FACILITY DESIGN GUIDELINE

V2022-1

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GENERAL

1. Application

.1 The guidelines established in this document are to provide project teams, including architects, engineers, contractors, as well as facility administrators and operators, with a set of recommendations for designing and constructing new SAIT facilities and buildings, as well as extensive renovations and additions. It should be reviewed by all on the onset of every project.

.2 The requirements have been developed by SAIT Facilities Management with consultation from industry professionals and extensive engagement of internal stakeholder groups. They incorporate knowledge from historic project experience, current industry standards, best practices, and review of similar institutional guideline documents.

.3 This document does not supersede building code, fire code, the authority having jurisdiction, health and safety codes or other applicable regulatory documents.

.4 The Guideline is formatted to reflect the Construction Specification Institute (CSI) and Construction Specifications Canada (CSC) MasterFormat divisions and titles. However, it is not a specification, should not be used as a contract document, and does not relieve consultants of professional responsibility for a project.

2. Renovations

.1 Smaller renovation projects not included in the scope of this document should be reviewed by project teams to assess where upgrades to match the Guideline makes sense financially and operationally to future-proof spaces, minimize maintenance costs, and integrate them with greater campus infrastructure and planning goals.

.2 A *gap analysis* is recommended for renovation projects. It is the process of comparing current performance (measured in time, cost, and labour) with the desired performance, ie. the expectation if it were a new build. The analysis should be reviewed by Facility Management to determine if a renovation should maintain the existing condition or if investment in capital or technology will deliver a better result.

.3 This analysis does not supersede required code updates or life safety recommendations.

3. Updates and Variances to the Guideline

.1 The Facility Design Guideline is a “living document” and will be updated to align with current design trends and technology, correct errata, and respond to consultant and management feedback.

.2 At the start of each project, consultants must verify the current guideline is being used.

.3 Variations on these guidelines are expected due to project-specific constraints or proposed creative and innovative solutions. Variances must be noted by the project team with written justification and approved by the responsible SAIT representative.

4. Guiding Principles

.1 The Facility Design Guideline has been developed to reflect the unique characteristic of the SAIT organization, culture, pedagogy, campus, and facilities, and is centred around the student experience.

.2 Under the umbrella of student experience, eight guiding principles have been established for all design and construction projects:

.1 Design Excellence
.2 Collaboration
.3 Flexibility
.4 Sustainability
.5 Universal Accessibility
.6 Intelligent Building Infrastructure
.7 Safety and Security
.8 Responsible Development

.3 Considerations for each guiding principle are outlined on the following page:

Guiding Principles:

STUDENT EXPERIENCE

Design Excellence

- **Campus As Living Lab** - Buildings reinforce education and are opportunities for learning.
- **In-house Knowledge** - Engage internal trade and research expertise.
- **Leaders** - Be open to progressive change and innovation.

Flexibility

- **Agility** - Adapt to industry trends and innovation.
- **Open Source** - Standards are transparent and a 'living document' with regular updates.
- **Forward Thinking** - Create roadmaps for future use.
- **Variety** - Accommodate diverse needs and uses.
- **Adaptable** - Spaces should be able to change efficiently to new occupancies and use.

Universal Accessibility

- **More Than Code** - Explore going beyond code minimums on all projects.
- **Universal Access** - Navigating campus and building interiors must accommodate people of all abilities.
- **Equity, Diversity and Inclusion** - Be pro-active and integrate EDI in all project planning and design.
- **Pedestrian Focused** - Promote campus walkability and recognize significant on campus living.

Safety and Security

- **Healthy Campus** - promote student health and personal safety on campus and inside buildings.
- **Access Control** - Ensure buildings can be secured during off-hours and access limited as appropriate.
- **Fire/Life Safety** - Meet or exceed code minimums.
- **Wayfinding** - Clear navigation, signage and identifiable main entrances.

Collaboration

- **System Integration** - Mindfully connect systems across buildings and departments.
- **Global** - recognize SAIT as an international institution and prepare students for the world.
- **Applied Learning** - Reflect in-person, hands-on learning, and education between peers and across faculties.

Sustainability

- **Net-Zero** - Near net-zero by 2040.
- **Local** - Source products and materials locally wherever possible.
- **Performance Requirements** - Follow SAIT guidelines and explore exceeding them where possible.

Intelligent Bldg Infrastructure

- **BIM** - Building Information Modeling used from design through to asset management.
- **Smart Campus** - technology integrated into BMS and compatible across campus.
- **Strategic** - Projects must contribute to holistic campus infrastructure goals.

Responsible Development

- **Sustainable Operations** - Optimize life cycle costs, ease of maintenance, and material/finish longevity.
- **Strategic Growth** - New components must fit within foretasted growth and priorities.
- **Triple Bottom Line** - Consider investment value fiscally, socially and environmentally.

PROJECT DEVELOPMENT

1. Project Planning

.1 SAIT Campus Development Framework - is a document intended to outline a plan for SAIT's physical campus(es) that will accommodate the needs of the institution over the next 3 years. It examines three things: student enrolment projections, the utilization of existing space, and the condition of existing facilities. It should be reviewed by consultants at project onset.

.2 Strategic Plan 2020-2025 "New World. New Thinking" – outlines the high-level institutional goals for SAIT. Projects should be evaluated for their alignment with the overall vision and five principles established in this document.

2. Project Delivery (Future Section)

.1 Roles and Responsibilities
.2 Procurement of Services
.3 Pre-Design
.4 Schematic Design
  .1 Report / Drawing submission requirements
  .2 Cost Estimate / Budget Update
  .3 Approvals
.5 Design Development
  .1 Report / Drawing submission requirements
  .2 Cost Estimate / Budget Update
  .3 Approvals
  .4 Development Permit / Liaison
.6 Construction Documents
  .1 Drawing Progress submissions (eg. 60%, 95% Pre-Tender)
  .2 Review and response process
  .3 Building Permit
.7 Construction Procurement
  .1 Tender packages
.8 Construction and Field Review
.9 Project Hand-Over
.10 Post Occupancy Evaluation

3. Commissioning

.1 Level of commissioning should be established early in project development and necessitates collaborative interaction between SAIT Facilities Management, project consultants, contractors,equipment vendors, third party testing agencies, and a selected Commissioning Authority (CxA), who is responsible for the process. Size and complexity of project will determine extent of service provided by the CxA.

.2 The commissioning process is intended to provide Facilities Management a finished product that is essentially free from defects and operational deficiencies according to industry standards (e.g., CSA Z320- Building Commissioning Standard, ASHRAE Standard 202- Commissioning Process for Buildings and Systems).

.3 LEED projects must be reviewed for additional commissioning requirements.

4. Heritage Buildings

.1 Existing buildings and campus features should be evaluated for their historic and cultural importance to determine acceptable levels of renovation or demolition.
.2 Opportunities to improve poor conditions of accessibility, EDI, health, and safety should be explored where possible *(refer to gap analysis process under Renovations*).
.3 Heritage Hall is a federal and provincial legally protected and recognized historic resource. It is also a municipal City-Wide Historic Resource without legal recognition. Review of legislation and character defining elements is required for all renovations or new construction that will affect the building.
.4 Renovation of Heritage Hall must adhere to the *Standards and Guidelines for the Conservation of Historic Places in Canada.*

5. Sustainability

.1 Purpose: These Design Guidelines are intended to set the minimum requirements and aspirational measures for new construction and renovations. Projects shall be designed to reflect sustainable design principles including reduced environmental footprint, optimized lifecycle costing, efficiency of energy and resource consumption, improved human health and wellness, and a triple bottom line approach to decision making that balances environmental, social, and financial benefits.
.2 Applicability: These Guidelines should be applied to all new construction and major renovation projects. For minor renovation projects, including infrastructure upgrades and material replacements, applicable requirements should be followed based on the scope of the renovation and the nature of the systems and materials affected. For such projects, coordinate with the Project Manager to confirm applicable requirements.
.3 Referenced Codes and Standards: The following standards shall be referenced in these guidelines and shall be referenced by project design teams as required during design and construction:
  .1 National Energy Code of Canada for Buildings 2017
  .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 – 2019 Energy Standard for Buildings Except Low-Rise Residential Buildings
  .3 ASHRAE Standard 209-2018, Energy Simulation Aided Design for Buildings except Low Rise Residential Buildings
  .4 ASHRAE Standard 62.1 – 2016 Ventilation for Acceptable Indoor Air Quality
  .5 ASHRAE Standard 55 – 2017 Thermal Comfort Conditions for Human Occupancy
  .6 US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) Versions 4 and 4.1 Building Design and Construction, Interior Design and Construction
  .7 International WELL Building Institute (IWBI) WELL Building Standard Version 2
  .8 Association for the Advancement of Sustainability in Higher Education (AASHE) Sustainability Tracking, Assessment & Rating System (STARS) Technical Manual Version 2.2

  Definitions
  New Construction: A new regularly occupied building, or an addition to an existing building, with a project floor area ≥ 500 m2.
  Major Renovation: An alteration within a regularly occupied building with a project floor area ≥ 500 m2 and typically including work on exterior building shell, structural components, and MEP systems.
  Minor Renovation: An alteration within a regularly occupied building with a project

floor area < 500 m2 or where the scope of work is limited primarily to interior finishes and fixtures (IE. Does not include major impact to building shell, structural, MEP systems).

.4 Integrated Design

.1 All new constructions and major renovations shall follow an integrated design process that creates synergies across disciplines and targets a higher level of sustainability performance as described in the following sections.

.2 Conduct an integrated design visioning workshop during the Pre-Design or Concept Design stage which includes the full range of applicable design discipline consultants and owner representatives. The Architect or Sustainability Consultant shall facilitate the workshop and distribute the workshop summary which includes a summary of topics discussed, targets set, and questions/action items for Pre-Design stage.

a) Recommended attendees: Architect, Engineers (Structural, Mechanical, Electrical, Civil), Landscape Architect, Interior Designer, Acoustic Consultant, Building Envelope, Sustainability Consultant, Energy Modeler, Project Manager, Facility Maintenance, User Group Representatives, SAIT Green Building Technologies Lab, and other stakeholders who may provide input at early stage.

b) Required topics to be summarized in the meeting output include project vision, energy and greenhouse gas (GHG) reduction targets, questions and action items for design stage, opportunities for innovation and living lab.

c) Prior to the visioning workshop, coordinate with the Project Manager to confirm if any green building certifications (e.g., LEED, WELL) are under consideration. If required, conduct a feasibility analysis for certification during Pre-Design to confirm green certification objectives.

.3 At each subsequent stage, host at least one sustainable design workshop or coordination meeting to review the notes from the previous workshop / coordination meeting and update status on minimum sustainability requirements, energy and GHG reduction targets, and any other measures including aspirational measures. Confirm the list of attendees and agenda for workshop sessions with the Project Manager prior to distribution.

.5 Energy and Carbon

.1 For all new constructions and major renovations, comply with the minimum energy use and GHG emissions targets identified below under the ‘Required’ column. Consider meeting the target under ‘Stretch Goal’ column as aspirational target. Analyze the project and select the target no later than the completion of Schematic Design phase. For projects where it is not clear whether the major renovation criteria are achieved, confirm with the Project Manager.

Table 1: Energy Use Targets by Building Type

Building Type	Energy Use Target (% better than NECB 2017)		GHG Emissions Target (% better than NECB 2017)	
	Required Target	Stretch Goal	Required Target	Stretch Goal
Academic (Classroom)	15%	25%	15%	25%
Laboratory	15%	25%	15%	25%
Office	15%	25%	15%	25%
Residence	15%	25%	15%	25%

Retail (cafeteria, bookstores, etc.)	15%	25%	15%	25%
Library	15%	25%	15%	25%
Athletic (gym, arena, pool, etc.)	15%	25%	15%	25%

.2 For all major renovations and minor renovations, achieve a reduction in Lighting Power Density (LPD) of at least 25% below the maximum allowances of NECB 2017.

.3 For new buildings and major renovation projects, at the completion of Pre-Design stage, issue an Energy Concepts Report which identifies energy benchmarking information, energy target setting, major energy end uses, and preliminary list of opportunities for Energy Conservation Measures (ECMs) as well as sources of operational GHG emissions and reduction measures. Achieving energy optimization should be prioritized in the following order:
   a) Load reduction: reduce energy loads through passive design
   b) Energy efficiency: use efficient mechanical equipment and technology
   c) On-site generation: generate renewable energy on-site

.4 At the completion of each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents) submit an energy modeling report, signed by the Energy Modeler, which reports the modeled energy performance of the project and demonstrates whether the targeted energy savings percentage is being achieved. Energy modeling shall be conducted in compliance with ASHRAE Standard 209-2018, Energy Simulation Aided Design for Buildings except Low Rise Residential Buildings.

.5 Complete enhanced commissioning for major energy consuming systems, energy generation systems and the building envelope. The Commissioning Authority shall be added to the project team no later than the completion of Design Development. The Commissioning Plan and associated activities shall be consistent with Fundamental and Enhanced Commissioning as defined by LEED Version 4 Building Design and Construction rating system.

.6 Large cooling equipment and other refrigerant systems as applicable shall comply with the 'Enhanced Refrigerant Management' credit as described in LEED Version 4 Building Design and Construction rating system.

.7 During Design Development Stage, confirm the project requirements for energy metering, submetering, reporting, and smart building integration. Develop a preliminary Energy Metering Plan for submission and approval in the 100% Design Development Stage. Update the Plan during preparation of Construction Documents and present to the Project Manager and other stakeholders, as appointed by the PM, for comment and approval.

.8 All refrigerators and ice machines shall be ENERGY STAR rated and no more than 5 model years old.

.6 Health, Wellness and Indoor Environmental Quality

.1 During construction, the prime contractor shall develop and implement an Indoor Air Quality (IAQ) Management Plan for the project. The IAQ Management Plan shall be consistent with the approach and considerations identified in the Construction Indoor Air Quality Management Plan credit as described in LEED Version 4 Building Design and Construction rating system.

.2 Use the Green Building Technologies (GBT) Product Directory as a resource while making material selections where possible. The Product Directory contains a list of preferred materials and effort should be made to incorporate materials from the list to the extent feasible.

.3 Consider meeting the following requirements as aspirational measures. During the Schematic Design stage, review with SAIT the opportunities, challenges, and key considerations for achieving aspirational measures and obtain direction from the Project Manager whether these measures should be incorporated.
   a) Meet the requirements of the 'Low Emitting Materials' credit as defined by LEED v4.1 Building Design and Construction rating system for as many product categories as feasible.
   b) Meet the requirements of the 'Enhanced Indoor Air Quality Strategies' credit as defined by LEED v4 Building Design and Construction rating system.
   c) Meet the requirements of Feature V03 Circulation Network as defined by WELL Building Standard v2 where feasible to promote active design.

.7 Materials and Waste
   .1 During construction and demolition work, create and implement a Construction Waste Management Plan for all projects and divert at least 80% of non-hazardous waste from landfill. The activities shall be consistent with the 'Construction and Demolition Waste Management' credit Option 1, Path 2: Divert 75% and Four Material Streams' as described in the LEED Version 4 Building Design and Construction rating system.
   .2 Evaluate material and product options to identify potential to incorporate recycled materials and local materials that are regionally sourced. Regionally sourced products and materials are those that are extracted, processed, and manufactured within 800km (500 miles) of the project site. At each design submission, summarize major products or materials that are selected to be recycled materials or regionally sourced.
   .3 For new buildings and major renovations at the completion of Pre-Design stage, issue an Embodied Carbon Reduction Report (ECRR) which identifies embodied carbon benchmarking information, embodied carbon reduction target setting, anticipated major sources of embodied carbon impact, and preliminary list of opportunities for Embodied Carbon Reduction Measures. Update the ECRR and submit for review at the completion of each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents).
   .4 Incorporate measures to reduce Embodied Carbon of Construction where practical, including selection of structural materials to reduce embodied carbon (such as mass timber), specification of preferred alternatives (such as low-carbon and/or Portland-Limestone cement, concrete that uses carbon capture technologies, and recycled materials such as fly ash or slag as supplementary cementing material and recycled steel), efficient structural and architectural design to reduce material usage, and material substitution of major non-structural components (e.g. cladding, insulation, glazing systems). Refer to the Structural Systems Sustainability Criteria within the Structural Systems section for more details.
   .5 Consult with the Project Manager to confirm whether Lifecycle Assessment (LCA) analysis and reporting is included in the design consultant scope of work. If included, a reduction of 20% in embodied carbon should be targeted, as a minimum (consult with LEED Version 4.1 Building life-cycle impact reduction for calculation methodology). Consider a reduction of 30% in embodied carbon as an aspirational measure. Analyze the project and select the target no later than the completion of Schematic Design phase. LCA shall be conducted starting in Schematic Design and updated in each subsequent phase. LCA results shall be included within the ECRR updates at each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents).

.6 Consider meeting the following requirements as aspirational measures. During the Schematic Design Stage, review with SAIT the opportunities, challenges, and key considerations for achieving aspirational measures and obtain direction from the Project Manager whether these measures should be incorporated.
   a) Meet the requirements of the 'Environmental Product Declarations' and 'Material Ingredients' credits as defined by LEED v4.1 Building Design and Construction rating system.

.8 Landscape and Biodiversity
   .1 Design project landscaping in a manner that eliminates or reduces potable water consumption for irrigation by at least 50% by minimizing turf grass and installing native and drought-tolerant plants, and provides habitat for local wildlife, and provides occupants with access to nature. Landscape architect to coordinate plant selection with the ground maintenance team.
   .2 Consider meeting the following requirement as aspirational measures. During the Schematic Design stage, review with SAIT the opportunities, challenges, and key considerations for achieving aspirational measures and obtain direction from the Project Manager whether these measures should be incorporated.
      a) Meet the requirements of the 'Light Pollution Reduction' credit as defined by LEED v4 Building Design and Construction rating system.

.9 Water and Resources
   .1 For non-process plumbing fixtures, achieve a minimum overall indoor water use savings of 35% in comparison to a baseline consumption as defined by LEED v4 Building Design and Construction rating system.
   .2 For process equipment, all dish washers and clothes washers shall be ENERGY STAR rated. Do not use once-through cooling with potable water for any equipment or appliance that reject heat.
   .3 Consult with the Project Manager to confirm, no later than the completion of Schematic Design phase, whether rainwater management is a good candidate for the project. If pursued, in a manner best replicating natural site hydrology processes, retain on site the runoff from the associated percentile of local rainfall events through infiltration, evapotranspiration or capture and reuse. Satisfy one of the following two compliance options:
      a) Option 1: Percentile of Rainfall Events
         All Projects – Manage on site the runoff from the developed site for 80th percentile of local rainfall events.
         Zero Lot Line Projects Only – Manage on site the runoff from the developed site for 70th percentile of local rainfall events.
      b) Option 2: Natural Land Cover Conditions
         Manage on site the annual increase in runoff volume from the natural land cover condition prior to any disturbance to the post-development condition.

.10 Tracking, Reporting and Feedback
   .1 At the completion of Pre-Design and each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents), submit a Sustainable Design Report for review and sign-off by the Project Manager which summarizes the status of each Minimum Requirement and any other sustainability initiatives. Include a copy of the Sustainability Requirements Tracking Matrix with this report. The Sustainable Design Report shall also summarize aspirational measures and design features which are intended to deliver holistic sustainability benefits beyond the minimum requirements. Energy Concepts Report, Energy modeling reports, minutes from sustainable design workshops, Embodied Carbon Reduction Reports, and LCA results (if within scope) shall also be included in the Sustainable Design Report, as applicable depending on the design stage.

.2 For renovation projects, confirm in Pre-Design / Schematic Design which measures are to be reported in the Sustainable Design Report. Obtain approval from the Project Manager prior to the preparation of 100% Schematic Design Report.
.3 Project will be required to report data needed to complete the reporting for the STARS program. Coordinate with the Project Manger to confirm information that is required.

6. Equity Diversity and Inclusion (EDI)

.1 The Office of EDI and the EDI Strategic Plan establish goals for a “Healthy Campus” that must be reflected in new project development. Project teams are encouraged to consult with and invite the participation of the Office of EDI in building design phases.
.2 Physical infrastructure and spaces must be designed with intent to recognize the diversity of the SAIT campus and provide all campus members with a strong sense of belonging.
.3 Building design should promote agency, choice, and positive interaction through a diversity of space options including those with various levels of socialization, less institutional learning environments, and community / cultural areas.
.4 New projects are required to implement a form of gender-inclusive washroom facility. The quantity, type, and configuration will be determined by taking into consideration the location, adjacent facilities, user-groups, and feedback through consultation with the Office of EDI.
.5 Renovation projects should look for opportunities for improved inclusivity of washrooms and public spaces.
.6 Recognize international student body and their specific needs.
.7 Explore opportunities to reflect indigenous peoples and traditional lands.
.8 Inclusive spaces and features should be explored in consultation with Facilities Management and the Office of EDI, including, but not limited to:
  .1 Service dog water and relief areas
  .2 Fountains and bottle refill stations
  .3 Wellness rooms
  .4 Mothers’ rooms
  .5 Needle use and disposal
  .6 Prayer / multi-faith rooms
  .7 Ablution stations
  .8 Sensory rooms
  .9 Child rooms
  .10 Universal signage
  .11 Use of braille
  .12 Additional washroom facility accessories (i.e., Adult and baby change tables)
  .13 Various consideration for sight and hearing impaired

7. Accessibility

.1 New facilities are expected to *exceed* building code minimums where possible in all spaces (i.e., washrooms, classrooms, faculty spaces, etc.)
.2 Project teams are encouraged to explore higher compliance standards than building code, including CSA Accessible design for the built environment, City of Calgary Access Design Standards, and The Rick Hansen Foundation Accessibility Certification.
.3 Accessibility of existing exterior and interior conditions should be thoroughly reviewed and improved wherever possible. Areas outside the immediate scope but adjacent to

projects boundaries should be considered through the *gap analysis* process described under Renovations.

8. Interior Space Planning

.1 This section is intended to provide high level considerations for interior planning, it should be read in conjunction with the technical guidelines in this document and supplemental documents including:
  .1 Campus Development Framework
  .2 SAIT EDI Strategic Plan
  .3 SAIT Accessibility Standards

.2 Consultants will work with the SAIT project team and provided functional program to develop suitable floor plans and space allocations, ensuring flexibility for various layouts and future use changes.

.3 Space planning considerations:
  .1 SAIT space standards
  .2 Specific project end users
  .3 Industry best practices
  .4 Flexibility and futureproofing
  .5 Accessibility standards
  .6 Safety and security

.4 Flexibility considerations:
  .1 Flexibility should be considered while in preliminary development of partition types, proportions of space, column locations, furniture types, built-in elements, and access to infrastructure like power.
  .2 Base future flexibility on expected length of use – some tenants will be more temporary than others.
  .3 Furniture should be moveable and adaptable for SAIT Facilities team, but not easily moveable by the end users such as students and faculty.
  .4 Purpose-built pre-manufactured furniture solutions are preferred as a first option wherever possible; millwork is acceptable where pre-manufactured solutions are not available.

.5 Hybrid learning & teaching requirements and standards should be discussed on a per-project basis.

9. Smart Systems Integration

1. Refer to the following electrical section relating to Smart Systems Integration.
    1. Mechanical Systems, Section 14 - Building Management Systems
    2. Div 26, Section 3.2 – Basic Electrical Requirements, Overarching Principals
    3. Div 26, Section 4.5 – Basic Electrical Requirements, Metering
    4. Div 26, Section 12 – Lighting Controls
    5. Div 28, Section 4 – Access Control
    6. Div 28, Section 5 – Camera System
    7. Div 28, Section 6 – Intrusion Detection
    8. Div 28, Section 11.1 – Fire Alarm, Access Control

10. Stakeholders

.1 Each project will need to be evaluated for appropriate involvement and potential workshops with internal SAIT stakeholders, which may include:

.1 Facilities Management
   a) Planning, Design and Projects
   b) Integrated Facility Maintenance Contractor
   c) Health, Safety and Environment Services
   d) Security
   e) Accessibility
   f) Sustainability
   g) Locksmith
   h) Signage / Wayfinding
.2 Information Technology Services (ITS)
.3 Office of Equity, Diversity, and Inclusion
.4 Academic Schools
.5 Centre for Academic Development and Innovation
.6 Indigenous Consultants

11. Reference Documents

.1 Various speciality documents need to be reviewed in conjunction with the Facility Design Guideline, including:
   .1 SAIT Campus Development Framework
   .2 Strategic Plan 2020 – 2025 – New World. New Thinking.
   .3 Equity, Diversity, and Inclusion (EDI) Strategic Plan 2020-2025
   .4 Indigenous Learner Success Strategy 2019/2021
   .5 Access Control Procedure (AD.4.1.1)
   .6 SAIT Access Control Standards (In development)
   .7 Door Hardware Standards
   .8 CCTV Surveillance Procedure (AD.4.4.1)
   .9 Electronic Security Device Standard
   .10 SAIT Fibre Infrastructure and Wi-Fi Upgrade – Statement of Requirements
   .11 Workplace Space Standards
   .12 Campus Exterior Accessibility Review (In development)
   .13 Brand Guidelines
   .14 Wayfinding and Signage Standards
   .15 Furniture Standards
   .16 Workplan Space Standards (In development)
   .17 Sustainability Plan (In development)
   .18 Standards and Guidelines for the Conservation of Historic Places in Canada (For development within Heritage Hall)

DIVISION 6 WOOD, PLASTICS, AND COMPOSITES

1. Architectural Woodwork

2. General

.1 Reference Standard: The Quality Standards for Architectural Woodwork by the Architectural WoodworkManufacturers Association of Canada (AWMAC), together with authorized additions and amendments, shall form part of this project specification. Where differences occur between the drawing, specification requirements, and the Manual, the more restrictive requirement shall prevail.

.2 Quality standards for materials and installation shall be in accordance with the definitions of terms referenced in the current edition of the AWMAC Manual.

- .1 'Custom' Grade: Typical Standard
- .2 'Premium' Grade: Areas with enhanced architectural character, such as, executive boardrooms and offices, ceremonial rooms, performing arts facilities, prestigious areas of high public use, etc.

.3 General Notes

- .1 Pre-manufactured furniture is preferred over millwork where possible; millwork is acceptable when pre-manufactured solutions are not available.

3. Architectural Wood Casework Specifications

.1 Cabinet Construction

- .1 All cabinets to be flush overlay construction.
- .2 All exposed and semi-exposed surfaces to be high pressure laminate (HPL) as a minimum, low pressure laminate can be used for concealed surfaces.

.2 Space Specific Materials for Countertops and Worksurfaces

- .1 Laboratory Classrooms: Preference is for pre-manufactured casework (refer to Division 11).
- .2 Kitchens:
  - a) White birch plywood construction (interior and boxes) is a minimum standard at all areas with possible moisture exposure.
  - b) No low-pressure laminate - Use HPL with PVC edges.
  - c) Countertops: Solid surface, plastic laminate with PVC edge (with veneer core plywood substrate) in high-use /high traffic areas, plastic laminate with rounded self-edge (no exposed seam) in low-traffic areas, and quartz composites are all acceptable materials.
- .3 Classrooms, Boardrooms, Meeting Rooms:
  - a) Low pressure laminate cabinet interiors (concealed) are acceptable in these spaces, consultant to consider millwork and room function when selecting materials.

.3 Hardware

- .1 General Design Considerations:
  - a) Finish hardware (handles, pulls, drawer glides, etc.) should meet minimum accessibility requirements, and should also meet commercial/ institutional applications.
  - b) Consider soft-close hardware on a per-project basis.
  - c) Consultant to consider design continuity within a building when selecting hardware.

DIVISION 7 THERMAL & MOISTURE PROTECTION

1. Building Envelope (General)

.1 All SAIT infrastructure shall follow principals of Pressure Equalization in Rainscreen Wall Systems. This design approach is recommended by SAIT and has been adopted by Alberta Infrastructure in their Technical Design Requirements for Facilities (as detailed in the *Technical Design Requirements for Alberta Infrastructure Facilities – Feb 2018*). The system is described as “PERSIST” or Pressure Equalized Rain Screen Insulated Structure Technique is characterized by the following:
- .1 Exterior cladding covering an air space that is pressure equalized with the exterior.
- .2 Insulation mainly located to the exterior of structural components, in direct contact with and exterior to the air barrier system.
- .3 An air barrier system that also functions as a vapour retarder installed exterior to and supported by the structure.

.2 While other design approaches are possible, SAIT recommends the approach because, properly implemented, it is relatively forgiving and minimizes the following:
- .1 Moisture deteriorating the building envelope due to ingress of exterior bulk moisture and trapping of condensation from relatively humid air introduced into the envelope by air exfiltration. Provide drainage and weep holes in addition to space for pressure equalization.
- .2 Detrimental effects on air barrier from exposure to:
  a) UV radiation
  b) Extreme temperature fluctuations, and
  c) Moisture.
- .3 Thermally induced movement of structural elements and any connected air barrier.

.3 Detail the building envelope to ensure that water, snow and ice sheds safely from exterior surfaces and is not trapped on or allowed to build up or to enter the assembly to cause deterioration or staining.

.4 Materials used in the building envelope assembly should be suitable for the environmental conditions to which each will be exposed, including during the construction period. Materials should provide a service life consistent with accessibility for maintenance of building components and planned building life.

.5 Select envelope assemblies and materials minimize maintenance requirements.

.6 Inert materials that are timeless, durable and non-stainable are preferred.

.7 Building Envelope Commissioning:
- .1 After basing Owner’s envelope life expectancy, retain a Building Envelope Commissioning Authority (BECA) to conduct 3rd party peer review.
- .2 Design review of Drawings, Details and Specifications, typically at 50%, 95% and 100%
- .3 Review for thermal performance, bulk moisture management, air and vapour barrier continuity, condensation, durability, life expectancy, buildability, compatibility
- .4 Examine the need for air, water, thermal, structural, condensation resistance and U-value testing and test accordingly
- .5 Identify, review and comment on the construction of mock-ups of typical envelope assemblies
- .6 Building Envelope Performance Testing:
  a) Air leakage
  b) Water penetration resistance

- Must pass all mock-up tests prior to proceeding with full scale construction
- Periodic Field Review and Quality Assurance Services, typically a minimum weekly review during full scale construction

c) Conduct Random Building Envelope Performance Testing including: air leakage/smoke testing, water penetration resistance, adhesion testing, and compatibility.
d) Confirm thermal performance of building envelope using infrared thermography

2. Air and Vapour Barrier

.1 Design building envelope components to meet the Material Performance: Provide air and vapour membrane materials which have an air permeance no greater than0.02 L/(m²·s) at a pressure differential of 75 Pa, when tested in accordance with ASTM E2178 (unmodified) or CAN/ULC S741. Water Vapour Permeance: Provide air and vapour membrane materials that have a water vapour permeance rating of 15 ng/(Pa·s·m2) (0.26 US perms) or less, when tested in accordance with ASTM E96/E96M.
.2 Locate the plane of the sealing element (usually a membrane) exterior to the major structural elements.
.3 The air barrier typically consists of a number of materials acting together as a system; minimize the number of materials used to form the air barrier.
.4 Minimize changes of plane in the air barrier system. Avoid changes of plane at air barrier membrane connections to window frames. Where unavoidable, details a method of supporting the transition such as galvanized sheet metal transition strips (mechanically fastened) to assist in bridging abrupt changes.
.5 Minimize penetrations through the air barrier system. Where unavoidable, detail a continuous air barrier that is easily constructed, such as transition plates around steel elements, and membrane collars or collared sleeves at pipe and conduit. Do not use materials that cannot be sealed if alternatives are available.
.6 Connections to Adjacent Assemblies and Materials: Provide air and vapour membrane accessory and transition materials to prevent air leakage at the following locations:
  .1 Foundation and walls, including penetrations, ties and anchors.
  .2 Walls, windows, curtain walls, storefronts, louvers and doors.
  .3 Different assemblies and fixed openings within those assemblies.
  .4 Wall and roof connections.
  .5 Floors over unconditioned space.
  .6 Walls, floor and roof across construction, control and expansion joints.
  .7 Walls, floors and roof to utility, pipe and duct penetrations.
  .8 Seismic and expansion joints.
  .9 Other potential air leakage pathways in the building enclosure.
.7 Identify in drawings, all elements that make up the continuous air barrier. Provide large scale details to show how air barrier continuity will be achieved, how differential movements will be accommodated, and where construction sequence must be considered.
.8 Avoid the use of systems or details that rely on sealants or caulking as air barrier elements.
.9 Do not consider polypropylene and polyethylene woven/ non-woven films, or plastic as air barrier elements.

3. Sealants

.1 Apply non-staining sealant materials to achieve:
  .1 Seals to the building envelope systems and around openings in the building envelope systems as required to prevent water ingress.
  .2 Seals around and over cavities in or behind surface elements to allow effective infection prevention and control (note that sealant around door frames must include joints at bottom of door frames (between floor finish and frames).
  .3 Sealed joints between dissimilar or similar materials to allow a smooth or even transitions.
  .4 Sealed expansion control joints in the building envelope systems or structural systems to allow movement.
  .5 Sealed joints that are not at the vapour/air barrier level.

4. Insulation

.1 Design insulation to be secured mechanically and in direct contact with the air barrier system.
.2 Design to prevent condensation on interior surfaces due to thermal bridging.
.3 Specify effective RSI values for envelope components as part of an integrated design to provide the mandatory LEED credits and minimum effective RSI value as required by National Energy Code for Buildings (NECB).
.4 Insulation thickness and detailing shall meet or exceed the Alberta Building Code and National Energy Code regulations in force.

5. Roof (General)

.1 Design the roof and provide details to meet or exceed the requirements of the ARCA Roofing Application Standard Manual or, a combination of ARCA and the manufacturers supplied warranty.
.2 Prepare roof plans that identify slope elevations from high points to drains. Indicate locations of drains, roof mounted equipment, roof penetrations, dividers and expansion control joints. Reference roofing detail drawings to the roof plan.
.3 On new applications, the standard roofing membrane system shall be a two-ply modified bituminous membrane (SBS) that includes a combined 20-year Certificate of Assurance from the Alberta Roofing Contractors' Association and Manufacturer's Warranty. For roof renovations where an ARCA warranty is already in effect, only ARCA accredited roofer shall be used. Roof detail designs are typically reviewed prior to, during and after construction, by a roofing consultant hired by SAIT. All roof details shall be in accordance with the Alberta Roofing Contractors' Association Roofing Manual.
.4 SBS Roofing: Modified Bitumen Roofing:
  .1 Modified bituminous membrane systems can be categorized as a conventional design (membrane applied above insulation), a protected membrane design (membrane applied below insulation) or a combination design (membrane applied between two insulation layers).
  .2 For all designs the modified bituminous membrane shall be uniformly adhered to and supported by an accepted substrate. The primary membrane shall be joined and sealed to the vapour retarder membrane extension at perimeters and penetrations.
  .3 Application of modified bituminous roofing systems must not be undertaken when the air temperature at roof level exceeds that of manufacturers

recommended installation procedures.

.4 Roofing systems components shall not be applied during periods of rain, snow or similar moisture conditions or as recommended by manufacturer. Follow manufacturer's recommended installation instructions.

.5 Insulation design shall meet minimum requirements according to NECB regulations.

.6 When developing a modified bituminous membrane system design, the Consultant shall consider the following:

a) The ARCA Warranty Certificate does not warranty the roof drainage system.
b) Manufacturer's Warranty conditions.
c) Ensure that the drainage system is designed in accordance with the governing Plumbing and Building Code to provide positive drainage and accommodate minimum roof drainage slopes in accordance with design and materials specified.

6. New Roof Design Considerations

.1 New roofing designs other than 2-ply SBS shall be considered on an individual project by project basis by the Owner and the Consultant.

.2 Minimum roof slope to drain on flat roof assemblies shall be in accordance with Manufacturer's Warranty and no less than 2% and no greater than 4%.

.3 Insulation shall be no less than 50mm thick at the lowest point (at drains, etc.). Insulation to be Type IV EPS rigid insulation or polyisocyanurate board to ASTM-C1289, Type II, Class 1, Grade 3 (25psi) for all new roof assemblies.

.4 Self-sealing flexible membrane shall be installed below all roofing and metal flashing. Metal roofing and flashing is for shedding purposes only and is not considered waterproofing.

.5 Where practical, provide roof access from the interior of the building with roof ladders, or access designed in conformance with Alberta Safety Code regulations.

.6 Each contained roof area must be designed to have a minimum of two drains. Provide overflow scuppers where a structural hazard would result from a blocked drain. Do not locate scuppers at roof expansion joints and over building access points. The minimum size of scupper to be 150mmx300mm installed 50mm above the roof membrane. Do not use scuppers to replace roof drains.

.7 Maintain constant elevations along the perimeter of a contained roof area.

.8 Minimize penetrations through the roof. Provide curbs at all roof penetrations other than drains. Curbs shall be provided for all roof equipment penetrations; the top of the curb shall be a minimum of 200mm above the roof membrane.

.9 Provide 1m of clearance around and between curbs and parapets to facilitate drainage.

.10 Design for emergency or overflow drainage to be incorporated into the roof drainage systems. The ARCA Warranty Certificate requires that emergency drainage be provided in designs using "flow control" type of roof drains.

.11 Incorporate building control joints into roofing where movement is anticipated.

.12 Splash pads shall be installed beneath drain outlets discharging water onto lower roofs to prevent the erosion of the membrane protection and damage to the primary membrane.

.13 Incorporate roof divider systems to divide the roofing system into manageable sections and to protect the membrane from stress related damage. Roof area dividers are required at changes in roof deck direction or deck construction type. Please consult with the membrane manufacturer for their roof divider requirements.

.14 If plaza-type decks are introduced as part of the roof design, drains at both deck and

membrane levels are required. The plaza deck should be ventilated, and geotechnical filter fabric should be used to protect the insulation layer. Additionally, a drainage mat should be used in between the insulation layer and membrane.

.15 Provide removable precast paver units or an additional layer of traffic membrane around roof top equipment, plaza decks and for access paths.

.16 If equipment on the roof requires servicing, provide main access to the rooftop from within the building, via a stair. Where practical, connect additional separate roof levels with external wall mounted caged ladders designed to meet or exceed safety regulations.

.17 Where parapets or curbs are used they shall extend a minimum height of 305 mm above the finished roof surface.

.18 The top surface of the parapet wall shall be sloped towards the roof when the width of the parapet is greater than 100 mm. The top of the parapet wall must have PWF wood blocking installed which can provide holding power for nails and/or screws used to secure the metal cap flashing.

.19 Fall arrest and window washing equipment system drawings and specifications shall be provided in conformance to current building and life safety codes and should be prepared by a professional Structural Engineer, licensed in Alberta. Consideration shall be given for minimum 1100mm-high parapets to be used as fall-protection where appropriate.

.20 It is recommended that extruded polystyrene insulation be installed in multiple layers, staggered, where each board is maximum 50mm thick. Where multiple layers of polystyrene insulation are required, the boards shall be adhered together with a compatible non-flammable insulation adhesive recommended by the insulation manufacturer.

.21 When specifying plastic foam insulation, the design authority must ensure compliance with the Alberta Building Code relative to the use of thermal barriers, as this falls outside the expertise of the roofing contractor.

.22 If a green roof is to be considered:

- .1 Consider all consequences and provide leak detection systems which integrate with building automation, to all areas of green roof and landscaping and all areas of paving, pathways and hard landscaping associated with such green roofs and landscaping where these are location above programmed space.
- .2 Provide the ability to irrigate plantings for the first year of growth.

.23 If photovoltaics are to be considered:

- .1 Determine if system is to be anchored or ballasted. Preference shall be given to ballasted systems to reduce thermal bridging conditions.
- .2 Provide traffic membrane in and around PV panel field. Allow 1200mm aisles as required by ARCA for maintenance between rows of PV panels as possible
- .3 PV panels to be set minimum 3000mm back from inside edge of exterior parapets

7. Re-Roof Design Considerations

.1 Re-roofing should only be done after a cut test and roof condition assessment outlining roof failures are documented by an ARCA Certified Roofing inspector.

.2 Where ARCA warranty is in effect, only an ARCA accredited roofer shall be used for retrofit or repairs.

.3 Cut tests should be done on all roof zones prior to preparation of re-roofing specifications and drawing details.

.4 All re-roofing drawing details and specifications should meet or exceed ARCA's Roofing Application Standards Manual.

.5 Minimum roof slope for flat roof sloped insulation shall be 2%.

.6 Insulation shall have a minimum depth of 50mm at roof drains. Maximum thickness of primary sloped insulation should be in 50mm layers up to a maximum built-up thickness of 150mm.
.7 Provide a minimum of two roof drains per contained roof area.
.8 Retrofit drains may be used for roof replacements (re-roofing) when cast drains are not practical. Retrofit drains shall be of spun aluminum or copper construction, with a minimum flange width of 100 mm. The flange shall be set in a bed of a compatible sealant and the top surface shall be cleaned and primed to ensure proper adhesion of the membrane flashing base sheet. The drain size shall match that of the existing drain line. The retrofit drain sleeve shall incorporate a seal to prevent back flow from the existing drain line.
.9 New parapet construction should be built with a minimum of 38mm x 140mm wood framing with cap sloped towards the roof.
.10 Remove and reinstall all mechanical roof top equipment to accommodate re- roofing. Raise curbs, ductwork, mechanical piping and electrical services to accommodate roof slopes.
.11 Provide a minimum of 610mm clearance between mechanical curbs.
.12 Specify removal of all redundant rainwater leader piping, hangers, and equipment.
.13 Include mechanical instructions for the removal and re-installation/ replacement of roof top units in the design.
.14 Fall arrest and window washing equipment system drawings and specifications shall be provided in conformance to current building and life safety codes and should be prepared by a professional Structural Engineer, licensed in Alberta.

8. Walls and Foundations

.1 Design exterior walls as “PERSIST” assemblies consisting of:
  .1 Exterior cladding
  .2 Ventilated air space
  .3 Thermal insulation with a fastening system designed to minimize thermal bridging
  .4 Air/Vapour barrier system
.2 Provide weep holes accordingly, in the cladding to allow drainage and pressure equalization of the air space.
.3 Size wall cavities to provide minimum 13mm clearance/ air space between the exterior face of insulation and back face of exterior cladding, or as recommended by cladding manufacturers.
.4 Allow for deflection where walls are associated with structurally framed systems (as opposed to load-bearing systems); locate and detail deflection joints.
.5 Compartmentalize air spaces in the wall cavity to restrict air flow around corners. Compartments should not measure more than 4m in any direction within the cavity in general. Detail and show the location of control joints and compartmentalization baffles in cladding.
.6 Provide moisture control (waterproofing membrane with drainage mat), extruded board insulation, and finish material to foundations.
.7 Radon Gas Mitigation
  .1 Employ techniques to minimize entry of Radon gas and allow for its removal, in accordance with the Building Code. A rough-in for the Radon gas mitigation system is to be installed below the basement floor slab. Coordinate Radon Mitigation with Architectural, Mechanical, Structural, and Environmental requirements on a project-by-project basis.

DIVISION 8 OPENINGS

1. Exterior Windows

.1 The design of the curtain wall shall have mechanically fastened keyed gaskets in the box section and pressure plate.
.2 Do not extend curtain wall to grade at the exterior or to the floor at the interior. Provide an exterior curb or other durable construction to minimize damage due to maintenance and abuse.
.3 Design windows, window treatment and interior surrounds to allow uniform, unobstructed movement of heated room air across glass and frame.
.4 Windowsill flashings: utilize self-sealing membrane flashings compatible products that will remain attached to the wall air barrier system.
.5 Gaskets are to be pre-formed closed-cell foam or rubber products that provide a seal by being compressed into a joint.
.6 Provide large scale details to indicate the plane of air seal of the wall-window interface. Ensure continuity of the air barrier as a crucial element in the installation of the window. This is achieved by incorporating a sealant and backer rod at the interior perimeter seal of the window assembly. The seal must be made continuous to the interior air barrier element to ensure continuity.
.7 Insulation to be placed continuously at the head, jambs and sill.
.8 Slope sill to minimum 5% to allow for proper drainage.
.9 Specify low-emissivity coating(s) for the insulating glass units, selecting surfaces to be coated that provides optimum benefit in the applicable climate zone of the project.
.10 Window Film: When window film is specified, it must be approved by SAIT Facilities Management stakeholders.

2. Exterior Doors

.1 All Exterior doors to be discussed with SAIT on a project-by-project basis, but as a general rule all exterior doors and frames should be insulated.
  .1 Aluminum Doors (Typical at Public Entrances):
    a) Entrance doors are to be by Alumicor, 600B Series “Insuldoor”; 178mm bottom rail, 203mm center rail, 143mm top rail, 146mmstiles. Other equivalent manufacturers are acceptable.
    b) Glazing components: By Pilkington; Outboard Lite = 6mm ‘Optifloat’ Blue-Green, ¼ inch air space, Inboard Lite = 6mm Clear‘Energy Advantage’.
  .2 Hollow Metal Doors: typically used at non-public entrances, side andback doors; glazing options depend on function and area.
  .3 Weatherstrips should be used on all exterior doors; refer to SAIT Access Control Standards for specifications.
  .4 Refer to SAIT Access Control Standards for door hardware requirements.
  .5 SAIT does not permit the use of wired glass; Fire Lite or a similar productis preferred.

3. Interior Doors

.1 All interior doors to be discussed with SAIT on a project-by-project basis.
  .1 Aluminum Doors: refer to 4.1.2.1.1(a); primarily used for office and public service entrance/ reception areas.
  .2 Hollow Metal Doors: typically used at classrooms, labs, interior offices, and storage rooms. Glazing options will depend on the function and area. Non-

sprinklered buildings to use hollow metal doors and pressed steel frames for office entrances.

.2 All Interior Doors are to be discussed with SAIT on a project by project basis, but as a general rule all interior doors and frames should be solid core wood doors in pressed steel frames.
.3 Classroom and stairwell doors to have vision panels; glazing should be tempered safety glass. Interior sidelites should also be tempered safety glass.
.4 SAIT does not permit the use of wired glass; Fire Lite or a similar product is required where glazing is present in rated doors.
.5 Refer to SAIT Door Hardware Standards for door hardware requirements.
.6 Door sizes should consider the room use/ function, as a standard 914mm (36 inch) wide door may not be suitable depending on the use (ie: Skilled Trades or Health & Life Sciences programs). For retro-fit renovations, the widths of doors are to be determined on a case by case basis.

4. Access Doors for Mechanical & Electrical Equipment

.1 Doors shall be sized appropriately to permit effective access for maintenance and operations. Access to cleanouts or wall valves shall be minimum 305mm x 305mm and ceiling access for valves shall be minimum 610mm x 610mm, for hand access. Man access doors to be minimum 610mm x 915mm.

5. Sectional Overhead Doors

.1 General requirements of overhead doors include industrial use application, 76mm (3 inch) track, and thermally efficient glazed vision panels.
.2 Doors should be insulated (assuming exterior O/H door).
.3 Manual or electric operation will depend on Program needs and room function.

6. Coiling Overhead Doors

.1 General requirements of overhead doors include industrial use application, 76mm (3 inch) track, and thermally efficient glazed vision panels.
.2 Exterior doors are to be insulated.
.3 Manual or electric operation will depend on Program needs and room function.

7. Skylights and Sloped Glazing

.1 Skylights and Sloped glazing often create operations and maintenance costs for building owners. SAIT prefers vertical clerestory glazing for roof glazing conditions. Skylights and sloped glazing are not permitted unless approved for use. Clerestory, skylights or sloped glazing shall include the following design recommendations:
  .1 Details of design shall be considered at an early design stage.
  .2 Units shall be accessible for maintenance.
  .3 Air Seal connections shall be accessible and not dependent on sequence of construction.
  .4 Provide interior condensation gutter and connect to mechanical drainage system.
  .5 Make provision for condensation, solar glare or heat gain control.
  .6 Use mechanically keyed, dry glazing seal for both interior and exterior seals.
  .7 Sealed unit shall be minimum:
    a) Heat strengthened exterior lite
    b) 12mm air space

c) 0.060 PVB laminated interior lite.

8. Door Hardware

.1 Refer to SAIT Door Hardware Standards for door hardware requirements.
.2 Doors shall have kick plates on both sides of the door; industry standard for height of kick plates is 203mm (8 inches); consider custom sizes depending on the function and area of door location.
.3 Classroom and Lab doors to have kick down stops, in addition to overhead or floor stops.
.4 Continuous hinges are not preferred due to difficulties with maintenance; any door with proposed continuous hinges must be reviewed by SAIT Facilities Management Group.

DIVISION 9 FINISHES

1. General

.1 Meet or exceed the current Alberta Building Code and fire code.
.2 Materials and finishes should be selected based on durability, maintenance, availability, aesthetics, and the projects sustainability targets.

2. Uses and Application

.1 Space Specific Guidelines (wall, base, flooring, ceilings)
.2 Public Spaces
  .1 Exterior entries (including vestibules):
    a) High-traffic, easily cleanable flooring.
    b) Walk-off mats are brought in seasonally, there's no requirement for specific entrance grill system.
    c) Entrance grill systems can be specified: If there's no drain incorporated into the entrance grill design, required maintenance regiment must be outlined and approved by SAIT.
    d) Staged mat system (coarse, medium, fine), can be considered, review with SAIT PDP.
  .2 Common Corridors: Highly cleanable and durable finishes are required in these areas, considering how future repairs or replacement can be accommodated:
    a) Avoid real stone tiles (marble, limestone, etc.); granite and basalt are possible acceptable stone solutions.
    b) Acceptable flooring solutions: Porcelain tile, resilient flooring.
  .3 Stairs, Ramps (handrails, treads/risers, nosing's, guardrails, etc.):
    a) Resilient stair systems can be acceptable (consider fire ratings in exit stairs).
    b) Other: Consider brightness and visibility when specifying stairwell finishes. Can consider incorporating self-illuminating tread strips for extra visibility.
  .4 Elevators:
    a) Finishes should be durable - needs will vary depending on elevator use (freight vs. passenger).
    b) Consultant to consider the weight of materials selected.
  .5 Washrooms:
    a) Flooring: Porcelain tile with epoxy grout or homogenous sheet flooring. *Avoid: small format tile and concrete.
    b) Walls: Tile (aligned to top of stalls is typical), paint is acceptable where not near fixtures.
    c) Partitions: Both conventional wall construction and toilet stall partitions (gap-free construction) can be considered (refer to Division 10).
    d) Ceilings: Preference is for GWB ceilings.
.3 Learning Spaces
  .1 Classrooms (theory type and computer labs):
    a) Flooring: Carpet tile is frequently used in classrooms, if room is potentially exposed to moisture, switch to resilient.
    b) 4" high Rubber wall base is standard.
    c) Ceilings: Acoustic ceiling tile is preferred, exposed ceilings can be considered if acoustic needs are reviewed.
    d) Walls: paint is standard, chair rail wall protection is recommended depending on furniture layout (i.e. behind chairs). Writable wall finishes are

not recommended, conventional wall mounted whiteboards are preferred.

.2 Classrooms (labs, specialty):
   a) Room use and specialty functions should be reviewed with SAIT prior to selecting finishes (I.e., chemicals used).
   b) Resilient sheet flooring and poured epoxy flooring (with integral base), are acceptable solutions.
   c) Epoxy paint is common wall finish, other cleanable wall finishes can be considered and approved by SAIT PDP team.

.3 Administrative Spaces (meeting rooms, boardrooms, offices):
   a) Flooring: Carpet tile is frequently used in classrooms, if room is potentially exposed to moisture, switch to resilient

.4 Back of House / Service Spaces:
   a) Janitor rooms
      - Floors: Sealed concrete floors, porcelain tile, and resilient sheet are acceptable.
      - Walls: Paint, water-resistant panels at mop sinks (Semi-rigid panels or fiber reinforced panels).
      - Ceilings: painted finish.
   b) Electrical closets, MECH rooms, loading room, and garbage
      - Floors: Sealed concrete floors.
      - Ceilings and Walls: paint.

3. Tiling

.1 General
   .1 Refer to section 09 00 02 ‘Uses and Applications’ for applicable spaces.
   .2 Reference standard: Terrazzo, Tile and Marble Association of Canada (TTMAC).
   .3 Tile Size:
      a) No mosaics (unless approved by SAIT PDP team).
      b) Large format tile: recommend avoiding anything larger than 18” on any edge.

.2 Ceramic Tiling
   .1 Flooring tile: slip resistant, non-glazed porcelain.
   .2 Wall tile: Glazed porcelain.

.3 Grout
   .1 Colour: grout color should be darker than the tile product.
   .2 Epoxy Grout: Specify epoxy grout for all wet or high traffic areas

.4 Install anti-fracture/waterproofing membrane systems in all shower compartments and areas.

.5 Consider the use of uncoupling membranes at porcelain tile floor locations, particularly in high traffic areas, elevator cabs, etc.

.6 In large open spaces, avoid linear/ monolithic placement (i.e. stacked, continuous). In most cases, tile products to have an installation method that includes options such as ashlar, quarter turn, brick, etc. Tile pattern installation to be approved by SAIT PDP department.

.7 Refer to TTMAC association for minimum required control joints.

.8 Edge finishing: consultant to consider finishing of all exposed tile edges.

.9 Additional materials: 5% backstock of materials should be provided (confirm with SAIT PDP group on a per-project basis).

4. Ceilings

.1 General
  .1 Refer to section 09 00 02 ‘Uses and Applications’ for applicable spaces.
  .2 Exposed ceilings: aesthetic consideration and equipment planning, organization and supports shall be considered when planning exposed ceilings.
.2 Consider Access Panels in General (location, size and type)
  .1 Keep a center aisle, minimum 600mm side for access to ducts and pipes on both sides.
  .2 Allow for accessibility to fire dampers for inspection purposes (annual fire code requirement).
  .3 Plan and coordinate potential location for sharing hangers and avoid access issues created by multiple side by side services.
.3 Provide acoustic ceiling treatments as needed; solutions may vary depending on adjacencies, room function and Program needs.
.4 Gypsum wallboard ceiling: lightweight gypsum board, ends square cut, tapered and beveled edges.
.5 Acoustic Tile Ceilings
  .1 Standard Acoustical Ceiling Tile
    a) Mineral Fiber panel.
    b) Acoustics: consider acoustic requirements on a per-project basis, considering when higher levels of absorption are required vs. higher levels of sound isolation.
    c) Basis of Design:
      - Profile: Square, lay-in tile is preferred.
      - *Avoid tegular edge profiles*
      - Size: 610 x 1220mm (2’ x 4’) or 610mm x 610mm (2’ x 2’) are acceptable.
      - Colour: White.
      - In renovations, match to existing.
.6 Wet Lab Acoustical Ceiling Tile
  .1 Cleanable, non-absorbent.
  .2 Vinyl faced tiles preferred.
.7 Metal Acoustic Ceiling Suspension Assemblies
  .1 Ceiling Suspension System: Commercial quality, cold rolled steel, zinc coated shop painted, satin sheen, white die-cut interlocking components.
  .2 Main and cross tee of double weld with rectangular bulb depth.
  .3 Hangars: 2.6mm steel wire, galvanized.
.8 Specialty Ceilings
  .1 Review with SAIT facilities group for suitability of proposed material.

5. Flooring

.1 General Flooring Selection Considerations & Standards
  .1 General
    a) Refer to section 09 00 02 ‘Uses and Applications’ for applicable spaces.
    b) The selection of flooring finishes (carpet, LVT, rubber, linoleum, porcelain, polished concrete, etc.) is to be reviewed and approved by SAIT PDP.
    c) Consideration of maintenance, cleaning and durability is important; the initial cleaning requirements, and preparation of the floor, post-installation, prior to turnover to SAIT should be considered.
  .2 Design Considerations
    a) Limit busy patterned products for field areas of a space; consider scale, color, and pattern in public corridors.
  .3 Wall Base
    a) Rubber wall base is standard unless integral wall base is required. The standard height for applied rubber wall base in new construction is 4 inches.
    b) Colour should remain consistent within buildings for ease of replacement and repairs.
    c) Coordinate with facilities management team for when integral wall base is required.
  .4 Misc.
    a) Floor expansion covers and transition strips to be stainless steel or aluminum and must be barrier free compliant.
    b) For retrofit renovations, the use of ‘Connectrac’ under-carpet wireway provides a good solution for cable management below carpet tiles (should the application be suitable).
.2 Resilient Base & Accessories (acceptable product types)
  .1 Resilient Base
  .2 Resilient Stair Treads and Risers
.3 Resilient Flooring (acceptable product types)
  .1 Vinyl Sheet Flooring
  .2 Rubber Sheet Flooring
  .3 Luxury Vinyl Tile Flooring
  .4 Rubber Tile Flooring
.4 Carpeting
  .1 General
    a) Refer to section 09 00 02 ‘Uses and Applications’ for applicable spaces.
  .2 Carpet tile is preferred on campus, broadloom can be considered in special circumstances (review with SAIT PDP team).
    a) Fiber content: appropriate anti-static properties, moisture resistance, staining and soil protection, dimensional stability, and abrasion resistance, warranted for the lifetime of installation.

6. Access Flooring

.1 Flooring consisting of a series of removable interchangeable panels, on an elevated support system, forming an accessible floor cavity for electrical and mechanical equipment.
.2 Coordinate with facilities for finishes and access requirements when selecting assembly type.

7. Wall Finishes

.1 General
  .1 Refer to section 09 00 02 'Uses and Applications' for applicable spaces.
  .2 Wall finishes shall be suitable to the application of programmed space. Materials are to be durable for heavy duty use and heavy traffic.
  .3 Other wall coverings & finishes: Review with SAIT facilities group for suitability of proposed material.
.2 Wall protection: refer to Division 10 for complete wall protection requirements.
.3 Wall Assemblies
  .1 Coordinate with SAIT to address specific to program area functions including but not limited to moisture protection, chemical protection, acoustic separation, and durability.
  .2 Wall assemblies shall be constructed of steel stud and gypsum board or concrete block. Wood stud framing is not permitted.

8. Painting & Coatings

.1 Interior Painting
  .1 General
    a) Refer to section 09 00 02 'Uses and Applications' for applicable spaces.
    b) Reference standard: Master Painter's Institute (MPI) – Architectural Painting Specification Manual (latest edition) for new surfaces, and the MPI Maintenance Repainting Manual (latest edition) for re-painting and previously un-coated surfaces.
    c) Consideration for MPI warranty on every project to be discussed with SAID PDP team.
  .2 Where possible, all paints shall be low VOC as prescribed by the sustainability metric targeted.
  .3 Preferred paint manufacturers: ICI or Benjamin Moore.
  .4 Interior Walls and Ceilings
    a) Office walls: high performance architectural latex, MPI gloss level 3 "eggshell like".
    b) All corridors, labs, and classrooms: latex, MPI gloss level 5 'semi-gloss'.
    c) All ceilings: latex, MPI gloss level 1 'matte'.
    d) All, doors, trim, frames, sills: latex, MPI gloss level 5 'semi-gloss'.
    e) Concrete masonry units follow MPI Painting Manual INT 4.2D – high performance architectural latex, semi-gloss coating.
  .5 Specialty Room Notes
    a) Classroom: Level 3 to 5, depending on architectural condition.
    b) Custodial Closets Throughout: Washable latex MPI gloss level 5 (semi-gloss).
    c) Custodial Closets behind and adjacent to floor sink (if not using FRP panels): Epoxy (tile-like) G5 (semi-gloss) finish.
    d) Washrooms, Sanitary Areas: Washable latex MPI gloss level 5 (semi-gloss).
  .6 Colour
    a) The general wall colour will consistent on a building-by-building basis.
      - Consultant to limit number of colours selected for ease of future maintenance.
      - Consider the space and the access to daylight when selecting dark paint colours.

DIVISION 10 SPECIALTIES

1. Visual Display Units

.1 All lecture halls, classrooms and labs shall be equipped with:
  .1 Minimum of 3 whiteboards per classroom, fill entire 'instructor wall' where possible.
.2 Whiteboard Basis of Design
  .1 Standard heights of 4' is acceptable.
  .2 Length to suit space (ideally wall to wall).
  .3 Provide marker tray.
  .4 Whiteboard finish: non-ghosting surface, aluminum trim acceptable, projection screen finish is preferred.
  .5 Magnetic is preferred, review on a per project basis if required.
.3 In renovations, match existing whiteboard products.

2. Signage

.1 Refer to SAIT Signage Standard for more detailed signage information and standards.
.2 For Room Numbering procedure, refer to SAIT Room Naming and Numbering Convention document included in Appendix 1.

3. General Notes on WC Planning

.1 Refer to the document Washroom Planning Principles and Standards (draft version) for more detailed information regarding WC planning and design (IN DEVELOPMENT).
.2 In general, wall mounted toilets are preferred in new construction, and floor mounted toilets are acceptable in renovations/ modernizations; the use of wall mounted toilets will depend on how much space is used for the plumbing wall. Heavy duty water closet carriers should always be specified for wall mounted toilets. Hardwired flush valves only (refer to DIV 22 for specifics).
.3 Hands-free, automated, hard-wired faucets are preferred; refer to Mechanical Guidelines (refer to DIV 22 for specifics).
.4 Barrier free guidelines - Consultant should follow the Rick Hansen Accessibility Guidelines for all barrier free requirements, in addition to the most current edition of the Alberta Building Code.
.5 When barrier-free toilet stalls are part of the washroom layout, the preference is to include a sink within the barrier free toilet stall.

4. Compartments and Cubicles

.1 Partition types: Hard construction partitions can be considered vs. standard toilet partitions. In all instances, toilet stalls shall be designed to maximize privacy, consultant to consider:
  .1 Acoustic privacy.
  .2 Visual privacy (a maximum tolerance of 6.4mm (1/4 inch) gap between partition stiles and doors; eliminating sightlines into the toilet compartment is desirable).
  .3 Security.
.2 Consider durability, ease of maintenance, and anti-vandalism properties when specifying toilet partitions.
.3 Toilet Partitions Basis of Design
  .1 Ceiling-mounted/overhead braced and floor mounted partitions are acceptable.

.2 Finish material: Fingerprint proof finish, avoid textured materials that are hard to wipe clean. Plastic laminate (HPL), phenolic, and stainless steel are acceptable finish materials.
.3 Heavy duty locks should be specified.

5. Washroom Accessories

.1 Washroom Accessories – coordinate with owner on all specifications. Some accessories will be owner supplied / contractor installed, some accessories will be specified by consultant and part of the base contract.
.2 All WC accessories (SAIT supplied and GC supplied) to be installed by the General Contractor. NOTE: mock-up is required.
.3 All mounting heights for barrier free compliance should adhere to the Rick Hansen Accessibility guide and the most current edition of the Alberta Building Code.
.4 Consider placement of freestanding waste receptacles:
  .1 Under paper towel dispenser to catch water dripping.
  .2 Near washroom exits (With doors) to catch waste towels.

6. Modular Service Walls

.1 Demountable Partitions: demountable and relocate-able, unitized, non-progressive, extend in four directions at posts without disturbing other panels. Accommodating floor to ceiling height variations of up to 25mm.
.2 Where space separation and building code requirements permit, consider modular demountable wall partition systems for all interior space division.
.3 There are a range of demountable partition manufacturers that are acceptable for use at SAIT, in general, the selection of the manufacturer by the consultant, should:
  .1 For renovations: match existing used in that area or building.
  .2 For new construction: selection will be approved by SAIT facilities management.
  .3 Selection of system to be based on long-term availability of components and finishes.
  .4 System design to suit easy integration with furniture and case goods.
  .5 System to accommodate electrical outlets and switches on posts or in panels, and wiring in posts, base, cap or panels as necessary.
  .6 Standard framing material: extruded aluminum or steel, clear anodized or powder coated finish.
  .7 Standard panel materials: plain gypsum board (painted), pre-decorated gypsum board, wood panel, acoustic panel (fabric), steel or glass.
.4 Design Considerations
  .1 Finishes: In general, anodized aluminum finish is preferred.
  .2 Consider panel heights and access into the buildings (existing and new construction) for initial installation as well as future repairs and maintenance.
  .3 When specifying specialty hardware (i.e. long bar pulls), consider placement of locking mechanisms in relation to usable and accessible height.
.5 For major projects, most general contractors have Demountable Partitions in their scope of work.
.6 Doors, hardware, and frames to be coordinated with Division 8, doors and frames.
.7 Coordinate electrical, communications requirements, and components.

7. Wall & Door Protection

Corner Guards

.1 Consultant to review all exposed corners for possible requirements of corner protection with SAIT.
.2 Stainless steel and acrylic are preferred construction types.

Bumper Rails

.1 A chair rail shall be installed in classrooms, meeting and boardrooms, waiting areas and any space that would require wall protection from furniture and/or other moving equipment.
.2 Consider heights of furniture when specifying heights of bumper rails.
.3 Extent of coverage and height of installation to be reviewed with SAIT PDP team during design stage.

Protective Wall Covering

.1 Other than washrooms, where there is a sink or where there is a potential for moisture, ensure the surrounding walls are protected using a water-resistant covering (Tile or Rigid acrylic product) – i.e. Janitorial closets.

8. Lockers

.1 Generally, lockers are required in corridors, as many as possible. Review requirements on a per project basis.
.2 When possible, lockers should remain consistent within buildings. Refer to O & M manuals when specifying new lockers in an existing building and maintain the manufacturer, color, style and locker base.
.3 Both single and double-tiered lockers are used. Typical sizes are 305mm (12 inch) width and 381mm (15 inch) depth.
.4 Wider lockers may be used in specific applications.
.5 Minimum construction to include 20-gauge double pan doors, 16-gauge frames, 24-gauge, interior components, continuous door hinges, and include three coat hooks and a shelf (in full height lockers). The type of locker will depend on stakeholder needs, subject to approval by SAIT FACILITIES MANAGEMENT
.6 The locker base should be constructed with a wood or masonry support to suit the application.
.7 Lockers shall be ordered with matching pre-finished metal tops (full height or sloped) if not recessed in alcove, edge trims and end panels on exposed sides.
.8 Locker tags are to be coordinated by the manufacturer, tags to meet the SAIT numbering system. These tags are often supplied by another vendor and installed by a General Contractor.
.9 Provide latching mechanism, suitable for owner or student supplied lock.

DIVISION 11 EQUIPMENT

1. Audio Visual Equipment

.1 Audio visual requirements are to be coordinated with SAIT AV / ITS department, and with Part 4: Electrical guidelines.
.2 Consultants to coordinate with internal SAIT AV / ITS department for all space requirements.

2. Laboratory Fume Hoods

.1 Design and installation of fume hoods to comply with recognized authorities (CSA, ASHRAE, SEFA) as prescribed in the Alberta Building Code.
.2 Coordinate with Mechanical consultant and program requirements on a per-project basis.

3. Appliances

.1 Appliance requirements are to be outlined in the program document or clarified at the design stage of any project.
  .1 Full-sized fridges are preferred where possible in faculty areas.
  .2 If no space for dishwasher, double-bowl sink should be provided.
.2 Review water dispenser requirements with SAIT team.
.3 Generally, appliances are selected by SAIT PDP and included in the contract documents for installation and procurement by the general contractor. This will be reviewed on a per-project basis.

DIVISION 12 FURNISHINGS

1. Furnishings

.1 In addition to the functional program, consultant to reference the space standards Master Plan document when planning furniture layouts.
.2 Consultant is responsible for coordinating the furniture details with other MEP consultants and other room/space requirements.
.3 In general, selection and procurement of furnishings can be handled by SAIT PDP department; to be confirmed on a per project basis. When furniture selection is deemed part of the consultant's scope, there are some furniture vendors / brands that have been successful in the past:
  .1 Systems furniture: Haworth.
  .2 Loose furniture: Steelcase, KI.
.4 SAIT PDP can assist with existing furniture inventory information, initial space planning schematics, and provide overall assistance with furniture selection.
.5 Furniture selection or replacement in renovations should match existing furniture systems that have been established for that particular building or area. New facilities / buildings may have new furniture systems unique to that facility, solution will be provided by SAIT PDP department.
.6 The furniture vendor must provide drawings of all components and installation methods to SAIT. SAIT will coordinate furniture drawings submitted by the vendor and provide drawings to consultants for final project coordination.
.7 Consultant to review all power requirements for furniture with SAIT PDP in order to coordinate with complete MEP consultant team.
.8 SAIT PDP / ITS will provide details of data/power cut-out requirements in tables.
.9 Installation of furniture shall be done by the manufacturer's certified installers.
.10 Where furniture is required to be wall mounted, coordination with in-wall backing is required. Consider where items such as, desk hutches/overhead cabinets, can be supported by the furniture.

2. Window Coverings

.1 In general, for major projects, the general contractor will install window coverings. Installation can also be handled by the vendor; factors such as scale, quantity, etc. will determine if installation is by vendor or general contractor.
.2 The basis of design for standard window coverings is:
  .1 Manual operation is standard, motorized can be considered where manual operation is not feasible (i.e. over height spaces).
  .2 Dual shades, with 3% openness and a blackout shade (5% openness can be considered where budget constraints are a factor). 3% openness is the standard, consultant to consider LEED requirements for daylighting, MECH requirements, and possible daylighting controls integrated in architecture.
  .3 manual chain operation.
  .4 North sides of buildings often don't require window coverings; review the specific project needs considering daylighting and adjacencies to other buildings (privacy needs etc.).
  .5 Provide valance at roller blinds except where architecture accommodates pocked to conceal mounting.
  .6 Non-residential grade blinds.
.3 Roller Shade System
  .1 Factory assembled unit including extruded aluminum housing / cassette box

closed on all sides, 2 end brackets, shade tube, extruded aluminum fascia and hem-bar, shade cloth guide and fabric.
.2 Local manufacturers are preferred.
.4 Sunscreen Fabric
.1 Dense Shade cloth, suitable for clear low 'E' glazing.
.2 Composition: 36% Fiberglass / 64% vinyl on fiberglass.
.3 Weight: 14ox / yd2.
.4 Thickness: 0.71mm (0.028").
.5 Basis of design, to be confirmed on a per project basis:
a) Manufacturer: Altex; TexScreen 8103 (3% openness).
.5 Specialized Rooms, i.e., classrooms, research spaces or laboratories that require blackout blinds or motorized blinds will be identified in the design stage; consider if side, top, and bottom channels are required to eliminate light infiltration.
.6 Motorized blinds basis of design, to be confirmed on a per project basis:
.1 Manufacturer: Moduline; 105 RTS Motorized shade.
.2 Fabric: e-screen 3%; colour: White/Pearl.
.3 Control: battery operated RTS wireless wall mounted switch.
.4 Fascia & Bottom bar: clear anodized, standard bottom bar.
.7 Blackout Fabric
.1 Room darkening shade shall be 100% opaque material, 3 or 4 ply, PVC or vinyl laminated to both sides of 100% fiberglass base fabric. Washable, flame retardant treated and fade resistant.
.2 Basis of design, to be confirmed on a per project basis:
a) Manufacturer: Mermet; Product: Avila Twilight, Flock.
b) Manufacturer: Phifer SW 7000 Blackout.

3. Interior Window Treatment

.1 Interior Window Film Design Considerations
.1 Provide window film to interior glazing that requires additional privacy.
.2 Must provide gaps at the bottom, middle, and above for security.
.3 All glazing where film will be used as signage or graphic representation, to be applied with non-permanent adhesive.
.4 Translucent film is preferred (vs. opaque).
.5 In public spaces, apply film to the interior window surface of adjacent rooms.

4. Laboratory Casework

.1 Metal Laboratory Casework should be specified based on end user's needs (i.e., chemical usage, types of activities, etc.).
.1 Preference is for prefabricated metal casework with factory finishes in all laboratory applications.
.2 Painted steel casework is preferred. Avoid other casework materials (i.e., plastic laminate, wood).
.3 Neutral colors are preferred, with white or light grey as the main or dominant color.
.4 Consider lead times, product warranty, product offerings, and customer service when selecting laboratory equipment suppliers.

5. Countertops

.1 Design countertops to minimize joints. Where possible, tops to be continuous with no open seams.

.2 Surfaces to be integral with backsplash wherever possible.
.3 All edges to be continuously wrapped.
.4 Most laboratory countertops are black epoxy resin, to be verified with SAIT PDP team for specific user groups.
.5 Ensure all surfaces meet the requirements for the room usages (i.e., chemical usage, activities, etc.).
.6 Acceptable Materials
  .1 Solid epoxy resin.
  .2 Stainless Steel: minimum 14 ga. Grade 304 or 316 (if required).
  .3 Natural stone (excluding marble, sandstone, travertine, or other porous types).
  .4 Phenolic Resin.

DIVISION 14 CONVEYING EQUIPMENT

1. Conveying Equipment

.1 Elevator Requirements
- .1 Elevator installation shall be in compliance with AEDARSA (Alberta Elevating Devices & Amusement Rides Safety Association).
- .2 Locate designated electrical services for the elevator in the elevator machine room where appropriate.
- .3 Elevators serving floors having labs may require specialized deliveries – coordinate weight capacity and minimum clear door opening with delivery equipment dimensions.
- .4 Provide elevator pad hooks or wall studs within the interior of the elevator cab.
- .5 Finishes:
  - a) General: All finishes within elevator to be water resistant, vandal resistant and have a flame spread rating in accordance with CAN/ULC S102.
  - b) Ceilings: Avoid egg-crate style, preference is for solid panels.
  - c) Flooring: Resilient flooring has been an acceptable finish; porcelain tile can be considered, consultant to consider added weight.
  - d) Wall finishes: Entrance frames and back panels should be brushed stainless steel; interior wall panels can be HPL laminate. Other durable finishes can be considered to suit the design intent, consider ease of cleaning and finger-print resistance, subject to SAIT PDP approval.
- .6 If no freight elevator is provided, passenger elevator to be taller, allowing for movement of larger items (minimum of 9’-0” high).
- .7 Interior height of elevator cab minimum 2438mm (8 feet).

.2 Freight Elevators should have:
- .1 Stainless steel interior finishes with bumper rails.
- .2 Teardrop plate or diamond plate steel floor finish or other durable material as approved by SAIT.

.3 Escalator Requirements
- .1 Maintenance contract should be included as part of the purchase contract
- .2 Escalator installation shall be in compliance with AEDARSA (Alberta Elevating Devices & Amusement Rides Safety Association).
- .3 Designated electrical service for the escalator should be located in the escalator machine room.

STRUCTURAL SYSTEMS

1. General Overview and Design Objectives

.1 The structural design and the completed structure, whether the facility is new construction or is an existing building being renovated, shall address the needs of the facility identified at the time of design and construction. In addition, it should anticipate and accommodate the reasonable and foreseeable future objectives for SAIT and the trends in teaching or operational equipment with respect to equipment mass and vibration requirements. The intent of this section is to incorporate a reasonable level of future adaptability and flexibility into the structural design and provide direction to the design team without unnecessarily penalizing the initial capital cost of the facility.

.2 The structural design, including minimum design loads, general provisions, and material specifications will satisfy the more stringent requirements of the current, in-force versions of the ABC, NBC and this design guideline. In addition, the design will meet the requirements of other applicable or referenced design standards and the design criteria identified by equipment suppliers. Anticipated increases in the Code climatic or seismic provisions (typically later in the Code revision cycle) shall be incorporated into the design.

2. Structural Flexibility and Adaptability

.1 The structural design is crucial to the occupancy, performance, and longevity of any facility. The structure is to be adaptable and be able to accommodate the changing programmatic or equipment requirements, operational techniques, and building services for similar design load parameters. This structural flexibility will be achieved without additional structural members or reinforcing and with minimal disruption to building operation over its intended lifespan:

- .1 Stack lateral stability elements in plan and locate lateral load resisting elements around stair and elevator cores and around the perimeter if required, to maximize the flexibility of the floor plate.
- .2 Design the floor areas to accommodate equipment loads anywhere on the floor that is allocated to that equipment.
- .3 Design the floors and roofs to be capable of supporting the future access, transport, removal and replacement of the existing plant and equipment. During this removal and replacement, the existing plant area or equipment must remain operational, without affecting the vertically or horizontally adjacent areas.
- .4 Prestressed concrete, whether pre- or post-tensioned, is not recommended. Where functional program requirements identify long clear spanning spaces as a necessity, prestressed concrete can be evaluated on a case-by-case basis.

.2 New structures that are completed under this design guide, including all secondary structure that supports cladding systems, are to be designed for a minimum 50-99 year (long-life) lifespan in accordance with CSA S478 Guideline on Durability in Buildings, with no substantial maintenance required during that time frame. Structural elements will be provided with appropriate protection against corrosion; attention will be paid to elements that may be subject to spills, or leaks of corrosive solutions.

.3 The structural design of the facility should consider the potential for future vertical or horizontal expansion. A life cycle cost analysis shall be conducted to aid the project team in determining the extent of structural accommodation for future expansion. All future loads and design assumptions, including specific staging or construction requirements, shall be clearly identified on the design drawings.

.4 For existing structures undergoing renovation or retrofit, review original project

documentation to determine design loadings and serviceability criteria to aid the project team in determining acceptable future use and occupancy objectives.

3. Loads, Deflections and Vibrations

.1 The structural design shall comply with the minimum load requirements of the NBC and conform with this design guideline.
.2 All design loads and allowances shall be clearly indicated on the structural drawings.
.3 Importance Factor
  .1 The structure for all new facilities shall be designed with a Normal Importance Factor.
  .2 Where it has been identified that the facility may be used as a community shelter following a climatic or seismic event, the requirement to elevate the Importance Factor from Normal to High or to Post-Disaster shall be evaluated on a case-by-case basis.
.4 Live Load
  .1 Generally, the design live loads should be applied to broad areas (i.e. a full column bay as a minimum) as opposed to small discrete areas, to accommodate changes to future occupancy.
  .2 Table 1 lists the minimum live loads based on occupancy. The identified load shall apply to the entire floor or roof area, unless otherwise specified.

Table 2

Occupancy	Minimum Live Load (kPa)
Assembly areas, including dining and recreation	4.8
Catwalk (exclusively walking surface)	2.0
Classroom, lecture hall	4.8
Classroom, testing laboratory	7.2
Freezer / refrigerator areas	9.6
Library	7.2
Loading dock, shipping/receiving area, delivery vehicles exceeding 9000 kg	12
Mechanical Equipment Areas	9.6
Mezzanine	4.8
Office	4.8
Parking structures, passenger vehicles not exceeding 4000 kg	2.4
Plaza (pedestrian or vehicle accessible) over areaway or basement	12.0
Roof, minimum load (not including snow drift or future expansion areas)	1.2
Stairs, corridors	4.8
Storage rooms	7.2

Notes:
I. Load values shown are to be applied to the next broader area – where occupancy extends over more than a single structural bay, the load should be applied to the entire floor plan; where the occupancy is a single room, the load should be applied to the entire structural bay,
II. Design for intended use, including concentrated point loads from delivery

vehicles and/or firefighting equipment, but not less than the indicated load.

.5 Snow Load
- .1 Roof areas adjacent to future building sites should accommodate the possible effects of snow accumulation from the future building to the heigh extent that is permitted by currently applicable bylaws.
- .2 If photovoltaics are being considered for the roof, the snow drift accumulation from the array must be considered. It is recommended that a specialty consultant is engaged to determine appropriate drift factors to be used for design.

.6 Wind Load
- .1 If photovoltaics are being considered for the roof, the wind load resulting from the array must be considered. A specialty consultant may be required to determine appropriate wind load for design.
- .2 Design internal partitions for a minimum unfactored pressure differential of 0.5 kPa; partitions around mechanical rooms with fans must be designed for a minimum unfactored pressure differential of 1.2 kPa.

.7 Dead Load
- .1 The structure shall be designed to support the self-weight of the structure, the weight of all construction materials, and finishes that are incorporated into the building for permanent support by the structure. Additionally, it shall support the weight of partitions, the weight of permanent equipment, and the vertical load due to earth, plants, or trees. All below grade walls, in addition to soil loads, should assume a minimum surcharge load of 12 kPa.
- .2 Table 2 lists the minimum partition loads that should be used. Partition load allowances for wall types not listed below shall be determined on a project specific basis but should not be less than 1.5 kPa.
- .3 All suspended floors or roofs will be designed for a minimum specified uniform dead load allowance for mechanical and electrical services of 0.50 kPa, except for mechanical or electrical floors and roofs, which will be designed for a minimum mechanical and electrical dead load allowance of 2.4 kPa. Additional superimposed dead loads for ceilings, partitions, finishes etc. shall be added to this load value to obtain an overall design dead load.
- .4 The minimum dead load allowance for the roof structure shall include for, but not be limited to the actual roofing construction, ceilings, and mechanical and electrical dead load allowance noted in 2.7.3. The overall dead load allowance shall not be less than 2.0kPa. If photovoltaics or glycol heating loops are being considered for the roof, a minimum 0.5 kPa allowance should be added to the design dead load value for the roof.
- .5 The assumed construction assembly weights shall be indicated on the structural drawings.

Table 3

Partition Type	Uniform Dead Load Allowance (kPa)
Steel Stud and Gypsum	1.5
Concrete Block Walls	2.5*

*Partition load allowance is based on 190mm thick, 4.0m tall hollow concrete block walls, spaced at not less than 4.0m on center.

.8 Other Loads
- .1 Structural columns and walls located adjacent to vehicle traffic, including roadways, parkades and driveways, shall be designed for vehicle impact loads,

including both accidental and intentional impact, unless other protective means are provided.

.2 Exposed structural elements shall be designed for thermal effects that are based on the range determined by the 1% January and the 2.5% July design temperatures.

.3 Load effects such as snow drift accumulation, wind (including uplift) and additional superimposed dead load from PV arrays shall be accounted for in the structural design and design load values shown on the structural drawings. In instances where a future PV array is being considered for the building, the design team should consider the effects on the structure and where appropriate incorporate the additional load effects into the structural design.

.4 The structure shall be designed to support operable partition walls where required. Design for the supporting structure of the partition walls shall include for all dead loads (including self-weight) and wind load from unbalanced pressure differences.

.9 Deflections

.1 The building structure shall be designed to limit structural deflections and movements so that they do not adversely affect the serviceability or intended use and occupancy of the building, nor damage non-structural components including façades, cladding, glazing, interior partitions, equipment, and finishes. Deflections shall be in accordance with all the applicable codes, standards and regulations, and, those indicated in Table 2, whichever is more stringent.

.2 The structural analysis shall consider all factors that contribute to the calculation of the structural deflection including creep, shrinkage, and thermal effects.

.3 The structural members shall be proportioned so that the differential deflections of adjacent parallel support members in the same vertical or horizontal plane do not exceed the smaller of L/500 or 25 mm, where “L” is the distance between adjacent parallel members.

.4 To accommodate services that run vertically within mechanical shafts, more stringent differential deflection criteria than noted above may be required. The design team should determine appropriate differential limits between floors to incorporate into the structural design of the building.

.5 Reinforcing steel in all concrete flexural members should be designed so that the crack control parameter "Z" does not exceed 25,000 N/mm, regardless of interior or exterior exposure, to enhance long-term structural durability.

.6 The building structure shall be designed to meet all equipment deflection limit requirements as recommended by the manufacturer, and, those indicated in Table 3, whichever is more stringent.

Table 4

Member Type and Load Case	Maximum Calculated Deflection	Deflection Limit (mm)
Concrete floors, total design load including time effects	< span length/360	≤ 25
Steel floors, total deflection	< span length/360	≤ 25
Parking structure floors, live load deflection	< span length/360	≤ 25
Parking structure floors, total design load including time effects	< span length/240	≤ 40
Transfer elements, total deflection (incl. time effects where applicable)	< span length/600	≤ 40
Framing members supporting	< span length/480	≤ 20

masonry walls, due to wind		
Concrete roofs, total design load including time effects	< span length/360	≤ 25
Steel roofs, total deflection	< span length/360	≤ 25
Craneways, vertical due to wheel loads	< span length/800	≤ 12.5
Inter-storey drift due to wind	< floor to floor/500	≤ 10
Inter-storey drift due to seismic	< floor to floor/200	≤ 25
Framing members supporting facades, cladding and glazing	< span length/360	≤ 25

Notes:

I. For long spanning members (span lengths in excess of 18.3m or 60'), less stringent deflection criteria can be evaluated and implemented on a case-by-case basis. These reduced deflection limits should only be applied to roof supporting members.

.10 Vibrations

.1 The building structure, excepting building mechanical rooms, and roof areas, should be designed to a velocity tolerance limit of 50μm/s to minimize the effects of floor and lateral vibration transmission. This limit corresponds to a VC-A designation as outlined in AISC Design Guide 11. In instances where equipment or instruments require a more stringent limit, the structural designer shall design the structure for the corresponding acceptable limits, as provided by the equipment manufacturer.

.2 Adjacent sources of vibration shall be taken into consideration to determine the vibration effects that arise from building use, operations, and equipment.

.3 The structural design, where practical, should locate sensitive equipment on concrete slab-on-grade construction.

4. Mechanical, Electrical and Plumbing (MEP) Integration

.1 The structure shall be designed to support the future access, installation, and replacement of the building mechanical and electrical plant (operations) equipment and their associated works. Where possible, the point loads from equipment should be increased by 25% for the design of the floor structure along all equipment travel paths; equipment loads and travel paths shall be shown on the structural drawings. structural design, where practical, should locate sensitive equipment on concrete slab-on-grade construction.

.2 Shaft Design

.1 The perimeter framing around the ventilation, plumbing and electrical shafts, risers, cores, and equipment chases (collectively described as shafts) shall be designed to support the total weight of all equipment and services contained within the shaft. It should be designed to include the supporting structure plus an additional 25% of the total weight. The perimeter framing must accommodate a complete infill of the open area for the total live, dead, and superimposed dead loads of the adjacent floor areas, if this produces the greater loading effect. The design loads for all shafts shall be shown on the structural drawings. The floor and wall openings at service shafts should be sized to accommodate the future growth and expansion of the facility. The design team shall determine the appropriate sizes of the shaft openings to accommodate this future growth.

.3 Sleeve Allowances

.1 Suspended floor structures should be designed to allow for these sleeve

penetrations at the building columns:

a) All interior columns – allow for two 200 mm maximum diameter cast-in sleeves, plus two 200 mm diameter future sleeves.
b) All edge columns, including the interior columns at all floor openings and shafts – allow for two 200 mm maximum diameter cast-in sleeves, plus one 200 mm diameter future sleeve.
c) Corner columns, including the interior columns at all floor openings and shafts – allow for one 200 mm maximum diameter cast-in sleeve, plus one 200 mm diameter future sleeve.
d) Columns in parking areas – allow for one 200 mm maximum diameter cast-in sleeve, plus one 200 mm diameter future sleeve.
e) All cast-in sleeves and future sleeve locations shall be shown on the structural drawings.
f) The structural drawings shall include details to indicate that the floor system fire ratings are maintained for future sleeve provisions.

.4 Coring Procedure - Through Existing Structural Framing

.1 For all cores through an existing structural member, the subcontractor shall provide the following information to the structural consultant for review prior to coring.

a) Provide a structural plan showing the location and size of all proposed cores, drawn to scale and dimensions to grid lines or walls.
b) Each proposed core shall be numbered on plan, with a corresponding photograph for each location showing the following information.
- Proposed core location and size drawn to scale on the surface of the slab with core number and diameter labelled.
- Reinforcement in all layers of the structural member clearly identified in the immediate vicinity of the proposed core, as determined by an appropriate scanning method to accurately determine reinforcement location; and
- Location of any other items embedded in the member, including electrical lines and conduits.

.2 Under typical conditions, and upon review by the structural consultant, the following guidelines will generally result in acceptable of proposed cores.

a) Do not core through post-tensioned floors, drop panels or column capitals and beams.
b) Locate cores a minimum of 1000 mm away from the face of any column.
c) Maximum core diameter is 200 mm.

.3 If any reinforcement is unexpectedly encountered during the coring work, stop coring immediately and contract the structural consultant for assessment.

5. Superstructure Systems

.1 Materials and Systems

.1 The selection of structural framing materials, whether structural steel, concrete, mass timber, or a combination thereof, shall be based on the needs and functional requirements of the facility. Different structural framing schemes should be evaluated by the design team to reduce the overall construction materials and volumes, where possible. Material selection should assist in limiting the overall carbon footprint of the facility, while maintaining the functional requirements.

a) The design team should take a cost/benefit approach during evaluation of the appropriate structural materials and the employed framing schemes.
b) Where structural framing is employed for the floors and/or roofs immediately

above building plant areas (i.e. mechanical or electrical rooms, penthouse floors), the structural framing members should be steel beams rather than open web steel joists.

.2 Structural Planning Considerations
  .1 The design team should consider the functional requirements of the instructional spaces and the distribution of MEP services when developing the framing scheme for the project. Where possible, the design team should incorporate a typical grid spacing throughout the project.
  .2 For non-instructional designated spaces such as an office area, the design team should endeavor to repeat the same structural grid throughout these areas to safeguard for future planning of these areas as instructional spaces.
  .3 Floor-to-floor heights should be determined based on these areas being developed into instructional spaces and allow sufficient ceiling space and clear heights for future needs, including ceiling height and servicing requirements.

6. Substructure and Main Floor Systems

.1 A foundation wall perimeter drainage system should be provided for all substructures that contain a basement.

.2 Limit the number of construction joints for below grade elements, where practical. Construction joints, where required, shall be designed to prevent water ingress. The location of construction joints shall be shown on the construction documents.

.3 Where concrete floor slabs on grade are located adjacent to deeper foundation or basement areas, where the difference in slab elevation between the two levels is in excess of 2.0m, a structural slab on grade for the upper level floor slab shall be utilized to minimize the potential slab deflections due to soil backfill settlement.

.4 Radon Mitigation System
  .1 To minimize the entry of radon gas, the project team shall specify a high puncture resistant plastic underslab soil gas impermeable vapor suppression membrane specifically manufactured for contact with ground under concrete slabs on grade, including installation of gas permeable depressurization layer and accessories required for a complete installation.
  .2 Location of radon vent piping shall be placed in back of house areas, easily accessible by the operations team, where possible. The locations of radon pit and vent pipes shall be shown on the construction documents.

7. Specialty Structures – Recreational and Industrial

.1 Aquatic Center Corrosive Environment Considerations. The following should be considered by the project team where providing corrosion protection to internal highly corrosive environments is critical to the performance and longevity of the facility.
  .1 The protection system life expectancy should exceed 25 years without the need for major maintenance.
  .2 Steelwork should be made accessible for visual inspections and maintenance, where required.
  .3 In conjunction with the owner, it is recommended that the design team develop an annual cleaning and maintenance plan for all exposed steelwork.
  .4 Extra protection should be applied at steel/concrete interface locations where steel is partially embedded in concrete.

.2 High Bay Considerations.
  .1 Where required load values are greater than what is noted in Table 1, the design team in conjunction with the facility user group shall determine the appropriate

uniform and point loading values for design of the floor and roof structure.

.2 The portion of facility designated as high bay should be designed with column free, long span spaces, with increased floor to floor heights to accommodate overhead cranes.

.3 All load design values, including crane loading, should be shown on the structural drawings.

.3 More stringent criteria for vibration, and increased loadings for gyms and exercise facilities should be considered by the design team. This can include, but not limited to the following: moveable partitions, basketball backboards and rigging supports for the purposed of conducting specialty events.

8. Historical/Existing Building Interface

.1 Any new work located within an historical or existing building or being integrated into the composition of a new facility must be done in a manner that does not adversely impact the existing structure and architectural intent of the building.

.2 When temporary support measures and shoring are required to maintain an existing heritage structure or façade, the temporary support measures should be designed to limit deflection of supported elements to less than L/720. During excavation, demolition and general construction around the area, the temporary supporting structure should be designed to minimize obstructions for adjacent activities, where possible.

.3 All new bracing and tie-ins to an existing structure shall be designed and detailed to minimize the impact to the existing structure. The structural designer shall design the new facility so that all lateral loading is resisted by the new structures' lateral force resisting system only; no lateral forces shall be transferred into the existing structure.

.4 The design team, in conjunction with the Contractor, should develop a crack observation and monitoring program to monitor any structural movements and cracking during construction activities, including excavation, shoring, and demolition. Where required, additional measures to mitigate or reduce observed structural movements should be incorporated into the structural design, and/or temporary support measures.

.5 Where construction involves pile driving, compaction or other similar vibration-causing activities, the design team should consider an initial screening for buildings within 250m of the project site. Thresholds for potential damage should be based on peak particle velocities of 5.0mm/s for transient and 0.25mm/s for continuous vibrations. If estimates of peak particle velocity are below the threshold, no further work is necessary. If otherwise, measures for vibration reduction should be evaluated and implemented.

9. Parking Structures

.1 All parking structures shall be constructed of reinforced, cast-in-place concrete in conformance with CSA S413. Precast concrete construction is permissible for standalone parking structures.

.2 Parking structure floor and roof protection systems should be designed to a minimum protection level of Type MI as defined in CSA S413 Table 1.

.3 All concrete shall conform to the requirements of CSA A23.1 Table 2, Exposure Class C-1; concrete for slab-on-grade construction shall conform to Exposure Class C-2.

.4 Cast-in-place concrete elements are to be designed such that the CSA A23.1 crack control parameter Z does not exceed 25,000 N/mm regardless of exposure condition.

.5 To provide extra protection against deterioration, a corrosion inhibitor for concrete elements not protected by a traffic membrane, including slabs on grade, is

recommended.

.6 Where the traffic membrane cannot be extended up the vertical surfaces of a concrete wall or column, breathable concrete sealers shall be applied for a minimum distance of 100mm above the top of the slab. For other locations where concrete is exposed to traffic and not protected by a membrane, is it recommended that a concrete sealer is applied to the exposed face of the concrete member.

.7 Parking structures that are located within, or accessible to the loading dock and shipping/receiving traffic, should have a corrosion protection system that includes a reinforced concrete topping slab, with a minimum topping thickness of 100mm above a fully adhered waterproofing sheet membrane system.

.8 The primary slope of the parking floor shall be limited to 4% or less.

.9 The minimum clearance from the parking structure driving surface to the underside of the ceiling should be no less than 2.4m. The underside includes, but is not limited to, concrete soffit, all mechanical and electrical services, and sprinkler heads. Service zones located beneath slabs should be maintained throughout the parkade, the depth of zone should be determined in collaboration with the mechanical and electrical design teams.

.10 The design team should consider the potential for future vertical expansion or conversion of the parking structure to occupied space; and where feasible, incorporate provisions into the structural design to accommodate the future transition of the facility. The future design provisions and load allowances shall be shown on the structural drawings.

.11 The location of parking spaces above or below occupied facilities should be avoided, where possible.

10. Structural Systems Sustainability Criteria

.1 This section shall be read in conjunction with the overall Sustainability Section.

.2 The building materials that comprise the structure of a building have a considerable impact on the carbon footprint for the project. Materials should be chosen that promote environmental and social sustainability.

.3 The following provisions can lower the embodied carbon of the structure and should be evaluated for each project and incorporated, where practical.

- .1 Utilize renewable building materials, such as mass timber into the structure, where possible.
- .2 Use low-carbon and/or Portland-Limestone cement (PLC) to reduce the carbon footprint of the facility.
- .3 In conjunction with industry and government partners, evaluate and implement concrete technologies such as carbon capture, usage and storage to permanently store carbon in concrete.
- .4 Provide an Environmental Product Declaration (EPD) for all structural materials being used on the project.

.4 It is recommended that recycled structural materials are evaluated and implemented on the project. Recycled materials can include the following:

- .1 Fly ash or blast furnace slag as a supplementary cementing material for use in concrete.
- .2 Recycled concrete for use as aggregate, either in the production of concrete or granular fill material.
- .3 Recycled steel in the manufacturing of structural steel and reinforcing steel.

.5 Reductions in total material usage through efficient structural and architectural design, and optimization of the building form should be evaluated on a project-by-project basis and implemented where practical.

.6 Specify materials that can be procured locally, where possible.
.7 In collaboration with the mechanical, architectural and sustainability designers, evaluate the potential for utilizing the structure as a thermal mass for mechanical system considerations, and to facilitate the application of efficient mechanical heating/colling strategies.

MECHANICAL SYSTEMS

1. Mechanical Design Requirements

.1 General Requirements
- .1 Mechanical Permits (HVAC, plumbing, gas, etc.) are required for all mechanical work on the SAIT campus in accordance with the Authority Having Jurisdiction .
- .2 Design all new and renovated mechanical systems in accordance with applicable codes, regulations, and standards.

.2 Mechanical Design Conditions
- .1 Indoor Environmental Conditions:
- .2 Design all new buildings and major renovations to satisfy the following environmental conditions:

Program Type	Heating Setpoint (°C)	Cooling Setpoint (°C)	Humidity Range	Unoccupied Setbacks
Mechanical Rooms	21	23-25	60% RH Max.	Yes
IT/Data Rooms	21	22-25	60% RH Max.	No
Washrooms	21	23-24	60% RH Max.	Yes
Storage Rooms	21	23-25	60% RH Max.	Yes
Janitor Rooms	21	23-26	60% RH Max.	Yes
Office & Meeting	21-23	23-25	25-60% RH	Yes
Lecture rooms	21-22	23-25	25-60% RH	Yes
Trade classrooms	21-22	23-25	25-60% RH	Yes
Laboratories	21-22	23-24	25-60% RH	Yes
Public spaces	21-22	23-25	25-60% RH	Yes
Workshops	21-22	23-25	60% RH Max.	Yes
Medical	21-22	22-24	30-60% RH	Yes
Culinary	21-22	23-24	25-60% RH	Yes

- .3 Design spaces with unoccupied setbacks as follows:
  - a) Design systems with daily setback schedules for weekdays and weekends.
  - b) Sequence a minimum 1-hour pre-conditioning period prior to occupied hours.
  - c) Setback schedules and setpoints are to be fully adjustable by SAIT operations.
  - d) Default unoccupied heating setpoint: 18°C
  - e) Default unoccupied cooling setpoint: 26°C
- .4 Design all spaces to satisfy occupant comfort criteria in accordance with ASHRAE Standard 55.
- .5 Ventilate all mechanical, IT/data, and elevator machine rooms at a minimum rate of 0.3 L/s/m2 of fresh air. Fresh air that is allocated and transferred from an adjacent space is acceptable.
- .6 Base design of heating and cooling systems on outdoor ambient temperatures noted in the Alberta Building Code:
  - a) Heating Design Day: 1% value
  - b) Summer Design Day: 2.5% value

.3 System Redundancy
- .1 Design systems and equipment to provide levels of redundancy that accommodates shutdowns for inspections, maintenance, and failures. Provide appropriate means for isolation, drain down, and fill to accommodate individual

equipment shutdowns.

.2 Heating:
   a) Two parallel heat exchangers each sized at 70% total load.
   b) Provide a minimum two building hot water pumps in a parallel lead-lag configuration. Size individual pumps such that 70% building flow may be accommodated with a single pump out of service.

.3 Cooling:
   a) Provide a minimum two building chilled water pumps in a parallel lead-lag configuration. Size individual pumps such that 70% building flow may be accommodated with a single pump out of service.

.4 Domestic Hot Water:
   a) Provide a minimum two building domestic hot water heaters each with assigned recirculation pumps. For buildings with critical domestic hot water service, size individual heating units such that 70% of peak load may be accommodated with a single unit out of service.

.5 HVAC Fans :
   a) Utilize multiple fan units in parallel were possible to provide redundancy. Refer to the Air Handling Units Section of this guideline.

.4 Central Plant Utilities

.1 SAIT's main campus utilizes a centralized plant that distributes the utilities listed below. Buildings on the main campus shall be designed to utilize these utilities within the noted operating parameters.

.2 High pressure steam:
   a) Utilize district steam to generate building hot water, domestic hot water, and low-pressure humidification steam.
   b) Design Parameters:
      - Steam service is available continuously year-round.
      - Generated district steam pressure: 1206 kPa (saturated).
      - Available steam pressure to be calculated by design team based on friction loss. Verify based on adjacent building connections where possible.

.3 Condensate:
   a) Condensate return systems shall be gravity fed to at atmospherically vented receiver with condensate pumps.
   b) Return condensate to central plant with dedicated building pumps. Do not dump condensate to drain.

.4 Chilled Water:
   a) Utilize district chilled water for space cooling.
   b) Design Parameters:
      - Chilled water service is available on a daily schedule from May through October, at the discretion of plant operations.
      - Central plant CHW supply temperature: 5.5^{o}C
      - Central plant CHW return temperature: 12.7^{o}C
      - Maximum district CHW system pressure: 700 kPa
      - Provide direct bridge connection between the campus tunnel utility and building system. The bridge connection shall be SAIT's standardized arrangement as indicated below:

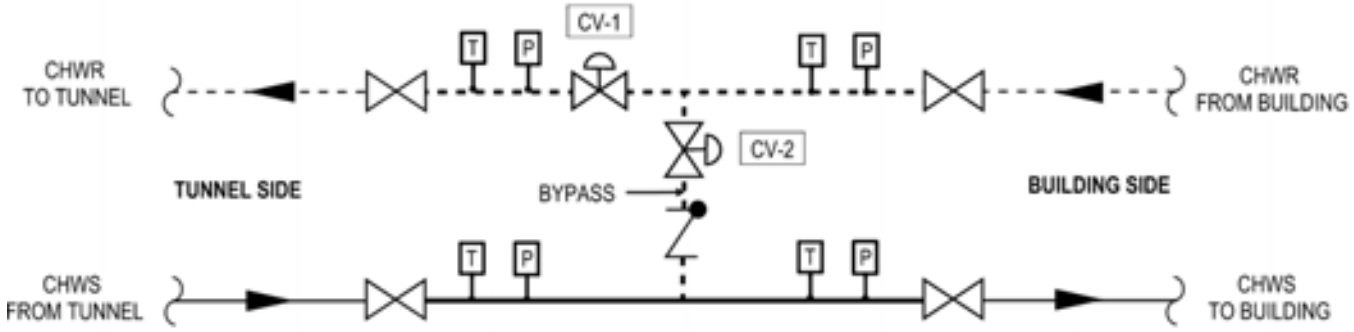

Figure 1 - Standard Building CHW Bridge Connection

- If the building CHW pressure will exceed the maximum allowable district CHW pressure, utilize a heat exchanger for an indirect connection between the tunnel and building CHW systems.

.5 Natural Gas:
  a) Available pressure varies by location. Design team to analyze and evaluate available pressure.

.6 Domestic Water:
  a) Available pressure varies by location. Design team to analyze and evaluate available pressure.

.5 Building System Design
  .1 Load analysis: provide anticipated building utility loads to SAIT during schematic design phase. Coordinate with SAIT to review existing campus load, plant capacity, and evaluate the project's implications on the plant operations.
  .2 Tie in point: coordinate with SAIT to determine the appropriate building tie-in point to the central plant utilities.

2. Piping Systems

.1 Design Requirements
  .1 Design the following piping systems in accordance with this section:
    a) Hydronic
    b) Natural gas
    c) Compressed air
    d) Vacuum

.2 Piping
  .1 Design piping systems with the following materials:
    a) Hydronic: Schedule 40 steel, Type 304 Stainless Steel, or Type "L" Hard Copper.
    b) Natural gas: Schedule 40 steel.
    c) Compressed air: Galvanized schedule 40 steel, Type 304 Stainless Steel, Type "L" Hard Copper.
    d) Vacuum: Galvanized schedule 40 steel, Type 304 Stainless Steel, Type "L" Hard Copper.

.3 Fittings
  .1 Piping joints to be welded, flanged, soldered or threaded.
  .2 Mechanical fittings may only be used in exposed applications within mechanical rooms, including:
    a) Grooved & gasketed fittings

b) Press fittings

.4 Hydronic Systems
- .1 Maximum pipe velocity in mechanical rooms, shafts and utility tunnels: 8 ft/s (2.44 m/s)
- .2 Maximum pipe velocity in any space aside from those mentioned in previous clause: 5 ft/s (1.5 m/s)
- .3 Maximum pressure drop: 3.5 ft/100ft
- .4 Do not route piping or plumbing services through sensitive equipment rooms such as elevator machine rooms, electrical rooms, data rooms, etc.

.5 Devices
- .1 Mount all valves and devices in accessible location at maximum height of 4.57m (15 ft).
- .2 Provide unions at every terminal equipment connection.
- .3 Provide unions on every electronic control valve.
- .4 Provide instrument tappings on every terminal connection.
- .5 Provide accessible isolation in the following locations:
  a) Supply and return mains
  b) Bottom of each riser
  c) Takeoffs from riser at each floor
  d) Equipment connections
  e) Upstream and downstream of control valves and flow meters.
- .6 Balancing valves shall not serve as means for isolation. Provide dedicated isolation valves where required.
- .7 Pressure gauge and thermometer locations:
  a) Air handling unit coil connections
  b) Service equipment connections

3. Plumbing Systems

.1 Piping and Devices
- .1 All new DCW, DHW and DHWR piping shall be Type L Hard Copper or Schedule 40 Type 304SS. Acceptable joints are solder, brazed, threaded, welded, flanged or grooved.
- .2 Mechanical fittings may only be used in exposed applications with mechanical rooms, including:
  a) Grooved & gasketed fittings
  b) Press fittings
- .3 Shark bite type fittings are prohibited.
- .4 All new sanitary, vent, and storm piping shall be DWV copper, cast iron, and DWV PVC.
- .5 All new lab waste and vent to be electrofused polypropylene or PVDF.
- .6 Provide accessible isolation in the following locations:
  a) Bottom of each riser
  b) Takeoffs from riser at each floor
  c) Each washroom group
  d) Individual fixtures
  e) Upstream and downstream of filters, strainers, and meters
  f) Non-freeze hosebibs

.2 Domestic Water
- .1 The following shall be included on domestic water services entering each building:
  a) Premise isolation.
  b) Domestic water meter with line-size bypass.

c) Dual backflow prevention.

.2 The following shall be included on hydronic system fill services:
a) Isolation.
b) Water meter with line-size bypass.
c) Dual backflow prevention.
d) Combine system filles where possible.

.3 Buildings requiring uninterrupted domestic water service shall be equipped with redundant backflow prevention to facilitate maintenance and testing.

.4 Backflow devices shall be installed with indirect drain lines routed to the nearest floor drain.

.5 Premise isolation, water meters, and backflow devices shall be installed in accessible locations to support regular maintenance, readings, and testing.

.6 Do not exceed 2.0 m/s on cold water systems to minimize noise, erosion and corrosion.

.3 Domestic Hot Water

.1 Design domestic hot water system to produce 60-70^{o}C water depending on building requirements. Size domestic hot water heaters based on domestic cold water temperature of 4^{o}C.

.2 Do not exceed 0.76 m/s (2.5 ft/s) on hot water supply and recirculating pipe to minimize noise, erosion, and corrosion.

.3 Domestic hot water heaters:
a) Utilize the central plant utilities as the heating source for domestic hot water generation wherever feasible.
b) Natural gas burning hot water heaters may be utilized when central plant utilities are not available, upon review and approval by SAIT. Gas burning heaters to be power vented and condensing type.
c) Provide equipment redundancy in accordance with the Mechanical Design Requirements Section to facilitate inspections, testing, and maintenance.
d) Semi-instantaneous heaters:
- Skid mounted packaged units with integral controllers.
- Double-wall, shell-and-tube exchanger.
- Tanks constructed of duplex alloy stainless steel. Glass lined steel tanks are not acceptable.

e) Instantaneous heaters:
- Requires review and approval by SAIT.
- Instantaneous natural gas burning heaters are not acceptable.
- Provide checkvalve on the domestic cold water service to hot water heaters to prevent backflow from recirculation system.

f) Domestic hot water systems to be fully recirculated when piping length exceeds 15m. All fixtures shall be located within 3m of a circulated domestic hot water branch.
g) Hot water recirculation pumps shall include means for isolation, checkvalve on discharge, and strainer on inlet.
h) DHWR branches are to include balancing valves. Branch flowrates are to be included in contract documents and verified balancing to be submitted within balancing report and O&M manuals.

.4 Tempered Water

.1 Tempered water shall be potable and delivered to the following fixtures:
a) Washroom lavatories
b) Emergency showers
c) Eyewash stations

.2 Tempered water shall be produced between 38-45^{o}C with localized thermostatic

mixing valves or by a centralized service. The design team shall review with SAIT and recommend the appropriate option to suit each individual project.

.5 Sanitary, Venting, & Storm
- .1 Air admittance valves are not acceptable as means for venting.
- .2 The minimum size of any rainwater leader is 100mm.
- .3 The minimum size of any equipment drain shall be 30mm.
- .4 Coordinate clean out locations with interior finishes and structure to ensure sufficient access is maintained. Cleanouts within ceiling spaces should extend to the floor above to facilitate access.
- .5 Provide oil and dirt separators in parking garages and automotive workshops.
- .6 Laboratory Waste:
  - a) Provide large laboratory areas with dedicated acid waste drainage and venting directed to a neutralizing sump.
  - b) Where dedicated waste drainage and venting is not feasible, provide laboratories with point-of-use dilution or neutralizing traps.
- .7 Trap primers:
  - a) All floor drains shall be connected to a wet-service trip primer unit. Waterless trap seals are not acceptable.
  - b) Trap primers to be electronically operated with 24-hour timer and adjustable delay. Tapping adjacent fixture supplies as means of trap priming is not acceptable.
  - c) Multiple floor drains may be served by single trap primer unit with manifolded connector.
- .8 Roof drains:
  - a) Minimum drain size: 100mm (4”)
  - b) Provide a minimum of 2 roof drains per drainage area: one (1) regular service drain and one (1) emergency overflow drain.
- .9 Sumps:
  - a) Sumps to be a minimum of 900mm in diameter.
  - b) All sumps to come equipped with two duty-standby pumps, a four-float system, and control panel with BMS integration for alarm and status.
  - c) Duty-standby pump assignment shall automatically rotate monthly.
  - d) Sumps to be provided with air-tight covers of sufficient strength to withstand anticipated use and traffic.
  - e) Vent all sump pits with a dedicated vent service. Sumps of the same drainage service may connect to a common dedicated vent.
- .10 Water Treatment
  - a) Provide water softening stations on all evaporative equipment and steam generating devices.

.6 Plumbing Fixtures
- .1 Water-use Requirements:
  - a) Plumbing fixtures for all new buildings and major renovations shall satisfy the Water and Resource management requirements of the SAIT Sustainability Design Standard.
- .2 Laboratory and Shop Fixtures
  - a) Coordinate with SAIT and the user-groups to determine the appropriate fixtures on a case-by-case basis.
- .3 Select building fixtures in accordance with the design requirements listed within the Plumbing Fixture Schedule. Actual fixtures shall be selected to suit the project on a case-by-case basis, as approved by SAIT.
- .4 Building fixtures shall be selected from acceptable manufacturers listed within the Plumbing Fixture Schedule. Alternates may be proposed suit the project on a

case-by-case basis, as accepted by SAIT. Preference is given to manufacturers with North American production and locally available replacement components and service.

Plumbing Fixture & Trim Schedule (Part 1 of 2)

Fixture Type	Design Requirements	Acceptable Manufacturers	
		Fixture	**Trim**
Water Closet – Public	• Wall mounted is preferred for new construction. Floor mounted is acceptable when replacing existing. • Flush valves on public water closets: hands-free automated, hardwired with low-voltage.	• Kohler • American Standard • Crane	• Delta Commercial • Moen • Sloan
Water Closets - Private	• Flush tanks permitted on residence water closets only. • Dual flush (6L/3L)	• Kohler • American Standard • Crane	N/a
Urinals	• Carrier mounted. • Flush valves: hands-free automated, hardwired with low-voltage. • Waterless urinals are to be avoided as a measure of satisfying water-use reduction requirements.	• Kohler • American Standard • Crane	• Delta Commercial • Moen • Sloan
Lavatories – Public	• Hands-free automated with adjustable run time, hardwired with low-voltage. • Serve with tempered water. • Locate thermostatic mixing valve below sink with access for service.	• American Standard • Crane • Kohler • Kindred / Franke	• Delta Commercial • Moen • Sloan
Lavatories – Private	• Individually adjustable temperature control with pressure balanced mixing valve.	• American Standard • Crane • Kohler • Kindred / Franke	• Delta Commercial • Moen • Sloan • Zurn

Plumbing Fixture & Trim Schedule (Part 2 of 2)

Fixture Type	Design Requirements	Acceptable Manufacturers	
		Fixture	**Trim**
Showers – Public	• Individually adjustable temperature control with pressure balanced mixing valve.	• Custom to suit project. • Fiat • Hytec	• Delta Commercial • Moen • Sloan • Symmons
Showers – Private	• Individually adjustable temperature control with pressure balanced mixing valve.	• Custom to suit project. • Fiat • Hytec	• Delta Commercial • Moen • Sloan • Symmons
Emergency Fixtures	• Emergency showers and eyewash stations shall be equipped with thermostatic mixing valve or fed with tempered water. • Emergency showers shall be equipped with dedicated floor drain directly below water fixture. • Eyewash station basins must be directly piped to sanitary.	• Bradley • Hughes	N/a
Drinking Fountains	• Drinking fountains shall be unfiltered. • Utilize refrigerated as requited to suit the project. • Include combination fountain and bottle fillers with digital bottle-fill counter display.	• Hawes • Elkay • Oasis	N/a
Janitor & Utility Sinks	• Janitor Sinks: Floor mounted basin with wall guards. • Janitor Faucets: wall mounted, heavy duty construction with spot brace. Outlet with garden hose threads and pail hook.	• Fiat / Crane • American Standard • Metcraft	• Delta Commercial • Zurn
Hose Bibs	• Non-freeze hydrant with integral vacuum breaker. • Public areas: concealed within flush mounted enclosure and loose keyed access.	• Watts • Zurn	N/a

4. Mechanical System Identification

.1 General:
  .1 All equipment, valves, pipes, ducts and building automation system components shall be identified to SAIT's standards.

.2 New Buildings:
  .1 Teams shall tag and number mechanical equipment within design documents in accordance with SAIT's typical nomenclature.
  .2 All mechanical equipment for new construction shall be numbered sequentially within each equipment type.
  .3 Variable frequency drives shall be numbered to match the equipment they serve.

.3 Renovations / Expansions
  .1 Same general approach as new buildings. Coordinate with SAIT to determine best approach to integrate with existing building nomenclature.

.4 Typical Nomenclature
  .1 Mechanical equipment shall be tagged as follows:

_____ -	_____ -	_____
[Building Code]	*[Equipment Type]*	*[Equipment Number]*
Building List:	Typical Equipment List:	Number

AA – Heritage Hall
BA – Clayton Carrol
C – Aldred Centre
DA – East Hall Residence
E – John Ware
FA – Art Smith Aero Centre
G – E.H. Crandell
HA – Begin Tower
JA – Cenovus
KA - Johnson-Cobbe
L – GBT
M – Stand Grad
N – Senator Burns
PA – SAIT Parking Garage
Q – Eugene Coste
S – Nellie McClung
T – Thomas Riley
V – Campus Centre
W – Mayland Heights
YE/YC– Culinary Campus
YB – Crane & Ironworker Facility

AHU – Air handling unit
AC – Air conditioner
SF – Supply fan
EF – Exhaust or return fan
TF – Transfer fan
TBS – Terminal box supply
TBE – Terminal box exhaust
VFD – Variable frequency drive
WEF – Welding exhaust fan
MUA – Makeup air unit
HU – Humidifier
SPU – Stairwell pressurization unit
B – Boiler
CH – Chiller
CU – Condensing unit
DC – Dry cooler
P – Pump
CV – Control valve
ET – Expansion tank
TK – Fluid tank
HE – Heat exchanger
DWH – Domestic water heater
GFS – Glycol fill station
CUH – Cabinet unit heater
UH – Unit heater
FCU – Fancoil unit
RAD – Radiant heating
AS – Air separator
FE – fire extinguisher
FEC – fire extinguisher and cabinet

.5 Equipment Identification
  .1 All equipment shall be complete with the manufacturer's nameplate and equipment nameplate.
  .2 Equipment Nameplates:
    a) Mechanically fastened to each piece of equipment.
    b) 3 mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.
    c) Lettering shall be 20mm in size, raised, white colour and on black background.
    d) All name plates shall include the following as appropriate:
      - Manufacturers name, model, size, serial number and capacity.
      - Motor voltage, frequency, phase, power factor, duty and frame size.
      - Do not conceal nameplates with equipment insulation.

.6 Valve Identification
  .1 All valves, except those in plain sight of equipment served, shall be tagged with brass tags.
  .2 Brass tags are to be 40 mm (1½") diameter with 12 mm (½") high lettering and brass jack chain for fastening to the valve.
  .3 Number valves in each system consecutively.
  .4 Provide a valve tag directory showing valve number, location, service, make/model size, with/without hand wheel, type of control and normal position.
  .5 The valve tag directory to be mounted in a metal frame and protected with acrylic sheet.

.7 Duct Identification
  .1 Ductwork shall be labelled to identify the air service (eg. RETURN AIR) and the air system (eg. AHU-1).
  .2 All ductwork to be identified with black stenciled paint. Stenciling shall be in capitalized block lettering, 65 mm (2½") in size.
  .3 Duct identification nomenclature:

Service	Legend
Return Air	RETURN AIR
Supply Air	SUPPLY AIR
Mixed Air	MIXED AIR
Combustion Air	COMBUSTION AIR
Relief Air	RELIEF AIR
General Exhaust Air	GENERAL EHXAUST AIR
Washroom Exhaust Air	WASHROOM EXHAUST AIR
Laboratory Exhaust Air	LAB EXHAUST AIR

.8 Piping Identification
  .1 All exposed piping shall be identified with standardized labelling.
  .2 Natural gas piping must be labeled as yellow in colour in concealed, semi concealed and exposed location, and not have any other colour applied to it, except as stated for banding identification only.
  .3 Non-potable water piping must be labeled as purple in colour or marked with a continuous purple stripe. Both the bare pipe and insulation must be labeled.

.4 Provide vinyl pipe labels that are visible, legible, and accessible for maintenance and operations. Vinyl labels to include colour banding, service identification, and flow arrows.

.5 Label Colour Bands:

a) Apply identification label bands on all exposed or concealed piping, except drainage piping and vent piping outside mechanical rooms, in the primary colours listed in this Section.

b) Label bands to completely encircle the pipe for a length of 150 mm in primary colour. Neatly arrange all bands in straight lines across groups of pipes.

.6 Label Identification Letters:

a) Label lettering to conform to the following schedule based on ASME A13.1 identification system:

Outside Diameter of Pipe or Covering	Length of Field Colour	Size of Letters
19 mm to 32 mm	200 mm	13 mm
38 mm to 50 mm	200 mm	19 mm
65 mm to 150 mm	305 mm	32 mm
200 mm to 250 mm	610 mm	65 mm
Over 250 mm	800mm	89m

.7 Label identification nomenclature

a. Refer to the below tables:

Table 4 - Piping Service Identification Nomenclature Part 1 of 2

Service	Colour Band	Lettering	Legend
Sprinkler	Red	White	WET SPRINKLER
Wet Stand Pipe	Red	White	WET STANDPIPE
Dry Stand Pipe	Red	White	DRY STANDPIPE
Carbon Dioxide (Fire)	Red	White	*[ ]kPa CO2
Oxygen	Orange	Black	*[ ]kPa O2
Natural Gas	Yellow	Black	*[ ]kPa NATURAL GAS
Vacuum	Aluminum	Green	VAC.
Compressed Air	White	Green	*[ ]kPa COMPRESSED AIR
Distilled Water	Green	White	DISTILLED WATER
Domestic Cold Water	Light Blue	White	DOMESTIC COLD WATER
Domestic Hot Water	Light Blue	White	DOMESTIC HOT WATER
Domestic Hot Water Recirc.	Light Blue	White	DOMESTIC HOT WATER RECIRC.
Heating Hot Water Supply	Yellow	Black	*[ ]°C HOT WATER HEATING SUPPLY
Heating Hot Water Return	Yellow	Black	*[ ]°C HOT WATER HEATING RETURN
Heating Glycol Supply	Yellow	Black	*[ ]°C HEATING GLYCOL SUPPLY
Heating Glycol Return	Yellow	Black	*[ ]°C HEATING GLYCOL RETURN
Chilled Glycol Supply	Green	White	CHILLED GLYCOL SUPPLY
Chilled Glycol Return	Green	White	CHILLED GLYCOL RETURN
Chilled Water Supply	Green	White	CHILLED WATER SUPPLY
Chilled Water Return	Green	White	CHILLED WATER RETURN
Condenser Water Supply	Green	White	CONDENSER WATER SUPPLY
Condenser Water Return	Green	White	CONDENSER WATER RETURN
Plug Load Cooling Water	Green	White	PLUG COOLING WATER SUPPLY
Plug Load Cooling Water Return	Green	White	PLUG COOLING WATER RETURN
Low Pressure Steam	Yellow	Black	*[100] kPa LP STEAM
High Pressure Steam	Yellow	Black	*[ ] kPa HP STEAM
Steam Condensate	Yellow	Black	*[ ] kPa HOT STEAM CONDENSATE
Dry Mop	Aluminum	Green	DRY MOP
Fuel Oil	Brown	Black	FUEL OIL

Table 5 - Piping Service Identification Nomenclature Part 2 of 2

Service	Colour Band	Lettering	Legend
Ammonia	Grey	Black	AMMONIA
Freon-Liquid	Grey	White	FREON-LIQUID
Freon-Gas	Grey	White	FREON- GAS
Carbon Dioxide	Grey	White	*[ ]kPa CO2
Lubricating Oil	Brown	White	LUBE OIL
Engine Exhaust	Aluminum	Black	ENGINE EXHAUST
Boiler Feed Water	Yellow	Black	HOT BOILER FEED WATER
Strong Acid	Purple	Black	*ACID [CHEMICAL SYMBOL]
Nitrogen	Orange	White	*[ ] kPa N2
Brine	Green	White	BRINE
Demineralized Water	Green	White	DEMINERALIZED WATER
Softened Water	Blue	White	SOFT WATER
Deionized Water	Blue	White	DEIONIZED WATER
Chemical Feed Line	Green	Black	*CHEMICAL FEED [CHEMICAL SYMBOL (S03) (P04)]
Drains	Aluminum	Green	DRAIN
Vent	Aluminum	Green	VENT
Blow Down	Aluminum	Green	HOT BLOW DOWN
Acetylene	Orange	Black	*[ ]kPa ACETYLENE
Hydrogen	Orange	Black	*[ ]kPa H
Carbon Monoxide	Orange	Black	*[ ]kPa CO
Propane	Orange	Black	*[ ]kPa PROPANE
Methane	Orange	Black	*[ ]kPa METHANE
Butane	Orange	Black	*[ ]kPa BUTANE
Ethane	Orange	Black	*[ ]kPa ETHANE
Combine Methane Argon	Orange	Black	*[ ]kPa METHANE/ARGON
Argon Gas	Orange	White	*[ ]kPa ARGON
Lab Air	White	Green	*[ ]kPa LAB AIR
Helium	Orange	White	*[ ]kPa HELIUM

.9 Above Ceiling Equipment Markers
  .1 Provide markers in T-bar and drywall type ceilings to identify locations of all dampers, valves and equipment located above the ceilings.
  .2 Locate markers on T-bar closed to equipment.
  .3 Apply self-adhesive plastic dots, 15 mm (¾") diameter, colour coded, to T-bar ceiling or access door.
  .4 Colour code as follows:
  .5 Yellow – HVAC equipment
  .6 Red – Fire dampers / smoke dampers
  .7 Green – Plumbing Valves
  .8 Blue – Heating / cooling valves.
.10 Building Automation System Identification
  .1 Utilize tags and nameplates as described for mechanical equipment and valves for automation system components.
  .2 Use BAS mnemonics specified in BAS specification sections on tags and nameplates to identify BAS physical points and equipment.
  .3 Identify the following BAS components with laminated plastic nameplates:
    a) Remote control unit (RCU) panels.
    b) Subpanels.
    c) Associated equipment panels.
    d) Panel mounted valves; identify function of each valve.
  .4 Building automation conduit and conductors to be banded orange.

5. Insulation Requirements

.1 General
  .1 All insulation materials shall comply with the fire and smoke hazard ratings in accordance with CAN/ULC-S102 and NFPA 255. Accessories such as adhesives, mastics, cements and tapes shall have the same or better fire and smoke hazard ratings.
  .2 Insulation shall satisfy the minimum requirements of ASHRAE Standard 90.1.
  .3 Insulation that is subject to damage or reduction of thermal resistivity if wetted shall be enclosed with a vapour barrier jacket.
.2 Duct Insulation
  .1 Insulate all supply air ductwork with vapour retardant jacketing. The insulation shall cover the duct system with continuous and unbroken seal.
  .2 All ductwork that penetrates the building envelope shall be insulated for a minimum of 3 m (10 feet) from the penetration.
  .3 Supply air duct insulation shall have a vapour barrier jacket.
  .4 The insulation of return and exhaust air distribution systems needs to be evaluated for each project and for each system to guard against condensation formation and heat gain/loss on a recirculating or heat recovery system. Generally, return and exhaust distribution systems do not require insulation if located in a ceiling plenum or mechanical room used as a return air plenum.
.3 Equipment Insulation
  .1 All equipment, heat exchangers, converters and pumps shall be insulated in accordance with ASHRAE Standard 90.1.
  .2 All heating equipment connected to the district serves shall be aluminum jacketed.
.4 Pipe Insulation
  .1 All concealed or exposed piping with surface temperatures below average dew point temperature of the indoor ambient air shall be insulated.
  .2 Provide vapour retardant jacketing on all chilled water piping.

.3 Non-potable and tempered water piping shall be insulated.

.5 Thermal Pipe Insulation for Plumbing Systems

.1 All vents terminating through the roof shall be insulated for a minimum of 3 m (10 feet) from the roof penetration.

.2 Insulate roof drains and connected storm water piping for a minimum of 3m (10 feet) from the roof penetration.

.3 All live steam lines inside air handling units (e.g. steam humidification supply headers) shall be insulated.

6. Fire Suppression

.1 Common Work Results for Fire Suppression

.1 Pipe material: Schedule 40 steel.

.2 Fittings: Screwed, flanged, welded, or mechanical grooved with gasketing.

.3 Copper piping permitted only in areas susceptible to magnetic fields.

.4 Provide adequate drainage locations to outside of buildings for testing and draining all portions of standpipe and sprinkler systems. Coordinate with design team and SAIT to locate suitable locations for exterior drains that accommodate full flow without damaging building or landscaping.

.5 Standpipe and sprinkler system shall be hydraulically designed by a delegated design professional who satisfies the following requirements:

a) Licensed as a Professional Engineer in the province of the Alberta and having relevant experience in fire protection engineering.

b) Responsible for design of sprinkler system required by the project, codes, standards, and regulations of the Authorities Having Jurisdiction.

c) Responsible for suppling all building code scheduling and close-out certificates, submitted to the project team for coordination with the Authority Having Jurisdiction.

.6 Requirements for sprinkler system design shop drawings are as follows:

a) Include detailed design calculations in accordance with applicable codes, standards, and requirements of the Authorities Having Jurisdiction.

b) Include drawings that indicate all piping, devices, and sprinkler head locations.

c) Full shop drawing package to bear the engineering seal of the delegated design professional.

d) Shop drawings to be reviewed and approved by project design team and SAIT.

e) Shop drawings to be reviewed by SAIT's insurance underwriter.

.7 Information on water supply available for firefighting must be obtained from SAIT.

.8 All piping and system components must be fully accessible for maintenance purposes.

.9 Alarm only emergency conditions. Do not alarm test conditions.

.10 Pressure gauges to have dual scales; PSI and kPa.

.11 Flexible sprinkler head connections: ULC listed connections intended for fire protection use are acceptable if approved by the project design team, SAIT, and the Authority Having Jurisdiction.

.12 Where a major renovation occurs in a building not currently sprinklered, the design team shall review applicable requirements of current code. Sprinkler system upgrades to satisfy current code requirements shall be implemented on a project-by-project basis as reviewed by the design team, SAIT, and the Authority Having Jurisdiction.

.13 Fire alarm panels shall be keyed on SAIT common fire alarm panel key.

.14 Sprinkler or standpipe zone valves accessible by or within reach of the public shall include a lock and chain in addition to a standard tamper switch.
.15 For standpipe and hose systems, provide 65mm hoses only.

.2 Sprinkler Systems
.1 The sprinkler piping layout shall generally follow the tree system, with each branch representing individually supervised zones that correlate with the fire alarm zoning. Cross mains shall be continuous in size from the connection at the standpipe to the end of the run. Cross mains shall be a minimum of 50 mm in light hazard areas and 80 mm in ordinary hazard areas.

.3 Specialty Fire Suppression Systems:
.1 Areas requiring specialty fire suppression systems shall be determined on a project-by-project basis, as recommended by the design team and approved by SAIT. Specialty systems are generally required for:
a) Data rooms
b) Elevator machine rooms
c) High voltage electrical rooms
.2 The type of specialty fire suppression system shall be determined on a project-by-project basis, as recommended by the design team and approved by SAIT. Preferred specialty system types include:
a) Pre-action
b) Vortex dual agent
.3 All specialty fire suppression systems shall be connected directly to the building fire alarm system. Systems with standalone internal alarming is not acceptable.
.4 All specialty fire suppression systems shall utilize an uninterruptable power supply with 72 hours of battery backup capacity.
.5 Provide dry sprinkler systems/heads is areas:
a) Where subject to freezing temperatures (i.e. cold soffits, within 3 meters of an overhead door, loading docks, generator rooms, etc.).
b) Where a wet system would result in an unacceptable level of damage to records, equipment, or research. Review these requirements with the project team and SAIT on a case-by-base basis.
.6 Provide quick response heads in all locations except mechanical rooms. Sprinkler heads in mechanical rooms and some shop spaces shall be high temperature (i.e. 140°C).
.7 All suspended sprinkler heads located in storage rooms, electrical rooms, mechanical rooms and data rooms are to be equipped with guards to provide protection against impact damage.
.8 Provide spare sprinkler heads as follows based on system size:
a) 0-299 units in project: six (6) spare heads.
b) 300-1000 units in project: twelve (12) spare heads.
c) Over 1000 units in project: twenty four (24) spare heads.

.4 Fire Pumps
.1 Fire pumps shall be centrifugal type, single stage, ULC listed and labelled, complete with starter, controller, and jockey pump. The entire pump package shall be preassembled, tested, wired, and skid mounted, conforming to NFPA 20.
.2 Size fire pumps to deliver a minimum of 150% of rated capacity at a discharge pressure of not less than 65% of the total rated pump head, with shut-off pressure not exceeding 120% of total rated pump head.
.3 Pipe all flow test drain ports to dedicated funnel floor drains.
.4 Connect to emergency power supply with a transfer switch integral to the pump controller.

.5 Fire Extinguishers
  .1 In general, mounting height for fire extinguishers in cabinets is 1200 mm above floor. Mount in semi or fully recessed cabinets where possible.
  .2 Fire extinguishers can be combined with fire hose valve cabinets.
  .3 Fire extinguishers shall be minimum 4.5 kg capacity unless otherwise directed by SAIT.

7. Heating & Cooling Systems

.1 Chemical Treatment
  .1 Coordinate with SAIT to utilize their preferred chemical treatment agency.
  .2 Provide side stream chemical treatment arrangements on all heating, glycol, and cooling systems:
    a) Corrosion coupon rack.
    b) Micron Filter
    c) Flow indicator
    d) Balancing valve and isolation.
  .3 Chemical pot feeders:
    a) Floor mounted with factory mounted support legs.
    b) Quick opening top cap.
    c) Bottom drain connection.
.2 Heating Water Systems
  .1 Generate building heating water with central plant utilities as described in the Mechanical Design Requirements section of this guideline.
  .2 For addition or renovation to existing systems, confirm supply temperature and design delta-T on a case-by-case basis with SAIT.
.3 Glycol Systems
  .1 Utilize glycol solutions when hydronic service will be exposed to ambient temperatures equal to or less than 0oC. Solution shall be propylene glycol/water with minimum 50% concentration, suitable for temperature range at -36^{o}C to 104^{o}C. Solutions must be factory premixed and include appropriate corrosion inhibitors.
  .2 Acceptable glycol products: Dowfrost HD, Heat Transfer Fluid.
  .3 Provide packaged automatic fill tank & pump for each glycol system.
.4 Chilled Water Systems
  .1 Generate building chilled water with central plant utilities as described in the Mechanical Design Requirements section of this guideline.
  .2 For addition or renovation to existing systems, confirm supply temperature and design delta-T on a case-by-case basis with SAIT.
.5 Low Pressure Steam Systems
  .1 Utilize low pressure steam services within buildings on a project-by-project basis. Typical application for building low pressure steam service is for humidification.
  .2 Utilize central plant steam utility as described in the Mechanical Design Requirements section of this guideline. Provide one or two stage steam pressure reducing stations, complete with pilot operated pressure reducing valves, valved bypass, strainer and pressure gauge on upstream side, relief valve and pressure gauge on downstream side.
  .3 Pressure reducing valves shall be selected to produce flat reduced pressure curve for all ranges of capacity.
  .4 Relief valves:
    a) Set relief valve to relieve at not more than 20% above reduced pressure.
    b) Terminate vent lines from relief valves outdoors. Provide drip pan at elbows

with drain connection to nearest floor drain.
c) When several relief valve vents connect to one vent header, the header cross sectional area shall equal the sum of individual vent outlet areas.

.5 Return condensate to central plant. Do not dump condensate to drain.

.6 Expansion Tanks
.1 Provide full acceptance bladder type tanks for all hydronic systems. Bladder to be removable and replaceable.
.2 Size heating water expansion tanks to accommodate 4-100oC temperature range.
.3 Size cooling water expansion tanks to accommodate 4-30oC temperature range.
.4 Minimum static pressure at system high point: 25 kPa.

.7 Hydronic Heat Exchangers
.1 Plate and frame type exchangers:
a) Use type 304SS plates.
b) Gaskets: NBR, EPDM, or Viton to suit fluid and temperature ranges.
c) Size to accommodate maximum and minimum fluid flow conditions.
d) Size to account to 15% transfer loss from fouling.
e) Size to accommodate 30% additional plates.
.2 Shell and Tube Heat Exchangers:
a) Size to account for 0.0005 fouling factor
.3 All heat exchanger connections to include the following:
a) Temperature and pressure gauges on all ports.
b) Bypass for system flushing
c) Drain with cap and chain.
d) Pressure release valve.

.8 Terminal Heat Transfer Units
.1 Radiant Panels
a) Provide foil backed insulation above all radiant panel installations unless they are deliberately designed to heat the ceiling space above.
b) Pipe radiant panels with flexible connections to facilitate lift out.
c) Design and balance zone flowrates to maintain turbulent conditions per panel manufacturer requirements.
.2 Finned Tube Radiation
a) Ensure there is sufficient room inside the cabinet for isolation valves, control valves, balancing valves, air vents and drains without compromising the active fin requirements.
b) Provide factory made access sections- access doors cut in after the fact are not acceptable.
c) Include wall mounting joggle strip to prevent wall finish damage during cabinet removal.
d) Cabinet to be minimum 16 ga for durability.
e) Design finned tube with water velocity at or below 0.46 m/s (1.5 ft/sec).
f) Use the same flow rate for all zones for each type of fin- maximum length of zone to be determined by water temperature drop per unit of length and the maximum system delta-T.
g) Use 18°C as entering air temperature for capacity rating.
.3 Unit Heaters
a) Use 18°C as entering air temperature for capacity rating.
b) Provide finger proof fan guards on all units.
c) Provide anti-stratification thermostatic controls for heaters mounted 4m or more above the finished floor.
d) Provide deflection grilles or cone diffusers for heaters mounted 4m or more above the finished floor.

e) On hydronic unit heaters, provide digital control valve and room sensor connected to the BMS. During heating mode, the BMS will activate continuous coil flow and enable or disable the fan based on the room sensor. The BMS will monitor room temperature and fan status.

.4 Cabinet Unit Heaters
   a) For wall mounted CUH, airflow pattern to be front/bottom inlet and front/top outlet.
   b) PSC motors only- no shaded pole.
   c) Provide unit mounted disconnect switch
   d) Provide key locked access doors.
   e) Provide aluminum bar grilles. No punched louvers.
   a) Provide digital control valve and room sensor connected to the BMS. During heating mode, the BMS will activate continuous coil flow and enable or disable the fan based on the room sensor. The BMS will monitor room temperature and fan status.

8. Common Motor Requirements

.1 General design requirements:
   .1 Performance Requirements: Provide only inverter grade motors, in accordance with NEMA Standard MG-1, Part 31.
   .2 Select motors to operate at a maximum of 85% of the motor rating.
   .3 Motors connected to VFDs shall have a Service Factor of 1.15.
   .4 Design motors for speed ranges between 1160rpm and 1760rpm. Motor speeds of 3600rpm should be avoided.
   .5 Motors shall be intended for varied operation over the defined speed range.

.2 Motor type:
   .1 Motors to be Totally Enclosed Fan Cooled (TEFC) type.
   .2 Design motor to prevent free exchange of air between inside and outside of motor housing.
   .3 Provide integral fan to direct cooling air over exterior surface of frame; fan constructed from one piece corrosion-resistant material.
   .4 Construct fan covers from pressed steel for frames 140T-400T and of cast iron for 440T frames.
   .5 Construct motor frame and end brackets from cast iron construction; include stainless steel nameplate.
   .6 Provide two (2) drains at lowest point in frame.

.3 Operating Characteristics:
   .1 Torque: Motors must meet or exceed the locked rotor (starting) and minimum breakdown torques specified in NEMA standard for Design B for the ratings specified. The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.
   .2 Current: Locked rotor (starting) currents are not to exceed NEMA Design B maximum values for the specified rating. Motors are capable of a 20 second stall at six times full load current without injurious heating to the motor components.
   .3 Efficiency: Premium Efficient design Motors will have a minimum and nominal full load efficiency that will meet or exceed the values listed in NEMA MG-1, 12.55 Table 12-6B when tested in accordance with NEMA test standard MG1-12.54.1, IEEE Test Procedure 112, Method B using accuracy improvement by segregated loss determination including stray load loss measurements. The minimum efficiency is guaranteed.

.4 Winding. Motors shall be wound using inverter spike resistant magnet wire capable of the greater of 1600V and 3.1 times the rated line-to-line voltage. There shall be no deviation from this requirement.
.5 The maximum temperature rise of the windings, above ambient temperature, shall not exceed the values given in Table 31-2 of NEMA MG-1, adjusted for an altitude of 3650 feet, when tested at any rated load within the rated speed range with the identified VFD. The temperature attained by cores, squirrel-cage windings, and miscellaneous parts shall not injure the insulation of the motor in any respect

.4 Shaft Grounding Brushes
.1 Shaft grounding brushes shall be used on all motors connected to VFDs such to divert induced voltage potential between the rotor and stator.
.2 Grounding brushes shall be micro-fiber type.

.5 Manufacturers: The following manufacturers of motors are acceptable:
.1 Toshiba
.2 Hyundai
.3 Westinghouse Optim HE
.4 WEG

9. Ventilation Systems

.1 Design Requirements
.1 Building Pressurization
a) Maintain a positive building pressurization of 20-35 Pa relative to exterior ambient conditions.
b) Achieve building pressurization through variable speed return and/or exhaust fans that are continuously monitored and controlled through the BMS.

.2 Room Pressurization
a) Maintain negative room pressurization of 12-25 Pa as follows: Spaces with chemical hazards, biohazards, dust or fume generating occupancies.
b) Maintain positive room pressurization of 12-25 Pa within major electrical and data/server rooms.
c) Spaces of similar usage may be neutral relative to each other.
d) SAIT will identify any other spaces where room relative pressurization is critical.
e) Achieve room pressurization through sequenced control of room supply, return, and exhaust air as monitored and controlled through the BMS to avoid pressure fluctuations. Control sequence to be developed on a case-by-case basis to suit the application, which may include:
- Local supply and exhaust/return terminal equipment and flowrate monitoring.
- Interlocking supply and exhaust/return air equipment.
- Adjustable time delay between equipment start-up and shut-down.
- Automated alarms and shut-downs.
- Individual room pressure monitoring between pressurized room and adjacent space.

.3 Ductwork
a) Construct with appropriate material based on application:
- Base building ductwork: galvanized steel or stainless steel.
- Laboratory chemical exhaust: Stainless steel.
- Workshop exhaust: Galvanized steel or stainless steel.

- Kitchen exhaust: Carbon steel or stainless steel.

b) Use corrosion resistant materials for exhaust ducts conveying corrosive fumes and vapours, or where condensation is likely to occur.
c) Design industrial ductwork, including specialty dust/fume extraction, in accordance with ACGIH Industrial Ventilation Manual
d) Seal ductwork with a minimum of two (2) layers of liquid applied sealant. Sealing tape shall not be used as the primary sealant for ductwork and plenums.
e) Exposed ductwork should be round/spiral whenever feasible.
f) Rectangular ductwork shall not exceed a 3:1 width-to-height ratio.
g) Provide access doors for duct cleaning at intervals not exceeding 6m.
h) Flex duct may only be used for low-pressure ductwork with maximum 500 Pa (2" w.g.) operating pressure. Flex duct runs shall not exceed 600mm (24") with no offsets or changes in direction.

.2 Accessories and Devices

.1 Ductwork Accessories

a) Provide air plenums with hinged, sealed access doors and lighting for inspection of each chamber. The doorsill should be not higher than 75 mm above finished floor. Secure doors with heavy duty quick access fittings operational from both sides of the door. Arrange door swings so that the fan static pressure holds the door in a closed position.
b) Provide locking nots on all air balancing dampers.
c) Locate balancing damper at least 2 m (6 feet) upstream of diffuser/outlet.
d) Use vibration control in ductwork to maintain acceptable noise levels in occupied spaces.
e) Use flexible connections between fans, equipment, plenums and all related ductwork. Construct flexible connections form polyvinyl chloride coated polyester that is double fold locked between sheet metal flanges.

.3 Terminal Equipment

.1 Terminal (VAV) Boxes

a) All new terminal boxes shall be electronically controlled with factory set integral controller. Boxes shall operate independent of inlet static pressure based on flow measurement. Exceptions may be made for renovation work, as reviewed and approved by SAIT.
b) Ensure heating terminal units are easily accessible for inspection, cleaning and disinfection. Where possible, locate terminal units within common areas and corridors.
c) Utilize markers on T-bar and drywall ceilings to identify terminal box access in accordance with the Mechanical Systems Identification section of this guideline.
d) Provide unique equipment tag limacoid on all terminal boxes in accordance with the Mechanical Systems Identification section of this guideline.
e) All terminal box reheat coils shall be provided with upstream and downstream removable access hatches that allow full inspection of both coil faces.
f) All terminal box coil connections shall include the following:
   - Supply and return isolation
   - Control and balancing valve
   - Unions
   - Valved bypass for system flushing.
   - Drain and air vent.
g) Select terminal boxes on basis of both in-duct and radiated noise level.

Manufacturer's VAV box noise data often assumes the equipment is located above a mineral fibre suspended ceiling and assumes the use of acoustically lined duct. Ensure that design conditions correspond with these requirements.

h) Provide 900 mm of acoustically lined attenuator on the room side of the terminal box.

.4 Intakes and Exhaust

.1 Design Criteria

a) Net free area air velocity not to exceed 500 fpm for intakes and 750 fpm for exhaust louvers.

b) Maintain clearances between fresh air intakes and contaminant emission sources (exhaust vents, exhaust fans, chimneys, plumbing vents, vehicle exhaust, etc.) as required to avoid contaminant entrainment. Design teams shall analyze the risk of air contamination based on site-specific conditions and establish clearance requirements generally as follows:

- Maintain minimum clearance requirements as mandated by Building Code.
- Consider the influence of all annual wind conditions and all directions. Perform environmental study as required to address the macro influence of surrounding campus infrastructure as well as the micro influence of building features.
- Consider air contamination risk from common building services and surrounding campus infrastructure. Review existing campus infrastructure with SAIT to ensure surrounding fresh air intakes and contaminant emission sources are identified and addressed.
- Summarize the air contamination risk analysis and resulting clearance requirements for SAIT’s review and approval.

c) All fresh air intakes, exhaust vents, and exhaust fans shall be equipped an insulated motorized damper located as near as possible to the thermal plane of the building envelope. The damper shall be normally closed and operated by the BMS.

d) Provide collection pan and drainage line to all fresh air intakes and plenums.

.2 Louvres:

a) 150mm deep double drainable blades and drainable heavy channel frame.

b) Include birdcreen constructed from 2mm diameter aluminum wire.

c) Finish in factory baked enamel or anodized finish.

.5 Kitchen and Other Exhaust Stacks:

.1 Design upblast arrangement with the appropriate stack height to minimize cross contamination.

.2 Include bird screen on the outlet.

.3 Provide weather-proof access port to service fan and remove debris from outlet.

.4 Upblast outlet shall not be restricted. Rain hoods and other coverings are not permitted.

.5 Provide means of water drainage within duct stack and connected fan housing.

.6 Stack shall include dedicated supports to structure. Do not support stacks from fan housings alone.

.6 Air Diffusers and Grilles:

.1 Select diffusers with appropriate ADPI in accordance with ASHRAE HVAC Applications to maintain appropriate thermal comfort conditions. Consider full and variable air volumes to avoid drafts and “air dumping.”

.2 Use of light troffer diffusers for air distribution is prohibited.

.3 Select diffusers/air outlets so that the combined sound from all diffusion in a room

meets the design criterion.

.4 Provide at least 600 mm of straight duct ahead of diffuser inlet. Use cushion head tees where appropriate.

10. Air Handling Units

.1 Design Requirements

.1 Standard catalogue or semi-custom configuration air handling units are preferred. Use of fully custom units shall be reviewed and approved by SAIT on a case-by-case basis to suit the project.

.2 Provide indoor air handling units unless otherwise approved by SAIT. Indoors units to rest on raised concrete housekeeping pads, minimum 100mm thick exceed unit footprint by a minimum of 150mm on all sides.

.3 Design teams shall consider the following for all new air handling units on campus:

a) Incorporating heat recovery.
b) Reducing air flows during unoccupied hours where feasible.
c) Use occupancy sensors and CO2 sensors for energy efficiency.

.4 Outdoor Air Handling Units

a) Outdoor air handling units shall be installed on manufacturer supplied roof curbs that are insulated with a minimum height of 350mm.
b) Provide architectural screening or custom colouring as required to suit the project conditions.
c) Avoid placing equipment over instructional space.
d) Avoid roof hatch access requirements wherever possible.

.5 Units shall include a solid liner except fan sections and upstream of fan sections where a perforated liner can be used to improve acoustical performance.

.6 All air handling units are to be capable of utilizing 100% outdoor air for free cooling.

.7 Equipment shall serve zones with common operating schedules to maximize the energy saving potential of unoccupied shutdowns. Consult with SAIT during the design phase for anticipated operating schedules.

.8 Air handling systems shall not be used to offset building heat loss. Building temperature must be able to be maintained without air handling system operation.

.9 Provide plenums with hinged, sealed access doors to access all components. Provide windows and lighting for inspection of each chamber.

.10 Outdoor air dampers to be insulated, thermally broken and low leakage.

.11 Provisions of hoist rails or rigging points shall be made for all central air handling units with motors greater than 7.46 kW. Access routes shall be identified for replacement of all motors.

.2 Fans

.1 Refer to HVAC Fans section of this guideline.

.2 Heating and Cooling Coils

b) Maximum 12 FPI
c) Fins to be aluminum with a minimum thickness of 0.25mm
d) Maximum dimension for any coil is 3.0m. Split coils for larger loads.
e) Minimum design pressure 1034 kPa.
f) Headers to be extra heavy seamless copper tube.
g) Connections to be copper or red brass, sweat or grooved. No threaded connections.
h) Coils shall be cased with heavy gauge galvanized steel
i) Cooling coils and heat recovery coils shall be provided with type 304SS drain pans with continuously welded seams.
j) Provide access to both sides of coil for cleaning purposes.

k) Limit the size of cooling coils to prevent condensation carryover into the airstream.
l) For central air systems, always situate the cooling coil downstream of the supply fan(s).
m) Provide high point air vents, low point drains, and instrument tappings at all coil connections.
n) Arrange piping with unions or flanges such that coils can be replaced in the future with minimal system interruption

.3 Heat Recovery
.1 Heat recovery equipment shall operate with minimum 70% efficiency.
.2 Monitor the following within the BMS with alarms:
a) Status
b) Entering and leaving temperature and humidity.
c) Supply and exhaust air pressure drop
d) Operating parameters (wheel speed, heat pipe tilt, etc.)
.3 Provide filtration as described in Air Filtration under this section.
.4 Preheat coils are the preferred approach to avoiding frost build-up. Size and sequence preheat coils to maximize heat recovery potential. Other methods of defrosting shall be reviewed and approved by SAIT.

.4 Air Filtration
.1 Coordinate with SAIT the filtration requirements for exhaust air streams containing process contaminants such as welding exhaust or dust collection. The appropriate filtration and collection equipment shall be designed on a case-by-case basis to suit the project.
.2 Filter sections shall be designed at 2.5 m/s (500 fpm) maximum face velocity.
.3 Provide summer and winter position filters for 100% fresh air systems, high outdoor air systems, or heat recovery systems.
.4 Heat recovery systems to include return/exhaust air filter upstream of recovery device.
.5 50 mm pleated filters are the standard type up to and including MERV 8 applications.
.6 SAIT's minimum acceptable filtration levels for central air handling units are as indicated. The design team shall select filtration levels on a case-by-case basis to suit the project's program requirements.
a) Pre-filters: MERV 8
b) Final filters: MERV 12
c) Heat recovery exhaust-stream filters: MERV 8
.7 Filters are to be held in a common universal holding frame for upstream service with universal clip hardware to secure filters in place.

.5 Humidification
.1 Humidification service is preferred for all central air handling systems to promote environmental quality and occupant health. Humidification requirements to be reviewed with SAIT on a case-by-case basis to suit the project.
.2 Monitor space humidity through the BMS and control humidifier to maintain environmental limits summarized in the Mechanical Design Requirements section of this guideline. Program automated humidity setpoint resets based on outdoor air temperature for building moisture control.
.3 Steam Humidification:
a) Steam humidification is the preferred approach and should utilize steam generated by the central plant.
b) Utilize insulated steam dispersion manifolds for airstream injection.
.4 Wetted Media Evaporative Humidifiers

a) Utilize recirculation type humidifiers where appropriate to limit water consumption. Once through systems should be avoided and only utilized with approval from SAIT.
b) Provide water treatment for system fill: water softener and micron filter.
c) Provide side-stream treatment for each humidifier unit: Micron filter and UV-disinfection.
d) Program automated blow-down and refill to maintain basin water quality.
e) Monitor basin water temperature and conductivity and generate high-limit alarms.

.5 Electric and electrode type humidifiers are prohibited.

11. HVAC Fans

.1 General design requirements:
- .1 Select fan units to provide the required system redundancy as described in the Mechanical Design Requirements section of this guideline.
- .2 Fan motors to comply with the Common Motor Requirements section of this guideline.
- .3 Design fans with variable frequency drives as described in Variable Frequency Drive section of this guideline.
- .4 Fan arrays are preferred for main building supply, return, and exhaust air. Refer to the Air Handling Units section of this guideline for fan array design requirements.
- .5 Provide all fan units with means for vibration isolation in accordance with the latest version of ASHRAE Handbook HVAC Applications, Chapter 49 - Noise & Vibration Control.
- .6 Select fan type based on best efficiency for the duty point.
- .7 The use of Class I fans is prohibited. Main building supply, exhaust, and return fans shall be Class III. All other fans shall be minimum Class II.
- .8 Fans shall be capable of accommodating static pressure variations of ±15% with no objectionable operating characteristics
- .9 Direct-drive fans are the preference on the SAIT campus. Belt driven fans should be avoided where possible.
- .10 Motor drive guards shall meet OH & S requirements and be easy to remove & install. Provide guards with expanded metal face that does not extend over the top and bottom of the sheaves

.2 Fan Arrays
- .1 Maximum motor size in fan array limited to 5.6 kW.
- .2 Size arrays so that loss of one fan shall maintain a minimum of 90% of the full flow at design conditions (this may include over-driving the fans).
- .3 Fans shall be aluminum airfoil, Class III, direct drive arrangement and shall be individually housed. Fans shall be certified by AMCA for performance. Fan shall be housed in a “cell”. Class I and Class II fans are not acceptable.
- .4 Fan/motor assembly shall be mounted within the housing on an adjustable slide rail base. Fan/motor assembly must be capable of either horizontal or vertical application.

.3 Centrifugal Fans
  .1 Enclosures to be constructed in a heavy gauge reinforced steel and supplied by the fan manufacturer.
  .2 Provide access door and drain connection to scroll. Drain connection to include ball valve and cap with chain.
  .3 Provide heavy duty, self-aligning, anti-friction bearings with locking pin and dimple system to prevent rotation. Lubrication lines are to be accessible without removing guards or shutting down the fan.
.4 Axial Fans:
  .1 Fan to be of vane-axial design and controlled by VFD.
  .2 Extend lubrication fitting to outside of fan casing. Lubrication lines are to be accessible without removing guards or shutting down the fan.
  .3 Provide external flanges in housing for duct connections.
  .4 Provide inlet cones when fan is not connected to ductwork.
.5 Roof Mounted Fans
  .1 Provide all roof mounted exhaust fans with bird screen on inlet, local disconnect switch, curb caps and multi-blade, and rattle free backdraft dampers with felt lined blade edges.
  .2 For washroom and general exhaust, use direct drive dome type centrifugal with direct discharge design, multi-directional independently mounted vibration isolators, & one-piece housings with no welds or seams. If V-belt drives are used, the fan and motor are to be separated from the main housing with multi-directional independently mounted vibration isolators.
  .3 For fume extraction or industrial exhaust, finish exterior steel fan parts with baked enamel primer and enamel final paint coat. Finish fan interior, including blades and other parts in contact with the air stream with two coats of acid resistant paint.
  .4 For kitchen exhaust, use up blast type fans. Motor shall be two-speed plug-in type with permanently lubricated bearings.
  .5 Heavy aluminum dome type housings shall be reinforced as necessary on sizes with a 500mm wheel and larger.
  .6 Design kitchen and other exhaust stacks in accordance with the Ventilation Systems section of this guideline.
.6 Inline Cabinet Fans
  .1 Inline cabinet fans are the preferred approach for room transfer air.
  .2 Construction: Forward curved fan wheel and insulated galvanized steel housing.
  .3 Power: 120V single phase with solid state speed controller for adjustable fan speed.

12. Pumps for Mechanical Systems

.1 General design requirements:
  .1 Size pump units to provide the required system redundancy as described in Mechanical Design Requirements section of this guideline.
  .2 Pump motors to comply with the Common Motor Requirements section of this guideline.
  .3 Design pumps with variable frequency drives as described in the Variable Frequency Drive
  .4 Provide all pump units with means for vibration isolation in accordance with the latest version of ASHRAE Handbook HVAC Applications, Chapter 49 - Noise & Vibration Control.
  .5 Mount all pumps greater than 2.24kW (3 HP) at floor level.
  .6 All pumps 3.73 kW (5 HP) and larger to be split coupled.

.7 All pumps over 11.2 kW (15 HP) shall be base mounted horizontal arrangements.
.8 Provide means to fully isolate each pump unit and its associated devices including strainers, check valves, flexible connections, and balancing valves. Parallel pumps shall be isolated independently.
.9 Provide condensate drip pan for all major chilled water pumps and domestic cold water booster pumps. Hard pipe with drain line routed to nearby floor drain.

.2 Base mount pumps:
.1 Install with factory provided steel framed base over concrete housekeeping pad per manufacturer recommendations. Provide neoprene isolation between support framing and housekeeping pad.
.2 Provide flexible pipe connections on the suction and discharge connections. Flexible connector type shall be braided stainless steel with 321 stainless steel bellows type inner core with Type 312 braided stainless-steel sheath.

.3 Vertical in-line pumps:
.1 Install with factory provided support framing fastened to concrete housekeeping pads per manufacturer recommendations. Provide neoprene isolation between support framing and housekeeping pad.
.2 Vertical inline pumps can be racked provided that their motors can be lifted straight up without removing any installed componentry.

.4 Pump devices, fittings, & accessories:
.1 Provide line sized strainer on suction line and line sized check valve discharge.
.2 Provide renewable bronze wear rings on high-temperature service pumps.
.3 Provide thermometers upstream and downstream of every pump.
.4 Provide pressure gauges in the below locations. Use of a single gauge with common piping and valves is acceptable.
a) Upstream of strainer
b) Between strainer and pump suction inlet.
c) Downstream of pump discharge

.5 Manufacturers: The following manufacturers of pumps are acceptable.
.1 Armstrong Fluid Technology
.2 Taco
.3 Bell & Gossett

13. Variable Frequency Drives (VFDs)

.1 General Design Requirements:
.1 VFDs are required for motors that are 3.73 kW or greater. In general, motors of this size should be designed for variable speed application to minimize energy use.
.2 Integrated drives on pumps shall not be accepted.
.3 VFD locations and mounting requirements:
a) Do note locate VFDs directly below wet services wherever possible. Provide galvanized steel drip covers when proximity to wet services cannot be avoided.
b) Mount at normal working height to allow for maintenance and repair without requiring ladders, scaffolds or movable platforms
c) Do not mounted on high vibration surfaces such as plenum walls. Proper vibration isolation must be maintained at all times.
.4 Drive components to be flush mounted in free-standing enclosure, front cover includes:
a) Disconnect operator.
b) Power ON indicator.

c) Percent speed indicator.
d) Selector switch (HOA) or key pad entry.
e) Manual speed adjust potentiometer or key pad entry.
f) Fault indicator

.2 Harmonic Mitigation:
.1 Refer to the SAIT Electrical Design Standard for overall project requirements related power quality management.
.2 All VFD units are to include harmonic mitigation as follows:
a) Line Reactor: 5% effective impedance that is non-saturating (linear), providing full harmonic filtering throughout entire load range. Dual DC link reactors with AC line reactors are acceptable.
b) Load Reactor: Dv/Dt filter when cable length between motor and VFD exceeds 90m (300 ft). Provide protection from high peak voltage.

.3 Controls Communication
.1 Electronic controls packaged with this equipment are required to communicate with the building Direct Digital Control (DDC) system as follows:
a) Controller must reside on a BACnet network and communicate with building network to read the information and change the control set points as shown in the points list, sequences of operation, and control schematics.
b) Controller shall have a BACnet Data Link/Physical layer compatible connection for a laptop computer or a portable operator's tool.
c) Distributed Processing: Controller must be capable of standalone operation and shall continue to provide control functions without being connected to the network.

.4 VFD Bypass:
.1 Provide full-voltage VFD bypass for all equipment that is not 100% redundant through a duty-standby arrangement per the Mechanical Design Requirements section of this guideline.
.2 Bypass type: 3-contactor bypass that isolates the load and line side of the drive but allows the motor to be powered up at full speed (60Hz). Bypass system must provide overload protection as well as system control points for enable, status, freeze stat, vibration, end damper, fire alarm control, etc. Provide VFD/OFF/Bypass selector switch.

.5 Manufacturers: The following manufacturers and models of VFDs are acceptable.
.1 ABB
.2 Mitsubishi
.3 Toshiba
.4 Hitachi

14. Building Management System

.1 Campus Infrastructure
.1 The SAIT campus Building Management System (BMS) is BACnet based.
.2 The field infrastructure consists of multiple control vendor systems including control panels and associated hardware. These systems provide physical connection to electrical, heating, ventilation, air conditioning, and miscellaneous process equipment. The following control vendor systems are currently installed on campus:
a) Delta Controls
b) Johnson Controls
.3 The system included centralized Supervisory Workstations and software to provide web-based operator interface for point viewing, adjustments, and

overrides of objects. The interface includes graphics, control panel objects, alarms (including email), trends and reports.

.4 Introduction of any additional and/or new BMS installations must be BACnet. Where retrofits/renovations are considered, the existing building controls systems shall be utilized.

.5 The scale, capacity and compatibility of the vendors supporting software and SAITs Supervisory Workstation must be reviewed and updated as part of the project(s).

.2 Design Requirements

.1 SAIT's approved control vendors shall supply and install all controls and peripheral devices to make complete operating including all programming, supervisory workstation updates, documentation, commissioning, and training. Approved vendors include:

a) ESC Automation (Delta Controls)
b) Johnson Controls

.2 The BMS shall consist of BACnet, microprocessor-based, peer-to-peer, networked, distributed devices utilizing the BACnet communication protocol in an open, interoperable system.

.3 System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall have web-based access over the control system network, SAIT's provided local area network, and remotely over the Internet.

.4 The Contractor shall provide connection to the SAIT Network for the BMS. The LAN connection type and configuration (TCP/IP addressing scheme, etc.) will be information provided to the System Contractor from SAIT

.5 Enrollment and naming of controllers per SAIT's provided naming convention.

.6 DDC controllers that are not BACnet compliant shall not be acceptable.

.7 The BMS shall be modular in nature and comprised of a network of stand-alone control units (SCU) DDC devices. The System shall be designed and implemented in such a way that it may be expanded in both capacity and functionality through the addition of DDC Devices, sensors, actuators, etc.

.8 All BMS controllers shall be tested, certified, clearly stamped and listed by the BACnet Testing Laboratories (BTL).

.9 Program database, data acquisition, and all control sequence logic shall reside in each DDC Device. The Building Level Communication Network (BLCN) (MS/TP) shall not be dependent upon connection to a Server or Master Controller for performance of the Sequence of Control. Each individual Device shall, to the greatest possible extent, perform its programmed sequence without reliance on the BLCN.

.10 All BMS DDC Devices shall be capable of updating firmware using software via internet without replacing any hardware, microprocessors or chips.

.11 The BMS shall be capable of sending system alarms to SAIT email services to multiple specific addresses.

.12 Each Mechanical System and/or major piece of Mechanical Equipment shall have one (1) dedicated DDC controller with sufficient I/O capacity such that it shall be connected to ALL field devices and sensors associated with that system and/or piece of equipment. Distributed control of one (1) single piece of major mechanical equipment shall not be performed by multiple controllers.

.13 The primary BMS components shall include but not be limited to:

a) Web Server with operating software.
b) Operator Workstation Software: Physical, remote, and portable workstations. Communication through BACnet IP.

c) Building Controllers: to operate through BACnet IP.
d) Application Controllers: operate through BACnet IP and/or MS/TP.
e) Third Party Devices – operate through BACnet IP and/or MS/TP.

.3 BACnet BMS Devices
.1 Software - BACnet B-OWS (Operator Workstation)
a) Use most current versions that can be used to fully manipulate databases which includes input/output/variables/functions/programs/network communication. Programming must be plain English BASIC like language.
b) If SAIT does not have existing, then must be provided and/or upgraded to most current version, including all extended user licenses.
.2 Routers - BACnet B-BC (Building Controller)
.3 Use most current versions, with max. capacity. Can be used for networking purposes MS/TP to other BACnet devices. BBMD/BDT configurable. All outputs to have integrated Hand/Off/Auto and adjustments.
.4 Control Panels- BACnet B-AAC (Advanced Application Controllers)
a) Use most current versions, with sufficient capacity. One controller, one system.
b) Any or all application controllers shall be fully programmable using plain English BASIC like language including Terminal Box Controllers.
c) Power supplies for main cabinets to be complete with switch, fuse, and outlet.
d) Power supplies for terminal boxes: one power supply one controller.
e) All outputs to have integrated Hand/Off/Auto and adjustments.
.5 Control Panels- BACnet B-ASC (Application Specific Controller)
a) Use most current versions, with sufficient capacity. One controller, one system.
b) Any or all application controllers shall be fully programmable using plain English BASIC like language including Terminal Box Controllers.
c) Power supplies one per unit, not shared.

.4 Campus Metering
.1 Building energy and water data shall be collected by the BMS daily.
.2 Metering requirements shall be determined on a project-by-project basis. The following building services shall be metered as a minimum:
a) Steam Heating Energy
b) Chilled Water Energy
c) Domestic Water Volume
.3 Energy Meters:
a) Integrated meter assembly consisting of volumetric flow meter and temperature sensors.
b) Remote mounted transmitter with digital energy calculator and display.
c) Communication protocol: BACnet IP.
.4 Water Meters:
a) Positive displacement meters with nutating disc measuring chamber.
b) Direct reading totalizer counter.
c) 4-20mA pulsed output.

.5 Miscellaneous Devices
.1 Temperature Sensors
a) All temperature sensors shall use precision 10kOhm thermistors accurate to +/- 0.5^{o}C over a range of 5 to 40^{o}C.
b) Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless-steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 1.3m^{2}

c) Averaging sensors shall be employed in ducts which are larger than 1.3m^2.

.2 Thermostats
   a) All temperature devices shall use precision 10kOhm thermistors accurate to +/- 1^{o}C over a range of –30 to 120^{o}C.
   b) Standard space sensors shall include removable housing for mounting on a standard electrical box.
   c) Direct powered via BMS connection.
   d) Programmable LCD display, at a minimum room temperature, set point, override mode, time.

.3 Humidity Sensors
   a) Duct and room sensors shall have a sensing range of 20%-80%. Duct sensors shall have a sampling chamber. Outdoor air humidity sensors shall
   b) have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of -40°C to 50°C (-40°F to 122°F).
   c) Humidity sensors shall not drift more than 1% of full scale annually.

.4 CO2 Detectors
   a) Direct Duct or Remote mounting. Accurate to ±20 ppm or 1%. Measurement range from 0 to 2,000 ppm. Temperature. Field selectable 0-5Vdc, 0-10vdc and 4-20mA outputs5-year calibration guarantee

.5 Airflow Sensors
   a) Airflow measurement devices shall be multi-probe grid style mounted within ductwork, plenums, or air handling unit sections.
   b) Airflow measurement devices shall utilize the principle of thermal dispersion with one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
   c) Airflow measurement devices shall integrate with the BMS to provide average airflow rate, temperature, airflow alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.
   d) A remotely located transmitter with digital readout shall be provided for each measurement location to display live flowrate readings and alarms.
   e) Accuracy requirements:
      - Airflow accuracy of ±2% of reading over an operating range of 0 to 25.4 m/s.
      - Temperature accuracy of ±0.1°C over an operating range of -28.9°C to 71°C.
   f) The following airflow measurement devices are not preferred by SAIT and may only be utilized upon SAIT's review and acceptance:
      - Fan-mounted airflow measurement devices.
      - Vortex shedding airflow measurement devices.
      - Pitot tubes, pitot arrays, piezo-rings and other differential pressure measurement devices.

.6 Pressure Sensors
   a) Air pressure measurements in the range of 0 to 1.5 kPa will be accurate to +/- 1% using a solid-state sensing element. Differential pressure measurements of liquids or gases shall be accurate to +/- 0.5% of range.
   b) The housing shall be NEMA 4 rated.

.7 Occupancy Sensors
   a) The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control an "On" / "Off" function and provide a binary output.
   b) Sensing technologies shall be completely passive meaning that they will not

emit any radiation that is known to interfere with certain types of hearing aides, or electronic devices. Installer, in accordance with manufacturer's recommendation, shall determine final sensor location.

c) All sensors shall have adjustable factory calibrated sensitivity for maximum performance. Time Delay and field adjustments shall be provided as needed.
d) The installing contractor shall be responsible for supply and installation of guards where deemed necessary.
e) Differential Pressure Switches
f) Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

.8 Flow Switches

a) Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown.
b) Switches shall be CSA certified, SPDT snap-acting, and pilot duty rated (125 VA minimum).
c) Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
d) Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

.9 Relays

a) Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure.
b) Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 ms or less.
c) Relays shall be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage.
d) Time delay relays shall be 2 PDT with 8-pin connectors dust cover and a matching rail mounted socket. Where applicable timing range shall be 0 to 3 minutes.
e) Relays shall be complete with led indication and manual over ride feature.
f) Power consumption shall not be greater than 3 watts.

.10 Current Sensing Relays

a) Current sensing relays shall be of a design that provides normally open (NO) single-pole, single throw (SPST) contact rated at minimum of 50 volts peak and one-amp or 25 VA non-inductive.
b) Current sensing relays shall be split core, single unit construction with provisions for firm mounting. They shall have a single hole for passage of current carrying conductors and sized for operation at a nominal 50 percent of current rating of sensed device.
c) Relay shall be provided with adjustable current sensing range.

.11 Current Sensors

a) The current sensor shall be utilized for monitoring load operation. Sensor shall provide an analog signal corresponding to amperage. Low motor amps resulting from low loading or belt failure shall initiate an alarm in the control programming.
b) Current sensors shall be split core, single unit construction with provisions for firm mounting. They shall have a single hole for passage of current carrying conductors and sized for operation at a nominal 50% of current

rating of sensed device. The current sensor shall be isolated to 600 VAC rms.

c) The Current Sensor shall be self (2 wire) powered induced from the monitored conductor. The Current Sensor shall have an slide switch for amp range selection with the choices of 0-20,0-40,0-80 Amps; shall be isolated to 600 VAC rms; Output shall be 0-5VDC or 4-20ma, minimum aperture of
d) .75”D for load power feed; shall have an adjustable/removable mounting bracket
e) Install a Current Sensor on any motor required to have motor status. The split core current sensor shall clamp around one phase of the motor power feed. The contractor shall use the control system to interpret the signal from the sensor and show proof of flow only when the fan or pump is operating normally.

.6 Wiring, Conduit and Cable

.1 All wire will be copper and meet the minimum wire size and insulation class listed below

Wire Class	Wire Size	Insulation Class
Power	12 ga.	600V
Class I	14 ga.	600V
Class II	18 ga.	300V
Class III	18 ga.	300V
Communications	Per Mfr.	Per SAIT electrical standard

.2 Power and Class I wiring may be run in the same conduit. Class II and III wiring and communications wiring may be run in the same conduit.

.3 Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

.4 All wiring required to be installed in conduit. EMT conduit with a minimum diameter of 20mm shall be used. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

.5 Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior locations subject to moisture.

.6 Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasket covers.

.7 Pneumatic tubing will be FR rated polyethylene instrumentation tubing, type M hard copper tubing, or Type L soft copper tubing. All pneumatic tubing will be sized for a maximum pressure drop of 2 PSI from the pressure-reducing valve to end device.

.8 All MSTP Network cable shall be 22 AWG stranded, shielded, low capacitance, low impedance wire.

.9 All input wire shall be stranded shielded, no smaller than 22 AWG.

.7 Hardware Installation Guidelines

.1 Installation Practice for Wiring

a) All controllers are to be mounted vertically.
b) The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
c) A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel
d) Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
e) Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction.
f) Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
g) Where possible, conduit, in non-finished areas will be concealed in ceiling cavity, spaces, plenums, furred spaces, and wall construction.
h) Exposed conduit will run parallel to or at right angles to the building structure.
i) Wires are to be kept at a minimum of three (3) inches from hot water, steam, or condensate piping.
j) Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
k) Wire or pneumatic tubing will not be allowed to run across telephone equipment areas.

.2 Installation Practice for control air tubing

a) Control air tubing shall be run concealed wherever possible and properly supported. Laying tubing on top of ceiling will is prohibited.
b) Control air tubing may be run exposed in occupied areas only with written approval of the Owner. In finished areas, copper or plastic tubing shall be run in two-piece metal surface raceway.
c) Control air tubing shall be installed in EMT conduit when run in equipment rooms, apparatus rooms, mechanical shafts, and return air plenums.
d) All control tubing or wiring run down exposed walls to controls or control panels shall be installed in EMT conduit or completely enclosed in metal raceways.
e) All control tubing or wiring in concrete walls or floors shall be installed in rigid conduit precast into the structure.
f) Except in return air plenums, properly supported tubing may be run exposed above lay-in ceilings.
g) All control air tubing installed for the project shall be thoroughly cleaned before placing in operation to rid the system of dirt, piping compound, mill scale, oil, and any other material foreign to the air being circulated.

.3 Installation Practices for Field Devices

a) Well-mounted sensors shall include thermal conducting compound within the well to insure good heat transfer to the sensor.
b) Surface mounted sensors will include thermal insulation wrap.
c) Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
d) Relay outputs will include transient suppression across all coils. Suppression

devices shall limit transients to 150% of the rated coil voltage.

e) Water line mounted sensors shall be removable without shutting down the system in which they are installed.
f) For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
g) For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building. Ensure exterior port is not subject to inaccuracy due to wind pressure.
h) For current sensing sensors, to be mounted on the load side of the intended device i.e. for Variable Speed Drives, the current sensor shall be mounted on the motor side to reflect actual motor operation status.

.8 Commissioning and Startup Guidelines

.1 Point to Point Checkout – each I/O device shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Owner's representative.
.2 Controller Operating System Software – workstation functions will include monitoring and program of all DDC controllers. Programming of controllers can be done either offline or on-line from any operator workstation.
.3 Controller and Workstation Checkout – a field checkout of all controllers and front-end equipment shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated will be prepared and submitted to the owner at the completion of the project.
.4 Control System Air Pressure – confirm air pressure is maintained as per preconstruction.
.5 System Acceptance Testing

a) All existing points are included along with all additional points and are full accessible (including virtual). A checkout sheet shall be provided to the owner.
b) All application software will be verified and compared against the existing and additional sequences of operation. Control loops will be exercised by inducing a set point shift of a least 10% and observing whether the system successfully returns the process variable to set point.
c) Test each alarm in the system and validate that the system generates the appropriate alarm and fault code, and that the on-site Mechanical Light appears at all prescribed destinations, and that any other related actions occur as defined in the existing alarm sequences. Submit a Test Results Sheet to the owner
d) Perform an operational test of each third part interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any reports have been completed.
e) Perform an operational test to ensure site clocks are synchronized to the Building Management Control System.
f) This installation shall be "Turn Key".

.9 Training & Turnover

.1 The project team shall provide both on-site and classroom training to SAIT's project representative's and maintenance personnel. The training material shall be jointly developed and presented by the following:

a) Design consultant (preferred, as applicable)
b) Commissioning agent (preferred, as applicable)
c) General contractor and associated trades (required)
d) Controls contractor (required)

.2 On-site training shall consist of a minimum of (4) hours of hands-on instruction geared at the operation and maintenance of the systems.

.3 The curriculum shall include:

a) System overview and design intent.
b) System operation, sequencing, and schedules
c) Operator Workstation graphics, access, and navigation
d) Setpoints, alarms, overrides
e) System maintenance

DIVISION 26 ELECTRICAL AND LIGHTING

1. Purpose

This guideline specifies the electrical requirements for new projects and existing building upgrades. The scope is for buildings that are on the secondary of the Medium Voltage ring distribution. All guidelines provided in this document shall be used a minimum requirement for new construction.

Renovation of existing buildings should be compared against these guidelines and identify any gaps between the existing conditions and what the renovated condition should be. This analysis should then be discussed with SAIT and the Integrated Facility Maintenance Contractor to decide the recommended approach for that renovation.

2. Acronyms / Abbreviations / Definitions

The following acronyms and abbreviations are used in this document:

TDR	Technical Design Requirements for Alberta Infrastructure Facilities
MV	Medium Voltage
BMS	Building Management System (mechanical controls)
EV	Electric Vehicle
VFD	Variable Frequency Drive
SPD	Surge Protection Device
CDP	Central Distribution Panel (also known as Switchboard)
ATS	Automatic Transfer Switch
CRI	Colour Rendering Index (typical values of 80+ or 90+)
CCT	Correlated Color Temperature (typical values of 3500K, 4000K)
c/w	Complete with (must include)

Following definitions are used in this document:

FM&E	Refers to SAIT Facilities Mechanical and Electrical department
SAIT IT	Refers to SAIT Information and Technology department
Utility power	Medium Voltage service from Enmax
EM power	Emergency power provided by back-up generator
UPS power	Uninterruptable Power Supply
Service Transformer	A transformer provided to service an individual building. Typically 13.2kV:347/600V or 13.2kV:120/208V is provided.
Occupancy control	Lighting - Auto On, Auto Off
Vacancy control	Lighting - Manual On, Auto Off

3. Basic Electrical Requirements

.1 Intent
- .1 The intent of the Basic electrical requirements is to outline design standards for electrical systems not otherwise covered by applicable codes and standards. These principles should serve as the standards to which new building and renovations are designed.

.2 Overarching Principles
- .1 Look to enhance the student experience by providing opportunities to view and investigate construction methods, technology and systems in a meaningful way.
- .2 Consider the larger campus framework when designing. Consider what systems are currently in operation at the campus and the best way to integrate into them or have provisions for future integration.
- .3 The electrical design needs to meet current and future needs in terms of growth, sustainability and flexibility.
- .4 Growth:
  a) Larger student base. Evolving programs that campus offers. Industry specific needs.
  b) Physical buildings being added / removed / renovated.
  c) Demand to service to meet sustainability goals in terms of GHG reduction strategies, EV charging.
- .5 Sustainability:
  a) Energy efficient lighting and controls
  b) Metering and measuring to track EUI (Energy Use Intensity) for lighting, receptacle and Mechanical loads. Verification of sustainability strategy effectiveness.
  c) Finding opportunities for renewable energy integration
- .6 Flexibility:
  a) Ensuring reliability of electrical service.
  b) Avoid proprietary systems and or licensing where possible
  c) Use current technology
  d) Ability to accommodate changing functionality or accommodate expansion in future while minimizing changes to electrical infrastructure or service spaces.
- .7 Provide a safe and secure environment for students, staff and visitors to the campus.
- .8 Ensure high quality products that are current to today's standards are used while being economical to build and operate.
- .9 When doing renovations, prepare a gap analysis of what the design guidelines are versus the existing building systems and conditions.

.3 Reference Standards
- .1 General Standards
  A.B.C - Alberta Building Code
  CSA C22.1: Canadian Electrical Code, Part I
  TDR – Technical Design Requirements for Alberta Infrastructure Facilities
  SAIT – Energy Master Plan
  CAN/CSA C282: Emergency Electrical Power Supply for Buildings
  CAN/CSA C802.2: Minimum Efficiency Values for Dry-Type Transformers
  CAN/CSA B72-M87: Installation Code for Lightning Protection Systems
- .2 Power Quality
  CSA Z462: Workplace Electrical Safety (Arc Flash)
  IEEE 242 - Recommended Practice for Protection and Coordination of Industrial

and Commercial Power Systems
IEEE 519-2014 Harmonic Mitigation

.3 Fire Alarm
CAN/ULC S524: Standard for the Installation of Fire Alarm Systems
CAN/ULC S536: Standard for Inspection and Testing of Fire Alarm Systems
CAN/ULC S537: Standard for Verification of Fire Alarm System
CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems

.4 Lighting
IES: The Lighting Handbook
NECB - National Energy Code of Canada for Buildings

.5 Communications
SAIT - Telecommunications Rooms and Data Centre Standard
ANSI/TIA 568.1: Commercial Building Telecommunications Infrastructure Standard (and addenda)
ANSI/TIA 569: Telecommunications Pathways and Spaces
ANSI/TIA 606: Administration Standard for Telecommunications Infrastructure
ANSI/TIA 607: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

.4 Key Design and Performance requirements

.1 Minimum building and life safety codes must be maintained for all projects. Ensure Building Permits or Electrical trade permits are in place where required.

.2 Site Service philosophy

a) The SAIT campus is served by two utility connections, with a double ended medium voltage switchgear lineup, connected with a tie breaker.
b) The intent is for three separate service rings to serve the campus. Each ring has a connection to both Utility A (Enmax 1A/B) and Utility B (Enmax 2A).
c) Each building shall have a medium voltage switchgear connection to the ring allowing for service from Utility A or B.
d) Refer to SAIT Energy Master Plan (EMP) for site servicing details relating to operation of Co-Gen and Medium Voltage Ring distribution.

.5 Sustainability

.1 Incorporate electricity reduction strategies into the design by utilizing electrical distribution equipment and products that are energy efficient.

.2 Support greenhouse gas emission reduction strategies by accommodating mechanical electrification of gas-burning appliances.

.3 Look for opportunities to incorporate solar into new building rooftops or parking areas.

.4 Meter electrical usage (kW, kVA, kVAR, A and V) at main service and each 600V main feeder breaker.

.5 Arrange distribution so that lighting, receptacle loads and large mechanical loads can be tracked separately.

.6 Spare Capacity

.1 Electrical rooms must be sized to accommodate 25% free wall space for future growth.

.2 Free wall space shall only apply to continuous sections over 300mm in width, clear from floor to ceiling.

.3 Size all electrical distribution equipment and cabling to accommodate 25% future growth demand.

.4 Include 25% spare physical space when sizing switchgear, switchboards (CDP's) or MCC's. All spare physical space in switchgear must be fully prepared cubicles or sections.

.5 Provide minimum 15% spare breakers and 15% minimum space for future breakers based on total number of available breaker positions.

.7 Maintenance

.1 Ensure TDR requirements are met in terms of

a) O&M manuals are provided at the end of each project
b) Spare Parts and Maintenance
c) Starting and testing
d) Equipment and systems demonstration
e) Commissioning

.2 Confirm local availability of service parts and personnel when specifying systems.

.3 Avoid proprietary products that are not already present on campus. Avoid systems or software that require ongoing service contracts or licensing fees if not already in use on campus.

.4 Provide sufficient space and access around electrical equipment to satisfy safety codes and allow for replacement.

.8 Power Quality

.1 Harmonics - Key Terms

PCC	Point of Common Coupling	15kV Switchgear on primary side of Service Transformer serving individual buildings.
THD	Total Harmonic Distortion	Voltage sine wave distortion at the PCC. The ratio of harmonic content expressed as a percentage of the fundamental voltage. Also shown as (% THDv).
TDD	Total Demand Distortion	Current waveform distortion. The ratio of harmonic content expressed as a percentage of the demand current at the PCC. Electrical loads with Current distortion will be expressed as % THDi.
	Passive Harmonic mitigation	Use of transformers or filters to mitigate harmonic currents.
	Active Harmonic mitigation	Use of equipment that produces harmonic currents that cancel harmonic current distortion present in the system.

.2 Meter electrical power quality (Power Factor and Harmonics) at building service transformer and each 600V main feeder breaker. Connect to power monitoring software provider at SAIT.

.3 Harmonics not to exceed values stated in IEEE 519 at the Point of Common Coupling.

a) Identify loads with high harmonic distortion. Review effect of harmonic distortion of current (%THDi) on overall system voltage (%THDv).
b) Mitigate single loads that have greater than 15% THDi.
c) Use Harmonic mitigation transformers in areas where non-linear loads such as Computers, LED Lighting, UPS's or rectifiers occur.
d) Ensure VFD's for mechanical equipment have 5% line and load reactors as a minimum. Review Mechanical specifications for conformance.

.4 Provide Harmonic Study for all new buildings or renovation projects where the main distribution equipment is being replaced.

.5 Where Active Harmonic mitigation is being provided, ensure the connection is on the low voltage secondary side of the building service transformer.

.6 Overall Power Factor must be at 0.92 or above at service connection point within

building.

.7 A preliminary short circuit study showing all fault levels must be completed prior to completion of design documents. Show equipment short circuit current rating (kA) on the single line diagram.

.8 Prior to final acceptance of the project, ensure a full Low Voltage Breaker Coordination study and an Arc flash hazard study has been completed and implemented meeting CSA Z462 requirements. The maximum arc rating of electrical equipment on the load side of the main breaker is not to exceed 8 cal/cm2.

a) Digital format of study to be provided.
b) Arc Flash labels to be 4”x6” standard. Printed Polyvinyl or Vinyl labels to be affixed to electrical distribution equipment.

.9 Renovation requirement

.1 Review existing conditions of all systems including Lighting, Lighting control, Fire Alarm, Electrical Distribution, Communications and Security.

.2 Intent is to approach renovation with a Holistic view towards entire site. Also to keep current with other maintenance or planned replacement projects.

.3 Perform simple gap analysis stating what the existing conditions are versus what the stated requirements should be per the SAIT Electrical Design Guide.

.4 Refer to Appendix-A for sample Gap Analysis.

.10 Electrical Equipment Identification

.1 Refer to TDR for general requirements regarding identification of electrical systems, equipment and conduits.

.2 Identify communications equipment and cabling as outlined in SAIT - Telecommunications Rooms and Data Centre Standard.

.3 Where existing electrical distribution equipment occurs, follow existing formatting for naming of equipment.
.4 Refer to Division 26 – Appendix B – Electrical Distribution equipment labelling requirements.

4. Service Requirements

.1 Service Sizing
  .1 Refer to TDR for guidelines relating to new building service sizing.
  .2 Ensure service demand considers seasonal as well as operational peaks in demand.
  .3 New building or existing building service connections to be in accordance with SAIT – Energy Master Plan.
  .4 Primary heating and cooling loads to be connected to central plant distribution system.
.2 Medium Voltage Ring Distribution
  .1 Refer to SAIT – Energy Master Plan for description of 15kV ring distribution.
  .2 Utility service for each building to consist of typical 15kV Medium Voltage switchgear ring connection and incoming feed from 13.2kVA:347/600V Service transformers.
  .3 Medium Voltage cabling to be routed through existing service tunnels.
.3 Protection and control
  .1 Each building service to have Utility-A and Utility-B connections to medium voltage ring. Utility switching to be provided at medium voltage switchgear level.
  .2 Monitor the open/close status of each circuit breaker on the primary and secondary side of the Service transformer. Connect to power monitoring software provider at SAIT.
  .3 Emergency Generator connections to building service to occur on secondary side of service transformer (600V distribution). Connect emergency generator to distribution using automatic transfer switch to prevent need for reverse power monitoring on buildings main circuit breaker.
  .4 Ensure priority tripping and co-ordination of overcurrent and ground fault devices on low voltage feeders. Co-ordinated trip curves to be provided in Low Voltage Breaker Coordination study.
  .5 Mechanical Kirk-Key system in place for 15kV and 5kV distribution. Circuit breakers to have remote operation provided outside of Arc Flash boundary or outside room. No automatic controls. No recloser action on protective relays.
  .6 Provide dedicated control cabinet for circuit breaker remote operation. Cabinet to have pushbuttons to close or open circuit breakers c/w visual indication lights showing current breaker status.
.4 Surge Protection Devices
  .1 Provide integral BUS mounted SPD's in service switchgear.
  .2 Additional SPD's to be provided in low voltage distribution equipment at the following locations:
    a) Panelboards where 20% or more of the connected load is serving computer receptacles.
    b) Panelboards serving IT / network racks, BMS, security or fire alarm.
    c) CDP's / Panelboards serving classrooms or labs where sensitive electronic equipment will be used.
    d) MCC equipment
  .3 Ensure all SPD's are cUL listed and labeled as Type 2 devices. Coordinate suppression with anticipated energy levels and sensitive loads.

.5 Metering
- .1 Meter electrical usage (kW, kVA, kVAR, A and V) at Medium Voltage circuit breakers and each 600V main feeder breaker on secondary side of Service Transformer.
- .2 Provide power metering on low voltage distribution so that lighting and large mechanical loads can be tracked separately.
- .3 Metering of selected floorplan areas or loads may be needed based on project requirements.
- .4 Metering of tenant electrical services.
- .5 Provide network connection to electrical meters and relays using BACnet interface.

5. Onsite Power Generation

.1 Diesel Electric Generating Units
- .1 Review applicable building codes to determine if or when a generator is best suited to provide emergency power. Other uses of generators can be to supply backup (non-life safety) power or peak-shaving of building load.
- .2 Provide a 2-hour rated dedicated electrical room at grade level. Do not locate on roof or penthouse level.
- .3 Avoid noise sensitive areas adjacent to the generator room.
- .4 Use diesel as the fuel source where emergency power is being relied upon for life safety systems. Fuel supply to meet minimum run time of 4-hours.
- .5 Use vibration isolation and exhaust silencers.
- .6 Connections to BMS, fire alarm and elevator controller required.
- .7 Control wiring for BMS Monitoring of Generator shall include:
  - a) Generator room temperature if indoors
  - b) Generator Fault or Alarm
  - c) Generator Run Status
  - d) Generator Block Temperature (analogue)
- .8 Fire Alarm monitoring:
  - a) Supervise generator Fault or Alarm
  - b) Generator Run status
- .9 BMS Interface via BACnet to monitor:
  - a) Generator Fault or Alarm
  - b) Generator Run Status
  - c) Generator Block Temperature
  - d) KW, KVA
  - e) Hours
  - f) # of Starts
  - g) Phase voltage/amps
  - h) Oil pressure
  - i) Operation temperature
  - j) Fuel level as a % of tank capacity and run time
- .10 Provide load bank connection on building exterior. Use weatherproof enclosure c/w cam-lock type connections. Alternate approach can be Synchronization and Load sharing provided minimum base load requirements are met.
- .11 Locate automatic transfer equipment external to the emergency generator room.
- .12 Provide DC battery pack and lighting within emergency generator room.

.2 Solar
- .1 Solar plays an important role in sustainability by allowing for a passive source of renewable energy that can offset the electrical demand of the site and reduce

greenhouse gas emissions.
.2 For rooftop, wall or site installations, use software tools to determine the best solar panel coverage. Avoid panel locations that are under-utilized due to shading.
.3 Solar installations are to be line interactive and utilized as the power is produced.
.4 Where electricity produced may exceed building demand, tie the solar directly into the Medium Voltage ring as a stand-alone installation.
.5 Where tied to the low voltage primary service of a building ensure lockout of solar installation is active when primary circuit breaker on secondary of Service transformer is Open.

.3 Co-Gen
.1 The Co-Gen is used to offset electrical power consumption and provide thermal heat for the campus.
.2 Refer to SAIT – Energy Master Plan for description of Co-Gen distribution and operation.

6. Electrical Distribution

.1 Low Voltage Switchgears
.1 Low voltage switchgear relates to main service equipment within the building after the Service transformer, rated 600V or less. Low voltage switchgear must be protected by a Main Circuit breaker on the secondary of the Service transformer.
.2 Main service and distribution equipment shall be in a dedicated electrical room, separate from mechanical, communications or other service spaces.
.3 All switchgear to be free-standing and mounted on 100mm thick housekeeping pads.
.4 Solid copper bussing only.
.5 Draw out Air Circuit breakers to be used. Provide suitable lifting equipment. Unused breaker cells to be fully provisioned.
.6 One meter working clearance to begin from fully extended position of circuit breaker.
.7 Air circuit breakers to include solid state trip device capable of LSI functions.
.8 Provide ground fault protection on Main Circuit breaker and any breaker larger than 600Amps.
.9 Bussing and circuit breakers to be minimum 65kA rated unless otherwise demonstrated by short-circuit study.
.10 Circuit breakers to have remote operation provided outside of Arc Flash boundary or outside room. No automatic controls. No recloser action on protective relays.
.11 Provide dedicated control cabinet for circuit breaker remote operation. Cabinet to have pushbuttons to close or open circuit breakers c/w visual indication lights showing current breaker status.

.2 Low Voltage Switchboards / CDP
.1 Locate in dedicated electrical rooms or mechanical service spaces only.
.2 All switchboards to be free-standing and mounted on 100mm thick housekeeping pads.
.3 Solid copper bussing only.
.4 Molded case circuit breakers to be used.
.5 Circuit breakers 400A and larger to be solid state trip with LSI functions. 600A and large to have Ground fault protection.
.6 Bussing and circuit breakers to be minimum 35kA unless otherwise demonstrated by short-circuit study.

.3 Branch circuit / Distribution panelboards
.1 Locate in dedicated electrical rooms or mechanical service spaces only.

a) If an exception were made, do not locate in shared closets or service spaces that may be locked typically.
b) Exceptions can be made for panelboards located in Shops, Labs, Kitchen areas, Computer Labs or Control labs where the panelboard is dedicated to the space it serves.
c) Do not locate in public corridors.

.2 Solid copper bussing only.
.3 Circuit breakers to be molded case thermal trip devices. Bolt-on.
.4 Lockable door-in-door construction.
.5 Bussing and circuit breakers to be minimum 35kA rated @600V or 22kA rated @208V unless otherwise demonstrated by short-circuit study.

.4 Dry type transformers
.1 Conform to the following applicable CSA standard CAN/CSA C802.2: Minimum Efficiency Values for Dry-Type Transformers.
.2 Locate in dedicated electrical rooms or mechanical service spaces only.
.3 Ensure transformer heat rejection loads are provided to mechanical consultant where transformers are installed. Cooling loads to be reviewed by Mechanical.
.4 Size transformers to 60% average loading to achieve best efficiency and mitigate harmonics.
.5 Consider LSI circuit breaker on secondary of transformers 150kVA-600:120/208V or larger to control arc flash.
.6 All transformers 30kVA or larger to be free-standing and mounted on 100mm thick housekeeping pads. Provide vibration isolators.
.7 Product specifications to include:
a) Copper windings only.
b) Temp rating of 150°C rise
c) Four 2.5% taps; two above and two below nominal for voltage adjustment.
d) K-13 rated where feeding computer / workstation receptacle loads
e) Harmonic Mitigating where non-linear loads such as Computers, LED Lighting, UPS's or rectifiers account for more than 50% of the load.
.8 Secondary voltage for distribution transformers:
a) 347/600V, three phase, four wire.
b) 120/208V, three phase, four wire.
c) 120/240V, single phase, three wire.
.9 Impedance:
a) 3-4% max. up to 112.5 kVA
b) 3-4.8% max. above 112.5 kVA
c) 4-5.9% above 500 kV
.10 Sound level at 2m:
a) 45 dB max. up to 45 kVA
b) 50 dB max. up to 150 kVA
c) 55 dB max. up to 300 kVA
d) 60 dB max. above 300 kVA
.11 Use flexible conduit connections to transformer. Do not exceed 1m length. Use liquid tight where subject to wet conditions.

.5 Automatic Transfer Switches (ATS)
.1 Locate in dedicated electrical rooms or mechanical service spaces only.
.2 Where emergency generation provided, separate life safety from non-life safety loads. Provide dedicated ATS for each load type.
.3 Do not locate life safety ATS in same room as emergency generator.
.4 Refer to TDR for general requirements.
.5 Provide elevator pre-transfer signal for use in test mode.

7. Branch Wiring and Circuiting

.1 Wire types
  .1 All conductors to be copper, 600V jacket. Min size #12 AWG.
  .2 For Mechanical loads:
    a) 120V or 208V 1 Phase, 2 Wire service for motors under 1/2HP or heaters under 2kW.
    b) 208V, 3PH, 3W service for motors under 5HP and heaters under 10kW.
    c) 600V, 3PH, 3W service for motors 5HP and greater or heaters 10kW and greater.
  .3 AC-90 (BX) cable permitted only under certain conditions.
    a) AC-90 can be used where serving individual drops to luminaires, not exceeding 1m in length. Do not daisy-chain fixtures together.
    b) Consideration will be given to other electrical devices mounted to removable ceiling tiles.
    c) Receptacles on a single circuit can be linked using AC-90 within the wall space provided the homerun is in conduit.
  .4 Dedicated neutrals to be provided for computer receptacle circuits and lighting circuits.
  .5 Wire for DC emergency lighting circuits to be minimum #10AWG.
  .6 Wires/cable sets on secondary of VFDs to be 1000V rated.
  .7 Circuit breakers should not be used as disconnects. Provide separate disconnects for classroom equipment.
.2 Raceways
  .1 Install wiring in EMT conduit, except where specifically stated otherwise.
    a) Use metallic rigid conduit where subject to mechanical damage or explosion proof is required.
    b) Any conduit under fixed elements such as pathways must be at a sufficient depth prevent expansion or contraction. Provide compacted frost stable material around conduit and use expansion joints where transitioning to above ground conduit.
    c) Re-enforced Concrete ductbank to be provided under roadways subject to vehicle traffic.
  .2 Use minimum 21mm conduit.
  .3 Dedicated ground wire to be provided in all conduits.
  .4 Use liquidtight conduit and connections where subject to wet locations or outdoors. Avoid vertical penetrations through roof. Side exit through box or wall preferred.
  .5 Provide penetration detail showing materials and methods used.
  .6 Provide roof curbs for exposed conduit runs on roof.
  .7 Use flexible conduit connections for motors, transformers or other equipment where vibration may occur. Do not exceed 1 meter in length.
.3 Wiring Devices
  .1 Refer to TDR for general requirements.
  .2 Provide specification grade devices for receptacles and switches.
  .3 Devices to be white in colour unless matching existing condition.
  .4 Cover plates to match device colour.
  .5 Do no install outlet boxes back to back within a wall. Non-acoustic wall spacing of 150mm apart. Acoustic walls to have minimum 600mm spacing or one empty stud space between outlets.
  .6 Housekeeping receptacle circuits to be minimum 20Amps, maximum 4 receptacles per circuit.

.4 Receptacle Requirements for specific areas
  .1 Office
    a) Computer workstations to be provided with one quad receptacle per desk. One circuit to be provided for every two computer workstations.
    b) General receptacles to allow for six 15A receptacles per circuit
    c) Use 20A circuits, two receptacles per circuit for kitchen counters.
    d) Dedicated 20A circuits for microwaves.
  .2 Classroom
    a) Use computer workstation and general receptacles rules per above Office requirements.
    b) Use independent supports to two ceiling members (T-bar or studs) for any projectors, screens or other ceiling mounted equipment
  .3 Labs / Shop areas
    a) Use computer workstation and general receptacles rules per above Office requirements.
    b) Use stainless steel cover plates where receptacles are exposed to high use
    c) Provide local dedicated panelboard c/w shunt trip override button in rooms where electricity / motors / power tools are being used by students. Override button to be placed at each entry door and at instructor desk.
  .4 Kitchen
    a) Provide local dedicated panelboard c/w shunt trip override button for heat generating appliances per Alberta Building Code and NFPA requirements.

8. Grounding and Bonding

.1 Service Grounding requirements
  .1 A dedicated main ground bus bar to be provided per building. Establish grounding grid connections per CEC requirements. Ground bus to be min. 100mm wide, 300mm long and 6.25mm thick.
  .2 Separate Telecommunications Main Grounding Bus Bar (TMGB) in main network room to connect to this main ground bus.
  .3 Refer to SAIT Telecommunications Rooms and Data Centre Standards for telecom bonding requirements. Telecom ground to be dedicated riser separate from electrical grounding and bonding requirements.
  .4 In cases where there is a discrepancy between the CEC and TIA standards, the larger wire size is to be used.
.2 Bonding
  .1 All conduits to contain separate grounding / bonding conductor. Use of metallic conduit as a bonding means is not acceptable.
.3 Lightning Protection
  .1 Review requirements for lightning protection within CAN/CSA B72-M87: Installation Code for Lightning Protection Systems.
  .2 Use copper braided cable for lighting protection downconductors.
  .3 Use aluminum braided cable for lighting protection cabling on roof or where exposed to weather (to prevent corrosion where in contact with galvanized or painted steel).
  .4 Provide accessible AL/CU terminations in weatherproof box where transitions occur.
  .5 Run downconductor cable via conduit or embedded in concrete (min 50mm concrete cover and strapped to rebar)
  .6 Provide ground test wells at lowest point of building near ground grid connections.

9. Lighting Performance Requirements

.1 General
- .1 Lighting shall provide a comfortable environment for students, staff and visitors. It shall enhance task-oriented activities. It shall provide a secure and safe environment.
- .2 The lighting shall promote sustainability in terms of energy efficient product types, control and longevity.
- .3 Light fixtures to be CSA certified to meet CAN UL listings and are Energy Star certified.
- .4 Select Light fixtures from North American manufacturers that have been in business for 10 years and offer 5 year warranty.
- .5 All light fixtures and exit signage shall be LED.
- .6 Light fixtures to conform to:
  - a) IES LM-79 Electrical and Photometric Measurements
  - b) IES LM-80 Lumen Maintenance
  - c) IES TM-21-11 Long Term Lumen maintenance to be minimum 60,000 hours and L70
- .7 Base target light levels as described in the IES Lighting Handbook and ANSI/IES RP-3-13 American National Standard Practice on Lighting for Educational Facilities.
- .8 Locate fixtures in maintainable positions. Avoid locating above a staircases or escalators unless reachable by hand or on a system that raises and lowers fixtures for maintenance.
- .9 Ensure lighting accessible by public is vandal resistant.
- .10 Where upgrading or replacing lighting within an existing facility perform a GAP analysis to determine where to match existing or upgrade to new. Confirm replacement products are available during design stage, where applicable.
- .11 Review applicable life safety codes and standards for minimum light levels and exit signage requirements.

10. Interior Lighting

.1 Interior Fixtures
- .1 Select luminaires to minimize glare and discomfort to users of the facility.
- .2 Use CRI of 80 or higher, except where color matching activities may occur. Then use CRI of 90+. These areas may include art, medical or cooking activities.
- .3 Use CCT of 4000K.
- .4 Do not use accent lighting as primary source of lighting.
- .5 Provide 200lux minimum light level at elevator lobby floor. Use EM power where available.
- .6 Provide light fixtures for mock-up where specifical lighting design requirements are noted.

.2 Emergency Lighting
- .1 All exit signage to be green pictogram type (running man). Preference for line voltage connections with internal battery backup or connected to emergency power.
- .2 Ensure any battery powered emergency lighting circuits are served by the same electrical panel servicing the lighting circuits in the area. When the panel loses power, the emergency lighting is to be activated.
- .3 Annual testing of Battery Packs, DC Heads and exit signage required.
- .4 Use dedicated circuits for Exit signs or Battery packs to facilitate simple testing

procedures.

11. Exterior Lighting

.1 General
- .1 Design exterior lighting to minimize light trespass to adjacent roadways or property and minimize glare and sky-glow.
- .2 Design exterior lighting to minimize any dark or unsecure areas. Use lighting as a means for wayfinding especially along pathways or travelling between buildings or parking areas.
- .3 Recommended 2 Lux minimum for entire building perimeter whether from light fixtures attached to building or adjacent pathway / roadway lighting.
- .4 Consider vertical illumination levels to allow for facial recognition in areas where camera coverage is provided. Vertical illumination values are generally half of horizontal distribution values.

.2 Exterior Fixtures
- .1 Use CRI of 80 or higher.
- .2 Use CCT of 4000K for general illumination.
- .3 Provide adequate IP rating for fixtures exposed to weather.

12. Lighting Controls

.1 General
- .1 Lighting is to be monitored for energy usage.
- .2 Do not use addressable controls unless specifically requested. Preference is for a relay-based system monitored by a central panel. Provide suitable monitoring software with communication protocol compatibility to the building management system. Central Control panel to be at minimum BACnet Compatible.
- .3 Provide fire alarm relay module to activate input in lighting control panel. Input to trigger full brightness of dimmed fixtures when fire alarm is activated.
- .4 In case of lighting control failure, ensure light fixtures are fail-safe to default “ON”.

.2 Control Methodology
- .1 Low Voltage switching to be provided.
- .2 Consider line voltage scenarios during retrofit scenarios only unless line voltage relay monitored by central control panel.
- .3 Ensure lighting of public, circulation and administration areas are controlled from a central location.
- .4 Provide one or more accessible manual controls for the lighting of individual spaces or sections of larger zones.
- .5 Where applicable, provide an automatic occupancy/vacancy sensor to turn off lighting following a 30-minute unoccupied period. Use dual function (sound / motion) occupancy/vacancy sensor for washrooms.
- .6 Classrooms/Labs/Offices/Conference Rooms – allow for occupied/unoccupied light levels, daylight harvesting and zoned fixtures. Provide local dimming only where requested by client.
- .7 Common Areas/Corridors – allow for occupied/unoccupied light levels and daylight harvesting. Provide multi level sources of lighting where large accent lighting fixtures used. IE: pendants or cylinders providing base illumination, but only activated when custodial activities are required.
- .8 Custodial – Manual On/Off control. Can control zones or groups of zones for large area control.
- .9 Where Daylight Harvesting is provided, use dimmable control.

.10 Exterior lighting to be provided with Photocell and programmable astronomical timeclock control c/w automatic update for daylight savings.
.11 Keep 5% overstock of each type of light fixture, or as discussed with SAIT.
.12 Requirements may be higher on custom fixtures, or lower for fixtures considered a commodity item.

13. Appendix A – Renovation GAP Analysis

A Gap analysis is the process of comparing current performance (measured in time, money and labour) with the desired or expected performance. Reviews current resources and determines if investment in capital or technology will deliver a better result than continuing the current trend.

This does not supersede code updates or life safety recommendations.

Topics listed below.

.1 Lighting
  .1 Upgrade to LED required? Use 120 or 347V?
  .2 If using existing fixtures – is there available stock on site. Is new stock available for purchase?
  .3 Revise existing control? Connect to existing system or stand-alone?
  .4 Existing systems such as Lutron or Douglas systems to be considered.
  .5 Consider Zoned classroom with daylight row scenario.
.2 Fire Alarm / Life safety
  .1 Will renovation require Building Permit?
  .2 Match existing system or replace with new?
  .3 Is existing coverage sufficient for current codes?
  .4 Replace exit signage?
.3 Electrical Distribution
  .1 Keep existing or replace with new? Is an overall maintenance / replacement strategy planned?
  .2 Availability of existing circuit breakers if keeping existing.
  .3 Upstream distribution sized to accommodate new load?
  .4 Arc Flash study, or update required?
.4 Communications
  .1 Keep existing equipment / racking / cabling or replace with new?
  .2 Cables suitably rated for plenum space?
  .3 Sufficient spare capacity on patch panel?
.5 Security
  .1 Keep existing Access control / Help system or replace with new?
  .2 Integration required or stand-alone system?
  .3 Lighting / visibility sufficient?

14. Appendix B - Electrical Distribution Equipment Labelling Requirements

Refer to TDR for general requirements regarding identification of electrical systems, equipment and conduits. Refer to section below for site specific requirements.

.1 Colour identification of equipment

VOLTAGE	COLOUR	Standard 595C Colour numbers
High Voltage (Above 750V)	Brown	10115
347/600V	Sand	13613
277/480V	Bronze	13275
120/208V	Grey	16307 or AS61 Grey
Fire Alarm and Firephone	Red	11350
Security/Intrusion/CCTV	Green	14449
Low Voltage Switching	Black	17038
Data/Tel Cabinets	Blue	15052
Public Address / Intercom	Purple	17100

.2 Labels
- .1 Use lamacoid labels for electrical equipment as outlined in the TDR. Receptacles to be identified with thermal plastic labels on coverplate.
- .2 Provide wire identification labels using one of the following methods:
  - a) Heat Shrink Sleeves
  - b) Clear plastic tape wrap-on strips with white writing
  - c) Wrap on strips, pre-numbered.
  - d) Slip-on identification bead markers or sleeves.
- .3 Colour code conduit and cable in associated colour as follows:
  - a) Apply colour banding (tape or paint) in required colours
  - b) At least once in each 3 meter run
  - c) Where conduit or cable enters inaccessible ceiling space, wall and floor spaces
  - d) At least once in each room or area through which the conduit or cable passes.
- .4 Identify pull or junction boxes over 100mm in size; use pre-finished boxes in identified colour, or spray paint inside and outside of boxes prior to installation. Apply lamacoid label per TDR requirements.
- .5 Identify pull or junction boxes under 100mm in size; spray paint inside of boxes in identified colour. Apply permanent markings to box covers designating voltage or system.

.3 Equipment naming
.1 Where existing equipment occurs, follow existing formatting for naming of equipment within that building.
.2 For new power installations, name electrical equipment using a standardized equipment naming scheme per below.

ELECTRICAL EQUIPMENT NAMING

ROOM NUMBER	VOLTAGE		PANEL/EQUIPMENT TYPE		ORDER OF EQUIPMENT
NR206	6		NP		A
Electrical room that equipment is located in. Based on SAIT's building plans.	2	120/208/240	1st letter (prefix)		If multiple pieces of equipment of same type and voltage are in the same room this letter shall indicate their order alphabetically.
	4	277/480	N	Normal Power	
	6	347/600	E	Emer. Power	
			U	UPS Power	
			2nd letter(s) (description)		
			P	Panel	
			C	CDP	
			M	MCC	
			X	Transformer	

NR206-6EPA refers to a 347/600 volt panel in NR206. The EP indicates this is an emergency panel and the A indicates it is the first panel of its type in that room.

.3 For new communications installations, Identify communications equipment and cabling per TIA-606 standards.
.4 Current Fibre cabling infrastructure is arranged as:
a) Cable End 1 / End 2
b) (End 1) COMM ROOM#:RACK ID-PANEL ID:PORT / (End 2) COMM ROOM#:RACK ID-PANEL ID:PORT
c) Example: CB405A:R25-PB:A01-L12 / TT209:R31-PA:A01-L12

.4 For new Fire Alarm installations, name Fire Alarm devices using a standardized equipment naming scheme per below.

FIRE ALARM INITIATING DEVICE ADDRESS				
FIRE PANEL ID	FIRE ZONE	LOOP	DEVICE	ADDRESS
TTA	Z1	1	SM	01
Example: TTA-Z1-1-SM-01				

TYPICAL DEVICE ABBREVIATIONS	
SM	Smoke detector
HD	Heat detector
DD	Duct detector
FS	Flow Switch
TS	Tamper Switch
CM	Control Module / relay
MM	Monitor Module
IM	Isolation Module

FIRE ALARM SIGNALLING DEVICE ADDRESS			
FIRE PANEL ID	FIRE ZONE	NAC ID	ADDRESS
TTA	Z1	NAC1	01
Example: TTA-Z1-NAC1-01			

DIVISION 28 ELECTRICAL SECURITY AND LIFE SAFETY

1. Purpose

.1 This guideline specifies the Security and Life Safety requirements for new projects and existing building upgrades. All guidelines provided in this document shall be used a minimum requirement for new construction.

.2 Renovation of existing buildings should be compared against these guidelines and identify any gaps between the existing conditions and what the renovated condition should be. This analysis should then be discussed with SAIT and the Integrated Facility Maintenance Contractor to decide the recommended approach for that renovation.

2. Acronyms / Abbreviations / Definitions

The following acronyms and abbreviations are used in this document:

TDR	Technical Design Requirements for Alberta Infrastructure Facilities
c/w	Complete with (must include)
BMS	Building Management System (mechanical controls)
CACF	Central Alarm Control Facility
EOL	End of Line device

Following definitions are used in this document:

FM&E	Refers to SAIT Facilities Mechanical and Electrical department
SAIT IT	Refers to SAIT Information and Technology department
Utility power	Medium Voltage service from Enmax
EM power	Emergency power provided by back-up generator
UPS power	Uninterruptable Power Supply
Class A	Wiring forming a loop from a central panel
Class B	Wiring ending at an end of line resistor (supervised wiring)
Initiating device	Fire Alarm devices that trigger an alarm. Pullstations, fire detectors, monitoring modules, Flow / tamper switches.
Signaling device	Fire Alarm devices that take action when an alarm has been triggered. Horns, Bells, Strobes, Speakers and Relay Modules.

3. Basic Security and Life Safety Requirements

.1 Intent
- .1 The intent of the basic Security and Life Safety requirements is to outline design standards for systems not otherwise covered by applicable codes and standards. These principles should serve as the standards to which new building and renovations are designed.

.2 Overarching Principles
- .1 Look to enhance the student experience by providing opportunities to view and investigate construction methods, technology and systems in a meaningful way.
- .2 Consider the larger campus framework when designing. Consider what systems are currently in operation at the campus and the best way to integrate into them or have provisions for future integration.
- .3 The design needs to meet current and future needs in terms of growth and flexibility.
- .4 Growth:
  - a) Larger student base. Evolving programs that campus offers. Industry specific needs.
  - b) Physical buildings being added / removed / renovated.
- .5 Flexibility:
  - a) Ensuring reliability of service.
  - b) Avoid proprietary systems and or licensing where possible
  - c) Use current technology
  - d) Ability to accommodate changing functionality or accommodate expansion in future while minimizing changes to electrical infrastructure or service spaces.
- .6 Provide a safe and secure environment for students, staff and visitors to the campus.
- .7 Ensure high quality products that are current to today's standards are used, while being economical to build and operate.
- .8 When doing renovations, prepare a gap analysis of what the design guidelines are versus the existing building systems and conditions.

.3 Reference Standards
- .1 General Standards
  - a) A.B.C - Alberta Building Code
  - b) CSA C22.1: Canadian Electrical Code, Part I
  - c) TDR – Technical Design Requirements for Alberta Infrastructure Facilities
  - d) SAIT – Energy Master Plan
- .2 Fire Alarm
  - a) CAN/ULC S524: Standard for the Installation of Fire Alarm Systems
  - b) CAN/ULC S536: Standard for Inspection and Testing of Fire Alarm Systems
  - c) CAN/ULC S537: Standard for Verification of Fire Alarm System
  - d) CAN/ULC-S1001, Integrated Systems Testing of Fire Protection and Life Safety Systems
- .3 Communications
  - a) SAIT - Telecommunications Rooms and Data Centre Standard
  - b) ANSI/TIA 568.1: Commercial Building Telecommunications Infrastructure Standard (and addenda)
  - c) ANSI/TIA 569: Telecommunications Pathways and Spaces
  - d) ANSI/TIA 606: Administration Standard for Telecommunications Infrastructure
  - e) ANSI/TIA 607: Generic Telecommunications Bonding and Grounding

(Earthing) for Customer Premises

.4 Key Design and Performance Requirements
  .1 Minimum building and life safety codes must be maintained for all projects. Ensure Building Permits or Electrical trade permits are in place where required.
  .2 Site Security Philosophy
    a) Integrate all security devices: Card readers, Call boxes, CCTV Cameras, Public address and Intrusion alarm onto a single control platform.
    b) Current security control platform is Genetec. Ensure product compatibility with Genetec system for any new or renovated device.
  .3 Spare Capacity
    a) Provide 25% spare capacity for installed systems.
      - Includes 25% spare terminals or connections points on hardware
      - Allow room for 25% expansion slots/cards within enclosures
      - Individual circuits to speakers / horns / signaling devices to be loaded to 75% capacity.
  .4 Maintenance
    a) Ensure TDR requirements are met in terms of
      - O&M manuals are provided at the end of each project
      - Spare Parts and Maintenance
      - Starting and testing
      - Equipment and systems demonstration
      - Commissioning
  .5 Confirm local availability of service parts and personnel when specifying systems.
  .6 Avoid proprietary products that are not already present on campus. Avoid systems or software that require ongoing service contracts or licensing fees if not already in use on campus.
  .7 Provide sufficient space and access around electrical equipment to satisfy safety codes and allow for replacement.
  .8 Where batteries are used for backup power or wireless devices – submit list of batteries for Facilities to incorporate into battery maintenance schedule. List:
    a) Device name
    b) Battery model #, size, voltage, capacity
    c) Location
    d) Anticipated service period (1 year, 5yr, 10yr)

.5 Renovation Requirements
  .1 Review existing conditions of all systems including Lighting, Lighting control, Fire Alarm, Electrical Distribution, Communications and Security.
  .2 Intent is to approach renovation with a Holistic view towards entire site. Also to keep current with other maintenance or planned replacement projects.
  .3 Perform simple gap analysis stating what the existing conditions are versus what the stated requirements should be per the SAIT Electrical Design Guide.
  .4 Refer to SAIT - Division 26 – Appendix-A for sample Gap Analysis.

.6 Electrical Equipment Identification
  .1 Refer to TDR for general requirements regarding identification of electrical systems, equipment and conduits.
  .2 Identify communications equipment and cabling per TIA-606 standards.
  .3 Identify Electrical Distribution equipment and cabling as outlined in SAIT - Division 26 – Appendix B – Electrical Distribution equipment labelling requirements. Also notes cabinet and conduit coloring code and methods.

4. Access Control

.1 General
- .1 New Access control systems are to form part of overall campus wide electronic security system monitored by on-site security. Current security control platform is Genetec. Ensure product compatibility with Genetec system for any new or renovated device.
- .2 Provide connections to each device including, but not limited to:
  - a) Card readers
  - b) Door Position switches
  - c) Request to exit device (integrated into door hardware, or separately mounted sensors)
  - d) Electric strikes
  - e) Magnetic locks
  - f) Security pushbutton release (or Blue pullstation)
  - g) Auto Operator pushbuttons
  - h) Barrier Free emergency call kits
- .3 All devices shall be CSA/UL compliant.
- .4 All wiring to be suitably protected using EMT or Cabletray.

.2 Door Access Control
- .1 Basis of design to be centralized security cabinets with wired connections to individual devices. Security cabinets to be located in TR or electrical rooms and clearly identified.
- .2 POE devices preferred where possible.
- .3 Certain wireless access control devices may be reviewed by Facilities Management.
- .4 Avoid locating devices in ceiling or plenum spaces.
- .5 Provide UPS power or emergency power. Only use battery backup when other sources not available. All batteries must be added to maintenance schedule.
- .6 Refer to SAIT Electronic Security Device standards for recommended product types.

5. Camera System

.1 General
- .1 New Camera systems are to form part of an overall campus wide electronic security system monitored by on-site security using Genetec system.
- .2 All devices shall be CSA/UL compliant.
- .3 Provide network cameras with POE capability.
- .4 New camera licenses to be coordinated with SAIT IT and FM&E.
- .5 Provide work order request for any new camera installation. SAIT to allocate network rack requirements.
- .6 All wiring to be suitably protected using EMT or Cabletray.
- .7 Use CAT6a or 6-strand Multimode Fibre for network camera connections. Where fibre used, provide POE and Media converter kits c/w 120v connection.
- .8 Provide dedicated 120V connection where dome heaters required.
- .9 Refer to SAIT Electronic Security Device standards for recommended product types.
- .10 Refer to SAIT Telecommunications Rooms and Data Centre Standards for recommended cabling types.

6. Intrusion Detection

.1 General
- .1 Basis of design to be centralized security cabinets with wired connections to individual Glassbreak or motion detectors.
- .2 Ensure product compatibility with Genetec system for any new or renovated device.
- .3 POE devices preferred where possible.
- .4 Certain wireless access control devices may be reviewed by Facilities Management.
- .5 Security cabinets to be located in TR or electrical rooms and clearly identified.
- .6 Provide UPS power or emergency power. Only use battery backup when other sources not available. All batteries must be added to maintenance schedule.
- .7 Refer to SAIT Electronic Security Device standards for recommended product types.

7. Campus Help Phone

.1 General
- .1 Refer to SAIT Electronic Security Device standards for recommended product types. Currently Code Blue mfg.
- .2 Help phones are analog, CAT3 twisted pair cabling.

8. Public Address System

.1 General
- .1 Refer to TDR for general Paging and Public Address system components.
- .2 Field devices to include PA speakers grouped into zones and a feedback microphone per zone. Feedback microphone to dynamically adjust speaker output based on ambient noise level.
- .3 Provide intelligibility report meeting criteria set in IEC 60268. Review acoustic and sound control considerations with architectural.
- .4 PA system not to be used for Life Safety messaging from fire alarm system. Output speakers to be via separate speakers from fire alarm.
- .5 Use global messaging system - zoned approach.
- .6 Use sound over IP system.
- .7 Refer to SAIT Electronic Security Device standards for recommended product types.

9. Master Clock system

.1 General
- .1 Where required, provide a synchronized clock system for use within selected classrooms, shops, labs and common areas.
- .2 Provide wirelessly controlled 120V clocks.
- .3 Current product type is Primex Wireless System, Levo series. Review with SAIT for current product types.

10. Radio and Digital Antenna

.1 General
- .1 Existing Radio booster system on site. Review signal coverage and provide

recommendations on booster requirements.
.2 GPS receiver and transmitter to be provided where required.
.3 Digital Antennae System (DAS) cell phone booster provided by telecom provider. Co-ordinate rough-in requirements where provided.

11. Fire Alarm

.1 General
.1 Refer to TDR for general Fire Alarm requirements.
.2 Where upgrading or replacing fire alarm devices within an existing facility perform a GAP analysis to determine where to match existing or upgrade to new. Confirm replacement products are available during design stage, where applicable. Review applicable life safety codes and standards to ensure renovated space is brought up to current codes.
.3 Existing Fire Alarm system is a mix of Simplex and Edwards. New installations to be Edwards.
.4 Fire Alarm system components must be addressable and capable of tying into a central fire alarm system.
.5 System to be fully supervised.
.6 Single or two stage system with voice communication. Single stage operation preferred.
.7 Use Class A wiring for initiating device loops with zone isolation modules between fire zones.
.8 Use Class B with supervised wiring (EOL device) for signaling devices.
.9 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signaling to monitoring agency.
.10 Signaling to Central Fire Alarm Control room MD112 in Stan Grad Center.
.11 Fire Alarm verification to be witnessed by a registered engineering professional and Facilities Management. Verification reports to be submitted to Facilities Management. Fire alarm Technicians must be capable of providing certification from CFAA or approved training facility in the province of Alberta.
.12 Entire Fire alarm system is to be tied into Fireworks system. Provide new or revised floorplans in CAD for integration into Fireworks system.

.2 Products
.1 Fire Alarm panels to be in electrical room or dedicated CACF (Central Alarm Control Facility) room.
.2 Locate annunciator at main entrance.
.3 Provide exterior strobe to indicate Annunciator or CACF room location.
.4 Fire Alarm panel to include:
a) Addressable Class A loop controllers c/w 25% spare capacity, plus room for additional loops.
b) Fire Fighter Command station c/w
- Master microphone handset
- Manual toggle of speaker zones
- BACnet compatible
- LCD multiline display
- Static fire alarm colour graphic overlaid on floorplan showing building levels and exit locations, sprinkler valve locations, duct detector locations, North Arrow and “You are here” indicator.

c) Amplifiers with 25% spare capacity per circuit, plus room for additional

amplifiers.
   d) 120V Line voltage power connection. Provide Battery backup sized for 24 hours.
   e) Individual pushbutton or 3-postion (hand-off-auto) switches for operation of smoke ventilation fans or dampers (where required).

.5 Smoke dampers that are manually operated from fire alarm panel to have Relay module and Monitoring module at each damper. Use indicator lights at panel to indicate damper open or closed status.

.6 Where distributed fire alarm panels are located throughout the building provide suitable communication link. Link to form a class A loop with diverse paths. Provide 1-hour fire rating of cable.

.7 Ensure initiating devices are wired to the same panel as the signaling devices.

.8 Remote panels to operate independently if communication link to central fire alarm panel lost.

.9 Provide 53mm conduit from Main fire alarm panel to each elevator machine room or shaft for remote elevator operation.

.10 Provide fire alarm relays for the following systems:
   a) Air system shutdown (based on associated duct detector)
   b) Door Hold open release for doors located in fire or smoke separations
   c) Magnetic lock release c/w master key reset in CACF or by main Fire Alarm Control Panel.
   d) Relays to Elevator Controller (recall to home floor, recall to alternate floor, machine room smoke, elevator shaft smoke)
   e) Motorized Smoke dampers (not fusible link fire dampers)
   f) Shutoff for Commercial kitchen panel serving heating appliances and gas line solenoid. Kitchen hood to run continuously. Makeup air unit to be shutdown. Monitor module for hood suppression system.

.11 Use Zone Isolation modules or provide separate loops for individual fire zones:
   a) Individual floors
   b) Stairwells
   c) Elevator shaft / machine room
   d) Floor areas exceeding 2000m2 or sprinkler zones monitored by flow / tamper device. Refer to sprinkler riser and layouts for sprinkler zones.

.12 Firephones at each stairwell entrance in high buildings.

.13 Provide smoke detectors in dedicated electrical and communications rooms.

.14 Provide pre-action system in Main electrical and communications rooms where high-value equipment is located.

.15 Provide dry pipe sprinkler system in areas subject to low temperatures.

.16 Refer to SAIT - Telecommunications Rooms and Data Centre Standards for communications fire protection requirements.

.17 Use VESDA system elevator shafts or other remote locations. Consider innovative solutions for detector locations not accessible by ladder.

.18 Keep mounting height of devices under +2400mm where practical. Do not locate over stairs / ramps / overhangs not easily accessible by a standard 6’ ladder.

.19 Allow for hold-open device release on corridor doors located within a fire separation wall.

.20 All fire alarm junction boxes shall be identified red as per SAIT – Division 26 – Appendix B - Electrical Distribution equipment labelling requirements.

.21 Provide revised as-built drawings showing fire alarm conduit routing and junction boxes.

APPENDIX

1. Sustainability Requirements Tracking Matrix

Project Name

Sustainability Requirements Tracking Matrix

This document shall used to track the SAIT Sustainability Requirements, and the strategies to achieve them on the project. The document shall be updated regularly as needed during design and construction, based on the most recent design documents and information provided by the design team. The document does not represent a final documentation of sustainability performance, but shall be accurate based on the information provided as of the date shown.

Minimum Requirements

Updated: 10-6-2022

Topic	Requirement Summary	Deliverables	Strategies	Update	Responsibilities	Compliance Status
1. Integrated Design	**1.1 Integrated Design:** Follow an integrated design process that creates synergies across disciplines for higher level of sustainability performance.	A Visioning Workshop meeting output summarizing the Project Vision, Energy and GHG Reduction Targets, Affirmation of Intent to Achieve Minimum Sustainability Requirements, Questions and Action Items for Design Stage, Opportunities for Innovation and Living Lab. All subsequent Sustainable Design coordination meeting shall produce an output summarizing items discussed, including update on sustainability requirements.	1.1.1 Conduct an integrated design Visioning Workshop during the Pre-Design or Concept Design stage which includes the full range of applicable design disciplines and owner representatives. 1.1.2 During Schematic Design, host a Sustainable Design coordination meeting to update status on sustainability requirements. 1.1.3 During Design Development, host a Sustainable Design coordination meeting to update status on sustainability requirements. 1.1.4 During Construction Documents, host a Sustainable Design coordination meeting to update status on sustainability requirements.			
2. Energy and Carbon	**2.1 Energy Performance:** For all new constructions and major renovations, achieve an energy use reduction and GHG emissions reduction of at least 15% better than National Energy Code for Buildings (NECB) 2017 baseline.	At Pre-Design stage, issue an Energy Concepts Report which identifies energy benchmarking information, energy target setting, major energy end uses (and sources of operation GHG emissions), and preliminary list of opportunities for Energy Conservation Measures (ECMs). An energy modeling report for each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents) which demonstrates whether the targeted energy savings % is being achieved is to be signed by the Energy Modeler or Mechanical Engineer and submitted to the Project Manager.	2.1.1 Benchmarking and target setting - Compare the facility to other completed comparable facilities to identify useful data for EUI (kWh/m2) and % savings vs. energy standards & codes. 2.1.2 Early Stage Energy Modeling - Conduct a Schematic-level energy model for preliminary goal setting and evaluation of architectural strategies. 2.1.3 Energy Conservation Measures - Evaluate and identify strategies to improve energy performance to realign with project targets. 2.1.3 DD Energy Modeling - Evaluate envelope performance, lighting power densities, mechanical systems and other components for contribution to energy performance, operations, business case, and % NECB target. 2.1.5 Final Design Energy Modeling - Provide an energy model report based on 100% CD documents and final selections for glazing, HVAC, lighting, control sequences, etc.			
	2.2 Lighting Power Density: For all major renovations and minor renovations, achieve a reduction in Lighting Power Density (LPD) of at least 25% below the maximum allowances of NECB 2017	Lighting power density calculations.	2.2.1 Evaluate allowable lighting power densities and identify opportunities to reduce lighting power densities early in the design process.			

Project Name

Sustainability Requirements Tracking Matrix

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Minimum Requirements

Updated: 10-6-2022

Topic	Requirement Summary	Deliverables	Strategies	Update	Responsibilities	Compliance Status
	2.3 Commissioning: Complete enhanced commissioning for the major energy consuming systems, energy generation systems and the building envelope as per the Fundamental Commissioning pre-requisite and Enhanced Commissioning credit defined in the Leadership in Energy and Environmental Design (LEED) V4 reference manual.	Deliverables defined in the LEED V4 Fundamental and Enhanced Commissioning prerequisite and credit are to be submitted to the Project Manager.	2.3.1 Commissioning Authority (CxA) - Appoint a commissioning authority, before the end of design development stage, to coordinate and complete commissioning activites on the project.			
	2.4 Enhanced Refrigerant Management: Use either low-impact refrigerants or no refrigerants. Select systems with refrigerants that meet the requirements of the 'Enhanced Refrigerant Management' credit of LEED v4 BD+C.	Submit to the Project Manager: • Refrigerant product datasheets for used refrigerants • Calculations demonstrating GWP and ODP of project refrigerants	2.4.1 Benchmarking / Feasibility: Mechanical engineering team to provide experience of similar facilities; feasibility of meeting LEED Refrigerant requirements. 2.4.2 Evaluation of refrigeration equipment.			
	2.5 Energy Metering: During Design Development Stage, confirm the project requirements for energy metering, submetering, reporting, and smart building integration and develop a preliminary Energy Metering Plan.	If applicable, develop a preliminary Energy Meterign Plan with a list of meters to be installed, including type, energy source metred along with manufacturers' cutsheet. Update the Energy Metering Plan during Construction Dcuments.	2.5.1 Identify sources and end uses that require energy metering. 2.5.2 Formalize the Energy Metering Plan for submission and approval in the 100% Design Development Stage. 2.5.3 Update the Plan during Construction Dcuments for comment and approval.			
	2.6 Energy Star Appliances: All refrigerators and ice machines shall be ENERGY STAR rated and no more than 5 model years old.	Submit product cutsheets demonstrating compliance with the requirements to the Project Manager.	2.6.1 Select appliances that meet the requirements outlined.			
3. Health, Wellness and Indoor Environmental Quality	**3.1 Construction Indoor Air Quality (IAQ) Management:** Develop and implement an IAQ Management plan for project construction. The IAQ management plan should align with the approach and considerations identified in the Sheet Metal and Air Conditioning National Contractors Association (SMACNA)'s IAQ Guidelines for Occupied Buildings Under Construction, 2007 (chapter 3) and LEED V4 credit Construction Indoor Air Quality Management Plan.	Prior to construction, the prime contractor shall develop and submit an IAQ management plan outlining how the contractor will maintain good indoor air quality. The prime contractor shall also provide construction photos demonstrating compliance with the IAQ plan taken intermittently throughout construction.	3.1.1 Contractor Design Kick-off - Facilitate meeting with contractor to discuss requirements. 3.1.2 Specifications - Include Construction IAQ Management requirements in the specifications.			
	3.2 GBT Product Directory: Use the Green Building Technologies (GBT) Product Directory as a resource while making material selections where possible. The Product Directory contains a list of preferred materials and effort should be made to incorporate materials from the list where feasible.	List of products from the GBT Product Directory that were used on the project.	3.2.1 Review the GBT Product Directory and specify products from the list where feasible.			

Project Name

Sustainability Requirements Tracking Matrix

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Minimum Requirements

Updated: 10-6-2022

Topic	Requirement Summary	Deliverables	Strategies	Update	Responsibilities	Compliance Status
4. Materials and Waste	**4.1 Construction and Demolition Waste Management:** Divert at least 80% of non-hazardous construction and demolition waste from landfill.	A Construction Waste Management Plan is to be created and submitted by the Prime Contractor to the Project Manager. Waste diversion tracking sheets identifying overall diversion rates, and that break out each shipment / delivery with associated material streams, diversion rates and diversion destinations shall also be provided to the Project Manager.	4.1.1 Contractor Design Kick-off - Facilitate meeting with contractor to discuss requirements. 4.1.2 Specifications - Include waste diversion requirements in the specifications.			
	4.2 Recycled Materials and Local Materials: Evaluate material and product options to identify potential to incorporate recycled materials and local materials that are regionally extracted, processed, and manufactured.	List of major products or materials that were recycled or regionally sourced.	4.2.1 Review preliminary design concepts and identify opportunities to use recycled or local materials. 4.2.2 At each design submission, summarize major products or materials that are selected to be recycled materials or regionally sourced. 4.2.3 During construction, track major products and materials that are recycled materials or regionally sourced.			
	4.3 Embodied Carbon: At the completion of Pre-Design, identify embodied carbon benchmarking information, embodied carbon reduction target setting, anticipated major sources of embodied carbon impact, and preliminary list of opportunities for Embodied Carbon Reduction Measures. Incorporate measures to reduce Embodied Carbon of Construction. If Lifecycle Analysis (LCA) is within scope of work, target a reduction of 20% in embodied carbon.	For new buildings and major renovations at the completion of Pre-Design stage, issue an Embodied Carbon Reduction Report (ECRR). Update the ECRR and submit for review at the completion of each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents). If LCA is within scope of work, include LCA results within the ECRR updates at each design stage (100% Schematic Design, 100% Design Development, 100% Construction Documents).	4.3.1 During Concept and Schematic Design phases, conduct comparative studies of structural materials as well as cladding materials to understand the relative impact of material selections on embodied carbon. Conduct additional research as needed in subsequent phases. 4.3.2 If applicable, starting at Schematic Design phase and then subsequent phases, conduct a whole building life-cycle assessment (LCA) to determine the preliminary embodied carbon for the project. 4.3.3 Implement the strategies recommended from research and LCA activities to reduce the embodied carbon of construction on the project.			

Project Name

Sustainability Requirements Tracking Matrix

This document shall used to track the SAIT Sustainability Requirements, and the strategies to achieve them on the project. The document shall be updated regularly as needed during design and construction, based on the most recent design documents and information provided by the design team. The document does not represent a final documentation of sustainability performance, but shall be accurate based on the information provided as of the date shown.

Minimum Requirements

Updated: 10-6-2022

Topic	Requirement Summary	Deliverables	Strategies	Update	Responsibilities	Compliance Status
5. Landscape and Biodiversity	**5.1 Responsible Landscaping:** Design project landscaping in a manner that reduces or eliminates potable water consumption for irrigation by 50% by minimizing turf grass and installing native and drought-tolerant plants, provides habitat for local wildlife, and provides occupants with access to nature.	Provide a description of the proposed approach to comply with the requirements. Provide Landscape, Irrigation and Civil drawings to the Project Manager.	5.1.1 Consider strategies including but not limited to smart irrigation, retention of stormwater, drought tolerant native vegetation, supporting of local fauna and minimization of turf grass. 5.1.2 Consider irrigation with Captured Rainwater.			
6 Water and Resources	**6.1: Indoor Water Use:** Achieve a minimum designed non-process plumbing fixture water savings of 35% above the defined baseline in LEED V4. For process equipment: • All dish washers and clothes washers shall be Energy Star rated; • Do not use once-through cooling with potable water for any equipment or appliances that reject heat.	Submit water fixture product data sheets and completed water use calculations demonstrating compliance with the above requirements to the Project Manager.	6.1.1 Mechanical engineering team to provide experience of similar facilities; feasibility of meeting 35% water savings. 6.1.2 Run water use calculations based on preliminary occupancy estimates and fixture flow rate selections. 6.1.3 Low-Flow Fixtures: Indicated flow rates in the Schematic Design report and discuss at sustainability workshops.			
	6.2 Stormwater Management: If pursued, manage stormwater on-site using green stormwater infrastructure. Satisfy one of the following two compliance options: Option 1: Percentile of Rainfall Events • All Projects – Manage on site the runoff from the developed site for 80th percentile of local rainfall events. Zero Lot Line Projects Only – Manage on site the runoff from the developed site for 70th percentile of local rainfall events. Option 2: Natural Land Cover Conditions • Manage on site the annual increase in runoff from the natural land cover condition to the post-development condition.	Calculations demonstrating compliance with the requirements should be submitted to the Project Manager.	6.2.1 Evaluate opportunities for on-site treatment of rainwater early in the design process. 6.2.2 Run SWM treatment calculations to update % runoff treated onsite. Provide option(s) for SWM infrastructure to meet requirements.			
7 Tracking, Reporting and Feedback	**7.1 Sustainable Design Reports:** At the completion of each design stage, submit a Sustainable Design Report including a copy of the Sustainability Tracking Matrix for review and sign-off by the Project Manager which summarizes the status of each Minimum Requirement and any other sustainability initiatives.	A Sustainable Design Report including a copy of the Sustainability Tracking Matrix at the completion of each design stage.	7.1.1 During each design stage, compile all information related to sustainability including project aspirations, design features, workshop summaries, energy modeling reports, ECRRs and LCA results (if applicable) to be included in the Sustainable Design Report.			
	7.2 Data Reporting: Report data needed to complete the reporting for the STARS program.	Information on the STARS program and the data required can be found here: (Include link to STARS information requirement)	N/A			