Queen's Building Standards

Date of Issue
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1.000 General

1.001 Drawings and Specifications

The storage, use and maintenance of record documents, which includes drawings and specifications, have physical limitations and technology limitations that requires some standardization. Drawings should be created with this in mind and reference made to section 01.721 (As-Built Drawings) for standard sizes. Queen's drawing room storage sticks are limited to "E" size drawing prints. Specifications shall be standard letter size (8½" by 11"). Both drawings and specifications shall be provided as hard copies and in computerized format on disk.

1.002 Architectural Details

Standard and special architectural details shall be submitted to PPS and approved in consultation with Campus Planning and Development before being incorporated into the building design.

1.003 Building Area Calculations

The University, in its consideration of building projects, requires that gross and net assignable areas be calculated in the following manner:

.1 "Gross Area" shall be construed to mean the sum of the floor areas included within the outside faces of exterior walls for all levels, or areas, which have floor surfaces.

.1 Gross area shall be computed by measuring from the outside face of exterior walls, disregarding cornices, pilasters, buttresses, etc., which extend beyond the wall face.

.2 In addition to all levels of internal floored spaces covered above, gross areas shall include basements (except unexcavated portions), attics, garages, enclosed porches, penthouses and mechanical equipment floors, lobbies, mezzanines, all balconies--inside or outside-- utilized for operational functions, and corridors etc. that are within the exterior face of the building. Roofed loading or shipping platforms should be included whether within or outside the exterior face of the building.

.3 Open courts and light wells, or portions of upper floors occupied by high ceiling rooms or lobbies which rise above single-floor ceiling height, shall not be included in the gross area. Unenclosed, roofed-over areas or floored surfaces with less than 6 feet 6 inches clear head-room shall not be included unless they can properly be designated and used as net assignable, mechanical, circulation, or custodial areas.

.2 "Net Assignable Area" refers to the total of the floor areas of all 'usable rooms', measured from the inside face of an exterior wall to the face of an interior wall, and from face to face of all other walls. 'Usable rooms' are defined as rooms providing direct academic facilities, such as classrooms, laboratories, seminars, departmental offices, technical workshops and stores. Not included in this category are: corridors, washrooms, mechanical rooms, or any other service facilities.

1.400 Blasting

.1 All tenders for projects which require blasting will include an amount to allow for a pre-blast survey made of nearby buildings or structures by an independent and competent person or firm.

The successful contractor will present a copy of this survey to the University or to Owners of other buildings or structures, for their approval and comment before any blasting is carried out.

1.500 Temporary Construction Facilities

PPS should be consulted before locating or selecting temporary construction facilities such as hoarding, material storage, trailers and temporary services, in order to minimize interference with other University functions or services, etc.

1.510 Temporary Services

Where water, steam and electricity are available, PPS may provide these services to the contractor. The University will be the sole judge of setting a reasonable cost for these services and may withdraw these services, if, in the University's opinion they are being wasted.

1.602 Hoarding

When required, contracts shall provide for a 2400 mm high hoarding completely around the site prior to commencing any work, and this hoarding shall be maintained by the contractor and remain in place for the duration of the project or until instructed otherwise by PPS. Locations are to be shown on drawings.

1.605 Salvage

PPS may wish to remove salvageable materials and equipment prior to demolition of existing buildings or portions of existing buildings. Materials to be salvaged will be identified by PPS prior to tender call.

1.610 Parking

The availability of parking space at Queen's University is limited. Two service vehicle parking permits will be issued on request to a contractor and on the approval of the project manager, allowing that contractor to park their vehicles on campus in service areas for the duration of the permit. The permit may be obtained free of charge from:

Queen's University - Parking Services (613) 533-6979

Rideau Building, 207 Stuart Street, Second Floor

All other vehicles without a valid permit must be parked off campus, or in the Underground Parking Area located on Stuart Street at University Avenue.

1.710 Commissioning

.1 Process

Commissioning is the process, prerequisite to handover, which is required in order to:

- Provide an opportunity for operations to review new projects to ensure operations concerns are addressed.
- Provide the operating philosophy for new projects and explain system operation.
- Inform the operations department what work has been done.
- Verify the proper functioning of all new systems.
- Provide documentation for all new systems.
- Provide warranty information and to start the "warranty clock" running.

.2 Levels

There shall be three levels of commissioning determined by the complexity of each project. The Project Manager and Area Manager shall determine, in the early stages of the project, which level is appropriate using criteria as outlined in the following table:

LEVEL	APPLIES TO PROJECT	COMMISSIONING CARRIED OUT BY:	WHAT IS TO BE DONE	DOCUMENTATION REQUIRED	WARRANTY FOLLOWUP
1	- Small projects usually less than $100K - No major changes to building systems	Area Manager and Project Manager	1. Visual inspection 2. Check system 3. Equipment tagged by shop 4. Solve outstanding problem	1. Warranty letter from PM 2. Manuals on all equipment to Drafting via Area Manager 3. Equipment list 4. Project Handover Form (Project Mgr) (Area Mgr)	Fixit Area Manager
2	- Medium projects $25K → $5M	Area Manager and Project Manager	1. Copy of Drawings and Specifications sent to operations when tendered 2. In progress visits by Area Manager and Trades	Manual to contain 1. Scope of project 2. Philosophy of operation 3. Warranty letters 4. Equipment data sheet	Fixit Area Manager

			3. Project Manager to coordinate list of deficiencies/problem areas throughout construction 4. Equipment tagged as part of contract; numbering system provided by Area Manager 5. Training sessions by contractor for all major systems 6. Verification with operations of all major systems 7. Warranty inspection at end of warranty period	5. Schematic control drawings 6. All licences and government inspection forms for installed equipment 7. Air balance reports 8. Project handover with listed accepted deficiencies *NOTE: documentation to be kept in Engineering	
3	Large Projects such as Stauffer Library	Consultant	Procedures the same as Level 2 except that a consultant will be hired by the Project Manager to participate as part of the building design team and to coordinate the commissioning activities outlined in Level 2.		

1.721 Record Drawings

.1 General Requirements

.1 Record drawings are those drawings prepared by the architect when contracted to do so. All new construction and major renovations are to include record drawings. These are a compendium of the original drawings, site changes known to the architect and information taken from the contractor's as-built drawings.

.2 During the planning stages of a project Physical Plant Services (PPS) will review this section of the guide with the architect/consultant to establish some basic drawing guidelines to ensure that all of Queen's requirements can be met and to facilitate future revisions.

At the completion of a project PPS shall be provided with at least two (2) complete sets of record drawings on bond paper, and a digital copy of all the record drawings in AutoCAD and Adobe PDF formats. The total number of copies to be determined at the start of the project. See Appendix ? for the definition of a 'Record' drawing issued jointly by the Ontario Association of Architects and the Ontario General Contractors Association.

.3 <u>The project will remain incomplete and a holdback will be retained until satisfactory record drawings, O&M manuals, reports and studies as hard copies and digital files are received by Queen's.</u>

.4 All new construction and major renovations to be designed using REVIT software. Full record drawing REVIT model to be submitted to PPS upon completion of project including full drawing set in AutoCAD and PDF format.

.2 Procedure

.1 A complete set of prints of record drawings shall be submitted for review by PPS engineer(s)/owner prior to final billing for project.

.2 Following the review, the revised drawings shall be returned to the architect/consultant and corrections shown shall be made to the AutoCAD record drawings. Two sets of corrected record drawings and electronic copies shall then be submitted for Queen's permanent record.

.3 Final record prints/plots shall not contain markings or corrections by hand (i.e. marker, pen, pencil, etc.).

.4 Drawing sheet sizes shall be to the ANSI/ASME standard:

SIZE	METRIC
A	216 X 279 millimetres
B	279 X 432 millimetres
C	432 X 559 millimetres
D	559 X 864 millimetres
E	864 X 1118 millimetres

Size of drawing sheets shall not exceed the ANSI E size.

.5 All drawings shall include the PPS project number, architect/consultant project number and CAD file reference.

.6 Record drawings shall be in AutoCAD DWG format. Drawings may be delivered on DVD disk, USB drives or downloaded by FTP or a direct link from a cloud service. A drawing list shall accompany all drawing submissions.

.3 CADD Requirements

.1 A complete list of layer names and brief description of each layer's use shall accompany all files.

.2 Hand rendered drawings are NOT acceptable.

.3 Fonts shall be AutoCAD, or Windows standard. Custom or proprietary fonts are NOT to be used.

.4 Provide macros or scripts to freeze and thaw layers so that individual disciplines (i.e. architectural, mechanical, electrical etc.) can be turned on or off.

.5 Symbols (aka "Blocks") are not to be grouped (i.e. power outlets and data outlets). All text that forms a part of the symbol shall be an "attribute".

.6 Multiple layers of a given discipline shall not be combined into single layers (i.e. bundling individual architectural layers into a single layer). If Xrefs are used in a drawing they are to be "bound" prior to submission to PPS.

.7 All drawings shall be in metric units. Buildings shall be in millimeters (mm), plot plans in meters (m). Imperial units are not acceptable.

.8 Special effort shall be made to ensure that drafting in AutoCAD is accurate: i.e. appropriate lines are indeed horizontal and vertical; lines that should intersect do but not over-intersect and ensure that entities are placed on correct layers.

.9 All CAD file references shall include the consultants/architects project number and drawing number. (i.e. 1055M01.DWG)

1.730 Operating and Maintenance Data

.1 Provide an organized compilation of operating and maintenance data including detailed technical information, shop drawings, photographs, test results, certificates, warranties, documents and records describing installation, operation and maintenance of individual products or systems as specified in individual sections of the specification.

.2 Hard Copies

.1 Assemble, coordinate, bind and index required data into the Operation and Maintenance Manual.

.2 Submit 1 copy of a complete Manual to Owner for review prior to final billing for project.

.3 Submit 2 final copies in English unless otherwise agreed upon at the start of the project.

.4 Organize the data into logical sections by systems. Review with Owner.

.5 Label each section with tabs.

.6 Drawings, diagrams and manufacturer's literature must be legible.

.7 Prepare instructions and data by personnel experienced in maintenance and operation of described products.

.8 Provide a PDF document to match each binder and/or submission.

.3 Binders

.1 Binders shall be vinyl, hard covered, three inch (maximum), D-ring side mounted, loose leaf, sized for 8½ X 11 inch paper with spine pocket.

.2 Identify contents of (each) binder on spine: include building name, building number, contents (generally), project number and date.

.4 Contents

Each binder shall contain the following:

.1 Cover sheet containing:
- .1 Date submitted
- .2 Building name and number
- .3 Project title
- .4 Project numbers (PPS and Contractor)
- .5 Name of Contractor

.2 Names and addresses of Contractor and all sub-contractors.

.3 Table of contents listing all sections and subsections included.

.4 For each item of equipment and each system include description of unit or system and component parts. Give function, normal operation characteristics and limiting conditions. Complete nomenclature and commercial number of replaceable parts.

.5 Maintenance manuals including manufacturers required/recommended maintenance schedule(s), routine procedures and guide for troubleshooting.

.6 Operations manual including manufacturers printed operation instructions and any supplementary data required.

.7 Provide original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance. List spare parts recommended/required.

.8 Include test reports, inspection certificates and warranties.

.9 An outline of the mechanical and electrical portions of the manual will be provided to the consultant at the start of the design process.

.5 Digital Copies

.1 Shall be in Adobe PDF format without password protection.

.2 Shall match the hardcopy version 1:1 including;

.3 All TABS in the hardcopy shall appear as a ‘bookmark’ in the digital copy.

.4 Where possible manuals are to be those provided by the manufacturer (not scanned from paper manuals).

.5 All manuals are to be 'text searchable'.

1.731 Handover

.1 The milestone at which point a project is turned over from a contractor via the project manager, to the maintenance department is known as the "Handover".

1.800 Minimum Energy Performance

.1 Major mechanical equipment must meet ASHRAE 90.1 latest edition.

.2 New construction must demonstrate a 10% cost improvement in the proposed building performance rating compared with the ASHRAE 90.1, latest edition, baseline building performance rating.

.3 Major renovation projects must demonstrate a 5% cost improvement in the proposed building performance rating compared with the ASHRAE 90.1, latest edition, baseline building performance rating.

.4 Energy Modelling

.1 Feasibility Studies and Conceptual Designs: Proof of compliance with Section 1.800 must be submitted in the form of a whole building energy simulation for each proposed design concept, including existing conditions if presented as an option. Energy modelling results must be summarized in main report and compared between options. Detailed energy simulation reports must be attached as an appendix to the Feasibility Study. The whole building project simulation must follow the procedures outlined in LEED Canada guidelines.

.2 Construction Projects: Proof of compliance with Section 1.800 must be submitted in the form of a whole building energy simulation before construction tender of the project. The whole building project simulation must follow the procedures outlined in LEED Canada guidelines. Compliance with Section 1.800 must be maintained throughout the construction process. Change Notices which effect building energy performance will require an updated energy simulation to prove compliance.

2.000 Sitework

2.001 General

Trees, shrubs, shrub beds and hedges are recorded on the digitized campus map and have associated data attached as attributes. The required data shall be provided on input forms found in the appendices.

2.200 Earthwork

The method of disposal of spoil must be cleared with Physical Plant Services (PPS) prior to calling for tenders.

2.480 Landscaping

Landscaping may be included in the building contract. Landscape design shall be reviewed by the Campus Grounds Advisory Committee (CGAC) and approved by the Campus Planning and Development Committee (CPDC).

2.491 Trees

.1 No trees shall be removed from building sites without the explicit written approval of the University.

.2 Tree Removal Guidelines

.1 Introduction

Trees are a valuable asset to the character of the campus. These guidelines form part of the maintenance and renewal program required to manage this living resource.

.2 Scope

These guidelines apply to trees on Queen's University property. The City will be advised of trees requiring attention on City property adjacent to University property. Other plants are managed by ongoing grounds maintenance.

.3 Policy

.1 Tree removal shall not be considered if hazard and/or obstruction can be eliminated by:

- treatment for disease
- pruning
- change in project design
- transplanting at reasonable cost (comparable to cost of equivalent replacement)

.2 Request for removal shall be considered when:

- trees are damaged by accident, Acts of God, disease or death and are deemed hazardous to people and/or property
- Trees unduly obstruct pathways, roadways, vision, and redevelopment of campus buildings, roads, paths, landscapes and utilities.

.4 Dead Trees

Trees that are completely dead will be removed by Physical Plant Services (PPS). Campus Planning and Development (CPD) will be informed in advance and a pictorial record will be kept.

.5 Emergency Removal

.1 If damage or obstruction has created an immediate hazard, PPS will provide temporary clean-up for safe travel of pedestrians and vehicles and to ensure that no additional damage will occur to Queen's property. Security and Parking or Environmental Health and Safety (EHS) staff may be present to advise during clean-up. Within one working day of clean-up, PPS Grounds Supervisor and CPD staff will meet on site to determine if a tree is to be saved or removed. PPS will implement the decision. CPD will notify the Vice Principal, Operations and Finance (VPOF) of the decision in writing.

.2 The "Dead Tree" procedure may also be used if a tree needs to be removed to facilitate emergency maintenance work or where extraordinary expense will be incurred without an immediate decision and consultation with CPD is not feasible within a reasonable time.

.6 Non-emergency Removal

.1 Requests for removing trees which do not create an immediate hazard, but require corrective measures for safety, shall be sent in writing to the Director of CPD with a copy forwarded to the Grounds Supervisor at PPS. CPD and PPS will together decide on the corrective action required. Where there is opposition to the corrective measures, a report from an external arborist may be obtained by the PPS Grounds Supervisor.

.2 CPD coordinates the above review with PPS and, where appropriate, consults with EHS and adjacent building users. CPD sends a recommendation to VPOF requesting a decision within five working days. A copy of the decision of the VPOF will be sent to PPS for action.

.3 Removal or relocation of trees on project site and immediate

surroundings identified during the planning stages of major building and landscape projects will be reviewed at various levels as follows:

- CPD and PPS (Grounds) review the landscape component of the project together with the Building/User Committee. PPS Project Manager will obtain municipal approvals for trees on City property.
- CPD forwards the results of the review to the VPOF for approval or for further review and direction.

.7 Records Update

.1 Photographic records of trees before removal will be maintained by CPD.

.2 After removals, map files will be updated by PPS from data supplied by the Grounds Supervisor.

.3 Record of removals, e.g., species, location, date and reason for removal, will be maintained by the Grounds Supervisor.

.3 See Appendix B, Form 2.491.3-B for an example of a tree data input form.

.4 See Appendix B, Form 2.491.4-B for an example of a shrub data input form.

.5 See Appendix B, Form 2.491.5-B for an example of a shrub bed data input form.

.6 See Appendix B, Form 2.491.6-B for an example of a hedge data input form.

2.700 Building Services

Provision of building services, sewers, water, steam and electricity shall be discussed with PPS, as well as with the local authority.

2.770 Concrete Walks and Curbs

.1 Walkway construction in a project should take into consideration the specific character of the site and the campus precinct, recognize the unique purpose of the project, ensure the continuity of design in the pedestrian circulation network, and effect economies in the long-term maintenance of that network. Walkway layout and dimension should follow desired line of pedestrian movement and adequately accommodate pedestrian traffic. Walkway detailing should signify pedestrian priority, indicate changes in use (e.g. city sidewalk, sidewalk widening, transition space and linkages), and provide clear separation between pedestrians and vehicles at high use zones.

.2 Major sidewalk shall be poured-in-place concrete. Width shall be 4.5 m, and may be modified if justified by use and site conditions. Where city sidewalks need to be widened to accommodate pedestrian needs, sidewalk widening of l m or wider than the standard city sidewalk shall have a unit paver border at the back of the city

sidewalk. The standard unit paver border shall be 600 mm wide, unless approved by the University. Unit paver shall be 100 x 100 mm grid size, textured, natural (light grey) colour, laid in stack bond pattern, flush with adjacent paving.

.3 Standard sidewalk shall be poured-in-place concrete, natural (light grey) colour, 2.8 m wide. Standard unit paver border at the back of the curb shall be determined on a project-by-project basis, depending on local conditions. Unit paver border if required shall be as specified in 2.770.2.

.4 Major walkways shall be 4.5 m to 6 m wide. Standard walkways shall be 2.8 m wide. Major and standard walkways shall be poured-in-place concrete, natural (light grey) colour, with unit paver border along both edges. The width of the border shall be approximately 750 mm (5 courses) wide for walkways 3 m or wider, and approximately 450 mm (3 courses) wide for walkways less than 3 m wide. The University shall approve variances in border width that are required to suit site and walkway proportion. Border shall be tumbled concrete unit paver 150 x 150 mm size, dark grey colour, laid in stack bond pattern. Walkway and border surfaces should finish flush.

.5 Minor walkway shall be a minimum 1.8 m wide poured-in-place concrete, natural (light grey) colour. If a minor walkway is not the sole accessible route to a facility, alternate materials may be accepted subject to University approval. Alternate materials should be durable, attractive, low maintenance, slip resistant, wheelchair accessible and convenient for snow removal.

.6 Concrete walkway configuration, finish and detailing should be compatible with the established design on campus, be appropriate for the intended use and maintenance equipment, and should be durable, attractive, low maintenance, slip resistant, wheelchair accessible and convenient for snow removal. Concrete shall be broom finish, in straight lines perpendicular to the primary direction of travel. Paving patterns may be adapted in response to setting, but should ensure continuity with the established walkway design on campus. Unnecessary grade changes and steps should be avoided, and if present, alternate and convenient accessible routes should be provided.

.7 Concrete curbs at sidewalks shall be flush with sidewalk. Concrete curbs defining shrub beds and turf areas shall be raised a minimum of 100 mm above finish grade of adjacent paving.

.8 Exposed edges of concrete curbs shall be rounded or chamfered to prevent chipping and damage from maintenance equipment. Sharp edges and corners shall be avoided.

.9 The dimension, finish and detailing of concrete curbs should be compatible with the predominant precedent in the vicinity, and should be durable, attractive and low maintenance.

.10 Curbs adjacent to hard surfaces shall be fitted with skateboard deterrent devices that are tamper-proof, safe, attractive, designed to minimize liability and blend in with the character of the site.

2.771 Concrete Patios and Courts

.1 Patios and courts along major pedestrian routes shall be poured-in-place concrete to provide ease of wheelchair access. Field paving materials other than poured-in- place concrete are subject to University approval. The use of unit pavers shall be limited to borders, banding and accents.

.2 Poured-in-place concrete shall meet the appearance and performance criteria specified for concrete walks in Division 2, Section 2.770. Unit paver for border and banding shall be 100 x100 grid size, textured, natural (light grey) colour, laid in stack bond pattern, flush with adjacent paving. The standard widths for unit paver border and banding shall be 600 mm and 400 mm respectively, unless approved by the University.

2.785 Unit Paving

.1 Unit paving should be unified by set dimensions and colours for field paving, borders, banding and accents. Variety can be achieved by varying the pattern at specific locations in response to the setting. The perimeter of unit paving areas should be defined by walls, curbs, and paver edging system and banding material, as appropriate for the location. Unit paver for field paving shall be 200 x 200 mm size in dark grey colour, and for borders and banding shall be 100 x 100 mm grid size, textured, natural (light grey) colour. Pavers shall be laid in stack bond pattern, flush with adjacent paving. The standard widths for unit paver border and banding shall be 600 mm and 400 mm respectively. The University shall approve paver size, colour and pattern for non-standard field, banding and accents.

.2 Unit pavers approved for use at walkways shall be of colour and pattern consistent with the predominant precedent in the streetscape and vicinity. Finish and detailing should be durable, attractive, low maintenance, slip resistant, wheelchair accessible and convenient for snow removal.

2.788 Landscape Edging

.1 Where the perimeter of unit pavers abuts planting areas or where no curb edge is present, paver-edging products are required.

.2 Aluminum edging system is preferred, and should have locking joining system with no obstructions, be durable, flexible and non-rusting.

2.823 Metal and Chain-link Fences and Gates

.1 Fence and fittings shall be aluminum, minimum 11 gauge.

.2 Minimum post size shall be 50 mm (1 7/8 in.) outside diameter. Fence post shall be direct buried in concrete footing for permanent installations.

.3 Chain-link fabric shall be secured on all sides to post and frame. Maximum panel module size shall be 50 ft. wide.

.4 Gate design should distribute forces evenly to avoid premature wear. Swing gate is preferred.

2.833 Cast-in-Place Concrete Planter and Seat Walls

.1 Walls serve a variety of functions such as controlling the movement of people and vehicles, defining edges, and screening bicycles and cars. The design of walls should complement the setting and be appropriate for the intended use.

.2 Poured-in-place concrete is the preferred material. Other materials are subject to University approval.

.3 Exposed edges shall be rounded or chamfered to prevent chipping and damage from maintenance equipment. Sharp edges and corners shall be avoided.

.4 Finish and detailing should be compatible with the predominant precedent in the vicinity, and should be durable, attractive and low maintenance. Seat wall should be minimum 400 mm wide in cross section. The standard concrete finish shall be natural (light grey) colour. Non-standard colours require University approval.

.5 Walls shall be fitted with skateboard deterrent devices that are tamper-proof, safe, attractive, designed to minimize liability and blend in with the site and architectural character.

2.834 Segmental Masonry Retaining Walls

.1 Retaining wall system using modular concrete units installed without mortar should be limited to areas of lower visibility and usage.

.2 The colour and face texture should be grey or earth tone, depending on site and building character. Natural rock-like texture is preferred. The top of wall should be finished with cap unit. Skateboard deterrent device along top of wall shall be as specified in 2.833.5.

.3 Installations should follow manufacturer's specifications.

2.848 Bollards

.1 Rigid and collapsible bollards are used to prevent access by unauthorized vehicles to walkways and fire lanes, but do not interfere with pedestrians. A special tool allows the collapsible bollard to be lowered to the ground, remaining attached to a hinge, and then replaced in the upright position.

.2 Bollards shall be Maxiforce 1 collapsible style bollard Model MF and rigid type bollard Model MF, supplied by G. Reale Enterprises, Inc., 3444 Marshall Road, Drexel Hill, PA 19026, Tel. 610-623-2611. Standard dimensions of extruded steel tubing are 6 in. x 3 in., above ground height is 32 in. Bollards shall have powder coat finish, RAL 7024 graphite grey semi-gloss. Apply reflective tape as specified. Installation shall be per manufacturer's specifications.

2.849 Bicycle Racks

.1 Bicycle racks should be in well-lit and convenient locations to meet the needs of potential users. Locations that allow casual supervision from building occupants and passers-by may provide additional safeguard against theft.

.2 Bicycle rack should allow the frame and one wheel to be locked to the rack with a high security, U-shaped shackle lock if both wheels are left on the bicycle.

.3 Bicycle rack shall be bolted to pavement. Placement of racks should allow for parking perpendicular to the rack on both sides. A minimum clearance of 2 m between parked bicycles is required for snow removal.

.4 Racks should be catalogue item rather than custom made. The preferred product is the Ring Rack by Bikeup Bicycle Parking Systems Inc.

2.871 Benches

.1 Benches should be conveniently located in areas of frequent use. A variety of seating arrangements for different social patterns and for choices in sun and shade should be provided. Seating arrangements can also help define a space.

.2 Bench should be catalogue item rather than custom made. The design should be comfortable, durable, attractive and low maintenance.

.3 Freestanding bench shall have back with no arm rests. The base plate shall be anchored to a concrete pad or footing with tamper-proof hardware.

.4 Where the bench is built-in such as a seat wall, refer to section 2.833, Cast-in- Place Concrete Planter and Seat Walls, for requirements.

.5 Free-standing bench shall be Victory Stanley model NRB-6, 6 ft. length, surface mount base, powder coat finish RAL 7024 graphite grey semi-gloss.

2.872 Trash Receptacles

.1 Trash receptacles should be located at major activity centres and along major routes. The location of individual units should not be visually intrusive.

.2 Receptacle unit should be durable, vandal resistant, attractive in design with easy to remove liner and protection of contents from rain and weather.

.3 Trash receptacle shall be production item, Victor Stanley model S-42 with S-2 spun steel dome, powder coat finish RAL 7024 graphite grey semi-gloss. Anchor to concrete using tamper-proof hardware.

2.873 Precast Free-Standing Planters

.1 In general, cast-in-place planters are preferred to portable planters as the former provides better growing conditions. Corners should be rounded or chamfered, finish should be lightly textured natural (light grey).

.2 Portable planters shall be precast concrete, Cylindrical Grade Adjusting Planter Type JJR by Alpha Precasts, sandblasted finish. Planter size shall be 36 in. (91.4 cm) diameter and 24 in. (61.0 cm) height. Planters shall allow drainage at base.

2.874 Precast Tree Grates

.1 Tree grate finish, slot openings and detailing should enable barrier-free accessibility.

.2 Top of tree grate shall be level with adjacent pavement. A minimum clearance of 100 mm (4 in.) is required between the bottom of the tree grate and the finish grade of soil in the tree pit.

.3 Tree grate shall be precast concrete, Type TG1 (circular) and Type TG3 (square), by Alpha Precasts, sandblasted finish. Tree grate size shall be 121.9 cm (4 ft.) minimum diameter or square, centre hole shall be 45.7 cm (18 in.) diameter.

2.881 Wood Fences and Gates

.1 Wood fence should be sturdy, durable, attractive and low maintenance.

.2 Design should discourage climbing. Footing and joint detailing should minimize damage from moisture and impact from vehicles and maintenance equipment.

.3 Lumber shall be pressure-treated. Colour and finish should be compatible with the site and architectural character. Apply weatherproof sealant per manufacturer's specifications.

.4 Hardware should be rustproof and tamper-resistant.

2.892 *Commemorative Displays*

.1 Donor recognition plaques for memorial gifts of bench and tree shall follow University procedures for plaque design, procurement, installation and maintenance.

.2 The University's Graphic Design Services is responsible for preparing camera- ready artwork for the plaque and arranging for fabrication of the plaque in accordance with plaque design guidelines.

.3 Physical Plant Services is responsible for bench installation, tree planting, plaque installation and maintenance of the gift and plaque.

2.901 *Tree and Shrub Preservation*

.1 Existing plant material to be retained, including plants that may be affected by construction activities both within and outside the actual project limits, shall meet the protection and maintenance requirements specified in this section. Such plant and root systems shall be protected from damage, compaction and contamination resulting from construction.

.2 All deciduous trees within the work zone shall be protected with wood plank tree protection. Maintain tree protection during construction period. Remove only when risk of damage has passed and upon approval by the University's representative.

.3 Tree protection shall be 28 x 89 mm wood planks, minimum 1500 mm long, secured with two bands of metal strapping. Place wood planks around base of trunk at 150 mm maximum on centre to provide full protection from impact and abrasion. Do not puncture or damage bark with wood planks or fasteners. Arrange wood planks around branches and other irregularities to provide protection without damaging tree.

.4 Prevent damage to trees and shrubs in lawn areas or planting beds that are to remain by erecting a snow fence barrier to provide a continuous barricade between designated plant materials and the work area prior to construction. Place snow fence at drip-line of trees unless inadequate to provide a 1.5 m buffer zone between the fence and limit of construction. Drip-line is defined as ground surface directly beneath tips of outermost branches, at least 3 m radius from the tree trunk or larger as directed by the University's representative. With the permission of the University's representative, the fence may be placed within drip-line of tree in order to provide a buffer zone of up to 1.5 m, but in no case less than 1 m from the outer circumference of the trunk.

.5 Do not operate, park, repair or refuel equipment, do not store construction materials or stockpile any earth materials within barricades or within 2 m of the outer edge of the drip line of a tree. Do not cause flooding or deposition of sediment where trees are located. Maintain barricades during construction operations, and remove on completion as directed by the University's representative.

.6 Snow fence barrier shall be standard plastic fencing or approved equivalent in good condition, 1.2 m high, supported vertically by steel T-bars, and horizontally at the top of the fencing by 39 x 89 mm wood railing, bolted to the steel T-bars. T-bars are to be straight, 1.8 m long. Drive T-bars vertically 60 cm into ground, spaced maximum 4.5 m apart. Wire snow fence at 3 places to each T-bar. Stretch snow fence to prevent sag.

2.906 Tree and Shrub Planting

.1 Tree planters for a single specimen in paved areas shall have a minimum inside dimension of 3.05 m (10 ft.). The minimum clearance from adjacent paving and structures (e.g., steps, curbs, walls, fences, and buildings) shall be 3.05 m (10 ft.) or 50% of the average mature spread for trees, and 900 mm (3 ft.) or 50% of the average mature spread for shrubs, whichever is the greater measurement. Departure from these minimum clearance requirements must have the approval of the University before installation begins.

.2 Planting mixture should be 3 parts topsoil, 1 part sterilized mushroom compost, 1 part peat moss, free of weeds, roots, stones, and similar material. It should be placed in layers of not more than 150 mm at a time.

.3 Installation requirements for subgrade, plant pit, planting soil mixture, root ball, mulch, finish grade around tree, staking, trunk wrap, and pruning shall be as shown in Appendix A, Figure 2.906.3-A.

.4 Installation requirements for subgrade, base of plant pit, planting soil mixture, root ball, mulch, and pruning shall be as shown in Appendix A, Figure 2.906.4-A.

.5 Planting should be inspected by the project manager at all stages of installation.

2.911 Subgrade Preparation and Finish Grading

.1 Subgrade preparation is required under all areas designated to receive landscaping as shown on drawings.

.2 Subgrade should be free of rocks, weeds, roots and other debris. Foreign material shall not be buried beneath areas to be landscaped.

.3 Completed subgrade should be even and have positive drainage. Subgrade should be scarified to a minimum 100 mm (4 in.) depth. Subgrade shall be approved by project manager before topsoil placement begins.

.4 Topsoil mixture shall be 3 parts Grade 1 topsoil, 1 part sterilized mushroom compost, 1 part peat moss. Mixture should avoid being excessively wet and should be free of weeds, roots, rocks and other debris.

.5 Place topsoil in dry weather, on dry unfrozen grade to obtain minimum depth after settlement of 100 mm (4 in.) or depth specified in planting details. Allow settling to occur for 1 week or roll to facilitate settling. Top layer should be loosely raked to allow for rooting of seed or sod. Surface should be smooth, uniform and sufficiently firm to prevent sinkage pockets when irrigated. Surface should fall smoothly to catch basin rim and finish flush, and ensure positive drainage away from building and sidewalks.

.6 Project manager should be present for inspection at all stages of grading.

2.921 Seeding

.1 Seed mixture should be 60 percent Kentucky Blue Grass, 20 percent Red Fescue, 10 percent Annual Rye, 10 percent Perennial Rye

.2 Apply half of the seed at the recommended rate in a north-south direction, half in an east- west direction. Lightly rake to cover seed and roll. Water lightly and frequently until seed is established. Contractor should be responsible for two cuttings, the first at the highest level of the mower.

.3 Project manager should be present for inspection at all stages of seeding.

2.933 Sodding

.1 Sod should be laid within 24 hours of being cut. Sod should be laid in a brick-like pattern so that joints are staggered. Cuts should be made with a sharp instrument, preferably a knife or a spade. No overlaps or gaps should be present. Sod should be rolled immediately after installation to remove air from under the sod.

.2 Sod should be watered after installation to penetrate 300 cm (6 in.) into soil. Sod should be watered daily except in periods of intense heat or drought when frequency should be increased.

.3 Contractor is responsible for first two cuttings of sod. The first cutting should be approximately 10-14 days after installation when sod is firmly established. Cutting should be on the highest level of the mower.

.4 Project manager should be present for inspection at all stages of sodding.

5.000 Metal Fabrications

5.500 Metal Fabrications

Metal fabrications, such as stairs, handrails, guard rails etc., should be a production item where possible rather than custom made, and with practical utility in mind rather than decoration. Painted ferrous metal shall not be used for exterior use unless galvanized after fabrication. Stainless steel, copper, bronze, monel, or aluminum may also be considered.

7.000 Thermal and Moisture Protection

7.600 Insulation

.1 The use of thermal insulation is required between all heated and unheated spaces in the interest of operating economy and comfort which shall conform with the standards and recommendations described in the Ontario Building Code, Sect. 9.25.

.2 All walls, floors, and ceilings with thermal insulation shall include a complete and effective air/vapour barrier on the inside surface to prevent leakage of air from the building interior to the insulation, as described in the Ontario Building Code, Sect. 9.25.3.

.3 All new insulation applications shall have a mock-up prepared for review by the owner and a building sciences specialist prior to construction, and a site inspection by a building sciences specialist during construction.

7.601 Roofing and Flashing

.1 Built-up flat roofs and associated flashings constitute one of the University's largest maintenance problems. Extreme care should be given to the design and detailing of flat roofing as per C.R.C.A. standards.

.2 Access to roofs shall be by stairs, ladders and hatches will not be permitted. Sufficient guarding of roof must be included to allow navigation of roof and access to equipment without the need for fall protection.

.3 All flat roofs at the University shall be four ply inverted membrane consisting of asphalt with glass fibre felts on horizontal surface, asphalt with cloth fibre felts on vertical surfaces mechanically fastened at the upper edge. Roofing system shall include a polyethylene slip sheet between the membrane and the insulation. Insulation shall be placed in staggered layers, (bottom layer 1", top layer 3" shiplap) with drainage trenches in the lower layer on 10 foot centres to direct water to drains. Insulation shall be covered with filter fabric and a washed, crushed limestone ballast.

.4 The University considers the following points of great importance in achieving a satisfactory roof:

.1 Proven flashing details are preferred to special architectural effects.

.2 Roofing membranes should be designed to provide complete waterproof integrity to the roof, without metal flashings.

.3 Generally, metal flashing should be regarded only as mechanical protection for membrane edges.

.5 At wall junctions, expansion joints, cants, etc., the membrane should be turned up a minimum of six inches above the wooden cant strip and secured to pressure treated plywood backing.

.6 The University will require one hundred percent inspection, during application, by a specialist roofing agency; cut tests to determine asphalt quantity; and a twenty- four hour test of all roofs flooded to a depth of 100 mm.

.7 Metal flashings should be of copper or galvalume and care should be taken to prevent staining from mortar or concrete. Particular attention should be given to thermal expansion and fixing problems.

.8 With reference to metal wall panels, care shall be taken to avoid an electrolytic action between dissimilar metals. Copper flashing for example shall not be in direct contract with metal wall panels at any point including fastenings. Plastic isolating washers and ferrules shall be used in all cases.

.9 Testing of ballast shall include petro graphic analysis and magnesium sulphate test to establish freeze/thaw stability. Ballast must also meet or exceed aggregate strength requirements for concrete or asphalt paving.

.10 Provide walking paths from service access hatches, ladders or access stairs to all rooftop equipment which requires servicing. Walkways to typically be 2'x2'x2" precast concrete pavers on adjustable pedestals. Cast-in-place concrete or duckboards are not acceptable.

.11 Integrate approved anchors on the roofs to allow for all workers to be attached with a harness when working close to the edge.

7.602 Fire-Stopping

.1 For renovation projects, in addition to the necessary new joints and penetrations, specify the fire-stopping of all existing assemblies where fire-stopping is damaged, discontinued or absent.

.2 Where possible, use metal sleeves for floor penetrations to prevent/mitigate the consequences of leakage or flooding.

.3 As through-wall cabling is often updated, cable tray penetrations shall be closed with a fire stop system for active openings.

7.603 Caulking

.1 The type of caulking to be used in any situation shall be selected to suit the particular conditions of the job, with careful adherence to the manufacturer's instructions for application.

.2 Caulking shall be tooled to a smooth concave finish (with backer rod where required) to a maximum 1:3 thickness/width ratio.

.3 Caulking installation sample shall be reviewed by a building science specialist for approval prior to use.

.4 Caulking shall never be used to hide or make-up for design or construction errors or faults.

.5 Where necessary, the colour shall match the adjacent surfaces and shall not be subject to ultra violet degradation or fading.

8.000 Doors and Windows

8.100 General

.1 Building entrances shall typically be aluminum, or wood when required to match an existing condition. Use steel exterior doors at locations with low public traffic (utility rooms, service access, etc.). Exterior metal doors and frames shall be thermally broken wherever possible.

.2 Typical door sizes:

Typical thickness: 44mm.
Minimum stile and top rail width: 125mm metal, 150mm wood doors.
Bottom rail: min. 250mm.
Minimum width: 900mm single and 1800mm double doors.
Mechanical and electrical rooms: minimum width 1200mm, single or double doors. Double doors shall have the active leaf 900mm (or 915mm) wide.

.3 The University encourages the use of glass panels in interior doors, to provide natural light in corridors. Frameless glass doors shall be avoided.

.4 Interior door locations shall provide adequate clearance behind the door opened at 90° and the adjacent wall. The clearance between the edge of hinge side frame and adjacent wall:

100mm – typical at offices, classrooms, labs.

.5 Shop drilling and notching shall be specified wherever possible.

.6 Door and vestibule are to be selected based on expected use. Consideration for revolving doors and air curtains to limit heat loss.

.7 For rooms with special acoustical requirements, specify doors and frames filled with acoustical insulation. Specify required hardware to meet acoustical needs.

8.110 Metal Doors

.1 Use hollow core, welded assemblies (pressed seams are not acceptable).

.2 Thickness of materials (minimum):

Face Sheet – interior doors typical 1.2mm (18 gauge)
Face Sheet – exterior doors 1.6mm (16 gauge)
Top and Bottom Channels 1.2mm (18 gauge)

8.140 Wood Doors

Faces (Rated and Non-Rated Assemblies):

.1 Type 1: Hardwood Veneer:
Solid core, rotary cut sound birch or maple
Finish: clear factory coating, satin sheen

.2 Type 2: Hardboard: solid core, painted

.3 Core: Solid wood or composite core (mineral core is not acceptable).

8.500 *Windows*

.1 All new windows shall conform to CAN/CSA-A440, and meet the following minimum level of performances for fixed or operable windows (except double hung):

.1 Air infiltration factor: higher or equal than A3

.2 Water infiltration factor: higher or equal than B7

.3 Wind load resistance: higher or equal than C5

.4 Resistance to condensation: higher or equal than I55

.5 For all old buildings, particular attention has to be given to condensation problems if there is not enough perimeter heating. A higher I factor (condensation resistance) would therefore be required.

.2 Finish:

.1 Aluminum:
Clear anodized typical for new construction.
Other finish to match existing where necessary.

.2 Composite: Light colours only.

.3 Hardware:

.1 Premium hardware as recommended by manufacturer for compatibility.

.2 Latching/locking devices shall be cam handle type (rotor operators, push bars are not acceptable).

.3 Finish to complement frames or match/complement existing in-situ products.

.4 Operable Windows:

.1 Vents: Awning or casement outswing vents.

.2 Screens hall not be provided, except some ground floor rooms, reviewed on a case by case basis.

.3 Operable windows in laboratories and other specialty spaces are to be installed with specialized hardware to suit opening only during a mechanical system failure or shutdown.

.5 Glazing:

.1 Low-emissivity coating must be used. Rating of Low-E is to be chosen according to characteristics needed, depending on the case.

.2 All interior doors that require glazing shall be glazed with 6mm (1/4") clear, tempered glass set in continuous gaskets on both sides.

.3 All fire-rated exit doors that require glazing shall be glazed with 6mm (1/4") polished wire glass and set in continuous gaskets on both sides and shall not rattle when door is slammed.

.4 Interior windows shall consist of tempered glass panes. Glass shall be clear, 6mm (1/4") thick, free of distortions, polished plate or float, with neoprene setting blocks and glazing tape.

8.700 Cabinet Hardware

.1 Where banks of lockers or cabinets are provided, a system of visual identification of keys with their respective lock shall be used with numbers stamped on both the key and the lock. The system shall also be capable of expansion to double the original number of units without duplication of any existing keys.

.2 Locking devices for use in corrosive or humid atmospheres such as chemistry laboratories or pools shall be carefully selected to remain functional at all times, and unaffected by corrosive fumes or humidity.

.3 Where the users wish to have lockable closets or storage units in office buildings and residences, the locks to these doors should be keyed alike with the room door. In cases where the application does not warrant the expense of such locks, the requirements of visual identification outlined in paragraph (.1) shall apply.

8.710 Door Hardware

.1 FINISH: Standard Finishes shall be Builders Hardware Manufacturers Association (BHMA) as follows:

Device	Standard	Finish

Hinges (exterior)	BHMA 630 (C32D)	Satin Stainless Steel
Hinges and stops	BHMA 619 (C15)	Satin Nickel Plated
Locks	BHMA 626 (C26D)	Satin Chromium Plated
Misc. hardware, pulls, pushes, kick plates	BHMA 630 (C32D)	Satin Stainless Steel

Any deviations from these finish schedules must be approved in writing by Campus Planning and Development and PPS (Project Manager).

.2 INSTALLATION: All hardware shall be installed and adjusted by carpenters skilled in the application of architectural hardware and as per manufacturers printed instructions and templates. All locations as per Door and Hardware Institute (D.H.I.) standards. See Appendix A, Figure 8.710.2-A as per Architect's instructions.

8.711 Locks, Locksets and Latchsets

LOCKS:	Schlage Series "L" with appropriate function
Lever:	"03" where required
Knob:	"42 (D Orbit)"
Escutcheon:	"N" where required
Rose:	"B-Wrought Rose"
Finish:	626

8.712 Hinges

BUTT HINGES:

Manufacturer		Hager
Interior Standard Duty		BB 2222
Exterior Standard Duty		BB 1191
*Interior Heavy Duty		BB 1168
*Exterior Heavy Duty		BB 1199
Size	4.5 X 4	
Finish	Interior 619	
	Exterior 630	

*To be used on doors larger than 3'0" X 7'0" or on high usage doors

8.713 Pulls and Plates

.1 PUSH/PULL PLATES:

Manufacturer - Hager
HA 9500 X 127 X 508
Finish 630

.2 DOOR PULL:

Manufacturer - Hager
HA 7012
Finish 630 or HA 5509 X 630

.3 KICK PLATE:

Manufacturer - Hager
HA 9550 X 203
Finish 630

8.714 Door Stops

.1 WALL STOPS:

Manufacturer - Hager
HA 1200 for passage/panics/pulls HA 1202 for locksets
Finish 619

.2 FLOOR STOPS:

Manufacturer - Hager
HA 1119 for metal doors
HA 1118 for wood doors
Finish 619

.3 OVERHEAD STOPS:

Glynn Johnson
GJ313 (GJ100-2AS)

8.715 Door Closers

.1 CLOSERS:

Interior	Corbin 110-3 or P110-3 (parallel arms)
Exterior Regular	LCN 4040
Exterior Handicap	LCN 4041
Finish	689 (painted aluminum)

.2 EXIT DEVICE:

Manufacturer - Von Duprin
Rim and surface vertical rod (98 Series with function to suit application)
Finish 628 or 626
Trim 992L X 03 lever X 626

.3 SPRING HINGES

Manufacturer - Dorex

9.000 Finishes

9.100 Colour Schedules

.1 The colour schedule proposed for any new project shall be submitted to the University for approval by Campus Planning and Development, PPS, and the Department using the space, before issuing to the contractor.

.2 Consideration for the visually impaired shall be included by way of colour contrasts and material textures.

9.101 Walls - Non Load Bearing

.1 Interior walls or partitions shall be concrete block (plastered or unplastered) or gyprock on steel studs as best meets the project needs.

.2 Studs should extend from slab to slab and the void should be filled with fibreglass batts (see 13.080 for sound attenuation).

.3 Demountable (relocatable) partitions or moveable (accordion or leaf) partitions with few exceptions, are not acceptable.

9.500 Acoustical Ceilings

.1 Access to mechanical services contained in ceiling space is considered extremely important, and ceiling construction which hinders this access must be avoided. Preferred ceilings are the "T" bar lay-in acoustic panel type. Provide access doors/panels in finished ceilings as necessary to all equipment and controls for service and maintenance.

.2 Generally laboratories will not have finished ceilings, and all services shall be painted, and pipes labelled.

.3 Classrooms shall have suspended acoustic tile ceilings.

.4 Office, corridors, etc. may have painted drywall ceilings or "T" bar with acoustic panels.

.5 Suitable permanent markers shall be placed on the underside of all tiles covering controls of mechanical services such as valves, dampers, etc. These shall be colour-coded and numbered, and listed on the valve and control charts provided for use with the mechanical equipment. See Section 23/206.2 for labelling instructions.

9.501 Acoustical Tiles

.1 Acoustic-tile ceiling panels shall be mineral fibre, fire-rated, minaboard fissured lay-in type, made by Armstrong World Industries Ltd., "Georgian" or "Cross Fissure" design.

.2 Spare acoustic tiles or panels are to be handed to Physical Plant Services in full cartons, clearly marked with the Physical Plant Services project number, project name and type of tile. Quantities of spares should equal three percent of the areas covered by each type, to the nearest full carton.

.3 Special Architectural effects including acoustic treatments should be considered from the point of view of fire resistance, initial cost and maintenance.

9.650 Resilient Tile Flooring

.1 As general purpose flooring, the University has been satisfied with the performance of vinyl composition floor tile 3.2 mm thick and rubber cove baseboards (see 09.661). Tiles should be medium tones and not solid colours, except in accents.

.2 Spare floor tiles of each colour and type shall be handed to PPS in full cartons clearly marked with the PPS project number, project name and colour of tile. The quantity of spares shall be two full cartons of each type or five percent (ten percent for new builds) of the area covered, whichever is the greater.

9.651 Cove base

.1 All interior walls shall be finished with moulded rubber cove base 101.6 mm high x 3.2 mm thick, secured in place with glue only, using preformed corners.

.2 Colour shall be restricted to black, brown, medium blue, light grey, beige, or dark green.

9.680 Carpeting

.1 Floor carpeting is not a standard floor finish except in specialized areas (i.e. library) or with special permission.

.2 A separate document will be issued by PPS when required which contains specifications for types of carpet, adhesives, installation requirement, guarantees, lifting and removal of existing carpet, and floor preparation.

.3 The university carpeting policy applies to all sectors of the university community and permits the installation of carpet if specific circumstances are satisfied. These circumstances are:

.1 Housekeeping Services must be satisfied that the installation of carpet is consistent with the uses of the area and will not result in higher housekeeping costs.

.2 The Department of Occupational Health and Safety must be satisfied that the installation of carpeting will not represent a safety hazard.

.3 The quality of carpeting to be installed must be consistent with a standard established by the Purchasing Department.

.4 Maintenance of the carpeting will be the responsibility of Housekeeping Services and they will determine the appropriate level of maintenance unless some mutually agreeable arrangement concerning maintenance is reached.

.5 Individual departments will be responsible for cleaning costs requested in addition to the regular cleaning schedule.

.4 Carpet installation shall be done under the supervision of PPS. All costs associated with the purchase and installation of the carpet and reparation costs incurred at the time of removal are the responsibility of the respective department.

.5 Carpets shall be purchased with the assistance of the Purchasing Department to ensure carpet quality meets university standards for wear and maintenance.

9.910 Painting

.1 Painting shall be performed by qualified personnel, using a primer when necessary, and using as many layers as necessary.

.2 All paintings shall be zero (0) VOC (volatile organic compound), except for dark color painting and exterior painting that shall be low VOC (max 50g/L).

.3 All stains shall be low VOC (max 250 g/L). All varnishes shall be low VOC (max 230 g/L).

.4 Painting colorant shall contain no glycol and no other toxicity.

.5 Paint shall be 100% acrylic or enamel based (non-oil).

.6 Interior painting shall follow these guidelines:

.1 All areas (except those in .2): latex, MPI Gloss Level 3 (eggshell-like) finish.

.2 Laundry rooms, washrooms, change rooms, food prep area, and laboratories: washable latex MPI Gloss Level 5 (semi-gloss) finish.

9.960 *Transparent Finishes*

If a concrete floor surface is specified it shall be sealed using a clear concrete floor sealer. Painting of concrete floors requires approval from PPS and Campus Planning and Development.

10.000 Specialties

10.500 Graphics and Wayfinding

Graphics and wayfinding shall be made a part of the cash allowance and designed in consultation with PPS, Campus Planning and Development, Graphic Design and the building user(s) in accordance with the Queen's University Signage Policy.

Link to Queen's University's Signage Policy – click here

10.140 Building Signs

Building Signs shall conform to the specifications contained in Queen's University's Signage Policy - Appendix 10.400.

10.442 Room Numbers

.1 Except for unusual projects, architects will designate floors in numerical sequence from the lowest level upward, i.e. level 1, level 2, etc. and to avoid such designations as "basement" and "ground floor".

.2 In residences, bedrooms should be designated in numerical sequence, clockwise around each floor. Rooms other than bedrooms may be designated subsequently but should not break the sequence of bedroom numbers. The purpose of this approach is to facilitate room location and key coding.

.3 The actual installation of room numbers and signs shall be included in the contract.

.4 All rooms will have a unique number

- usually 3 digits and possibly a letter prefix and/or suffix
- the first digit corresponds to the floor level (e.g. Rm. A206a is a room on the second level)

.5 Preceding letters (upper case) are used only to differentiate blocks or wings of a building complex. In a larger complex, wings or blocks will need to be designated. (e.g. A206a - Block A, Room 206a)

.6 Letters following the digits (lower case) are normally used to indicate a room which opens into another room other than a public corridor system. (e.g. A206a) See Figure 10.442.16-A in Appendix A as an example.

.7 All assignable rooms (offices, labs, classrooms, etc.) to start numbering at 01 in an orderly sequence (clockwise rotation or odd/even as in example below) from the main entry of the floor if possible. Numbering of very large rooms (capable of subdivision with corridor access at a later date) should be sequenced to allow for future subdivisions, aligned with building column lines where possible.

.8 All non-assignable spaces (stairs, corridors, washrooms, mechanical rooms, etc.) to start numbering at 99 and work down (backwards). Refer to space numbering sequence below.

.9 All vertical elements to have the same last two digits on each floor if possible. (E.g. stairwells, elevators, corridors, etc.)

.10 No more than five digits will make up a room number.

.11 If the building project is large (over 100 spaces per floor), consideration should be given to room numbering to a thousand. Assignable spaces would be numbered 1001, 1002, etc. ascending, and non-assignable spaces numbered 1099, 1098, etc. descending.

.12 The smallest space to be assigned a number shall be nominally one square metre.

.13 If the above procedures cannot be followed, please contact the office of Campus Planning and Development or Physical Plant Services.

.14 Room numbering will be reviewed and approved by Campus Planning and Development prior to tendering of contract.

.15 Space numbering sequence:

Elevators
Stairs
Entrances
Washrooms
Mechanical Rooms
Electrical Rooms
Corridors
Janitors
Other non-assignable spaces
Assignable Spaces

.16 See Appendix A, Figure 10.442.16-A for an example of room numbering procedure.

13.000 Special Construction

13.100 Sound Barriers

.1 All walls and partitions shall extend to underside of floor above, with few exceptions.

.2 Light switches, power and communication outlets shall not be installed back to back in wall, but staggered twelve inches minimum and caulked.

.3 Ducting shall be acoustically insulated externally for a distance equal to the largest duct dimension, both sides of the wall, or a minimum of 24".

.4 When privacy or sound isolation is particularly important, the wall or partition shall be:

.1 Concrete block with all edges and penetrations sealed. All other penetrations such as pipes etc., shall be sealed and caulked with ULC approved firestop material.

.2 Half inch (12.7 mm) drywall on staggered metal stud construction with a blanket of acoustic insulation, acoustically continuous throughout the wall cavity.

.3 Two, five eights inch (15.9 mm) thicknesses of drywall on each side of the metal studs, with staggered joints and without acoustic insulation.

.4 Doors to be solid wood core with soft type weather strip on sides and top and automatic threshold closer at bottom.

14.000 General Elevator Requirements

14.200 Applicable Codes

Equipment shall meet all current applicable codes including CSA B44-94.

14.201 Access

Barrier free access shall be provided in all new construction. Design shall comply with all current codes and Queen's University Accessibility Guidelines.

14.202 Identification

Each elevator has a unique identification number in addition to its registration number from the Ministry. This number is required and assigned by the Maintenance Department. It shall be displayed prominently on the elevator by means of an engraved novoply or lamacoid nameplate to Queen's standard.

14.203 Equipment Data

A data base is maintained at the University for all elevator equipment. Any change or addition shall be submitted to PPS Engineering for entry in the data base. For convenience, there is an equipment data sheet form available that may be used to collect and submit the data. See Section 14.213.

14.204 Maintenance Data

.1 Provide the necessary elevator maintenance data for all newly installed equipment and incorporate them into the maintenance manual (ref. Section 01.730).

.2 The maintenance data must include the following information:

.1 Description of elevator system's method of operation and control including door operation, signals, fire-fighter's service, and any special or non-standard features provided.

.2 Parts catalogue giving complete list of repair and replacement parts with catalogue cuts and identifying numbers.

.3 Legible schematic wiring diagrams covering electrical equipment as supplied and installed, including changes made in final identification of markings on both machine room and hoistway apparatus.

.4 Legible schematic wiring diagrams covering solid state and/or computerized control as supplied and installed, including necessary changes made to the installation.

.5 Three (3) sets of operating and maintenance manuals are required: one for the machine room, one for the maintenance office and one for the drafting records area.

14.205 Supply of Parts

.1 The manufacturer/contractor shall agree to supply to the Owner, within five (5) working days, any replacement part for equipment supplied under contract when requested by the Owner for a period of ten (10) years after completion of the contract.

.2 Parts to be supplied at the contractor's normal billing rate for such parts.

14.206 Communications Equipment

.1 Provide a hands free, vandal resistant, emergency communications device containing an internal speaker and microphone to enable two-way voice communication

between elevator passengers and the "Emergency Report Centre". Emergency telephones with handsets will not be accepted.

.2 The device shall be activated by pressing a button located on the faceplate of the device and shall automatically ring a telephone number (of the Owner's choice) at the Emergency Report Centre.

.3 The telephone shall operate on the Queen's PABX which is a Northern Telecom Meridian 1, and be able to be programmed for autodial operation or as an automatic ringdown telephone. The unit shall have multiple disconnect features which the client can choose to activate or deactivate i.e.

- .1 called party disconnect
- .2 emergency button disconnect
- .3 call timeout disconnect (adjustable)

.4 The unit shall have auto answer capability, which allows the user to monitor the elevator and converse with the users.

.5 The unit shall have an isolated auxiliary output to allow interface to operate other devices such as bells, strobe lights, CCTV, etc.

.6 All necessary wiring shall be provided for the complete installation of the system from the device in the car cab to the telephone room within each building. Use shielded #22 wire, type FT4.

.7 The device shall have a stainless steel faceplate and be flush mounted in a location that is accessible for servicing. It shall be located at a height to accommodate physically challenged persons and be adjacent to the car station.

.8 Connection to the telephone line in the telephone room shall be by Queen's Communications Services.

14.212 Hydraulic Elevators

Hydraulic elevators shall have scavenger pumps installed in sumps in pits to recover any hydraulic fluids that may become contained in them.

14.213 Elevator Data Sheet

An Elevator Data sheet must be included with all elevator submittals. See Appendix B, Form 14.213-B for an example of the Elevator Data Sheet.

23.000 Mechanical

23.100 Drawing Symbols

Designers shall submit their list of drawing symbols to Physical Plant Services for review prior to creating design drawings. Standard symbols are normally acceptable.

23.101 Drawings and Records

Queen's University has an established system of files and records for "as-built" drawings and data. It is imperative that costs are included to ensure that accurate and reliable information is collected and recorded during the construction period and subsequently handed over to the University. As-built drawing requirements are described in Section 01.721; Maintenance Manual requirements are described in Section 01.730.

23.102 Services

.1 The city water pressure is approximately 450 kPa (65 psig). City water temperatures vary from a low of 10C (35oF) in mid-winter to a high of 25oC (77oF) in late summer.

.2 The minimum water service connection size is 6" diameter.

.3 Water service connections shall be designed to prevent breakage due to settlement and frost heaving. This may be accomplished either by a firm support or a flexible pipe connection.

.4 All water service connections must include a premise backflow preventer installed per Section 23.450. Two full size backflow preventors must be installed in parallel to ensure no interruption in water service during annual testing.

.5 The pressure in the gas utility main is approximately 1.5 kPa (6" W.G.).

.6 The Central Heating Plant generates steam at 1860 kPa (270 psig). It is reduced to 830 kPa (120 psig) for the West Campus & East Campus lines and 380 kPa (55 psig) for the Central Campus line. Equipment within buildings should be designed for a steam pressure not greater than 15 psig.

.7 The steam supply to a building will normally be provided by a steam line from a manhole just outside the building.

.8 Steam lines entering buildings must be provided with double block and bleed valves.

23.103 Controls and Instruments

.1 Ventilation heating coils shall be controlled even when the fan is not operating.

.2 Multiple heaters, air conditioners or heat pumps located in one room should have a common thermostat and controls.

.3 Valve and damper actuators shall be pneumatic, with some exceptions. For example: solenoid valves, diesel generator radiator dampers and solenoid operated back draft dampers on small fans may be electric. Most exceptions are due to equipment design, emergency requirements or manufacturer's warranty requirements.

.4 Thermostats that control pneumatic valves and dampers shall be pneumatic. Thermostats controlling fractional horsepower motors and that do not control valves or dampers may be electric.

.5 Union cocks shall not be used on pressure gauges. Shut off valves for pressure gauges shall have packing or elastic seals on valve stems. Ball valves are an acceptable alternative.

.6 Strap-on thermometers are not acceptable.

23.200 Water Treatment

.1 Water treatment shall be provided for all closed water systems. Systems shall include water filters. Queen's University currently engages GE Betz.

.2 Pipe system filters shall be installed across pumps in closed loop heating, cooling and condenser systems.

.3 Water treatment systems for cooling towers shall use the conductivity method of control.

23.201 Testing, Adjusting and Balancing

.1 Prior to startup of any pump, all construction debris shall be removed from the system.

.2 Pipe systems shall be thoroughly flushed prior to the startup of circulating pumps.

.3 The locations of Pitot tube test ports in ducts should be specified by the designer and not left to the contractor.

.4 Pumps shall not be started without a strainer on the suction line.

.5 All ducting shall be inspected to confirm that they are sufficiently clean for operation.

.6 Air distribution systems shall be balanced to design volumes ± 5%.

.7 Liquid handling systems shall be balanced to design volumes ± 15%.

.8 The functionality of all systems shall be verified and confirmed to Queen's University before final acceptance of the work will be considered.

23.202 Mechanical Rooms

.1 Main mechanical rooms shall have a wash sink with hot and cold water.

.2 Mechanical rooms shall have floor drains.

.3 Mechanical rooms should not be located adjacent to or over classrooms, theatres, libraries or study areas.

.4 Mechanical rooms shall be provided with double doors with removable mullions.

.5 Mechanical rooms shall have both mechanical supply and exhaust ventilation systems and shall be maintained at a negative pressure with respect to adjacent rooms and corridors.

.6 Noise from mechanical equipment shall be attenuated within the mechanical rooms as necessary to achieve the recommended noise criteria range for conference rooms, classrooms, theatres, libraries, study areas and bedrooms.

.7 Mechanical rooms shall have sufficient space to allow for replacement and proper servicing of equipment.

.8 Above grade mechanical rooms shall have waterproof floors.

.9 Provide 110v outlets for portable service equipment.

.10 Provide adequate lighting for servicing.

23.203 Radioisotope Laboratories

The designs of radioisotope laboratories shall conform to "Design Guide for Basic and Intermediate Level Radioisotope Laboratories," 1991, Regulatory Document R-52, Atomic Energy Control Board and its subsequent revisions and amendments. Laboratory designs require the approval of the Queen's University Environmental Health and Safety Department.

23.204 Biohazard Laboratories

The designs of biohazard laboratories shall conform to "Canadian Biosafety Standard," 2nd edition 2015, Health Canada. Laboratory designs require the approval of the Queen's University Environmental Health and Safety Department.

23.205 Pumps - Vacuum

.1 Laboratory vacuum pump exhaust shall discharge either directly to the roof or through oil mist separators to exhaust ducts which discharge above roof level. Vacuum pump exhaust shall not be discharged internally.

.2 Laboratory vacuum pumps shall be provided with auxiliary contacts for monitoring of run times by the QUEMS.

.3 Laboratory vacuum pumps shall be provided with auxiliary contacts for monitoring of low vacuum pressures by the QUEMS.

23.206 Mechanical Identification

.1 Identification of Piping Systems

Piping contents shall be classified by colour and identified by name. Colour markings shall be applied on the piping by using paint, plastic bands or full circumference tape made to conform to the standards. Legends shall be applied on the piping with paint or plastic bands. Arrows shall be used to indicate the direction of flow. Decals shall not be used. Classification colours for common piping contents shall comply with Table 15.190.

Table 23.206—1

IDENTIFICATION OF PIPING SYSTEMS

SERVICE	COLOUR	CLASS
Brine	Green	Safe
Chilled Water Return	Green	Safe
Chilled Water Supply	Green	Safe
Condenser Water Return	Green	Safe
Condenser Water Supply	Green	Safe
Controls Compressed Air	Green	Safe
Cooling Tower Water Return	Green	Safe
Cooling Tower Water Supply	Green	Safe
Deionized Water	Green	Safe
Domestic Cold Water	Green	Safe
Nitrogen	Green	Safe
Lab Compressed Air	Green	Safe
Plumbing Vent	Green	Safe
Sanitary Drain	Green	Safe
Storm Drain	Green	Safe
Ammonia	Yellow	Dangerous
Condensate	Yellow	Dangerous
Condensate Vent	Yellow	Dangerous
Domestic Hot Water Supply	Yellow	Dangerous

Domestic Hot Water Return	Yellow	Dangerous
Fuel Oil	Yellow	Dangerous
Glycol Yellow Dangerous	Yellow	Dangerous
Hot Water Heating Supply	Yellow	Dangerous
Hot Water Heating Return	Yellow	Dangerous
Lab Vacuum	Yellow	Dangerous
Natural Gas	Yellow	Dangerous
Pumped Condensate	Yellow	Dangerous
Refrigerant - Liquid	Yellow	Dangerous
Refrigerant - Suction	Yellow	Dangerous
Steam	Yellow	Dangerous
Halon - Fire Protection	Red	Fire Protection
Sprinkler Water Red	Red	Fire Protection

.2 Identification of Concealed Mechanical Equipment

Provide round adhesive labels on ceiling t-bars and access doors to identify concealed valves, air terminal units, fire dampers, or similar concealed mechanical equipment. The diameter of the label is to match the width of the t-bar or be 1" for access doors.

Use permanent black marker with the following colors for specified labels:

i. Fire-protection devices, including dampers: Red Label
ii. Air-handling terminal devices: Orange Label
iii. Isolation, balancing and control valves: Green Label

Label colour is to match shade of Figure 23.206.2-A as closely as possible. Label shall follow the layout shown in Figure 23.206.2-A and be oriented to indicate the equipment location. The tag number shall match the as-built drawings. Label description to comply with Appendix C of this standard.

23.207 Insulation General

.1 Thermal and acoustic insulation media shall not contain asbestos.

.2 Thermal and acoustic insulation adhesives shall not contain starch.

23.208 Thermal Insulation for Piping

.1 Valves, pressure regulating valves (PRV), strainers, expansion joints and equipment that must remain accessible for servicing shall be insulated with reusable insulating blankets.

.2 Insulate pipe, fittings, valves and strainers carrying: rainwater, steam, gravity condensate, pumped condensate, cooling tower piping inside and outside of building, city water, domestic cold water, domestic hot water, domestic hot water recirculation, cold water meter assemblies and fire protection headers. Insulation jackets for

exposed piping should be either PVC or aluminum. Jackets for steam piping shall not be PVC.

23.209 Thermal Insulation for Ducting

.1 Externally insulate fresh air ducts, conditioned supply ducts, sheet metal fresh air plenums, mixed air plenums, silencers and blankoffs behind unused sections of louvres.

.2 Provide appropriate vapour barrier on the warm side of all systems where that temperature can be less than the dew point temperature of the surrounding environment, such as ducting, chilled water pipes, domestic cold water pipes.

.3 Equipment data/name plates shall not be covered with insulation.

23.210 Thermal Insulation for Equipment

.1 Use reusable blankets to insulate heating convectors, domestic water heaters, condensate receivers and heat exchangers (shell and tube, plate and frame.), and backflow preventers.

.2 Equipment data/name plates shall not be covered with insulation.

23.211 Portable Fire Extinguishers

.1 Fire extinguishers will be provided in accordance with Underwriters/Kingston Fire Department recommendations.

.2 Water extinguishers shall be CO2 cartridge pressurized.

.3 CO2 extinguishers shall be similar to the Kidde type with renewable valve seat.

.4 Dry powder extinguishers shall be Underwriters approved.

.5 Suitable directional signs shall be placed to indicate locations of all extinguisher cabinets so that locations are obvious when approached from any direction.

23.212 Sprinkler and Fire System Piping

.1 If sprinklers are to be installed they shall be designed to NFPA 13

.2 For pipe sizes 6" and smaller sprinkler and fire system piping should have rolled groove connections and should use either schedule 10 steel pipe or "Allied XL" steel pipe.

23.300 Domestic Water Supply Piping

.1 Dielectric couplings shall be used when pipes or equipment of dissimilar metals are joined.

.2 Piping should be located so as not to require heat tracing.

.3 Where possible, pipe expansion should be accommodated with "U" bends or braided flexible connectors rather than mechanical expansion compensators.

.4 Hot, cold and recirculating water above ground piping shall be Type L hard tempered copper tubing, and fittings shall be wrought copper. For sizes larger than 76mm (3”), ductile iron pipe, stainless steel, or Victaulic copper may be used.

.5 Pure water piping shall not be glass.

.6 All soldered joints shall be made with lead-free solder.

.7 Lead inserts shall not be used between hangers and copper pipe. The hangers should be copper or epoxy coated or copper coated. Black steel hangers should not be used to prevent dissimilar metals from interacting.

.8 Sleeves must be 1” above the floor and sealed to prevent water seeping to the floor below.

23.301 Drainage Waste and Vent Piping

.1 Piping should be located so as not to require heat tracing. If heat trace is used, ensure that it is labelled.

.2 All sanitary and storm lines above grade shall drain to sewer by gravity. Only lines on floors below grade shall be permitted to be pumped to the sewer.

.3 Combined trapping or gang trapping will only be allowed with special permission from PPS Plumbers and PPS Mechanical Engineers. Combined trapping should not be used for washrooms and kitchens.

.4 Fume hoods shall be separately trapped and vented.

.5 Trap primers shall be valved on the pressure side of the primer. Individual or manifold trap primers may be used. For manifold trap primers, the associated traps should be identified on a list and attached to the manifold.

.6 Access doors, 300 mm x 300 mm (12" x 12") minimum, shall be provided to service traps.

.7 Soil waste and vent lines larger than 76 mm (3") shall be cast iron. Lines three inches and smaller shall be type DWV copper tubing and fittings shall be wrought copper with soldered connections. In laboratories plastic may be used from sinks to stacks.

.8 In new buildings that are to use steam all underground sanitary piping should be cast iron. Plastic may be used if cast iron will not provide acceptable resistance to chemicals. In repairs to existing buildings that use steam plastic shall not be used to repair non-plastic sanitary or storm drains.

.9 Rainwater leaders shall be cast iron.

.10 All drainage clean-outs shall be accessible and shall be of the plate, gasket and bolt type.

.11 In general sump or sewage pump discharge lines shall be threaded or welded.

.12 Grooved pipe joining methods may only be used within mechanical rooms.

.13 Grease intercpetors to be stainless steel, FRP, or plastic. They are to be located outdoors. If a suitable outdoor location is not available, they are to include an automatic draw off connection allowing the interceptor to be pumped from outside.

23.400 Valving

.1 Sufficient valving should be provided to isolate the services on each level, and each major branch.

.2 Drain valves shall be provided at the bottom of all building risers, storage tanks, heaters, and system low spots. Drain valves shall consist of a hose bibs with a cap on a chain or shall be piped to drain. Drain valves shall be located to provide maximum effectiveness. Preferred manufacturers: Jenkins, Crane, or Zurn.

.3 Isolation (shut-off) valves shall be provided for servicing pressure reducing valves, major components of the systems, individual floor mains, risers and fixtures. Isolation valves 100mm (4”) and smaller shall be ball valves. Preferred manufactures: Jenkins, Crane, Victualic, Zurn or Watts.

.4 Hot water, chilled water, and steam control valves shall be sized for 100%, and not 33% and 66%.

23.401 Plumbing Fixtures and Trim

.1 General

.1 All fixtures to be CSA approved.

.2 Exposed plumbing brass to be chrome plated.

.3 Fixtures in any one location to be product of one manufacturer and of same type, white in colour.

.4 Trim in any one location to be product of one manufacturer and of same type, chrome finish.

.5 All fixtures and trim to be commercial grade.

.6 Approved manufacturers; American Standard, Kohler, Moen, and Sloan.

.2 Washroom Lavatories

.1 Vitreous china with splash lip and front overflow.

.2 Faucet to include aerator with maximum 3.8 litres per minute.

.3 Automatic sensing faucets; new construction to include hardwired automatic sensing faucets.

.3 Service Sinks

.1 Sinks to be acid-resisting porcelain enameled cast iron with roll rim and stainless steel rim guard.

.2 Supply fitting shall have vacuum breaker, heavy cast brass spout with pail hook and brace to wall.

.4 Water closets

.1 Public water closets shall have flush valves.

.2 Private water closets may have flush tanks or flush valves.

.3 Student public areas: Floor mounted water closets are preferred.

.4 Office: wall hung closets are acceptable, however, they should have top spuds and heavy duty wall hangers.

.5 Water closets shall be of vitreous china.

.6 Flush tanks to include tank liner.

.7 Flush volume to be 6 litres per flush.

.8 Tank type toilets to be American Standard Cadet Pro or approved equal.

.9 Pressure assist tank toilets are not permitted.

.10 Automatic flush valves; new construction to include hardwired automatic flush valves. Retrofit projects to include, if feasible hardwired automatic flush valves, or solar powered automatic flush valves. Flush valves to be exposed hardware.

.11 Seats to be white, solid plastic, less cover, stainless steel hardware with check hinges.

.12 Floor mounted rear exit toilets are not permitted.

.5 Urinals

.1 Flush tanks are not permitted on urinals.

.2 Urinals to have automatic flush valves. New construction to include hardwired automatic flush valves. Retrofit projects to include solar powered automatic flush valves.

.3 Urinals and flush valves to be rated for 3.8 litres per flush.

.4 Urinals shall be of vitreous china with extended shields, integral trap, and removable stainless steel strainer.

.6 Baths

.1 Stain-resisting, acid resisting, one-piece, porcelain enameled steel, glossy white finish, with non-slip surface, integral wide rim seat, sound insulating package.

.2 Waste: concealed pop-up waste and overflow fitting with lever-operated mechanism.

.7 Shower

.1 Shower head: MOEN model 5263EP15 – 5.7 litres per minute max, or approved equivalent.

.2 Control valve to be pressure balancing.

23.402 Pumps - Plumbing

.1 Sanitary (sewage) and storm (sump) pumps shall be duplex type, dual lobe and equipped with automatic pump change over controls. Sanitary pumps should be grinders.

.2 All 0.5 HP and larger sanitary (sewage), storm (sump) and circulating pumps shall be provided with auxiliary contacts for monitoring of run times by the QUEMS.

.3 Sanitary and storm sumps shall be provided with high water alarms monitored by the QUEMS and connected to Emergency Report Centre (ERC).

.4 All 0.5 HP and larger sanitary (sewage) and storm (sump) pumps shall be 220 V.

Armstrong, Barnes SE and Little Giant are preferred manufacturers of sanitary (sewage) and storm (sump) pumps.

23.403 Domestic Water Heaters

.1 Domestic hot water shall be available for distribution from 50 degrees C to 60 degrees C. (120 degrees F to 140 degrees F).

.2 Dielectric couplings shall be used when connecting copper pipe to steel tanks.

.3 To reduce the rate of scale build-up, tube bundles for steam to hot water converters shall not be helically wound. Tube bundles to be stainless steel.

23.404 Domestic Water Conditioning

.1 Where purified water is required it shall be provided by reverse osmosis and appropriate filters. Stills shall not be used.

.2 Ensure that purified water faucets will provide adequate flow from the small static head available.

.3 Purified water piping shall not be glass. Plastic piping is preferred.

23.450 Backflow Preventors

.1 RP backflow preventors, where required, shall include a relief valve monitoring switch to be monitored by Queen's ERC system and may only be installed in mechanical rooms.

.2 All backflow preventors to include an upstream strainer.

23.500 Compressed Air Systems

.1 A refrigerant dryer is required for control air. The dryer should be mounted in a cool place and should not be mounted above the compressor(s). The preferred supplier is Hankison.

.2 Control air and laboratory air systems shall be separate.

.3 Control air compressors are required to be duplexed and should be sized to provide a run-time ratio of 0.3:1 to 0.5:1. Two separate electrical feeds from different sources shall be furnished for each compressor.

.4 Control air compressors shall be provided with auxiliary contacts for monitoring of run times by the QUEMS.

.5 Control air compressors shall be provided with auxiliary contacts for monitoring low air pressures by the QUEMS.

.6 Control air compressors shall have air-cooled intercoolers and aftercoolers. Coolers shall not use once-thru water.

.7 Control air piping shall be Type "L" hard copper. All common pipe shall be copper. Plastic pipe shall only be used for short runs from the main copper pipe to the equipment. Any tee in a chase should be accessible in case it needs to be repaired.

.8 Compressed air receivers shall be equipped with automatic blow down.

.9 Control air compressors shall be on emergency power where possible.

.10 Preferred manufacturers: Gardner Denver, Quincy, Ingersoll Rand

23.501 Ventilation

.1 Queen's University is a smoke free workplace. Ventilation equipment and air flow rates shall be designed on the basis of a non-smoking environment.

.2 Outdoor air requirements for ventilation shall comply with ASHRAE Standard 62 "Ventilation for Acceptable Indoor Air Quality", and the Ontario Building Code.

.3 Return air shall be ducted to the return fan. Transfer grilles, dump boxes, ceiling return plenums, etc., should not be used.

.4 Roof mounted fans or mechanical equipment requiring periodic service and located within 3 metres (10 feet) of the roof edge shall be provided with railings or barriers around the service area for safety purposes.

.5 Emphasis is drawn to the University's requirement for quiet operation of all mechanical heating and air handling systems. With respect to this requirement careful attention should be given to the selection and design of equipment, in particular: air velocities, fan design and selection, unit ventilators, unit heaters, pumps etc.

.6 In existing installations with steam coils; Ventilation systems shall use steam preheat coils with integral face and bypass dampers. Where possible, steam coils shall be piped vertically. Glycol/water mixtures shall not be used.

23.502 Heating and Cooling

.1 The economic conservation of resources shall be considered in the selection of energy and water consuming equipment. To meet this objective the designer shall apply life cycle costing in the selection of systems, such as main HVAC systems, that are not expected to change significantly while in service.

.2 Where possible, each room or space shall be provided with a thermostat for the control of space temperatures.

.3 Steam shall be used as the primary source of building heat when available. When steam is used it shall be brought into the main mechanical room and immediately converted to domestic hot water and heating water for distribution throughout the building. Steam shall only be used in main mechanical room.

.4 Residences, private offices and rooms occupied by only a few individuals shall have thermostats that are adjustable by users and that indicate the set point and room temperatures. Thermostats in lecture theatres, classrooms and public areas shall have thermostats that are not adjustable by users.

.5 Chilled beam cooling shall not be used.

.6 Low level perimeter radiant heat shall be used in all occupied areas.

23.503 Refrigeration

.1 All installations require best refrigeration practices.

.2 All piping system must be pressure tested to 1 ½ times operating pressure.

.3 All piping system must be evaluated to 500 microns.

.4 All piping system over 3 ton must have TSSA Certification

.5 All systems under 3 tons must undergo pressure test and evacuation tests. Tests must be witnessed by PPS Engineer or Refrigeration Mechanic.

.6 All systems must be designed and installed to allow for serviceability.

.7 All brazing must be performed by TSSA certified trades person.

.8 All systems are to be installed by license trades persons.

.9 Licenses and certificates must be provided prior to start of installation. Licensed HVAC technician must be on site while installation is performed.

.10 O.D.P certification is required for all installs including completed refrigerant charge.

.11 O.D.P forms to be delivered to PPS Engineers and Refrigeration Mechanics.

.12 Centrifugal or screw water chillers shall use refrigerant 134a.

.13 To assist in tube cleaning, centrifugal chillers shall have marine water boxes on the condensers.

.14 Refrigerant vapour detection systems shall be provided with auxiliary alarm contacts for monitoring by the QUEMS.

.15 Vessels shall be provided for the storage of the full refrigerant charge of the largest chiller.

23.504 Piping, Valves and Fittings - Heating & Cooling

.1 Valves shall meet the requirements of the Manufacturers Standardization Society: iron gate valves to M55-SP-70, iron globe and angle valves to M55-SP-85, iron swing check valves to M55-SP-71, and bronze gate, globe, angle and check valves to M55-SP-80.

.2 Piping should be located so as not to require heat tracing.

.3 Pipe and fittings shall normally be schedule forty black steel. Consult Physical Plant Services when other types of pipe are being considered.

.4 Flow balancing valves shall be installed at each hot water heater, convector and radiator. Tour & Andersson model STA or Armstrong model CBV flow balancing valves are preferred. If other values are used a flow balancing meter should be provided.

.5 Dielectric or brass couplings shall be used when pipes of dissimilar metals are joined.

.6 The attachment for flexible hoses shall be made with the hose manufacturer's recommended jointing system.

.7 Where possible, pipe expansion should be accommodated with "U" bends rather than mechanical expansion compensators.

.8 Sufficient valving shall be provided to isolate the services on each level or wing, each piece of equipment and individual coils and convection heaters. Valves shall be either a ball or butterfly valve.

.9 Frequently insufficient drain valves are provided. Drain valves shall be provided at the bottom of all building risers, main ventilation system coils, convertors, pumps, cooling towers, expansion tanks, storage tanks, water chillers and system low spots.

.10 Drain valves shall be provided with a hose bib or piped to drain.

.11 Drain valves shall be located for maximum effectiveness and convenience.

.12 Air vents shall be provided at the top of all building risers, system and equipment high spots, coils convectors, heaters, expansion lines, pumps and storage tanks.

.13 Isolation valves shall be provided for pressure reducing valves, major components of systems, individual floor mains, risers, entrance heaters, force flow heaters and fan coil units.

.14 Strainers shall be installed ahead of PRV's, pumps, and control valves.

.15 In general, hot and chilled water piping shall be threaded or welded. Grooved pipe joining methods shall only be used on:

Condenser water;
Chilled water within mechanical rooms;
Hot water within mechanical rooms.

Grooved pipe joining methods should be used at water chiller evaporator and condenser ends to facilitate disassembly.

.16 Cooling coils shall have fittings to allow compressed air to be blown through coils for winter lay up.

.17 Colton is the preferred manufacturer of check valves.

.18 Crane is the preferred manufacturer of shut-off valves (< 3").

.19 Swing-type and piston-type check valves shall not be used.

23.505 Water Specialties - Heating and Cooling

.1 Spare heat pumps should be provided for installations requiring numerous incremental heat pumps. The number of spares required shall be determined by Physical Plant Services.

.2 Heating and cooling system expansion tanks shall be equipped with water level gauges that are conveniently located and easy to read, and a bladder to separate the air from the water.

.3 Cooling coil drain pans shall be all welded and constructed of stainless steel.

.4 Cooling coil bases and supports shall be protected against corrosion.

.5 Pipe system filters shall be installed across pumps in closed loop heating, cooling and condenser systems. Filter housings by Filterite (model LM0) and Filterite filter cartridges (model RL0A10T) are preferred.

.6 Chilled water and condenser water pumps shall be started by chiller control systems and not by the QUEMS.

.7 Cooling towers shall have stand-alone controls. They shall not be controlled by the QUEMS.

23.506 Piping Valves & Fittings - Steam & Condensate

.1 Valves shall meet the requirements of the Manufacturers Standardization Society: iron gate valves to M55-SP-70, iron globe and angle valves to M55-SP-85, iron swing check valves to M55-SP-71, and bronze gate, globe, angle and check valves to M55-SP-80.

.2 Steam piping and fittings shall normally be seamless and schedule forty (SCH.40) black steel to ASTM A106 Grade B.

.3 Condensate piping and fittings;

.1 Within the building envelope; shall normally be seamless and schedule eighty (SCH.80) black steel to ASTM A106 Grade B.

.2 Outside the building envelope; shall normally be seamless and schedule forty (SCH.40) stainless steel to ASTM A312 TP 304L.

.4 Strainers shall be installed ahead of PRV's, traps, and control valves.

.5 Drain valves shall be provided at condensate tanks and shall be located for maximum effectiveness and convenience.

.6 Isolation valves shall be provided for pressure reducing valves, major system components and building mains. The main line isolation valve, as it enters the building, shall be double block and bleed. On high pressure lines, a warming line should be installed in parallel with the downstream “double block and bleed” valve to slowly build pressure and prevent water hammer.

23.507 Steam Specialties

.1 All steam fed tube bundles, coils and heat exchangers shall be equipped with vacuum breakers.

.2 Steam condensate from steam modulated equipment shall not be lifted by steam pressure.

.3 Condensate pumps shall not be greater than 1800 RPM.

.4 Pressure reducing valves shall be sized for 100%, and not 33% and 66%.

.5 Safety relief valves and condensate tank vents shall be separately piped outside to a safe location. If they terminate on a roof, terminate 2.2m above roofline with a 45° angle out on top of the pipe. Vents for condensate tanks shall not be combined with vents for safety relief valves.

.6 Condensate pumps shall be duplex and equipped with alternating switch.

.7 Pumped condensate shall be metered, not the steam feed. All condensate tanks to include a condensate meter Flowmec model GNT complete with RT40 flow rate totalizer.

.8 All steam traps shall have a 12 mm (1/2") or 19 mm (3/4") test valve, located downstream of the trap, to allow maintenance personnel to observe trap operation.

.9 Condensate tanks shall be cast iron or stainless steel and shall not use plastic multi-level float switches.

.10 Flanged steam pressure reducing valves shall be supported close to each flange to reduce gasket failures.

.11 All steam traps on steam modulated equipment shall be located 300 mm minimum below the condensate outlet of the equipment. All Packaged Air handling Units shall be mounted at heights that allow for a minimum of 300 mm of head at the inlet to steam traps.

23.508 Pumps - Heating and Cooling

.1 Circulating pumps shall have gauges to indicate both low and high side pressures. Pressure gauges should be provided with pressure snubbers to protect gauges from pulsations in pressure.

.2 Heating and cooling pumps shall be duplex type and equipped with automatic pump change over controls.

.3 Vertical in-line pumps 1 HP (0.75 KW) and larger should have a split type spacer coupling.

.4 When size & pressure permit, in-line pumps with mechanical seals are preferred. Mechanical seals should be of the outside type and should be Durametallic or equal.

.5 Circulating pumps should have flexible connections to limit the transfer of vibrations to the piping system.

.6 Pumps 1 HP (0.75 kW) and larger should have seal flushing connections complete with filter, sight flow indicator, and quarter-turn shut-off valves.

.7 All 0.5 HP and larger pumps shall be provided with auxiliary contacts for monitoring of run times by the QUEMS.

.8 All pumps should run at 1800 RPM or less.

.9 Armstrong is the preferred manufacturer of water circulating pumps. An alternative manufacturer is Grundfos.

.10 All circulating pumps shall have air vents.

.11 Flo-Trex suction guides and check/balancing/shut-off combined valves shall be installed on circulating pump inlets and outlets, respectively. As part of commissioning, ensure all three-way valves are balanced to achieve a minimum of a 20 degree difference between the discharge and return flow.

.12 Pressure gauges shall be properly sized and installed such that all pump inlet and outlet pressures can be measured quickly and accurately.

.13 With multiple pumps, provide mounts (either anchors or a monorail system) to service the pumps

.14 Do not put water cooled units above drywall. Units must be easy to access and service.

23.600 Oil Storage Tanks

.1 Fuel oil storage tanks shall not be installed underground. Install tanks inside the building.

.2 Fill and vent lines shall be installed above ground.

23.700 Cooling Towers

.1 Closed system cooling towers are preferred.

.2 Evaporation type towers do not require sump heaters.

.3 For water treatment, see Section 23.200.

.4 Motors shall be provided with lifting lugs.

.5 Towers not accessible for servicing from the floor shall have factory designed catwalks and ladders, and shall conform to all safety standards.

23.701 Heat Exchangers

.1 For building perimeter heaters, hot water heating shall be used rather than direct steam heating.

.2 All water lines into and out of heat exchangers shall have thermometers located in a convenient position for reading from the floor.

.3 In order to provide reserve capacity in hot water heating systems, system sizes should be based on a flow temperature of 80 C (180 F) and should be regulated by an indoor/outdoor control.

.4 Steam/hot water heating converters do not require a backup or standby. However, 100% backup capability is preferred.

.5 Sufficient clearance shall be provided in mechanical rooms for the removal of tube bundles.

.6 Building entrances shall be provided with separately controlled heaters to prevent chronic overheating, but these systems must also be provided with adequate freeze protection devices.

.7 Tube bundle baffles in shell and tube heat exchangers shall be constructed of brass, stainless steel or other corrosion resistant metals. Carbon steel baffles are not acceptable.

.8 For steam feed heat exchangers the steam shall enter the shell clear of the tube bundle. Increase the length of the shell to suit.

23.702 Humidifiers

.1 For buildings with steam supply, ventilation systems requiring 500 L/s (1000 CFM) or more of outdoor air shall have direct steam injection humidifiers fed from the Campus steam supply.

.2 For buildings without steam supply, humidifiers that use cannisters are not permitted. Preferred suppliers are Dri-Steem and Neptronic.

23.703 Packaged Air Handling Units

.1 General

.1 Where possible, packaged air handling units should be shipped to the job in one piece, factory assembled.

.2 Packaged air handling units should have an electrical disconnect.

.3 All units should have stainless steel data plates.

.2 Unit Construction

.1 Unit casings should be a minimum of 16 gauge (1.6 mm) galvanized metal.

.2 A perforated galvanized metal liner of 24 gauge (0.70mm) minimum should be provided over insulated areas in fan, coil, mixing and access sections. A solid galvanized metal liner of 22 gauge (0.85mm) minimum should be provided over insulated areas in filter sections.

.3 Access doors should be provided at the following locations: mixing sections; damper sections; upstream and downstream of heating and cooling coils; humidifiers; cooling compressors; and fans and motors.

.4 Access doors for air stream sections should be hinged, insulated, lined, with bulb gaskets and with a minimum of two handles openable from both sides. Access doors should be mounted in welded steel frames. Whenever possible, access doors to areas of negative pressure should open out, and to areas of positive pressure should open in. where space constrictions require the use of outward opening doors to an area of positive pressure, a warning label should be affixed. Access doors should incorporate a glass viewing window.

.5 All units should be internally insulated with a minimum of 2" (50mm) thick 3 lb./cu. ft. (48 kg. / cu.m.) density acoustic insulation. Drain pans and floor areas should be insulated on the underside.

.6 Unit casing floors in walk in sections should be fabricated with a minimum of 14 ga (2.0mm) checker plate steel with grip coating.

.7 Cooling coil and steam humidifier drain pans should be all welded and constructed of stainless steel with stainless steel drain connections. Drain pans should be sloped and pitched such that there is no standing water.

.8 Service platforms, where required, should run the entire unit length and should be located on the service access side.

.9 Integral service corridors should be insulated with a minimum of 2" (50mm) thick 3 lb. / cu. ft. (48 Kg / cu. m) density acoustic insulation and be fully lined with a solid galvanized metal liner. Floors should be fabricated with a minimum of 14 ga (2.0mm) checker plate steel with grip coating. Corridors should have a minimum of one duplex service receptacle.

.10 Access doors to service corridors should be lockable.

.11 Marine lights with switch and pilot light should be provided in all air handling unit and compressor sections with access doors and in service corridors. Lights should be located either on ceilings or on sides opposite access doors. All wiring should be in EMT conduit. Raintight connections should be used in humidifier sections.

.12 Air handling units for outdoors should not allow the infiltration of rain and snow and should have rain gutters over all exposed access doors.

.13 Air handling units should incorporate "low leak" construction details.

.14 Sufficient room should be provided for the installation of pneumatic damper operators.

.3 Fans

.1 Centrifugal fans should be rated in accordance with AMCS. Where possible, centrifugal fans should be of the airfoil type.

.2 Forward curved fans greater than 18" (450mm) in diameter, should be equipped with greaseable pillow block bearings, supported on rigid steel frames.

.3 Airfoil and backward inclined fans should be equipped with greaseable pillow block bearings, supported on rigid steel frames.

.4 Bearing grease fittings should not be extended to the outside of casings.

.5 Motor mountings should be adjustable to allow for alignment and variations in belt tension.

.6 Belt guards should be provided on fans with walk in sections. The front face of guards should be constructed of expanded metal to allow for visual inspection and cooling.

.7 Fan-motor assemblies should be provided with vibration isolators.

.8 All fan motors should be of energy efficient design.

.9 Fan scrolls should have drain plugs or access doors.

.10 One set of spare drive belts should be provided.

.4 Coils

.1 Coils should have a galvanized steel casing.

.2 Where subject to freezing temperatures, hot water heating coils should be glycol-water coils. The glycol-water loop shall be heated with a steam-glycol heat exchanger. Only propylene food based glycol shall be used. Steam heating coils to be face and bypass.

.3 Coils should be removable from the unit. Piping unions or flanges should be provided to facilitate coil removal.

.4 Refrigerant coils with multiple compressors should be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions.

.5 Heating coils should have double pole discharge air low limit thermostats (freezestats) requiring manual resetting. Freezestats should be installed as per manufacturer's instructions.

.6 All steam traps on steam coils shall be located 300 mm minimum below the condensate outlet of the coil. All Packaged Air Handling Units shall be mounted at heights that allow for a minimum 300 mm of head at the inlet to steam traps.

.7 It is the responsibility of both the controls contractor and equipment suppliers to insure the proper operation of valves, dampers and linkages.

.8 Damper operators shall not be mounted in the air stream. Damper operators shall be easily accessible for adjustment, maintenance and replacement.

.5 Humidifiers

.1 Humidifiers should be the steam separator type which discharge dry steam through steam jacketed distribution manifolds. Humidifier should be equipped with strainers, steam traps and a pneumatic control valve.

.2 Where possible, steam should be supplied from the Central Heating Plant.

.3 Steam humidifiers located within packaged air handling units should have drain pans.

.6 Dampers

.1 Outdoor air dampers should be thermally insulated and similar to TAMCO Series 9000 dampers.

.2 Damper actuators shall be pneumatic.

.7 Refrigerant Compressors

.1 Compressor sections and electrical control panels should have hinged and gasketed access doors.

.2 Each compressor should have "rotalock" service valves on the suction and discharge lines for easy removal.

23.704 Fans

.1 Fans are frequently specified with excessive rotational speeds. Emphasis is drawn to the University's requirement for quiet operation of all air handling systems. Therefore speed and type of fan must be given careful consideration.

.2 Fume hood and fume exhaust fans shall be roof mounted with exhaust stacks of a height that substantially reduces gas entrainment and reentry at other intakes. Preferred type: direct-drive Strobic with sealed motor bearings.

.3 All exhaust fans shall have backdraft dampers.

.4 All 0.5 HP and larger fans shall be provided with auxiliary contacts for monitoring of run times by the QUEMS.

.5 Use centrifugal fans or silencers on axial fans where exterior noise is a problem.

.6 In-line fans are difficult to service and should not be used, unless with the permission of PPS Trades and Engineers.

.7 Fans with either A, B, or C belts are preferred.

23.705 Filters

.1 Filters shall be placed upstream of supply fan preheat coils.

.2 Filters shall provide a minimum atmosphere dust spot efficiency of 35%.

.3 Manometers similar to the Dwyer Photohetic style shall be provided across filter banks to show the resistance to air flow through the filters. Gauges must have capability to be remotely monitored.

.4 Manometers shall be provided with auxiliary contacts for monitoring of high pressures by the QUEMS.

.5 Bag filters shall be rigid and shall not be constructed of glass fibre. A plastic filter is preferred for easy handling. A Camil - Durafil 2V is a good product. Units with bag filters shall be designed with a 2” pleaded pre-filter.

.6 Where possible filters shall be front loading.

.7 Replaceable media filters should be enclosed in permanent galvanized metal frames with metal retainers on both sides.

.8 One set of spare filters should be provided.

.9 Filters must be easily accessible and serviceable.

23.706 Fume Hoods

.1 Fume hood exhaust shall comply with CSA Standard Z316.5 "Fume hoods and associated Exhaust Systems".

23.707 Ductwork - Low Pressure

.1 Fume hood exhaust ducting & fans should be either plastic coated or non- corroding material. Galvanized steel duct shall not be used in areas of high humidity or corrosive fumes.

.2 Return air shall be ducted to the return fan. Transfer grilles, dump boxes, ceiling plenums etc., should not be used.

23.708 Duct Accessories

Access ports of a practical size shall be provided in ducts to permit access and visual inspection of all fire dampers, air valves, heating & cooling coils, balancing dampers, fire detection devices and other duct mounted equipment requiring periodic service.

23.709 Balancing Dampers

.1 Frequently insufficient balancing dampers are installed in ductwork. For supply ducts, splitter dampers shall be used at all branches. For all ductwork, balancing dampers shall be used in trunk ducts for each floor or in major branches. It is preferred that individual supply diffusers be balanced using a duct splitter or balancing damper rather than using dampers located at diffusers.

.2 All manual dampers shall have an accessible, locking quadrant located on the duct exterior. If necessary ceiling access doors shall be provided.

23.710 Louvres, Intakes and Vents

Exterior louvres, intakes and vents shall be easily removable to allow cleaning of bird screens.

23.711 Grilles, Registers and Diffusers

Supply diffusers without integral balancing dampers are preferred. Individual supply diffusers should be balanced using a duct splitter or balancing damper and not with diffuser located dampers.

25.000 QUEMS II

25.001 Responsibility for Supply

.1 All DDC control panels, expanders and multiplexors, etc. shall be supplied by the contractor. The panel cabinets and all necessary installation components shall be supplied by the contractor.

.2 The successful supplier shall be responsible for all work under this contract.

25.002 Field Control Work

.1 Work shall include all the required services to complete the system.

.2 Work shall include the supply and installation of all field devices including sensors, interface devices, individual room controls, transducers, relays, valves, dampers, actuators, solenoid valves, field wire, tubing, BIX terminations, connections and panels.

.3 The contractor shall provide all necessary co-ordination in order to achieve a successful project.

25.003 Building Automation System

.1 Work shall include installation of DDC panels including all programming. Where start/stop is specified the installer shall establish programs and schedules suitable to the equipment controlled.

.2 Where analog control is specified, the installer shall establish programs suitable to the equipment controlled. To be accepted the programs must be functional and demonstrate stable control, conserve energy and meet Ontario Building Code requirements.

.3 The contractor shall provide all necessary co-ordination in order to achieve a successful project.

.4 The contractor shall provide engineering and commissioning of all field components.

.5 The contractor shall provide a full two (2) year warranty on all hardware and installation

25.004 Removal of Existing Devices

All pneumatic devices, freezestats, etc. which are removed shall be turned over to the owner.

25.101 DDC Control Panel

The DDC control panel shall match the existing installation, or if a new installation, be one of the following installed with latest software:

- Delta panel
- Automated Logic panel

25.102 Expanders, Multiplexors etc.

Expanders, multiplexers, network repeaters, universal input monitoring devices etc. units shall be chosen to be compatible with item 17.101.

25.103 Power Supply

.1 Each control panel shall be powered from a dedicated, fused, Class 2 type transformer, minimum 50 VA. There shall also be a UPS for backup power.

.2 Each universal input monitor shall be powered by 24 Vac, 5 VA, Class 2 type transformer.

.3 Acceptable power supply noise filters are:

- Delta LFT730
- Corcom 2VK3
- Curtis F1400BB03

25.104 Remote Server and Web Access

The building automation system (BAS) will be accessible remotely through the use of the hardware's built in web server. A static IP address will need to be given to the hardware, coordinate with PPS. The BAS server will be housed on a virtual server in the Queen's Dupuis Data Centre. The existing BAS dashboard will be updated with a link to the new BAS server.

25.105 DDC Graphics

.1 The DDC system shall be provided with a graphical user interface allowing the display and modification of system parameters. The graphical user interface shall include but not be limited to:

.1 Floor plans showing the location and current reading in engineering units of all space condition sensors (i.e. temperature, humidity, CO2, pressure).

.2 System schematics for heating and cooling systems showing all related sensor readings, all related control device values and setpoints, as well as related pump and fan command and status values.

.3 Ventilation system schematics showing all related sensor readings, all related damper and valve control values and setpoints as well as and related fan and pump commands and status values.

.4 A graphically oriented means by which the owner may adjust system parameters such as operating schedules and set points.

.5 Online documentation describing the characteristics and sequence of operation of major building systems.

25.106 Spare Parts

Upon completion of the contract the contractor shall provide the following spare parts which form part of the handover documentation:

Outdoor Air Temperature Sensor
Duct Temperature Averaging Sensor
Three (3) Room Temperature Sensors
Duct Temperature Sensor
Freezestat, 2 Pole

25.200 Sensors

25.201 Duct Temperature Sensors

Acceptable Sensor types are:

- Enercorp model TS-D-12-T-10K (12")
- Enercorp model TS-D-6-T-10K (6")
- Greystone TE-200-B-7-C-2 (6")
- Greystone TE-200-B-7-D-2 (8")
- Greystone TE-200-B-7-E-2 (12")

25.202 Room Temperature Sensors

Acceptable Sensor types are:

- Delta RTS400 (standard)
- Delta RTS403 (tamper resistant)
- Enercorp TS-S-S-T-10K(standard)
- Greystone TE-200-A-7 (standard)
- Greystone TE-200-AS-7(tamper resistant)

25.203 Duct Temperature Averaging Sensors

Acceptable Sensor types are:

- Enercorp model TS-A-24-9-T-10K (24')

- Enercorp model TS-A-20-4-T-10K (20')
- Enercorp model TS-A-12-4-T-10K (12')
- Greystone model TE-200-D-7-J-3 or TE-200-FD-7-D (24')
- Greystone model TE-200-D-7-I-3 or TE-200-FD-7-C (20')
- Greystone model TE-200-D-7-H-3 or TE-200-FD-7-B (12')

25.204 Outdoor Air Temperature Sensors

Acceptable Types are:

- Enercorp model TS-S-E-T-10K
- Delta OTS430

25.205 Duct Humidity Sensors

The following 4-20mA sensors are acceptable:

- Enercorp model HT-D-420 (metal box only)
- Greystone HS-250-C-01 or HS-250-C-02

25.206 Room Humidity Sensors

It is preferred that duct humidity sensors be used, however, the following room humidity sensors are acceptable:

- Greystone HS-150-B-01 or HS-150-B-02
- Enercorp HT-S-420

25.207 Duct Air Flow Sensors

Sail switches are not acceptable. Preferred alternative is sensing of control voltage in motor starter via status relays. Other methods may be used with the approval of PPS.

25.208 Immersion Sensors

.1 The following immersion temperature sensors are approved:

- Enercorp TS-P-4-T-10k c/w brass 1/2 NPT well
- Greystone TE-200-C-7-B-2-A w/ brass thermowell T1-1/2 BR4
- Delta WTS 420-1 c/w Brass 1/2 NPT well

.2 Contact-type pipe temperature sensors are not acceptable.

25.209 Status Relays

.1 Where the status of electrical devices such as motors or heaters must be monitored, the preferred interface with the control panel is via a status relay. In such an

installation the relay coil should be connected across the device. The coil may, however, be connected in parallel with the device contactor if direct connection is impractical.

.2 The following relays are approved:

- Omron LY2 with Omron PT08A socket and Omron PFP-100N DIN rail mounting track.
- Equivalent.

25.210 Freezestats

.1 Freezestats shall be manual reset for all systems and shall be capillary type sensitive to the nearest 0.3 ft. The element shall be of sufficient length to traverse ducts, coils or plenums three times (see 17.517). Replace existing 1 pole freezestats with suitable 2 pole freezestats to provide alarm connection.

.2 Low condensate temperature freezestats shall not be installed or connected.

25.211 Pressure Sensors

.1 Pressure sensors shall be differential pressure type with range and output to suit application.

.2 Acceptable sensor types are:

- Enercorp Model LPTB
- Equivalent.

25.212 Current Operated Switches

Acceptable current operated switches are:

- Greystone CS-100
- Enercorp Model D150-1

25.300 Actuators (Output Transducers)

25.301 Solid State Relays

.1 Interface to motor controllers or other electrical loads shall be through a high "coil" impedance solid state relay. Where the controlled load exceeds two (2) amperes, provide an electro-mechanical relay controlled by the solid state relay to make and break the controlled circuit.

.2 Acceptable types are:

- Grayhill #70S2-04-B-06-S (120V, 6A)

- Grayhill #70S2-04-B-12-S (120V, 12A)
- Delta #SSR700 (240V, 12A)
- Syrelec #ARSF 15AD (15A, 24/240 VAC)

(hockey puck mount to snap track adapter required)

25.302 *Electric to Pneumatic Transducers*

.1 Pneumatic equipment shall be controlled using electric to pneumatic transducers (EPTs). Acceptable types are:

- Delta EPT750
- Greystone ETP-8500
- Enercorp VIP-9000
- Barber Colman CP-8551

.2 Acceptable filters to be installed with EPTs:

- Johnson A-4000-137
- Barber Colman AL-431
- Balston 9900-05DX
- Equivalent.

.3 Air pressure gauges installed with EPTs shall be 1-1/2" in diameter and have a range of 0-30 psig. Gauges shall be firmly supported by mounting in brass gauge blocks which are to be securely attached to enclosures with mechanical fasteners.

25.400 *Cabling*

25.401 *Cabling to Field Interface Box (FIB)*

Cabling to the field interface box shall be accomplished using copper multi-pair cable with uniquely colour-coded pairs. AWG 24 wiring shall be used for runs of 300 feet or less. AWG 22 shall be used for runs of 300 feet or more. Aluminum conductor cable shall not be used for signal transmission purposes. Size cables for 25% spare conductors. CAT6 cable shall be used for Ethernet-enabled devices.

25.402 *Floor Distribution*

Cabling from the floor distribution box to sensor/actuator location shall be accomplished with 24 AWG stranded cable Beldon 9501 or equivalent.

25.404 *Room Temperature Sensor Cable*

Cable between room temperature sensors and remote I/O units shall be Belden 9501 single pair cable or approved equivalent.

25.405 Remote I/O Unit Network Cable

Cabling between the main control panel and remote I/O units shall be FT6 CAT6 data cable containing 2 pairs of conductors minimum.

25.500 Installation Practices

25.501 Installation Practices - General

All installations shall be performed in a neat and professional manner throughout and shall comply with applicable codes and legislation.

25.502 Conduits

.1 Unless explicitly specified by PPS, all wiring outside electrical enclosures shall be installed in EMT. Conduits shall not be filled past 75% of capacity. A pull rope shall be left in each conduit when the installation is complete. Bend radius shall be greater than 3 times the conduit diameter. A maximum of three 90 degree bends is permitted between pull boxes. The installation shall follow horizontal and vertical lines to fit the layout of the area and shall be properly installed.

.2 Conceal conduits except in mechanical and electrical service rooms and other unfinished areas.

.3 Where it is not practical to conceal conduits in finished areas, obtain written authorization from PPS to use surface mounted raceway (SMR). Use a commercially available SMR acceptable to PPS with compatible components.

.4 All surface mounted boxes shall have covers designed to fit the box without exposed sharp corners.

25.504 Cable Labelling

.1 Each multi-conductor cable shall be indelibly labelled at both ends with its cable number. A list identifying the signal carried by each pair in the cable and the cable colour code shall be provided as part of the documentation package.

.2 Single pair cable, such as is used in floor distribution (17.402), shall be indelibly labelled at both ends with the name of the signal conveyed.

25.505 Pneumatic Installation

.1 An air pressure gauge shall be installed on the control side of each electric to pneumatic transducer and on the supply to each transducer enclosure. An inline air filter shall be installed on the supply side of each electric to pneumatic transducer.

Exposed control air piping shall be type "M" copper. The installation shall follow horizontal and vertical lines to fit the layout of the area and shall be properly installed. Copper tubing joints shall be solder fittings except at the instruments where compression fittings may be used. Nonmetallic tubing joints shall use barbed connectors. The use of tubing as connectors is not acceptable. Pneumatic tubing shall be tagged at both ends with the name of the signal conveyed. All pneumatic components removed shall be turned over to the owner.

.2 Exposed tubing below a dropped ceiling or less than 3m above the floor in rooms without a dropped ceiling shall be type "M" copper. Nonmetallic pneumatic tubing may be used if it is installed in EMT.

25.506 Component Labelling

.1 Engraved lamacoid plastic name plates with white lettering and a black background shall be installed at all sensors, control panels, field interface boxes and all other instruments to clearly indicate the service of a particular device.

.2 On all sensor nameplates provide the point descriptor name (e.g. DUN_A01_MAT). Point descriptor names shall follow the Descriptor Naming Guideline presented in Section 25.601.

.3 Provide a nameplate at each computer connection labelled "COMPUTER CONNECTION".

.4 Attach a nameplate to the outside of each FIB and control panel. Nameplate shall indicate panel type and panel number (e.g. FIB-2A).

.5 Each FIB nameplate shall also indicate associated control panel and control panel location.

.6 Beside each relay, EPT etc. attach a permanent nameplate indicating the point descriptor associated with the relay.

.7 Mechanically fasten nameplates.

.8 On each motor starter attach a nameplate indicating point descriptor of the starter.

25.507 Component Attachment

Components, as well as cable, conduit and tubing, shall be attached to a means of support using suitable hardware. Adhesive mounting devices are not acceptable.

25.508 Outdoor Air Temperature Sensors

.1 Outdoor Air Temperature Sensors (OAT) shall be installed on the north side of the building, well away from sources of heat such as lamps or exhaust vents. OAT sensors shall not be mounted in locations where there is a horizontal surface less than five feet below the sensor.

.2 All acceptable OAT sensors have a solar shield. The sensor shall be oriented so that the shield opens downward. The conduit running to the sensor box from the building interior shall be sealed to prevent ingress of warm building air. Sensor shall be mounted to an FS type box. An FS cover and gasket shall be installed.

.3 OAT sensors shall not be mounted in fan intakes.

25.509 Control Panel Installation

.1 The control panel shall be installed in a non-locking electrical enclosure with hinged cover and with minimum dimensions of 30" in height, 20" in width and 6" in depth. The panel shall be mounted in such a way as to allow the installation and access to expander modules.

.2 Control panel cabinets shall have a removable inner mounting plate.

.3 Field interface devices such as relays and pneumatic transducers shall not be mounted in the same enclosure as the control panel.

.4 The control panel 24Vac supply transformer shall be mounted in a 12"x12"x6" electrical enclosure with hinged cover. A dedicated 120Vac circuit shall be wired to the transformer enclosure with hinged cover. The contractor shall provide a 120Vac, 15A duplex receptacle at the transformer enclosure for use by maintenance personnel.

.5 A power supply filter shall be provided on the primary side of the control panel supply transformer and the transformer shall be fused appropriately.

25.510 Field Interface Devices

.1 Field interface devices such as relays and pneumatic transducers shall be mounted in suitably sized electrical enclosures with hinged covers. Multiple devices may be installed in each enclosure, however, pneumatic devices and relays shall not be mounted in the same enclosure.

.2 Where it is necessary to control an electrical load drawing more than 2.0 A RMS current, or where it is necessary to control a load supplied from more than 240 VAC, provide an electromechanical relay to open and close the control circuit. Mount in an enclosure near the associated FIB. The coil of the electromechanical relay shall be controlled by a solid state relay.

25.511 Thermowell Installations

Piping shall be fitted with 1/2 NPT saddles or threadolet fittings to accommodate brass wells. Wells shall be filled with a thermally conductive compound.

25.512 Communication Installations

Network communications connections are to be coordinated with PPS. BAS to use dedicated BAS network inside the building. Communication to the BAS server in Dupuis Hall shall be through a subnet IP Address.

25.513 Cutting, Patching and Painting

The contractor shall do all cutting and breaking works, removal of rubbish, etc. required in the building for the installation of the work. The contractor shall be responsible for patching and painting to match existing finishes damaged during construction.

25.514 Cleaning

Leave area clean at the end of the day. Remove waste materials and rubbish from the site.

25.515 Fire Prevention

All necessary precautions must be taken to eliminate any possible fire hazard. Provide sufficient and adequate firefighting equipment in first class order, to protect against any fire emergency in the area of the work.

25.516 Existing Enclosures

Where approved by PPS, existing enclosures containing equipment made redundant by this installation may be reused provided they are of sufficient size and are undamaged. Remove redundant equipment. When reusing enclosures ensure any reference to cable numbers in or on the enclosure are corrected to indicate the current cable number.

25.517 Sensor Installation

.1 Mount sensors to manufacturers' instructions. Duct temperature averaging sensors shall have capillaries of sufficient length to traverse the duct three times. Averaging type duct temperature sensors shall be used for measuring:

- mixed air temperatures;

- supply air temperatures when the sensors cannot be placed downstream of both coils and fans;
- hot deck temperatures;
- cold deck temperatures;
- temperatures that are to be sensed immediately downstream of coils.

.2 Return air temperature sensors shall be installed upstream of return fans.

.3 Supply air temperature sensors shall be installed downstream of supply fans.

25.518 Dampers and Valves

.1 It is the responsibility of both the controls contractor and equipment suppliers to insure the proper operation of valves, dampers, and linkages.

.2 Damper operators shall not be mounted in the air stream. Damper operators shall be easily accessible for adjustment, maintenance and replacement.

25.600 Programming

25.601 Naming Convention

.1 Names shall be reviewed with PPS before implementation.

.2 QUEMS II computer names are composed of 8 to 16 characters, including two underscores (###_###_########).

.3 The first three characters (***_###_####) define location, or logical grouping (e.g. JEF for Jeffery Hall, GOO for Goodwin Hall).

.4 The next two or three characters (###_***_####) define the system. Air handling systems are named as A## (i.e. A01 to A99).

.5 Last set of (3 or up to 8) characters (###_###_********).

.6 The first two characters (###_###_**) define the "device" (e.g. PU for pump, HC for heating coil, IV for chiller inlet vanes, SW for supply water, ZN for a zone, etc. ...).

.7 The third or fourth character (###_###_##* or ###_###_###*) usually defines the function of the point (e.g. C for control of equipment (start/stop or analog output), S for status of equipment (such as on or off), T for temperature, Z for setpoint.

.8 Extra characters MAY be needed to identify particular devices. Such is the case with multiple zones (zone l to zone n), multiple pumps (induction heating loop, reheat heating loop, etc.), or any system with more than one item of similar function. This

"qualifier" character will appear (when needed) as the character before the function (last) character (###_###_##*#). This character may be digits or letters.

EXAMPLE: Dunning Hall Air Handling Unit #1 mixed air temperature DUN _AO1_MAT

EXAMPLE: Dunning Hall Heating System Pump #1 status: DUN_HTG_PU1S

25.602 Programs

The contractor shall program the panels with programs suitable to the equipment controlled. To be accepted the programs must be functional, demonstrate stable control, conserve energy and meet Ontario Building Code requirements.

25.603 Control of Major Equipment

Major equipment such as chillers and boilers shall be equipped with controllers from the manufacturer to control the equipment. The equipment controller shall be used to control related equipment critical to the proper function of the system such as pumps, valves and cooling towers. The BAS shall be hardwired to the equipment controller for enable, disable, and status signals. Other non-critical communications can be accomplished using BACnet.

25.700 Commissioning

25.701 Procedure

.1 The contractor shall give 5 working days' notice to PPS before starting commissioning of a system. PPS reserves the right to witness commissioning.

.2 As part of commissioning the contractor shall verify that each sensor and actuator is correctly wired back to the control panel input and that the wiring is free from opens, short circuits and ground faults. Switch or contact inputs shall be checked to insure that the state is interpreted correctly by the panel and graphics Actuator response to commands shall be verified. Record actuator pressure control ranges and if values are N.O. or N.C.

.3 The contractor shall coordinate system shutdowns with PPS in order to minimize inconvenience to the building occupants.

.4 During commissioning the contractor shall record on a form acceptable to PPS the status of each point when commissioning. Any deficiencies shall be noted. When deficiencies are corrected the point shall be rechecked for proper operation and recorded.

.5 Provide a copy of all signed verification reports to PPS.

25.800 Documentation

25.801 Requirements

The following documentation shall be provided:

- Schematic of each system showing component names
- Floor plan showing areas served and location of equipment
- Cross referenced point names to be provided on paper and in Excel or compatible format on USB drive.
- Description of dampers and valves including whether normally open or normally closed
- Commissioning signed verification report
- Sensor calibration data
- Catalogue cuts for parts supplied
- Diagram of each FIB showing location of components, control circuit wiring, point descriptor and name of equipment controlled or monitored. Indicate relay type.
- Control narrative, describing in detail the sequence of operation.

25.802 Standards and Format

.1 Drawings shall be provided on paper and in AutoCAD format on a USB drive.

.2 Drawings shall contain the standard Queen's University at Kingston drawing block supplied by PPS

.3 Each system shall be on an individual drawing with the sequence of operation for that system on the drawing in Queens University at Kingston format.

.4 See Appendix D for an example of the standard format of documentation required for each building.

25.803 Schedule for Provision of Documentation

Draft documentation package shall be delivered to PPS on or before the start of commissioning. Final documentation shall be delivered following completion of commissioning and revision of draft documentation.

26.000 Electrical

26.001 Drawing Symbols

A wide variety of drawing symbols are used in the electrical industry. To facilitate interpretation and record keeping, effort shall be made to conform to standard symbols. Proposed symbols shall be used on preliminary design drawings to be reviewed by Queen's.

26.002 Drawings and Records

There are many established systems at Queen's which have master drawings and records. Any changes or additions which affect these systems will require the amending of records and databases. It is imperative that provision be made for the supply of appropriate data to maintain these records and that funds are apportioned to facilitate the changes.

26.003 As-Built Drawings

As-built records (Division 1.721) shall conform to Queen's standard records and be in AutoCAD format. Records include but are not limited to: the campus digital map, showing all underground services; the main 5kV power distribution operating diagrams; building floor plans illustrating major conduit runs, locations of equipment, proper equipment identification, circuit numbers; fire, security, emergency power system riser diagrams.

26.004 Floor Plans, Risers

.1 Building floor plans shall accurately represent the architectural as-built conditions.

.2 Electrical systems and equipment shall be illustrated showing major conduit/wireway locations, equipment, receptacles, lighting, communications systems, security systems, fire alarm, emergency lighting and power on appropriate layers as per Queen's standard.

.3 Riser diagrams shall be provided for all major systems and shall conform to Queen's standard arrangements, showing equipment by floor levels.

26.005 Identification of Equipment

.1 All equipment including panels, disconnect devices, safety switches, control equipment etc., shall be labelled with white lamacoid nameplates using black engraved lettering.

.2 Nameplates shall be permanently secured in place with screws and/or PPS approved adhesive.

.3 Nameplates shall include all pertinent information such as equipment designation, panel and circuit it is fed from and location of feeder panel.

.4 The following abbreviations and numbering schemes shall be used:

Abbreviation	Equipment Description
HPP	High Voltage Power Panel in Vault (600V)
LPP	Low Voltage Power Panel in Vault (208V)
HDP	High Voltage Distribution Panel (CDP or QMQB)
LDP	Low Voltage Distribution Panel
HP	High Voltage Panelboard (600V)
LP	Low Voltage Panelboard (208V)
MCC	Motor Control Centre
HSP	High Voltage Splitter (Panel or Trough)
LSP	Low Voltage Splitter (Panel or Trough)

.5 Prefix "E" shall be added to any of the abbreviations to designate "Emergency" power when fed from a standby generator or central inverter system, i.e. EHP = Emergency High Voltage (600V) Panel.

.6 Suffixes shall be provided for each abbreviation used as follows:

.1 Main Switchboards, Power panels, Distribution Panels and Splitters shall be assigned double letters in sequence i.e., HPP-AA, LDP-BB, LSP-CC.

.2 Branch circuit panelboards shall be assigned alphanumeric suffixes with floor level and single letter in sequence i.e., LP-1A, HP-1B, ELP-1C, LP-2A, EHP-2B.

.7 Receptacles on emergency power shall be of the colour red.

.8 A sticker indicating the source panel and circuit number shall be placed on all receptacles.

26.006 Source of Power

.1 In general, any new building will require a unit substation fed at 4,160V from the existing campus grid. This substation shall be indoors unless special permission given by PPS.

.2 Only in exceptional cases will the power be supplied at secondary voltage from an adjacent building. The connection to the existing 4160V power distribution network shall be specified by PPS.

.3 Flexibility is maintained through the use of network switches, multiple cables to each building and cross connections of the cable through network switches.

.4 The network uses a four-wire system. The load conductors are 500 MCM AWG copper and the neutral is 4/0 AWG copper.

.5 Phasing is marked from left to right or top to bottom Red-Yellow-Blue, Red- White-Blue, or A-B-C.

26.007 Electrical Interference

.1 The use of electronic, low voltage devices in research and teaching is increasing. To avoid interference, electrical fixtures and equipment should be electrically "quiet" and non-arcing.

.2 Special effort shall be made to ensure that harmonics generated by equipment have no deleterious effect on the distribution system or other building equipment.

26.008 Equipment Housekeeping Pads

Install base mounted equipment on chamfered edge housekeeping pad: minimum 4" high, minimum 2" larger than equipment dimensions all around.

26.009 Schedules

.1 Motor and apparatus schedules, lighting fixture schedules and panelboard schedules are required. Suggested forms which can be included in specifications are illustrated in the appendices. Completed, accurate, "as-built" schedules shall be produced and submitted as part of the Operations and Maintenance data.

.2 For renovations and equipment replacements, existing schedules are to be updated.

26.010 Maintenance and Operating Data

Manufacturer’s catalogue data, equipment schedules, panel schedules, panel summaries, warranties, certificates, verification and test reports, spare parts, operating and maintenance instructions shall be provided and assembled in an organized fashion as detailed in Division 1.730 of Queen's Building Standards.

26.011 Electrical Materials and Methods

26.012 Buried Services and Duct Banks

.1 Location of all 4160V cables in duct, will be marked with a brass markers either supplied by Queen's or to Queen's standard design. A sufficient number of these

markers will be so arranged that the cable route can easily be determined. Direct buried cables are not acceptable.

.2 All concrete encased, buried electrical power duct banks shall be coloured red. Install red warning tape above the duct bank as required by code.

.3 New or changed underground services shall be recorded on the digital campus map and on the 5kV operating diagram as well as on the design drawings associated with the project.

.4 All concrete encased, buried electrical power duct banks shall be installed according latest Ontario Electrical Safety Code and Ontario Provincial Standard Drawings.

26.013 Wiring Methods

.1 Wiring shall be installed in conduit to facilitate changes, i.e. increasing wire gauge, adding circuits, repairing damaged wiring etc. Where practical, conduit shall be oversized to accommodate such change.

.2 Connection to equipment subject to vibration/movement (such as motors) shall be flexible conduit.

.3 Lighting circuits shall be wire in conduit except final drops may be made with type AC90 cable. No runs of type AC90 cable shall exceed 3 meters in length.

.4 Provide a separate (minimum #12 AWG) green insulated ground wire in all conduits and raceways.

.5 The use of isolated grounding systems is strongly discouraged.

.6 Main electrical distribution shall be solidly grounded.

.7 All branch circuits are to be stranded type.

.8 Label all wires in junction boxes as well as at terminations.

.9 Where 347V and 120V lighting is in the same space, they shall be clearly marked as such, and easily identifiable.

26.014 Conduit

.1 Conduit shall be adequately sized with room for fifteen percent more wire in general areas and fifty percent in lab and research areas.

.2 No more than three 1/4 bends (or equivalent) shall be allowed in any conduit run between pull points.

.3 Conduit shall be Electrical Metallic Tubing (EMT) electro-plated steel where code permits; Electrical Non-metallic Tubing (ENT) embedded in concrete is acceptable in most applications.

.4 Aluminum conduit may be used provided that the alloy used conforms to Canadian Standard Association (CSA) standards and provided that it is not embedded in concrete.

26.015 Bus Duct and Other Flexible Systems

Bus ducts systems shall be strongly discouraged. Special permission must be given by PPS for bus duct or other flexible system.

26.016 High Voltage Power Cables and Terminations - 15kV

.1 The main campus power grid comprises a 4,160V distribution system utilizing 15,000V (minimum) insulated phase conductors with insulated ground. The phase conductors are 500 MCM AWG, the ground is size 4/0 AWG.

.2 New services will require evaluation of the network to establish interconnection requirements. New power cables may be 500 MCM AWG single conductor, concentric neutral, XLPE-TR insulated or 500 MCM AWG single conductor, tape shield, XLPE-TR insulated. If tape shield is to be used, a separate 4/0 AWG ground shall be installed.

.3 15kV Terminations shall be 3M Cold Shrink QT-III or approved equivalent and 15kV splices shall be 3M Cold Shrink QS-III or approved equivalent. Splices will be kept to a minimum and shall be installed in accessible, preferably dry locations.

26.017 Wire and Cables (0-1000V)

All branch wiring shall be copper conductor, #12AWG minimum. Feeder cables shall XLPE rated at 90°C. Building wiring may be XLPE or TWH. A separate insulated ground conductor shall be installed in all conduit systems.

The following colour code shall normally be used:

Ground: Green
Neutral: White
Phase A: Red
Phase B: Black
Phase C: Blue
Low voltage wiring: Brown

26.050 Wiring Devices

.1 Devices shall be "specification grade" heavy duty.

.2 Preferred manufacturers are Hubbell, Bryant, Arrow Hart, Pass & Seymour and Leviton. Stainless steel cover plates are preferred.

.3 Occupancy sensors may be proposed but shall be reviewed first with PPS.

.4 Manufacturer's catalogue cuts including specifications are required for wiring devices provided.

26.051 Connectors and Terminations

.1 Wiring connectors that enable the connection to be inspected, before the insulation is applied, are preferred such as MARR connectors with socket-type screws or compression-type connectors such as the Buchanan connectors.

.2 All power cable terminations shall be of the compression fitting type such as Thomas & Betts 54100 series or Burndy Hylugs.

26.052 System Short Circuit, Co-ordination, and Arc Flash Studies

.1 A short circuit, co-ordination, and arc flash study shall be provided for all protective devices and equipment in the electrical distribution system in co-operation with suppliers of all pertinent equipment. Any short circuit, co-ordination, and arc flash problems shall be resolved or brought to the attention of PPS for resolution.

.2 A copy of the short circuit, co-ordination, and arc flash study shall be included in the Maintenance Manual.

26.053 Power and Transmission

26.054 Electrical Equipment Rooms

.1 Access to electrical equipment rooms shall be limited to authorized personnel. Entrance doors shall be marked according to latest revision of Ontario Electrical Safety Code. Door locks shall be keyed to Medeco J1 for electrical rooms containing >750V and Medeco JB for electrical rooms containing <750V. In some cases a padlock hasp shall be provided, padlock to be supplied by PPS.

.2 Provide copper ground bus around entire electrical room and connect to all conducting parts such as exhaust grills, doors etc., as well as all electrical switchgear.

.3 Electrical equipment rooms shall be sized to provide room and cable entrance space for (up to) a six pole network switch and include room to expand the secondary distribution panel.

.4 The layout of electrical equipment rooms shall be reviewed and approved by PPS.

.5 The main electrical room of a building shall be above grade.

.6 Design Checklist for electrical equipment rooms:

.1 Location
Facilitate transformer replacement/repair
Avoid proximity of water (pipes, sumps)
Minimize noise transmission to adjacent spaces

.2 Ventilation
Isolated
Adequate to control temperature
Supply and exhaust
Minimum Noise

.3 Access
Key specified by Operations Department

.4 Protection
Fire Detection (Ionization or Photo Electric preferred)
Fire Suppression may be considered

.5 Lighting
All lighting to be switched
Emergency battery operated as well as standby required

.6 Emergency
Provide Emergency Receptacle(s) if standby power is available

.7 Signage
In accordance with latest revision of Ontario Electrical Safety Code and Queen's Signage Policy
Single Line Distribution Diagram to be framed, posted

.8 Grounding
In accordance with code requirements

.9 Records
Accurate As-Built Drawings

26.055 Transformers - Dry Type 5kV

.1 Transformers shall be three phase, indoor, dry type with copper windings and have 220 insulation class and 115^{o}C temperature rise.

.2 The primary shall be delta-connected, rated 4160V and a Basic Impulse Level (BIL) of 60kV minimum. Four taps shall be provided: 2 at 2½% full current above nominal (FCAN), 2 at 2½% full current below nominal (FCBN). Normally the primary taps will be set at 97½%.

.3 The secondary voltage shall be wye-connected at 600/347V, three phase, four wire, and grounded neutral. 208/120V distribution shall be provided locally as required throughout the building. System design shall be reviewed and approved by PPS.

.4 The transformer capacity shall be double the designed operating load (not connected load).

.5 Transformers shall be provided with Qualitrol winding temperature indicators complete with remote terminals and shall be connected to a remote monitoring system.

.6 PPS shall be provided with appropriate data for updating the 5kV operating diagram and the 5kV computer model.

.7 PPS shall be provided with complete nameplate data to be entered in the 5kV transformer (TR) database and the PPS maintenance database.

.8 The transformer shall be identified according to Queen's naming convention and shall be identified with a nameplate manufactured to Queen's standard.

.9 Documentation for transformers shall include manufacturer's catalogue cuts, shop drawings, manufacturer's recommended operating and maintenance instructions and warranty information.

.10 A disconnecting device for the transformer shall be located within the same room.

26.056 Lightning and Surge Protection

.1 Intermediate class metal oxide arresters rated at 2.55kV maximum continuous operating voltage (MCOV) shall be provided at the incoming service to a building (sized to protect transformers from surges). Arresters shall be housed within the primary switchgear assembly.

.2 Exterior lightning rods or grounding mats may be required to protect sensitive electronic equipment. All grounding means must conform to the Ontario Electrical Safety Code. Isolated ground rods are not permitted.

.3 Surge protection shall be provided at distribution panels throughout the building when warranted.

.4 Documentation shall include manufacturer's catalogue cut sheets for the arresters and surge protectors plus any operating or maintenance data.

26.130 Network Switches - 15kV

.1 15kV network switches are used on campus to interconnect the 4160V grid. New switches are SF6 insulated and are manufactured by G&W Electric Limited. The requirement and configuration for a switch shall be determined by PPS. (15kV switches are used because 5kV switches are no longer manufactured.)

.2 Network switches shall include test positions to facilitate grounding of connected cables. Each network switch shall be supplied complete with three (3) Cooper Power System LBI-215 deep-well bushing insert kits and three (3) Cooper Power System LPC-215 protective caps. The inserts and caps shall be installed prior to network switch commissioning.

.3 Network switches are assigned PPS identification numbers (NS numbers). Nameplates shall be manufactured to Queen's standard and fastened to the front of the network switch.

.4 Complete nameplate data must be provided to PPS to enter in Queen's NS database.

.5 Documentation shall include manufacturer's operating and maintenance instructions, specifications, data sheets and shop drawings.

26.132 Primary Switchgear Assembly - 5kV

.1 Primary gear shall not include metering, breakers or special control equipment unless approved by PPS.

.2 Switchgear shall be rated to withstand the available fault energy estimated by Utilities Kingston to be 150 MVA.

.3 The insulation rating of all 5kV class primary supply equipment shall have a Basic Impulse Level (BIL) rating of 60kV minimum.

.4 Each substation transformer shall be provided with a fused, load break switch rated at 600A, 5kV minimum. Clearly visible potential indicators shall be provided on each phase of the line and load side of the switch and shall be viewable via factory-installed windows.

.5 Isolation switches shall be manufactured and supplied by S&C Electric. Neither used nor recondition nor new old stock equipment may be used without the express permission of PPS. Power fuses shall be refill type SM-5 as manufactured by S&C. The refill current, voltage and time current rating shall be specified in conjunction with PPS.

.6 Isolation switches (IS) are assigned PPS identification numbers. Associated data must be provided to PPS to enter in Queen's IS database.

.7 Documentation shall include manufacturer's operating and maintenance instructions, specifications, data sheets and shop drawings.

26.133 Padlocks for Electrical Switchgear

.1 Switchgear that is energized, that requires a lock, shall be padlocked with the standard electrical Master Padlock with key number X2286.

.2 Network Switches shall have each Test Position Access normally locked open using the standard Master Padlock with key number X2286.

.3 Switchgear that, in the open position, defines an open point in the distribution system shall be locked open using the standard Master Lock Padlock with key number 2233.

.4 Switchgear access doors requiring restricted access shall be locked using the 2233 padlock.

.5 Padlocks shall be manufactured by Master Lock Company. They shall have a 44mm wide (1 ¾") laminated brass body and hardened steel shackle 8mm (5/16") diameter; 19mm (3/4") horizontal clearance; 38mm (1 1/2") vertical clearance. Padlock shall be complete with protective bumper, precision 4 pin tumbler locking mechanism and number stamped into padlock base.

.6 Acceptable products: Master Padlock catalogue numbers - 2KALF to key X2286 and 2KALF to key 2233.

26.240 Service Distribution (600V and Below)

26.241 Secondary Switchgear

.1 The transformer main secondary switchgear shall be draw-out type air circuit breakers. All equipment shall be of Canadian manufacture or with parts readily available to PPS.

.2 A spare breaker shall be provided for maintenance purposes to allow for calibration and servicing with minimal interruption of service.

.3 Documentation shall include manufacturer's shop drawings, catalogue cuts, data sheets, operation instructions and maintenance instructions.

.4 Circuit identification shall conform to Queen's standards. Nameplates shall be reviewed with PPS prior to manufacture.

26.242 Secondary Metering

.1 All substations shall be provided with secondary metering, which provides: amps for each phase kilovolt-amps

Volts phase to phase (all phases)	kilovolt-hours
Volts phase to neutral (all phases)	kilovolt-ampere hours
Kilowatts	power factor
Kilowatt demand	digital output
Kilowatt-hours (total)	frequency
KiloVARS	% harmonic distortion

.2 In order to facilitate reading of the meter the display shall be installed at eye level (1.7m AFF)

.3 Current Transformers (CT's) shall be sized to maximum rated current of transformer (not larger) with 5 amp secondary.

.4 A colour coded test switch is required to facilitate testing and removal of each meter. ABB Flexitest switches are normally used.

.5 Queen's central metering system uses Schneider PME metering software. To be compatible, new meters shall be Schneider PM5560 or Eaton PXM 2260 with Ethernet communications. Where power quality monitoring is also required, the new meters shall be Schneider PM8000 or Eaton PXM4000 with Ethernet communications. The requirement for a power quality meter instead of a standard meter shall be determined by PPS.

.6 Queen's provides the final connection of these meters to the central server via conduit and Ethernet cable in conduit. Conduit to be supplied and installed by the contractor and Ethernet cable to be installed by Queen's ITS. The conduit and wire/cable will normally terminate at the main incoming communications node. Termination location shall be coordinated with PPS.

.7 Documentation shall include catalogue cuts for meter, CT's and test switch; operating and maintenance manual for meter.

26.243 Fused Disconnects

.1 Heavy duty safety switches shall be specified.

.2 Disconnects shall accommodate CSA certified HRC1-J (Class J) fuses.

.3 Preferred manufacturers are Schneider (Square D), Siemens, and Eaton (Cutler-Hammer).

.4 Documentation shall include catalogue cuts clearly indicating specified products and options.

26.244 Transformers - Dry Type 600V

.1 Primary windings shall normally be copper conductor, delta connected, 1.2 kV class insulation, standard BIL complete with four 2½% taps, 2FCAN and 2FCBN.

.2 Secondary windings shall normally be copper conductor, wye connected.

.3 Normally 80°C temperature rise above 40°C ambient shall be specified.

26.245 Panelboard Summary

.1 The assignment of panel names is managed using a table recording information related to all panels used throughout a building.

.2 The table is normally created when a building is built and updated when changes occur. The provision of this data is the responsibility of the contractor executing the work.

.3 The completed table shall be included in the operation and maintenance manual.

26.246 Panelboards - Power Distribution Type

.1 Power distribution panels shall be type CDP utilizing molded case circuit breakers. All panels shall be three phase, four wire, solid neutral, copper bus, 600/347V or 208/120V as required. Interrupting capacity shall be calculated and specified for each case.

.2 Fused panels are only to be used if it can be shown that coordination cannot be achieved or if the interrupting capacity of the available breakers is insufficient for the available fault current.

.3 Distribution panels and breakers must be of Canadian manufacture or with parts readily available in Kingston.

.4 Preferred manufacturers are: Schneider (Square D), Siemens, Eaton (Cutler-Hammer).

.5 Documentation shall include catalogue cuts and shop drawings for each panelboard; nameplates shall be installed as per section 26.005; panel schedule shall be provided with accurate as-built data to Queen's standard.

26.247 Panelboards - Breaker Type

.1 Branch circuit panelboards shall use bolt-on breakers.

.2 All panels shall be three phase, four wire, solid neutral, copper bus, 600/347V or 208/120V as required.

.3 Equipment panels for student laboratories shall be provided with a main disconnect.

.4 Panels in general areas shall be sized to accommodate at least 15% additional circuits. Those in lab areas shall be sized to take at least 50% more than the original number of circuits

.5 Panelboards and breakers must be of Canadian manufacture or with parts readily available in Kingston.

.6 Preferred manufacturers are: Schneider (Square D), Siemens, Eaton (Cutler-Hammer).

.7 Documentation shall include catalogue cuts and shop drawings for each panelboard; nameplates shall be installed as per section 26.005; panel schedule shall be provided with accurate as-built data to Queen's standard.

26.280 Molded-Case Circuit Breakers

.1 Molded-case breakers shall be bolt-on type.

.2 Include 10% spare breakers, normally 1P-15A.

26.281 Fuses

Fuses shall be CSA certified HRC1-J (Class J) time delay type.

26.282 Branch Circuit Loading

.1 Normally the maximum number of receptacles per 15 amp circuit shall be four.

.2 Service receptacles shall be fed separate from other receptacles (i.e. corridor receptacles intended for floor polishers will not be on the same circuit as office receptacles).

26.283 Transient Voltage Surge Suppression

.1 Transient voltage surge suppression devices shall be used to protect Fire Alarm control panels.

.2 Suppression devices should be considered for any critical loads utilizing computer or solid state technology (such as life safety and security equipment).

26.500 Lighting

26.501 Lamps

.1 The selection and specification of lamps shall result in low operating and maintenance costs for lighting.

.2 Lamps shall be specified from the PPS Approved Lamp List.

26.502 Lighting Fixtures

.1 Fixtures shall be selected for quality, performance, efficiency and economy.

.2 Fluorescent and LED fixtures are preferred for most interior applications.

.3 Fixtures shall have hinged, framed lenses or louvers. Lenses shall be acrylic prismatic (K12). Deep parabolic diffusers or direct/indirect lighting may be specified when applications require.

.4 Custom made fixtures shall be avoided whenever possible. Fixtures and parts should be equal to those manufactured by Lithonia, Visioneering, and Cooper.

.5 Ballasts shall be high efficiency, high power factor, sound rated A.

.6 Fluorescent ballasts for T8 lamps shall be electronic, rapid start. Instant start may be specified where approved by PPS.

.7 Cast metal fixtures shall be specified for exterior applications.

.8 Documentation shall include manufacturer's catalogue cut indicating fixture specified, fixture designation, quantity specified, options specified.

.9 Fixtures with remote ballasts/drivers are not acceptable. All fixtures must have integral ballasts/drivers.

.10 Where T5 fixtures are specified, they are to be HO (High Output) and not standard T5's due to ballast incompatibility.

26.503 Interior Lighting

.1 Lighting systems shall have demonstrated optimum life cost for all components (i.e. lamps, fixtures, ballasts, etc.).

.2 Lighting shall be designed to provide high quality illumination appropriate for the identified tasks.

.3 Whenever practical, task lighting shall be considered and energy consumption minimized.

.4 Illuminance values shall be based on the latest edition of the Illuminating Engineering Society (IES) lighting handbook. Assume a maintenance factor of .80

.5 Unless information is given by the architect to the contrary, lighting design shall be based on the following reflection coefficients:

Ceilings	80% or higher with a non-glossy surface: acoustically treated ceilings may be somewhat lower.
Walls	50 - 60%
Desk Tops	35 - 40%
Floor Coverings	30% or higher

.6 Interior areas shall be provided with sources that provide high colour rendering (CRI -75 or greater). Colour temperature shall be 3500K.

.7 Ultra Violet (UV) filters are required in art galleries and throughout the space occupied by the art department.

.8 For 24/7 lighting applications or non-switched fixtures (stairwells, hallways, etc.) consideration should be given to daylight harvesting, and occupancy control with dimming to 20% with functionality to ramp to 100% under emergency power. Illumination level shall be 50 lux minimum (O.B.C. -3.2.7.1.(1)).

.9 Lighting in washrooms are to be LED with a 20% dimmed unoccupied mode through the use of occupancy sensors.

.10 All LED fixtures to be controlled by dimmable switching. Dimming switches to be specified wherever possible.

26.504 Exit Lights

.1 Code requirements and life cost, including energy and maintenance, dictate the selection of exit fixtures. Fixtures must comply with C860 standard.

.2 As stipulated in the latest version of the Ontario Building Code, exit signs shall be the “green running man” sign. When only a portion of a building is being renovated and exit signs are being added to the space, the exit sign shall be the “green running

man" and all exit signs that are visible from that new sign shall also changed to the "green running man". The energy requirement shall be 5 watts per face (maximum). Minimum fixture warranty shall be 5 years, expected lamp life 25 years.

.3 Fixtures shall be illuminated during both normal and emergency conditions. Emergency power shall be supplied from a generated source. Battery power shall be provided if generated power is not available.

.4 Fixtures must use a LED source for illumination.

.5 Documentation shall include manufacturer's catalogue cut indicating specific fixture and options, complete lamp data (including emergency lamp when used) fixture designation and quantity specified.

26.505 Emergency System Lighting

.1 Emergency lighting shall be powered from the building or area standby generator. When there is no building or area standby generator, emergency lighting shall be fed from a central, battery powered inverter. When there is no inverter, or installing an inverter is not feasible, emergency lighting fixtures shall have battery packs.

.2 Unit equipment for emergency lighting shall be selected for optimum life cost, maintenance being of utmost consideration. Automatic controls shall be provided for charging at both high and low rates. Meters/monitors shall be provided to indicate charge rate and condition.

.3 Unit equipment output voltage shall normally be rated 24 VDC.

.4 Commissioning of emergency lighting shall include recording the illumination levels achieved for all areas where provided.

.5 Fixtures (other than unit lamp head type) used for emergency lighting shall be marked with a visible label indicating that it is an emergency lighting fixture.

.6 Documentation shall include manufacturer's operation instructions, maintenance instructions, catalogue cut sheets, data sheets, as-built floor plans, unique identification and listing of all emergency fixtures.

26.506 Exterior Lighting

.1 Exterior lighting shall conform to the principles outlined in the Campus Master Plan (2014).

.2 Pedestrian walkway fixtures, poles and lamps shall match the campus standards.

.3 Illuminance values for applications not included in the plan shall be based on the latest edition of the IES Lighting Handbook. Generally:

Minimum Average Levels	Illuminance (Lux)	Illuminance (Foot-candles)
Residential Areas	2	.2
Parking Areas	5	.5
Walkways	2	.2

.4 Exterior fixtures are assigned unique numbers referred to as grid numbers. Each fixture shall be labelled with the grid number assigned by PPS.

.5 Underground parking lighting is to be LED, dimmable, and appropriate locations shall be dimmed to 20% through the use of occupancy sensors.

.6 Documentation shall include manufacturer's catalogue cut indicating specific fixture and options, fixture designation and quantity specified.

26.507 Lighting for Assistance Phones

.1 Assistance phones utilize a characteristic blue light to make them stand out clearly at night. The lens interior is painted with translucent blue paint to create the blue colouring.

.2 Pole mounted fixtures are McGraw-Edison (Cooper Lighting) MQS using a 70 watt metal halide lamp. The pole shall have a fixture mounting height of ten feet, a tenon matching the fixtures socket and a final pole outside diameter of four inches to match the fixture mounting plate. Aluminum or high quality fibreglass poles are acceptable.

.3 Wall mounted fixtures are Lumark (Cooper Lighting) WP type using a 70Wmetal halide lamp.

26.700 Special Systems

26.701 Emergency Power - General

.1 Standby emergency power is required for most University buildings to supply emergency lighting and other emergency services such as fire pumps, sump pumps and similar critical loads. Since maintenance on standby equipment is regulated, it is important to minimize the quantity of generators. Groups of buildings shall be fed from a single generator servicing a designated area.

.2 Generators shall be diesel powered with three phase, four wire 600/347 volt output complete with automatic transfer switch and battery charger. The engine and

generator shall be installed in a room separate from the main transformer and associated switch gear, shall be installed above grade, and shall allow easy access for a resistive load bank for required annual testing .

.3 In scientific buildings consideration shall be given to providing each floor with a panel fed at 60 amps located adjacent to the main power panels on each floor. These panels should be separate from electrical feeds to specific equipment.

.4 Preferred generator manufacturers are Cummins, Onan, Kohler, SDMO, and Catapillar.

.5 Documentation for the standby equipment shall include all operations and maintenance documentation recommended by the manufacturer, factory load test data, a single line diagram illustrating the complete, as-built distribution of the standby power, a table or panel schedule indicating the precise connected load, the measured load under test conditions and a completed Queen's data sheet for standby generators.

26.800 Communications

26.801 Fire Alarm Systems - General

.1 Queen’s University has a sole source partnership agreement with Siemens Building Technologies Cerberus Division for the supply of all fire alarm equipment. Designers should contact Siemens in order to obtain assistance in producing a design optimized for Siemens equipment.

.2 Fire alarm systems will conform to all applicable codes and standards.

.3 Addressable fire alarm systems will be provided in buildings exceeding three stories in height above ground or exceeding 5000 m2 in gross area. Conventional systems may be used in smaller buildings.

.4 Addressable fire alarm systems shall be installed as two-stage systems with the general alarm delay set to zero. Full two-stage operation will be implemented at the university’s discretion. Conventional systems shall be single stage, non- coded.

.5 Control panels shall be easily accessible with the annunciator portion visible to the fire department personnel at the main entrance and located to the satisfaction of all fire departments concerned.

.6 Fire alarm systems are monitored centrally by both Fire Monitoring of Canada(FMC) and Queen’s Emergency Report Centre (ERC). Separate, normally-closed contacts shall be provided in the control panel to provide trouble, supervisory and alarm signals to FMC, and trouble, supervisory, and alarm signals to the ERC. Conduit is required from the interface box to an ITS Comms Room - coordinate with PPS.. FMC requires both Ethernet and telephone connections. ERC requires a hardwired

connection to the nearest Queen's security panel. System commissioning requires that both central monitoring stations be operational before acceptance testing commences.

.7 System verification is to be provided by Siemens Building Technologies, Cerberus Division.

26.802 Fire Alarm Systems – Products / Materials

.1 Long life lead acid batteries shall be used for stand by power.

.2 Metering shall be provided to monitor the battery voltage and charging current.

.3 Wiring shall be in conduit, and be shielded low-energy red jacketed cable approved for fire alarm use. Solid copper wire size to be that recommended by the manufacturer.

.4 Ground fault indication shall be provided.

.5 Visible trouble signal and audible signal with silencing switch shall be provided.

.6 Each end of line device shall be located in a separate box with a distinctive cover adjacent to the last station of the line or in the riser terminal box on a terminal strip labelled with the zone number. The method used must be consistent through the building.

.7 The preferred audible device is a horn. Emergency voice systems should be used only where there is a demonstrated need or a code requirement.

.8 Strobes shall also be provided throughout the building above and beyond code requirement.

26.803 Fire Alarm Systems - Installation

.1 The fire alarm graphic shall be developed in conjunction with PPS. The graphic shall be submitted to PPS in the current revision of AutoCAD or another mutually agreed format. Use of active graphic displays is strongly discouraged.

.2 The branch feeder breaker or disconnect shall be located as close as possible to the main power supply of the building and will be painted red and labelled "FIRE ALARM POWER". When available, source shall be Emergency Power.

.3 All addressable devices shall have their addresses clearly identified on them.

.4 All wiring joints in the fire alarm system shall be identified on as-built drawings.

26.804 Fire Alarm Systems - Documentation

Documentation for the fire alarm system must include: an equipment list stating the type, catalogue number and quantity of each device installed/purchased including spares; all the manufacturers recommended operation and maintenance manuals; the complete verification report; accurate as-built floor plans showing the location and address of all devices and a riser diagram illustrating the network layout of the fire alarm system.

26.805 Intrusion Alarm Systems

.1 Intrusion alarm systems will conform to all applicable codes and regulatory approvals.

.2 Intrusion alarm systems will be monitored internally by the Emergency Report Centre (ERC). Control panels shall be compatible with the ERC front end monitoring system (SurGuard MLR2).

.3 Control panels shall be secured within a protected area (usually in the armed area). They shall be easily accessible for service work.

.4 Materials

.1 Monitoring:

Mandatory features for digital / DVAC's controls communicating with the ERC front end:

- Pulse / DTMF Dialing
- Contact I.D. format
- SIA Format
- Radionics Format
- 1400 / 2300 HZ Handshake / Kissoff
- Universal Format

.2 Detection Devices

All detection devices shall:

- Be Motion Detectors
- Have Form "A", "B" or "C" relay output for Grade C & B
- Have Form "C" with tamper, ULC certified for Grade A & ULC
- Be Passive Infrared Type
- Have dual technology (passive & microwave) in unstable environments
- Have sensitivity adjustment
- Be equipped with an independent tamper switch
- Include Temperature Compensation circuit
- Be Microprocessor Based

- Provide Minimum 900 Sq. Ft. coverage

.3 Magnetic Door Contacts shall:

- Be recessed type
- Accommodate ¾, 7/8 or 1 inch wide gap for steel doors
- Accommodate ¼, 3/8 or ¾ for wood doors and frames
- Be installed on window surfaces to prevent accessibility (concealed)
- Be suspended at the end of the line

.4 Panel Features:

Intrusion alarm panels shall have the following features for each Grade noted:

FEATURES	GRADE		
	A	B	C
AC Power Supervision	X	X	X
Low Battery Supervision			X
Loss of Communication line supervision	X	X	X
Static / Lightning Protection	X	X	
LCD Keypad	X		
LED or LCD Keypad		X	
LED Keypad			X
Keypad Tamper	X		
Detector Supervision	X	X	
Keypad Supervision	X		
Expansion module supervision	X		
Multiplex expansion bus	X		
Open / Short/ Ground input supervision	X	X	
EOL supervised zones	X	X	
EOL supervised zones (end of line resistors)			X
Static Lighting Protection			X
Swinger shutdown	X	X	X
History Buffer	X	X	
Individual Zone Programming and Characteristics	X		X
Minimum of six hardware zones			X
Minimum of eight hardware zones		X	
Minimum of ninety-six hardware zones	X		
Minimum of two partitions		X	
Minimum of eight partitions	X		
Minimum of six users			X
Minimum of sixteen users		X	
Minimum of ninety-six users	X		
Minimum of sixty-four relays	X		
Uploadable / Downloadable Control Capabilities	X		
Printer output	X	X	
Pulse / DTMF dialing	X	X	X
Test transmissions, Daily	X	X	X
Open / Closing by user	X	X	X
Alarm / Restore by Zone	X	X	X
Contact I.D. Format	X	X	X

SIA Format	X	X	X
Radionics Format	X	X	
1400 / 2300 HZ Handshake / Kissoff	X	X	X
Universal Format	X	X	X

.5 Batteries

All batteries shall be maintenance free, sealed, leak proof, gelled electrolyte, rechargeable
Grade C: 4 amp-hour (minimum)
Grade B: 7 amp-hour (minimum)
ULC: 7 amp-hour (minimum)
Grade A: 14 amp-hour (minimum)

.6 Control Transformers

Transformers shall be CSA approved and meet OEM specifications.

.7 Preferred manufacturers

Panels (CPU): Napco, SurGuard, and DSC
Contacts: Sentrol or ADI

.5 Wiring

- All connecting wire used in the installation shall meet the original equipment manufacturers specification.
- All wire used in the installation shall meet all respective fire and safety codes.
- Each device wired to the control panel shall use an independent wire, which is free of joins and splices.
- Wiring shall normally be in conduit to Queen's University's Standards.

.6 Telephone

- Queen's telephone service is provided under the direction of the Information Technology Services Department (ITS). All installations must be coordinated and approved by ITS.
- Verify with ITS that DVAC's control panel space is available at the end users site.
- Voice and data signals are combined in the cable plant and are both processed through the Meridian SL-1 switch located centrally on campus.

.7 Most service points require only a single gang outlet box large enough for a 3 twisted pair jacketed cable.

The University's policy regarding the installation of telephones is to provide for the most flexible system possible. This is accomplished by providing conduit roughed in any and all office areas. The actual service installed in this conduit system will be determined later in the planning process.

.8 Documentation

.1 Intrusion alarm system shall include:

- An equipment list stating the type, catalogue number and quantity of each device installed / purchased including spares.
- All the manufacturers recommended operation, programmers and maintenance manuals.
- Accurate as-built floor plans showing the location of all devices and a complete wiring diagram illustrating the interconnection of all field devices, power source and monitoring devices.

.9 Maintenance

.1 It is the end user's responsibility to ensure that their Intrusion Alarm Systems are maintained in good working order.

.2 Routine maintenance is imperative on any intrusion detection system to ensure that it is operating as it was originally intended. It is recommended that all alarm systems should be serviced on a regular basis. The most economical way to ensure these tests are completed is for the user to enter into a service contract with a reputable alarm system contractor. The service contract should include:

- Clean and test all motion and contact detectors
- Test back up battery
- Check that all peripheral devices are in good working order
- Ensure all zones that are programmed to report an alarm signal are functional
- Check that all keypads are in good working order
- Two programming changes per year (code changes)
- When the service is complete the end user should request a document stating the serviceability of the system.

.3 In the event a user requires or requests repair work (non-warranty coverage) or upgrades to their existing system, a request in writing for system repair shall be completed by the user and sent to Physical Plant Services (PPS). The individual requesting the service will be financially responsible for any cost incurred due to the repair request. The aforementioned financial responsibility will be void if the request form indicates "Quote only".

.10 Training

The contractor shall include in their quote adequate training for the end user.

.11 Warranty

Installed parts: 3 year (minimum)
Door Contacts: Lifetime Warranty
Labour: 1 year (minimum)

26.806 Access Control Systems

Access Control Systems conform to all applicable codes and regulatory approvals.

.1 Materials

.1 Access Control Panels

Access control panels (more commonly known as Intelligent Access Control Processors) should have the following features:

- Minimum of 500 transactions in buffer
- Minimum of 6 site codes
- Minimum of 2 readers
- Minimum of 2 keypads
- Capable of 7 reader technologies
- Minimum of 16 NO/NC supervised zones on motherboard
- Alarm points up to 2000 feet away
- Minimum of 4 relays on motherboard
- Metal cabinet with tamper
- Buffered or non-buffered mode
- 300 to 9600 baud communication speed
- Internal memory retention
- Up to 64 panels per communication loop
- Fully distributed database
- Computer enhanced not computer dependent
- Dial up modem programming capabilities
- Free egress, door ajar, door open to long outputs
- Minimum of 3800 card user's
- RS-485/RS-232/current loop, communication protocol
- Hyper Terminal Diagnostics
- .21 Minimum of 32 Times Zones

.2 Locking Devices

.1 Locking devices used in conjunction with any Access Control System shall be limited to either magnetic locks or electric strikes.

.2 New Magnetic-locking device installations are not normally permissible because of Ontario Building Code restrictions. Magnetic-locking devices shall only be used with the explicit approval of the Chief Building Official and Physical Plant Services.

.3 Magnetic-locking devices will supply a minimum holding force of 1,200 pounds and when in the released state shall supply no residual magnetism. All magnetic locks shall be equipped with built in surge protection and shall be held in place with tamper resistant mounting hardware.

.4 Electric strikes shall be of the fail-safe (or fail unlock) type. Each

strike shall be equipped with a surge suppression kit to ensure collapsing magnetic fields do not harm or interfere with the proper operation of the control panel. A minimum holding force of 1,400 pounds is required when the strike is in the locked position. The strike when installed shall operate in the same manner as the original mortise lock set.

.3 Exit Devices

The "trail" requirements of the system determine what exit devices are required:

.1 If an audit trail (entry/exit history) is required the exit device shall be the same as the installed entry device.

.2 If the audit trail is required for entry only, several types of exit devices may be employed.

Pushbutton: Request exit button, located next to the latched side of the door. The button shall be a laminated type, clearly marked "EXIT".

Key Switch: When a key switch is used to override a magnetic lock or electric strike a signal shall be sent to the control panel to indicate that the locking device has been manually bypassed. The keyway on the switch should be a high security keyway and weather resistant.

Pull Station: When an auxiliary pull station is required to override the locking device it will be painted blue to distinguish it from fire alarm devices. A sign must be placed above the pull station which reads "IN CASE OF EMERGENCY PULL TO RELEASE DOOR". All signage must meet university stated signage policy. The pull station shall be fitted with a set of double contacts. One set will signal the control panel that the station has been activated and the other will interrupt the power to the locking device.

.4 Signage

.1 When magnetic locks or other devices are used to impede egress, proper signage shall be posted. The sign shall clearly indicate the proper procedure for exiting through the locked door. All signage must meet university stated signage policy.

.2 When magnetic locking devices are used on doors released by fire alarm systems a sign which reads "EMERGENCY EXIT UNLOCKS BY FIRE ALARM" must be permanently mounted on the door. All signage must meet university stated signage policy.

.5 Interior Room Requirements

When an access control system is installed on an interior room a telephone must be made available in that room to ensure users have direct access to the Emergency Report Centre (ERC). The phone may be a direct dial (to the ERC) lift set or regular office type with a posted number. Queen's telephone service is provided under the direction of the Information Technology Services Department (ITS). All installations

must be coordinated and approved by ITS. The University's policy regarding the installation of telephones is to provide for the most flexible system possible. This is accomplished by providing conduit roughed in any and all office areas. The actual service installed in this conduit system will be determined later in the planning process.

.6 Card Readers

Readers shall be proximity type, 4 inch read, and mullion style.

Batteries

.1 Batteries shall be maintenance free, sealed, leak proof, gelled electrolyte, rechargeable

.2 14 amp-hour (minimum)

.7 Wiring

.1 All connecting wire used in the installation shall meet the original equipment manufacturers specification.

.2 All wire used in the installation shall meet all respective fire and safety codes.

.3 Each device wired to the control panel shall use an independent wire, which is free of joins and splices.

.4 Harshness of the environment will determine if conduit is required.

.8 Transformers

Shall be CSA approved and meet OEM specifications.

.2 Documentation

Shall include:

.1 Equipment list stating the type, catalogue number and quantity of each device installed / purchased including spares

.2 Manufacturer's operation, programming and maintenance manuals

.3 Accurate as-built floor plans showing the location of all devices and a complete wiring diagram illustrating the interconnection of all field devices, power source and monitoring devices.

.3 Maintenance

.1 It is the end user's responsibility to ensure that their Access Control Systems are maintained in good working order.

.2 Routine maintenance is imperative on any Access Control System to ensure that it is operating as it was originally intended. It is recommended that all systems should be serviced on a regular basis. The most economical way to ensure these tests are completed is for the user to enter into a service contract with a reputable alarm system contractor.

The service contract should include:

- Clean and test all entry and exit devices.
- Test back up battery.
- Check that all peripheral devices are in good working order.
- Ensure all zones that are programmed to report a signal and are functional.
- Check that all keypads are in good working order.
- Two programming changes per year (code changes).
- When the service is complete the end user should request a document stating the serviceability of the system.

In the event a user requires or requests work (non-warranty coverage) or upgrades to their existing system, a request in writing for system repair shall be completed by the user and sent to Physical Plant Services (PPS). The individual requesting the service will be financially responsible for any cost incurred due to the repair request. The aforementioned financial responsibility will be void if the request form indicates "Quote only".

.4 Training

The contractor shall include in their quote adequate training for the end user.

.5 Warranties

Installed parts: 3 years (minimum)
Card readers: 5 years (minimum)
Labour: 1 year (minimum)

26.900 Clocks

Independent clocks (not master/slave systems) shall be used. The operation and maintenance of clocks shall be the responsibility of the user.

26.901 Telephones

.1 Queen's telephone service is provided under the direction of the Information Technology Services department (ITS). All installations must be coordinated and approved by ITS.

.2 Voice and data signals are combined in the cable plant and are both processed through the Meridian SL-1 switch located centrally on campus.

.3 Most service points require only a single gang outlet box large enough for a 3 twisted-pair jacketed cable.

.4 The University's policy regarding the installation of telephones is to provide for the most flexible system possible. This is accomplished by providing conduit roughed in to any and all office areas. The actual service installed in this conduit system will be determined later in the planning process.

26.950 Motors and Controls

26.951 Motors

.1 All motors shall be of energy efficient design.

.2 All motors shall have life seal lubricant ball bearings.

.3 Motors up to but not including 3/4HP may be single phase 120V. However, fractional horsepower motors that are required to start and stop frequently shall be three phase.

.4 Division 15 (Mechanical) often provides motors for pumps, fans, air conditioners etc. The specifications for these motors and controls must be coordinated with Division 16 and meet all requirements of Division 16.

.5 Motors to be controlled by variable frequency drives shall be inverter-duty rated.

.6 All motorized equipment shall be designated with maintenance identification supplied by PPS maintenance.

.7 Documentation shall include motor nameplate data, catalogue cuts and specification sheets.

26.952 Variable Frequency Drives

.1 All VFD’s shall have a bypass option unless the application does not allow bypass operation.

.2 All VFD’s shall be BACnet compatible. However, start/stop, status (i.e. running), and speed signals to/from the VFD shall be hardwired.

.3 ABB is the preferred manufacturer of VFD’s. ABB ACH550 series drives shall be the standard.

26.953 Motor Starters

.1 Motor starters shall be NEMA rated.

.2 5kV motor starters shall be equipped with digital electrical metering as specified in section 26.242.5.

.3 All three phase motor starters must be equipped with protective devices that will disconnect the motor completely from the supply in the event of an overcurrent or sustained overload condition and prevent single phasing.

.4 Solid state motor starters shall have proper temperature, overcurrent and overvoltage protection included in the design. The starters shall be shipped with proper fuses installed. The fuses selected shall be based on actual tests of fuses in series with the semiconductors. Overvoltage protection shall be voltage breakover clamping inherent in the starter design.

.5 Documentation shall include manufacturer's catalogue data, shop drawings, manufacturer's replacement parts list, operation and maintenance data.

26.954 Motor Control Centres

.1 Motor control centres (MCC's) shall be complete with nameplates as per Queen's standard.

.2 MCC motor starters shall comply with section 26.953. Motor status shall be acquired using current switches and not by using auxiliary contacts.

.3 Preferred manufacturers are: Schneider (Square D), Siemens, Eaton (Cutler-Hammer), and Allen-Bradley.

.4 Documentation shall include manufacturer's catalogue data, shop drawings showing dimensions, equipment parts and catalogue numbers, complete manufacturer's wiring diagrams, engineering consultant's single line diagrams provided by the designer showing the interconnection with all control elements.

29.000 Construction Guidelines

29.001 Purpose

These guidelines and standards are published in order to help designers meet the objectives of the University in the preparation of their work.

Based on past experience, these guidelines and standards:

.1 Provide answers to questions most frequently asked by designers,

.2 Point out recurrent maintenance and users' problems,

.3 Pass on experience of satisfaction or dissatisfaction with various products,

.4 Seek to facilitate maintenance procedures and limit maintenance inventories,

.5 Outline definite University requirements both in contract procedure and standards of construction,

.6 Attempt to summarize the University's policy with regard to standards of accommodation in new projects.

The thrust of these documents is to be concerned more with utility than embellishment. The goal is to provide quality consistent with high reliability and low maintenance.

It is hoped that the designer will feel stimulated rather than restricted by these guidelines and building standards. It is also recognized that absolute adherence is not always advisable. However, the specifications should cover all items listed, and Physical Plant Services should be consulted regarding any deviations.

29.100 General Design Criteria

.1 Building Design

The design of a university building should enhance the learning and working environment for students, faculty and staff and create a positive presence within the Kingston community

.2 Building System Design

Systems required to be in these buildings shall be designed:

- To meet the requirements of the university.
- To minimize life cycle costs.
- To stay within budget.
- To minimize operating costs.
- To minimize energy requirements.

- To optimize maintainability of the building and its equipment.
- To allow easy modification in the future.

In all cases the design philosophy of each system shall be discussed with Engineering Personnel of Physical Plant Services before the detailed designs are carried out.

.3 Environment

Both building and systems designs shall incorporate measures to protect the environment as stated in Queen's Policy Statement on Environmental Management which is accessible at queensu.ca.

.4 Health and Safety

Building and systems designs shall incorporate measures to provide healthy and safe premises as stated in Queen's Policy Statement on Health and Safety which is accessible at queensu.ca.

.5 Accessibility

Queen's University is committed to facilitating the integration of persons with disabilities into the university community and accordingly has developed a series of preferred guidelines to be used for both new construction and retrofits. These guidelines, in many cases, exceed the minimum requirements of the Ontario Building Code. When the budget allows and when the University decides it is appropriate to implement the preferred measures, the design shall follow these published guidelines.

Further details on the accessibility guidelines are available from Queen's University Campus Planning and Development located in Rideau Building, 207 Stuart Street, Kingston, Ontario K7L 3N6, Telephone (613) 533-6827 or FAX (613) 533-2724.

.6 Smoking / Tobacco Products

Use of any tobacco products (smoking, chewing, etc.) is not permitted in any University building or Residence.

.7 Copyright Symbol

The various crests and marks of Queen's University may not be used in any manner, including artists variations without prior written authorization from the Office of the Dean of Student Affairs.

29.200 Construction Project Process

29.201 Goals

The three primary general goals of the University provide the context for campus physical development. (Qualities of a Queen's Education, Principal's Report, 1989-90)

.1 Commitment to exceptional quality in undergraduate and graduate programs.

.2 First-rate research and scholarship.

.3 Basic to Queen's purpose is service.

Accordingly, physical development of the campus requires "...a comprehensive approach to overall design, materials, facilities, construction standards..." reflecting year round use of the campus and its facilities. (Planning for Campus Development, supplement to Queen's Gazette, December 1987)

The report of the Task Force on Physical Resource Planning (Board of Trustees, May 1988) provides further guidance for the Construction Project Process. These excerpts illustrate the relationship between University goals and physical planning and development.

• "Queen's must choose to build high quality buildings which represent the best in contemporary design and construction, and that will add to the University's heritage."

• "The campus planning and development process must have as an integral part an effective interface with the users of the campus, the University community..."

• "… decision making can be improved and accelerated...by clarifying lines of authority and the loci of various decisions, and by attaining a higher competence and stronger focus in planning and development matters in the administration."

• "Aesthetic quality in a building or landscape is not an "add-on" or a "frill"."

The procedure sets out the flow of reviews and points of decisions for the planning and implementation of building and grounds construction projects on campus. Appropriate input and adequate time are required for the process to function properly. It takes into account the concerns identified by the Task Force and is intended:

• To clarify the administrative systems and the role of various participants in the campus planning and development process; and to improve coordination and consultation with constituencies inside and outside the University.

29.202 Procedures

.1 INITIATE REQUEST

.1 Proposals, except for minor changes of less than $2,000, must be endorsed by a V.P., Dean or department heads. Proposals for projects are sent to the Construction Manager, Physical Plant Services (PPS). Campus Planning and

Development (CPD), PPS staff and service groups are available for consultation if required for proposal preparation.

Projects may include:

- Renovation to meet user requirements.
- Replacement or upgrade of building systems equipment.
- Upgrade or renewal of facilities to comply with code changes and other regulatory requirements.
- Expansion of existing programs into new space.
- New initiatives.
- Changes to exterior space.

.2 On receipt of a proposal the Construction Manager has it recorded in a computer file and assigns a project manager. The Architectural Planner in Campus Planning and Development (CPD) receives a copy of the computer file and details of user requirements for projects having architectural, space use, or landscape implications or changes. The Construction Manager returns requests which are not consistent with University campus development plans to the sender without an estimate. A minimum of 10 working days is required for review and response.

.2 COST ESTIMATE (Stage I)

.1 The Project Manager consults with the user to review the program, develop a scope of work and prepare diagrams which help describe the project. Other specialists (see Part IV - Service Groups and Responsibilities) add their comments on conformity with long range plans, general approach and specific design. The Project Manager prepares an initial (stage 1) cost estimate for the project to help the user set priorities and identify funding sources. The estimate describes the scope of work, quantities involved, quality expectations, and standards of workmanship. It may also include assumptions or uncertainties which affect the estimate.

.2 The estimate is normally prepared within three weeks of receipt of the request. The Stage 1 estimate goes to a coordinating group of PPS Project managers and service department representatives for system wide review and standards check. The Project Manager then sends the cost estimate back to the initiating group and awaits further instructions.

.3 ADMINISTRATIVE REVIEW

.1 Funding Available - the initiating department, when it has the funds for the project, requests authority to proceed from its dean and the appropriate approval group (see Part III - Approval Policy and Committee Structure)

.3 Funding Required - the dean or V.P. provides both approval in principle and planning funds, or denies the request, or recommends to the V.P. Operations and Finance (O&F) that the request be included in the capital project budget review.

.5 The V.P. (O&F) prepares a list of projects for budget review. The principal, vice principals and deans consider the list at one of their regular meetings, normally in November, to set institutional priorities and approve projects for funding. The approval is confirmed by memorandum or by transfer of funds to the project.

.4 DESIGN DEVELOPMENT (Sketch Plans or Schematics)

.1 The Project Manager works with the architect, consultants and Building Committee to prepare sketch plans for major projects. The Project Manager may also have to coordinate the preparation of sketch plans for minor projects where scale of the project, changes in space use, or specialized program requirements require careful monitoring of specialist consultant's work. Other small scale minor projects do not normally require sketch plan preparation and review, in which case the Project Managers work directly with a user group and service groups on an informal basis to prepare and review plans.

.2 In all projects, users have input into the design work done by the architect or consultant, CPD or PPS. During design development, the review process coordinated by the Project Manager is continuous and involves CPD, service departments, users, and regulatory agencies as appropriate to ensure that plans meet the program objectives, University standards and guidelines, and applicable legislation or code requirements. CPD is consulted in changes of scope. The Project Manager informs service groups and user representatives when sketch plans will be ready for final review and allows enough time for proper review (minimum 5 working days). Each group is responsible for prompt review to ensure the design proposal addresses its concerns. Acceptance is formally noted by all parties signing a file copy of the plans. For major projects signing off a design basis memorandum prepared by the consultants in consultation with the "owner" also indicates formal acceptance. The Project Manager confirms the scope of work is still within budget.

.3 The Campus Planning and Development Committee (CPDC) must be advised of projects involving external changes, space changes or projects over $1 Million. At the discretion of the V.P. (O&F), other projects may be forwarded to the CPDC for approval or information before tender.

.5 WORKING DRAWINGS REVIEW

The Project Manager informs service groups, external agencies and user representatives in advance when working drawings will be ready for formal review and allows enough time for proper review (minimum 5 working days). Each group is responsible for a prompt review to ensure the drawings and specifications meet program requirements and codes. For renovation projects, the Project Manager should ensure that users in adjacent space are consulted in evaluating the impact of the renovation on their activities. Acceptance is formally noted by all parties signing a file copy of the plans which is kept in PPS.

.6 DETAILED COST ESTIMATE

On major projects, the Project Manager or architect submits the plans to a quantity surveyor for a detailed cost estimate. For minor projects the Project Manager prepares a detailed cost estimate. On all projects the Project Manager verifies the estimate is within budget to ensure the scope of the project is achievable

.7 TENDER (Stage II Estimate)

For tenders greater than $100,000, SPS manages the tender. For tenders less than $100,000, the Project Manager tenders the project. The tendered prices represent the most accurate level of cost estimate. If authorized funding is not adequate, the Project Manager reviews the scope of the project initially stated in Step 2 and further refined by Step 5. Modification to the scope requires internal review, including consultation with user and service groups.

.8 AWARD

For tenders greater than $100,000, SPS communicates the award of the project. For tenders less than $100,000, there are no procedures that must be followed. An email to the winning recipient is suffice.

.9 CONSTRUCTION (Stage III)

.1 The Project Manager is responsible for quality control and for keeping the project on time and on budget. For renovations or additions the Project Manager works with deans and department heads to inform all occupants in the affected building of disruptions due to construction activities. The Project Manager oversees the work of the contractor to ensure it is done according to specifications and University standards of workmanship. Service departments advise the Project Manager on standards relevant to their responsibility. Service department staff may review work in the field with the Project Manager as required.

.2 Most projects require some on-site adjustments to the plans. The Project Manager consults with the Architectural Planner (CPD) about visible changes such as finish, material, detail, furnishings, fixtures and layout. Unless by prior mutual agreement, the Architectural Planner normally

provides input on the changes within 24 hours. The Project Manager will also inform service departments about changes which affect their operations. At the discretion of the Project Manager, users are advised of significant changes. Unless by prior mutual agreement, the normal time for response is 24 hours.

.10 COMMISSIONING

.1 For all projects, the Project Manager works with the contractor to demonstrate to Queen's service groups that building systems (heating, mechanical, electrical, access, etc.) function as specified, to explain the design philosophy and performance targets of the system, and to provide an agreed level of documentation and training to Queen's staff. The extent of the commissioning is commensurate with the scope of the project, ranging from simple acceptance of smaller projects to full verification, documentation and training for major projects.

.2 The Project Manager tours the project with the contractor, users and service groups to review and accept if the work meets project specifications. The acceptance process includes preparing a list of and correcting all deficiencies.

.3 The Project Manager arranges for clean up by the contractor, building inspection, turning on utilities to ready the project for use and notifies service groups to provide services (e.g. telephone, computer hook-up, security, access, housekeeping, etc.) prior to move in.

.11 MOVE IN

Purchasing and Space Planning and Management plan and implement the move with the user.

.12 EVALUATION AND RECORD UPDATE (Stage IV)

After move-in the Project Manager and service department staff seek user comments about the finished project and make appropriate adjustments to University procedures, standards, and specifications for future projects. Staff from service departments update inventory and building system data files, e.g. drawings, fire, safety, telephone, signs, campus maps and directories, etc. Any remaining deficiencies are corrected.

.13 COMPLETION (Stage V)

Once all deficiencies and outstanding items are resolved, PPS staff complete payments on all aspects of the project and the project accounts are closed out.

29.203 *Definitions*

Building Committee is a project planning committee established by and reporting to the Vice Principal (Operations & Finance) to review the work of the architect or consultants for a large scale (major) project. It is made up of users and service department staff. For details refer to Part III - Approval Policy and Committee Structure.

Building Standards are a collection of detailed requirements developed by service groups and maintained by Physical Plant Services to be used by the design team for design development and contract documents of major or minor projects. The requirements are subject to periodic updates based on project evaluation (step 12 in the Construction Project Process), changes in policy, technology etc.

Building Systems a general term referring to various systems used to provide utility and other services to the building, including heating, mechanical (air supply and exhaust), plumbing, electrical, access (keys).

Code is an act passed by the Provincial or Federal governments setting out rules and regulations for safe construction and occupancy. The Building Code and Fire Safety Code are most frequently referred to and provide detailed requirements for various elements of building construction.

Consultants are specialists contracted by the University to provide expert advice and resources for particular aspects of projects. They include architects, consulting engineers, landscape architects, planners and other specialists.

Design Basis Memorandum is a formal compilation of information at the end of the design development stage. It consists of outline specifications and drawings to adequately describe the building systems. It provides the design development team a basis to proceed to working drawings and the University administration an understanding of what is specifically being developed.

Estimates specify anticipated expenses for a project based on the scope and requirements of the project. Estimate accuracy improves as the project proceeds and more detail is available. At all stages the estimate shall reflect University standards of practice and quality.

Major Project is a project which requires formal review at executive levels in the University on the basis of the characteristics described in Part III, including:

- Budget exceeding $500,000.
- Major siting implications.
- Impact on multiple departments.
- Extensive changes in space use.

Minor Project is a project which requires routine review and approval at operational levels within the University. Projects which qualify are described in Part III, including:

- Budget less than $500,000.
- No major siting requirements.
- Impact on a single department or function.

Program describes the requirements for the building or facilities to be resolved in the project. The program covers functions to be served in the facility, number of occupants, space standards, equipment needs and service requirements. The priority of each function and affinity relationship between functions are also identified.

Project Manager is the job title for the staff person in Physical Plant Services who has responsibility for the design, coordination, estimation and implementation of projects. One person is normally assigned for all stages of each project although PPS may make staff changes as circumstances require.

Scope of Work is an outline of program, services and outcome required to complete a project.

Sketch Plans are simple line drawings which illustrate how activity areas and infrastructure fit into a building or exterior space. They translate a functional program into two - and three-dimensional physical forms.

User Group is a project planning committee convened by the Project Manager for small scale (minor) projects that advises the Project Manager during a project. It is similar to the Building Committee but is an informal group made up of users and service department staff. For details refer to Part III - Approval Policy and Committee Structure.

Working Drawings include all architectural, landscape and engineering plans, details and specifications forming the contract documents to instruct contractors in the construction of the project. Contract documents are required for tendering of all projects.

29.204 Approval Policy & Committee Structure

.1 Approval Policy

.1 A forerunner to the following policies was developed in the spring of 1990 to establish procedures for construction projects on University property with respect to project approval, architect/design consultant selection, tendering and execution of construction contracts.

.2 This approval policy and committee structure is in accordance with the "Construction Project Approval" (May 1994) approved by the Board of Trustees. This policy is reviewed every 3 years. The official document can be obtained from clarification.

.3 The role of the Finance Committee with respect to project funding approval is clearly defined in more general financial policies. As well, all projects to be funded by restricted funds (Provincial Government Renovations Fund or Provincial Government Special Programs Fund) are subject to prior review by the funding agency.

.4 The present practice with respect to projects entailing: 1) the creation of new space; 2) a change in configuration or use of existing space; or 3) grounds, requires the review and approval of the Campus Planning and Development Committee (CPDC).

.5 As a proposal for expansion or renovation proceeds through the construction project process, the bodies or their representatives that will be involved are as follows:

.1 Campus Planning and Development (CPD)

.2 Physical Plant Services (PPS);

.3 Vice Principal (Operations and Finance) (V.P. O&F);

.4 Campus Planning and Development Committee (CPDC).

.6 For the purpose of tender-opening, a Users' Committee may be involved.

.2 Architect/Design Consultant Selection

Dependent upon estimates of project costs, the selection of architects or design consultants will be the responsibility of the following:

- up to $100,000 - PPS
- $100,000 to $1,000,000 - VP(O&F)
- $1,000,000 or more - CPDC

.3 Tendering

.1 Procurement Methods

.1 Four types of procurement methods are in general use in the construction industry:

1) design/build
2) construction management
3) stipulated price bids
4) cost-plus

.2 Unless prior approval is obtained from the VP (O&F), all projects costing over $10,000 will be subject to competitive price processes (types (1), (2) or (3)).

.3 All quotes must be in writing.

.2 Tendering Protocol

Queen's University invites tenders from specific contractors. Contractors are selected to bid on projects based on the complexity and scale of the project, previous work done at Queen's by the contractor or by a prequalification process. The tender package includes a set of working drawings signed off by the users. The Tendering Subcommittee (outlined below) and the architect or consultant review the tender documents to ensure conformity to tendering protocol. Bids which are properly tendered are ranked according to price and the low bid, if it is within budget, is normally awarded.

.3 Tendering Subcommittees

.1 Contracts of less than $1,000,000

i. Tenders for contracts of less than $1,000,000 will be received by the Construction Manager of PPS who will arrange for an appropriate meeting place and will notify the members of the Tendering Subcommittees of the time and place for the opening of tenders.

ii. The Project Manager shall be present and act as secretary for the tender opening process.

.2 Contracts of $1,000,000 or more

i. Tenders for contracts of $1,000,000 or more will be received by the Secretary of the University who will arrange for an appropriate meeting place and will notify the members of the Tendering Subcommittee of the time and place for the opening of tenders.

ii. The Secretary of the University shall be present and act as secretary for the tender opening process.

.4 Advisors

.1 Other persons, such as the Legal Advisor to the University and/or Architect/Consultant Representatives, may be invited to attend any tender opening as advisors.

.5 Composition of Tendering Subcommittees

Tendering Subcommittees for individual projects will comprise the following:

1) up to $250,000 - Construction Manager (PPS) and Project Manager (PPS)
2) $250,000 to $1,000,000 - Director (PPS) Construction Manager (PPS) and User Committee representative
3) $1,000,000 or more – VP (O&F) Director (PPS) and User Committee representative

.4 Execution of Contracts

.1 Signing authority on behalf of the University for Construction Contracts shall be as follows:

.1 Up to $250,000 - Construction Manager (PPS)

.2 $250,000 to $500,000 - Director (PPS)

.3 $500,000 to $1,000,000 - VP Operations & Finance

.4 More than $1,000,000 – VP Operations & Finance and Secretary of the University

(The following text is not part of the approval policy dated May 1990)

.5 Project Planning Committees

Project planning committees (Building Committee and Users' Group) are established to assist the Project Manager and consultants in the detailed planning for projects. The membership of the committee is made up of a cross section of users and service department staff with experience which is relevant to the project. Major projects require a Building Committee. Most minor projects have a Users Group. In some cases a Building Committee may be struck for a minor project.

.6 Building Committee

.1 The Building Committee is established by and reports to the Vice Principal (Operations and Finance). The Building Committee reviews the work of the architect or consultant for a project.

.2 Building Committee Membership

V.P. (O&F) or delegate
Project Manager (minutes)
Representative from CPD
Representative from other service groups
Representatives from users
Architect/consultant
Chair designated by V.P. (O&F)

.3 Building Committee Mandate

- Refines user program and incorporate campus wide concerns into project requirements.
- Advises architect to ensure project meets program requirements and conforms to guidelines and standards.
- Reviews and accepts sketch plans.
- Reviews and accepts working drawings.

.7 User Group

.1 The User Group is convened by the Project Manager. It is similar to the Building Committee and reviews the work of the Project Manager for smaller scale projects.

.2 User Group Membership

Project Manager (minutes)
Architectural Planner from CPD for architectural changes, external projects
Representative from other service groups
Representative from users
Architect/consultant (if required)

.3 User Group Mandate

- Refines user program and incorporates campus wide concerns into project requirements.
- Works with the design team (PPS and CPD) to ensure the project meets program requirements and conforms to guidelines and standards.
- Advises the department or authorized agent on cost/benefits of project.
- Reviews and accepts working drawings.

29.210 Service Groups and Responsibilities

29.211 Internal to Queen's

Department	Responsibility
1) Physical Plant Services	**Engineering design** – Codes & standards compliance – Building science review – Mechanical Services – Electrical – Structural/architectural **Housekeeping standards** – Floor covering – Washroom fixtures – Caretaker closets **Utilities management** – Central heating plant – Distribution systems **Maintenance systems** – Operation of building system

	– Repair/Replacement of fabric and building equipment **Project estimates** **Project management** **Waste management**
2) Campus Planning & Development (Space Planning & Management)	**Campus wide system review** **Circulation and parking** – Exterior and interior public spaces – Landscaping, site furnishing – Lighting – Signage system – Gifts and memorials – Materials and finishes **Accommodation standards** – Space use guidelines – Functional analysis – Space programs **Architectural layouts and design** – Furniture and fixtures – Exterior and interior detail and finishes – Room numbering **Departmental moves**
3) Computing and Communication Services	**Computing equipment and services** **Emergency assistance devices** **Telephones**
4) Graphic Design	**Sign design**
5) Investments & Insurance	**Project insurance**
6) Environmental Health & Safety	**Personnel safety** **Fire protection & safety** **Hazardous materials**
7) Purchasing	**Acquisition of furniture and equipment** **Bids for service contracts (moves)** **Delivery systems (mail, supplies)**

8) Security & Parking Services	**Access control system (keys)** **Security and safety** **Parking implications**
9) Special Needs Office	**Accessibility** **Washroom location and design** **Entrance ramp and door design** **Other requirements, e.g., braille signs, hearing assistance systems**

29.212 *External to Queen's*

Agency	Responsibility
1) City of Kingston	**Zoning Bylaw** **Occupancy permit** **Site Plan Control** **Building Permit** **Building Inspection** **Streets, sewers** **Fire Protection & Safety**
2) Public Utilities Commission	**Electricity** **Gas** **Transit** **Water**
3) Local Architectural Conservation Advisory Committee (L.A.C.A.C.)	**Preservation of designated properties**
4) Ministry of the Environment	**Approval for handling of hazardous materials and waste systems**
5) Ministry of Labour	**Approval for safety of:** – Construction site – Occupied space

6) Ministry of Consumer and Commercial Relations — **Steam/pressure vessels**
Elevators, lifts

29.300 Accommodation Requirements

29.301 Introduction

.1 The objective of this section is to present a set of accommodation standards which will ensure that suitable facilities are provided for students, faculty and staff to meet current and future requirements.

.2 While these standards are by no means exhaustive, they provide a basis from which to commence project design.

.3 For additional information on specifications, please refer to Campus Planning & Development.

29.302 Instructional Spaces (Classrooms/Lecture Theatres)

.1 Classrooms are general spaces designed for effective and efficient transfer of information between a presenter and an audience. The whole room establishes a suitable environment for this transfer to occur, considering the needs of both the presenter and the audience. General criteria for the design of classrooms are outlined below.

.2 The criteria outlined here in point form are taken from a more detailed publication (Design Of General Purpose Classrooms And Lecture Halls, Robert L. Allen, Penn State University, 1991) written in collaboration with colleagues from other universities. This publication contains an excellent description of requirements for a teaching environment and is available at the office of Campus Planning and Development.

.1 Location and Space

- Classrooms should be concentrated on the lower floors of buildings and should be located away from noise-generating activities. When the classroom is tiered there shall be an entrance at the lower level to accommodate handicapped access for both students and instructors.
- The ideal classroom dimension is length equals one and one-half times width. The instructor should be located on the narrow end of the room at the opposite end of the entrance(s).

.2 Windows

- Windows should be provided, however the ability to provide blackout capability for AV projection is required. Wherever possible

the blackout blinds should be motorized and controlled from the main lectern. If there is a major noise potential from the exterior area around the building the windows may be eliminated however extra care must be given to the interior decoration to compensate for the lack of windows.

.3 Finishes

- In general classrooms should be painted with a light colour and the finish should be sufficiently durable to withstand washing. (For colour specification and approval please contact Campus Planning and Development.)

.4 Floors

- Floors should be one of the following: vinyl, linoleum, rubber, epoxy paint, with a non-slip surface on stairs. Carpeting should be used only in special circumstances as it is difficult to maintain.
- The colour of the floor should be medium to light and should contain a subdued pattern or fleck to minimize the monotony and improve the overall maintenance quality.
- There should be a 4" vinyl cove base installed to all walls.

.5 Walls

- All wall surfaces shall be washable.
- Wall finishes should be chosen with appropriate acoustical characteristics.
- Walls should have a Sound Transmission Coefficient (STC) rating of no less than 50.
- Sound levels generated from mechanical systems or other ambient noise must have a Noise Criterion (NC) rating of no more than 35.
- All walls shall extend to the floor above and not stop at the ceiling.
- Accent colours or design elements should be chosen carefully so as not to overpower the room.

.6 Ceiling

- The ceiling should be a light colour and of non-reflective material.
- Special emphasis should be placed on the acoustic properties of the ceiling to minimize echo in the room.

.7 Lighting and Lighting Control

- All lighting controls shall be kept simple. (See also Div. 16 Section 500)
- All lights should be dimmable fluorescent with controls at the main lectern or adjacent to the main entrance.
- Lighting levels should achieve 500 - 700 lux at each writing surface and should be reducible to 50-100 lux.

- Provide highly concentrated, high level, evenly distributed illumination on the blackboards or whiteboards.

.8 Electrical Services

- All electrical services should be protected from surges and spikes.
- Each room should have at least one dedicated circuit not shared with any other room.
- New construction or major renovations should provide for a recommended
- 40% future increase in the need for electrical requirements.
- The number of receptacles will depend in part on the specific requirements of the room, however, as a minimum the following number of outlets should be provided:

rooms under 50 occupants	– single duplex on each side of the room
	– one funplex in the centre of the rear wall
	– one fourplex in the centre of the front wall
	– one duplex in the lectern
	– one duplex in each of the front corners.
rooms over 50 occupants	– two duplex outlets on each side of the room
	– two fourplex outlets evenly spaced on the rear wall
	– three fourplex outlets evenly space on the front wall
	– one duplex in the lectern

.9 Telecommunications

- Provision should be made for voice, data and video feed for each classroom.
- The following number of outlets should be provided:
  - one voice, data and video feed at the front of the classroom
  - one voice, data and video feed in the lectern
  - one data feed at the rear of the classroom

.10 Audio/Visual equipment

- Specifics regarding the supply and installation of audio/visual equipment will be determined in conjunction with the Communications Department and Campus Planning and Development.

.11 Furniture

- Specifications for furniture shall be reviewed with Campus Planning and Development.

29.303 Laboratories

.1 Laboratories are specialized spaces which have "built in" equipment and services making them unsuitable for other uses. Labs can be characterized as wet (e.g., chemistry, biology, medicine) or dry (e.g., physics, electrical, art, music), high bench (stand to work) or low bench (sit to work) and as high, medium or low service.

.2 Laboratory work may involve the use of hazardous substances or methods which can put at risk the investigator and other lab workers or support staff (caretakers, building occupants). There are code requirements issued by national or provincial agencies which provide more specific regulations than the building code to ensure the safety of workers. Design of laboratories must meet these specialized requirements in a manner which allows for future changes in the use of the lab.

.1 Teaching laboratories provide space for practical instruction of groups of students. The layout of the lab, the area per work station and the inclusion of specialized features depends on the nature of the discipline. Lab standards are measured in general terms such as area per station or area per lab contact hour, where these factors represent overall space estimates. Service space (store room, instrument rooms, etc.) is included. A range of values apply depending on the specific type of lab being developed. (Please refer to Campus Planning and Development for further details.)

.2 Research laboratories provide space for specialized investigation of physical phenomena. The characteristics of the space change depending on the nature of the research and equipment or special conditions (HVAC, fumes, and hazardous substances). Research labs should be of a generic design so as to accommodate changing research needs. Individual researchers then have the basis for a variety of equipment layouts and specific laboratory functions. The lab standards are measured in general terms as area per primary investigator, bench space per lab researcher or area per work station where the range of values change depending on the nature of the investigative work. (Please refer to Campus Planning and Development for further details.)

29.304 Offices

.1 Offices are general work spaces assigned on a continuing basis for individuals and small groups of individuals. The room contains office type equipment including microcomputers. Offices are the largest category of space on campus and need to be designed for effective use in a variety of furniture and equipment layouts.

.2 Standard Office:

- Minimum area – 12 m^2
- Minimum width clearance between walls including internal protrusions - 2.5 m
- External window
- Duplex on each side wall 0.5 m up from floor - service feed from outside wall
- Telephone and data receptacle on one wall .5m up from floor
- Shape - suitable for up to 4 standard desks when used as graduate student work spaces
- No internal closets
- Door offset to side wall

.3 Office Furniture Supplies

Preferred Vendors are:

.1 Calstone Inc. 415 Finchdene Square Scarborough, Ontario M1X 1D7, and can be ordered through:

Parkhouse Office Furniture

2720 Queensview Drive

Suite 1166

Ottawa, Ontario K2B 1A5 (613)820-8289

.2 Woodlore International Inc. 6160 Netherhart Road, Unit 21, Mississauga, Ontario, and can be ordered through:

Grafton House

P.O. Box 1045

Cobourg, Ontario K9A 4W5 (905)349-2923

29.305 Libraries

.1 Library space is designed for acquisition storage, study, circulation of books and magazines or other published materials; tapes, CD's, etc., under the administration of the library system.

.2 Although the space is general purpose in that it is lightly serviced office space, some specific standards must be considered:

.1 Floor Structure

- To support book shelf units (stacks).

.2 Structural Grid

- Distance between obstructions such that a multiple of shelf units fit in between,
- Suitable to adapt to new uses.

.3 Air Controls

- suitable for long range storage of materials in a stable environment,
- Adjusts to a variety of user loads as facilities are used for study purposes.

.4 Layout

- Should facilitate ease of movement in and out of the building, and to various services once inside.

.5 User Space

- Reading areas should provide a variety of study environments.

.6 Windows

- Should filter out ultraviolet rays,
- Consider impact on air conditioning and heat control system.

.7 Security

- The building should be designed with personal safety in mind, as well as security for the materials and collections.

29.306 Other Spaces

.1 Universities are often communities within a community, and thus offer many of the services associated with communities, e.g., recreation space, food services, lounge areas, commercial outlets, etc. Each of these services is specialized in nature, and is subject to a variety of constraints and controls regarding construction and operation. Details about these aspects should be contained in the space program document describing the project.

.2 Service space requirements may vary from building to building; however, the following general criteria should be included in all building designs.

.1 Communication Services requires a receiving and distribution room of approximately 9 m^2 as well as a closet on each floor for the termination and distribution of all voice, data and video cabling requirements. This closet is best centrally located and vertically stacked for ease of wiring. Closet size should not be less than .6m deep and 1.2 m wide, accessible from the public corridor.

.2 Custodial Services requires a minimum of:

- One supply and equipment room of approx. 22 m^2 per building
- One janitorial closet of approx. 6 m^2 on each floor with mop sink.
- Shelves and racks for supplies and equipment will be required in each of these rooms.

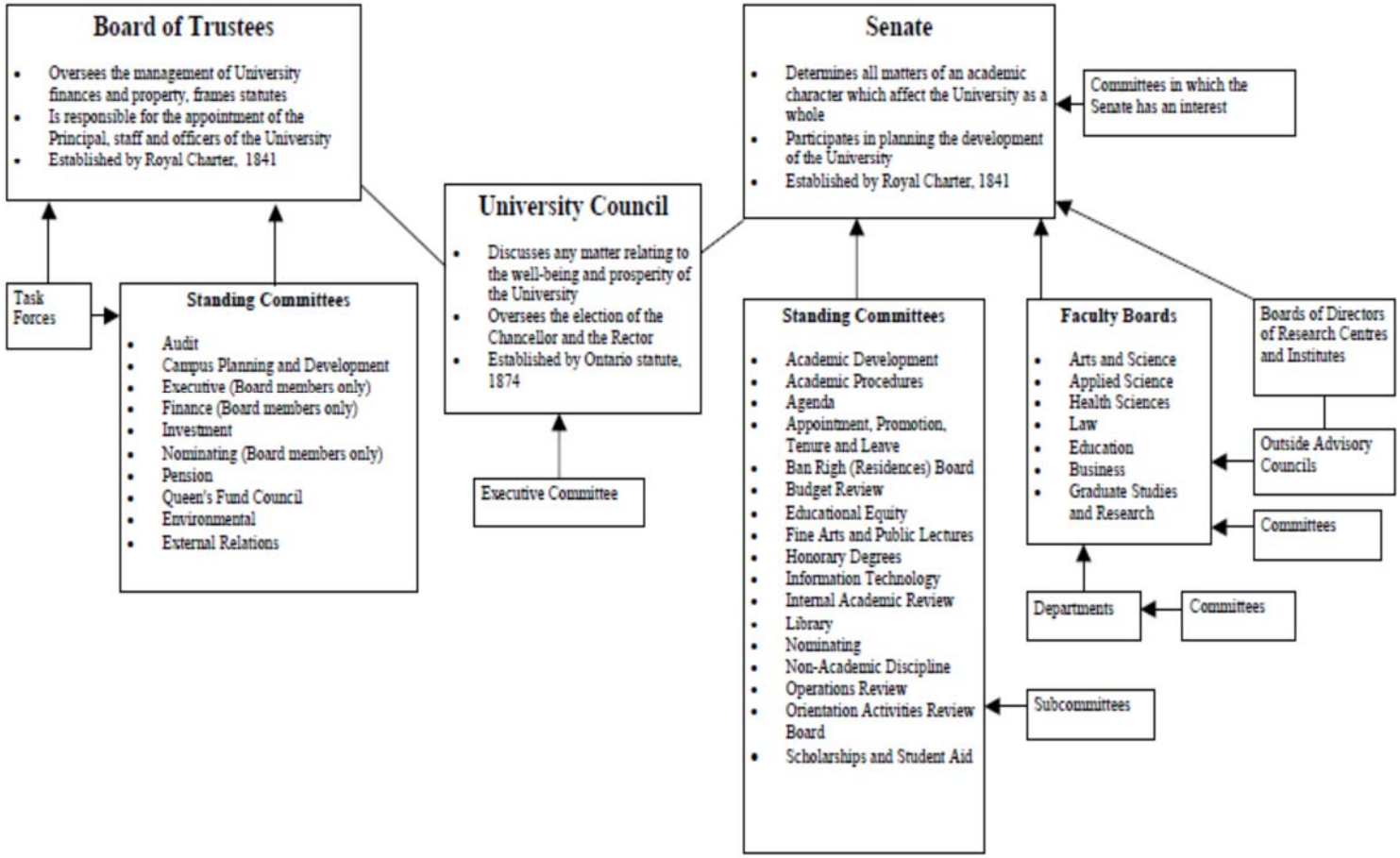
.3 Space requirements for mechanical and electrical equipment are outlined in Divisions 15 and 16 of the standards. Specific requirements will evolve with each building design.

.3 Additional information about these guidelines or any other related aspect of architectural planning is available from:

Campus Planning and Development
Queen's University Rideau Building Kingston, Ontario K7L 3N6
Telephone: 613-533-6827
FAX: 613-533-2724

29.400 *Section E* *The Governance of Queen's University*

THE GOVERNANCE OF QUEEN'S UNIVERSITY



29.500 *Section F* *Campus Maps*

.1 Campus maps are available at Queensu.ca or from the PPS CAD department.

29.600 *Section G* *Buildings and Structures – Reference Numbers*

.1 Building reference numbers are available from the PPS CAD department.

29.700 *Section H* *Designated Heritage Buildings*

BUILDINGS RECOMMENDED FOR DESIGNATION IN QUEEN'S UNIVERSITY MAIN CAMPUS AREA

.1 **OLD MEDICAL BUILDING** **Historic and Architectural Significance**
Built in 1859 to plans by architect Thomas R.P. Power, this building was called the College Building until 1880. Storeys have been added and removed, the interior altered but the symmetry of the facade has been maintained with the central entrance its fanlight, sidelights and double doors.

.2 **THEOLOGY HALL** **Historic and Architectural Significance**
Queen's third building erected in 1879 - 1880 to plans by Gordon and Helliwell, was for many years called "The College". All administration offices were in this building for 44 years and the semi-circular end housed the library until the Douglas Library was opened in 1924. Convocation Hall was the first large public meeting hall.

The monumental entrance is set in the central four storey tower which rises to smaller towers topped by pinnacles. On either side of the central tower are two storey sections with two and a half storey gable roofed sections at the corners. The symmetry of the facade is maintained while the shape of windows differ, square headed on the first storey, rounded arched on the second, strong courses following the window shapes give horizontal emphasis to balance the vertical aspect of the building.

The circular, west end has a truncated hip roof with four gabled projections interrupting the roof edge. The most notable feature of the north side is a large round stained glass window in the gable end of Convocation Hall. Theological Hall's combination of tower, buttresses, pellet moulding, ashlar string courses and variety in roof line and window shape makes this large building an important architectural feature of the campus.

.3 **CARRUTHERS HALL** **Historic and Architectural Significance**
John Bell Carruthers, a wealthy Kingston merchant gave the money in 1890 for a building to house the Ontario School of Mining and Agriculture. In 1894 Queen's established a Faculty of Practical Science; in 1897 the School of Mining

affiliated with Queen's. Architects Gillen and Gillen designed the building with a symmetrical facade, the central entrance set well inside a projecting section which rises to a gable roof. The combination of flat arched windows in one storey, round arched in another and string courses plus large dormers are architectural features.

.4 **FLEMING HALL** **Historic and Architectural Significance**
Built in 1902-04 to plans by W.L. Symons, rebuilt after the 1933 fire, the architect being Colin Drever, who also designed an addition in 1964. Named in honour of Sir Sanford Fleming the building is three storeys with two storey wings, all with flat roofs. The central entrance is recessed under a large round arch, all windows in the original building are flat arched with transoms, and the 1933 additional storeys have round arched fanlights. At the rear the addition is attached at the second floor level.

.5 **ONTARIO HALL** **Historic and Architectural Significance**
Built 1902-03, Architects Symons and Rae, this was a gift from the Ontario government. The front of the building is almost symmetrical. Twin flights of stairs curve up to the triple arched porch protecting a double door, fanlighted entrance. On each side of the wide porch are tall square towers with buttressed corners and high conical roofs. Beyond the towers are broad gabled projections. The south side has a huge fanlight over five tall windows. At the rear two wings with entrances enclose a courtyard. The building has buttressed corners, string courses, corbel tables, dentilled cornices and a variety of window shapes.

.6 **KINGSTON HALL** **Historic and Architectural Significance**
Symons and Rae designed this 1901-03 building which was a gift from the City of Kingston. The main facade is symmetrical with projecting gable roofed wings at each end with one and a half storey buttresses. The central entrance, double doors with side lights and a huge fanlight are set inside compound arches in a two storey, hip roofed projection. All first floor windows are flat arched in the wings. The west end abutting Grant Hall has a two storey angled bay. The most notable feature of the north side is a large two storey round arched, glassed section which contains a double door, side lighted entrance and huge fanlight.

.7 **GRANT HALL** **Historic and Architectural Significance**
Named in honour of Principal G.M. Grant this 1902-04 building was also designed by Symons and Rae. The most dominant feature is the tall, square clock tower at its southwest corner. The pyramidal roof of the tower rises above other buildings. The main, gabled roofed section of grant Hall has four pairs of round arched, stained glass windows set under round arches with a tracery plate set in the spandrel above the pairs of windows. A moulded string course above these windows is the base for triple windows set between pilasters and topped by a corbel table. The north, gable end of Grant Hall is flanked by small square towers. The east side has the same window arrangement as the west. The inner campus entrance is like the western entrance in the base of the tower.

.8 **KATHLEEN RYAN HALL** **Historic and Architectural Significance**

(Former New Medical Building) Built 1907, Architects Power and Son, this building was financed by a grant from the Ontario government to aid medical education at Queen's. In 1982 the building underwent extensive alteration to fit it for a modern archives facility. Today it houses the archives of Queen's, of the City of Kingston, of Kingston General Hospital, plus collections of provincial and national importance. The double doored entrance and transom are recessed under a flat keystoned arch in the central projecting section which rises to a large dentilled pediment. Above the entrance is a large window flanked by narrow ones; the whole topped by a large fanlight. The window arrangements are three with transom lights set under flat arches with voussoirs.

.9 **CRAINE BUILDING** **Architectural Significance**
Dr. Agnes Douglas Craine, an 1888 graduate of Queen's Women's Medical College gave money for this 1938 building, designed by Colin Drever, for biochemistry. This completely symmetrical building four storeys high has panels of ashlar at the base of each window set between pilasters of hammer dressed limestone. The capitals of the pilasters support an entablature under a strong moulded cornice. The fourth floor rises above this to a flat roof. There are central entrances on both the east and west side. That on the west has a plaque bearing the name and date of the building. Window arrangements are duplicated in the east side of the building.

.10 **JACKSON HALL** **Historic Significance**
This 1906 building, designed by Profs. Kirkpatrick and Macphail, was the gymnasium and swimming pool. When the new gymnasium on Union Street opened in 1930, this building became the home of the Department of Hydraulic Engineering. In 1959 a new top floor was added, designed by architect Logan Gallagher. The flat roofed top floor is marked by a string course and the arrangement of windows matches that in the old building. The west, main facade is divided into three sections by pilasters which rise from the wide stone stairs. The central, double door, fanlighted entrance is flanked by two round arches windows. The sides and rear of the building are also divided into sections by pilasters.

.11 **GORDON HALL** **Architectural Significance**
Built in 1910 designed by architects Power and Son and altered in 1963 with the addition of a top floor this building was named in honour of Principal D.M. Gordon. The street facade is symmetrical; the central fanlighted entrance is set inside a large round arch in a central projection. Pairs of windows are set between buttresses, the windows have flat arches and transom lights. The top, flat roofed storey duplicates the placement of windows in the original building.

.12 **NICOL HALL** **Historic and Architectural Significance** Built in 1911 to designs by Joseph W. Power, the building was named for Prof. William Nicol who gave half the cost of the building. The 1930 and 1961 additions have not altered the Union Street facade. The central entrance with segmental arched fanlight is in a central a projection which rises to a large gabled dormer. All corners have heavy buttresses, windows have transoms and the main gable roof has parapetted end walls. Some windows have dripstone moulds.

.13 **DOUGLAS LIBRARY** **Historic and Architectural Significance**
Built in 1924 to designs by Shepard and Calvin and named for Chancellor James Douglas, the Library had a major addition in 1965, designed by Mathers and Haldenby, which more than doubled the stack space. In 1990 plans were started for a new, additional library building. The most notable architectural features of the Douglas Library are the large tower on the east side and the great gothic arched, mullioned and stained glass windows in the gable ends at the south and west which light the reading rooms. There are corner buttresses, slender buttresses between groups of windows, dripstone labels and slender column groupings topped by pinnacles.

.14 **MILLER HALL** **Historic and Architectural Significance**
In 1930 Architect Colin Drever designed a building to house Geology and Mineralogy. Its capacity was greatly enlarged by the addition of the Bruce Wing in 1973. Miller Hall is four storeys with flanking three storey wings. The facade is symmetrical, the entrance in the base of a central tower with buttresses and battlements. The window groupings are separated by slender buttresses.

.15 **GYMNASIUM** **Historic and Architectural Significance**
The oldest part of the present Physical Education Centre, designed by Archibald Associates, was built in 1930. It has round corner towers rising above the roof to octagonal sections diminishing to a peak. There are four sets of triple windows; the upper two thirds of the facade is a blind arcade. The double door entrance is set in a projection which has corner buttresses.

.16 **JOHN J. DEUTSCH UNIVERSITY CENTRE**

(Student's Memorial Union) **Historic and Architectural Significance**
Queen's in 1927 bought the 1862 Orphan's Home and renovated it to become, in 1929, the first Students' Union. Destroyed by fire September, 1947, it was replaced in 1949. In 1964 a large addition housed graduate students and the International Centre. Architect Arthur Erickson designed a further large addition in 1974. The resulting complex was named in honour of Principal John J. Deutsch. The architecture of the 1949 building has similarities to the earlier Queen's buildings - strong corner buttresses, ashlar string course and projecting wings. The entrance, double doors, are set behind compound arches in a buttressed projection. The east wing has on the first storey a single storey by with stained glass windows of the memorial room. The west wing has large arched windows indicating the size of the large dining area named Wallace Hall. The architect at this time was Colin Drever.

.17 **AGNES ETHERINGTON ART CENTRE Historic and Architectural Significance**

This was originally a Victorian House built for George Richardson to plans by Power in 1879. In 1920 Architect David Shennan was commissioned to enlarge and remodel the house. The resulting Georgian style house was left to Queen's by Mrs. Agnes Richardson Etherington in 1921 "for the furthering of art and music at the University". In 1956 Shennan designed the addition and renovation to fit the house

for an art centre. In 1962, 1975 and 1978 there were further additions and alterations. A further expansion is being considered. This is a two storey brick building set on a high stone foundation. Above a white moulded and dentilled cornice the roof is hidden by a brick parapet topped with stone and broken at intervals by sections of white balustrades. The main facade is symmetrical, the central slight projection has on the first storey double French windows flanked by single windows. On each side of the projection are two windows on the first floor and one of the second. The main entrance, a one storey section, sits slightly back on the right of the facade, has a transormed doorway with classical enframement. The main glass walled entrance lobby, to the north, joins the old house to the first extension. The south wall has a chimney breast and sunroom windows.

.18 **BAN RIGH HALL** **Historic and Architectural Significance**
Queen's women raised the money to build this residence in 1923, designed by architect Shepard and Calvin. The Ontario government supported the addition of a dining hall in 1968. Ban Righ is an L-shaped building on a corner and has a variety of roof lines and facade projections emphasized by buttresses which give the impression of a series of connected buildings. The corner section contains the main entrance and rises four storeys to a high parapet. There is variety in the treatment and size of windows, some round arched, some flat. The south University Avenue facade has hip roofed dormer windows on the front slope of the roof. The west Queen's Crescent facade has steeply pitched gabled sections rising through the roof line.

.19 **ADELAIDE HALL** **Historic and Architectural Significance**
Built in 1951 designed by architect Drever, at the corner of University Avenue and Stuart Street, Adelaide Hall, named for Mrs. R.S. McLaughlin, was planned as an extension of Ban Righ Hall. The difference in street level makes the second floor of Adelaide level with the first floor of Ban Righ. The corner entrance has above it a large angled bay which rises to a roof parapet. The eastern facade has window placement matching that in Ban Righ. A wide string course above the lintels of the first storey windows goes around the building.

RESIDENTIAL

.20 **51 QUEEN'S CRESCENT** **Architectural Significance**
This frame house, built about 1890, at the corner of Queen's Crescent and the former Alfred Street is larger than the usual wooden house. It is also an unusual style for Kingston with a Palladian window, a triangular bay window above it. Beside the central door is an angled bay rising to the wide eaves. On the west front is a two and a half storey projection with each storey a different shape. The trim on the house is very good.

.21 **32 QUEEN'S CRESCENT** **Architectural Significance**
Vice Principal W.E. McNeill left his 1924 brick house to Queen's. It now houses the Ban Righ foundation. Its importance to the streetscape lies in its Queen's Crescent facade which is dominated by the large gable roofed entrance porch. Square brick piers support the porch roof and a low brick wall capped by stone extends around the

open porch. A central window with sidelights in each storey rises to a large gabled dormer.

.22 **143 KING STREET WEST** **Historic & Architectural Significance**
In 1845 Rev. W.M. Herchmer, whose Loyalist family had been granted extensive lands, had architect William Coverdale design his country home. From July 1909 Francis Hill Macnee owned the cottage for 25 years. Harry Muir in 1926 commissioned architect Colin Drever to make extensive alterations and additions to the house. In 1965 Queen's bought the property and in 1969 Andrew Connidis designed the large Stuart Street addition. The siting of this two and a half storey stucco building with false timbering makes it imposing. A large two storey angled bay with small paned casement windows. Beyond the central door is a triple transomed window. The extension is compatible with the 1969 alteration.

.23 **169 UNION STREET** **Architectural Significance**
Built in 1878 for W.B. Anglin, who called it Hedgewood, this two and a half storey brick house was acquired by Queen's to house the School of Public Administration. It is now used as a Day Care Centre. The central entrance is recessed between large, one storey bay windows whose flat roofs are extended to roof the entrance porch. There are one storey enclosed porches on each side of the house and a rear kitchen wing.

.24 **169 UNIVERSITY AVENUE*** **Architectural Significance**
Architect Joseph Power designed this red brick house in 1889 for George Young. The central entrance with transom and sidelights is protected by a wooden porch whose roof forms a balcony. On the roof is a central gable roofed dormer window with decorative spindle work. The left bay is a slight projection with three tall windows in each storey, in the first are stained glass transom, above these are terra cotta panels. The right bay is angled with three windows each storey and terra cotta panels. Above its flat roof is a gable roofed dormer with arched window and decorative barge board.

.25 **181 UNIVERSITY AVENUE*** **Architectural Significance**
Built about 1907 by Arthur Ellis, Architect, this brick house features a broad arch with decorative brick work with the entrance set back from it. The same brick design goes around the arched window with leaded glass fanlight. A high gable roofed dormer with palladian window rises through the front edge of the roof.

.26 **185 UNIVERSITY AVENUE*** **Architectural Significance**
In 1896 contractor C.J. Graham was building two houses, presently 185 and 187. The projecting bay of this brick dwelling with a double fanlighted first storey window, a pair of flat arched windows in the second, is topped a large wooden gable end with decorative barge board.

.27 **187 UNIVERSITY AVENUE*** **Architectural Significance**
This 1896 red brick house built by C.J. Graham has some fine wood trim in barge board and especially on its wooden porch.

.28 **189 UNIVERSITY AVENUE*** **Architectural Significance** In 1894 contractor Robert Gow built this red brick house to design by William Newlands. The roofline, a gable end within a large gable end, the wood trim and the angled bay windows are features of this dwelling.

.29 **193-195 UNIVERSITY AVENUE*** **Architectural Significance** Architect Joseph Power designed this double house about 1888 for Captain Thomas Donnelly, a boat inspector. A wide flat roofed one storey porch covers the centre of this house. On the front slope of the roof are two dormers, one with two windows has a barge board with pellet moulding, the second with a sunburst design at the peak of the gable. To the left of the porch is an angled bay which rises through the roof edge to a tall conical roof topped by a pinnacle. On each floor the stone sills of the windows are joined to form string courses. To the right of the central porch is an angled bay which rises to a dentilled cornice and bell shaped roof.

.30 **162-164 BARRIE STREET*** **Architectural Significance** Built in 1889 for J.B. McIvor to design by Architect J.B. Reid and occupied for many years by the McIvors and George Cliff, this important corner house is now the Graduate Club. The symmetrical two and a half storey brick building has central doors and on each side projecting angled bays, the window sills on each storey join to form string courses. Above the first storey are small, square decorative panels. The flat roofs of the bays have above them pairs of arched windows under a gable roof with panelled barge board.

.31 **170 BARRIE STREET*** **Architectural Significance** This two and a half storey brick house was built about 1880 by Architect builder John Cunningham and occupied by the family of Mrs. Mary Morley Rose. The vertical elements of the brick building are emphasized by white wooden trim.

.32 **172-174 BARRIE STREET*** **Architectural Significance** William Newlands designed these two dwellings in 1897, C.J. Graham built them for H.F. Mooers. The two dwellings, mirror images, have central doors and angled bays rising two storeys to balustraded porches protected by gable roof with barge boards. The two storey central porch has a shed roof.

.33 **178 BARRIE STREET*** **Architectural Significance** In 1897 builder C.J. Graham finished this house, designed by Architect William Newlands for Thomas Mills. The projecting bay, its window sills joined to form a strong course, has on the third storey a balcony under the gable roof with barge boards. To the right a two storey gable roofed porch protects doors at both the first and second storeys.

* Notice of intention to designate posted 1994 October.

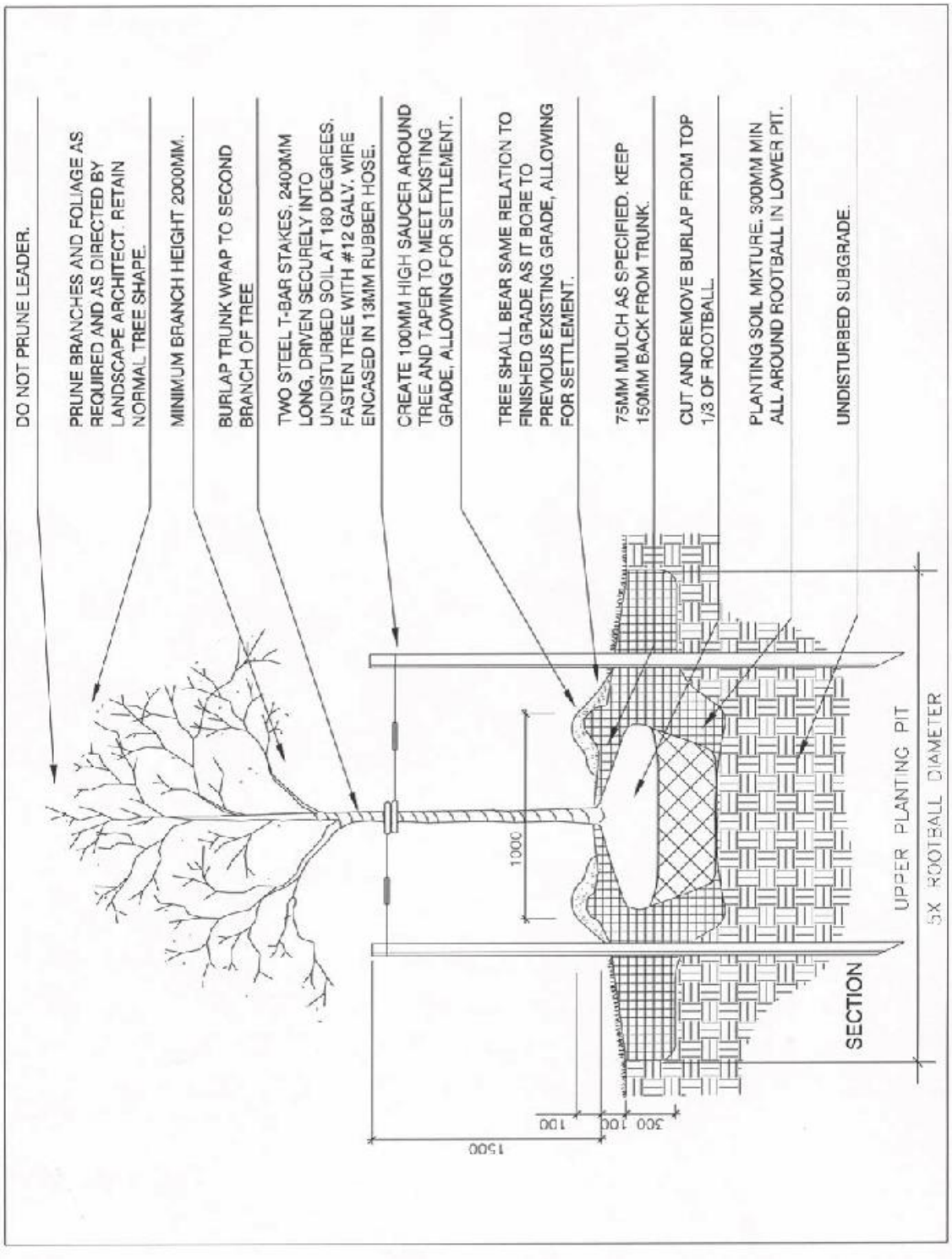


Figure 2.906.3-A

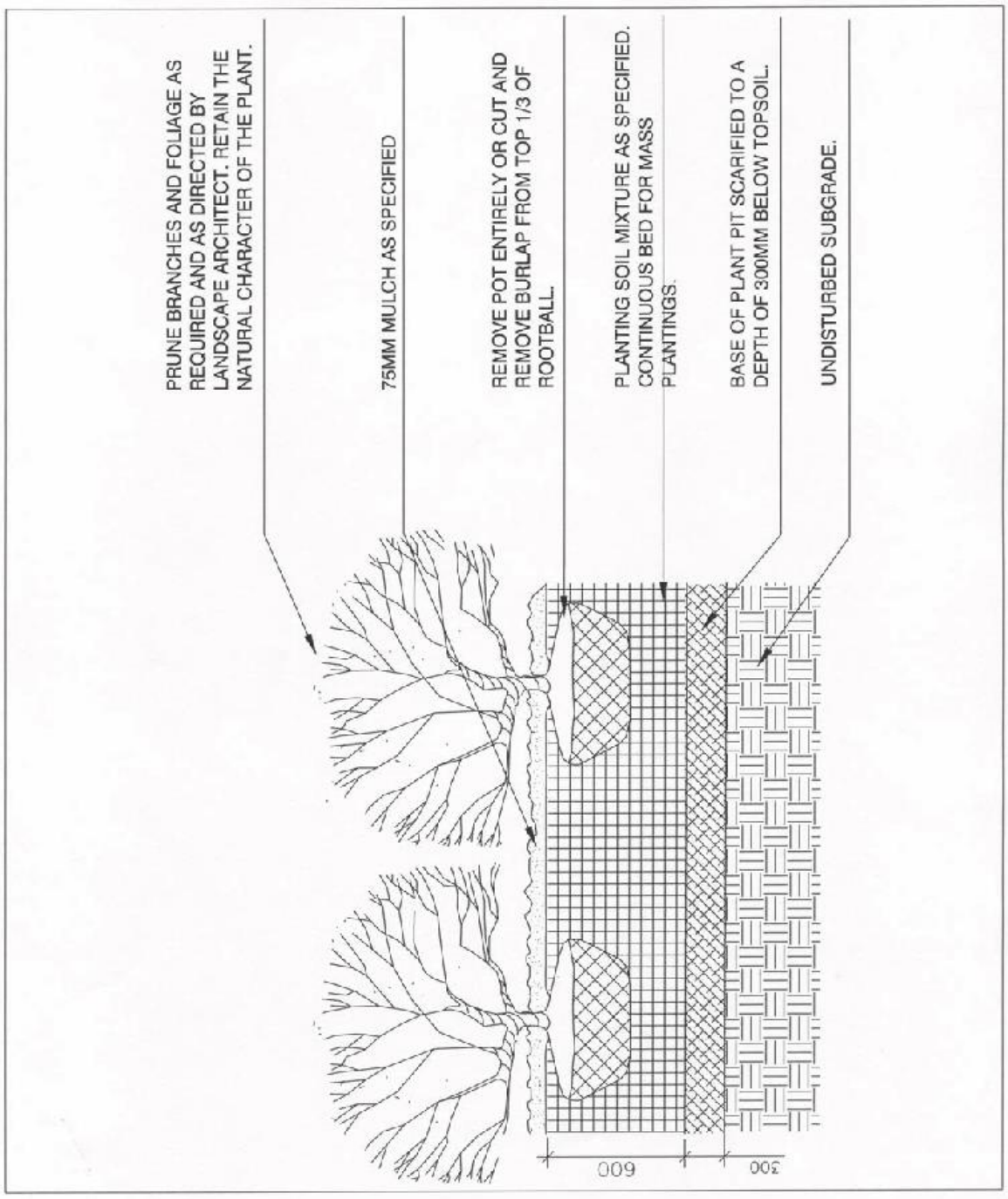


Figure 2.906.4-A

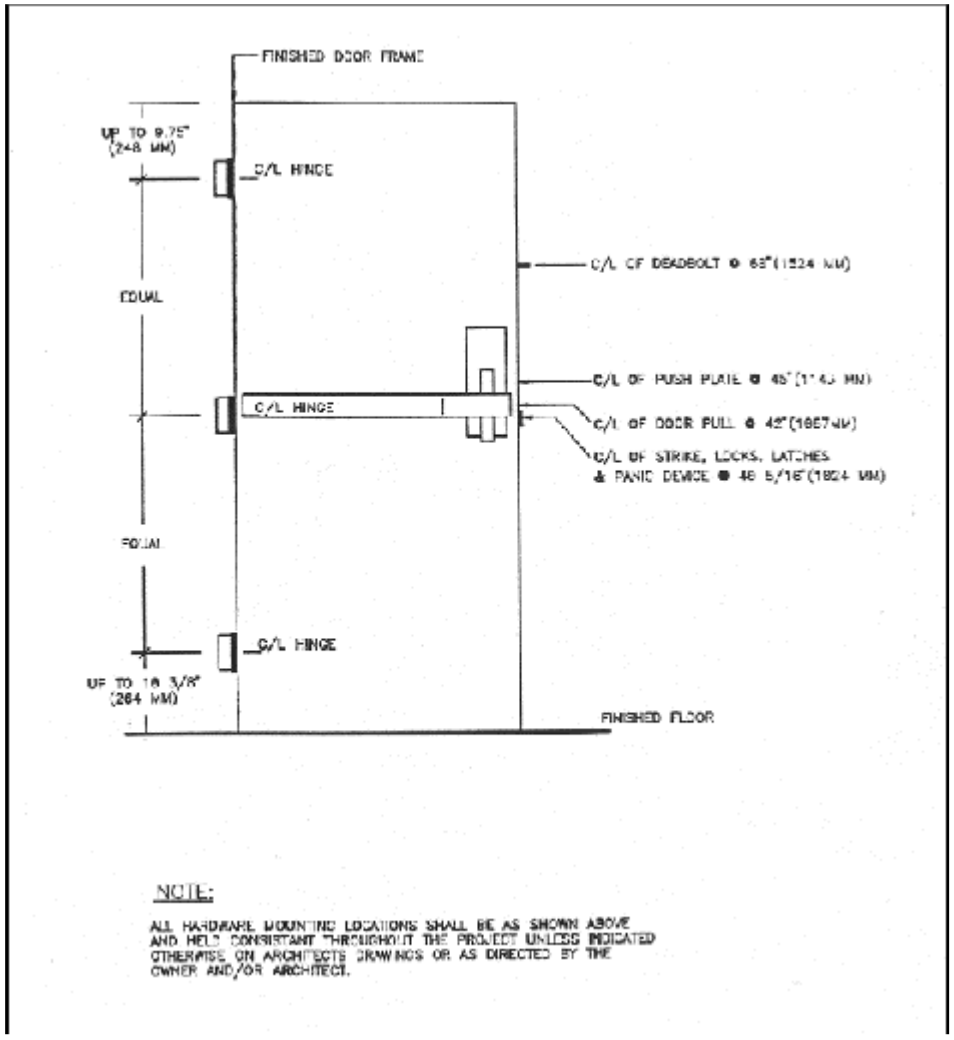


Figure 8.710.2-A

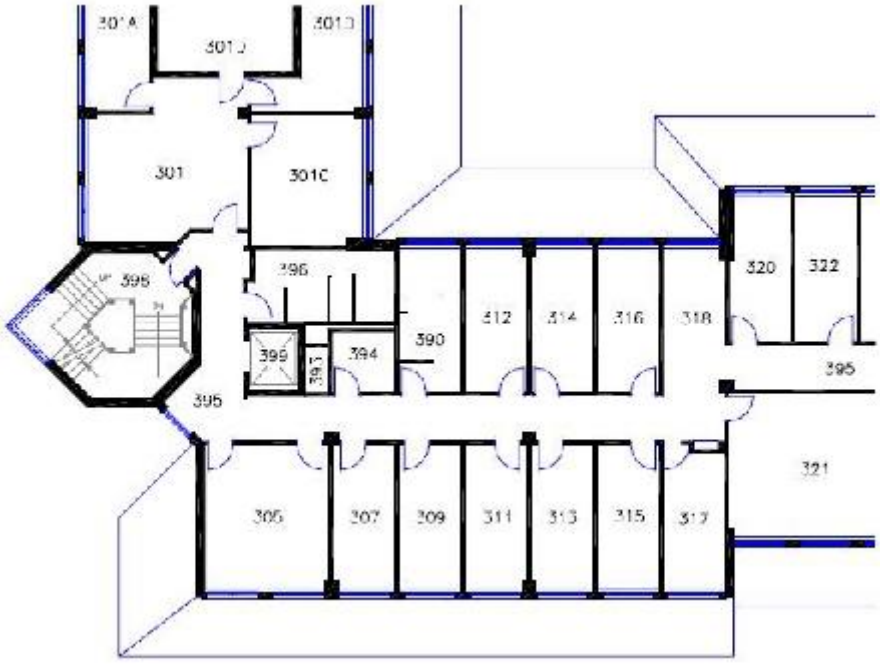


Figure 10.442.16-A

Figure 23.206.2-A

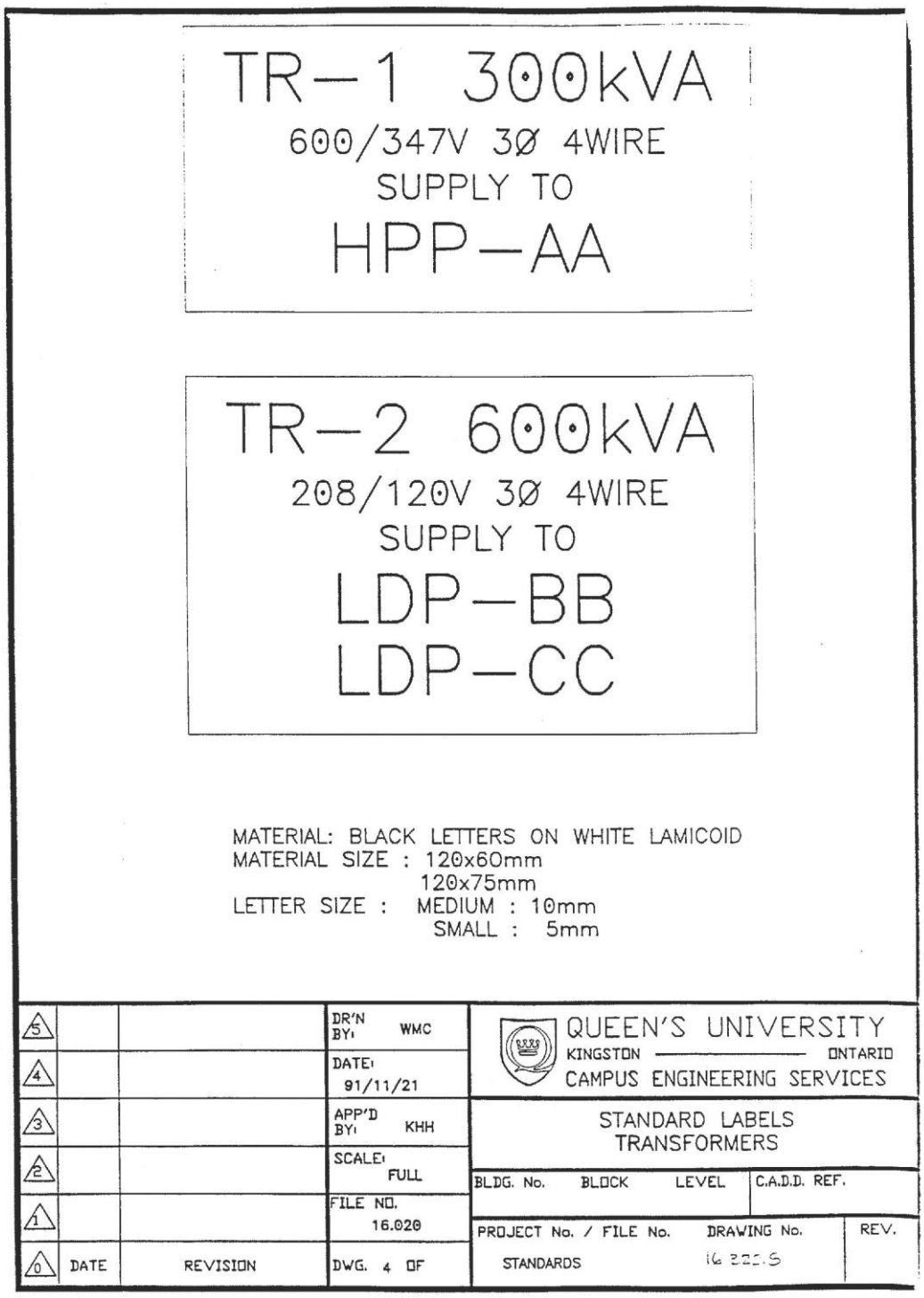


Figure 26.055.7-A

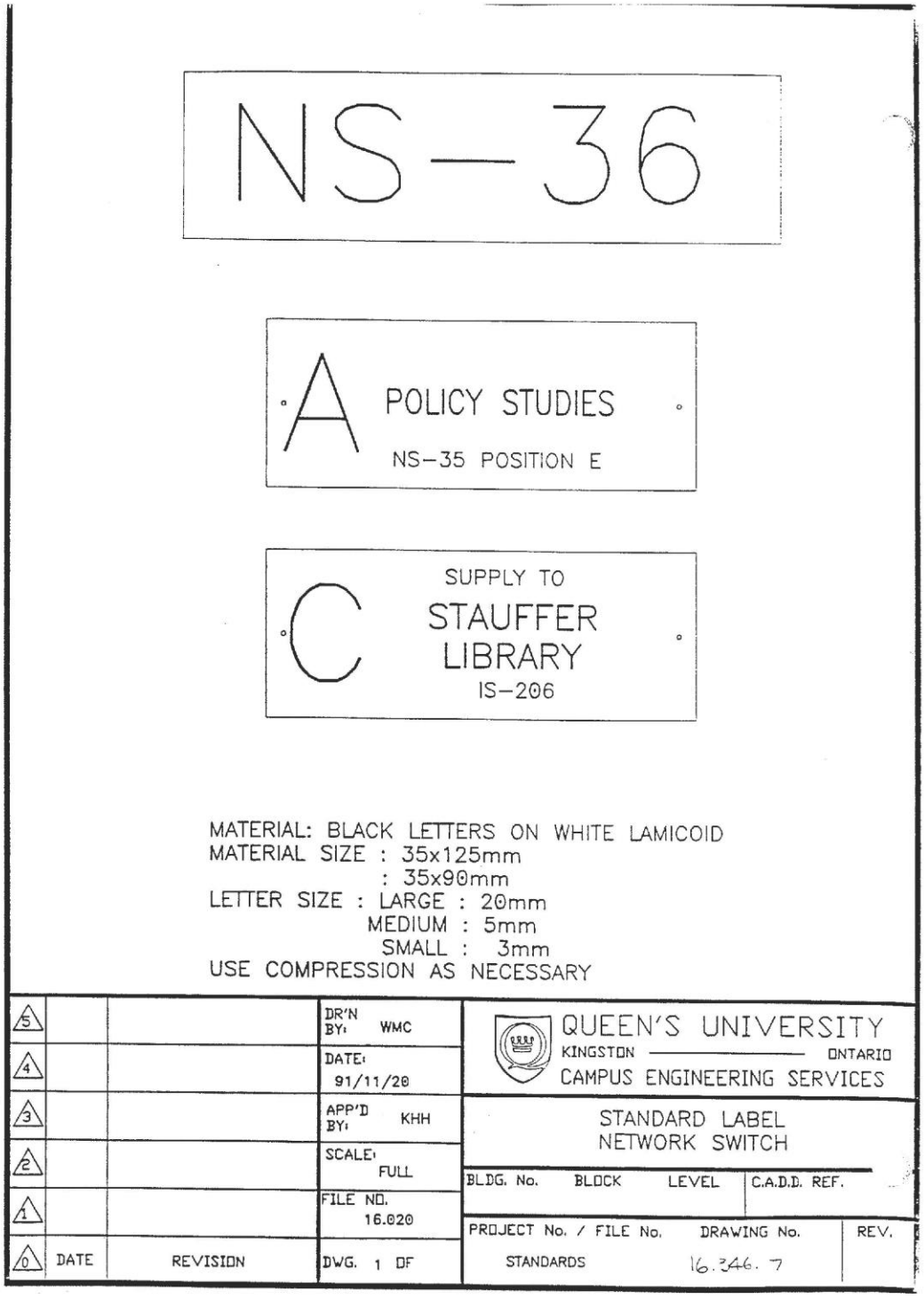


Figure 26.130.5-A

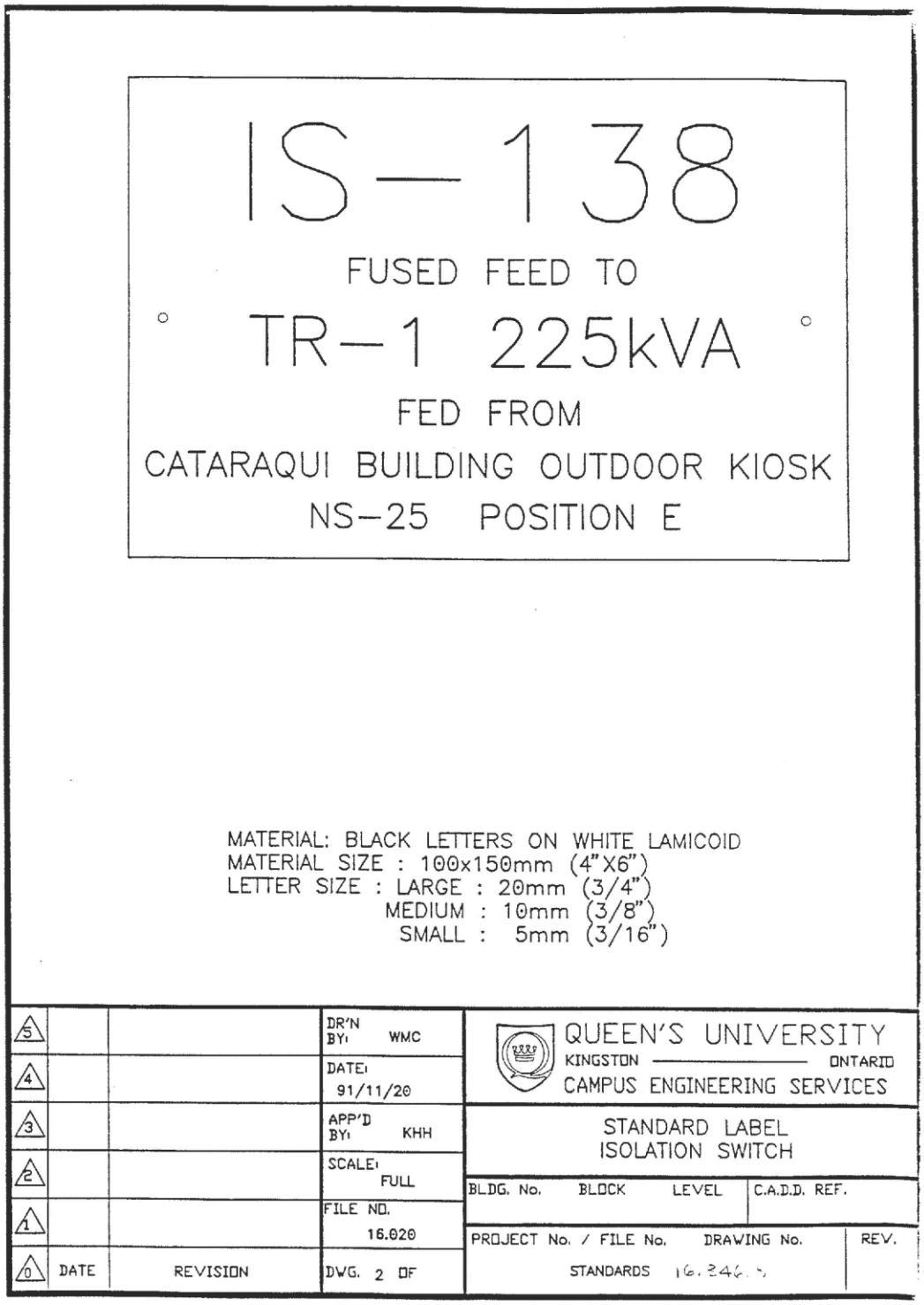


Figure 26.132.8-A

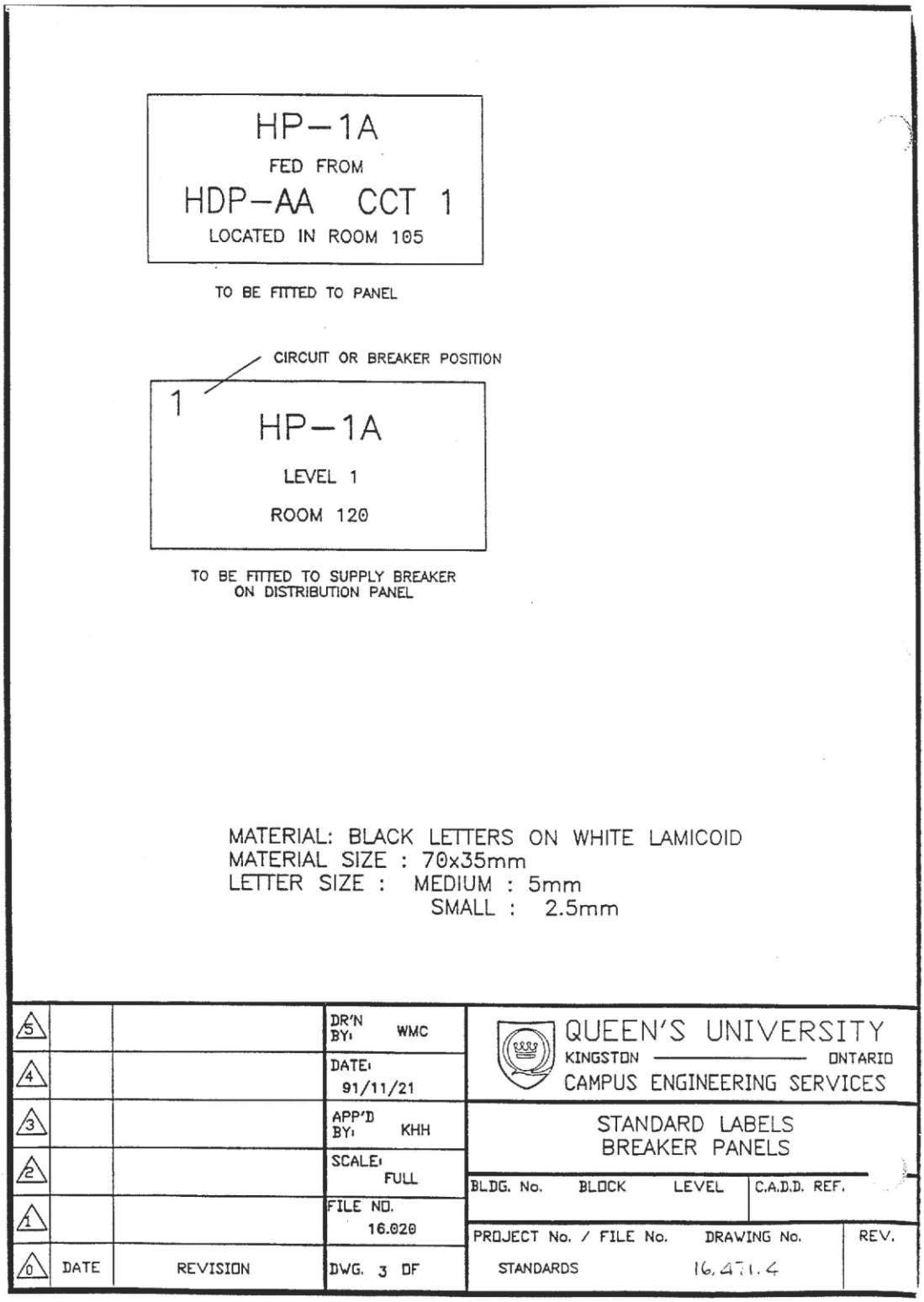

HP–1A
FED FROM
HDP–AA CCT 1
LOCATED IN ROOM 105
TO BE FITTED TO PANEL
CIRCUIT OR BREAKER POSITION
1
HP–1A
LEVEL 1
ROOM 120
TO BE FITTED TO SUPPLY BREAKER ON DISTRIBUTION PANEL
MATERIAL: BLACK LETTERS ON WHITE LAMICOID
MATERIAL SIZE : 70x35mm
LETTER SIZE : MEDIUM : 5mm
SMALL : 2.5mm
5
4
3
2
1
0
DATE
REVISION
DR'N BY: WMC
DATE: 91/11/21
APP'D BY: KHH
SCALE: FULL
FILE NO. 16.020
DWG. 3 OF
QUEEN'S UNIVERSITY
KINGSTON ONTARIO
CAMPUS ENGINEERING SERVICES
STANDARD LABELS
BREAKER PANELS
BLDG. No. BLOCK LEVEL
C.A.D.D. REF.
PROJECT No. / FILE No. DRAWING No.
REV.
STANDARDS
16.471.4

Figure 26.246.6-A

BUILDING NAME

PANEL HPP-AA

BUILDING: NUMBER & NAME — POWER DISTRIBUTION PANEL

SUPPLIED FROM 1000KVA TRANSFORMER AT 600/347V 3PHASE 4 WIRE

CCT #	X	PANEL #	CB AMPS	CONNECTED KW	CONNECTED KW	CB AMPS	PANEL #	X	CCT #
	1							1	
	2							2	
	3							3	
	4							4	
	5							5	
	6							6	
	7							7	
	8							8	
	9							9	
	10							10	
	11							11	
	12							12	
	13							13	
	14							14	
	15							15	
	16							16	
	17							17	
	18							18	
	19							19	
	20							20	
	21							21	
	22							22	
	23							23	
	24							24	
	25							25	
	26							26	
	27							27	
	28							28	
	29							29	
	30							30	
	31							31	
	32							32	

TOTAL CONNECTED LOAD 0 kW

80% RATING OF TRANSFORMER 180 kW

MANUFACTURE---- : CDP

MAINS 600 A @ 208/120V 3PHASE 4WIRE

MAIN BREAKER 600 AMPS

TRANSFORMER RATING 225 AMPS

Figure 26.246.7-A

BLDG NAME

PANEL

BUILDING:
LOCATION: ROOM #
FED FROM DP-

PANEL SCHEDULE UP-DATED ON : - 199-/--/--

#	*	ROOM DETAILS	LOAD	AMP	CCT		CCT	AMP	LOAD	#	*	ROOM DETAILS
					1	A	2					
					3	B	4					
					5	C	6					
					7	A	8					
					9	B	10					
					11	C	12					
					13	A	14					
					15	B	16					
					17	C	18					
					19	A	20					
					21	B	22					
					23	C	24					
					25	A	26					
					27	B	28					
					29	C	30					
					31	A	32					
					33	B	34					
					35	C	36					
					37	A	38					
					39	B	40					
					41	C	42					

PHASE A CONNECTED LOAD	0 KW	0 kW = 80% Rating of Feeder/Phase
PHASE B CONNECTED LOAD	0 KW	0 kW = 80% Rating of Feeder
PHASE C CONNECTED LOAD	0 KW	0 kW = TOTAL CONNECTED LOAD

MANUFACTURER	FLUSH/SURFACE CAT #
225A MAINS @208/120v 3PH 4W	42 CIRCUIT PANEL
MAIN BREAKER AMPS	DOOR KEY--
FEEDER AMPS	CONDUCTORS--
FEEDER FUSE OR BREAKER AMPS	CONDUIT--

* LEGEND

L - LIGHTING FIXTURES
EX - EXIT LIGHTS
DR - DUPLEX RECEPTACLE
SR - SINGLE RECEPTACLE
SP - SPLIT RECEPTACLE
CR - CLOCK RECEPTACLE
QR - QUAD RECEPTACLE
TL - TWIST LOCK RECEPTACLE
WM - WIREMOLD RECEPTACLE STRIP
J - JUNCTION BOX / HARD WIRED
FH - FUME HOOD
UN - UNIT HEATER
15R - TO LV LIGHTING CONTROL RELAY
15# - 15 AMP GFI BREAKER
F - FAN
HP - HEAT PUMP
HT - HEATER
P - PUMP
PP - POWER POLE
15L - 15 AMP LOCKED BREAKER
DF - DRINKING FOUNTAIN

Figure 26.247.8-A

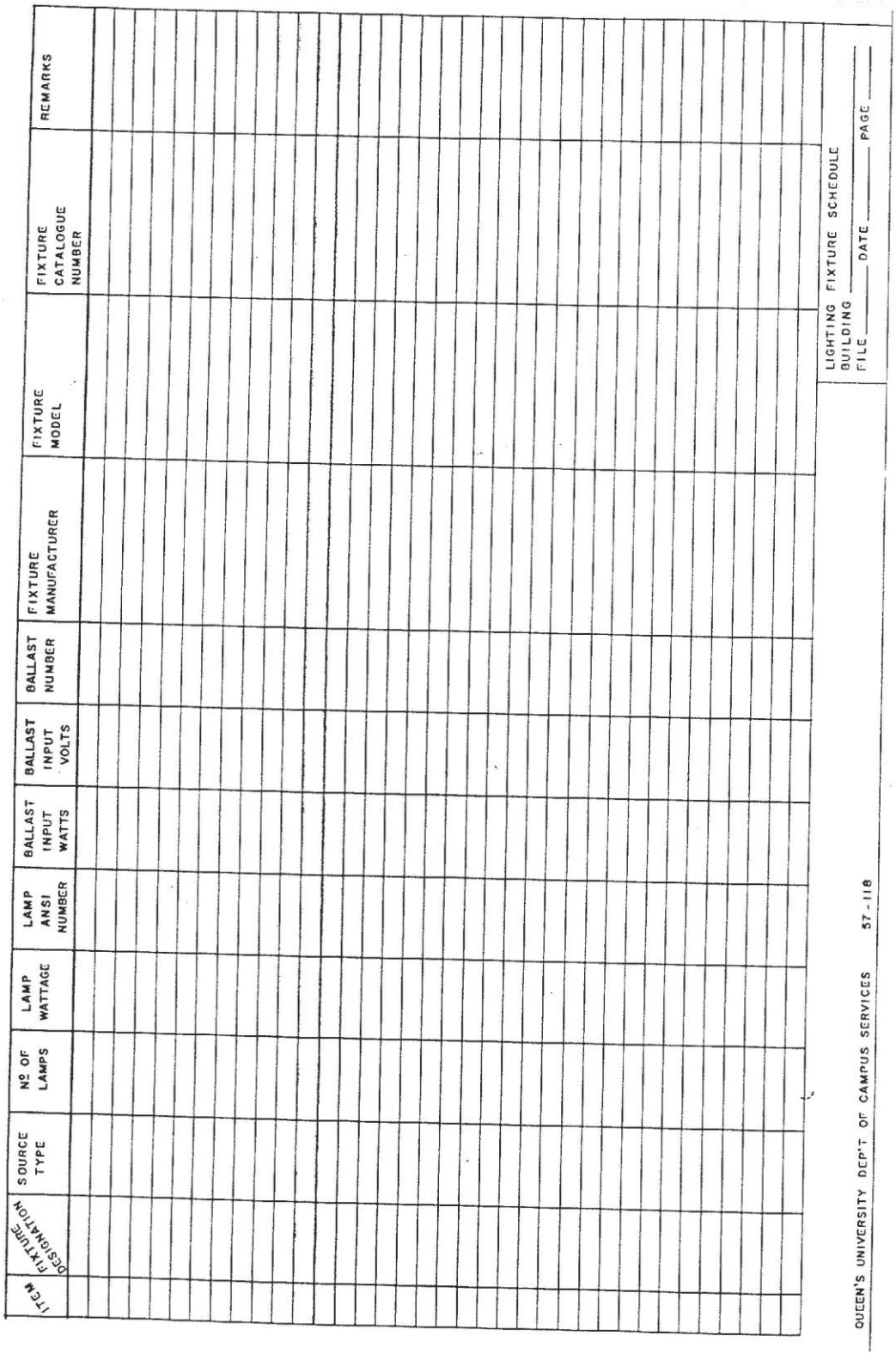

ITEM
FIXTURE DESIGNATION
SOURCE TYPE
Nº OF LAMPS
LAMP WATTAGE
LAMP ANSI NUMBER
BALLAST INPUT WATTS
BALLAST INPUT VOLTS
BALLAST NUMBER
FIXTURE MANUFACTURER
FIXTURE MODEL
FIXTURE CATALOGUE NUMBER
REMARKS
LIGHTING FIXTURE SCHEDULE
BUILDING
FILE
DATE
PAGE
QUEEN'S UNIVERSITY DEPT OF CAMPUS SERVICES
57-118

Figure 26.502.11-A

(White lettering on red background)

Figure 26.505.5-A

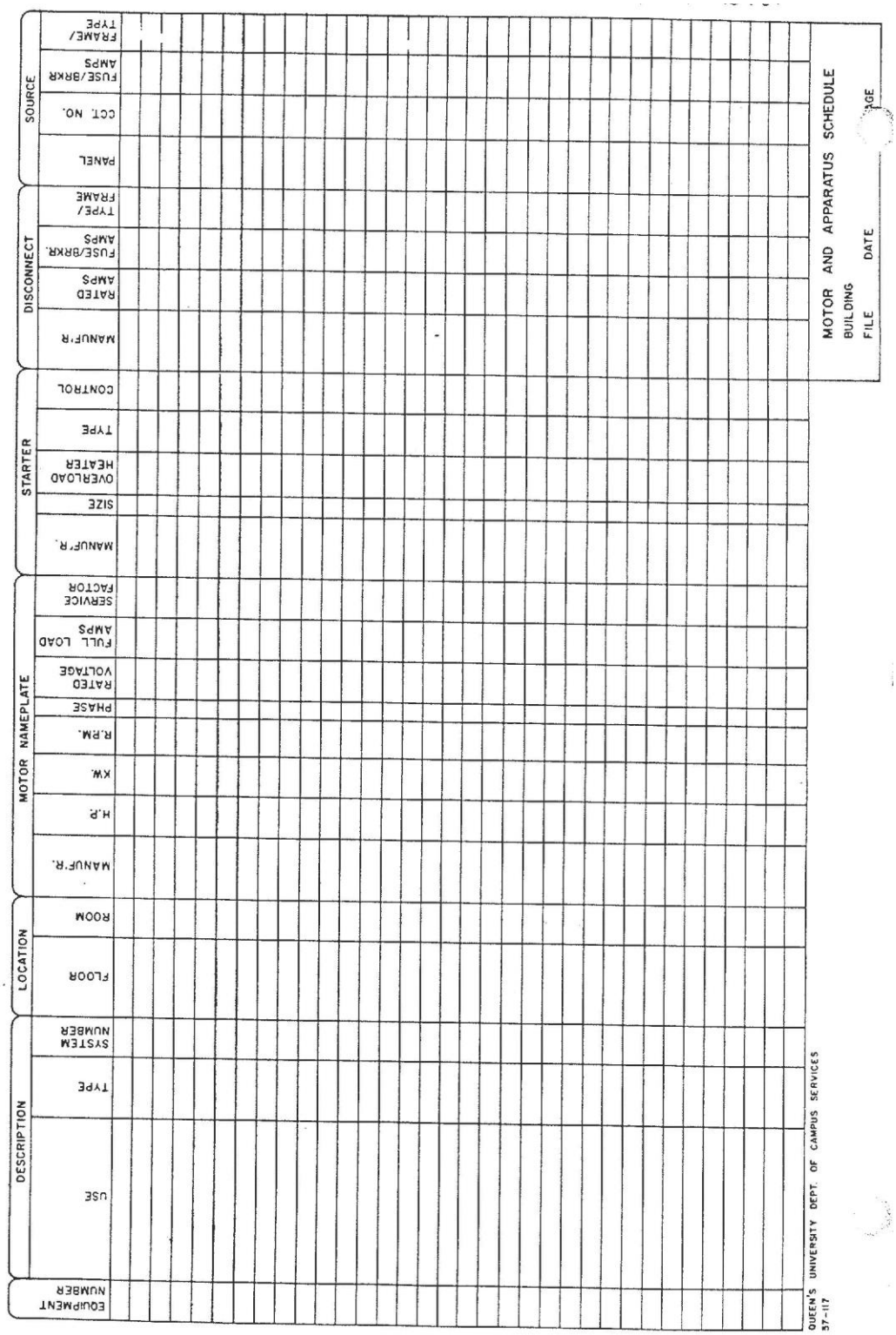


Figure 26.951.7-A

ITEM NO.	ITEM	DATA
1	Planting ID number	
2	Tree caliper	
3	Planting genus	
4	Planting species	
5	Planting common name	
6	Tree drip line diameter	
7	X coordinate (by drafting dept.)	
8	Y coordinate (by drafting dept.)	
9	General location	
10	Priority zone value	
11	Growth stage rating	
12	Species rating	
13	Root condition	
14	Trunk condition	
15	Crown condition	
16	General Condition	
17	Potential contribution to location	
18	Appraisal value	
19	Other factors concerning location	
20	Observation date	
21	Maintenance comments	
22	Acquisition date	
23	Acquisition source	
24	Acquisition form/size	
25	Acquisition condition	
26	Removal date	
27	Historical notes / Heritage status	
28	Name of Donor	
29	Previous ID number (if replacement)	

PROJECT	DATE	
	NUMBER	
	CONTRACTOR	
	PROJECT MANAGER	
DATABASE	DRAWING	
	REVISED BY	
	DATE	

☐ NEW

☐ CHANGE

DATE: _____

BY: _____

Form 2.491.3-B

ITEM NO.	ITEM	DATA
1	Planting ID number	
2	Planting genus	
3	Planting species	
4	Planting common name	
5	X coordinate (by drafting dept.)	
6	Y coordinate (by drafting dept.)	
7	General location	
8	Priority zone value	
9	Growth stage rating	
10	Species rating	
11	Root condition	
12	Heritage Status	
13	Crown condition	
14	General Condition	
15	Potential contribution to location	
16	Appraisal value	
17	Other factors concerning location	
18	Observation date	
19	Maintenance comments	
20	Acquisition date	
21	Acquisition source	
22	Acquisition form/size	
23	Acquisition condition	
24	Removal date	
25	Historical notes	
26	Name of Donor	
27	Previous ID number (if replacement)	

PROJECT	DATE	
	NUMBER	
	CONTRACTOR	
	PROJECT MANAGER	
DATABASE	DRAWING	
	REVISED BY	
	DATE	

☐ NEW

☐ CHANGE

DATE: _____

BY: _____

Form 2.491.4-B

ITEM NO.	ITEM	DATA
1	Planting ID number	
2	Planting genus	
3	Planting species	
4	Planting common name	
5	X coordinate (by drafting dept.)	
6	Y coordinate (by drafting dept.)	
7	General location	
8	Shrub/hedge bed width	
9	Shrub/hedge bed length	
10	Priority zone value	
11	Growth stage rating	
12	Species rating	
13	Root condition	
14	Heritage Status	
15	Crown condition	
16	General Condition	
17	Potential contribution to location	
18	Appraisal value	
19	Other factors concerning location	
20	Observation date	
21	Maintenance comments	
22	Acquisition date	
23	Acquisition source	
24	Acquisition form/size	
25	Acquisition condition	
26	Removal date	
27	Historical notes	
28	Name of Donor	
29	Previous ID number (if replacement)	

PROJECT	DATE	
	NUMBER	
	CONTRACTOR	
	PROJECT MANAGER	
DATABASE	DRAWING	
	REVISED BY	
	DATE	

☐ NEW

☐ CHANGE

DATE: _____

BY:

Form 2.491.5-B

ITEM NO.	ITEM	DATA
1	Planting ID number	
2	Planting genus	
3	Planting species	
4	Planting common name	
5	X coordinate (by drafting dept.)	
6	Y coordinate (by drafting dept.)	
7	General location	
8	Shrub/hedge bed width	
9	Shrub/hedge bed length	
10	Priority zone value	
11	Growth stage rating	
12	Species rating	
13	Root condition	
14	Heritage Status	
15	Crown condition	
16	General Condition	
17	Potential contribution to location	
18	Appraisal value	
19	Other factors concerning location	
20	Observation date	
21	Maintenance comments	
22	Acquisition date	
23	Acquisition source	
24	Acquisition form/size	
25	Acquisition condition	
26	Removal date	
27	Historical notes	
28	Name of Donor	
29	Previous ID number (if replacement)	

PROJECT	DATE	
	NUMBER	
	CONTRACTOR	
	PROJECT MANAGER	
DATABASE	DRAWING	
	REVISED BY	
	DATE	

☐ NEW

☐ CHANGE

DATE: _____

BY: _____

Form 2.491.6-B

Building Name	Elevator ID Number

Elevator Description			
Manufacturer:		Installation Number:	
Speed:		Class Number:	
Capacity:		Class Type:	
Catagory:		Number of People:	
Drive Type:		Type of Control:	
		Floors Served:	
Door Width:		Number of Stops:	
Door Type:		Number of Entrances:	
Barrier Free Design:		Emergency Phone Number:	
Date of Manufacture:		Shaft Room Number:	
Sales Number:		Machine Room Number:	
Controller			
Serial Number:		Type:	
Wiring Diagram:		Voltage:	
Drive Motor			
Serial Number:		Connection:	
Type:		Voltage:	
Horsepower:		Amperage:	
RPM:		Temperature Rise:	
Motor/Generator Set	**Motor**		**Generator**
Motor Serial Number:		Generator Serial Number:	
Motor Type:		Generator Type:	
Motor Rated Voltage:		Generator Rated Output:	
Motor Rated Amps:		Generator Time Rating:	
Motor Rated Horsepower:		Generator RPM:	
		Generator Temperature Rise:	
		Generator Rated Amps:	
Electrical Supply			
Supply Voltage:		Supply Source:	
Switch Amps:		Breaker Size:	
Fuse:		Location:	

Form 14.213-B

CAMPUS LIGHTING DATA BASE INPUT FORM Page ___ of ___

SUBMIT COMPLETED FORM TO ENGINEERING FOR RECORD UPDATE: NEW / CHANGE

DATE: _____ BY: _____

GRID	NUMBER (attach diagram)	
SOURCE	BUILDING (fed from)	
	BUILDING NUMBER	
	ROOM (where panel is)	
	PANEL DESIGNATION (name)	
	CIRCUIT NUMBER (S)	
	CONTROL TYPE (PHOTO, TIMER)	
FIXTURE	TYPE (SPEC DESIGNATION)	
	MANUFACTURER	
	MODEL (attach cat. cut)	
	QUANTITY	
	CATALOGUE NUMBER	
LAMP	QUANTITY	
	WATTS	
	TYPE (METAL, HPS, LPS etc.)	
	BASE (MED, MOGUL, DC etc)	
	CATALOGUE NUMBER	
	VOLTS (rated) [incandescent]	
BALLAST	INPUT WATTS	
	QUANTITY	
	CATALOGUE NUMBER	
	VOLTS (rated)	
PROJECT	DATE (installed)	
	NUMBER	
	CONTRACTOR	
	PROJECT MANAGER	
	PARKING LOT LIGHTING (Y/N)	
DRAWING 207-E025 MAIN CAMPUS LIGHTING		REVISED BY:
DRAWING 222-E003 WEST CAMPUS LIGHTING		REVISED BY:
MNFRS DATA BOOK 207 CAMPUS LTG FIXTURES		REVISED BY:
DATA BASE LIGHTING/OUTDOOR/EXTLTGDB.WQ1		REVISED BY:
PANEL SCHEDULE(S)		REVISED BY:
AS-BUILT DRAWING(S)		REVISED BY:

Form 26.506.2-B

SYSTEM		DEVICE		FINAL ELEMENT	
A## air handling unit	(fans)	SF	supply fan	C	control
		RF	return fan	S	status
		EF	exhaust fan	T	temperature
		FF	fumehood exhaust fan	H	humidity
		IV	inlet vanes	P	pressure
		SFM	supply fan motor	DP	differential pressure
		RFM	return fan motor		
		FPB	fan powered box	CO	controller output
		FC	fan coil	Z	setpoint
				HL	high limit or level
	(coils)	HC	heating coil		
		CC	cooling coil	LL	low limit or level
		PHC	preheat coil	CO2	carbon dioxide
		RHC	reheat coil	HI	high
		EC	exhaust coil	LW	low
		DXC	direct expansion coil	N	on
		GLC	glycol coil	F	off
				SC	speed control
	(valves)	HV	heating valve	SP	static pressure
		CV	cooling valve	VP	velocity pressure
		HUV	humidity valve	TP	total pressure
		SV	steam valve	OP	outlet pressure
		RHCV	reheat coil valve	IP	inlet pressure
		PHCV	preheat coil valve	A	alarm
		CCV	cooling coil valve	HTA	high temperature alarm
		HCV	heating coil valve		
		GLCV	glycol coil valve	LTA	low temperature alarm
		V	valve		
				Q	quality
	(dampers)	OAD	outside air damper	VOL	volume
		MAD	mixed air damper	AMPS	amperage
		D	damper	LLA	low limit or level alarm
		CDD	cold deck damper		
		HDD	hot deck damper	HLA	high limit or level alarm
		ZND	zone damper		
		SAD	supply air damper	PT	plenum temperature
		RAD	return air damper		
		EAD	exhaust air damper		
		BAD	bypass air damper		

SYSTEM		DEVICE		FINAL ELEMENT
A## air handling unit	(equipment)	HU	humidifier	
		HD	hot deck	
		CD	cold deck	
		FLT	filter	
		PFLT	pre-filter	
		FFLT	final filter	
		FS	firestat	
		FZ	freezestat	
		VM	volume monitor	
		VA	variable frequency	
	(other)	ZN	zone	
		SA	supply air	
		MA	mixed air	
		RA	return air	
		EA	exhaust air	
		BA	bypass air	
		OA	outside air	
		PHA	preheat air	
		GL	glycol	
		DX	direct expansion	
		PH	preheat	
HTG heating system		UH	unit heater	
		EUH	electric unit heater	
		EFFH	electric force flow heater	
		FFH	force flow heater	
		EH	electric heater	
		ESH	electric soffit heater	
		HE	heat exchanger	
		BU	burner	
		EBL	electric boiler	
		BL	boiler	
		PU	pump	
		HV	heating valve	
		SV	steam valve	
		FC	fan coil	
		MV	mixing valve	
		DV	diverting valve	
		ZN	zone	
		SW	supply water	

SYSTEM		DEVICE	FINAL ELEMENT
HTG heating system	(other)	RW return water GL glycol RM### room number MW mixed water STM steam	
CLG cooling system		DV diverting valve CT cooling tower CH chiller IV inlet valves HP heat pump FC fan coil CV cooling valve PU pump CTF cooling tower fan CTBV cooling tower bypass valve CTHE cooling tower heat exchanger CTEH cooling tower electric heater CTD cooling tower damper MV mixing valve ZN zone SW supply water RW return water GL glycol RM### room number CTSW cooling tower supply water CTRW cooling tower return water VF variable frequency AMON ammonia CHEM chemical treatment	

SYSTEM		DEVICE	FINAL ELEMENT
CON condenser system		DV diverting valve MV mixing valve CT cooling tower CTF cooling tower fan CTBV cooling tower bypass valve CTEH cooling tower electric heater CTD cooling tower damper PU pump CTBV cooling tower bypass valve V valve SW supply water RW return water ZN zone GL glycol CTSW cooling tower supply water CTRW cooling tower return water	
DHW domestic hot water		EH electric heater PU pump TA tank STMH steam heater GASH gas heater SW supply water RW return water TAW tank water STM steam	
DCW domestic cold water		PU pump IRR irrigation TRAP trap primer FLASH flash condenser SW supply water RW return water	

SYSTEM	DEVICE		FINAL ELEMENT
STM steam system	LN	line	
	HE	heat exchanger	
	V	valve	
	BL	boiler	
COND condensate	PU	pump	
	TA	tank	
	HP	heat pump	
CA control compressed air	C	compressor	
	TA	tank	
	DR	dryer	
LA laboratory compressed air	C	compressor	
	DR	dryer	
	TA	tank	
VAC laboratory vacuum	PU	pump	
SPR sprinklers	C	compressor	
	PU	pump	
STRM storm system	PU	pump	
SAN sanitary system	PU	pump	
OIL diesel oil	TA	tank	
	PU	pump	
GAS natural gas	SOLV	solenoid valve	
SNW snow melting	PU	pump	
	GL	glycol	
	STM	steam	
	EH	electric heater	

SYSTEM	DEVICE	FINAL ELEMENT
ROW reverse osmosis water	PU pump TA tank SW supply water RW return water CFLT carbon filter SOFT softener TAQ tank quality SWQ Supply water quality TAL tank level UV ultraviolet light	
FSP fire standpipe	PU pump	
MTR metering	STM steam GAS natural gas KWD kilowatt demand KVA kilovolt - amp DCW domestic cold water COND condensate EL electric	
LTG lighting	CR corridor SC security DC decorative LO lobby OS outside PCELL photocell	
RM### room number	HC heating coil	
REFRIG refrigeration		

1. *APPENDIX D Operations Manual – Sample Building (17.802)*

1.01 *Appendix D-1 Overview of Heating, Ventilation and Air Conditioning Systems (HVAC)*

Built in 1960
Ductwork and dampers retrofit; 1988
Last air balance completed; 1988
Main air handling units replaced; 1991

Levels:

.1 Ground Floor
.2 First Floor
.3 Second Floor
.4 Third Floor
.5 Penthouse

Sample Building's Air Handling Unit A03 is controlled by DDC energy management system with pneumatic actuators.

Sample Building has one air handling system:

- A03 - Air handling unit 03 is located in Mechanical Room 146, First Floor, serving the Auditorium. The system capacity is 9,100 cfm and is divided into three zones, one north, one south and one west (stage) zone.
- Heat is supplied by plenum steam coils. The supply air temperature for each zone is controlled by the zone return air temperature through the use of hot deck/cold deck dampers.
- Heating is maintained by hot water convectors and force flows located on exterior walls and staircases. The majority of heaters are locally controlled by roomstats. Hot water is supplied to these units from a steam convertor in Mechanical room 13. There are two hot water distribution systems, one servicing force flows and one servicing convectors. Each system has two pumps, one of which is on standby. There is a common hot water temperature control.
- A03 has a cooling coil located in the housing of the respective systems. The chilled water is obtained from a reciprocating chiller system located in the penthouse. The cooling tower is located on the roof.
- A03 receives its outside air by the west entrance at Ground Floor level.
- System A03 receives its return air from the auditorium through grills located on each side of the stage.
- There is an electric 60 gallon recirculating domestic hot water system to supply hot water to the building.
- The electrical room has a dedicated exhaust system. Fresh air is supplied from a

louvre located by the main entrance of the building. A grill from this duct supplies Mechanical room 13 with outside air.

- The building also has various exhaust systems not noted above:

Mechanical room exhaust 146, Mechanical Room 13, toilet exhaust, kitchen exhaust and projection room exhaust.

1.02 *Appendix D-2 Panel 49, Points List*

Physical Education Center Panel #23 (Room 074A)

DDC System Points List

Outputs

Expansion Slot #1 = IP16, Expansion Slot #2 = IP16, Expansion Slot 3 = DO16

Point Name	Description	Location	Type	F.I.B	Cable	Point
PEC_STM_HV1C	Heating Water Convertor #1 Steam Valve Control	Mechanical Room 017	AO	1E	05-16	23.OP01
PEC_STM_HV2C	Heating Water Convertor #2 Steam Valve Control	Mechanical Room 017	AO	1E	05-17	23.OP02
PEC_HTG_HV1C	Heating Water 3-way Valve zone #2	Mechanical Room 017	AO	1E	05-18	23.OP03
PEC_HTG_HV2C	Heating Water 3-way Valve zone #3	Mechanical Room 017	AO	1E	05-19	23.OP04
PEC_DHW_HV1C	DHW Convertor #1 Valve Control	Mechanical Room 017	AO	1E	05-20	23.OP05
PEC_DHW_HV2C	DHW Convertor #2 Valve Control	Mechanical Room 017	AO	1E	05-21	23.OP06
PEC_DHW_HV3C	DHW Convertor #3 Valve Control	Mechanical Room 017	AO	1E	05-22	23.OP07
<unused>						23.OP08
PEC_DHW_PU1C	Domestic Hotwater Pump #1 Control	Mechanical Room 017	DO	1B	02-03	23.OP09
PEC_DHW_PU2C	Domestic Hotwater Pump #2 Control	Mechanical Room 017	DO	1B	02-05	23.OP10
PEC_DHW_PU3C	Domestic Hotwater Pump #3 Control	Mechanical Room 017	DO	1B	02-07	23.OP11
PEC_HTG_PU2C	Reheat Coil Pump #22 Control	Mechanical Room 017	DO	1B	02-22	23.OP12
PEC_A14_SFC	F34 Garage Supply Fan Control	Mechanical Room 017	DO	1C	03-01	23.OP13
PEC_A15_EFC	F36 Arena Locker Rm. Ex. Fan Control	Mechanical Room 017	DO	1C	03-03	23.OP14
PEC_A15_SFC	F35 Arena Locker Rooms Supply Fan Control	Mechanical Room 017	DO	1C	03-05	23.OP15
PEC_A22_EFC	F38 Dryer Exhaust Fan Control	Mechanical Room 017	DO	1C	03-07	23.OP16
PEC_HTG_PU4C	P2 Coil and Door Heating Pump Control	Mechanical Room 017	DO	1C	03-12	23.OP17
PEC_HTG_PU5C	P3 Hot Water Heating Convector Pump Control	Mechanical Room 017	DO	1C	03-14	23.OP18
PEC_HTG_PU6C	P4 Arena Hot Water Convector Pump Control	Mechanical Room 017	DO	1C	03-16	23.OP19
PEC_A15_BADC	S15/R15 (Arena Lockers) F/Bypass Damper Control	Mechanical Room 017	AO	2B	18-09	23.OP20
PEC_A15_HVC	S15/R15 (Arena Lockers) Heating Valve Control	Mechanical Room 017	AO	2B	18-10	23.OP21
<unused>						23.OP22
<unused>						23.OP23
<unused>						23.OP24

1.03 *Appendix D-3 Elements List Legend*

The elements list represents the designation of various components indicated on the system schematic drawings.

CODE DEVICE

EPT - ELECTRONIC/PNEUMATIC TRANSDUCER V -VALVE
T -TEMPERATURE SENSOR
D -DAMPER
N.C. - NORMALLY CLOSED
N.O. - NORMALLY OPEN
H - HUMIDIFIER
HS - HUMIDIFIER SENSOR
EA - EXHAUST AIR
SA - SUPPLY AIR

MA - MIXED AIR
RA - RETURN AIR
OA - OUTSIDE AIR
CD - COLD DECK
HD - HOT DECK
BAD - BYPASS AIR DAMPER
FS - FIRE STAT
ZN - ZONE
FZ - FREEZE STAT
ST - STEAM
COND - CONDENSATE

EXAMPLE: H-1 represents Humidifier # 1

H-2 represents Humidifier # 2 etc.

1.04 *Appendix D-4 Schedules Winter/Summer*

WORK SCHEDULE - 49.WS1

SB_A03_WS-WINTER

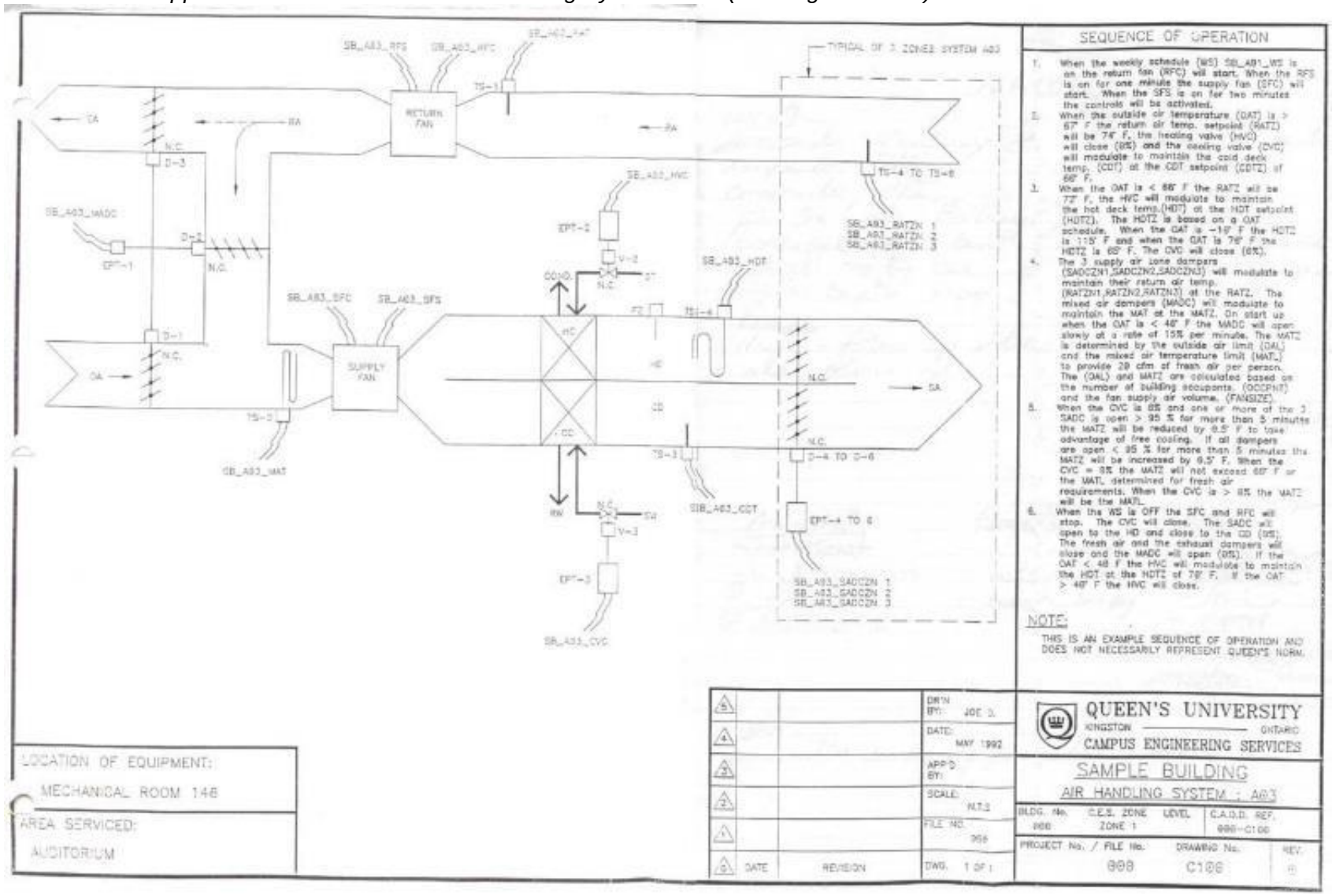
	ON	OFF	ON	OFF
SUNDAY	9:00	12:00		
MONDAY	8:00	17:00		
TUESDAY	8:00	17:00		
WEDNESDAY	8:00	17:00		
THURSDAY	8:00	17:00		
FRIDAY	8:00	23:00		
SATURDAY	8:00	15:30		

WORK SCHEDULE - 49.WS1

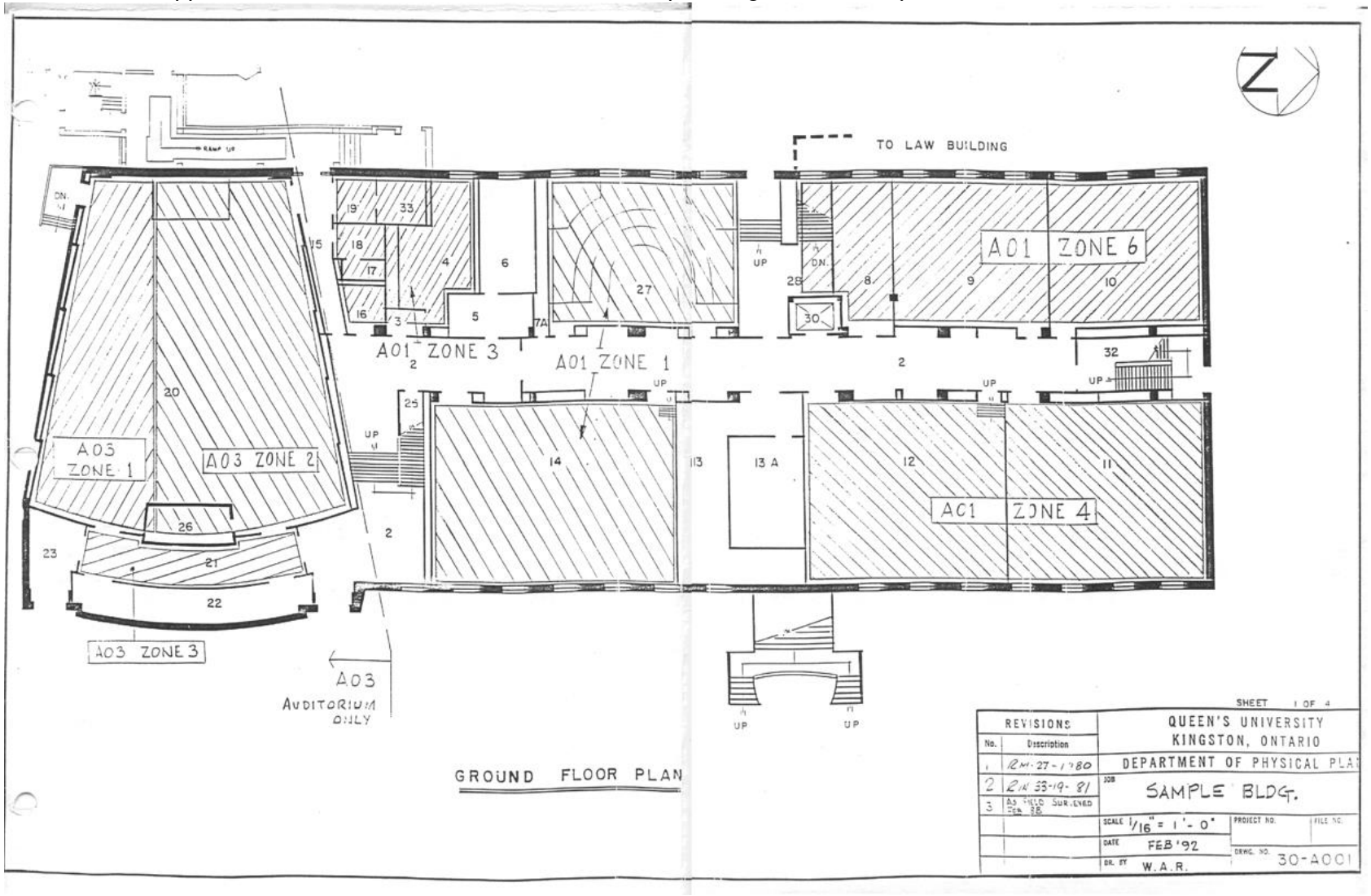
SB_A03_WS-SUMMER

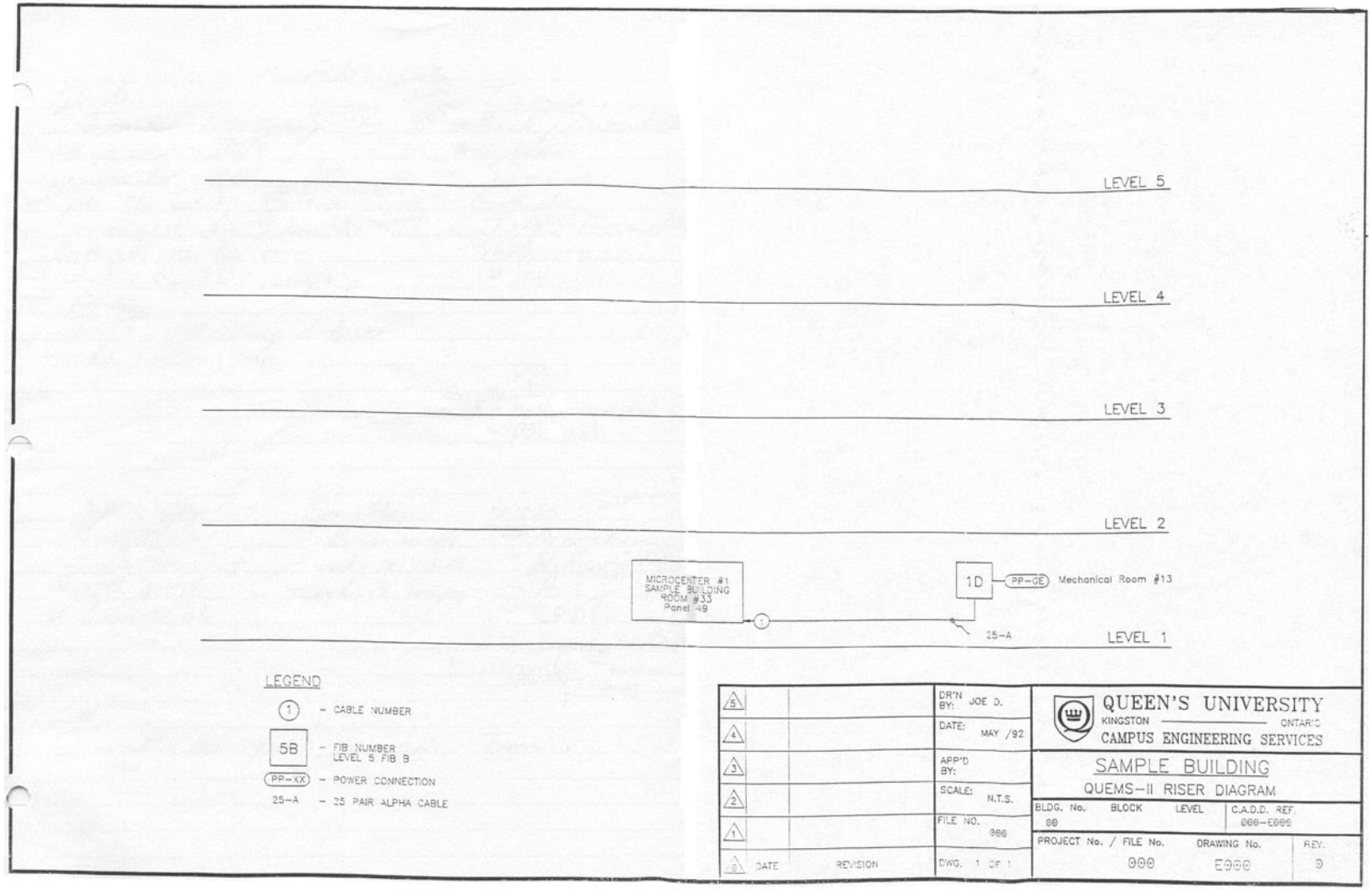
	ON	OFF	ON	OFF
SUNDAY				
MONDAY				
TUESDAY				
WEDNESDAY	AS PER ROOM BOOKINGS THURSDAY			
FRIDAY				
SATURDAY				

1.05 *Appendix D-5 Schematics – Air Handling System: A03 (Drawing No. C100)*



1.06 *Appendix B-6 Floor Plans – Ground Floor Plan (Drawing No. 30-A001)*




LEVEL 5
LEVEL 4
LEVEL 3
LEVEL 2
LEVEL 1
MICROCENTER #1
SAMPLE BUILDING
ROOM #33
Panel -9
1D
PP-GE
Mechanical Room #13
25-A
LEGEND
1 - CABLE NUMBER
5B - FIB NUMBER LEVEL 5 FIB B
PP-XX - POWER CONNECTION
25-A - 25 PAIR ALPHA CABLE
DR'N BY: JOE D.
DATE: MAY /92
APP'D BY:
SCALE: N.T.S.
FILE NO. 000
DWG. 1 OF 1
DATE REVISION
QUEEN'S UNIVERSITY
KINGSTON ONTARIO
CAMPUS ENGINEERING SERVICES
SAMPLE BUILDING
QUEMS-II RISER DIAGRAM
BLDG. No. 00
BLOCK
LEVEL
C.A.D.D. REF. 000-E000
PROJECT No. / FILE No. 000
DRAWING No. E000
REV. 0