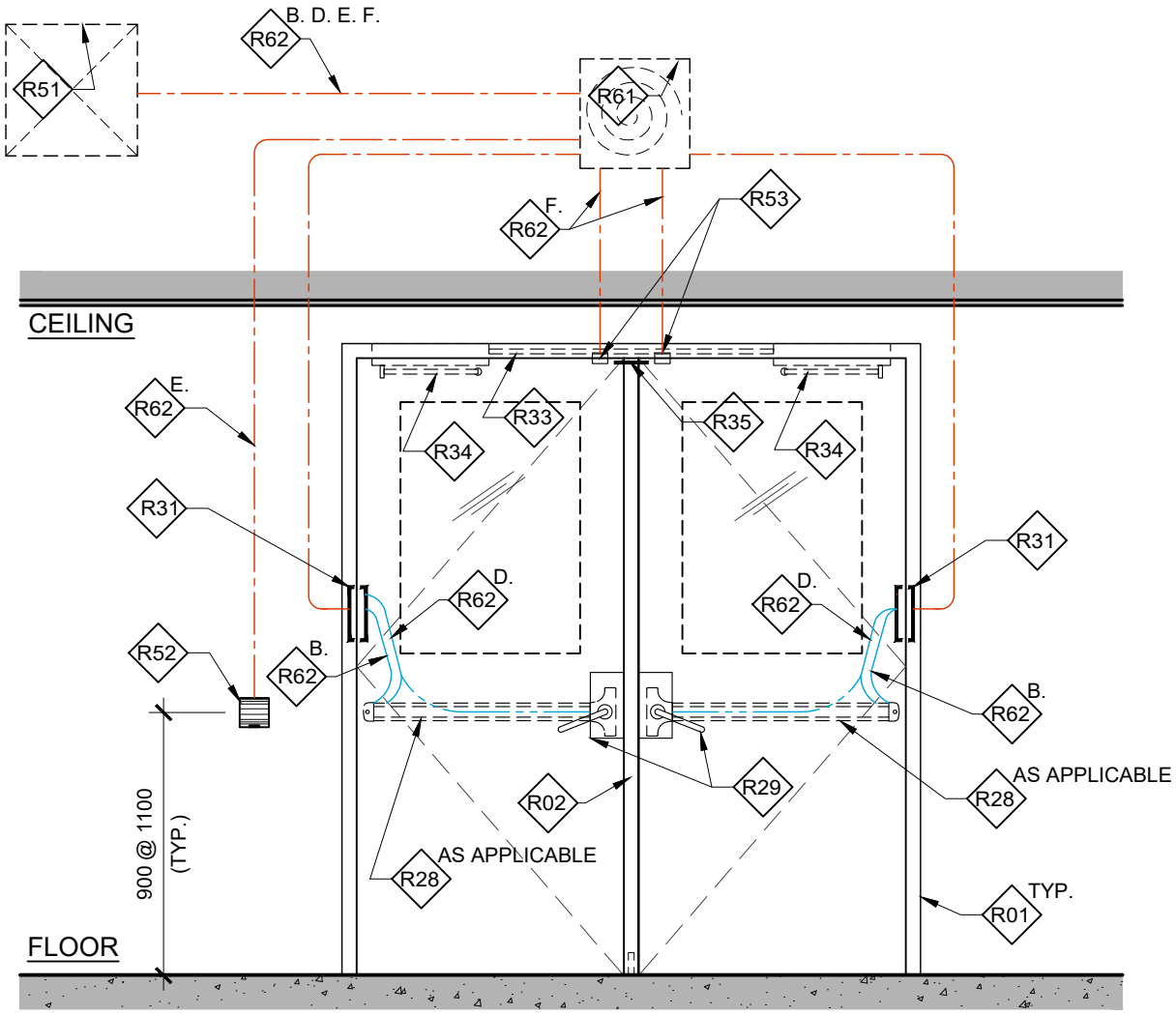
SCALE: 1:25



FEATURES:

	FRR ENCLOSURE
X	SCHED. CARD READER
	PANIC BAR
	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

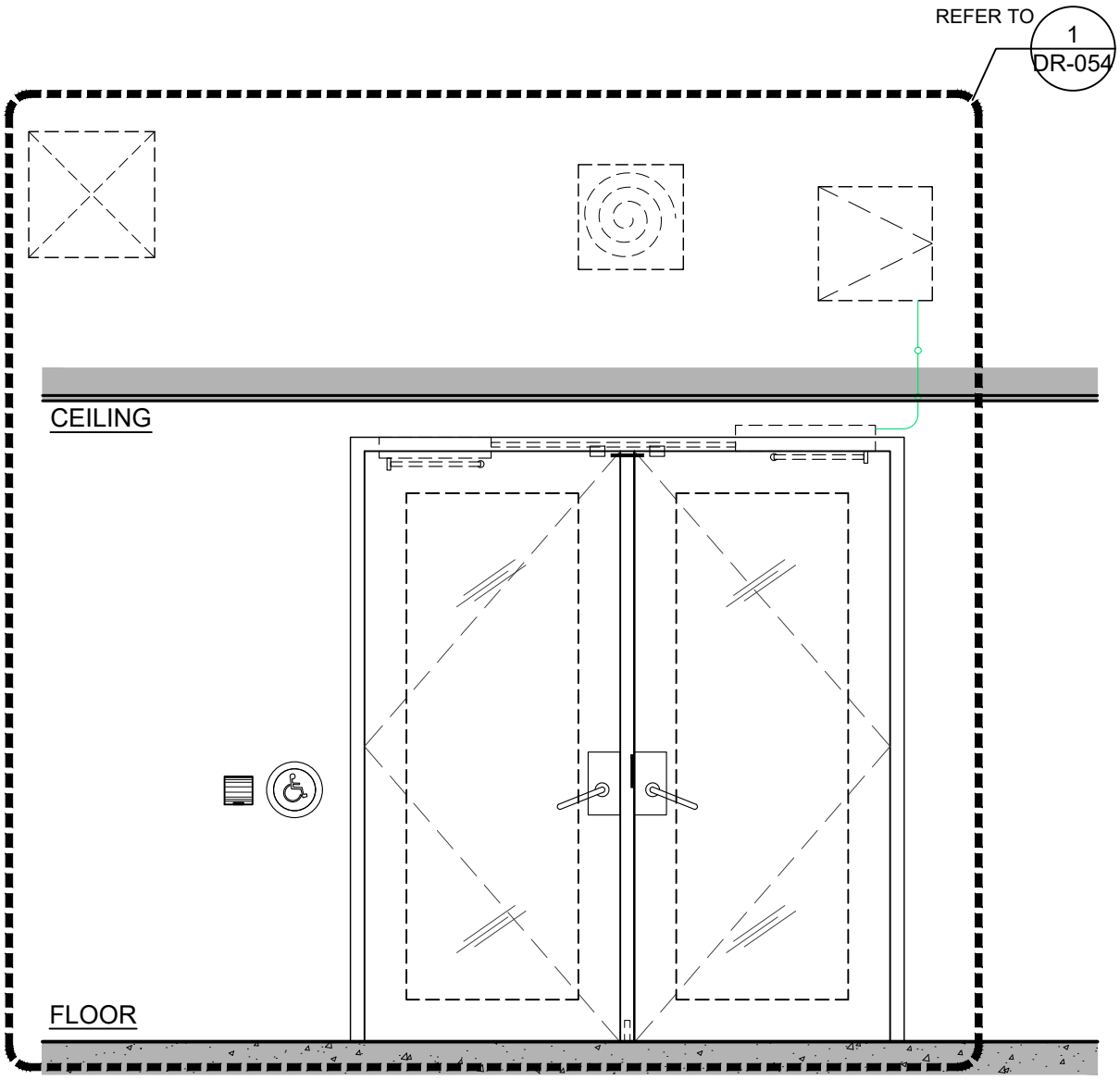
A01
1
DR-050
DOUBLE DOOR / TWO ACTIVE LEAVES
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

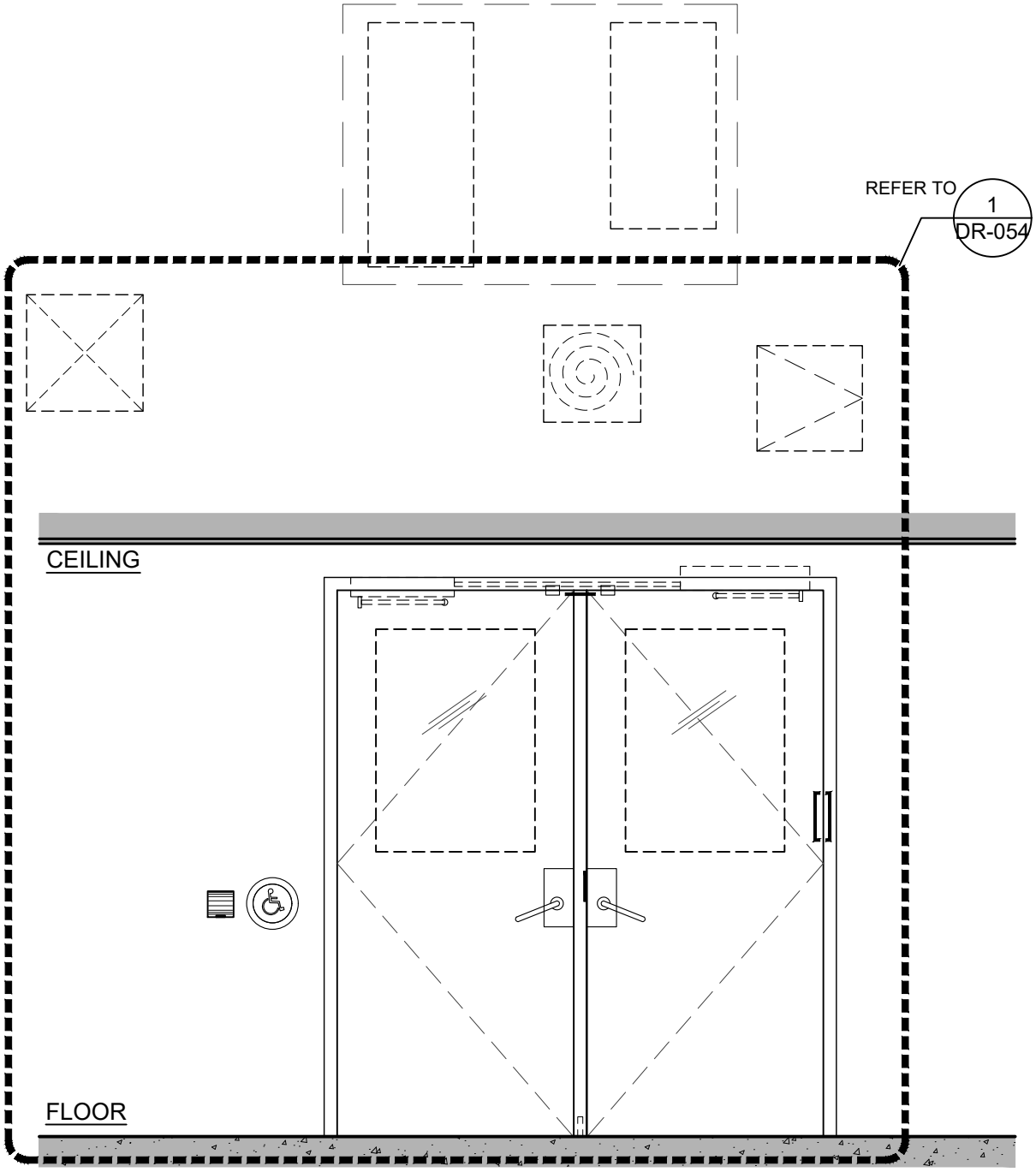
A01
1
DR-051
DOUBLE DOOR / TWO ACTIVE LEAVES
SCALE: 1:25



FEATURES:

	FRR ENCLOSURE
X	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-052
DOUBLE DOOR / TWO ACTIVE LEAVES
SCALE: 1:25



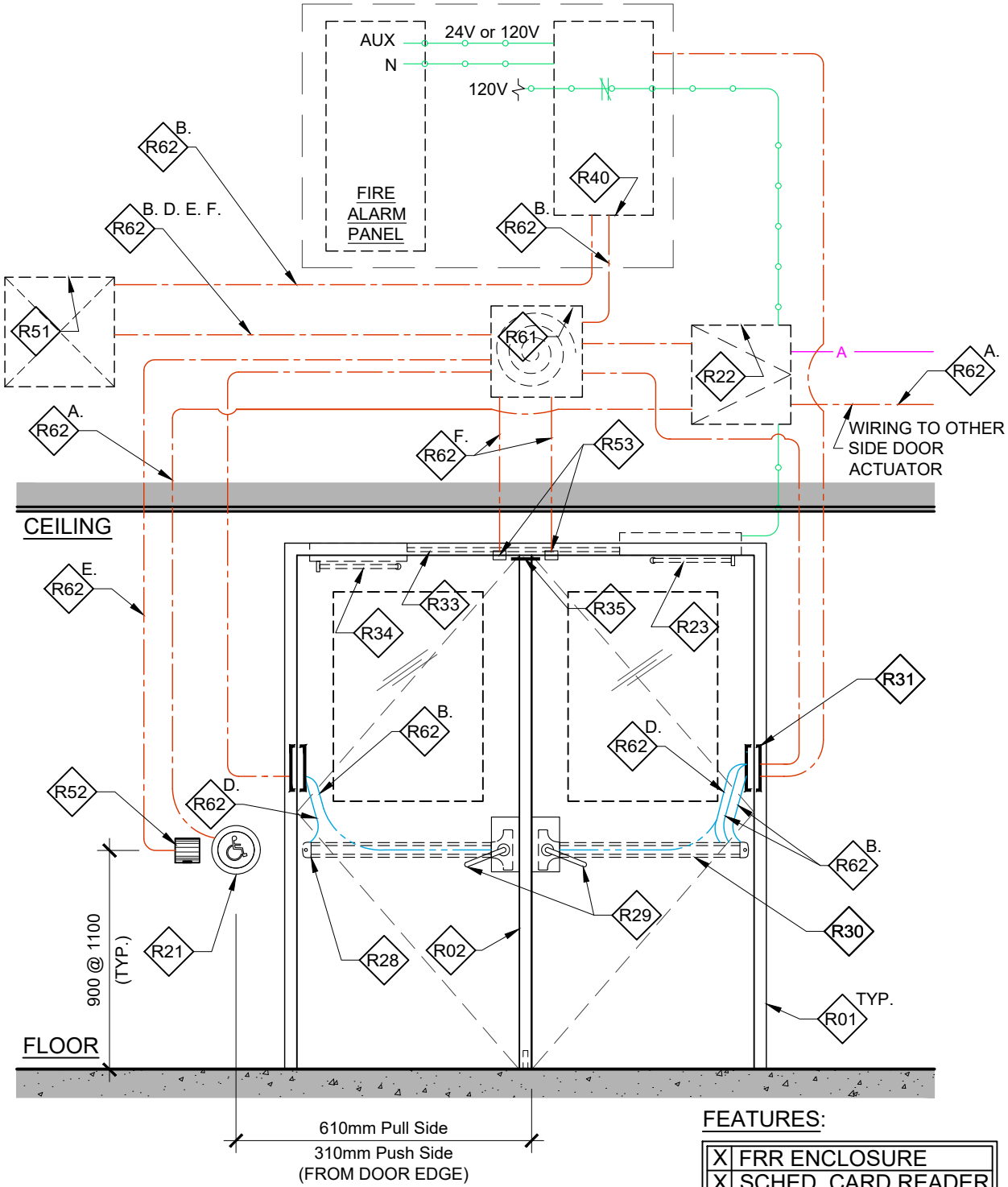
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-053

DOUBLE DOOR / TWO ACTIVE LEAVES

SCALE: 1:25



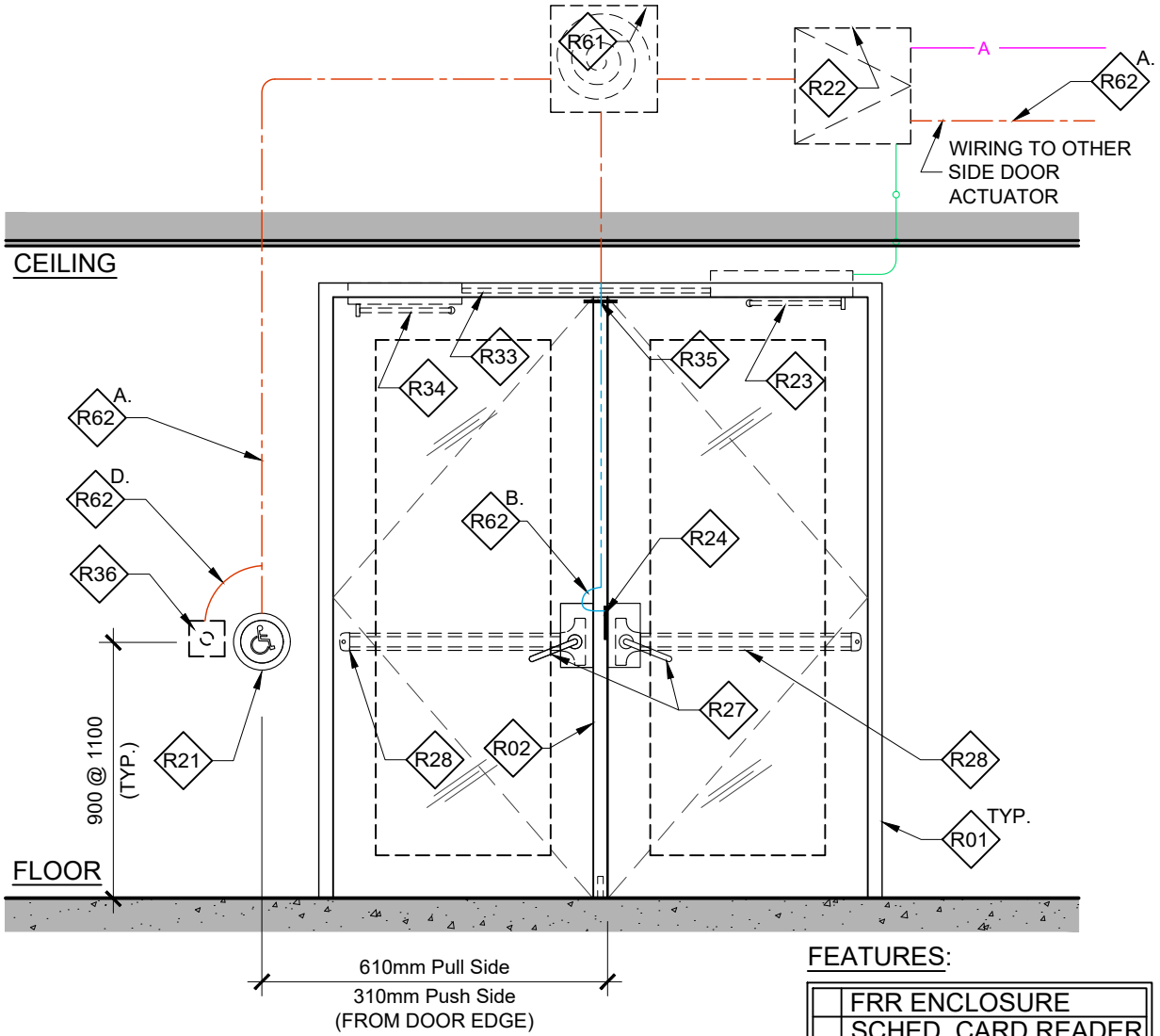
FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
	KEY SWITCH

A01
1
DR-054

DOUBLE DOOR / TWO ACTIVE LEAVES

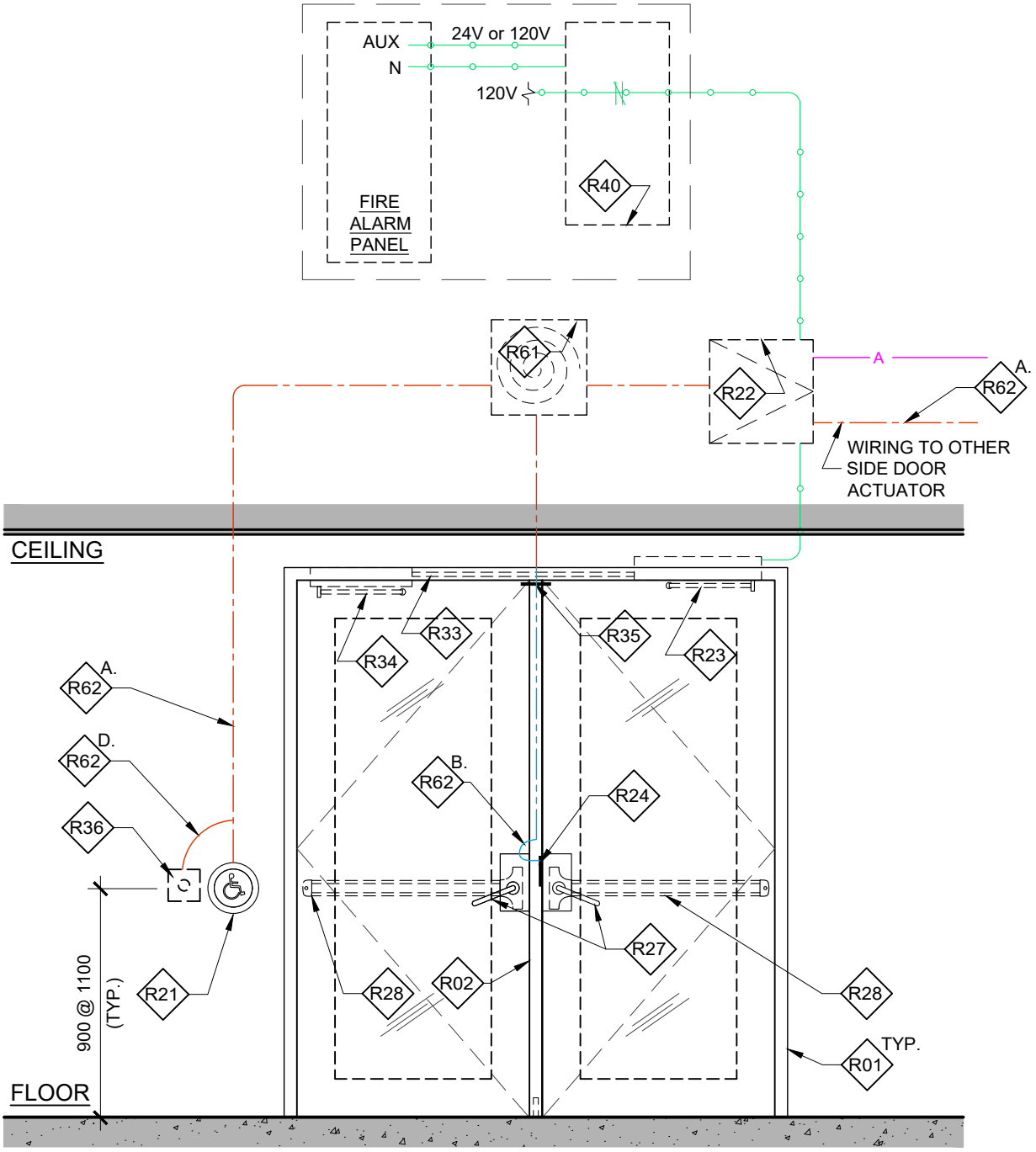
SCALE: 1:25



FEATURES:

	FRR ENCLOSURE
	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
X	KEY SWITCH

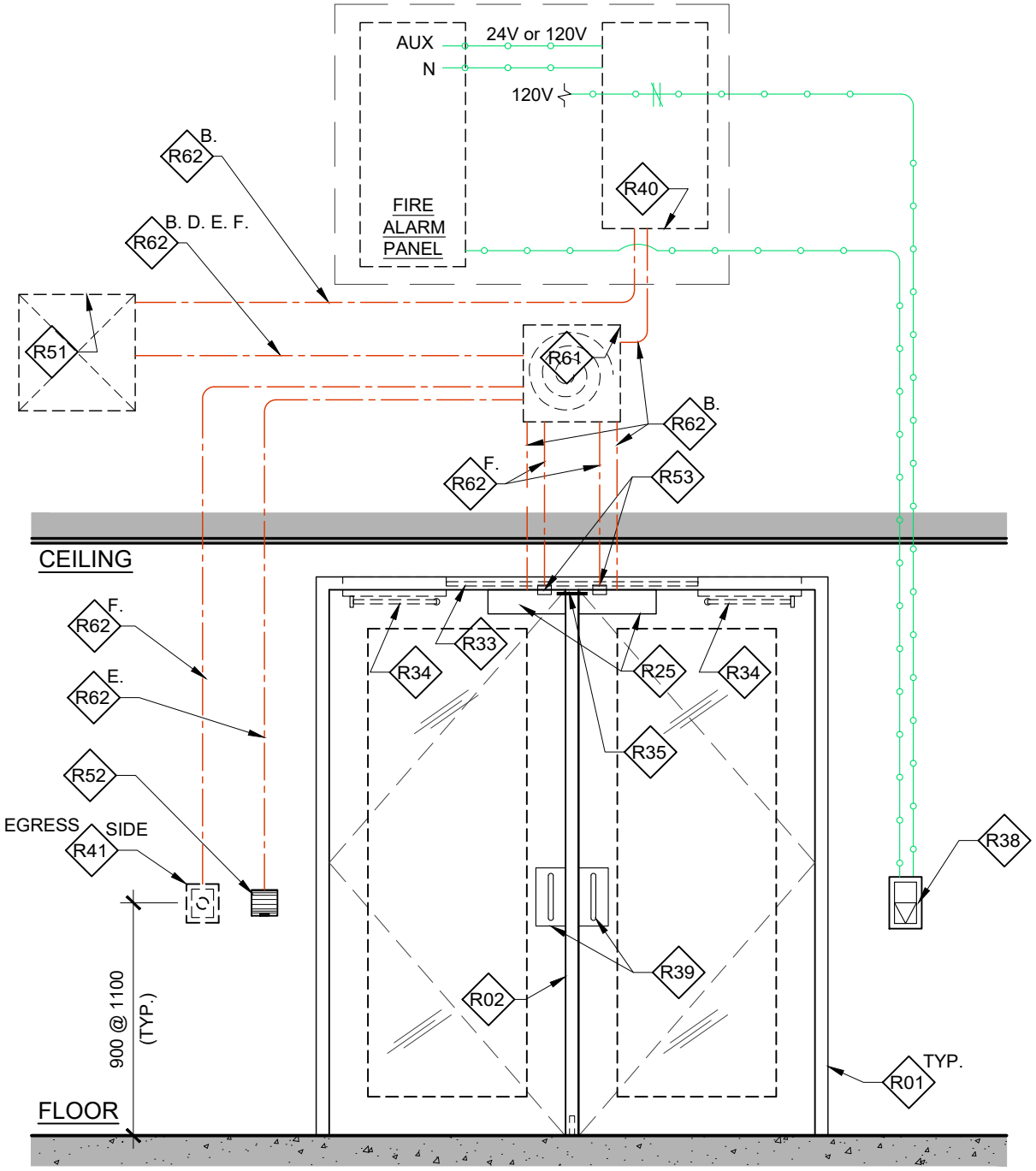
A01
1
DR-055
DOUBLE DOOR / TWO ACTIVE LEAVES
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
	SCHED. CARD READER
	PANIC BAR
X	DOOR OPERATOR
	MAGLOCK
X	KEY SWITCH

A01
1
DR-056
DOUBLE DOOR / TWO ACTIVE LEAVES
SCALE: 1:25

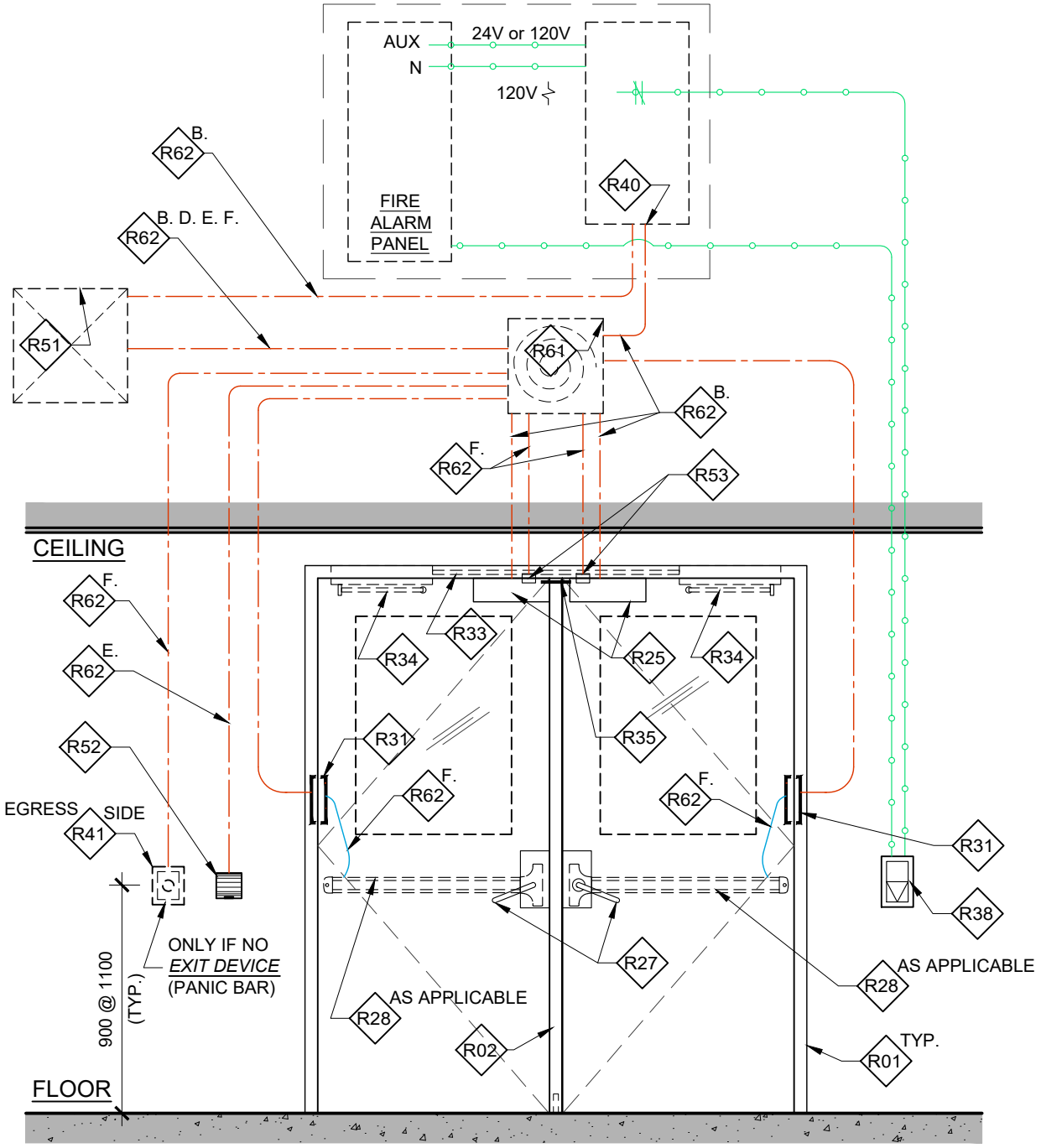


FEATURES:

	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

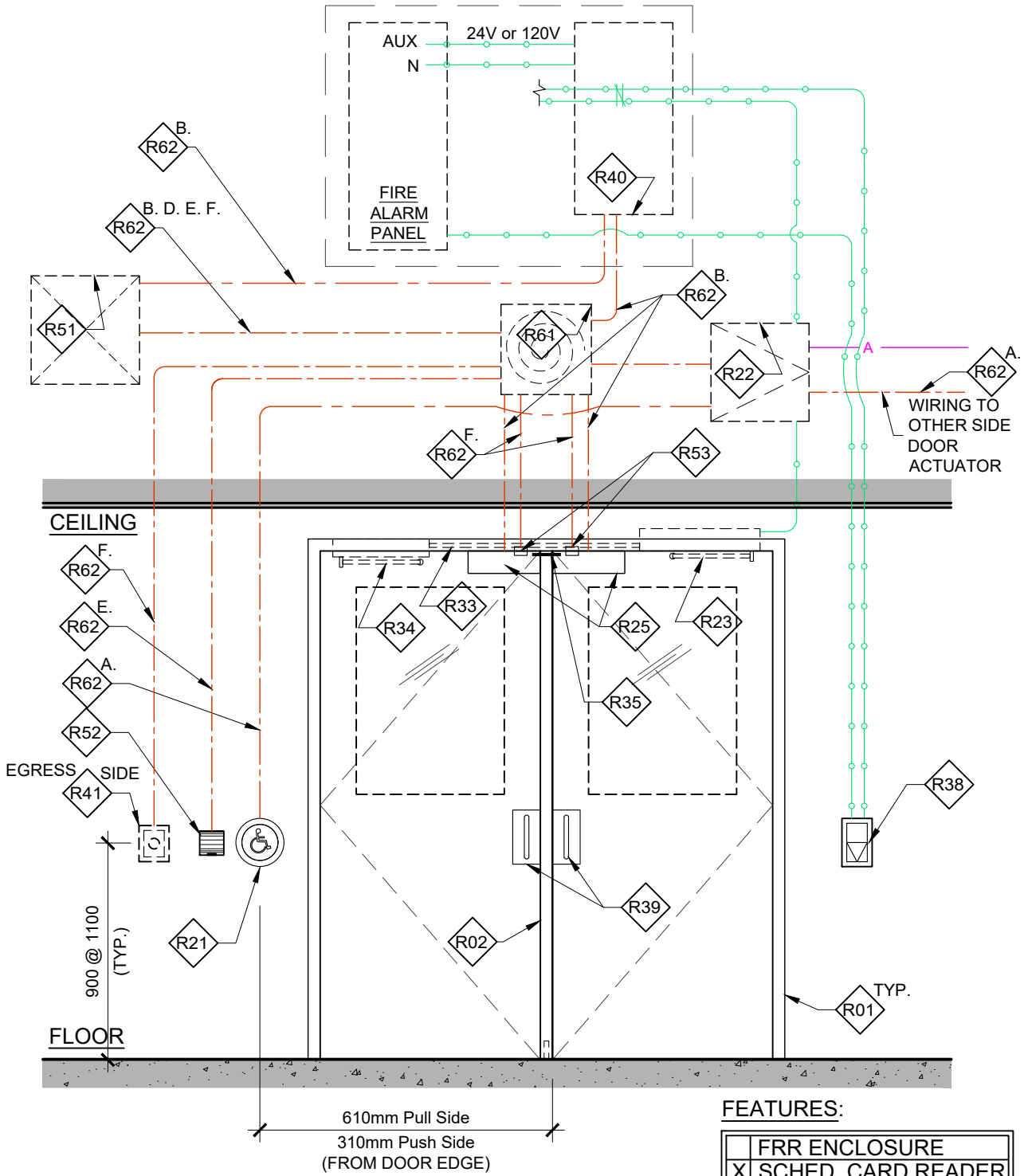
A01
1
DR-057
DOUBLE DOOR / TWO ACTIVE LEAVES
SCALE: 1:25



FEATURES:

X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

A01
1
DR-058
DOUBLE DOOR TWO ACTIVE LEAVES
SCALE: 1:25



FEATURES:

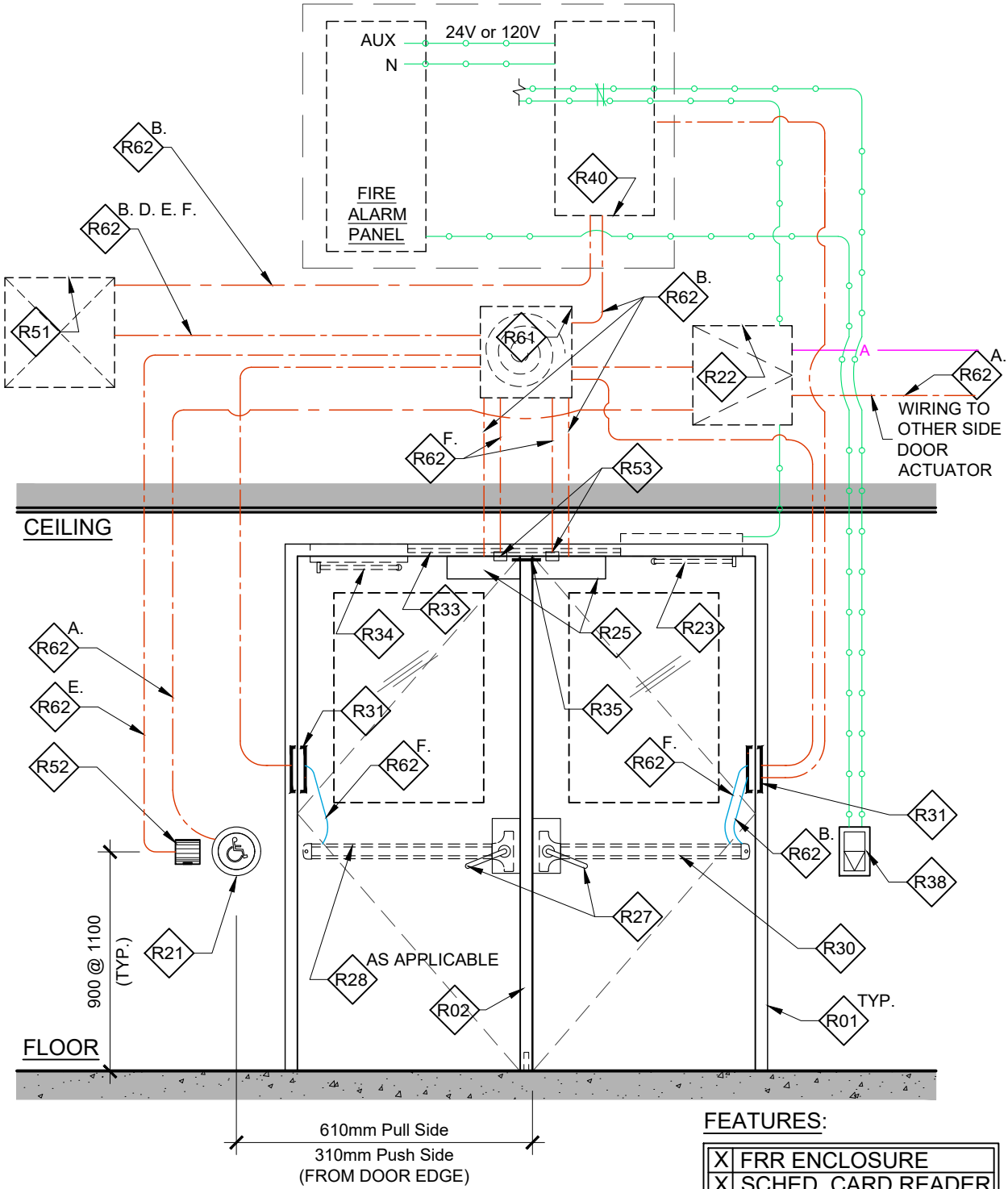
	FRR ENCLOSURE
X	SCHED. CARD READER
*	PANIC BAR
X	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

* REFER TO FRR SCENARIOS

A01
1
DR-059

DOUBLE DOOR / TWO ACTIVE LEAVES

SCALE: 1:25



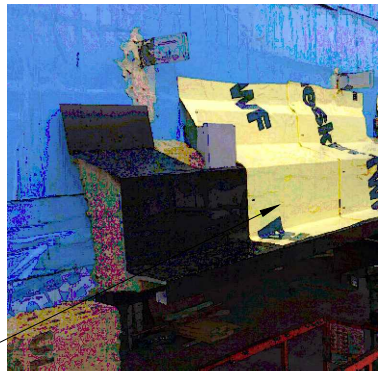
FEATURES:

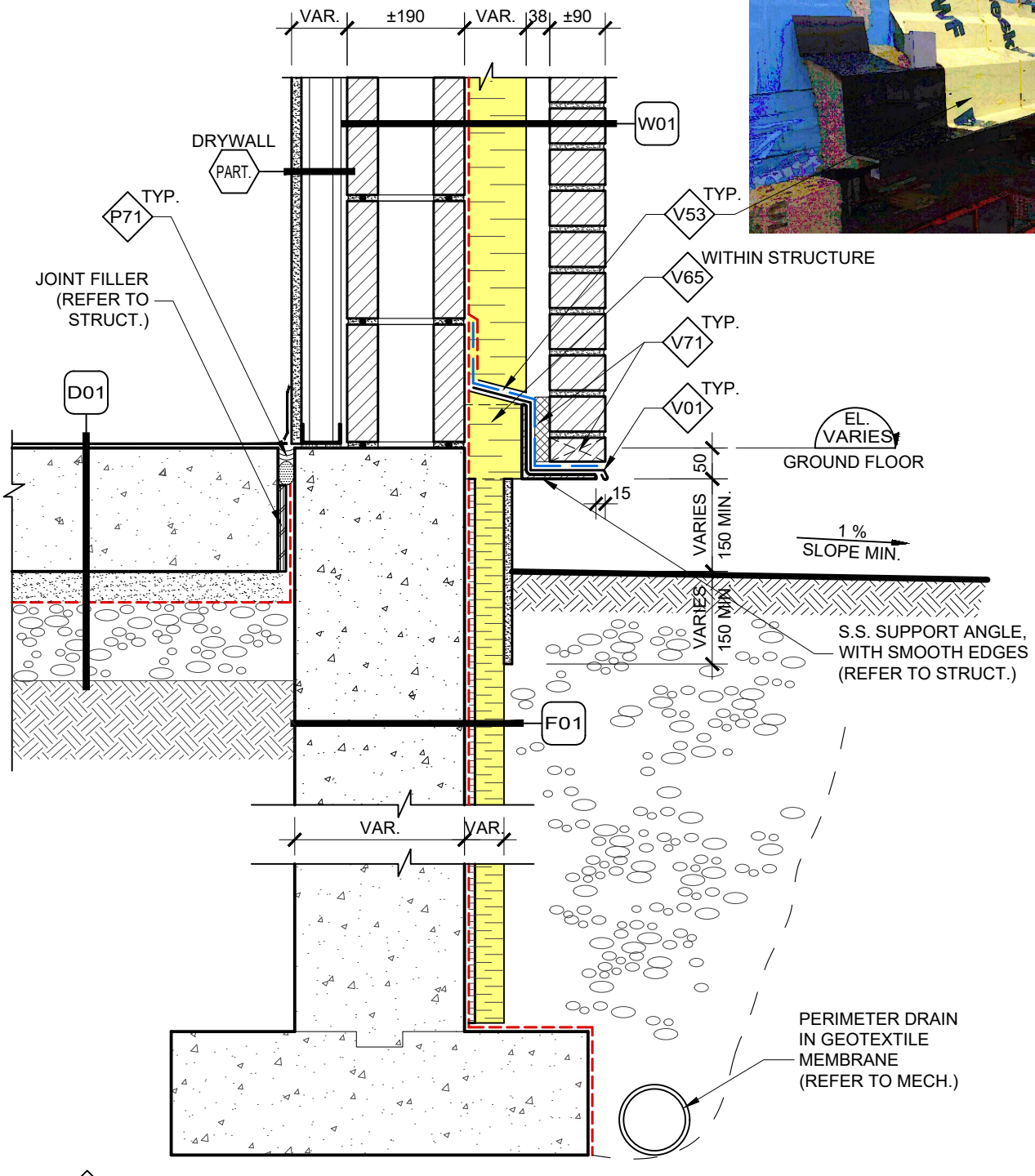
X	FRR ENCLOSURE
X	SCHED. CARD READER
X	PANIC BAR
X	DOOR OPERATOR
X	MAGLOCK
	KEY SWITCH

A01
1
DR-060

DOUBLE DOOR TWO ACTIVE LEAVES

SCALE: 1:25

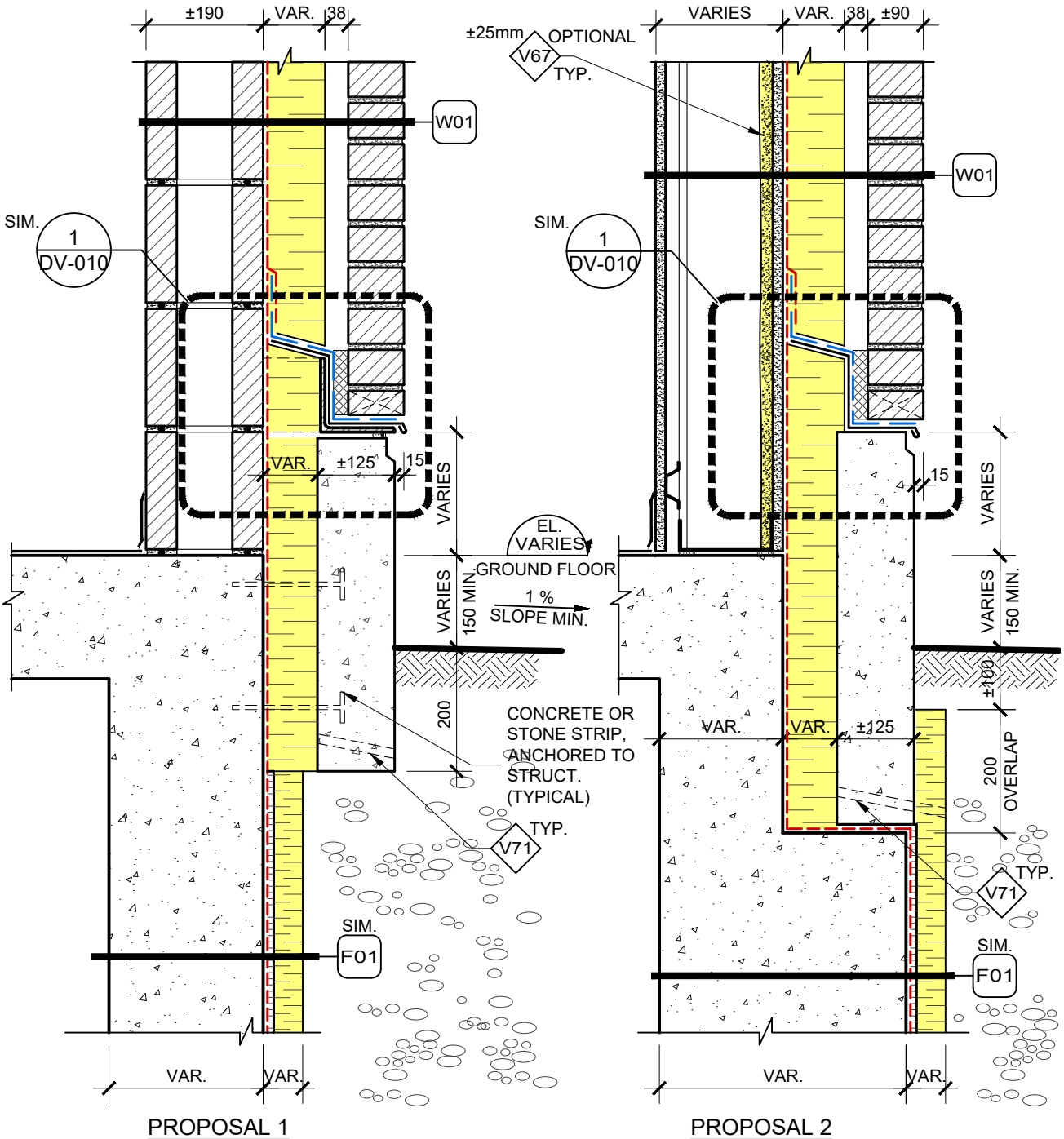




A01
1
DV-010

MASONRY CLADDING FOUNDATION - RECESSED EDGE SECTION DETAIL (TYPICAL)

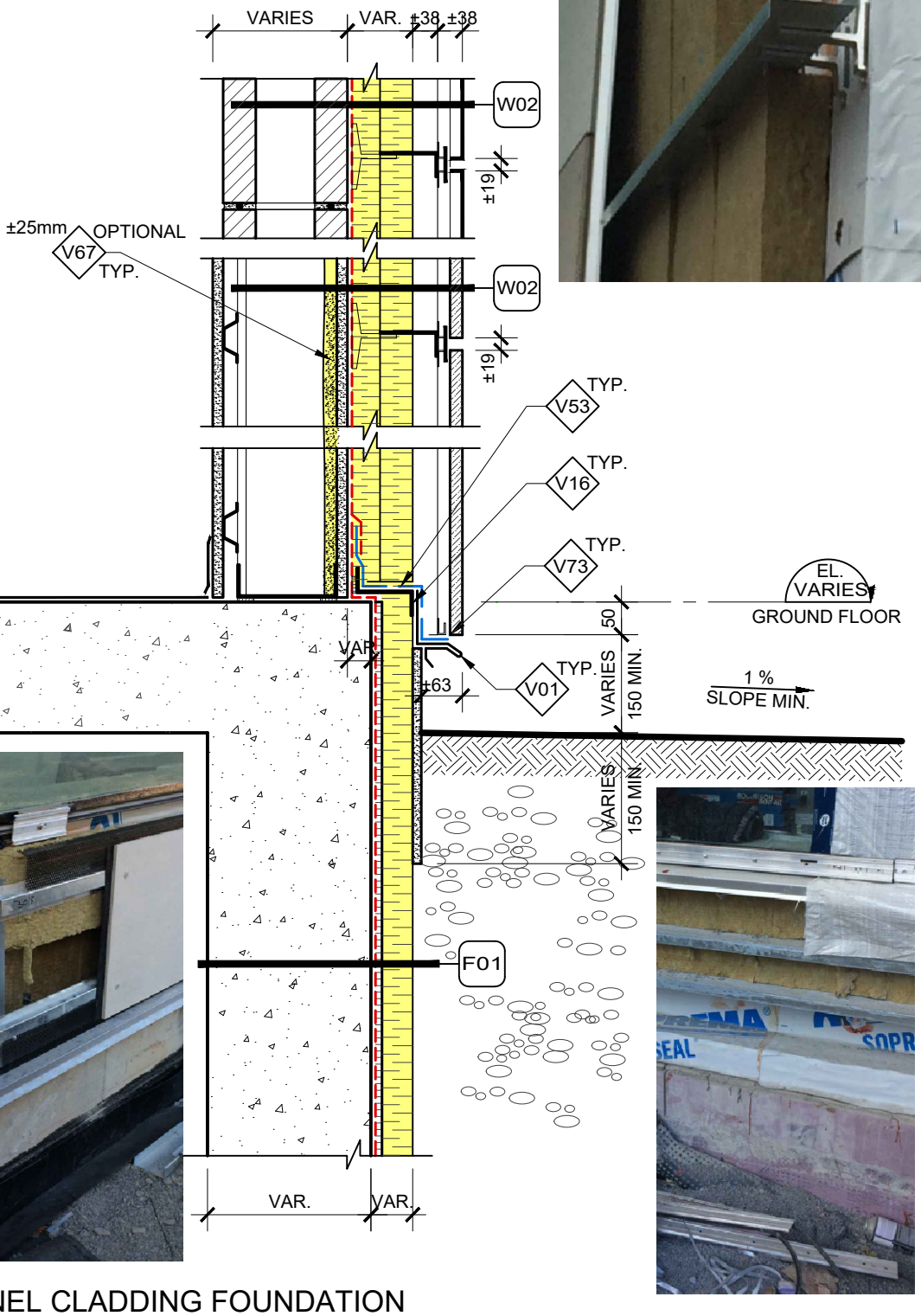
SCALE: 1:10



A01
1
DV-011

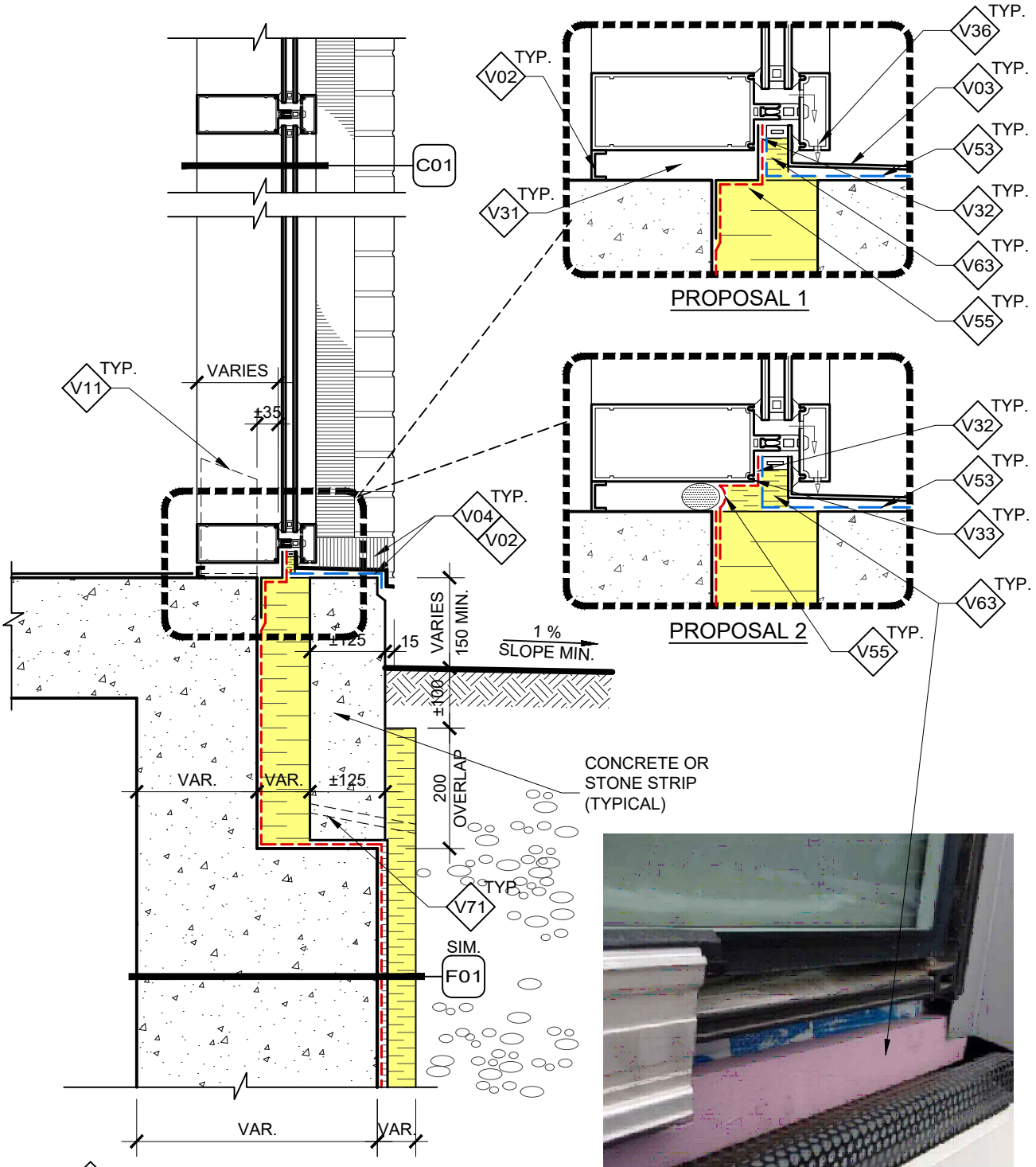
MASONRY CLADDING FONDATION - FLUSH EDGE SECTION DETAIL (TYPICAL)

SCALE: 1:10

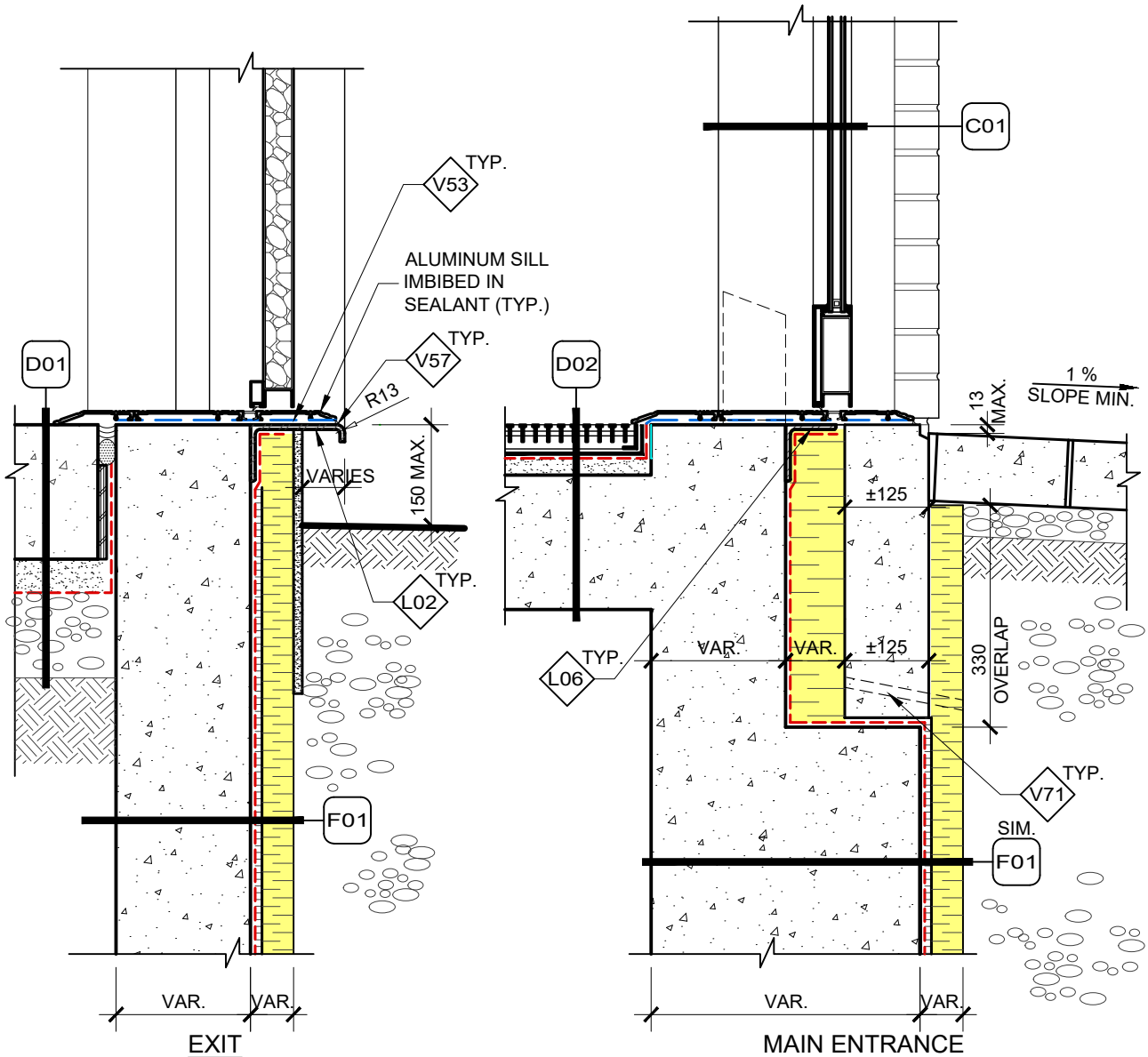


1 / DV-012 PANEL CLADDING FOUNDATION SECTION DETAIL (TYPICAL)

SCALE: 1:10

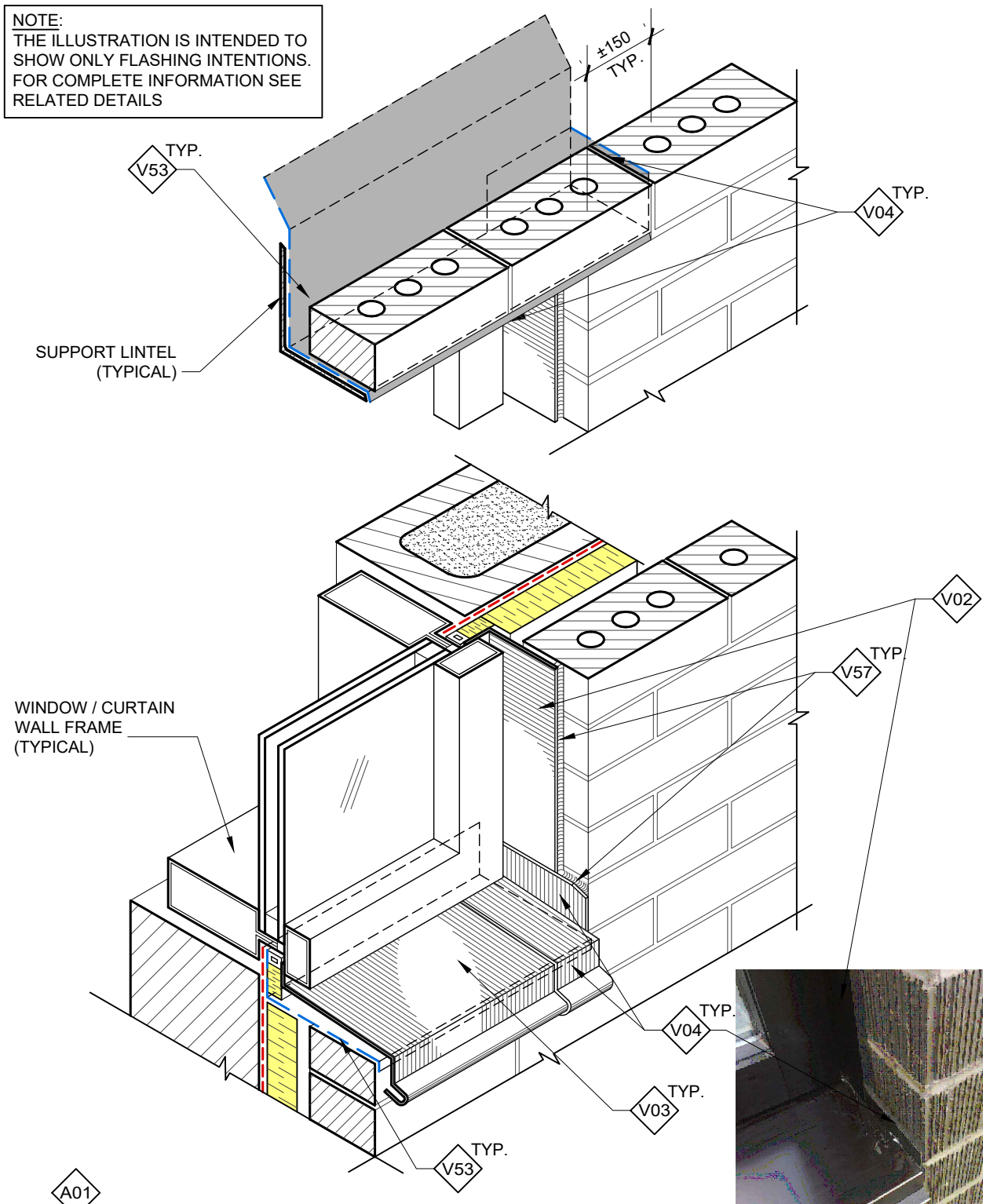


A01
1
DV-013
CURTAIN WALL BASE
SECTION DETAIL (TYPICAL)
SCALE: 1:10

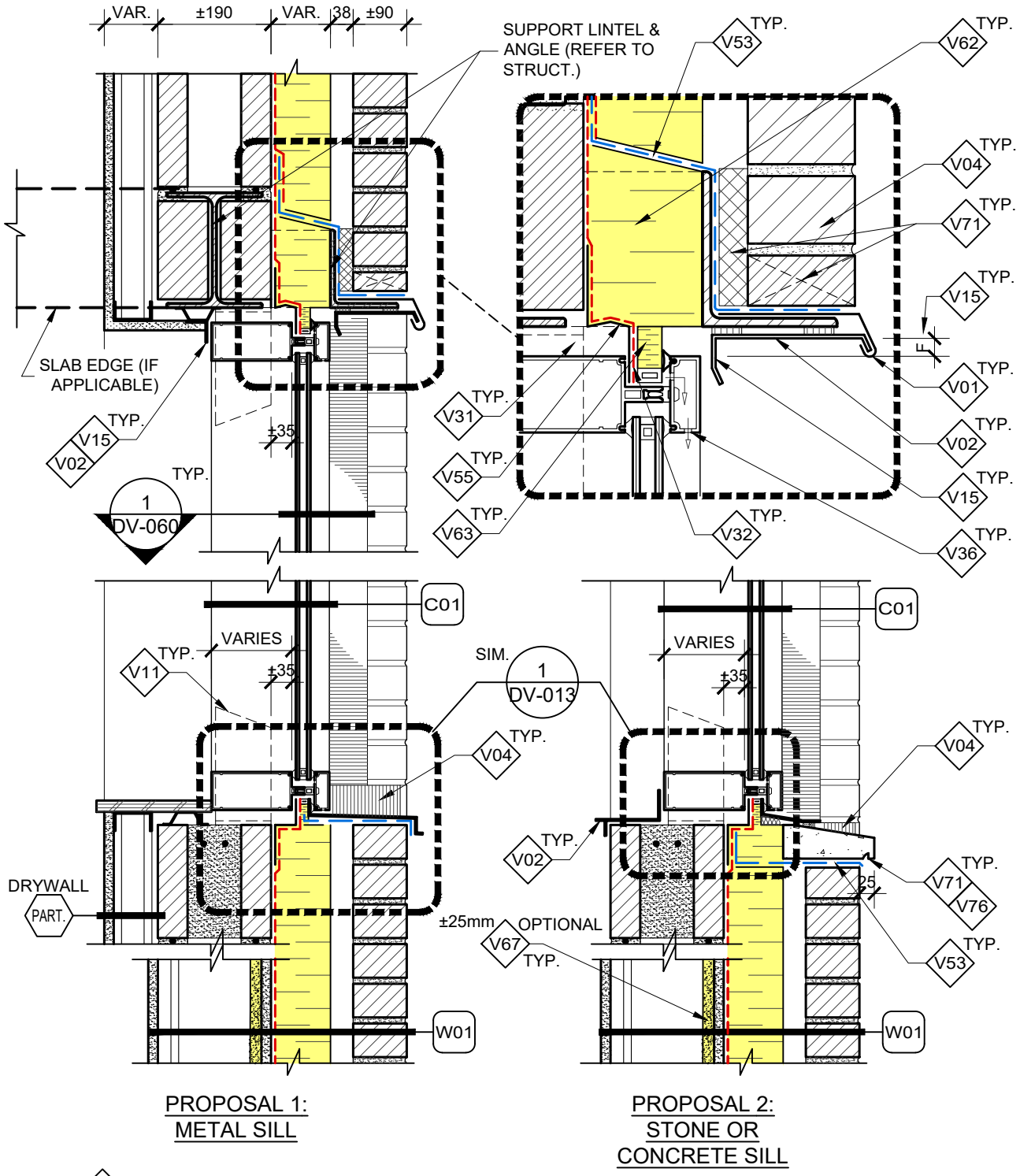


A01
1
DV-014
DOOR SILLS
SECTION DETAIL (TYPICAL)
SCALE: 1:10

NOTE:
THE ILLUSTRATION IS INTENDED TO SHOW ONLY FLASHING INTENTIONS. FOR COMPLETE INFORMATION SEE RELATED DETAILS



A01
1
DV-020
WINDOW FLASHING
ISOMETRIC DETAIL (TYPICAL)
SCALE: 1:10



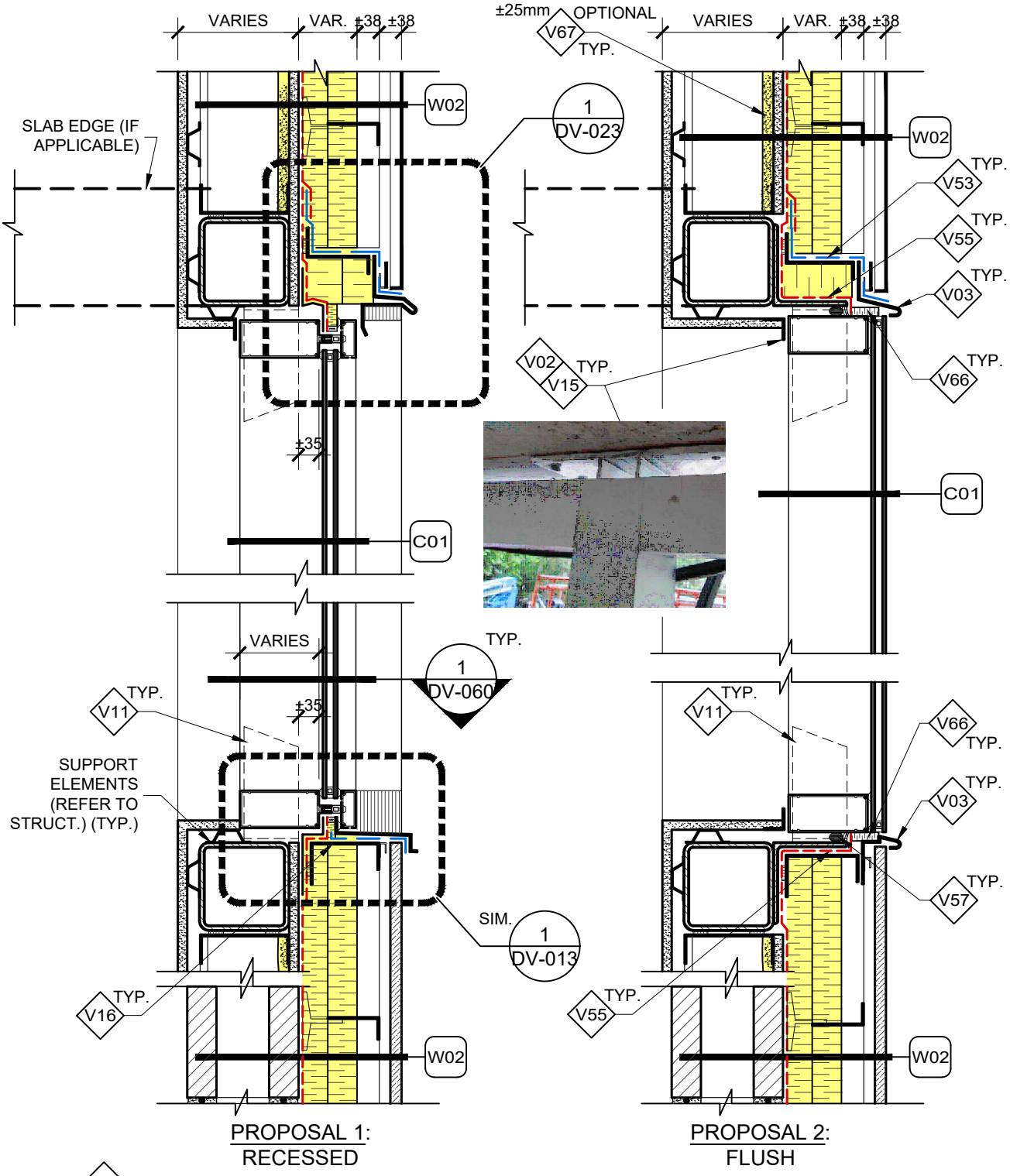
PROPOSAL 1:
METAL SILL

PROPOSAL 2:
STONE OR
CONCRETE SILL

A01
1
DV-021

CURTAIN WALL HEAD AND SILL - MASONRY CLADDING SECTION DETAIL (TYPICAL)

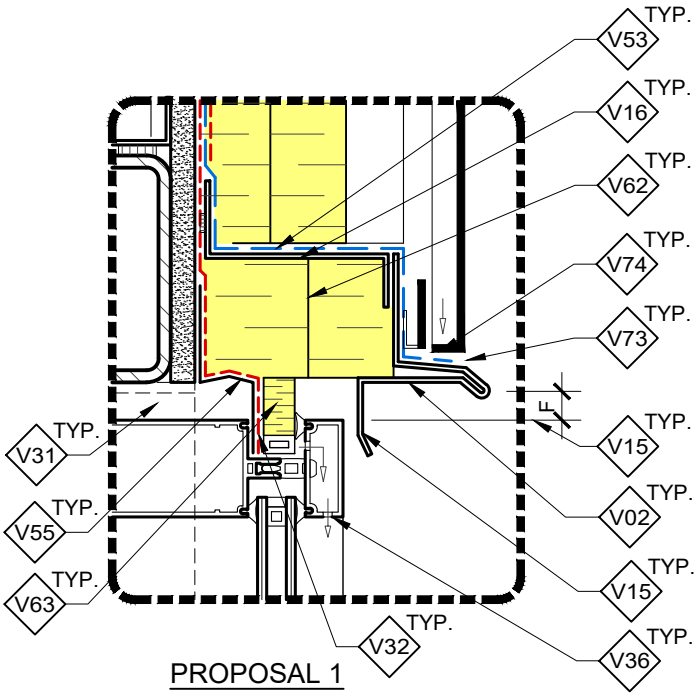
SCALE: 1:10



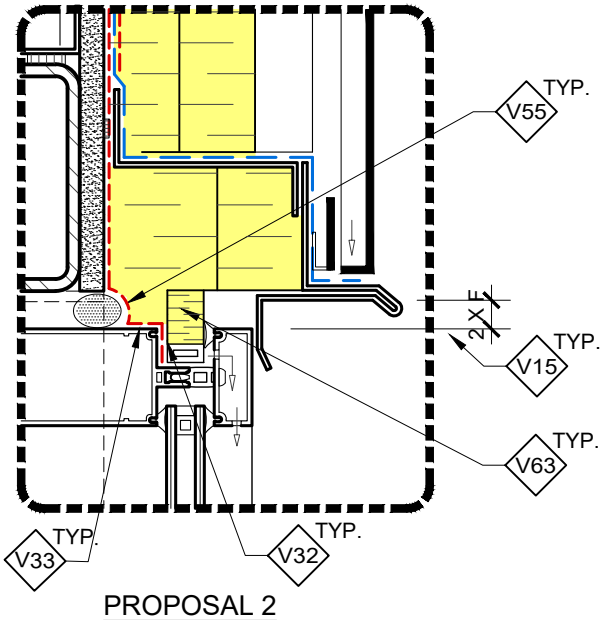
A01
1
DV-022

CURTAIN WALL HEAD AND SILL - PANEL CLADDING SECTION DETAIL (TYPICAL)

SCALE: 1:10



PROPOSAL 1

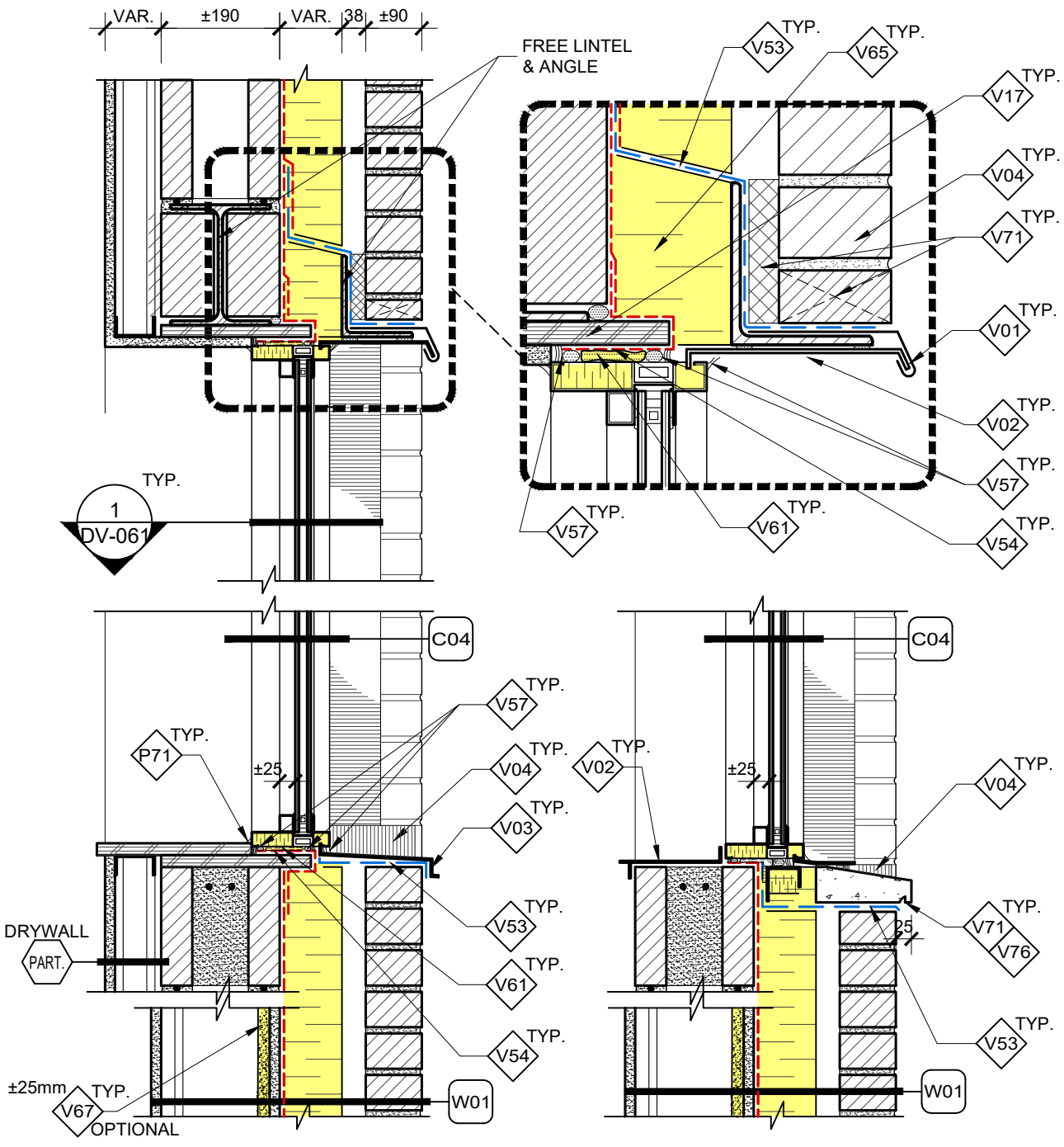


PROPOSAL 2

A01
1
DV-023

CURTAIN WALL HEAD - PANEL CLADDING SECTION DETAIL (TYPICAL)

SCALE: 1:10



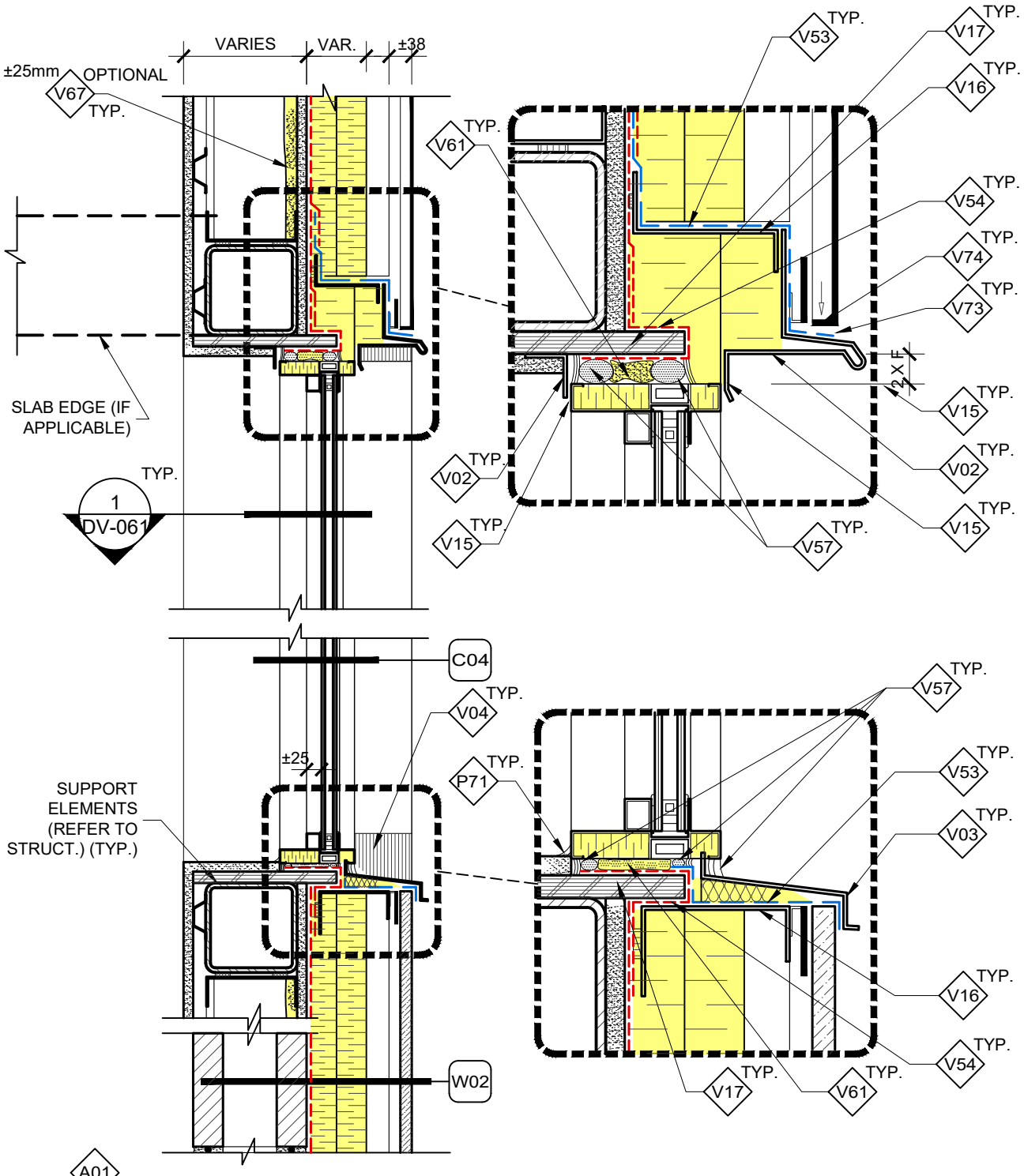
PROPOSAL 1:
METAL SILL

PROPOSAL 2:
STONE OR CONCRETE SILL

A01
1
DV-024

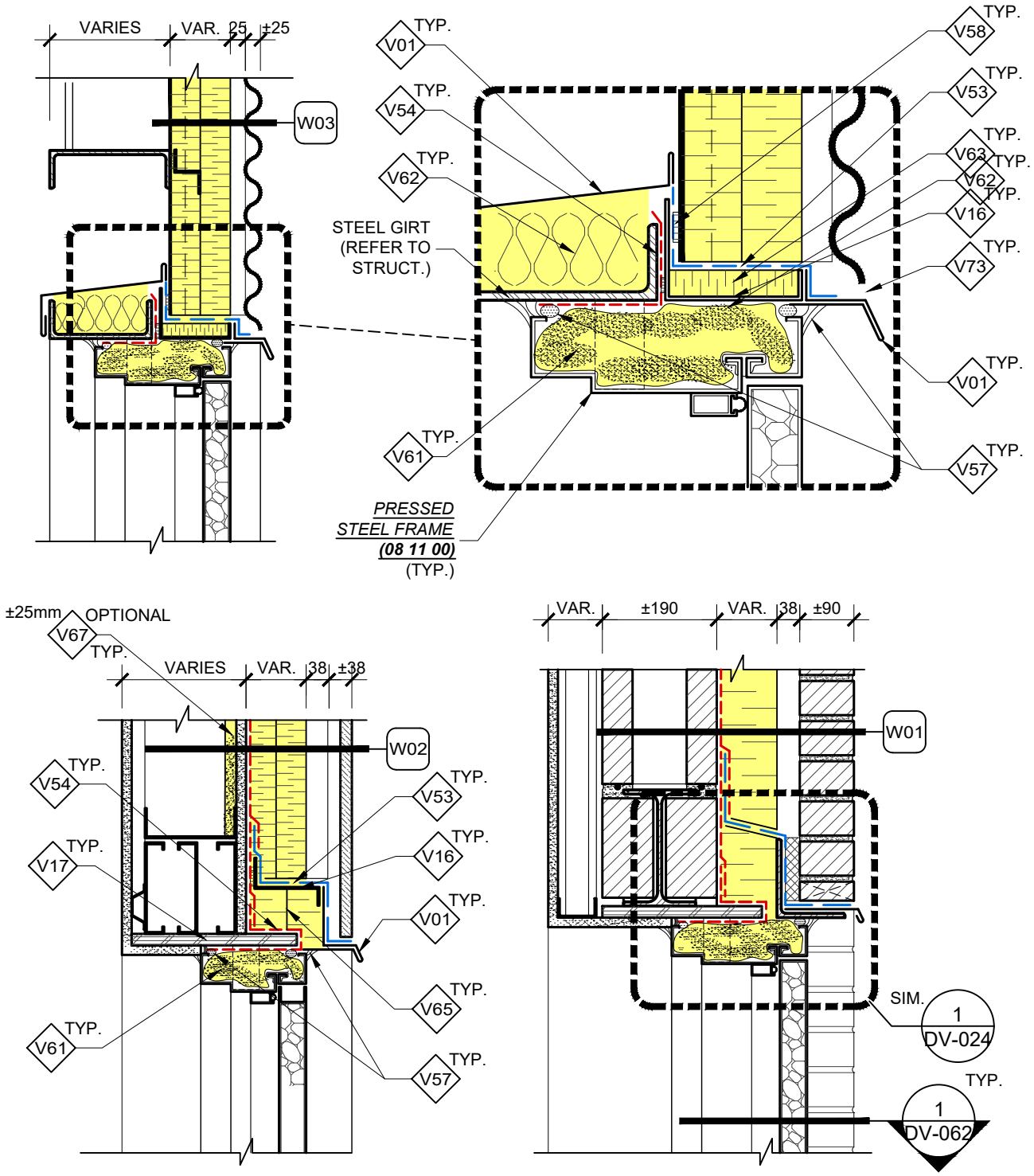
WINDOW UNIT HEAD AND SILL - MASONRY CLADDING
SECTION DETAIL (TYPICAL)

SCALE: 1:10



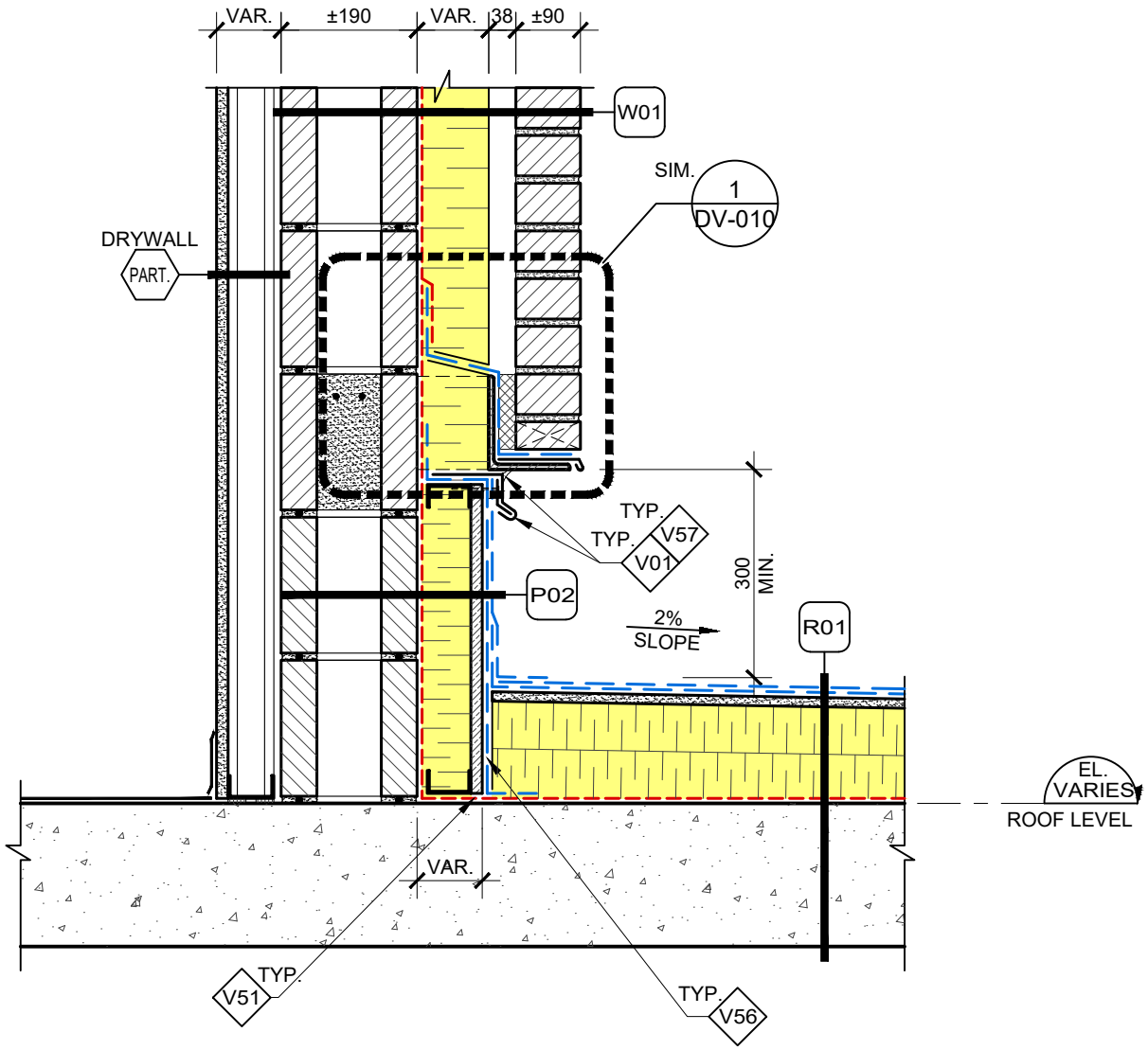
WINDOW CONTINIOUS TRIP HEAD AND SILL - PANEL CLADDING
SECTION DETAIL (TYPICAL)

SCALE: 1:10

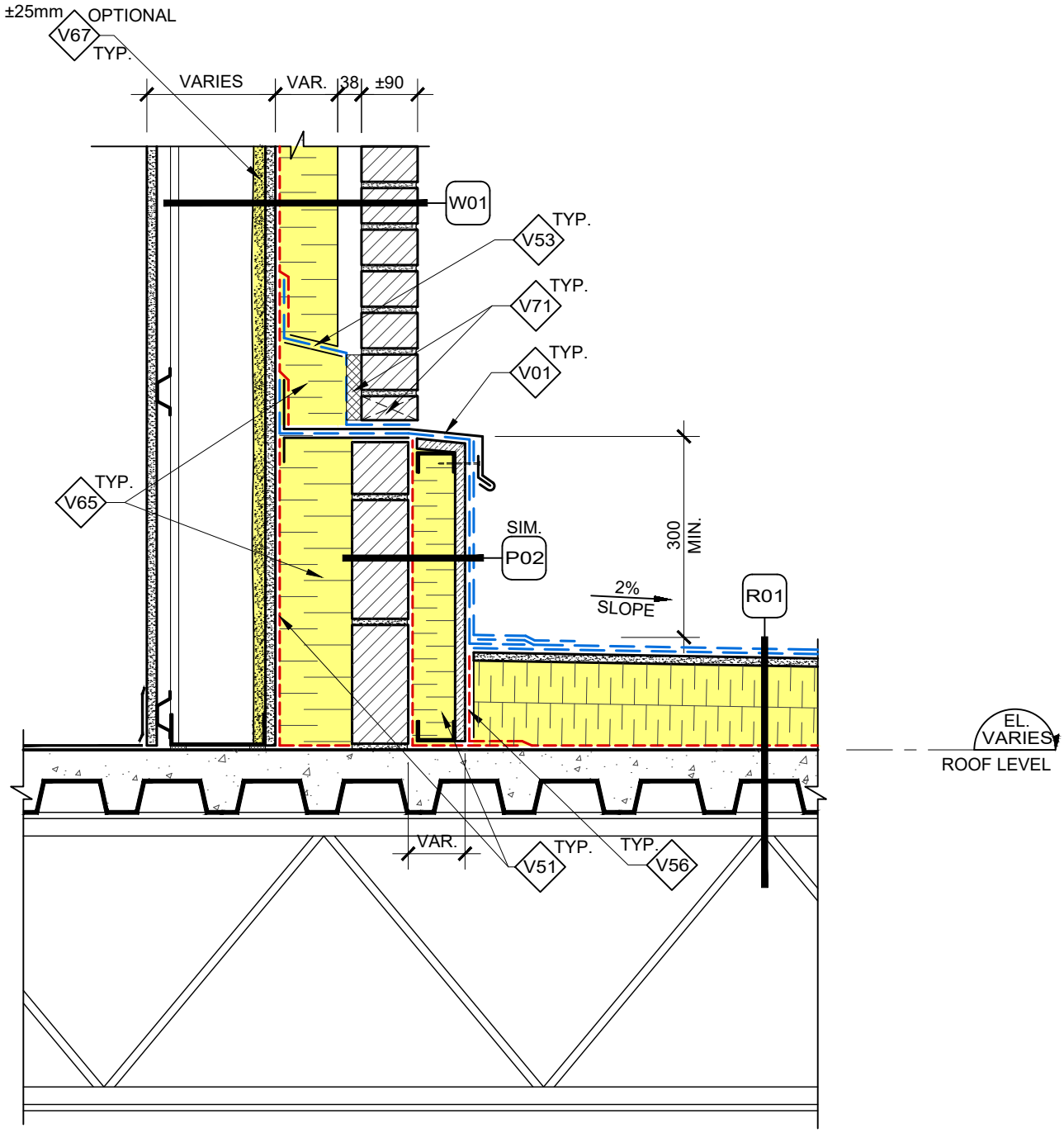


A01
1 / DV-026 PRESSED STEEL FRAME HEADS SECTION DETAIL (TYPICAL)

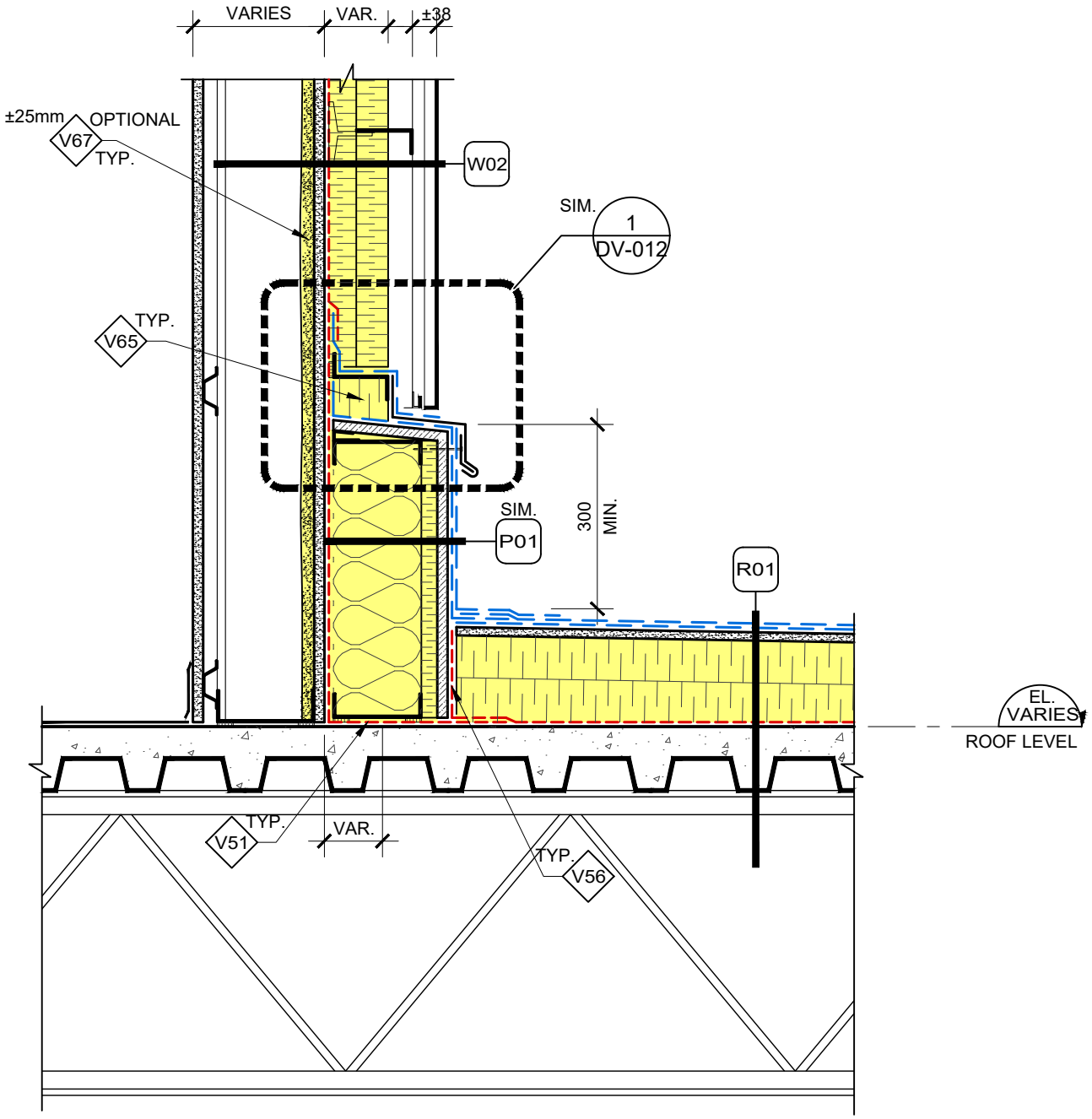
SCALE: 1:10



A01
1
DV-030
MASONRY CLADDING - CMU PARAPET ROOF EXTENSION
SECTION DETAIL (TYPICAL)
SCALE: 1:10



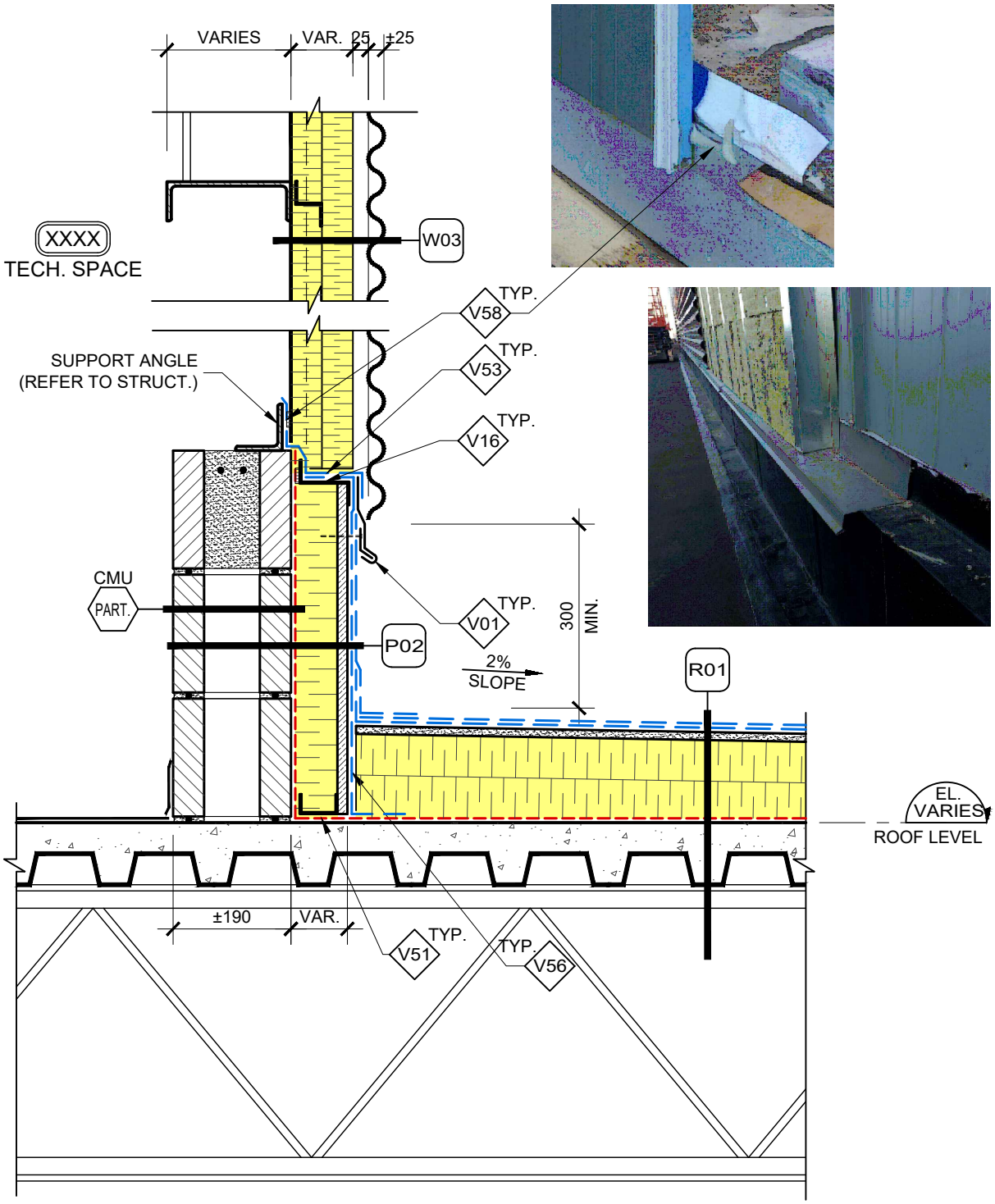
A01
1
DV-031
MASONRY CLADDING - STUD PARAPET ROOF EXTENSION
SECTION DETAIL (TYPICAL)
SCALE: 1:10



A01
1
DV-032

PANEL CLADDING - STUD PARAPET ROOF EXTENSION SECTION DETAIL (TYPICAL)

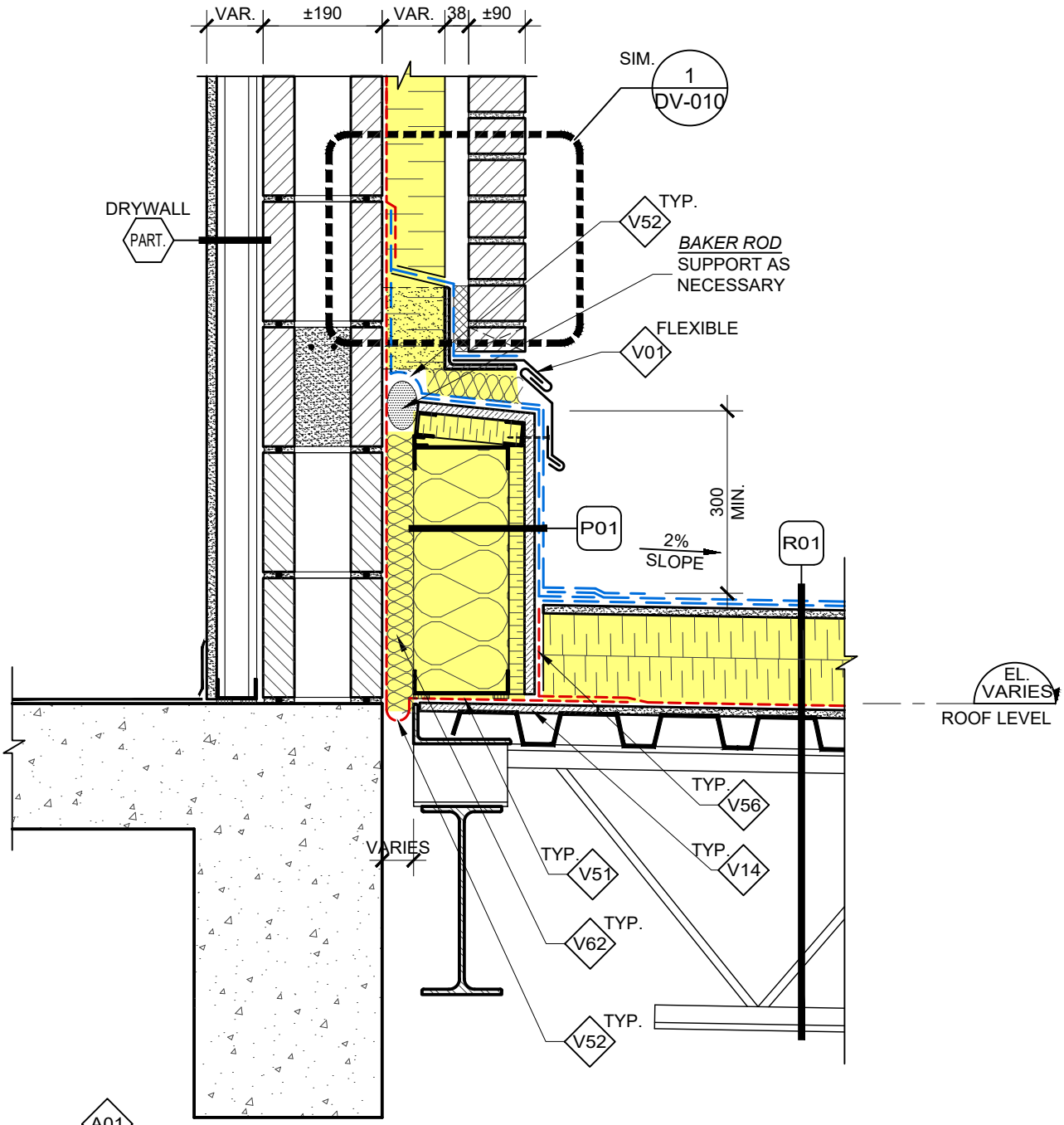
SCALE: 1:10



A01
1
DV-033

CORRUGATED METAL CLADDING - STUD PARAPET ROOF EXTENSION SECTION DETAIL (TYPICAL)

SCALE: 1:10

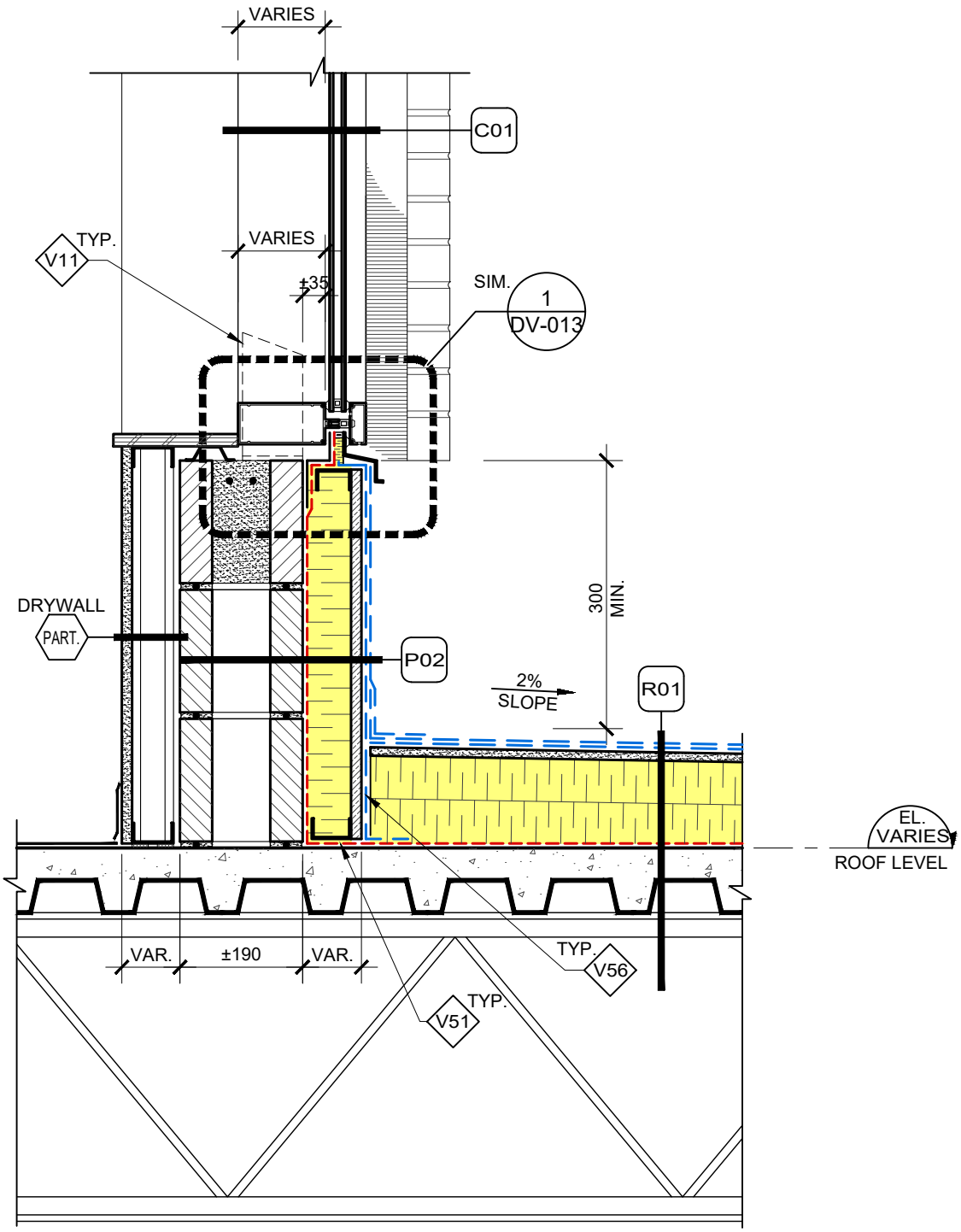


A01

1
DV-034

MASONRY CLADDING - ROOF EXTENSION & EXPANSION JOINT SECTION DETAIL (TYPICAL)

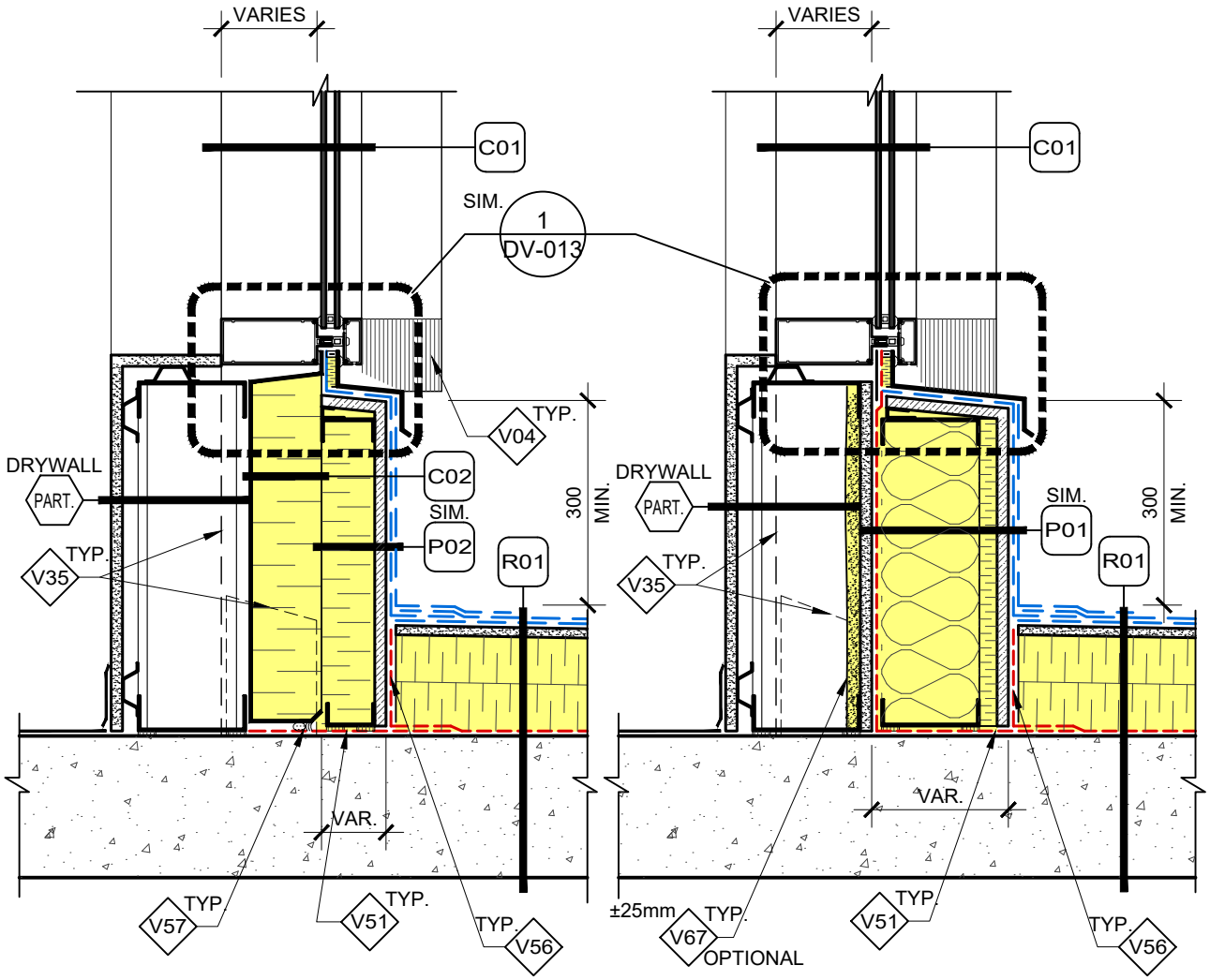
SCALE: 1:10



A01
1
DV-035

CURTAIN WALL - PARAPET ROOF EXTENSION SECTION DETAIL (TYPICAL)

SCALE: 1:10



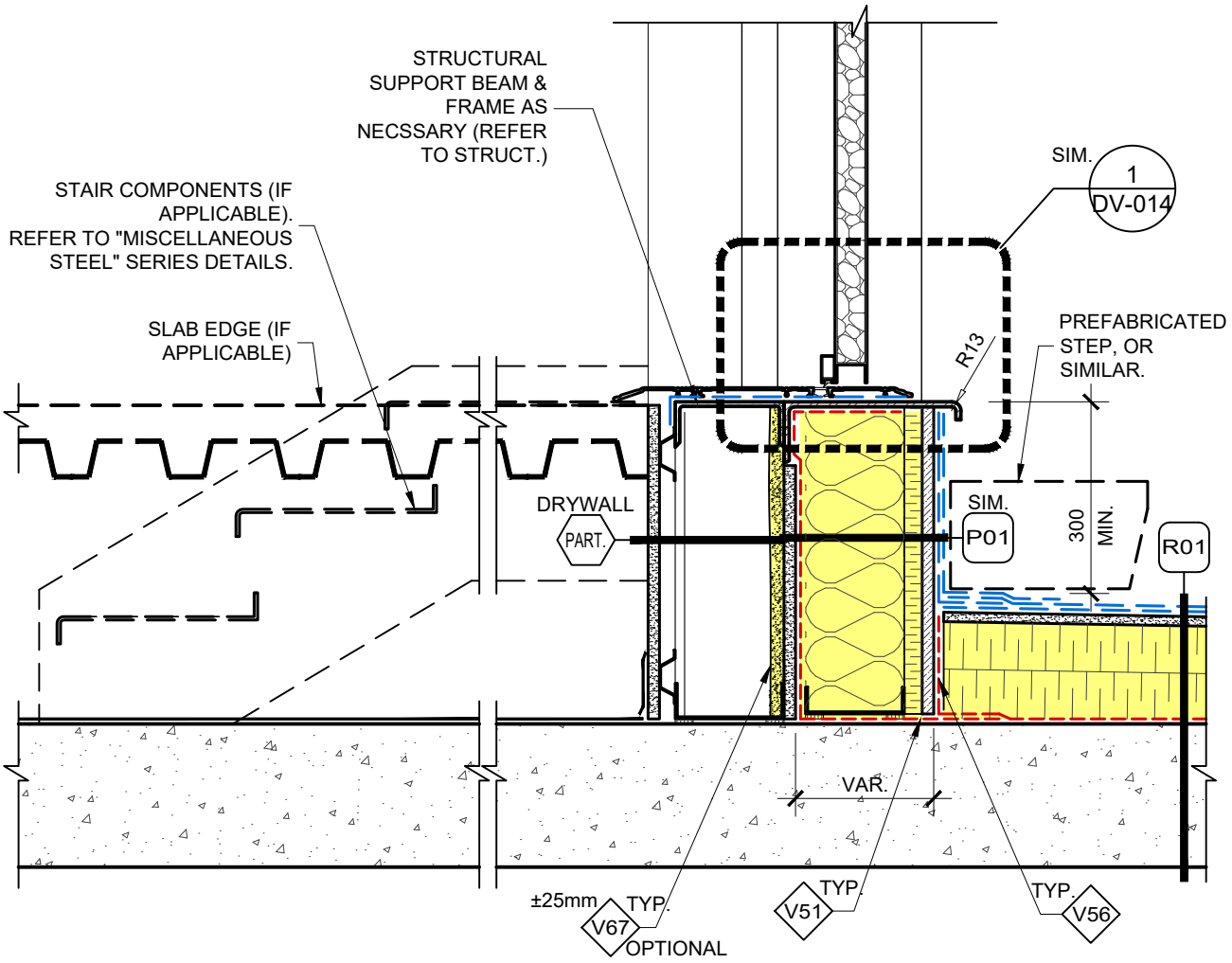
PROPOSAL 1:
AIR/VAPOUR
BARRIER PAN

PROPOSAL 2:
EXTENDED
MULLION

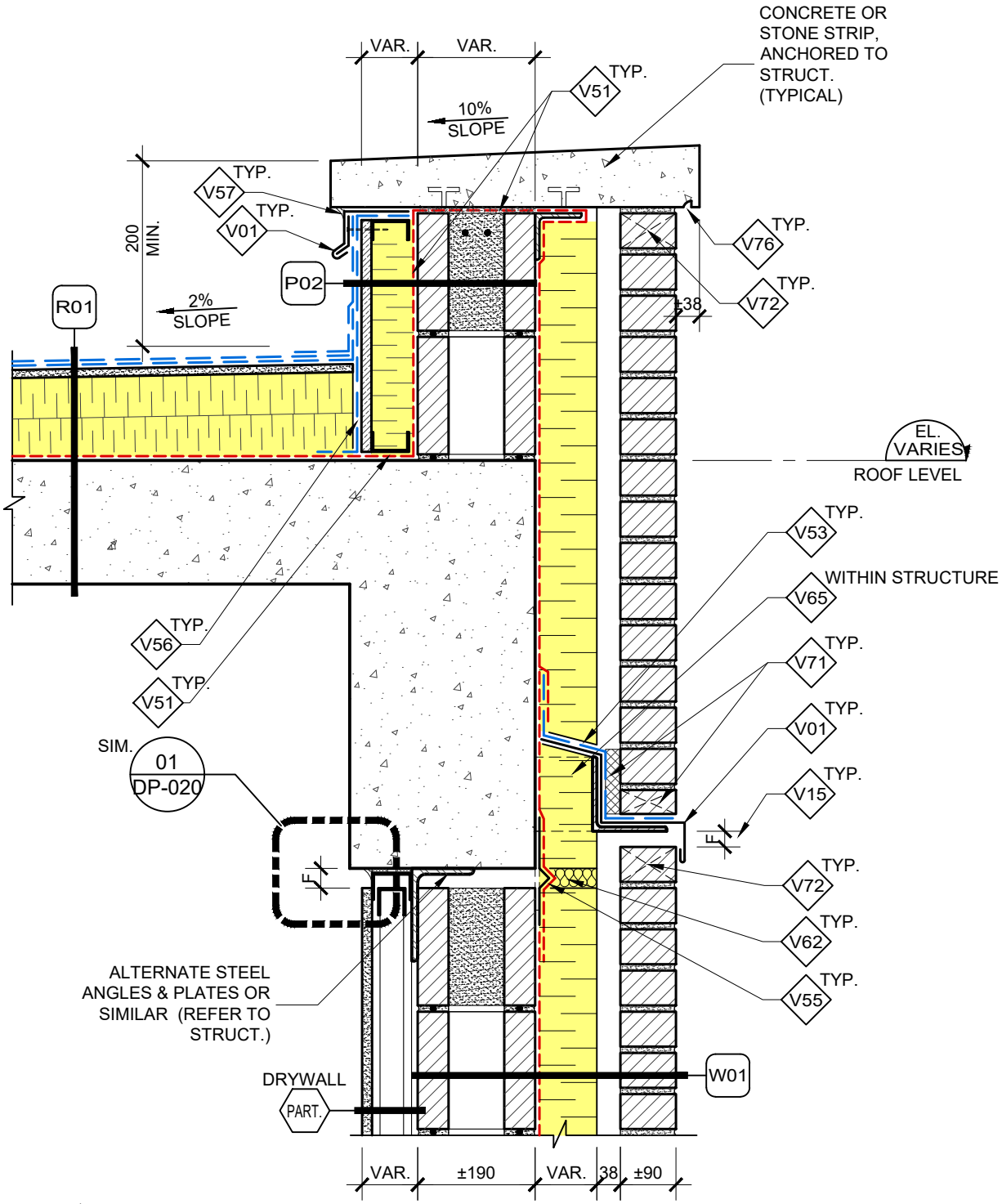
A01
1
DV-036

CURTAIN WALL MULLION EXTENSION - ROOF EXTENSION SECTION DETAIL (TYPICAL)

SCALE: 1:10



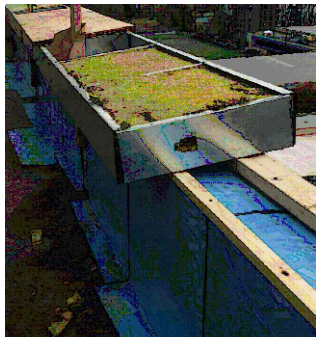
A01
1 DV-037 DOOR SILL - ROOF EXTENSION SECTION DETAIL (TYPICAL)
SCALE: 1:10

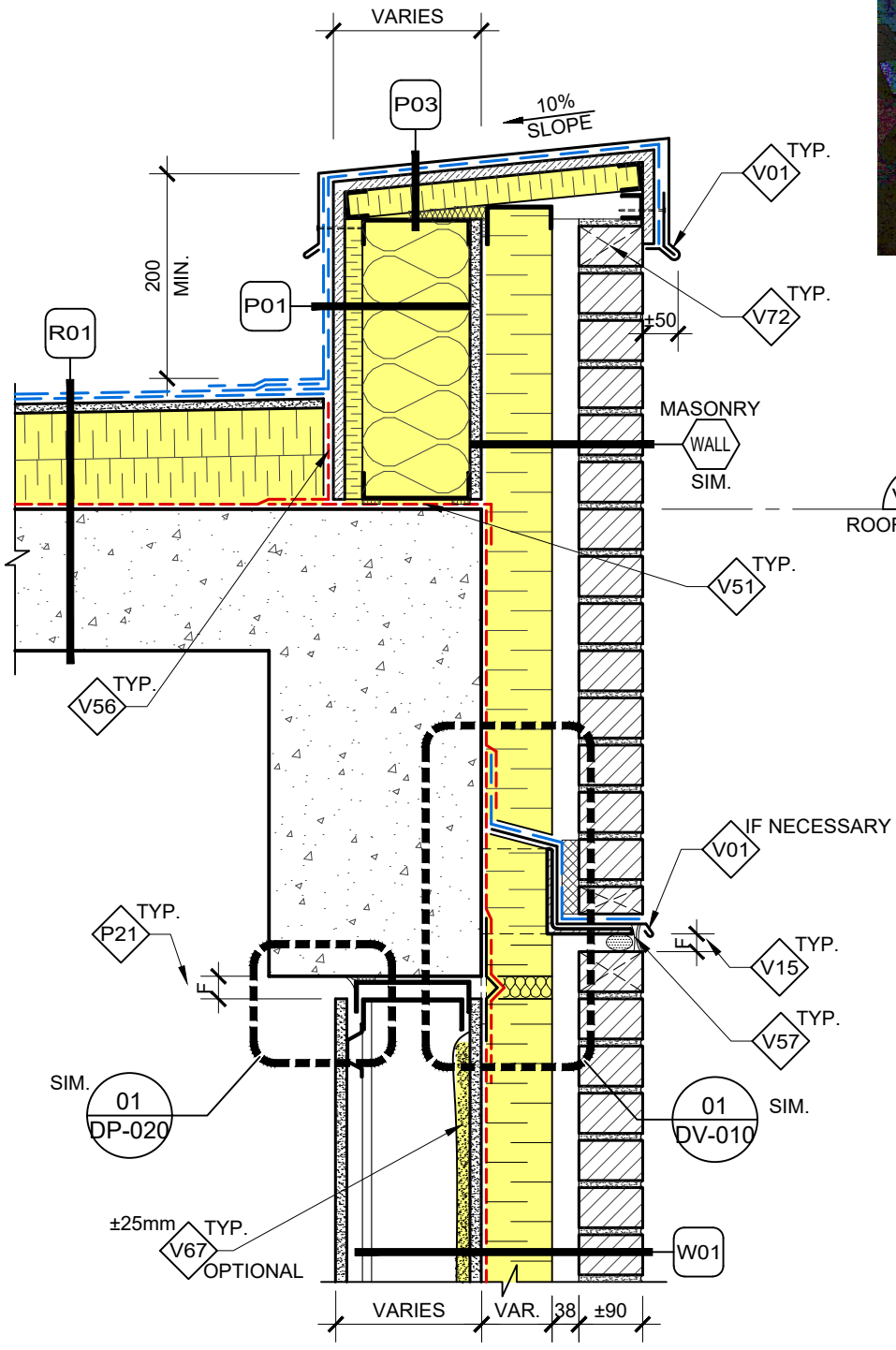


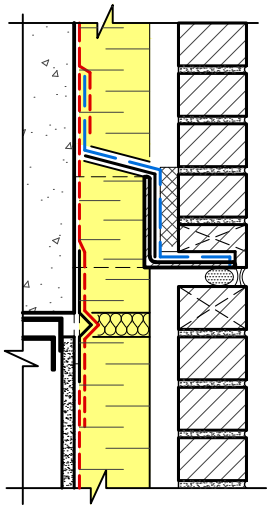
A01
1
DV-040

MASONRY CLADDING - CMU PARAPET SECTION DETAIL (TYPICAL)

SCALE: 1:10

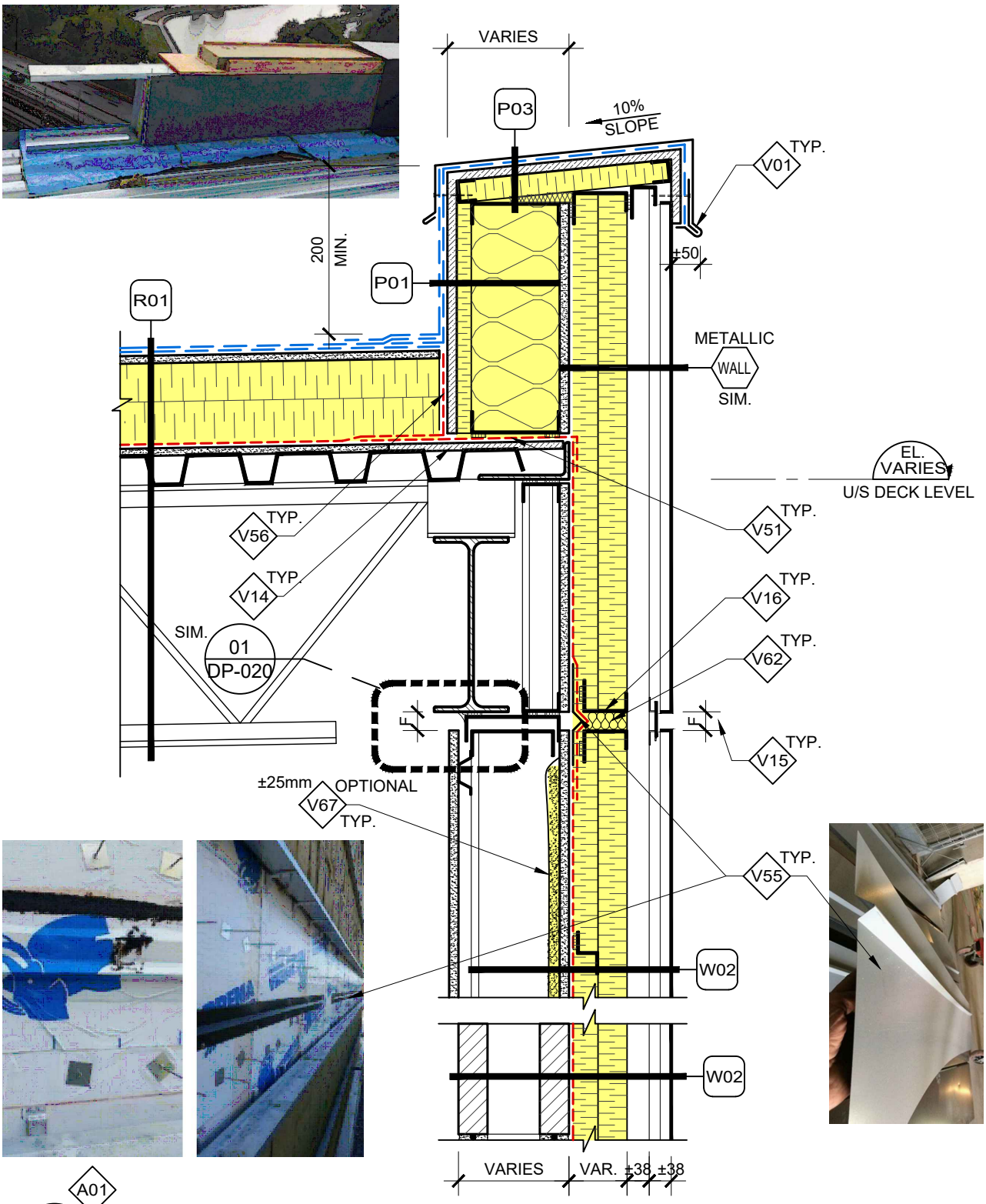




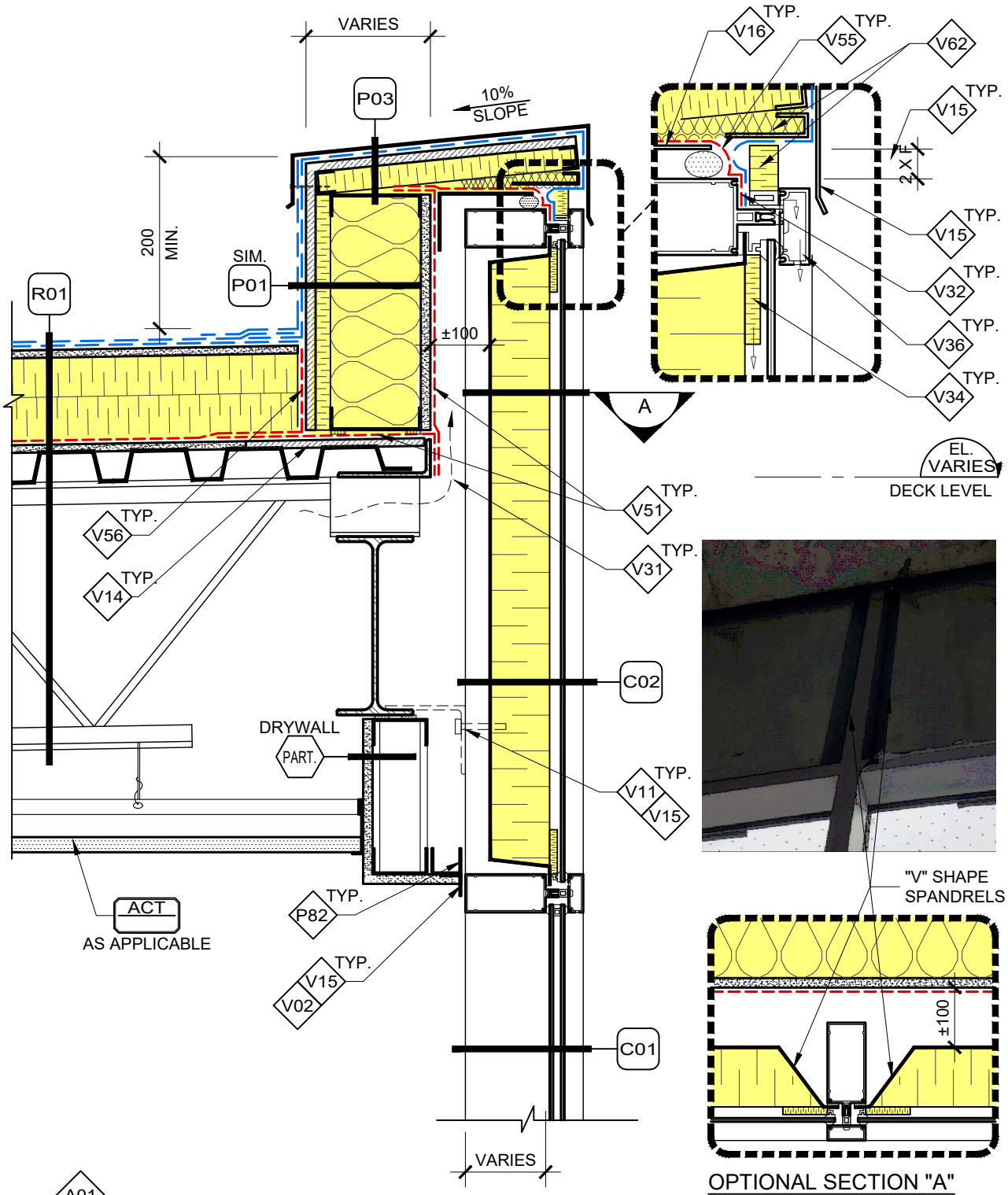


PROPOSAL:
LIP STRETCHER
BRICK

A01
1
DV-041
MASONRY CALDDING - STUDS PARAPET
SECTION DETAIL (TYPICAL)
SCALE: 1:10



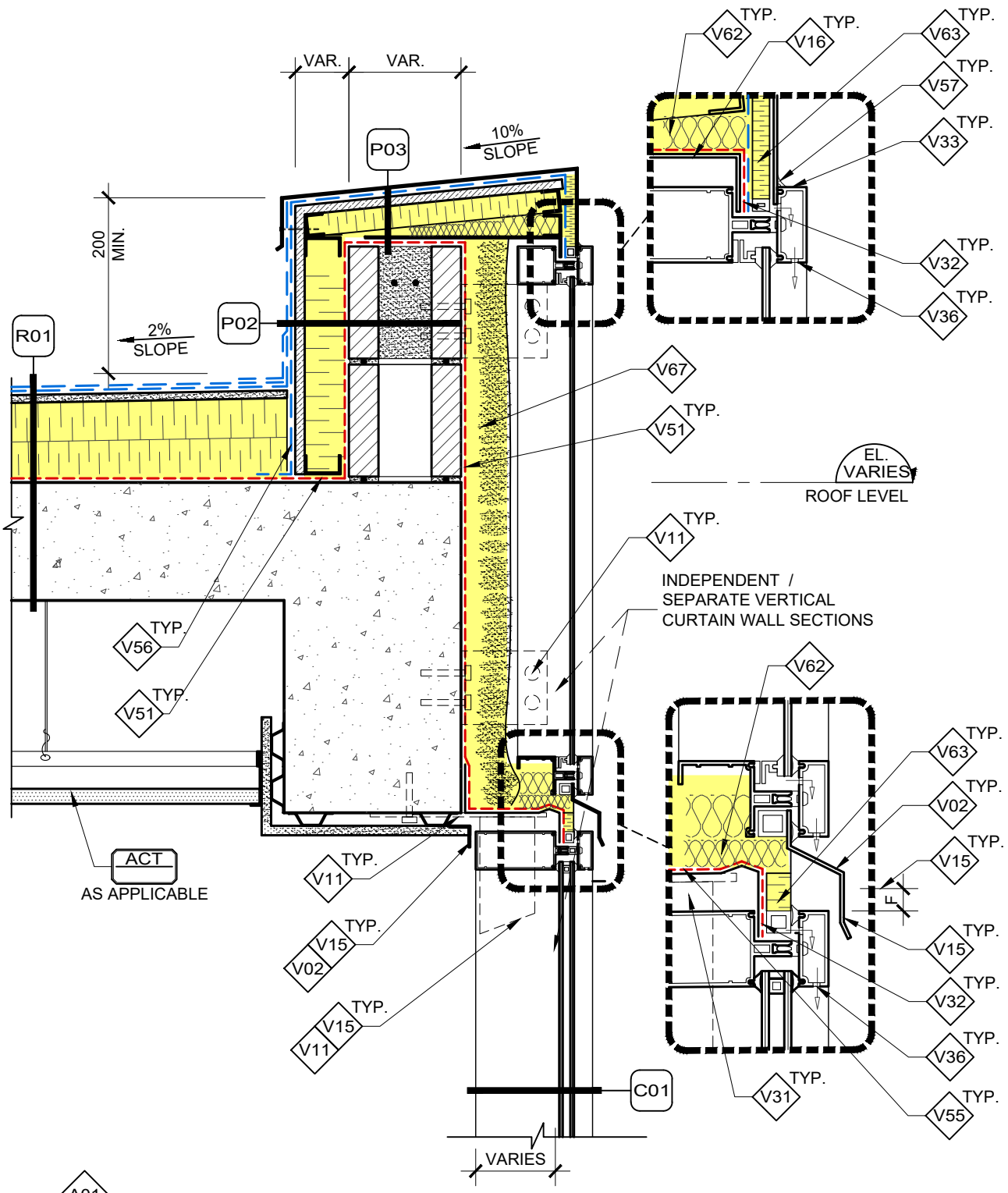
A01
1
DV-042
METAL / COMPOSIT CALDDING - STUDS PARAPET
SECTION DETAIL (TYPICAL)
SCALE: 1:10



A01
1
DV-043

CURTAIN WALL - STUDS PARAPET
SECTION DETAIL (TYPICAL)

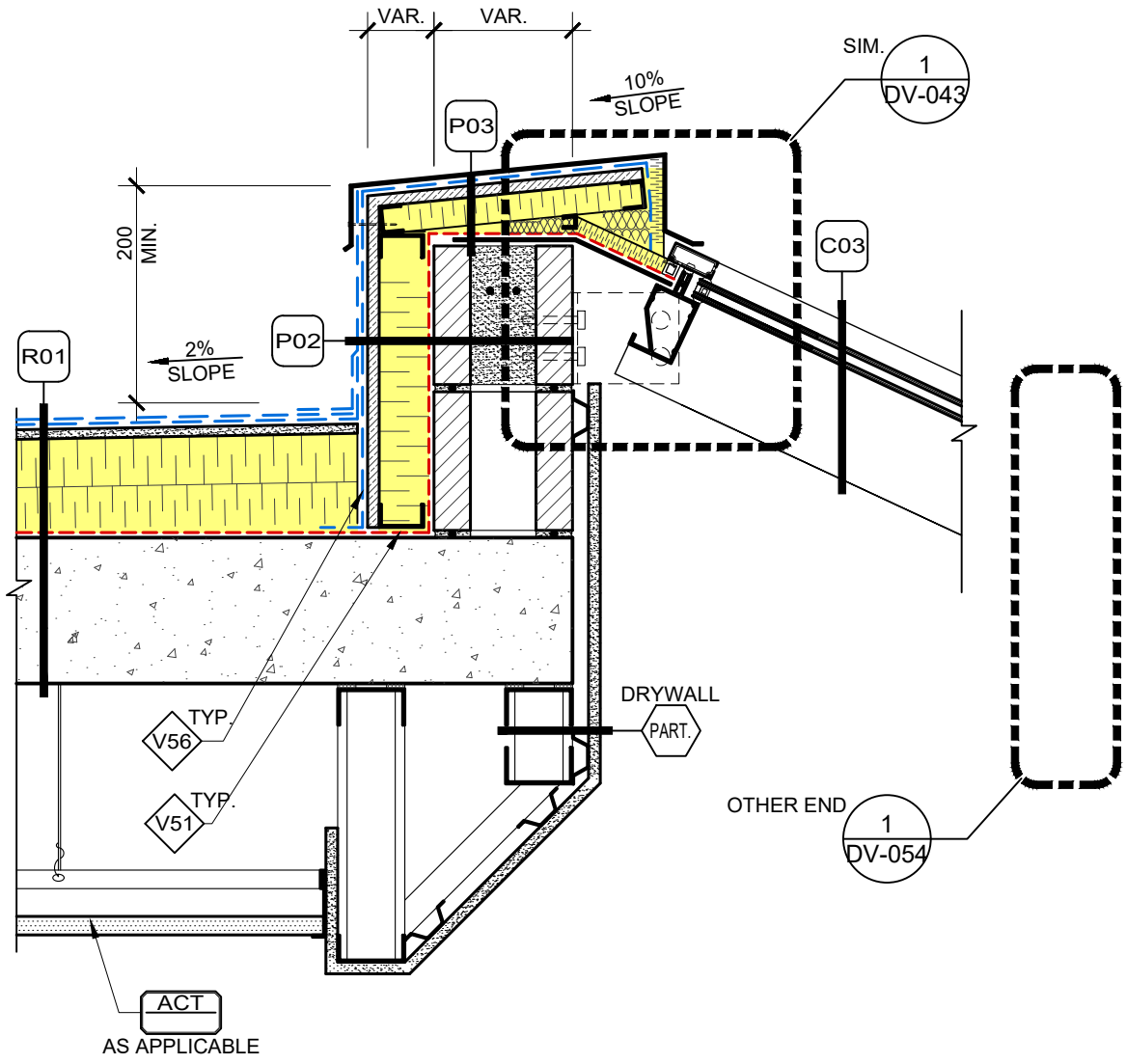
SCALE: 1:10



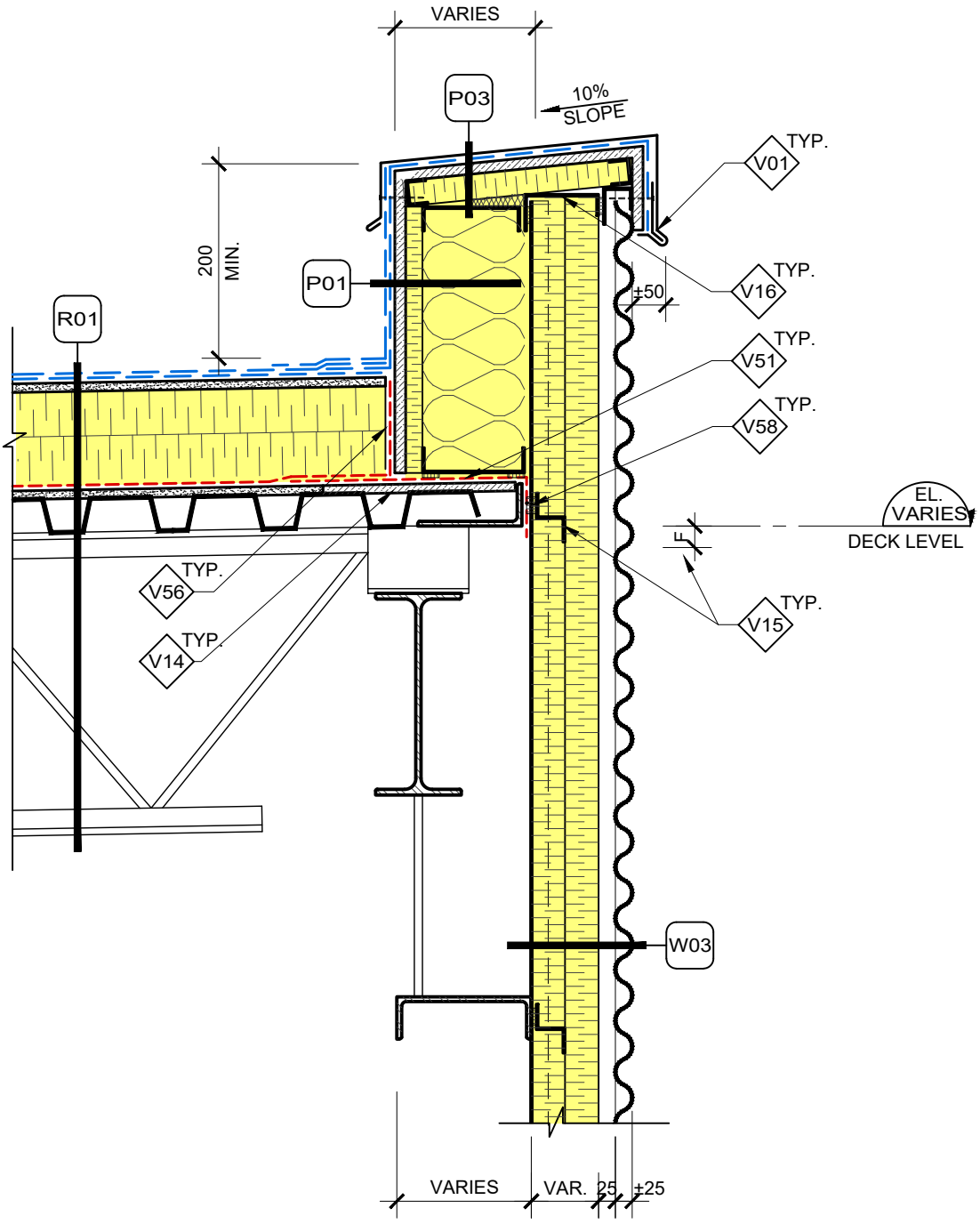
A01
1
DV-044

CURTAIN WALL - MASONRY PARAPET SECTION DETAIL (TYPICAL)

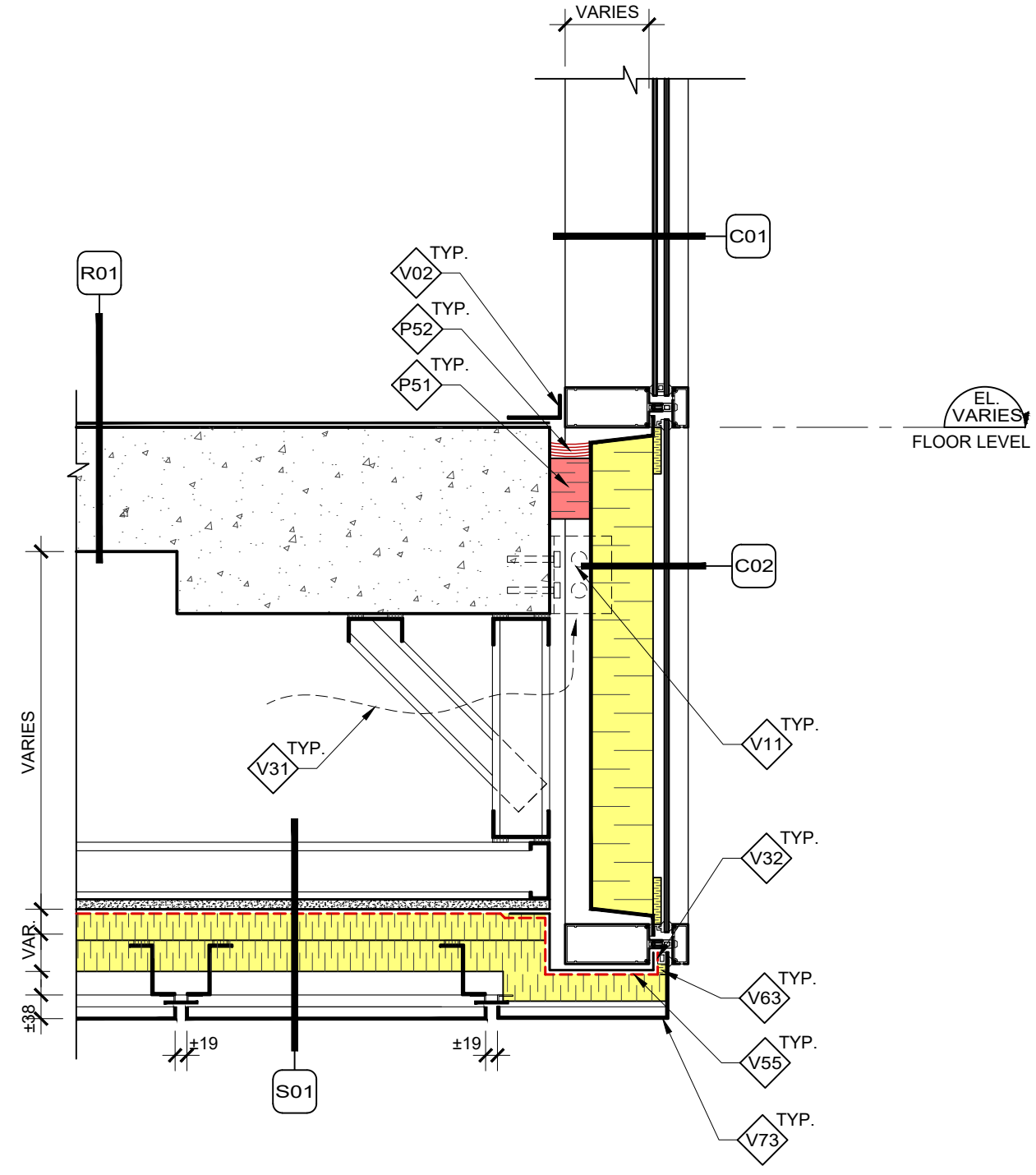
SCALE: 1:10



A01
1
DV-045
SKIPANEL - UPPER POINT
SECTION DETAIL (TYPICAL)
SCALE: 1:10



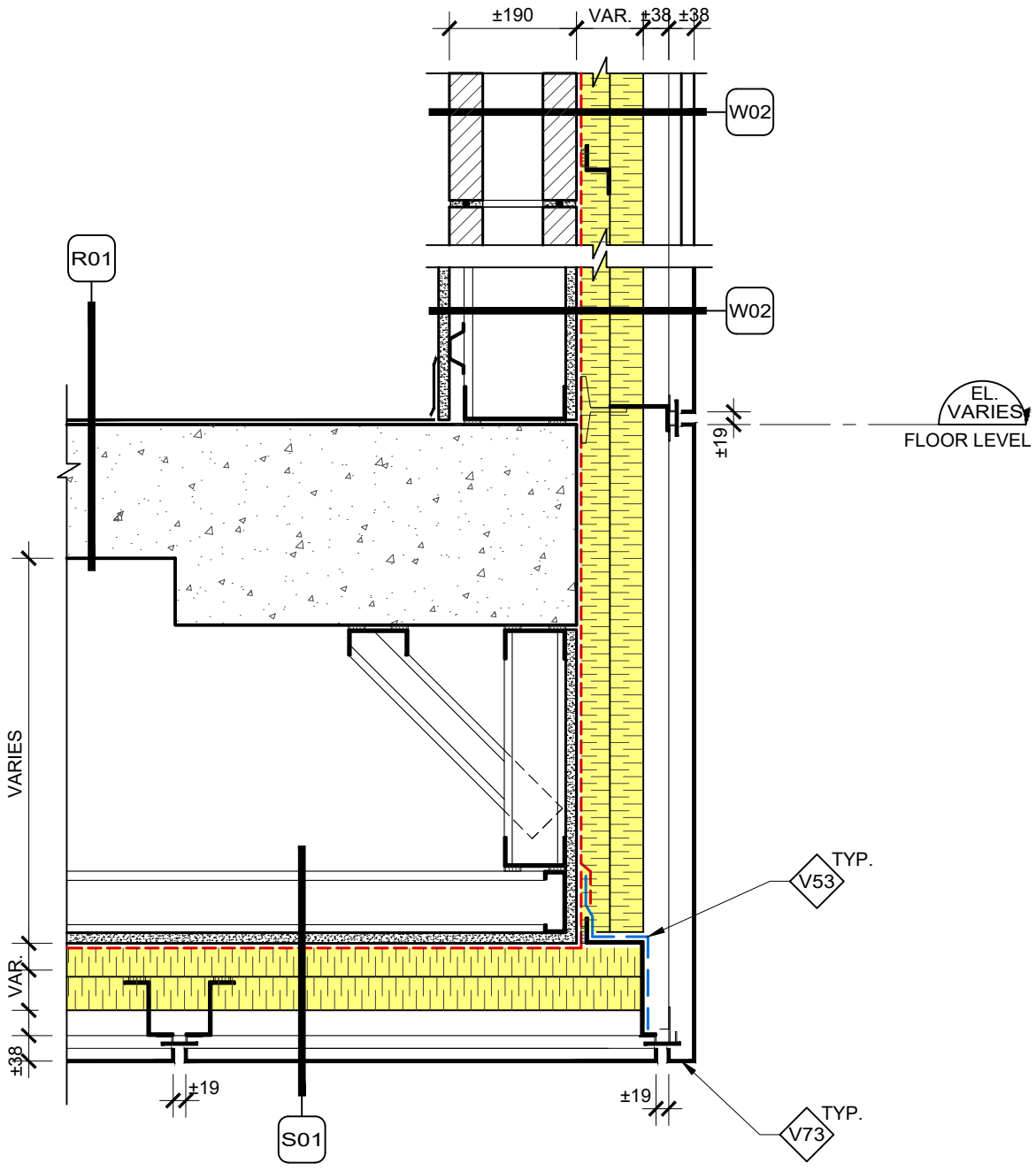
A01
1
DV-046
CORRUGATED METAL CALDDING - STUDS PARAPET
SECTION DETAIL (TYPICAL)
SCALE: 1:10



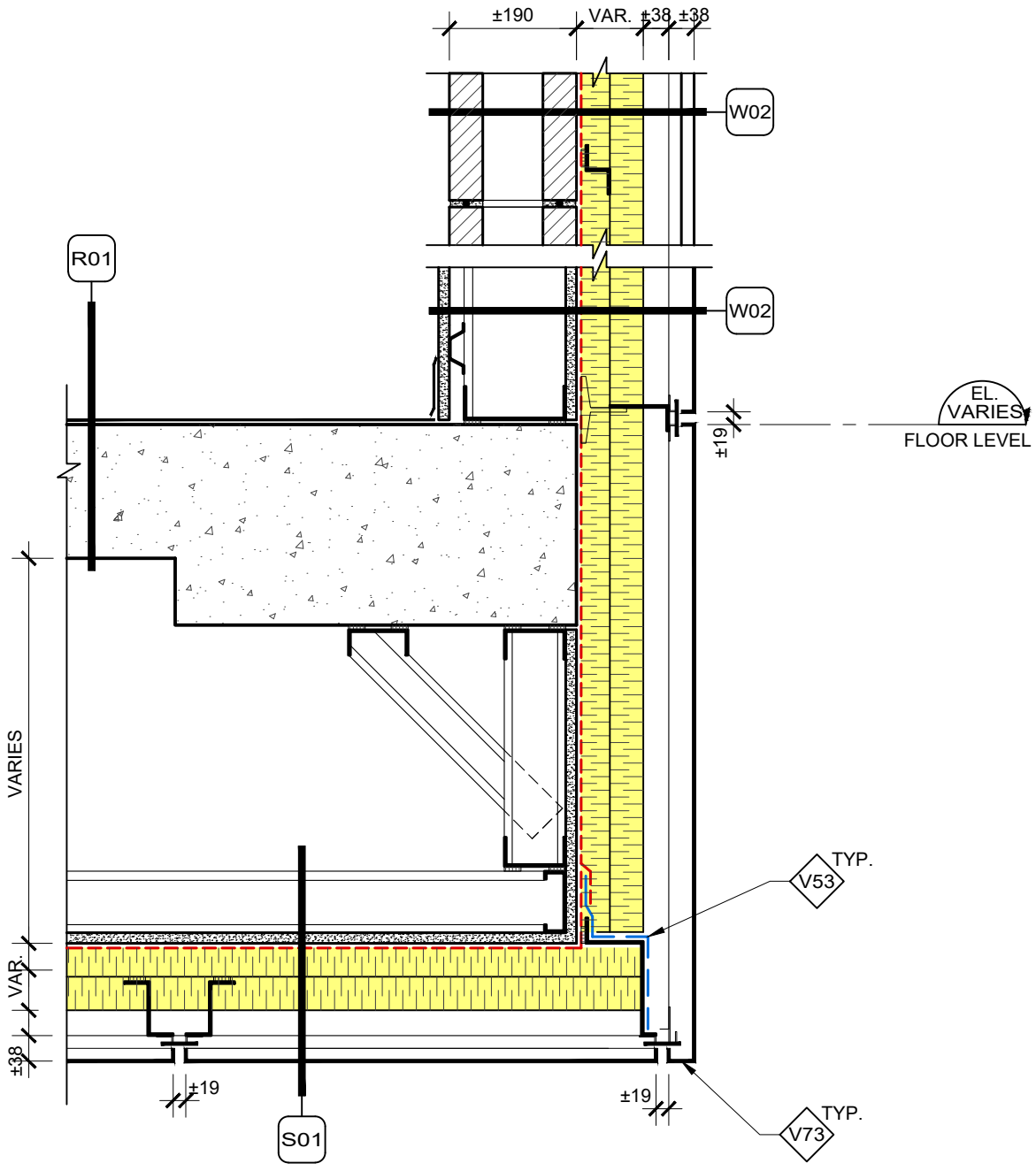
A01
1
DV-047

CURTAIN WALL - HEATED SOFFIT CONNECTION SECTION DETAIL (TYPICAL)

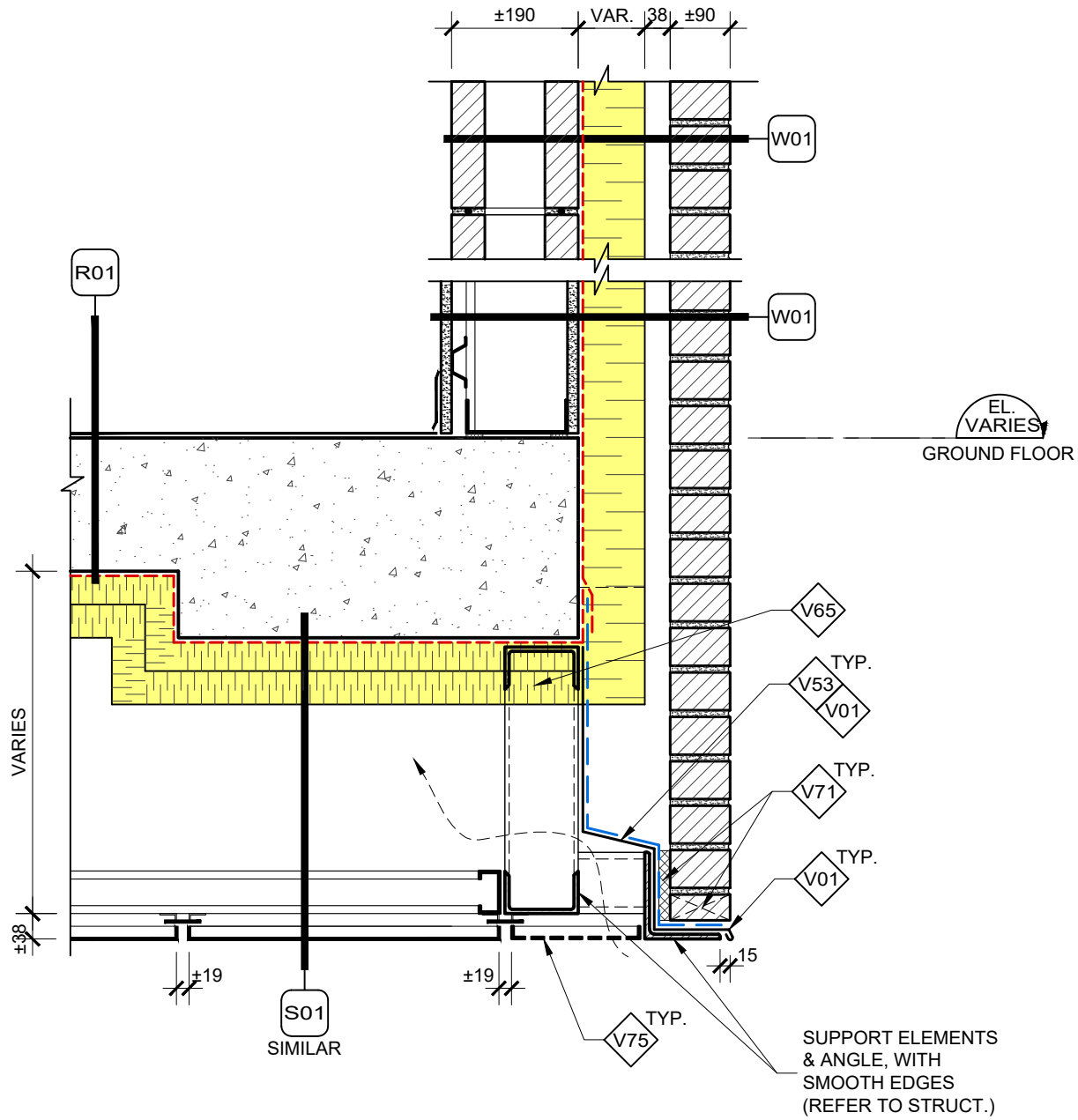
SCALE: 1:10



A01
1
DV-047A
EXTERIOR WALL - HEATED SOFFIT CONNECTION
SECTION DETAIL (TYPICAL)
SCALE: 1:10



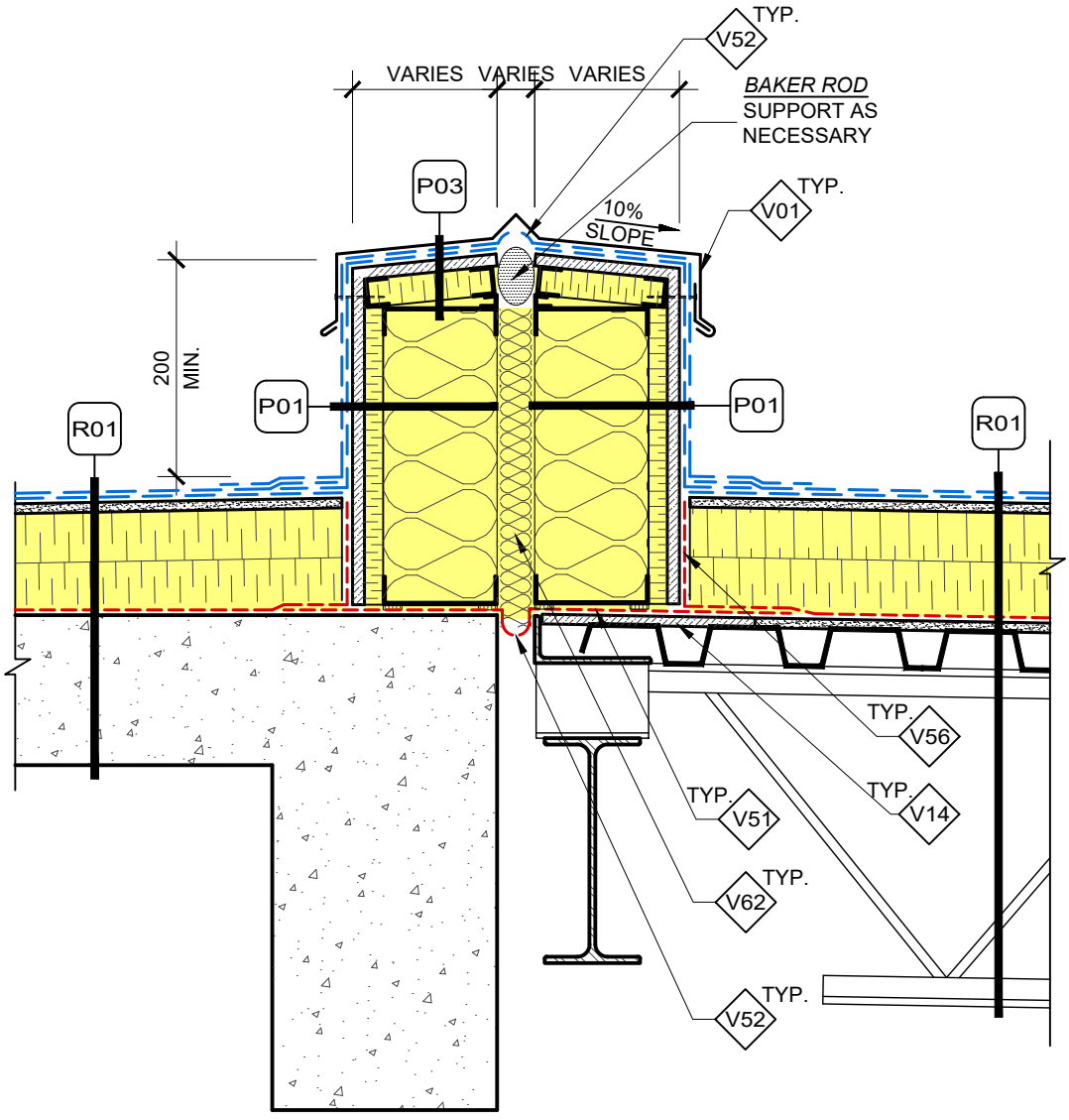
A01
1
DV-047A
EXTERIOR WALL - HEATED SOFFIT CONNECTION
SECTION DETAIL (TYPICAL)
SCALE: 1:10



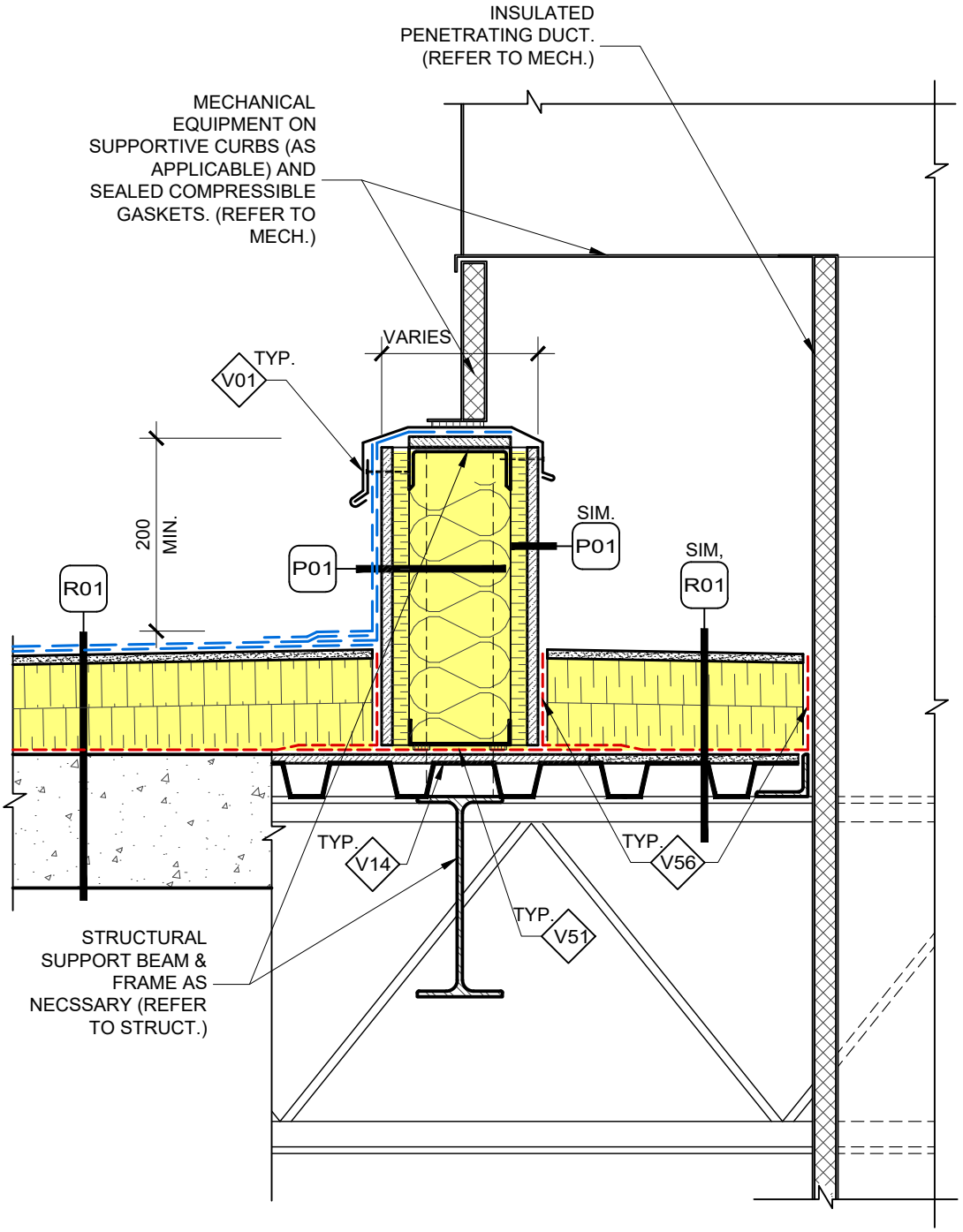
A01
1
DV-048A

EXTERIOR WALL - NON-HEATED SOFFIT CONNECTION
SECTION DETAIL (TYPICAL)

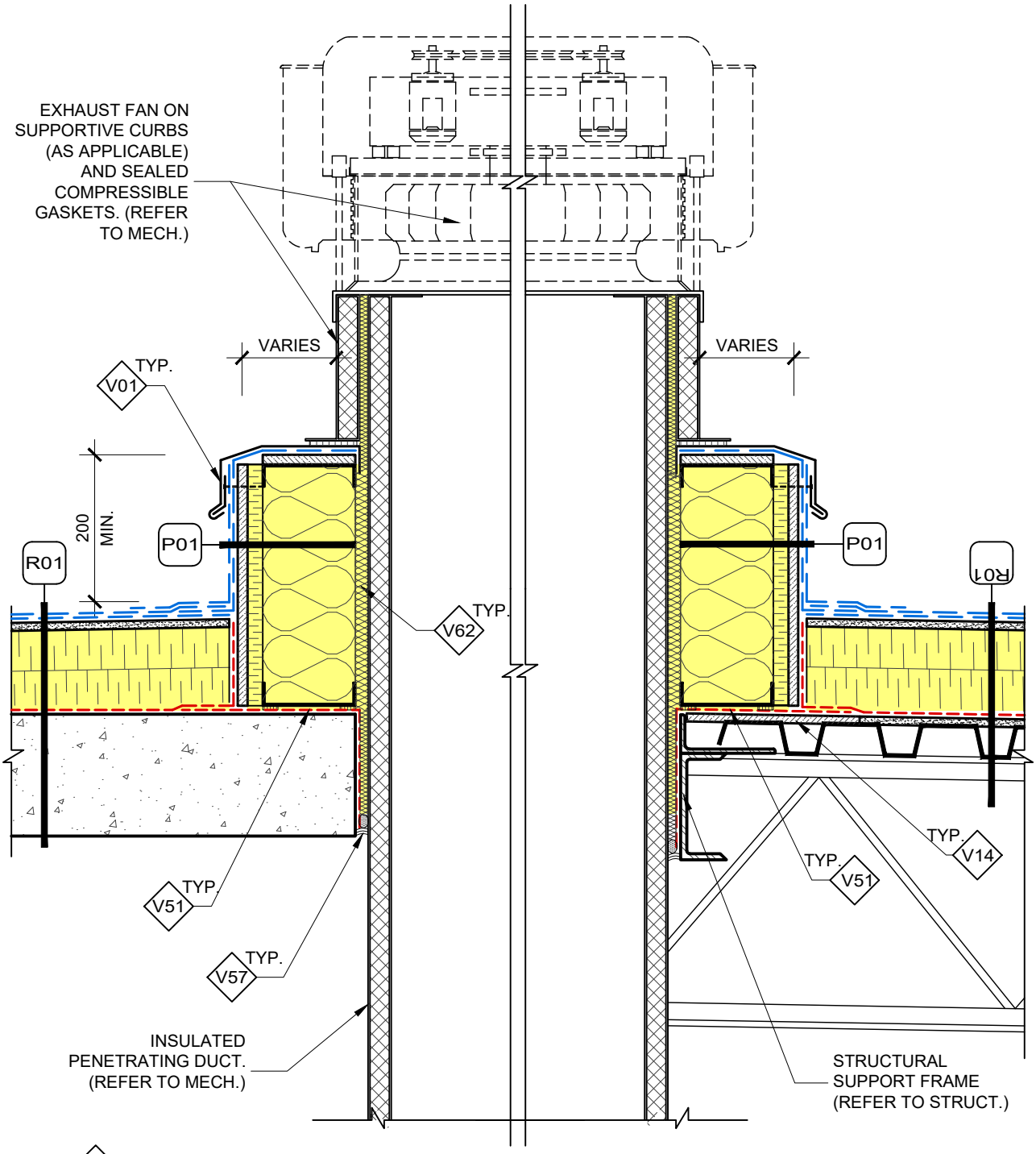
SCALE: 1:10



A01
1
DV-050
EXAPNSION JOINT - STUD PARAPET
SECTION DETAIL (TYPICAL)
SCALE: 1:10



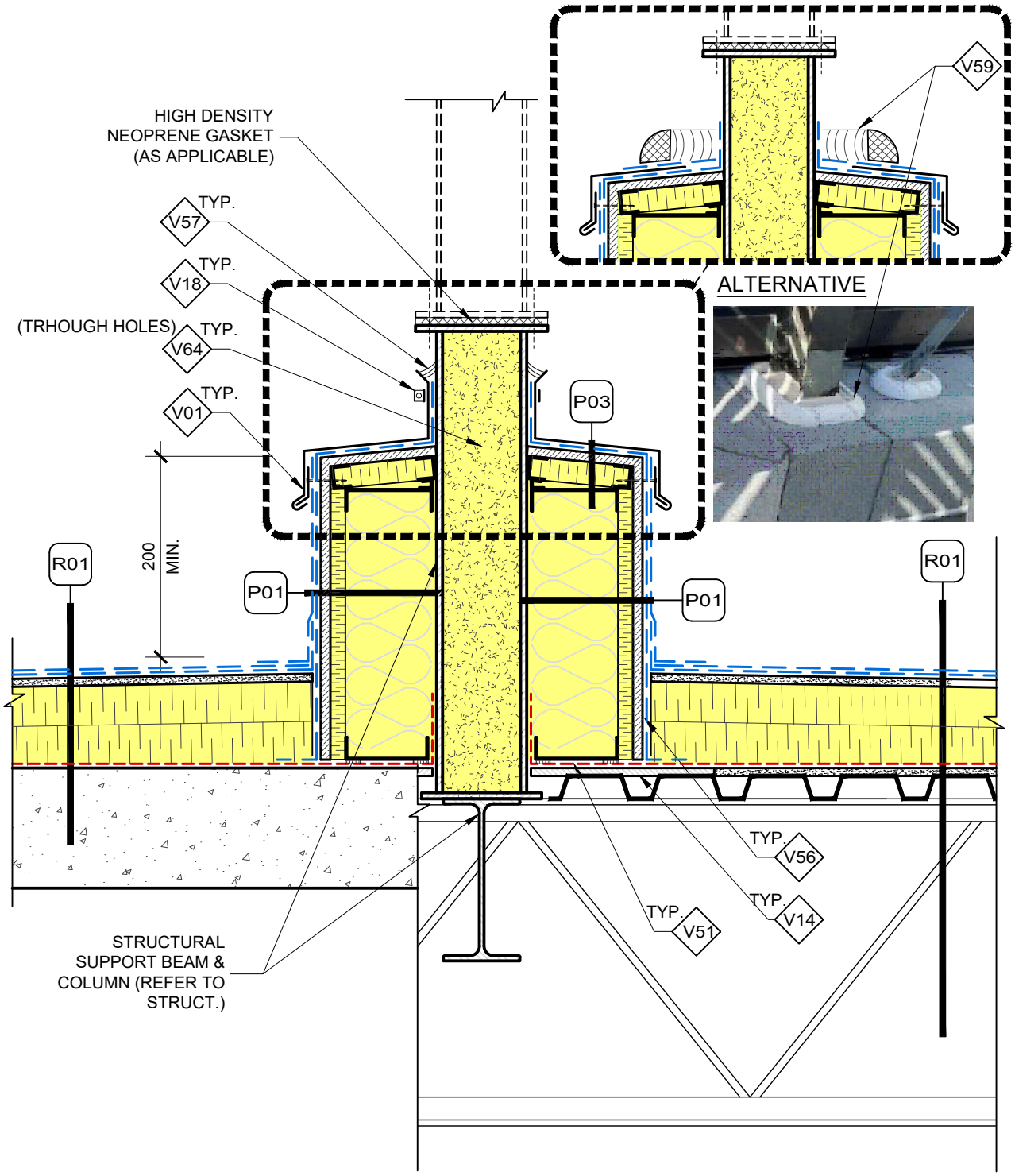
A01
1
DV-051
EQUIPMENT SUPPORT & PENETRATIONS SECTION DETAIL (TYPICAL)
SCALE: 1:10



A01
1
DV-052

EXHAUST FAN, AIR INTAKE OR GOOSENECK SECTION DETAIL (TYPICAL)

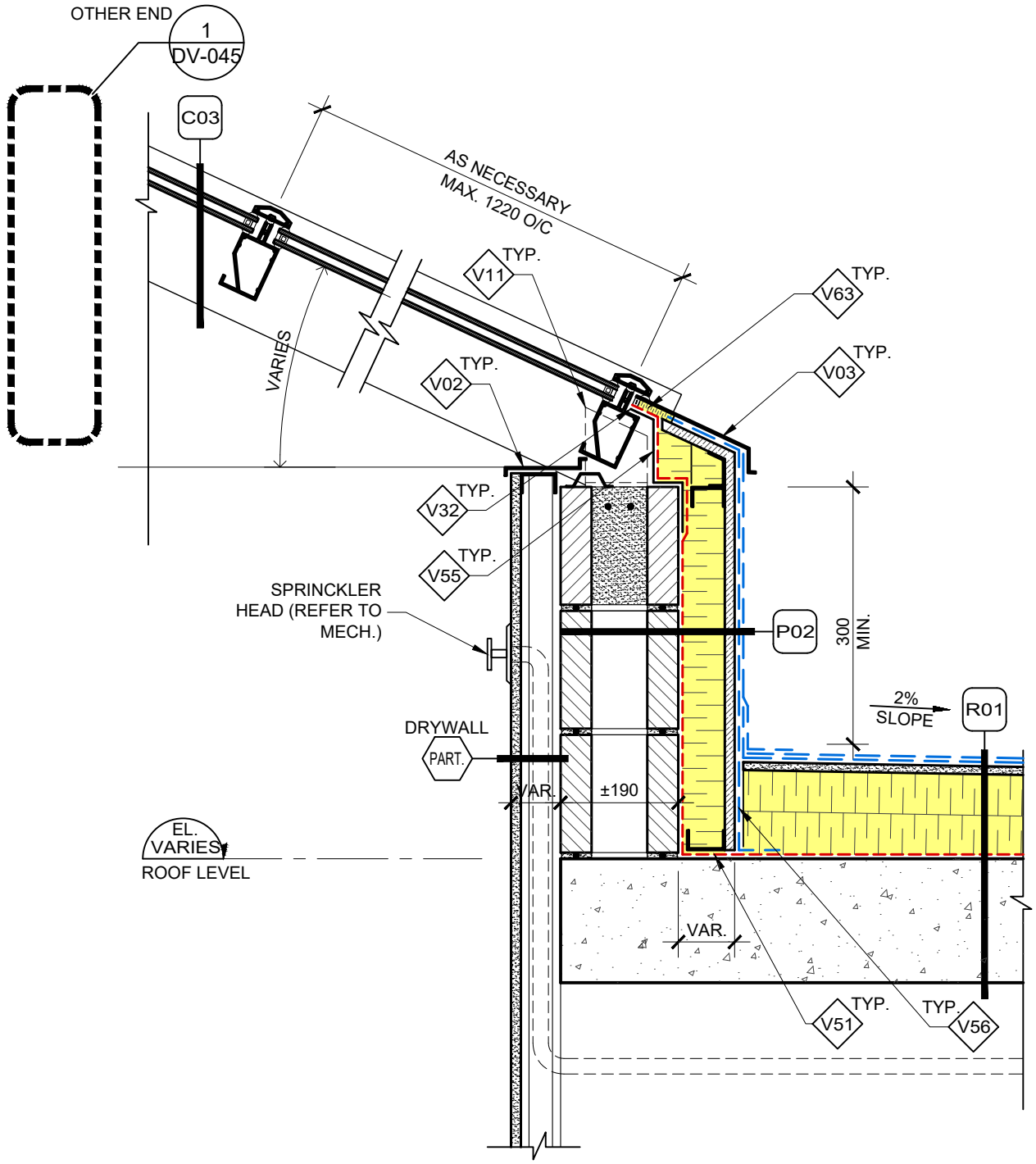
SCALE: 1:10



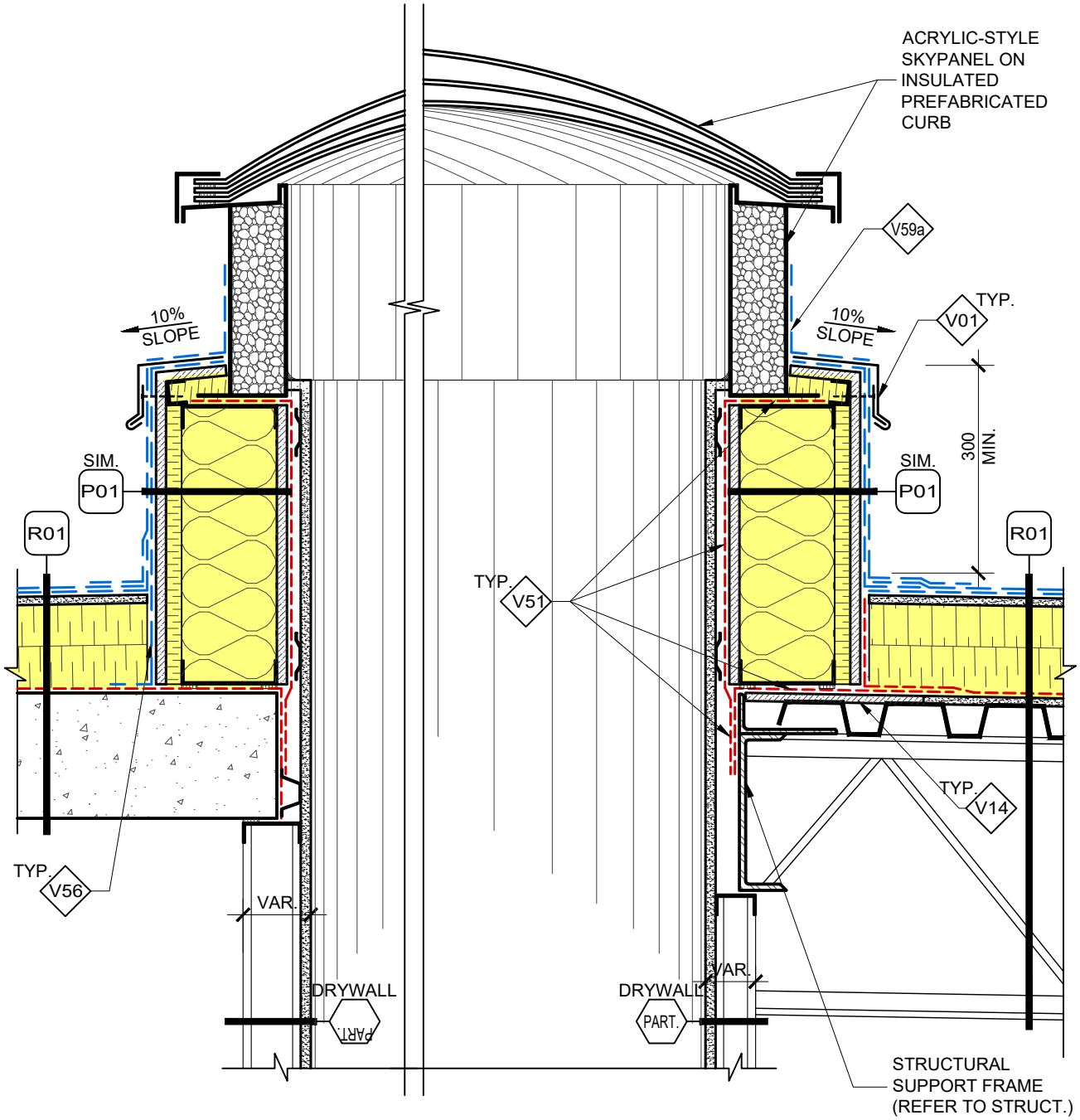
A01
1
DV-053

CONTINOUS COLUMN PENETRATION
SECTION DETAIL (TYPICAL)

SCALE: 1:10

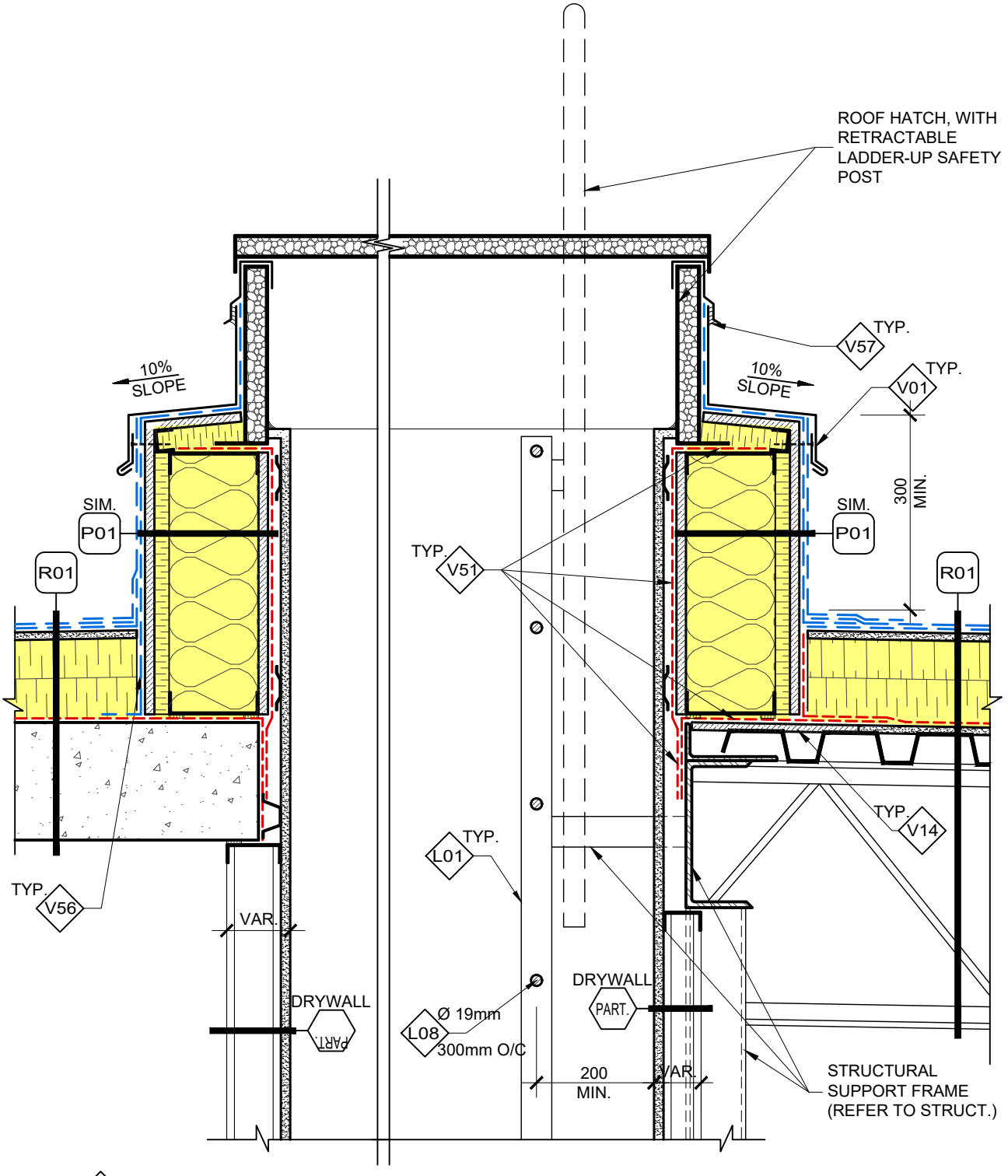


A01
1
DV-054
SKYPANEL - LOWER POINT
SECTION DETAIL (TYPICAL)
SCALE: 1:10



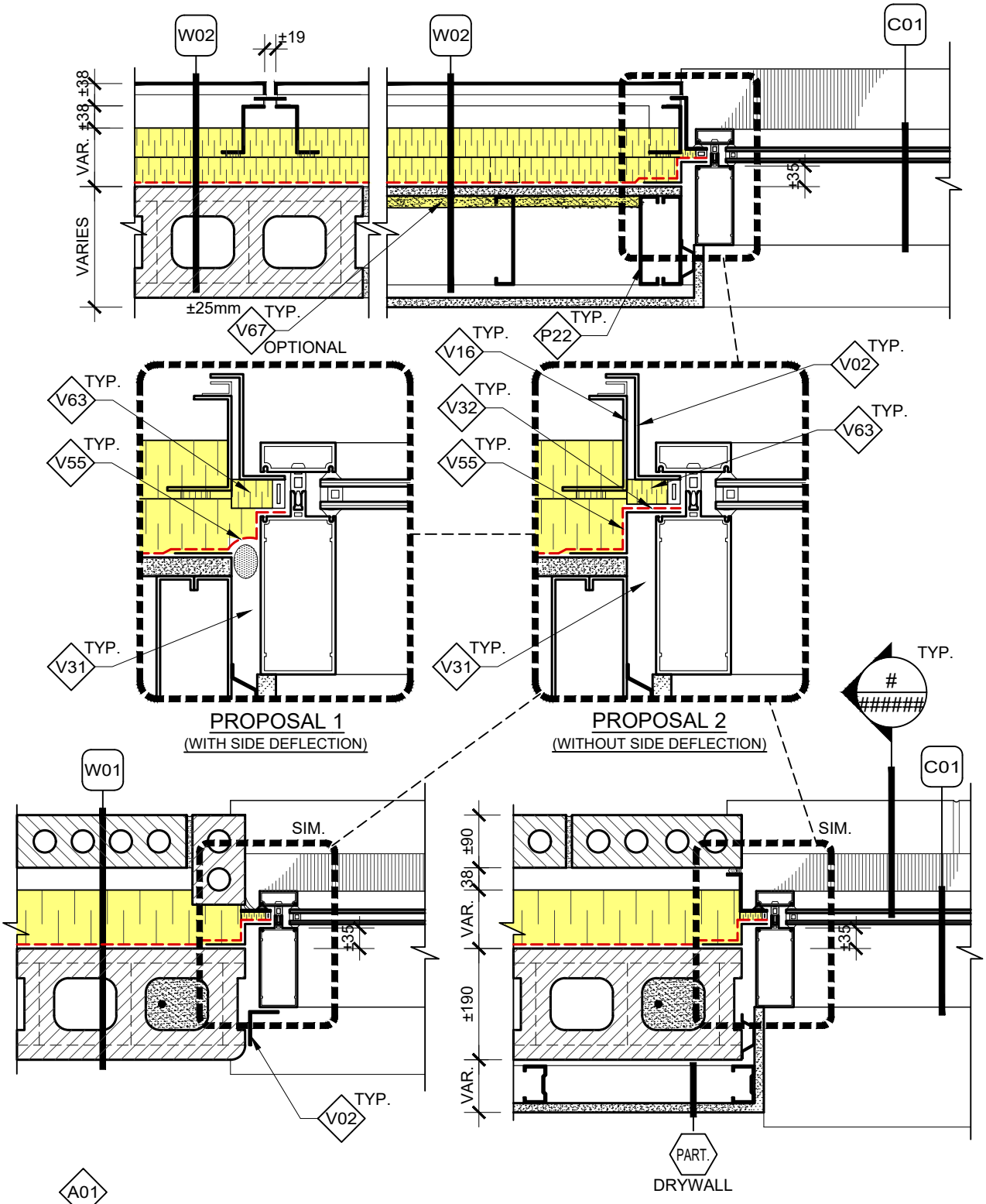
A01
1 / DV-055
PREFABRICATED SKIPANELS SECTION DETAIL (TYPICAL)

SCALE: 1:10



A01
1 / DV-056
ROOF HATCH SECTION DETAIL (TYPICAL)

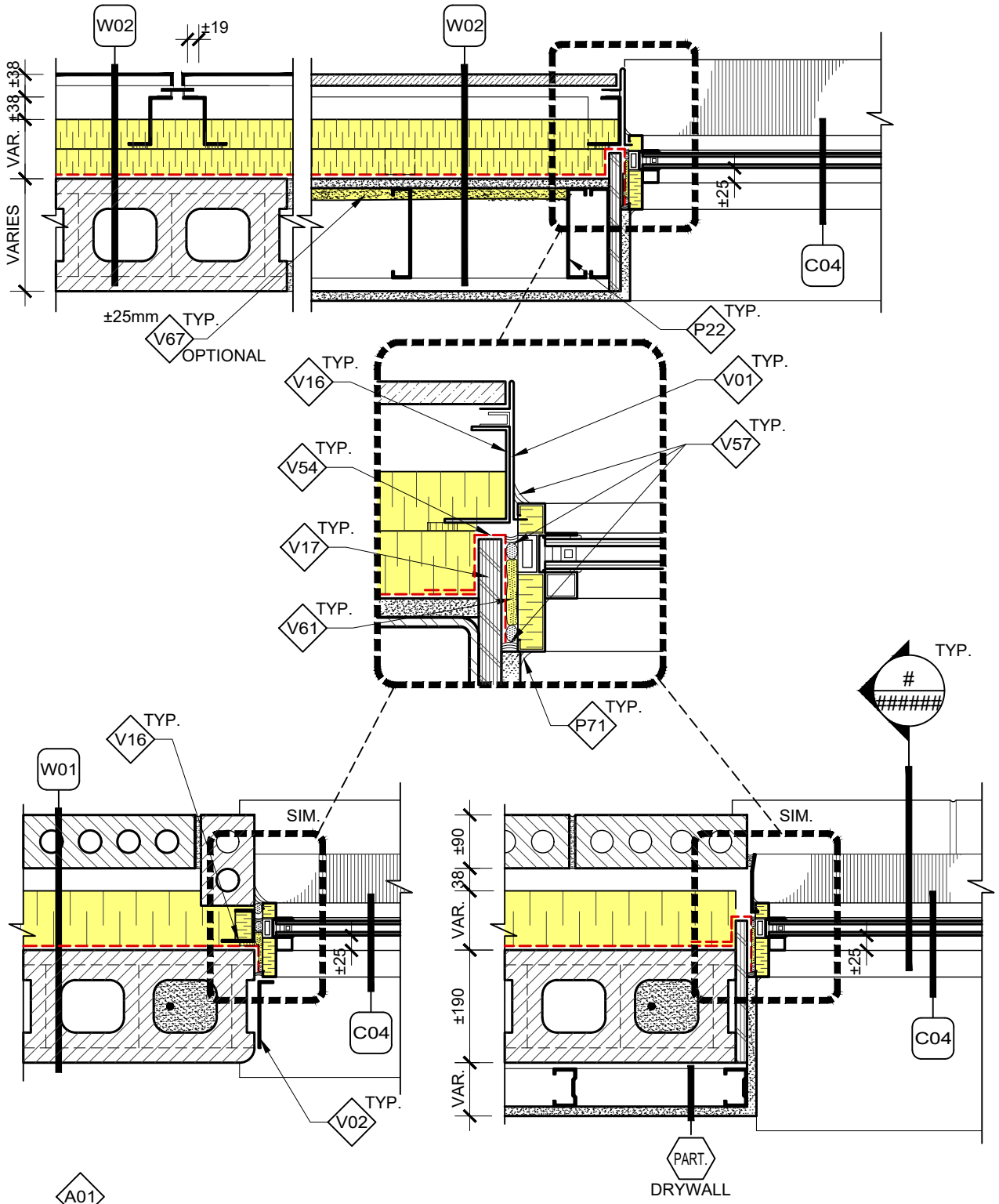
SCALE: 1:10



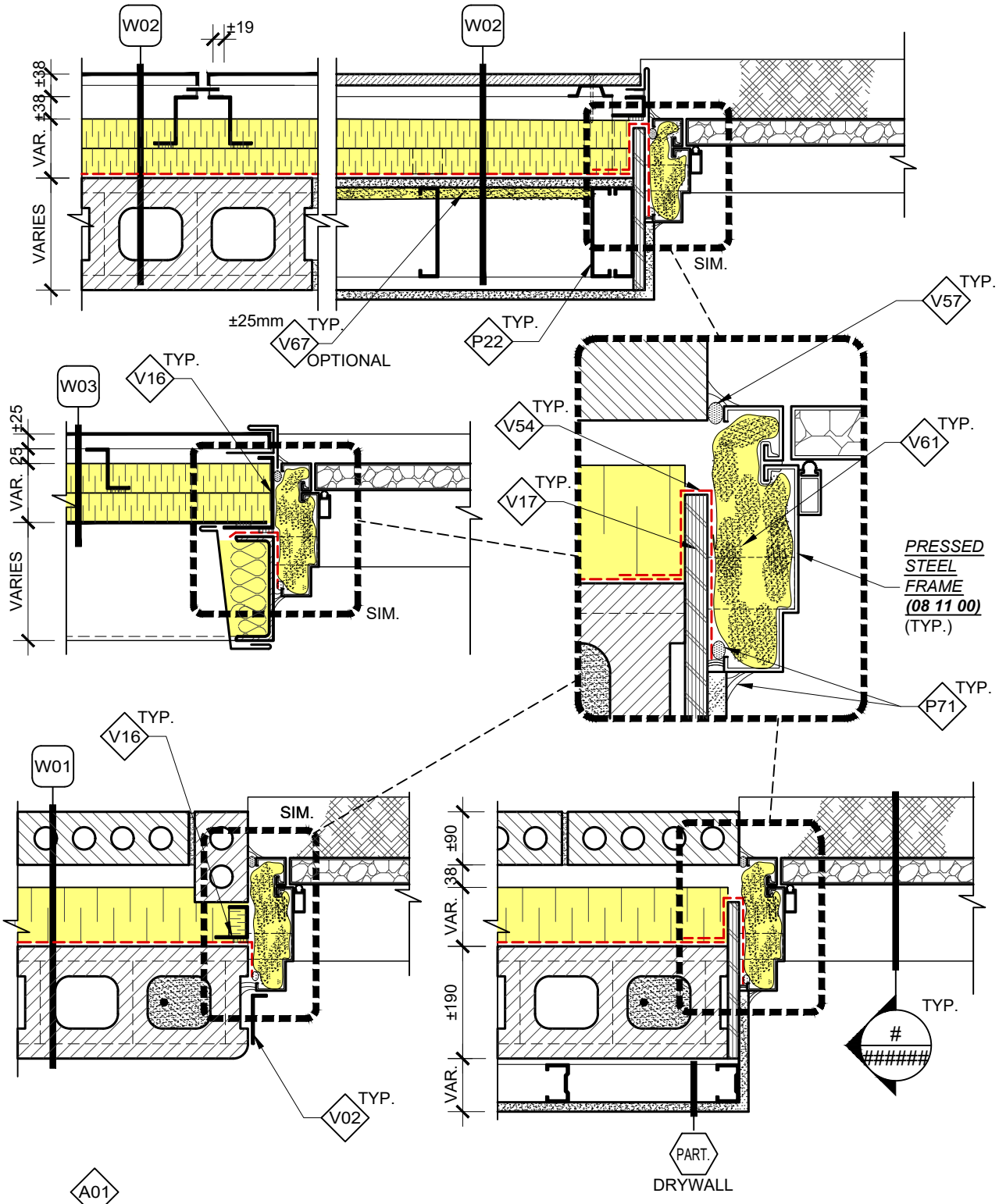
A01
1
DV-060

CURTAIN WALL JAMB CONNECTIO
JAMB DETAIL (TYPICAL)

SCALE: 1:10



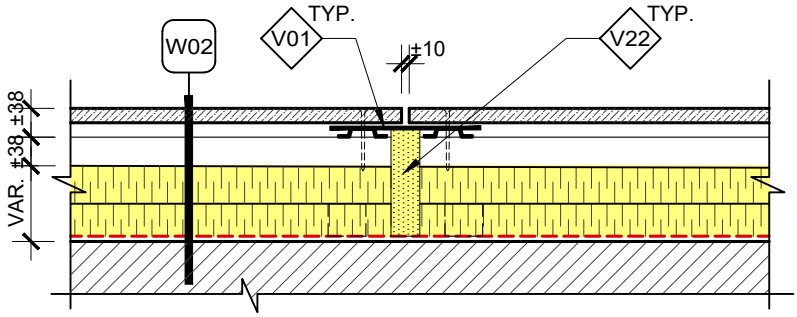
A01
1
DV-061
WINDOW UNIT JAMB CONNECTION
JAMB DETAIL (TYPICAL)
SCALE: 1:10



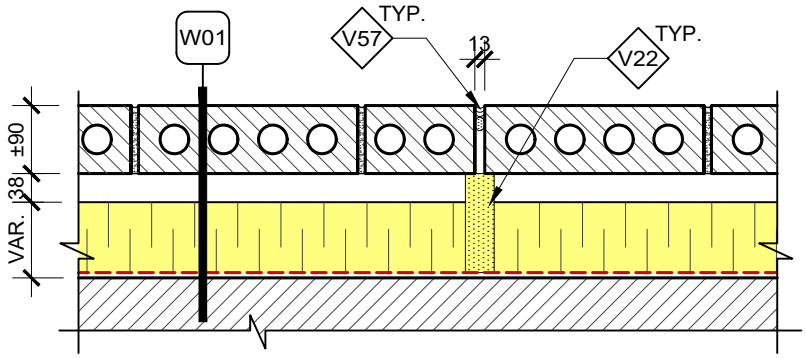
A01
1
DV-062

PRESSED STEEL FRAME JAMB CONNECTION
JAMB DETAIL (TYPICAL)

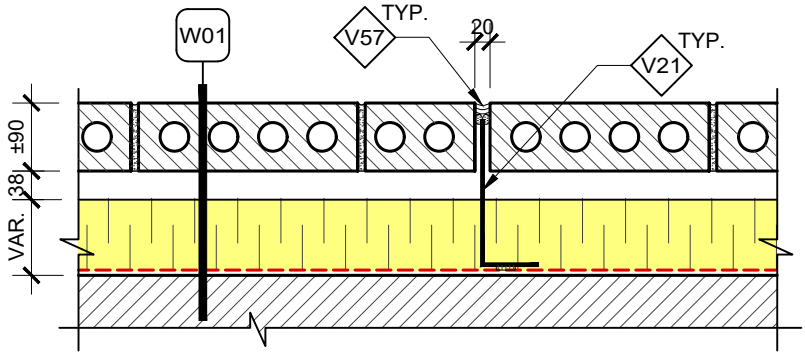
SCALE: 1:10



METAL OR
COMPOSITE PANEL



MASONRY WITH STAGGERED
CONTROL JOINT

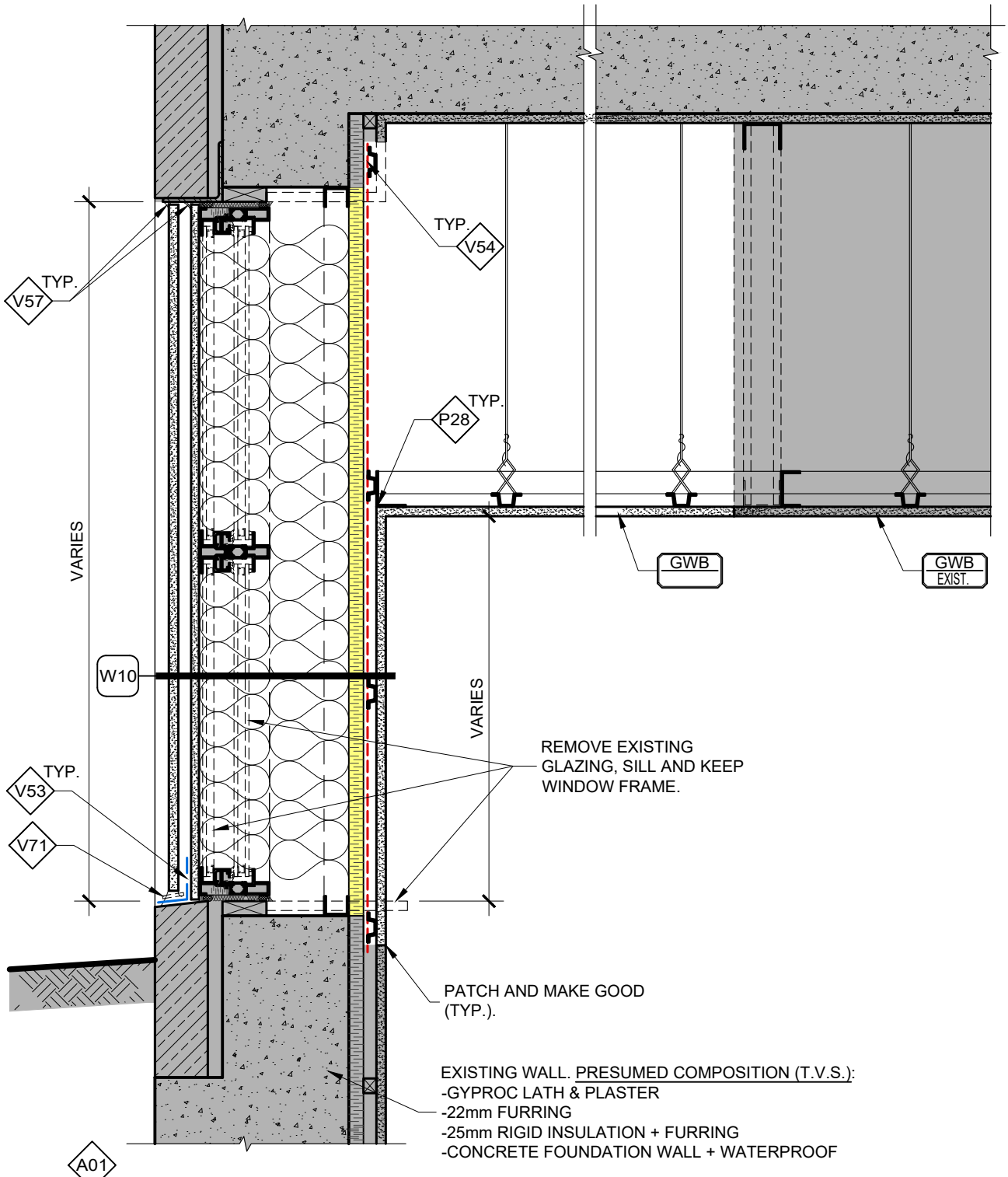


MASONRY WITH CONTINUOUS
CONTROL JOINT

A01
1
DV-063

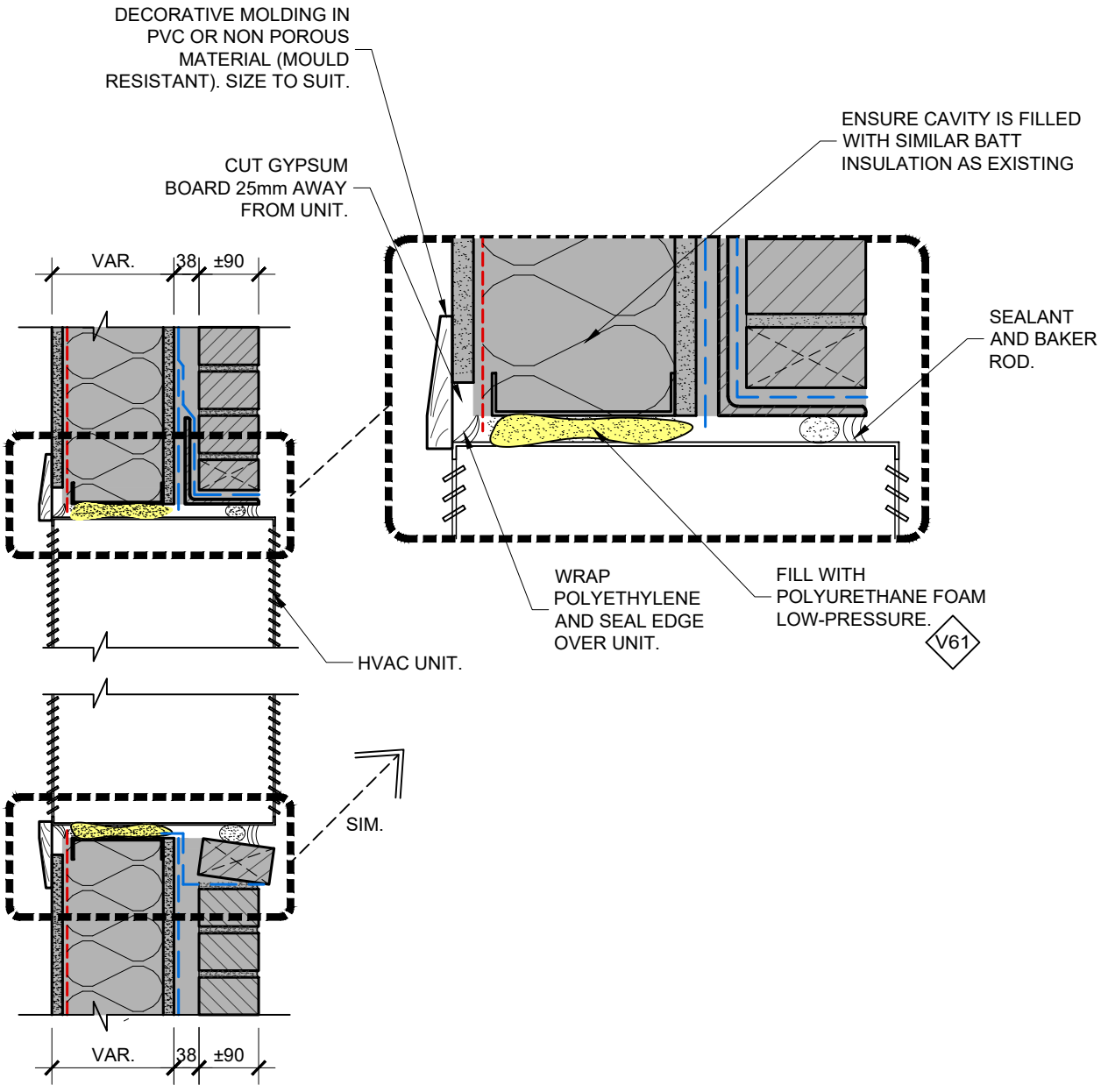
CONTROL & COMPARTMENTALIZATION JOINT
JAMB DETAIL (TYPICAL)

SCALE: 1:10

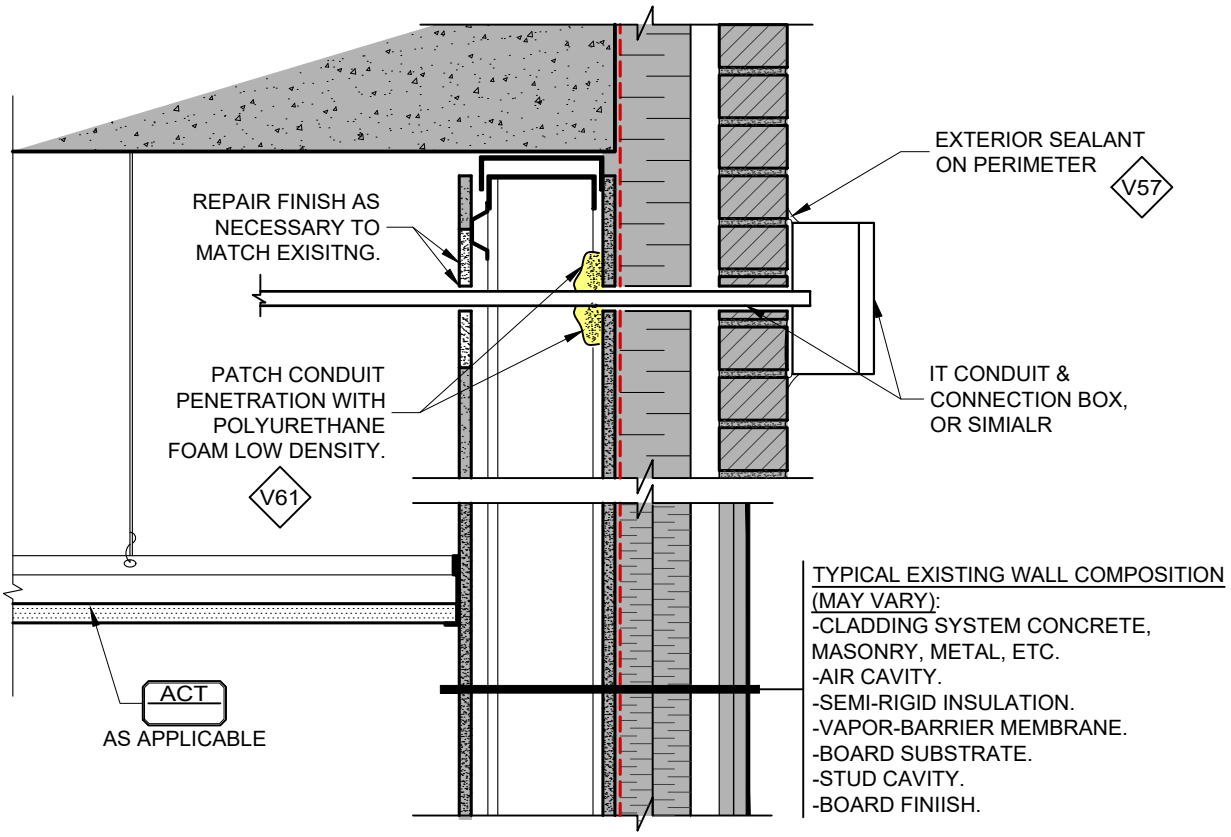


1 / DV-070 WINDOW BLOCKING SECTION DETAIL (TYPICAL)

SCALE: 1:10

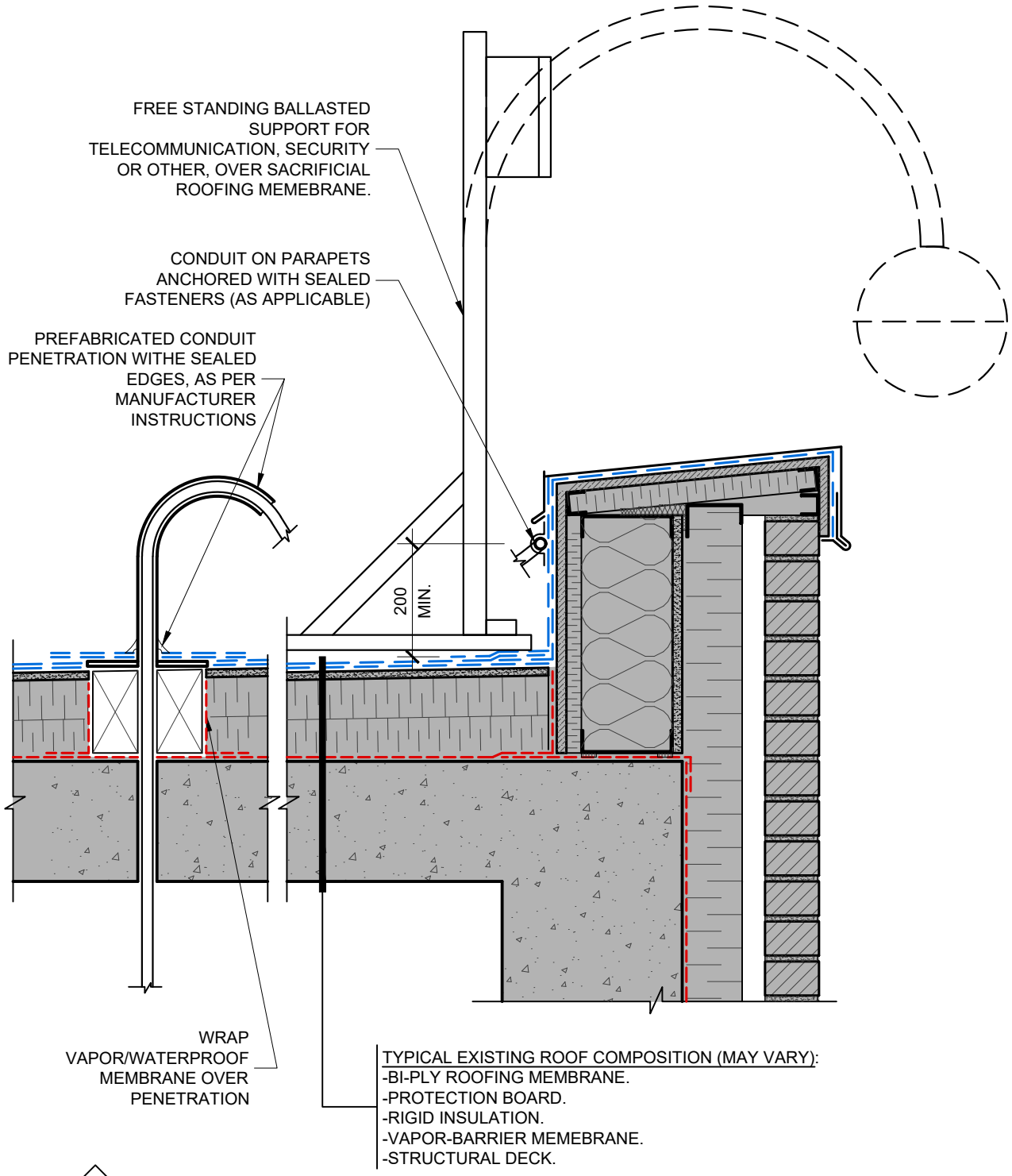


A01
1
DV-071
HVAC UNIT RETROFIT
SECTION DETAIL (TYPICAL)
SCALE: 1:10



A01
1
DV-072
CONDUIT PENETRATION SECTION DETAIL (TYPICAL)

SCALE: 1:10



A01
1
DV-073

CONDUIT PENETRATION SECTION DETAIL (TYPICAL)

SCALE: 1:10