Brock University
Capital Planning & Project Management

Design Standards

Brock University

Version 2.0
October 2019

TABLE OF CONTENTS

APPROVAL

This document has been reviewed and approved according to:

Paul Smeltzer, P.Eng.
Director, Capital Planning and Project Management
Brock University

October 16, 2019
Effective Date

INTRODUCTION

1. General

The Brock University Design Standards have been developed to aid Brock University Capital Planning and Project Management staff along with external designers, consultants and project managers in understanding the minimum expectations required for construction projects at the University.

Based on the consolidated knowledge of Brock staff across various disciplines, current codes, standards and industry best practice this document presents procedures and products formatted to Master Format number and titles.

This document is intended to outline the performance requirements of primary materials, components and systems but is not exhaustive of all products that may be used within a project. Specific products, manufacturers or installers are applicable as noted.

Projects are to follow Brock University policies and master plans to provide a safe, healthy, inclusive, exciting and functional environment that works toward current short- and long-term goals.

2. Compliance Criteria

The Design Standards are applicable to all projects at Brock University administered by Facilities Management.

Any deviations from the requirements of the Design Standards must be approved by the University Project Manager. A request for deviation is to be submitted prior to the completion of Schematic Design. Approval of Schematic Design by the University is dependent on design documents meeting the standard with any deviations as approved.

University staff or Consultants may propose alternates with an explanation of why a deviation is being requested using the Compliance Criteria Deviation form (Appendix A). Supplemental information including drawings, sketches, technical information, calculations, references are to be included as appropriate.

Deviations may be a result of various factors including project budget, project scope, project timeline, site specific constraints or stakeholder needs and wants.

3. Responsibility

The Design Standards in this document do not remove or diminish the standard of care, professional responsibility, duty or due diligence of the consultant.

Brock University encourages design innovation to which this document is intended to form a basis of design.

4. Reference Documents

1. Brock University Project Management Manual
2. Brock University Accessibility (AODA) Policy
3. Brock University Arc Flash Study
4. Brock University Campus Plan
5. Brock University Facility Accessibility Design Standards (FADS)
6. Brock University Facility Needs and Priorities Study
7. Brock University Grounds Services Facilities Management – Grounds and Landscape Development Design Standards for Project Delivery and Maintenance Initiatives
8. Brock University Occupational Health & Safety Policy
9. Brock University Respectful Work and Learning Environment Policy
10. Brock University Sustainability Policy
11. Brock University Tobacco and Smoking Policy
12. Crime Prevention Through Environmental Design
13. Facility Management Operating Procedures:

    #1-5 Notice of Temporary Disruptions

    #1-7 Design of Public Space Standard Maintenance Planning

    #2-1 Control of Hazardous Energy

    #2-8 General Safety Rules & Personal Protective Equipment

    #2-11 Ladder Safety

    #5-2 Construction Document Set-Up and Document Submission Requirements

    #5-7 Contractor/Consultant Identification Cards
14. Niagara Peninsula CAD Standard
15. Niagara Peninsula Standard Contract Document

5. Version Control

This is intended to be a living document where developments and improvements can be incorporated. This document is to be reviewed periodically by the Brock University Capital Planning and Project Management team and approved by the Director. Table 1 lists the version history of this document.

Table 1. Brock University Design Standards Version Control

Revision No.	**Date** (YYYY/MM/DD)	**Section**	**Description**
1.0	2018/07/27	All	Initial issue
2.0	2019/10/16	All	Technical updates to several sections; addition of 23 83 14 and 26 01 01; re-formatting of entire document; and addition of interactive table of contents.

00 00 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

00 00 10 GENERAL REQUIREMENTS

1. Description:

1. Contract documents prepared for Brock University developments are to be per the Niagara Peninsula Standard Contract Documents. The documents are listed below.
2. Consultants and Contractors shall use Brock University's Project Management Manual templates and forms, including the Request for Information (RFI) Form, RFI Log Template, Supplemental Instruction Form, Contemplated Change Notice Form, Change Order Form, Change Directive Form and Change Register Template.

2. Niagara Peninsula Standard Contract Documents:

1. **Special Instructions to Bidders:** Special Instructions are completed for each independent tender call, based on the specific project requirements.
2. **Instructions to Bidders:** Standard instruction document.
3. **Form of Tender including Statements:** The Form of Tender is completed for each independent tender call, based on the specific project requirements.
4. **Form of Agreement:** The Form of Agreement is completed for each independent tender call, based on the specific project requirements.
5. **Schedule of Drawings:** The Schedule of Drawings is completed for each independent tender call, based on the specific Drawings completed.
6. **Special Provisions:** Standard document.
7. **Special Provisions - Tender Items:** Standard document.
8. **Special Provisions – Supplementary:** (if applicable) Supplementary Special Provisions are completed for each independent tender call, based on the specific project requirements.
9. **Special Provisions - Labour Conditions and Fair Wage Schedule:** (if applicable) The Labour Conditions and Fair Wage Schedule is completed for each independent tender call, based on the specific project requirements.
10. **Standard Details:** Refer to OPSD.
11. **Supplementary General Conditions:** Standard document.
12. **General Conditions:** Standard document.
13. **Geotechnical Report:** (if applicable) A geotechnical report is completed by a professional geotechnical engineering consultant for each independent tender call, based on the specific project requirements.

00 73 00 SUPPLEMENTARY CONDITIONS

1. Description:

1. Adhere to the following supplementary conditions:
    1. See Virtual Library – Supplementary Conditions to Document 600, 2013 – Ontario Association of Architects Standard Form of Contract for Architect's Services between Brock University and the Architect.
    2. See Virtual Library – Supplementary Conditions to CCDC 5B Construction Management Contract.
    3. See Virtual Library – Supplementary Conditions to CCDC 2 Stipulated Price Contract.
2. Adhere to the following sections regarding insurance and bonding requirements.

2. Construction Project Standard Insurance Requirements:

1. **Projects Less than $250,000 (SOA's)**:
    1. Commercial General Liability: $3M per occurrence
    2. Automobile Liability: $3M per occurrence
    3. Non-Owned Automobile Liability: $3M per occurrence
2. **Projects $250,000 to $10M**:
    1. Commercial General Liability: $5M per occurrence
    2. Automobile Liability: $5M per occurrence
    3. Non-Owned Automobile Liability: $5M per occurrence
3. **Projects greater than $10M**:
    1. Commercial General Liability: $10M per occurrence
    2. Automobile Liability: $5M per occurrence
    3. Non-Owned Automobile Liability: $5M per occurrence
4. **All Projects**:
    1. Review project and project agreement to determine if the following insurance policies are required. The project team may contact the Risk Management Office to assist with the assessment if needed.
        1. Professional Liability/Malpractice Liability: $5M
        2. UAS/UAV/Drone Insurance: $5M per occurrence
        3. Environmental/Pollution Liability: Each project shall be individually assessed for Environmental/Pollution Liability insurance requirements.

2. The Risk Management Office requires as much notice as possible for policies which are required and are Brock's responsibility to obtain. On average it takes approximately one month to market these policies with the potential insurers in order to gain competitive quotes as per policy.

3. Contractual Insurance Requirements:

1. The Supplier agrees to obtain, prior to the first day of supplier operations (as outlined in this agreement), and will maintain in full force and effect throughout the contract period, at its own cost, insurance satisfactory to the University. The policies will be with financially sound and reputable insurance companies, licensed to underwrite insurance in the province of Ontario. All insurers will have an AM Best (or equivalent) rating of A- or better. The Supplier shall be responsible for payment of all amounts within the deductible or self-insured retention under each policy of insurance. All insurance policy requirements may be met through an inclusive combination of primary and/or umbrella liability insurance, up to the maximum limits and deductibles specified and shall not call in to contribution any insurance available to the University.
2. The insurance shall include but not be limited to:
    1. Ontario Workplace Safety and Insurance Board coverage or General Employers Liability Insurance as required by law and shall submit a valid clearance certificate prior to commencement of the work and at any other time during the course of the work at the request of the University.
    2. Commercial general liability insurance, in respect of the Supplier, and all obligations and operations of the Supplier as outlined in this agreement against claims for bodily injury and death, broad form property damage, indemnifying and protecting the Supplier. For value refer to 00 73 00 Section 2. Limited Pollution Coverage shall be endorsed to be included under the policy for a limit as determined on a case by case basis.
        1. Such insurance shall specifically state by its wording or by endorsement that:
            1. The University, its board of governors, trustees, officers, employees, servants and agents are included as additional insured under the policy with respect to the operations and obligations of the Supplier as outlined in this Agreement;
            2. The policy includes tenant's legal liability, contractual liability, SPF. 6 Non-Owned Automobile Liability, SEF.96 Non-Owned Automobile Contractual and/or SEF.94 Legal Liability for Damage Hired Automobiles coverage, products and completed operations coverage (24 months), advertising injury liability, contingent employer's liability, and include employees as additional insured's;
            3. The policy contains a cross-liability clause

4. The policy shall contain a waiver of subrogation against the University, its board of governors, trustees, officers, employees, servants and agents;

***INCLUDE NUMBER 3 BELOW IN ADDITION TO THE ABOVE REQUIREMENTS IF THE SUPPLIER WILL BE PERFORMING PROFESSIONAL SERVICES SUCH AS ENGINEERING, ARCHITECTURE OR LEGAL SERVICES (PROFESSIONAL LIABILITY) OR MEDICAL SERVICES (MALPRACTICE LIABILITY). FOR VALUE REFER TO 00 73 00 SECTION 2.

3. Professional Liability/Malpractice Liability indemnifying and protecting the Supplier, their respective employees, servants, volunteers, agents and invitees. The policy must protect the supplier against claims or allegations of professional negligence. Such insurance shall contain a waiver of rights of subrogation against the University, its board of governors, trustees, officers, employees, servants and agents.

*** INCLUDE NUMBER 4 BELOW IN ADDITION TO THE ABOVE REQUIREMENTS IF THE SUPPLIER WILL BE USING THEIR OWN EQUIPMENT, NOT INCLUDING A UAV OR UAS, COMMONLY KNOWN AS A DRONE, TO CONDUCT AGREED UPON SERVICES. FOR VALUE REFER TO 00 73 00 SECTION 2.

4. All Risk Property and Machinery insurance coverage on a replacement cost basis to provide protection to the Supplier's equipment and other such property in the care, custody and control of the Supplier. The policy shall contain a waiver of rights of subrogation against the University, its board of governors, trustees, officers, employees, servants and agents.

*** INCLUDE NUMBER 5 BELOW IN ADDITION TO THE ABOVE REQUIREMENTS IF THE SUPPLIER WILL BE USING THEIR OWN AUTOMOBILES TO CONDUCT THE AGREED UPON SERVICES. FOR VALUE REFER TO 00 73 00 SECTION 2.

5. Automobile Liability Insurance. The policy must provide coverage for bodily injury or property damage arising out of the ownership, use or operation of all automobiles and/leased by the Supplier.

*** INCLUDE NUMBER 6 BELOW IN ADDITION TO THE ABOVE REQUIREMENTS IF THE SUPPLIER WILL BE PERFORMING SERVICES UTILIZING AN UNMANNED AERIAL SYSTEM/VEHICLE (UAS/UAV), COMMONLY REFERRED TO AS A DRONE. FOR VALUE REFER TO 00 73 00 SECTION 2.

6. UAS/UAV/Drone Insurance. The policy must provide coverage for Bodily Injury or property damage arising out of the ownership, use or operation of an Unmanned Aircraft System or Unmanned Aerial Vehicle.

   *** INCLUDE NUMBER 7 BELOW IN ADDITION TO THE ABOVE REQUIREMENTS IF THE SUPPLIER WILL BE PERFORMING ANY SERVICES RELATING TO ANY ENVIRONMENTAL TESTING, PHASE 1,2,3 AND 4 ENVIRONMENTAL SITE ASSESSMENTS, REMEDIATION/ABATEMENT, DESIGN REMEDIATION, ENVIRONMENTAL CONSULTING AND ENGINEERING, DEMOLITION, NEW CONSTRUCTION OR RENOVATION OR EMERGENCY SPILL RESPONSE SERVICES. FOR VALUE REFER TO 00 73 00 SECTION 2.

7. Environmental/Pollution liability insurance providing coverage for first party property damage and site clean-up and any third party claims for bodily injury, property damage and clean-up arising from the operations of the Supplier and its contractors in the performance of the work. Note: Each project shall be individually assessed for insurance requirements related to Environmental/Pollution Liability insurance.

3. The policies shall be issued for an annual term of 12-months and the limit shall apply to each annual term.

4. Such policies shall include the University, its board of governors, trustees, officers, employees, servants and agents are included as additional insured under the policies with respect to the operations and obligations of the Supplier and as outlined in this agreement; shall be provided with 30 days prior notice of cancellation or notice of any reduction in coverage limits.

5. Such policies shall not be terminated, cancelled or materially altered without written notification of such termination, cancellation or material change given by the insurers to the University, at least thirty (30) days in advance of the effective date thereof.

6. Evidence of insurance coverage required must be provided to the University in advance of commencement of Supplier operations as outlined in this Agreement, Brock University – Contractual Insurance Requirements.

4. Recommended Bonding:

1. Bid bonds should be required of bidders for all tendered contracts with an estimated value greater than $100,000. Other acceptable security, such as a certified cheque or letter of credit, may be permitted for contracts with a pre-tender estimate of less than $1,000,000.

2. Labour and Material bonds and Performance bonds shall comply with the requirements of the Construction Act.

3. A Consent of Surety (letter from the Surety Company) indicating that the Contractor will obtain the required final bonding will be required to be submitted by all bidders.

01 00 00 GENERAL REQUIREMENTS

01 31 00 PROJECT MANAGEMENT AND COORDINATION

1. Description: Requirements Included:

1. Coordination and Cooperation
2. Preconstruction Meetings
3. Administration of Project Meetings

2. Coordination and Cooperation:

1. Coordinate all Sections. Maintain efficient and continuous supervision. Ensure cooperation of workers in laying out the Work. Be responsible for co-ordination and placement of openings, sleeves and accessories. Take into account previously installed installations to ensure best arrangement of components in the available space. For critical locations where adequate direction is not given by the Documents, consult the Architect or Engineer.
2. The Work noted in each Section of the Specifications and the description of the various systems shall not relieve the Contractor from their responsibility to assign the various parts of the Work to the appropriate Subcontractors and forces and shall not impose upon the Architect or Owner the duty to arbitrate disputes between the Contractor and the Subcontractors nor shall it relieve the Subcontractors from their responsibility for carefully examining all the Drawings and Specifications and co-ordinate their work with each other and the Contractor.
3. Take field dimensions relative to the Work. Fabricate and erect Work to suit field dimensions and field conditions. Provide forms, templates, anchors, sleeves, inserts and accessories required to be fixed to or inserted in the Work and set in place or instruct related Sections as to their location, giving required supervision.
4. Pay cost of extra work caused by, and make up time lost as a result of failure to co-ordinate all Sections or to obtain from them co-operation and information necessary to co-ordinate their work with others.
5. Co-operate and co-ordinate with Sub-Contractors on the Project as required for satisfactory and expeditious completion of the Project.
6. Afford all Sub-Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work.

3. Preconstruction Meetings:

1. Attend a meeting requested by the Architect or Engineer following award of the Contract. Senior representatives of the Owner, Contractor, Subcontractors requested by Architect, Engineer, and Sub-Consultants will be in attendance.

4. Administration of Project Meetings:

1. Schedule and administer project meetings twice a month.

2. Prepare agenda for meetings.
3. Provide physical space and make arrangements for meetings.
4. Record the minutes, include significant proceedings and decisions, and identify ‘action by’ parties.
5. Reproduce and distribute copies of minutes within 48 hours after each meeting and transmit to meeting participants, affected parties not in attendance, and the Owner.

01 41 00 REGULATORY REQUIREMENTS

1. Description: Requirements included:

1. General Regulatory Requirements
2. Authorities
3. Codes and Acts

2. General Regulatory Requirements:

1. The Architect or Engineer has the right of the authority named in any referenced or applicable standard to approve, select, interpret or otherwise exercise any authority afforded by the standard.
2. Where the Contract Documents exceed the requirements of this Section, provide such additional requirements.

3. Authorities:

1. Conform to all requirements of all authorities having jurisdiction including the public utilities. The above are referred to in the Contract Documents as the authorities.
2. Notwithstanding 3.3. and 3.4. the Owner will pay for the Building Permit.
3. The Contractor of each Section is to apply for, pay for and obtain all other permits required by the authorities for the Work of their Section.
4. The "Building Permit Copy" of the drawings and specifications as approved by the local Building Department shall be kept on the job and maintained in good condition from commencement to completion of the Work. On completion of the Work this Building Permit copy shall be delivered in good condition to the Architect or Engineer.

4. Codes, Acts, and Standards: Conform to but not limited to:

1. Accessibility for Ontarians with Disabilities Act, 2005.
2. Canadian Electrical Code (CSA C22 Series, latest editions).
3. Niagara Peninsula Standard Contract Documents
4. Occupational Health and Safety Act, 1990 and Regulations for Construction Projects (Ontario Regulation 691/1990)
5. Ontario Building Code
6. Workplace Hazardous Materials Information System
7. Safety Data Sheets

01 50 00 TEMPORARY FACILITIES AND CONTROLS

1. Description: Requirements Included:

1. Temporary Electricity, Water, Communications, Fire Protection, First Aid Facilities, Heating and Ventilation, Sanitary Facilities, Protection, Fences/Barriers and Signage
2. Security
3. Parking
4. Water and Debris Control
5. Project Sign
6. Construction Office
7. Safety Apparel
8. Confirm to the requirements of 31 25 00 Erosion and Sedimentation Controls

2. Temporary Utilities:

1. Provide and pay, locate where directed, and maintain temporary facilities for the Work and for all trades, and remove them upon completion of the Work.
2. Where specified to provide utilities, make all arrangements with the public utilities, obtain all necessary permits, provide or pay for connections and pay all respective fees.

3. Temporary Electricity:

1. Provide and pay for temporary power during construction for power and lighting. Maintain minimum 162 lx at floors and stairs.

4. Temporary Fire Protection:

1. Provide and maintain temporary fire protection equipment during performance of the Work to construction site and existing buildings as required by governing codes, regulations and by-laws.
2. When temporary fire protection is not feasible, the Contractor shall provide for fire watch for the duration of the fire system downtime. This shall be coordinated through the Project Manager and with Campus Security.
3. Provide and maintain in working order suitable Underwriter's labelled fire extinguishers and locate in prominent positions to approval of authorities**.**
4. Maintain exits or where not feasible due to construction activities provide acceptable alternate exits**.** To be approved by authorities.
5. Maintain existing fire routes including lateral and overhead clearances.
6. Take necessary precautions to eliminate fire hazards and to prevent damage to the Work, building materials, equipment and other property both public and private having to do with the Work. Inspect the Work at least once a week for this purpose.

7. Open fires or burning of rubbish or debris are not permitted on the Site.

5. Temporary Heating and Ventilation:

1. Provide temporary heat, heating equipment and shelter to keep that work which requires protection from cold adequately warm and sheltered from elements maintaining minimum temperature of 10°C or higher if required. Provide heating for materials affected by cold both in storage and during construction.
2. Before concrete slabs are placed on grade completely thaw out subsoil and raise its temperature to, and maintain at, 10°C minimum.
3. Use temporary heaters, forced warm air type, vented to exterior or radiant panel type. If used in areas of completed building provide protection on floors and adjacent surfaces to prevent damage to floors and adjacent surfaces particularly when re-fueling.
4. Provide temporary sheltering enclosures for part or all of the building as required to ensure minimum temperatures noted above are maintained.
5. Use of permanent heating and ventilation system is not permitted.
6. Provide temporary ventilation required by construction activities for curing or drying of completed installations, meet health regulations, prevent harmful accumulation of hazardous or volatile substances and protect installations from adverse effects of high humidity.

6. Temporary Water:

1. Provide and pay for temporary potable water for construction use.

7. Construction Office:

1. Provide trailer for the use as Contract Administration offices during the progress of the Work. Trailer to be of sufficient size to accommodate bi-weekly site meetings and be furnished with table and chairs of sufficient size and numbers for all attendees. Heat trailer and clean on a regular basis. Subcontractors may provide their own offices as necessary. Direct location of same.

8. Temporary Communications:

1. Provide and pay for a temporary telephone, fax line and electronic communication service (e.g. internet) for Contractor's own use. Provide for an automatic message recording.

9. Safety Apparel:

1. Provide five (5) spare safety helmets, safety glasses and safety vests for visitors, and enforce the use of safety helmets and safety footwear by all, including visitors.

10. Temporary First Aid Facilities:

1. Provide well stocked and maintained first aid kit adequate to handle requirements of hazards in the Work in the Site office.

11. Temporary Sanitary Facilities:

1. Provide temporary toilet, odourless flushing chemical type, properly enclosed, weatherproof, with a wash system and serviced periodically as required by the authorities. Use of permanent toilets, urinals, and lavatories is prohibited.

12. Temporary Protection:

1. Should the project be closed down for any cause, assume all responsibility for its proper protection during such period.

13. Parking:

1. Parking shall be considered during the design phase and direction provided by the Project Manager. If authorized by University Project Manager to use existing roads for site access, maintain and repair all damages. Ensure roads are suitable to carry proposed loads. Follow erosion and sedimentation control plan regarding access points.

14. Temporary Fences/Barriers:

1. Provide hoarding, fencing, barriers and plant protection as required by the authorities, Contract Documents, and specified herein to protect persons and property, public and private.
2. Provide minimum 2.4 m high, non-climbable, 13 mm exterior grade plywood butt jointed on 38 mm x 89 mm construction grade lumber framing at 600 mm on center around portions of the Site Work to protect the Work at all times. Provide access gates as required. Maintain in sound condition throughout the Work. Remove at completion of Work and make good all surfaces. Layout to be approved by Brock University Project Manager.
3. Provide interior construction hoarding around portions of the Work to separate construction areas from Owner occupied areas. Construct hoarding using wood framing and plywood, acoustic batts and vapour barrier (for dust control). Gypsum board will be considered (e.g. fire separation) for approval by the University Project Manager. Carry partitions to u/s of structural deck above or provide ceiling using same construction. Provide acoustic sealant at perimeter junctions. Provide lockable access doors as required. Maintain in sound condition throughout the Work. Remove at completion of Work and make good all surfaces.

15. Security:

1. Take all necessary precautions to guard Site, premises, materials and the public at all times other than when supervised work is in progress. Secure premises at end of working day.

16. Temporary Support:

1. Provide support as required at soil banks and adjacent public and private property.
2. Protect by bracing or shoring the Work and its parts from movement and damage, especially from wind and during filling and compaction and until elements are securely anchored and braced to permanent structure and cannot be damaged or moved by filling, compaction or wind.
3. Restrict access by placing barricades or posting guards to unauthorized personnel to areas of the Work being temporarily shored. Unauthorized personnel shall mean the public and anyone not directly concerned with the execution, supervision or inspection of the shoring.

17. Freezing and Frost Under Footings and Slabs:

1. Do not allow footings or slabs to be placed on frozen ground. Do not permit excavations to full depth indicated when freezing temperature may be expected unless footings or slabs can be placed immediately after excavation has been completed. Protect excavation from frost by placing of suitable approved insulating material to adequate depth if placing of concrete is delayed and after placing of concrete until backfilling sufficient to prevent freezing has been done, or freezing conditions terminate.

18. Temporary Tree and Plant Protection:

1. Protect tops, trunks and roots of existing trees on the Site to remain.
2. Protect trunks of trees adjacent to construction work, material storage areas and trucking lanes from grade to 2,400 mm above grade by wrapping with two layers of burlap and encasing with 38 x 39 mm lumber at 150 mm held in place with 3 metal bands at 1 m.
3. Do not permit heavy equipment or stockpiles within branch spread. When approved, remove interfering branches without injury to trunks, and cover scars with tree paint.
4. Fence off areas near construction activity containing shrubs and gardens to remain, and keep area clear of debris and materials.
5. Protect sod to remain and to be temporarily covered by covering first with burlap (do not cover with non-breathing plastic sheeting). Cover sod no longer than two weeks, then remove covering and cut and expose sod for minimum two weeks before recovering.

19. Water Control:

1. Provide necessary pumps (including spare pumps) and temporary drainage for keeping the Work free of water throughout construction period. Pump water by approved means. Control grading around excavation to prevent surface water from draining into excavation and from damaging adjoining property. Protect excavation,

trenches and building from damage by rain-water, ground water, backing up of drains or sewers and other water, frost and other weather conditions.

20. Debris Control:

1. Keep Site clear of debris and all materials and equipment not necessary for the progress of the Work. Follow erosion and sedimentation control plan.

21. Indoor Air Quality Management:

1. **HVAC Protection**:
    1. Prevent dust from getting into HVAC system. Seal off any duct work during construction and keep stored ducts sealed in plastic to prevent any dust from getting into them.
    2. Do not use HVAC system during construction.
    3. Do not store construction or waste materials in mechanical rooms.
    4. Seal diffusers with plastic when stored and/or not actively in use including at end of day once installed.
    5. Inspect and clean, where necessary, all ducts and diffusers at completion of Work.
    6. Complete filter change at Substantial Performance or occupancy, whichever occurs first.
2. **Source Control**:
    1. Prohibit idling motors on site during construction.
    2. Use bottled gas for equipment as opposed to diesel.
    3. Switch to electrical equipment as opposed to gas wherever possible.
    4. Emit exhaust directly outside of building, well away from intakes.
    5. Use enclosed tanker vs. open kettle for roofing operations.
3. **Pathway Interruption**:
    1. Use dust curtains, continuous plastic seals, to zone-off work areas and containing dust and dirt particulate.
4. **Housekeeping**:
    1. Minimize dust with wetting agents or sweeping compounds.
    2. Remove spills quickly when dealing with odorous materials.
    3. Remove any accumulated water. Keep work areas as dry as possible and dehumidify where necessary.
    4. Vacuum with HEPA filtered vacuums to reduce airborne dust.
    5. Keep porous materials dry. Do not allow any insulation to become wet.

6. Site clean-up every day.

5. **Scheduling**:

    1. If the building is occupied after substantial completion, the ongoing work-areas should be kept under negative pressure to contain odour and dust.

    2. Wherever possible, work where off gassing occurs should be scheduled during the occupant's off-hours.

    3. All interior of duct work to be scrub cleaned as part of final clean of the building.

    4. Ensure there is adequate time in the construction schedule for cleaning and ventilation/flush-out of the building prior to occupancy.

22. Project Sign:

1. Brock University shall provide the project sign as required. Contractor to install and maintain.

23. Temporary Signage:

1. Provide construction warning/safety/fire signage as required by authorities to notify workers, visitors and the public of the presence of the construction site, required safety apparel and applicable dangers. Provide temporary traffic signage in accordance with Ontario Traffic Manual.

24. Protect the Work during construction from damage by weather. Provide protection as required to protect work in progress from damage and to provide suitable conditions for the progress of finishing work.

25. Take reasonable and required measures including those required by authorities having jurisdiction to protect the public and those employed on the Work from bodily harm. Comply with requirements of The Occupational Health and Safety Act, and Regulations for Construction Projects.

26. Direct all Subcontractors to protect their own work, existing property, adjacent public and private property and work of other Sections from damage while working.

27. Owner to inspect work prior to any demolition that will cause dust and/or debris.

28. Provide pavement protection for public thoroughfares and the Work in progress as required by the authorities and to protect public property and the Work.

01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS

1. Description: Requirements Included:

1. Cutting, Patching and Making Good
2. Site Examination
3. Workmanship
4. Prohibited Actions
5. Services and Utilities
6. Unused Sleeves and Holes
7. Concealed Services and Headroom
8. Floor Surfaces
9. Dissimilar Metals and Metal Contact
10. Fastenings
11. Trademarks and Labels

2. Cutting, Patching and Making Good:

1. Cut, patch and make good to leave work in a finished condition. Cutting in this sense shall mean the actual cutting of components to allow other components to pass through or to provide new openings.
2. The Section requiring cuts, holes or sleeves for its work shall locate same. General Contractor to make cuts using Trade trained in such work. Cuts shall be clean, true with smooth edges.
3. Patching shall be done by the Section which did original work being patched or by a Trade trained in such work. Patches shall be invisible in final assembly. Complete and tightly fit, and seal if exterior wall, all construction to pipes, ducts and conduits which pass through construction to completely prevent the passage of air. Maintain or restore vapour barrier, air barrier, insulation and cavity in the building envelope. Maintain or restore fire or smoke rating of cut element.
4. Damaged work shall be made good by appropriate trades trained in such work but at the expense of those causing damage. Make good using matching materials.

3. Site Examination:

1. Examine site conditions and other work upon which your work depends. Immediately notify the Consultant of any existing conditions which are not as indicated in the Contract Documents.

4. Workmanship:

1. Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Consultant if necessary work is such as to make it impractical to produce required results.
2. Do not employ any unfit person or anyone unskilled in their required duties. The Owner reserves the right to require the dismissal from the site of workers deemed incompetent, careless, insubordinate or otherwise objectionable.
3. Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Owner, whose decision is final.

5. Prohibited Actions:

1. Bar all workers impaired by drugs or alcohol from the Work.
2. Smoking is only permitted within Brock University designated external smoking areas.

6. Services and Utilities:

1. Verify the location and/or availability of services and utilities within the building site, or on adjoining properties, sidewalks and streets. Should there be any variance with the provisions of the Contract Documents, notify the Consultant.
2. Neither the Consultant nor the Owner shall assume responsibility for the scope or accuracy of any information given on the Drawings relating to existing services.
3. Protect, relocate and maintain existing active services wherever they are encountered. Wherever inactive services are encountered, cap them off and remove the unwanted portion, with the approval of the authorities and/or the public utility concerned in the manner approved by them.
4. In case of damage to active services, notify the Consultant, utilities and authorities immediately, and make all required repairs under direction of appropriate utility. Carry out repairs during off-hours if required. In absence of specific requirements or direction, plug or cap unused or abandoned utility lines or as required by utilities, codes and authorities. Make necessary repairs at no cost to Owner**.**

7. Unused Sleeves and Holes:

1. Fill solid all unused sleeves and holes to level of construction that they penetrate.

8. Concealed Services and Headroom:

1. Install and arrange ducts, piping, tubing, conduit, equipment and fixtures in such a way as to conserve headroom and space as much as possible, to provide minimum interference and to be neat, orderly and tidy. Unless otherwise noted, run pipes, ducts, tubing and conduit, vertical, horizontal and square with building grid. Conceal pipes, ducts, tubing and conduit above ceilings, behind furring or in walls, except in

mechanical rooms, equipment rooms and unfinished spaces, unless indicated or specified otherwise.

9. Floor Surfaces:

1. Adequately protect trowelled concrete floors and finished flooring from damage. Take special measures when moving heavy loads or equipment on them.
2. Keep floors free from oils, grease, or other materials likely to damage them, discolour them or affect bond of applied finishes. Once building is enclosed, keep floors dry. Repair any damage immediately.

10. Dissimilar Metals and Metal Contact:

1. Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals, and between metals and masonry, concrete or gypsum board. Use Bituminous paint, butyl tape, building paper or other approved means. Use bituminous paint only on aluminum surfaces.

11. Fastenings:

1. Supply all fastenings, anchors and accessories and adhesives required for fabrication and erection of the Work.
2. Exposed metal fastenings and accessories shall be of same texture, colour and finish as base metal on which they occur unless specified otherwise.
3. Metal fastenings shall be of the same material as the metal component they are anchoring or of a metal which will not set up an electrolytic action which would cause damage to the fastening or metal component under moist conditions. In general, exterior anchors for windows, roofing sheet metal and anchors occurring on or in an exterior wall or slab shall be non-corrosive, hot dip galvanized steel, stainless steel or brass.
4. Anchoring and fastening devices or adhesive shall be of appropriate type and shall be used in sufficient quantity and in such a manner as to provide positive permanent anchorage of the unit to be anchored in position. Install anchors at spacing to provide for required load carrying capacity.
5. Keep exposed fastenings to a minimum, evenly spaced and neatly laid out.
6. Supply adequate instructions and templates and, if necessary, supervise installation where fastenings or accessories are required to be built into work of other trades.
7. Fastenings shall be of permanent type. Wood plugs permitted with prior approval by Consultant.

12. Trademarks and Labels:

1. Trademarks and labels shall not be exposed in the finished work except for labels of ULC and other similar authorities and except where necessary to identify mechanical

and electrical equipment for maintenance and replacement and except where specified otherwise.

2. Locate permitted trademarks and labels on concealed or inconspicuous surfaces. Remove trademarks and labels not permitted by grinding if necessary or paint out where surfaces painted, if located conspicuously.

01 74 19 CONSTRUCTION WASTE MANAGEMENT

1. Description:

1. Salvage, recycle and divert from landfill all construction waste generated from the Work based on the Brock University waste reduction targets. Identify significant generic types of products, work, or requirements that will achieve this goal. Develop Waste Reduction Plan and participate in Materials Source Separation Program.
2. Comply with the requirements of the latest edition of the Ontario Environmental Protection Act and Ontario Regulation 103/94 Industrial, Commercial and Institutional Source Separation Programs related to source separation (recycling) programs and waste audits and waste reduction work plans on construction sites.
3. Take active role in implementing environmentally sound business practices and producing goods and services that lessen burden on environment in production, use and final disposition. Support implementation of reduction, reuse and recycling strategies and use of environmentally sound products. Reduce or eliminate excessive packaging and promote use of environmentally responsible packaging practices.
4. Enter into agreements with local recycling companies and haulers for all anticipated recycled materials.

2. Waste Reduction Plan:

1. Types and estimated quantities of salvageable materials that are expected to be generated during demolition.
2. The methods to be used to salvage or reuse these materials on site. Methods include one or more of the following options:
    1. Contracting with a deconstruction specialist to salvage all or most materials generated.
    2. Selective salvage as part of demolition contractor's work.
    3. Reuse of materials on site or in new construction.
3. Types and estimated quantities of recyclable materials expected to be generated during demolition and construction including but not limited to those listed below.
4. The method to be used to recycle these materials. Methods shall include one or more of the following options:
    1. Requiring subcontractors to take materials back for recycling at a permitted facility.
    2. Contracting with a full service recycling service.
    3. Processing and reusing materials on site.
    4. Recycling materials on site.

01 77 00 CLOSEOUT PROCEDURES

1. Description: Requirements Included:

1. Take-Over Procedure
2. Finished Areas
3. Final Cleaning
4. Systems Demonstration
5. Project Commissioning

2. Take-Over Procedure:

1. **General:** The procedure for completing contracts and acceptance by the Owner is to be in accordance with the method described in the OAA/OGCA Document 100 and any additional requirements described below. The following procedure will be required:
    1. Stage 1 Contractor's Inspection for Substantial Performance
    2. Stage 2 Contractor's Application for Certificate of Substantial Performance
    3. Stage 3 Architect's Certificate of Substantial Performance
    4. Stage 4 Consultant's Certificate for early release of Holdback Monies
    5. Stage 5 Final Inspection for Total Performance
    6. Stage 6 Architect's Final Payment Certificate
    7. Stage 7 Warranty Period(s).
2. **Publication Copy:** Submit promptly two copies of the construction trade newspaper containing publication of copy of the Certificate of Substantial Performance. Arrange and pay all costs associated with publication notices.
3. **Defect and Deficiency**:
    1. A defect is an item of the Work required by the Contract which has been installed but requires repair and/or replacement at a specific time.
    2. A deficiency is an item of the Work required by the Contract which has not been installed or put into operating condition.
    3. A guarantee item is an item of work, installed under a contract which the manufacturer or installer agrees to maintain in, or restore to perfect condition for a specific period of time, after the Owner's acceptance of the Work as being substantially complete.
    4. When, in the Consultant's opinion, the Work under the Contract is substantially complete, and prior to the final inspection by the Owner, a preliminary inspection shall be made at which time all defects and deficiencies shall be listed, taking care to distinguish between the two.

4. **Deficiency Lists**:

    1. Neither the Owner's representatives nor the Consultant will be responsible for the issue of a deficiency list. The Contractor is to understand that the prime responsibility for ensuring that all items shown on the Drawings and described in the Specification are complete is the Contractor's. Any inspections to approve Certificates of Substantial Performance must be immediately cancelled if it becomes obvious that deficiencies are outstanding.
    2. Make every effort to ensure that both defects and deficiencies are made good prior to final inspection.
    3. During the inspection, decision must be made as to which defects must be rectified before the building can be accepted and which defects are to be treated as guarantee items.
    4. Deficiencies shall be made good before the Contract is considered complete.

3. Finished Areas:

1. Close rooms and areas when Work of finished flooring, painting and wall covering is at final application stage and is complete.

4. Final Cleaning: Final cleaning includes all new and existing elements of the Work.

1. Remove all waste materials and debris from the Site. This includes both existing and construction related waste. Do not burn waste materials on site. Walk site with Consultant prior to commencing work and document items to be removed.
2. Visually inspect entire site for construction debris and objects and remove all detected materials. Provide an affidavit indicating that the site is clear of all foreign objects.
3. Immediately prior to occupancy by Owner, clean and dust and remove all stains and smudges from all finished surfaces, and all exposed fixtures and equipment.
4. Remove dust and soil from all surfaces by vacuuming, damp mopping, washing or scrubbing, as required. Vacuum behind grilles, louvers and screens.
5. Wash down exterior paved walkways and roadways.
6. Glass, mirrors and polished metal surfaces shall be cleaned and polished free of streaks.
7. Clean all mechanical and electrical equipment, plumbing fixtures, light fixtures, casework, specialties and accessories.
8. Remove all temporary labels, protective coatings, markings and tags, thoroughly clean surfaces of adhesive.
9. Wax, seal, shampoo or prepare floor finishes.
10. Clean roofs, gutters and downspouts.
11. Clean drains and drainage systems and leave open and functioning.

12. Purge potable water system.
13. Avoid contamination of surrounding surfaces with cleaning fluids. Install temporary protection, if required, and remove same immediately upon completion of the cleaning operation involved.
14. Methods and materials for cleaning shall be in accordance with the manufacturer's recommendations for the finishes involved. Exercise extreme care with abrasive and chemical cleaning agents, and verify their compatibility with the finish and materials to be cleaned.

5. Systems Demonstration:

1. Prior to final inspection, demonstrate operation of each system to Owner and Consultant.
2. Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.
3. The Contractor and responsible personnel from the sub-trades whose work is being demonstrated shall be present at these demonstrations.

6. Project Commissioning:

1. Expedite and complete deficiencies and defects identified by the Consultant.
2. Review maintenance manual contents (operating, maintenance instructions, record "as-built" drawings, materials) for completeness. Review supply and completeness of all spare parts, and provide list, required by the Documents and the manufacturers.
3. Submit required documentation such as statutory declarations, Workers' Compensation Certificates, warranties, certificates of approval or acceptance from the authorities.
4. Attend 'end-of-work' testing and break-in or start-up demonstrations.
5. Arrange and co-ordinate instruction of Owner's staff in care, maintenance and operation of building systems and finishes by suppliers or Subcontractors.
6. When partial occupancy of uncompleted project is required by the Owner, coordinate Owner's uses, requirements, access, with Contractor's requirements to complete project.
7. Coordinate Owner's moving-in of staff, furnishings, equipment with building accessibility, traffic, and Contractor's and Subcontractor's cleaning-up and completion activities all to suit Owner's work schedule and not disrupt Owner's productivity.
8. Provide ongoing review, inspection and attendance to building call-back, maintenance and repair problems during the Warranty periods.

01 78 36 WARRANTIES

1. Description: Requirements Included:

1. Date of Commencement of Warranty Period
2. Submittals
3. Transition to Warranty Period
4. Warranty
5. Extended Warranty

2. Definitions:

1. Failure of a product, a system of products, a piece of equipment or a system of equipment to operate in the manner in which they were designed and/or specified shall constitute a defect.
2. The term "defect" shall not be construed as embracing such imperfections as would naturally follow misuse, failure to perform recommended maintenance or accident.
3. Generally, any manufactured item or material which, when used as directed, must be capable of such use for the duration of the specified warranty period. Failure to comply with this requirement shall be considered as being a "defect".
4. The costs of investigations, tests, repairs and/or replacement and the making good of any resulting damage shall be borne by the contractor.
5. Perform all required remedial work without undue delay.

3. Date of Commencement of Warranty Period:

1. The warranty period for each product or installation commences on the date of Substantial Performance as certified by the Consultant or the date of acceptance of a product or system, whichever comes later.
2. The above applies for products or installations used by the Contractor during the progress of the Work, and the Contractor assumes such upon putting to use such products and installations.

4. Submittals:

1. Submit a fully executed and notarized copy of each extended warranty and each warranty with special provisions, worded as per the specifications, along with application for Certificate of Substantial Performance.

5. Transition to Warranty Period:

1. Execute transition of Performance Bond to warranty period requirements.

6. Warranty:

1. Warrant the work for the period prescribed in the Contract Documents.

7. Extended Warranty:

1. Each Section of the specifications may require additional warranty periods beyond the prescribed warranty period. All such warranties are applicable and in force.

03 00 00 CONCRETE

03 30 00 CAST-IN-PLACE CONCRETE

1. Concrete Mixes:

1. Use ready-mix concrete. Proportion concrete in accordance with CSA A23.1, Alternative 1 - Performance Method for Specifying Concrete.
2. Use water-reducing agent in all concrete.
3. Do not use admixtures containing chlorides.
4. Minimum dosage of corrosion inhibitor is 10L/m^3 of 30% solution of calcium nitrite, asper per CSA-S413.
5. Coordinate concrete mix design for fibre reinforced slab on grade with fibre supplier.
6. Supplementary cementing materials (SCM):
    1. Conform to CSA A23.1.
    2. Follow slag and fly ash manufacturers' directions for proportioning and mixing of concrete.
    3. Do not use SCM in architecturally exposed concrete.
    4. Use a minimum of 15% SCM for concrete that is not architecturally exposed.
    5. For projects seeking LEED standards, provide concrete mixes to achieve a specified limit of total post-industrial and post-consumer recycled materials. Maximize SCM content in foundations, walls, columns and any other elements that do not require horizontal finished surface or rapid strength gain to permit early formwork stripping.
    6. Limit SCM content to 20% for floors with special finishes (such as Retroplate), to be compatible with the finish.
    7. Do not use concrete with more than 40% of SCM when ambient temperature is forecast to be below +10ºC at the time of concrete pour and during the seven days after the pour, except for footings, walls and columns.
    8. Reduce W/C ratio to 0.45 where using more than 40% of SCM in concrete for slabs and other horizontal finished surfaces, in order to reduce bleed water and to increase rate or strength gain.

2. Joints:

1. Attention should be given to joints, with maximum spacing and details provided in typical details or drawing notes.
2. Construction joints in formed slabs and slabs-on-deck should be provided where necessary.
3. Provide standard continuous 38 mm x 89 mm (2" x 4") formed keys at all construction joints. Centre at joints and chamfer sides.

4. Slabs may also require control joints, where visible cracking would need to be avoided. In such cases, use semi-rigid filler to protect against slab edge breakdown, after concrete is at least 120 days old. Refer to Slab-on-grade section for other recommendations.
5. For interior walls, it is recommended that vertical construction joints be located every 30 m maximum, with control joints in between at 7.5 m maximum spacing. It is recommended that evenly spaced vertical control joints in walls be specified.
6. Shear walls shall not have construction or control joints.
7. Expansion Joints shall be shown on structural drawings.

3. Waterstops:

1. The use of either PVC or bentonite (for walls over 225 mm thick) are recommended for waterstops.
2. Provide PVC waterstops for expansion, construction and control joints in exterior walls, basement walls, retaining walls, slabs supporting earth, and at other locations shown.
3. Do not use surface mounted waterstops at control joints which will be protected by hot applied waterproofing.
4. Use equipment to manufacturer's requirements to field splice waterstops for continuity over the full length of runs.
5. Use only straight heat sealed butt joints in the field.
6. Use factory welded corners and intersections.
7. Securely tie waterstops to reinforcing bars at 1 m (3'-0") maximum centers to keep them in alignment when concrete is placed.
8. Provide swellable waterstops for construction and temporary joints in exterior walls, basement walls, retaining walls, slabs supporting earth and at other locations shown where minimum required distance to concrete edge can be achieved. Do not use for expansion joints.
9. Bentonite waterstops: Locate bentonite waterstops 75 mm (3") clear from outside face of concrete to avoid spalling of concrete due to swelling pressure of bentonite.
10. Butt strips together. Do not overlap.
11. Fasten to concrete at 600 mm (2'-0") maximum.

4. Exposed Concrete:

1. Exposed concrete is acceptable, so long as it is within existing material palette on campus.
2. Minimize formwork joints. Locate joints and ties in a uniform pattern with no ties within 300 mm (1'-0") of an edge or joint.

3. Make panels forming slab soffits and wall / beam faces as large as possible, and arrange symmetrically.
4. Make form joints in columns level from column to column and consistent with form joints in other parts of the structure. Locate lowest horizontal form joints 2.4 m (8'-0") above finished floor elevation.
5. Where grooves, reglets or chamfers are shown, locate panel form joints to be hidden behind them.
6. Provide reglets at all concrete joints.
7. Seal all joints in formwork and between formwork and concrete.
8. Place 16 mm (5/8") bevel strips at member corners to form chamfers unless architectural details show an alternative profile. When beams are supported on columns of the same width, extend chamfer across face of column.
9. Do not reuse formwork if there is any evidence of surface damage or wear, which could impair the visual quality of the concrete surface.
10. Exposed surfaces to be dense, even, uniform in colour, texture and distribution of exposed aggregate.
11. Defects such as honeycombing, voids, loss of fines, visible flow lines, cold joints or excessive bug holes may be cause for rejection at the discretion of the Consultant.

5. Slab-on-Grade:

1. **Cracking Control**:
    1. Construction joints and sawcut joints:
        1. Refer to Notes on Structural Drawings for maximum spacing requirements.
        2. Saw cut depth to be equal to one quarter of the concrete thickness.
        3. Locate joints on column lines wherever possible and on intermediate lines, which result in approximately square panels, without re-entrant corners.
        4. Do not create “L” shaped panels nor “T” shaped joint intersections.
        5. Protect edges of sawcuts from breakage.
        6. Clean out sawcuts in exposed concrete and fill with control joint filler after concrete is at least 120 days old.
        7. Sawcut top 25 mm (1") at construction joints in exposed concrete for a width of 5 mm (3/16") and fill with control joint filler after concrete is at least 120 days old. Alternatively, form construction joint with a 5 mm x 25 mm (3/16”x 1’’) chamfer strip at top.
        8. Clean out sawcuts in other concrete and fill with a sand-cement paste one month prior to installing floor coverings.

2. Isolation Joints:
    1. Unless otherwise shown on structural drawings, provide min.10 mm (3/8”) thick pre-moulded joint filler of the same depth as the thickness of the concrete wherever slabs-on-grade abut foundation walls, columns and piers. Omit if slab is chased or dowelled into structure.
    2. Furnish filler for each joint in single piece for depth and width required for joint.
    3. When more than one piece of filler is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
3. Cracks in Slabs-on-Grade:
    1. Extensive cracking of slabs-on-grade or cracks in excess of 3 mm (1/8”) in width may be cause for rejection of slab or portion of slab at the Consultant’s discretion.
    2. Protect edges of cracks in slabs-on-grade from breakage.
    3. Exposed slab on grade: Unless slab is rejected, repair cracks that are over 0.4 mm (0.016") wide. Fill cracks with a sand-cement grout after concrete is at least 120 days old. Seven days later, cut out top 20 mm (3/4") of crack for a width of 5 mm (3/16") and fill with control joint filler.
4. Architectural slab on grade:
    1. Unless slab is rejected, repair cracks that are over 0.2 mm (0.008") wide. Fill cracks with epoxy after concrete is at least 180 days old. Take all measures necessary to prevent epoxy on surface of exposed slab. Have manufacturer’s technical representative present during initial repairs.

2. **Vapour Barrier/Retarder**:
    1. Vapour Barrier/Retarder may not be required, depending on granular base beneath Slab-on-grade, architectural requirements, and geotechnical conditions.
    2. In cases where vapour barrier is required for architectural reasons, such as moisture control, or due to geotechnical requirements, provide vapour barrier under slabs placed on the ground, including slabs-on-grade and framed slabs.
        1. Lap minimum 150 mm at joints and seal.
        2. Seal all punctures before placing concrete.
        3. Use patching material at least 150 mm larger than puncture and seal.

6. Architectural Concrete:

1. Construct forms for architectural concrete, and place ties as indicated. Joint pattern may not be based on using standard size panels or maximum permissible spacing of ties.

2. Use form liners as indicated.
3. Ensure members have sharp and accurate definition of corners, reglets, etc. and are free from chips and spalls.
4. Forms for columns and walls thicker than 900 mm (3'-0") to be insulated.
5. Do not patch surfaces unless instructed in writing by the Consultant. All patches must match colour and texture of adjacent concrete to approval of the Consultant.
6. Provide smooth-form finish or other specified by the Consultant. Do not rub surfaces unless agreed to by the Consultant.
7. Provide a sandblast finish where required by Architectural Drawings. Finish surface first as required for smooth rubbed finish and arrange for review by the Architect and Engineer before sandblasting. After concrete is at least 21 days old and has reached a minimum of 90% design compressive strength, sandblast using a hard sharp sand until coarse aggregate is in uniform relief and a desired texture is achieved.

7. Concrete Toppings and Sealers:

1. **Unbonded Concrete Toppings**:
    1. Place unbonded concrete topping over bondbreaker.
    2. Provide construction, sawcut and isolation joints same as specified for slab on grade.
2. **Bonded Concrete Toppings**:
    1. Place bonded topping over hardened concrete base slab in accordance with CSA A23.1.
    2. Not less than 24 hours prior to applying concrete toppings, remove all laitance, dirt, dust, debris, grease, or other substances that would interfere with the bond between the base slab and the topping using one or more of the following methods:
        1. Wet or dry grit sand-blasting.
        2. High-pressure water-blasting.
        3. Mechanical removal by scarifiers, scabblers, or grinding wheels.
    3. Bond topping to base slab using an epoxy bonding agent or cement/sand grout procedure.
    4. Provide joints in topping to match locations of those in base slab.
3. **Penetrating Sealer**:
    1. Concrete to receive penetrating sealer to be at least 28 days old.
    2. Surfaces to be treated with the sealer to be dry and free of dirt and other contaminants.
    3. Completely remove all curing compounds before the sealer application.

4. Follow manufacturer's recommendations for coverage rate and application procedure.
5. Do not apply in inclement weather or if ambient air temperature or concrete surface temperature is less than 5ºC or more than 38ºC.

03 40 00 PRECAST CONCRETE

1. General:

1. Design precast elements and their connections in accordance with CSA A23.3 and A23.4, to resist forces indicated and to carry handling stresses.
2. Design members and their connections for diaphragm shear in accordance with CPCI Design Manual for Precast and Prestressed Concrete. Design for a minimum factored shear of 5 kN/m or larger, depending on structural requirements.
3. Design reinforcement to accommodate openings.
4. Supplementary cementing material (SCM) requirements to follow those specified in Cast-in-Place Concrete section 03 30 00.
5. All elements cast into the concrete and bearing plates to be galvanized.
6. Provide hardware suitable for handling elements.
7. Exposed surfaces to be free from honeycombing, voids, loss of fines, excessive bug holes, chips or spalls, and shall have a uniform finish.
8. Provide even, smooth and clean surfaces to receive any architectural finishes specified. Exposed surfaces to be free from honeycombing, voids, loss of fines, excessive bug holes, chips or spalls.
9. Use only one brand of cement for all members exposed to view.
10. The final appearance of permanently exposed members is as important a factor as the structural integrity of the members and failure to meet the required standard of appearance shall be cause for rejection at the discretion of the Consultant.
11. Prepare tops of floor slabs to receive floor finishes. Provide steel trowel finish.
12. Prepare tops of roof slabs to receive roofing. Provide wood float finish.
13. Install items provided by other trades for setting in concrete.
14. Provide sleeves and openings required by other trades. Openings 75mm (3”) diameter or less shall be cored.
15. Concrete topping to have a minimum thickness of 38 mm (1½") at the maximum upward camber locations.
16. Composite topping to be installed by the precast manufacturer.
17. Coring shall be in accordance with CSA A23.3 and A23.4. Any proposed deviation shall be reviewed with the Consultant and may be rejected if the Consultant is not in agreement with the methodology.
18. Precast concrete structures shall have identification specified on each member, including the following:
    1. Manufacturer’s Specification
    2. Manufacturer’s Name

3. Date of Manufacturing

2. Precast Concrete Hollowcore Planks:

1. Design precast hollowcore planks and their connections in accordance with the requirements of CSA A23.3 and A23.4, to resist forces indicated on structural drawings and to carry handling stresses.
2. Do not consider toppings to be structural.
3. Design members to provide the required fire rating indicated on Architectural or Building Code Compliance drawings.
4. Design pre-installed elements for connection of balustrades, railings, stairs and other items noted to transfer the loads shown on drawings or specified by applicable Building Codes.
5. Provide one extra prestressing strand in bottom of each slab to allow for possible cutting of strand during coring for plumbing fixtures.
6. Engineer responsible for precast hollowcore planks to review sleeving drawings for openings required by other trades for any impact the cutting and coring of the openings may have on precast hollowcore planks, and to issue a letter stating that the required cutting and coring will have no detrimental impact on the plank's ability to support the design loads.

04 00 00 MASONRY

04 20 00 UNIT MASONRY

1. Description:

1. Blockwork, brickwork and installation of metal fabrications as required.
2. Placing loose steel lintels, steel frames and miscellaneous steel embedments.
3. Patch and repair of existing masonry.
4. Coordination with structural steel, firestopping, sealants and sheathing.

2. Quality Assurance: Conform to the requirements of:

1. CSA-S304.1-04, Design of Masonry Buildings
2. CAN/CSA-S371-04, Masonry Construction for Buildings
3. CAN/CSA-A370-14, Connectors for Masonry
4. CAN/CSA-A179-04, Mortar and Grout for Unit Masonry
5. CAN/CSA-A165 Series-14, CSA Standards on Concrete Masonry Units
6. CAN/CSA-A82-14, Fired Masonry Brick Made from Clay or Shale
7. Ontario Building Code, Part Four, Structural Design

3. Products:

1. **Protection**:
    1. Store masonry units on pallets; do not double stack.
    2. Cover with tarpaulins adequately weighted or anchored down when not in use.
    3. Protect finished units from work and other materials: e.g. roofing bitumen, concrete, mortar, sand and backfill materials, road dust and splatter.
    4. Store bagged products, such as lime, cement and metal accessories in dry, waterproof place.
    5. Keep masonry materials completely free from ice and frost. Heat and maintain temperature of masonry materials to at least 4°C but not more than 71°C and maintain air temperature above 4°C on both sides of masonry for a period of at least 72 hours.
    6. Do not use scorched sand. Do not use salts, admixtures or anti-freezes. Use approved smokeless heaters.
    7. Protect freshly lain masonry from drying too rapidly by means of waterproof membrane, non-staining.
    8. Protect laid masonry from damage by weather. At end of each day or shutdown period cover exposed tops of masonry with canvas or strong waterproof membrane securely clamped down and overhanging on each side of wall at least 600 mm.

9. Brace walls during construction until the structure provides sufficient lateral support.
10. Keep exposed faces free from stains, chips and cracks. Keep tolerance in place to 3 mm in 3 m. Do not use chipped, cracked or deformed units in exposed work.
11. No mortar droppings will be permitted in cavity behind exterior face veneer.

2. **Materials**:
    1. **Concrete block**: Preferred for partitions in area of student occupancy.
    2. **Brick Veneer**: Permitted for residence buildings only.
    3. **Stone**: Tyndall of a variety of finishes is encouraged.
    4. **Date Stone**: For new buildings and additions. Locate in a prominent location near the main entrance. Minimum 200 mm high x 300 mm wide. Font: Times New Roman.
    5. **Flexible Flashing**: Lap Cements, Primers, Tapes and Mastics as recommended by the flashing material manufacturer.
    6. **Sheet Metal Flashing**: Commercial quality steel prefinished where exposed to view ASTM A526 galvanized Z275 zinc coating.
    7. **Horizontal Masonry Reinforcement**:
        1. Hot-dipped galvanized after fabrication for exterior walls in accordance with CSA G164-M.
        2. Sized maximum 50 mm narrower than wall or partition.
        3. Provide prefabricated corners and intersections where required.
        4. Co-ordinate with manufacturer for wedge securement system requirements.
    8. **Cavity Wall Masonry Face Vents**: Vented PVC mortar joint insert colour to match mortar. Provide vents in first course above base of cavity at grade and above lintels.
    9. **Control Joints Filler for Masonry**: 25 mm narrower than masonry unit width.
    10. **Mortar Deflection Device**: Polymer core geomatrix mesh free of fines.
    11. **Mortar**: Coloured.
    12. Coordinate bearing pads in all load bearing walls to receive structural components with Structural Steel.
    13. **Mixes**:
        1. Prepare and mix mortar materials under strict supervision and in small batches for immediate use only. Mix proprietary mortars in strict accordance with manufacturer's instructions to produce mortar types in

accordance with CSA A179-94. Mortar strength shall not vary more than 25% down nor 50% up from strengths specified.

2. Use within 2 hours of mixing when the ambient temperature is 27°C or more. Use within 3 hours if lower temperature.

14. Obtain masonry units from the same manufacturer. Provide units of uniform texture and colour.
15. Provide special shapes and sizes as required.
16. Minimize cutting of masonry units. Adhere to indoor air quality requirements.
17. Carefully dismantle existing masonry walls salvaging sufficient units where applicable.
18. Joints to be tooled to form a concave profile.
19. Provide solid exposed surfaces of blockwork at window heads.
20. Provide control joints at average 9 m intervals, maximum 11 m, in continuous walls.
21. Build in items provided by other Sections including steel door frames, anchor bolts, sleeves, inserts, loose steel lintels, access panels, special security construction, masonry flashings and other items as required. Build in items to present a neat, rigid, true and plumb installation.
22. Leave wall openings required for ducts, grilles, pipes and other items.
23. Keep wall clean and free of mortar stains during laying.
24. After work is complete, remove mortar with wood paddles and scrubbing brushes before wetting. Saturate masonry with clean water and flush off loose mortar and dirt.

05 00 00 METALS

05 12 23 STRUCTURAL STEEL FOR BUILDINGS

1. General:

1. For large and complex projects, it is recommended that the structural steel fabricator to be a member of the Canadian Institute of Steel Construction and to have at least five year experience with structural steel for buildings.
2. Structural steel fabricator and erector to be certified by the Canadian Welding Bureau under the requirements of CSA W47.1, Division 1 or 2 for fusion welding and/or CSA W55.3 for resistance welding of structural steel components, and to have CWB approved procedure for welding rebar (Grade 400W) to structural steel.
3. Connection design to include consideration of all pass-through forces, including tension, compression, moment and shear. Provide local reinforcement at connection or joint as required.

2. Shop Painting:

1. Clean all members to SSPC-SP 1 – Solvent Cleaning, Remove loose mill scale, rust, oil, dirt and foreign matter using any suitable method.
2. In addition for members receiving shop primer paint: Clean steel to SSPC-SP 7 Brush-Off Blast Cleaning. For some special paints with glossy finish SSPC SP6 (commercial blast cleaning) or SSPC SP10 (near white blast cleaning) may be required. Coordinate with the Consultant.
3. In addition for members receiving intumescent coating: Clean steel to SSPC-SP 6 Commercial Blast Cleaning
4. In addition for members receiving zinc-rich coating: Clean steel to SSPC-SP 10 Near White Blast Cleaning.
5. For many buildings where steel will be in a controlled (air conditioned) environment, a shop coat of paint may not be required. Confirm with the Consultant. If required, apply one coat of shop paint CISC/CPMA 1-73a to steelwork in the shop with the exception of:
    1. Members to receive spray fireproofing.
    2. Members to receive a finish coat of paint on site for which a CISC/CPMA 2-75 shop primer is required.
    3. Members to receive intumescent coating for which a compatible shop primer is required.
    4. Members to receive zinc-rich coating.
    5. Galvanized members.
    6. Shear connectors and top flanges of composite beams with field welded shear connectors.

7. Surfaces encased in or in contact with cast-in-place concrete including top flanges of beams supporting slabs.
8. Surfaces and edges to be field welded for a distance of 50 mm (2") from joints.
9. Faying surfaces of slip-critical connections.

6. Apply one coat of contrasting colour shop paint to all protected zones indicated on structural drawings to clearly delineate their extent.
7. Apply one coat of compatible primer paint (CISC/CPMA 2-75) in the shop to steelwork to receive a finish coat of paint on site. For some high class paints, special primer may be required. In addition, some special paints on Architecturally Exposed Structural Steel (AESS) may require the first top coat to be shop applied, (e.g. inside swimming pools). Design team to coordinate.
8. Apply one coat of compatible primer paint in the shop for steel to receive intumescent coating on site.
9. If more than one type of paint is specified, each paint to be visually identifiable after application.
10. Apply galvanizing in the shop to all structural steel located beyond the vapour barrier, including, but not limited to, those elements listed below. The list of steel elements requiring galvanizing should be included on the drawings.
    1. Shelf angles and hangers in exterior walls.
    2. Spandrel angles to which precast panels are attached.
    3. Lintels in exterior walls.
    4. Exposed exterior steel members. (Note that galvanized steel cannot be shiny. Stainless steel may be a preferred alternative).
    5. Exposed anchor rods.
    6. Other steel noted on drawings.
11. If galvanized steel is to be painted, use only non-passivated galvanizing process (without chromate coating).
12. Apply paint under cover, on dry surfaces when surface and air temperatures are above 5°C.
13. Maintain dry condition and 5°C minimum temperature until paint is thoroughly dry.
14. Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.
15. If structural steel is in direct contact with ground (i.e. column base not encased in concrete), protect steel with epoxy paint.

05 50 00 METAL FABRICATIONS

1. Description:

1. Provide miscellaneous metal work. Where items are required to be built into masonry, concrete or other work, supply such items to respective Sections with all anchors and accessories.
2. Coordination with concrete, masonry, rough carpentry, finish carpentry and painting.

2. Quality Assurance: Conform to the requirements of:

1. Codes, Acts, and Standards, Section 01 41 00, Regulatory Requirements
2. CSA S16-14, Design of Steel Structures
3. CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum
4. CSA W47.1-09, Certification of Companies for Fusion Welding of Steel
5. CAN/CSA W117.2-12, Safety in Welding, Cutting, and Allied Processes
6. American Galvanizers Association, Design of Products to be Hot Dip Galvanized After Fabrication

3. Products:

1. Use galvanized steel as a minimum for exterior applications including lintels. Do not passivate galvanized surfaces to be finish painted.
2. Powder coating is permitted except at hand/guard rails that may be subjected to abuse e.g. skateboarding, bicycle grinding.
3. Stainless steel should be used in exterior applications (e.g. hand/guard rails) where it will be visible except for maintenance assemblies on roofs.
4. Use fasteners suitable to the base material to prevent dissimilar metal corrosion.
5. Exterior metal stairs for mechanical equipment are to be provided by the mechanical manufacturer.
6. Ship ladders are not to be used except for accessing the roof of a mezzanine. Confirm to Ministry of Labour (MOL) Fixed Access Ladders.
7. Design each item to be structurally sound.
8. Fit and assemble work in shop where possible.
9. Do all welding in accordance with requirements of CSA W59-M. Continuous welds, ground smooth where exposed to view.
10. Complete all assembly and welding possible before galvanizing.

11. Supply all fastenings, anchors accessories required for fabrication and erection of work of this Section. Such items occurring on or in an exterior wall or slab shall be hot dip galvanized.
12. Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum evenly spaced and neatly laid out. Make fastenings of permanent type unless otherwise indicated.
13. Fabricate gratings and other items with multiple parts so that a regular pattern is presented in the finished work with all members lined up or evenly spaced and pattern is unbroken.
14. Shop prime paint all interior metal unless otherwise indicated on drawings. Do not prime paint galvanized items to be left as exposed galvanized.
15. Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and masonry, concrete or gypsum wallboard.
16. After erection and installation thoroughly clean the work and apply coat field touch up paint to all damaged surfaces of shop-primed or galvanized material.

06 00 00 WOOD, PLASTICS AND COMPOSITES

06 10 00 ROUGH CARPENTRY

1. Description:

1. Provide wood framing, sheathing, interior plywood and blocking.
2. Coordination with Finish Carpentry, Thermal Insulation, Ceilings, Light Gauge Steel Studs and Exterior Sheathing and Painting.

2. Quality Assurance: Conform to the requirements of:

1. Ontario Building Code, Part 9, Wood framing and sheathing
2. CAN/CSA-086-01, Engineering Design in Wood (Limit States Design)
3. HLGA 1970, Standard Grading Rules for Canadian Lumber
4. Pressure treated wood must bear stamp of processing plant indicating treatment

3. Products:

1. Pursue the use of materials with high recycled content.
2. Protect all wood products from wetting and moisture. Protect wood products from moisture gain, by covering with well secured tarpaulins during rain or snow or storing indoors during prolonged inclement weather.
3. Be considerate of acoustic separation goals to prevent transfer of sound/vibration.
4. Forestry Stewardship Council (FSC) certified and kiln dried.
5. **Framing lumber:** To be SPF, structural grade “Studs” and “Structural Joists and Planks No. 1”.
6. **Other lumber:** To be SPF.
7. **Plywood Sheathing:** To be Standard Exterior Grade, CSA 0121-08
8. **Adhesive:** To be low-VOC, CSA 0112.7
9. **Moisture Barrier to Concrete**: Provide commercial compressible sill plate gasket in a continuous strip with width to match plate width.
10. **Vapour Retarder**: Virgin polyethylene sheet, 0.152 mm (6 mil) thick.
11. **Flexible/Transition Membrane**: Complete with primer and adhesives.
12. **Exterior Timber**: Pressure treated within/part of the building envelope.
13. **Blocking:** In walls for wall mounted millwork, furniture, accessories (e.g. hand dryers, grab bars), shelving, etc.; 0.5 mm (24 ga.) thick, 610 mm wide (stud-to-stud) continuous horizontal sheet metal.
14. Ensure suitable support for fastening or anti-tip bracket for furniture/casegoods.
15. Reinforcement required at wall mounted door stops.
16. Provide moisture barrier specified under all wood products resting on concrete.
17. Provide equipment back panels as required.

06 20 00 FINISH CARPENTRY

1. Description:

1. Provide finish wood items, trim, grommets and nailing strips.
2. Install architectural woodwork, metal fabrications as specified, finish hardware unless specified otherwise, ceiling access hatches, access doors for concealed mechanical equipment, door grilles, chalkboards, washroom and janitorial accessories/facilities and built-in equipment.
3. Coordination with Metal Fabrications, Rough framing, Architectural Woodwork, Doors and Frames, Door Hardware, Specialties, Mechanical and Electrical.

2. Quality Assurance:

1. Ontario Building Code
2. CAN/CSA-086-01, Engineering Design in Wood (Limit States Design)
3. The National Lumber Grades Authority Standard Grading Rules
4. Quality Standards For Custom Architectural Woodwork, by the Architectural Woodwork Manufacturers Association of Canada (AWMAC), latest edition
5. CSA O112.9, Evaluation of Adhesives for Structural Wood Products
6. CSA O115 - M, Hardwood and Decorative Plywood
7. CSA O121-08, Douglas Fir Plywood
8. CSA O141-05, Softwood Lumber
9. CSA O151-17, Canadian Softwood Plywood
10. CSA O153-13, Poplar Plywood

3. Products:

1. All interior wood products shall have a moisture content of 7% with range permitted in individual pieces of 5% to 9% at time of delivery and installation.
2. **Unfinished Lumber**: To be SPF, “Construction” grade.
3. **Unfinished Plywood**: Douglas Fir, good one side and sanded.
4. **Moisture Resistant Plywood**: Marine grade plywood.
5. **Indoor Exposed Wood for Paint**: AWMAC Paint Grade.
6. **Interior Exposed Wood for Clear Finish**: AWMAC Custom Grade.
7. **Concealed Hardwood** – AWMAC Standard Grade at concealed hardwood.
8. **Interior Exposed Plywood for Paint**: AWMAC Paint Grade.
9. **Interior Exposed Plywood for Clear Finish**: AWMAC Architectural Grade on exposed faces and AWMAC Good Grade on exposed faces as indicated on drawings.

10. **Adhesive**: To be low-VOC, waterproof, CSA 0112.
11. **Grommets**: Provide for placement in millwork.
12. Fabricate work of this Section to AWMAC Millwork Standards Custom Grade.
13. Prep doors and frames for (but not limited to) heavyweight hinges, continuous hinges, mortise lock case exit devices, cylindrical locksets, surface door closures and concealed overhead stops.
14. Secure woodwork and other products in accordance with manufacturer's recommendations for best results, in accordance with AWMAC standards.

06 40 00 ARCHITECTURAL WOODWORK

1. Description:

1. Provide architectural woodwork requiring shop fabrication complete with locking hardware: casework, countertops and shelving. Consideration for keying alike or different to suit function to be addressed during the design phase.
2. Coordination with Rough Carpentry, Finish Carpentry, Metal Framing, Plumbing and Electrical.

2. Quality Assurance: Conform to the requirements of:

1. Architectural Woodwork Manufacturer's Association of Canada (AWMAC), Premium Grade.
2. Manufacturer/Fabricator shall have a minimum five (5) years experience on work of similar size and quantity, to be verified during tendering process.
3. Installer shall have successfully completed two (2) projects similar in scope, materials and design within the last five (5) years, to be verified during tendering process.

3. Submittals:

1. Provide samples of clear finishes, 300 x 300 mm of each type of finish on each species of wood, joinery, plastic laminate and hardware.
2. Provide finish materials catalogue cuts and maintenance instruction.

4. Warranty:

1. Provide Millwork Contractors Association two-year Certificate of Guarantee for all work of this Section. Warrant plastic laminate and melamine work for a period of two (2) years.

5. Products:

1. Woodwork to be fabricated, finished and installed by a single manufacturer/fabricator.
2. No added urea formaldehyde.
3. Maintain indoor temperature and humidity within range recommended by AWMAC's Standard for location of project.
4. **Medium Density Fiberboard:** Industrial Grade, paint grade.
5. **Solid Surface:** 13 mm thickness. In high profile and wet areas (e.g. washrooms).
6. **Plastic Laminate:** High pressure.
7. **Door and Drawer Edges:** Vinyl to match adjacent laminate colour/pattern.
8. **Cabinet Hardware**:

1. **Hinges:** Heavy duty, soft-closing, five-knuckle, Grade 1, 170° open angle (110° when open against a wall or other obstruction), steel. All metal plated parts with six-way adjustability.
2. **Pulls:** 100 mm D-style pull, finish from complete range.
3. **Drawer Slides:** Heavy duty ball bearing carrier, full extension.
4. **Pilaster Strips and Shelf Brackets:** Metal, recessed, finish from complete range with adjustable clips. Seismic clips where required.
5. **Shelf Pins:** Metal.
6. **Locks:** Cam style, each room keyed alike or different to suit function.

9. **Adhesive**: Waterproof resin type except for plastic laminate which shall be recommended by plastic laminate manufacturer. All conforming to CSA 0112 Series – M and in conformance with The South Coast Rule #1168 VOC limits for adhesives.
10. **Lectern**: As required.
11. Plastic laminate surfaces shall be free of core ghosting.
12. Make all joints tight, flush, level and plumb. Adjacent sheets of plastic laminate on finished work shall be matched in colour with an inconspicuous seam.
13. Minimize waste and off cuts. Do not use more than one sheet when a sheet size is available that will cover required area.
14. No exposed fasteners on exterior surfaces of melamine panels in finished (installed) condition. Assemble melamine millwork using doweled/wafered-and-glued construction unless otherwise specified.
15. Make provisions for electrical, gas and water services and outlets and provide concealment of service lines in the work except where service connections must be exposed.
16. Ship all work fully assembled as far as practicable.
17. Protect all work with wrappings of cardboard or heavy craft paper as is necessary to protect shipped work until final acceptance.
18. Interior surfaces of casework to match exterior when exposed to view including door with glazing.
19. Integral backsplash required when adjacent to porous surface at wet locations.
20. Provide sufficient support for cantilevered countertop applications.

07 00 00 THERMAL AND MOISTURE PROTECTION

07 13 00 DAMPPROOFING AND WATERPROOFING

1. Description:

1. Provide dampproofing and waterproofing membrane systems.
2. Coordinate with geotechnical investigation.
3. Coordination with Concrete, Masonry and Foundation Insulation.

2. Quality Assurance: Conform to the requirements of:

1. Approved by the membrane manufacturer as an applicator, fully experienced in this type of work and have a proven record of satisfactory installations. Workers shall be trained and experienced in the installation of this type of barrier system and shall be under full time competent supervision.
2. Construct mock up for review required.

3. Warranty:

1. Warrant that the waterproofing membrane will remain in a watertight condition and will not leak as a result of faulty materials for a period of five (5) years.

4. Products:

1. The membrane system shall be applied at ambient temperatures satisfactory to the manufacturer and under dry conditions only.
2. Co-ordinate manufacturer's recommended limit for exposure of completed membrane system with work of other Sections.
3. **Dampproofing:** Permitted in lieu of waterproofing when there is no floor below grade and no cause for concern over high water table/content in surrounding soils or overland flow during any season.
4. **Waterproof Membrane:** Elastomer modified bitumen, self-adhering sheet membrane with a cross-laminated polyethylene film.
    1. Thickness: 1.5 mm (60 mils) min.
    2. Flexibility: Pass @ -40°C to ASTM D197
    3. Vapour Permeance: 2.8 ng/Pa.s.m² (0.05 perms) to ASTM E96
    4. Tensile Strength (membrane): 2.24 MPa to ASTM D412
    5. Tensile Strength (film): 34.5 MPa to ASTM D882
    6. Elongation: 300% to ASTM D412
    7. Puncture Resistance: 222 N min. to ASTM E154
5. **Primer**:

1. Polymer emulsion based adhesive type, quick setting for temperatures above -4°C coordinated with and by same manufacturer as Waterproof Membrane.
    1. Weight: 1.0 kg/l
    2. Solids by weight: 53%
    3. Water based, no solvent odours
    4. Drying time (initial set): 30 minutes
2. Synthetic rubber based adhesive type, quick setting for all temperatures.
    1. Weight: 0.8 kg/l
    2. Solids by weight: 35%
    3. Drying time (initial set): 30 minutes

6. **Liquid Membrane:** Cold applied one component elastomeric waterproofing compound and sealant designed to be used in conjunction with sheet membrane. By same manufacturer as sheet waterproofing membrane. Compatible with sheet waterproofing membrane, substrate and insulation materials.
    1. Solids by volume: 60%
    2. Vapour permeance: 2.9 ng/Pa.m^2.s, ASTM E96
    3. Remains flexible with ageing
    4. Chemical resistance: Alkalis, calcium chloride, mild acid and salt solutions
7. **Termination Sealant:** Polymer modified sealing compound compatible with sheet waterproofing membrane, substrate and insulation materials.
    1. Solids by volume: 70%
    2. Vapour permeance: 2.9 ng/Pa.m^2.s, ASTM E96
    3. Complies with CGSB 37.29
    4. Remains flexible with ageing
    5. Adheres to wet surfaces
    6. Chemical resistance: Alkalis, calcium chloride, mild acid and salt solute
8. **Drainage Layer:** Extruded polystyrene insulation for horizontal surfaces and vertical surfaces above grade.
9. Prior to the installation, inspect areas to receive membrane system to ensure they are clean, dry, sound, smooth, continuous and suitable for installation to manufacturer's recommendations.
10. Fill spalled areas in substrate to provide an even plane.
11. All cracks in concrete 1.5 mm to 3 mm wide are to be pre-treated with a 1.5 mm (60 mil) coating of liquid membrane 50 mm wide centered on the crack. Alternately, apply

a 150 mm wide strip of waterproof membrane 200 mm centered over crack. Provide 75 mm end laps.

12. Horizontal to vertical inside corner transition areas are to be pre-treated with a liquid membrane fillet extending 19 mm vertically and horizontally from the corner. Apply a minimum 225 mm strip of waterproof membrane centered at the joint.
13. All outside corners are to be pre-treated with a minimum 225 mm strip of waterproof membrane centered at the joint.
14. Extend waterproof membrane tight to projection and seal with waterproof membrane liquid membrane extending 65 mm along projection and 65 mm onto waterproof membrane.
15. Provide 65 mm laps of waterproofing membrane at both sides and ends.
16. Terminate membrane using termination mastic or termination bar, reglet, or counter flashing as indicated. Refer to manufacturer's standard details.
17. All laps within 300 mm of a 90° change in plane are to be sealed with termination mastic.
18. Protect waterproofing membrane from job site abuse as soon as possible following membrane application.

07 20 00 THERMAL PROTECTION

1. Description:

1. Provide insulation and air barrier system.
2. Coordinate with Vapour Barriers, Firestop Insulation and Mechanical Services Insulation.

2. Quality Assurance:

1. Sprayed Thermal Insulation:
    1. Application of insulation/air barrier system only by applicators certified by CUFCA/NECA (Canadian Urethane Foam Contractors Association/National Energy Conservation Association) or certified by the manufacturer of the system being installed for the insulation of their system and have third party independent certification in accordance with the training requirements outlined in CAN/ULC S705.2-98.
    2. Membrane: applied by applicator trained and approved by manufacture for application of its products.
    3. Applicators: minimum 5 years proven experience.
    4. Material manufacturer/distributor must have an on-site quality assurance program.

3. Products:

1. Comply with manufacturer's printed recommendations respecting protection.
2. Take suitable fire precautions were recommended by manufacturer for specific products.
3. Store materials in dry area and protect away from areas of work causing dirt, dust and debris.
4. WHMIS Safety bulletins on all hazardous products are to be readily available to the work crew at all times.
5. **Under Slab Rigid Insulation:** High density expanded polystyrene insulation suitable for applicable floor loading.
6. **Semi - Rigid Insulation:** High density thermal insulation mineral fibre.
7. **Batt Insulation:** To be used only in unique applications in exterior walls where spray or semi-rigid insulation is not feasible.
8. **Sound Batt Insulation:** Glass fibre with minimum 50% recycled content or mineral fibre batts. Partitions to offices and meeting rooms to achieve minimum STC 45; higher if sensitive use.

9. **Foamed-In-Place Insulation:**
    1. Polyurethane foam, slow rise, low expanding. Low VOC.
    2. Installation locations: perimeters of all door and window frames, louvers, and mechanical openings through exterior walls, fill exterior hollow metal frames.
    3. Ensure all shimming and final adjustments to frames has taken place, and welding of steel has been completed prior to commencing injection of insulation.
    4. Ensure minimum surface and ambient temperature of minimum 5°C during and 3 h after application.
    5. Inject insulation to completely fill voids between frames and wall opening and to completely fill exterior hollow metal frames.
    6. After insulation has set, re-check application and top off any low area. Trim off excess as directed by manufacturer.
10. **Fasteners for Rigid and Semi Rigid Insulation:** (Above Grade Installation) Impale type, perforated 50 mm x 50 mm galvanized steel, 2.6 mm thick mild steel copper coated spindle, length to suit insulation, 25 mm dia. washers of self-locking nylon.
    1. **Wedge Fasteners for Rigid Insulation**: (Above Grade Installation) High density plastic wedge or nylon spring clip.
11. **Metal Girts**: Galvanized commercial quality sheet steel, galvanizing as specified ASTM A526.
12. **Sprayed Thermal Insulation**:
    1. Sprayed polyurethane foam material, when tested, shall meet the requirements of CAN/ULC S705.1-01.
    2. Modified spray foam to suit temperature application in accordance with insulation manufacturer's recommendations.
    3. Maximum burning characteristic values in accordance with CAN/ULC-S102-03:
        1. Flame Spread: 500
        2. Smoke Development: 500
    4. Water vapour permeance maximum 60 na/Pa.m2.s. (1 perm) when tested to ASTM E96/E96M-05; with outer skins to simulate actual in-situ conditions.
    5. Long Term Thermal Resistance (LTTR) tested by an independent laboratory in accordance with CAN/ULC S770-09. Aged thermal resistance values based on test methods other than LTTR or at densities lower than specified will not be accepted. Values shall be based on

density not less than minimum insitu density. Core density shall be confirmed by field testing.

6. Conduct adhesion testing between the polyurethane foam and transition membranes, and substrates for compliance in accordance with the manufacturer's guidelines for use of SPF in an air barrier application, and to CAN/ULC S705.2-98. To be performed daily and recorded.

13. **Air Barrier Membrane**: Composite performed membrane system consisting of SBS modified asphalt for low temperature flexibility and polyethylene scrim reinforcing, with physical properties as follows:

    1. Thickness: 1 mm (40 mils)
    2. Application temperature: minimum +5°C
    3. Elongation: 200% minimum in accordance with ASTM DE412-06ae2-modified
    4. Low temperature flexibility: to -30°C to CGSB 37-GP-56M-1985
    5. Air Leakage: 0.005 $L/m^2 \cdot s$ under a pressure differential of 75 Pa in accordance with ASTM E283-04
    6. Water vapour transmission: 2.8 $na/Pa \cdot s \cdot m^2$ in accordance with ASTM E96/E96M-05
    7. Locations: substrate transitions, control joints, over parapet wall at roof air barrier locations down onto roof air barrier and between junctions of dissimilar material prior to the application of the insulation.
    8. Install in widths of minimum 300 mm with 150 mm cover to each side of joints or onto dissimilar products.
    9. As approved in writing by sprayed foam insulation manufacturer.
    10. Conduct adhesion testing between the transition membranes and substrates for compliance in accordance with the manufacturer's guidelines for use in an air barrier application. To be performed daily and recorded.

14. **Air Barrier Membrane Primer:** As required by CAN/ULC S705.2-98 Annex A and to suite environmental conditions at time of application. As approved in writing by sprayed foam insulation manufacturer and recommended by manufacturer of air barrier sheet membrane.

15. **Termination Mastic:** Rubberized asphalt-based mastic with maximum 200 g/L VOC content. As recommended by manufacturer of air barrier sheet membrane.

16. Work shall be executed by experienced applicators having had a successful history of such applications and having manufacturer's approval of applicators.

17. Mix and apply adhesives, and install insulation in strict accordance with manufacturer's printed recommendations using minimum recommended quantities and recommended mix ratios.
18. Ensure that environmental and site conditions are suitable for installation of material in accordance with each manufacturer's recommendations.
19. Apply materials in accordance with manufacturers' written instructions.
20. Finished Work shall be installed neatly, tightly bonded and level. Fit boards neatly with tight joints around pipes, ducts, obstructions, openings, corners, and all structural members. Butt edges of each board snugly against adjacent board to form an unbroken thermal envelope.
21. Ensure integrity and continuity of insulation at juncture with different types of materials and seal in an acceptable manner. Stagger joints in each row.
22. Use adhesives within temperature ranges recommended by manufacturer. Remove excess adhesive.
23. Surfaces to receive insulation shall be dry and free of dew, frost, voids, loose material, oil, grease, asphalt, curing compounds, oxidation and other matter detrimental to bond of the adhesive or fasteners. Wipe down metal surface to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the foam insulation. Report in writing defects in substrate which may adversely affect the performance of the foam insulation/air barrier.
24. Ensure substrate is level such that no voids or air pockets will occur behind insulation boards.
25. Provide damp course integral to insulation and prepare for incorporation of damp course by other Sections in locations as follows as a minimum:
    1. Top of foundation wall on exterior walls
    2. Over exterior lintels
    3. Under copings
    4. Under sills.
26. Ensure that materials used are compatible.
27. Apply foam insulation/air barrier with +6.4 mm (1/4") and -0 mm (0") of indicated thickness.
28. Do not allow foam insulation to cover or mark adjacent surfaces. Use masking materials if necessary. Remove over-spray and masking material immediately after foam has cured to hard surface film.
29. Protect work of this section from damage due to adjacent work.

07 25 00 WEATHER BARRIERS

1. Description:

1. Provide air/vapour barrier membrane systems.
2. Coordinate with unit masonry, insulation including adhesive, sheathing, door frames, storefront and window/curtain wall assemblies.

2. Quality Assurance:

1. Approved by the air/vapour membrane manufacturer as an applicator, fully experienced in this type of work and have a proven record of satisfactory installations. Workmen shall be trained and experienced in the installation of this type of air/vapour barrier system and shall be under full time competent supervision.
2. Components used shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics, and adhesives.

3. Products:

1. Store role materials on end in original packaging. Protect rolls from direct sunlight until ready for use.
2. The membrane system shall be applied at ambient temperatures satisfactory to the manufacturer and under dry conditions only.
3. Prior to the installation inspect areas to receive membrane system to ensure they are clean, dry, sound, smooth, continuous and suitable for installation to manufacturer's recommendations.
4. Coordinate manufacturer's recommended limit for exposure of completed membrane system with work of other Sections.
5. **Air/Vapour Barrier:** SBS modified bitumen, self-adhering sheet membrane.
    1. Thickness: 1.0 mm (40 mils)
    2. Air leakage: <0.005 L/s·m^2 @ 75 Pa to ASTM E283
    3. Water vapour permeance: 1.6 ng/Pa·m2·s (0.03 perms) to ASTM E96
    4. Low temperature flexibility: -30°C to CGSB 37-GP-56M
    5. Elongation: 200% to ASTM D412-modifed
    6. CAN/CGSB-51-33 Type I Water Vapor Permeance requirements.
6. **Primer**: Polymer emulsion based.
    1. As recommended by and compatible with Air Vapour Barrier
    2. Water based, no solvent odours
    3. 30 minutes drying time
7. **Adhesive:** To be low VOC, 30 minutes drying time.

8. **Through-wall Flashing Membrane:** SBS modified bitumen, self-adhering sheet membrane:
    1. Thickness: 1.0 mm (40 mils)
    2. Low temperature flexibility: -30°C to CGSB 37-GP-56M
9. Prime all surfaces according to manufacturer's recommendations. Surfaces not covered in the same working day to be reprimed.
10. Apply components of air/vapour barrier system according to the manufacturer's recommendations.
11. Apply a continuous and unbroken air/vapour barrier in an overlapping shingle fashion to outside face of exterior walls, from top of foundation wall to roof membrane. Ensure continuity of air/vapour barrier at all control joints and penetrations. Stagger all vertical joints.
12. Carry air/vapour barrier into window openings and terminate in a neat straight line on top of sill block, sides of jamb block and bottom of lintel block.
13. Seal membrane around all wall penetrations and protrusions and patch any damaged membrane during construction. Seal top edge with termination sealant at the end of each day's work.
14. Ensure minimum 100 mm overlap at all end and side laps of membrane including at inside and outside corners of sheathing boards, tie-in to structural beams, columns, floor slabs and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials.
15. Through-wall flashing membrane to extend a minimum 200 mm up the back-up wall and be overlapped by air/vapour barrier.
16. Protect work of this section from damage due to adjacent work.
17. Protect exposed back-up wall against wet weather conditions during and after application of membrane.

07 50 00 MEMBRANE ROOFING

1. Description:

1. Provide for the proper and complete installation of a cold applied, SBR-reinforced EPDM single ply protected membrane, low-slope roofing system as required to prevent entry of moisture into the insulation and structure below the roofing and flashing.
2. Metal roofing is permitted on a case-by-case basis to be approved by the University Project Manager.
3. Shingle roofing is permitted on non-low slope roofs for residential applications only.
4. Vegetated roofing systems aren't desired.
5. Work includes, but is not limited to, all vapour retarders and insulation, roofing membrane, membrane flashings, control joints, vent pipe flashings, roof drains not connected to storm system, setting of all roof drains supplied by Division 20, walkway pavers and insulation in acoustic steel roof deck.
6. Coordinate with steel deck, wood nailers/blocking/curbs, insulation, metal cladding, sheet metal flashing and trim, and mechanical vents, stacks and roof drains.

2. Quality Assurance:

1. Work shall be executed by an applicator that has adequate plant, equipment and skilled trade's people to perform this work expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years.
2. Applicator must be a member of the Canadian Roofing Contractors' Association (CRCA) and a member in good standing with the Ontario Industrial Roofing Contractors Association (OIRCA).
3. Applicator must be approved by the roof consultant and the roofing material manufacturers.
4. Conform to CRCA Roofing Specification Manual – latest edition.
5. Obtain all products from a single manufacturer: Tremco Inc., no substitutions.
6. Membrane manufacturer to inspect installation to ensure compliance with product application requirements. It is the contractor's responsibility to arrange with the manufacturer's representative to provide inspections. The manufacturer's representative shall visit the project during the course of roofing work often enough to ensure that the work is being undertaken in accordance with the manufacturer's written recommendations. Notify Inspection Authority of all such visits in writing.

3. Warranty:

1. OIRCA Standard Form of Warranty for two (2) years from final acceptance for roofing and related work against defects in materials and workmanship and actual leakage.

Agree to make good promptly any defects which occur or become apparent within the warranty period at no additional expense to the Owner.

2. Manufacturer's twenty (20) year extended warranty.

    1. Membrane manufacturer to conduct periodic inspections of the roof surface during years 2, 5, 10 and 15 of the warranty and complete the following duties:

        1. Sealing of flashing seams
        2. Filing of pitch pockets
        3. Repairs to blisters and ridges
        4. Caulking at metal details
        5. Removal of vegetation and light debris from the roof premises
        6. Cleaning of roof drain screens
        7. Written inspection report with any deficiencies and maintenance parameters.

4. Products:

1. Store containers upright and roll materials on end to prevent flattening. Do not double stack unless product is on pallets and packaged as received from factory.
2. Protect materials from moisture at all times.
3. Store materials marked "keep from freezing" in areas where temperatures will remain above 4°C (40°F). Do not store membranes at ambient temperatures above 49°C. Store adhesives and primers between 15°C and 26°C, or restore to temperature range immediately prior to use.
4. An independent Inspection Authority will be retained by the Owner. Notify Inspection Authority minimum two working days in advance of commencing work and provide further notification as required due to temporary postponement of work.
5. Allow for two (2) cut tests. Contractor to make and repair all cut tests for testing purposes at locations requested. Cut tests will be made during progress of work or on completion of work.
6. Samples of roof membrane from cut tests and samples of material taken from containers may be kept by the roof consultant. These samples may be submitted to an independent laboratory for testing purposes. Reinstate cut test locations with material and installation as specified immediately after cut tests have been provided.
7. Should test results prove that a material is not functionally equal to specified material Roofing Contractor will be charged all costs for testing. Remove roofing installed and found not to comply with the specifications and replace at no change to the Contract value.
8. Do not install membranes when air and substrate temperature and or wind chill will preclude proper bonding of materials. Ensure that temperature of substrate and its

moisture content conforms to manufacturers' minimum requirements, before proceeding with work.

9. Install membranes on dry substrate, free of snow and ice. Use only dry materials and apply only during weather that will not introduce moisture into system.
10. Coordinate works with other trades and ensure all openings, drain pipes, sleepers, etc. are installed and flashed at the appropriate time.
11. Protect the building and work of other trades from soiling and other damage. Damage to the building as a result of this work shall be repaired as instructed, all at no extra cost to the contract.
12. Install and seal roofing, flashings, membrane repairs and insulation in a watertight manner on same day of installation or before arrival of inclement weather.
13. Protect building surfaces at set-up areas with a secured tarpaulin. Immediately clean up spilled or scattered debris. Remove material to be disposed from roof as it accumulates.
14. Provide clean plywood walkways and take other precautions required to prevent tracking of aggregate/debris from into new work areas where aggregate/debris pieces can be trapped within/damage new roofing membrane. Presence of entrapped aggregate/debris within new membrane is sufficient cause for its rejection.
15. Schedule the roofing installation so that all unnecessary work over the finished roofs will be avoided. Provide adequate protection to the finished roof where traffic or work must be over the finished roofs.
16. Installed built-up roofing and base flashings shall withstand applicable uplift pressures, thermally induced movement, and exposure to weather and be weathertight.
17. **Membrane: TRA**
    1. SBR-modified EPDM, polyester reinforced by Tremco meeting ASTM D4637.
        1. Thickness: 1.1 mm
        2. Weight: 1.3 kg/m^2
        3. Tear Strength: 313 N MD, 348 N XD at 25°C
        4. Surfacing: Highly reflective (i.e. Solar Reflective Index), non-granular surface is to be avoided due to slipping hazard.
    2. Install sheet along the flat of the roof and turn up at the perimeter details and vertical surfaces a minimum 75 mm.
    3. Install base sheet flashing over the perimeter detail, carried down on the base sheet a minimum of 100 mm.
    4. Overlap previous day's work by a minimum 610 mm.
18. **Adhesive**:

1. Recommended by membrane manufacturer and compatible with membrane roofing.
2. Membrane, Lap, and Flashing: Tremlar-LRM by Tremco Inc.
3. Insulation: Per insulation manufacturer.

19. **Vapour Retarder**:
    1. Self-adhering SBS rubberized asphalt laminated to a slip resistant, cross laminated polyethylene surface film: AVC Membrane by Tremco.
        1. Thickness: 1 mm (40 mils)
        2. Permeance: 0.05 perms
    2. Lap all edges of vapour retarder a minimum of 75 mm and lap ends 150 mm. Edge joints, in all cases, shall occur over a flat surface of a high rib.
    3. At junction of deck to vertical surfaces and along perimeter exposed eaves of roof deck, extend vapour retarder 200 mm beyond the point where the insulation will terminate.
    4. Conforming to ASTM D 1970.
20. **Vapour Retarder Primer**: AVC Membrane applied to top of each high rib of steel deck in continuous beads at rate required by manufacturer.
21. **Sealant**: Apply Tremco approved sealant at all penetrations, lap joints not oriented to shed water and T-joints.
22. **Insulation**:
    1. **Base Insulation**:
        1. Polyisocyanurate preformed board faced with non-organic sheet approved by membrane manufacturer conforming to CAN/ULC-S704-11, Type II, Class 1, Grade 2 and CAN/ULC-S770-09.
        2. Maximum 1.2 m x 2.4 m when loose-laid or mechanically attached and maximum 1.2 m x 1.2 m when adhered to the substrate.
    2. **Overlay/Coverboard:** To be adhered to insulation, 25 mm thick.
    3. **Tapered Insulation:** Fibreboard high density asphalt impregnated to CAN/ULC-S706.1, minimum 25 mm thick.
    4. **Steel Deck Flute Insulation:** Mineral rockwool precut to fit tight within steel deck flutes.
    5. Install specified base layer of insulation mechanically secured to steel deck to FM 1-75 requirements.
    6. Two (2) layers are minimum. Stagger all joints from the insulation below.
    7. Lay no more insulation than can be completely covered with the roofing membrane on the same day. At the end of each day, turn roofing membrane

down over the exposed edges of the insulation and provide temporary water stop. Remove temporary water stop when roofing is recommenced.

23. **Insulation Fasteners:** Coated and tested to Factory Mutual 4470 for Class I-90 with 75 mm recessed washers.
24. **Insulation Adhesive:** By Tremco, low VOC.
25. **Insulation Ballast:** Aggregate, clean, dry, opaque to ASTM D 1863
26. **Protection Mat and/or Fabric:** As recommended by roofing system manufacturer.
27. **Fasteners**:
    1. Nails, bolts, screws and other fastenings to be same metal finish as metal being used.
    2. Size and type of fasteners shall be suitable to the applicable conditions and standard trade practice.
28. **Expansion Joints:** Same materials as roof.
    1. Cover structural roof expansion joints per the manufacturer's recommendations and standard details to allow for thermal expansion and contraction.
29. **Walkway Pavers & Gas Line Supports**:
    1. 610 mm x 610 mm x 45 mm standard precast concrete pavers set on 560 mm x 560 mm x 25 mm pads.
    2. Provide from roof access door to all roof top equipment requiring maintenance.
30. **Roof Protrusion Flashings**:
    1. Pre-fabricated flanges composed of spun copper or aluminum.
    2. Install flashings with flange set in trowel coat of mastic and flashed into roof system with 4 (four) additional plies of membrane. Apply mastic at perimeter of flashing.
31. **Caulking Sealant**:
    1. 1 part acrylic, high molecular weight terpolymer flexible sealant meeting ASTM E-42 aging and CGSB 19-GP-5M-TT-S-00230 adhesion and staining requirements supplied by Tremco.
    2. Where the final ply of membrane flashing terminates at vertical walls, apply mastic caulking supplied by Tremco.
    3. Sealant in contact with roofing shall be to membrane manufacturer's recommendations and instructions.
    4. Prime reglets with compatible caulking primer or cleaner to ensure adequate bonding. Insert metal into reglets to form tight fit and secure with lead plugs at minimum 300 mm on center. Seal flashings into reglet with sealant to prevent moisture penetration. Use termination bars where reglets are not feasible.

5. Ensure exposed sealant is smooth, free from ridges, wrinkles, air pockets and embedded foreign materials.

32. **Cants:** Asphalt impregnated wood fibreboard. Preformed at 45° angle.

33. **Roof Drains**:

    1. Install roof drains according to membrane manufacturer's recommendations and standard details complete with tapered insulation sumps.

    2. Inlet to be a membrane level with collar extending full height of insulation.

34. **Conduit Lines:** Provide pre-manufactured one piece copper or aluminum flanges at all pipe, conduit, etc., passing through roofs of sizes as required.

35. Inspect the underside of the deck to ensure fasteners will not be visible or damage the structure, interior surfaces or effect electrical and mechanical services. Investigate the location of all hidden services which include mechanical, electrical, cable, security and fire alarms which may be installed under the deck.

36. Roofing to be surrounded by minimum 1,070 mm high parapets. Otherwise provide fall protection (e.g. guardrails, travel restriction/tie off).

37. Provide roof anchors where required when window cleaning can't be completed from the ground.

38. Maintain a minimum 2% slope to roof drains. Sloping structure is preferred over tapered insulation.

39. Extend new roofing minimum 305 mm on prepared area of existing roofing (remove existing ballast/granulars and debris).

40. Roofs are intended to be accessed via a stair. Provide a roof hatch where not feasible (ladder or ship stair) – to be approved by University Project Manager. Thermally broken, fully insulated and weather resistant. Provide a premanufactured telescoping post permanently mounted to the top two rungs of any fixed ladder, providing a positive hand-hold and enabling the user to enter or exit an opening in an upright and balanced position.

41. Roofing framing and systems are to be designed to support future photovoltaic assembly.

07 60 00 FLASHING AND SHEET METAL

1. Description:

1. Provide sheet metal flashing, soffit and trim.

2. Quality Assurance:

1. Subcontractor to have five (5) years previous experience in high quality sheet metal flashing and trim work.
2. Conform to:
    1. ASTM A446, Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality;
    2. CSSBI Publications No. 18.26, 1978 Metric Practice Guide, Steel Deck and Cladding;
    3. CSSBI Publication No. 40.5, Coated Galvanized Sheet Steel for Exterior Building Products;
    4. CSA G164-M, Hot Dip Galvanizing of Irregularily Shaped Articles;
    5. CSA H-1 Series, Alloy and Temper Designations of Non-Ferrous Metals and Alloys

3. Warranty:

1. Warrant the work of this Section for two (2) years. Provide written warranty addressed to the Owner warranting that finish paint process to metal will withstand fading or discolouration for a period of five (5) years from date of Substantial Performance.

4. Products:

1. **Sheet Metal for Exposed Components**:
    1. **Sheet Steel:** ASTM A446 and CSSBI Publications No. 18-26, 0.71 mm (24 gauge) core thickness.
    2. **Finish:** Series 8000 precoating.
    3. **Soffits:** Z275 galvanized and finished with PPG Duranar XL coating.
2. **Wood:** Permitted in areas that aren't subject to direct weathering (e.g. soffit).
3. **Starter Clips and Continuous Starter Strip:** Minimum 2 gauge heavier than flashing.
4. **Insect Screen:** Metal mesh, prefinished in colour black.
5. **Adhesive for Fascias:** Waterproof, permanent, appropriate for bonding wood to metal, CSA 0112 Series-M.

6. **Underlayment:** No. 30 asphalt saturated roofing felt, CSA A123.3-M.
    1. Use underlayment between metal and wood substrate except at bonded fascia.
7. **Sealants:** Per Section 07 92 00. Colour to match adjacent finish.
8. **Back-Paint:** Bituminous paint, CGSB 1-GP-108M, Paint, Acid and Alkali Resistant, Black.
    1. Apply two coats of bituminous back paint to all surfaces of metal in contact with masonry, concrete or dissimilar metals.
9. All seams shall be of a "slip lock type" that permit adequate movement without resulting in deformation or loosening of metal flashings. Double back exposed edges at last 12 mm. Unless indicated otherwise on Drawings, metal shall be hooked over continuous starter strips. Secure starter strips at 300 mm on center or closer as required.
10. Exposed fastenings will only be permitted where concealed fastening is not possible. Provide neoprene washers.
11. Locate sub-girts to manufacturer's recommendations and fix to steel structure. Provide intermediate supports fixed to steel deck between beams as required to maintain true, rigid installation of soffit.
12. Ensure a tight fitting installation to prevent insect access.

07 80 00 FIRE AND SMOKE PROTECTION

1. Description:

1. Provide firestopping and smoke seals in fire separations.
2. Coordinate with sealants, mechanical and electrical firestopping.

2. Quality Assurance:

1. Conform to CAN 4 - S115-M, Fire Tests for Firestop Systems.
2. All systems to be ULC listed conforming to the construction assembly, penetration type, annular space and fire-resistance rating for each application. Provide shop drawing for each application.
3. Subcontractor to have a minimum of five (5) yearsf experience in the work specified.

3. Products:

1. Ensure that substrates and surfaces are clean, dry and free of frost, grease, oil, dirt, loose material, etc. that would affect adhesion or performance of firestopping component/system.
2. Ensure all required penetrations, existing and new, in area of work are addressed and protected adequately.
3. Maintain insulation around pipes and ducts penetrating fire separation.
4. Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.
5. Comply with manufacturer's temperature, relative humidity and substrate moisture content for storage, mixing, application and curing.
6. Do not use materials that contain flammable solvents.
7. Coordinate installation with work in other Sections. Protect installations from damage by other work.
8. Provide systems composed of components that are compatible with each other, the substrates forming openings and the items, if any, penetrating the firestopping under conditions of service.
9. Systems shall provide the fire-resistance rating required by the applicable fire separation.

07 90 00 JOINT PROTECTION

1. Description:

1. Provide sealants and joint fillers.
2. Coordinate with firestopping, glazing, partitions, mechanical and electrical sealing.

2. Quality Assurance:

1. Subcontractor to have a minimum of five (5) years' experience in the work specified.

3. Warranty:

1. Warrant sealant work for a total of two (2) years.

4. Products:

1. Inspect work of other Sections upon which work of this Section depends and verify that conditions are suitable for this work to proceed.
2. Store materials in a dry area having ambient temperature within limitations recommended by material manufacturer. Protect from freezing, moisture and water.
3. Install sealants at temperatures above 4.4°C. Ensure material temperatures are above minimum established by material manufacturer. Maintain minimum temperature post installation per material manufacturer.
4. **Primer:** As recommended by sealant manufacturer for type of surface being primed and conditions of service. Low VOC.
5. **Joint Filler and Back-up:** Circular cross-section unless shown as slab or sheet, min. 25% wider than joint, semi-rigid: closed cell polyethylene or polyurethane.
6. **Bond Breaker:** As recommended for use by sealant manufacturer.
7. **Sealant Colours:** For exposed sealants, from manufacturer's complete range.
8. Check compatibility of proposed sealants with materials to be in contact with sealant and ensure durable seal is provided.
9. Protect adjacent surfaces against staining.
10. Clean joints and surfaces and ensure that they are dry and free of dust, loose mortar, oil, grease and other foreign material. Clean ferrous metals of rust, mill scale and foreign materials by wire brushing, grinding or sanding.
11. Seal joints in surfaces to be painted before surfaces are painted. Where surfaces to be caulked are prime-painted in shop before caulking, check to make sure prime paint is compatible with primer and sealant.
12. Ensure masonry and concrete have cured minimum 28 days.
13. Apply in strict accordance with manufacturer's directions and recommendations.

14. Form surface of sealant smooth, concave, free from ridges, wrinkles, sags, air pockets and embedded foreign matter.
15. Use only low emitting materials.

08 00 00 OPENINGS

08 10 00 DOORS AND FRAMES

1. Description:

1. Provide doors, frames and screens.
2. Coordinate with Rough Carpentry, Thermal Insulation, Door Hardware, Glazing, Door Grilles, power door operators, security and access control.

2. Quality Assurance: Conform to the requirements of:

1. Canadian Manufacturing Specifications for Steel Doors and Frames, of Canadian Steel Door Manufacturers' Association (CSDMA) latest edition, except as otherwise specified herein.
2. CAN/CSA 0132.2-Series, Wood Flush Doors.
3. Architectural Woodwork Manufacturers Association of Canada (AWMAC) "Quality Standards for Architectural Woodwork", Premium Grade.
4. Brock University Facility Accessibility Design Standards (FADS).

3. Warranty:

1. Warrant against defects for two (2) years.

4. Products:

1. Give full cooperation to finish hardware distributor's representative.
2. Manufacturer's numbering system shall correspond to the Brock University numbering system.
3. Minimum specification for products specified herein shall be Canadian Steel Door Manufacturers' Association.
4. **Door Size**: 1,015 x 2,135 mm (3'-4" x 7'-0") minimum. Double door required at mechanical and electrical rooms and main caretaking/custodial closets.
5. **Solid Core Wood Flush Doors:**
    1. **Facing**: Wood veneer
    2. **Core Material**:
        1. Solid Eastern White Pine or Western Red Cedar conforming to CAN3-0188.1 M, Grade R.
        2. Narrow kiln dried wood strips not less than 40 mm wide, grain running vertically and joints well staggered, electronically glue bonded.
    3. **Stiles:** Minimum 19 mm thickness one piece full length hardwood, matching edge.
    4. Top and bottom rails to be sealed.

5. **Finish:** Factory.
6. **Adhesive:** Low VOC.
7. No added urea formaldehyde.
8. Ensure complete protection of edges and finishes of wood doors during shipping, delivery and storage. Package individually in plastic bags. Store off floor in well ventilated room.
9. Do not deliver doors to site until work of wet trades is complete and moisture readings of surfaces in proposed storage area are less than 18%.

6. **Steel Doors and Frames**:
    1. Applicable at service rooms and at fire separations.
    2. Hot-dip galvanized steel to requirements of ASTM A924[M] with minimum coating designation ZF075 to ASTM A653[M] (Z275 to ASTM A653[M] at exterior doors and frames).
    3. Fabricate metal jamb anchors from hot dipped galvanized sheet steel.
    4. Labelled frames – in accordance with ULC requirements.
    5. Minimum core thickness in accordance with CSDMA Specifications:
        1. Interior door face sheets: 1.3 mm (16 ga) steel
        2. Exterior door face sheets: 1.3 mm (16 ga) steel
        3. Glazing stops and lite trim: 0.9 mm (20 ga) steel.
        4. Frames up to 1,015 mm wide: 1.3 mm (16 ga) steel.
            1. Retrofit applications.
        5. Frames over 1,015 mm wide: 1.7 mm (14 ga) steel.
        6. Hardware reinforcing:
            1. Butts, Pivots, Closers and Panic Bars: 3.5 mm (10 ga) steel.
            2. Locks: 2.5 mm (12 ga) steel.
            3. Magnetic Locks: 3.5 mm (10 ga) steel.
            4. Mortar Boxes: 1.0 mm (20 ga) steel.
            5. Strikes: 2.5 mm (12 ga) steel.
            6. Flush bolts: 2.5 mm (12 ga) steel.
    6. **Core**:
        1. Interior non-rated doors: Resin impregnated Kraft honeycomb core.
        2. Interior fire-rated doors: Resin impregnated Kraft honeycomb core. Mineral core for temperature rise doors.

3. Exterior doors: Semi-rigid glass fibre insulation with stiffeners (R1.5, RSI 0.25).

7. Frames to be thermally broken in exterior applications.

8. Exterior doors to be insulated with faces fully laminated to core material. Provide continuously welded, ground and ground smooth vertical edge seams of doors, with top and bottom voids filled with 1.3 mm thick (16 ga) steel channels tack welded in position, and a flush watertight steel cap welded to top edge of door.

9. **Touch-Up Primer:** Zinc rich primer conforming to CGSB 1-GP-181M for galvanized surfaces; CISC/CPMA 2-75 for plain steel or wipe coated surfaces, low VOC.

10. **Adhesives:** Low VOC.

11. **Metal Filler:** Low VOC. Fill all exposed surface depressions and all joints resulting from fabrication of frames and sand to a smooth, uniform finish.

12. **Miscellaneous**:

    1. **Panel Fasteners:** Concealed fasteners of hot dip galvanized steel, type to provide accurate, secure installation.

    2. **Labels:** Brass plate, riveted to door and door frame – do not paint over.

    3. **Screws:** stainless steel screws with countersunk head.

13. Provide honeycomb core construction without face seams, including fire-rated and non-insulated doors.

14. Provide continuous mechanically interlocked, tackwelded 150 mm on center, filled and ground vertical edge seams to doors, with top and bottom voids filled with 1.3 mm (16 ga) thick steel channels tack welded in position.

15. Form each face from a single sheet of metal.

16. Reinforce doors to ensure that the maximum corner-to-corner racking of doors does not exceed 1.5 mm.

17. Bevel strike edges of doors 3 mm maximum per 50 mm thickness.

18. Terminate all door frames at top of concrete slab. Provide concealed floor plates for anchorage to slab. Provide jamb anchors spaced at maximum 600 mm on center up each jamb.

7. **Frameless Glass Doors:** Not permitted at exterior. When using frameless glass doors on interior locations, Lawrence Patch Fittings are required to install a standard North American mortise lockset at standard height. No floor level locks will be permitted.

8. **Sliding Doors:** Permitted except at residences.

9. **Panel/Overhead Sectional Doors:** Preferred over rollup type, insulated.

10. Prep doors and frames for (but not limited to) heavyweight oversize butt hinges, mortise locks, and surface door closers.
11. Provide closely fitted glass stops with mitred corners where required, set flush and true. Drill and countersink tamperproof fasteners symmetrically at 150 mm on center and place on secure side of frame. Screw stops in place or tamper-proof snap in place as applicable.
12. Provide fire-rated/labeled doors to ULC requirements, including applicable time temperature requirements, and provide ULC labels for all fire-rated door frames and glazed screens. For designated oversized doors, provide letter attesting that construction is equivalent to that of a rated door.
13. All doors equipped with full mortise butt hinges to be supplied with high frequency reinforcement plates at hinges.
14. Where pairs of doors occur prepare meeting edge to form integral astragal at exterior locations and to receive planted bar astragal for interior locations. Provide permanent astragals in accordance with ULC requirements, NFPA 80.
15. Incorporate provisions for electrical controls and wiring where applicable.
16. Brace frames rigidly while building in to wall construction and ensure square and plumb.
17. Provide and install 3 bumpers on strike jamb of each single leaf door frame and 2 bumpers on head of double leaf door frame.
18. Door placement and operation (e.g. swing direction) to account for pressure differences and wind to ensure door opening action isn't accelerated by these forces nor is the door prevented from closing fully by normal means (e.g. door closer).
19. Protect work of this section from damage due to adjacent work.
20. At side-by-side doors, thresholds are to be continuous for the entire width of the door opening(s) and cut to fit as necessary.
21. Doors with glass shall ensure hardware does not extend to within the glass panel per FADS mounting height and to include an exit device at mid-rail at FADS height to hide from the secure side.
22. Wherever possible create single frame door rather than pairs of doors.
23. When a removable mullion is required the door style shall be of sufficient width to accommodate the head of the exit device as well as the mullion between the doors.

08 40 00 ENTRANCES, STOREFRONTS, CURTAIN WALLS & WINDOWS

1. Description:

1. Provide glazed entrance doors and screens, curtain wall/storefront system and windows.
2. Coordinate with Masonry, Structural Steel, Air/Vapour Barrier, Foam-in-place Insulation, Sealants, Glazing, Door Hardware and Electrical door operators.

2. Quality Assurance: Conform to the requirements of:

1. Ontario Building Code, Part 4, Structural Design and Part 5, Wind Water and Protection
2. CAN3-S157-M, Strength Design in Aluminum
3. CSA-W59.2-M, Welded Aluminum Construction
4. CAN3 S16.1-M: For steel reinforcement and support brackets
5. CAN/CSA-A440 Windows
6. CAN/CGSB-12.8 for hermetically sealed insulating glass units
7. CAN/CGSB-12.1 CAN/CGSB-12.3 and CAN/CGSB-12.20 for glass
8. CAN/CSA-A440 for materials
9. Fabricator and Installer to have minimum ten (10) years experience with installation of aluminum entrances.
10. Ontario Registered Professional Structural Engineer responsible for design and fabrication.

3. Warranty:

1. Warrant work for a total of two (2) years.

4. Products:

1. Give full cooperation to finish hardware distributor's representative.
2. Design and size assemblies, components and connections to withstand dead and combination of loads caused by seismic and pressure and suction of wind and internal pressure.
3. Rain screen principle, pressure equalized.
4. Be capable of sustaining a minimum interior lateral load required when considered a guard.
5. **Aluminum Extrusions:** Aluminum Association alloy AA6063-T5 or T6 temper for framing.
6. **Aluminum Sheet:** Minimum 3 mm thickness.

7. **Vents:** Not desired except at residences.
8. **Thermal Break Component:** Rigid polyvinyl chloride or neoprene. Thickness shall be as required to meet design, 6 mm (1/4") minimum thickness**.**
9. **Fastening Devices:** Stainless steel with not less than 12% chromium content. Exposed screws or pop rivets are not acceptable.
10. **Adhesive:** Low VOC.
11. **Door Size:** 1,015 x 2,135 mm (3'-4" x 7'-0") minimum.
12. **Frameless Glass Doors:** Not permitted.
13. **Sliding Doors:** Permitted except at residences.
14. Prep doors for (but not limited to) heavyweight butt hinges, cylindrical locks, rim exit devices, surface door closers and concealed overhead stops.
15. Incorporate provisions for electrical controls and wiring where applicable.
16. Door placement and operation (e.g. swing direction) to account for pressure differences and wind to ensure door opening action isn't accelerated by these forces not is the door prevented from closing fully by normal means (e.g. door closer).
17. Apply two shop coats of rust-inhibiting primer over all ungalvanized steel components.
18. Apply two shop coats of zinc chromate primer or bituminous paint to all surfaces where necessary to prevent corrosion, contact of dissimilar materials.
19. Provide pressure equalizing and weep holes for enclosed air spaces.
20. Maintain a continuous air barrier and insulation barrier with adjacent wall assemblies.
21. Seal joints between frame members and adjacent materials at window openings at outside and inside. Seal air and vapour barrier transition sheet around entire perimeter of each window frame.
22. Ensure continuity of seal at end joints between lengths of material by overlapping and cementing.
23. Provide extruded aluminum sills (with end caps) of proper size and thickness complete with concealed fastenings, to shed water and prevent entry of water into wall, and to suit wall condition. Make sills one continuous piece wherever practicable. Where length of sill necessitates joints to prevent oil-canning, or for other reasons, lap and make joints watertight. 2% slope away from building.
24. Protect work of this section from damage due to adjacent work.

08 71 00 DOOR HARDWARE

1. General:

1. **Work Included**:
    1. Furnish, deliver and install finish hardware.
    2. It is intended that the following list of hardware will cover finish hardware to complete the project. Bring to the Consultants attention any omissions, discrepancies that will affect work in this section during the bidding period.
2. **Related Sections**:
    1. General Requirements Division 1
    2. 06 20 00 Finish Carpentry
    3. 06 40 00 Architectural Woodwork
    4. 08 10 00 Doors and Frames
    5. 08 40 00 Entrances, Storefronts and Curtain Walls
    6. Division 26 Electrical
    7. Division 28 Electronic Safety and Security

    Note: Delete/revise section numbers to suit contract document related sections
3. **Products Supplied but Not Installed in this Section**:
    1. Power supplies, compressor/control boxes, junction boxes installed by Division 26.
4. **Allowances**:
    1. Allow for cash amount specified in Division 1 to be carried to cover cost of keying permanent core Medeco cylinders by Pinder's Security Products, St. Catharines, ON. Supply of cylinders is by this section.
5. **References**:
    1. Door and Hardware Institute - Recommended locations for Architectural Hardware for Standard Steel Doors and Frames
    2. Door and Hardware Institute - Recommended locations for Architectural Hardware for Flush Wood Doors
    3. NFPA 80-Standard for Fire Doors and Windows, 1999 Edition
    4. Door and Hardware Institute - Sequence Format for Hardware Schedule
    5. Door and Hardware Institute - Key Systems and Nomenclature
    6. Door and Hardware Institute - Abbreviations and Symbols used in Architectural Door and Hardware Schedules and Specifications
    7. Door and Hardware Institute - Installation Guide for Doors and Hardware

8. Ontario Building Code

6. **Submittals**:

    1. **Updated Finish Hardware Schedule**: Submit submittals in accordance with Section 01 30 00 Submittal Procedures. Prepare detailed hardware schedules in Door and Hardware (DHI) vertical format as detailed in Reference 1.4.4.

    2. **LEED Submittals**:

        1. Submit LEED submittals in accordance with Section 01 35 00 Special Procedures.

        2. Submit documentation to verify compliance with LEED objectives and requirements.

    3. **Product Data**: Submit in a three-ring binder six (6) copies of product data sheets with the finish hardware schedule showing items of hardware to be used on the project.

    4. **Samples**: When requested in writing, provide (to the Consultants Site Office) one sample of each hardware item complete with fasteners, within thirty (30) calendar days of award of a purchase order. Samples to be clearly labeled with their hardware schedule designation and manufacturers' name and model number. Samples will be incorporated into the work.

    5. **Templates**: Submit templates within to related trades when requested.

    6. **Keying Schedule**: After a keying meeting between representatives of the Owner, furnish a keying schedule listing the levels of keying as well as an explanation of the key system's function, the key symbols used and the door numbers controlled. Utilize "Door and Hardware Institute - Key Systems and Nomenclature" as a guideline for nomenclature, definitions, and approach for selecting the optimal keying system. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

    7. **Wiring Diagrams**: Co-ordinate with related trades, meet with the owner and security provider and submit a written description of the functional use (mode of operation) of electrical hardware products specified. Include operation for ingress, egress, fire alarm, and after hours use where applicable. Include door and frame elevations showing the location of each item of electrical hardware to be installed, mode of operation including a diagram showing number and size of conductors. Indicate on elevation drawing items provided by related trades, include for back boxes, and 120V power sources. Provide point to point drawings showing terminal connections necessary for a complete installation.

8. **Operations and Maintenance Data**: Prior to Substantial Completion, furnish to the owner, two (2) copies of an owner's operation and maintenance manuals in a three-ring binder with the following information:
    1. Name of hardware distributor, address and contact name
    2. Copy of final "as-built" finish hardware schedule
    3. As installed "wiring diagrams, elevations, risers, point to point"
    4. Copy of final keying schedule
    5. Copy of floor plans with keying nomenclature assigned to door numbers as per the approved keying schedule
    6. Catalogue cut sheets and product specifications for each product
    7. Parts list for each product
    8. Installation instructions and templates for each product

7. **Quality Assurance**:
    1. Review installation procedures with the Contractor's Designated Installers. Hold instruction meetings with installers prior to installation and subsequent review meetings during the installation period. Submit minutes of meetings to the Consultant.
    2. **Substitutions**: Only approved products specified are accepted. Make substitution requests in accordance with Division 1. Include product data and indicate benefit to the project.
    3. **Supplier Qualifications**: Successful hardware distributor to have a minimum of five (5) years' experience in the door and hardware industry. Distributor to have on staff an Architectural Hardware Consultant (A.H.C.) whose name will be listed on the hardware schedule title page submittal and will be responsible for scheduling, detailing, (see Reference 1.5.4) ordering and co-ordination of the finishing hardware for this project. If so requested by the Consultant and or installer this individual will be required to visit the jobsite for any installation problems that may occur.
    4. **Designated Installers**: Hardware Installers must have a minimum of five (5) years' experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. Installers to attend review meetings with the Hardware Distributor.

8. **Delivery, Storage and Handling**:
    1. **Marking and Packaging**:
        1. Mark cartons with heading number, door number, and key-set symbol where applicable in original packaging provided by the manufacturer. Pack packaged hardware in suitable wrappings and containers to protect it from damage during shipping and storage.

2. Enclose accessories, fastening devices and other loose items with each applicable item of hardware.

2. **Delivery**: Deliver hardware to related trades.

3. **Storage**: Store in a clean, dry room with lockable man door and adequate shelving to permit organization so item numbers are readily visible.

9. **Warranty**:

1. Furnish warranties by the accepted manufacturers:

Hardware Item	Length of Warranty
Mortise Hinges	1 year
Locks (ND Series)	10 years
Locks (Mortise)	3 years
Keypad Locks	1 year
Exit Devices	3 years
Door Closers – Mechanical 4010 series Door Closers – Mechanical 4110 series Door Closers – Mechanical 4020 series	30 years 30 years 30 years
Electric Hold Open Devices - Electro mechanical	2 years
Overhead Stops/Holders	1 year
Floor/Wall stops	1 year
Electric Strikes	5 years
Key Switches/Power Supplies	1 year

10. **Maintenance**:

1. **Maintenance Service**: After the building is occupied arrange an appointment with the maintenance staff from Brock University for instruction of proper use, servicing, adjusting and lubrication of hardware furnished. Submit to the consultant a list of attendees and meeting date.

2. **Extra Materials**: Furnish the following items in proper manufacturer's cartons once the job has been completed:

1. Five (5) of each installation tool used for locks/passage/privacy, type of door closers, and exit devices.

2. Products:

1. **Manufacturers**:

1. Products listed in the hardware groups are from the manufacturers listed below:

ITEM	MANUFACTURER NAME
Full Mortise Hinges	Ives
Locksets, Latchsets/Deadbolts	Schlage
Keypad Locks	Schlage Electronics
Cylinders	Medeco
Exit Devices	Von Duprin
Keypad Locks	Schlage
Surface/Flush Bolts	Ives
Door Closers	LCN
Overhead Door Holders/Stops	Glynn Johnson
Door Pulls/Flatware	Canadian Builders Hardware
Wall/Floor Stops	Ives
Weather/Smoke/Sound Seals	ZERO
Door Sweeps/Thresholds	ZERO
Safety Coat Hooks	Frost
Mullions	Post Latch, Von Duprin
Keyswitch	RCI
Electric Strikes	HESS
Power Supplies	Schlage Electronics, Von Duprin

2. **Materials**:

    1. **Screws and Fasteners**: Screws and fasteners to be matching finish to their product and to be manufacturer's standard. Door closers, door holders and exit devices installed on fire rated wood doors and hollow metal doors to be attached with fasteners to meet NFPA 80 requirements.

    2. **Materials – Acceptable Manufacturers** (Note: Supply products in a given category from the same manufacturer):

        1. **Mortise Hinges**:

            Provide five knuckle bearing hinges with NRP option on reverse bevel doors with locking hardware. Hinge width to accommodate door closer projection, door trim and allow for 180-degree swing. Doors up to 2286mm in height, supply 3 hinges, doors greater than 2286mm in height add one hinge for every additional 760mm of door height. Doors 915mm wide and less furnish 114 mm high hinges, doors greater than 915mm wide furnish 127mm high hinges, heavy weight or standard weight as specified. Supply ferrous (steel), stainless steel material for all interior and/or fire-rated doors and stainless steel for exterior doors.

            As Specified: Ives Hinges, 5BB1, 5BB1HW

2. **Surface/Flush Bolts/Co-Ordinators**:

Surface Bolts:

Surface bolts to have 1" throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy-duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8' in height.

Supply as Specified: Ives SB1630 series

Manual Flush Bolts - Metal Doors:

Manual flush bolt for metal doors to be cUL listed for 3-hour fire doors with ½" diameter bolt tip with ¾" throw. Standard rod length to be 12", supply longer length rods to suit higher door heights. Provide dustproof strikes with flush bolts that incorporate a bottom bolt.

Supply as Specified: Ives FB458 series

Manual Flush Bolt - Wood Doors:

Manual flush bolt for wood doors to be cUL listed for 90min fire doors with 3/4" throw with a 7/8" vertical adjustment. Provide dustproof strikes with flush bolts that incorporate a bottom bolt.

Supply as Specified: Ives FB358 series

Automatic Flush Bolts - Metal Doors:

Automatic flush bolts for metal doors to be fully automatic cUL listed for 3 hour fire doors, low actuation forces-top bolt has not spring tension, non-handed with ¾" throw with a 7/8" vertical adjustment. Optional rod lengths for non-rated openings as well as models with auxiliary fire latch that eliminates the bottom bolt for cUL listed doors. Standard rod length 12", supply longer rod length to suit higher door heights. Provide dustproof strikes with auto flush bolts that incorporate bottom bolt.

Supply as Specified: Ives FB30 series

Automatic Flush Bolts - Wood Doors:

Automatic flush bolts for wood doors to be fully automatic cUL listed for 90min fire doors, low actuation forces-top bolt has not spring tension, non-handed with ¾" throw with a 7/8" vertical adjustment. Models with auxiliary fire latch that eliminates the bottom bolt for cUL listed doors (20min only). Provide dustproof strikes with auto flush bolts that incorporate bottom bolt.

Supply as Specified: Ives FB40 series

Constant Latching Flush Bolts - Metal Doors:

Constant latching flush bolts for metal doors to be cUL listed for 3-hour fire doors. Inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically. Standard rod length 12", supply longer rod length to suit higher door heights. Non-Handed with fire-rated models with auxiliary fire latch to eliminate the use of a bottom bolt. Provide dustproof strikes with flush bolts that incorporate bottom bolt.

Supply as Specified: Ives FB50 series

Constant Latching Flush Bolts - Wood Doors:

Constant latching flush bolts for wood doors to be cUL listed for 90min fire doors. Inactive door remains latched until the active door is opened, releasing the automatic bottom bolt and then the top bolt can be manually released. Inactive door will relatch automatically. Non-Handed with fire-rated models with auxiliary fire latch to eliminate the use of a bottom bolt (20min only). Provide dustproof strikes with flush bolts that incorporate bottom bolt.

Supply as Specified: Ives FB60 series

Co-Ordinators and Filler Bars:

cUL listed for installation on labeled frames. COR series co-ordinator channels and fillers made of aluminum, furnished in 628 finish. Provide co-ordinators of correct size for use on pairs of doors when one door is required to close before the other. Provide filler bar to suit opening width to maintain architecturally clean lines. Provide mounting brackets for other soffit applied hardware. Co-ordinator units to be equipped with an override feature which allows the active door to close under extreme pressure.

Supply as Specified: Ives COR Series Bar Co-ordinators

Roller Latch:

Roller latch constructed of brass or stainless steel. Roller latch to have maximum projection of ½" allowing for variance in the door clearance. Projection of the roller by turning the knurled knob on the back of the latch. Roller latch to fit heavy duty cylindrical latch cutout, non- handed, nylon roller standard, optional roller nylon covered brass roller, optional ASA strike.

Supply as Specified: IVES RL32

3. **Locksets/Deadlocks/Privacy Sets**:

Cylindrical:

Extra heavy duty residential, commercial, institutional and industrial applications. Latch bolts to be steel with minimum ½" throw deadlocking on keyed functions. ¾" throw anti-friction latchbolt on pairs of fire doors. Provide manufacturer's standard wrought box strike for each latch or lock, with curved lip extended to protect frame. Locks and latchsets tested to exceed 8,000,000 cycles. Provide molex connections for electrified functions as a standard. Lock case to be steel, incorporate one piece spring cage and spindle. Precision solid brass 6-pin cylinder with nickel silver keys available in Schlage keyways. Levers to be solid with no plastic inserts.

Supply as Specified: Schlage "ND" series

Mortise:

Grade 1 Operational, Grade 1 Security, mortise lock for commercial and institutional buildings. Manufacture lock cases from fully wrapped, heavy 12 gage steel with a protected leading edge and screw configuration that limits access to operating parts. Lock components to be manufactured of zinc dichromate plated steel. Latch bolts to have a standard 2 ¾" backset with a full ¾" throw. Latchbolts to be non-handed, field reversible without opening the lock case. Latchbolts to be 2 piece anti-friction, manufactured from stainless steel. Solid latchbolts and/or plastic anti-friction devices are not acceptable. Deadbolts to be 1 ¾" total length have standard 1" throw with a minimum ¾" internal engagement when fully retracted. Deadbolts to be constructed of stainless steel, incorporating a security roller pin with a minimum Rc60 rating for surface hardness. Lever assembly (external) to be one piece design attached by threaded bushing. Lever assembly (internal) to be attached by screw less shank. Lever attachments by common tools (allen nuts and/or set screws) are not acceptable. Thru bolt lever assemblies through the door for positive interlock. Levers to have independent rotation in both directions. Lever operation to be freewheeling (clutch) when in the locked mode. Spring cages are to be incorporated into the lever assemblies. Hub blocking plate to be solid, cast stainless steel. Manufacturers utilizing open hub designs are not acceptable. Spindles to be independent, designed to "break away" at a maximum of 75psi torque. Mounting tabs are to be automatic self-adjusting, vertically and horizontally for door bevel and strike alignment. Cylinders to be secured by a cast stainless steel, dual retainer. Manufacturers utilizing screws and/or stamped retainers are not acceptable.

Supply as Specified: Schlage "L" series

Keypad Locks-Stand Alone Battery Operated:

Mortise:

Heavy-duty mortise type with three-piece, beveled stainless steel latchbolt with ¾" throw and equipped with an anti-friction latch. Chassis shall accommodate ANSI standard mortise lock prep with a 2 ¾" backset. Locksets shall be provided from the factory with the appropriate handing. Outside escutcheon to contain a 12-button keypad to support 500 user capacity with tri-coloured LED's and audible indicators to provide information on activation, operational system status, system error conditions and low power conditions. Electrical operation to be battery operated capable of 80,000 operating cycles using four non-proprietary "AA" alkaline batteries. Keypad lock to be capable of operation for exterior applications, operating temperature -35 to 66 degrees Celsius.

Supply as Specified: Schlage Electronics CO-100MS series

Strike Plates:

Provide lockset and latchset strike plates with lip centre dimensions sized to minimally clear trim. Where strike lip extends beyond the projection of the casing or other trim, provide curved lip strikes. Strike plates applied to inactive leaf of paired openings to have flat lip sized to fit flush with the face of the door skin.

4. **Exit Devices/Device Trims/Mullions**:

Narrow Style:

Exit device to be cUL listed for panic hardware and fire exit hardware. Supply exit devices and fire exit devices featuring coil compression springs on device mechanism subassemblies and dead latching mechanisms for active latch bolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Doors greater than 950mm wide supply long bar exit devices. Fits door stiles as narrow as 1 ¾".

Supply as Specified: Von Duprin 35A series

Heavy Duty:

Exit device to be cUL listed for panic hardware and fire exit hardware. Supply panic hardware and fire exit devices featuring coil compression springs on device mechanism subassemblies and dead latching mechanisms for active latch bolts. Supply exit devices with smooth mechanism case and "the quiet one" fluid dampener to eliminate noise associated with exit device operations. Non-handed device with touchpad

assemblies with no exposed fasteners and cast end caps, reinforced aluminum with stainless steel touchpad and raised edge to minimize pinching. Roller strikes to be standard on rim and surface vertical rod devices, mortise exit devices (626) complete with strikes that match the same finish as the device. Doors greater than 950mm wide supply long bar exit devices.

Supply as Specified: Von Duprin 98 series

Exit Device Trim:

Supply device trim featuring recessed cylinder mounting and coil compression spring design with shear pin protection for lever designs. Similar lever designs for exits as specified for locksets.

Supply as Specified: Von Duprin 996 series

Rigid Exit Device Trim:

Vandal resistant rigid pull applications, supply trim featuring 11 gage stainless steel construction, direct thru bolt mounting to device, available built in lock protector, tapered stainless steel cylinder collar deflecting side impacts and providing free rotation. Grip area coated in Plastisol to provide resistance to temperature extremes.

Supply as Specified: Ives VR900 Series Trim

Mullions Non-Rated:

Aluminum mullions complete with mullion stabilizers prepared with 1408 strikes for use with Von Duprin narrow stile rim devices on narrow stile doors to provide single door performance and security on double door applications.

Supply as Specified: Von Duprin 5754

Mullions Non-Rated:

Steel mullion prepared for use with Von Duprin rim devices and thumb release latch to provide quick removal to provide single door performance and security on double door applications. Provide housing for control wires for use with electric strikes on double door applications.

Supply as Specified: Post Latch

Mullions Rated:

Fire rated cUL approved mullion for up to three-hour openings using Von Duprin fire rated rim devices prepared for 499F strikes. Supply with thumb

release latch kit to provide quick removal to provide single door performance and security on double door applications. Provide housing for control wires for use with electric strikes on double door applications.

Supply as Specified: Post Latch cUL Listed

5. **Door Closers**:

Door closers to have the following features:

1. Fully hydraulic, rack and pinion action with high strength cast iron cylinders and one-piece forged steel pistons.
2. Include high efficiency, low friction pinion bearings.
3. Hydraulic fluid of a type requires no seasonal adjustments, ULTRA X TM fluid has constant temperature control from -35 degrees Celsius to +49 degrees Celsius.
4. Hydraulic regulation controlled by tamper-proof, non-critical screw valves, adjustable with a hex wrench.
5. Separate adjustments for backcheck, general speed and latch speed.
6. Door closers with special template (ST-) numbers include required associated product, information sheets and instructions.
7. Size 1 manual door closers to provide less than 5 pounds opening force on a 900mm door leaf.
8. Door closer with Pressure Relief Valves are not accepted.
9. Door closer bodies, arms, covers to be powder coated.
10. Closers with powder coat finishes to exceed a minimum 100-hour salt spray test, as described in ANSI A156.18 and ASTM B117.
11. Closers detailed with plated finishes to include plated covers (or finish plates), arms and visible fasteners.

Medium Duty Mechanical (Interior/Exterior):

Non-sized (1-6) and non-handed cylinder body to have 1 ¼" (32mm) piston diameter with 5/8" (16mm) single heat-treated shaft. Track closer cylinder body non-sized (2-4) or (1-2). Closers to have full cover, forged steel main arm and forearm EDA and CUSH type arms. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

Supply as Specified: LCN1460 HD FC series

Heavy Duty Mechanical (Pull Side Mount):

Non-sized (1-5) and handed cylinder body to have 1 1/2" piston diameter with 11/16" double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1, 3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

Supply as Specified: LCN 4010 series

Heavy Duty Mechanical (Top Jamb Mount):

Non-sized (1-5) and handed cylinder body to have 1 1/2" piston diameter with 11/16" double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1,3 or 4. Closers to have forged steel main arm. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

Supply as Specified: LCN 4020 series

Heavy Duty Mechanical (Push Side Mount):

Non-sized (1-5) and handed cast iron cylinder body to have 1 1/2" piston diameter with 11/16" double heat-treated shaft and certified to exceed ten million (10,000,000) full load operating cycles by a recognized independent testing laboratory. Track closers sized 1,3 or 4. Closers to have forged steel main arm and forearms. Optional arms to be interchangeable within the series of closers, except track arm type closers. Track arm type closers to have single lever arm with low friction track and roller assembly and provisions for an optional bumper to assist backcheck.

Supply as Specified: LCN 4110 series

Heavy Duty Single Point Hold-Open (Pull and Push Side Mount):

Non-sized (1-4) and non-handed cast iron cylinder body to have 1 1/2" piston diameter with 11/16" double heat-treated shaft with adjustable single-point hold open function controlled by solenoid assembly located in a head frame mounted track. Track arm to have single lever arm with low friction track and roller assembly. Unit to have a momentary on/off switch

board assembly for testing door release and also provides over-voltage protection.

Supply as Specified: LCN 4040SE series

6. **Overhead Door Stops/Holders**:

Heavy Duty Surface Mounted:

Surface overhead stops/holders to be stainless steel base, non-handed for single-acting doors with a heavy-duty channel/slide-arm design and offset jamb bracket to allow for simple field modifications of functions. Channel to be surface mounted to the door with thru bolts and the jamb bracket is surface mounted to the frame soffit.

Supply as Specified: Glynn-Johnson 90 series

Heavy Duty Concealed Mounting:

Concealed overhead stops/holders to be stainless steel base, non-handed for single or double-acting doors with a low-profile channel, mortised in the door and jamb bracket is mortised in the doorframe. Unit to be fully concealed when door is in the closed position. Units to be field adjustable for function changes if required.

Supply as Specified: Glynn-Johnson 100 series

7. **Door Pulls/Flatware/Coat Hooks**:

1. Door Pulls are to be 19mm, 25.4 mm diameter
2. Flatware to be of stainless steel material, .050 gauge.
3. Door Pulls are to be ¾""(19mm),1" (25.4 mm), 1 ¼" (31.2mm) diameter
4. Supply as Specified:
    1. CBH 6037-2, (Door Pulls) 1 ¼" diameter, mounting as indicated in the hardware sets
    2. CBH 7008-1, (Door Pull) mounting as indicated in the hardware sets.
    3. CBH923 T304 B4E c/w tape mounting push plates
    4. CBH 903 T304 B4E c/w tape mounting (Kickplates 40mm less door width single door and 25mm less door width double doors)
    5. GSH-90F c/w tape mounting (armour plates 40mm less door width single door and 25mm less door width double doors)

8. **Sliding Door Track**:

    1. Sliding door track manufactured from extruded aluminum 6063T5 alloy weighing 1.229 lbs. per foot, load capacity 200 lbs. (2 hangers) Track recessed in the bottom of the door and heavy ball bearing door guides ensure secure and smooth door travel. Door hangs on "Spinwheel" quick release hanger for single face mounted doors. Aluminum fascia manufactured from extruded aluminum 6063T5 alloy weighing 1.269 lbs. per foot, wall thickness is 0.100 inches. C110 fascia interlocks with the C108 track and is to be supplied in a clear anodized finish complete with C110 end caps.
    2. Supply as Specified:
        1. K.N. Crowder Inc. C-911 hanger
        2. K.N. Crowder Inc. C914 mortised bottom channel, C-913 roller
        3. K.N. Crowder Inc. C108 track c/w C100-HD stops
        4. K.N. Crowder Inc. C110 fascia and C110 end cap

9. **Floor/Wall Stops**:

    Floor Stops:

    Floor stops to be heavy-duty cast dome stop constructed of brass/bronze with grey, non-marring rubber bumper.

    Supply as Specified: Ives FS439

    Wall Stops (No Button on Locking Hardware):

    Wall stops to be constructed of stainless steel base with special retainer cup that makes the rubber stop tamper resistant. Convex design of rubber bumper.

    Supply as Specified: Ives WS407CVX

    Wall Stops (Projecting Button on Locking Hardware):

    Wall stops to be constructed of stainless steel base with special retainer cup that makes the rubber stop tamper resistant. Concave rubber bumper to avoid damage to locks with projecting buttons.

    Supply as Specified: Ives WS407CCV

10. **Weather/Smoke/Sound Seals/Automatic Door Bottoms**:

    Supply as Specified: ZERO

11. **Thresholds/Weatherstrip/Door Sweeps**:

Supply as Specified: ZERO

12. **Keyswitch/Electric Strikes/Power Supplies, Power Transfers, Mortar Guards**:

Keyswitch:

Keyswitch housing to be cast zinc to protect against vandalism, housing to provide a concealed rear mounting attachment which cannot be compromised when the cylinder is attached with a set screw.

Supply as Specified: RCI 960N-MA-LED SPDT

Electric Strikes:

Grade 1, electric strikes to be cUL listed burglary-resistant and electric strike for fire doors and frames. A label for single doors and B label for double doors. Electric strikes to be stainless steel construction, non-handed available in 12V or 24V AC or DC with continuous duty solenoid and accept ¾" throw latchbolts.

Supply as Specified: HESS 1006, 4500C, 9500 series

Power Supplies:

Power supplies to be tested and certified to meet UL294. Universal 120-240 VAC input, low voltage DC output, regulated and filtered. Power supplies to have 2A, 4A, 6A output,12/24VDC field selectable with jumper. Provide emergency release terminals, where required, that allow the release of devices upon activation of the fire alarm system complete with fire alarm input for initiating "no delay" exiting mode. Power supply to be flat mounting design and polarized locking connections for additional option boards specified.

Supply as Specified: Schlage Electronics PS-902, PS-904, PS-906

Power supply to be tested and certified to meet UL294. Universal 120-240 VAC input, low voltage 4 amp DC output, 12/24VDC field selectable with jumper, regulated and filtered. Power supply to provide 4 amp high inrush for Von Duprin, Monarch, Doromatic electric latch retraction exit devices. The power supply to be flat mounting design and polarized locking connections for additional option boards specified.

Supply as Specified: Von Duprin PS-914

Electro-Magnetic Door Holders:

Provide floor and wall mounted units to hold door in open position and to release and automatically close under fire alarm conditions.

Electromagnet shall be protected against transients and voltage surges up to 600 volts. Power requirements, tri-voltage field selectable, 12, 24VDC, 120VAC.

Supply as Specified: LCN-SEM 7800 series

Power Transfer:

Provide a means to transfer power from frame to door stile. Devices shall be reversible and allow a full 180° door swing with 4 1/2" x 4 1/2" butt hinges or 3/4" offset pivots. When door is in closed position, transfer unit shall be concealed. Transfer units shall contain ten 24 awg UL approved conductors. Rating: 10 Amps at 24 VDC (Class 1 low voltage)

Supply as Specified: Von Duprin EPT

Mortar Guards:

Provide and supply to hollow metal supplier to weld in place TA 6400 series by Thomas Access Control at frame locations where electrified hardware components are to be mounted. Provide handing of mortar guard boxes to the hollow metal frame supplier. Hollow Metal frame supplier is responsible for ensuring the proper location of required mortar boxes.

Molex Connectors:

Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

Junction Box:

Provide high quality NEMA 1, junction box to provide convenient installation for electrified hardware. Units are surface mounted 254mm high, 254mm wide, 152mm deep and includes hinged door with twist turn lock, 20 position terminal strip to accept 24 to 12 gauge wire.

Supply as Specified: Von Duprin JB7

3. **Finishes**:
    1. Unless otherwise specified, finishes to be brushed chrome (BHMA 626/652).

2. Finishes are specified as follows:

ITEM	BHMA#	DESCRIPTION	BASE MATERIAL
Hinges	630	satin stainless steel	stainless steel
Hinges	652	satin chrome plated	steel
Lock Trim	626	satin chrome plated	brass/bronze
Exit Devices	626	satin chrome plated	brass/bronze
Exit Devices	630	satin stainless steel	stainless steel
Door Closer	689	powder coat aluminum	steel
Door Pulls	630	satin stainless steel	stainless steel
Protective Plate	630	satin stainless steel	stainless steel
Door Stops/Holders			
Overhead	630	satin stainless steel	stainless steel
Wall/Floor	626/630		
Thresholds	628	anodized aluminum	aluminum
Weatherstrip	628	anodized aluminum	aluminum
Miscellaneous			
Coat hooks	626	satin chrome plated	brass/bronze
Mullions	628	powder coat aluminum	steel
Key Switches	630	satin stainless steel	stainless steel
Electric Strikes	630	satin stainless steel	stainless steel

4. **Cylinders, Keying Systems and Key Control**:

1. Provide permanent cylinders and keys to an existing Medeco keyway, supplied sub-assembled complete with cylinder housing, cylinder collars, plug, pins and cam or tail bar, and 2 blank keys. Cylinders to be forwarded to Pinder's Security for keying/pinning and installation. Supply of cylinders is by this section.

2. Pinder's Security will meet with the Owner to finalize keying requirements and obtain keying instructions in writing as outlined in Division 1. Cost of establishing the key system, pinning of cylinders and installation by allowance in Division1.

3. Provide temporary construction keying system during construction period. See Misc. Hardware for quantity of keyed alike cylinders.

4. Permanent cylinders to be pinned/keyed by Pinder's Security, combinated in sets or subsets, master keyed or great grand master keyed, as directed by Owner. Pinder's to supply Key Data and Location Data to Owner formatted for import into Key Wizard software, supply Key Inventory and Keying Schedule formatted for Owner input into Key Wizard software

5. Furnish a sum total of two (2) change keys per cylinder. Keyed alike groups supply two (2) change keys per keyed alike group. This sum total of keys shall

be cut and furnished as directed by OWNER. Any unused balance of cut change keys shall be furnished as key blanks directly to Owner with the Cut.

6. Deliver permanent key blanks and other security keys direct to Owner's representative from Pinder's Security by secure courier, return receipt requested. Failure to properly comply with these requirements may be cause to require replacement of or any part of the cylinders and keys involved as deemed necessary at no additional cost to the Owner.

3. Execution:

1. **Examination**:

    1. Ensure that doors and frames are prepared and reinforced to receive finish hardware prior to installation.

    2. Ensure that door frames and finished floor are plumb and level to permit proper engagement and operation of hardware.

    3. Verify power is run to door opening requiring electrified hardware.

    4. Submit in writing a list of deficiencies determined as part of inspection required in 3.1.1 and 3.1.2 to supervising consultant prior to installation of finished hardware. Correct door frame installation before proceeding with finish hardware installation.

2. **Installation**:

    1. Hardware Installers must have a minimum of five (5) years' experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. Installers to attend review meetings conducted by the hardware distributor.

    2. Install hardware at mounting heights as specified in the manufacturer's templates or specific references in approved hardware schedule or approved elevation drawings.

    3. Where mounting height is not otherwise specified, install hardware at mounting heights as indicated in 1.5.1, 1.5.2.

    4. Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.

    5. Ensure locksets / latchsets / deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position. **Handing is part of installation procedure.**

    6. Ensure that exit devices are of the correct hand and adjust device cam/drive screw for proper outside trim function prior to installation. Handing is part of installation procedure.

7. Follow manufactures installation instructions. Adjustment of door closers is inclusive of spring power, closing speed, latching speed and back-check, valve screws to achieve backcheck at the time of installation.
8. Adjust delayed action door closers to forty (40) second delay for barrier free accessibility and movement of materials. Time period to be approved by Owner.
9. Install head seal weatherstrip prior to installation of soffit mounted hardware. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.
10. Counter sink through bolt of door pull under push plate during installation.
11. Install blocking material in cavities of metal and wood stud walls and partitions. Located concave and convex type door bumpers at the appropriate height to properly contact protruding door trim.
12. Outlet back boxes, provisions for power, conduit complete with pull strings for security systems power and control boxes for integrating of security system with fire alarm system and coordination of complete system to be furnished under the Electrical Division for the project.
13. The authorized system Integrator shall be responsible for mounting card readers, controllers, master controllers, input panels and interface with EAC hardware and power supplies. They are also responsible for low voltage wiring, wire terminations, final hookup, testing, system setup, warranty and owner turnover with training.
14. Prior to installation of hardware, install hardware on the following doors for review by the consultant. Do not proceed with installation of hardware until mock up doors have been reviewed for proper installation. Install hardware on a classroom door, exterior pair of doors with outside cylinder operation and auto door operator, pair of stair doors with magnetic hold open device, pair for doors with a hardware removeable mullion, classroom door with access control and auto operator. Upon written approval of hardware installation by the Consultant remaining doors and hardware can be installed.

3. **Field Quality Control**:

1. Verify each door leaf opens closes and latches. Inspect fire rated openings to ensure they are installed in compliance with NFPA 80 requirements. Test access control system and electrified hardware devices for proper operation with owner to sign off on verification of operation. Verify electric door release hardware operates to close the door upon activation of the fire alarm system.
2. Perform bi-monthly on-site inspections during hardware installation and provide inspection reports listing progress of work, unacceptable work and corrective measures. Repair or replace as directed by the Consultant.

3. Before completion of the work but after the hardware has been installed, submit a certificate to the Consultant stating that final inspection has been made and that hardware has been checked for installation and operation.

4. After certificate has been issued as per 3.3.3, retain the services of Allegion Canada Inc. to perform an inspection of hardware with a written report forwarded to the consultant and owner.

4. **Adjusting and Cleaning**:

1. Check and make final adjustments to each operating item of hardware on each door to ensure proper operation and function.

2. Adjust doors with self-closing devices or automatic closing devices for operation after the HVAC system is balanced and adjusted. Adjust spring power of non sized door closers to close and latch the door.

3. Hardware to be left clean and free of disfigurements.

4. Instruct owner personnel in the operation, adjustment and maintenance of hardware.

5. Check locked doors against approved keying schedule.

5. **Protection**:

1. Protect hardware from damage during construction. Wrap locks, panic hardware, and fire exit hardware, door pull trim with kraft paper or plastic bubble materials to protect finish from damage until date of substantial completion. Remove and reinstall or where necessary, use temporary hardware to maintain finish in new condition and maintain manufacturer's warranty.

6. **Hardware Groups**:

END

08 80 00 GLAZING

1. Description:

1. Provide glazing units in accordance with the design documents.
2. Coordinate with hollow metal and aluminum doors, frames and screens, wood doors and sealants.

2. Quality Assurance:

1. Conform to:
    1. Ontario Building Code for glass as guard.
    2. Glazing Recommendations for Sealed Insulating Glass Units published by the Insulated Glass Manufacturers Association of Canada (IGMAC)
    3. Glazing Sealing Systems Manual, published by the Flat Glass Marketing Association, U.S.A.
    4. NFPA 80, Fire Doors and Windows, published by National Fire Protection Association Inc.
    5. CAN/CGSB-12.8 for hermetically sealed insulating glass units
    6. CAN/CGSB-12.1 CAN/CGSB-12.3 and CAN/CGSB-12.20 for glass
    7. CAN/CSA-A440 for materials
2. Submit CSA A440.2 simulation reports for insulated glass units from an independent CSA accredited simulator.

3. Warranty:

1. Warrant insulating glass units against internal condensation or seal failure for five (5) years.

4. Products:

1. Limit percentage of glazed openings per OBC SB-10 requirements.
2. Horizontal skylights are not permitted. Clearstories/monitors are acceptable.
3. Safety glazing materials, laminated preferred, shall be used in all doors, sidelights and other areas prone to accidental damage (e.g. unprotected fixed glass panels).
4. Wired glass is not permitted.
5. Colour to be Clear. Tinted colours are not permitted.
6. **Standard Glass**:
    1. Float glass, min. 6 mm thick, conforming to CAN2-12.3-M
    2. Non fire rated screens
7. **Tempered Glass**:

1. 6 mm thick

8. **Laminated Glass**:
    1. 6 mm thick panes, conforming to CAN2-12.1-M, Class B, tempered glass.
9. **Fire Rated Glazing**:
    1. Conforming to CAN/ULC S104 and S106, low iron, high light transmission
    2. Fire rated doors and screens.
10. **Insulated Glass Unit**:
    1. Double 6 mm thick panes with 12.7 mm air space or triple pane
        1. Tempered outer lite, clear inner lite at South and West facing elevations and Clear outer and inner lites at North and East facing elevations.
    2. Low-E: Soft Low E coating on Surface 2 at South and West facing elevations and on Surface 3 at North and East facing elevations
    3. Argon filled
    4. Warm edge, non-metallic spacer
    5. Solar Heat Gain Coefficient:
        1. < 0.3 South and West facing elevations
        2. > 0.5 North and East facing elevations
11. Ensure maximum size of any panes of interior glazed systems is set to fit through the constructed building including elevator for installation and replacement.
12. Glass canopies may be considered.
13. Glass guards to have limited use.
14. Provide privacy film/spandrel where glass extends below office desk height.
15. Minimum bite or lap of glass on stops and rabbets as recommended by glass manufacturer.
16. Interior Doors and Screens: Glaze in conformance with FGMA Setting No. 43 (setting blocks, plain glazing tape both sides, one removable stop).
17. Glaze using compound, or glazing tapes, or gaskets to secure glass in frame and render airtight and vibration free.

09 00 00 FINISHES

09 20 00 PLASTER AND GYPSUM BOARD

1. Description:

1. Provide gypsum board wall, bulkhead and ceiling assemblies.
2. Coordinate with Insulation, Sealants, Wall Tile and Suspended Acoustic Ceilings.

2. **Quality Assurance:** Conform to the requirements of:

1. CSA A82.21-M, Gypsum and Terms Relating to Gypsum Products
2. CSA A82.27-M, Gypsum Board Products
3. CSA A82.31-M, Gypsum Board Application
4. ASTM C645-88, Specification for Non-load Bearing Steel Studs, Runners, and Rigid Furring Channels for Screw Application of Gypsum Board
5. ASTM E336, Method for Measurement of Airborne Sound Insulation in Buildings
6. ASTM E413, Classification for Rating Sound Insulation

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Commence this work only after air temperature has been maintained at 13˚C to 21˚C for at least 24 hours before and can be maintained at same until joint cement and adhesives are fully cured, with proper ventilation to provide dry condition.
3. Straight, vertical, flat and true to building lines to within 3 mm in 3 m.
4. Suspended gypsum board assemblies to be level to within 8 mm in 3 m.
5. Partitions to offices, meeting rooms and washrooms to achieve minimum STC 45; higher if sensitive use.
6. Partitions to extend to underside of floor/roof above.
7. Partitions in areas of student occupancy are preferred to be concrete block for durability. Use of gypsum board assemblies will be considered; approval by the University Project Manager is required.
8. **Gypsum Board**:
    1. Conforming to CSA A82.27-M
    2. Minimum 90% recycled content
    3. 1.2 m wide by longest lengths practicable
    4. Thickness:
        1. 12 mm, for ceilings
        2. 12 mm exterior grade
        3. 16 mm, for walls

4. 16 mm Type X ULC listed, for fire rated assemblies.

5. Leave minimum 10 mm gap between top of board and structure above to accommodate deflection of structure.

9. **Moisture Resistant Gypsum**:

   1. Conforming to ASTM C 1178
   2. Thickness: 12 mm
   3. For use in washrooms and changerooms.

10. **Cement Board**:

    1. Thickness: 16 mm.
    2. For use at showers.

11. **Sheathing**:

    1. Conforming to Gypsum to ASTM C 1177 and ASTM E 136
    2. Thickness: 12 mm exterior grade and 16 mm Type X
    3. Joint Tape: 50 mm wide 10x10 glass mesh

12. **Non-Loadbearing Steel Studs**:

    1. Minimum 0.53 mm core, Z275 galvanized, with min. 31.8 mm knurled faces and minimum 6 mm return, knock-outs in web for horizontal services and bracing, increase core thickness for heights over 2,400 mm to manufacturer's recommendation.
    2. 400 mm maximum spacing and at every 400 mm center across any wall surface.
    3. Provide double studs each side of all openings and infill studs above and below openings.
    4. Provide double studs at head and sill of all openings under 1,200 mm wide.
    5. Provide reinforced box stud assemblies at all openings over 1,200 mm wide.
    6. Brace with secured cross-bridging at every 1,200 mm vertically all walls that exceed 2,700 mm.
    7. Brace as above walls between 2,400 mm high and 2,700 mm high with one row of cross-bracing at mid-height.

13. **Neoprene Sheet:** Dense, solid neoprene, 6 mm thick by full width of stud track.

14. **Access Doors:** Provide where required. Ensure they are of adequate size and placement to fully service equipment located above gypsum board installations.

15. **Control Joints**:

    1. Double furring members or studs at control joints:

       1. Where gypsum board is installed over masonry control joints,

2. Abutting structural elements,
3. Dissimilar walls and ceilings,
4. Changes in substrate construction,
5. Approximate 10 m spacing on long partition runs,
6. Approximate 15 m spacing on large ceilings, and
7. Changes in superficial area.

16. Metal trim L-moulding shall be required for junctions at windows and door jambs.
17. Seal all junctions between gypsum wallboard and adjacent surfaces.

09 30 00 TILING

1. Description:

1. Provide tile and prepare sub-floor.
2. Coordinate with Concrete slabs, Masonry, Gypsum Board and Mechanical floor drains.

2. Quality Assurance: Conform to the requirements of:

1. ANSI A108.1, Specification for the Installation of Ceramic Tile
2. CAN/CGSB-75.1, Tile, Ceramic
3. Terrazzo, Tile and Marble Association of Canada (TTMAC), Tile Specification Guide 09300, Tile Installation Manual
4. Tile to have passed ASTM C627, cycles 1 through 12 testing, heavy foot traffic load bearing performance.
5. Applicator to be a member company in good standing of the TTMAC with a minimum of five (5) years of successful work in projects of comparable or larger size.

3. Warranty:

1. Provide (ten) 10 year labour and material warranty on mortars, waterproofing, bond coat, adhesive, grout and sealers.

4. Products:

1. Pursue the use of materials with recycled content.
2. Execute work while temperature is maintained between 10°C and 22°C for period of 72 hours before commencement, during and following installation. Avoid concentrated or irregular heating during curing period.
3. Concrete must be cured for a minimum of 28 days.
4. Protect work against damage by other trades for minimum 72 hours after application of grouting by prohibiting passage of traffic over tile. Cover completed floors with non-staining construction paper until other construction in tiled areas is complete. Do not immerse in water and protect tile work from freezing for at least 28 days after installation.
5. Obtain each specified material from one source with resources to provide products from the same production run for each contiguous area consistent in quality, appearance and physical properties.
6. Maintain adequate ventilation during installation.
7. Provide 3% extra stock of ceramic tile and trim in colours, patterns and sizes furnished to the University. Wrap in original protective containers, permanently labeled as to exact contents.

8. Provide all special shapes and finished tiles such as caps, inside and outside corners, solid trim pieces, bullnose, coved base, safety treads and catalogued accessories as required for complete work in conformance to applicable Codes.
9. **Wall Tile:**
    1. Glazed porcelain, Class MR 1 in accordance with requirements of CAN/CGSB-75.1-M88, square edged.
    2. Ensure coefficient of friction is suitable for intended application.
10. **Floor Tile**:
    1. Unglazed porcelain, Class MR 1 in accordance with requirements of CAN/CGSB-75.1-M88, square edged.
    2. Application: Corridors and washrooms.
    3. Minimum size shall be 600 mm x 1200 mm (2'-0" x 4'-0") unless noted by the Consultant as not feasible/increased risk (e.g. existing floor slab). University Project Manager to approve in Schematic Design.
    4. Ensure adequate slope to drain in showers/wet areas. Small tile size is preferred in these areas.
11. **Grout:** Epoxy, low VOC. Water cleanable, chemical resistant, factory blended. To be finished flush/level with surface of tile.
12. **Primer:** Low VOC. As recommended by tile manufacturer.
13. **Sealer:** Low VOC. As recommended by tile manufacturer to CAN/CGSB 25.20.
14. Completely remove oil, grease, loose mortar, dust and all contaminants from areas scheduled to receive tile.
15. Except where tiles have setting tabs, and except for expansion, control and isolation joints, maintain 3 mm joints for ceramic tile.
16. When appropriate mix tiles from several boxes prior to installation to assure that colour variations from tile to tile are evenly distributed throughout the field.
17. Extend tiles behind mirrors, cabinets, cupboards and other fixed objects at walls.
18. Provide trim at all exposed edges.
19. Provide thresholds and transitions.
20. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; adjust joints in consultation with Consultant where joints are not coordinated.

09 51 00 ACOUSTICAL CEILINGS

1. Description:

1. Provide ceiling framing, tee grid and tile for a complete acoustic ceiling.
2. Coordinate with Acoustical Ceiling Suspension Assemblies, Gypsum Board, Mechanical and Electrical.

2. Quality Assurance: Conform to the requirements of:

1. Acoustic Ceiling System to be ASTM 635 Light Duty Standard, installed in accordance with ASTM 636.
2. CANULC-S102, Surface Burning Characteristics of Building materials and Assemblies.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Ensure product is stored in an area away from sources of dust and moisture. Store off the floor.
3. Supply a minimum of 2% of gross ceiling area of each type and pattern of acoustic tile.
4. Design for adequate support of electrical fixtures as required by Electrical safety Authority.
5. Maximum deflection for completed ceiling to be L/360 of span.
6. **Acoustical Ceiling Tile:**
    1. **Product:** Armstrong Cortega 769, 600 mm x 1200 mm or approved equal by University Project Manager.
    2. **Edge:** Square lay-in.
    3. **Colour:** Manufacturer's standard range.
    4. **Flame Spread Rating**: 25 or less.
    5. **Smoke Developed**: 50 or less.
7. **Suspension System**:
    1. **Construction:** Commercial quality cold rolled steel.
    2. **Main Tees:** 25 mm (1") exposed face. Nominal 3600 mm (12'-0") long, rectangular bulb at top of web, 38 mm (1/2") high web, 9 mm (1/4") face width designed to lock into consecutive lengths to function structurally as a single unit with face at joint perfectly aligned and presenting a tight inconspicuous seam.

3. **Cross Tees:** 1" exposed face**.** 610 mm (2'-0") long, same design as main tee except designed to connect at main tee to form positive lock without play, loss or gain in grid dimensions with offset over-ride of face over main tee face flange to provide flush tee faces at joints.
4. **Edge Moulding:** Min. of 0.46 mm thick steel, 14 mm wide legs, capable of supporting all superimposed loads**.**
5. **Trim:** Extruded aluminum at suspended panels/clouds, minimum 6".
6. **Fixture Clips:** As recommended by acoustic tile manufacturer.
7. **Finish:** All metal products shall be steel galvanized to Z275. All exposed surfaces shall first receive a prepaint treatment, CGSB 31-GP-116M, and then a baked-on factory finish with satin sheen enamel in colour to match acoustic tile.

8. Touch up paint to be low VOC.
9. Cooperate with mechanical, electrical and other trades to accommodate fixtures, fittings and other items in acoustic ceilings.
10. Unless noted on drawings, center ceiling system on room axis leaving equal border tiles or panels not less than 1/2 a full width.
11. Recessed items shall re be centered on acoustical panels, except where indicated otherwise.
12. Acoustical ceiling panels shall not be installed until the building is enclosed and the environment is controlled.

09 60 00 FLOORING

1. Applications:

1. Entryways: floor grille (public entryways)
2. Corridors: Terrazzo, polished concrete or ceramic tile
3. Offices: Caret tile, carpet roll at residences
4. Classrooms: Vinyl sheet, LVT, or VCT.
5. Laboratories, Computer: Vinyl sheet or VCT.
6. Laboratories, Science: Quartz tile or epoxy.
7. Gymnasium/Dance Studio: Wood
8. IT Room: Static dissipative
9. Washrooms: Terrazzo, polished concrete or ceramic tile
10. Stairs: Stairway management
11. Stainless steel baseboards shall not be used in any application.

2. Submittals:

1. Coloured floor plan showing all flooring products for University approval prior to tender.

09 65 00 RESILIENT FLOORING

1. Description:

1. Provide sheet flooring, resilient base and sub-floor preparation.
2. Coordinate with Concrete and Masonry.

2. Quality Assurance: Conform to the requirements of:

1. Installer to have with minimum five (5) years' experience in application of products, systems and assemblies specified and with approval and training of Product manufacturers.
2. Test for moisture vapour transmission in accordance with ASTM F710-11 and ASTM F1869-11 or ASTM F2170-11 in accordance with manufacturer's written flooring installation instructions. Results must not exceed 170 µg/m^2 (3 pounds per 1,000 ft^2) in 24 hours when tested to ASTM F1869-11, or exceed 75% when tested to ASTM F2170-11.
3. Ensure existing floor slab is smooth and level to within 1:1000.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Temperature of room, floor surface and materials maintained between 18°C and 21°C for 48 hours before, during and for 48 hours after installation.
3. Supply a minimum of 2% of gross area of each type and pattern/colour of flooring.
4. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
5. Ensure that adequate ventilation is provided during installation and curing of materials.
6. **Vinyl Sheet:**
    1. Thickness: 2.5 mm.
7. **Moisture Barrier:** On new concrete floor slab on grade, moisture barrier is required. Follow flooring manufacturer's recommendation on product selection.
8. **Adhesive/Primer:** Low VOC, as recommended by flooring manufacturer.
9. **Substrate Filler:** Low VOC, as recommended by flooring manufacturer
10. **Seaming System:** Heat welding rod system as manufactured by flooring manufacturer.
11. **Thresholds and Binder Bars:** Vinyl, screw-down type as recommended by flooring manufacturer, colours from manufacturer's complete range. FADS compliant.

12. **Resilient Base:** 100% rubber, 102 mm high x 30 m roll lengths x 3 mm thick with grooved back and standard toe.
13. **Stairway Management:** Integrated high contrast strip.
14. Lay flooring to produce a minimal number of seams.
15. Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
16. At edge of dissimilar floor finishes, resilient and other flooring, other than carpet, provide one piece thresholds and edge reducer strips.

09 67 00 FLUID-APPLIED FLOORING

1. Description:

1. Provide epoxy flooring, base and sub-floor preparation.
2. Coordinate with Concrete, Masonry and Gypsum Board.

2. Quality Assurance: Conform to the requirements of:

1. ASTM E 1907-97 - Standard Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes.
2. ASTM D 4263-83 - Indicating Moisture in Concrete by Plastic Sheet Method.
3. ASTM F 1869-98 - Measuring Moisture Vapour Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
4. ASTM D 4414-84 - Measurement of Wet Film Thickness by Notch Gages.
5. CSA A23.2-00 A23.2-6B Method of Test to Determine Adhesion by Tensile Load.
6. International Concrete Repair Institute (I.C.R.I) Guideline Number 03732 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays
7. Applicator to have with minimum five (5) years experience in application of products, systems and assemblies specified and with approval and training of product manufacturer.
8. Determine if the surface texture of the concrete is comparable to I.C.R.I. Texture CSP 3-5.
9. Determine the tensile bond strength of the concrete before application begins in accordance with CSA A23.2-6B. Minimum acceptable test result is 1.5 MPa (210 psi).
10. Test for moisture vapour transmission in accordance with ASTM F710-11 and ASTM F1869-11 or ASTM F2170-11 in accordance with manufacturer's written flooring installation instructions. Results must not exceed 170 µg/m^2 (3 pounds per 1,000 ft^2) in 24 hours when tested to ASTM F1869-11, or exceed 75% when tested to ASTM F2170-11.
11. Determine the surface moisture content by using an impedance moisture meter designed for use on concrete as detailed in ASTM E1907. Acceptable test results shall be 4% by mass or less.
12. Determine the Dew Point of the surface to be coated before application. The Contractor must monitor the Dew Point during application and initial cure. The surface must be a least 3°C (5.5°F) above the measured Dew Point at all times during application and cure.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.

2. The concrete surface must be dry, clean and sound. Remove dust, laitance, grease, oil, dirt, curing agents, impregnations, wax, foreign matters, coatings and disintegrated materials from the surface by an appropriate mechanical means, i.e. steel shot blasting, sand blasting or any other method approved by the manufacturer. Surface texture I.C.R.I CSP 3-5.
3. Protect adjacent surfaces, fixtures and equipment with a drop cloth or adequately cover to prevent damage from splatter, spillage or any other damage resulting from work.
4. Fill all non-moving cracks, control joints, pockmarks, depressions or rough concrete with manufacturer's recommended product.
5. Key all edges that do not terminate at a wall or curb to avoid featheredges. All through floor penetrations such as drains and trenches require a keyed edge that maintains a uniform 6 mm (1/4") thickness.
6. Temperature of room, floor surface and materials maintained between 18°C and 21°C for 48 hours before, during and for 48 hours after installation.
7. Supply a minimum of 2% of gross area of each type and pattern/colour of flooring.
8. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
9. Ensure that adequate ventilation is provided during installation and curing of materials.
10. **Epoxy:**
    1. **Thickness**: 3.0 mm
    2. Three-coat application consisting of a prime coat of 8 mils, a neat resin coat at 45 mils / broadcast to rejection with selected sand and a topcoat at 10-20 mils. Low VOC.
    3. **Cove Base**: 150 mm high radius with integral seal at floor-to-wall interface.
11. During application check the wet film thickness of the materials in compliance with ASTM D 4414-84 test method 'Measurement of Wet Film Thickness by Notch Gages'.
12. Finished Work must be uniform in thickness, sheen, colour, texture, and shall be slip resistant.
13. Provide adequate temporary protection from traffic, water and chemical exposure until flooring is fully cured.

09 68 00 CARPETING

1. Description:

1. Provide carpet tile and base and sub-floor preparation.
2. Coordinate with Concrete, Masonry and Gypsum Board.

2. Quality Assurance: Conform to the requirements of:

1. CGSB 4-GP-129, Carpets, Commercial;
2. CGSB 4-GP-156, Direct Glue Down Carpet, Guide to Selection and Installation;
3. CGSB 20-GP-23M, Cashion Carpet, Flexible Polymeric Material.
4. CAN/ULC-S102.2-M88, Canadian Flammability Testing
5. Subcontractor to be approved by the carpet manufacturer.
6. Determine if the surface texture of the concrete is comparable to I.C.R.I. Texture CSP 3-5.
7. Meet or exceed Carpet & Rug Institute Green Label Plus testing requirements.

3. Warranty:

1. Warrant carpet for a total period of fifteen (15) years against wear, edge ravel, zippering, backing resiliency, static control and delamination including full product replacement in areas of wear to include the whole room when defined by 3 interior walls or visible area of open office. Warranty not to be pro-rated and to include product re-installation.
2. Warrant installation for a total period of two (2) years, including seaming and delamination.

4. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Deliver and store where directed; 3% extra stock of carpet proportioned to colours and textures installed.
3. Store in a heated area maintained at minimum temperature of 10°C or at such temperature as recommended by the product manufacturer.
4. Ensure that adequate ventilation is provided during installation and curing of materials.
5. **Carpet Tile:** Integral underpad.
6. **Adhesive System:** Low VOC, water based as recommended by carpet manufacturer.
7. **Seam Cement:** Low VOC, water based as recommended by carpet manufacturer.
8. Provide edge adaptors/transition strip/thresholds as required.

9. Position edges of carpet in door openings, under door, in its closed position.
10. Provide adequate temporary protection from traffic, water and chemical exposure until flooring is fully cured.

09 90 00 PAINTING AND COATING

1. Description:

1. Provide all labour, materials, tools and other equipment, services and supervision required to complete all exterior and interior painting and decorating work. Work also includes, but is not limited to, surface preparation of substrates as required for acceptance of painting, including cleaning, small crack repair, patching, caulking, making good surfaces and areas, pre-treatment, priming and back-priming.

2. Quality Assurance: Conform to the requirements of:

1. Architectural Painters Institute, Architectural Painting Specification Manual
2. ECP-07-89/ECP-12-89
    1. Interior Latex Type, Flat Paint - CAN/CGSB-1.100-M (Ceilings ONLY)
    2. Primer-Sealer, Wall, Interior Latex Type - CAN/CGSB-1.119-M
    3. Paint, Exterior, Latex Type, Flat - CGSB 1-GP-138M
    4. Emulsion Type Filler Masonry Block - CAN/CGSB-1.188-M
    5. Interior Semigloss Latex Paint - CAN/CGSB-1.195-M
    6. Primer, Exterior, Latex Type - CGSB 1-GP-203Ma
    7. Stain, Pigmented, Exterior Latex Type - CGSB 1-GP-204M
3. Subcontractor to have a minimum of five (5) years proven satisfactory experience.
4. All paints and coatings to meet the applicable VOC limits of the South Coast Air Quality Management District (SCAQMD) Rule 1113 effective June 3, 2011.
5. Supply paint from a single manufacturer.

3. Products:

1. Do not paint stainless steel ducts.
2. Perform no painting or decorating work when the ambient air and substrate temperatures, relative humidity and dew point and substrate moisture content is below or above requirements for both interior and exterior work.
3. Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.
4. Ensure that adequate ventilation is provided during installation and curing of materials.
5. Schedule work to minimize absorption of fumes into surrounding porous materials.
6. Ensure containers are keep closed when not in use.

7. Paint, stain and wood preservative finishes and related materials (thinners, solvents, caulking, empty paint cans, cleaning rags, etc.) shall be regarded as hazardous products. Recycle and dispose of same subject to regulations of applicable authorities having jurisdiction.

8. **Water Based Paint Standard:**

    1. **Approved:** Dulux Lifemaster and Dulux Diamond or approved equivalent.

    2. In accordance with Environmental Choice Program guideline ECP-07-89, water based paint shall be formulated or manufactured free from formaldehyde, halogenated solvents, aromatic hydrocarbons, mercury or mercury compounds, or be tinted with pigments of lead, cadmium, chromuim VI and their oxides.

9. **Solvent Base Paint Standard**:

    1. In accordance with ECP guideline ECP-12-89, solvent based paint shall not be formulated with formaldehyde, halogenated solvents, aromatic hydrocarbons in excess of 10% of weight, mercury or mercury compounds, or be tinted with pigments of lead, cadmium, chromium VI and their oxides.

10. All paint shall be ready-mixed and pre-tinted.

11. Paint gloss in accordance with the following MPI values:

Gloss Level	Description	Units @ 60°	Units @ 85°
G1	Matte or Flat finish	0 to 5	10 max.
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 min.
G5	Semi-Gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

12. **Finishes**:

    1. **Exterior Galvanized Steel**: Unpainted

    2. **Interior Concrete Horizontal Surfaces**: Floors and stairs

        INT 3.2G - Waterborne concrete floor sealer semi-gloss finish.

    3. **Interior Concrete Masonry Units**: Smooth and split face block and brick

        1. 1 coat high-solids, pigmented block filler used full body, 3 mils DFT.

        2. 2 coats vinyl acrylic Latex enamel, 1.5 mils/coat DFT. Total 6 mils DFT. INT 4.2E - Institutional semi-gloss finish.

4. **Interior Structural Steel and Metal Fabrications**: Columns, beams, joists, etc.
    1. 1 coat shop applied, oil Alkyd primer (metal surfaces already primed need only touchup),
    2. 1 coat 100% Acrylic emulsion, waterborne, corrosion resistant paint as tie-coat at 1.5 - 2 mils DFT.
    3. 2 coats Acrylic emulsion finish at 1.2 mils/coat DFT. Total 3.9 - 4.4 mils DFT - INT 5.1S – Institutional semi-gloss
5. **Interior Galvanized Steel:** Hollow Metal Doors, Screens and Deck
    1. 1 coat 100% Acrylic emulsion, waterborne, corrosion resistant primer at 2 mils DFT.
    2. 2 coats water reducible Latex house and trim paint at 1.2 mils/coat DFT. Total 4.4 mils DFT. Semi-gloss finish at doors and screens. Flat finish at steel deck.
6. **Interior Gypsum Board**:
    1. 1 coat Latex primer sealer at 1.0 mil DFT.
    2. 2 coats interior Latex enamel at 1.5 mils/coat DFT. Total 4. 0mils DFT

        INT 9.2M - Institutional semi-gloss (general), eggshell (offices).

        Provide 3 coats at high contrast colours.
7. **Painted Woodwork**:
    1. 1 coat undercoater, low-odour, pigmented, interior alkyd primer at 1.5 mil DFT. Back paint wood base.
    2. 2 coats interior Latex enamel at 1.5 mils/coat DFT. Total 4.5 mils DFT.
8. **Clear Finish for Wood**:
    1. 1 coat sanding sealer.
    2. 2 coats water based Urethane gloss varnish at 2.0 mils/coat. Total 4.0 mils DFT.
9. **Painted Concrete:** 2 coats high-solids purpose made floor paint with non-slip surface.
10. **Insulated and Uninsulated Pipes, Ducts, Conduit, Valves, Fittings and Equipment and Ancillary Items where "Exposed" in Completed Work:**
    1. Insulated Work: 1 coat Latex primer sealer, 1 mil DFT. 2 coats interior Latex enamel, 1.5 mils/coat. Total 4.0 mils DFT.
    2. Non-insulated Work: 1 coat structural steel primer, 1 mil DFT. 2 coats interior Latex enamel, 1.5 mils/coat. Total 4.0 mils DFT.

13. Unless otherwise specified or noted, paint all “unfinished” conduits, piping, hangers and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in the following areas:
    1. Where exposed-to-view in all exterior and interior areas.
    2. In all interior high humidity interior areas.
    3. In all boiler room, mechanical and electrical rooms.
14. Refer to Mechanical and Electrical specifications for painting, banding, stenciling of other surfaces/equipment.
    1. **Fire Protection Piping**: Red
    2. **Natural Gas Piping**: Yellow.
15. Use sufficient drop cloths and protective coverings for full protection of floors and work not being painted.

10 00 00 SPECIALTIES

10 11 00 VISUAL DISPLAY UNITS

1. Description:

1. Provide markerboards and bulletin boards.
2. Coordinate with Masonry, Finish Carpentry, Architectural Woodwork and Gypsum Board.

2. Quality Assurance:

1. Brock University Facility Accessibility Design Standards (FADS)

3. Warranty:

1. Warrant product by manufacturer for a total period of five (5) years against manufacturing defects.

4. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Trim:** Extruded aluminum trim, clear anodized.
3. **Marker Tray:** 69 mm extruded aluminum, clear anodized per Series 400 by Architectural School Products or equivalent. To be installed in length to match length of markerboard.
4. **Surface**:
    1. **Markerboard:** Porcelain enamel on steel, write on – wipe off, magnetic or glass with appropriate backing.
    2. **Bulletin Board:** Natural cork on particle board (offices) or Forbo.
5. **Size**:
    1. **Classrooms and meeting rooms:** Minimum 1200 mm x 2400 mm or 1200 mm x 1200 mm where space limitations exist. Maximize as much as possible.
    2. **Offices:** Minimum 900 mm x 1200 mm.
6. **Spline Joint:** Concealed and continuous.
7. **Adhesive:** Type recommended by manufacturer, low VOC.
8. **Dry Erase Markers:** Provide boxes of black and or assorted colours.
9. **Mounting:** Mechanical Attachment Only.
    1. To concrete or solid masonry use lag screw, tapcons and expansion bolts or screws and fiber plugs as appropriate for stresses involved.
    2. To hollow masonry use toggle bolts or equivalent.
    3. To wood or sheet metal use screws secure into framing members in stud walls. Reinforce stud partitions as required.
    4. Do not adhere to any walls.

5. Mount markerboards and bulletin boards in accordance with manufacturer's installation instructions.

10. **Mounting Height**: Per FADS.

10 14 00 SIGNAGE

1. Description:

1. Provide signage to the interior of the building.
2. Coordinate with wall finishes and glazing systems.

2. Quality Assurance: Conform to the requirements of:

1. Brock University Facility Accessibility Design Standards (FADS).
2. Source all signage from one manufacturer.
3. Submit representative sample of each type of sign, sign image and mounting method.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Materials:** As directed by the University Project Manager.
3. Renovations to match signage colours in existing buildings.
4. **Universal Washroom:** white panel sign CM-SE21A by Camden Door Controls for emergency call.
5. **Mounting**:
    1. **Concrete/Solid Masonry:** Lag screws and expansion bolts or screws and fibre plugs as appropriate for stresses involved.
    2. **Hollow Masonry:** Toggle bolts.
    3. **Steel:** Bolts with nut and lock washers, self-tapping screws or welding as appropriate.
    4. **Wood:** Screws.
    5. **Stud Walls/Ceiling Cavities:** Secure to framing members or butterfly toggle bolt as appropriate for stresses involved.
    6. In exterior applications fasteners to be non-staining, non-ferrous.
    7. Signage to be at accessible height with tactile characters and numbers per FADS.

10 21 00 COMPARTMENTS AND CUBICLES

1. Description:

1. Provide toilet partitions and urinal divider screens.
2. Coordinate with Rough Carpentry, Sealants and Washroom Accessories.

2. Quality Assurance:

1. Brock University Facility Accessibility Design Standards (FADS)

3. Warranty:

1. Warrant product by manufacturer for a total period of three (3) years against defects in design, materials and workmanship.

4. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Toilet Partition Style:** Floor mounted, overhead braced or ceiling mounted with continuous hinge.
3. **Urinal Divider Screen Style:** Wall mounted. Custom shelf across top of dividers, 250 mm deep.
4. **Construction:** Doors, Panels and Pilasters shall be constructed of two sheets of panel flatness zinc-coated steel, Galvanneal ASTM A653 GR33, laminated under pressure to a honeycomb core for sound deadening and rigidity. Formed edges to be welded together and inter-locked under tension with a roll-formed oval crown locking bar, mitered, welded and ground smooth at the corners. Honeycomb to have a maximum 25 mm cell size.
5. **Doors:** 25 mm thick with cover sheets not less than 0.8 mm (22-gauge).
6. **Panels:** 25 mm thick with cover sheets not less than 0.8 mm (22-gauge).
7. **Pilasters:** Shall be 32 mm thick with cover sheets not less than 1.2 mm (18-gauge).
8. **Hardware and Fittings:** All panel and pilaster brackets and all door hardware shall be chrome plated zinc die castings.
    1. **Fasteners:** Zinc plated, chrome plated or stainless steel. 6-lobe security screws.
    2. **Hinge:** Adjustable gravity type, mounted on the lower pilaster hinge bracket, fully concealed within the thickness of the door. Threaded upper hinge pin shall have a metal core and self-lubricating nylon sleeve to ensure smooth, quiet operation
    3. **Coat Hook:** 102 mm x 50 mm x 110 mm, Model# 843.65.600 by Hafele. Matt nickel finish. Provide at on each door.

4. **Latch:** Concealed latch, with face mortised flush with edge strip of door. Barrier-free doors shall include thumb turn lever to activate latch without fingertip grip application. Both standard and barrier-free latches shall have a turn slot designed to allow emergency access from exterior.
5. Door stop and keeper.
6. **Pilaster Shoe:** Minimum 102 mm high, welded one-piece polished stainless steel.
7. **Door Pull:** “C” type on out swinging doors.

9. **Finish:** All sheet metal to be thoroughly cleaned, phosphated and finished with a high performance poly-urethane anti-graffiti powder coating, electrostatically applied and oven cured to provide a uniform smooth protective finish. Colour from complete range.

10 26 00 WALL AND DOOR PROTECTION

1. Description:

1. Provide corner guards, door protection and wall protection for drywall applications in all public spaces.

2. Quality Assurance:

1. Provide each element as complete unit produced by single manufacturer, including fittings, accessories, bases and anchorage devices.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Corner Guard:** Surface mounted, full height standard 90 mm x 90 mm legs, 1.3 mm thick (16 gauge) stainless steel angle in accordance with ASTM A276-10, Type 304, AISI No. 4 satin finish, radius edge. Use continuous adhesive.
3. **Door Protection:** Stainless steel mop, kick or armour plate with de-burred edges.
    1. Application:
        1. All exposed corners within circulation areas where there is a high likelihood of impact to corners of walls.
        2. Leading into caretaking/housekeeping, mechanical and electrical rooms.
4. **Mop Sink Wall Guard:** 0.9525 mm thick (20 gauge) stainless steel angle in accordance with ASTM A276-10, Type 304, AISI No. 4 satin finish. Minimum 610 mm high.
5. **Wall Protection:** Provide wall protection in public areas and classrooms where chairs are present near walls to prevent wall finish damage.
6. **Adhesive:** Low VOC.

10 28 00 TOILET, BATH AND LAUNDRY ACCESSORIES

1. Description:

1. Provide washroom accessories and allow for custodial space in facility design.
2. Coordinate with Concrete, Rough Carpentry, Mechanical and Electrical.

2. Quality Assurance:

1. Ontario Building Code (OBC), Part 3
2. Brock University Facility Accessibility Design Standards (FADS)

3. Products:

1. Building materials shall be manufactured in North America and readily available to the extent possible.
2. Pursue the use of materials with high recycled content.
3. Knock down 16-gauge construction with individual top, bottom, side, back and shelves with a common side separating compartments. Perimeter ventilation.
4. **Paper Towel Dispenser:** Not used.
5. **Waste Receptacle:** Wall mounted polypropylene unit with spring loaded swing door, 15 gal (US) capacity, beige colour.
6. **Soap Dispenser:** Supplied by University.
7. **Toilet Tissue Dispenser:** Supplied by University.
8. **Sanitary Napkin Disposal:** Supplied by University.
9. **Sanitary Napkin Dispenser**: Supplied by University.
10. **Mirror:** FADS compliant installed height/angle.
11. **Coat Hook:** 102 mm x 50 mm x 110 mm, Model# 843.65.600 by Hafele. Matt nickel finish. FADS compliant installation.
12. **Grab Bar:** 32 mm dia. stainless steel, brushed and peened finish, concealed mounting. Per OBC and FADS.
13. **Shelf**:
    1. **Materials**: Surface-mounted type 304 stainless steel with bright polished finish.
    2. **Shelf**: 0.8 mm (22 gauge) and roll-formed edges.
    3. **Flanges and Supports Arms**: 0.8 mm (22 gauge) with concealed, all-welded 1.6 mm (16 gauge) mounting brackets secured to concealed 1.6 mm (16 gauge) wall plate.
    4. Provide at Universal Washrooms per FADS.

14. **Hand Dryer:** AirMax by World Dryer (air flow and heat), automatic operation with touchless sensor. Install at FADS compliant height.
15. **Adult Change Table:** Provide necessary FADS compliant space and reinforcement/ blocking in walls.
16. **Sharps Disposal:** Supplied by University.
17. **Fastening:** Concealed and vandal proof and securing products in place for long life under heavy use. Provide heavy duty anchors suited to wall construction. Provide blocking in stud walls. Soap dispensers and other fixtures shall not be installed on mirrors.
18. **Custodial Closet:**
    1. **Mop and Broom Holder:** Shelf is 1.2 mm (18-gauge), type 304 stainless steel, satin finish; 915 mm long, 150 mm H, 205 mm D. Four anti-slip mop holders have spring-loaded rubber cam that grips handles 20–30 mm diameter. Three stainless steel rag hooks. Rod for wet rags below shelf.
    2. **Slop Sink:** Maximum depth at front of 150 mm to allow for draining of floor cleaning machine. Minimum dimensions of 900 mm x 900 mm.
    3. **Storage Area:** Minimum area of 900 mm wide x 1,500 mm long for storage of floor cleaning equipment.
    4. Floor Drain
    5. Outlet
    6. Exhaust Fan

10 43 00 EMERGENCY AID SPECIALTIES

1. Description:

1. Provide defibrillator kit cabinet, first aid cabinet, emergency phones and panic strips.
2. Coordinate with Concrete, Rough Carpentry and Signage.

2. Quality Assurance:

1. Provide each flagpole as complete unit produced by single manufacturer, including fittings, accessories, bases and anchorage devices.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Defibrillator Cabinet:**
    1. Flat trim, 360 mm x 360 mm x 150 mm interior dimensions to suit University supplied LIFEPAK 500 AED defibrillator by Medtronic.
    2. Key lock with alarm connected to alert Campus Security.
    3. Mounted with top at 1,200 mm with studs on either side.
    4. To be centrally located and highly visible.
3. **First Aid Cabinet:** Provide in each building complete with signage. Coordinate location with University Project Manager.
4. **Exterior Emergency Communication Station**:
    1. **Freestanding Stanchion**:
        1. Powder coated epoxy steel construction, 250 mm x 250 mm x 2895 mm, weather resistant, with “EMERGENCY” lettering on all sides.
        2. Integrated panel light.
        3. Accommodate telephone at FADS compliant height.
        4. cUL/ULC listed.
        5. **Colour:** Safety Yellow 234-062.
        6. RED ALERT Tower Model 234 by GAI-Tronics Corporation including tower mounting kit.
        7. **Base:** Concrete pier according to manufacturer recommendations.
    2. **Wall Mount Stanchion**:
        1. Powder coated epoxy steel construction, 250 mm x 240 mm x 1030 mm, weather resistant, with “EMERGENCY” lettering on sides.
        2. Integrated panel light.
        3. Accommodate telephone at FADS compliant height.

4. cUL/ULC listed.
5. Colour: Safety Yellow 234-062.
6. Model 234WM by GAI-Tronics Corporation.

3. **Telephone:** Flush-mounted with push button within E-1600-GT brushed stainless steel panel. Connected to Campus Security. By Viking Electronics Inc. Mount at FADS compliant height.
4. **Strobe:**
    1. LED, 120V, constant-on, die-cast aluminum, baked enamel finish base with polycarbonate dome: blue. cUL listed. Model 530-001 by GAI-Tronics Corporation.
    2. **Mount:**
        1. **Freestanding:** Combined for strobe and camera, 84503 by GAI-Tronics Corporation.
        2. **Wall Mount:** Integrated to stanchion.

5. **Interior Emergency Telephone**:
    1. **Housing:** Recessed, 25300 Back Box by Minelec Ltd.
    2. **Telephone:** 255 mm x 305 mm x 70 mm, stainless steel front panel, 25300B by Minelec. Mount at FADS compliant height.
6. **Panic Strip:** Aluminum mounting channel, waterproof ribbon switch and top cover. Provide caps and corners. DaDo by Tapeswitch. For Universal Washrooms.

10 51 00 LOCKERS

1. Description:

1. Provide lockers.
2. Coordinate with Insulation and Architectural Woodwork.

2. Quality Assurance:

1. Brock University Facility Accessibility Design Standards (FADS).

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Knock down 16 gauge construction with individual top, bottom, side, back and shelves with a common side separating compartments. Perimeter ventilation.
3. **Types:**
    1. **Type 1A:** Single tier units, 305 mm wide x 455 mm deep x 1830 mm high.
    2. **Type 1B:** Single tier units, 380 mm wide x 455 mm deep x 1830 mm high.
    3. **Type 2A:** Two-tier units, 305 mm wide x 455 mm deep x 1830 mm high.
    4. **Type 2B:** Two-tier units, 380 mm wide x 455 mm deep x 1830 mm high.
4. **Base:** Integral 90 mm high galvanized metal box
5. **Door Hinge:** Continuous.
6. **Latching:** Single point latching/locking device for padlocks. FADS compliant.
7. **Coat Hook:** Three (3) separate – one on each wall.
8. **Shelf:** Perforated upper. FADS compliant installed height.
9. **Fastening:** Concealed fastenings and heavy duty anchors suited to wall construction.
10. **Number Plates:** FADS compliant, raised or recessed colour contrasting lettering.
11. All required bench/pedestal, spacers, closure/filler panels and trim for complete installation.

10 56 00 STORAGE ASSEMBLIES

1. Description:

1. Provide wall mounted shelving.
2. Coordinate with Finish Carpentry, Architectural Woodwork and Gypsum Board.

2. Quality Assurance: Conform to the requirements of:

1. Brock University Facility Accessibility Design Standards (FADS).

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Provide metal blocking in walls where wall mounted shelving is intended; see Rough Carpentry section.
3. **Basis of Design:** Standard office use shelving. Each application is to be reviewed against intended use/type and weight of material to be stored with products selected to suit.
    1. **Pilaster:** 1.3 mm (16 ga.), 32 mm wide x 2135 mm tall, surface mounted steel. Colour from manufacturer's complete range. Secured to studs where possible. Minimum top two fasteners to be secured through blocking with toggle bolt when no wall stud is present. Minimum one layer 19 mm gypsum board required. Use 4.75 mm (3/16") x 57 mm (2-1/4") Tapcon fasteners in masonry.
    2. **Shelf:** 250 mm deep. Provide within accessible reach ranges per FADS in accessible storage spaces.
4. Provide required clearance/clear floor space per FADS.

10 75 00 FLAG POLES

1. Description:

1. Provide aluminum flagpoles.
2. Coordinate with Concrete.

2. Quality Assurance:

1. Provide each flagpole as complete unit produced by single manufacturer, including fittings, accessories, bases and anchorage devices.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Aluminum: Aluminum Association alloy AA 6063-T5 seamless extruded aluminum tubing.
3. Isolation coating: alkali-resistant bituminous paint or epoxy resin solution.
4. **Cone tapered flagpole**:
    1. Seamless, uniform, straight line tapered section above cylindrical butt section.
    2. Taper: 25 mm of run.
    3. Provide internal splicing, self-aligning sleeve of same material as flagpole for snug fitting, watertight field joints.
5. Include base, mounting bracket, anchorage and fittings.

11 00 00 EQUIPMENT

11 12 00 PARKING CONTROL EQUIPMENT

1. Description:

1. Provide parking lot control equipment.

2. Products:

1. Building materials shall be manufactured in North America and readily available to the extent possible.
2. Pursue the use of materials with high recycled content.
3. **Materials**: As directed by University Project Manager in consultation with Parking Services.

11 13 00 LOADING DOCK EQUIPMENT

1. Description:

1. Where a loading dock is necessary or desired the required equipment is to be presented to the University Project Manager based on a needs assessment from stakeholders for review (e.g. bumpers, canopy, enclosure, door bell, etc.).
2. At each loading dock ensure a building entrance door is in near proximity.
3. The need for a dock leveler is to be reviewed against the intended use of the loading dock (e.g. size of trucks/trailers) and available grading measures.

11 14 00 PEDESTRIAN CONTROL EQUIPMENT

1. Description:

1. Provide pedestrian control equipment.

2. Products:

1. As directed by University Project Manager.

11 21 23 VENDING EQUIPMENT

1. Description:

1. Provide sufficient space and access for University supplied vending machines.
2. Coordinate with flooring, wall finish and Electrical.

2. Products:

1. Per Brock University.
2. Vending machines should be located in alcoves that provide adequate ventilation along an accessible route.
3. Provide sufficient clearance for access for operation, stocking and servicing.

11 28 00 OFFICE EQUIPMENT

1. Description:

1. Provide sufficient space and access to University supplied telephones, computer, printer and copiers.
2. Coordinate with Electrical.

2. Products:

1. Per Brock University.
2. High volume printers/copiers should be served by mechanical ventilation.

11 52 00 AUDIO-VISUAL EQUIPMENT

1. Description:

1. Provide audio, video and control systems.
2. Coordinate with Concrete, Rough Carpentry, Architectural Woodwork, Gypsum Board, Furniture, and Electrical.

2. Products:

1. Design and installation is by Cinema Stage. Cables supplied by Cinema Stage.
2. Design of Audio-Visual is to be coordinated with Brock University IT, FM, and Security along with material supplier.
3. Contractor to provide infrastructure to support system design (e.g. conduit, junction boxes).

11 80 00 FACILITY MAINTENANCE AND UTILITIES EQUIPMENT

1. Description:

1. Provide sufficient space in mechanical and electrical rooms for access to service equipment.
2. Engineered lifting points/devices shall be included in mechanical and electrical rooms where required for servicing. Access to rooms shall be designed to enable removal/replacement of equipment.
3. Provide sufficient space and access into caretaking rooms for floor cleaning equipment, housekeeping carts and vacuums.
4. Exterior glazing is desired to be cleaned from the ground. Provide sufficient clearance around the building perimeter to support his activity along with adequate finish at grade.
5. Where glazing cleaning from the ground isn't practical (e.g. due to building height, form, cantilevers, façade design, etc.) provide Fall Protection System (e.g. roof anchors) and window washing system supports (e.g. complete davit system).
6. When parapet design isn't 1,070 mm tall (standard) provide Fall Protection System.
7. Provide sufficient space and access for solid waste and recycling bins/equipment.
8. Coordinate with Concrete, roofing assembly, Rough Carpentry, Architectural Woodwork, Gypsum Board, Furniture, and Electrical.

2. Quality Assurance:

1. Fall Protection System to be design and certified by a professional engineer registered in the Province of Ontario.
2. Design Engineer to complete site review and provide Letters of Assurance certifying that the anchoes meet performance requirements of CSA Z91M.

3. Products:

1. Caretaking/housekeeping equipment per Brock University.
2. Fall protection system to use rust resistant metal (e.g. galvanized).
3. Areas of a roof that are accessible to the general public shall use guardrails where the standard 1,070 mm high parapet isn't present.
4. Provide concrete pad for placement of front-load waste and recycling bins per Brock University unless in-ground products are being used.
5. Provide sufficient outside service area for recycling cart pickup.
6. Provide enclosure for waste and recycling bins.

12 00 00 FURNISHINGS

12 10 00 ART

1. Description:

1. Under development by Brock University.

12 20 00 WINDOW TREATMENTS

1. Description:

1. Provide interior manual and motorized window shades.
2. Coordinate with Rough Carpentry, Storefront/Curtainwall/Windows, Acoustical Ceilings, Gypsum Board and Electrical.

2. Quality Assurance:

1. Verify that all blocking and framing necessary to carry shade assembly hardware is properly installed and secure.
2. Electric shade motors to comply with ULC standards.

3. Warranty:

1. Hardware, fabrics/shade cloth, aluminum and steel coatings, chain and ten (10) years.

4. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Manual Roller Shade**:
    1. **Shade Mounting Brackets**:
        1. 71.5 mm x 76 mm (2.875" x 3"), 12 gauge, L shaped, coated steel mounting brackets.
    2. **Manual Chain Operator**:
        1. Chain operator type, gear reduction operating hardware, manufactured with a braking mechanism to stop shade at any desired point of travel.
        2. Drive chain to be #10 stainless steel, tested strength of 50 kg (110 lb.).
        3. Left hand or right hand operating system to avoid conflict with adjacent cabinets.
        4. Must be break-away type chain.
    3. **Roller Tube Assembly**:
        1. Top roller tube of one piece extruded aluminum tube, with 10 micron thick clear anodized coating, at the manufacturer’s recommended engineered diameter and wall thickness for maximum allowable deflection of L/700.
        2. The spline will be an extruded vinyl profile, welded to the fabric band or panel, such that removal and re-installation of the fabric panels can occur without removing the roller tube and hardware. Fabric panels must be replaceable on site. Attachment of the fabric to the tube with double sided adhesive tapes, adhesives, staples, or rivets is not acceptable.
    4. **Hembars and Hembar Pockets**:

1. Round shaped profile, 15 mm (0.625") diameter, wall thickness engineered to weight requirements, in welded hembar pocket with open ends. Finished with coloured, round end caps.

5. **Fasteners:** Non-corrosive to manufacturer's recommendations.

6. **Fabric**:

    1. Tested in accordance with ASHRAE Standard 74073, "Methods of Measuring Solar-Optical Properties of Materials" and flame spread to NFPA 701-1999 TM#1, Standard Methods of Fire Tests for Flame Resistant Textiles and Films 1999 edition - test method #1 (Small Scale) Toxicity: UPITT Fungal resistance: ASTM G21 Bacterial Resistance, ASTM G22.

    2. **Type 1**:

        1. **Openness Factor:** 3%, GreenScreen, 100% polyester yarn, PVC free, 12 oz/yd^2.

        2. **Flame Resistance:** 0.0 sec after flame.

        3. **Fuel Contributed Value:** 0.

        4. **Colour:** From manufacturer's complete range.

    3. **Type 2**:

        1. **Openness Factor:** 0% (Blackout), GreenScreen, 100% polyester yarn, PVC free, 12 oz/yd^2.

        2. **Flame Resistance:** 0.0 sec after flame.

        3. **Fuel Contributed Value:** 0.

        4. **Colour:** From manufacturer's complete range.

    4. **Type 3:** Dual Shade combining Type 1 and 2.

7. **Accessories:** All necessary accessories to produce a complete and functioning system. Aluminum side and sill channels for blackouts blinds.

3. **Motorized Roller Shade**:

    1. **Motor**:

        1. Tubular, asynchronous motors with a 3 conductor keyed AC power plug at the motor head that can be detached at the motor head assembly directly. Concealed inside roller shade tube. Quiet operation of up to 44 dBa within 915 mm (3'-0").

        2. Intelligent AC motor 115 VAC, 50-60 Hz, thermally protected, lifetime lubricated, equipped with an internal thermal overload protector.

        3. Provide the ability to set limit stop positioning (maximum up/down limits).

4. Use motors rated at the same nominal speed for all roller shades in the same room.
5. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of 6 Nm when operating up to 3962 mm (156") overall width, and 12 Nm when operating beyond 3962 mm (156") overall width.
6. Motors must include an embedded Motor Control System without requiring any external motor logic control system outside of the motor assembly unit itself.

2. **Keypad/Local User Override**:
    1. Allow for keypad switch control for up to 24 buttons connected directly to the motor assembly to allocate for individual and group control with up to four intermediate stop positions. Grouped shades in the same room must be able to stop perfectly aligned with each.
3. **Motor Control System**:
    1. Integrated into the motor.
    2. Bidirectional feedback.
    3. To be compatible with building automation system, audio-visual system, light control system, light sensors, radio frequency and infrared remote operation.
    4. Allows motors to be networked together.
    5. Allow for up to four intermediate stop positioning via the keypad/local-user override, or up to 98 intermediate stop positioning if accepting commands via serial input (computer, third party light control systems, or automation systems).

4. Adhesives, sealants, paints and coatings to be low VOC.

12 31 00 MANUFACTURED METAL CASEWORK

1. Description:

1. Provide laboratory metal casework system including countertops.
2. Coordinate with Rough Carpentry, Mechanical and Electrical.

2. Quality Assurance: Conform to the requirements of:

1. SEFA 8: Laboratory Furniture – Casework, Shelving and Tables Guidelines, Science Equipment and Furniture Association (SEFA)
2. Brock University Facility Accessibility Design Standards (FADS).
3. Manufacturer to be a member of SEFA with a minimum five (5) years experience in manufacturing SEFA compliant metal laboratory casework.
4. Casework to meet or exceed SEFA 8 specifications with chemical resistance test report of cabinet and countertop to be submitted.
5. Casework and work surfaces/countertops to be sourced from one manufacturer.
6. Installer to be certified by the manufacturer with a minimum five (5) experience installing metal laboratory casework.
7. National Fire Protection Association (NFPA) 34, Standard on Fire Protection for Laboratories Using Chemicals.
8. Ontario Fire Code.

3. Warranty:

1. Warrant casework, countertops and accessories against defects in materials and workmanship; include cost of labour and replacement parts for a period of two (2) years from date of Substantial Performance.

4. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Coordinate mechanical and electrical service runs to be incorporated into the casework.
3. **Approved Manufacturers:** CIF Lab Solutions, mottLAB, Canadian Scientific Lab Systems (CSI).
4. **Sheet:** Cold rolled mild steel to ASTM A366.
5. **Polypropylene Sheet**: 6 mm thick, white, non-combustible.
6. **Base and Wall Cabinets**:
    1. 1.02 mm (18 ga.) for sides and backs.

2. **Backs:** To be removable where required to access mechanical/electrical services.
3. **Base:** 102 mm high formed steel with 2.3 mm (11 ga.) steel gussets at corners and leveling screw.
4. Bottoms to be removable.
5. Wall cabinets to.be secured to masonry, stud or metal blocking with toggle bolt.

7. **Doors**: 19 mm thick, double wall 0.8 mm (20 ga.), pre-painted with continuous sound deadening
8. **Drawers**:
    1. **Fronts:** 19 mm thick, double wall 0.8 mm (20 ga.), pre-painted.
    2. **Body:** Bottom and all sides 0.8 mm (20 ga.) formed into one piece with bottom and sides covered and formed top edges.
    3. Filled with sound deadening material.
    4. Built-in stops.
9. **Shelves**: 1.02 mm (18 gas.) thick, turned down edges and returned
10. **Finish**: Chemically resistant baked on epoxy power coat enamel.
11. **Cabinet Hardware**:
    1. **Door and Drawer Pulls:** “D” style, 102 mm wide, 25 mm projection, stainless steel.
    2. **Door Hinges:** 1.91 mm thick, five knuckle stainless steel hinge, stainless steel finish. Provide three hinges for doors over 915 mm.
    3. **Door Catches:** Adjustable type, spring actuated nylon roller.
    4. **Elbow Catches:** Elbow catches and strike plates for non-active side of double locked doors, burnished cast aluminum.
    5. **Shelf Adjustment Clips:** Polycarbonate locking seismic type.
    6. **Locks:** 5 pin tumber cam locks with offset cam. Exposed face chrome plated to be keyed alike with master key.
    7. **Drawer Slides:** Bottom mount 45 kg (100 lb.) capacity full extension.
12. **Control Panel**: Blank panel above cupboard doors
13. **Epoxy Resin Countertop**:
    1. Composed of modified epoxy resin, mold cast with a uniform mixture throughout full thickness, non-glaring surface finish, 25 mm thick, exposed edges beveled top, drip grooves provided on the underside at all exposed edges by Durcon or approved equal.

2. Sink cut-outs smooth and uniform without saw marks with the top edge bevelled. Bottom edge of the sink opening finished smooth with the edge broken to prevent sharpness. Corners of sink cut-outs radiused not less than 20 mm.
3. Provide integrally molded back and end splashes where appropriate.
4. Joints to be field welded/epoxy grout.

14. **Solid Phenolic Countertop**:
    1. Multiple layers of kraft paper saturated with phenolic resin and impregnated overlays are Electron Beam Cured and fused together using heat and pressure. 3.2 mm (1/8") bevel edges.
    2. **Grade:** Standard or Chemical Resistant based on needs assessment and expected chemical exposure.
15. **Sealants:** Low VOC.
    1. Junction between countertop and adjacent walls: silicone one part mildew resistant.
    2. Junction between self-rimming sinks and countertop: silicone one part mildew resistant, concealed.
    3. Junction between female sleeve of service holes and countertop: silicone one part mildew resistant, concealed.
16. Countertop seams to be located minimum 915 mm from water source/sink.
17. Provide filler strips, corner filler panels, finished back panels, apron service covers, gable legs, turret supports, angles, and brackets to enclose all gaps between casework and adjacent surfaces, to conceal columns and service drops and to joint sections of casework.
18. Provide casework units to special, non-standard sizes where needed to rationalize use of space.

12 48 16 ENTRANCE FLOOR GRILLES

1. Description:

1. Provide recessed floor grilles.
2. Coordinate with Concrete.

2. Quality Assurance: Conform to the requirements of:

1. Brock University Facility Accessibility Design Standards (FADS).

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. **Depth:** Minimum 19 mm to maximum 43 mm.
3. **Loading:** Minimum 180 kg (400 lb)/wheel. To be reviewed against stakeholder needs assessment.
4. **Frame and Grid:** Recessed type, extruded 6063-T5 aluminum alloy. Tread rails to incorporate EPDM support cushion. Furnish anchors for attachment to concrete. Colour to be mill.
5. **Tread insert:** Carpet, COF 0.6, from manufacturer's full colour range meeting Carpet Rug Institute Green Label Plus with fibres bonded to rigid two-ply backing in continuous, splice-free lengths. Weight to be 1.1 kg/m^2 (33 oz./yd^2).
6. Ensure recessed slab is level and square.
7. Coordinate top of grid surfaces with bottom of doors that swing across to provide ample clearance between door and grid.
8. Defer installation of floor grids until time of substantial completion of project

12 50 00 FURNITURE

1. Description:

1. Provide furniture for the interior of the building.
2. Coordinate with project finishes and electrical.

2. Quality Assurance: Conform to the requirements of:

1. Brock University Facility Accessibility Design Standards (FADS).
2. Brock University Environmental Sustainability Plan.
3. Furniture to be supplied by Brock University.

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Adhesives, sealants, paints or coatings shall be low VOC.
3. Pursue the use of products with reduced packaging weight and volume. Supplier/installer to remove packaging.
4. Preference shall be given to modular pieces that are height adjustable (where possible), interchangeable, reusable and repairable to maximize their useful life.
5. Schedule installation of furniture after all painting, coating, sealing and other work resulting in emissions is complete.
6. Select chairs based on clearances for work surfaces.
7. **Materials:**
    1. To be identified by Brock University on a project by project basis. Refer to the Furniture Selection Matrix in Appendix B for guidance.
    2. Preference shall be given for non-porous furniture materials in public spaces.
    3. Public Spaces: High pressure laminate.
    4. Offices: Low pressure laminate.
8. **Office Furniture Layouts:** Refer to typical office furniture layouts in Appendix C.
9. **Classroom and Seminar Room Desks:** Provide one duplex receptacle with protective cover for every four (4) seats. Consider the use of combined duplex receptacles with USB ports. Install receptacles no more than 75 mm from the top edge of the desk.

14 00 00 CONVEYING EQUIPMENT

14 20 00 ELEVATORS

1. Description:

1. Provide all labour, materials and equipment necessary or required to fully complete the installation of an electric traction elevator.
2. Coordinate with Structural Steel, Masonry, Gypsum Board shaft wall, Mechanical and Electrical.

2. Quality Assurance: Conform to the requirements of:

1. Ontario Building Code (OBC)
2. Brock University Facility Accessibility Design Standards (FADS)
3. B44-10 Safety Code for Elevators and Escalators
4. Technical Standards and Safety Act, 2000, Statues of Ontario, 2000, Chapter 16
5. Elevating Devices (O. Reg. 209/01)
6. CAN/CSA B44.1/ASME A17.5 "Elevator and Escalator Electrical Equipment"
7. CAN/CSA C22.1 Canadian Electrical Code
8. Elevator manufacturer and installer shall have an active in-house quality assurance program inclusive of internal operations, manufacturing, field staff and operations as well as sub-component suppliers
9. Elevator work shall be performed by properly trained and skilled mechanics, licensed and certified in the Province of Ontario with accreditation as an EDMA qualification in the Province of Ontario

3. Warranty:

1. All equipment shall be provided with a two (2) year warranty starting from date of Substantial Performance.
2. Maintenance beyond the two (2) year warranty period shall be by Brock University.

4. Products:

1. Pursue the use of sustainable products with high recycled content.
2. Non-proprietary car controllers and motor drive controls.
3. **Load Capacity:** Minimum 1,270 kg (2,800 lb.); ay be higher depending on use.
4. **Approved**: KONE Ecospace or Monospace or approved equivalent by University Project Manager during Pre-Design stage upon confirmation of design requirements.
5. **Car**:
    1. Finishes: Stainless steel handrail full width (with returns) on all non-access sides and LVT flooring.

2. Size: Per OBC and FADS.
3. Provide emergency phone.
4. Provide protection padding and associated hooks.

6. Mounting height of all call and operation buttons to be per FADS.
7. Provide tactile floor level plates and marking plates for car call operating buttons.
8. Elevator machine room temperature to be maintained per manufacturer requirements.
9. Provide pit drain and pit ladder.
10. In ground hydraulic cylinders are not permitted.
11. Maintenance period is one (1) year.

20 00 00 PIPE LABELLING

20 00 01 GENERAL REQUIREMENTS

1. Introduction:

1. **General**:
    1. After completion of insulation and/or painting, all piping shall be identified to show the service and direction of flow as described below.
    2. Additional requirements may apply to pipe identification within the Central Utility Building (CUB) and service tunnels.
2. **Applicable Codes and Standards**:
    1. CSA Standard B53 – Identification of Piping Systems
    2. ANSI/ASME A13.1-2007 – Scheme for the Identification of Piping Systems
    3. NFPA 99/CGA C-9 Standards for Medical Gas and Vacuum Systems
3. **Label Placement**:
    1. The entire piping system is to be identified, including piping located in ceiling spaces, interstitial spaces, or within walls.
    2. Pipe identification is required:
        1. At every point of entry or exit to a space, where the pipe penetrates a wall, floor, service column or enclosure;
        2. Within 1 m (3 ft.) of and behind access doors;
        3. Within 1 m (3 ft.) of pipe termination point;
        4. Within 1 m (3 ft.) of branching off (or connecting to) a distribution header;
        5. At least every 8 m (25 ft.) along straight pipe lengths.
    3. Pipe identification shall be visible from point of normal approach.
    4. Pipe identification shall be applied to clean, dry surfaces only and installed according to manufacturer's instructions.
4. **Label Configuration**:
    1. Pipe identification shall consist of a label identifying the piping system contents, along with directional arrows indicating the flow direction.
    2. Flow direction arrows shall be located at both ends of the pipe identification label.
    3. Electrically traced piping shall have additional identification to show it is traced.
    4. Nylon cable ties shall be used to secure pipe identification labels at both ends. Cable ties are in addition to the method of attachment provided by the pipe identification label itself.

5. Piping installed indoors shall be identified using labels meeting either Option A or Option B requirements defined in Section 6 below.
6. Piping installed outdoors (above grade) shall be identified using labels meeting Option B requirements defined in Section 6 below.

5. **Label Size**:
   1. Pipe identification and flow direction markers shall be appropriately sized to match the outer diameter of the finished pipe installation.
   2. Label length and minimum text height shall be determined based on outside diameter of the finished pipe installation as follows:

Outside Pipe Diameter	Minimum Length* of Label	Minimum Text Height
13 – 32 mm (1/2” – 1-1/4”)	205 mm (8”)	13 mm (½”)
38 – 50 mm (1-1/2” – 2”)	205 mm (8”)	19 mm (¾”)
63 – 150 mm (2-1/2” – 6”)	305 mm (12”)	32 mm (1-1/4”)
205 – 255 mm (8” – 10”)	610 mm (24”)	63 mm (2-1/2”)
Over 255 mm (10”)	815 mm (32”)	90 mm (3-1/2”)

*Note: not including flow direction arrows

6. **Materials**:
   1. **Option A** – pressure sensitive adhesive label and banding tape:
      1. Minimum 6 mil thick vinyl or polyester with pressure sensitive backing;
      2. Chemical, UV light, heat, and water resistant;
      3. Label printed with applicable abbreviation from Section 7 below;
      4. Label and text color as defined in Section 7 below;
      5. Banding tape with directional flow arrows placed at both ends of label and wrapped 360° around outside diameter;
      6. Banding tape colors to match label color scheme;
      7. Standard of acceptance:
         1. Brady
         2. Seton
         3. SMS Smillie McAdams Summerlin
         4. Dura Label
   2. **Option B** – semi-rigid plastic vinyl:
      1. Semi-rigid plastic vinyl label printed with applicable abbreviation from Section 7 below;
      2. Label shall include text and flow direction arrows;

3. Label and text color as defined in Section 7 below;
4. Chemical, UV light, and heat resistant, waterproof;
5. Piping up to 150 mm (6”) OD: coil wrapped to snap around pipe and provide 360° visibility;
6. Piping larger than 150 mm (6”) OD: saddle style
7. Standard of acceptance:
    1. Brady: Snap-On and Strap-On
    2. Seton: Snap-Around
    3. SMS Smillie McAdams Summerlin: Coil Mark
    4. Dura Label: Pipe Grabber Sleeves

7. **Label Legend**:

Label Abbreviation	System, Pipe Contents	Label Colors (Text - Background)
Piping		
CHWS	Chilled Water Supply	White - Green
CHWR	Chilled Water Return	White - Green
COMP AIR	Compressed Air	White - Blue
DI WATER	Deionized Water	White - Green
DUAL TEMP S	Dual Temperature Supply	White - Green
DUAL TEMP R	Dual Temperature Return	White - Green
FIRE	Fire Suppression Water	White - Red
FIRE (DRY)	Fire Suppression (Dry Pipe)	White - Red
FIRE (insert gas/chem type)	Fire Suppression (Gas or Chemical)	White - Red
F O S	Fuel Oil Supply	Black - Yellow
F O R	Fuel Oil Return	Black - Yellow
GLY R	Glycol Return	White - Green
GLY S	Glycol Supply	White - Green
HTG W R	Heating Water Return	White - Green
HTG W S	Heating Water Supply	White - Green
HIGH PRESS COND	High Pressure Condensate	Black - Yellow
HIGH PRESS STEAM	High Pressure Steam (≥125psi)	Black - Yellow
LOW PRESS COND	Low Pressure Condensate	Black - Yellow
LOW PRESS STEAM	Low Pressure Steam (≤15psi)	Black - Yellow
MED PRESS COND	Medium Pressure Condensate	Black - Yellow
MED PRESS STEAM	Medium Pressure Steam (>15psi,<125psi)	Black - Yellow

Label Abbreviation	System, Pipe Contents	Label Colors (Text - Background)
NAT GAS	Natural Gas (all piping painted yellow)	Black - Yellow
PUMPED COND	Pumped Condensate	Black - Yellow
RO WATER	Reverse Osmosis Water	White - Green
VAC	Vacuum	White - Blue
VENT	Vent (non-plumbing)	Black - Yellow
Plumbing		
CAPTURED RAIN WATER	Captured Rain Water	White - Green
GREY WATER	Grey water	White - Green
NON POT ANIMAL CW	Non Potable Animal Water	White - Green
NON POT CW	Non Potable Cold Water	White - Green
NON POT HW	Non Potable Hot Water	White - Green
NON POT HWR	Non Potable Hot Water Recirculation	White - Green
POT CW	Potable Cold Water	White - Green
POT HW	Potable Hot Water	White - Green
POT HWR	Potable Hot Water Recirculation	White - Green
PROTECTED POT CW	Protected Potable Cold Water	White - Green
PROTECTED POT HW	Protected Potable Hot Water	White - Green
PROTECTED POT HWR	Protected Potable Hot Water Recirculation	White - Green
TEMPERED	Potable Tempered Water – Safety Eqpt	White - Green
R W L	Rain Water Leader	White - Green
RAW WATER	Raw Water	White - Green
SAN VENT	Sanitary Vent	White - Green
SAN	Sanitary Waste	White - Green
STORM	Storm Water Drain	White - Green
Medical Gas		
CO_2	Carbon Dioxide	White - Grey
He	Helium	White - Brown
MED AIR	Medical Air	Black - Yellow
MED VAC	Medical Vacuum	Black - White
N2	Nitrogen	White - Black
N2O	Nitrous Oxide	White - Blue
O2	Oxygen	White - Green

21 00 00 FIRE SUPPRESSION

21 01 01 GENERAL REQUIREMENTS

1. Introduction:

1. **General**:

1. This Fire Protection Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Fire Protection Systems (Sprinklers and Fire Standpipe) installed on campus.
2. The University's minimum expectations and requirements for new Plumbing Systems installed on campus are covered under Standard 22 00 00.
3. This Standard is based on current Codes and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

2. **Compliance Criteria**:

1. Full compliance is mandatory on projects involving new construction.
2. Full compliance is mandatory for new Fire Protection installation within projects involving significant renovations.
3. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Fire Protection infrastructure.
4. Any deviations from the minimum requirements outlined in this Standard must be approved by the University before the completion of Schematic Design.

3. **Responsibility of the Designer**:

1. The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes, Acts & Standards in force at the time of the design.
2. Any conflict between applicable Codes, Acts & Standards and this Standard shall be identified and presented to the University, together with proposed measures for addressing the conflict.

4. **Design Innovation**:

1. This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
2. All proposed Design Innovation shall be tabled for consideration by the University, before the completion of Schematic Design.

5. **Reference Documents**:

1. Ontario Building Code

2. Ontario Fire Code
3. Mechanical Plumbing Systems Standard 22 00 00
4. Electrical Power Systems Standard 26 00 00
5. Electrical Fire Alarm Systems Standard 28 00 00
6. Campus Domestic Water System Schematic
7. City of St. Catharines Water Bylaw 2005-200
8. NFPA Standards
9. University's Identification Standard
10. Underwriters Laboratories Canada (ULC)
11. Insurers' Advisory Organization (IAO) Risk Management Services (RMS)

6. **General Requirements – Fire Protection System**:

    1. **Renovation Projects – Minor Renovations**:

        1. Modify existing Fire Protection Systems, as applicable, to suit new Work. Maintain the design criteria followed for the existing installation.

    2. **Renovation Projects – Major Renovations**:

        1. Modify existing Fire Protection Systems, as applicable, to suit new Work. Maintain the design criteria followed for the existing installation.
        2. Where an existing building does not have a functioning Sprinkler System, develop a conceptual design solution with an accompanying Class C Cost Estimate to provide the area of work and the building a new Sprinkler System following the criteria outlined under Clause 6.3. Also, in collaboration with the Architect develop a Cost-Benefit Analysis addressing a new sprinkler installation versus other Compensating Construction to comply with Codes. This Conceptual Design Solution and Cost-Benefit Analysis shall be tabled as a part of the Schematic Design submission.

    3. **New Construction Projects**:

        1. All new buildings shall be fully sprinklered.

            1. Arrange sprinkler zones in accordance with NFPA 13.
            2. Where practical and feasible without increasing the number of sprinkler zones, arrange sprinkler zones to overlap with architectural fire separations forming a part of an all-encompassing Fire Compartment for the purposes of establishing an Area of Refuge.
            3. Where sprinklers are being used in lieu of detectors, coordinate sprinkler zoning with the Fire Alarm System design.

1. Sprinklers serving Chemical Storage Rooms and other Special Areas (to be identified through consultation with the architect during the Schematic Design Phase) shall be zoned independent of other zones.

4. Where building is equipped with a fire alarm system, zoning of sprinkler systems shall match the boundaries of the fire alarm zones. More than one fire alarm zone may be contained within each sprinkler zone.

5. If a sprinkler system is not required by Code then option to omit sprinkler system, together with an accompanying cost-benefit analysis, shall be presented for the approval of the University before completion of the Schematic Design. Consultation with the City of St. Catharines will be required.

4. All new buildings shall be provided with a fire standpipe system. If a standpipe system is not required by Code then option to omit standpipe system, together with an accompanying cost-benefit analysis, shall be presented for the approval of the University before completion of the Schematic Design.

7. **General Requirements - Fire Protection System Valves**:

1. All valves shall be supervised.

1. Supervisory devices shall be hard-wired; use of plug-in cord type supervisory devices is not permitted.

2. Shut off valves shall;

1. Be located in restricted use corridors or service rooms, not within occupied spaces, and locked in the open position.

2. Be accessible by personnel standing on the floor without ladders or other aids.

8. **General Requirements – Equipment**:

1. **Fire Pumps**:

1. Fire Pumps shall be installed on a 150 mm (6”) housekeeping pad.

2. Fire Pumps shall be installed with an upstream strainer and upstream and downstream supervised isolation valves.

3. Fire Pumps shall be installed in a dedicated Service Room or a Mechanical Room. This room may be shared with the Incoming Water Meter Room as called for under the Plumbing Systems Standard 22 00 00.

2. **Incoming Fire Water Service Cross-Connection Protection Device**:

1. Cross-Connection Protection Device on the incoming fire water service shall be installed between upstream & downstream isolation valves. These isolation valves may be shared with the Fire Pump.
2. Cross-Connection Protection Device shall be installed in the same Service Room or Mechanical Room as the Fire Pump.

3. **Fire Department Connection**:

1. When adding an addition to a building with an existing fire protection system it is required to tie back into the original fire department connection. New fire department connections will not be accepted for building additions.

9. **General Requirements - Identification and Labeling**:

1. All fire water piping should be painted “Fire Red” and labelled as to its service – Sprinkler Pipe, Dry-Sprinkler, Pre-Action Sprinkler, Standpipe.
2. All Equipment and Piping Systems shall be identified in accordance with the University’s Identification Standards, 20 00 00 Pipe Labelling, and numbering convention. Equipment numbers are to be provided by the University’s.
3. Equipment numbering strategy shall be presented for review/approval by the University prior to completion of Design Development.

2. Design Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all Fire Protection Systems; Application Specific requirements are outlined under sections 21 10 00 – 21 30 00.
2. Space Hazard Classification for Protection:

1. Space Hazard classification for the purposes of establishing the minimum level of fire protection shall be as defined under NFPA 13.

3. Fire Protection Systems shall encompass the following:

1. Standpipe & Hose Systems
2. Sprinkler System – Dry Sprinklers, Wet Sprinklers & Pre-action Sprinklers
3. Gas Fire Suppression Systems
4. Kitchen Hood Suppression Systems.

21 10 00 PORTABLE FIRE EXTINGUISHERS

1. Fire Extinguishers:

1. A Fire Extinguisher shall be provided in every Fire Hose Cabinet, Mechanical Room, and Electrical Room.
    1. In addition provide a fire extinguisher in all other areas as called for in the Room Data Sheets or identified though the Functional Planning and Programming.
2. Fire Extinguishers not included with a Fire Hose Cabinet shall be installed in Mounting Cabinet.
3. Standard of Acceptance: Amerex.

21 11 00 WATER SERVICE PIPING FOR FIRE SUPPRESSION

1. Incoming Fire Water Service:

1. Incoming water service shall be extended from the University's Fire Loop Main.
    1. Incoming water service shall be common with the water service extended to serve the building plumbing systems.
    2. Branch off the fire water service line upstream of any water meter and/or cross-connection protection device.
    3. Provide a single Double Check Detector Assembly (DCDA) on the fire water service main.

21 12 00 STANDPIPE AND FIRE HOSE

1. Standpipe Systems:

1. Standpipe systems shall be hydraulically designed.
2. **Standpipe Cabinets**:
    1. Cabinets shall be Recessed type in all “Finished” areas.
    2. Cabinets shall be Semi-recessed or Surface mounted type in all other areas.
    3. Cabinets shall be sized to accommodate one 9 kg (20 lb.) ABC fire extinguisher.
    4. Door shall be flush, with a full Lexan face, hinged, positive latch device as required.
        1. Use of Glass or Wired Glass is permitted only with the prior approval of the University. Such requests shall be tabled for consideration at the Schematic Design Phase.
    5. Cabinet finish shall be suitable for the application and location; all internal components shall be polished and chrome plated. As a rule cabinets shall be painted Visible Red or left as polished Stainless Steel.
    6. Hose lengths shall be 30 m (100 ft.).
3. **Standpipe Piping**:
    1. Piping shall be Schedule 40 Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the University.
    2. Use of Press fit piping is not permitted.
4. Use of Pressure Reducing Devices shall be avoided to the extent possible and will only be permitted upon completion of a system hydraulic analysis for pressure and flow. Where provided, a dedicated and appropriately sized drain riser shall be provided adjacent to the Pressure Reducing Device to facilitate annual testing.
5. **Valves:** Refer to Section 21 01 01 Clause 1.7.

21 13 13 SPRINKLER SYSTEMS

1. Sprinkler Systems:

1. Sprinkler Systems shall be hydraulically designed.
2. Each sprinkler zone shall have its own auto pump.
3. Sprinkler Systems shall be the “Wet-Pipe Type”; exceptions include:
    1. Dry-Pipe System shall be considered for Loading Docks, Unheated or Partially Heated Soffits and other areas that could be exposed to freezing conditions.
    2. A Single-Interlock or Double-Interlock Pre-action System shall be considered for a Transformer Room, Main Electrical & Switchgear Room. Critical Equipment Rooms, Computer Rooms and LAN Rooms.
        1. Selection of a Pre-action System as the sprinkler system of choice shall be presented for the approval of the University before the completion of Schematic Design.
        2. Where provided, a Pre-action System shall be configured around the use of a Packaged Pre-action System Cabinet such as the Total Pac Pre-action System or equivalent.
    3. **Sprinkler Piping**:
        1. **Wet-Pipe Systems**:
            1. Piping shall be Schedule 20 Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the University.
            2. Use of Press fit piping is not permitted.
        2. **Dry-Pipe Systems**:
            1. Piping shall be Schedule 20 Galvanized Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the University.
            2. Use of Press fit piping is not permitted.
            3. A Blow-out connection with a Schrader Valve shall be provided on all Dry-Pipe Systems.
            4. Compressor provided is required to be approved for fire protection application.
        3. **Pre-action Systems**:
            1. Piping shall be Schedule 20 Galvanized Black Steel with flanged, screwed or grooved connection; use of a lower pipe schedule is not permitted without the prior approval of the University.
            2. Use of Pressfit piping is not permitted.

3. A Blow-out connection with a Schrader Valve shall be provided on all Dry-Pipe Systems.

4. Use of “Prefabricated Flexible Piping” with an integral sprinkler head is permitted only with the prior approval of the University. Such requests shall be tabled for consideration at the Schematic Design Phase.

4. **Sprinkler Heads**:

    1. Sprinkler heads for Wet-Pipe Systems and Pre-action Systems in areas with a finished ceiling shall be of the Semi-Recessed type. Exceptions include:

        1. Use of Concealed type sprinkler heads may be considered only in Board Rooms, Large Meeting Rooms and other similar areas where “Form & Aesthetics” are deemed as important as “Function”. However, use of Concealed type sprinkler heads is not permitted without the prior approval of the University.

        2. Sprinkler heads for Wet-Pipe Systems, Dry-pipe and Pre-action Systems in areas without a finished ceiling shall be of the Upright type.

        3. Sprinkler Heads in Mechanical Rooms, Gymnasiums, or other similar areas where mechanical damage is a possibility, shall be provided with “cages”.

        4. Sprinkler heads in Generator Rooms and other areas with expected high ambient temperature shall be selected as High Temperature Heads suitable for the intended location.

5. **Valves:** Refer to Section 21 01 01 Clause 1.7.

21 13 19 ALTERNATIVE FIRE SUPPRESSION SYSTEMS

1. Gas Fire Suppression Systems:

1. Selection of a Gas Fire Suppression System as the sprinkler system of choice for a specific area shall be presented for the approval of the University before the completion of Schematic Design.
2. Where provided, a Gas Fire Suppression System shall be configured around the use of a Novec 1230 as the suppression agent of choice.
3. **Valves:** Refer to Section 21 01 01 Clause 1.7.

21 30 00 FIRE PUMPS

1. Fire Pump:

1. A Fire Pump Assembly (Fire Pump + Jockey Pump) shall be provided, as necessary, to support the facility Standpipe and Sprinkler Water Demand; Jockey Pump Start/Stop shall be automated.
2. The need for a fire pump assembly shall be identified at the Schematic Design stage and supported with a Hydrant Flow Test and Preliminary Hydraulic Calculations.
    1. Consideration shall be given to increasing the size of the sprinkler and standpipe system piping to satisfy the system hydraulic demand before opting to use a fire pump.
    2. Where provided, a fire pump installation shall comply with NFPA 20.
        1. Fire Pump Assembly must be on the Essential Power system.
        2. Coordinate Essential Power supplies to the Fire Pump Assembly with the electrical designer and the Electrical Power Systems Standard 26 00 00.
        3. Coordinate Fire Alarm interface to the Fire Pump Assembly with the electrical designer and the Electrical Fire Alarm Systems Standard 28 00 00.
        4. Provide a ULC/FM listed Bypass Flow Meter across the Fire Pump.

22 00 00 PLUMBING

22 01 01 GENERAL REQUIREMENTS

1. Introduction:

1. General:

1. This Plumbing Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new Plumbing Systems installed on campus.
2. The University's minimum expectations and requirements for new Fire Protection Systems installed on campus are covered under Standard 21 00 00.
3. This Standard is based on current Codes, Acts and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

2. Compliance Criteria:

1. Full compliance is mandatory on projects involving new construction.
2. Full compliance is mandatory for new Plumbing installation within projects involving significant renovations.
3. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing Plumbing infrastructure.
4. Any deviations from the minimum requirements outlined in this Standard must be approved by the University before the completion of Schematic Design.

3. Responsibility of the Designer:

1. The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes, Acts & Standards in force at the time of the design.
2. Any conflict between applicable Codes, Acts & Standards and this Standard shall be identified and presented to the University, together with proposed measures for addressing the conflict.

4. Design Innovation:

1. This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
2. All proposed Design Innovation shall be tabled for consideration by the University, before the completion of Schematic Design.

5. Reference Documents:

1. Ontario Building Code

2. ASHRAE Standards
3. ASPE Standards
4. LEED Certification – Measurement & Verification
5. Mechanical HVAC Systems Standard 23 00 00
6. Mechanical Fire Protection Systems Standard 21 00 00
7. Campus Domestic Water System Schematic
8. Campus Storm & Sanitary Piping Schematic
9. City of St. Catharines Water Bylaw 2005-200
10. University's Metering Standard
11. University's Identification Standard, Pipe Labelling 20 00 00
12. Brock University Facility Accessibility Design Standards (FADS)

2. Design Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all Plumbing Systems; Application Specific requirements are outlined under clauses 2.2 – 2.6.
2. Potable water system design temperature:
    1. Cold water: 13ºC (56ºF)
    2. Hot water: 60ºC (140ºF)
3. Typical building water systems:

System Configuration	Definition	Typical Applications
Potable Water Systems		
Potable Water System (cold and/or hot)	Water Distribution System delivering cold and/or hot water suitable for human consumption.	Washrooms, Hand Washing Sinks, Pantry Supplies, Drinking Fountains, Sterilizers, Coffee Machines, Soda/Pop Machines, etc.
Tempered Potable Water System	Water Distribution System delivering tempered potable water suitable for human consumption.	Eyewash Stations, Emergency Showers, Sinks, etc.

System Configuration	Definition	Typical Applications
Protected Potable Water System (cold and/or hot), Animal Drinking Water System (cold)	A Process Water Distribution System derived from the Potable Water Distribution System but separated from the same through the use of Cross-Connection (Backflow) Protection Devices. Water delivered through this system is suitable for Food Contact or Animal Consumption within the protected zone.	Food Preparation, Inspection & Testing Laboratories, Animal Facilities (for Animal Drinking) and Areas required by the Canadian Food Inspection Agency to be serviced with water supplies suitable for human consumption.
Non-potable Water Systems		
Non-Potable Water System (cold, hot or RO)	A Process Water Distribution System derived from the Potable Water Distribution System (cold and/or hot) but separated from the same through the use of Cross-Connection (Backflow) Protection Devices. Water delivered through this system is not suitable for human consumption.	Lab Sinks & Lab Supplies, Fume Hood Supplies, Process Equipment Supplies, Kitchen Equipment Supplies, Hose Bibbs, Custodial/Slop Sinks, Laundry Supplies,
Raw Water System (Gray Water System)	Water Distribution System delivering untreated well water not suitable for human consumption	Aqua Lab, CUB, Greenhouse
Other Water Systems		
Fire Protection Water	A Process Water Distribution System derived from the Potable Water Distribution System but separated from the same through the use of Cross-Connection (Backflow) Protection Devices. Water delivered through this system is strictly for fire suppression and is not suitable for human consumption.	Fire suppression sprinkler and stand-pipe systems

4. University’s Building Hazard Classification:

    1. This classification is intended to group buildings based on the Activities envisaged within the buildings now and in the future. In each instance the University's own Building (Hazard) Classification is equal to or higher than

the Hazard Classification assigned by the City of St. Catharines Water Bylaw 2005-200.

2. Building Hazard Classified as “Light”, “Moderate” or “Severe”; classification identified by the University, before the commencement of Schematic Design.

2. **Incoming Water Service**:

1. Incoming water service shall be extended from the University’s Campus Water Distribution Loop Main and all buildings shall have a premise isolation valve.

2. Premise Protection against Cross-Connection shall be provided in accordance with the City of St. Catharines Water Bylaw 2005-200 for the Building Hazard Classification identified under clause 2.1.4.2. Exceptions include:

1. Buildings classified as “Light” or “Moderate” Hazard do not require Premise Protection on the incoming water service as the University’s Campus Water Distribution Main is already Premise Protected from the City Water Service. However, in such instances the incoming water service piping shall be arranged with a flanged spool piece to allow a Reduced Pressure Backflow device c/w an upstream & downstream isolation valve to be installed at any time.

2. A Funnel Floor Drain shall be provided in the immediate vicinity of any Backflow Device, whether installed or provisioned for.

3. A pressure reducing valve is required to regulate the water pressure in the building within the range of 448 kPa (65 psi) to 517 kPa (75 psi).

3. **Metering:** An electro-magnetic water meter shall be provided on the incoming water service.

1. Meter shall have a BACnet output for interface with the University’s Building Automation System.

2. Meter shall be HART (Highway Addressable Remote Transducer) protocol enabled.

3. Refer University’s Metering Standard for additional details.

4. All meters shall be read in m^3.

3. **Potable Water Dist. ribution Systems**:

1. **Renovation Projects**:

1. Modify existing Plumbing Systems to suit new Work. Maintain the design criteria followed for the existing installation.

2. Provisions to protect against cross-connection.

1. Where practical and economically feasible, create a new Non-Potable Water System (Loop) to limit the number of new testable devices required to protect against cross-connection.

2. Options to create a non-potable water loop with an accompanying cost-benefit analysis shall be presented for review by the University at the Schematic Design Stage.

2. **New Construction Projects**:

1. Potable Water Booster Pumping System

1. A Potable Water Booster Pumping System shall be provided, as necessary, to support the Facility Potable Water Demand (Flow and Terminal Pressure).

2. Sizing supported by Connected Load and Demand Load Calculations.

3. Potable Water Booster Pumping System shall be configured as follows:

1. A Variable Speed Duplex Pumping System with each pump sized to satisfy 75% of the Peak Demand, or

2. A Variable Speed Triplex Pumping System with each pump sized to satisfy 50% of the Peak Demand. This configuration shall be provided in the case of designated critical applications requiring 100% availability of potable water.

4. The Potable Water Booster Pumping System shall be common for each of the three (3) Potable Water Distribution System configurations outlined under Clause 2.1.3.

5. University preferred manufacturer is Armstrong.

3. **Potable Water Systems**:

1. A Potable Cold Water System shall be provided to support the building's potable cold water demand.

1. Potable cold water for the Protected Potable Water System (where provided) shall be extended from the Potable Water System; cross-connection protection devices shall be provided on the potable water supply piping to protect the Potable Water System.

2. A Potable Hot Water System shall be provided to support the building's potable hot water demand.

1. Potable hot water for the Protected Potable Water System (where provided) shall be extended from the Potable Water System; cross-connection protection devices shall be provided on the potable hot water supply piping and recirculation piping to protect the Potable Water System.

3. The Potable Hot Water System shall be configured as follows:

1. Use central heating water supplied from the Central Utilities Building (CUB) as the primary source of input heat.
    1. Alternate measures (such as gas-fired heaters, point-of-use electric heaters, etc.) for hot water production shall be presented for review by the University at the Schematic Design Stage.
4. The Potable Water Distribution Systems shall be sub-divided into a Protected Potable Water System as needed.
5. Sizing supported by Connected Load and Demand Load Calculations.

4. **Non-potable Water Systems**:
    1. A Non-potable Water System shall be provided to support the building's non-potable water demand and limit the number of testable backflow devices installed.
    2. A separate Non-potable Hot Water System may be required depending on the application and calculated demand.
    3. Sizing supported by Connected Load and Demand Load Calculations.
    4. Non-potable Hot Water System shall have dedicated hot water heaters (independent of potable hot water heaters) configured as follows:
        1. Use central heating water supplied from the Central Utility Building as the primary source of input heat.
        2. Alternate measures (such as gas-fired heaters, point-of-use electric heaters, etc.) for hot water production shall be presented for review by the University at the Schematic Design Stage.

5. **Mechanical Rooms & Service Rooms**:
    1. **Mechanical Rooms**:
        1. One (1) hand-washing sink connected to the Potable Water System shall be provided in each.
        2. One (1) deep bowl chemical service sink connected to the Non-Potable Water System shall be provided in each Mechanical Room housing Heating & Cooling System or Closed Loop System Recirculation Pumps.
        3. At least one (1) hose connection connected to the Non-Potable Water System shall be provided in each.
    2. **Service Rooms**:
        1. One (1) slop sink connected to the Non-Potable Water System shall be provided in each.
        2. One (1) eye wash station connected to the Potable Water System or Tempered Potable Water System shall be provided in each.

3. **Custodial Closet**:
    1. One (1) slop sink connected to the Non-Potable Water System shall be provided in each.
    2. One (1) soap dispenser compliant with the University's Standard shall be provided within each.
    3. No plumbing services or components requiring maintenance access shall be located within or routed through/above this room.
    4. All areas that house chemicals shall have an eye wash station. Floor drains shall have primers installed, regardless of the equipment designed for the room.

6. **Drainage & Venting Systems**:
    1. **Storm Drainage Systems**:
        1. Roof Drains shall be of the "controlled flow" type, as required.
        2. To the extent feasible, storm drainage systems shall be designed for gravity flow.
        3. **Sump Pump Systems**:
            1. Where required to handle storm water inflow from a weeper system or storm drains that cannot flow to the storm sewer under gravity, a duplex self-priming sump pump system with automatic alternation shall be provided.
            2. Storm water from weeping tile shall be collected via a sand interceptor pit.
            3. Each pump shall be capable of supporting 100% of the calculated storm water inflow.
            4. Sump levels shall be monitored with High and High High Levels alarmed at the Building Automation System.
            5. Power supply to the sump pumps shall be extended from the facility's Essential Power System.
        4. Rain Water Leaders shall not be routed along any exterior wall.
        5. Rain water Leaders to be insulated for first 10ft (3m) from drain penetration into building.
        6. Pumps with a discharge greater than 50 mm (2") and at a depth greater than 1200 mm (4'-0") shall have a rail system.
    2. **Sanitary Drainage Systems**:
        1. Floor Drains shall be provided at a minimum in the following locations:

1. A combination funnel floor drain at each equipment or group of equipment to serve as a point to drain condensate from equipment or a point of drain to serve piping systems.
2. Floor drains in each mechanical room and custodial closet.
3. A floor drain at each eyewash and emergency shower.

2. Automatic Trap Priming System in the form of an Electronic Trap Seal Primer comprising a timer, a solenoid valve and an air gap shall be provided for each floor drain or a group of floor drains; exceptions include:
    1. An insertion type Trap-Guard Primer or a Mechanical Pressure Drop Type Primer may be used with the prior approval of the University. Intent to use such alternate measures shall be identified and presented for approval prior to completion of the Design Development Stage.
3. To the extent feasible, sanitary drainage systems shall be designed for gravity flow.
4. **Sump Pump Systems**:
    1. Where required to handle sanitary drains that cannot flow to the sanitary sewer under gravity, a duplex self-priming sump pump system with automatic alternation shall be provided.
    2. Each pump shall be capable of supporting 100% of the calculated sanitary water inflow.
    3. Sump levels shall be monitored with High and High High Levels alarmed at the Building Automation System.
    4. Power supply to the sump pumps shall be extended from the facility's Essential Power System.
    5. Sump pit covers shall be gasketed to ensure an air-tight seal. Vent piping shall be extended to the outside.
5. **Elevator Pits:** Elevator pits shall be drained to the sanitary drainage system and a back-water valve provided after the sump pit in an accessible location for maintenance.

3. **Service Tunnel Drainage**:
    1. Weeper drains associated with a Service Tunnel should be directed to a storm drain. Comply with the requirements of Storm Drainage Systems listed under Clause 2.5.1.
    2. Floor drains and sump pits within a Service Tunnel should be directed to a Sanitary Drain. Comply with the requirements of Sanitary Drainage Systems listed under Clause 2.5.2.

4. **Gray Water (Rain Water Harvesting) System:** Shall be considered where a Cost-Benefit analysis demonstrates the viability of such a system. Viability shall be demonstrated to the University prior to completion of Schematic Design.

7. **Miscellaneous Requirements**:

1. **Drinking Fountains**:

1. Shall be barrier free,
2. Of the “Refrigerated Type”, and
3. Equipped with Bottle-Filler c/w totalizers.

2. **Domestic Water Piping to Water Closets and Urinals:** In all new construction, domestic water piping to Water Closets and Urinals shall be arranged independent of all other domestic water piping (Potable, Protected Potable, or Non-Potable), to allow the system to be fed off a Grey Water System.

3. Product and Installation Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all Plumbing Systems; Application Specific requirements are outlined under Clauses 3.2. – 3.4.
2. Piping Risers shall be routed through accessible pipe chases or accessible service shafts. In the case of the latter at least one light c/w manual light switch and one duplex receptacle shall be provided within the service shaft at each level.
3. All Equipment and System Components shall be arranged and located to allow proper access for service and maintenance.
4. Mechanical systems shall be installed to maximize the building’s usable space while maintaining optimal service clearances for maintenance and repair.
5. All equipment and materials shall be installed in a neat and orderly fashion.
6. In finished areas mechanical systems will be concealed. Exceptions are subject to the approval by the University.

2. **Equipment**:

1. **Water Meters**:

1. Water Meters shall be installed with an upstream strainer and upstream and downstream isolation valves.
2. Water Meters shall be installed in a dedicated Service Room or a Mechanical Room.

2. **Incoming Water Service Cross-Connection Protection Device**:

1. Cross-Connection Protection Device on the incoming water service shall be installed between upstream & downstream isolation valves. These isolation valves may be shared with the water meter installation. Connections shall be completed using unions for piping NPS 75 mm (3") or smaller and flanges for piping NPS 100 mm (4") and larger.
2. Discharge from the Cross-Connection Protection Device shall be directed to a floor drain located directly underneath or in the immediate vicinity of the device; drain piping shall be arranged with a fixed air gap.
3. Cross-Connection Protection Device shall be installed in the same Service Room or Mechanical Room as the Water Meter.

3. **Valves**:
    1. All Valves within the Plumbing Water Systems – Potable, Non-Potable and Protected Potable, shall have ball & stem fabricated from stainless steel.
    2. For all services 50 mm (2") and smaller 4,136 kPA (600 psig) WOG ball valves shall be used.
4. **Cross-Connection Protection Devices**:
    1. All Cross-Connection Protection Devices shall be manufactured by Conbraco for NPS 50 mm (2") or less and Zurn or Conbraco for all other sizes.
5. **Plumbing Fixtures and Trim**:
    1. Plumbing fixtures shall be water conserving type. Minimum baseline requirements:
        1. Water closets: 48 Lpf
        2. Urinals: 19 Lpf
        3. Lavatories: 19 Lpm
        4. Showerheads: 57 Lpm
        5. Faucets: 19 Lpm
    2. All plumbing trim shall be sourced from a single manufacturer.
        1. Identify the preferred manufacturer in consultation with the University before completion of the Design Development phase.
    3. A hose bibb connection shall be provided below the lavatory counter in washrooms.
    4. Trim shall include ceramic disk cartridges.
    5. All exposed valves, fittings, escutcheons, trim, etc. at each fixture shall be polished chrome plated brass. Exceptions are subject to the approval by the University.

6. **Water Closets**:
    1. All water closets shall be of the wall mounted type with automatic flush valves.
    2. Seats for water closets shall be anti-microbial.
    3. Accessible toilets shall have a FADS compliant back support where there is no seat lid or tank. The back support shall have a stainless steel hardware.
7. **Urinals**:
    1. All urinals shall be of the wall mounted low flow (Lpm) type with automatic flush valves.
    2. Waterless urinals shall not be installed.
8. **Piping Specialties**:
    1. Automatic Air Vents c/w manual isolation valves shall be provided at all high points in the system.
    2. Drain Valves (ball) with a garden hose connection c/w screwed cap shall be provided at all low points in the system.
9. **Plumbing Fixtures:** University standard plumbing fixtures should be provided whenever possible and are listed as follows:
        1. **Urinal (UR-1):** WASHBROOK FloWise Universal Urinal, Model 6590 001, SLOAN Solis Solar-Powered Flushometer, SOLIS 8186-0.125, WATTS Drainage Urinal Carrier CA-321.
        2. **Lavatory (L-1):** MEZZO Semi-counter top sink, Model 9960.403, SLOAN Electronic Hand Washing Faucet, Model ETF-600-LT-BDT, WATTS Floor Mounted Lavatory Carrier with concealed arms, Model CA-411-WC, provide with thermostatic mixing valve and transformer.
        3. **Lavatory (L-2):** DECORUM Wall-Hung Lavatory with Everclean, Vitreous China, Model 9024.004EC, SLOAN Electronic Hand Washing Faucet, Model ETF-600-LT-BDT, WATTS Floor Mounted Lavatory Carrier with concealed arms, Model CA-411-WC, provide with thermostatic mixing valve and transformer.
        4. **Water Closet (WC-1):** American Standard, CADET PRO Right Height Elongated Toilet, Floor-mounted flush tank, Vitreous China, Model 3517A 101 with Model 4188A 174 Tank Configuration, Solid plastic elongated seat.
        5. **Water Closet (WC-2):** American Standard, MADERA FloWise 419 mm Height Elongated Flushometer 4.8L Toilet, Model 3461 001, Vitreous China, Floor-mounted flush valve, SLOAN Royal Optima Flushometer, Model 111-1.28 ESS YG.

3. **Plumbing Water Piping Systems**:

    1. All below ground buried domestic water piping systems shall be constructed out of AWWA C900 PVC DR-18 (OPSS 441).

    2. All above ground domestic water piping systems shall be constructed out of Type L Copper.

    3. All Valves shall be in accordance with the University's Valve Standard.

        1. Isolation valves shall be provided on all Branch Piping and at individual fixtures and equipment connections.

    4. Joints & Fittings:

        1. All joints and fittings shall use soldered connections, except at connection to valves, specialties or equipment where screwed or flanged connections shall be used. Any other types of joints and fittings are subject to an approval by the University; table requests for approval prior to completion of the Concept Design phase.

4. **Drainage & Vent Piping Systems**:

    1. All below ground buried storm and sanitary drain piping systems shall be constructed out of PVC gravity piping, SDR 28 for up to 150 mm (6") and SDR 35 for 200 mm (8") and greater.

    2. All above ground storm and sanitary drain piping systems 65 mm (2-1/2") or larger shall be cast iron. 50 mm (2") and smaller shall be hard temper DWV copper or PVC.

        1. Provide a Cost-Benefit Analysis (incl. Maintenance costs) for use of cast iron, DWV copper and PVC piping for consideration by the University, before the completion of Schematic Design.

    3. All pumped storm and sanitary drain piping systems shall be constructed out of galvanized steel or rigid type "L" copper pipe. Schedule 80 PVC pipe may be permitted subject to an approval by the University; table requests for approval prior to completion of Design Development.

    4. All drain piping serving Chemistry Labs and Wet Labs shall be constructed out of acid resistant borosilicate glass for the greater of the first 15.24 m (50'-0") or until the effluent is neutralized and deemed safe for use of more conventional drain piping materials.

22 63 53 LABORATORY SYSTEMS AND SPECIALTY GASES

1. General:

1. **Laboratories (Wet Labs, Chemical Labs & General Labs)**:
    1. Water supplies to Lab Sinks, Lab Benches, Fume Hoods and Process Equipment shall be extended from the Non-Potable Water System.
        1. Zone Protection in the form of a non-testable device shall be provided for individual labs fed from the Non-Potable Water System.
            1. A Lab Faucet Vacuum Breaker shall be provided on each outlet within a Zone Protected Lab where it is necessary to protect individual outlets from self-induced cross-contamination.
        2. A Hose Connection Vacuum Breaker shall be provided on each hose connection.
        3. Fixtures/Equipment shall be clearly labeled as fed off a Non-Potable Water Supply.
    2. Each Lab shall be provided with at least one (1) hand-washing sink (hands-free) near the point of entry; water supplies to this sink shall be extended from the Potable Water System.
    3. Each Lab shall be provided with at least one (1) Eyewash/Emergency Shower Assembly near the point of entry; water supplies to this Eyewash/Emergency Shower Assembly shall be extended from the Potable Water System or the Tempered Potable Water System.
2. **Animal Facilities**:
    1. Water supplies to Lab Sinks, Lab Benches, Fume Hoods and Process Equipment shall be extended from the Non-Potable Water System.
        1. A Lab Faucet Vacuum Breaker shall be provided on each outlet.
        2. A Hose Connection Vacuum Breaker shall be provided on each hose connection.
        3. Fixtures/Equipment shall be clearly labeled as fed off a Non-Potable Water Supply.
    2. Each Lab shall be provided with at least one (1) hand-washing sink near the point of entry; water supplies to this sink shall be extended from the Potable Water System.
    3. Animal Drinking Water supplies shall be extended from a designated Protected Potable Water System.
3. **Deionized (DI) Water, Lab Vacuum, Compressed Air, Specialty Gases**:
    1. **Deionized (DI) Water System**:

1. The Campus DI Water Distribution Main shall be the preferred source of DI Water. Exceptions where a new standalone DI Water System may be considered with prior approval from the University include:
    1. An application with a very low DI Water demand where it is more economical to provide a dedicated “Centralized” or a “Point-of-Use” DI Water System, or
    2. A facility located remote from the DI Water Distribution Main, making it impractical and economically unfeasible to extend piping from the Campus DI Water Distribution Main, or
    3. The Campus DI Water Plant located in the CUP and/or the sizing of the Campus DI Water Distribution Main does not support the calculated facility DI Water demand.
2. Where a “Centralized” or a “Point-of-Use” DI Water System is envisaged, the same shall be provided to support the facility DI Water needs.
    1. A Centralized DI Water System shall be arranged with a continuously recirculating loop.
    2. System shall be sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program.

2. **Lab Vacuum System**:
    1. A “Centralized” or a “Point-of-Use” Lab Vacuum System shall be provided to support vacuum outlet needs within the facility.
    2. System shall be sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program.
    3. Vacuum equipment shall be air-cooled type. Use of a compressed air venturi cooling system, aeration, etc. is not permitted.
    4. Vacuum distribution systems shall be equipped with vacuum traps & filters at or close to the vacuum outlets for contaminant capture at source.

3. **Compressed Air System**:
    1. A Compressed Air System shall be provided to support the facility compressed air needs.
        1. System shall be sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program.
        2. A compressed air outlet shall be provided in the vicinity of each air handling unit cooling coil to facilitate winterization of the coil.

1. This outlet shall be appropriately sized to permit blowing out all residual chilled water after draining the cooling coil(s).

3. Communicate the compressed air requirements to the University before the completion of the Schematic Design Phase and verify that the Central Compressed Air Plant located in the CUB and the sizing of the Campus Compressed Air Distribution Main (see clause 1.6. below) is adequate to support the identified compressed air needs.

4. **Metering**:

   1. A compressed air meter shall be provided on the building incoming compressed air service.

   2. Meter shall have a BACNet output for interface with the University's Building Automation System.

   3. Refer to University's Metering Standard for additional details.

5. The Campus Compressed Air Distribution Main, operated at 100 PSI (690 kPa) shall be the preferred source of compressed air. Exceptions where a new standalone Compressed Air System may be considered include:

   1. An application with a very low compressed air demand where it is more economical to provide a "Point-of-Use" compressor, or

   2. A Facility located remote from the Campus Compressed Air Distribution Main, making it impractical and economically unfeasible to extend piping from the Campus Compressed Air Distribution Main, or

   3. The Central Compressed Air Plant located in the CUB and/or the sizing of the Campus Compressed Air Distribution Main does not support the calculated facility compressed air demand.

6. Any new standalone Compressed Air System shall incorporate the following:

   1. Sized & configured with due consideration to peak and average demands and level of redundancy and availability identified in the functional program plus a 20% future spare capacity.

   2. Compressors shall be air-cooled or utilize closed loop cooling via the campus chilled water system.

   3. Compressors shall be of the variable speed type.

7. Compressed air distribution system shall incorporate point-of-use filtration and oil-separation devices where the application demands a very high quality air supply.

8. Compressed air supplied by the Campus Compressed Air Distribution Main or any new standalone Compressed Air System shall not be used to support "Bubblers" and/or "Cleaning/Housekeeping" equipment.

9. All compressed air piping systems requiring registration with the Technical Standards and Safety Authority (TSSA) shall be constructed and registered under the University's current P-Number by extending the scope of the existing registration.

4. **Specialty Gases**:

1. A Storage and Distribution System for Specialty Gases shall be provided if required by the functional program.

1. Specialty Gases could include amongst others: Oxygen, Carbon Dioxide, Nitrogen and Helium.

2. Consideration shall be given to the use of Bulk Storage & Distribution Systems where anticipated gas consumption rates could require a frequent swap-out or replacement of cylinder(s) or cylinder banks.

1. Where bulk storage tanks are provided, the same shall be installed outdoors, on a 150 mm (6") concrete pad and within a lockable fenced enclosure.

3. Where a Multi-Tank Manifold System serves as the source of a Speciality Gas, the same shall be installed in a dedicated room or a closet, readily accessible from a circulation corridor; exceptions include:

1. Instances where a specialty gas is required in one single room (space) and it is more practical to locate the gas cylinder(s) within the space served.

2. Product and Installation Standards:

1. **Deionized (DI) Water, Lab Vacuum, Compressed Air, Specialty Gases**:

1. **Deionized (DI) Water System**:

1. All DI Water piping shall be Stainless Steel SS 316 or PVDF.

2. **Lab Vacuum System**:

1. All Lab Vacuum System piping shall be Copper Type K.

3. **Compressed Air System**:

1. All Compressed Air System piping shall be Copper Type K.

2. High Pressure Stainless Steel Flexible Tubing may be used for the final connection; length less than 915 mm (3'-0").

4. **Oxygen, Carbon Dioxide, Nitrogen and Helium Gas Piping**:

1. Medical grade copper.

2. High Pressure Stainless Steel Flexible Tubing may be used for the final connection; length less than 915 mm (3'-0").

5. **Liquid Nitrogen and Helium Piping**:

1. Vacuum Jacketed stainless steel.

2. **Identification and Labeling**:

    1. Identification and labeling shall follow the University Standard, 20 00 00 Pipe Labelling.

    2. Equipment numbers are to be provided by the University.

    3. Equipment numbering strategy shall be presented for review/approval by the University prior to completion of Design Development.

23 00 00 HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

23 01 01 GENERAL REQUIREMENTS

1. Introduction:

1. General:

1. This HVAC Systems Design Standard has been developed to establish the University's minimum expectations and requirements for new HVAC Systems installed on campus.
2. ABB variable frequency drives are preferred for all motor applications.
3. This Standard is based on current Codes, Acts and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

2. Compliance Criteria:

1. Full compliance is mandatory on projects involving new construction.
2. Full compliance is mandatory for new HVAC installation within projects involving significant renovations.
3. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing HVAC infrastructure.
4. Any deviations from the minimum requirements outlined in this Standard must be approved by the University before the completion of Schematic Design.

3. Responsibility of the Designer:

1. The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.
2. Any conflict between applicable Codes, Acts & Standards and this Standard shall be identified and presented to the University, together with proposed measures for addressing the conflict.

4. Design Innovation:

1. This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
2. Design of HVAC systems shall include consideration of energy efficiency and potential revenue from the utilities benefits to the University.
3. All proposed Design Innovation shall be tabled for consideration by the University, before the completion of Schematic Design.

5. Reference Documents:

1. Ontario Building Code
2. ASHRAE Standards
3. SMACNA Standards
4. Public Health Agency of Canada - Laboratory Biosafety Guidelines
5. Canadian Council for Animal Care
6. LEED Certification – Measurement & Verification
7. Mechanical Plumbing Systems Standard 22 00 00
8. Mechanical Building Automation Systems Standard 25 00 00
9. Electrical Power Systems Standard 26 00 00
10. Utilities 33 00 00
11. University's Metering Standard
12. University's Identification Standard, Pipe Labelling 20 00 00
13. Campus Heating and Chilled Water System Piping Schematic.

2. Design Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all HVAC Systems; Application Specific requirements are outlined under clauses 2.2. – 2.9.

2. **Outdoor Design Conditions**:

Parameter	Winter	Summer
Dry Bulb	-21°C	29°C
Wet Bulb		23°C

3. **Indoor Design Conditions**:

1. The Indoor Design Conditions tabulated below apply to all air-conditioned spaces within a facility.

Parameter	Winter	Summer
Dry Bulb	21°C ± 1°C	23°C ± 1°C
Relative Humidity	20-30%	50%

2. Indoor Design Conditions for spaces that are "naturally ventilated" and/or "only heated" shall be determined to suit the application. In such instances the chosen Indoor Design Conditions shall be tabled for consideration by the University, before the completion of Schematic Design.

1. Considerations shall be given to the provision of pressurized vestibules at the entry from conditioned to unconditioned, naturally ventilated or heated only spaces to guard against infiltration into the conditioned spaces.

2. **Ventilation Systems**:

1. Air Systems serving Office Areas, Classrooms, Corridors or other General Occupancies shall be separate from those serving Lab Spaces. Exceptions include:

1. Offices directly attached to or located within a larger Lab Space.

2. Air Systems serving Office Areas, Classrooms, Corridors or other General Occupancies shall be designed as Variable Air Volume Systems.

3. Air Systems serving Lab Spaces shall be designed as Constant or Variable Air Volume Systems as outlined under Section 23 63 53.

4. **Space Noise Criteria**:

Area	Noise Criteria (NC Level)
Offices – Private	32-34
Offices – Open Plan	36-38
Labs – General	34-38
Labs – Animal	34-38
Classrooms & Lecture Halls	30-32
Conference / Board Rooms	30-32
Corridors	36-38
Public Areas	38-40
Vestibule	38-40

1. Engineered Silencers shall be provided within the main supply, return and exhaust air ductwork and/or at terminal units to achieve the specified NC Limits.

1. Use of internally lined ductwork is not permitted except in the case of Transfer Air Ducts less than 2m in length.

5. All Supply and Exhaust fans shall be controlled using Variable Frequency Drives.

6. 100% Outdoor Air systems shall be complete with Heat Recovery system.

7. 100% Outdoor Air systems to be complete with face and bypass dampers.

8. **Air Handling Equipment**:

1. Arranged with: Outside Air Dampers; 35% Pre-Filters (MERV 8); 95% Pleated Final Filters (MERV 14); Hydronic Pre-heating Coil (in case of

100% Outdoor Air Units); Hydronic Heating Coil, Humidification Section; Mist Eliminator, Cooling Coil; and Supply Fan.

2. Self-supporting continuous structural steel base.
3. **Casing**:
    1. Minimum 100mm thick double walled insulated construction
    2. Pressure tested cabinet
    3. Satin Coated Galvanized Steel, G90, all sides
    4. Heavy gauge checkerboard flooring
    5. Full size gasketed access doors
    6. Marine lights
4. **Coils**:
    1. Bottom Draining Coil with Air-Blowout Connection
    2. Means to continually circulate supply air drawn from the supply air section through the coil.
    3. Stainless Steel Drain Pans.
5. Drain piping arranged to be piped to a Deep-Seal Trap Primer.

3. **Heating Systems**:
    1. **Renovation Projects**:
        1. Modify existing Heating Systems to suit new work in consultation with the University. Maintain the design criteria followed for the existing installation.
    2. **New Construction Projects**:
        1. Heating water supplied from the Central Utility Building (CUB) shall be the primary source of heat to the Building. Heating within the Building including its Air Systems shall be based on the use of Hydronic Distribution Systems.
            1. **Heating water Supply Pressure from the CUB to Building**:
                1. Design 150 PSI / Operating 70 psi (1034 kPa / 483 kPa)
                2. Incoming heating water to be extended from the campus mains.
                3. Incoming heating water to be metered in accordance with the University's Metering Standard. Meter to be integrated into the Building Automation System.
            2. **Hydronic Heating Distribution Systems**:
                1. Separate and dedicated Heating Distribution Systems to service:

1. 100% Outdoor Air Systems (Air Handling Units) or areas susceptible to freezing.
2. Perimeter Heating Systems and Heating Coils within Recirculation Type Air Handling Systems.
3. Terminal Reheat Systems.

2. Heating Systems serving 100% Outdoor Air Systems to utilize Propylene Glycol.
3. **Design Temperature and Temperature Differential**:
    1. Supply Water Temperature "Scheduled" based on Outdoor Air Temperature.
    2. 100 % Outdoor Air Systems: 82.2^{0}C (180^{0}F) / Delta T: 11.1^{0}C (20^{0}F).
    3. Perimeter Heating and Heating Coils within Recirculation Type Air Handling Systems: 82.2^{0}C (180^{0}F) / Delta T: 11.1^{0}C (20^{0}F).
    4. Terminal Reheat Systems: 82.2^{0}C (180^{0}F) Supply / Delta T: 11.1^{0}C (20^{0}F).
4. Distribution pumps shall be duplex (duty/standby), arranged in parallel.
    1. Each pump shall be sized for 100% of the circulation rate.
    2. Pumps shall be fed from the building's dedicated Essential Power System.
    3. Variable frequency drives shall be utilized with two-way control valves in lieu of three-way control valves.
    4. System shall incorporate a 2-way pressure controlled bypass.
    5. Chemical treatment system shall be provided for the heating water system including pipe line filters. Glycol mixing station required for glycol systems.
    6. Systems to include ability to isolate pumps and other components requiring service or replacement.

3. A traps shall be free draining and shall not use siphoning.
4. Considerations shall be given for the provisioning of Heat Recovery Systems on all ventilation and exhaust systems. A Cost-Benefit Analysis shall be presented for review by the University, as a part of the Schematic Design.

4. **Cooling Systems**:
    1. **Renovation Projects**:

1. Modify existing Cooling Systems to suit new work in consultation with the University. Maintain the design criteria followed for the existing installation.
2. Installation of window-shaker style air conditioners is not permitted without prior consent of University.

2. **New Construction Projects**:
    1. Chilled Water supplied from the Central Utility Plant (CUP) shall be the primary source of cooling to the Building.
        1. **Chilled Water Supply Pressure from the CUP to Building**:
            1. Design / Operating: 120 / 100 PSI (827/690 kPa).
            2. Return Pressure Differential: 20 PSI (138 kPa).
        2. Incoming chilled water supply/return lines to be metered in accordance with the University's Metering Standard. Meter to be integrated into the Building Automation System.
        3. Incoming chilled water supply/return lines shall be complete with differential pressure station to isolate building chilled water system from pressure fluctuations in the campus mains.
3. **Chilled Water Distribution Systems**:
    1. **Design Chilled Water Distribution Pressure within the Building**:
        1. Design / Operating: 120 / 100 PSI (827/690 kPa) (utilize system pressure).
    2. **Design Temperature and Temperature Differential**:
        1. Supply Water Temperature: 5.5 – 8.9 ^{0}C (42 – 48 °F).
        2. Return Water Temperature Differential: 5.6 – 6.7 ^{0}C (10 – 12 °F).
    3. Chilled water distribution system within a building is to be a closed system whereby all chilled water is returned to the main campus distribution system. Sending chilled water to drain is not permitted.
4. Provide dedicated point-of-use cooling only as detailed elsewhere in this Standard.
5. Use of DX Cooling Systems including Split Ductless and VRF Units is permitted only in buildings without a chilled water supply from the Central Utility Building or where it deemed uneconomical to extend chilled water piping to provide point-of-use cooling. In each of these instances comply with the following:
    1. A choice to use DX Cooling, Split Ductless, or VRF Units is to be tabled for consideration and approval by the University before completion of the Schematic Design Phase, and

2. The capacity permitted for DX Cooling Systems, Split Ductless, or VRF Units is no more than 5 Tons.

5. **Humidification Systems**:

1. **Renovation Projects:** Maintain the design criteria followed for the existing installation.

2. **New Construction Projects**:

1. Humidification Systems shall be designed around the use of direct steam injection systems utilizing gas-fired steam generators supplied with softened water.

2. Consideration shall always be given to the collection of condensate, wherever possible.

6. **Office Areas, Classrooms, and General Occupancy**:

1. **Office Areas**:

1. A maximum of three (3) offices served by a single zone thermostat with averaging sensors in each room.

2. Research Offices intended to be used for experimentation using temperature sensitive or heat generating equipment to be zoned independent of other Offices.

2. **Classrooms**:

1. Each Classroom shall be served by a dedicated Zone Thermostat.

1. Where the size of a Classroom is greater than 140 m^2, provide multiple thermostat zones to limit the size of a single zone to under 140 m^2.

2. . Where specified by the Functional Program, arrange the Air Distribution Systems to allow a single large classroom to be sub-divided into smaller rooms.

3. **General Occupancy:** University preference is for individual thermostats per space, averaging for temperature when multiple thermostats are installed in a single thermal zone.

7. **Electrical Rooms**:

1. Air Distribution and Cooling Systems for Main Electrical Rooms to be independent of similar systems serving other spaces; equipment not to be installed in the Electrical Room. No water services to be installed in Electrical Room. Exceptions include:

1. Cooling for Electrical Distribution Closets on a floor can be extended from the HVAC Systems serving the floor.

2. Cooling Solutions for Main Electrical Rooms shall be designed around the use of Mechanical Ventilation using Outdoor and Recirculation Air. Exceptions include:
    1. Land-locked Electrical Rooms without ready access to an exterior wall.
3. **Indoor Environmental Conditions**:
    1. Mechanically Ventilated Electrical Rooms: 35^0C
    2. Mechanically Cooled Electrical Rooms: 30^0C, Non-Condensing
    3. All exhaust fans to be thermostatically controlled and accessible for servicing.

8. **IT/COMM Rooms**:

1. Air Distribution and Cooling Systems for IT/COMM Rooms to be independent of similar systems serving other Spaces. Exceptions include:
    1. Cooling for IT/COMM Distribution Closets on a floor and not housing heat generating equipment can be extended from the HVAC Systems serving the floor.
2. **Cooling Solutions**:
    1. Shall be designed around the use of Mechanical Cooling Solutions utilizing Chilled Water supplied from the Central Utility Building.
    2. Cooling Coils shall be sized to provide Cooling with an incoming cooling water temperature of 5.6 - 8.9^0C (42 - 48^0F).
    3. Provide backup exhaust fan for critical systems.
    4. Use of domestic water for back-up cooling is to be avoided where possible. Should domestic water for back-up cooling (to maintain continuity of cooling in the event of a loss of chilled water supply) be required, a request is to be tabled for consideration and approval by the University before completion of the Schematic Design Phase.
        1. Back-up cooling switchover shall be completely automatic, including return to use of chilled water.
        2. Non-potable water shall be used.
        3. Parameters to be monitored to trigger switchover may include:
            1. Chilled water flow, temperature, pressure.
        4. Status (open/close) of all valves forming part of the automatic switchover scheme is to be monitored by the BAS.
        5. Alarming (both local and on BAS) is required.
        6. Proposed sequence of operation and PI&D sketch to be submitted with Request for consideration.

3. Indoor Environmental Conditions: 22^0C, Non-Condensing.

9. **Equipment/Elevator Machine Rooms**:

1. Air Distribution and Cooling Systems for Equipment/Elevator Machine Rooms to be independent of similar systems serving other Spaces.

2. Cooling solutions shall be designed around the use of Mechanical Cooling Solutions utilizing Chilled Water supplied from the Central Utility Plant.

3. Indoor Environmental Conditions: 28^0C, Non-Condensing.

3. Installation Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all HVAC Systems; Application Specific requirements are outlined under Section 23 63 53.

2. **Mechanical Rooms**:

1. Designated and dedicated Mechanical Room(s) shall be provided to accommodate HVAC Plant Equipment and Process Equipment.

1. Provide at least one double door for entry into each.

2. Provide Elevator Access for each Mechanical Room located above or below the Ground Floor Level. Incorporate measures to facilitate movement of materials into and out of Mechanical Room(s).

3. Drawing shall be developed showing the Building Pressurization Regime as well as the Pressure Control Regime for functional areas and units within the building.

4. All Equipment and System Components shall be arranged and located to allow proper access for service and maintenance.

5. Mechanical systems shall be installed to maximize the building's usable space while maintaining optimal service clearances for maintenance and repair.

6. All equipment and materials shall be installed in a neat and orderly fashion.

7. In finished areas mechanical systems will be concealed. Exceptions are subject to the approval by the University.

8. Equipment Starters shall not be installed above finished ceilings.

2. **Equipment**:

1. **Floor Mounted Equipment**:

1. Installed on 150 mm concrete housekeeping pads.

2. Provided with vibration isolation between the equipment and the housekeeping pad.

2. **Suspended Equipment**:
    1. Provided with mounting base frame or suspension brackets as recommended by the equipment manufacturer.
    2. Anchored to structure using Spring Isolation Hangers.

3. **Heating & Cooling Piping Systems**:
    1. **Materials**:
        1. Black Steel:
        2. Copper.
    2. **Jointing Systems**:
        1. Screwed Connections
        2. Welded Connections
        3. Flanged Connections
        4. Grooved Joint System (Victaulic)
        5. Use of Press fit Joints is not permitted.
    3. **Valves**:
        1. Manual valves shall be provided at a minimum at the following locations:
            1. At individual equipment, all branches, and rooms for isolation.
            2. On every branch pipe serving more than three (3) individual pieces of equipment or having a length in excess of 20 m.
            3. Upstream of all control valves and components requiring service.
        2. Valve construction shall be in accordance with the University Valve Standard.
    4. **Cleaning & Flushing**:
        1. All heating and cooling piping systems shall be cleaned and flushed according to procedures provided by the University's approved water treatment supplier prior to operation, and before being connected to the University's distribution systems.
        2. All hydronic systems must be compatible with the University chemical treatment Nitrite based corrosion inhibitor: CorrShield NT4207 (maintained at 800 - 1200 ppm as $NaNO_2$).

4. **Air Distribution Systems**:
    1. **Materials**:
        1. Galvanized Steel, G90
        2. Stainless Steel, SS 316

3. Aluminum.

2. **Jointing Systems**:

    1. Designed in accordance with SMACNA Standards to withstand the intended system operating pressure and application.

3. **Balancing Dampers**:

    1. Shall be provided on every main, sub-main, branch-main and branch ducts (definitions as per ASHRAE systems hand book) and at locations required to perform testing, adjusting & balancing.

4. **Relief Dampers**:

    1. Shall be provided on every return/exhaust system sized at 4500 L/s or higher and located within or in close proximity to the return/exhaust fan inlet ductwork.

5. **Filtration**:

    1. Oil impregnated filters shall not be used.

    2. Unless specified elsewhere in this Standard, or required by the application, filters are not required on exhaust systems except upstream of heat recovery/enthalpy wheels.

    3. Standard filter sizes: 305 x 305mm (1'-0" x 1'-0"), 305 x 610mm (1'-0" x 2'-0"), and 610 x 610 (2'-0" x 2'-0").

6. **Flexible Ductwork**:

    1. To allow easy location of diffusers flexible ductwork may be used to make the final connection from the sheet metal ductwork.

    2. Maximum length of flexible ductwork shall be 1.0m (3'-3").

    3. Flexible ductwork shall not pass through floors of fire walls.

    4. Flexible ductwork shall be a single section of duct (no joints).

    5. Flexible ductwork shall be connected to sheet metal duct and diffusers using duct sealer, minimum of 2 screws (180° apart), and metal draw bands.

    6. Flexible ductwork installed on supply air systems shall be insulated and of a rigid aluminum flex type.

5. **Registered Pressure Piping System**:

    1. All pressure piping systems requiring registration with the Technical Standards and Safety Authority (TSSA) shall be constructed and registered under the University's current P-Number by extending the scope of the existing registration.

6. **Identification**:

1. All Equipment and Piping Systems shall be identified in accordance with the University's Identification Standards, 20 00 00 Pipe Labelling, and numbering convention. Equipment numbers are to be provided by the University.
2. Equipment numbering strategy shall be presented for review/approval by the University prior to completion of Design Development.

23 63 53 LABORATORY AND SPECIALIZED ROOM REQUIREMENTS

1. General:

1. **Laboratories – Chemical/Wet/Bio/Chemistry**:
    1. Air Systems serving Lab Spaces shall be designed as Constant Air Volume Systems, with a minimum Air Change Rate of 8-10 Air Changes per Hour (ACH). Exceptions include:
        1. Labs equipped with Variable Air Flow Exhaust Hoods wherein design provisions shall be made to match supply air volumes to the exhaust air volumes with a minimum offset of 10% to assure desired Pressure Control Regime.
        2. Labs equipped with Indoor Air Quality Sensors.
        3. In the case of either of the two (2) exceptions listed above, the Air Systems, Supply & Exhaust, shall be sized to allow an average of 6 -8 ACH in all labs. Diversity of 75 – 80%.
    2. Provided with Terminal Units or Air Valves (University preferred vendor: Phoenix Valves) within the Supply & Exhaust air streams to allow spaces to be maintained at the desired Pressure Control Regime.
    3. Laboratory spaces shall be provided with Space Pressure Monitor system (see Building Automation System Design Manual 25 00 00).
    4. Supply and Exhaust Systems serving designated Containment Labs:
        1. Independent of systems serving other similar Labs, even if located immediately adjacent.
        2. Designed with 100% Redundancy in Exhaust Systems.
        3. Incorporate Pressure-Independent Air Valves on the Supply & Exhaust Air Streams.
        4. Equipped with Dynamic Differential Pressure Controls interfaced with the Phoenix Valves to maintain desired differential air pressure across the containment zone(s).
        5. Real-time Audio-Visual Monitoring of the Differential Pressure Control Regime with an interface to the Building Automation System.
    5. Local Exhaust Air Drop, Articulating Arm Type Exhaust Drops and Bench Sweeps shall be provided where a requirement for local point-of-use exhaust is identified through the Functional Programing and Planning exercise.
2. **Animal Facilities**:
    1. Air Systems serving Animal Spaces shall be designed as Constant Air Volume Systems, with a minimum Air Change Rate of 8-10 Air Changes per Hour (ACH). Exceptions include:

1. Systems serving Animal Cages, which shall be designed to support the performance requirements of the Cage.
2. Spaces equipped with Variable Air Flow Exhaust Hoods wherein design provisions shall be made to match supply air volumes to the exhaust air volumes with a minimum offset of 10% to assure desired Pressure Control Regime.
3. Spaces equipped with Indoor Air Quality Sensors.

2. Provided with Terminal Units or Air Valves (University preferred vendor: Phoenix Valves) within the Supply & Exhaust air streams to allow spaces to be maintained at the desired Pressure Control Regime.
3. Laboratory spaces shall be provided with Space Pressure Monitor system (Building Automation System Design Manual 25 00 00).
4. Supply and Exhaust Systems serving designated Containment Labs:
    1. Independent of systems serving other similar Spaces, even if located immediately adjacent.
    2. Designed with 100% Redundancy in Exhaust Systems.
    3. Incorporate Phoenix Valves on the Supply & Exhaust Air Streams.
    4. Equipped with Dynamic Differential Pressure Controls interfaced with the Phoenix Valves to maintain desired differential air pressure across the containment zone(s).
    5. Real-time Audio-Visual Monitoring of the Differential Pressure Control Regime with an interface to the Building Automation System.
    6. Source Filtration on return/exhaust air system through the provision of 30% (MERV 8) filters at each Return/Exhaust Air Grille.
    7. Air Handling Units, Exhaust Fans and Supply & Exhaust Air Trunk (Main) Ductwork shall be sized with a 25% Spare Capacity over and above the Day 1 requirements.
        1. All Supply and Exhaust fans shall be controlled using Variable Frequency Drives.

3. **Freezer Rooms / Specialized Lab Equipment Rooms**:
    1. Ventilation Air shall be extended from the HVAC Systems serving the floor on which the Room is located.
    2. Space Cooling shall be provided using dedicated point-of-use cooling equipment as noted below:
        1. University has preference towards freezer farms where applicable.
        2. Shall be designed around the use of Mechanical Cooling Solutions utilizing Chilled Water supplied from the Central Utility Building. Ductwork shall be sized based on the load from the room.

3. Cooling Coils shall be sized to provide Cooling with an incoming cooling water temperature of 15^0C (59^0F).
4. Use of domestic water for back-up cooling is to be avoided where possible. There is no requirement for backup systems. Should domestic water for back-up cooling (to maintain continuity of cooling in the event of a loss of chilled water supply) be required, a request is to be tabled for consideration and approval by the University before completion of the Schematic Design Phase.
    1. Back-up cooling switchover shall be completely automatic, including return to use of chilled water.
    2. Non-potable water shall be used.
    3. Parameters to be monitored to trigger switchover may include:
        1. Chilled water flow, temperature, pressure.
    4. Status (open/close) of all valves forming part of the automatic switchover scheme is to be monitored by the BAS.
    5. Alarming (both local and on BAS) is required.
    6. Proposed sequence of operation and PI&D sketch to be submitted with Request for consideration.

3. Indoor Environmental Conditions: 24^0C, Non-Condensing.

23 83 14 RADIANT FLOOR HEATING

1. General:

1. The radiant floor heating systems shall provide for the melting of snow and ice at high volume building access/egress locations. Guidance on the location of the radiant floor heating systems shall be provided by the University during the schematic design phase of the project.
2. As part of the radiant flooring heating system design, the following shall be considered:
    1. A minimum of one temperature sensor per heated zone shall be required.
    2. The system equipment, i.e. controller, pumping system, manifold, etc. shall be located in a single room per heated zone.
    3. A critical mass is required (concrete area) for effective snow and ice melt and this shall be considered during design.
    4. Preference shall be given to north facing access/egress locations.

2. Reference Documents:

1. ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
2. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
3. CAN/CSA-B137.5 Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.

3. Products:

1. Furnish and install radiant floor heating system tubing, distribution manifolds with venting/air purge valve, manifold to tubing fittings, embeddable compression sleeve tubing repair couplings, circuit isolation and balancing valves, controls and installation specialties, supervision and field engineering required for complete and proper function of the systems. Radiant floor heating systems shall be Rehau, Watts Radiant or Uponor (Wirsbo).
2. **Tubing**:
    1. All radiant floor heating tubing shall be high density cross-linked polyethylene manufactured in accordance with ASTM F877 as certified by NSF or the CSA or equivalent testing organization and with an approved cell classification in accordance with ASTM D3350. All tubing shall be fully cross-linked to the specified standard prior to shipment from the manufacturing facility.
    2. Temperature and pressure rating: Tubing shall be rated for not less than 82.2 deg. C. (180 deg. F.) working temperature and 100 psig working pressure.

3. Tubing shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the tube to no greater than 0.10 g/cu.m./day (6.243 E-006 lb/cu. ft/day) at 40 deg. C. (104 deg. F.) water temperature. In accordance with DIN 4726.
4. The minimum bend radius for cold bending of the tube shall not be less than five (5) times the outside diameter. Bends with a radius less than stated shall require the use of a bending template as supplied by the tube manufacturer.

3. **Fittings:** Fittings shall be manufactured of brass and shall be supplied by the tubing manufacturer as part of a proven catalogued system. Tube couplings embedded within the thermal mass shall be brass compression type with ribbed insert and compression sleeve.
4. **Manifolds:** Distribution manifolds shall be a proven catalogued part of the manufacturer's systems. Manifolds shall be equipped with balancing and isolation valves for each circuit.
5. The radiant floor system component manufacturer shall warrant the crosslinked polyethylene tubing and all related water distribution components, except controls, to be free from defects in material and workmanship for a period of twenty-five (25) years. Warranty shall be issued upon presentation of design calculation record forms and manufacturer approved site inspection reports. The design shall be approved either by submittal or stamped by a registered engineer as being complete and accurate.
6. All controls shall be warranted for two (2) years and/or two heating seasons.
7. Deliver and store tubing and specialties in shipping containers with labelling in place. Do not expose to ultra violet light for more than 90 days.
8. Supervision of the radiant floor system installation shall be completed by the supplier approved installation supervisor. The supervisor shall document the installation with pictures, pressure tests and a system signoff sheet.
9. **Snow Melting Systems**:
    1. For each heated zone, provide a pre-packaged mechanical system including lockable manifold enclosure, manifold, circulator pump, expansion tank (bladder type), valves, glycol fill connection, glycol charge, heat exchanger suitable for boiler water temperatures.
    2. Snow melting system shall include a minimum of one temperature sensor in each zone.
    3. **Control System**:
        1. For each heated zone, include a stand-alone programmable controller with slab sensor input and output to a control valve. Controller shall be non-proprietary and compatible with LonWorks and/or BACnet.
        2. Provide slab sensor connected back to the controller.

3. The control system shall operate on 120V electrical connection.
4. Where the manifold serves a single zone the Building Automation System (BAS) Contractor shall provide the two-way control valve to control the flow of water to the manifold. The control valve shall be controlled by the BAS.
5. The system shall be controlled by the Building Automation System.

4. **Control Sequence**:
    1. System shall be activated when the outdoor temperature is lower than 5 deg. C. (41 deg. F.).
    2. Start the glycol pump and modulate the control valve to maintain a slab temperature of 5 deg. C. (41 deg. F.)

4. Snow Melting Information Sheet:

1. Provide the following components for each manifold:
    1. Zone Served
    2. Fluid Type
    3. Pump
    4. Manifold Serves a Single Zone: Yes
    5. Three Way Mixing Valve Required
    6. Floor Area Served (sq. ft)
    7. Heating
        1. Inlet Fluid Temperature: 60 deg. C. (140 deg. F.)
        2. Outlet Fluid Temperature: 43.3 deg. C. (110 deg. F.)
        3. Heating Capacity (BTU/sq. ft)
    8. Flow Rate (GPM)
    9. Pressure Drop (ft)

5. Warranty

1. System shall be covered by a ten (10) year Limited System Performance Warranty. The warranty requires that system design, installation supervision and witnessing of the pressure test all be performed by authorized personnel.
2. The manifolds and fittings shall carry a five (5) year non-prorated warranty against failure due to a defect in material or workmanship.
3. Controls and electrical components shall carry a two (2) year non-prorated warranty against failure due to defect in material or workmanship.

4. The tubing shall carry a twenty-five (25) year non-prorated warranty against failure due to manufacturing defect or exposure to stress cracking agents. This warranty is to include tubing embedded in concrete.
5. Warranty shall apply to all defects arising from defects in material manufacturing. Liability is subject to the installation being performed in a qualified manner according to General Installation Guidelines and in compliance with specific installation guidelines, installation instructions and applicable technical standards.
6. Warranty shall be transferrable to subsequent owners.

25 00 00 INTEGRATED AUTOMATION

25 01 01 GENERAL REQUIREMENTS

1. Introduction:

1. **General**:

1. This Building Automation Systems (BAS) Design Standard has been developed to establish the University's minimum expectations and requirements for new BAS installations on campus.
2. This Standard is based on current Codes, Acts and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.

2. **Compliance Criteria**:

1. Full compliance is mandatory on projects involving new construction.
2. Full compliance is mandatory for new BAS installation within projects involving significant renovations.
3. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing BAS infrastructure.
4. Any deviations from the minimum requirements outlined in this Standard must be approved by the University before the completion of Schematic Design.

3. **Responsibility of the Designer**:

1. The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes, Acts & Standards in force at the time of the design.
2. Any conflict between applicable Codes, Acts & Standards and this Standard shall be identified and presented to the University, together with proposed measures for addressing the conflict.

4. **Design Innovation**:

1. This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
2. All proposed Design Innovation shall be tabled for consideration by the University, before the completion of Schematic Design.

5. **Reference Documents**:

1. Ontario Building Code.
2. Canadian Electrical Code

3. ASHRAE Standard ANSI/ASHRAE 135 – BACnet
4. ASHRAE Guideline 13, Specifying Direct Digital Control Systems
5. ANSI/TIA/EIA862 Building Automation Systems Cabling Standard for Commercial Buildings
6. Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices
7. Public Health Agency of Canada - Laboratory Biosafety Guidelines
8. Canadian Council for Animal Care Guidelines
9. LEED Guidelines
10. Mechanical Plumbing Systems Standard 22 00 00
11. Mechanical HVAC Systems Standard 23 00 00
12. Electrical Power Systems Standard 26 00 00.

2. Design Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all Building Automation System (BAS) installations. Application Specific requirements are outlined under Clauses 2.2. – 2.15.
2. This document is not intended to describe the controls or sensors required for correct operation of the building systems or equipment. The Designer remains responsible for ensuring equipment and systems can be appropriately operated and maintained.
3. **Overarching Design Principles**:

1. The University currently utilizes Opto 22 system which is read by ICONIC's 64 front end. All BAS controllers are required to have the capability to communicate with ICONIC's 64 software.
2. All new BAS installations shall be designed as an integrated, open protocol, BACnet compliant system to ANSI/ASHRAE Standard 135.
3. All BAS installations in projects involving significant renovations shall be designed as an integrated, open protocol, BACnet compliant system to ANSI/ASHRAE Standard 135; any proposed deviations shall be presented to the University, for approval during the Schematic Design Phase.
4. All BAS installations in projects involving minor renovations to areas currently served by legacy systems will potentially be extensions of the existing legacy system. Practicality of extending existing legacy system will be reviewed by the University on a project-by-project basis; any proposed deviations, including modifying existing legacy system, shall be

presented to the University, for approval during the Schematic Design Phase.

5. Buildings shall not have multiple BAS systems.
6. Port requirements need to be known for all projects so that port capacity issues can be addressed.
7. The Universities master control schematic shall be updated for all projects which modify the control system.
8. Central Utility Building (CUB) is Modbus, rest of campus is BACnet IP.

4. **Interfacing Standards**:
   1. Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EIA (Electronic Industry Association) interfaces.
   2. CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).
   3. IEEE 8023. Ethernet 10Base-T LAN.
5. All Components and Equipment shall be designed and selected to provide the requisite level of function and performance when operating in following minimum ambient condition ranges:
   1. Temperature: 0°C to 40°C (32°F to 104°F) for Indoor Installation / -30° to 40°C (-22°F to 104°F) for Outdoor Installation.
   2. Relative Humidity: 10% to 90% non-condensing.
   3. Withstand VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes.
6. All equipment, components& devices shall be designed to operate on an electrical power service rated at 120 VAC +/- 10%, 60 Hz nominal.
   1. Components installed within Motor Control Devices to be designed to operate with transient electrical fields occurring within these devices.
7. **Licenses and Ownership**:
   1. Ownership of, and licenses for, all hardware and software originally installed or required for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.
   2. Licensing to permit an unlimited number of users to access system without additional fees.
   3. As of last month of the warranty period, software is to be upgraded to current version or release at no cost to the Owner.

2. **BAS Architecture – Individual Buildings**:

1. **BAS Network Architecture**:
    1. Dedicated LAN for BAS with single network drop to University network.
    2. BAS communication architecture to consist of at least two tiers. Each tier will utilize local area networks with totally open protocols based on industry leading standards.
        1. **Tier 1/Level 1: Building Controller network**:
            1. Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network for reliable peer-to-peer communications.
            2. Future connected systems shall have compatibility specifications to provide communication with the first tier LAN.
            3. The operator workstations shall also be supported on the high speed LAN level 1.
            4. Communication speed on first tier network shall be at a rate of 10Mbps or higher.
            5. Shall be designed with an expansion capacity of at least 10 additional Building Control Units (BCU's)/Routers over and above those required to complete the original installation.
        2. **Tier 2/Level 2: Equipment Controller network**:
            1. Lower level network, based on BACnet networks, which provide the interconnection between Equipment Control Units (ECU's) and BCU's (Supervisory Controllers).
            2. Open, peer-to-peer control networks to interconnect BAS Direct Digital Control (DDC) controllers.
            3. Peer-to-peer configuration means units exist and speak equally on same bus.
            4. Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.
            5. Connection to first tier network shall be provided on every floor of the building.
            6. Communication speed on the lower tier network shall be at a rate of 76Kbps or higher.
    3. System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware.
    4. Use of non-networked stand-alone control devices is not permitted.
2. **Control System**:

1. High speed, peer-to-peer network comprising microprocessor based Direct Digital Control (DDC) controllers with a web-based operator interface.
2. Each system controlled or monitored through the BAS, building floor plan, and control device to be displayed through point-and-click graphics.
3. Web server with network interface card to gather data from this system and generate web pages that can be accessed through conventional web browser on any PC connected to network.
4. Operators to access this system through web browser, and browser interface to perform normal operator functions.
5. BAS should provide support for smart phones & portable devices via one or more of the current common standards: Apple iOS (iPhone, iPad), Android Open Source Project (Droid devices), Windows Mobile devices.
6. BAS to operate on building LAN communication infrastructure.
7. Supply and install new architecture – New JACE's shall be "Open" version of Johnson Facility Explorer.
8. Integrate all new equipment graphics and controls into the existing ICONIC's 64 web based control platform/front end. Integration contractor for the existing ICONIC's platform/front end subject to right of approval of the University. New system shall be BACnet.
9. All graphics and equipment labelling shall be consistent with Brock Standards and shall be submitted accordingly in the shop drawing submission.
10. All control devices shall be wired. Wireless devices shall not be acceptable.
11. **OEM Controller integration**:
    1. BAS to incorporate hardware and software to allow bi-directional data communications between BAS and 3rd party manufacturers' control panels.

3. **BAS Functional Requirements**:
    1. Functional requirements shall be defined through the use of Control Sequences & Schematics and Points List used in combination.
        1. Control sequences shall be developed based on overarching criteria defined under Section 25 90 00.
    2. All meters on campus to be BACnet compatible and tied to BAS.
    3. **Controllers**:
        1. Designed to operate with local closed loop programming, independent from server, if peer-to-peer communication is interrupted.

2. DDC controller may control more than one system provided that points associated with those systems are connected to that same controller.

4. **Central BAS Web Server**:

1. Designed to perform global application programs and data consolidation including:

1. Communications with controllers

2. Host software routines for:

1. BAS Server operation

2. Database creation and data storage

3. Web based Graphical User Interface (GUI) with graphics generation and display

4. Reporting.

5. Installer is to coordinate work with University Facilities Management and IT Services.

6. Mobile viewing from outside University network to have monitoring capabilities only. Only workstations shall be capable of interrogating University control devices.

4. **BAS Server – Individual Buildings**:

1. A dedicated BAS Server is not required; rather the BAS software shall be installed on a designated Campus Server residing on a Tier I network.

1. Minimum performance levels for the server shall be estimated before completion of the Design Development Phase and submitted to the University.

2. Performance levels for the server shall be validated by the chosen BAS vendor and finalized within 60 days of commencement of the Construction Phase.

5. **Main Operator Workstation – Individual Buildings**:

1. The University will provide one operator workstation for each individual building.

2. If the project is an addition to an existing building the expanded BAS system would be tied back into the existing operator work station for that building.

3. Each Mechanical Room / Equipment Room shall have at least one (1) designated connection point to allow access to the BAS Graphics using a portable device.

6. **Internet Appliances**:

1. BAS architecture and software to incorporate minimal client design software to allow remote access to BAS via tablets and smartphones for authorized personnel.

7. **Fibre Optic Cable**:
    1. Duplex 900 mm tight-buffer construction designed for intra-building environments.
    2. UL listed sheath 50 micron/125 OM3 Fiber Optic Cable.
    3. Field terminations made using SC/LC type connectors with ceramic ferrules and metal bayonet latching bodies.
8. **Routers and Bridges**:
    1. Selected as Industry standard hardware.
        1. Central system to use an Ethernet Local Area Network (LAN) for communication.
        2. Communication between central server and controllers to be IP.
        3. Router to bridge IP and data link (ARCNET, BACnet, MS/TP, LON) to be used between controllers if required.
        4. Router to use FLASH memory and allow firmware updates to be performed from remote work station.
9. **BAS Software**:
    1. University utilizes Facility Explorer software.
    2. University preference is to stay with current software unless it is required to upgrade.
    3. System software to support alternate operating systems.
    4. Software to be completely web based without need for interface/translation devices or need to load software individually on each computer.
    5. System and software to permit remote access, for multiple users, through internet connections.
    6. Graphic files to be created with use of graphics generation package furnished with system.
    7. Software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:
        1. BACnet,
        2. MODBUS,
        3. LONTalk,
        4. OPC, and
        5. SNMP

8. Operator Interface designed to operate through standard desk top or lap top personal computers without requiring purchase of special software from BAS manufacturer.
    1. The primary point of Interface on these personal computers to be standard Web Browser by Microsoft Internet Explorer.
9. System software to support automatic paging.

10. **BAS Graphics**:
    1. At a minimum BAS graphics shall display the following:
        1. Facility Site Graphic
        2. BAS Network Schematics
        3. Individual Graphics for each System
        4. Terminal Unit & Equipment Floor Plan:
            1. Room Number and Area designation for each Terminal Unit & piece of Equipment.
        5. A Main Page in Tabular Format displaying, as applicable, the following information for each piece of equipment/system:
            1. Command Status,
            2. State Status,
            3. Current Setpoints,
            4. Current Speed, and
            5. Current Temperatures.
        6. Alarm Condition, if any, displayed in a different color.
            1. Alarms to be assigned a Priority Ranking and include Descriptor identifying relevant equipment and its location. (eg. E1 BLDG 040 P4 Condensate Pump failed to start <Room 008>).
        7. Area served by Equipment/System with a link to the individual graphic for the said Equipment/System.
    2. Graphics shall be developed using a standard library of image files and industry standard symbols.
    3. Controls graphics on all projects to include the creation of mobile viewing platform approved by the University.

11. **BAS Alarms**:
    1. The BAS system shall be complete with all alarming required for proper operation of the equipment and systems.

2. All time delays and alarm thresholds shall be adjustable via the software, not via the BAS graphics.
3. Alarms shall include any specific alarms required for specialized applications.
4. At a minimum the following alarms are to be provided, categorized by priority:
    1. **High Priority - Critical Alarms**:
        1. High-high level for all condensate tanks, sump pits, or any other application where a flood will occur if the high-high level is surpassed.
        2. High CO2 level (when CO2 sensor(s) are utilized).
        3. Any high or low limit alarm on mechanical systems.
        4. Freeze Stat tripping off, need manual reset.
        5. Positive and negative pressures exceeded in critical areas (e.g. Labs).
        6. Elevator Failure.
        7. Fire Alarms – Trouble, Supervisory, and Alarm.
        8. Generator and Life Safety – ATS Switchover.
        9. UPS Failure.
        10. High Voltage Switch – Trip Alarm (Open or Close).
        11. BAS communication failure.
        12. All equipment alarming for:
            1. Boilers
            2. Compressors
            3. Pumps
            4. Air Handling Units
            5. Chillers
            6. Cooling Towers
            7. Domestic Hot Water Tanks and Boilers
            8. Fan Units
            9. Engines
    2. **Medium Priority - Moderate Alarms**:
        1. Motor not started after commanded on,
            1. Applies to all motors (pumps, fans, etc.).
        2. Motor not stopped after commanded off,

1. Applies to all motors (pumps, fans, etc.).

3. High and low static pressure alarms (pumps, fans, ducts, etc.).
4. Minimum and maximum damper positions when exceeded.
5. Equipment out of range, all equipment (speed, amps, temperature and Pressure).
6. Set point exceeded – Hot Water Heating, Domestic Hot Water, Glycol and Chilled Water systems.
7. Transformer high temperature.

3. **Low Priority – Low Alarms**:
    1. Differential pressure across filter bank exceeds 250pa.
    2. High supply humidity level in supply air duct.
    3. High duct temperature.
    4. Supply and return fan current sensor.
    5. Exhaust fan failure in critical areas (ie. IT, Boiler Room, Electrical Room).
    6. Supply air temperatures more than 5°C from setpoint for more than 10 minutes.
    7. Space temperature out of range (humidity, temperature, pressure).
    8. Converter/Heat exchanger temperatures more than 10°C from setpoint for more than 10 minutes.

12. **Power Supplies and Line Filtering**:
    1. **Power Supplies**:
        1. Where Essential Power is available in a building, all Tier I devices shall be fed off an Essential Power source.
        2. Power supplies to all BCU's and all ECU's/Control Elements associated with equipment fed from an Essential Power source shall be extended from an Essential Power source, preferably the same Essential Power source feeding the equipment in question.
            1. An On-Board UPS Power source with a minimum 12 hour battery life shall be provided within each BCU & ECU.
        3. Control transformers shall be UL listed.
        4. Line voltage units shall be CSA listed.
        5. Provided with over-current protection in primary and secondary circuits.
        6. Sized to limit connected loads to 80% of rated capacity.
    2. **DC Power Supplies**:

1. Output to match equipment current and voltage requirements.
2. Units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50% load changes.
3. Units shall have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure.
4. Units shall be capable of operation between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.

3. **Power Line Filtering**:
    1. Shall be provided to afford internal or external transient voltage and surge suppression for workstations and control modules.
    2. **Surge Protection**:
        1. Dielectric strength of 1000 V minimum.
        2. Response time of 10 nanoseconds or less.
        3. Transverse mode noise attenuation of 65 dB or greater.
        4. Common mode noise attenuation of 150 dB or greater at 40 -100 Hz.

13. **Automatic Control Valves**:
    1. **Performance**:
        1. **General**:
            1. Straight through water valves shall be single seated type with equal percentage flow characteristics and minimum resolution of 40:1 or greater.
            2. Designed to close at a differential pressure of 280 kPa (40 psi), with an inlet pressure of 1035 kPa (150 psi).
            3. Three-way mixing water valves: linear for each port giving constant total flow.
        2. **Water Valves, Pressure Drop**:
            1. Two position: maximum 10% of system pump head.
            2. Modulating, two-way: maximum of 36 kPa (12 psi) pressure drop.
            3. Modulating, three-way: maximum of 60 kPa (20 psi) pressure drop.
    2. **Proportional valves - Globe**:
        1. **Body**:

1. Carbon steel, bolted body.
2. Maximum allowable water pressure: 860 kPa (150 psi).
3. Maximum working temperature: 216°C (260°F).

2. **Trim**:
    1. Stem guided plug.
    2. V-port cage, equal percentage.
    3. 316 stainless steel.
    4. Threaded seat ring, T316 stainless steel.
    5. Disc, seals, and other valve components suitable for clean water.
3. ANSI Class IV leakage.

3. **Actuators**:
    1. Electric or electronic action.
    2. Electronic interface control board, solid state drive, reversible motor, oil immersed gear train.
    3. Spring return mechanism to return valve to “normal” position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)).
    4. Manual override for valves over NPS 2½.
    5. **Valve Positioners**:
        1. Microprocessor based digital valve controllers.
        2. HART communications protocol.
        3. Two independent adjustable travel position switches and wiring to BAS for indication of valve position.
        4. To be provided on automatic valves NPS 2½ and larger.
    6. General purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use.

14. **Automatic Dampers**:
    1. Multi-leaf Dampers for general service.
        1. Shall be parallel blade type for two-position OPEN/CLOSED service.
        2. Shall be parallel blade or opposed blade type for modulating service.
        3. **Performance**:
            1. Leakage in closed position: maximum 2% of rated air flow at 500 Pa (2 in wg) differential across assembly.

2. Pressure drop in open position: maximum 50 Pa (02. in wg) differential at 5 m/s (1000 fpm).

4. **Frame & Blade Construction**:

    1. Insulated or non-insulated depending upon service. Thermal breaks in insulated frame construction.
    2. Extruded aluminum for general applications; formed stainless steel for corrosive environments.
    3. Extruded aluminum, thermally broken.
    4. Seals: extruded vinyl seals, and spring stainless steel side seals.
    5. Maximum blade width: 125 mm (5 in).
    6. Maximum blade length: 1200 mm (4 ft).
    7. Self-lubricated bronze bearings.
    8. Blade linkage with steel tie rods, brass pivots and steel brackets.

5. **Damper Actuator (Operator)**:

    1. Electric or electronic action.
    2. Electronic interface control board, solid state drive, reversible motor, oil immersed gear train.
        1. Spring return mechanism to return valve to “normal” position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)).
        2. Manual override.
        3. Damper positioners: microprocessor based digital damper controllers c/w
        4. HART communications protocol two independent adjustable travel limit switches with wiring to BAS for indication of damper position and alarm annunciation in the event position is not positively verified.
        5. General purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use.

2. **Isolation / Control Valves Type for Isolation Service**:

    1. Single blade type for modulating and two position, OPEN/CLOSED, service.
    2. **Performance**:
        1. Leakage in closed position: maximum 0.01% of rated air flow at 7 kPa (28 in wg) differential across assembly.

2. Linear characteristic with 20:1 turndown.
3. Sized using Cv numbers in 65% open position for pressure drop of less than 150 Pa (06. in wg) differential at 5 m/s (1000 fpm).

3. **Construction**:
    1. 316L stainless steel construction for Body, Trim, Shaft and all elements exposed to the air stream.
    2. Teflon packing glands.
    3. Seat: elastomer seat compatible with paraformaldehyde and ethylene gas.
    4. Flanged gasketed connections for 7 kPa (28 in wg) service.
4. **Damper Actuator (Operator)**:
    1. Electric or electronic action.
    2. Electronic interface control board, solid state drive, reversible motor, oil immersed gear train.
    3. Spring return mechanism to return valve to “normal” position on power failure (i.e. Normally Open (NO), or Normally Closed (NC)).
    4. Manual override.
    5. Damper positioners: microprocessor based digital damper controllers c/w
    6. HART communications protocol two independent adjustable travel limit switches with wiring to BAS for indication of damper position.
    7. General purpose, drip proof NEMA 2 die-cast housing with corrosion resistant steel cover for indoor applications, watertight NEMA 4 enclosure for outdoor use.

15. **Cleanroom and Laboratory Pressure Monitor (Includes Animal Laboratories)**:
    1. Space pressure measurement, referenced to adjacent space, designed, tested, and packaged by a single manufacturer.
        1. **Standard of Acceptance**: Phoenix Controls.
        2. **Acceptable Alternates**:
            1. Tek-Air model Iso-Tek,
            2. TSI, and
            3. Honeywell.
    2. **Monitor unit construction**:
        1. Industrial grade metal case mounted on an electrical junction box.
        2. Local digital display control unit:

1. Range: -50 to + 50 Pa (-019999. to +019999. in.wg.),
2. Resolution: 5% of reading,
3. Display updated every second,
4. Spill-proof membrane keypad for programming, and
5. Local calibration protected by pass-code.

3. **Indicating lights**:
    1. Low pressure alarm,
    2. Normal,
    3. High pressure alarm, and
    4. Audible Mute.
4. Audible alarm annunciates when pressure in monitored room is in alarm condition.
    1. Adjustable time-delay on alarm initiation for door opening.
5. **Remote alarm annunciation**:
    1. High pressure alarm contact - contacts normally open.
    2. Low pressure alarm contact - contacts normally open.

3. **Pressure Sensor**:
    1. Two velocity sensing elements mounted in-line to each other, with temperature compensating element.
        1. Pressure measurement accuracy: -50 to + 50 Pa (-019999. to +019999. in.wg.).
        2. Temperature compensation range: 127 to 35 °C (55 to 95 °F).
    2. **Alarm Setpoints**:
        1. Low pressure: 25 Pa (0.01 in.wc.) relative to adjacent space.
        2. Resettable to any point over sensing range.

16. **Building Pressure Control**:
    1. A dynamic Building Pressure Control System shall be provided to maintain the building pressure at set-point relative to the outside.
        1. Building reference pressure shall be measured from a central reference point away from sources of disturbance (ie. Middle floor/middle height of the building).

3. Installation Standards:

1. **General**:

1. The requirements outlined in the following clauses are applicable to all BAS Installation. Application Specific requirements are outlined under Clauses 3.2. – 3.13.
2. All campus network drops required to complete the BAS installation shall be provided by the BAS Contractor.
    1. Extend network a connection(s) from the nearest IT/Communications Closet; coordinate this activity with the Electrical/Communications contractor.

2. **BAS Panels & Cabinets**:
    1. Install Building Control Units, Equipment Control Units, and Field Panels in cabinets.
        1. Cabinets shall be mounted on a painted non-combustible backboard which is rigidly mounted to a wall or on a galvanized steel, floor mounted support frame.
            1. Installation on ductwork, equipment, and locations subject to vibration is not acceptable.
            2. Cabinets for Terminal Equipment Controllers may be installed on the terminal equipment provided there is no vibration that could affect controller operation or calibration of control device(s).
        2. Cabinets to be sized to accommodate 20% future I/O points.
        3. Cabinet locations are to be coordinated with other trades and the general contractor.
    2. No panels (except Terminal Equipment Controllers) shall be installed in the ceiling space or at an elevation inaccessible for normal & ready access from the finished floor.

3. **BAS Wiring**:
    1. **Wiring**:
        1. Wiring shall be installed in conduit, raceways and enclosures separated from other wiring.
        2. Wiring may be installed without conduit in the interstitial space above finished ceilings provided the following conditions are met:
            1. Wiring has a minimum rating of FT6; and
            2. Interstitial ceiling space is within the room where final termination of wire will be made.
        3. Each run of communication wiring to be continuous length without splices.
        4. Wiring within BCU’s, ECU’s and Field Panels (Cabinets) shall be installed in a plastic tray with a removable cover.

1. Wiring shall be terminated at field-removable, modular terminal strips.

5. Connections within cabinets and panels shall be done using terminals.
    1. Wire nuts and Marr connections are not acceptable.
6. Wiring to field sensors shall not be daisy-chained.
7. Should it become necessary to splice field wiring it shall be soldered and a 500 mm (1'-8") loop length is to be provided.
    1. Wire nuts and Marr connections are not acceptable.
    2. If soldering is not possible approved B-type crimp connectors are an acceptable alternative.

2. **Conduit**:
    1. Thin wall (EMT) conduit up to and including 32 mm (1¼") size for exposed wiring up to 3 m (10'-0") above floor level.
    2. Rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40 mm (1½") size and larger.
    3. Conduit to be parallel with, or at right angles to, building walls.
    4. Concealed within finished shafts, ceilings, and walls where possible.
    5. Route all conduit to clear beams, plates, footings, and structural members.
    6. Watertight compression fittings in exterior locations.
    7. Provide watertight seals at penetrations through outside walls.
    8. Conduits leaving a building to the outside shall be sealed internally to prevent moist air from being pulled through the conduits, condensing, and then the water freezing inside the conduit.
    9. Empty or unused conduit openings and stubs to be plugged or capped with compatible Fittings.
        1. Plugs or caps on conduit openings are to be maintained during construction.
    10. Conduits travelling between separate pressure regime areas shall be sealed internally to prevent migration of air and odors.
    11. Conduit to field sensors shall not be daisy chained.
3. **Flexible Conduit**:
    1. Shall be provided for the final conduit run to vibrating or rotating equipment so that vibration and equipment noise is not transmitted to the rigid conduit.
        1. Minimum 450 mm (1'-6") / maximum 900 mm (3'-0").

2. Shall be provided for the last 450mm (18 in.) of conduit runs to field sensors.
    1. A junction box / enclosure shall be provided for terminations.
3. Waterproof flexible conduit to be provided where exposed to weather or in damp or wet Locations.
4. Lightning arrester shall be provided according to manufacturer's recommendations between the communication cable and ground wherever cable enters or exits building.

4. **Air Handling Units**:
    1. At a minimum instrumentation shall be provided at each Air Handling Unit to monitor the following:
        1. Outside Air Temperature (may be common to a building),
        2. Return Air Temperature,
        3. Mixed Air Temperature,
        4. Filter Pressure Drop across each bank of filters,
        5. Air Temperature Upstream & Downstream of all Coils,
        6. Supply Air Relative Humidity,
        7. Supply Air Static Pressure,
        8. Supply Air Flow,
        9. Supply Fan Speed (where fan is equipped with a Variable Frequency Drive),
        10. Return Air Relative Humidity,
        11. Return Fan Speed (where fan is equipped with a Variable Frequency Drive),
        12. Return Air CO2 sensor.
5. **Heating & Cooling Coils**:
    1. A water temperature sensor shall be provided on the inlet and outlet of each coil installed within an air handling unit.
    2. An air temperature sensor shall be provided upstream and downstream of each coil installed within an air handling unit.
6. **Reheat Coils & VAV Boxes**:
    1. An air temperature sensor shall be provided downstream of each reheat coil.
    2. Air temperature sensors shall be provided such that the discharge temperature of each VAV can be measured.
7. **Terminal Units**:

1. Terminal units shall be equipped with an Air-flow Monitoring device interfaced with the BAS.

8. **Heat Exchangers**:
    1. Temperature sensors shall be provided on the inlet and outlet of each heat exchanger.
    2. Where a dual (or triple) heat exchanger system is used temperature sensors shall be provided on the outlet of each exchanger plus a common sensor for the mixed outlet.
9. **Compressed Air**:
    1. A pressure sensor shall be provided on the building's incoming compressed air line (if present).
10. **Water**:
    1. A pressure sensor shall be provided on the building's incoming domestic water line.
    2. A pressure sensor shall be provided on the building's incoming deionized water line (if present).
    3. Pressure and temperature sensors shall be provided on the building's incoming chilled water supply and chilled water return lines.
11. **Identification**:
    1. Point Object Numbering systems shall include the Building Identification as a prefix to all object identifiers.
    2. All Equipment shall be identified in accordance with the University's Identification Standards, 20 00 00 Pipe Labelling, and numbering convention. Equipment numbers are to be provided by the University.
    3. Equipment numbering strategy shall be presented for review/approval by the University and prior to completion of Design Development.
    4. **Wiring**:
        1. All wires shall be tagged at both ends. The tagging shall identify the device a wire is connected to. Use of the point object name is an acceptable means of device identification.
        2. All junction boxes shall be tagged "BAS" with a sequential number suffix.
    5. Control Devices shall be labelled using a Blue Flag Tie-Marker, such as Nelco PT#N-9L (or equivalent). Labels shall be white or yellow with large black text.
    6. All local alarm devices (lights, strobes, horns, etc.) shall be clearly labelled as to their purpose with an appropriately sized lamacoid plastic plate that is securely affixed so as to be visible and legible from the direction of normal approach.

1. Prior to fabrication, proposed alarm device labels (wording, size, colors) shall be presented for review/approval by the University.

12. **Redundant or Obsolete Pneumatic, Electric, Electronic, and DDC Devices**:

    1. Existing BAS control equipment rendered redundant or obsolete by the installation of a new BAS system or component shall be removed to the greatest extent possible.

        1. Control drawings and graphics shall be updated accordingly.

    2. Removal shall include the clean-up, removal, and proper termination of all existing pneumatic equipment (tubing, piping, panels, actuators, sensors, etc.), existing electronics (wiring, conduit, actuators, sensors) or existing DDC system (controllers, cabinets, sensors, relays, transformers, power supplies, etc.) no longer used by the BAS.

        1. Ductwork or walls affected shall be patched and sealed or covered with a suitable wall plate.

        2. Removal may require the re-piping or rewiring of existing BAS control equipment that is to remain.

        3. Pneumatic tubing or piping that cannot be removed shall be suitably plugged to prevent air leakage. Crimping or folding of tubing/piping is not acceptable.

        4. Wiring remaining shall be suitably terminated.

    3. Removal shall occur immediately after commissioning of the new control system in the building is complete.

25 30 00 CONTROLS AND INSTRUMENTATION

1. Sensors and Instrumentation:

1. All field sensors and instrumentation shall have a measurement range suitable to the application.
2. All field sensors, instrumentation, and control loops shall meet the minimum performance requirements tabulated below.

Parameter	Variable	Reporting Accuracy	Control Accuracy	Remarks
Temperature	• space • ducted air • liquids • outside air • differential • dew point • low limit (Freezestat)	±025°C (±05.0°F) ±05°C (±1.0°F) ±015°C (±025.°F) ±1.0°C (±2.0°F)	±1.0°C (±2.0°F)	RTD type • 3 attempts at Automatic Reset before lockout • range: 17°C to 72°C (35°F to 45°F) • field adjustable
Humidity	• relative humidity	± 3%	± 5%	Electronic type Range: 10-100% RH
Pressure	Air • ducts / space • static / differential	± 1%	± 5Pa (±0.02”w.g)	Electronic type • for compressed air see Liquids requirements
	Liquids • absolute / static / differential	± 1%	± 15 psi	

Parameter	Variable	Reporting Accuracy	Control Accuracy	Remarks
Flow	Air • proving switch	± 1% full scale -	± 10% full scale	Multiple-head Pitot Tube Type or Thermal Anemometer Probe Type • differential pressure activated diaphragm type
	Liquids • flow switch	± 2% full scale -		 • differential pressure activated paddle type
Gas Detection	• CO • CO2	± 3% ± 5 ppm		

25 90 00 SEQUENCES OF OPERATION

1. Control Sequences – Overarching Criteria:

1. Control sequences shall be developed with consideration to the overarching criteria listed below. Where criteria have not been defined, develop control sequences based on guidelines published in the ASHRAE Handbook and/or following Industry Best Practices.
2. Control sequence descriptions, and list of control and alarm points, shall be submitted for review/approval by the University prior to the completion of Design Development.
3. **Minimum Requirements**:
    1. Occupied/Unoccupied mode schedule for terminal unit set-back controls.
    2. Occupied/Unoccupied mode schedule and Occupancy sensors to control AHU(s) dedicated to an individual classroom.
    3. Standalone local washroom exhaust fan interfaced with the light switch and an Off-Timer.
    4. Control Valve sequences shall incorporate a feedback loop to detect leakage past valve when in “Closed Position”.
    5. Supply Air Temperature Reset based on Terminal Unit Damper Position (for VAV Systems) and Reheat Valve Position.
    6. Mixed Air Temperature as a means of controlling Fresh Air Damper.
4. **Fan Scheduling**:
    1. Ability to set fan schedules for Summer and Winter Schedules. This schedule will be based on University terms.
    2. Override Schedules to turn fans on or off for Holidays and special events.
    3. Systems that can be shut down will do so based on the schedule.
    4. Systems that cannot be shut down will have their SAT setpoint offset based on the schedule.
5. **Mode Control**:
    1. To prevent the various control components (valves and dampers) from competing with one another, they are operated in sequence (based on heating or cooling demand). This sequence is determined by a "mode"; various modes are described below. In each mode the pre-heat temperature low limit (PHT LL) controller will always be active and will keep the heating valve from closing when the pre-heat temperature (PHT) is below its low limit setpoint. In each mode the mixed air temperature low limit (MAT LL) controller will be active and will close the dampers (even below the min fresh air setting) when the mixed air temperature (MAT) is below its low limit setpoint.
    2. **Mode 0 - Shutdown**:

1. Fans will stop
2. Dampers will close
3. Cooling valves will close
4. Humidity valves will close
5. If outside air is colder than the mixed air temperature (MAT) setpoint then the heating valve will modulate to control the mixed air temperature at the low limit setpoint, otherwise the heating valve will close.

3. **Mode 1 - Startup**:
    1. This mode is only necessary when it is cold outside otherwise the system will simply energize and directly enter into one of the control modes.
    2. On 100% FA units the heating valve will fully open (on cold days) to preheat the coil before the fan starts (this is necessary since the coils may not respond fast enough when a cold PHT is detected and the unit will trip off on freezestat). Once the fan starts the heating valve will ramp down to the control point.
    3. On mixed air units the outside dampers will remain closed on cold days (to remove any residual heat that may have accumulated in the duct when it was off). After the morning warm-up the dampers will slowly ramp open to the control point.
    4. After the morning warm-up period the system will switch out of startup mode.
4. **Mode 2 - Damper**:
    1. The heating coil will modulate to maintain the PHT LL setpoint.
    2. Cooling coil will be closed.
    3. Damper will modulate to maintain the supply air temperature set-point (SAT SP).
5. **Mode 3 - Heating**:
    1. Cooling coil will be closed.
    2. Damper will be at minimum.
    3. The heating valve will modulate to maintain the supply air temperature (SAT) at setpoint.
6. **Mode 4 - Face and Bypass Damper or Reheat**:
    1. The damper will be at minimum position.
    2. The cooling coil will be closed.

3. When this mode is active the heating valve will be open at least 75% and the damper will modulate the air around the coil. If the air is being all directed to the coil then the heating valve will ramp open further.

7. **Mode 5/6 - Heating Stage 1 and Stage 2**:
    1. The damper will be at minimum position.
    2. The cooling coil will be closed.
    3. This mode is used for on/off heating stages (gas or electric).
8. **Mode 7 - Cooling**:
    1. The damper will be at maximum (economizer/enthalpy control may close this to minimum position).
    2. Heating valve will be closed (PHT LL always active).
    3. The cooling coil will modulate to maintain the SAT at setpoint.
9. **Mode 8/9 - DX Stage 1 and Stage 2**:
    1. The damper will be at maximum (economizer/enthalpy control may close this to minimum position).
    2. Heating valve will be closed (PHT LL always active).
10. **Mode 10 - Dehumidification (without dehumidification wheel)**:
    1. This mode is rarely used (it requires a cooling coil before a reheat coil).
    2. If a temperature sensor is installed after the cooling coil then the coil will be modulated to maintain the coil discharge temperature at the dew point. If no temperature sensor is installed after the cooling coil then the coil will be 100% open.
    3. The reheat coil will be used to maintain the SAT at its setpoint, reheating the supply air and providing dehumidification.

6. **Mixed Air Handling Units**:
    1. To prevent a large inrush current draw the fans across the campus are staggered using a pre-determined time delay calculated by the University.
    2. Lag fans (when controlled by the automation system) will start 5 seconds after the lead fan.
    3. When the unit is off, the dampers will be closed and the heating valve will be used to maintain the MAT at its low limit setpoint (cold side of the coil). If the outside air temperature is below the MAT LL SP then a morning warmup flag will be enabled.
    4. On system startup, if the morning warmup is enabled then the dampers will remain closed during the warmup period. Once the warmup period is over the dampers will ramp open to their control point.

5. The system will operate according to the "Mode Control" as outlined above.

7. **Fresh Air Handling Units**:

    1. To prevent a large inrush current draw the fans across the campus are staggered using a pre-determined time delay calculated by the University.
    2. Lag fans (when controlled by the automation system) will start 5 seconds after the lead fan.
    3. When the unit is off, the dampers will close automatically and the heating valve will be used to maintain the PHT at its low limit setpoint (cold side of the coil is preferable if a sensor is available). If the outside air temperature is below the MAT LL SP then a morning warmup “Heat Blast” flag will be enabled.
    4. The "Heat Blast" will just open the heating coil 100% for 2 minutes before the fan is given a start command. Once the fan is running the heating valve will ramp down to the control point.
    5. The system will operate according to the "Mode Control" as outlined above.

8. **Variable Air Volume Units (VAV’s)**:

    1. VAV's will maintain space temperature by adjusting the volume of air into the space while keeping it between an operator adjustable minimum and maximum volume.
    2. If a reheat coil is installed then a discharge temperature sensor after the coil must be provided to identify any leaking valve.
    3. If the space temperature is below the setpoint then the VAV will switch to reheat mode in which case the volume of air will increase to a heating setpoint (minimum air volume may be too little to allow the warm air from reaching the occupants); this is typically 10% of the span between minimum and maximum and then added to the minimum.
    4. A demand limit variable is generated which can be used by the AHU to adjust the duct pressure and supply air temperature. A value of 0% indicates the AHU should increase the supply air temperature while a value of 100% indicates that the temperature should be lowered. The AHU will only use this information if it has feedback from most of the spaces it affects.

9. **Exhaust Fans:** Exhaust fans will typically operate based on a predefined Occupancy Schedule.

10. **Standard Reset Schedules**:

    1. Air handlers will use a standard outdoor air temperature reset schedule unless there is a calculated reset from the space (typically if an AHU only feeds a few areas).

OAT	SP
30	18
20	15
10	18

2. In the winter it may be possible to throttle (close) a heating valve to a point which causes an air handling unit to trip on a freezestat. To minimize this occurrence a minimum position for the heating valve is calculated from the outdoor air temperature.

OAT	SP
5	0
-15	20

3. The return air humidity setpoint is also adjusted by an outdoor air temperature reset schedule.

OAT	SP
-25	15
10	40

11. **Heat Reclaim**:

    1. Plate heat exchanger for air to air systems will use a bypass damper when the exhaust air "ices up" and the pressure increases across the exhaust plates.
    2. "Run around" glycol loops heat reclaim systems will be disabled when the energy required to run the pumps is greater than the heat reclaimed (typically OAT > 10°C).

12. **Global Commands**:

    1. **Chilled Water Clamp**:

        1. Ability to clamp all chilled water control valves to a fixed position (excluding critical systems).
        2. This will allow the chilled water valves to be limited to a maximum position for extreme hot days as well as any Central Utility Building (CUB) production limitations.

    2. **Heating Setpoint Offset**:

        1. Ability to offset the setpoint for all heating systems (excluding critical systems).
        2. This will allow temperature setbacks for Holidays, and will limit hot water heating requirements due to any Central Utility Building (CUB) production limitations.

3. **Maximum Damper Position (all Mixed Air units)**:
    1. Ability to adjust maximum damper position.
    2. This will allow maximum damper position to be limited based on outdoor temperature and humidity.
4. **Supply Air Temperature (SAT) Setpoint Offset**:
    1. Ability to put an offset on all fan units.
    2. This will allow a temperature offset to be introduced for extreme temperature days to allow for reduction of chilled water use as well as heating water use.
5. **Perimeter Heating Disable**:
    1. Ability to disable perimeter heating for all buildings.
    2. This will allow buildings, on days with cool mornings and warmer days, to not use Perimeter heat in the morning and chilled water later on.
6. **VFD Maximum Clamp**:
    1. Ability to limit the VFD speed for critical global adjustment days (excluding critical areas).
7. **Global Command Page**:
    1. A Global Command Page shall be created on each BAS system to allow operator to monitor status of global command points and have the ability to set the values and override automatically calculated values.
    2. This page will include:
        1. Current Schedule running
        2. Chilled Water Maximum clamp value
        3. Heating setpoint offset value
        4. Damper Maximum Position value
        5. SAT offset value
        6. Perimeter Heating enable status
        7. VFD Maximum clamp value
        8. Chilled water pressures and temperatures in various locations.
    3. This page is also to display the status of chilled water cooling systems that have domestic water backup.

25 90 10 COMMISSIONING

1. General Commissioning Requirements:

1. The commissioning plan is intended to confirm that all parties involved understand the overall commissioning process and activities, as well as the individual responsibilities for each consultant, contractor, and the University. The commissioning plan will produce pre-functional and functional test forms for each piece of equipment and system to be commissioned.
2. Commissioning Plan to include at minimum:
    1. Requirements for construction review
    2. Installation verification
    3. Equipment Start-up reports
    4. Functional Performance Testing reports (Equipment and Sequences of Operation)
    5. Owner/operator training
    6. Preliminary Commissioning Schedule

2. Functional Performance Testing & Verification:

1. During the equipment operational and controls sequence verification phase functional performance testing direction shall be provided by commissioning agent for all equipment being commissioned. During this phase functional performance checklists are to be provided, commissioning agent is to coordinate testing and request the appropriate contractor to operate the required equipment during testing. Any deficiencies that result from testing will be the contractor's responsibility to correct and the commissioning agent will oversee/direct the re-testing after these deficiencies have been corrected.
2. Functional performance testing is generally required in the summer and winter seasons for heating and cooling system verification respectively. The contractor is required to return to verify operation and performance in the opposite season to which the work was completed.
3. Commissioning agent and contractor are to hand over equipment and systems to the University once all equipment functionality and sequences of operation have been tested and confirmed to meet design intent/requirements.

26 00 00 ELECTRICAL

26 01 01 GENERAL REQUIREMENTS

1. Introduction:

1. **General**:
    1. This Electrical Design Standard has been developed to establish the University's minimum expectations and requirements for new electrical installations on campus.
    2. This Standard is based on current Codes, Acts and Standards, Industry Best Practices and the University's preferred approach to standardizing design from the perspective of system configuration and performance, operating flexibility and efficiency, maintenance practices and protocols and inventory management.
2. **Compliance Criteria**:
    1. Full compliance is mandatory on projects involving new construction.
    2. Full compliance is mandatory for new electrical work within projects involving significant renovations.
    3. Compliance is recommended to the extent practical and feasible for all projects involving minor renovations and rework of existing electrical infrastructure.
    4. Any deviations from the minimum requirements outlined in this Standard must be approved by the University before the completion of Schematic Design.
3. **Responsibility of the Designer**:
    1. The System Designer remains responsible for ensuring any proposed design solution is in full compliance with applicable Codes & Standards in force at the time of the design.
    2. Any conflict between applicable Codes, Acts & Standards and this Standard shall be identified and presented to the University, together with proposed measures for addressing the conflict.
4. **Design Innovation**:
    1. This Standard is not intended to preclude or constrain an Innovative Approach to Design. It however remains the responsibility of the Designer to demonstrate that any proposed design innovations are in general compliance with the design intent outlined in this Standard.
    2. All proposed Design Innovation shall be tabled for consideration by the University, before the completion of Schematic Design.
5. **Reference Documents**:
    1. Ontario Building Code
    2. Ontario Electrical Safety Code

3. Canadian Electrical Code with applicable regional amendments
4. National Building Code
5. Ontario Fire Code
6. National Fire Code and Fire Commissioner Canada requirements
7. LEED Guidelines

2. Design Standards:

1. **General**:
    1. Cleaning shall be performed inside and out of all electrical equipment prior to being turned over to the Owner.
    2. Any decommissioned wiring conduit, etc. shall be removed back to the panel of origin.
    3. Decommissioned equipment shall be reviewed with Brock Facilities Management prior to removing from site or disposing.

26 05 00 BASIC ELECTRICAL MATERIALS AND METHODS

1. Conduits:

1. All conduits inside the building shall be electrical metallic tubing (EMT) unless specified otherwise.
    1. 21 mm (3/4”) minimum for power and lighting.
    2. 16 mm (1/2”) minimum for single device control, fire alarm, security and access control devices.
    3. 27 mm (1”) minimum for concealed and exposed data conduits.
2. Conduits exposed to the weather, in wet locations, subject to mechanical injury, or in any hazardous locations, or where required by local governing electrical code requirements, shall be rigid threaded, aluminum conduit.
3. Conduits in ceiling plenums shall be EMT.
4. Motor feeder drops shall have flexible liquid-tight conduit for final connection to motor. EMT or rigid metal conduit for the drops shall start at least 1 m (3'-3") ahead of the actual bend and have two additional clips over normal requirements. The minimum conduit size for the drops shall be 21 mm (3/4”).
5. All branch wire conduits in finished areas shall be concealed. Surface conduits in unfinished areas may be allowed based on Owner’s approval for use.
6. Conduits shall be installed so that the conductors can be drawn in without strain or damage to the conductors.
7. Expansion fittings shall be installed in conduits crossing expansion joints.
8. Conduits shall be installed to allow for expansion and expansion fittings shall be provided where required.
9. The use of running threads shall not be permitted. Ericson couplings shall be used where required.
10. Connectors for EMT conduit shall be steel, compression type, nylon insulated. In rooms where sprinkler systems are installed complete with seal ring, Compression Type M connectors shall be used. Steel set screw type is acceptable.
11. Poly pull wires shall be installed in all empty conduits, including telephone and computer conduits.
12. A separate insulated ground wire shall be installed in all conduits, except computer telephone/control conduits.
13. Buried conduits:
    1. Joints in conduits installed underground, in concrete slab on grade or in a concrete duct bank shall be made completely watertight.
    2. Conduits shall be installed parallel or perpendicular to building walls.

3. Minimum 2000 psi concrete thickness over or around a conduit in a concrete slab shall be 53 mm (2").
4. Use rigid PVC conduits for direct burial. For concrete encased duct banks, use DBII PVC.
5. Polyethylene flexible plastic conduit shall not be installed.
6. Minimum sizes for buried conduits:
    1. High Voltage/Medium Voltage – 103 mm (4”).
    2. Low Voltage (up to 750V) – 53 mm (2”).
    3. Emergency/Essential power – 53 mm (2”).
    4. Security/Access Control – 27 mm (1”).
    5. Parking/Roadway lighting and power – 35 mm (1 ¼”).
7. Adjacent duct couplings shall be staggered by at least 200 mm (8") with a duct support within 600 mm (2’-0") either side of the furthest couplings.
8. To prevent any displacement of the duct structure during pouring, the duct structure shall be braced down every 10 feet (3m) and the concrete shall be deflected down alongside the ducts to the bottom and up through the duct assembly.
9. The duct bank elevations shall be arranged to slope downwards towards the termination points (building or manhole) such that water cannot accumulate anywhere along the length of the duct bank.
10. The ducts entering into buildings, service tunnels, substations or manholes shall be bell shaped and sealed.
11. One continuous length of 13 mm (1/2") diameter polyethylene rope shall be installed in each duct to facilitate the installation of the cables in the duct.

2. Outlet Boxes:

1. Use CSA approved stamped galvanized steel outlet boxes.
2. Standard general purpose service floor boxes:
    1. CSA approved, UL scrub water compliant.
    2. Fully adjustable angular and vertically, cast iron for on-grade, formed steel for above grade, round single gang / rectangular or square multi-gang as required.
    3. Flush in concrete floor installation, boxes complete with conduit knockout openings, adjustable collars, hinged flip open brass covers with provisions for mounting of duplex power receptacles and data outlets.
    4. Provide barriered boxes when boxes contain both power and communication outlets and different voltage levels.

5. Size boxes to suit thickness of floor slab and also to suit required bending radii of conductors.

3. In gathering areas, cafeterias and meeting halls: provide 300 mm x 300 mm (1'-0" x 1'-0") floor box with 30A, 208V, 3-phase power for showcase complete with twist lock receptacle.

4. Boxes exposed on exterior of building or in non-climate controlled locations to be weatherproof boxes complete with gasketed covers

3. Sleeves:

1. Provide No. 24 gauge, Schedule 40, galvanized steel sleeves with an integral flange at one (1) end to secure to formwork construction.

4. Firestopping and Smoke Seal Materials:

1. Where work penetrates or punctures fire rated construction, provide ULC certified, listed and labelled firestopping and smoke sealing packing material systems to seal openings and voids around and within raceway to ensure that continuity and integrity of fire separation is maintained. Openings not in the immediate vicinity of working areas are to be fire stopped and sealed same day as being opened.

5. Identification Nameplates:

1. Laminated plastic (Lamacoid), beveled edges, self-tapping stainless steel screws, and proper identification engraving.

2. Each nameplate to be sized to suit equipment for which it is provided, and required wording.

3. Black core with white top.

4. For each power and distribution transformer, provide 125 mm x 75 mm nameplate to indicate the following information:

Line 1 (text 13 mm high):	Equipment tag number
Line 2 (text 1 0mm high):	Rated voltage, kVA, phase and frequency
Line 3 (text 10 mm high):	Power source

5. For each panelboard, disconnect switch, control panel and cabinets, provide 75mm x 50mm nameplate to indicate the following information:

Line 1 (text 10 mm high):	Equipment tag number
Line 2 (text 7.5 mm high):	Rated voltage, phase and wires
Line 3 (text 7.5 mm high):	Power source

6. Warning nameplates:

Line 1 (text 25 mm high):	DANGER

Lines below (text 10 mm high): Warning description

6. Typical Equipment Nomenclature:

e.g. MCCA PP 2 A 1 N 1

"MCCA" denotes building designation;

"PP" denotes equipment type
- LP: Lighting Panel
- PP: Power Panel
- RP: Relay Panel
- SP: Splitter
- DP: Distribution Panel
- MC: Meter Centre
- MCC: Motor Control Centre
- MS: Main Switchboard
- TX: Transformer
- XP: Lighting Switching Panel
- CP: Control Panel
- LMH: Lighting Management Hub
- BAS: BAS Panel

"2" denotes voltage
- 2: 208/120V
- 6: 600/347V

"A" denotes area
- A: West Core
- B: East Core

"1" equipment designation;

"N" denotes power designation
- N: Normal Power
- X: Emergency Life Safety
- E: Emergency Non-Life Safety
- U: UPS

"1" denotes floor level
- 1: Level 100
- 2: Level 200
- Etc.

7. Typical Circuit Nomenclature:

e.g. 2A1N1-2-3

Denotes equipment connected to Panel 2A1N1, Circuit #2, controlled by switch designated 2A1N1-2-3.

8. Temporary Fire:

1. Install rooftop support system for conduits/raceways to suit type of raceway and roofing materials.
2. Use properly sized clamps to suit conduit sizes.
3. Ensure that system does not invalidate existing roof warranties.

9. Branch Circuit Balancing:

1. Connect branch lighting and power circuits to panelboards so as to balance actual loads (wattage) within 5%.
2. If required, ensure Contractor transposes branch circuits when work is complete to meet this requirement.

10. Service Interruptions and System Shut-downs:

1. Follow the latest revision of Brock's Facilities Management Operating Procedure (FMOP) for work related to system shutdowns.
2. Shutdowns and interruptions to existing systems and services are to be coordinated fully with and performed at times acceptable to Owner. Services for operation of existing non-renovated areas of building are to be maintained.
3. Where working in close proximity to "live parts" or inside energized panels or energized cubicles of switchboards/substations, provide protection "boots" over bussing and insulating mats to cover areas of exposed live parts. Ensure that appropriate PPE is used, in accordance with the most recent arc flash requirements as per CSA-2462, when preforming "live work".
4. Contractor shall provide temporary backup power needed for any power interruptions caused through the project at the Owner's discretion.
5. Two (2) weeks written notice shall be given to the Owner prior to any power interruptions.

11. Finish Painting of Electrical Work:

1. Use coloured couplings for conduit runs.
2. Use coloured junction/pull box covers.
3. Spray painting is not permitted.
4. Colours shall be matched to the system for which they are used, as follows:
    1. Silver (no paint) Standard Wiring systems 120 to 250 volts
    2. Yellow: 347/600 volts
    3. Blue: Low voltage wiring, Audio/Visual
    4. Green: Security/Access control

5. Orange: Fiber Optics, Computer wiring
6. Red: Fire alarm, life-safety

26 05 13 MEDIUM VOLTAGE CABLES

1. General Requirements:

1. Utilize a qualified high voltage contractor to provide cable and installation work. Installation of cables and terminations are to be made by personnel skilled in this type of work.
2. Advise Owner of selected high voltage contractor prior to commencing work.
3. Each new cable to be continuous with no splices.
4. Provide cable connectors and lugs as recommended by cable manufacturers, to suit application and match connection provisions of connected equipment.
5. Install proper lugs using matching size die and crimping tool.
6. Perform high voltage DC test of cables before putting into service. Do not exceed manufacturer's recommended test voltage or duration. Perform acceptance testing in accordance with manufacturer's recommendations.

2. Cable Construction:

1. Teck 90 shielded armoured cables as follows:
    1. Certified to CAN/CSA C22.2 No.131, Type Teck 90 Cable.
    2. Certified CSA FT1 and FT4.
    3. Certified CSA C68.3.
    4. Outer jacket colour: Orange.
    5. Minimum size: 500 MCM
    6. 1-conductor or 3-conductor; no concentric neutral.
    7. Rated for outdoor, weather resistant and wet locations applications.
    8. Nominal voltage rating: 15 kV system.
    9. Insulation level: 133%.
    10. Conductor: bare, soft drawn, Class B Compact or Compressed Stranded Copper conductors per ASTM.
    11. Conductor shield: extruded thermoset semi-conducting shield.
    12. Insulation: cross linked thermosetting polyethylene (XLPE).
    13. Insulation shield: extruded thermoset semi-conducting shield.
    14. Metallic shield: helically applied 15% gapped copper tape.
    15. Bonding conductor: stranded bare copper conductor.
    16. Inner jacket: flame retardant and moisture resistant PVC jacket.

17. Armour: flexible interlocked aluminum armour, over inner jacket for mechanical protection.
18. Overall outer jacket: red, low temperature, moisture resistant, sunlight resistant PVC jacket.

2. Acceptable manufacturers:
    1. Texcan.
    2. Nexans.
    3. Prysmian Cables (Pirelli).
    4. General Cable.
    5. Aetna Cables.
    6. Kerite Company.

3. Cable Terminations:

1. Cold shrink silicone rubber termination kits as follows:
    1. CSA approved.
    2. Meet requirements of IEEE standard 48-1996 with voltage rating 15 kV.
    3. Maximum continuous operating temperature rating of 105°C (221°F), with an emergency overload rating of 140°C (284°F).
    4. Pre-stretched cold shrink design with removable core; when core removed, product shrinks to provide tight seal, without application of heat source;
    5. Capacitive termination stress control constructed of stress control compound and EPDM rubber tube;
    6. Termination insulator of a skirted or tubular design, constructed of tracking resistant silicone rubber with enhanced water repelling action; skirted for outdoor applications;
    7. Accommodate jacketed concentric neutral, concentric neutral or tape shield cables;
    8. Include required compression lugs of type compatible with cable type and vinyl electrical tape.
2. Acceptable manufacturers:
    1. 3M Company.
    2. Tyco Raychem.
    3. Prysmian Cables.

4. Cable Splices:

1. Cold shrink silicone rubber in line splice kits as follows:

1. CSA approved and labelled.
2. Meet requirements of ANSI/ IEEE standard 404 with voltage rating of 15 kV, to suit rating of cable to be spliced.
3. Maximum continuous operating temperature rating of 105°C (221°F), with an emergency overload rating of 140°C (284°F).
4. Cold shrink design which requires no application of heat source for installation.
5. Splice jacketing consisting of cold shrink tubing constructed of EPDM rubber.
6. Cold shrink splice body of moulded silicone rubber.
7. Accommodate jacketed concentric neutral, concentric neutral or tape shield cables.
8. Kit includes slice bodies, adapter tubes, jacketing tubes, shielding sleeves, ground straps, spring ground connectors, compound, mastic sealing strips, rubber mastic tape rolls, tape strips, cleaning pads and preparation template.
9. Include required compression lugs of type compatible with cable type.

2. Acceptable manufacturers:
   1. 3M Company.
   2. Tyco Raychem.
   3. Prysmian Cables.

26 05 19 LOW VOLTAGE CABLES

1. General Requirements:

1. Each new cable to be continuous with no splices.
2. Provide cable connectors and lugs as recommended by cable manufacturers, to suit application and match connection provisions of connected equipment.
3. Conductors to be copper only (no exceptions) and be suitable for applications as noted in governing local electrical code.
4. Conductors shall be identified with the proper numbers and at all termination and junction points. Brady type markers shall be used.
5. Conductors shall be installed in a neat and orderly fashion. The utmost care shall be taken to avoid damage to conductor insulation when cables are installed. All conductors shall be installed in conduit.

2. General Power Cables:

1. CSA approved, ULC labelled and certified.
2. Perform meggar test of all feeders 100A and above before putting into service. Do not exceed manufacturer's recommended test voltage or duration. Perform acceptance testing in accordance with manufacturer's recommendations.
3. Neutral conductors shall not be used for more than one branch circuit, for more than one multiwire branch circuit, or for more than one set of un-grounded feeder conductors.
4. All power conductors shall be colour coded at each termination as follows:
    1. Phase "A" – Red
    2. Phase "B" – Black
    3. Phase "C" – Blue
    4. Neutral – White
    5. Ground – Green
5. Minimum conductor size shall be No. 12 AWG stranded.
6. Solid wire conductors to be minimum No. 14 AWG; stranded conductors in sizes larger than No. 10 AWG; branch circuit conductors constructed of 98% conductive copper; and approved for minimum 600 volts, with minimum 1000 volts where noted.
7. Non-metallic sheath cable type NMD, (Romex) and type NMW (Farmex) shall not be used.
8. "RW90" CSA certified, in PVC conduit for buried underground installations.
9. "T90" CSA certified, in conduit within buildings.

10. "RWU90" CSA certified, for wet and direct buried underground installations (no PVC conduit). Owner approval required for direct burial without PVC conduit.
11. "AC90" flexible armoured cable with bare copper ground conductor and overall interlocked aluminium tape armour.
12. “Teck90” cable is allowed for outdoor installation, exposed above ground, in lieu of wiring in rigid galvanized steel conduit.
13. “BX wiring” with dedicated ground conductor will be allowed to a maximum length of 6 feet only as follows:
    1. Drops from lighting junction boxes to light fixtures.
    2. Fire alarm system wiring drops from accessible ceiling junction boxes to ceiling heat/smoke detectors. All other fire alarm initiating/signal wiring shall be installed in conduit.
14. Light fixtures shall not be “daisy chained” with BX. Provide individual BX drops form junction boxes which are part of a lighting conduit and wire system.
15. BX cables shall not be used to wire equipment power or controls for mechanical systems.
16. BX cables shall not be surface mounted.
17. The limitations on the use of non-metallic sheath cable (NMD, NMW) and metallic sheath cable (BX) shall be strictly enforced.

3. Fire Rated Cables:

1. Mineral insulated (MI) or “pyro” cables may be used for life safety systems.

4. Tray Cables:

1. Use tray cable for power and control systems installed in cable trays in service tunnels.

5. Control Wiring:

1. To be used for BAS, thermostat, sensors, security, access control and clock systems.
2. Instrumentation wiring for BAS to be No. 18 AWG minimum with colour coding as follows:
    1. Blue – DC
    2. Red – 120V, minimum No. 16 AWG
    3. Yellow – Outputs
    4. Black/White – (-ve/+ve)
    5. Black/Red – (-ve/+ve)

26 05 26 GROUNDING AND BONDING

1. General Requirements:

1. Provide components for complete grounding and bonding work to meet requirements of local governing electrical authority, codes and standards.
2. Where required, perform ground resistivity testing of soil to determine measurement expressed in ohm meters as defined by IEEE 80-2013 – IEEE Guide for Safety in A.C. Substation Grounding.
3. Effectively bond metallic pipe services such as gas mains, water mains, and dry risers to main grounding terminal at their point of entry. Make connections to services with purpose-made grounding clamps.
4. Throughout complex, solidly ground systems and make required bonding connections to electrical devices and apparatus.
5. Ground and bond various telecommunications, audio visual, security, life safety and control systems in accordance with respective system manufacturer's recommendations and in accordance with local governing electrical code requirements.
6. Comply with cable tray manufacturer's grounding and bonding recommendations. Bond metallic structures of wireway to provide 100% electrical continuity throughout wireway system.

2. Standards:

1. CSA Standard 22.2 No 41-17 – Grounding and Bonding Equipment.
2. CSA Standard 22.2 No 0.4-17 – Bonding and Grounding of Electrical Equipment.
3. Ontario Electrical Safety Code – Sections 10 and 36.

3. Basic Materials:

1. Ground Rods: Copper-clad steel, 20 mm (3/4") diameter circular cross-sectionalized, with driving cap and bronze tip, overall length of 3 m (10'-0") long.
2. Ground and Bonding Conductors: Solid copper, insulated and bare to suit application and code requirements.
3. Ground Busbar: Solid copper busbar, predrilled for two-hole lug connections, of size of 50 mm x 9 mm x 600 mm (2" x 3/8" x 2'-0"), for wall and backboard mounting using standoff insulators.
4. Main Electrical Room Ground Busbar: Solid copper busbar, predrilled for two-hole lug connections, of size of 50 mm x 9 mm (2" x 3/8") and of continuous length around perimeter of room, for wall and backboard mounting using standoff insulators.
5. Ground Connections:
    1. Below Grade: Exothermic-welded type connectors.

2. In Manholes: Exothermic connections.
3. Above Grade: Compression type connectors or exothermic connections permitted.
4. When making ground and bonding connections, apply a corrosion inhibitor to contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between metals used.

4. Perimeter Ground Bus:

1. Provide perimeter ground bus in electrical rooms, 300 mm (1’-0") above finished floor level.
2. Secure ground bus on standoff insulators.
3. Bond all equipment such as transformers, switchboards, panelboards, and similar metal work to perimeter ground bus.

5. Telecommunications Grounding:

1. Comply with TIA/EIA-607 grounding and bonding requirements.
2. Provide wire and hardware required to properly ground, bond, and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
3. Ground bonding jumpers to be continuous with no splices. Use shortest length of bonding jumper possible.
4. Provide ground paths which are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to building grounding electrode. Resistance across individual bonding connections to be 10 milliohms or less.
5. Telecommunications Equipment Rack and Cabinet Ground Bars: solid copper ground bars designed for mounting on framework of open or cabinet-enclosed equipment racks with minimum dimensions of 6 mm (1/4") thick by 20 mm (3/4") wide.
6. LAN Room Ground Bus: 50 mm x 9 mm x 300 mm (2" x 3/8" x 1’-0") copper ground bus with eight (8) drilled taped holes; mounted on walls with standoff insulators.

26 05 31 ELECTRICAL CONCRETE PRODUCTS

1. Transformer Pad:

1. Consist of steel reinforced precast concrete top cover and foundation.
2. Sized as per transformer requirements.
3. CSA approved and in accordance with OPSS 616.
4. Concrete of minimum strength of 32 MPa (4600 psi) which shall be confirmed with transformer manufacturer.
5. Provide lifting holes and/or lifting hooks;
6. Top cover openings to be coordinated with final design of transformer.
7. Foundation cable openings coordinated with duct bank entry.
8. Duct drainage to suit designed sloping of ducts.

2. In Ground Handholes and Pull Boxes:

1. Fully weatherproof, watertight and corrosion resistant types for splices, pulls and junction applications:
    1. Pre-fabricated made of semi-concrete or non-concrete materials polymer concrete.
2. CSA approved and in accordance with following, as applicable:
    1. OPSS. PROV 602;
    2. ASTM C857;
    3. ANSI/SCTE 77;
    4. Local governing authority requirements.
3. Enclosures to be designed and installed to withstand loads likely to be imposed and be of size, with wiring/duct entries, covers and bottoms (as noted) and of type to suit specific applications.
4. **Polymer Concrete Covers**:
    1. Flush mounted with gaskets to prevent ingress of water;
    2. No protrusions extending out from top of cover; no tripping hazards;
    3. Skid resistant;
    4. Tamper-proof, stainless steel head bolts recessed into cover;
    5. Area for logo;
    6. Minimum thickness of cover is 20 mm (3/4").
5. Provide PVC seals on cable entry openings.
6. **Identification**:

1. Identification engraving / warning signage, weather and corrosion resistant.
2. Identification markings on each box embedded on outside vertical surface of box, showing manufacturer's name or trademark, and date of manufacture.
3. Top surface of cover permanently marked, showing manufacturer's name or trademark, and date of manufacture; this marking embedded into top surface of cover, or embedded into a corrosion-resistant metal plate securely cemented to top surface of cover.

3. Decorative Concrete Bases:

1. Art Forms International Inc. (905-642-3225) cast-in-place architectural concrete bases for pole mounted exterior luminaires. Bases include but not be limited to following:
    1. Breakaway construction forms.
    2. Vertical steel reinforcing rods and horizontal steel reinforcing ties.
    3. Cast and cured as per Division 03 requirements.
    4. Co-ordinated with installation of poles/bollards and conduits.
    5. Self-locking, vandal resistant wrap around aluminium band of finish reviewed with Owner.
    6. Anti-graffiti sealer.
2. **Parking lots and roadways:** Art Form Newavea 510R-High, 915 mm (3'-0") high.
3. **Landscape and pathways:** Art Form Classica 460R, 140 mm (5.5") high.

26 05 36 CABLE TRAYS

1. General:

1. Where cable tray penetrates fire rated construction, provide ULC listed and labelled, fire stopping and smoke seal materials or fittings to protect integrity of fire rated construction. Install work in compliance with ULC standards and where required by local governing codes, provide suitable for plenum environments.
2. Provide continuous paths along entire lengths of cable tray to maintain proper ground continuity. Utilize system manufacturer's proper grounding and bonding fittings and hardware. Ground and bond system as per local governing electrical code requirements.
3. Provide proper fittings in cable tray at points of conduit entry. Terminate conduits at or in tray with proper grommetted and bushed terminations.
4. Equip tray with necessary wall flanges, dropouts, enclosures, reducers, fittings, and similar accessories required, maintaining effective free cross-sectional area of tray clear of obstructions that might damage conductor insulation during installation. Accessories are to be typically pre-manufactured by manufacturer to suit specific applications.
5. Install expansion connectors where cable tray crosses building expansion joints.

2. Basket Cable Tray:

1. CSA approved and labelled, or ULC listed, basket type cable tray system complete with factory made couplers, fittings, tee sections, elbows, universal dropouts, etc., and required supporting and installation accessories.
2. Use for telecommunications and control conductors.
3. Continuous, rigid, welded steel wire mesh cable tray system.
4. Minimum 300 mm x 100 mm (1'-0" x 4").
5. For indoor climate controlled locations: Welded wire construction of minimum 5 mm (0.197") diameter carbon steel wires and hardware, conforming to requirements of ASTM A510 Grade 1008 with black powder coated finish paint to ASTM D 3451.
6. For non-climate controlled locations: Welded wire construction of minimum 5 mm (0.196") diameter stainless steel wires and hardware, conforming to requirements of AISI Type 304L cleaned and passivated to ASTM A 380.
7. Acceptable manufacturers:
    1. Legrand-Cablofil.
    2. Cooper "Flextray".
    3. Eaton B-Line.
    4. Canadian Electrical Raceways.

5. Hubbell.
6. WBT.

3. Ladder Cable Tray:

1. Provide cable trays in compliance with CSA C22.2 No. 126.1 and NEMA VE1.
2. Use only for power conductors.
3. Minimum 300 mm x 100 mm (1’-0" x 4").
4. Side rails and rungs constructed of pre-galvanized steel conforming to requirements of ASTM A653 with G90 coating thickness.
5. Acceptable manufacturers:
    1. Thomas & Betts;
    2. Legrand;
    3. Eaton B-Line;
    4. Canadian Electrical Raceways.

4. Outdoor Ventilated Cable Tray:

1. Provide cable trays in compliance with CSA C22.2 No. 126.1 and NEMA VE1.
2. Use only for power conductors.
3. Minimum 300 mm x 100 mm (1’-0" x 4").
4. Constructed of stainless steel conforming to requirements of AISI Type 304.
5. Acceptable manufacturers:
    1. Thomas & Betts;
    2. Legrand;
    3. Eaton B-Line;
    4. Canadian Electrical Raceways.

26 05 48 VIBRATION ISOLATORS AND SEISMIC RESTRAINTS

1. General:

1. Electrical equipment installation is to meet local governing authority having jurisdiction and code seismic requirements and additional requirements for vibration isolation.
2. Seismically restrain electrical equipment and equipment bases including concrete pads, and guarantee function of materials and equipment supplied.
3. Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to local governing authority having jurisdiction so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.
4. In the event that inadequate isolation is provided by isolation product manufacturer's isolation package, be responsible for improving isolation to an acceptable standard at no additional cost to contract.
5. Isolation product manufacturer's seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose in compliance with applicable local building code requirements.
6. Provide additional seismic requirements for suspended electrical raceways, luminaires, and other equipment as per governing local authority requirements and requirements of current codes and by-laws.
7. Acceptable manufacturers:
    1. Vibro-Acoustics;
    2. Mason Industries;
    3. Kinetic Noise Control;
    4. Eaton B-Line.
8. Following electrical equipment require seismic protection:
    1. Dry type distribution transformers.
    2. Switchboards/switchgear.
    3. Panelboards.
    4. Engine/generator and associated components/accessories installed within enclosure, such as exhaust system and fuel system.
    5. Genset control system and cabinet.
    6. Automatic transfer switch
    7. Fire alarm system, cabinets and devices.
    8. Luminaires.
    9. Conduit and duct banks.

10. Mobile generator connection box.
11. Other electrical equipment, as required.

26 05 70 ELECTRICAL WORK ANALYSIS AND TESTING

1. General:

1. Arc flash labelling shall provide maximum energy level at equipment.
2. Arc flash study to consider that only Level 2 and Level 4 PPE is used by Brock.
3. Brock policy is to perform no work on live equipment.
4. Brock has a “campus wide” arc flash study. Addendums to this study shall be provided for renovations and new installations.
5. Series rating shall not be allowed for protection coordination.
6. Update and replace existing single line drawings on each building substation wall to reflect any changes from the project as per OESC 2018 Edition.

2. Preliminary Study:

1. Upon contract award, the Contractor shall submit a “preliminary” short circuit, protection coordination and arc flash study for review with equipment shop drawings to the Consultant.
2. Contractor shall liaise with the local hydro utility to obtain the available fault current for use in the report, and include copies of correspondence in the study. Changes to be implemented based on the results of the study to ensure proper coordination of distribution breakers. Ensure that the Contractor submits all data for review sufficiently in advance of equipment assembly.

3. Final Study:

1. Ensure that Contractor submits an updated short circuit, protection coordination and arc flash study for review based on the available fault current obtained by the local hydro utility. The new study shall capture all changes implemented after the preliminary study submission stage.
2. All equipment included within the scope of the protection coordination are to be included within the scope of the arc flash study and are to be furnished with arc flash labels upon completion of project.

4. Distribution System Coordination Study and Short Circuit Calculations:

1. Contractor to prepare coordination study and short circuit calculations (available fault currents) of system.
2. Contractor to submit coordination study and short circuit calculations reports as part of shop drawing submission.
3. Consultant to review coordination study and short circuit calculations and provide comments to be incorporated into electrical distribution equipment shop drawings. Check for selective coordination of devices and confirm withstand ratings of equipment meet results from reports.

5. Shock and Arc Flash Protection:

1. Contractor to provide a study to determine severity of potential exposure, plan safe work practices and select personal protective equipment under general guidelines of governing edition of CSA Z462.
2. Determine arc flash hazard distance and incident energy that workers may be exposed to from electrical equipment under general guidelines of IEEE 1584.
3. Arc Flash Warning Labels:
    1. Location designation.
    2. Nominal voltage
    3. Flash protection boundary.
    4. Hazard risk category.
    5. Incident energy.
    6. Working distance.
    7. Engineering report number, revision number and issue date.
4. Provide labels for following equipment:
    1. Panelboards.
    2. Motor control centres (MCC's).
    3. Variable Frequency Drives (VFD's).
    4. Distribution transformers.
    5. Switchboards.
    6. Transfer switches.
    7. Generator set control equipment.
    8. Switchgear.
    9. Medium voltage equipment.
    10. Other equipment as required by local governing authorities.

6. Acceptable Companies for Coordination, Short Circuit and Arc Flash Study:

1. Eaton Electric Services Division.
2. Schneider Electric Services Division.
3. Siemens Electric Services Division.
4. G.T. Woods.
5. AC Tesla.
6. EnKompass Power and Energy.

7. Infrared Scanning:

1. Provide infrared scanning for projects where requested by Brock.
2. Use of latest technology infrared fast scanning thermal imaging camera with colour digital conversion thermographic imaging capabilities; camera to be capable of determining temperature differences using generated isotherms.
3. Equipment to detect emitted radiation and convert detected radiation to visual image.
4. Infrared surveys to be performed during periods when equipment is under intended full operating load.
5. Perform scanning of essential power equipment when gensets are in operation and essential power is on line.
6. Acceptable infrared scanning companies:
    1. GT Wood.
    2. EnKompass Power and Energy.
    3. AC Tesla.
    4. Eaton Electric Services Division.
    5. Schneider Electric Services Division.
    6. Siemens Electric Services Division.

26 09 00 LIGHTING CONTROLS

1. General:

1. Lighting controls and luminaires when integrated together for control purposes must be 100% compatible with each other.
2. Coordinate with ballast/driver and lamp manufacturers and dimmer/occupancy control manufacturers to ensure that components are compatible with each other and that interconnections do not affect performance, life or any warranties.
3. Use Stand-Alone Room Lighting Controllers for the following:
    1. Basic classrooms.
    2. Teaching labs.
    3. Offices.
4. Use Dimming Control Systems (Scene Control) for the following:
    1. Active learning classrooms and labs.
    2. Gymnasiums.
    3. Auditoriums.
    4. Theatres.
    5. Lecture Halls.
5. Use LV Lighting Relay Panels for Corridor lighting.

2. Stand-Alone Room Lighting Controllers:

1. System to consist of the following:
    1. Room controller.
    2. Occupancy/vacancy sensors.
    3. Daylight sensors.
    4. Power and slave packs.
    5. LV switches.
    6. Data wiring.
    7. 0-10VDC dimming control wiring.
2. Approved manufacturers:
    1. Eaton/Copper
    2. Phillips
    3. Wattstopper
    4. Hubbell

5. Leviton
6. Acuity

3. Dimming Control Systems (Scene Control):

1. Shall be able to program multiple scenes.
2. Scenes can be selected based on use at the time.
3. Requires A/V coordination with lighting controls.
4. Approved manufacturers:
    1. Lutron
    2. Acuity

4. LV Lighting Relay System:

1. System to consist of the following:
    1. Relay panel.
    2. LV switches.
    3. Occupancy/vacancy sensors.
    4. Power and slave packs.

5. Corridors:

1. Lighting system shall not possess local toggle switches in the corridors. Control shall be via the relay panel and LV switches in the electrical room/closet.
2. Lighting to be full on during work hours.
3. After hours, allow control by occupancy sensors.

6. Outdoor Lighting:

1. Responsible for parking lot and roadway lighting.
2. Controller to be located only in buildings that is a source of outdoor lighting.
3. Existing photocells are located at CUB from where signal is sent through BAS to the buildings.
4. Each building to have a 365 day clock and contactors.
5. Hand-Off-Auto to be located at each building.
6. BAS inputs to be used to manually switch outdoor lights on/off.
7. System shall separate lighting control for the parking lots from the roadway lighting.

26 11 00 UNIT SUBSTATIONS

1. General:

1. High voltage substation to consist of integrated component cubicles/sections as follows:
    1. Primary switchgear with vacuum actuated breakers.
    2. Main power transformer (refer to Section 26 12 00).
    3. Secondary power with drawout circuit breakers (refer to Section 26 23 00).
2. High voltage switches to include remote switching c/w remote indication back to Brock's SCADA system.
3. Integrate sections with interconnecting close coupling copper bussing and control wiring as required.
4. Interconnecting bus throughout switchgear to be constructed of top quality, 98% pure, rectangular copper bars, silver flashed or silver-plated at joints.
5. Power bus to be properly isolated and fully insulated for entire length including connections, supported on porcelain bus supports and designed to carry currents noted with a temperature rise in accordance with ANSI standards to suit application. Joints to be secured with steel bolts, nuts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint.
6. Ground bus to be provided continuous for length of apparatus and to be solidly bolted to its framework. Ground bus to be copper and to have a momentary rating equal to or greater than that of apparatus and in no case is cross sectional area of ground bus to be less than 6 mm x 50 mm (1/4" x 2").
7. Secure and attach sections together forming a common integrated line-up.
8. EEMAC2 with drip shield.
9. Enclosures to match with factory finished ANSI gray enamel and mount onto common pad.
10. Provide required facilities and hardware for incoming feeder, and outgoing cable in conduit feeders.
11. Kirk keys to be provided with dual incoming MV feeders.
12. Unit to be self-contained.
13. Acceptable manufacturers
    1. Eaton.
    2. Schneider Electric (Square D).
    3. Siemens Electric Ltd.
    4. ABB.

2. Vacuum Circuit Breakers:

1. Horizontal draw-through vacuum circuit breakers, each of same current rating within each switchgear, each calibrated and interchangeable (mechanically and electrically), and each with minimum ratings as per following paragraphs.
    1. Rated voltage and phase – 15 kV - 3 pole.
    2. Rated nominal voltage – 13.8 kV.
    3. Rated continuous amperes – 600A.
    4. Basic impulse insulation level – 95 kV BIL.
    5. Short circuit current at rated maximum kV – 37 kA.
2. Each circuit breaker to contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit which can be removed easily.
3. Each breaker to carry its rated continuous current without exceeding a 65°C (117°F) temperature rise above a 40°C (104°F) ambient temperature if main current carrying contacts have silver to silver contact surfaces, 30°C (54°F) above an ambient of 40°C (104°F) if main current carrying contacts have other types of contact surfaces, e.g., copper to copper. Temperature rise to be measured relative to ambient temperature outside switchgear.
4. Each circuit breaker cell to be equipped with a test position. In this position, primary disconnecting devices to be disengaged and shutters to be closed, but secondary device to be engaged or to be capable of being engaged.
5. Control voltage to be 125 VDC. Breakers to be operated by a DC stored energy mechanism and a DC shunt trip coil, supplied from batteries with charger located internal to switchgear.
6. Interlocks to be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from housing.
7. Circuit breaker control switches to be pistol grip type three (3) positions (close-off-trip) with target indication of last operation and spring return to off position. Each circuit breaker have two (2) type "A" and two (2) type "B" auxiliary switches.
8. Each breaker to include red/closed and green/open breaker LED indicator lights and electrically operated pushbutton. Pushbutton includes protective flip cover to prevent inadvertent operation.
9. Each breaker is equipped with auxiliary contacts for future interconnection to control system.

3. Relays:

1. Provide protection system relays as required. Coordinate with Owner.
2. Relays, except auxiliary relays, to be semi-flush mounted draw out type, with built-in test facilities and fitted with targets as required to indicate operation.

3. Include for required front panel spaces for relays and required cell space for CT's/PT's.

4. DC Battery Power:

1. DC batteries for switchgear to be integral to switchgear, maintenance free, sealed, lead acid batteries to operate motor operators, indicating lights and relays. Batteries to be 125 VDC as coordinated to suit application and to be of sufficient capacity to operate motors and required devices consecutively with battery charger out of service for duration of test.
2. Batteries to be designed and guaranteed for minimum 10 years of service life.
3. Batteries to be of type not requiring ventilation and to be to applicable code requirements.
4. Provide a set of contacts to initiate battery low voltage alarm. Contacts to initiate alarm when voltage falls to pre-selected level or less and to reset at selected battery voltage.

5. Lightning Protection:

1. Provide metal oxide polymer type distribution class lightning protection arrestors of rating to suit application and as recommended by switchgear manufacturer.

6. Metering:

1. Square D ION7650, microprocessor based monitoring and protective digital metering system to provide complete electrical metering and system voltage protection.
2. System to measure and display voltage, current, frequency and time, and calculate and display kW, kWh, kW demand, ampere demand, kVA, kVA demand, kVAR and kVARh. system to include adjustable protective alarm features including voltage phase loss, current phase loss, line voltage phase loss, voltage phase reversal, over voltage, under voltage and time delay.
3. Bright LCD display screen with adjustable contrast to be provided on unit.
4. System to include required inputs/outputs, contacts, RS232/485/MODBUS/ ETHERNET interface for communications to remote printer or BAS, TCP/IP communications interface, current transformers, potential transformers and control wiring.
5. Include custom clear acrylic, hinged locking cover over each unit.

7. Current & Potential Transformers:

1. Potential transformers to be of draw-out type and to incorporate current limiting fuses, and two (2) viewing windows in front panel, one (1) on each side for maintenance check on alignment of primary disconnecting sleeves. Steel framework of drawer to be grounded at all times.

2. Current transformers to have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers, and be insulated for full voltage rating of switchgear.

8. Mimic Bus:

1. Red, single line vinyl bus approximately 3 mm (1/8") thick x 9 mm (3/8") wide representing internal bussing and components rivetted to front of substation and extending through handles of respective breakers.

26 12 00 MAIN POWER TRANSFORMERS

1. Main Power Transformers:

1. Dry-type ANN 13.8kV, 3-phase, 3-wire, 60 cycle AC delta primary, 600 volt, 3-phase, 4-wire, 60 cycle AC wye low voltage secondary, indoor, main power transformer.
2. Minimum size to be 1000kVA.
3. Transformers to be CSA approved and/or ULC listed and labelled.
4. Transformer to be dry type, designed, manufactured, and complete with accessories.
5. Transformers to comply with latest applicable codes and standards.
6. Continuous self-cooled rating when operating on any tap with a temperature rise, by resistance, not in excess of 150C° (270F°) over a maximum ambient of 40°C (104°F).
7. Constructed such that units not be damaged by short circuit across secondary terminals, with primary voltage sustained for 5 seconds.
8. Overall transformer efficiency not less than 98.5%.
9. Insulation to be Class 220°C rated.
10. Primary and secondary windings to be copper.
11. Transformer and windings vacuum impregnated with polyester resin.
12. Impedance (Z) values to be 5.5% to 6%.
13. Provide transformers of equal ratings with matching reactance and resistance.
14. Off-load tap changer terminal board accessible from rear, complete with four 2-1/2% full capacity high voltage taps, two (2) up and two (2) down and lockable enclosure door.
15. Primary and secondary terminators to suit primary and secondary connections.
16. Provision for fan cooling is not required.
17. 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.
18. Acceptable manufacturers:
    1. Hammond Power Solutions / Delta.
    2. Schneider Electric.
    3. Siemens Electric.
    4. ABB.
    5. REX Power Magnetics.

6. Bemag Transformer.
7. Eaton.

26 22 00 DISTRIBUTION TRANSFORMERS

1. General:

1. Dry-type transformers; 600V, 3-phase, 3-wire primary; 208/120V, 3-phase, 4-wire secondary; delta-wye; CSA approved and/or ULC listed and labelled, constructed and factory tested in accordance with applicable requirements of the following:
    1. CSA Standard C9;
    2. CAN/CSA C22.2 No. 47;
    3. CAN/CSA-C802.2 with upgraded efficiency requirements matching DOE 2016 requirements;
    4. UL 1561;
    5. NEMA ST-20;
    6. Department of Energy (DOE) 10 CFR Part 431 (DOE 2016);
    7. Local governing authority codes and standards.
2. For standard indoor applications: minimum EEMAC 2 ventilated, drip proof enclosure with rigid end frame, removable plates, terminal compartment. Provide top mounted factory painted drip shield.
3. For additional indoor protection and standard outdoor applications: minimum EEMAC 3R enclosure with a rigid end frame, removable plates, a terminal compartment; ventilation louvres designed to prevent penetration of water spray from activated sprinklers onto live parts, and gasketted doors and component openings.
4. Minimum sizes:
    1. 15 kVA for 1-phase applications.
    2. 45 kVA for 3-phase applications.
5. Secure transformers 75 KVA and larger to a concrete housekeeping pad.
6. Secure transformers smaller than 75 KVA in place on an angle wall mounting bracket support assembly located approximately 300 mm (1’-0") below ceiling. Provide support assembly and adequately secure to wall and/or ceiling construction.
7. Ground and bond equipment to ground electrode grids as per local governing electrical code and inspection authority requirements.
8. Acceptable manufacturers:
    1. Hammond Power Solutions / Delta.
    2. REX Power Magnetics.
    3. Delta Group.
    4. Schneider Electric.
    5. Siemens Electric.

6. ABB.
7. Eaton/Cooper Power Systems.

2. General Purpose Dry-Type:

1. Copper windings.
2. Class "H", 220°C class, coil insulation, such that winding temperature rise to not exceed 150°C (270°F) and enclosure temperature rise not exceed 65°C (117°F) under full load in a 40°C (104°F) ambient temperature.
3. Core construction consisting of stacked laminations of high permeability silicone steel.
4. Vacuum impregnated polyester or epoxy resin.
5. Lugs or pressure type terminals to suit primary and secondary conductors.
6. Up to 15 kVA: two - 5% full capacity taps; one above normal and one below normal; taps located on primary winding.
7. Greater than 15 kVA: four - 2-1/2% full capacity taps; two (2) above normal and two (2) below normal; taps located on primary winding.
8. An integral vibration dampening system with anti-vibration pads used between coil and core and enclosure.
9. Seismic restraint requirements to suit local governing authority requirements and codes.
10. Basic impulse level to meet CSA C9 standards.

3. Dry-Type K-Rated Distribution:

1. Same as specifications for General Purpose Dry-Type with the following additional requirements:
    1. K factor 13 rating as per ANSI/IEEE C57-110.
    2. Electrostatic shielding.
    3. Neutral sized for twice rated current.
    4. Common mode noise attenuation 60 dB minimum.

26 23 00 LOW VOLTAGE SWITCHGEAR AND SWITCHBOARDS

1. General:

1. Equip with 10% to 20% spares and spaces to allow for future work. Coordinate requirements with Owner.
2. Switchgear and switchboards to comply with and be designed, manufactured and tested in accordance with applicable conditions of following:
    1. CSA 22.2 No.31.
    2. ANSI-C37.20.1/C37.51.
    3. UL 1558.
3. Draw-out circuit breakers are to comply with and be designed, manufactured and tested in accordance with applicable conditions following:
    1. ANSI-C37.13/C37.16/C37.17/C37.50;
    2. UL 1066.
4. Moulded case breakers are to comply with and be designed, manufactured and tested in accordance with applicable conditions of:
    1. C22.2 NO. 5-16;
    2. U L 489.
5. Equipment to consist of individual sections bolted together to form an enclosed, self-contained, self-supporting structure with necessary facilities for proper ventilation. Sections to be of modern welded or bolted construction, fabricated from sheet steel in accordance with NEMA and CSA requirements and reinforced wherever necessary to provide adequate strength. Front doors to be formed type, fabricated with cold rolled sheet steel and complete with handle lock operators and locking tabs. Rear access to be provided with rear doors of hinged type with thumb screw hardware. Unless otherwise required, top and side panels to be secured suitably to a channel type base. After fabrication, equipment to be factory cleaned, bonderized, and finished in ANSI grey enamel.
6. Entire enclosure to be in accordance with minimum EEMAC 2 requirements with additional sprinkler protection requirements. Top of each cell to be complete with a "drip shield" designed to shed water without dripping on cell. Enclosure to be designed to prevent penetration of water spray from activated sprinklers onto live components. Doors and component openings to be gasketted.
7. Full height and depth fire retardant and non-hygroscopic barriers to be provided in sections, from top to bottom and from front to rear to contain faults and to minimize passage of ionised gases between vertical sections.
8. Where required to suit onsite access restrictions, equipment to be shipped to site in sections, and assembled on site.

9. Provide bus terminations for future extensions and gasketted water-tight removable side panels to accommodate installation and connection of future cells.

10. Main bus bars to be constructed of top quality, 98% pure, rectangular copper bars, silver plated at joints with lap type joints bolted using high strength steel bolts and extra wide, extra thick washers to ensure maximum pressure and even current distribution at each joint. Bus and connections to be designed so that maximum temperature rise in any part of equipment will not exceed 65C° (117F°) over an ambient temperature of 40°C (104°F). Bus to be properly isolated and designed to carry currents as required.

11. Continuous ground bus shall not be less than 6 mm (1/4") x 50 mm (2") cross section area extending length of equipment and to be solidly bolted to steel framework. Ground bus to be constructed of same material as main bus and complete with suitable lugs for grounding connections outlined on drawings. Ground bus to be rated for momentary current rating equal to or greater than that of apparatus in equipment.

12. Equipment to be suitable for use in building ground system with adequate short circuit capacity and to suit specific application to local governing electrical code requirements.

13. Acceptable manufacturers:

    1. Schneider Electric (Square D).
    2. Siemens Electric.
    3. ABB.
    4. Eaton.

2. Low Voltage Switchgear:

1. To be used for 600/347V, 3-phase distribution incorporated in Unit Substation equipment (refer to Section 26 11 00).

2. Indoor, metal enclosed units that are CSA approved and ULC listed and labelled as per local governing code requirements.

3. Switchgear bussing, structure and draw-out circuit breakers to be rated for 30 cycle withstand rating.

4. Where future draw-out circuit breakers are indicated, provide bus, stationary element, CT's, control and metering wiring such that only draw-out element is needed.

5. Allow for physical space and allow for future extension of an additional vertical section at one end of switchgear.

3. Metering:

1. To be used only on 600/347V switchgear.

2. Square D 5560, microprocessor based measuring and digital metering system in compliance with ANSI C12.20 Class 0.2%, to provide complete electrical metering with embedded WEB server.
3. System to measure and display voltage, current, frequency and time, and calculates and displays kW, KWh, KW demand, ampere demand, kVA, kVA demand, kVAR, kVARh and individual current and voltage harmonics.
4. System to include configurable event triggers that initiate alarm output. Alarm features including voltage phase loss, current phase loss, line voltage phase loss, voltage phase reversal, over voltage, under voltage and time delay.
5. Backlit LCD display with adjustable contrast to be provided on unit.
6. Unit to include inputs/outputs, contacts, RS485/MODBUS/TCP/IP Ethernet interfaces as required for communications to remote monitoring terminal or printer or BAS.
7. Suitable current transformers, potential transformers and control wiring to be provided.
8. Include custom clear acrylic, hinged locking cover over each unit.

4. Current and Potential Transformers:

1. Potential transformers (PTs) to be of compartment type and incorporate current limiting fuses.
2. Current transformers (CTs) shall have ratios to suit application, a mechanical rating equal to momentary rating of circuit breakers, and be insulated for full voltage rating of switchgear.

5. Low Voltage Switchboards:

1. To be used for 208/120V, 3-phase distribution.
2. Indoor, metal enclosed, standardized switchboards that are CSA approved and ULC listed and labelled as per local governing code requirements.
3. Use moulded case circuit breakers:
    1. Adjustable trip >= 400A
    2. Fixed trip < 400A

26 24 16 DISTRIBUTION PANELBOARDS

1. General:

1. Equip with 20% spares and spaces to allow for future work. Coordinate requirements with Owner.
2. Used for 600/347V and 208/120V, 3-phase systems.
3. Minimum bus rating: 200A.
    1. Use of lower bus rating requires Owner approval.
4. Minimum 14 kAIC rating.
5. Factory assembled dead front panelboards as per drawing schedules, manufactured to CSA Standard C22.2. No. 29.
6. 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 and conforming to CSA Standard C22.2 No. 5.
7. Locate both main lugs and neutral bar at same end. Shield main lugs through a removable cover.
8. Identify each circuit breaker adjacent to breaker handle.
9. Group mount circuit breakers.
10. Panelboard interior to have three flat bus bars stacked and aligned vertically with insulators laminated between phases. Insulators support and provide phase isolation to entire length of bus. A solidly bonded equipment ground bar and a neutral bar to be provided.
11. Bus bars (phases, grounds and neutrals) to be hard drawn electrical grade copper, silver plated and extend throughout panel.
12. Panelboard boxes to be constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements, complete with removable ends and wiring gutter space on sides in accordance with CSA requirements.
13. Floor mounted enclosures to be free-standing type, EEMAC 2 with sprinkler drip shield, reinforced as required to provide adequate strength.
14. Panelboards sized up to 600A and panelboards located in unsecure areas to be complete with doors, latches, and keyed alike locks.
15. Install floor mounted panelboards on concrete housekeeping pads. Provide seismic restraints as required by local governing authorities and codes.
16. Surface wall mount other panelboards, unless otherwise noted, independent of connecting conduit.
17. Equip each panelboard with suitable lugs to accommodate main and branch conductors as scheduled.

18. Identify panelboard and breakers with Lamacoid identification nameplate with nomenclature to Owner's requirements.
19. Ground and bond equipment as per local governing electrical code and inspection authority requirements.
20. Acceptable manufacturers:
    1. Schneider Electric (Square D).
    2. Siemens Electric.
    3. Eaton.

26 24 17 BRANCH CIRCUIT PANELBOARDS

1. General:

1. Equip with 20% spares and spaces to allow for future work. Coordinate requirements with Owner.
2. Used for 600/347V and 208/120V, 1-phase and 3-phase systems.
3. Minimum bus rating: 100A.
4. Minimum 10 kAIC rating.
5. Factory assembled dead front panelboards as per drawing schedules, manufactured to CSA Standard C22.2. No. 29.
6. Enclosures to be:
    1. EEMAC 1 for recessed installations.
    2. EEMAC 2 with sprinkler drip shield for surface installations.
7. Circuit breaker type panelboards to be complete with moulded case, bolt-on circuit breakers.
8. Panelboards to be equipped with one (1) continuous bus bar per phase. Each bus bar to have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. Bussing to be fully rated and of plated copper construction.
9. Identify each circuit breaker adjacent to breaker handle.
10. Enclosures to be constructed of code gauge, hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements, trim for flush or surface wall mounting; front panel to not be removable with the door locked.
11. Panels, doors and trim are to be factory painted with ANSI grey enamel finish. Recessed backboxes (tubs) need not be finished painted.
12. Equip breakers of frame size 400 amperes and greater, with solid state adjustable trip units. Breakers less than 400 amperes to be fixed trip.
13. Equip each panelboard with suitable lugs to accommodate main and branch conductors as scheduled.
14. Identify panelboard and breakers with Lamacoid identification nameplate with nomenclature to Owner’s requirements.
15. Ground and bond equipment as per local governing electrical code and inspection authority requirements.
16. Acceptable manufacturers:
    1. Schneider Electric (Square D).
    2. Siemens Electric.
    3. Eaton.

26 27 19 SURFACE RACEWAYS

1. General:

1. CSA certified, ULC listed and labelled, prime coated galvanized steel, 2-compartment, surface mounted, metal service raceways, complete with following:
    1. Duplex grounding receptacles and mounting knockout plates.
    2. Data outlet mounting bracket.
    3. Dual covers (one for power and one for communications).
    4. Clips, couplings, brackets, fittings, elbows, boxes, tees mounting hardware, etc., for a complete raceway system.
2. Provide stainless steel type raceways in laboratories and similar type rooms.
3. Size raceways for computer network structured cabling in compliance with EIA/TIA Standards for required Category of cabling. Increase raceway sizing to suit.
4. Acceptable manufacturers:
    1. Legrand-Wiremold.
    2. Thomas & Betts.
    3. Hubbell.
    4. Panduit.

26 27 26 WIRING DEVICES

1. General:

1. All to be CSA approved, ULC listed, certified and labelled devices.
2. Decora style devices to be used for staff areas (offices and for devices with USB ports).
3. Devices shall be minimum commercial grade; specification grade products shall not be used.
4. Standard style devices for meeting rooms and all other areas.

2. Light Switches:

1. CSA approved, heavy duty, industrial grade, quiet action toggle type, 20 ampere, 120-277 VAC.
2. Acceptable manufacturers:
    1. Hubbell Canada Inc.
    2. Eaton - Cooper Wiring Devices (Arrow Hart).
    3. Legrand - Pass & Seymour.

3. Receptacles:

1. CSA approved, ULC listed, extra heavy duty, commercial grade, duplex U-ground, 15/20 ampere, 125V, 2-pole, 3-wire grounding receptacles.
2. Where noted that 20 A receptacles are required, include for "T" slot type of respective series of receptacles.
3. CSA approved, ULC listed, 2- USB ports (5V DC, type A and C) and 15 ampere, 125V rated duplex decorative power receptacles.
4. Extra heavy duty grade, 15/20 ampere, 125 V, duplex, ULC Class "A", Group One, weather resistant ground fault circuit interrupting receptacles complete with automatic self-test diagnostics, green power ON LED, red ground fault LED and 10kA short circuit current rating.
5. Heavy Duty decorator series, CSA approved, ULC listed, 15/20 ampere, 125 V, 2-pole, 3-wire grounding, duplex receptacles complete with wrap around galvanized steel mounting strip and oversize terminal screws.
6. EEMAC type 14-30R, 30 ampere, 125/250 V, 3-pole, 4-wire single electric clothes dryer receptacles with steel faceplates.
7. EEMAC type 14-50R, 50 ampere, 125/250 V, 3-pole, 4-wire single electric range receptacles with steel faceplates.
8. Commercial grade, 30 ampere, 250 V, single, 3-pole, 4-wire grounding twist lock receptacle.

1. Showcase receptacle.
2. Installed in 300 mm x 300 mm (1'-0" x 1'-0") box.
3. Used in gathering areas, cafeterias and meeting halls.
4. Coordinate locations with Owner.

9. Isolated ground receptacles are not typically used. Owner approval required.
10. Acceptable manufacturers:
    1. Hubbell Canada Inc.
    2. Eaton - Cooper Wiring Devices (Arrow Hart).
    3. Legrand - Pass & Seymour.

4. Faceplates:

1. All devices shall possess stainless steel faceplates.

5. Drop Cord Assemblies:

1. CSA approved, drop cord assemblies including but not limited to following:
    1. Ceiling mounted junction/outlet box;
    2. Kellems type strain relief grips and bus drop / drop cord grips to prevent tension being transmitted to ceiling boxes/conduit, and joints and terminations of cord;
    3. Type SO, CSA approved, ULC listed and labelled, yellow neoprene jacket, oil resistant, 300 VAC rated, minimum No. 12 AWG conductors, drop cord;
    4. Appleton No. RE PPB non-conductive rubber and plastic power outlet box with duplex 15A-125V receptacle and matching to box gasketted faceplate.
2. Acceptable manufacturers:
    1. Hubbell.
    2. Appleton.
    3. Cooper B-line.

6. Retractable Reels:

1. CSA approved, ULC listed and labelled, designed for indoor and outdoor applications.
2. Rugged all steel construction.
3. Cast aluminum frame and steel reel sides.
4. Adjustable four roller cable outlet guide allowing cable way out up to 30 degrees in all directions from center.
5. Rated 30A, 120VAC, 1-phase.
6. 3-runs of no. 10 AWG, type SO oil resistant copper conductor cable.

7. Acceptable manufacturers:
    1. Appleton Electric.
    2. Crouse-Hinds.
    3. Thomas & Betts.
    4. Cooper Wiring.

26 32 03 NATURAL GAS GENERATOR SETS

1. General:

1. Engine generator sets (gensets) to be factory assembled and tested, radiator cooled, natural gas engine driven electric gensets including necessary controls and accessories to comprise a continuous, standby/emergency electric generating plant for operation in conditions.
2. A complete system shall include, but limited to, the following:
    1. Engine.
    2. Alternator.
    3. Fuel system.
    4. Exhaust system.
    5. Coolant heaters.
    6. Cooling system.
    7. Starting system.
    8. Vibration isolators.
    9. Control panels.
    10. Remote annunciator panel.
    11. Enclosure (refer to Section 26 32 05).
    12. Automatic transfer switch (refer to Section 26 36 00).
    13. Shore power connections for temporary genset (refer to Section 26 32 06).
3. Gensets to be equipped with necessary operating accessories such as air cleaner, radiator fan, lubricating oil pump, governor, alternating current generator and other specified and required engine driven components and accessories.
4. Gensets and associated equipment to be constructed to and to perform in accordance with local governing authority enforced edition of CSA Standard CAN/CSA C282, "Emergency Electrical Power Supply of Buildings".
5. Genset shall comply with the levels of noise and air emissions approved by Ministry of the Environment, Conservation and Parks (MECP).
6. Genset shall possess separate breakers for the following:
    1. Essential loads.
    2. Standby loads.
    3. Fire pump.
    4. Load bank test breaker sized for the full load rating of the unit.

7. Gensets and associated equipment to comply with mechanical systems base design parameters (ie. fuel consumption, cooling operating data, air/exhaust operating data, etc.) to ensure that design minimum standards and performance criteria for units are met.
8. Coordinate natural gas piping connections and alarm connections with Mechanical.
9. Provide connection to gas isolation valves at incoming gas supply on main building and indicate alarm when valves are isolated preventing gas supply.
10. Size room/enclosure to ensure that proposed gensets and associated equipment can be accommodated and also allow for sufficient space for maintenance, repairs, and safety as per applicable code requirements.
11. Gensets and associated equipment to be fully integrated to comprise a standby/emergency power system which automatically functions as follows:
    1. Start in event of a commercial power failure;
    2. Stop when commercial power has been restored;
    3. Be capable of operating at light loads for an extended period of time as normal power failure may occur when only part of full output of genset is required.
12. Gensets to be rated for 600/347V, 3-phase, 4-wire, 60Hz. Owner approval required for other voltages.
13. Engines to be a multi cylinder, 4-cycle, capable of operating at a nominal speed of 1800 RPM when directly connected to alternator and free from critical vibrations throughout its entire operation range.
14. Location:
    1. Indoor in generator room.
    2. Outdoors at grade level.
    3. Unit shall not be installed on the roof.
15. Include for a five (5) year service/maintenance contract from the supplier.
16. Acceptable suppliers:
    1. Tormont.
    2. Approved equal.
17. Factory testing of engine generator sets to be performed prior to delivery to job site.
18. On site testing to be performed at times acceptable to Owner.
19. Electronic controls shall monitor various engine performance characteristics including, but not limited to, following:
    1. Oil temperature.
    2. Timing of engine.

3. Coolant pressure and level.
4. Oil and fuel pressure.
5. Running hours.
6. Air temperature.
7. Battery voltage.
8. Engine overspeed.

20. Provide controls, contacts and annunciation of shut downs (red) and warnings (amber) alarms for following conditions:
    1. High oil temperature – red;
    2. High oil temperature warning – amber;
    3. High coolant temperature – red;
    4. Low oil pressure warning – amber;
    5. Low oil pressure – red;
    6. Overcrank – red;
    7. Overspeed – red;
    8. Over voltage – red;
    9. Low dc voltage – amber (alarm lamp complete with dc voltage sensor);
    10. Cool down period – white;
    11. Reverse power – red;
    12. Undervoltage – red;
    13. Low frequency – red;
    14. High frequency – red;
    15. Low coolant level – amber;
    16. Low fuel pressure – amber;
    17. Gas supply valves isolated – amber;
    18. Battery charger failure – amber;
    19. Emergency bus alive – blue;
    20. Generator bus alive – amber;
    21. Ecs not in auto – amber;
    22. Low engine temperature – amber;
    23. Alarm silence – amber;
    24. Alternator winding and bearing high temperature – amber;

25. Ground fault – amber;
26. Genset main breaker open - amber;
27. Automatic transfer switch in non-auto or bypass mode – amber;
28. Combustion air intake damper does not open to 85% after 30 seconds - amber;
29. Air shutdown damper (if applicable) – amber;
30. Ventilation dampers not open – amber;
31. Remote emergency stop station (if provided) – amber;
32. Ancillary building alarms as required;
33. Two spares for future.

2. Shore Connections:

1. Provide shore power and control connection boxes for a temporary generator rated the same size as the building generator.
2. Connection box enclosures shall be EEMAC 3R with removable openings for temporary power and control cables.
3. Location of power and control connections to be coordinated with Owner and be close to the temporary generator.
4. Power connection box shall allow for easy connection of portable cables from temporary generator. Possibility of exposed connections in the box shall be avoided.
5. Control connection box shall all for the automatic control of the temporary generator. Allow for all control connections typical for a temporary generator.
6. The building generator shall be completely isolated when the temporary generator system is in use. In no way shall both the building generator and temporary generator be online.
7. Generator is to be tied into building's fire alarm system such that fire alarm panel enters supervisory alarm when:
    1. Generator is running;
    2. Generator is not in auto;
    3. Generator trouble;
    4. Gas valve position;
    5. Automatic transfer switch – change of state.
8. Service lights for generator are to be 120 volt. No battery-based emergency lighting system is required.

26 32 05 GENERATOR SET ENCLOSURES

1. General:

1. "Skin-tight" type genset enclosure to be provided to house genset complete with silencers, control panel, batteries and accessories.
2. Outdoor, weatherproof, sound attenuated, corrosion resistant.
3. Non-combustible fire-rated construction designed to required local governing authority and code requirements.
4. Heavy duty aluminium or steel outer skin over heavy duty steel framework construction and primed and finished with corrosion resistant paint finish.
5. Dry type distribution transformer and breaker panelboard, sized to accommodate loads of enclosure components requiring power feeds.
6. Locking access panels.
7. Radiator guard.
8. Heavy duty steel beam mounting base.
9. Insulated ventilation louvers and dampers.
10. Insulated enclosure with non-hydroscopic materials.
11. Corrosion resistant stainless steel door hardware, hinges and locks.
12. Warning signs.
13. Vandal proof construction.
14. Thermostatically controlled forced air internal heater to keep interior temperature at minimum temperature as per CSA C282.
15. Exhaust fan for internal high temperature heat removal from enclosure and include modulating thermostat control.
16. Weatherproof cable stub and openings for connection cabling through underside of base.
17. Acceptable suppliers:
    1. Tormont.
    2. Approved equal.
18. Coordinate structural base requirements for mounting of containerized genset with Structural. Provide concrete pad of dimensions covering size of genset enclosure and extending 600 mm (2’-0”) beyond each side, and of depth to accommodate weight of entire unit. Include for seismic restraints as required.
19. Provide required vibration isolation and seismic restraints.

26 36 00 AUTOMATIC TRANSFER SWITCHES

1. General:

1. CSA approved, automatic transfer switch and bypass isolation switch (ATS/BPS), double-throw, electrically operated, mechanically held, fully protected, complete with voltage sensing relays, a manual transfer facility incorporating spring handles, current ratings as indicated, arc chutes, magnetic blow-out coils and components necessary to provide proper performance and operation.
2. Automatic transfer and bypass isolation switch to conform to CSA requirements including latest edition of CSA Standard, C22.2 No. 178, "Automatic Transfer Switches".
3. ATS/BPS to be of withstand current ratings meeting available short circuit currents at location of each transfer switch.
4. ATS/BPS to be provided to manually permit convenient electrical bypass and isolation of automatic transfer that could not otherwise be tested and maintained without interrupting load.
5. ATS to consist of a power transfer module and a control module, interconnected to provide complete automatic operation. Automatic transfer switch to be mechanically held and electrically operated by a single solenoid mechanism energized from source to which load is to be transferred.
6. Control panel to consist of a digital microprocessor controller with LCD display. Panel to be supplied with a protective cover and be mounted separately from transfer switch for ease of maintenance.
7. ATS/BPS supplying power for elevators to be equipped with a selective load disconnect and time delay control circuit to inhibit transfer for a pre-set amount of time to allow elevator controls to sense contact position of transfer switch to program itself to accommodate up-coming transfer.
8. Enclosures to be dead front access, free standing enamelled steel, minimum NEMA 2 cubicle with sprinkler protection provisions including drip shield, ventilation louvers designed to protect live components from water spry from activated sprinklers and gasketted doors and openings. Units to be finished in ANSI grey enamel.
9. Acceptable suppliers:
    1. ASCO (no exceptions).
10. Standard factory tests to be performed on ATS equipment in accordance with CSA, UL and NEMA standards.

26 41 00 LIGHTNING PROTECTION

1. General:

1. Provide lightning protection for all new builds.
2. Lightning protection system to be designed to meet latest requirements of CSA Standard CAN/CSA B72, "The Installation Code for Lightning Protection" and where applicable, Provincial Lightning Rods Act.
3. Lightning protection system to consist of CSA approved or ULC listed materials, including but not be limited to:
    1. 16 mm (5/8") diameter solid copper air terminals; of lengths as per system manufacturers recommendations to suit application.
    2. 25 mm (1") x no. 17 gauge copper grounding straps.
    3. Minimum 4 ounce braided stranded copper "lightning conductor" down lead cables and roof network conductors.
    4. Minimum 4 ounce braided stranded copper roof conductors.
    5. Rigid PVC conduit; exposed PVC conduit to include UV protection coating.
    6. Minimum 20 mm (3/4”) diameter and minimum 3 m (10'-0”) long (sectionalized 1.2 m [5'-0”] lengths) circular cross section copper bond type ground rods with rod section couplings, driving cap and bronze tip; top of rods to be accessible in waterproof sealed grounding pits; each pit to include a disconnectable measuring point.
    7. Inspection pit with test coupling, earth equipotential bar, die cast brass connectors, die cast brass clamps and ground rods.
    8. 4 ounce stranded copper ground conductors.
    9. Ancillary devices as required and as recommended by system manufacturer.
4. When copper lightning conductors and materials come in contact with surfaces of dissimilar materials such as aluminum, aluminum conductors and components may be provided in accordance with applicable local governing codes and standards, and as per system manufacturer’s recommendations. Conductors and components extending into ground or are in contact with ground are to be copper.
5. Products to satisfy requirements of local governing authorities.
6. Installers to be as recommended by system manufacturers/suppliers and have minimum 10 years’ experience in installation of lightning protection systems.
7. Acceptable manufacturers/suppliers:
    1. Dominion Lightning Rod Co. Ltd., (Dundas, Ontario)
    2. Burchell Lightning Protection Ltd.
    3. Heary Bros.

4. Dodd & Struthers Ltd.

26 50 00 LIGHTING

1. General:

1. Lighting designs shall conform to:
    1. IESNA Lighting Handbook.
    2. IESNA RP-3-10 Lighting for Educational Facilities.
    3. Brock University Facility Accessibility Design Standards (FADS).
2. Age requirements for illuminance targets:
    1. Classrooms, labs and other areas occupied by students: <25 years.
    2. Offices and areas occupied by staff: between 25 and 65 years.
3. Confirm to SB-10 and ASHRAE 90.1 requirements for new builds and additions only.
4. Indoor lighting targets:
    1. Offices 40 fc, 2:1 avg:min uniformity
    2. Corridors & Circulation areas 20 fc, 2:1 avg:min uniformity
    3. Mech/Elec rooms 20 fc, 3:1 avg:min uniformity
    4. Washrooms/changerooms/locker rooms 20 fc, 2:1 avg:min uniformity
    5. Classrooms 40 fc, 2:1 avg:min uniformity
    6. Teaching Labs 40 fc, 2:1 avg:min uniformity
    7. Sciences Labs 50 fc, 2:1 avg:min uniformity
    8. Workshops 50 fc, 2:1 avg:min uniformity
    9. Gymnasiums 100 fc, 3:1 avg:min uniformity
    10. Specialized areas – to suite IESNA and/or Brock's FADS requirements.
5. Outdoor lighting targets
    1. Parking areas (secure), 3 fc avg, 4:1 avg:min uniformity
    2. Building entries (canopies) 3 fc, 2:1 avg:min uniformity
    3. Pedestrian walkways/paths 1 fc, 4:1 avg:min uniformity
6. Color temperature:
    1. Indoor – 4000K, no exceptions.
    2. Outdoor – 5000K, no exceptions.
7. DLC and Energy Star listed fixtures will be preferred for use in rebate program.
8. Equipment shall be minimum commercial grade; specification grade products shall not be used.
9. Installations in minor renovations to follow existing fixture specs.

10. Installations for major renovations, additions and new builds shall use new LED type fixtures. Fluorescent, compact fluorescent, HID and other technologies shall be avoided. Owner approval required for use of other technologies.
11. Projects involving the replacement of HID outdoor lighting shall use new LED fixtures.
12. Luminaires including integrated LEDs and drivers are to be CSA approved or have special local electrical authority approval.
13. LEDs and drivers shall be supplied and factory installed by the same luminaire manufacturer.
14. Warranty for LED luminaires and LED drivers shall be for a period of 5 years from date of application for Certificate for Substantial Performance of the Work.
15. Outdoor fixtures shall possess “bird control spikes” where possible.
16. Poles shall be suitable for steady wind velocity and gust velocity of area of installation, and suitable for total effective projected area of mounted lighting equipment.
    1. Roadway – tapered 7.6 m (25’-0”) round, aluminum.
    2. Parking lots – straight 12.2 m (40’-0”) round, aluminum.
    3. Pathways – 127 mm x 127 mm (5” x 5”) square, 3.66 m (12’-0”), aluminum.
    4. All poles to be black, powdered coated.
17. Poles shall be supplied with banner support arms 30 inches wide by 60” long.
18. Light pole bases to conform to Section 26 05 31.
19. Voltage ratings:
    1. Interior lighting – 120VAC.
    2. Building mounted outdoor lighting – 120VAC.
    3. Roadway lighting – 347VAC.
    4. Parking lot lighting – 347VAC.
    5. Landscape/pathway lighting – 347VAC.
20. Indoor linear LED luminaires bodies to be constructed of extruded aluminum and of rigid construction. Provide body finishes of corrosion resistant, chemically treated and electrostatically applied post powder coat finish.
21. Vandal resistant luminaires to be constructed of heavy duty extruded aluminum rails and die cast end caps, complete with stainless steel torx with centre reject pin and Allen head set screws. Screw heads to be mounted and concealed under lens. Lens to be extruded UV stabilized polycarbonate lens with internal linear ribbed design.
22. Acceptable manufacturers:
    1. Cree – currently base spec for roadway lighting fixtures.
    2. Lumark – currently base spec for parking lot lighting fixtures.

3. Eaton/Cooper.
4. Lithonia.
5. Phillips.
6. Thomas.

23. **Base Fixture Models**: These will be considered on a project specific basis and reviewed with the University for approval.

26 52 00 EMERGENCY AND EXIT LIGHTING

1. **General:** No inverters or UPS systems shall be used for life safety systems.

2. **Emergency Lighting:**
    1. Fixtures in existing facilities to be fed from essential power system (120VAC).
    2. Fixtures for additions shall be supplied by either of the following:
        1. New emergency generator.
        2. Add to existing essential power system if loading permits.
    3. Fixture for all new builds to be fed from new emergency generator.
    4. Illumination levels to conform to OBC and FADS requirements.
    5. 1 fc average, 0.1 fc minimum.
    6. Fixtures used for emergency will be assigned from general lighting in the space.
    7. For corridors, every 5-6 fixtures to be on emergency circuit. Design to be dictated by illumination requirements.
    8. Provide bypass shunt relays on emergency power lighting circuits in gymnasiums and event areas.

3. **Exit Lighting:**
    1. Use green running man pictogram type in accordance with the OBC.
    2. Fixture body shall be manufactured from extruded aluminum, be gasketed to eliminate light leaks, have field selectable direction chevrons and universal mounting.
    3. Fixtures in existing facilities to be fed from essential power system (120VAC).
    4. New builds and additions to be fed from the same system feeding emergency lighting i.e. new generator or existing essential power system.
    5. All fixtures shall be LED only.
    6. Use vandal resistant exit signs in residences.
        1. Surface mounting preferable in residences.
        2. Avoid suspended, ceiling mount or arm mount in residences.
    7. Where required, provide wire guards manufactured by the manufacturer specifically for the exit fixtures(s) being supplied.
    8. Acceptable manufacturers:
        1. Beghelli.
        2. Stanpro.
        3. Emergi-Lite – Thomas & Betts.

4. Lumacell – Thomas & Betts.
5. Dual Lite.

26 60 20 ELECTRIC HEATERS

1. General:

1. Provide CSA approved systems in compliance with local governing codes and standards.
2. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
3. Provide contactors as required for connected loads and relays suitable for connection to remote thermostats.
4. Generally, in finished areas, ceiling or wall mounted units to be flush mounted and complete with flush trim.
5. Acceptable manufacturers:
    1. Dimplex.
    2. Stelpro.
    3. Ouellet.

2. Baseboard Heaters:

1. Standard watt density electric baseboard heaters.
2. Construction – contoured front and top constructed of extruded aluminium with front air intake and exhaust vents; large rear entry junction boxes on both sides; knockouts for power connection.
3. Elements - stainless steel sheath enclosing nickel chromium finned tubular element; aluminum fins.
4. Finish - hybrid polyester epoxy powder coat.
5. Thermostat - adjustable, integral, tamperproof, 7°C - 30°C (45°F - 85°F) range.
6. Full length automatic overheat protection.
7. Mounting hardware, as required to suit specific applications and installations.
8. Relays and transformer kit of rating to suit thermostat.

3. Electric Unit Heaters:

1. Wall or ceiling mounted blower type unit heaters.
2. Cabinet - fabricated of minimum 18 gauge steel; individual adjustable 20 gauge convex profile air directing louvers.
3. Finish – hybrid polyester epoxy powder coat.
4. Elements – metal tubular sheath fused with spiral fins; nickel chromium wire encased in solidly packed magnesium oxide insulation.

5. Motors and fan – fan size and pitch matched to power and speed of unit; heavy duty, continuous operation, totally enclosed, with over temperature protection built-in and sealed permanently lubricated ball bearings.
6. Thermostat - adjustable, integral, 7°C - 30°C (45°F - 85°F) range.
7. Ceiling and wall mounting brackets as required to suit specific applications and installations.
8. Summer fan control and low voltage control to suit specific applications and installations.

4. Electric Fan Forced Heaters:

1. Ceiling or wall mounted.
2. Cabinet – front panel fabricated of minimum 20 gauge steel and finished in polyester epoxy powder coating; surface or recessed mounted; knockouts for wiring connections.
3. Elements – spiral steel fins; nickel chromium resistance wire with a steel sheath.
4. Motors – totally enclosed, with sealed permanently lubricated ball bearings; black anodized 5 blade mixed flow aluminum fan; bi-metallic snap action fan delay.
5. Tamperproof access door over controls.
6. Thermostat - adjustable, integral, 7°C - 30°C (45°F - 85°F) range.
7. Surface mounting backbox, as required for surface mounting applications.
8. T-bar ceiling mount trim for recessed in T-bar ceiling mounting applications.

27 00 00 COMMUNICATIONS

27 10 00 STRUCTURAL CABLING SYSTEM

1. General:

1. Designs to conform to the following:
    1. ANSI/TIA-568-C, family of Telecommunications Standards.
    2. ANSI/EIA/TIA 606-B (CSA T528) - Administration Standard for Telecommunications Infrastructure of Commercial Buildings.
    3. ANSI/EIA/ TIA-607-B (CSA T527) - Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.
    4. ANSI/EIA/TIA-569-C (CSA T530) - Commercial Building Standards for Telecommunications Pathway and Spaces.
    5. ANSI/TIA-526-14-B - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
    6. ANSI/TIA/EIA-526-7 - Optical Power Loss Measurements of Installed Single mode Fiber Cable Plant.
    7. Latest Building Industry Consulting Service International (BICSI) standards.
    8. Applicable local Building Codes.
2. Installation shall be by system manufacturers certified system installers/vendors who are certified and experienced in implementing selected data cabling system and to perform related testing programs.
3. System final installation layout to be designed and/or reviewed by a RCDD. Submit shop drawings verifying this requirement.
4. System manufacturers to provide a minimum twenty (20) year full parts, labour, and performance warranty on all passive components including structural cabling system.
5. Acceptable structured cabling system manufacturers:
    1. Belden.
    2. Commscope Systimax/Uniprise.
    3. Panduit.

2. Approved Contractors and Qualifications:

1. **Approved Contractor List**: Cinema Stage.
2. **Contractor/Vendor Qualifications**:
    1. The successful contractor/vendor awarded to perform the scope of work described herein, must have a minimum of (5) years of experience.
    2. The vendor must have an RCDD® (Registered Communications Distribution Designer) assigned to Brock University projects or equivalent BICSI industry standard certification. These may include RITP (Registered Information

Technology Professional), Registered Telecommunication Project Manager (RTPMi), Data Center Design Consultant (DCDC) or Network Technology Systems Designer (NTS). The RCDD/equivalent must have a minimum of (3) years' experience in this type of project design, as to adequately support the installers during installation, during the warranty/extended warranty period, and during support maintenance periods.

3. The vendor must have manufacturer/industry (BICSI) certified installers and technicians on staff assigned to this project. Substitute personnel will not be accepted. The project shall be staffed at all times by installers and technicians who have a minimum of (2) years experience.

3. Wiring:

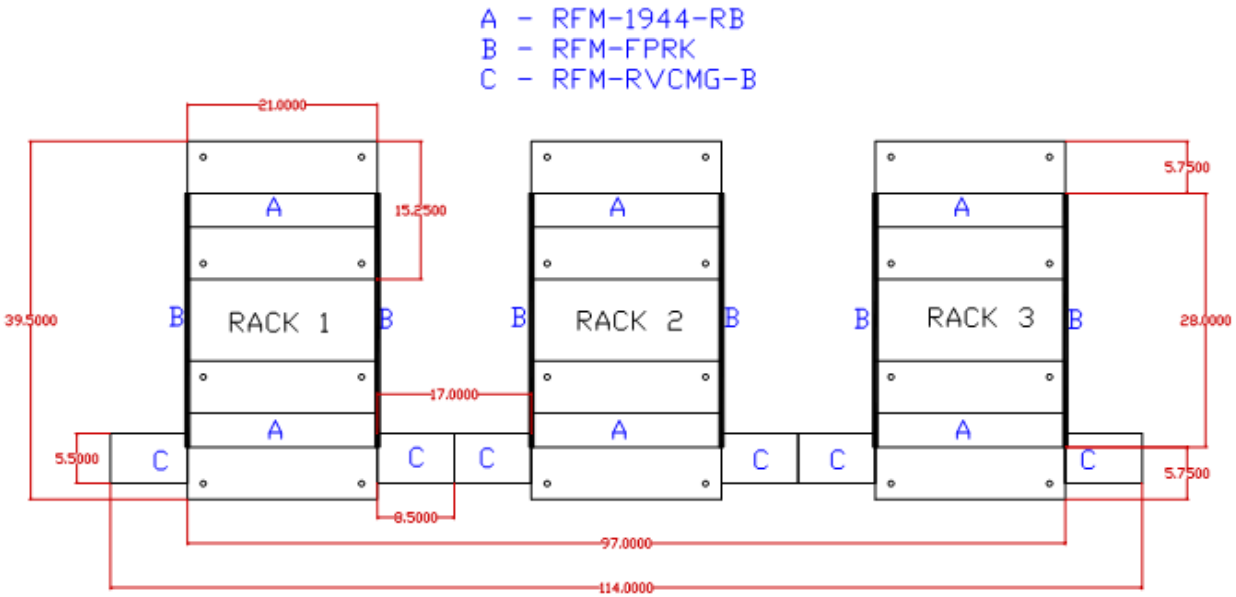
1. **Data/Analog Voice Rise**r:
    1. Copper 50 pair.
    2. CAT3 (16MHz), DIW 50-Pair, U/UTP-unshielded, Plenum-CMP, Premise Backbone Cable, 24 AWG solid bare copper conductors, LS-PVC insulation, ripcord, LS-PVC jacket.
    3. Belden part # DPLN50 732CUT; ordering part # 24571235.
2. **Data/Analog Voice Feed**:
    1. Copper 100 pair.
    2. CAT3 (16MHz), DIW 100-Pair, U/UTP-unshielded, Plenum-CMP, Premise Backbone Cable, 24 AWG solid bare copper conductors, LS-PVC insulation, ripcord, LS-PVC jacket.
    3. Belden part # DPLN100 732CUT; ordering part # 24571250.
3. **Horizontal Station Cables**:
    1. Cable from each station drop to the communications closets.
    2. CAT6+ (350MHz), 4-Pair, F/UTP-foil shielded, Plenum-CMP, Premise Horizontal cable, 23 AWG solid bare copper conductors, FEP/PO insulation, patented X-spline, overall Beldfoil® shield, Flamarrest® jacket.
    3. Belden GigaFlex 2400 series (2413F Plenum); ordering part # 24567945 "blue".
4. **Station Patch Cables**:
    1. 7ft, 10ft and 15ft length patch cables.
    2. Quantity of cables must equal the number of horizontal drops.
    3. CAT6+ Patch Cord, Bonded-Pair, 4 Pair, 24 AWG Solid, CMR, T568A/B-T568A/B, blue.
    4. 7ft Belden ordering part # C601106007.
    5. 10ft Belden ordering part # C601106010.

6. 15ft Belden ordering part # C601106015.

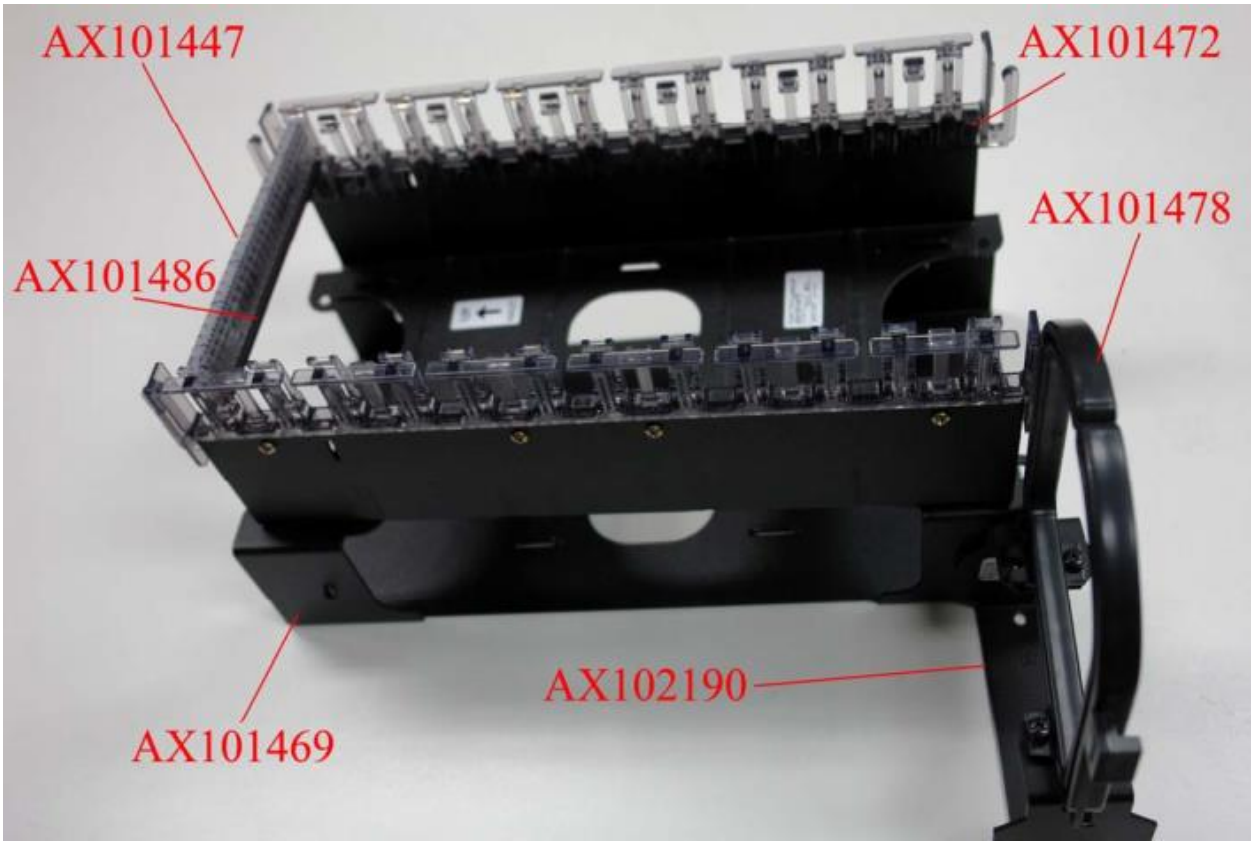
5. **Copper Alarm Cable**:
    1. Provo #99422 – Station Plenum Type “Z”, 2 pr, 22 AWG., CSA, CMP FT-6
    2. Provo #996705 – 5 conductor, shielded, 22 AWG, 7x30 Stranded, CSA CMP FT-6.
6. **Multimode Fiber**:
    1. 24 pair 10Gbps optimized OM3 multimode 50um fiber.
    2. Corning #024S8P-31190-29.
7. **Single mode Fiber**:
    1. 24 pair single mode fiber.
    2. Corning # 024E8P-31131-29.

4. Copper Support Systems:

1. Provide three 208 VAC, 30A LC AC plugs located on racks, connected to building emergency power.
2. **Rack system**:
    1. Four post rack kit: R.F. Mote #RFM-FPRK.
    2. Relay rack tapped both sides: R.F. Mote # RFM-1944-RB.
    3. Rack cable managers: R.F. Mote # RFM-RVCMG-B.
    4. Three (3) four post racks with six RFM-RVCMG-B vertical management systems to be installed in each communications room.
    5. Two (2) RFM-1944-RB with two (2) RFM-FPRK makes one four post rack.



3. **Horizontal Cable Management**:
    1. For every switch installed, provide a single sided D-ring manager.
    2. Panduit part #CMPHH2.
4. **GigaBIX Cross Connect Wires**:
    1. CAT6, 4-Pair, U/TUP-Unshielded, Premise Cross-Connect Cable, 23 AWG solid bare copper conductors, Dual FRPO/FEP insulation.
    2. Belden part #XCGB4.
5. **GigaBIX System**:
    1. All pigtails and horizontal cables to be punched down onto a GigaBix setup shown below.



2. GigaBIX Connector, 6-port: Belden part # AX101447.
3. GigaBIX Cable Management Module: Belden part # AX101469.
4. GigaBIX Mount, 12-connector: Belden part # AX101472.
5. GigaBIX Management Ring: Belden part # AX101478.
6. GigaBIX Wire Guard: Belden part # AX101486.
7. GigaBIX Management Ring Spacer: Belden part # AX102190.

5. Fiber Support Systems:

1. In main communication rooms, provide Belden part # AX101085 Fiberexpress Manager Shelf 19 inch.
2. All other communication rooms:
    1. Belden part # AX101943 Fiberexpress Manager Shelf 1U rack mount patch panel, 19 inch.
    2. Belden part # AX102032 Fiberexpress Manager Shelf 1U cable management accessory.

6. Fiber Connector Modules:

1. Belden part # AX101120 - SC Duplex (ST in), 12 fibers for multimode.
2. Belden part # AX101119 – SC Duplex (St in), 12 fibers for single mode.

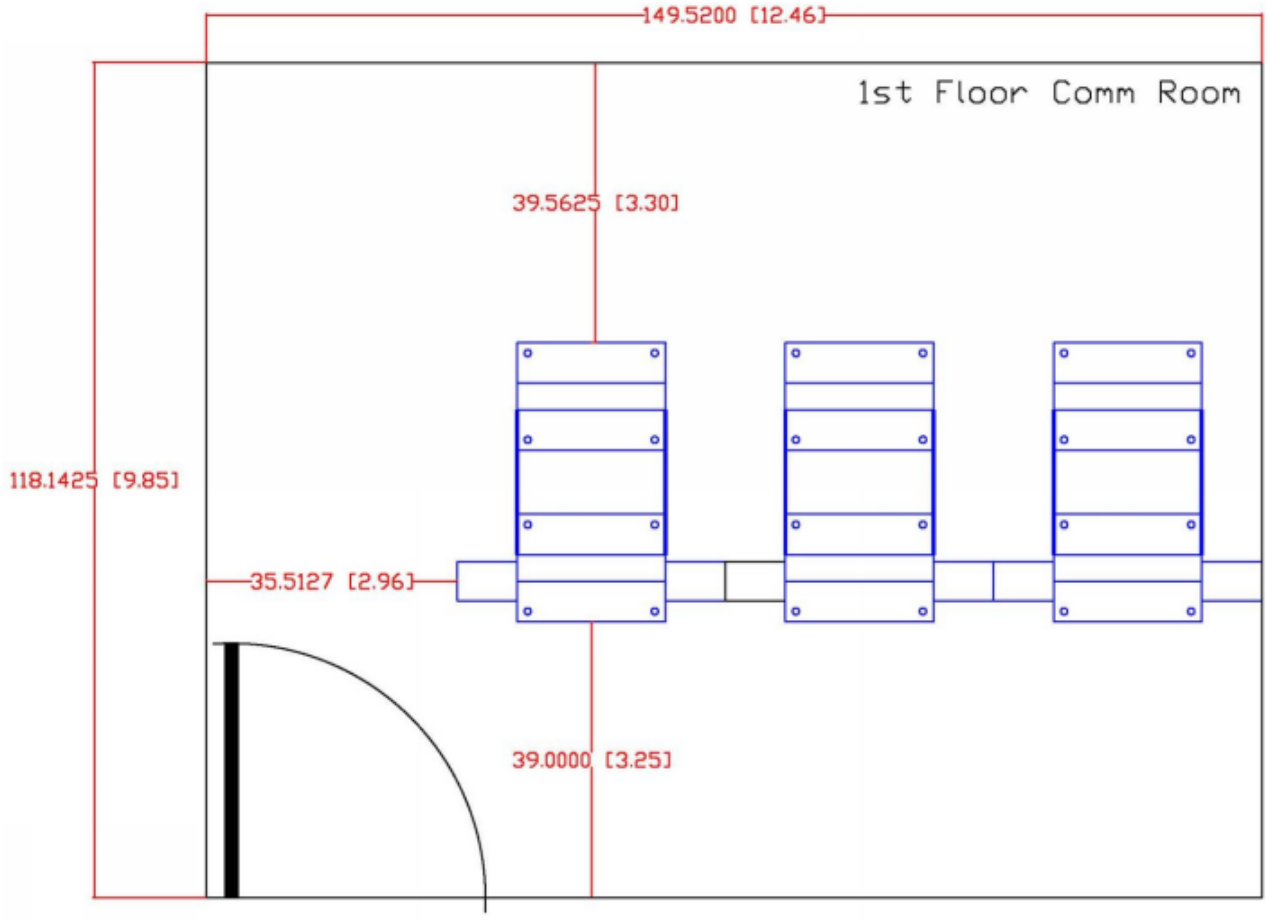
7. Data Jacks:

1. Data jacks to be blue in colour.
2. Panduit # CJ88 for CAT3 wiring.
3. Panduit # CJ6X88TG for CAT6 wiring.

8. Faceplates:

1. All faceplates to be white in colour.
2. Stainless steel faceplates shall not be used for any applications.
3. Panduit # CFPL2 for 2 jack.
4. Panduit # CFPL4 for 4 jack.
5. Panduit # CFPL6 for 6 jack.

9. Typical Communications Room Layout:



1. Provide fire rated plywood (3/4”) on all walls, floor to ceiling.
2. Provide the following connected to building emergency power:
    1. Two 120 VAC, 20A L5-20 T-slot on each long wall.
    2. One 120 VAC 20A L5-20 T-slot on short wall by door.
3. Provide grounding bus in communications room. Refer to Section 26 05 26.
4. All communications racks to be connected to ground bus.
5. Provide adequate lighting illuminate walls in front and behind of communications racks.
6. Communications cable tray above racks to be basket type, sized 300 mm x 600 mm (1’-0” x 2’-0”). Refer to Section 26 05 36.

10. Labelling and Identification:

1. All cabling, faceplates and terminations must be labelled according to ANSI/EIA/TIA-606(B) Standards.
2. Labels that are machine-printed will only be accepted.
3. Hand written labels are unacceptable.

11. Testing:

1. All testing shall comply with ANSI/EIA/TIA-568-C.1/C.2 specifications for the cabling.
2. Testing must be performed using Level IIe or higher field testing equipment approved for use with standard industry practices.
3. Testing of optical fiber must be done at 850 nm and 1300 nm as per ANSI/TIA-568-C.3 standards.
4. Test results for all terminations may be submitted to the Owner in electronic format.

27 51 25 ASSISTANCE CALL SYSTEMS

1. General:

1. Provide CSA approved and/or ULC listed system in compliance with local governing codes and standards.
2. Provide wiring in conduit.
3. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
4. System supplier/installer to be an established communications and electronics contractor that currently maintains locally run and operated business for at least 5 years and holds applicable provincial and local licenses.
5. Provide power supplies, wiring and mounting hardware as required per system manufacturer requirements.
6. Sound level of interior audible devices to be set at level required by local governing authorities and acceptable to Owner.
7. Acceptable manufacturers:
    1. Camden Door Controls.
    2. Edwards (Chubb Edwards).
    3. Aiphone.
    4. TOA.
    5. Telecor.
    6. Rauland.
    7. Mircom.
    8. Jeron.
8. System manufacturers authorized representative to program system and to integrate to other low voltage systems.

2. Universal Washroom Assistance Call System:

1. Activated call station in washroom sends signal to audible and visual devices that indicates that someone in washroom needs assistance.
2. Audible devices and visual devices located over washroom door illuminates and sound tone when remote stations are activated; visual and audible signals to be distinct and of different type of signals from other building systems; audible device sound levels to be user protectable adjustable.
3. Call stations, audible devices and visual devices to only be reset when call has been responded to and activated station locally reset.
4. Provide door controls with flush mounted kits for the following:

1. “Press for Emergency Assistance” mushroom push button.
2. “Press for Emergency Assistance” panic strip at floor level.
3. “Assistance Requested” annunciator with sounder.
4. Dome light with identification lettering and sounder.
5. White panel sign with instruction lettering. (In Event of Emergency Push Emergency Button and Audible and Visual Signal will Activate)

5. Sounder devices to include tamper-resistant adjustable level control.
6. Audible signals to be distinct from other building systems.

27 53 13 MASTER CLOCK SYSTEMS

1. General:

1. Provide CSA approved system with clocks and controls.
2. Provide wiring in conduit and/or in cable trays.
3. Ground and bond system as required by local governing electrical code and authority and system manufacturer.
4. Provide manufacturers supplied and recommended suitable power and hanging receptacle that is integrated with backbox to allow for recessed wall mounting of clocks.
5. System manufacturers authorized representative to program system and to integrate to other low voltage systems.

2. Master Wired Clock System:

1. Time control center shall include the following:
    1. Minimum six (6) programmable microprocessor program control circuits.
    2. Minimum four (4) program schedules.
    3. System software programme.
    4. LCD display.
    5. 7 day battery standby.
    6. Automatic daylight savings adjustment.
    7. Manual override switches.
    8. Impulse clock control.
    9. Interface to external synchronization via RS232.
    10. Clock load relays.
2. Direct-read, digital, synchronous wired clocks shall include the following:
    1. Illuminated 50 mm (2") high LCD.
    2. Integral nickel cadmium battery backup.
    3. Line amplifiers.
    4. Moulded high impact case.
    5. Protective wire guards;
    6. Protective acrylic guards.
    7. Flush mounting backbox with semi-flush mounting kit.
    8. Low voltage operation.

3. Acceptable manufacturers:
    1. **Small and Medium Classrooms**: Advanced Network Devices IPCSS-RWB (Small IP Clock with Flashers, 18 inches)
    2. **Large Classrooms and Corridors**: Advanced Network Devices IPCSL-RWB (Large IP Clock with Flashers, 28 inches)
    3. **Larger Areas**: Advanced Network Devices IPSIGNL-RWB (IP Clock Signboard with Flashers, 52 inches)

28 00 00 ELECTRONIC SAFETY AND SECURITY

28 10 00 ACCESS CONTROL

1. Description:

1. Supply, install, configure and commission card access control devices for Brock University residence doors.
2. **Resident Door**: Resident bedroom doors are to be equipped with Power over Ethernet (PoE) controlled mortise latches which comply with the Ontario Building Code's Automatic Locking Prohibition (OBC 3.3.4.5) requiring an escape return function.
3. **Resident Barrier Free Door**: Resident barrier free bedroom doors are to be equipped with electric strikes, automatic door operators and Power over Ethernet (PoE) controlled mortise latches which comply with the Ontario Building Code's Automatic Locking Prohibition (OBC 3.3.4.5) requiring an escape return function.
4. **Lounge Access Door**: Lounge access doors are to be equipped with electric strikes, card readers, automatic door operators and all associated equipment. Interior lounge doors are to be equipped with barrier free push buttons.
5. **Exterior Residence Doors**: Exterior residence doors are to be equipped with electric strikes, card readers, automatic door operators and all associated equipment. Primary access/egress doors are to be equipped with barrier free push buttons.
6. Coordinate with Rough Carpentry, Doors, Door Hardware, Power Door Operators, Security and Access Control.

2. Quality Assurance:

1. Canadian Manufacturing Specifications for Steel Doors and Frames, of Canadian Steel Door Manufacturers' Association (CSDMA) latest edition, except as otherwise specified herein.
2. CAN/CSA 0132.2-Series, Wood Flush Doors.
3. Architectural Woodwork Manufacturers Association of Canada (AWMAC) "Quality Standards for Architectural Woodwork", Premium Grade.
4. Brock University Facility Accessibility Design Standards (FADS).
5. Lowenberger Residence Access Control Installation Phase III Drawing #E1 (Moon-Matz Ltd., May 2019)

3. Warranty:

1. Written warranty, executed by manufacturer(s), agreeing to repair or replace components of the installed access control system hardware and software that fails in materials or workmanship, including all related parts and labor, within specified warranty period after final testing and acceptance by the Owner. Failures include, but are not limited to, the following:
    1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

2. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
3. Special Warranty Periods: Two years for Integrated Access Control Door Hardware.

4. Products:

1. Card access system shall be a fully integrated 100% IP-based, solid state, web-based access control system including the following:
   1. Software
   2. Programming
   3. Proximity readers
   4. Networked controllers
   5. Network interface
2. System shall have control software with the ability to 'read' data encoded on cards containing finely tuned circuits via remotely mounted proximity sensors.
3. System shall limit the ability of individuals without proper authorization to pass through controlled doors, based on time of day and other criteria specified herein.
4. All card access controlled doors will be maintained secure by electric strike or electromagnetic locking devices. The electric door strike and electromagnetic locks will be provided by door supplier.
5. **Electrified Quick Connect Data Transfer Hinges**:
   1. Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate Electrified Quick Connect Data.
   2. Transfer Hinges: Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through- door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
   3. Data transfer hinges feature two Molex connectors and earth ground connection on each leaf.
   4. Specified Manufacturer: McKinney PoE Series – no alternate.
6. **Integrated IP Enabled Access Control Lockset**:

1. IP Enabled Power-over-Ethernet (PoE) Integrated Card Reader Mortise Lock: IP enabled ANSI/BHMA A156.13 Grade 1 mortise lockset with integrated credential reader, request-to-exit, and door position signaling in one complete unit. Motor driven locking/unlocking control of the lever handle trim, 3/4" projection latchbolt, and optional 1" steel deadbolt. Lock is U.L.C. listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.
    1. Completely intelligent and integrated locking unit with Ethernet power and communication connection capability directly from the locking unit back to the central system host server without additional access control interfaces or components (excluding PoE Endspan and Midspan devices) via an existing or newly installed IEEE 802.3af PoE enabled network.
    2. Open architecture design supports wired integration with third party access control systems applications via software development kit (SDK). Real-time software accessible alarms for forced door, unknown card and door held open, with inside lever handle (request-to-exit), battery status, tampering, and door position (open/closed status) monitoring.
    3. 2,400 users and 10,000 event transaction history (audit trail). Distributed intelligence allows standalone operation in absence of network communication allowing for system operational redundancy.
    4. Provide a network and lock configuration CD tool kit for initial lock setup and programming via a USB connection.
    5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
    6. Integrated reader supports the following credentials:
        1. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    7. Communication between access control system and device is protected by AES 128 bit encryption via the SDK. Programmable for time zones, holidays and automatic unlocking.
    8. Power and communication from one Ethernet (CAT5e or higher) cable. Compliant with 802.3af Class 1 device specifications requiring 3.84 watts for Power over Ethernet.
    9. Supports real-time system lockdown capabilities. Inside lever retracts latch bolt and deadbolt simultaneously.
    10. Supports “escape return” function through Persona software.
    11. High security mechanical key provides emergency override retraction of latchbolt without need for electronic activation.
    12. Ethernet system framework, network cabling, mounting boxes, PoE end span/mid-span, electrical hard wiring, grounding and connections are

required for complete system functionality. All system components are by others and are specified elsewhere.

1. Power Requirement: PoE Class 2, maximum 7 watts.
2. Network Cabling Requirements: Cat5e or higher meeting or exceeding ANSI/TIA/EIA-568-C. 24 AWG Plenum rated.
3. Bonding and Grounding: Meet or exceed TIA-607-B requirements. Connect device ground cable to building electrical earth ground.
4. Network Surface Mount Box: Meet or exceed ANSI/TIA/EIA-568-C requirements. Cat5e or higher (RJ45).

13. Acceptable Manufacturers: Sargent Manufacturing (SA) – IN220 Series c/w Bluetooth credential.

7. **Cables**:

1. **Power/Signal Cables**:

1. Where specified, Door and Frame Elynx cables have been specified at a provisional length at each of these locations. It is the responsibility of the finishing hardware supplier to supply these cables, prior to door/frame manufacture, in appropriate lengths required by the various manufacturers. The hardware supplier is responsible to contact the door manufacturers to determine the cabling route and supply the correct length.
2. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening. Where the door manufacturer requires flying ends on Elynx cables the hardware installer will be responsible to map and pin Molex connectors.
3. Provide one each of the following tools as part of the base bid contract:
    1. McKinney Products (MK) – Molex Service Kit: QC-R001.
    2. McKinney Products (MK) – Molex Hand Crimp Tool: QC-R003.
4. Specified Manufacturer: McKinney

2. **PoE Cables**:

1. Where specified, cables are to be provided that included connectors at both ends for plug in connection. Cables are to be a Cat 6, 26 AWG

stranded 100 ohm or greater and include a separate ground wire. Door and frame cables are to have two Molex connectors at the hinge end for connection to the PoE hinge and a RJ45-M connector at the other end. Cable length to be confirmed with door manufacturer prior to ordering.

2. Specified manufacturer: McKinney – no alternate

8. **Card Readers**:

1. Card reader to mount in a single gang electrical box and offer a migration path for 125 kHz HID Prox, AWID and EM4102 card technologies. Read range for HID Prox to be 7 cm and have physical dimensions of 8.4 cm x 12.2 cm x 2.4 cm. Current draw to range from 50-80 mA with peak current draw being no more than 200 mA. Reader to be able to read HID Prox4, AWID4, Indala, EM41024 and Secure Identity Object™ (SIO®) on iCLASS Seos, iCLASS SE/SR, MIFARE DESFire EV1 and MIFARE Classic (On by Default), standard iCLASS Access Control Application (order with Standard interpreter), ISO14443A (MIFARE) CSN, ISO14443B CSN, ISO15693 CSN, MIFARE Classic and MIFARE DESFire EV1 custom data models, FeliCa™4 CSN, CEPAS4 CSN or CAN. Reader to have Pigtail or Terminal strip for connections.
2. Card Readers to be located 900mm – 1100mm above finished floor.
3. On Barrier Free Paths of Travel on Pull side of door, card reader shall be located 600mm clear of the door swing. Confirm with Consultant if any questions on site arise.
4. Specified Manufacturer: HID 92PTTNEK00000-RP40

9. **PoE Controllers**:

1. Controllers to be used as an interface between building PoE system and security peripherals. Controller to store a complete access control and configuration database for a minimum of one door and up to 125,000 cardholders. Access control processing, host functionality and power for a single door, lockset or electric strike, card reader, door status, REX device and auxiliary sounder. Connects to the host and other devices on a TCP/IP network. Controller receives and processes in real time commands from host software application, while reporting all activity to host and buffering up to 99,999 transactions. Controller to be supplied with firmware compatible with Persona.
2. Specified Manufacturer: HID Edge EH400-K x PERSONA firmware – no alternate

10. **Access Control Software**:

1. Access Control software to provide customized access by user, facility or individual lock and have database integration and software interface with popular enterprise, transactional and housing systems. System to support both mag stripe and contactless technology be browser based and work from a multi-user SQL server. System to have auto-discovery of new devices, offer complete customization and have the ability to configure alarm notification via client

applications, web browser and e-mail. User information shall be stored in a partitioned database. System shall have advanced reporting options and role based security to make grating and revoking access easy. Escape-return functionality to be included in system operation.

2. Specified Manufacturer: ASSA ABLOY PERSONA – no alternate

11. **Proximity Cards**:

1. Proximity cards shall be ‘credit card’ size, with horizontal punch out complete with strap and pocket clip. Application of photo identification to the card shall not affect its operation.

2. The proximity cards shall neither affect, nor be affected by magnetically encoded cards (i.e. credit or ATM cards).

28 31 00 FIRE ALARM SYSTEM

1. General:

1. Design and installation to follow CAN-ULC S524 and CANULC S537.
2. Devices to be ULC listed and labelled devices suitable for fire alarm applications.
3. Power supplies and other components to be CSA approved where required by local governing authorities and codes.
4. Maintain existing fire alarm systems in operation until replacement system is fully installed, in operation, is fully certified and verified to satisfaction of Owner.
5. Phase work in a manner as required such that existing fire alarm system equipment in adjacent areas being renovated, is maintained in operation.

2. Acceptable Manufacturers:

1. Edwards (EST).
2. Simplex.
3. No exceptions.

3. Existing Panels:

1. Most buildings already have addressable panels.
2. CUB has a conventional panel.
3. Other than Cairns building, all existing panels are 1-stage, zoned, non-coded.
4. Walker Complex A has an EST3 addressable panel, but system is wired conventionally.
5. Walker Complex B is fed from Walker Complex A.
6. The following buildings are currently networked:
    1. Scotiabank Hall.
    2. South Academic.
    3. Walker Complex D.
7. Generally, other buildings are stand-alone systems, with trouble signals to adjacent buildings.

4. Panel Replacements:

1. Existing conventional systems shall be replaced with addressable systems described below.

5. New Systems:

1. All new panels shall be multiplexed, 2-stage, addressable, zoned, non-coded.

2. Obtain Owner approval to replace existing 1-stage addressable panels with 2-stage ready panels.
3. System to be verified for 1-stage operation, with the option to change to 2-stage in the future.
4. Provide active graphics for new builds.

6. System Software:

1. All new systems shall be provided with Fireworks software for EST systems.
2. Similar software to be provided for Simplex systems.
3. The following buildings have existing Fireworks software:
    1. Schmon Tower / Thistle Complex, covering Cairns Building.
    2. Mackenzie Chown.
4. All renovations shall allow for updating the existing Fireworks (or similar) software to reflect the conditions after the project completion.

7. Manual Pull Stations:

1. Addressable, two stage, single action, non-coded, semi-flush mounted type.
2. Pull stations to be of die cast metal construction with red enamel finish and "PULL IN CASE OF FIRE" lettering.
3. Stations to include front break-glass rod, tamper proof reset function, one set of N/O contacts and a secondary set of contacts and key switch for general alarm two-stage operation. Contacts close when handle is pulled down with single action, breaking glass rod and activating first stage fire alarm condition. Second stage is activated via key switch.

8. Initiating Devices:

1. Smoke detectors.
    1. Ionization.
    2. Photoelectric (preferred).
2. Heat detectors.
    1. Fixed temp.
    2. Rate of rise.
    3. Combination fixed temp/rate of rise.
3. Duct smoke detectors.
4. Manual pull stations.

9. Signaling Devices:

1. Existing buildings have either horn or bells.
    1. Renovations to conform to existing signaling.
    2. Add strobes according to OBC requirements.
2. New builds and system replacements shall have voice annunciation with strobes.
3. Fire alarm to be tied to BAWS and programmed to alert Campus Security and Facilities Management.
4. Mass notification (ENS) to be tied to fire alarm. Mass notification to be supplied by University and installed by Contractor.

10. Ancillary Connections:

1. Sprinkler devices.
2. Waterflow devices.
3. Suppression systems.
4. Maglocks.
5. Mechanical equipment shutdowns.
6. Elevator connections to OBC and TSSA.
7. Emergency generator connections – gen run; gen trouble.

11. Fire Signs:

1. "FIRE DO NOT ENTER" custom nomenclature, illuminated, flashing, 24-volt D.C., slim line satin aluminum housing and with black face and red letters; lettering not visible until sign is energized.

12. System Testing, Verification and Certification:

1. Include for fire alarm system manufacturer to inspect, test, verify and certify system components and wiring, individually and as a complete system, in accordance with requirements of latest edition of CAN/ULC S537.

31 00 00 EARTHWORK

31 11 00 CLEARING AND GRUBBING

1. Clearing:

1. Clearing includes trimming and cutting of trees into sections and satisfactory disposal of trees and other vegetation designated for removal, including snags, brush, and rubbish occurring within cleared areas.
2. Clear as directed by consultant, by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.
3. Cut off branches and cut down trees overhanging area cleared as directed by Consultant.
4. Cut off unsound branches on trees designated to remain as directed by Consultant.

2. Isolated Trees:

1. Cut off isolated trees as indicated or directed by Consultant at height of not more than 300 mm above ground surface.
2. Grub out isolated tree stumps.
3. Prune individual trees as indicated.
4. Trim trees designated to be left standing within cleared areas of dead branches 40 mm or more in diameter; and trim branches to heights as indicated.
5. Cut limbs and branches to be trimmed close to bole of tree or main branches.

3. Underbrush Clearing:

1. Clear underbrush from areas as to within 300 mm of ground surface.

4. Grubbing:

1. Remove and dispose of roots larger than 75 mm in diameter, matted roots, and designated stumps from indicated grubbing areas.
2. Grub out stumps and roots to not less than 200 mm below ground surface.
3. Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 m^3.
4. Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface to ground.

5. Removal and Disposal:

1. Remove cleared and grubbed materials off site.
2. Remove diseased trees identifies by Consultant and dispose of this material to approval of Consultant.

6. Finished Surface: Leave ground surface in condition suitable for immediate grading operations and stripping of topsoil to approval of Consultant.

7. Cleaning:

1. Leave work area clean at end of each day.
2. On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

31 14 00 EARTH STRIPPING AND STOCKPILING

1. Stripping of Topsoil:

1. Shall conform to OPSS 206 and OPSS 802
2. Ensure that procedures are conducted in accordance with applicable Provincial and Municipal requirements and to the satisfaction of the Departmental Representative.
3. Remove topsoil before any construction procedures commence to avoid compaction of topsoil.
4. Handle topsoil only when it is dry and warm.
5. Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by composting.
6. Remove brush from targeted area by non-chemical means and dispose of through mulching.
7. Strip topsoil to depths required to remove all topsoil. Avoid mixing topsoil with subsoil.
8. Pile topsoil by mechanical hoe in berms in locations as directed by the Inspector. Stockpile height not to exceed 2.5 m.
9. Dispose of unused topsoil off-site.
10. Protect stockpiles from contamination and compaction.
11. Topsoil that has been piled for long term storage will be covered with trefoil or grass to maintain agricultural potential of soil.

2. Preparation of Grade:

1. Verify that grades are correct. If discrepancies occur, notify the Departmental Representative and do not commence work until instructed by the Departmental Representative.
2. Grade area only when soil is dry to lessen soil compaction.
3. Grade soil establishing natural contours and eliminating uneven areas and low spots, ensuring positive drainage.

3. Placing of Topsoil:

1. Place topsoil only after the Departmental Representative has accepted subgrade.
2. During dry conditions spread topsoil by mechanical hoe and/or dozer in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
3. Establish traffic patterns for equipment that will prevent driving on topsoil after it has been spread to avoid compaction.
4. Cultivate the soil following spreading procedures.

4. Sub-Soiling:

1. Following the spreading and cultivating procedures sub-soil the area to improve drainage and agricultural potential of soil.
2. With a vibrating sub-soiler work the area to a depth of 40 cm. Follow the contour lines of the natural grades of the area.
3. Cross sub-soil the area following the first pass.
4. Cultivate the soil with a chain harrow to de-clod the soil.

5. Cleaning:

1. On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

31 22 00 GRADING

1. Examination:

1. Verify that survey benchmark and intended elevations for the work are as indicated.
2. Verify existing conditions before starting work.

2. Preparation:

1. Identify required lines, levels, contours, and datum.
2. Stake and flag locations of known utilities.
3. Locate, identify, and protect utilities that remain, from damage.
4. Notify utility companies to remove and relocate utilities if required and as directed by the Departmental Representative.
5. Protect above and below grade utilities that remain.
6. Protect plant life, lawns, rock outcropping and other features remaining and as a portion of final landscaping.
7. Protect benchmarks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
8. Provide silt and sediment fence, temporary silt sacks in structures and mud mat as indicated on engineering drawings.

3. Stripping of Topsoil:

1. Handling of topsoil shall conform to OPSS 802 and as directed by the Inspector.
2. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by the Departmental Representative.
3. Commence topsoil stripping of areas as directed by the Departmental Representative after area has been cleared of brush, weeds and grasses and removed from site.
4. Strip topsoil to depths as indicated and as directed by the Departmental Representative. Rototill weeds and grasses and retain as topsoil on site. Avoid mixing topsoil with subsoil.
5. Stockpile in locations as indicated or as directed by the Departmental Representative. Stockpile height not to exceed 2.5 m.
6. Dispose of unused topsoil off site at a location secured by the contractor.

4. Subsoil Excavation:

1. Complete in accordance with OPSS 206, OPSS 314 and OPSS 402.
2. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.

3. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
4. When excavating through roots, perform work by hand and cut roots with sharp axe.
5. Stockpile in area designated on site to depth not exceeding 2.5 m and protect from erosion. Remove from site, subsoil not being reused.
6. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

5. Filling:

1. Install Work in accordance with OPSS 401, OPSS 402, OPSS 1010, The City of Niagara Falls, and to the satisfaction of the Departmental Representative.
2. Fill areas to contours and elevations with unfrozen materials.
3. Place fill material on continuous layers and compact in accordance with the geotechnical report.
4. Maintain optimum moisture content of fill materials to attain required compaction density.
5. Make grade changes gradual. Blend slope into level areas.
6. Remove surplus fill materials from site.

6. Grading:

1. Grading shall conform to OPSS 206, The City of St. Catharines and to the satisfaction of the Departmental Representative.
2. Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
3. Rough grade to following depths below finish grades:
    1. 150 mm for grassed areas.
    2. 490 mm for light duty asphalt paving or as indicated by the Departmental Representative.
    3. 275 mm for concrete walks or as indicated by the Departmental Representative.
4. Slope rough grade away from building as indicated on GSP1.1 Site Grading, Servicing, ESC and Notes & Details Plan.
5. Grade ditches and landscaped areas to depth as indicated on GSP1.1 Site Grading, Servicing, ESC and Notes & Details Plan.
6. Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

7. Compact filled and disturbed areas to maximum dry density to ASTM D698, as follows:
    1. 85% under landscaped areas.
    2. 95% under paved and walk areas.
    3. As directed by the by the Departmental Representative.
8. Do not disturb soil within branch spread of trees or shrubs to remain.

7. Testing:

1. Inspection and testing of soil compaction will be carried out by testing laboratory designated by the Departmental Representative. Contractor is responsible for coordination of inspection with the Departmental Representative.
2. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

8. Tolerances:

1. In accordance with OPSS 206.

9. Surplus Material:

1. Remove surplus material and material unsuitable for fill, grading or landscaping off site at a location secured by the contractor.

10. Cleaning:

1. Progress Cleaning: clean to the satisfaction of the Departmental Representative.
2. Leave Work area clean at end of each day.
3. Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment to the satisfaction of the Departmental Representative and the Departmental Representative.

11. Protection:

1. Protect existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as indicated on the drawings and as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.
2. Maintain access roads to prevent accumulation of construction related debris on roads.

31 23 00 EXCAVATION AND FILL

1. Materials:

1. To conform to OPSS 1004 and OPSS 1010.
2. Type 1 and Type 2 fill: properties to the following requirements:
    1. Crushed, pit run or screened stone, gravel or sand.
    2. Gradations to be within limits specified when tested as specified in Geotechnical Report.
3. Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
4. Granular material: to satisfaction of the Departmental Representative and Ontario Provincial Standard Specification 1010 for Granular A and B.
5. Sand: clean, washed, minimum 100% passing 4.75 mm sieve, maximum 5% passing 0.075 mm sieve to OPSS 1004.05.04.
6. Drainage material: 19 mm crushed stone or 19 to 63 mm clean gravel to OPSS 1004.05.07.
7. Unshrinkable fill: proportioned and mixed to provide:
    1. Maximum compressive strength of 0.4 MPa at 28 days.
    2. Maximum cement content of 25 kg/m3 with 40% by volume fly ash replacement: to CSA A3001, Type GU.
    3. Minimum strength of 0.07 MPa at 24 h.
    4. Concrete aggregates: to CSA A23.1/A23.2.
    5. Cement: Type GU.
    6. Slump: 160 to 200 mm.
    7. All as specified by the Departmental Representative.

2. Site Preparation/Protection:

1. Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.
2. Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.
3. Protect existing features in accordance with the drawings and as directed by the Departmental Representative.
4. Keep excavations clean, free of standing water, and loose soil.

5. Where soil is subject to significant volume change due to change in moisture content, cover and protect to the satisfaction of the Departmental Representative.
6. Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
7. Protect buried services that are required to remain undisturbed.

3. Stripping of Topsoil:

1. In accordance with 31 22 00.

4. Stockpiling:

1. Stockpile in accordance with OPSS 314.
2. Stockpile fill materials in areas designated by the Departmental Representative.
3. Stockpile granular materials in manner to prevent segregation.
4. Protect fill materials from contamination.
5. Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

5. Dewatering and Heave Prevention:

1. Keep excavations free of water while work is in progress.
2. If required, provide for the Departmental Representative's review details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
3. Avoid excavation below groundwater table if quick condition or heave is likely to occur.
4. Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.
5. Protect open excavations against flooding and damage due to surface run-off.
6. Dispose of water in accordance with City standards to an approved location in a manner not detrimental to public and private property, or portion of Work completed or under construction.
7. Provide and maintain temporary drainage ditches and other diversions outside of excavation limits as directed by the Departmental Representative.
8. Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas as directed by the City.

6. Excavation:

1. Advise Departmental Representative at least 7 days in advance of excavation operations for initial cross sections to be taken.
2. Excavate subsoil to accommodate paving, site structures, site services, and construction operations.
3. Grade top perimeter of excavating to prevent surface water from draining into excavation.
4. Remove concrete and paving and other obstructions encountered during excavation as required.
5. Hand trim excavation as required and remove loose matter.
6. Excavation must not interfere with bearing capacity of adjacent foundations.
7. Do not disturb soil within branch spread of trees or shrubs that are to remain.
8. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.
9. For trench excavation, unless otherwise authorized by the Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
10. Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.
11. Restrict vehicle operations directly adjacent to open trenches.
12. Dispose of surplus and unsuitable excavated material in an approved location off site secured by the contractor.
13. Do not obstruct flow of surface drainage or natural watercourses.
14. Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
15. Notify Departmental Representative when bottom of excavation is reached.
16. Obtain Departmental Representative’s approval of completed excavation.
17. Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by the Departmental Representative.
18. Correct areas over excavated in accordance with OPSS 402.
19. Excavation shall conform to OPSS 402 and OPSS 902.
20. Trenching and Backfilling shall conform to OPSS 401 and OPSS 402.
21. Perform compaction in accordance with the Departmental Representative’s recommendations and OPSS 401
22. Grading shall conform to OPSS 206.

7. Fill Types and Compaction:

1. Use types of fill as directed by the Departmental Representative.

8. Bedding and Surround of Underground Services:

1. Place and compact granular material for bedding and surround of underground services as indicated and as specified in Section 33 10 00 – Water Utilities, Section 33 30 00 – Sanitary Sewerage, Section 33 40 00 – Stormwater Utilities.
2. Place bedding and surround material in unfrozen condition.

9. Backfilling:

1. Backfilling activities shall conform to OPSS 401 and OPSS 402 and the engineering drawings.
2. Do not proceed with backfilling operations until completion of following:
    1. The Inspector has inspected and approved installations.
    2. The Inspector has inspected and approved of construction below finish grade.
    3. Inspection, testing, approval, and recording location of underground utilities.
    4. Removal of concrete formwork.
    5. Removal of shoring and bracing; backfilling of voids with satisfactory soil material.
3. Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
4. Do not use backfill material which is frozen or contains ice, snow or debris.
5. Place backfill material in uniform layers not exceeding 300 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
6. Backfilling around installations:
    1. Place bedding and surround material as specified elsewhere.
    2. Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
    3. Place layers simultaneously on both sides of installed Work to equalize loading.

31 25 00 EROSION AND SEDIMENT CONTROLS

1. Sediment Control Products:

1. All products to conform to the City of St. Catharines and Greater Golden Horseshoe Area Conservation Authorities (GGHACA) Erosion and Sediment Control Guidelines for Urban Construction and the Ontario Provincial Standard Specifications.
2. Silt fencing as per OPSD 219.130
3. Catchbasin silt sack manufacturers:
    1. Terrafix – Product: Silt Sack.
    2. Blue Huron Environmental – Product: Catch Basin Sediment Trap.

2. Dust Control Agents:

1. To conform to OPSS 506.

3. Stabilization:

1. Implement stabilization including seeding, mulching, protection of trees and preservation of any existing mature vegetation. Protect stored topsoil from loss and contamination. Make up lost or contaminated topsoil with new, approved topsoil.

4. Installation:

1. Install erosion and sediment control devices as per Engineering Drawings prior to the start of construction.

5. Silt Fences:

1. Place silt fences/geofabric (R270) as detailed on Engineering Drawings or as directed by the Consultant.
2. Install per OPSD 219.130.

6. Catchbasin Silt Sacks:

1. Install catchbasin silt sacks/geofabric as detailed on Engineering Drawings or as directed by the Consultant.
2. Install per manufacturer’s specifications.

7. Mud Mat:

1. Install mud mat at entrance/exit to/from the construction site.
2. To be 15 m long x 6 m wide x 300 mm deep excavation filled with minimum 300 mm thick, 100 - 200 mm rip-rap and lined with filter cloth.
3. To be cleaned throughout construction.

8. Monitoring and Maintenance:

1. Comply with maintenance requirements specified by the City of St. Catharines and GGHACA guidelines and Ontario Provincial Standard Specifications.
2. Silt Fences:
    1. Maintain integrity of silt fences.
    2. Inspect silt fences within twenty-four (24) hours of rainfall, and snow melt, and daily during prolonged rainfall or storm. Correct deficiencies.
    3. During holidays and when construction is not in progress, maintain and monitor silt fences on a weekly basis or as required by the Consultant.
    4. Daily review location of silt fences in areas where construction activities have changed natural contours and drainage run-off. Relocate or add additional measures as required to maintain required effectiveness.
    5. Repair or replace damaged products within twenty-four (24) hours.
    6. Remove sediment deposits when deposit reaches approximately one-third (1/3) the height of silt fence. Dispose of sediment in location where sediment will not erode into construction areas, offsite properties or watercourses.
    7. Do not remove silt fences until directed by the Consultant.
3. Catchbasin Silt Sacks:
    1. Maintain integrity of catchbasin silt sack.
    2. Inspect catchbasin silt sacks within twenty-four (24) hours of rainfall, and snow melt, and daily during prolonged rainfall or storm. Correct deficiencies.
    3. During holidays and when construction is not in progress, maintain and monitor silt sacks on a weekly basis or as required by the Consultant.
    4. Daily review location of silt sacks in areas where construction activities have changed natural contours and drainage run-off. Add additional measures as required to maintain effectiveness.
    5. Repair or replace defective products within twenty-four (24) hours.
    6. Remove sediment deposits when deposit reaches approximately one-third (1/3) the height of catchbasin silt sacks or per the manufacturer's specifications. Dispose of sediment in location where sediment will not erode into construction areas, offsite properties or watercourses.
    7. Do not remove catchbasin silt sacks until directed by the Consultant.

9. Clean-up and Removal:

1. Remove erosion and sediment control measures after final stabilization is achieved and upon approval of the Consultant.
2. Remove and dispose of materials off site.

3. Remove accumulated sediment or spread to match finished grade; ensure proper drainage.
4. Stabilize area disturbed by removal operations.

32 00 00 EXTERIOR IMPROVEMENTS

32 12 00 ASPHALT PAVING

1. Asphalt Pavement Design:

1. A geotechnical consultant with experience in pavement design will provide the design requirements for proposed roads. The road composition shall be designed based on the following factors:
    1. Mechanical analysis of subgrade soil
    2. Drainage
    3. Frost susceptibility
    4. Future volume and class of traffic expected
    5. Bus/public transit routes (if applicable)
2. The pavement structure shall be designed in accordance with the recommendations of the geotechnical consultant. If no geotechnical report is requires for the project, the designer shall assume a minimum pavement structure designed per the City of St. Catharines Standards Section 5.1.4.
3. Sub-drains are required to run continuous along both sides of all roads in accordance with OPSD 405. Sub-drains will be a minimum length of 6m on the upstream side of all catchbasins per the City of St. Catharines Standards Section 5.1.7. Sub-drains should also be installed at all CB's and CBMH's at low points in asphalt areas.
4. A minimum road grade of 0.50% shall be required for all new roads.

32 13 13 CONCRETE PAVING

1. Granular Base:

1. Obtain the inspector's approval of subgrade before placing granular base.
2. Place granular base material to lines, widths and depths as indicated.
3. Compact granular base in maximum 150 mm layers to at least 95% of maximum proctor density as directed by the inspector.

2. Concrete:

1. Obtain the inspector's approval of granular base and reinforcing steel prior to placing concrete.
2. Concrete curb to be OPSD 600.100 unless otherwise noted on the engineering drawings.
3. Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to center line.
4. Provide edging as indicated with 10 mm radius edging tool.
5. Slip-form pavers equipped with string line system for line and grade control may be used in quality of work acceptable to the inspector can be demonstrated. Hand finish surfaces when directed by the inspector.
6. Hand finish surfaces when directed by Consultant.
7. Conform to OPSS 351.
8. Curb cut's to be completed as shown on the engineering drawings, as directed by the inspector and to the City of St. Catharines specifications.

3. Tolerances:

1. Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.

4. Expansion and Contraction Joints:

1. Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, as directed.
2. Install expansion joints as directed at intervals of 6 m.
3. When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

5. Isolation Joints:

1. Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure as specified on the engineering drawings and as directed by the inspector.

2. Install joint filler in isolation joints.
3. Seal isolation joints with sealant approved by the inspector.

6. Curing:

1. Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by the inspector.
2. Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period.
3. Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

7. Backfill:

1. Allow concrete to cure for 7 days prior to backfilling
2. Backfill to be designated elevations with material as directed by the inspector. Compact and shape to required contours as indicated and as directed by the inspector.

8. Cleaning:

1. On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

9. Pedestrian Paving:

1. Shall comply with Brock University's Facility Accessibility Design Standards, Section 4.1.4.

32 33 00 SITE FURNISHINGS

1. Description:

1. Provide site bicycle racks, site waste/recycling containers, site seating and site tables.

2. Quality Assurance: Conform to the requirements of:

1. Brock University Facility Accessibility Design Standards (FADS).

3. Products:

1. Pursue the use of sustainable materials with high recycled content.
2. Wood based materials are to be Forestry Stewardship Council (FSC) certified.
3. Adhesives, sealants, paints and coatings to be low VOC.
4. **Site Bicycle Rack:** Ring Rack, Lean & Lock System by Bike-Up.
5. **Site Trash and Recycling Receptacle:** Brushed stainless steel finish, 2-147 L compartments (left side: Cans/Bottles, right side: Litter), cam style lock, message board area, doors hinged at top or front face, adjustable feet. Model Hazelton by Envyrozone.
6. **Site Seating:**
    1. Benches by Landscape Forms or Maglin.
    2. Provide along an accessible route, be stable, have a seat height per FADS and be colour contrasting. Provide suitable clearance adjacent to unit for a mobility device that doesn't block the accessible route.
7. **Site Tables**:
    1. By Landscape Forms.
    2. Picnic tables by Jubilee.
    3. Be adjacent to an accessible route, be stable with firm ground surroundings, have sufficient knee space and top surface height per FADS and be of contrasting colour.

32 90 00 PLANTING

1. Description:

1. To be developed by Brock University.

2. Quality Assurance:

1. Follow the Canadian Landscape Standard.

33 00 00 UTILITIES

33 10 00 WATER UTILITIES

1. Design Guidelines:

1. Watermains will be a minimum size of 150mm diameter and sized to ensure minimum system pressures per Ontario Ministry of the Environment, Conservation and Parks (MECP) guidelines.
2. The minimum depth of cover shall not be less than 1.7m measured from the top of pipe to finished ground elevation per the City of St. Catharines Standards Section 8.2.2.
3. All material, fittings and appurtenances shall be CSA and AWWA approved. Watermains to be designed per Niagara Peninsula Standard Contract Documents and OPSS 441.
4. Separation between watermains and sewers must be in accordance with the latest version of MECP design guidelines. The distance between watermains and sewers shall be as follows:
    1. Vertical separation: minimum 0.5m
    2. Horizontal separation: minimum 2.5m
5. Watermains must cross above sewers where possible, in accordance with the separation requirements listed above. If it is not possible to cross above, the watermiain shall pass under with a minimum 0.5m vertical separation with the length of the watermain centered at the point of crossing.
6. Dead ends shall be avoided where possible. Otherwise, a fire hydrant, flushing hydrant or 50mm blowoff is required.
7. Valves must be as per the Niagara Peninsula Standard Contract Document (NPSCD) requirements, and the City of St. Catharines Standards.
8. Fire hydrants shall be installed on watermains greater than or equal to 150mm diameter with the maximum spacing of 100m per City of St. Catharines standards.

2. Water Service Connections: Service connections must be installed in accordance with the City of St. Catharines Standard Drawings.

1. The minimum size for a service connection shall be sized to provide minimum operation pressure per MECP guidelines and City of St. Catharines Standards.
2. Water service connections must be installed at a depth of 1.70m below finished grade per the City of St. Catharines Standards Section 8.3.3.
3. Domestic and Fire Service Connections to be designed per the City of St. Catharines Drawing No. 110-5010.

33 30 00 FACILITY SANITARY SEWERAGE

1. **Description:** This section outlines criteria to be used when designing sanitary sewers. There is reference to Ontario Provincial Standard Drawings (OPSD) when dealing with standards for sewers, manholes, catchbasins, etc. and should be used whenever possible.

2. **Design Flows:** Design flow calculations per the latest edition of the Ontario Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Sewage Works, the Ontario Building Code, and City of St. Catharines Standards Section 6.1.

3. **Sewer Design:** Sewer capacities shall be designed using Manning's Equation for a pipe flowing full, as per the City of St. Catharines Standards Section 6.2.

    1. A roughness coefficient of n=0.013 shall be used for all pipes.
    2. The minimum velocity and grade shall be calculated using the City of St. Catharine's standards, Section 6.2.2.
    3. The minimum size for sewers is 200 mm (8") for mains and 100 mm (4") for service connections.
    4. Within streets, the minimum depth shall be 2.5 m where possible. The depth is measured from the centerline grade of the road to the top of the sewer.
    5. The location of underground utilities shall be determined through consultation with the University.
    6. Manholes shall be precast concrete and are required at each change in alignment, size and grade, pipe material, at all junctions and at the end of each line.
        1. The maximum change in direction of flow in any sanitary manhole shall be:
            1. 90 degrees for sewers with diameter less than 450 mm
            2. 45 degrees for sewers with diameter greater than or equal to 450 mm
        2. A change of flow direction at acute interior angles is not permitted.
        3. The maximum drop allowed across a manhole is 0.6 m without the use of a drop structure.
        4. The following allowanced shall be made to compensate for hydraulic losses:

Alignment Change	Drop Required
Straight run	Grade of sewer
15-45 degrees	0.03 m
45-90 degrees	0.06 m

    7. Watermains shall cross above sanitary sewers with sufficient separation to allow for sufficient bedding and structural support, or a minimum of 0.5 m. Watermain

crossings must adhere to the City of St. Catharines Standards and the latest MECP Design Guidelines.

4. Pipe Materials: Sanitary sewers shall be constructed of concrete pipe, polyvinyl chloride (PVC) pipe SDR35. Pipes shall be joined by rubber gaskets, per the City of St. Catharines Standards.

5. Connections:

1. Drains shall be installed per OPSD 1006.01 (rigid main sewer) or OPSD 1006.02 (flexible main sewer).
2. A manhole is required where the diameter of the sanitary drain is greater than 200 mm.
3. A clean out is required at all changes in elevation, slope or direction per Ontario Building Code.
4. The service shall be graded as such:
    1. Minimum 100mm diameter connection – 2%
    2. Minimum 150mm diameter connection – 1%
5. The minimum low flow velocity shall be 0.60m/s.

33 40 00 STORMWATER UTILITIES

1. Description:

1. This section outlines criteria to be used when designing storm sewers. Ontario Provincial Standard Drawings (OPSD) must be applied for storm sewer design including sewers, manholes, catchbasins, etc.

2. Objectives:

1. Stormwater management designs should be completed to achieve the following objectives:
    1. Ensure that there is no increase in potential for flood damage.
    2. Protect the natural geomorphic conditions of existing water courses.
    3. Enhance water quality of stormwater prior to outletting to natural conveyance systems.
    4. Protect groundwater and base flow systems.
    5. Minimize impact on local and downstream aquatic habitats.
2. Minor storm systems shall be designed for the 1:5 year storm per the City of St. Catharines Standards Section 7.1.1.1.
3. Major storm systems shall be designed for the 1:100 year storm per the City of St. Catharines Standards Section 7.1.2.1.
4. Rainfall data can be found in the City of St. Catharines Standards Appendix A.
5. Hydrological analysis data, information and requirements can be found in the City of St. Catharines Standards Appendix B. Generally SWM controls are required to control post-development peak flows to the 1:5 year pre-development peak flows for the 1:10 year, 1:25 year, and 1:100 year storm events per the City of St. Catharines Runoff Quantity Control requirements Section 7.1.7.3.
6. A minimum of “Normal” level of water quality treatment, as defined in the MECP design guidelines (2003) is required for all SWM facilities. All rainwater leaders must discharge to a landscaped area at grade.
7. Per the MECP SWM Design Manual, water balance impacts should be evaluated during the design of each stormwater management system. Generally, stormwater management conveyance systems shall be designed to capture and infiltrate the first 25 mm of rainfall. Potentially contaminated runoff must be treated to “Normal” level of water quality treatment prior to infiltration.
8. Recommended ranges for runoff coefficients per the City of St. Catharines Standards Section 7.3.1.8. are as follows:

Surface Type of Land Use	Recommended Coefficient
Parks	C = 0.25
Paved Areas (asphalt, concrete, roof areas)	C = 0.90 – 1.00

9. The following values may be used as a guide for depression or detention storage per the City of St. Catharines Standards Section 7.3.1.6.:

Surface	Depression Storage	
	(mm)	(in)
Asphalt, Concrete	0.5 – 4.0	0.01 – 0.16
Flat Roof	2.5 – 7.5	0.10 – 0.30
Sloped Roof	0.5 – 2.5	0.02 – 0.10
Lawn, Grass	2.5 – 5.0	0.10 – 0.20
Open Field	5.0 – 10.0	0.20 – 0.40

3. Storm Sewer Design:

1. Manning's Formula shall be used to compute the capacity of storm sewers on a basis of the pipe flowing full per the City of St. Catharines Standards Section 7.3.1.
2. The slope of a storm sewer pipe shall be chosen such that an ideal velocity is obtained to minimize the settling of solids. Minimum slopes for storm sewers shall be referred to in the City of St. Catharines Standards Section 7.3.1.9.
3. The velocity in storm sewers shall be a minimum of 0.6m/s and a maximum of 6.0m/s.
4. The minimum pipe size is 300 mm used for sewer mains, 200 mm for single catch basin connections and 250 mm for double catch basin connections.
5. The minimum depth of cover shall be 1.4 m per the City of St. Catharines Standards Section 7.3.4.
6. Bedding and backfill for storm sewers shall be determined based on the geotechnical consultant recommendation. Granular 'A' may be considered where utility is located within the roadway, compacted to 95% maximum dry density in a confined trench condition and will be in accordance with OPSS for rigid and flexible pipe.
7. The location of underground utilities shall be determined through consultation with the University.
8. A minimum clearance of 225 mm must be provided between the outside of sewers and other utilities at the point of pipe crossing. Watermain crossings must adhere to the City of St. Catharine's Standards and the latest MECP Design Guidelines.
9. Storm sewers shall be constructed of concrete pipe or polyvinyl chloride (PVC) pipe. Pipes shall be joined by rubber gaskets, per the City of St. Catharines Standards.

4. **Storm Service Connections:** Drains shall be installed per OPSD 1006.01 (rigid main sewer) or OPSD 1006.02 (flexible main sewer).
    1. Connections shall be designed per the City of St. Catharines design standards.
    2. The service shall be graded with a minimum of 2% in the upper section of each sewer leg, and a maximum of 8%.
    3. The velocity shall fall into a range of 0.80 m/s to 3.65 m/s.

APPENDICES

APPENDIX A: COMPLIANCE CRITERIA DEVIATION FORM

COMPLIANCE CRITERIA DEVIATION FORM

Project Name: _____

University Project No.: _____

Purpose: Design and construction projects must conform to the Brock University Design Standards. If a requirement of the Standards can't be met this form is required to be completed and submitted to the University Project Manager for approval. This document is to be submitted early in the project schedule Schematic Design stage. Associated work can only commence once signed approval is obtained. Supporting documentation should be attached as necessary.

Design Standard Reference	Requirement of the Design Standard	Requested Deviation	Rationale For Deviation	Impact: Capital Cost/Maintenance Cost/Schedule/Other	University Approval

Company Name: _____

Name, Title: _____

Signature: _____

Date: _____

University Project Manager: _____

Signature: _____

Date: _____

APPENDIX B: FURNITURE SELECTION MATRIX

FURNITURE SELECTION MATRIX

Furniture	Single Office	Shared Office	Non-Assigned Work Space	Seminar Room	Meeting Room
Work Surface	Two (2) work surfaces with modesty panels: – 30 x 60 inches (height adjustable) – 24 x 72 inches	One (1) height adjustable work surface with modesty panel per work station – 30 x 48 inches	One (1) work surface with modesty panel per work station – 30 x 42 inches	One (1) work surface for every two (2) seats – 24 x 72 inches	At least one (1) work surface per meeting room – Size as required
Task Chair	One (1) fully adjustable ergonomic chair **Examples:** – ergoCentric tCentric – ergoCentric airCentric	One (1) fully adjustable ergonomic chair per work station **Examples:** – ergoCentric tCentric – ergoCentric airCentric	One (1) height adjustable ergonomic chair per work station **Examples**: – ergoCentric ecoCentric Mesh (height adj. only)	Set of four-leg or sled base stack chairs, padding optional **Examples:** – KI Strive Stack Chair	Set of height adjustable chairs, padding optional **Examples:** – KI Strive Task Chair
Guest Chairs	One (1) guest chair with padding **Example:** – Teknion Nami	One (1) guest chair with padding **Example:** – Teknion Nami	N/A	N/A	N/A
Book Shelf or Shelving	One (1) shelving unit – 36 x 12 x 72 (H) inches	One (1) shelving unit per work station – 36 x 12 x 72 (H) inches	N/A	N/A	N/A
Filing Cabinet	One (1) unit with two (2) or three (3) drawers – 18 x 36 inches	One (1) unit with two (2) or three (3) drawers – 18 x 36 inches	N/A	N/A	N/A
Mobile Pedestal	Maximum two (2) units per office	One (1) unit per work station	N/A	N/A	N/A
Guest Table	One (1) round table, if needed – 30-inch diameter	N/A	N/A	N/A	N/A

Note: *Furniture selection shall adhere to Brock University's Facility Accessibility Design Standards (FADS).*

APPENDIX C: STANDARD FURNITURE LAYOUTS