Capital Project Design Guidelines

Northeastern University

May 2023

Northeastern University Capital Project Design Guidelines

Planning, Real Estate, and Facilities

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Purpose

The purpose of this guide is to provide architects and engineers under contract with Northeastern University with design standards for capital projects at the Boston Campus as well as throughout the University's Global Network. These standards provide a baseline of expectations regarding architectural and engineering requirements for University facilities. These requirements form the basis of cost budgeting and integration with the University's infrastructure framework. Additionally, they are intended to expedite the design process by providing clear guidance and direction to designers involved in the development of capital projects. Deviation from these requirements must be approved by the University's project manager.

The majority of the University's projects are interior modifications of existing buildings and this document is written with that understanding.

Northeastern requires a firm commitment to project budgets and consistently enforces a "design to budget" clause in their design contracts that requires redesign to meet the project budget at each design phase. As a project develops through the different phases of design, architects/engineers must be diligent in keeping their project within the prescribed budget.

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The Guidelines are organized by chapters related to building systems commonly found in typical projects. Each Chapter expands upon Facilities Management expectations for the primary design related subject matters that are common to most projects within the Capital Plan. The subjects and summary for purpose of each are described in the following paragraphs.

1 Design and Construction Phase Policies and Procedures - Chapter 1 outlines the level of service expectation standards for the in-house and contracted architectural and engineering consultant team. A typical capital project development process is outlined in terms of expected meetings and deliverables. The consultant shall use this information to strategize with the NU Project Manager (PM) for a schedule of milestones for the project. The PM will usher the consultant through any procession of meetings and information exchange that requires the involvement of NU departments and staff.

2 Sustainable Design Standards - Northeastern University has developed a strategy for incorporation of Sustainability and Green Building standards and practices across all aspects of University operations. This Chapter helps to define the expectation for implementation of sustainable practices within capital projects. LEED Platinum certification has been determined as the NU goal (with LEED Gold minimum) for development of projects that meet certain thresholds. Chapter 2 also identifies a number of sustainable design standards that shall be examined and implemented appropriately as project scope allows.

3 Security Measures - Security Measures refers to the concerns for the personal security of the students and staff of NU. The consultant is directed to engage the Northeastern University Campus Police Department and the office of Information Technology Services for design strategies that are preferred and manageable by NU for safety and security.

4 Signage and Graphics - The University has developed a significant protocol for the use of proprietary logos and branding for NU graphics. The University encourages individuality of project aesthetics; however, consultation with the graphic standards is suggested in the development of facility identifying and informational signage.

5 Architectural Design Standards - There are a number of preferences that the University has developed for minimal standards for spatial requirements and materials. Chapter 5 describes expected levels of performance for building materials; and preferences that are based on durability and maintainability for campus operations.

6 Fire Protection and Alarm - The design of fire protection and alarm systems must comply with the applicable codes and referenced standards summarized in Chapter 6. Any variance from the requirements of the referenced design standards must be approved by the Northeastern University Fire Safety Department. Chapter 6 also references requirements associated with two-way communication systems.

7 Plumbing - Plumbing systems should be designed for longevity, durability, flexibility, and for ease of maintenance. The University may also consider redundant equipment in the design to provide the ability to maintain plumbing systems without disturbing normal building operation. Chapter 7 summarizes standards and requirements for identification and hangers, water piping and distribution systems, sanitary and laboratory waste and vent piping, fuel gas piping, water heaters, plumbing fixtures, compressed air and vacuum systems, and laboratory fixtures and systems.

8 HVAC - Chapter 8 contains general design criteria for Heating, Ventilation, and Air Conditioning (HVAC) Systems. Standards and requirements are summarized for space design conditions and noise criteria, air handling systems, chilled water systems, heating systems, pumps, hydronic piping specialties, fans, duct systems, piping systems, insulation, variable frequency drives, and terminal devices.

Basic HVAC systems design considerations include using a modular approach, energy responsiveness, flexibility for future changes, durability and ease of maintenance, reliability, and redundancy of critical components, and systems shall be designed and arranged to encourage routine preventive maintenance by providing easy access for maintenance personnel.

9 Integrated Automation - Northeastern University is working towards a single master user interface for management of all building control assets, including HVAC controls, lighting controls, energy meters, Internet of Things monitoring devices, third-party demand response devices/signals, and third-party monitoring-based commissioning systems. The standards in Chapter 9 are to be used in the design and installation of all applicable control devices across the campus so that they are compatible with the master user interface when it is installed in the future.

10 Electrical - Chapter 10 contains general design criteria for Electrical Systems. Standards and requirements are summarized for identification, low voltage conductors and cables, grounding and bonding, hangers and supports, raceway and boxes, transformers, panelboards, enclosed bus assemblies, wiring devices, enclosed switches and circuit breakers, and interior lighting.

Basic electrical systems design considerations include incorporating adequate clearances and accessibility to equipment to allow for safety, operation, maintenance, repair and replacement; energy efficiency; sustainability/recyclability; future expansion capabilities; quality and consistency throughout campus; and cost considerations.

11 Furniture Fixture and Equipment - Ensuring that furniture, fixtures, and equipment are carefully incorporated and considered for each project, Chapter 11 establishes a minimal expectation for quality and consistency of materials. The Chapter also identifies purchasing programs through which the University can purchase quality items at appropriate costs. Consultants are encouraged to consider these programs and the suggested products at the earliest stages of design.

12 Campus Open Space and Landscape Standards - As the campus has developed, campus open space has decreased significantly. Chapter 12 suggests that any open space be carefully planned to ensure that it is safe and identified appropriately. Open spaces shall be easily identified as recreational spaces, gathering spaces, formal entry areas, or service zones. This type of planning is increasingly more important as usable open space within an urban campus is at a premium.

13 General Requirements for Construction - Northeastern University has requirements that contractors must adhere to during construction of a project on campus. Those general requirements are summarized in Chapter 13. A/E consultants should also be familiar with these requirements and include them in Division 1 Specifications.

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Appendix - Prototype Benchmark Examples - The appendix includes examples of space prototype models developed by the University for projects based on established design standards. The current prototype spaces include an Office, Classroom and Wet Lab. Selective plans for the prototypes are included, and these plans identify some basic material and technical standards that have been implemented across the University.

The Northeastern University Guidelines for Capital Project Design and Implementation are intended to be utilized to inform the consultant to comply with the outlined processes and goals as required, and to meet or exceed design standards wherever possible. The Guidelines are not intended to limit design expression. Exceptions will be reviewed by project Planners, Design Reviewer(s), and Project Managers.

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Design and Construction Phase Policies & Procedures

1.0 DESIGN AND CONSTRUCTION PHASE POLICIES & PROCEDURES

1.1 TERMS AND DEFINITIONS

A / E: For the purpose of these Guidelines, any architect, engineer, designer, landscape architect that is engaged by and contracted with the University to provide design services related to the scope of University facilities design and/or for the improvement of University facilities.

Consultant: For the purpose of these Guidelines, any consultant shall refer to any services, service provider/contractor and vendor that is engaged by and contracted with the University to provide professional services related to the scope of University facilities design and construction and/or purchasing of goods and services for the improvement of University facities.

As-Built - Drawings are prepared at the end of a construction project by the contractor. These are drawings / plans that show the work, as actually installed. They show, in red ink, on-site changes to the original construction documents. These drawings are coordinated with changes made throughout the construction process under direction from the A/E and NU PM. As-built drawings shall also be provided as CADD files for incorporation into the Record Drawings. More specific requirements for the as-built drawings submission are provided in the NU Requirements for Closeout Deliverables included in University RFP and contract.

Basis of Design: A product or process identified to provide a level of quality, performance, assembly, design expectations, and operational requirements expected for the particular use described therein. Such items shall be considered, and alternates provided on a case-by-case basis by each project's University Project Manager

Building Information Modeling (BIM): An intelligent computerized 3-D model-based process that provides insight on integration of building systems during planning and design for the benefit of construction and management of buildings and infrastructure.

Computer Aided Design and Drafting (CADD or CAD): Software developed to improve the productivity of the designer, the quality of the design, and the levels of communication throughout a building project through better illustrated documentation. The file standards shall be in accordance with those included in the agreement between NU and the consultant, NU Requirements for Closeout Deliverables, and any other reasonable requirements of the Owner.

Deliverable(s): Any reports, studies, analyses, drawings, and specifications submitted to the University at contracted milestones throughout the design and construction process.

Contract Documents (documents): Contract Documents including all drawings and specifications provided during all project phases for design and construction projects. This includes contract bid documents used for construction pricing and build-out. Further, the term "Contract Documents"shall mean the documents described in agreement between the owner and consultant, subject to additions, modifications, and deletions made in accordance with the provisions of that agreement.

Furniture Fixtures and Equipment (FF&E): Movable furniture, fixtures, or other equipment that have no permanent connection to the structure of a building or utilities.

Information Technology Services (ITS): Northeastern University department that is the central provider of technology infrastructure, services, and applications for more than 30,000 students, faculty, and staff at Northeastern University.

Integrated Design: Collaborative process involving all disciplines and project team members from the start of the project to examine the project within its entirety, producing a more efficient end-product to fulfill the required program. This design approach examines the interaction of all building systems with the goal of producing a sustainably responsible facility

Life-Cycle Cost Analysis: Analysis method that estimates overall costs and performance of project systems alternatives with the goal of selecting the design that provides the lowest cost of ownership that meets the proposed program. A Life-Cycle Cost Analysis is to be performed in accordance with the project goals outlined within the Guidelines.

Memorandum of Understanding (MOU): A signed agreement between two entities for a specific course of action. NU utilizes the MOU agreement internally between a particular University department and the office of Campus Planning, Real Estate and Facilities to agree upon program and an estimated budget in order for projects to proceed.

NU: Northeastern University

Owner: The terms "Owner," or "Northeastern," or "University" shall be defined as Northeastern University through the Vice President of Planning, Real Estate and Facilities or

his/her designee as may be appointed as the Owner's authorized representative.

Planner: Northeastern University Capital Planning and Real Estate Project Planner

PM: Northeastern University Planning, Real Estate, and Facilities Project Manager

Record Drawings: Record drawings are prepared by the architect/engineer and reflect on-site changes the contractor noted in the as-built drawings. They are often compiled as a set of on-site changes made for the owner per the owner / architect contract. The record drawings shall also be provided as CADD files. More specific requirements for the record drawings submission are provided in the NU Requirements for Closeout Deliverables.

Reflected Ceiling Plan (RCP): Type of documentation used to convey messaging about equipment and fixtures located within the ceiling of a building that are visible form the floor of that building.

Request for Information (RFI): A standard business acronym for the process of requesting additional information in a documented and legally binding form. In the construction industry, said request is initiated by the contractor to the design consultant during construction administration.

1.2 CONSULTANT AGREEMENT

The University uses their own form of agreement with A/E consultants. The Northeastern University Agreement Between Owner and Architect/Engineer includes minimum insurance requirements and diversity and inclusion goals that are made available when an RFP is issued and included in all main agreements with architects/engineers already under agreement with NU. While these documents may be available and maintained on the NU web site, A/E consultants are responsible for understanding the terms of the agreement in its most recent form, and modifications to the agreement will be not considered by the University, unless agreed to in writing prior to submission of proposals.

1.3 CODES, REGULATIONS AND ACCESSIBILITY

1.3.1 Codes and Environmental Regulations - All NU construction projects are subject to all permitting processes and code requirements of the United States Federal Government, Commonwealth of Massachusetts, Suffolk County, and the City of Boston and/or the local jurisdiction and agencies where the project is located. A/E consultants are responsible for providing a full code analysis specific to each project to ensure compliance with all applicable codes, regulations, and national standards.

1.3.2 Accessibility - A/E consultants are responsible for ensuring that all exterior and interior spaces are designed in accordance with the most current guidelines of the American with Disabilities Act (ADA), the Massachusetts Architectural Access Board Rules and Regulations (521 CMR), (or applicable state or local authority where the project is located outside of Massachusetts).

1.3.3 Applying the Principals of Universal Design - As a general goal, design solutions

should make all functions accessible to everybody on an equal basis, regardless of minimum code requirements and accessibility standards. Attempt to provide easy entrance to buildings and at every point along the accessible route. Strive for design solutions that are flexible, adaptable, safe, and efficient.

1.3.4 Accessibility Design Tolerances - To ensure that the constructed space meets all applicable codes, designers are advised to build minor tolerances for accessibility requirements into the design document. For example, do not design to the maximum height defined in the code, but design to half an inch below the maximum height.

1.3.5 Campus Barriers Removal Plan - The Department of Campus Planning has developed a plan for removal of accessibility barriers in many campus locations. Coordinate with Campus Planning to understand the accessibility plan for the project area or the vicinity.

1.4 UNIQUE PROJECT REQUIREMENTS

The requirements and procedures for any given project will vary, and A/E consultants should engage the NU PM early in the process to establish an understanding of their role and responsibilities in supporting the University's needs and goals. Requirements determined on a project-by-project basis may include the following:

1.4.1 Insurance Provider Review - On all projects where a building enclosure system(s) is being constructed or modified, FM Global (or the designated insurance provider) must be consulted prior to system selection and after initial detailing. Additionally, when the project involves any external building improvements exposed to the elements that can be affected by wind, rain, and snow, FM Global should be consulted for input. This consultation needs to be coordinated with the Northeastern Project Manager. A/E consultants should confirm with the NU PM, how compliance with FM Global requirements will affect their scope of services, if requirements are not otherwise defined in the RFP.

1.4.2 Sustainability Goals - Reference NU commitment to sustainability, and goals described in Chapter 2. The sustainability program and goals pursued for each project varies as determined by the University. A/E consultants shall confirm the requirements with the Project Manager at the initial design phase.

1.4.3 Commissioning - Commissioning is a systematic process of confirming that all building systems perform interactively according to the Owner's Project Requirements (OPR) and the Basis of Design (BoD), or the Design Intent. At NU, Commissioning begins early in the design phase through construction, acceptance, and into the warranty phase with actual verification of functional performance. The Commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment installation and startup, control system calibration, testing, adjusting and balancing of air and water systems, functional performance testing and O&M training. Commissioning a project contributes to the design, construction, and eventual operation and maintenance of a project that meets the OPR for energy, water, indoor environmental quality, and durability.

- NU requires all projects consisting of mechanical, electrical, plumbing, and renewable energy systems and assemblies, to be Commissioned. These projects will be Commissioned in accordance with ASHRAE Guideline 0-2005, ASHRAE Standards 202-2018 and ASHRAE Guideline 1.1-2007 for HVAC&R Systems, as they relate to energy, water, indoor environmental quality, and durability.
- Commissioning of a building envelope or exterior enclosures are limited to inclusion in the Owner's Project Requirements (OPR) and Basis of Design (BoD), as well as the review of the OPR, BoD and project design documents. NIBS Guideline 3-2012 for Exterior Enclosures provides additional guidance.
- The Commissioning process for projects seeking LEED certification will include the requirements of the LEED Energy & Atmosphere Prerequisite 1- Fundamental Building Systems Commissioning and LEED Energy & Atmosphere Credit 3 - Enhanced Commissioning.
- **Design Phase Commissioning:** Commissioning during design is intended to achieve the following specific objectives:
  - *For the majority of capital projects, Northeastern commissions all MEP installations with in-house commissioning agents. The commissioning effort is adjusted to meet the requirements of each project. At the start of design, the University's commissioning agents host a kick-off meeting to present the overall commissioning process, review the scope, and develop and present a commissioning plan tailored to the project that outlines roles and responsibilities of the Project team through the design and construction process.*
  - *The commissioning plan outlines the commissioning process. It identifies the review of the OPR and the engineer's documented basis of design (BOD) that describes the performance objectives of all major building systems.*
  - *On larger projects with significant exterior closure scoping, Northeastern may contract with an independent Building Enclosure commissioning agent to perform these services*
  - *Verify the OPR and BoD are clearly documented, and they meet the Owner's goals and objectives.*
  - *Provide Design Reviews during Architectural/Engineer (A/E) design efforts.*
  - *Provide Commissioning Specifications applicable to each applicable Division. Verify systems and equipment adequately reflects the bid documents.*
- **Construction Phase Commissioning:** Commissioning during the construction phase of a project is intended to achieve the additional specific objectives:
  - *Provide direction for the Commissioning process during construction, via the Commissioning Plan, particularly identifying and providing resolution to issues and providing details not developed during design (ex. scheduling, participation of various parties, lines of reporting and approvals, coordination, etc.)*
  - *Performing reviews of applicable equipment submittals.*
  - *Verify that applicable equipment and systems are installed properly and receive*

adequate operational checkout with installing contractors.

- *Verify and document proper functional integrated performance of equipment and systems.*
- *Verify that O&M and As-Built documentation complies with the NU Requirements for Closeout Deliverables.*
- *Verify that the NU O&M personnel are adequately trained.*
- *A 10-12-month warranty review with the Design Team, Owner's representatives, and occupants of the project space.*

- The Commissioning process does not take away from or reduce the responsibility of the installing contractors to provide a finished and fully functioning product. Each project will have selected building systems Commissioned. The Commissioning process will be directed by the designated Northeastern University Commissioning Authority/ Agent (NUCxA).
- Commissioning during the Warranty Phase of a project is intended to include seasonal testing and other deferred testing that may be required. Final O&M manual and "As-Builts" adjustments will be made at this time if required due to testing. Before the 10 to 12-month warranty period is over the NUCxA will return to the project to review the building operations with the Construction Manager (CM), Owners Representative, NU Facility O&M staff and building occupant/s. This will provide an opportunity to review current building operations and the condition of outstanding issues related to the original and seasonal testing. The NUCxA will also interview NU Facility staff and identify problems or concerns they are experiencing with operating the building as originally intended. The NUCxA will document items to be addressed and record these changes for edits to existing documentation including the O&M manuals. Items will identify areas that may come under warranty or under the original construction contract. The CM assists NU Facility staff in developing documents for services to remedy outstanding items.
- A/E consultants will be expected support the NUCxA team or CxA consultant as needed throughout all phases of the project.
- A/E consultants should incorporate equipment labeling into the final deliverable. This would be either a 2D drawing, 3D model, or spreadsheet with the following data:

NU Building Code	Submittal Number
NU Floor Code	Manufacturer/Model
NU Room Number/Name	Serial Number**
NU Design Tag*	NU Barcode**
NU Uniformat Classification***	Install Date

*The Design Tag requires the label with which designers or trade contractors uniquely label their equipment. If working in Revit, designers and contractors may also use a different Parameter field for their tags, to work with their own schedules and annotation, but Northeastern University requires that all stakeholders copy those tags in the common NU Design Tag field as well.

** Serial Number and Barcode values shall be provided to the Architect.

***Please consult the NU BIM Standards Section 19 for more information on

Uniformat Classification Standards.

- For labeling equipment, examples of the University's naming convention follow below. The naming sequence includes Building Name, Equipment Item Description, Unit Number, Room Number being served by the equipment:
  - *EXP-ACB14-401: EXP, active chilled beam, 14th unit, located in room 401, fourth floor*
  - *EXP-AHU05: EXP, AHU, fifth unit, serving the building*
- A/E consultants should confirm with the NU PM, the commissioning scope planned for the project to understand how it will affect their scope of services, if requirements are not otherwise defined in the RFP.
- Environmental Health and Safety Commissioning Lab Requirements: At the end of a construction project NU commissions all labs to confirm that fume hoods, new eye washes and safety showers are inspected and inventoried, and that paper towels and soap dispensers, and required door signage are provided.

1.4.4 BIM Utilization - On all projects where a BIM Model is available as a resource, the NU PM should discuss the use of Revit as part of the project delivery. If A/E Consultants agree to utilize Revit for project documentation, the NU PM should complete the following tasks:

1. Engage the NU BIM Manager and include them in project kickoff with A/E consultants
2. Provide NU BIM Standards Document to the A/E consultants and any subconsultants utilizing Revit
3. Discuss final BIM deliverable with project team.

At construction closeout, the contractor is expected to provide final as-built documentation to the Prime A/E. The format of this deliverable can be determined by the GC and Prime A/E. The Prime A/E is expected to take any changes made during construction and incorporate them into a final record deliverable which will be provided to NU. This deliverable will include a 2D document set, and for agreed upon projects, a 3D model. The inclusion of a 3D deliverable will be determined by the project team at the start of the project.

1.5 DOCUMENTS

- Documents shall include drawings and specifications and shall conform to the most recent version of AutoCAD or Revit as required.
- Construction documents shall conform with NU drafting and graphics standards, currently the National CAD Standards - V6.
- If a project will utilize Revit, NU will utilize Autodesk Construction Cloud (ACC) to share 3D models. A/E consultants will host their working model in their own Hub, and be responsible for all ongoing model maintenance for the duration of the project.
- A/E consultants are expected to clean up the model before final delivery, including purging unused families & materials, auditing & compacting the model, eliminating unnecessary working views and sheets, and removing working linked/inserted DWG files that are no longer necessary. See NU Requirements for Project Closeout

Deliverables for more information.

- Models should not be upgraded without written consent from NU BIM manager and PM team.
- The University uses e-Builder software to manage documents on all projects. E-Builder is a web-based project management tool. Use of e-Builder involves a formal process that all A/E consultants will be required to participate in. The NU PM will provide the A/E consultant access to the e-Builder system at the commencement of design work. Consultants should contact NU Project Controls to determine the current e-Builder software training schedule and to ask any questions. The PM can provide an email address to contact Project Controls.
- Contract Documents shall represent any separate construction phases or sequences for projects where the University has determined that the project needs to be bid or constructed in multiple packages.

1.6 PROJECT APPROVALS AND GOVERNANCE

Capital projects are developed at Northeastern University through a multi-stage approval process allowing the University's leadership to access the viability of proposed projects at key developmental stages. For most projects, an internally produced study called, Phase Assessment #1 describes the general scope, budget, program and preliminary complexities is presented for review and approval of limited funding to pursue further project definition by starting the design process. In most projects, this limited funding is utilized to seek an outside architect to develop the design. The design is developed sufficiently so that the assumptions made in Phase Assessment #1 are confirmed or expanded. This usually is accomplished through the Schematic Design phase where scope, costs, schedule, and site issues are better understood through a more thorough study culminating in a document entitled, Phase Assessment #2. Phase Assessment #2 is utilized to seek full project funding to the end of construction from the University's leadership.

1.6.1 Phase 1 Assessment - The Phase 1 Assessment explores the Scope and Feasibility of a potential project. The NU Project Manager is responsible for completing the Assessment. A/E consultants are not typically involved at this stage, but depending on the scope, scale and complexity of the project, A/E consultants may be retained to assist on an as needed basis. The Phase 1 Assessment is the first step in the University's Capital Project Approval Process. The Phase 1 Assessment focuses on defining the following:

- Potential Locations and square footage
- Existing conditions analysis based on information gathered through a kickoff meeting.
- Proposed solution and scope definition
- Other assumptions, if any
- Enabling projects required
- Project risks and opportunities
- Estimated project schedule
- Fit plan, which illustrates the potential programmatic and space layout requested

within one or more options.

- Cost estimate generated from a cost per square foot based on project benchmarks and/or comparable known project costs.
- LEED Certification determination. This discussion shall include initial reactions, assumptions, intention of whether the proposed program shall be able to meet with the NU expectation that all projects be LEED Platinum Certified whenever possible. (LEED Gold minimum)
  - *Site analysis showing project integration with campus Master Plan, environmental benefits and improvements. Include analysis of ability to service project as required for trash collection and pick-up, loading and deliveries, fire department and emergency vehicle access.*
  - *Site analysis in relation to planning and zoning requirements of site relating to campus Master Plan and City of Boston, Boston Redevelopment Authority and other governing agency regulations.*
  - *Traffic impact study for project implementation and construction as well as final conditions of project. This shall include a parking study and analysis as well as documentation that the project complies with safe accessibility to multiple modes of public transportation available nearby.*
  - *Life safety analysis of initial concept design.*
  - *Sustainability Goals analysis shall include integrated project design intent with decision to pursue selection of particular building systems for further analysis as project design progresses.*
  - *Consider completing a Life Cycle Cost Analysis and expectations based on selection of particular building systems for further analysis as project design progresses. This information to inform initial cost estimates.*
  - *LEED Certification and scorecard analysis based on the expectation of project to meet LEED criteria.*

1.6.2 Phase 2 Assessment - If the Phase 1 Assessment is approved by the University, the project proceeds to a Phase 2 Assessment. The Phase 2 Assessment is the Pre-Design phase. The NU Project Manager is responsible for completing the Phase 2 Assessment. Depending on the scope, scale and complexity of the project, A/E consultants may be retained to assist on an as needed basis. The Phase 2 Assessment is the final step in the University's Capital Project Approval Process. The Phase 2 Assessment updates and provides and the following:

- Proposed location and square footage
- MEP/ FP narrative, which expands on existing conditions analysis and provides further information related to the proposed design.
- Check in with the NU HVAC and Energy Groups to understand if there are any on-going or near-term planned upgrades to the building automation infrastructure on campus that will affect the proposed project or should be incorporated into the project's scope
- Proposed solution and scope definition

- Cost related assumptions
- Enabling projects required
- Project risks and opportunities
- Estimated project schedule
- Conceptual design, which illustrates the programmatic and space layout requested
- Cost estimate generated from take-offs included within conceptual drawing set.
- Identification of major changes from Phase1 Assessment.

1.7 PROFESSIONAL SERVICES AND DELIVERABLES

These Guidelines are not intended to stifle creativity but rather create a framework in which each University project is delivered. The sections below outline multiple factors that are considered essential to the process and deliverables expected by the University at each contracted project milestone. These are minimal project expectations.

Each consultant shall examine their contracted project as they see fit to meet the program and budgetary needs of the specific project. A complete outline of the consultant project approach and involvement shall be determined with the University Project Manager as part of project kick-off. Notwithstanding the forgoing, the professional services and guidelines below shall not supersede, conditions in the agreement between NU and consultant.

1.7.1 Project Delivery Approach - Project delivery methods most often utilized at NU include Construction Manager at Risk, and design-bid-build. A/E consultants shall confirm with the NU PM, the project delivery approach for the project to understand how it will affect their scope of services, if requirements are not otherwise defined in the RFP.

1.7.2 Schematic Design (SD) - The goal of Schematic Design is to develop and finalize the overall arrangement of spaces, establish performance requirements for building systems, establish reliable project costs, and define overall project approach. On larger projects Schematic Design serves as the basis for Assessment #2 that is used to seek funding to complete the project. Projects affecting major interior and/or exterior public areas will need to be reviewed and approved by the University's senior leadership. This review needs to be coordinated with the project manager. Sufficient time must be allowed to address comments and resubmit as necessary.

- Begin integration of NU CADD and BIM standards in document development.
- Begin in-depth review of site analysis for site work and site testing as it pertains to existing site surveys and newly commissioned surveys, geotechnical surveys and testing, site utilities, and other conditions that may have impact on the project.
- Begin in-depth review of engineering systems requirements to ensure compliance with NU standards and with established sustainability goals. Refer to Chapters 6 through 10 for standards for mechanic and electrical engineering systems.
- Refine diagrams and other analysis materials from concept design to develop actual floor plans and drawings for final construction documents.
- Meet with and engage NU Commissioning Manager, as coordinated by the PM, to

determine commissioning goals and process.

- Begin development of interior design schemes and materials to better inform the cost estimate. This includes initial discussions with end-users for preferences and expectations.
- Engage end users and stakeholders to determine needs and expectations for FF&E to ensure program functions at project completion.
- Engage NU ITS Department to plan for the best way to integrate AV technology, data cabling, ceilings, infrastructure etc., and to ensure success in achieving the University's integrated automation standards. Evaluate requirements shared by ITS in coordination with space program and budget.
- Engage the Northeastern University Police Department (NUPD) to coordinate technology and security requirements.
- Continue development of sustainable design elements to meet expectations and comply with NU Guidelines.
- Develop preliminary Commissioning Plan for project completion.
- Schematic Design documents to include but not be limited to:
  - *Code Analysis*
  - *Civil Site Plans*
  - *Architectural Site Plans*
  - *Floor Plans*
  - *Elevations*
  - *Vertical Building Sections*
  - *Illustrative views, models, etc. as required to convey design progress*
  - *LEED Scorecard to reflect current project assumptions*
  - *Revised project schedule*
  - *Phasing and implementation analysis*

1.7.3 Design Development (DD) - The goal of design development is further refine the general design in Schematic Design defining the size and location of primary equipment and distribution systems supporting building systems, dimensioned drawings informing occupants of specific attributes of each room and provide a more detailed cost estimate confirming the budget.

Projects affecting major interior and/or exterior public areas will need to be reviewed and approved by the University's senior leadership as the public spaces are further defined with finishes. This review needs to be coordinated with the project manager. Sufficient time must be allowed to address comments and resubmit as necessary.

- Continue review of project scope and program with consultant, NU PM, and project stake holders.

- Perform detailed check on project program and projected costs in compliance with the expectations outlined in the MOU.
- Confirm that project schedule and budget are currently on-target.
- Revise and confirm code compliance with current design scheme and systems assumptions.
- Begin development of project signage and graphics. Ensure compliance with NU standards for use and placement of NU logo and other trademarks. Refer to Chapter 4 Signage and Graphics for additional information.
- Coordinate room numbering and naming with NU Project Manager, Campus Planning and Real Estate, and Spatial Systems Manager for compliance with University space standards. Develop project schedules based on approved system for numbering and naming.
- Ensure that room names are easily identifiable and relate to specific program needs.
- Develop project phasing to determine any possible needs for development of separate bid packages in order to maintain schedule and compliance.
- Determine that design and phasing will minimize interruption to adjacent facilities and campus operations during implementation and construction.
- Determine schedule for submission of permit and other review processes by government agencies for all disciplines in order to ensure adherence to project schedule.
- Meet with and engage NU Commissioning Manager, as coordinated by the PM, to determine commissioning goals and process.
- Meet with NU EH&S, as coordinated by the PM, for expectations of project on environmental health and occupational safety controls to keep faculty, staff, and students safe from potential impact of project activities.
- Make final determination of building systems to perform updated Life Cycle Cost Analysis and move forward with project documents.
- Register Project for LEED Certification. Refer to Section 2.3 for NU LEED and Sustainable Design requirements and expectations.
- Continue development of landscape architecture or urban site design as integrated part of project design. Ensure compliance with water usage and stormwater management requirements (when applicable).
- Prior to proceeding with design ideas, give a Design Review Presentation to present current concepts and budget to the University.
- Determine final scheme for interior design components and general FF&E items to ensure timely integration into contract documents for updated cost estimate as part of DD submittal.
- Review all unreconciled budgetary items with NU PM.
- Determine criteria for approval to move project forward to construction document phase.

- Ensure timely review and response to comments received on DD package from NU PM.
- Design Development submittal materials to include but not be limited to:
  - *Revised drawings including further development of documentation from all project team disciplines. Drawings to include a minimum of:*
    - *Architecture*
      - Floor Plans RCP's
      - Life Safety Plans
      - Building Elevations
      - Building Sections
      - Finish Schedules
      - Door Schedules
    - *Structure*
      - Foundation Plans
      - Framing Plans
      - Typical Details
    - *Mechanical / Electrical / Plumbing / Fire Protection*
      - Mechanical Duct Layout
      - Large Scale Plans of Mechanical Rooms
      - Electrical Plans
        - Power
        - Lighting
        - Special Systems
        - One-line Diagrams
      - Plumbing / Fire Protection
        - Floor Plans
        - Riser Diagrams
      - Integrated Automation
        - Responsibility Matrix
        - Inventory of Control Assets
        - Monitoring-Based Commissioning Plan
    - *Civil*
      - Site Survey or Plat of Survey
      - Existing Conditions
      - Site Layout Plan
      - Utility Plan
      - Grading and Stormwater Drainage Plan
      - Stormwater Quality Basin Plan
      - Erosion Control Plan
    - *Landscape Architecture / Urban Design*
      - Landscape and Hardscape plans
      - Irrigation Plans

Landscape Details

- *Revised specifications including all general conditions and up to date project systems and materials assumptions and selections.*
- *LEED Scorecard showing refined assumption of project's ability to meet expectations within current budget.*
- *Revised project schedule showing all submittal and review dates for all disciplines.*
- *Phasing plans as needed if determined that project will be implemented in multiple phases.*
- *Revised up to date cost estimate*

1.7.4 Construction Documents (CD) - The goal of construction documents is to define the project with sufficient detail to acquire competitive bids from general contractors and to utilize as the basis of the construction contract that describes every building system and component.

- Review document procedures and expectations with NU CADD Manager and Facilities Department to ensure compliance with naming conventions and layering and usefulness of submitted documents for building maintenance. The University utilizes the following CADD standard: National CAD Standards - V6.
- Review any outstanding unreconciled budget items with NU PM.
- Hold final meetings with NU PM and all NU end-users and stakeholders to ensure program requirements are met.
- Integrate any final program requests and changes in a timely manner. Inform NU PM of impact to project budget and schedule.
- Determine actual needs and costs for any last minute or design impacting program changes.
- Perform detailed check on project program and projected costs in compliance with the expectations outlined in the MOU.
- Continue to assist NU with any presentation materials needed for project fundraising, marketing, and community awareness processes.
- Meet with and engage NU Commissioning Manager, as coordinated by the PM, to determine commissioning goals and process.
- Prepare documents for all permitting submittals including all required NU and governmental applications as required.
- Establish level of support expected for consultant during bidding and permitting phases of final construction documents.
- Construction Document submittals during this phase may include but are not limited to:

- *90% or greater construction drawings and specifications.*
- *Revised LEED Scorecard and assumptions.*
- *Final report on integration and implementation of sustainable design strategies. Coordinate with NU PM and other staff to ensure compliance with all NU Sustainable Design Guidelines and Programs.*
- *Submit estimated construction schedule based on project assumptions.*
- *Submit revised cost estimate for comparison to proposed bids.*

- Bid Set
  - *Consultant shall support NU PM during bidding process.*
  - *Consultant shall attend any pre-bid conferences and respond as required to any requests for information during the bidding process.*
  - *Consultant shall evaluate any proposed alternates and substitutions.*
  - *Consultant shall attend all bid openings as required by the NU PM and shall assist with any bid evaluation and determination of final scope and implementation approach.*
- Construction Documents for Permit
  - *Consultant shall manage any and all permitting and approval processes as necessary.*
  - *Consultant shall perform due diligence and provide all necessary documentation required for permitting and approvals process.*
  - *Consultant shall participate and manage process of response to permit review comments and resubmit as needed in coordination with NU and any selected construction professionals.*

1.7.5 Construction Administration

- Consultant shall attend any pre-construction meetings.
- Consultant and contractor to determine document review and submittal processes to ensure compliance with project schedule.
- Support and engage in discussions for construction innovation and opportunities or cost savings during implementation.
- Update and provide any and all supporting documentation for revised drawings, addenda, bulletins, etc. as well as develop conformed set of contract documents.
- Attend regular site meetings as established at beginning of project process or as required to meet established schedule.
- Consultant shall provide NU PM with field reports and documentation on observations.
- Respond to RFIs and submittal reviews within a timely manner. Provide additional sketches as required.
- Review and coordinate with contractor's proposed changes, any change orders, and scope changes.

- Punch list preparation and inspection.
- Document project for substantial completion with NU PM and contractor.

1.7.6 Project Close-Out

- For more in-depth information, please refer to the NU Requirements for Project Close-Out Deliverables. This document is typically included in the Owner-Consultant Agreement and may be obtained through the NU Project Manager.
- Review submitted Operations and Maintenance manuals for final training and submittal to NU Facilities.
- Provide final fire egress diagrams with appropriate display system as needed.
- Provide final sustainable design assessment, final LEED Scorecard and manage submittal process for LEED Certification.
- Provide NU with final as-built documents in required format in both print and electronic submittal.
- Schedule any photographic documentation of new projects prior to final occupancy of facility by student body.

1.7.6 Project Close-Out BIM Standards

- Models should be delivered in the same year/version of Revit that they were provided by NU. Models must be submitted in *.rvt format.
- Redundant families should be corrected & removed (e.x. only one duplex outlet family).
- Utilize provided NU template families whenever possible.
- Avoid using generic models, and modeled-in-place families.
- Minimize use of overly-detailed manufacturer models, particularly for furniture (note: this does not apply to MEP usage)
- Ensure the following parameters have been properly filled out for all new equipment. Information should be provided by contractor:

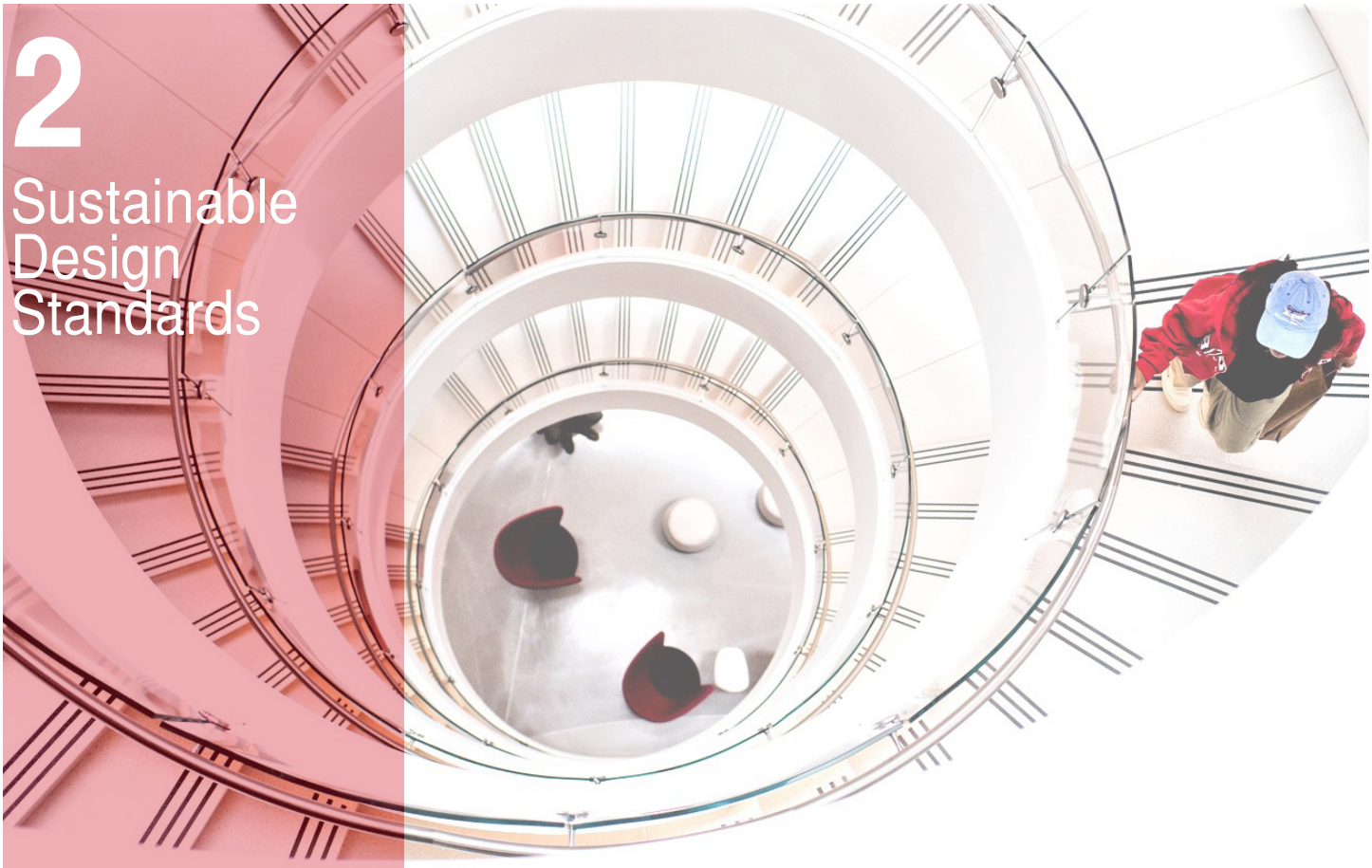
NU Building Code	Submittal Number
NU Floor Code	Manufacturer/Model
NU Room Number/Name	Serial Number**
NU Design Tag*	NU Barcode**
NU Uniformat Classification***	Install Date

*The Design Tag requires the label with which designers or trade contractors uniquely label their equipment, fixtures and building features. If working in Revit, designers and contractors may also use a different Parameter field for their tags, to work with their own schedules and annotation, but Northeastern University requires that all stakeholders copy those tags in the common NU Design Tag field as well.

** Serial Number and Barcode values shall be provided to the Architect. Contractor is responsible for providing this information.

***Please consult the NU BIM Standards Section 19 for more information on Uniformat Classification Standards.

2 Sustainable Design Standards



2.0 SUSTAINABLE DESIGN STANDARDS AND GOALS

Sustainable, resilient, and just design plays a large role in addressing the climate crisis. Buildings account for 39% percent of greenhouse gas emissions in the United States. This pollution contributes to global climate change and has disproportionate impacts on low-income, communities of color locally and across the globe. Local, state, and federal jurisdictions are increasingly implementing policies and regulations that require developers and building owners to minimize climate pollution and other impacts of development. Furthermore, Americans, on average, spend approximately 90%, and studies show that indoor air quality can impact cognitive function, underscoring the importance of ensuring our indoor environments are healthy and sustainable. Buildings are also the backdrop and stage to how we engage with our internal and neighboring communities. For these reasons and more, a sustainable approach to capital projects is key to helping the University meet its climate justice and sustainability goals, including decarbonizing our buildings as quickly as possible.

This section provides guidance for capital projects, big and small, on how to reduce consumption of non-renewable energy, track progress, minimize waste, improve healthy environments, support equity, create a project that considers the environmental impacts over its lifetime, and more. Staff from Northeastern's Climate Justice and Sustainability Hub are ready to answer questions and provide guidance for projects throughout, with an emphasis on the early stages of planning and design.

2

Sustainable Design Standards

2.1 Evolving Demand and Opportunities

Innovations and evolutions in building technology, design, policy and climate justice are constant, and building designs should reach accordingly, striving for the best solutions available at the time.

In 2022, with the launch of the Climate Justice and Sustainability Hub, Northeastern refocused efforts on a Climate Justice Action Plan that reflects the needs and ideas of our communities broadly, including those most impacted by climate change. As the process and development of the plan unfolds into 2024, PREF will update design guidance to reflect the goals and objectives laid out in the plan.

2.2 Policies and Regulations

The policies, regulations, and incentives to build more sustainably are becoming stronger across Northeastern's global network. Building Performance Emission Standards are in place Boston, Seattle, Vancouver, and the United Kingdom. Oakland and Seattle have banned natural gas for new projects. These policies are evolving quickly, the local project team should look carefully at applicable regulations and incentive opportunities at the time of project design. Note that projects should strive for the highest plausible standards, no matter how advanced the local regulations.

The following table describes the types of sustainability related policies and regulations where Northeastern has campuses. In addition, a few key regulations and programs are highlighted below.

Policy/Regulation	Global Campus Application
Building Performance Emission Standards	Boston, Seattle, Vancouver, and London
Fossil Fuel Ban (New Projects)	Oakland, Seattle
Additional Requirements	Boston and Massachusetts (Stretch Energy Code), Oakland (Green Building Ordinance)

2.2.1 Boston Building Emissions Reduction and Disclosure Ordinance

Boston BERDO 2.0 sets progressively rigorous targets for building operational energy in five-year increments, leading towards net fossil-fuel free buildings in 2050. For meeting these targets, Northeastern's buildings in Boston are considered as a portfolio. This affords the university the opportunity to align energy reductions with capital projects driven by other needs. Projects need to assess how they can contribute to energy goals for the building and campus not only for the current energy target, but also out to 2050. Offsets, if required, will be addressed at a campus level, whereas individual projects and buildings are responsible for direct energy use and carbon emissions reductions.

2.2.2 Massachusetts Stretch Energy Code

Boston, Burlington, Dedham, and Nahant have all opted into the Massachusetts stretch energy code, applying stricter energy requirements for new construction and major renovations. The December 2022 update of the Massachusetts Stretch Energy Code offers a higher tier called the "Specialized Energy Code" which Boston has signaled they will adopt. In addition to greater efficiency standards, this code requires all new

buildings and major renovations to be all electric or pre-wired for future electrification.

2.2.3 Oakland Green Building Ordinance

Oakland City has adopted requirements to ensure that new development and additions and alterations meet high green building performance standards. Furthermore, the state has also adopted a Green Building Standards Code (CALGreen). Our projects might need to comply with one, the other or both laws.

2.3 Sustainability Standards

The following capital project standards will help projects jurisdictional regulations and university goals for sustainable, resilient, just, and inclusive campuses. Section 2.3.1 applies to new building construction and extensive whole-building renovations while Section 2.3.2 applies to a range of renovations.

Staff from Northeastern's Climate Justice and Sustainability Hub, Energy Group, and elsewhere are ready and available to discuss your project and how these standards apply. Project Managers and designers should meet with these teams early in the project, particularly for those projects over $10 million and those addressing building mechanicals or envelope.

2.3.1 New Construction and Extensive Whole Building Renovation (excluding projects under 20,000 GSF)

General Standards:

- Achieve, at a minimum, LEED Gold certification – achieve all regional priority credits and pursue innovation credits.
- Perform life cycle analyses, life cycle cost analyses, and energy modeling at contracted project delivery milestones

General Aspirations:

- LEED Platinum Certification or Living Building Challenge Core Certification

Energy Standards:

- Buildings should be Net-Zero Carbon-Ready
- Meet or exceed building-based EUI target set by Northeastern near the beginning of a project
- Design buildings to perform in all-electric mode during non-peak, non-emergency operations – Combustion, if needed, is limited to peak requirements and emergency backup power. For specialized, high-intensity uses, or on district thermal system, discuss alternative options with Hub and Energy Teams.
- In Boston, discuss future district energy solution for the building site with Northeastern’s Hub and Energy teams to help determine thermal energy source.
- Maximized on-site renewable energy such as solar, geothermal

- Achieve building energy 30% better than ASHRAE 90.1-2019
- Projects should maximize roof area dedicated for solar PV

Energy Aspirations:

- Carbon Neutral, Net Zero Energy Building
- Renewable fuel use for any on-site fuel needs
- On site equipment which runs on fossil fuels should be capable of future retrofit to accept renewable options

Embodied Carbon Standards:

- Reduce the embodied carbon of primary materials in the building by 20% from a typical design
- Perform a whole building life cycle analysis (LCA) to study carbon conservation measures.
- Integrate carbon reduction strategies such as:

  Efficient engineering to optimize material selection

  High recycled content for steel

  Low carbon concrete

  Sustainably Harvested Mass Timber structure, particularly in shorter-span buildings.

  Interior materials with lower than industry average carbon footprint

Embodied Carbon Aspirations:

- Achieve a Zero Carbon building construction by purchasing offsets for 100% of the embodied carbon.
- Reduce the embodied carbon of primary materials in the building by 30% from a typical design.
- Advocate for Environmental Product Declarations (EPDs) for all concrete used on the project.

Responsible Materials Standards:

- Source at least 80% of wood products from sustainably managed forests or salvaged/ reclaimed wood suppliers.
- In coordination with the contractor, identify which sustainable and healthy materials can be sourced regionally.
- Specify PFAS-free carpet, rugs, and fabrics
- Use best practices for low emitting materials, aligning with the LEED Low-Emitting Materials credit.

- Divert at least 70% of construction and demolition waste from the landfill.
- Use best practices for bird friendly design.
- Target Red List free finishes in offices, classrooms, and common spaces, as well as Red List free office furniture and workstations.
- Provide dedicated disposal, sorting, and storage facilities recycling (including glass / metal / plastic, paper / cardboard), organics, and landfill streams for all buildings.

Reponsible Materials Aspirations:

- Specify PFAS free products wherever possible, beyond carpets, rugs, and fabrics
- Divert at least 80% of construction and demolition waste from the landfill.
- Achieve a zero-waste building during construction and operations.
- Eliminate Red List chemicals from 50% of new construction products by cost, utilizing the LBC v4. Materials Petal guidance to document compliance.

Water Standards:

- Use water conservation features, such as low flow-fixtures, throughout the building.
- Maximize the use of native and drought tolerant landscaping.
- Treat stormwater on site through low impact development strategies such as green roofs, impervious pavement, and rain gardens.
- Use reclaimed water from AHU condensate and/or RO reject where feasible.

Water Aspirations:

- Greywater processing and reuse for non-potable end-uses.
- Where applicable, design landscapes that will not require use of petrochemical fertilizers or pesticides.

Occupant Experience Standards:

- Provide operable windows in regularly occupied spaces and access to quality views for 75% or more of regularly occupied spaces.
- Optimize natural daylight and mitigate glare.
- Incorporate biophilic design principles.
- Use the building to educate building and site users.

Occupant Experience Aspirations:

- Integrate circadian lighting principles into the interior lighting design for targeted spaces.

Equity Standards:

- Engage diverse voices to inform key decision making; Depending on the project, this may include neighbors, a range of project team members and different types of users.
- Integrate the Seven Principles of Universal Design as defined by the Center for Excellence in Universal Design.
- Design entrances to be inviting and welcoming.
- Incorporate design elements that are beneficial and accessible to all members of the public. This may include seating, shade, public restrooms, water fountains, covered bike-parking and more.
- Discuss with Planning and Hub whether the building should include shared gathering spaces to support community organizations, public events, and informal spaces for community to gather, work or study.
- Recognize sensitivities to the cultural heritage of the site.
- Consider opportunities to work with local artists and prominently display their work.
- All restrooms will accommodate all genders, and single stall restrooms should be made available as well.
- Discuss a plan for community engagement with Campus Planning, The Hub and City and Community Engagement.
- Provide facilities for nursing mothers to include a locking door, sink, changing table, comfortable seating, lighting control, and ample electrical outlets.

Transportation Standards:

- Provide on-site or contribute to campus resources for:
  Provide weather protected bike storage for the equivalent of 15% of occupants somewhere on campus.
  Support for bike share or other shared mobility options
  Note these commitments may be increased based on building type or as part of the TAPA in Boston, or other local permitting requirements.

Resilience Standards:

- Review climate risk and resilience hazards based on future conditions (including heat, fire, flood). Choose materials, siting, and elevations accordingly. For Boston, refer to Northeastern's climate vulnerability report.
- Identify site-specific vulnerabilities including dependence on critical utility services.
- Incorporate long-term future-projected climate change data (2070+) in the design of the building and infrastructure, including flood resistant materials below the 2070+ design flood elevation and elevate critical infrastructure above this elevation.
- Incorporate near-term future-projected climate change data (2050s) in design of mechanical, electrical, and plumbing systems and/or components on a regular replacement cycle.

- Implement adaptive design strategies with flexible protection levels which reduce risk to acceptable levels over time.
- Adhere to city/state regulations around fire abatement. Develop an aligned Vegetation Management Plan (VMT) that meet these regulations while also preserving environmental assets.
- Maximize green infrastructure on-site.

2.3.2 Renovations and Small New Construction (Applies to renovations over 1$M unless otherwise indicated. Where "major renovations" are indicated, those guidelines apply to renovations over $10M or new buildings under 20,000 GSF.)

General Standards:

- For major renovations or where scope includes major MEP system or envelope upgrades, perform Life Cycle Cost Analyses and Energy Modeling at contracted project delivery milestones.
- For major renovations, strive to be at least LEED gold certifiable. Pay particular attention to regional priority and innovation credits.

General Aspirations:

- For major renovations, Achieve LEED Gold, Living Building Challenge Core Certification or other green certification programs.

Energy Standards:

- Demonstrate project will help meet the building's overall EUI and greenhouse gas emission targets. Report expected change in operational energy use and greenhouse gas emissions based on design. An energy model is not required. Work with Energy and Hub teams to identify whether project-specific energy reduction targets are applicable.
- For major renovations, evaluate opportunities to upgrade MEP systems to be more efficient or replace existing heating and cooling systems for the effected segment of the project to be decarbonization -ready. This is particularly critical if MEP systems will need to be replaced as part of the project. Labs and other special use high-intensity buildings will require further analysis.
- All MEP systems needing replacement should be replaced with the highest efficiency standard possible and/or reduce future dependance on fossil fuels .

Energy Aspirations:

- New appliances to be electrically powered, including ovens and stove tops.

Embodied Carbon Standards:

- Look for opportunities to refurbish and reuse existing materials that can align with project goals
- If materials and Furniture, Fixtures and Equipment cannot be used on site, look for opportunities to reuse or recycle outside of the project.
- When selecting new materials, choose low embodied-carbon alternatives where available.
- For major renovations, perform life cycle analysis (LCA) of new systems and materials to study carbon conservation measures and compare re-use vs. new.

Responsible Materials Standards:

- Specify PFAS-free carpet, rugs, and fabrics
- Target Red List free finishes and furnishings.
- Use best practices for low emitting materials, aligning with the LEED Low-Emitting Materials credit.
- In coordination with the contractor, identify which sustainable and healthy materials can be sourced regionally.

Responsible Materials Aspirations:

- Source at least 80% of wood products from sustainably managed forests or salvaged/ reclaimed wood suppliers.
- Divert at least 70% of construction and demolition waste from the landfill.
- Specify PFAS free products wherever possible, beyond carpets, rugs, and fabrics.
- Eliminate Red List chemicals from 50% of new construction products by cost, utilizing the LBC v4 Materials Petal guidance to document compliance.

Water Standards:

- Where applicable to project scope, look for opportunities for low flow fixtures.

Occupant Experience Standards:

- Optimize natural daylight for all occupants and mitigate glare. This may include locating private or enclosed spaces towards a building's interior and public open spaces along windows.
- Seek opportunities to incorporate biophilic design principles.
- Seek opportunities to educate users about sustainable use of the space.

Occupant Experience Aspirations:

- Integrate circadian lighting principles into the interior lighting design for targeted spaces.

Equity Standards:

- Engage diverse voices to inform key decision making; Depending on the project, this may include neighbors, a range of project team members and different types of users.
- Integrate the Seven Principles of Universal Design as defined by the Center for Excellence in Universal Design.
- Assess adequacy of all gender restrooms serving the space.
- Design public-facing spaces (particularly building-entry-adjacent or event spaces) to feel open and welcoming to a wide range of NU community members and neighbors.
- Public-facing spaces should incorporate design elements that are beneficial and accessible to all members of the public. This may include seating, shade, public restrooms, water fountains.

Equity Aspirations:

- Address scope-adjacent opportunities to improve universal accessibility in the building.
- Where adjacent all-gender restroom access is lacking, incorporate renovations into project scope or align work with simultaneous upgrades.
- Where reasonable access (typically in the same building) to lactation or wellness facilities is lacking, look for opportunities to identify space within the project scope.
- Consider opportunities to work with local artists and prominently display their work.

Resilience Standards:

- For large infrastructure projects and other major renovations, review future flood risks and design and locate infrastructure to be resilient to these risks.

Resilience Aspirations:

- Maximize green infrastructure opportunities where relevant to scope.

2.4 Greenhouse Gas Emissions Factors

All projects should use the following greenhouse gas emissions factors for reporting on operational energy use carbon impact.

- Electricity: Use latest emissions factors from the regional eGrid (Emissions and Generation Resource Integrated Database).
- Natural Gas: 0.05311 kg CO2e/kBTU
- No. 2 Fuel Oil: 0.07421 kg CO2e/kBTU
- District Steam (NU system): 0.0664 kg CO2e/kBTU
- Vicinity District Steam: Check with CJ&S Hub staff: data forthcoming.

2.5 Certifications and Standards

Projects may seek a variety of sustainability related building certifications, including LEED, WELL, Living Building Challenge, SITES.

2.5.1 LEED

LEED (Leadership in Energy Efficient Design) is a globally recognized green building certification program, and the most used on Northeastern projects to date. All projects seeking LEED certifications or certifiable performance should use the most current version of the LEED program and use the naming convention in the appendix.

2.5.2 ASHRAE

ASHRAE, American Society of Heating, Refrigerating and Air Conditioning Engineers, regularly updates guides and best practices related to building systems, energy efficiency, indoor air quality, and sustainability. Evaluate the potential to exceed the latest ASHRAE standards and guidelines. This may be done as part of a Life Cycle Carbon Analysis early in the project.

2.5.2 Leveraging Academics

One of Northeastern's Climate Justice and Sustainability goals is to leverage research and academic strengths to advance just and equitable solutions to the climate crisis. We encourage project teams to discuss with the Hub whether there are opportunities to leverage Northeastern faculty, researchers, and students to explore specific sustainability options for your project.

3 Security Measures

3.0 SECURITY MEASURES

3.1 SAFETY AND EQUIPMENT GOALS

3.1.1 Engage with the Northeastern University Police Department (NUPD) during the Schematic Design Process to coordinate technology and security requirements for each project.

3.1.2 Landscaping and building features should be designed such that there are no nooks or areas where someone can hide and pedestrian safety is maximized at all times.

3.2 TECHNOLOGY INTERFACE - DATA / TELECOM / CCTV / DOOR AND BUILDING ACCESS

3.2.1 Provide security cameras on both exterior site areas and interior public spaces. Location of cameras shall be coordinated with NUPD, through the Owner, to address security, privacy, and surveillance issues.

3.3 CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED)

3.3.1 Design with CPTED principles to enhance student, faculty, and staff safety

- Natural surveillance
  - *Placement of physical features and activities areas to maximize visibility and foster positive social interaction among legitimate users of private and public space.*
  - *Support NUPD ITS and security systems.*
- Natural territorial reinforcement
  - *Promote social control through increased definition of space and improved proprietary concern.*
  - *Create a sense of owned space, an environment where "strangers" or "intruders" stand out and are more easily identified.*
  - *Use buildings, fences, pavement, signs, lighting, and landscape to express ownership and define public, semi-public and private space so that natural territorial reinforcement occurs.*
- Maintenance
  - *Ensure ease of facility maintenance to prevent appearance of abandoned facilities and provide ability for natural surveillance.*
  - *Increase usability of space by NU programs.*
- Activity Support
  - *Placement of signage, site furnishings, and lighting should encourage use of space by NU students and organized programs.*

3.4 LIGHTING

3.4.1 Design adequate lighting and visibility for pedestrians to accommodate their safety.

3.5 HARDWARE

3.5.1 The A / E consultant shall coordinate with and conform to the University maintained preferred hardware product and installation specification. Such requirements shall be provided by the University Project Manager for each project as required.

3.5.2 Hardware selections shall be coordinated with NU Facilities Department and NUPD as required for bio-related or electronic / computer / card access systems.

3.5.3 Hardware selections shall be keyed per NU Facilities direction as reviewed and approved during construction submittal process. Duplicate keys / redundant access to be provided upon direction as well.

4 Signage & Graphics

4.0 SIGNAGE AND GRAPHICS

4.1 BRANDING AND LOGO USAGE

4.1.1 Governing Agency - Northeastern University Department of Marketing and Communications

- Guidelines - governs use, image, and placement of NU logo and branding: The Branding and Logo Guidelines are available on the University's web site or through the NU Project Manager.

4.2 WAYFINDING / INFORMATIONAL / IDENTIFICATION

4.2.1 Campus wayfinding (exterior signage) should be coordinated with the Northeastern University Department of Marketing and Communications as well as the Northeastern University Sign Shop.

4.2.2 Campus wayfinding shall not conflict with wayfinding signage of the City of Boston or other code / regulatory agency signage.

4.2.3 A wayfinding conceptual plan shall be presented as part of the design development phase submittal and review. Construction document submittals must include wayfinding elements to accomplish the approved wayfinding plan.

4.3 SIGNAGE

4.3.1 Exterior Building Identification Signage

- Coordinate all exterior building identification with NU Facilities for accurate name, building number, address, and preferred sign location.

4.3.2 Building Directories

- Provide main directory near the main entrance or entrances of the building - primarily at major public access points.
- Traditional building directories in existing buildings to be designed / manufactured and easily accessible to allow for ease of editing by the University sign shop.
- Consider the option of a monitor based digital directory, as opposed to traditional signage.

4.3.3 Interior Building Informational and Wayfinding Signage

- Informational and wayfinding signage design for building interiors to be coordinated so as to be designed in a style complementary to the selected building interior design scheme as well as conform to University standards and guidelines located within the University's Branding and Logo Guidelines available through the NU Project Manager.
- All code required, regulatory, and life safety signage to be coordinated and provided as part of building contract documents for all projects.
- Provide all code required life safety signage to include indication of emergency egress for street discharge and roof access in multi-story buildings.
- Provide interior way-finding signage and / or graphics as required to direct people within buildings. Building maps or floor plans may be installed at key locations. Directional signs and / or directories shall be installed on walls opposite elevators, and possibly at the intersection of several corridors. Signage must also be provided at key locations in the building to indicate destinations or other key building locations. Design and installation (i.e., mounting height, contrast, visibility, other factors) shall meet ADA guidelines for all signage.
- The method and appropriateness of donor recognition shall be coordinated by the NU PM with Institutional Advancement and Campus Planning and Real Estate.

4.3.4 Room Identification

- Every room shall have a wall mounted room sign or plaque, per technical specifications under the University Graphics and Signage Program. Signage shall contain room numbers, occupant name and room space identification as well as Braille symbols and meet all ADA requirements.
- Room Identification signage to be produced in accordance with NU Sign Shop protocols and standards with capabilities for replacement or repair.
- Coordinate room numbering and naming with NU Project Manager, Campus Planning and Real Estate, and Spatial Systems Manager for compliance with University space standards. Develop project schedules based on approved system for numbering and naming.

4.3.5 Attachment Systems / Mounting Heights

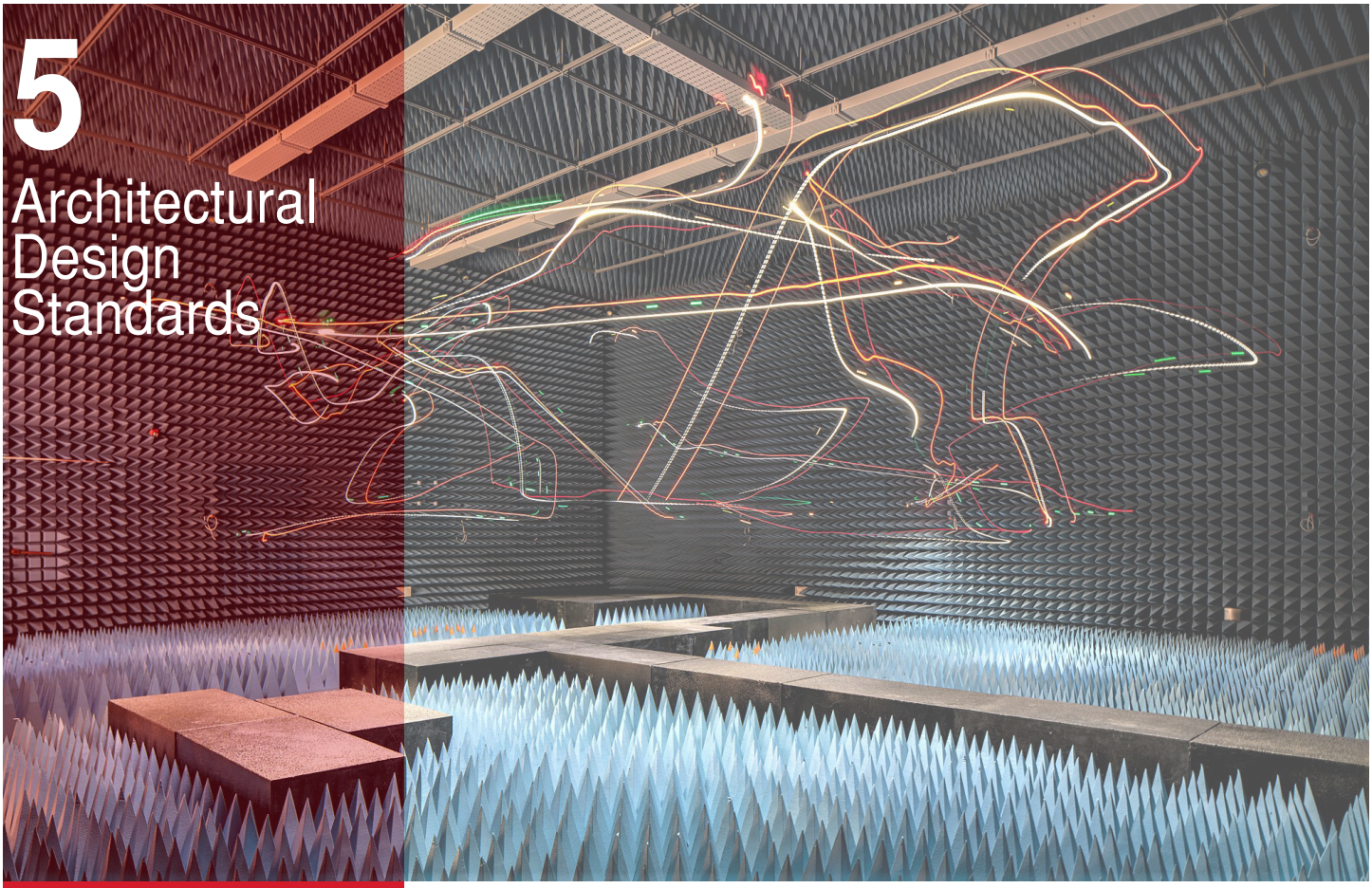
- To be compliant with NU Signage and Graphics guidelines and standards.
- Sign dimensions and positioning should comply with ADA standards.
- To be approved by NU as part of project approvals process.

4.3.6 All signage specifications and shop drawings for new construction and renovation projects should be approved by the Northeastern University Sign Shop prior to fabrication and shall coordinate with their details and standards.

4.3.7 NU Graphic Standards and Tools - Refer to the NU Marketing and Communications website for standards on usage of NU branding and imagery as well as formatting for all media, editing purposes, and academic use.

- NU **Marketing and Communications Guidelines** can also be obtained through the NU Project Manager.

5 Architectural Design Standards



5.0 ARCHITECTURAL DESIGN STANDARDS

The University encourages thoughtful and imaginative design throughout its interior and exterior public spaces in keeping with its philosophical focus on innovation. At the same time, it needs its interior and exterior finishes to be durable, cost effective, readily available and easy to maintain.

Since the University's mission is continuously evolving, interior spaces should be designed with the flexibility to meet various changing needs. For example, small tables that can be combined to form larger assemblies allow rooms to serve multiple functions are preferable to large inflexible pieces of furniture. Spaces that can serve multiple functions should be considered when possible.

As the budget allows, the University is interested in transparency and open spaces whenever possible. This results in interiors that are brighter, more open and facilitate collaboration.

On projects with significant public access, it is likely that the design will require approval by the University"s leadership. Normally, reviews are scheduled near the end of Schematic Design and Design Development. These reviews require coordination with the University"s leadership and may take several weeks to plan. For this reason, advance materials and careful planning with the project manager is vital for success.

5

Architectural Design Standards

Graphics and signage needs to be approved by the University and sufficient time must be planned for this review.

Individual University departments maintain various standards, specifications, and guidelines related to the specific function of their department. This Chapter is intended to provide broad guidelines and, where available, refer the design team to the appropriate source of specifications. This Chapter organization is as follows:

- General considerations for University-wide projects.
- Interior materials preferences and guidelines.
- Specific requirements for various programmed spaces.

Given that the University's environment is consistently evolving and changing, it should be noted that the requirements in this Chapter form a base line for design. Designers should also be aware that spaces should be designed to maximize functional flexibility. A/E must be aware of cost estimating services outlined in the contract.

With cost control being an equally important consideration, these base line standards also provide a structure of minimum requirements for space types including those that relate to the University's space prototype cost benchmarking models with associated anticipated range of costs.

5.1 GENERAL INFORMATION

5.1.1 The following information applies to all University projects and is to be incorporated with the highest level of benefit to the project.

5.2 EQUIPMENT AND TRASH ENCLOSURES

5.2.1 All exterior mechanical and / or electrical equipment shall be screened from view.

5.2.2 This includes rooftop equipment and ground-level equipment. The screening should be adequate to fully cover the equipment from ground level or adjacent building view. Screening shall also be reviewed and accepted by any applicable utility provider.

5.2.3 Trash enclosures shall be provided with each project unless waived by Owner.

5.2.4 Trash enclosures should also be screened from public areas, campus view corridors and building entries. Screening shall be provided from ground level views as well as any adjacent building views.

5.2.5 All enclosures and screenings shall conform to the requirements of the Boston Planning & Development Agency.

5.3 BUILDING / SPACE / ROOM DESIGN GUIDELINES GENERAL REQUIREMENTS

5.3.1 The standards below reflect campus development to date and are in accordance with the University's conventional space requirements as noted by faculty, staff, and enrollment projections. The University is aware that student expectations, technological advances, and changing industry conventions of space utilization will continue to impact these requirements. Northeastern University considers each building and space program to be unique and will evaluate each project on a case-by-case basis.

5.3.2 For reference, examples of the University's cost benchmarking models with drawings are included in the Appendix for office space, a classroom, and a wet lab. The benchmark drawings represent the minimum standards that comprises the referenced space prototype and establish the level of quality expected in such University spaces. This Chapter defines the standards for these prototype spaces as well as general requirements for building common areas and support spaces. It should be noted that space layouts represented in the prototype drawings are not intended to prescribe a design solution, and that specific requirements for every project may vary. Program requirements for all spaces will require further investigation during design. However, as cost control in part rests on understanding minimum design standards, designers should communicate identified program requirements that exceed the minimum requirements.

5.3.3 Consultants shall work with the University to assign space allowances to typical building program elements that are repeated to allow flexibility / consistency with building planning modules for building systems coordination.

5.3.4 Space assignment shall take into consideration future flexibility of space for potential building remodel or re-assignment as well. It is the goal that the minimum necessary space types be used to accomplish project space goals, accommodation of users and required FF&E in a space and provide modular flexibility for future remodel or reimplementation of space as functions and users change.

5.3.5 All programmed areas and assigned spatial layouts and sizes shall be verified with the University's Project Manager during programming and design.

5.4 INTERIORS PREFERENCES

Northeastern University's Office of Planning, Real Estate and Facilities Division encourage creative expression for facility design. The University does have some preferences for interior materials based on lessons learned, operations, and long-term maintenance. Materials used in NU facilities shall be durable and cost effective as well as complementary of the project's overall design intent. Materials shall also meet the requirements established for mechanical and electrical systems in Chapters 6 through 10.

5.4.1 Sustainability - Continuing the commitment to sustainability, NU would like all projects to incorporate as much natural lighting and other passive sustainable design elements as possible within each project. Interior design elements and materials shall complement and, where possible, enhance the experience of these measures. Materials selected shall contribute toward the sustainable design goals. A 0% VOC level is the preferred

standard for all materials, with a maximum of 10% by volume for emissions, and 0% in VOC content for paint, carpet, and adhesives. Regardless of the sustainable design program utilized on the project, specify materials with recycled content. 100% recyclable materials are preferred. Products should meet or exceed minimum requirements for LEED v4 certification contribution of 1 point for BD+C, ID+C, or O+M. This shall apply even if LEED certification is not pursued.

5.4.2 Materials Selection - Interior materials selection for all University projects shall meet or exceed the expectations of the following utilization preferences below.

5.4.3 Materials Installation - Installation of materials and finishing recommendations shall conform with manufacturer recommendations for product warranty.

5.5 FLOORING

Flooring materials shall be durable and attractive. Acceptable materials shall be determined based on the use of the programmed space and department / end user preferences as they relate to the selected project design. Acceptable materials include but are not limited to:

5.5.1 Tile and Sheet Carpeting - Commercial-grade modular carpet tiles. May be either square or rectangular plank, installed using various patterns - such as monolithic, brick, ashlar, quarter-turn, herringbone, basketweave, accent tiles, or mix and match. The use of broadloom carpeting is generally discouraged and should only be specified with approval by the NU Project Manager. When approved, specify commercial performance or high-performance broadloom with either integrated bonded cushion or detached synthetic rubber or urethane carpet cushion.

- **Physical Characteristics:**
  - *Appearance: Tufted loop-pile - patterned carpet preferred for spill/spot hiding ability.*
  - *Tile Sizes: 24"x 24" or 12" x 36", similar plank sizes, as required.*
  - *Broadloom Width: Minimum 12 ft. roll goods.*
  - *Material: 100% Solution-dyed, 100% first quality, type "6,6" or "6" bulk continuous filament nylon.*
  - *Tufted Pile Weight: Minimum 20 oz./sq. yd.*
  - *Gauge: Minimum 1/10.*
  - *Average Pile Yarn Density (APYD): Minimum 6,000 oz./cubic yard.*
  - *Finished Pile Thickness: Maximum 1/2" (per ADA requirements).*
  - *Primary Backing: Woven synthetic.*
  - *Secondary Backing: Moisture impervious reinforced thermoplastic or open / closed cell polymeric cushion bonded integral backing. Open-cell cushion is permeable and can provide an increased level of moisture-mitigation.*
  - *Detached Carpet Cushion/ Pad (for Broadloom): High density cushion. Cushion thickness should not exceed 3/8". Detached cushion/tackless installation approval required by NU Project Manager.*
  - *Broadloom Seams: Heat-welded.*

- *Texture Appearance Retention Rating (TARR) Area Guidelines: Moderate Use (≥ 2.5 TARR), Heavy Use (≥ 3.0 TARR), Severe Use (≥ 3.5 TARR):*
- *Adhesive: Adhesive is the only acceptable method of installation.*

- **Performance Standards:**
  - *Reference Standard: CRI (Carpet and Rug Institute) Carpet Testing Program*
  - *Fire/Flammability and Smoke Testing: ASTM E648, ASTM E662, 16 CFR 1630 and/or ASTM D2859, ASTM E84.*
  - *Static Resistance: AATCC 134*
  - *Delamination Resistance: ASTM D3936*
  - *Stain Resistance (GSA Standard): AATCC 175, Must rate no less than 8.0 on AATCC Red 40 Stain Scale (10.0 is best)*
- **Warranties:** Minimum 15-year commercial warranty.
- **Acceptable Manufacturers**: LEES Carpet / Mohawk Carpet, or equal approved by the NU Project Manager.

5.5.2 Resilient Flooring - Resilient flooring is typically utilized due to the benefits of durability, cost effectiveness, stain resistance, water resistance, chemical resistance, electrical charge resistance, sound absorption, sustainability, and ease of maintenance. Resilient flooring offers multitudes of color, pattern, and design choices. Material composition and sizing varies greatly. Many products are composed of recycled content and / or rapidly renewable resources.

- Flooring materials to be used should be confirmed with the NU Project Manager during the design process. Acceptable forms of resilient flooring materials include, but are not limited to:
  - *Vinyl Sheet Flooring*
  - *Vinyl Tile Flooring*
  - *Vinyl Composition Tile*
  - *Linoleum*
  - *Rubber Sheet Flooring*
  - *Rubber Tile Flooring*
- For laboratory spaces, otherwise, provide surfaces with chemical, static, microbial, or other resistance, based on program, use, and equipment requirements.
- Adhesives must be manufacturer-approved for the installation on project substrate. Test flooring substrate moisture content and alkalinity in accordance with the flooring/ adhesive manufacturers recommendations. Flooring substrate preparation shall be per ASTM F710 and the flooring/ adhesive manufacturers recommendations.

5.5.3 Performance Requirements for Resilient Flooring - Performance requirements for

each type of resilient flooring are provided in the sections that follow. Basic performance requirements for resilient flooring are as follows:

- Fire/Flammability and Smoke Testing: Class I ASTM E648, ASTM E662
- Slip Resistance: ASTM D2047
- Office Chair Castor Resistance: ISO 4918

5.5.4 Vinyl Sheet Flooring - Commercial Resilient Vinyl Sheet Floor Covering with Backing.

- **Physical Characteristics:**
  - *Total Thickness: Minimum 0.080".*
  - *Wear Layer Thickness: Minimum 0.02". Minimum 0.04" for high traffic areas.*
  - *Sheet Width: Minimum 6 ft., 12 ft. width preferred.*
  - *Seam Sealing: Heat weld seams.*
- Performance Standard: Reference specification (with backing): ASTM F1303, Type 1, Grade 1, Backing type as appropriate for substrate
- Warranties: Minimum 5-year commercial warranty.

5.5.5 Vinyl Tile Flooring (LVT and LVP) - Heterogeneous (multi-layered) luxury vinyl tile.

- **Physical Characteristics:**
  - *Total Thickness: Minimum 0.10".*
  - *Wear Layer Thickness: Minimum 0.02".*
  - *Tile Size: Square or rectangular plank as available from the manufacturer.*
- Performance Standards: Reference Specification: ASTM F1700, Luxury Vinyl Tile, Class III, Type B
- Warranties: Minimum 5-year commercial warranty.

5.5.6 Vinyl Composition Tile Flooring (VCT) - Tile composed of polyvinyl chloride resin, plasticizers, fillers, stabilizers and pigments with colors and texture dispersed uniformly throughout its entire thickness.

- **Physical Characteristics:**
  - *Total Thickness: Minimum 1/8".*
  - *Wear Layer Thickness: Entire product thickness.*
  - *Tile Size: Minimum 12" x 12".*
- Performance Standard: Reference Specification: ASTM F1066, Standard Specification for Vinyl Composition Floor Tile, Class 2, Through-Pattern
- Warranties: Minimum 5-year commercial warranty.

5.5.7 Linoleum Sheet Flooring

- **Physical Characteristics:**
  - *Total Thickness: Minimum 0.10".*
  - *Wear Layer Thickness: Entire product thickness.*
  - *Sheet Width: 79".*
- Performance Standard: Reference Specification: ASTM F2034, Standard Specification for Linoleum Sheet Floor Covering
- Warranties: Minimum 5-year commercial warranty.

5.5.8 Rubber Sheet Flooring - Homogeneous thermoset rubber sheet flooring without backing. Smooth profile.

- **Physical Characteristics:**
  - *Total Thickness: Minimum 0.12".*
  - *Wear Layer Thickness: Entire product thickness.*
  - *Sheet Width: 4 ft.*
  - *Seam Sealing: Seamless installation. Cold welding not required, but may be advisable in labs, where there are hygienic requirements, or in a frequently wet environment.*
- Performance Standard: Reference Specification: ASTM F1859 Standard Specification for Rubber Sheet Floor Covering Without Backing, Type 1
- Warranties: Minimum 5-year commercial warranty.

5.5.9 Rubber Tile Flooring - Vulcanized homogeneous rubber compound tile flooring.

- **Physical Characteristics:**
  - *Total Thickness: Minimum 0.118".*
  - *Wear Layer Thickness: Entire product thickness.*
  - *Tile size: 24" x 24" minimum if square, or plank size as available from manufacturer*
  - *Seam Sealing: Seamless installation. Cold welding not required, but may be advisable in labs, where there are hygienic requirements, or in a frequently wet environment.*
- Performance Standard: Reference Specification: ASTM F1344, Standard Specification for Rubber Floor Tile, Class 1, Types 1A (Solid Color) and 1B (Through-Mottled Colors)
- Warranties: Minimum 5-year commercial warranty.

5.5.10 Hard Flooring Surfaces - Hard flooring surfaces are reserved for high traffic areas and spaces that require maximum durability due to presence of water, chemicals, and

constant use. Hard flooring can also be used as a design feature for the specific design intent of the project or space. Acceptable hard flooring materials include, but are not limited to:

- **Porcelain or Ceramic Floor Tile**: Ceramic, porcelain glazed, gauged porcelain tiles (GPT), and gauged porcelain tile panels (GPTP) for floors, including thick or thin-set mortar, membranes, grout, and accessories.
  - *Basis of Design: Grade 1 Ceramic or Porcelain Tile. Large format (GPT/ GPTP) porcelain tiles, planks, panels, and slabs may be considered for inclusion in designs for floors, where appropriate - particularly for public areas, such as lobbies, libraries, etc.*
  - *Finish: Glazed or matte, unless otherwise directed.*
  - *Durability (Abrasion Resistance): PEI Heavy Commercial Abrasion Class V in high-traffic public areas*
  - *Maintenance: Stain Class A. Chemical Class A.*
  - *Grout: Use manufacturer's recommended grout for the tile product and joint dimensions. Consider grout sealer where appropriate.*
  - *Provide crack isolation membranes where cracks exist in concrete slabs, at control joints, and for large format tiles.*
  - *Provide a commercial grade waterproofing system for floors in wet areas and/ or in areas with floor drains.*
- **Alternative Hard Flooring Surfaces**: The following flooring materials will also be considered, as appropriate pending project requirements:
  - *Terrazzo*
  - *Concrete*
  - *Stone Flooring*
  - *Hardwood Flooring*
- **Applied Flooring Surfaces**
  - *It is often necessary for budget or programming requirements to simply coat or re-coat a flooring surface. This is typically done for slip resistance, chemical resistance, and extreme ease of maintenance and most often occurs in spaces that are not generally within the public realm. Acceptable hard flooring materials include, but are not limited to:*

    Sealed Concrete
    Stained Concrete
    Epoxy Coating
    Resinous Flooring

5.6 WALLS

Wall covering and decorative materials shall be durable and attractive. Acceptable materials shall be determined based on the use of the programmed space and department / end user preferences as they relate to the selected project design.

5.6.1 - Typically, the University uses paint as a decorative surface treatment. Other materials may be considered based on programmatic requirements and needs for durability such as the presence of water and chemicals. Acceptable materials and usage preferences include, but are not limited to:

5.6.2 Paint

- Basis of Design: Eggshell finish is preferred for all NU wall surfaces unless otherwise required to suit design intentions. Paint systems specifications shall be determined by the need for appropriate applications for project components. Semi-gloss shall be the standard for doors and door frames unless otherwise required to suit design intentions.
- Drywall surfaces in public areas and areas to be occupied full time by faculty and or students, and that will be receiving eggshell or semi-gloss paint, shall be specified to have a Level 4 or higher smoothness and quality prior to application. In locations where vinyl graphics will be applied, a Level 5 finish shall be provided.
- New Construction: Provide primer plus minimum two coats on painted surfaces.
- Repaint and Touch-up (including summer dorm upgrades): Patch and sand blemishes, holes until non-visible. Provide a minimum of two coats. Paint types and colors will, as much as feasible, match existing.
- Existing or historical unpainted masonry or concrete must be evaluated by Northeastern Project Management and pre-approved for painting.

5.6.3 Porcelain or Ceramic Wall Tile - Ceramic, porcelain glazed, or gauged porcelain tiles (GPT) for walls, including thin-set mortar, grout, and accessories.

- The University requires that typical wall treatment installations in restrooms / bathrooms, locker rooms, and similar "wet" spaces include ceramic and / or porcelain tile. A range of sizes, styles, and colors for field tiles are acceptable. Accents that include glass, metal, and stone shall be reviewed as part of the proposed design scheme.
- Basis of Design: Grade 1 Ceramic or Porcelain Tile.
- Acceptable Manufacturers: Daltile, Crossville, or equal approved by the NU Project Manager.
- Finish: Glazed or matte, unless otherwise directed, and as appropriates for the application.
- Grout: Use manufacturer's recommended grout for the tile product and joint dimensions.
- Provide appropriate wall tile trims and edging as part of the design scheme to avoid exposed unfinished / unsealed edges of tile.

5.6.4 Specialty Wall Treatments

- Specialty wall treatments and accents will be considered on a case-by-case basis. Any suggested materials shall be durable, cost effective, and easily maintained. Specialty materials shall carry a Class A fire rating or otherwise be approved by governing agency before use.

5.7 WALL BASE

5.7.1 Basis of Design - Rubber or vinyl Wall Base with cove profile for easy maintenance shall be the primary basis of design for NU projects. Specialty profiles may be considered as part of project design.

- Acceptable Materials:
  - *A. Thermoset Rubber Wall Base (TS).*
  - *B. Thermoplastic Rubber Wall Base (TP).*
  - *C. Thermoplastic Vinyl Wall Base (TV).*
- Profiles: Coved (Toe) profile, hard floor. Straight (Toeless) profile, carpeted floor.
- Total Thickness: 1/8"
- Height: 4" (or as required).
- Length: Use only coil stock, not pieces.
- Performance Standards:
  - *Reference Specification: ASTM F1861*
  - *Flexibility: ASTM F137*
- Warranties: Minimum 5-year commercial warranty.

5.7.2 Alternate Acceptable Wall Base Suggestions - Tile and Wood

- Tile wall base may be used in wet locations such as restrooms, bathrooms, locker rooms, etc., or where ceramic or porcelain floor tile is used.
- Wood Base may be used in administrative areas or areas of high importance and low volumes of traffic such as offices and conference rooms. Wood shall be appropriately painted or sealed to ensure durability.

5.8 CEILINGS

5.8.1 In general materials shall allow access to plenum spaces, light fixtures, mechanical equipment, etc. as required per project design. Acceptable materials include but are not limited to:

5.8.2 Lay-in Ceiling System - Commercial-grade acoustical ceiling tiles in exposed suspension metal grid systems.

- In most spaces, the University prefers a lay-in ceiling system of acoustical tiles. The exact style of design will be determined by the programmatic need. Optimizing

material light reflectance and noise ratio requirements should be a consideration.

- In addition to acoustical ceiling tiles (ACT), lay-in materials may include tiles specially designed for laboratory spaces, or decorative tiles such as metal, wood, or another pattern. Selection to be determined with NU PM during design development.
- Basis of Design: 2'x2' Acoustical Ceiling Tile, mineral-fiber and/or bio-based, with factory applied paint finish. Washable and chemical/stain resistant. Fiberglass is not acceptable unless approved by the NU Project Manager.
    - *Moisture Resistant Applications: Mineral fiber bonded with ceramic, moisture-resistant thermo-setting resin, or other moisture-resistant material, and having a factory-applied paint finish*
- Acceptable Manufacturers: Products of USG, Armstrong, or equal approved by the NU Project Manager.
- Finish: Generally fine textured. Special/upgraded finishes to address chemical, static, microbial, or other resistance, other as required based on program and use requirements.
- Suspension Grid: Color-coordinated, exposed metal grid system. Hot-dip galvanized steel grid system for general use areas. Use a stainless steel or aluminum grid system appropriate for the application in high-humidity environments, such as laboratories, food-preparation areas, and locker rooms.
- Performance Standards:
    - *Noise Reduction Coefficient (NRC) Rating: Optimize to suite the application, or as required by project.*
    - *Ceiling Attenuation Class (CAC) Rating: 35 or higher*
    - *Light Reflectance (LR) Value: .80 or higher.*
    - *Fire Performance: Minimum Class A.*
    - *Durability of Ceiling Tiles: Sag-resistant, mold/mildew resistant, impact-resistant, and scratch-resistant*

5.8.3 Drywall Ceiling / Drywall Suspension System - Drywall ceilings may be considered in spaces where access to utilities is not a concern. Drywall ceilings may also be a part of existing buildings. Finishes of these ceilings shall be Level 4 or greater in smoothness and shall be painted with a flat finish ceiling paint.

- Hard ceilings shall contain secured but accessible access panels for service of utilities that are contained within ceiling above. The locations and sizes of access panels shall be coordinated with NU Commissioning, through the NU Project Manager.

5.8.4 Specialty Ceiling System - NU does not have a basis of design or preferred manufacturer for specialty ceilings. Such systems shall be determined by the proposed

project design scheme. Specialty systems shall be durable, easy to maintain, and allow access as needed to ceiling fixtures, structure, support, electrical, mechanical, and other items within the system, exposed above the ceiling or concealed within the plenum space.

5.9 DOORS

5.9.1 Basis of Design / Preferred Material - Solid Core Wood Stain Grade Doors are the preferred door for public areas when appropriate.

5.9.2 Alternates: Metal Doors - for use as appropriate for programmed space and / or building design and for roll-up doors at garage and loading areas. Metal doors shall also be used for projects or spaces that need to achieve a higher fire rating.

- Hollow Metal Doors: Commercial quality, level, cold-rolled steel conforming to ASTM A-366 and free of scale, pitting or other surface defects.

5.9.3 Lites and Side Lites:

- Doors for public rooms and corridors other than doors specified for fire separation purposes shall contain a lite within the door to allow for visibility to adjoining spaces. Lites provided in fire rated doors shall meet the rating requirements of the wall/door assembly.
- All Classroom doors shall have a lite or side lite.
- Doors for residential spaces shall not contain lites within.
- Doors integrated within window systems and are abutted by side lites shall only contain lites if desired by end user or as part of particular design scheme.
- Lites and side lites for doors designated for higher fire ratings shall be sized appropriately per required codes.

5.10 DOOR HARDWARE

5.10.1 The University's Door Hardware and Locking Standards are as follows:

- Stanley Best 93K Series Heavy Duty Cylindrical Locks/ Series 16 Levers
- Stanley Best Small Format Interchangeable Core (SFIC) Locks, 1C-7 pin
- CBORD CS Gold Online Access Control System
- Schlage AD-400 Wireless Electronic Cylindrical Locks (Online Applications) - Note a 5" minimum door style/ trim is required to accommodate this lock
- Stanley Best Keypad EZ Cylindrical Locks (Offline Applications)- Note a 5" minimum door style/ trim is required to accommodate this lock
- Allegion LCN 4040XP Series Door Closers
- Allegion LCN Senior Swing Series ADA Automatic Door Operators
- Allegion Von Duprin 99 Exit Devices

5.10.2 The specific requirements and performance standards for all remaining door

hardware necessary for the project should be reviewed and confirmed with the NU Project Manager.

5.10.3 Coordinate hardware requirements and lock functions with security requirements of NUPD for all departments and access, through the NU Project Manager.

5.10.4 The specific requirements and performance standards for all remaining door hardware necessary for the project should be reviewed and confirmed with the NU Project Manager

5.11 WINDOW TREATMENTS

5.11.1 Basis of Design / **Preferred Material** - Hand operable, fabric screen roller shade such as Mechoshade or approved equal for all spaces where appropriate. Such shades provide maximum protection with maintenance of view and visual connection to outside environment. Color to be coordinated with project design intent.

- Shade Type: Light-filtering.
- Openness Factor - As appropriate for the project program requirements
  - *10% or over - Sheer shades. Reduced glare and reveals considerable detail.*
  - *3% -5% - Translucent shades. Softens light and reveals some details to outside. Provides moderate privacy.*
  - *1% or less - Privacy shades. Softens light. Reveals shadow-like outlines to outside. Provides substantial privacy.*
- Material Composition:
  - *PVC coated polyester yarns.*
  - *100% polyester.*
  - *100% TPO coated polyolefin yarn.*
  - *Polyester with acrylic backing.*
  - *Fiberglass with acrylic backing.*
  - *Vinyl coated fabric.*
- Provide motorized shades where required by the project program requirements
- Acceptable Manufacturers: MechoShade Systems, or equal approved by the NU Project Manager.

5.11.2 Alternates - Aluminum horizontal blinds, hand operable, such as Hunter Douglass or approved equal. Color to be coordinated with project design intent.

5.11.3 Provide specialty shades such as black-out shades in media centric spaces, or automated systems as program dictates.

5.12 TRASH AND RECYCLING STATIONS

5.12.1 The University uses a standardized three-bin trash and recycling station. The stations are located in lobbies, and corridors, and other building common areas. The typical station is provided in standardized colors, with graphics and pictorial decals which identify the trash, paper, and recyclables receptacles. The stations are purchased by the University.

5.12.2 The standard three-bin station is the Black Tie Kaleidoscope XL (extra large) Square Three-Stream Recycling Station, consisting of the following:

- Trash - 36 Gallon capacity, 18.25" wide (deep) x 18.25" long x 35.5" high.
- Paper - 36 Gallon capacity, 18.25" wide (deep) x 18.25" long x 35.5" high.
- Recyclables - 36 Gallon capacity, 18.25" wide (deep) x 18.25" long x 35.5" high.
- Overall dimensions - 18.25" wide (deep) x 54.75" long x 35.5" high

5.12.3 In locations where space is confined or options for placement are limited, the basic size Black Tie Kaleidoscope Square Three-Stream Recycling Station may be used, consisting of the following:

- Trash - 24 Gallon capacity, 15.75" wide (deep) x 15.75" long x 30" high.
- Paper - 24 Gallon capacity, 15.75" wide (deep) x 15.75" long x 30" high.
- Recyclables - 24 Gallon capacity, 15.75" wide (deep) x 15.75" long x 30' high.
- Overall dimensions - 15.75" wide (deep) x 47.25" long x 30" high

5.12.4 In some cases, the number of receptacles in the station may vary to suite the space or function. A single paper recycling bin may be used adjacent to printers/ copiers, or a paper recycling bin may be added to the standard three-bin station in an area where more paper recycling is anticipated. Stations in dining and food service areas may not incorporate a paper recycling bin. Confirm any unique requirements during the design phase.

5.12.5 Avoid locating stations below or adjacent to wall mounted monitors, digital messaging boards, plaques, etc., or where obscuring signage, display cases or bulletin boards. Locations of the stations should allow barrier free access. Placement of the stations should not impede or restrict means of egress.

5.12.6 Designers are responsible for considering space for the trash and recycling stations during the design phase, and for coordinating designated approved locations through the NU Project Manager.

5.13 ACOUSTIC DESIGN

5.13.1 Acoustic requirements of a space are impacted by the intended use of the space and the building construction and the completed finishes. Each shall be incorporated to achieve appropriate levels of design within the project spaces.

5.13.2 Each space shall achieve or exceed a minimal level of acoustic comfort based on

the following table for the transmission of sound for people talking. This chart gives guidelines for the expected effect on the space on the other side of a partition with a given STC rating, for common space types. Minimum STC ratings shall also meet any applicable code requirements.

STC	DESIRED SPEECH BLOCKING EFFECT	SPACES
20 - 25	Quiet speech is audible	Not applicable
25 - 30	Ordinary speech is audible and intelligible	Separations between storage rooms, utility rooms and closets
30 - 35	Loud speech is audible and intelligible	Separation of work and support spaces where acoustical privacy is not a primary concern
35 - 40	Loud speech is heard but is rarely intelligible	Separations between lobbies and corridors, general office areas, accessory spaces within labs and shops
40 -50	Loud speech can be heard, faintly	Offices, conference rooms, meeting rooms, classrooms, labs, toilet rooms, residential
50 - 60	Loud sounds can barely be heard	Performance and music spaces, recreation spaces, kitchens, shop spaces, offices and conference rooms requiring extra privacy, counseling rooms, spaces within libraries, residential dwelling unit separations, mechanical equipment rooms

5.13.3 Consultant shall incorporate noise control information as part of all project documentation and building detailing.

5.14 SPECIFIC SPACE REQUIREMENTS

Below are a series of specific requirements for spaces typically programmed into facilities at University. These requirements are intended to highlight major points / elements and items relative to the design, performance, and construction of these spaces. Specific project programming information may supplement these requirements. Additionally, spaces may exist in project programs that are not specifically addressed in these standards where supplemental program data may provide information for these spaces. These standards are to be used in guidance for design, construction, and performance of these spaces, and as general information for typical Northeastern University requirements.

5.14.1 Offices and Administrative Areas, and Computational Labs

- Indirect lighting is preferred for artificial light.

- Show data and power locations on plans. Provide 4 outlets minimum per workstation, below the desk, with 1 duplex outlet next to the NUnet Quad Box and a separate duplex outlet with two USB ports placed at a reasonable distance from the quadruplex, allowing convenient power access throughout the workstation.
- Provide acoustical privacy in private offices. Preferable methods are through insulated walls and ceiling tiles / surfaces. Insulated / finished walls to bottom of deck may be used as well. Consideration of measures of acoustical privacy relative to building systems shall be considered as well (i.e., HVAC provisions and other.) Provisions for acoustical privacy shall have special consideration and measures (i.e., insulated and finished walls to bottom of deck, other measures to meet performance criteria) at areas of high acoustical privacy, i.e., counseling rooms, HIPAA compliant spaces, spaces where matters of high privacy are discussed, etc.
- **Office Prototype Standards:** The University has developed a cost benchmark model for Office space. The benchmark is based on an office prototype which includes specific features and requirements which comprise the space standards. The standards have been implemented across the University and define minimum expectations. Any project requirements that exceed the basic standards should be identified by the designer during the design phase and need to have prior approval by the NU Project Manager before being integrated into program requirements and implemented. The Benchmark standards, information and selective drawings are included in the Appendix for reference.

5.14.2 Classrooms / Academic Facilities (Class Dry Labs / Computer Labs and Similar Spaces)

- General: Below are some general guidelines to support the requirements of these spaces that are subject to refinement, validation and further definition based on the specific function, requirements, and activities of a particular space.
- Coordinate with University Project Manager and ITS Department for system requirements and parameters. Typical systems can include visual systems/ projection, audio systems, lecterns, and other considerations to support classroom use. Audio-visual systems and their performance are to be coordinated with building services, acoustical, lighting, window treatments and other systems.
- Sloped floors in classrooms may need to be provided where size and configuration requires a sloped floor for sight-lines and classroom function subject to program verification.
- **Classroom Prototype Standards:** The University has developed a cost benchmark model for Classroom space. -The benchmark is based on a classroom prototype which includes specific features and requirements which comprise the space standards. The standards have been implemented across the University and define minimum expectations. Any project requirements that exceed the basic standards should be identified by the designer during the design phase and need to have prior approval by the NU Project Manager before being integrated into program requirements and implemented. The Benchmark standards, information and selective drawings are included in the Appendix for reference.

5.14.3 Wet Labs (Including Research, Teaching and other Wet Labs and Associated Spaces)

- The University has a desire to deploy open lab and shared lab concepts wherever practical to allow for maximum flexibility in use of the space.
- At the earliest stage of design, a formal equipment list is required from the PM that identifies all equipment (by make and model) that will be installed or operated in the lab. This will inform the design and layout of the space for all disciplines and systems.
- Laboratory design and layout shall be reviewed by and receive approval from Environmental Health and Safety. The University's Environmental Health and Safety Standards for Labs include the following:
  - *Laboratory Ventilation: ANSI/ASSP Z9.5*
  - *Chemical Hood Commissioning: ASHRAE 100*
  - *Constant Air Volume (CAV) Hoods:*
    - *The containment test measured at ≤ 0.10 ppm as installed (AI) would be considered acceptable, as set by the AIHA/ANSI Z9.5.*
    - *Target face velocity of 80 fpm +10/-0 (vertical) at operational height and target face velocity of 100 fpm +10/-0 (horizontal). Passing the containment test at 0.1 As Installed (AI) would be considered acceptable.*
  - *Variable Air Volume (VAV) Hoods:*
    - *The containment test measured at ≤ 0.10 ppm as installed (AI) would be considered acceptable, as set by the AIHA/ANSI Z9.5.*
    - *Target face velocity of 100 fpm +10/-0 (vertical) at operational height. Passing the containment test at 0.1 AI would be considered acceptable.*
    - *Where a high-performance low flow VAV hood is provided (Kewanee Venturi or equal approved by NU) the University may accept a face velocity calibration of 80fpm+10/-0.*
  - *Fume Hood Sash Stops: Sash stops should be provided on all hoods. Sash operating height should be confirmed with NU Environmental Health and Safety.*
  - *Fume Hood Location: Hoods should not be located near doors where moving occupants may cause air turbulence that affects the performance of the hood. Consideration should also be given to the locations of HVAC diffusers which can likewise affect hood performance.*
  - *Emergency Eyewash/Safety Showers: ANSI Z.3581. In addition to the requirements of this standard, the University requires all emergency eyewash/ safety showers to be designed and installed in a way that allows easy testing. Consideration should be given to space requirements for a bucket or collection device*

- *All emergency eyewashes/safety showers shall be flushed and checked for copper or other debris from construction. This should be done by the contractor prior to substantial competition and installation of signage.*
- *Guardian brand eyewashes/safety showers with an extra filter at the discharge nozzles to catch debris (or equal approved by NU) are the standard.*

- *Laboratory hand washing sinks should allow hands free operation with foot pedal controls*
  - *Provide faucet with discharge aerator.*
  - *Provide paper towel and soap dispensers in direct proximity of the sink.*
- *Lab sinks that allow hands free operation with foot pedal controls should be provided in all BSL-2 labs and are strongly recommended for all other wet labs.*
- *Chemical Storage Cabinets: Storage cabinets for flammables, acids & bases, controlled substances, acutely hazardous materials should be provided in all labs. In general, a flammables storage cabinet and corrosives cabinet should be provided below the hood(s). Where this is not possible, space should be provided for standalone cabinets.*
  - *Corrosive cabinets which contain chemicals with strong odors should be vented.*
  - *A lock box should be provided in labs where controlled substances and acutely hazardous materials are used.*
- *Radioactive and biological material storage requirements should be confirmed through the NU Project Manager, as it applies to the project.*
- *Laser Labs: ANSI Z136.5. Confirm specific requirements through the NU Project Manager*
- *Biological Safety Cabinets: NSF 49. Confirm biological safety cabinet types, features and commissioning requirements through the NU Project Manager.*
- *Gas Detection & Alarms: Confirm standard requirements and installation procedures through the NU Project Manager.*
- *Research Gases; Storage, Placement, & Pipeline Distribution: Conform to the Massachusetts Building Code for maximum allowable quantities for special gases, flammables, oxidizers, etc. Use gas storage cabinets when required.*
  - *Flammable gases and oxidizing gases must be separated by at least 20 ft. and per code. If this is not possible a gas cabinet will need to be provided, if approved by NU Environmental Health and Safety.*
  - *Toxic gases must be stored in a gas cabinet.*
- *Laboratory Door Sign: Each laboratory is required to have a NFPA door sign posted prominently for use during emergency situations. This NFPA door sign identifies emergency contacts for that space and hazard information*

that emergency responders can use. The sign holder should be provided as part the construction project. Confirm the sign holder design and dimensions through the NU Project Manager.

- *Hazardous Waste Collection and Storage: Each lab requires designated space for a satellite accumulation area (SAA) for collection of flammable chemical waste, and incompatible chemical wastes that need to be separated and stored in containers or cabinets. Space requirements should be determined during the design phase and approved by NU Environmental Health and Safety.*
- *Freezer Security and Temperature Alarms: Comply with Reese Scientific alarm systems for freezers that contain sensitive research. Equipment must be compatible with their alarm systems.*

- General: Wet Labs may be unique and custom designed to support the activities and research that occur within. It is typical that wet labs will have unique requirements accordingly, and special needs for fixed furniture, equipment, building services (i.e., power, water, RO / DI water, data, gas, compressed air, vacuum, and other services), shielding, vibration tolerances, EMI resistance / levels, HVAC service / tolerances / redundancy, access control, structural requirements and other features. Below are some general guidelines to support the requirements of wet labs that are subject to refinement, validation, and further definition based on the specific function, requirements, and activities of a particular wet lab.
- Floor / Base Finish: seamless surface, chemical, static, microbial, or other resistance, other as required based on program, use, equipment requirements.
- Walls: Paint - Semi-gloss, min. Special / upgraded finishes to address chemical, static, microbial, or other resistance, shielding requirements, or other as required based on program, use, and equipment requirements.
- Ceilings: Provide washable and chemical / stain resistant acoustical ceiling tile treatment - 2' x 2' lay-in. Special / upgraded finishes to address chemical, static, microbial, or other resistance, other as required based on program, use, and equipment requirements. Painted exposed structure ceilings may also be considered.
- Casework: Provide AWI Premium grade casework in laboratories which includes the following:
  - *Five knuckle exposed hinges.*
  - *Solid wood drawer sides.*
  - *Plywood drawer bottoms with chemical resistant finish.*
  - *150 lb. drawer guides with return.*
  - *Solid epoxy resin tops.*
  - *Chemical resistant plastic laminate shelving.*
  - *Under cabinet light, where approved.*
- Loose Furniture: Provide washable and chemical / stain resistant fabrics and finishes for all furniture within wet lab spaces.

- Provide all building services (HVAC, power, water, RO / DI water, data, gas, compressed air, vacuum, and other services) to support space use and to support equipment to be used in the space.
- Shielding: Provide shielding from electrical interference (EMI, RF and other types) or to contain any radioactivity or other items / activities requiring containment in the space (e.g., shielded walls), to support the operational requirements of equipment and activities in wet labs.
- Vibration Resistance / Tolerances: Ensure vibration tolerances are met for equipment / instrumentation operation and to support research activities.
- Special Considerations:
  - *Consider donor signage potentials and special signage for functional or warning purposes in design.*
  - *Plan wet labs on a modular basis to work with furniture and equipment.*
  - *Design with modularity to allow for future flexibility in space use, arrangement, assignment and provisions for furniture and equipment. This applies to many items in the wet lab design (structural bays, layout of bench and equipment areas, design of benches and their modularity/ adjustability (layout, height, etc.) and other considerations.*
  - *Lockable storage in furniture, equipment, and built-in casework should be provided based on the user needs.*
  - *Management and disposal of biohazards must be addressed, per the requirements of the operations needs of clinical facilities.*
  - *Provide analysis of and provision for any chemical storage and use provisions (fire separations / ratings, control areas, maximum allowable chemical storage, etc.)*
  - *Provide for and coordinate all lab safety provisions and requirements.*
  - *Provide eye-wash, emergency shower, and other safety equipment in appropriate locations within the lab where chemicals, fluids, pathogen carrying materials or other such items or activities warrant safety equipment and provisions.*
- **Wet Lab Prototype Standards:** The University has developed a cost benchmark model for a Wet Lab space. The benchmark is based on a wet lab prototype which includes specific features and requirements which comprise the space standards. The standards have been implemented across the University and define minimum expectations. Any project requirements that exceed the basic standards should be identified by the designer during the design phase and need to have prior approval by the NU Project Manager before being integrated into program requirements and implemented. The Benchmark standards, information and selective drawings are included in the Appendix for reference.

5.14.4 Lobbies

- Main entries should have vestibules with built-in recessed walk-off mats in accordance with LEED or sustainable design best practices. The walk-off mat should be provided the full width of the vestibule, a minimum of 10 feet in length in the direction of travel, and scaled to the space.
- Lobbies should have direct access to toilet rooms that are visually screened.
- Wayfinding: Provide building directories, wayfinding / directional signage, code required signage (exiting, accessibility, and other), and other signage in the construction budget. Building directories should be dynamic electronic signage wherever possible for new construction and renovated facilities. Signage that can be easily revised by the University sign shop should otherwise be provided.
- Provide a building directory in the main lobby and secondary entries as suitable. Discuss with the Project Manager, the option of incorporating a monitor display digital directory as opposed to conventional signage that requires manual updating.
- Stairs should be visible from the lobby and identified with appropriate and required signage.
- Passenger elevators should be convenient for the lobby and well signed for accessibility. Elevator finishes should be determined in accordance with the level of finishes selected for the entire building.
- Provide a location for University designated trash and recycling receptacles that is conveniently located within the typical path of travel to ensure visibility and use. See section 5.12 above for trash and recycling station information and requirements.
- Elements that should be considered when designing lobbies: donor wall, seating, screened trash / recycling receptacles, data and power for lobby users, campus phone, upgraded finishes for appearance and durability, monitors for building, information, specialty lighting, reception or security counter, natural lighting, display cases, bulletin boards, visibility and / or connectivity to circulation, and vehicle / bicycle parking.
- Additional potential areas near the lobby: concession area, and vending area.
- Preferred Finish Materials: Hard flooring material, lay-in acoustical ceiling tile or specialty ceiling system.

5.14.5 Audio / Visual Guidance

- Special consideration must be given to spaces with audio / visual program components. Consultant shall coordinate closely with University IT and Facilities for power requirements for AV equipment provided by the University.

5.14.6 ITS Closets

- NU ITS department to be engaged at earliest stages of on-going projects to ensure exchange and integration of most current requirements and preferences to suit needs of proposed project to be successfully integrated into campus environment.

5.14.7 Toilet Rooms

- In addition to all public restrooms required by code, each University facility shall include (whenever possible as part of a major renovation / expansion and required in new facilities), at least (1) one gender neutral restroom. This room shall comply with all applicable codes and standards for a single occupancy public restroom.
- Sight lines should screen the toilet room interior from public view.
- Floors to be of a durable material; easy to maintain. Consisting of ceramic or porcelain tile unless otherwise required.
- Walls and wall base to be of a durable material such as tile, to coordinate with wall and floor finishes.
- Provide at least one floor drain per toilet room and slope the floor to the drain.
- Ceiling hung toilet partitions (supported from the structure above the ceiling) are preferred. Floor mounted toilet partitions are acceptable if structural or budgetary constraints prevent the use of ceiling mounted partitions. Structural requirements for support of ceiling mounted partitions must be determined by the designer. Partition material should be solid surface. Solid core, such as phenolic resin, can be used as a lower cost alternative, and is to be approved by University Project Manager. No metal or painted metal partitions should be specified.
- Countertop material to be solid surface or durable stone surface for long term ease of maintenance.
- Toilet room accessories - Northeastern Facilities Building Services will provide accessories for toilet rooms, for installation by the contractor. Accessories provided by the University include the following:
  - *Hands free soap dispensers - SC Johnson TF Ultra TouchFREE Dispenser. The dispenser is ADA compliant with dimensions of 6.7" wide x 4.0" deep x 10.9" high. Ensure that the unit is located with adequate space to each side and below. Recommended space below the unit is 8" to 12". The dispenser is typically wall mounted, although sometimes mounted to a stand to suite conditions. The dispenser is battery powered, and an electrical power connection is not required.*
  - *Hands free paper towel dispensers - Tork Touch-Free Auto Transfer Hand Towel Roll Dispenser 86ECO, system H21. The dispenser operation is ADA compliant. The unit dimensions are 9.1" deep x 11.8" wide x 14.4" high. The unit is generally surface mounted, although semi-recessed if required to suite conditions. The dispenser is battery powered, and an electrical power connection is not required.*
  - *Single toilet paper dispensers -Tork Jumbo Bath Tissue Single Roll Dispenser 66TR, System T22. The unit dimensions are 5.8" deep x 10.6" wide x 12" high. The unit is surface mounted.*
  - *Twin toilet paper dispensers - Tork Jumbo Bath Tissue Twin Roll Dispenser 56TR, System T22. The unit dimensions are 5.5" deep x 19.3" wide x 11.8" high. The unit is surface mounted.*
  - *Feminine product dispensers - HOSPECO EV1 Napkin/ Tampon Vendor. The unit dimensions are 14" wide x 26" high x 5-5/8" deep. The dispenser push*

button operation is ADA compliant. The unit is surface mounted.

- *Feminine product receptacles - Verify product dimensions and requirements with the NU Project Manager*
- *Trash receptacles (In-wall undesirable) - 19" wide x 19" deep x 33" tall, free-standing receptacle.*
- *Consultants are responsible for providing details in the construction documents which consider the dimensions of the units and showing mounting heights and locations which conform to Massachusetts Architectural Access Board and ADA requirements. Provide clearances for servicing and unlocking, and coordinate requirements for wood blocking or other supplementary metal framing necessary for attachment.*
- *Review accessory products and dimensions with the NU Project Manager to confirm that substitutions will not be utilized.*

- Provide accessory shelves / hooks for personal items to be stored during sink use. They shall be 1' deep min.
- Toilet stalls to contain flat shelf surface, integrated with accessories such as roll dispenser, or located behind toilet. Determination based on project space allowance and design preference to be discussed with NU PM during design development phase.
- Moisture resistant cement board backing is required in wet areas. (i.e., Dura-Rock or equal). Provide a light fixture over each stall.
- A continuous recessed light fixture at the back wall of the stalls and over the mirrored wall of the sink area is preferred.
- Drinking fountains (wall mounted electric water cooler type) should be in the proximity of the toilet rooms.

5.14.8 Lactation Rooms

- Northeastern University has both a federal and ethical responsibility to provide lactation space for nursing mothers returning to work, students returning to course work, and visitors to campus.
- **Scope**
  - L*ocking door and number combination on outside*
  - *Signage and labeling as "Lactation" room unless space is provided within single sex bathroom suite*
  - *Chair and small table*
  - *Sink with countertop and base cabinet (ideal, but depends on location)*
  - *Mirror over sink*
  - *Paper towel dispenser*
  - *Accessible electrical plugs*
  - *White noise machine (depending on location)*

- *Privacy curtain (depending on location)*
- *Room Wizard for scheduling*

5.14.9 Elevators

- Walls around elevators should be finished in a hard durable surface (i.e. wall tile to match or coordinate with floor surfaces / tile or ceramic tile, other options). The surface should be cleanable, stain resistant, and able to withstand impact from equipment.
- Equip elevators with an emergency telephone that connects directly to the University Police Dispatch.
- Doors should be stainless steel.
- Floors shall be rubber with a non-skid raised pattern in service or exterior elevators (i.e., garages) or upgraded flooring (i.e., terrazzo tile, ceramic tile, other materials) in all other elevators.
- Interior cabs shall be of metal, solid surface, or other durable and high-quality finishes that will discourage and hide vandalism and provide an attractive elevator cab finish.
- Elevator controllers and door operators shall not be proprietary.
- Access to elevator equipment rooms shall be direct and shall be located in a discrete fashion to not appear as a publicly accessible room. Co-location of any non-elevator equipment (mechanical, electrical, data / telecommunications, facility / other storage, etc.) is not acceptable.
- Elevators may require access control, either for elevator access (outside the elevator) or for specific floor access (inside the elevator). Coordinate requirements with the University.
- Elevator ceiling shall be finished with vandal resistant coating and / or surface with sufficient lighting for visibility.

5.14.10 Custodial Closets

- Provide minimum one per floor.
- Custodial closets shall be separate spaces not intended for joint use or any other purpose. Co-location of any non-custodial equipment (mechanical, electrical, data / telecommunications, facility / other storage, etc.) is not acceptable.
- Custodial closets shall be directly accessible from a corridor or service hallway.
- Custodial closets shall not be accessed through intermediary spaces (restrooms, electrical rooms, others) unless approved by the University.
- Preferred Finish Materials: Resilient flooring material and lay-in acoustical ceiling tile. Consider using water-resistant finish materials adjacent to sinks.

5.14.11 Mechanical Spaces / Rooms

- Mechanical spaces shall have the floor painted with a two part urethane epoxy.
- Mechanical spaces shall be separate spaces not intended for joint use or any other purpose. Co-location of any non-mechanical equipment (custodial, electrical, data / telecommunications, facility / other storage, etc.) is not acceptable.
- Mechanical spaces shall be directly accessible from a corridor or service hallway.
- Mechanical spaces shall not be accessed through intermediary spaces (restrooms, electrical rooms, others) unless approved by the University. In some instances, mechanical spaces are preferable to be accessed through doors to the exterior or service yards. This shall be coordinated with the University Project Manager and Department Program requirements.
- Building HVAC controls should be located in these spaces, and not the electrical rooms or ITS rooms.
- Mechanical spaces and elements within shall be treated with sound, vibration and other attenuation measures to ensure they do not adversely impact the performance of the building and its spaces / elements / FF&E.
- All mechanical equipment is to be located in mechanical rooms. No mechanical equipment shall be located in rooms not specifically designated as mechanical rooms (i.e., storage areas and other areas.)
- Provide any standard or special building services to support mechanical room operations, conditions, and other factors for performance. This may include but not be limited to considerations for power, data, telephone, HVAC / venting, and other considerations to address unique issues and performance requirements.
- Housekeeping pads shall be provided for all equipment. When possible, conduit and piping penetrations into the mechanical space shall be made at the floor level and not the ceiling level. Floor sinks shall be located in appropriate areas and sized for full flow. Floor sinks shall be below the level of the surrounding area to allow for gravity flow.
- Preferred finish materials for mechanical spaces should be confirmed with the NU Project Manager.

5.14.12 Electrical Spaces / Rooms

- Electrical spaces shall be separate spaces not intended for joint use or any other purpose. Co-location of any non-electrical equipment (custodial, mechanical, data / telecommunications, facility / other storage, etc...) is not acceptable.
- Electrical spaces shall be directly accessible from a corridor or service hallway.
- Electrical spaces shall not be accessed through intermediary spaces (restrooms, mechanical rooms, others) unless approved by the University. In some instances, electrical spaces are preferable to be accessed through doors to the exterior or service yards. This shall be coordinated with the University Project Manager and Facilities Department.
- Electrical spaces and elements within shall be treated with shielding, sound, vibration and other attenuation measures to ensure they do not adversely impact

the performance of the building and its spaces / elements / FF&E.

- All electrical equipment and panels are to be located in electrical rooms. No electrical equipment shall be located in rooms not specifically designated as electrical rooms (i.e. storage areas and other areas.)
- ITS / Data rooms are separate rooms from electrical rooms / spaces and shall be addressed per the Owner's data / telecommunications standards for all aspects (i.e. building services / infrastructure, finishes, security / access control, and other items).
- Provide any standard or special building services to support electrical room operations, conditions and other factors for performance. This may include but not be limited to considerations for power, data, telephone, HVAC / venting, and other considerations to address unique issues and performance requirements.
- In addition to code requirements for electrical rooms containing emergency power electrical panels, considered enclosing all electrical rooms with 2-hour rated assemblies. Confirm with the NU Project Manager.
- Preferred Finish Materials: Resilient flooring material and lay-in acoustical ceiling tile.

5.14.13 Storage Spaces / Rooms

- Storage spaces shall have sealed concrete or resilient flooring unless an alternate flooring material is approved by the University Project Manager.
- Storage spaces shall be designed with module, sizing, and building services in mind for potential future conversion to office space. See office requirements for additional information.
- Preferred Finish Materials: Resilient flooring material and lay-in acoustical ceiling tile.

5.14.14 Parking Structures

- Parking structure shall include minimum stall size and aisle width requirements to comply with local regulatory requirements unless otherwise approved by the University. Stall sizes shall not be less than 8'-6" wide by 18'-0" deep and aisle widths shall not be less than 24'-0" wide, with a total bay width of 60'-0", unless approved otherwise in writing by the University.
- Floor / Ground Finish - Concrete with striping
- Interior Finish - Concrete: Pre-cast or cast-in place concrete with white or light-colored industrial grade epoxy paint (Tnemec or approved equal). Paint shall be applied to all interior surfaces 4'-0" from lowest bottom edge of perimeter beam or spandrel minimum (e.g., to include ceiling beams, and 4'-0" down on columns from bottom edge of deepest perimeter beam or spandrel), including but not limited to interior sides of spandrel panels, beams, slab, columns, and other surfaces.
- Interior Finish - Masonry (CMU)
- Interior Finish : Other: All material finishes in a parking garage must be durable,

low maintenance, and resistant to vandalism. They typically will be concrete (pre-cast or cast-in-place) or CMU masonry. Other materials are to be approved by the University Project Manager, whether they are significant in use or limited in use (i.e., upgraded finishes at circulation cores or other areas).

- Exterior Finish: Exterior finishes must be durable, low maintenance, and resistant to vandalism.
- Doors: Metal exterior paint grade doors. Glass lites in doors should be reviewed based on use and security.
- Provide all building services (HVAC, power, water, data, other services) to support facility use and to support equipment to be used in facility. Where rooms / elements are required to support these items (i.e., ITS rooms, electrical rooms, mechanical rooms, elevators / elevator equipment rooms, security equipment rooms, etc.), address the standards / requirements for those rooms.
- Provide fixed furniture and equipment (security cameras, directional signage, other signage, etc.), and coordinate with building services.
- Provide provisions on exterior of structure, two sides minimum, for electronic signage to be mounted to exterior at upper levels of garage. Provide all directional signs, interior and exterior, for vehicles and pedestrians (i.e. entry signage, accessible signage, vehicle wayfinding / directional signage, pedestrian vehicle / wayfinding signage, other signage). Coordinate all signage with power and data services to support signage operations. Use of branding images and logo to be coordinate with University graphics and signage program.
- Campus parking and access system for locations, quantity, etc. All parking structures are to provide accessible parking.
- Security / Safety - coordinate all safety measures and precautions including camera systems and locations with NUPD and ITS during initial facility planning stages.
- Lighting, both exterior and interior, must be carefully considered to provide adequate lighting for safety, wayfinding, security camera operation in night conditions, and other considerations.
- Provide concrete pedestrian walkways from all parking structure exits to the exterior. Provide managed and safe pedestrian access and movement within and outside of parking structures that does not conflict with vehicular movement.
- Special Considerations:
  - *Consider donor signage potentials and special signage for functional, safety, or warning purposes in design.*

6.0 FIRE PROTECTION, FIRE ALARM, AND TWO-WAY COMMUNICATION

6 Fire Protection, Fire Alarm, & Two-Way Communication

6.1 FIRE PROTECTION SYSTEMS

6.1.1 The fire protection system design must comply with these specifications and all applicable codes and standards, including 780 CMR, 527 CMR, FM Global, and the appropriate NFPA Standards for the specific system type (e.g., water-based, clean agent) and hazard classification(s), regardless of whether they are specifically referenced by applicable codes and standards.

6.1.2 Any variance from this requirement must be received in writing from Northeastern University Fire Safety Department. Design submittals must follow the requirements and process for Tier I (Bid Documents), Tier II (Shop Drawings), and Tier III drawings (Record Drawings) outlined within 780 CMR.

6.1.3 Submittal documents shall be prepared by a Professional Engineer in the field of Fire Protection Engineering. All proposed fire protection design projects require review and written approval from Northeastern Fire Safety to ensure the owner's project requirements are being met.

6.1.4 All new and replacement fire protection systems shall be hydraulically calculated with

a minimum safety factor of 10 psi. Sprinklers must be installed throughout the project area and all new buildings, including electrical spaces. Where acoustical ceiling tiles are provided, sprinklers will be installed in the center of tiles.

6.2 FIRE ALARM SYSTEMS

6.2.1 The fire alarm system design must comply with these specifications and all applicable codes and standards, including 780 CMR, 527 CMR, FM Global, and NFPA 72.

6.2.2 Any variance from this requirement must be received in writing from Northeastern University Fire Safety Department. Design submittals must follow the requirements and process for Tier I (Bid Documents), Tier II (Shop Drawings), and Tier III drawings (Record Drawings) outlined within 780 CMR.

6.2.3 Submittal documents shall be prepared by a Professional Engineer in the field of Fire Protection or Electrical Engineering. All proposed fire alarm design projects require review and written approval from Northeastern Fire Safety to ensure the owner's project requirements are being met.

6.2.4 All new and replacement fire alarm systems shall be addressable systems, as defined in NFPA 72. Where a tenant improvement project will not result in the replacement of a non-addressable fire alarm panel, NU Fire Safety must be consulted on best practices.

6.2.5 Wherever system survivability is required, it will be provided in accordance with NFPA 72, 527 CMR, and 780 CMR. Inclusion of these systems as part of a Mass Notification System will be based upon determination of Northeastern University's Fire Safety, Public Safety, and Risk Services Departments.

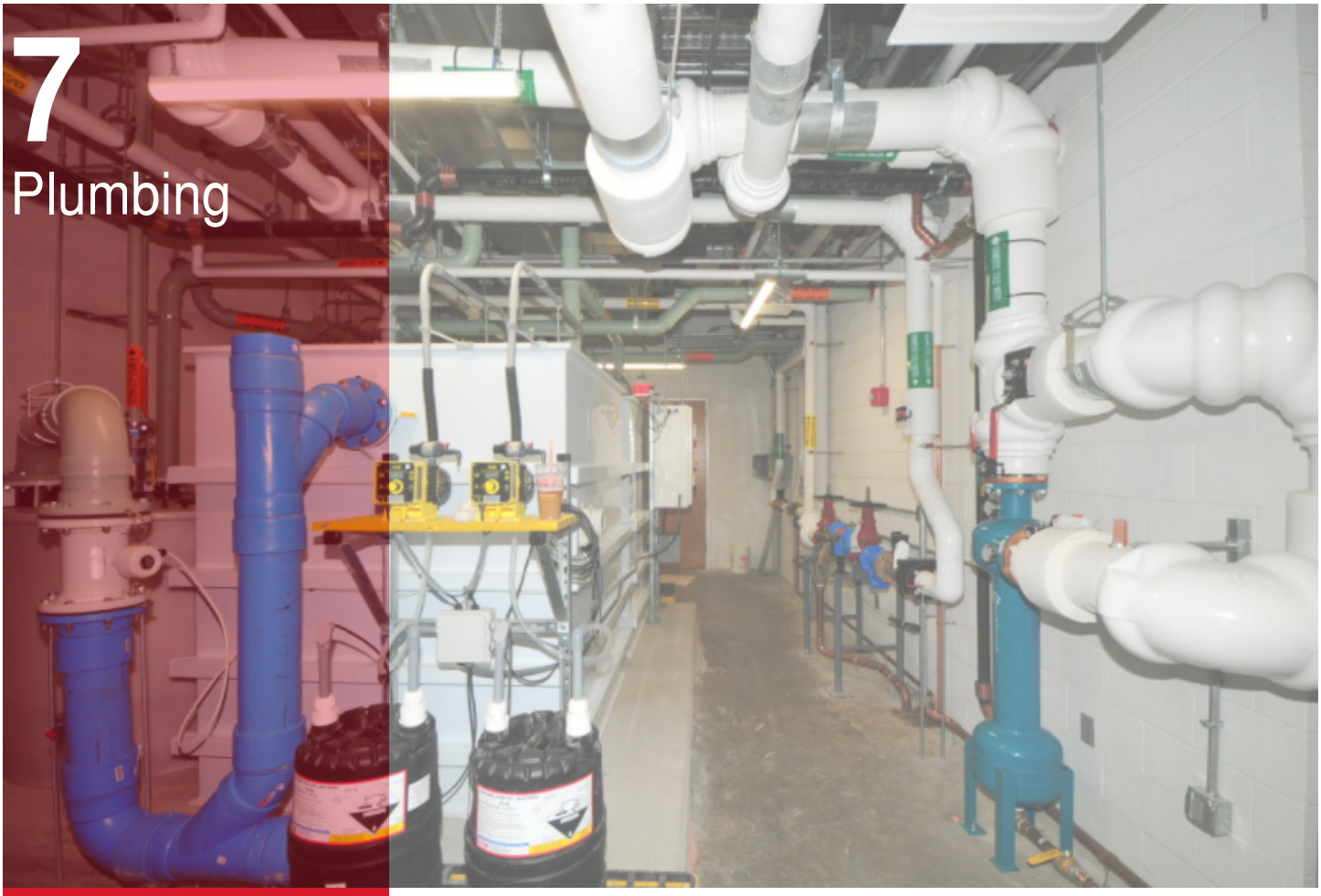
6.2.6 Interface with Onyxworks system and teledata quad to be installed at each panel, this equipment will be provided by Northeastern Fire Safety. All proposed fire alarm design projects require review and written approval from Northeastern Fire Safety to ensure the owner's project requirements are being met.

6.3 TWO-WAY BUILDING COMMUNICATIONS SYSTEMS

6.3.1 As required by 780 CMR, two-way communication systems will be provided at all passenger elevator lobbies as part of the accessible egress requirements under 780 CMR. These systems must be survivable, as required by NFPA 72.

7.0 PLUMBING

7 Plumbing



7.1 PRODUCT QUALITY STANDARDS AND COMPETITION

7.1.1 Prescriptive descriptions and references to specific manufacturers, products and vendors described in this document are intended to establish a quality standard. The University's goal is to promote competition whenever possible for better pricing, amongst products of comparable quality and utility. Designers are encouraged to look at product alternatives and provide the University with a range of options. Rather than specifying particular products, consultants should also describe the salient attributes of components and systems as the basis of design to ensure competition.

7.2 GENERAL PLUMBING DESIGN CONDITIONS

7.2.1 Install drains at all interior water faucets.

7.2.2 Install equipment that uses large volumes of water at an elevation that does not require pumping of effluent to the city sewer.

7.2.3 Coordinate with the HVAC engineer to ensure that equipment temperatures,

pressures, set-point deviations, and monitoring points are included in the building automation system controls.

7.2.4 Provide hose bibs at all mechanical equipment that requires water for wash down.

7.2.5 Include all pumped drain high-level alarms in the controls points list.

7.2.6 Plumbing fixtures installed shall be "low flow type"

7.3 PLUMBING REGULATORY AND DIRECTIVE STANDARDS

7.3.1 Design the plumbing system for longevity, durability, and flexibility. Include redundant equipment in the design to provide Northeastern University with the capability to maintain the plumbing system without disturbing normal building operation.

7.3.2 Several options are available when selecting systems and equipment for a given type of building. To best serve Northeastern University's facility management strategies and for ease of maintenance, use proven central-type systems. For example, use central storage or instantaneous domestic hot water heaters, instead of local hot water heaters on each floor.

7.3.3 The design team is responsible for coordinating the construction drawings to ensure that adequate space is available in the general location of each component. The general contractor or construction manager is responsible for coordinating the construction to ensure compliance with this space requirement. Any corrective work is at the expense of the general contractor or construction manager.

7.4 IDENTIFICATION AND HANGERS FOR PLUMBING PIPING AND EQUIPMENT

7.4.1 Ensure that identification systems are compatible with existing systems and are consistent throughout the project. Provide for future additions to the systems.

7.4.2 Plumbing Systems Identification

- Provide color-coded pipe identification markers with directional arrows on piping installed per this section. Use snap-on, laminated, plastic pipe markers.
- Use colored PVC jackets in penthouses, plumbing rooms, shipping docks, janitor's closets, and other areas without hung ceilings. Cover all insulated plumbing piping exposed in mechanical rooms with a Ceel-Co plastic jacket.

7.4.3 Tags, Valves, Equipment, and Instruments

- Upon completion of work, attach engraved laminated plastic tags to all valves and instrumentation. In every mechanical space, tags must be seen when hung with valve/riser charts.
- Equipment must bear stamped, stainless steel tags.
- Tags must be numbered consecutively with black characters on a white face. Tags

for general valves must be prefixed with the letter P. Tags must bear the number used in the P&IDs for those items so marked. Numerals must be at least 3/8" high.

- Embossed or engraved aluminum or brass tags may be substituted for stainless steel or laminated tags, if desired.
- Tags must be at least 1" in diameter, at least 1/8" thick, and attached by S-hooks and chains.

7.5 WATER PIPING AND DISTRIBUTION

7.5.1 Design Requirements

- The maximum water velocity in piping must not exceed 5 feet per second.
- Provide water shock absorbers at all flush valves and other locations where sudden valve closures would cause water hammer. Do not use capped air columns, which become waterlogged after a period of time.
- For large plan spaces, such as laboratories, consider a looped piping system to facilitate changes to the system and provide redundancy of feed and constant pressure to all areas.
- Provide adequate expansion loops and anchors.
- Provide freeze protection for exterior water lines, such as cooling tower feeds.
- Install hose bibs in all machinery rooms, kitchens, and in all rooms containing floor drains but no water-supplied fixtures.
- Install an isolation valve on each piping riser.
- Install drain valves with 3/4" hose connections and caps at all low points in the system.
- To prevent transmitting vibrations through the piping system, install flexible connections on piping connected to vibrating equipment.
- Do not install plumbing piping in transformer vaults, switchboard rooms, data centers or telephone rooms.
- Install frost-proof hose bibs every 100 ft around the building, on the roof for washing down air handling unit coils, and in mechanical rooms.
- Install approved backflow preventers where required. A check valve must be installed upstream from the reduced-pressure valve to prevent valve dumping every time the main line pressure drops.
- Use trap primers only when necessary. Install them in accessible locations for maintenance.
- Provide pressure gauges for every pump, except small so-called "boosters" which must have gauge cocks only.
- Cold water piping shall be provided with a minimum of 1/2" of insulation, hot water piping shall be insulated per code.

7.5.2 Materials

- Hard drawn Type L copper with wrought copper or cast brass fittings with lead-free solder joints. Pro Press mechanical fittings are acceptable on potable, non-potable, & tempered water systems.
- Isolation/Shut-off valves 2" and smaller shall be all bronze ball valves Watts Series B-6000 or Apollo 77-200, full port Teflon seated ball and 2-piece valve body designed for 600 PSI water and shall have threaded ends with sweat adapters. Pro Press shall be acceptable on domestic, non- potable, and tempered water systems.
- All wetted parts in recirculation hot water pumps and in-line boosters must be of bronze or stainless-steel construction (bronze impellers only).

7.5.3 Manufacturers - Refer to Table 7.0 for Northeastern standard manufacturers

TABLE 7.0 STANDARD MANUFACTURERS

PRODUCT	MANUFACTURER
Mixing Valves	Speakman Symmons
Water Hammer Arrestors	Wade
Backflow Preventers	Watts 909
In-Line booster, Circulator Pumps	Bell & Gossett (lubricated bearing with oil seals) Taco (sealed bearing) Grundfos
Domestic Booster Pump	Bell & Gossett (multiple control panel, 2-3 pumps with small tank) Canaris Corporation Grundfos

7.6 SANITARY AND LABORATORY WASTE AND VENT PIPING

7.6.1 Design Requirements

- Use cast iron or copper Type M drain lines for sanitary drainage. Plastic or copper will radiate noise more readily to the surrounding spaces. Acid waste piping to be utilized in lab drainage.
- All condensate from air conditioning equipment and other HVAC drains, must be directed to the sanitary sewer system or storm drain system based on waste type. The use of condensate pumps is approved. All traps must be deep seal type and provide trap primers where deemed necessary. Open-sight drains, if used, must not be in concealed spaces.
- Provide floor drains with trap primers at fire protection riser alarm valves and at test-and-drain valves when not discharged through a wall; at pumps, refrigeration

compressors, air compressors, vacuum pumps, boilers, water heaters, air conditioning equipment, water softeners, and other locations as required; in kitchens near dishwashers, steam kettles, large refrigerators, and at other locations as required.

7.6.2 Materials

- Sanitary, Waste, and Vent Piping - cast iron or copper pipe.
- Sanitary Force Main - galvanized steel.
- Lab waste, lab vent, lab force main piping - polypropylene. Schedule 40 fire retardant polypropylene, 2" and smaller to be mechanical joint system. Larger than 2" shall be fused joints as manufactured by Orion, Enfield, Georg Fischer, or Asahi.

7.7 FUEL GAS PIPING

7.7.1 Materials

- Carbon steel
- Malleable steel fittings
- May be used with Viega MegaPress G fitting system
- Valves 3" and small shall be Apollo Series 70-100-07 threaded bronze valve, 600 PSI WOG, or approved equal by Northeastern University.

7.8 WATER HEATERS

7.8.1 Design Requirements

- Design the plumbing system for safety, longevity, durability and flexibility.
- Provide a minimum of two central water heaters for dormitories.
- Provide a minimum of two central domestic water heaters for each laboratory facility, each supplying 75% of demand. Coordinate with the Northeastern University Facilities group for other types of facilities for number of water heaters.
- Provide temperature and pressure gauges at the inlet and outlet of each water heater.
- Use circulated hot water piping system, limiting dead ends to 20 feet.
- Install lockable-type shutoff valve, with lock, locked in the open position between the expansion tank and cold-water supply.
- Designer shall submit domestic hot water load calculations for major new hot water systems to Northeastern.
- Specify that water heaters be inspected by the manufacturer's authorized representative who shall submit a written report to the engineer with copy to Northeastern University stating that the water heaters have been properly installed, are operating correctly, and the installation is acceptable to the manufacturer in every respect.
- Domestic hot water heat exchangers must be double wall.

- Provide pull space for coils as applicable.
- Provide a 2" minimum clearance around the units for maintenance.

7.8.2 Manufacturers - Refer to Table 7.1 below for Northeastern standard manufacturers

TABLE 7.1 STANDARD WATER HEATER MANUFACTURERS

PRODUCT	MANUFACTURER
Gas Water Heaters	AO Smith PVI
Electric Water Heaters	AO Smith PVI
Instantaneous Steam Water Heaters (below 15 psi steam pressure)	Leslie Armstrong
Semi-Instantaneous Steam Water heaters (greater than 20 psi and less than 60 psi steam pressure)	Patterson-Kelley
Indirect Water Heaters	Thermo-Max Triangle Tube

7.9 COMMERCIAL PLUMBING FIXTURES

7.9.1 Fixture Quantities

- Northeastern University will tolerate under-fixturing on individual floors or in specific building areas only if horizontal or vertical occupant access to fixtures in other areas is sensible.
- Base quantities on the anticipated maximum, normal-use building capacity.
- For all new or remodeled building construction, the aim is to satisfy anticipated demand. However, avoid over-fixturing because of the comparatively high cost of these facilities and spaces.

7.9.2 Design Requirements

- Where practical provide gender neutral toilet rooms.
- Hang fixtures on walls wherever possible.
- Wherever possible, water coolers are to be specified with a bottle filling station, like Halsey Taylor's HYDROBOOST, Elkay's EZH2O and Oasis's Aqua Point.

7.9.3 Manufacturers

- Verify all acceptable manufacturers with Northeastern prior to final printing.
- Table 7.2 below represents the current Northeastern preferred plumbing fixtures.

TABLE 7.2 PREFERRED PLUMBING FIXTURES

TYPE	MANUFACTURER/MODEL	SPECIFICATION TYPE
Water Closets (Wall Hung)	Toto CT708E Toto TET1LA	CP
Water Closets (Floor Mount)	Toto CST744EL (ADA) Toto CST743S	OP
Urinal	Toto UT447E Toto TEU1LA	CP
Lavatory (Wall Hung)	Toto LT307	OP
Lavatory (China Drop In)	Toto LT402	OP
Lavatory (Undercounter)	Toto LT231	OP
Lavatory (Multi Station)	Bradley LVA-Series	OP
Lavatory Faucet (Manual)	Chicago 2200	CP
Lavatory Faucet (Electronic)	Chicago 116.102.AB.1	OP
Kitchen Faucet	Chicago 2300	OP
Drinking Fountain	Elkay VRCGRNTL8WSK Hasley Taylor, Oasis	CP
Mop Sink	Chicago 540-LD897SWXFXKCP	OP
OS: Open specification - No preference on manufacturer or model. OP: Open Preferred - Manufacturer and/or model listed is preferred but not required. CP: Campus Proprietary - Manufacturer and/or model listed shall be used unless project specific conditions prohibit its use. Manufacturers may present equal fixtures for consideration to be incorporated into this standard.		

7.10 COMPRESSED AIR AND VACUUM

7.10.1 Design Requirements

- Design the plumbing system for safety, longevity, durability and flexibility.
- Design compressed air and vacuum systems for medical, surgical, dental, and laboratory facilities to be completely independent of each other.
- Provide a dew point monitor for the compressed air system, and list the required system dewpoint in the contract documents.
- Submit laboratory air and vacuum calculations, with sketch, for piping and equipment selection for major new installations.
- Vacuum pumps serving medical facilities must be duplex package, with receivers, alarms, and control panels meeting NFPA 99 requirements. Each pump must be capable of carrying the entire load.
- Air compressors serving laboratories must be duplex or triplex package, with dryers, receivers, alarms, and control panels. Air compressors must meet NFPA 99

requirements.

7.10.2 Materials

- All compressed dry air, medical gas piping, and vacuum piping shall be Type L copper. Fittings shall be brazed and purged with inert gas during installation.
- Isolation/Shut-off valves 2" and small shall be all bronze ball valves Watts Series B-6000 or Apollo 77-200, full port Teflon seated ball and 2-piece valve body designed for 600 PSI water and shall have threaded ends with sweat adapters. 3-piece valves shall be utilized for brazed applications. Substitutes must be approved by Northeastern University.
- Medical Air - maximum operating limits: 125 psig, 120° F copper.

7.10.3 Manufacturers - Refer to Table 7.3 for Northeastern standard manufacturers

TABLE 7.3 STANDARD COMPRESSOR MANUFACTURERS

PRODUCT	MANUFACTURER
Compressors	Ingersoll Rand Quincy Compressor Zerk (Air Dryers) Atlas Copco
Compressors (Medical)	Nash Beacon Medical Ingersoll-Rand

7.11 LABORATORY SYSTEMS

7.11.1 General Design Requirements

- Laboratory sinks shall be provided with foot pedals.

7.11.2 Emergency Shower/Eyewash Design Requirements

- Provide a tempered water supply for all emergency showers and eyewashes.
- Eyewashes must be full-face.
- In conjunction with code and standard requirements, emergency showers must be located in adjacent corridors or at the hazard room door exits. The showers are to be accessible, require not more than 10 seconds to reach, and be within a travel distance of no greater than 50 ft from the hazard rooms.
- Provide full-size ball valves to isolate emergency showers or eyewash fountains. Lock the valves in the open position.

7.11.3 Specialty Gas Piping (Nitrogen and Argon)

- All piping shall be welded, drawn, and annealed Type 304 Stainless Steel tubing 16-gauge thickness to 2-1/2" size. Based on user purity of the lab gases, copper could be used. If used, piping must be brazed and purged during installation. Press joining systems shall not be used on laboratory gas piping.
- Fittings shall be Type 316 stainless steel Swage-Lock, Gyrolock, or Parter tube fittings. Fittings and pipe to be one manufacturer to assure proper fit and total system conformance.
- Joints shall be either flanged or swage connections to valves, equipment, and where indicated on the contract drawings.

7.11.4 Pure Water Piping (RODI)

- Piping shall be SRD11 series polypropylene with a wall thickness conforming to ASTM-2837 with butt fusion joints as manufactured by George Fischer, ASAHI, or SIMTECH.
- Valves shall be diaphragm type, spigot ends, EPDM diaphragm, position indicator, George Fischer type 315PPM, ASAHI, or SIMTECH

7.11.5 Testing Procedures

- Initial Lab Gas Testing: Before attachment of system components, such as pressure actuating switches for alarms, manifolds, pressure gauges, relief valves, etc., but after installation of the laboratory gas termination and vacuum outlets, with rest caps in place, and before closing of the walls and ceilings, each piping system shall be subject to a minimum test pressure of 150 psig with oil free dry air or nitrogen. This test shall be maintained until each joint has been examined for leakage by means of soapy water or other equally effective means of leak detection safe for use with oxygen. Leaks, if any, shall be repaired and the section retested.
- Final Lab Gas Testing: After testing each individual system as specified above, the assembled stations outlet valves and all other system components such as pressure actuating switches for alarms, manifolds, pressure gauges, relief valves, shall be installed and all laboratory gas piping systems shall be subject to a 24 hour standing pressure test at 20% above normal line pressure.

7.11.6 Manufacturers

- Emergency showers and eyewashes shall be manufactured by Guardian

8.0 HVAC

8 HVAC

8.1 PRODUCT QUALITY STANDARDS AND COMPETITION

8.1.1 Prescriptive descriptions and references to specific manufacturers, products and vendors that may be described in this document are intended to establish a quality standard. The University's goal is to promote competition whenever possible for better pricing, amongst products of comparable quality and utility. Designers are encouraged to look at product alternatives and provide the University with a range of options. Rather than specifying particular products, consultants should also describe the salient attributes of components and systems as the basis of design to ensure competition.

8.2 SUMMARY

This section contains general design criteria for Heating, Ventilation, and Air Conditioning (HVAC) Systems. These Guidelines convey both general and specific requirements but in brief terms. The design consultant or contractor is responsible for providing full detailed contract drawings and specifications.

HVAC system components and distribution layout shall have the following characteristics:

- Modular approach
- Energy responsiveness
- Flexibility for future changes
- Durability and ease of maintenance
- Reliability
- Redundancy of critical components
- Systems shall be designed and arranged to encourage routine preventive maintenance by providing easy access for maintenance personnel.

8.3 GENERAL DESIGN CRITERIA

8.3.1 All HVAC systems shall maintain the criteria established by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

- The consultant will review acceptable system types with Northeastern during the assessment or schematic design phase.
- The engineer shall base system sizing on project-specific load calculations.
- Size all system components to support 10 percent growth anywhere in the system. This includes, but not limited to AHUs, fans, ducts, diffusers, pumps, and heat exchangers
- The designer shall apply good engineering practice when designing mechanical equipment. All equipment will be designed to allow for adequate service, access, and maintenance. An acoustical consultant shall be retained for all new
- The designer shall consider noise criteria when designing new mechanical equipment. Air Handling Units, Fans, Duct and Piping systems shall be designed to limited excessive sound and vibration.
- Ventilation rates shall be in strict accordance with the latest Massachusetts adopted version of ASHRAE 62.1
- Commissioning is a part of the construction process. The engineer shall review proposed systems with Northeastern commissioning group at the end of each design phase.
- All new construction projects accreditation shall satisfy all of the prerequisites and the selected number of points required to attain a minimum GOLD certified rating in the Leadership in Energy and Environmental Design (LEED) Green Building Rating System of the United States Green Building Council (USGBC).
- The consultant shall analyze opportunities to reduce green house gas emissions during concept and schematic design phases and produce a report for Northeastern review and approval. Systems to be contemplated but not limited to shall be:

  1. Air side energy recovery to pre heat/ pre cool outside ventilation/make up air such as enthalpy type wheels or glycol run around loop.

  2. Water side energy recovery to preheat return hot water to reduce heating demands via heat recovery chiller(s) in buildings with annual heating demands.

  3. Identify opportunities to introduce air to water source heat pumps to the facility to

further reduce carbon heating type demands locally or at plant level.

4. HVAC engineer shall work with Electrical engineering consultant to review electrical capacity at the building and site level to support each option. Analysis should look at summer/winter electrical loads and take advantage of electrical chiller capacity available during winter periods.

8.4 DESIGN CONDITIONS

8.4.1 Use the following outside design temperatures for sizing mechanical equipment:

- Use ASHRAE weather data for Boston Logan, station #725090)
- Critical or 100% outside air systems: 0.4% DB, 0.4% WB
- Non-critical systems: 0.4% DB, 0.4% WB
- Critical air-cooled condensers: 0.4% DB +5° F
- Non-critical air-cooled condensers: 0.4% DB
- Cooling Towers 78 WB

8.4.2 Use the following interior design temperatures for sizing mechanical equipment:

TABLE 8.0 SPACE DESIGN TEMPERATURES

AREA DESIGNATION	TEMPERATURE	MAX SUMMER RELATIVE HUMIDITY (+/- 5%)
Offices	70 Winter - 72 Summer	---
Conference Rooms	70 Winter - 72 Summer	---
Lab	68 Winter - 72 Summer	50%
Corridors	68 Winter - 75 Summer	---
Lockers/Lounges	68 Winter - 78 Summer	---
Lobby/Atrium*	70 Winter - 75 Summer	---
Toilets	68 Winter - 75 Summer	---

TABLE 8.1 MINIMUM AIR CIRCULATION RATES (ACHR) AND RELATIVE PRESSURIZATION

SPACE	MIN. OCCUPIED RATE - ACHR	MIN. UNOCCUPIED RATE - ACHR	RELATIVE AIR PRESSURIZATION
Laboratories*	6	4	- in
Lockers	10	10**	- in
Toilets	10	10**	- in
Janitor Closets	10	10**	- in
Animal Holding Rooms	10-15	10-15	As Required

Cage wash - Soiled	10-15	-	- in
Cage wash - Clean	10-15	-	+out
Animal Procedure Room	6	10-15	+out
Feed and Bedding	10	10	- in
Quarantine	10	10-15	- in

*When there is no ceiling present in a given lab the ACHR calculation shall us a 9'-0" ceiling datum to obtain the total required airflow in the space.

**Depending on exhaust system design and distribution, there may be opportunities to reduce airflow exhaust systems in some locations during unoccupied periods.

8.5 SPACE NOISE CRITERIA

8.5.1 In general, all HVAC air systems shall be designed to maintain the criteria established by the American Society of Heating, Refrigeration and Air conditioning Engineers. HVAC Engineer shall coordinate with the Acoustical Consultant to review each equipment selection and system design.

- Private Offices: NC 35
- Open Offices: NC 40
- Public Areas and Corridors: NC 40
- Open Workstation Areas: NC 40
- Conference Room: NC 30
- Tele-Conference Room: NC 25
- Auditorium: NC 30
- Laboratories NC 45 (NC 50 within 10'-0" of hoods)

8.6 AIR HANDLING SYSTEM DESIGN

All new Air Handling Units shall be industrial grade. Depending on the application, location, quantity, and space requirements/restrictions, new air handling units construction shall be discussed with Northeastern University and analyzed for its merits during design.

8.6.1 Offices and Conference Rooms

- Provide factory-assembled or custom built air handling units.
- Recirculating supply air handling units (AHU) will be nominally sized for 100% of the connected load (sum of peaks), with no additional safety or future factors, duct leakage factor will be 3%, and the peak system diversity will be as indicated by

system block load calculations, but no less than 90%.

- Recirculating AHU cooling coils, heating coils, and filter banks will be sized for a maximum face velocity of 400 fpm at design air flow.
- Dedicated outdoor air systems (DOAS) will be nominally sized for 110% of the connected load (sum of peaks), with no additional safety or future factors, duct leakage factor will be 3%, and the peak system diversity will be as indicated by system block load calculations, but no less than 90%.
- DOAS unit cooling coils, heating coils, and filter banks will be sized for a maximum face velocity of 400 fpm at design flow (110% of connected).
- Cooling coils for AHUs and DOAS units will generally be selected for 52°F discharge air temperature. Coil selection to be based on maximum 8 rows and 10 fins per inch. In-series cooling coils may be required to achieve required performance. Air Handling Units may use return air or 100 percent outside air.
- 100% dedicated outdoor air units shall provide ventilation air only.
- Supplemental heating and cooling units are required to meet sensible space loads.
- All airside systems shall include an airside economizer.
- Even where reheat is allowed by code, enthalpy exchange energy recovery, supply air temperature reset, and other dehumidification methods, are required to minimize fuel-fired or electric reheat costs.
- Energy Recovery for air handling unit systems shall be designed in accordance with the latest adopted version of the Energy Conservation Code.
- Air handling systems with clean, non-hazardous exhaust airstreams shall utilize an enthalpy recovery wheel wherever possible.
- Units shall be custom fabricated by manufacturer experienced in providing full custom air handling units with 4" foam or fiberglass panels shall be provided for capacities greater than 5,000 cfm.
- Smaller units shall be standard modular type units with 2" fiberglass wall construction unless otherwise determined by the Owner and the design team.
- Supply Units shall include the following components as standard:
  - *Outside air and return air (where applicable) inlet Dampers and air flow stations.*
  - *Return air type units shall have an air blender downstream of mixing section.*
  - *Inlet sound attenuator*
  - *MERV 8 pre-filter bank and MERV 14 after filter banks (or per latest LEED Standards).*
  - *Energy Recovery Section (where cost effective and required by code).*
  - *Steam or hot water Pre-heat coil (steam is preferred where available).*
  - *Chilled water coil.*
  - *Supply fan array consisting of multiple plenum fans.*
  - *Variable speed drive (or drives depending on number of fans).*

- *Supply Airflow Station.*
- *Discharge sound attenuator (where required by acoustical consultant).*
- *Discharge plenum and smoke/isolation dampers.*
- *Additional filtration as required.*

8.6.2 Laboratories and Laboratory-Support Areas

- The requirements and approach to Lab buildings depend upon the location, number of floors, new versus office to lab conversion, and site permitting limitations.
- Lab supply air handling unit will be institutional grade 100% outside air custom air handling units.
- All cabinets will be double wall 3" foam injected aluminum panel construction with fully welded aluminum check plate.
- Supply Units shall include the following components as standard:
  - *Outside air inlet Dampers and air flow stations*
  - *Inlet sound attenuator*
  - *MERV 8 pre-filter bank and MERV 14 after filter banks (or per latest LEED Standards)*
  - *Energy recovery Pre-heat coil (similar to Konvekta or Run-around loop)*
  - *Chilled water coil*
  - *Supply fan array consisting of multiple plenum fans*
  - *Variable speed drive (or drives depending on number of fans)*
  - *Supply Airflow Station*
  - *Discharge sound attenuator (where required by acoustical consultant)*
  - *Discharge plenum and smoke/isolation dampers*
  - *Additional filtration as required.*
- Lab Exhaust units will be industrial grade and consist of the following:
  - *Inlet automatic dampers*
  - *MERV 8 pre-filters*
  - *Inlet sound attenuator*
  - *High performance glycol heat recovery coil*
  - *High-plume-dilution exhaust fans*
  - *Discharge automatic dampers.*
  - *Provide 10' discharge stack from each exhaust fan with discharge sound attenuator in each stack.*
  - *Provide Variable Frequency Drive (VFD) for each exhaust fan. EAHU's*

assumed to be outdoor custom EAHU's located on the roof. Assume each EAHU is provided with a heated and ventilated access corridor for piping connections and housing VFDs.

- Supply & Exhaust air shafts should be sized for 2 cfm/sf of lab
- Air handling units shall be manifolded at roof to extent feasible to allow for modular operation of building.
- Accommodations to install ring ducts on floors is recommended.
- General exhaust shall be provided equal to the make-up air capacity. There should not be return air systems in lab buildings unless the building is a conversion and existing systems remain to serve only office area of building.
- General exhaust ductwork shall be galvanized G-90.
- General exhaust is intended for lab exhaust, non-hazardous fume hood exhaust, office ventilation exhaust, and common area exhausts.
- General exhaust should be manifolded at penthouse or roof and exhausted via custom energy recovery air handling units. The units shall have a stainless steel interior liner, double wall construction, enclosed exhaust fans (as required for noise/ maintenance), and be designed for N+1 fan redundancy across the manifolded systems. Exhaust fans shall be on stand-by power to maintain minimum 50% capacity or higher as required to exhaust fume hoods.
- Specialty exhausts such as wet exhausts, ducted bio-safety cabinets, etc. should be run separate to roof exhaust fans.
- A run-around energy recovery system between the supply air and exhaust air systems shall be utilized for sensible energy recovery with minimum 55% effective recovery for heating systems.
- Enhanced energy recovery systems for both air and water shall be studied for each building with life cycle cost provided due to large savings and energy savings.

8.7 CHILLED WATER DESIGN

- Design building chilled water system to meet the latest requirements of the International Energy Conservation Code (IECC).
- Chilled water is the preferred medium for comfort cooling. The use of glycol, where unavoidable, shall be inhibited propylene glycol, pre-mixed to 30% by weight in water.
- Depending on the capacity of each system, the preference for chilled water production shall be: Centrifugal chillers with VFD-driven compressors. Compressors shall be magnetic-bearing oil-free centrifugal compressors ("Turbo-Cor"), variable-speed screw compressors, all water-cooled.
- Where water-cooled centrifugal chillers, are not feasible, air-cooled variable-speed magnetic bearing oil-free centrifugal compressors ("Turbo-Cor"), variable speed screw compressors, slide-valve screw compressors, digital scroll compressors, and scroll compressors. An IPLV and LCC analysis based on estimated hours of

operation is required to justify the selection.

- The nominal chilled water supply temperature is 42°F at the central chilled water at the building level. Expect a temperature rise of 2°F during distribution.
- The chilled water supply temperature is allowed to rise during periods of low load (winter) to as much as 46°F. During these periods, comfort-cooling systems are generally able to meet the demand with this higher supply water temperature. All year-round cooling equipment be selected for 46°F chilled water supply temperature.
- Cooling chilled water system will be variable volume system utilizing a modulating 2-way control valve at each terminal cooling device.
- Chilled water distribution pumps will each be provided with VFD. A differential pressure transmitter between the supply and return mains will be utilized to vary the speed of the pumps, via variable frequency drives, to maintain a constant pressure differential between the piping mains.
- Chilled water usage will be metered via automated BTU meter with flow rate, supply temperature and return temperature input. Data will be input to Building Automation System (BAS).
- All new chiller plants shall be designed with a Chiller optimization controls package. This package shall be provided by the ATC contractor.

8.8 HEATING DESIGN

- Hot Water is the preferred medium for heating. Steam use for heating should be phased out where applicable. However, where used it shall be used as efficiently as possible.
- Provide Low-temperature condensing boilers for new hot water plants and renovations. The design intent is to maximize efficiencies of all systems. A target water temperature of 120°F should be utilized to allow for future sustainability and electrification.
- Replacement boilers supplying hot water to existing heating terminals/coils originally designed for hot water temperatures greater than 120°F will be selected to satisfy the original supply temperature for existing heating equipment.
- All heating coils will be design for a water temperature drop of 30°F.
- Heating hot water system will be variable volume system utilizing a modulating 2-way control valve at each terminal heating device.
- Hot water distribution pumps will each be provided with VFD. A differential pressure transmitter between the supply and return mains will be utilized to vary the speed of the pumps, via variable frequency drives, to maintain a constant pressure differential between the piping mains.
- 100% outdoor Air Handling pre-heat/snow melt coils must be steam or glycol-hot water.
- Provide perimeter heating where glass/glazing is present.

- All Laboratory spaces shall be provided with airside reheats, perimeter radiation is not allowed.
- Where glycol is required due to freeze conditions, the extent of the glycol system shall be minimized via steam or hot water heat exchangers.

8.9 PUMPS

- Water pumping applications shall demonstrate selections for lowest energy use for duty. All pumps shall use a VFD control or balancing. Use ECM wet rotor circulators for smaller duty pumps where appropriate.
- Systems up to 350 gpm shall utilize inline pumps.
- Systems between 100gpm and 1,500 gpm shall utilize end-suction pumps.
- Systems over 1,500gpm shall utilize double-suction pumps.
- Select pumps for an impeller diameter not greater than 90 percent of the maximum pump impeller diameter.
- Select pumps between 65 and 115 percent of best efficiency point along the pump impeller curve.
- Where pumps are provide with a VFD AEGIS Shaft grounding rings shall be provided on each pump.
- Where fluids other than 100% water is used, ensure that the pump gaskets are compatible with fluid.

8.10 HYDRONIC PIPING SPECIALTIES

- Expansion Tanks - Expansion tanks shall be the pressurized captive air bladder type. Tanks shall be constructed and certified to ASME Section VIII and have a pressure rating of 150 psig and temperature rating of 240°F.
- Air Separators - Air separators shall be tangential-type with flanged inlet/outlet connections. Separators shall have valved drain connection, full-size removable strainer and be sized for a maximum velocity of 4 fps and pressure drop of 1 foot of water.

8.11 FANS

- Provide all fans of the various types, arrangement and sizes as required for appropriate application.
- Fans shall include all motors, drives, curbs, flashing, special coatings, and accessories.
- Furnish and install backdraft dampers will all fans.
- Furnish and install all roof curbs and automatic dampers.
- Provide fans capable of accommodating static pressure variations of ±10%.

- Provide balanced variable sheaves for motors 15 HP and under, and fixed sheaves for 20 HP and over.
- Provide OSHA and ANSI approved belt guards on interior mounted belt driven fans. Provide weatherproof ventilated housing for exterior mounted fans.
- Provide special construction fans such as spark proof, explosion proof, or coated fans as required to meet the application/duty.
- Where fixed speed sheaves are specified for a particular fan, provide (2) additional sheaves (one motor and one drive) as necessary for final air balancing.
- Fans serving laboratory fume hoods, pain spray booth, or scheduled on the drawings, shall be constructed in accordance with AMCA 99-0401 Type "A" or "B" spark resistant construction.

8.12 DUCT DESIGN

8.12.1 HVAC ducts and casings shall be per SMACNA guidelines, Refer to the chart below for construction requirements for duct systems.

TABLE 8.2 CONSTRUCTION REQUIREMENTS FOR DUCT SYSTEMS

Minimum SMACNA Construction Standards					
DUCTWORK LOCATION	**PRESSURE CLASS INCHES W.G.**	**SEAL CLASS**	**LEAKAGE CLASS**	**MATERIAL**	**SOUND LINING**
Supply from Air Handling units to terminal boxes	±6	A	4	G-90	No
Supply from terminal boxes to outlets	±2	A	4	G-90	No
Return from Air Handling units to terminal boxes	-6	A	4	G-90	No
Return from outlets to terminal boxes	-2	A	4	G-90	No
Exhaust from Exhaust Air Handling units to terminal boxes	-6	A	4	G-90	No

Exhaust branch duct from the shaft to the terminal box (medium pressure)	-4	A	4	G-90	No
Exhaust from outlets to terminal boxes	-2	A	4	G-90	No
Exhaust Stacks located on the exterior of the building	-6	A Welded	0.5	316L S.S.	No
Return to Air Handling units constant volume systems.	-4	A	4	G-90	No
Supply from Air Handling units constant volume systems	±4	A	4	G-90	No
Plenums	±4	A	4	Same as Ducts	As Indicated
Emergency Generator Plenums	±4	A	4	G-90	Board Insulation
Stair/Elevator pressurization	+3	A	4	G-90	No

- Ductwork in the following locations shall be constructed of aluminum or stainless steel and continuously welded (joints & seams) and pitched back to the outlets:
  - *Within 20'-0" of a shower area exhaust.*
  - *Within 20'-0" downstream and 5'-0" upstream of a duct humidifier (use of duct humidifiers will be evaluated on a project basis).*
  - *Within 20'-0" of a sterilizer area exhaust.*
  - *Within 20'-0" of a wash center equipment exhaust.*
  - *Within 20'-0" of a locker room and within room (exhaust).*

- Ductwork serving fume hoods shall be constructed of stainless steel and shall be continuously welded (joints and seams) back to the medium pressure main.

8.12.2 All ductwork shall be sized in accordance with the following chart:

TABLE 8.3 DUCTWORK SIZING

DUCTWORK CLASS/SOUND LEVEL		RISERS	SUBMAINS	BRANCHES	AIR DISTRIBUTION DEVICE NECK VELOCITY (FPM)
Medium Pressure	Max. Velocity	1,500 fpm	1250 fpm	----	----
	Max. P.D.	0.15"/ 100'	0.15"/100'	---	---
Low Pressure (Spaces < NC 35)	Max. Velocity	1,500 fpm	1,500 fpm	800 fpm	500 fpm
	Max P.D.	0.1"/ 100'	0.1"/ 100'	0.08"/ 100'	
Low Pressure (Spaces > NC 35)	Max. Velocity	1,200 fpm	1,000 fpm	400 fpm	250 fpm
	Max P.D.	0.08"/ 100'	0.07"/ 100'	0.05"/ 100'	---

8.13 PIPING DESIGN

8.13.1 Base pipe sizes, pressure loss, and other calculations for circulating water systems on Cameron Hydraulic Data, with C=100 for open (cooling tower) systems and C=130 for closed systems. Refer to the chart below for construction requirements for miscellaneous piping systems.

TABLE 8.4 REQUIREMENTS FOR PIPING SYSTEMS

SERVICE	TYPE	GRADE	WALL		JOINTS (MINIMUM SCH. SHALL MATCH WALL)		TEST PRESSURE
			to 10"	12"& Up	2" & Less	2-1/2" & Up	PSIG
Chilled water supply and return	A106 or A53 Seamless or ERW	A or B	Sch.40	Standard 0.375"	Threaded	Butt Welded or Grooved *Note 3	225
Condenser water supply and return	A106 or A53 Seamless or ERW	A or B	Sch.40	Standard 0.375"	Threaded	Butt Welded or Grooved *Note 3	225
Hot water supply and return	A106 or A53 Seamless or ERW	A or B	Sch.40	Standard 0.375"	Threaded	Butt Welded	225
Pumped condensate	A106 or A53 Seamless or ERW	A or B	Sch.80	Extra Strong 0.5"	Threaded	Butt Welded	225
Low pressure steam (0 to 15 psig)	A106 or A53 Seamless or ERW	A or B	Sch.40	Standard 0.375"	Threaded Malleable	Butt Welded	225
Hot well steam condensate and pump discharge to 2-1/2" & up	A106 or A53 Seamless or ERW	B	Sch.80	Extra Strong 0.5"		Butt Welded	325
Hot well steam condensate and pump discharge to 2"	A106 or A53 Seamless or ERW	B	Sch.80	Extra Strong 0.5"	Threaded Malleable		325
Low pressure condensate return	A106 or A53 Seamless or ERW	A or B	Sch.80	Extra Strong 0.5"	Threaded *Note 1	Butt Welded	225
Make-up and fill (up to 150F on grooved)	Hard Drawn Copper	ASTM B88	Type L		95-5 Solder	Silver Brazed or Grooved *Note 3	225
Miscellaneous drains 2-1/2" & up (up to 150F on grooved)	A53	A or B	Sch.40	Standard 0.375"		Butt Welded or Grooved *Note 2, 3	225
Miscellaneous drains to 2"	Hard Drawn Copper	ASTM B88	Type L		DWV 95-5 Solder		225
Refrigerant system	Hard Drawn Copper	ASTM B280	Type L		Silver Brazed or Zoom Lock	Silver Brazed	---
Chilled water 2" or Less	Hard Drawn Copper	ASTM B280	Type L	None	Silver Brazed 95-5 Solder		225
Hot water 2" or Less	Hard Drawn Copper	ASTM B280	Type L	None	Silver Brazed 95-5 Solder		225
Condenser water 2" or Less	Hard Drawn Copper	ASTM B280	Type L	None	Silver Brazed 95-5 Solder		225

Note 1: In concealed inaccessible location provide socket welded;

*Note 2: Outdoor portion of piping shall be painted with a high temperature rust inhibiting primer and two coats of high temperature enamel paint (color shall be black unless otherwise selected by the architect);

*Note 3: Grooved piping systems of standard wall or lighter shall be roll grooved according to Victaulic roll groove specification standards. On piping heavier than standard wall, cut grooving required per the manufactures cut groove specification standard. Gasket must be selected for intended service. Where possible, all steel piping 4" and larger shall be grooved with Victaulic intelligent roll grooving machine RG5200i that provides traceability. All couplings, valves, fittings and pump accessories shall be of same manufacturer. A Victaulic representative shall periodically visit job-site to provide contractor training and support in techniques associated with proper pipe grooving and product installation.

Note 4: Grooved piping systems and press fittings to be utilized in accessible and exposed piping only. All piping located in vertical pipe chases and shafts and the utility shall be butt welded

8.14 INSULATION

- All insulation materials, finishes, coatings, cements, tapes, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "R" and "K" values conforming to the Latest Energy Conservation Codes which control building construction materials that may be used on this project.
- Insulation values for all systems must meet or exceed the requirements listed in ASHRAE 90.1.
- Maximum flame spread/smoke developed rating of 25/50 (indoor) and 75/150 (outdoor) in accordance with ASTM E 84, NFPA 255, or UL 723.

8.14.1 Ductwork

- Flexible fiberglass duct insulation shall be fiberglass FSK-faced duct wrap, Type 75 having an approximate density of 0.75 lb./cu.ft. and an approximate thermal conductivity (K-value) of 0.29 at 75° F and facing water vapor permeance of 0.02 perm.
- Rigid fiberglass board insulation shall be fiber glass Insulation Board with FSK facing having an approximate density of 3 lbs./cu.ft. and an approximate thermal conductivity of 0.23 at 75°F and facing water vapor permeance of 0.02 perm.
- For ductwork exposed to weather, board density of 6.0 lb./cu.ft. shall be substituted on the top surface. K-value shall be 0.23 or better. For duct insulation exposed to weather provide flexible weatherproof jacket. Installation shall be in strict accordance with the manufacturer's published literature.
- For round ductwork, semi-rigid faced pipe and vessel insulation comprised of same base materials and FSK facing shall be substituted. Density shall be 3.0 lb./cu. ft. or greater; K-value shall be 0.26 or better.
- Wherever insulation is exposed within finished spaces, a white all-service jacket (ASJ+) facing shall be substituted for FSK facing.
- Duct systems in their entirety shall be insulated per the table below:

TABLE 8.5 DUCT INSULATION

Minimum Insulation Installed Thickness (inch) / R-value by Duct External Environment				Service Key Notes
DUCTWORK SERVICE	CONDITIONED SPACE	H&V SPACE	UNHEATED SPACE/ OUTDOORS	1
Heating and/or Cooling Supply	R-4	R-6	R-12	2
Return & heat-recovery exhaust	Not required	R-6	R-12	3
Exhaust <140°F	Not required	R-4	R-4	4
Exhaust >140°F	R-4	R-4	R-4	5

Minimum Insulation Installed Thickness (inch) / R-value by Duct External Environment, Continued				Service Key Notes
DUCTWORK SERVICE	CONDITIONED SPACE	H&V SPACE	UNHEATED SPACE/ OUTDOORS	1
Exhaust/Relief stacks	Not applicable	Not applicable	Not required	6
Outdoor air, relief, intermittent exhaust	R-12	R-12	Not required	7
Dedicated life-safety supply	See Key Note 8	See Key Note 8	See Key Note 8	8
Kitchen grease exhaust	See Key Note 9	See Key Note 9	See Key Note 9	9

General Notes (Duct Insulation Table):

- Flexible blanket insulation may be used only where ducts are concealed from occupied space, e.g., above ceilings, in shafts, and for round ducts in all indoor locations. Board insulation shall be used where ducts are exposed within conditioned and H&V space, for all outdoor and other applications requiring additional jacket Code WP, and wherever scheduled R-value is R-8 or greater.
- All ducts exposed to weather, within vehicular facilities, within unheated enclosures, and exposed in wash-down environments shall have additional jacket Code WP applied.

Service Key Notes (Duct Insulation Table):

- Note 1: "Conditioned Space" is any space controlled - directly or in-directly - to be between 60°F and 90°F, and dehumidified to <70°F dewpoint. Such spaces include occupied space and associated ceiling cavities or return air plenums, interior shafts and mechanically-cooled equipment rooms, and heated overhangs within the building thermal envelope. "Un-heated Space/Outdoors" includes ducts exposed to weather, and in un-heated sheltered spaces such as attics, crawl space, overhangs, parking garages.
- Note 2: Supply service includes all ducts supplying air that can be heated or cooled to 15°F above or below the space temperature of zone served. Supply service insulation is not required where the duct is exposed within a thermostat zone that it serves and downstream of the zone control terminal.
- Note 3: Return/heat-recovery service includes all ducts returning air to HVAC equipment for re-circulation or for heat-recovery prior to discharge.
- Note 4: Exhaust >60°F and <140°F includes any contaminated airstream to be discharged outdoors. Includes room exhaust, lab hood exhaust, toilet exhaust, clothes-dryer exhaust, vapor-capture hoods diluted with conditioned room air, e.g., for batch autoclaves. Insulation for un-heated space is to control internal or external condensation.
- Note 5: Exhaust >140°F includes any contaminated

8.14.2 Piping

- Pre-Molded Fiberglass Insulation: Recommended temperature to 850°F with facing. Molded in one piece split or hinged circular sections in three-foot lengths for piping and tubing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 4.0 pounds per cubic foot and a K value of 0.23 at 75°F mean temperature.
- Hydrous Calcium Silicate Pipe Insulation: Molded, rigid, asbestos free, hydrous calcium silicate water resistant pipe insulation shall be molded to dimensional standards conforming to the pipe. Insulation shall have an approximate density of 11 lbs./cu.ft., an approximate thermal conductivity of 0.41 at 200°F mean temperature and shall be suitable for application on surfaces which reach 1200°F.
- Mineral Wool Pipe and Tank/Equipment Insulation: Pre-formed, high density, asbestos free, mineral (rock) wool with inorganic binders to for a non-combustible, high-temperature insulation. Pipe cover shall be two-piece. Insulation and fitting coverings shall be molded to dimensional standards conforming to the pipe. Insulation shall have an approximate density of 8 lbs./cu.ft., an approximate thermal conductivity of 0.30 at 200°F mean temperature and shall be suitable for application on surfaces which reach 1200°F.
- Flexible, Closed-cell, Elastomeric Insulation: Insulation material shall be a flexible, closed-cell elastomeric insulation. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518.
- Insulation Facing: All service jacket (ASJ) composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire-retardant adhesive.
- Piping systems shall be insulated per the table below

TABLE 8.6 PIPING INSULATION

SERVICE	TYPE INSULATION AND THICKNESS	FACING	ADDITIONAL JACKET*
HPS Steam (greater than 120 psig, but less than 300 psig)	Mineral Wool		
Up to 1-1/4"	5	ASJ	
1-1/4" to 4"	5	ASJ	
5" and larger	5	ASJ	
MPS & HPS Steam (greater than 15 psig, but less than 120 psig)	10 Molded Fiberglass		
Up to 1-1/4"	3.5	ASJ	
1-1/4" to 4"	4	ASJ	
5" to 16"	4	ASJ	
18" & Up	4.5	ASJ	

SERVICE	TYPE INSULATION AND THICKNESS	FACING	ADDITIONAL JACKET*
LPS Steam (Up to 15 psig) Up to 1-1/2" 1-1/2" to 6" 6" & Up	Molded Fiberglass 2.5 3 3 1/2	 ASJ ASJ ASJ	
Hot Water Heating, Glycol Systems & Condensate Water (up to 200°F) Up to 2" 2 1/2" & Up	Molded Fiberglass 2 2	 ASJ ASJ	
Chilled Water Up to 2" 2 1/2" & Up	Molded Fiberglass 1 1/2 2	 10-15	
Condenser Water (up to 100°F) Up to 12" 14" & Up	Molded Fiberglass 1 2	 ASJ ASJ	
Condensation Drains & Vents, Cold Water Make-up	Molded Fiberglass 1	ASJ	
Blowdowns and Steam Condensate (All Pressures) 1/2" to 2" 2 1/2" & Up	Molded Fiberglass 2.5 3	ASJ ASJ ASJ	
Emergency Generator Exhaust Piping	Hydrous Calcium Silicate 3 1/2	ADJ-6	ADJ-3b
Piping with Heat Trace	Molded Fiberglass min 3", but thicker if noted above	ASJ	ADJ-3b
All outdoor piping	Two times thickness scheduled		ADJ-3b
Others not scheduled	Molded Fiberglass 1	ASJ	
MRI Quench Vent (in MRI Room	1" mineral fiber with vapor barrier plus 2" of elastomeric		
MRI Quench Vent (indoors)	2" Elastomeric		
MRI Quench Vent (outdoors)	2" Elastomeric		

*Including elbows, fittings, valves, complete system.

8.14.3 Equipment

- Calcium Silicate Block Insulation: Insulation shall have a density of 11 lbs./cu.ft., a thermal conductivity of 0.37 at 200°F mean temperature, and shall be suitable for application on surfaces which reach 1200°F. All block insulation shall be applied in layers not exceeding 1-1/2 inches thick.
- Rigid Fiberglass Board Insulation: Rigid fiberglass board insulation shall be provided with ASJ having an approximate density of 6 lbs./cu.ft. and an approximate thermal conductivity of 0.25 at 75°F.
- HVAC equipment shall be insulated per the table below:

TABLE 8.7 EQUIPMENT INSULATION

SERVICE	TYPE INSULATION AND THICKNESS	FACING	ADDITIONAL JACKET*
All Expansion, Compression Tanks and Air Separators	Calcium Silicate Block 1		ADJ-6
Flash Tanks and Condensate Tanks	Calcium Silicate Block 3		ADJ-6
Hot Water Pumps	Calcium Silicate Block 3		Same as piping
Emergency Generator Mufflers	Calcium Silicate Block 3		ADJ-3b
Emergency Generator Exhaust	Calcium Silicate Block 3		ADJ-3b
Breeching	Calcium Silicate Block 3		ADJ-3b
Humidifier Steam Kettles	Calcium Silicate Block 3		ADJ-6
Deaerator Tank	Calcium Silicate Block 3		ADJ-6
Deaerator and Surge Tank	Calcium Silicate Block 3		ADJ-6
Tanks	Calcium Silicate Block 3		ADJ-6
Boiler Feed System	Calcium Silicate Block 3		ADJ-6
Blowdown Tanks	Calcium Silicate Block 3		ADJ-6
Blowdown Separator	Calcium Silicate Block 3		ADJ-6
Heat Exchanger	Calcium Silicate Block 3		ADJ-6
Chilled Water Pumps	Armaflex 3	Formed Covers w/Velcro Fastening	Same as piping
Pressure Reducing Valves	Custom Cover Fiberglass Mat 2	Heat-Holder LD-1000	
Other	Fiberglass 3	FSKL	Same as piping

8.15 VARIABLE FREQUENCY DRIVES

- All motors driven with VFDs shall have shaft grounding rings.3.
- All motors 30 HP and greater shall be 18 pulse.
- All motors 25 HP and less shall be 6 pulse or greater.
- All drives shall have a rating of 100,000 AIC.
- Provide 5% line reactors on each drive as a minimum.
- Provide NEMA 3R enclosure where drives are located outside, and a single NEMA 1 metal enclosure for interior applications.

8.16 TERMINAL DEVICES

8.16.1 Air Terminal Units

- Provide all air terminal boxes with heating coils, sound attenuators, & access doors.
- Terminal units shall be UL labeled and listed as an entire assembly.
- Provide terminal units with 22 gauge sheet metal casing and insulation.
- All terminal boxes shall have Direct Digital Controls (DDC).
- Thermal and acoustic insulating shall be Hospital Grade.
- Hot water heating coils shall be 2 row or Electric with SCR control.
- Provide terminal boxes with Damper and primary air pressure sensor.
- Provide access doors securely attached to the box upstream and downstream of the heating coil.
- Provide a damper motor suitable for electronic (DDC) control.

8.16.2 Laboratory Airflow System

- The laboratory airflow control system shall be a fully stand-alone system for each individual laboratory.
- The air flow control device shall be a venture valve equal to Pheonix Control Accell II.
- The airflow control device shall be pressure independent overs it specific differential static pressure range.
- All valves shall have an electric actuator mounted to each valve.
- Supply and general exhaust valves shall be constructed of heavy gauge aluminum. All critical bearing surfaces shall be make of Teflon infused aluminum. The devices shaft and brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be constructed of aluminum.
- Airflow control devices serving corrosive air stream such as fume hood and bio safety cabinets shall have baked on corrosion resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting spring shall be made of 316 stainless steel. All shaft bearing surfaces shall be made of Teflon.

- Fume hood exhaust valves shall be constant volume, 2 position based on Northeastern standard dynamic barrier fume hoods.
- The laboratory control system shall maintain temperature control, minimum ventilation, airflow balance, and pressurization.
- The ATC contractor shall regulate the space temperature.

8.16.3 Fan Coil Units

- Fan coil units must include the following components:
- A galvanized steel cabinet and insulated
- Provide hinged service panels for access.
- All fan coils shall include Merv 7 throwaway 1" filters.
- Provide fan coil units with centrifugal fans with EC motors. All fans shall be statically and dynamically balanced, with permanently lubricated or ball bearing shaft bearings.
- Heating and cooling coils shall be constructed with 5/8" O.D. copper tubes bonded to aluminum fins. Leak test the coil at an air pressure of 300 psig.
- Drain Pans shall be full length of the coils.
- Whenever possible fan coil condensate shall drain by gravity. The use of condensate pumps is discouraged.
- Provide fan coils with sound attenuators to meet noise criteria of specific spaces.

8.16.4 Unit Heaters

- Cabinet unit heaters should be used in and near outdoor entrances, at the base of stairwells, and in other locations that require heat but do not have the wall space for fin tube radiation.
- Unit heaters should be used in non-public spaces that require additional heat and have water available. Non-public spaces include mechanical and storage rooms.
- Electric cabinet heaters should be used only if the cost to run steam or hot water is prohibitive.
- Hot water coils shall be designed for a 20°F water temperature drop.

8.16.5 Diffusers, Registers and Grilles

- Each grille, register, and diffuser provided must have the accessories necessary to perform satisfactorily and to be fully adjustable, including opposed-blade volume dampers operable from the front, air deflectors, vanes, blanking quadrants, and similar components. At each inlet and outlet device, provide accessories to accomplish the positive regulation of air volumes and the uniform distribution of airflow over the outlet.

- Specify low velocity, non-aspirating, unidirectional diffusers in areas requiring laminar air distribution of particle-free air, such as OR suites and pharmacy sterile compounding areas. Air supplied through non-aspirating diffusers helps to prevent updrafts by moving air from the point source directly toward the exhaust or return air terminal. Air terminals shall be designed in a counter-flow, high supply, low return/exhaust arrangement. This air movement reduces the risk of healthcare workers inhaling contaminants. Aspirating supply diffusers shall not be used in these spaces. Do not use integral opposed blade dampers (OBD) on supply air diffusers or return air grilles for balancing purposes.
- Specify linear diffusers in lobbies, atria, and other selected public areas.
- Supply air diffusers shall be sized per the following chart:

TABLE 8.8 SUPPLY AIR DIFFUSERS SIZES

NECK SIZE	MAX. CFM (450 FPM)	ROUND NECK	MAX. CFM (450 FPM)
6x6	100 CFM	6	85 CFM
9x9	250 CFM	9	200 CFM
12x12	450 CFM	12	350 CFM
15x15	700 CFM	15	550 CFM
18x18	1000 CFM	18	800 CFM
21x21	1375 CFM	21	1050 CFM
24x24	1800 CFM	24	1400 CFM

- Exhaust/Return grilles shall be sized per the following chart:

TABLE 8.9 EXHAUST/ RETURN GRILLES SIZES

NECK SIZE	MAX. CFM (450 FPM)	ROUND NECK	MAX. CFM (450 FPM)
8x8	200 CFM	8	150 CFM
10x10	300 CFM	10	225 CFM
12x12	450 CFM	12	350 CFM
14x14	600 CFM	14	475 CFM
16x16	800 CFM	16	625 CFM
18x18	1000 CFM	18	800 CFM
24x24	1800 CFM	24	1400 CFM

9 Integrated Automation

9.0 INTEGRATED AUTOMATION

9.1 PRODUCT QUALITY STANDARDS AND COMPETITION

9.1.1 Prescriptive descriptions and references to specific manufacturers, products and vendors that may be described in this document are intended to establish a quality standard. The University's goal is to promote competition whenever possible for better pricing, amongst products of comparable quality and utility. Designers are encouraged to look at product alternatives and provide the University with a range of options. Rather than specifying particular products, consultants should also describe the salient attributes of components and systems as the basis of design to ensure competition.

9.2 SUMMARY

9.2.1 The following standards are intended to facilitate Northeastern University's vision for the future creation and use of a single master user interface for management of all applicable building control assets, including:

- HVAC Controls
- Lighting Controls
- Energy Meters
- Internet of Things (IoT) Monitoring Devices

- Third-Party Demand Response Devices/Signals
- Third-Party Monitoring-Based Commissioning Systems

9.2.2 These standards are to be used in the design and installation of all applicable control devices across the campus so that they are compatible with the future master user interface when it is installed. In the interim period, most applicable devices shall be integrated into the existing building automation system (BAS) network in each building. All designer contracts for Design and Construction projects executed after the issuance of these standards shall be bound by these standards, in addition to the design standards for their specific disciplines.

9.2.3 Building automation system vendors and third-party equipment vendors shall utilize only open protocol hardware and software and the vendor shall assign all software licenses, product registration information, engineering configuration tools, and administrative access/passwords directly to the University so that the University has the option to make changes or change vendors at any time with no loss in functionality or control.

9.3 RESPONSIBILITY MATRIX

9.3.1 The following matrix represents NU's preferred methodology for delineating scope assignments among the various parties included in a design and construction project; however, the matrix shall be reviewed and adjusted, if necessary, based on the unique aspects of each project. The Owner and prime designer shall mutually agree and document any changes to the specifications column of the matrix as part of the design consultant task order. The Owner and design team shall discuss and document any changes to the remaining columns as part of the Construction Documents.

TABLE 9.0 CONSULTANT AND VENDOR RESPONSIBILITIES

SYSTEM/ TASK	SPECIFY	FURNISH	INSTALL	INTEGRATE/ PROGRAM
Building Automation System	ME	ATC	ATC	ATC
Third-Party Mechanical Controllers	ME	MC	MC	ATC
Electric Meters	EE	EC	EC	BCM[1]
Steam/ Condensate Meters	ME	MC	MC	ATC[2]/BCM[1]
Network Lighting Controls (NLC)	EE	EC	EC	NLC Vendor and ATC[3]
Occupancy Sensors	EE	EC	EC	NLC Vendor and/or ATC

SYSTEM/ TASK	SPECIFY	FURNISH	INSTALL	INTEGRATE/ PROGRAM
Generators	EE	EC	EC	ATC[3]
Automatic Transfer Switches (ATS)	EE	EC	EC	ATC[3]
Interruptible Power Supplies (UPS)	EE	EC	EC	ATC[3]
Plumbing System Controllers	PE or ME	MC	MC	ATC[3]
Monitoring-Based Commissioning (MBCx) Software	ME	MBCx Vendor	MBCx Vendor	MBCx Vendor
Internet of Things (IoT) Devices	Arch or EE	IoT Vendor	IoT Vendor and/or GC/EC	IoT Vendor or ATC

[1] BCM is the only service vendor for the Schneider Power Monitoring Expert (PME) metering database and management system

[2] Steam and condensate meters may be integrated directly into the BAS by the applicable ATC contractor, but must also be integrated into the Schneider PME system by BCM independent of the ATC contractor on the project

[3] Integration by ATC into BAS for integrated sequences of operation

9.4 DESIGN DELIVERABLES

9.4.1 In addition to the above Responsibility Matrix, each design discipline shall produce an asset list of all equipment being monitored, controlled, alarmed, etc. through a user interface. The list shall include the device type, location, wiring requirements, communication protocol, user interface (e.g. will data be displayed on the BAS graphics or through a separate portal), and any specific IT or installation requirements (e.g. communication ports to be opened, IP address requirements, requirements to make data visible over the network). The intent of this list is for the design team to collectively identify coordination issues and/or opportunities to consolidate and simplify the design. For example, if the electrical engineer specifies a network lighting controls system with BACnet MS/TP networking, but the base building BAS uses BACnet IP, then this should spur the team to consider BACnet IP for the network lighting controls or to coordinate a convenient tie in location to minimize the size or installation complexity of the MS/TP network. Similarly, if two MODBUS devices using RS-485 cabling are proposed, one in the penthouse and one in the basement in an otherwise Ethernet IP building, then this should spur the team to consider locating both MODBUS devices in the same area to minimize RS-485 wiring complexity.

9.5 HVAC BUILDING AUTOMATION SYSTEMS

9.5.1 Andover Continuum Building Automation System

- The design and installation of new Andover Continuum hardware and software shall be restricted to projects of limited scope (less than 10,000 ft2) or where the HVAC controls scope is limited to in-kind replacement of aging Andover Continuum hardware. For projects that do not fit this category and that occur within a building that NU designates as intended for Andover/Schneider long term (consult with the NU Energy Group for determination), the new controls infrastructure shall be specified as Schneider EcoStruxure. If there is not currently an Automation Server (AS) installed in the building, the scope of the project shall include installation of at least one Automation Server and associated networking equipment to facilitate the new equipment controllers included in the scope.
- Designers shall specifically coordinate all integration requirements between the new EcoStruxure controllers and any existing to remain Andover Continuum infrastructure necessary for control. For example, the new sequence of operation may require that the new EcoStruxure Automation Server communicate with the existing to remain Andover Continuum system to determine the availability of hot or chilled water, to call for upstream air handling unit(s) to cycle on, or to reset static pressure setpoints. This may be accomplished by establishing communication between the existing Continuum and new EcoStruxure systems or by removing the existing Continuum bCX building controller and integrating the Continuum RS-485 Infinet network into the Automation server.

9.5.2 Schneider EcoStruxure Building Automation System

- All new EcoStruxure networks shall be Ethernet-based. Ethernet networks at the building-level connecting the supervisory controllers and equipment controllers shall be furnished and installed by the installing contractors. Networking between buildings and between supervisory controllers shall utilize the existing NU VLAN system managed by NU IT. In order to increase redundancy and resiliency, network topology from Ethernet switches to the downstream control devices shall be in a star-configuration (i.e., "home run") or rapid spanning tree protocol (RSTP). Provide at least one Ethernet switch per floor and/or per wing of a given building. Installing contractors shall coordinate the quantity and location of Ethernet switches to minimize the overall installation cost.
- Each building shall have at least one BTL-certified BACnet Automation Server (model AS-P or equivalent) serving as the supervisory controller for the building network. An existing to remain RS-485 Infinet network may be integrated into a new Automation Server via one of the AS's RS-485 network ports or via another dedicated Automation Server. Existing to remain BACnet MS/TP third-party devices may be integrated into a new Automation Server via another of the AS's RS-485 network ports.
- The existing EcoStruxure network includes one Enterprise Server and no additional Enterprise Servers are expected to be needed to support near-term projects or upgrades.

- All new equipment controllers shall be Schneider BACnet IP controllers (model MP or equivalent) running on the EcoStruxure network. All new controllers shall be BTL-certified.

9.5.3 Alerton Ascent Compass Building Automation System

- All existing Alerton networks use BACnet MS/TP; however, new Alerton networks in new construction projects shall be Ethernet-based. Ethernet networks at the building-level connecting the supervisory controllers and equipment controllers shall be furnished and installed by the installing contractors. Networking between buildings and between supervisory controllers shall utilize the existing NU VLAN system managed by NU IT. In order to increase redundancy and resiliency, network topology from Ethernet switches to the downstream control devices shall be in a star-configuration (i.e., "home run") or rapid spanning tree protocol (RSTP). Provide at least one Ethernet switch per floor and/or per wing of a given building. Installing contractors shall coordinate the quantity and location of Ethernet switches to minimize the overall installation cost.
- Each building shall have at least one BTL-certified Ascent Control Module (model ACM or equivalent) serving as the supervisory controller for the building network. BACnet MS/TP third-party devices, if required, may be integrated into the same ACM via one of its RS-485 network ports.
- The existing Alerton network includes one Compass Enterprise Workstation Server and no additional Enterprise Servers are expected to be needed to support near-term projects or upgrades.
- All new equipment controllers shall be Alerton BACnet IP controllers (model VLC or equivalent) running on the Alerton network. All new controllers shall be BTL-certified.

9.5.4 KMC Niagara N4 Building Automation System

- All existing KMC networks use BACnet MS/TP; however, new KMC networks in new construction projects shall be Ethernet-based. Ethernet networks at the building-level connecting the supervisory controllers and equipment controllers shall be furnished and installed by the installing contractors. Networking between buildings and between supervisory controllers shall utilize the existing NU VLAN system managed by NU IT. In order to increase redundancy and resiliency, network topology from Ethernet switches to the downstream control devices shall be in a star-configuration (i.e., "home run") or rapid spanning tree protocol (RSTP). Provide at least one Ethernet switch per floor and per wing of a given building. Installing contractors shall coordinate the quantity and location of Ethernet switches to minimize the overall installation cost.
- Each building shall have at least one BTL-certified JACE controller (model KMN-J-8000 or equivalent) serving as the supervisory controller for the building network. BACnet MS/TP third-party devices, if required, may be integrated into the same JACE via one of its RS-485 network ports.
- The existing KMC network includes one KMC Niagara N4 server and no servers are expected to be needed to support near-term projects or upgrades.

- All new equipment controllers shall be KMC Conquest BACnet IP controllers (model BAC or equivalent) running on the KMC network. All new controllers shall be BTL-certified.

9.5.5 The building automation systems currently in use across the campus are listed in the table below by building:

ABS (Alerton)	BCM (Continuum / EcoStruxure)	Zenergy	Zenergy / BCM	Zenergy / ABS	ABS / BCM
Behrakis/ West E	Art/ Architecture Studio	Boat-house	Curry	Cargill	Calbot
Burlington Campus	Burstein/ Rubenstein	Hastings	140 The Fenway	Marino	Churchill
780 Co-lumbus	Chaners				716 Co-lumbus
Daven-port A	Coventry				Cullinane
Daven-port B	Dana				Ell
Dedham Campus	Dockser				Forsyth
East Village	Dodge				Hayden
Egan	153 Hemenway				Holmes
Fenway Arts	Hurtig				Knowles
Interna-tional Village	Kariotis				Matthews
ISEC	Kerr				Richards
Levine/ St Stephan	Lake				Snell En-gineering
Nahant Campus	Latino				
Smith	Melvin				
Speare	Meserve				
Squash-busters	Mugar				
Stearns	Nightingale				

ABS (Alerton)	BCM (Continuum / EcoStruxure)	Zenergy	Zenergy / BCM	Zenergy / ABS	ABS / BCM
Stetson East	Power Plant				
Stetson West	Robinson				
West A	Ryder				
West B/C	Shillman				
West F	Snell Library				
West G/H	White Hall				
	Willis				

9.6 CONTROL POINT NAMING CONVENTION

9.6.1 All control points within a BAS and within the future single master user interface shall follow an identical naming convention as follows. Separate descriptions should be created with the point name to give a plain English translation of the meaning of the point. Names for unique points not covered by the naming convention shall be coordinated with the Owner to maintain consistency from project to project. NU's Energy Management Group shall have final authority over such decisions.

- Formula - Building_Area_EquipmentName_Component_Property_Type
- Building - two character code for the building name from the NU Facilities Matrix. For example, SN for Snell Engineering or EC for Egan Research Center.
- Area (Optional) - abbreviation for the location served by the equipment
- Equipment Name - abbreviated equipment tag name. For example, AHU-1 for AHU-1 or CHW for Chilled Water System.
- Component (Optional) - abbreviated name of the sub-system within the piece of equipment. For example, CHWV for the chilled water valve in an air-handling unit or P-SUP for primary loop supply piping.
- Property - abbreviated name of the point being reference. For example, POS for valve position signal or TEMP for temperature.
- Type (if applicable) - abbreviate description of the point type. For example, blank for present value or SP for setpoint.
- Other examples:
  - *BK_AHU-4_OAD_POS for Behrakis AHU-4 outside air damper position*
  - *EV_RM105_LIGHT_F1_OCC_FBK for East Village Room 105 lighting fixture-1 occupancy sensor feedback*
  - *SL_SUMP-1_LVL_SP for Snell Library sump pump-1 water level setpoint*
  - *HT_GEN_OIL_TEMP_ALM for Hurtig generator oil temperature alarm*

9.7 DATA TRENDING AND ARCHIVING

9.7.1 Short- and long-term data trending and archiving are critical to the long-term operation and maintenance of NU facilities and assets. All control inputs, outputs, setpoints, and key system variables (e.g. calculated totals, averages, control modes, global parameters) must be trended and archived. Analog points shall be trended every 15 minutes and binary points may be trended at the same 15 minute time interval or upon a change in value. All trends associated with a given piece of equipment or system shall be stored together and retrievable as a group, rather than on a point-by-point basis. Operational data, such as from an HVAC controls system, shall be archived for a minimum of two years before being overwritten by more recent data. Alarm data shall be archived for a minimum of 3 years. Meter data shall be archived for a minimum of 5 years. Trend log data shall be exportable in .csv, .txt, .xls, or .xlsx format from the trending feature on a given graphic page or from a custom database export.

9.7.2 Designers shall specify that where proposed hardware, software, or networking would be insufficient to meet the above requirements, bidding contractors shall identify infrastructure upgrades that would be necessary to comply with these standards. NU and the engineer of record shall consider such upgrades and incorporate them into the project scope to the greatest extent possible.

9.8 THIRD-PARTY MECHANICAL CONTROL DEVICES

9.8.1 OEM controllers shall control the operation of each of the internal components of the equipment, such as the compressor staging, oil pumps, control valves, etc. The OEM controller shall be integrated into the HVAC BAS network that is responsible for controlling the other associated equipment in the building. For example, a new RTU shall be integrated with the BAS that controls the RTU's VAVs.

9.8.2 The OEM controller shall be paired a dedicated BAS controller with limited hard-wired input/output point connections. The only exception to this requirement among the above listed mechanical equipment shall be air compressors, which may be integrated directly with the BAS supervisory controller for monitoring only. The hard-wired points shall constitute the minimum points required to keep the equipment running properly per the sequence of operation in the event of a loss of BACnet network connection. Note that because of the reduce input/output point capacity requirements of the dedicated BAS controller, a more cost-effective BAS controller may be sufficient, as compared with a BAS controller for a full custom DDC arrangement. Examples of hard-wired input/output points to be provided by the dedicated BAS controller include the following.

- Start/stop command
- Status feedback
- General alarm
- Fan or pump VFD speed command
- Supply air or water temperature setpoint
- Supply air or water flow or pressure setpoint

9.8.3 All additional points available from the OEM controller shall be read by the BAS controller via BACnet. Such points may include power consumption, compressor of fan speeds, air, water, or refrigerant pressures and temperatures, flow switch statuses, alarms, and diagnostics. Designers shall specify that equipment vendors are required to expose all BACnet points to be visible to other network devices and make necessary points writeable (i.e. not read-only) per the sequence of operation. Where BACnet points lists are not published by the manufacturer, the equipment vendor is responsible for providing such information, including all point addresses, identification numbers, networking information, etc. as a condition of purchasing the equipment.

9.8.4 The BAS controller shall monitor the BACnet connection to the OEM controller via a built-in heartbeat point or by its own custom program and the BAS controller shall generate its own alarm in the event of a loss of BACnet connection to the OEM controller.

9.9 METERS

9.9.1 Refer to the Division 23 (Chapter 8) and Division 26 (Chapter 10) design standards for performance requirements for specifying new meters. New meters shall be provided with BACnet IP communication capabilities to the greatest extent possible. In the event that NU's preferred meter manufacturer does not offer BACnet IP communication, BACnet MS/TP is acceptable. Other communication protocols require specific coordination and approval by NU before inclusion in a set of construction documents. All data from meters shall be accessed by the Schneider PME system as read-only. New meters shall also be integrated with the BAS network in the applicable building. Data archiving on the BAS server is not desired, however, as all archiving is done in PME.

9.9.2 Steam meters shall be specified with the ability to sense directionality of flow and the BAS shall generate an alarm upon detection of backward flow. Steam meters shall also be specified with temperature and pressure compensation to calculate mass flow rate from volumetric flow rate or velocity.

9.9.3 Condensate meters shall be specified with the ability to sense directionality of flow and the BAS shall generate an alarm upon detection of backward flow. Condensate meters shall also be specified with temperature sensors. Refer to NU's Division 23 Design Standards for more specific technical requirements for specifying steam and condensate meters.

9.9.4 All available data points for each meter shall be read into the Schneider PME system and BAS, but at a minimum must include:

ELECTRIC	NATURAL GAS	STEAM	CONDENSATE
• kW, kVA, and kVAR • Voltage, amperage, and power factor for each phase • Frequency • Alarms and diagnostics	• Volumetric flow rate (ft3/h) • Alarms and diagnostics	• Velocity • Pressure and temperature • Mass flow rate (lb/h) • Flow direction • Alarms and diagnostics	• Volumetric flow rate (gpm) or flow pulse (gal) • Temperature • Mass flow rate (lb/h) • Flow direction • Alarms and diagnostics

9.10 NETWORK LIGHTING CONTROLS

9.10.1 Where possible, new network lighting controls systems shall integrate with the existing Lutron Quantum Enterprise View supervisory control and user interface. Network lighting controls systems shall be specified with BACnet communication. IP communication is preferred, but the cost may not be justified depending on the size and scope of the project. The engineer of record shall investigate and present to the Owner a summary of the costs and benefits of IP vs MS/TP communication for the Owner's input.

9.10.2 Where network lighting controls are used, occupancy/vacancy sensors shall be the primary determination of whether or not the fixtures in a given space are illuminated.

9.10.3 NU's preference is to have lighting control at the individual fixture level, rather than the zone-, circuit-, or floor-level. Fixtures shall be grouped at the circuit, zone, and floor level within the lighting controls software to allow for simultaneous control of numerous fixtures. By default, the base building schedule shall be applied to each fixture, but custom schedules may be generated, such as for lobbies and corridors. Network lighting control systems shall be specified with the ability to dim each fixture or group of fixtures through the user interface.

9.10.4 The network lighting controls system shall be integrated with the BAS for the purpose of enabling load shed mode. Load shed shall be enabled through the BAS graphics and then communicated by the BAS to the networking controls system via BACnet. The network lighting controls system shall be programmed by the electrical contractor to respond to a load shed event by dimming fixtures as much as possible. Coordinate with the Owner during construction to determine the allowable dimming levels in each type of zone during a load shed event.

9.10.5 All available data points shall be read into the Lutron Enterprise View system, but at a minimum must include the following. Designers shall specify that equipment vendors are required to expose all BACnet points to be visible to other network devices and make necessary points writeable (i.e. not read-only) per the sequence of operation. Where BACnet points lists are not published by the manufacturer, the equipment vendor is responsible for providing such information, including all point addresses, identification numbers, networking information, etc. as a condition of purchasing the equipment.

- Lighting status by fixture, zone, circuit, etc.

- Occupancy status by fixture, zone, circuit, etc.
- Dimming output by fixture, zone, circuit, etc.
- Alarms and diagnostics

9.10.6 Designers shall also specify applicable alarms that shall be configured by the Lutron vendor at the Enterprise View user interface. These should include at a minimum:

- Lighting inactive in occupied space
- Convey controller alarms and diagnostics through user interface

9.11 MAJOR ELECTRICAL EQUIPMENT

9.11.1 Major electrical equipment, including emergency and standby generators, automatic transfer switches (ATSs), and uninterruptable power supplies (UPSs), shall be integrated with the BAS in each applicable building via BACnet IP for monitoring purposes only. If BACnet IP communication is not available from NU's preferred manufacturer, then BACnet MS/TP, TCP/IP, or MODBUS may be acceptable, but must be coordinated in writing with the Owner and mechanical engineer to confirm compatibility with the BAS. Electrical engineers shall specify all new electrical equipment with control panels and/or communication cards, even if not provided standard by the manufacturer, to ensure that the desired data points are available and accessible for monitoring.

9.11.2 Designers shall review available options, sensors, configurations, etc. for the generator control panels and identify in their specifications any such options, sensors, configurations, etc. required so that at least the following data points are provided and the data points will be accessible to the future single master user interface.

9.11.3 All available data points shall be read into the BAS, but at a minimum must include the following. Designers shall specify that equipment vendors are required to expose all BACnet points to be visible to other network devices and make necessary points writeable (i.e. not read-only) per the sequence of operation. Where BACnet points lists are not published by the manufacturer, the equipment vendor is responsible for providing such information, including all point addresses, identification numbers, networking information, etc. as a condition of purchasing the equipment.

GENERATOR	ATS	UPS
• Status • Total kW and kVA • Power factor and frequency (Hz) • Voltage and amperage for each phase • Fuel level • Oil temperature and pressure • Alarms and diagnostics	• Status • Total kW and kVA • Power factor and frequency (Hz) • Source and load voltage and amperage for each phase • Alarms and diagnostics	• Status • Percent state of charge • Battery voltage • Output voltage and amperage for each phase • Internal temperature • Alarms and diagnostics

9.11.4 Software alarms will also be configured within the BAS. These will include the following at a minimum.

- Generator active
- Generator under ATS load
- High or low voltage
- Generator fuel level falls below low limit
- Generator oil temperature or pressure rises above high limit
- Low UPS battery charge
- High UPS internal temperature
- Convey device alarms and diagnostics through BAS user interface

9.12 PLUMBING DEVICES

9.12.1 Major plumbing equipment, including hot water heaters, indirect hot water generators, sump pumps, domestic water pumps, and acid neutralization systems, shall be integrated with the BAS in each applicable building via BACnet IP for monitoring purposes only. If BACnet IP communication is not available from NU's preferred manufacturer, then BACnet MS/TP, TCP/IP, or MODBUS may be acceptable, but must be coordinated in writing with the Owner and mechanical engineer to confirm compatibility with the BAS. Plumbing engineers shall specify all new plumbing equipment with control panels and/or communication cards, even if not provided standard by the manufacturer, to ensure that the desired data points are available and accessible for monitoring.

9.12.2 In the event that no networkable option is available from the manufacturer for a simple piece of equipment, such as a sump pump, designers shall specify that a BAS controller and associated hard-wired input/output points, such as current switch for pump status and water level indicator, be provided.

9.12.3 All available data points shall be read into the BAS, but at a minimum must include the following. Designers shall specify that equipment vendors are required to expose all BACnet points to be visible to other network devices and make necessary points writeable (i.e. not read-only) per the sequence of operation. Where BACnet points lists are not published by the manufacturer, the equipment vendor is responsible for providing such information, including all point addresses, identification numbers, networking information, etc. as a condition of purchasing the equipment.

- DHW Heater/ Generator
  - *Heater/generator status*
  - *Tank water temperature*
  - *Tank water level*
  - *Discharge water pressure, if available*
  - *Natural gas valve command and status*
  - *Alarms and diagnostics*

- General DHW
  - *DHW recirculation pump command and status*
  - *Pump speed, if applicable*
  - *DHW recirculation water temperature*
  - *Mixing valve inlet and outlet temperatures*
- Sump Pumps
  - *Pump status*
  - *Water level, analog feedback or binary switch status*
- Acid Neutralization System
  - *Pump status(es)*
  - *Water pH level*
  - *Tank water level(s)*
  - *Alarms and diagnostics*

9.12.4 Software alarms will also be configured within the BAS. These will include the following at a minimum.

- Tank water temperature too high or too low
- Tank water level too low
- DHW heater not running when temperature is below setpoint
- Pump not running while the domestic hot water system is active
- Sump pump not running with water level above maximum
- Water pH too low or too high
- Pump not running when commanded on
- Recirculation pump not running when recirculation water temperature falls below setpoint
- Convey device alarms and diagnostics through BAS user interface

9.13 MONITORING-BASED COMMISSIONING SOFTWARE

9.13.1 General - In order to more efficiently monitor and analyze the data being captured and archived by the BAS and future single master user interface, Northeastern University intends to utilize monitoring-based commissioning (MBCx) software tools to automatically mine data and provide targeted insights for users. At present, NU utilizes MBCx software from multiple providers in limited deployments across campus. The existing systems are generally cloud-based, gather data directly from NU equipment controllers on the NU network, and display analytic results via a dedicated web-based dashboard user interface. Any software purchased and deployed that is intended to remain operational once the single master user interface is installed must comply with the following standards.

9.13.2 In the event that the MBCx software is installed on a separated server/VM in NU's database, communication between the MBCx VM and single master user interface VM shall be limited to TCP/IP ports only.

9.13.3 In the event that the MBCx software is cloud-based, communication from the NU server to the MBCx cloud shall be via port 443 for https communication.

9.13.4 MBCx software installed on a VM in NU's data center shall strictly follow all firewall and encryption standards set and managed by NU IT.

9.13.5 Cloud-based MBCx software shall include tiered firewalls, preventing unauthorized access into or among its different components, including web services, data processing engines, and data storage.

9.13.6 The data connection between NU's IT network and the MBCx system shall be via a secure virtual private tunnel with RSA (or equivalent) encrypted communication and trusted certificates.

9.13.7 All user accounts for NU personnel shall integrate with NU's Active Directory system for secure single sign-on functionality.

9.13.8 MBCx system alarms and notifications shall be compatible with being streamed to the future single master user interface database and communicated to users through the single master user interface.

9.13.9 Analytics shall not replicate any alarms, such as equipment failing to run or spaces outside of acceptable temperature ranges, already implemented through the BAS, but rather should focus on conditions where equipment is operating inefficiently or otherwise not following the current or optimal sequence of operation for the particular application.

9.13.10 Examples of acceptable analytics include:

- Airflow detected through a VAV box damper that is commanded closed
- Simultaneous heating and cooling by an AHU
- Inefficient chiller staging based on part load performance curve data
- Lab zones operating at a higher than necessary air change rate
- Steam-to-hot water heat exchanger not providing any heat to entering hot water despite the valve being commanded open

9.13.11 Analytic results data shall be generated for each timestamp so that analytic results can be graphed with any other time series data to identify patterns or common issues affecting multiple systems.

9.14 DESIGN AND CONSTRUCTION DELIVERY

9.14.1 General - Until the single master user interface is installed, the extent of the responsibility of designers and contractors shall be to specify, furnish, and install systems that are compatible with the future single master user interface per these standards,

but not necessarily to take any active steps to start the integration process. NU's Commissioning Group representative or third-party commissioning agent on each project is responsible for assisting the project manager in achieving compliance with these standards. NU encourages a collaborative approach among the designers and building automation system vendors during the design process to coordinate specific details applicable these standards to achieve compliance.

9.14.2 The prime designer shall be responsible for coordinating each of the design disciplines' specifications and confirming they adhere to the requirements of these standards. The prime designer shall include an integrated automation system narrative in their specifications that expresses the overall design intent and provides an inventory of all assets covered by these standards. For any instances where the designer's specification, from any specific discipline, does not comply with these standards, the designer shall notify the Owner of this discrepancy and provide a brief written description of why the standards cannot or should not be followed in that instance.

9.14.3 As outlined elsewhere in these standards, each applicable trade contractor shall provide a submittal package for review and approval by the design team. The submittal package must include controls and network details necessary confirm compliance with these standards. These may include but are not limited to the follow items.

- Network architecture diagram
- Product data for all new hardware. Product data sheets shall be marked up to specifically call out only those items and options that are relevant to the scope of work.
- Product data for all new software, including upgrade software licenses. Product data sheets shall be marked up to specifically call out only those items and options that are relevant to the scope of work.
- Proposed alarm configuration details. Alarms in the submittal shall comply with the design specifications intent, but may recommend adjustments, if necessary, to improve system effectiveness and/or compliance with NU standards.
- Proposed equipment and occupancy schedules.
- Proposed integrated sequences of operation. Integrated sequences of operation, described further below, apply to controls programming implemented at the single master user interface in order to make use of data from across multiple disciplines. The prime designer shall provide these sequences as part of the design specifications. The master systems integrator integrated sequences of operation in the submittal shall comply with the design specifications intent, but may recommend adjustments, if necessary, to improve system effectiveness and/or compliance with NU standards.
- Graphics mockups for review and approval by the Owner and engineer of record.

9.15 COMMISSIONING

9.15.1 For functions that involve work by multiple contractors, each contractor is responsible for working with the NU assigned commissioning agent with their respective MEP system. And for example, for generating alarms from a packaged chiller controller, etc.:

- The mechanical contractor (who provides the chiller) is responsible for confirming that the chiller controller generates all alarms in the specifications
- The building automation system contractor is responsible for confirming that their controller(s) receive all of the chiller controller's alarms and that the building automation system controller(s) generate all required building automation system alarms corresponding to the chiller controller's alarms

9.16 INTEGRATED SEQUENCES OF OPERATION

9.16.1 Integrated sequences of operation involve the use of control inputs or behaviors on one system to influence the behavior of a separate system. Separate systems could include one or more of the building automation systems, lighting controls, backup generators, etc. Each engineering discipline is responsible for specifying the inputs and responses of their relevant systems as part of the integrated sequence of operation. The prime designer shall have responsibility for coordinating among the applicable design disciplines. The following integrated sequences of operation shall be included in the scope of a given project if each of the required subsystems is a part of the scope.

9.17 PLANT AND END DEVICE COORDINATION

9.17.1 For instances where central plant equipment, such as a chilled water system, is controlled by a different building automation system from the HVAC end devices, such as fan coil units, the single master user interface will eventually manage communication between the systems, but in the interim, the two systems shall be configured to share necessary data between each other via BACnet. The end devices' BAS shall monitor the end devices to determine if any are calling for service from the plant. In that case, the end devices' BAS shall generate a signal to the plant's building automation system indicating that there is a call for cooling. Similarly, if the plant is disabled and not available to run, the plant BAS shall pass a point value to the end devices' building automation system indicating that no service from the plant is available. The mechanical engineer of record is responsible for specifying these details.

9.18 ELECTRICAL DEMAND MANAGEMENT

9.18.1 The building automation system design in each building shall include demand management sequences of operation. The demand management sequences shall use the input of the current building meter demand data as an input to the HVAC and lighting controls systems to operate at lower output to reduce demand costs.

9.18.2 The applicable BAS shall monitor the electric meter demand of all applicable meters, via BACnet connection to the Schneider PME system, and if the demand of any meter rises above a minimum threshold, the BAS and/or lighting controls system shall initiate demand management mode. The BAS and/or lighting controls system shall calculate a demand reduction value from 0 to 100% for no demand reduction to maximum demand reduction, respectively. Upon calculating the demand reduction value, the following responses shall occur:

- The HVAC controls system shall increase space temperature cooling setpoints, reduce static pressure and differential pressure setpoints, and decrease maximum VFD speed setpoints.
- The lighting controls system shall dim applicable fixtures.

9.19 BACKUP GENERATOR MODE

9.19.1 The BAS shall monitor the status of the backup generator(s) in each building via MODBUS or TCP/IP and upon determination that a backup generator is running under load, the HVAC controls system shall initiate sequences of operation to reduce demand of applicable systems to extend the available runtime of the generator. Similarly, the lighting controls system shall dim applicable fixtures to reduce demand.

10 Electrical

10.0 ELECTRICAL

This section contains general design criteria for Electrical Systems. These Guidelines are intended to convey both general and specific requirements, but in brief terms. The design consultant or contractor shall prepare full detailed documents and specifications relevant to the project scope.

10.1 PRODUCT QUALITY STANDARDS AND COMPETITION

10.1.1 Prescriptive descriptions and references to specific manufacturers, products and vendors that may be described in this document are intended to establish a quality standard. The University's goal is to promote competition whenever possible for better pricing, amongst products of comparable quality and utility. Designers are encouraged to look at product alternatives and provide the University with a range of options. Rather than specifying particular products, consultants should also describe the salient attributes of components and systems as the basis of design to ensure competition.

10.2 GENERAL REQUIREMENTS

10.2.1 The basic design criteria shall incorporate the following:

- Clearances and accessibility to equipment to allow for safety, operation, maintenance, repair and replacement
- Energy efficiency
- Sustainability/Recyclability
- Future expansion capabilities (minimum 25% spare capacity)
- Quality and consistency throughout campus
- Cost considerations

10.2.2 The selection of equipment and distribution shall be developed based on an expected operational life expectancy of 30-40 years.

10.3 POWER SYSTEM STUDIES

10.3.1 A Power System Study shall be specified on the following projects:

- New Buildings
- Large renovation projects.
- As an expansion to an existing building that has had a Power System Study performed on it.

10.3.2 The Power System Study shall include the following:

- Short Circuit Study
- Device and Equipment Evaluation
- Selective Coordination Study
- Arc Flash Hazard Analysis

10.3.3 The Power System Study shall be performed a professional engineer registered in the Commonwealth of Massachusetts with more than 5 years' experience performing such studies.

10.3.4 Arc flash labels shall be machine printed vinyl signs complying with OSHA and NFPA 70E requirements including information and OSHA compliant color coding and symbology.

10.3.5 The Power System Study data files shall be provided to Northeastern University as a deliverable after acceptance by the engineer of record and Northeastern University personnel.

10.4 ALTERATIONS AND DEMOLITION

10.4.1 Maintain existing systems in service until permanent cutover. Obtain permission from Owner at least two weeks before partially or completely disabling any system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

10.4.2 Obtain Owner approval before interruptions to any existing operations/systems. Electrical contractor shall submit a Methods of Procedure (MOP) detailing the steps to complete the task. Submit detailed plan of work to be done and existing areas or equipment to be affected prior to all cutovers.

10.4.3 All unused wiring, raceways, junction boxes, etc. effected by renovation work shall be removed in its entirety, back to its source, unless identified as spare or for future use**.**

10.4.4 In compliance with Federal, State, and Local requirements, legally dispose of equipment and materials removed and not required for reinstallation, unless specifically designated to remain the property of the Owner. Provide certification of proper disposal for all regulated material.

10.5 IDENTIFICATION

10.5.1 Identification shall be of a material and attachment method suitable to the environment where it is located. Exterior identification shall be weather, chemical and UV resistant.

10.5.2 Regulatory Requirements and Standards:

- ANSI Z535 Safety Standards.
- ANSI A13.1.
- OSHA

10.5.3 Materials, colors and nameplate schedule shall be submitted to the Engineer of Record and Owner for review prior to order.

10.5.4 Power Conductor Identification - Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for conductors.

- Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
- Colors for 208/120-V Circuits:
  - *Phase A: Black.*
  - *Phase B: Red.*
  - *Phase C: Blue.*
  - *Neutral: White*
- Colors for 480/277-V Circuits:
  - *Phase A: Brown.*

- *Phase B: Orange.*
- *Phase C: Yellow.*
- *Neutral: Gray.*

10.5.5 Equipment Identification:

- Provide engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Minimum letter height shall be 3/8 inch (10 mm).

10.5.6 Device Identification:

- Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.
- Extra strength laminated TZ Tape by P.Touch or approved equivalent.

10.6 LOW-VOLTAGE CONDUCTORS AND CABLES (600V OR LESS)

10.6.1 Size branch circuit wiring not to exceed 3 percent voltage drop and feeders not to exceed 2% voltage drop.

10.6.2 Conductor insulation shall be rated for 90°C in wet or dry locations to comply with 100% rated overcurrent devices and for derating purposes.

10.6.3 Conductor ampacity shall be based on 60°C for circuits of 100A or less. 75°C for circuits over 100A.

10.6.4 All power feeder and branch circuit conductors and cables shall be copper and minimum conductor size shall be #12 AWG. Control signal and interlock wiring is permitted to be minimum #14 AWG.

10.6.5 Interior branch circuits #10 AWG and smaller, 600V insulation Type THHN/THWN for dry locations, Type THWN-2 or XHHW-2 for damp and wet locations.

10.6.6 Interior branch circuits or feeders #8 AWG and larger, 600V insulation Type THHN/ THWN-2 or XHHW-2 for dry, damp and wet locations.

10.6.7 Exterior branch circuits and feeders and 100% rated breakers, 600V insulation Type XHHW-2 for dry, damp and wet locations.

10.6.8 Control circuits: 600V insulation, stranded Type THHN/THWN for dry locations, Type THWN-2 or XHHW-2 for damp and wet locations.

10.6.9 Metal Clad (MC) cable may be used in concealed locations for branch circuit wiring.

10.6.10 Metal Clad (MC) cable shall be UL Listed with THHN insulated conductors with an insulated grounding conductor within a galvanized steel interlocked armor. Aluminum armor is not acceptable. Connectors shall be provided with lock nut connection to the termination point enclosure.

10.6.11 Metal Clad (MC) cable utilized for Fire Alarm service shall be identified with a factory applied tracer along the entire length.

10.6.12 For branch circuit homeruns, Metal Clad (MC) cable shall transition to conduit/ wireways and conductors before entering the panelboard.

10.7 GROUNDING AND BONDING

10.7.1 Install insulated green equipment grounding conductors with all feeders and branch circuits.

10.7.2 Provide Bonding bushings and associated jumpers on all raceways that terminate in eccentric and concentric knockouts and conduit entry openings not enclosed by metal structure.

10.7.3 Bonding bushings shall be threaded pressed steel hot dipped galvanized with conduit end stop and integrally molded noncombustible phenolic insulated surface rated for 150 C with a lay-in tin plated copper grounding lug.

10.7.4 Bond neutral, equipment grounding conductor, transformer case and the grounding electrode at the transformer.

10.7.5 For exterior transformers grounding electrode to consist of a grounding ring around the concrete pad and at least two rod electrodes. Bond to transformer in at least two separate locations.

10.7.6 Grounding busses stall be installed in electrical and communication rooms and in rooms housing service equipment.

- Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

10.7.7 In rooms with medium voltage distribution equipment wrap room with ground bus on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

10.8 HANGERS AND SUPPORTS

10.8.1 Hangers and Supports shall meet the following performance requirements:

- Size for 200% minimum safety factor.
- Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria specific to each project.
- Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

10.8.2 Channel support systems shall comply with MFMA-4 and be a minimum of #12 gauge.

10.8.3 Provide support system materials and accessories as follows:

- Interior non-corrosive areas:
  - *Pre-galvanized*
  - *Hot dip galvanized.*
- Interior corrosive areas:
  - *Stainless steel*
  - *Fiberglass*
- Exterior use:
  - *Hot dip galvanized.*
  - *Stainless steel*
  - *Fiberglass*
- Underground use:
  - *Fiberglass*
  - *Stainless steel*

10.8.4 Do not fasten supports to piping, support wires, ductwork, mechanical equipment, or conduit.

10.8.5 Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

10.9 RACEWAYS AND BOXES

10.9.1 Minimum raceway size shall be 3/4".

10.9.2 EMT fittings shall be zinc plated pressed steel gland and ring compression or zinc plated pressed steel set screw type that shall form a positive ground path. Utilize double set screws for 1-1/4" and up. Die cast fittings shall not be used.

10.9.3 EMT may be used for lighting and receptacle branch circuits, telephone, fire alarm, communications, signal and instrumentation circuits and for control circuits. EMT may be used in masonry walls, above hung ceilings, in equipment rooms, in mechanical and electrical chases and closets, in exposed locations along ceilings or walls above normal traffic level and where not subject to accidental damage or abuse.

10.9.4 EMT shall not be used in exposed applications below 8 feet above finished floor or in exterior or damp/wet/corrosive locations. Electrical, telephone and communications closets are considered exempt from this restriction and EMT may be installed below 8' AFF in this application only. EMT shall not be installed underground, in slabs on grade, in exterior locations, in hazardous areas, or for circuits operating at more than 600 V.

10.9.5 Galvanized Rigid Steel Conduit (GRSC) may be used for all raceway applications outlined for EMT and PVC. GRSC shall be used in locations where subject to accidental damage or abuse and for all above grade exterior applications. All circuit conductors in excess of 600 V shall be installed in GRSC.

10.9.6 GRSC shall not be used in corrosive environments. Utilize epoxy coated GRSC or PVC, as required for corrosive environment applications.

10.9.7 GRSC fittings shall be threaded. Split couplings or non-threaded fittings shall not be used. Utilize Erickson couplings where joining two threaded conduits that cannot be rotated.

10.9.8 Polyvinyl Chloride Non-Metallic Conduit (PVC) shall be a minimum of Schedule 40 and used in concrete encased, underground applications only.

10.9.9 PVC shall not be used for penetrations from concrete slabs. Transition to RGS shall be made a minimum of 2" below the slab finished surface, prior to penetration.

10.9.10 Provide flexible metallic conduits for connections to electrical equipment and to equipment furnished under other Divisions that are subject to movement, vibration or misalignment and/or where noise transmission must be eliminated or reduced.

10.9.11 Make connections to motors and equipment with PVC jacketed flexible metallic conduit and liquid-tight connectors. Liquidtight flexible metal conduit shall be used in short runs to connect motors where movement and vibration requires a flexible connection. Minimum length shall not be less than 1'-0", maximum length shall not exceed 5'-0".

10.9.12 Raceways shall be installed vertically down in corners then horizontal to device locations. The intent is to keep the wall surface clear of vertical drops.

10.9.13 All outdoor boxes and equipment shall be NEMA 4X.

10.9.14 Outlet boxes in wall partitions shall not be installed back-to-back, unless properly fire stopped.

10.9.15 Outlet boxes shall be 4" square with 1 gang or 2 gang plaster extension rings as required and manufactured by the following:

- Crouse-Hinds Company: Appleton
- Steel City Electric Company: RACO

10.9.16 Pull boxes and junction boxes shall be constructed of Code gauge galvanized steel and shall be installed at points required by code whether indicated on the drawings or not. Minimum dimension shall not be less than NEC requirements.

- Provide flat plain covers with suitable flat head machine screws or slotted truss head bolts

10.9.17 Raceways shall be provided between panelboards and surface mounted raceways in all laboratory applications.

10.9.18 Manufacturer for multi-outlet assembly shall be Wiremold Prewired Systems - Series 4000 with steel epoxy coated factory finish.

- Raceway shall have compartment divider for use with power and telecommunications wiring with field removable cover.
- Raceway shall have a nominal wall thickness of 0.078"
- Raceway covers shall be a minimum of 18" in length to facilitate future modification. Covers must be removable with a standard straight blade screwdriver without marring.
- Raceway covers shall have hole cut provision for telecommunications outlets, voice and data/LAN outlets.

10.10 TRANSFORMERS

10.10.1 Provide dry type general purpose factory assembled and tested, air-cooled transformers for 60-Hz service no greater than 600 volts. Design, manufacture and testing of transformers shall meet requirements of NEMA No. ST 20 and UL Standards.

10.10.2 Power transformers shall be two winding dry type for general power and lighting applications. Transformers rated 1000 kVA or below shall be UL listed and bear required Listing Mark.

10.10.3 Transformers shall have copper windings, continuous wound construction with vacuum impregnated insulation using non-moisture-absorbing varnish.

10.10.4 Transformers shall use properly classified UL approved temperature ratings. Temperature rise ratings shall be in accordance with UL 506. Insulation ratings shall be 220 degrees C based upon a 115 degrees C rise.

10.10.5 Transformers supplied shall be able to operate continuously at 100 percent nameplate rating at ambient temperatures not exceeding 40 degrees C. Maximum temperature at top of enclosure shall not exceed 50 degree C rise above 40 degree C ambient.

10.10.6 Lug kits and ground bus shall be provided by the manufacturer of the transformer.

10.10.7 K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

- Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
- Indicate value of K-factor on transformer nameplate.
- Neutral bars shall be sized for at least 200 percent ampacity of secondary phase conductors.

10.10.8 Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

- Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

- Include special terminal for grounding the shield.
- Shield Effectiveness:
- Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
- Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
- Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

10.10.9 Provide engraved nameplates indicating source and load served.

10.11 PANELBOARDS

10.11.1 Phase, Neutral and Ground bus bars shall be copper (98% conductivity) sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65°C above an ambient of 40°C maximum.

10.11.2 Provide a separate bolted ground bus for each panelboard.

10.11.3 Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices.

10.11.4 Panelboards shall be fully rated to interrupt symmetrical short-circuit current available at the terminals.

10.11.5 Neutral busses shall be rated to carry at least the full rating of the panelboard and shall have a suitable lug for each outgoing feeder requiring a neutral connection. Neutral bus shall be 200% rated where double sized neutrals are indicated and/or where the panel is supplied via a K-rated transformer.

10.11.6 Bolt-on type, heavy duty, quick-make, quick-break, single and multi-pole circuit breakers of specified types shall be provided for each circuit with toggle handles that indicate when unit has tripped.

10.11.7 All Panelboards shall be marked with engraved ID, amperage, voltage, phase and wire as well as source feeder location.

10.11.8 Circuit breakers shall be thermal magnetic type with common tie handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100 ampere frame and through 100 ampere trip sizes shall take up the same pole spacing. 20 ampere, single pole circuit breakers shall be UL listed as type SWD for lighting circuits.

10.11.9 All lugs shall be UL listed tin-plated aluminum suitable for copper or aluminum cable for sizes indicated on the drawings. Provide oversized lugs to accommodate designed cable sizes or increase gutter space to allow use of solid stud compression lugs where necessary. All terminations shall be suitable for 75 degree C cable.

10.11.10 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, Security, energy management and control system (EMCS) panels and fire alarm panels.

10.11.11 Enclosures shall be at least 20 inches wide and 5-3/4 inches deep made from galvanized steel. Provide minimum gutter space in accordance with the National Electric Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, an auxiliary gutter shall be provided, sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided. All panelboard covers shall be door in door type.

10.11.12 Enclosures shall be provided with removable blank ends.

10.11.13 All locks shall be keyed alike.

10.11.14 Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering.

10.11.15 Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 49 or 61 paint applied.

10.11.16 Acceptable Manufacturers

- General Electric
- Approved equal by Northeastern University

10.12 ENCLOSED BUS ASSEMBLIES

10.12.1 Plug-in units shall be factory pre-assembled and shall be of the types and ratings indicated on plans.

10.12.2 Plug-in units shall be mechanically interlocked with the busway housing to prevent their installation or removal while the switch is in the ON position. The enclosure of any plug-in unit shall make positive ground connection to the duct housing before the stabs make contact with the bus bars. All plug-in units shall be equipped with a defeatable interlock to prevent the cover from being opened while the switch is in the ON position and to prevent accidental closing of the switch while cover is open. The plugs shall be provided with a means for padlocking the cover closed and padlocking the disconnect device in the OFF position.

10.12.3 The operating handle and mechanism of the plug-in unit shall remain in control of the disconnect device at all times permitting its easy operation from the floor by means of a hookstick or chain. Plug-in units shall be equipped with a means for direct positioning or hanging, so that the weight is borne by the duct before the stabs make contact with the bus bards. For safety reasons, no projections shall extend into the busway housing other than the plug-in stabs. All plug-in units shall be interchangeable without alteration or modification of plug-in duct.

10.12.4 Plug-in units shall be circuit breaker type with integral time delay/thermal trip protection in one assembly and shall meet all requirements of UL Standard 489. Circuit breakers connected to normal power busways shall be solid state type with ground fault protection.

10.13 WIRING DEVICES

10.13.1 Wiring devices shall be Specification Grade.

10.13.2 Color of all wiring devices shall be as selected by the architect, except for receptacles on emergency systems shall be red and standby systems shall be orange.

10.13.3 Receptacles: Identify panelboard and circuit number from which served. Use hot machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

10.13.4 Catalog numbers specified for this section are Hubbell. Other manufacturers are acceptable at Northeastern University approval.

10.13.5 Duplex receptacles shall be U-ground, rated for 125V, 20 amperes, specification grade, Hubbell CR5352.

10.13.6 Duplex receptacles with ground fault interrupter characteristics shall be U-ground, rated for 125V, 20 amperes, specification grade, feed-through type. Ground fault receptacles shall meet the requirements of UL 943, 2006. All receptacles in toilets or bathrooms within 6'-0" of sink locations, exterior outlets, utility vault, in wet areas shall be ground fault type. Hubbell #HBL GF5362, or approved equal by Northeastern University.

10.13.7 Switches shall be full size, heavy duty, AC type, rated for 20 amperes - 120/277 Volts, Hubbell CS1221), CS1222 (two pole), CS1223 (three way), CS1224 (four way).

10.13.8 Provide 0.032" nominal brushed Type 430 stainless steel device plates by the manufacturer of the wiring device for all flush mounted switches and receptacles installed in dry locations and where not subjected to physical abuse. Ganged plates shall be of one-piece construction to accommodate the required number of installed devices. Oversized plates to cover wall finish blemishes adjacent to the device box shall not be used.

10.13.9 Residential Applications Only: Provide high-impact smooth nylon device plates by the manufacturer of the wiring device for all flush mounted switches and receptacles installed in dry locations and where not subjected to physical abuse. Fastening screws shall be color matched to the plate, plate color and to the device. Ganged plates shall be of one-piece construction to accommodate the required number of installed devices. Oversized plates to cover wall finish blemishes adjacent to the device box shall not be used.

10.13.10 Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum, in-use, lockable cover equal to Hubbell RW57XXX series, size and direction as required.

10.13.11 Provide weatherproof seals under the device plate and around the device for outlets in exterior walls or walls between environmentally or pressure-controlled rooms.

10.14 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

10.14.1 Fusible Safety Disconnect Switches:

- Switches shall be three-pole heavy-duty type rated for 600V in NEMA 1 (interior dry applications) and NEMA 3R (exterior applications) enclosures unless noted

otherwise on the drawings. All switches shall be horsepower rated and suitable for service entrance use. Provide with solid neutral where four wire circuits are indicated and with 200% solid neutral where neutrals are sized for 200% full load ampacity.

- Operating mechanisms shall be quick-make/quick-break. Current-carrying parts shall be high-conductivity copper. Contacts shall be silver-tungsten or plated. Provide positive pressure fuse clips and switch operating mechanism suitable for continuous use at rated capacity without auxiliary springs in current path. Switches shall withstand available fault current or let-through current before operating, without damage or rating change.
- Terminations shall be suitable for copper or aluminum conductors 60°/75° C rated. Clear shielding shall prevent accidental contact with energized line terminals.
- The cover shall be mechanically interlocked to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one to three padlocks with the door open or closed.
- The enclosure shall be given a phosphatizing pretreatment. The paint finish shall be manufacturer's standard color and shall pass 600 hours of corrosion resistance testing per ASTM B 117.
- Accessories:
  - *Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.*
  - *Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.*
  - *Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.*
  - *Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Required for all disconnects installed on the load of Variable Speed Drives for purposes of sending a "stop" signal to the drive when the disconnect switch is opened.*
  - *Hookstick Handle: Allows use of a hookstick to operate the handle.*
  - *Lugs: Mechanical type, suitable for number, size, and conductor material.*
  - *Service-Rated Switches: Labeled for use as service equipment.*
  - *Fused switches shall have short circuit ratings no less than 100,000 amperes RMS, with capabilities to 200,000 amperes when used with Class J, L or R fuses at 480V from 400A to 1200A.*

10.14.2 Manual Motor Starters:

- Manual Motor Starters shall have quick make, quick break toggle mechanisms with allowance for up to 10% field adjustment in nominal overload heater values. Manual Motor Starters shall be NEMA 1 (interior dry applications) and NEMA 3R (exterior applications) enclosed unless noted otherwise on the drawings.

10.14.3 Molded-Case Circuit Breakers

- General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- Electronic Trip Circuit Breakers from sizes 400A and larger or as indicated on Drawings: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:
  - *Instantaneous trip.*
  - *Long- and short-time pickup levels.*
  - *Long- and short-time time adjustments.*
  - *Ground-fault pickup level, time delay, and I2t response.*

10.14.4 Features and Accessories:

- Standard frame sizes, trip ratings, and number of poles.
- Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
- Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
- Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
- Alarm Switch: One NO/NC contact that operates only when circuit breaker has tripped.

10.15 INTERIOR LIGHTING

10.15.1 All buildings must be designed to the Illumination Engineering Society of North America (IESNA) lighting level design guidelines outlined in the latest IESNA Handbook.

10.15.2 Provide all LED fixtures with appropriate drivers and accessories for a complete installation. Standard led driver shall be class 2, 24v dc constant current with standard 0-10v dimming built-in with 5-year warranty.

10.15.3 LED arrays/modules shall be UL and ROHS compliant. Additionally, led arrays shall comply with IESNA LM-79 and LM-80 standards. Standard module shall be rated for 50,000 hours to l70 (70% lumen maintenance over life); 5 year warranty.

10.15.4 In compliance with Federal, State, and Local requirements, legally dispose of light fixtures and removed and not required for reinstallation, unless specifically designated to remain the property of the Owner. Provide certification of proper disposal for all regulated material.

11 Furniture, Fixtures, & Equipment

11.0 FURNITURE, FIXTURES, AND EQUIPMENT

11.1 PURCHASES

- The University generally purchases furniture through cooperatives and programs that offer reduced pricing for educational facilities, including:
  - *Massachusetts Higher Education Consortium (mhec.net)*
  - *The Boston Consortium (boston-consortium.org)*
  - *Educational Institutional Cooperative (eandi.org)*
  - *US Communities (public.omniapartners.com)*

11.2 FIRE PROTECTION

All furniture shall meet the requirements of the City of Boston Fire Department REGULATION OF UPHOLSTERED FURNITURE: BFD IX-10 and any other Boston Fire Code requirements for upholstered furniture.

11.3 PERFORMANCE

All materials shall be chosen, designed, and specified to address issues of constructability, appearance, durability, longevity of performance, and ease / efficiency of maintenance. The character of finish options for materials (especially but not limited to exterior building materials) is to be selected based on its ability to provide a consistent and high-quality finish and selections, quality, and characteristics must be coordinated with the University Project Manager.

11.3.1 Preferred Materials - Building interiors - Refer to Chapter 5 for preferences for various interior materials and finishes.

11.4 FF&E PREFERENCES

The University seeks to purchase materials that offer consistent quality over the life of the product. The University procurement department has established relationships with manufacturers, vendors, and suppliers that understand this, and who work to supply these items in a timely manner, with preferred pricing, and excellent customer service and warranty support.
The Procurement Department is available to supply the NU PM and consultant with the most appropriate list of vendor contacts and preferences to suit the need of that project. The following list of vendor products and services can be a basis of design:

11.4.1 Furniture

- Basis of Design: Herman Miller - Office, administrative, workstations, seating, desks, tables, etc.
- Alternates: Steelcase, Knoll, OFS, Technion, Allsteel - equal quality of products and level of design innovation.
- Ergonomics: NU endorses the use of ergonomic systems that encourage the health and safety of faculty, staff, and students. Such items as adjustable height workstations, desks, tables, and chairs shall be strongly considered.

11.4.2 General Merchandise and Supplies

- Basis of Design: Staples - carries lower priced furniture and other merchandise for more general applications. Supplies products in a timely manner.
- Alternates: WB Mason - Similar product lines and delivery service.

11.5 Northeastern University Procurement Department is available to provide support services in the early stages of each project. Procurement is available to manage the Request for Proposals (RFP) process for any project related FF&E items, and can work to coordinate purchase and install of said items during project completion if desired by NU PM

11.6 Consultant shall be able to review and comment on final selections and decisions related to FF&E items obtained through NU Procurement bids.

12 Campus Open Space & Landscape Standards

12.0 CAMPUS OPEN SPACE AND LANDSCAPE STANDARDS

The Northeastern University Boston Campus is unique. Established as an accredited arboretum in 2019, and part of the urban fabric of the City of Boston, the campus is accessible and integrated throughout the surrounding neighborhoods. Open space, once abundant and used for large surface parking areas has become increasingly sparse, reserved for ceremonial spaces and programmed support space. Creating an identity for these open spaces that complement NU structures has been accomplished through various treatments such as landscaping, paving, signage, graphics, and street furnishings, in addition to meticulous maintenance. The University endeavors that such consistent identity shall continue as new facilities develop and existing environments are upgraded.

Open campus areas must continue to be attractive, safe, and multi-functional, all while allowing for utilitarian purposes such as visual openness, free air movement, stormwater drainage or retention, and hidden utility corridors. Landscaping materials must be carefully considered for tolerance within the urban environment with little available sunlight and water, as well as exposure to hazards of urban life such as noxious fumes and residues. Open space and landscape design shall be an inherent part of meeting the University goals for a green and sustainable campus environment.

This shall be accomplished through the use of plant species and materials that are able to withstand the New England environment, harsh weather, varying temperatures, and wear and tear from coastal proximity. Guidelines for selections of landscape and open space materials are as follows:

12.1 LANDSCAPE - GROUND COVER / TREES / ACCENTS

12.1.1 The Northeastern University campus is an accredited Arboretum. An Arboretum Plan was completed in 2019. The plan includes a collection policy, a management plan, and design guidelines. Designers can acquire a copy of the Arboretum Plan through the NU Project Manager.

12.1.2 Shall allow for safe public access and shall visually connect existing architectural and site elements with the future buildings and parking facilities.

12.1.3 The design and selection of all landscape treatments should be integrated into the overall design approach for each site.

12.1.4 Special landscape treatments are recommended at primary building entrances and at pedestrian and roadway gateways.

12.1.5 Landscape treatments at primary building entrances shall be coordinated with architectural styles, materials, and color schemes.

12.1.6 All landscape treatments shall adhere to the principles of sustainable design to the fullest extent possible.

12.2 HARDSCAPE - MATERIALS AND METHODS / UTILIZATION

12.2.1 Shall allow for safe public access and shall visually connect existing architectural and site elements with the future buildings and parking facilities.

12.2.2 The site shall feature pedestrian and bicycle access along all access points and adjacent roadways.

12.2.3 Pedestrian and bicycle mixed use paths shall be no less than 10'-0" wide and shall be separated from the edge of the vehicular roadway by landscape wherever possible.

12.2.4 Pedestrian paths not intended to accommodate bicycle traffic shall be no less than 8'-0" in width where possible.

12.3 SITE FURNISHINGS AND FIXTURES - MATERIALS / VENDORS

12.3.1 Bicycle Parking - Buildings shall offer bicycle parking facilities or spaces designated for secure bicycle parking. These spaces should be provided within the parking structure or adjacent to the building.

12.3.2 The location of bicycle facilities shall be convenient to academic and housing facilities, but not immediately in front of building and main entrances in a safe and protected area. Bicycle facilities shall not intrude upon quadrangle and other open spaces in a visually negative manner.

12.3.3 Seating shall be an integral part of open space design and may take the form of built-in seats or ledges. Loose site seating may become part of the FF&E package for the project where applicable or purchased directly by the University. In either case, the designer should assist by coordinating the general layout and locations for loose seating.

12.3.4 Site furnishings and accessories shall include seating, tables, trash and recycling receptacles, bicycle storage / parking, signage posts, and others as dictated by site location and building program. Standards for commonly used site accessories are identified below. Specific selection should be confirmed with the University Project Manager.

12.3.5 Bike Racks - Different types of bike racks are used on campus to suite the conditions. With space at a premium, some conditions require parallel orientation, and others perpendicular. All bike racks should allow two means of attachment of the bicycle, using potentially different locking systems. Bicycle rack assemblies used include the following:

- Circular Ring Steel Pipe Bicycle Bike Rack
  - *Product: Anova Circle Bike Rack, or approved equal*
  - *Capacity: Two bicycles, one each side.*
  - *Material: 2.38" O.D. Schedule 10, 316L stainless steel pipe.*
  - *Finish: Brushed or satin.*
  - *Dimensions: 32.25" high by 35.88" long*
  - *Leg Base: 316/316L stainless steel. Where surface mounted, each leg shall be prefabricated with a 7.75" x 5.5" plate with three .5" diameter predrilled holes for surface mounting with appropriate hardware. Where embedded in the ground each leg shall be designed to extend 15.25" into the ground.*
  - *Warranty: 20-year limited structural warranty from the manufacturer.*
- Flowing Design Continuous Pipe Bicycle Rack
  - *Product: Landscape Forms Flo Bike Rack, or approved equal*
  - *Capacity: Three bicycles, based on access from both ends.*
  - *Material: 1.5" O.D.,.120" wall stainless steel tubing.*
  - *Finish: Brushed or satin*
  - *Dimensions: 27.75" deep by 25.5" wide by 32.5" high*
  - *Leg Base: 316 Stainless steel. Each leg shall be prefabricated with a plate with predrilled holes for surface mounting with appropriate hardware or shall be provided with a threated rod for an embedded mount.*
- Single Post Bicycle Rack
  - *Product: Ground Control Systems Varsity Bike Dock Campus Bike Rack, or approved equal*
  - *Capacity: Two bicycles, allowing right or left entry.*
  - *Head Assembly: Two steel locking loops encased in injection molded urethane to prevent metal to metal contact with the bicycle.*
  - *Post: 31.74" high single steel post with galvanized or thermoplastic finish.*

- *Wheel Troughs: Two metal wheel pocket docks attached to the post in an offset configuration, and located approximately .75" above the ground surface*
- *Base Configurations: The base shall consist of an injection molding support block supplied with anchors for attachment to concrete, asphalt, or pavers; or shall include an accessory post extension for an embedded mount in a concrete base.*
- *Freestanding Base: The dock shall be capable of being attached to a metal rail with provided hardware to create a pre-configured multiple dock assembly which can be left free standing or attached to the ground.*
- *Warranty: Minimum 5-year warranty from the manufacturer. Provide the manufacturer's standard 5 to 20-year corrosion protection warranty based on the finish selected and installation in a non-marine environment.*

- Sustainability: Product materials and packaging should be 100% recyclable.
- Bicycle Rack Mounting Plate: Where site conditions do not allow attachment of the racks to a slab by means of anchors or embedment, such as over below grade tunnels or occupied spaces, racks should be mounted to stainless steel base plates to prevent vandalism and theft.
  - *Provide stainless steel plates 36" x 36" x 3/4" thick, with four (4) 1/4"x 20 threaded holes in the corners with matching splice plates, and with 3/8"x16 threaded holes to accommodate and attach two (2) bike racks per plate. Coordinate the placement and arrangement of the threaded holes with the type of bicycle rack selected. All hardware should be stainless steel.*
  - *The plate material is type 316 stainless steel. The finish on the exposed side should match the bicycle rack finish. This is generally a #4 brush finish, although the finish should be coordinated with the type of bicycle rack selected.*

12.3.6 Site Trash and Litter Receptacles - The University generally uses solar powered litter compactors on campus grounds.

- The standard for site trash receptacles is 100L (28-gallon) approximately 19.6" x 21.6" x 47.2", or 120L (32-gallon) 23" x 24.1" x 58.2". An example of a trash receptacle that the University uses on campus includes Ecube Labs "CleanCUBE" smart solar powered trash compactor bin, provided with a foot pedal for hands free operation.
- Th University provides the trash receptacles when they are required on projects involving site development or landscape alterations, unless otherwise directed by the NU project Manager.
- A/E consultants should coordinate the locations and space requirements for trash receptacles with the University on projects that include site and landscape scope.

12.4 WALKWAYS - SIZE / PLACEMENT / MATERIALS / SECURITY / COORDINATION

12.4.1 Shall allow for safe public access and shall visually connect existing architectural and site elements with the future buildings and parking facilities.

12.4.2 Paving brick shall meet the requirements of the standard specifications for paving brick ASTM Designation C902, Class SX, Type 1, Application PS.

- Pavers shall be 7-3/4" x 3-1/2" x 2-1/4", City Hall blend sand struck pavers as manufactured by Stiles and Hart Inc., Bridgewater Massachusetts, unless approved otherwise by the NU Project Manager.

12.5 ROADWAYS - PUBLIC VS. SERVICE / CITY REQUIREMENTS

12.5.1 Vehicular paths connect to City streets as required.

12.5.2 Driveways, setbacks, and view corridors shall conform to City of Boston requirements.

12.5.3 Paving materials used adjacent to trees should be permeable to allow rainwater infiltration.

- Permeable pavement shall consist of a blend recycled rubber chips, kiln-dried aggregate, and a hard binder to create a pavement suitable for traffic.
  - *Thickness: Minimum 2" thick, over compacted base.*
  - *Permeability: Void space providing infiltration of approximately 5,800 gallons per hour per square foot.*
  - *Surface: Slip resistant and ADA compliant.*
- Base material should be clean drainable gravel material low in fines, with an aggregate in the range of 3/8" to 3/4", or as otherwise recommended by the manufacturer.
  - *Base thickness should be as recommended by the manufacturer for heavy traffic loads and graded and compacted to not less than 95% of maximum density per the recommended test method.*
- Provide an edging material to suite conditions if required.
- Acceptable Manufacturers/ Products: Porous Pave XL, K.B. Industries Flexi-Pave, or equal approved by the NU Project Manager.

12.6. PARKING - SURFACE LOT / ON-STREET

12.6.1 Surface parking lots for accessibility and building servicing should be located adjacent to new facility if possible.

12.6.2 Surface parking areas shall conform to setback, screening and landscape requirements of the City of Boston

12.7 WAYFINDING AND SIGNAGE

12.7.1 All wayfinding and signage shall conform to NU standards for graphics and signage. Refer to Chapter 4 Signage & Graphics for additional information.

12.7.2 Wayfinding messaging shall conform to requirements of the City of Boston.

12.8. RECREATIONAL SPACE

12.8.1 Outdoor recreational space shall be included in appropriate building programs as space allows.

12.8.1 Projects specifically programmed as recreational space shall be planned/ considered on a case-by-case basis.

12.8.2 Site requirements for active recreational space shall be coordinated with the appropriate campus department for the program.

12.9. LIGHTING

12.9.1 Site lighting shall be restricted to that required for safety and function and shall be shielded from adjacent properties and from the sky. Site lighting shall incorporate appropriately selected cut-off light fixtures that meet or exceed the sustainability initiatives, policies, and requirements as outlined in these Design Guidelines.

12.10 SECURITY

12.10.1 Refer to Chapter 3 for security and Crime Prevention Through Environmental Design (CPTED) principles.

12.11 SNOW REMOVAL / STORAGE

12.11.1 Coordinate with University policy for snow removal and storage to ensure adequate storage of snow pile up.

12.11.2 In locations were storage of snow is anticipated or possible, consideration should be given to using materials that can stand up to the use of ice-melt products.

13 General Requirements for Construction

13.0 GENERAL REQUIREMENTS FOR CONSTRUCTION

Northeastern University has specific requirements that contractors must be aware of and adhere to during construction of any project on campus. Those general requirements and guidance are summarized in the sections that follow. A/E consultants should confirm project delivery and form of construction contract with the NU Project Manager for each project and include any requirements in Division 1 of the specifications.

13.1 CONTRACT REQUIREMENTS

13.1.1 e-Builder Administration - Contractors shall be required to manage the project using e-Builder. e-Builder is a web-based project management tool. All licenses are owned by the University and accounts will be distributed upon award.

13.1.2 e-Builder Training - The University will provide any needed training. At a minimum the contractor will be expected to be proficient in the following e-Builder processes:

- 101 Navigation/Documents
- 104 RFIs and Submittals
- 102 Payment Processes
- 103 Change Management

13.1.3 Northeastern University Project Closeout Deliverable Requirements - The awarded contractor shall comply with and shall cause all of its subcontractors and sub-subcontractors to comply with the University's Project Closeout Deliverable Requirements available on the Northeastern University Facilities Management website (http://www.northeastern.edu/facilities) or through the NU Project Manager, and as included in the Agreement Between Owner and Contractor.

13.1.4 Utilization of Minority, Women, Veteran Owned and Small Local Subcontractors It is the policy of Northeastern University to contribute to the establishment, preservation, and strengthening of minority, women, and veteran owned business enterprises, as well as small local business enterprises ("MBEs," "WBEs," "VBEs," and "SLBEs" respectively), and to strongly encourage the participation of MBEs, WBEs, VBEs, and/or SLBEs in University procurement. The University has established subcontracting participation goals for projects of twelve percent (12%) of the total construction contract value (combined MBEs, WBEs, VBEs, and/or SLBEs). University reserves the right to adjust any such participatant's, qualifications for any project in it's sole discretion. Consultants and contactors are required to confirm under represented business goals with NU Project Manager.

13.1.5 MBE, WBE, VBE and SLBE Definitions - For the purposes of the University's participation goals, MBEs, WBEs, and VBEs shall be defined as companies with certified MBE, WBE, and/or VBE status with the Commonwealth of Massachusetts' Supplier Diversity Office's "Directory of Certified Businesses" or with the Greater New England Minority Supplier Development Council. SLBEs shall be defined as companies: (1) whose primary office is located within the City of Boston (as confirmed by ZIP Code), and (2) with fewer than 500 employees and less than $14,000,000 in annual sales).

13.1.6 M/W/V/SLBE Self-Certifications - Contractors may propose using M/W/V/SLBEs that do not hold the above certifications, provided that any such proposed M/W/VBE must provide a self-certification for the University's review, and any such proposed SLBE must provide a self-certification regarding their annual sales, for the University's review. The University may, in its sole discretion, accept such self-certification(s) and permit the Contractor to count such participation toward the project goals.

13.1.7 Substantiating M/W/V/SLBE Participation - The prime Contractor shall substantiate its use good faith efforts in cooperation with the Owner to procure M/W/V/SLBE subcontractor participation during the subcontractor buyout phase and shall substantiate its participation (or reasons for not obtaining the project goals) on the appropriate exhibit or schedule included on the construction agreement between owner and contractor. If the Contractor is using M/W/V/SLBE subcontractors, it shall substantiate its participation by submitting appropriate exhibit or schedule included in the construction agreement between owner and contractor with each of its Applications for Payment. The Owner may retain fifty percent (50%) of the Contractor's total fee from future Applications for Payment until the Contractor provides the required documentation.

13.2 CAMPUS RULES - CONSTRUCTION

13.2.1 Coordination with the Project Manager - All Work to be performed under the Agreement shall be coordinated through the NU Project Manager (or his or her delegate). The contractor shall not contact any other NU personnel without the Project Manager's prior approval.

13.2.2 Permits - This is for any project, therefore all state, local, building codes or zoning ordinances apply based on the jurisdiction where the project is located. The awarded contractor shall provide the University with electronic copies of each permit issued for the Project including without limitation the base building permit, fire alarm permits, subcontractor permits, demolition permits, and hot work permits. Receipt of all such permits is a condition of final payment.

- Building Permit: The building permit application and associated fees shall be coordinated with the NU Project Manager.
- All other permits, local license fee, shall be obtained and paid for by the Contractor unless otherwise indicated by the Project Manager.

13.2.3 Northeastern University Confined Spaces Permit Process - Access to confined spaces must be coordinated with Northeastern University.

13.2.4 Dig Safe - Unless otherwise advised by the Project Manager contractors should assume that Dig Safe is required on all projects involving site or building excavation. The awarded contractor shall coordinate the Dig Safe activities with the Project Manager. In addition to any Dig Safe requirements, all excavation must be reviewed with Northeastern prior to the start of work.

13.2.5 Working Hours - General building hours for occupants are Monday through Friday 8 AM (9 AM for residential with) to 10 PM. Activities that produce dust, odors, or loud noise shall be performed outside of these hours. Contractor shall ensure areas impacted by these activities are free of these issues at the start of general building hours the next day. Noisy work includes but is not limited to anchoring into the deck, coring, trenching, hammer drilling, saw cutting, and fire alarm testing. These requirements may vary, and project-specific hours and restrictions shall be confirmed by the NU Project Manager.

13.2.6 Shut-Downs -The need for utilities shutdowns is initiated through the NU Project Manager but processed by the NU Customer Service Center who assesses the impact on the building occupants, and what is required to mitigate disruption. The Contractor shall provide a minimum of five (5) business days' notice to request a shutdown of simple building systems and fifteen (15) business days' notice for building or utility shutdowns. Such notices must be provided to the Project Manager for communication coordination. Any shutdown that causes disruption to normal building systems which will affect other areas in the building, such as cut-ins or shutdowns of services, shall be completed during non-business hours.

13.2.7 Live Electrical Work - No live electrical work may be performed. All shutdowns shall

be coordinated with the University as outlined in section 14.2.6 above.

13.2.8 Signage and Scrim - All Project required signage and scrim shall be coordinated with the Project Manager.

13.2.9 Construction Personnel Conduct and Demeanor - Require construction personnel to treat other workers; members of the University including faculty, staff and students; and the public with respect and courtesy. Prohibit foul language, rude behavior, running, horseplay, fighting, and other unprofessional conduct and infractions of work rules.

- Owner reserves the right to remove construction personnel from the Project site and from campus for violation of these requirements.
- Contractors, their employees, subcontractors, and agents are prohibited from consuming or being under the influence of alcohol or any intoxicant while working on the Project. Personnel found not in compliance with these requirements are subject to immediate dismissal from Project site and campus in the University's sole discretion.

13.2.10 Construction Personnel Physical Appearance - Require construction personnel to dress appropriately in a clean, neat, and professional manner. Require long pants; do not permit short-sleeve shirts to be rolled up, shirts rolled up at the waist, or pants rolled up past the top of boots. No offensive slogans on hats or shirts.

- Proper personal protection equipment is always required.

13.2.11 Privacy and Sexual Harassment - Contractor shall make reasonable efforts to educate and inform all personnel assigned to the project of the University's policies related to Sexual Harassment. Such education may include but shall not be limited to the distribution of pamphlets and informative material supplied by the University.

13.3 WASTE MANAGEMENT

13.3.1 Construction Waste Management Reporting - The contractor shall complete and submit a construction waste management monthly progress report with each of its applications for payment using the Waste Stream Reporting Form provided by the University as an exhibit the construction contract and between owner and contract and/or as an attachment to the RFP for construction services. The form (and the application for payment) shall be submitted via e-Builder. Even if no waste was generated in the applicable period, the contractor must still submit the form.

13.3.2 EPA Refrigerant Reporting - For all services that include new appliance installation and/or existing appliance service, the contractor shall prepare and submit reports conforming to the requirements of the University, as applicable, with each pay application for such services and such other information relating to EPA compliance as may be reasonably required by the Owner.

13.3.3 Hazardous Materials and Waste - Adhesives, paints, solvents, and other hazardous materials must be reviewed by the project manager prior to use on campus. The Project Manager shall consult with a representative from the Office of Environmental Health and Safety (EH&S) to assist with this review. The contractor will provide applicable safety data sheets (SDS) as needed or requested by the project manager. Use of engineering controls, administrative controls or isolation of work will be utilized to prevent odors, dust, or other nuisances from impacting spaces outside of the project area. Any exception to this must be approved in advance in writing by the Project Manager. Throughout the duration of the Project, no hazardous waste will be stored or left on site nor disposed of in construction waste dumpsters.

- The contractor is responsible for disposal of all hazardous waste generated as part of the Project which include but are not limited to paint, refrigerant, oil, etc.
- If the contractor encounters any biohazardous waste at the Site, they shall immediately notify the Project Manager who will coordinate with EH&S.

13.3.4 Fluorescent Lamp Disposal - The contractor is responsible for disposal of fluorescent lamps and mercury containing thermostats. Broken lamps and thermostats are hazardous waste and must be properly cleaned up and are the responsibility of the contractor.

13.3.5 Dumpsters and Live Loads - If a dumpster is not permitted on site for a project, the contractor will be responsible for live loading of trash materials. The contractor shall coordinate with the project manager to schedule these in compliance with the vehicular access policy. Dumpsters must be covered before and after work concludes. Hazardous materials must not be placed in dumpsters.

- If a construction dumpster is permitted on site it must be enclosed by a fence and scrim.
- The awarded contractor shall not use any University owned dumpsters.

13.3.6 No Sink or Drain Disposal - The contractor shall not dispose of any waste materials, hazardous or otherwise, into sinks, drains, toilets, or public waterways.

13.4 FIRE SAFETY

13.4.1 The contractor is required to coordinate, through the Project Manager, with Northeastern University Fire Safety on all fire alarm, hot work, and sprinkler work.

13.4.2 The contractor shall obtain a "Hot Work" authorization letter from the NU Fire Safety Department prior to applying for a BFD Hot Work permit.

13.4.3 The contractor must provide at least a five-business day notice to the NU Project Manager for fire alarm panel coordination, sprinkler system shutdowns and any Hot Work

procedures. All systems shall be restored prior to the end of each workday.

13.4.4 The contractor must complete, (in conjunction with the Boston Hot Work Permit) a Northeastern FM Global Hot Work Permit for any hot work that is required.

- The permit is available at the Facilities Customer Service Center and must be filled out on a daily basis. The NU issued "Hot Work" Permit shall be issued on a daily basis. The permit is required for any temporary operation involving open flames or producing heat and/or sparks. This includes but is not limited to: brazing, cutting, grinding, soldering, torch applied roofing, and welding.

13.4.5 If the contractor will need to keep any flammable gases on site to complete its work such as but not limited to acetylene, oxygen, or natural gas, it must request, review, and receive permission from NU Fire Safety Department (coordinated through the Project Manager).

13.4.6 If a NFPA 241 plan is required for a project, the contractor must comply with the plan and communicate with the NU Fire Safety Department as required (including providing a copy of the NFPA 241 daily checklist and impairment plan).

13.5 BUILDING ACCESS

13.5.1 Keytrack Access - If the contractor will require keys for project access, they must complete all of the required information for the University's Keytrack system, which is available for review at the Northeastern University Facilities Management website (http://www.northeastern.edu/facilities), or through the NU Project Manager.

- It shall be the contractor's responsibility to regularly update Keytrack when it assigns new staff who will need project access or when staff no longer work for the company or at the University. The contractor shall be responsible for any Project delays caused by its failure to maintain all required staffing in Keytrack.

13.5.2 Keytrack Access for Laboratory Projects - If the contractor needs to sign lab keys out, all of its employees to be authorized must first attend lab signage safety training. Training shall be coordinated with the Project Manager. Any access to labs throughout the project's duration must be coordinated with project manager.

13.6 PARKING

13.6.1.Contractor Parking (Boston Campus) - No parking is allowed on the Boston Campus except in specific designated locations. This may include the Renaissance Park Garage or the Gainsborough Garage, to be confirmed by the NU Project Manager. The rate structures are managed by the garages and subject to change without prior notice. The University assumes NO liability for lost or stolen property or damage to any vehicle while it is parked on campus in one of our facilities.

13.6.2 Vehicular Access (Boston Campus) - A Vehicle Restriction Map is available showing where and when vehicular access is permitted on the University's Boston campus. The map is available on the Northeastern University Facilities Management

website (http://www.northeastern.edu/facilities) or through the NU Project Manager.

- When preparing their proposals, respondents should consider that for any work that will require vehicular access to the Boston campus, restrictions will apply for deliveries in the following three categories as defined on the Vehicle Restriction Map: (1) restricted short-term drop off/pick-up only, no personal vehicles permitted, (2) all vehicles prohibited, and (3) vehicle access prohibited from 7:30 AM to 7:00 PM. All deliveries shall be coordinated accordingly. Failure to comply with this policy shall put the contractor and its subcontractors at risk of towing without notice at their own expense.

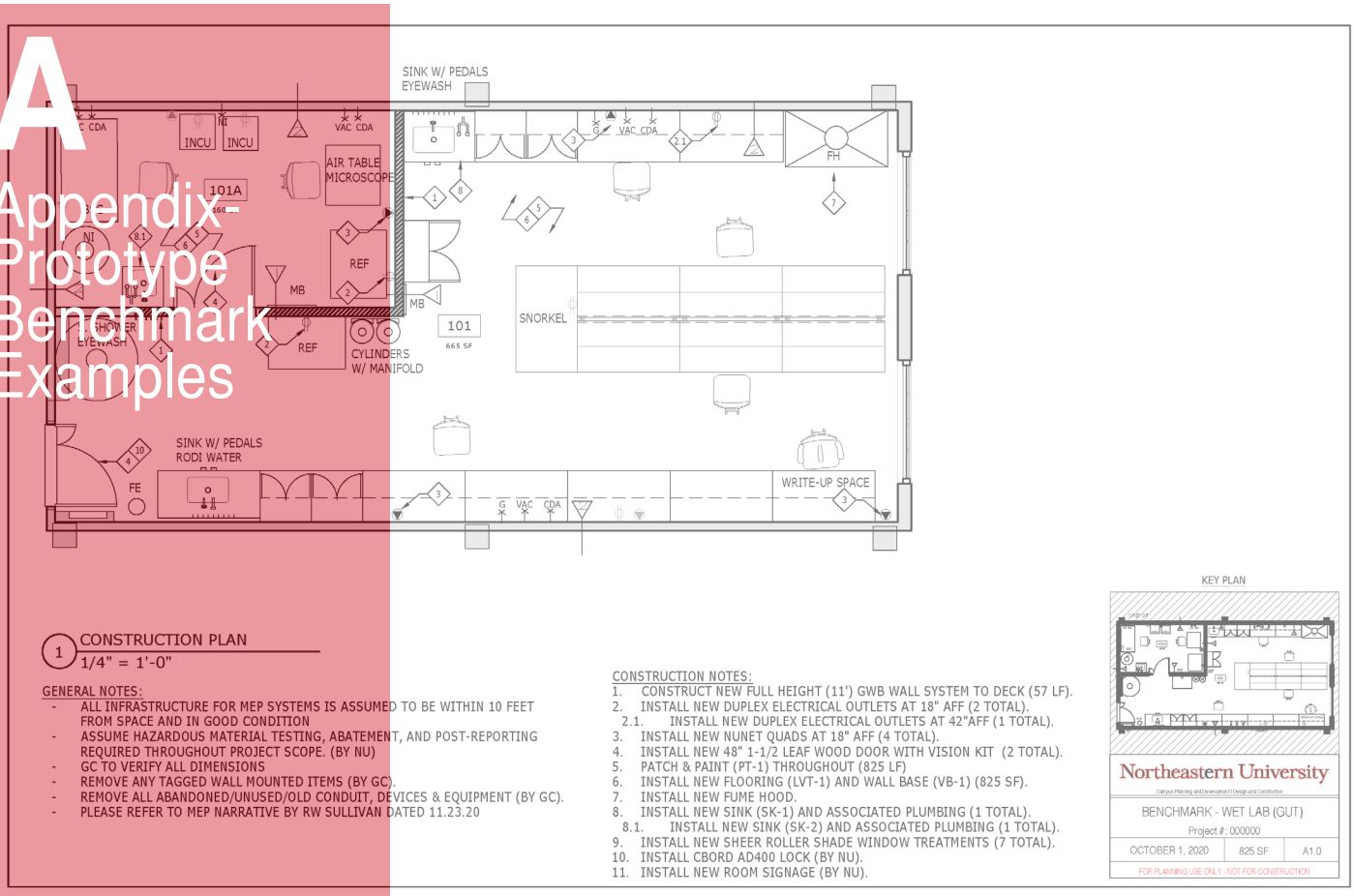
13.7 OTHER RULES AND REQUIREMENTS

13.7.1 Background Checks - The University's "Policy on Background Checks for Contractors and Vendors" may apply to any project and is available through the NU Project Manager. The contractor shall be required to execute the Policy's compliance certification concurrently with the Agreement Between Owner and Contractor. Recertification will be required on an annual basis as a condition of continuing award. Contractor will not be able to obtain key through the keytrack process as described in section 13.5 if background check certification is not signed by contract prior to requesting keys.

13.7.2 Smoke Free Campus - The successful bidder shall require all of its employees, subcontractors, and their employees to comply with Northeastern University's Smoke Free Campus Policy, available through the NU Project Manager,

13.7.3 Protection of Landscaping - Abuse of the University's open and growing spaces, plantings and landscape fixtures will not be tolerated. Protected growing zones will be established and demarcated prior to the commencement of work, through coordination with the NU Project Manager. Unauthorized movement into these zones is strictly prohibited.

A Appendix - Prototype Benchmark Examples



1 CONSTRUCTION PLAN
1/4" = 1'-0"

GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION
- ASSUME HAZARDOUS MATERIAL TESTING, ABATEMENT, AND POST-REPORTING REQUIRED THROUGHOUT PROJECT SCOPE. (BY NU)
- GC TO VERIFY ALL DIMENSIONS
- REMOVE ANY TAGGED WALL MOUNTED ITEMS (BY GC).
- REMOVE ALL ABANDONED/UNUSED/OLD CONDUIT, DEVICES & EQUIPMENT (BY GC).
- PLEASE REFER TO MEP NARRATIVE BY RW SULLIVAN DATED 11.23.20

CONSTRUCTION NOTES:
1. CONSTRUCT NEW FULL HEIGHT (11') GWB WALL SYSTEM TO DECK (57 LF).
2. INSTALL NEW DUPLEX ELECTRICAL OUTLETS AT 18" AFF (2 TOTAL).
2.1. INSTALL NEW DUPLEX ELECTRICAL OUTLETS AT 42"AFF (1 TOTAL).
3. INSTALL NEW NUNET QUADS AT 18" AFF (4 TOTAL).
4. INSTALL NEW 48" 1-1/2 LEAF WOOD DOOR WITH VISION KIT (2 TOTAL).
5. PATCH & PAINT (PT-1) THROUGHOUT (825 LF)
6. INSTALL NEW FLOORING (LVT-1) AND WALL BASE (VB-1) (825 SF).
7. INSTALL NEW FUME HOOD.
8. INSTALL NEW SINK (SK-1) AND ASSOCIATED PLUMBING (1 TOTAL).
8.1. INSTALL NEW SINK (SK-2) AND ASSOCIATED PLUMBING (1 TOTAL).
9. INSTALL NEW SHEER ROLLER SHADE WINDOW TREATMENTS (7 TOTAL).
10. INSTALL CBORD AD400 LOCK (BY NU).
11. INSTALL NEW ROOM SIGNAGE (BY NU).

APPENDIX - PROTOTYPE BENCHMARK EXAMPLES

A.1 SPACE PROTOTYPE COST BENCHMARKING MODELS

This appendix includes examples of space prototype cost benchmark models that the University developed, for internal use, in projecting a potential range of costs for projects based on established design standards. The current prototype spaces include an Office, Classroom and Wet Lab.

While the University has developed cost benchmark models, the cost data is not included in this document. Because of market fluctuations, cost escalation and other factors, publishing such cost data may not be helpful as it could become outdated and misleading. Designers will be expected to work with the University to set budget expectations for projects, and cost benchmark information may be shared with the designer when they are engaged in the process. When the estimated cost of the project is higher than the cost benchmark, the designer will be expected to explain the reasons. A narrative describing the differences between the benchmark assumptions and the project should be provided to the NU Project Manager during the design process beginning with schematic design.

The examples shown below are meant to be representative of typical conditions, and the University understands that each project is unique. While the prototype models shown are intended to be informative on material and technical standards that the University has established, design professionals are responsible for confirming the specific requirements for each project, and for full adherence with all code requirements.

A.2 BENCHMARK - OFFICE SUITE ALTERATIONS AND RENOVATIONS

A.2.1 Office Prototype Standards - The office prototype includes specific features and requirements which comprise the space standards, as identified below. The office benchmark Phase 1 Assessment and selective drawings that relate to these standards are included for reference in the paragraphs that follow. Office prototype requirements include the following:

- Full height GWB wall system to deck (where new office or support space is created)
- Modular glass wall up to ceiling, with sliding glass door (at video conference area)
- Provide blocking and install in-wall PAC box (provided by NU) for flat panel display (at video conference area)
- AV system (at video conference area, provided by NU)
- Carpet tile flooring
- Vinyl tile flooring (break room/ wet areas)
- Vinyl wall base
- Painted walls
- Wood door(s) with hollow metal frame
- CBORD AD-400 lock at each suite entrance door (by NU)
- Millwork reception desk with plastic laminate finish and solid surface work surfaces
- Upper and lower cabinets with plastic laminate finish and solid surface countertop
- Open solid surface counter with support brackets
- Kitchen sink and associated plumbing (at break area)
- Sheer roller shade window treatments
- Room signage (by NU)
- New furnishings throughout (by NU)
- Refrigerator (at break area)
- NUnet quads (2) at reception desk and work counters
- Duplex power outlet and NUnet quad in the in-wall PAC box (at video conference area)
- Duplex power wall outlets (in new walls and supplement existing in a renovation project)
- Duplex power wall outlets above break area and work counters (supplement existing in a renovation project)
- Provide electrical whip (2) into furniture partition panels
- 2' x 2' Acoustical Ceiling Tile
- Dimmable 2' x 2' LED direct/ indirect troffer light fixtures
- Linear LED pendant light fixtures (break area and video conference area)
- Dimmable light switches (1 per room, area, or space)
- Flex-drop sprinkler heads
- All infrastructure for MEP systems is assumed to be within 10 feet from the space and in good condition.

Northeastern University
Facilities Management
Campus Planning and Real Estate

PHASE 1

PHASE 1 PROJECT ASSESSMENT

Project Name: Office Benchmark

The purpose of the Phase 1 Assessment is to initiate a potential project, spend a limited amount of funding to better define the cost, scope, schedule, and execution requirements prior to a full commitment to the project by the University. This first assessment also facilitates discussions regarding the viability of the project, as well as potential alternatives by the University's Senior Leadership Team at a formative stage of development based on a rough order of magnitude cost estimate that will be refined during the next Phase 2 Assessment.

Project Purpose and Necessity
The purpose of this project is to identify a benchmark for a gut renovation and aesthetic refresh of an office suite. This benchmark is be used in project estimating, and to which future projects can be compared as a price point. This project is for a typical office suite in need of a full gut renovation.

Project Scope and Description
• The project scope is 1500sf, including (2) private offices, a kitchen, (1) small conference room, and (6) cubicle workstations.

Proposed Project Location(s)		
Building	Room Number	Square Feet
Benchmark	101	1500sf

Existing Conditions Analysis
• Flooring will require abatement throughout • Assume demolition of all interior non-demising walls • Assume new sprinkler flex heads and piping required throughout • Assume new mechanical HVAC equipment, ductwork, covers, and all applicable accessories within the project limit; hookup within 10' of suite • Assume new kitchen plumbing, hookup within 10' of suite • Assume new light fixtures throughout • (3) new fire strobes are required

Project Assumptions

The following scope **is included** within the Phase 1 Assessment Scope:

- Construction (Full GC Fees)
- Engineering Services (FP)
- MEP Upgrades

The following scope **is not included** within the Phase 1 Assessment Scope:

- Architectural Services
- Building System Upgrades

Enabling Scope

- Occupants will have to be temporarily relocated during construction.

Project Risks

- A structural assessment may be needed to ensure all interior walls can be demolished and are not load bearing.

Project Opportunities

- Creating a flexible and adaptable open workspace conducive to collaboration.
- Creating new touchdown workstations in the space for co-ops or hoteling.
- Providing an enclosed huddle room for meetings
- Providing new AV technology for video conferencing/meetings.

	Primary Characteristic	Secondary Characteristic		
Estimate Class	Level Of Project Definition	Purpose of Estimate	Methodology (Estimating Method)	Expected Accuracy Range
Class 5	0% to 2%	Concept Screening	Top Down Estimating (rough order of magnitude; cost per SF; and apportion of estimate)	± 20% - 50%
Class 4	1% to 15%	Study or Feasibility	Top Down Estimating (rough order of magnitude; cost per SF; and apportion of estimate)	± 15% - 50%
Class 3	10% to 40%	Budget Authorization, or Control	Bottom Up Estimating (Semi-detail unit cost with assembly level line items)	± 10% - 30%
Class 2	30% to 70%	Control or Bid Reconciliation	Bottom Up Estimating (Detail unit cost and detail take-off)	± 5% - 20%
Class 1	50% to 100%	Check Estimate or Bid Reconciliation	Bottom Up Estimating (Detail unit cost and detail take-off)	± 3% - 15%

Estimated Project Schedule

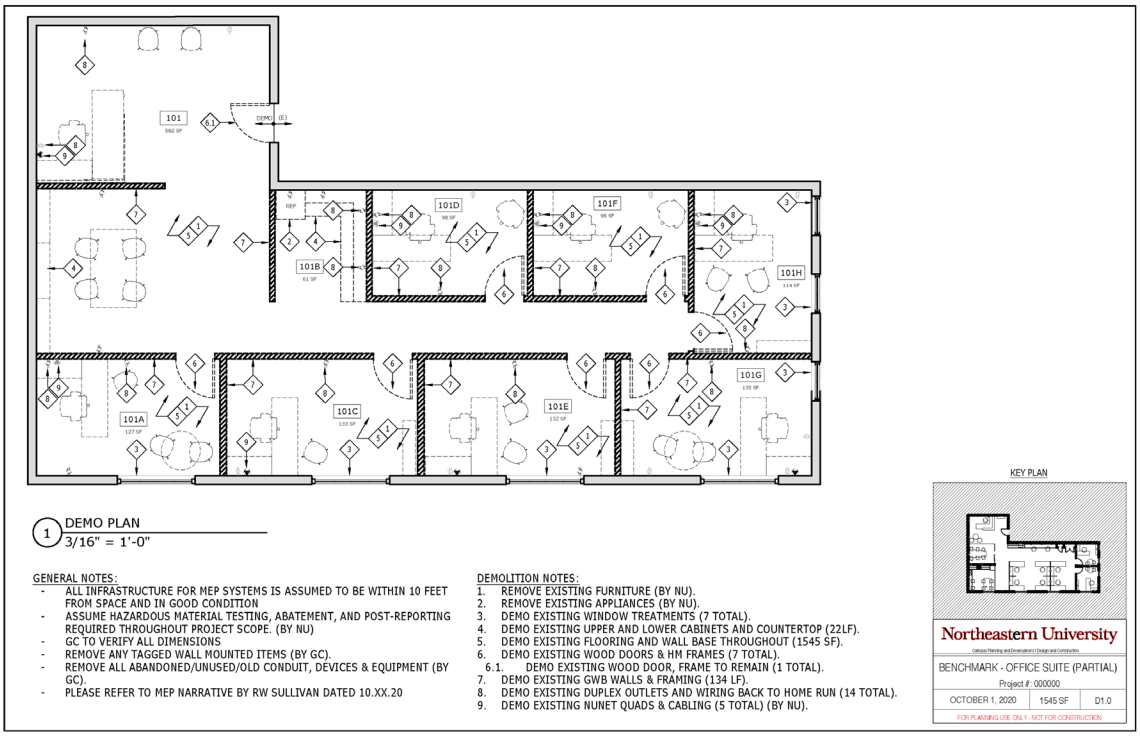
Upon Phase 1 Assessment approval, it is expected the project will take **38-54 weeks** (assessment through occupancy)

Schedule Assumptions	
Programming & Feasibility (Phase 1 Assessment)	2-4 weeks
Pre-Design (Phase 2 Assessment)	4-6 weeks
Design	12-14 weeks
Bid/Award	4-6 weeks
Construction	10-12 weeks
NU Install/ Move-In	2-4 weeks
Closeout	4-8 weeks

Phase 1 Assessment Attachments
• Test Fit Plan(s) • MEP/FP Narratives from the MEP Engineer.

Phase 1 Assessment Approval	
Note: All work related to project is on hold until project team's receipt of signed and approved Phase 1 Assessment	
Project Requestor	**Signature**
Funding Authority	**Signature**
Proposed Funding Source(s)	
Amount	**Source(s) / Index Number**

A.2.3 Demolition Plan

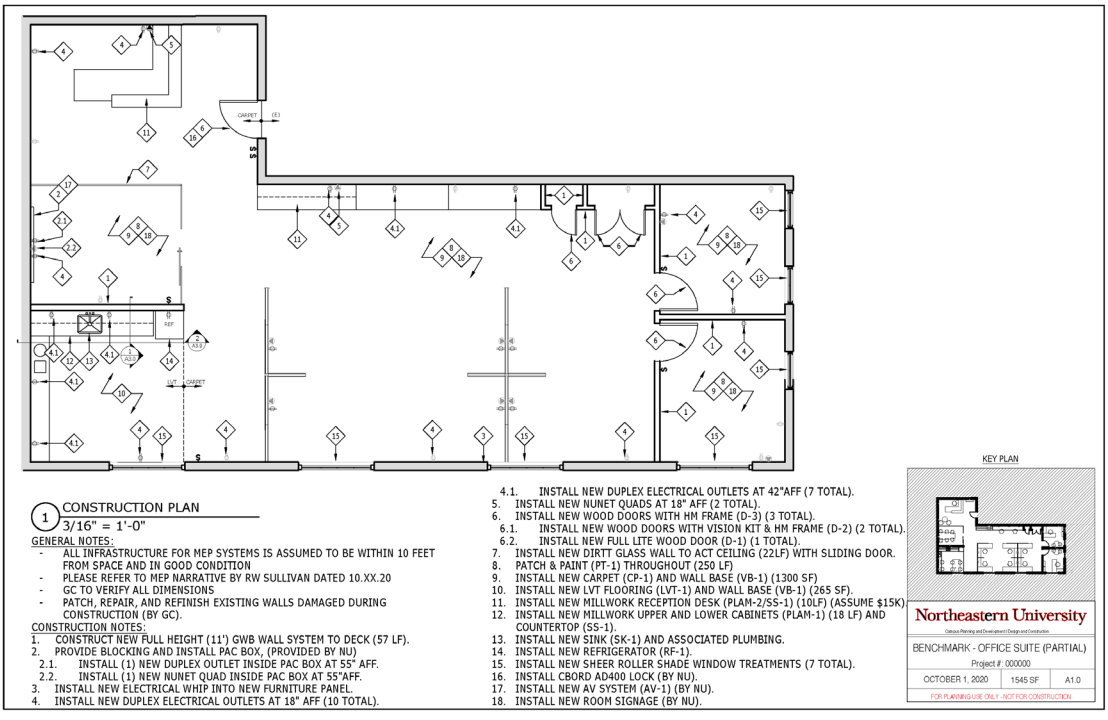


1 DEMO PLAN
3/16" = 1'-0"

GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION
- ASSUME HAZARDOUS MATERIAL TESTING, ABATEMENT, AND POST-REPORTING REQUIRED THROUGHOUT PROJECT SCOPE. (BY NU)
- GC TO VERIFY ALL DIMENSIONS
- REMOVE ANY TAGGED WALL MOUNTED ITEMS (BY GC).
- REMOVE ALL ABANDONED/UNUSED/OLD CONDUIT, DEVICES & EQUIPMENT (BY GC).
- PLEASE REFER TO MEP NARRATIVE BY RW SULLIVAN DATED 10.XX.20

DEMOLITION NOTES:
1. REMOVE EXISTING FURNITURE (BY NU).
2. REMOVE EXISTING APPLIANCES (BY NU).
3. DEMO EXISTING WINDOW TREATMENTS (7 TOTAL).
4. DEMO EXISTING UPPER AND LOWER CABINETS AND COUNTERTOP (22LF).
5. DEMO EXISTING FLOORING AND WALL BASE THROUGHOUT (1545 SF).
6. DEMO EXISTING WOOD DOORS & HM FRAMES (7 TOTAL).
   6.1. DEMO EXISTING WOOD DOOR, FRAME TO REMAIN (1 TOTAL).
7. DEMO EXISTING GWB WALLS & FRAMING (134 LF).
8. DEMO EXISTING DUPLEX OUTLETS AND WIRING BACK TO HOME RUN (14 TOTAL).
9. DEMO EXISTING NUNET QUADS & CABLING (5 TOTAL) (BY NU).

A.2.4 Construction Plan

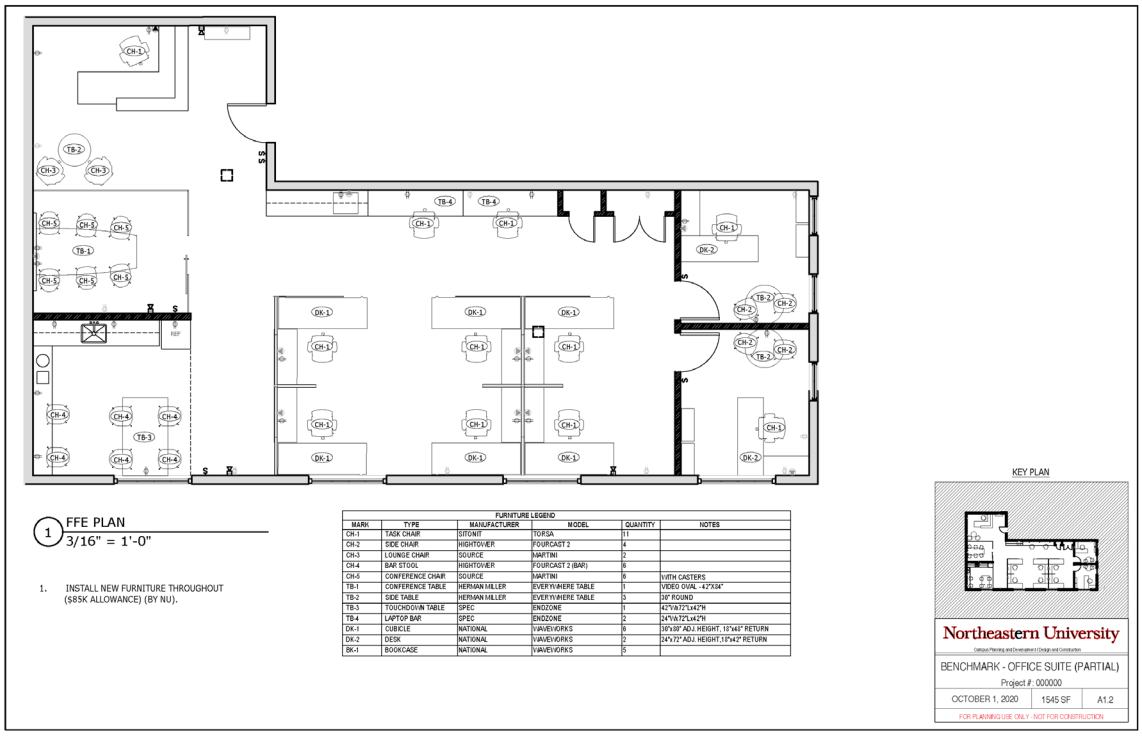


1 CONSTRUCTION PLAN
3/16" = 1'-0"

GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION
- PLEASE REFER TO MEP NARRATIVE BY RW SULLIVAN DATED 10.XX.20
- GC TO VERIFY ALL DIMENSIONS
- PATCH, REPAIR, AND REFINISH EXISTING WALLS DAMAGED DURING CONSTRUCTION (BY GC).

CONSTRUCTION NOTES:
1. CONSTRUCT NEW FULL HEIGHT (11') GWB WALL SYSTEM TO DECK (57 LF).
2. PROVIDE BLOCKING AND INSTALL PAC BOX, (PROVIDED BY NU)
   2.1. INSTALL (1) NEW DUPLEX OUTLET INSIDE PAC BOX AT 55" AFF.
   2.2. INSTALL (1) NEW NUNET QUAD INSIDE PAC BOX AT 55"AFF.
3. INSTALL NEW ELECTRICAL WHIP INTO NEW FURNITURE PANEL.
4. INSTALL NEW DUPLEX ELECTRICAL OUTLETS AT 18" AFF (10 TOTAL).
   4.1. INSTALL NEW DUPLEX ELECTRICAL OUTLETS AT 42"AFF (7 TOTAL).
5. INSTALL NEW NUNET QUADS AT 18" AFF (2 TOTAL).
6. INSTALL NEW WOOD DOORS WITH HM FRAME (D-3) (3 TOTAL).
   6.1. INSTALL NEW WOOD DOORS WITH VISION KIT & HM FRAME (D-2) (2 TOTAL).
   6.2. INSTALL NEW FULL LITE WOOD DOOR (D-1) (1 TOTAL).
7. INSTALL NEW DIRTT GLASS WALL TO ACT CEILING (22LF) WITH SLIDING DOOR.
8. PATCH & PAINT (PT-1) THROUGHOUT (250 LF)
9. INSTALL NEW CARPET (CP-1) AND WALL BASE (VB-1) (1300 SF)
10. INSTALL NEW LVT FLOORING (LVT-1) AND WALL BASE (VB-1) (265 SF).
11. INSTALL NEW MILLWORK RECEPTION DESK (PLAM-2/SS-1) (10LF) (ASSUME $15K).
12. INSTALL NEW MILLWORK UPPER AND LOWER CABINETS (PLAM-1) (18 LF) AND COUNTERTOP (SS-1).
13. INSTALL NEW SINK (SK-1) AND ASSOCIATED PLUMBING.
14. INSTALL NEW REFRIGERATOR (RF-1).
15. INSTALL NEW SHEER ROLLER SHADE WINDOW TREATMENTS (7 TOTAL).
16. INSTALL CBORD AD400 LOCK (BY NU).
17. INSTALL NEW AV SYSTEM (AV-1) (BY NU).
18. INSTALL NEW ROOM SIGNAGE (BY NU).

A.2.5 FF&E Plan



1 FFE PLAN
3/16" = 1'-0"

1. INSTALL NEW FURNITURE THROUGHOUT ($85K ALLOWANCE) (BY NU).

FURNITURE LEGEND

MARK	TYPE	MANUFACTURER	MODEL	QUANTITY	NOTES
CH-1	TASK CHAIR	SITONIT	TORSA	11	
CH-2	SIDE CHAIR	HIGHTOVER	FOURCAST 2	4	
CH-3	LOUNGE CHAIR	SOURCE	MARTINI	2	
CH-4	BAR STOOL	HIGHTOVER	FOURCAST 2 (BAR)	6	
CH-5	CONFERENCE CHAIR	SOURCE	MARTINI	6	WITH CASTERS
TB-1	CONFERENCE TABLE	HERMAN MILLER	EVERYWHERE TABLE	1	VIDEO OVAL - 42"X94"
TB-2	SIDE TABLE	HERMAN MILLER	EVERYWHERE TABLE	3	30" ROUND
TB-3	TOUCHDOWN TABLE	SPEC	ENDZONE	1	42"W/72"L/42"H
TB-4	LAPTOP BAR	SPEC	ENDZONE	2	24"W/72"L/42"H
DK-1	CUBICLE	NATIONAL	VAVEVIOFIKS	6	30"x30" ADJ. HEIGHT, 10"x48" RETURN
DK-2	DESK	NATIONAL	VAVEVIOFIKS	2	24"x72" ADJ. HEIGHT,10"x42" RETURN
BK-1	BOOKCASE	NATIONAL	VAVEVIOFIKS	5	

KEY PLAN

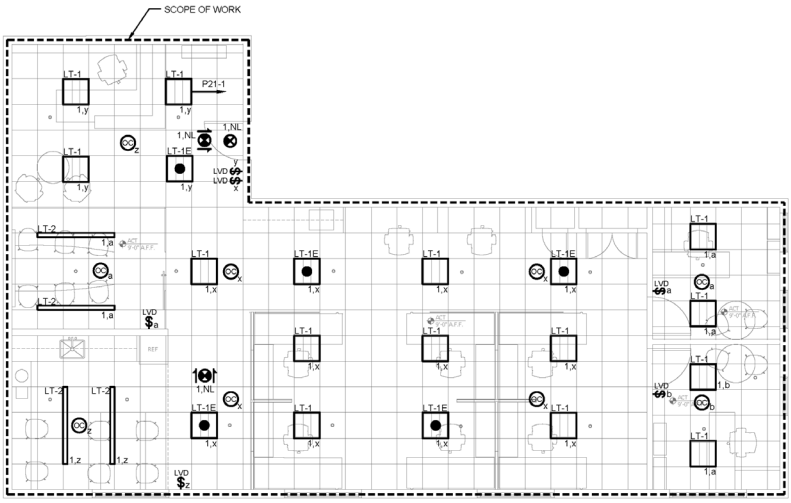
Northeastern University
Campus Planning and Development | Design and Construction

BENCHMARK - OFFICE SUITE (PARTIAL)
Project #: 000000

OCTOBER 1, 2020	1545 SF	A1.2

FOR PLANNING USE ONLY - NOT FOR CONSTRUCTION

A.2.6 Electrical Lighting Plan

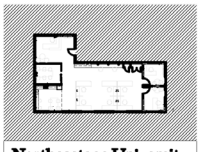


1 CONSTRUCTION PLAN
3/16" = 1'-0"

LIGHTING PLAN NOTES:

1. REFER TO DRAWING E000 FOR LEGEND AND GENERAL NOTES.
2. LIGHT FIXTURES SHALL BE INSTALLED AT MOUNTING HEIGHTS AND LOCATIONS AS INDICATED ON THE ARCHITECTURAL REFLECTED CEILING PLANS, ELEVATIONS, PART PLANS AND DETAILS. CONTRACTOR SHALL REFER TO ARCHITECTURAL DRAWINGS FOR INFORMATION.
3. EDGE-LIT TYPE EXIT SIGNS SHALL BE PROVIDED WITH MIRROR-BACKING AS REQUIRED TO SUIT FIELD CONDITIONS AND SPECIFIC INSTALLED LOCATIONS.
4. CIRCUIT NUMBERS ARE SHOWN FOR DESCRIPTIVE PURPOSES ONLY. EXACT NUMBERS SHALL BE DETERMINED IN FIELD AND SHALL BE NOTED ON THE CONTRACTORS' AS-BUILT DRAWINGS.
5. EXIT SIGNS, FIXTURES DESIGNATED AS NIGHT LIGHTS AND EMERGENCY BATTERY UNITS SHALL BE CONNECTED TO AN UNSWITCHED, CONSTANT "ON" SOURCE AS INDICATED. THE ASSOCIATED CIRCUIT BREAKER SHALL BE PROVIDED WITH A HANDLE LOCK.
6. BRANCH CIRCUIT CONDUCTORS SHALL BE SIZED AND INSTALLED FOR A MAXIMUM VOLTAGE DROP OF 3%. CONTRACTOR SHALL PROVIDE #10AWG CONDUCTORS FOR ALL 120V CIRCUITS GREATER THAN 60 FEET IN LENGTH. CONTRACTOR SHALL PROVIDE #8AWG CONDUCTORS FOR ALL 120V CIRCUITS GREATER THAN 100 FEET IN LENGTH, BUT LESS THAN 160 FEET IN LENGTH. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS AND OPTIONS.

KEY PLAN



Northeastern University
Campus Planning and Development | Design and Construction

ELECTRICAL LIGHTING CONSTRUCTION PLAN
BENCHMARK - OFFICE SUITE (PARTIAL)
Project #: 000000

NOVEMBER 23, 2020	1545 SF	E1.0

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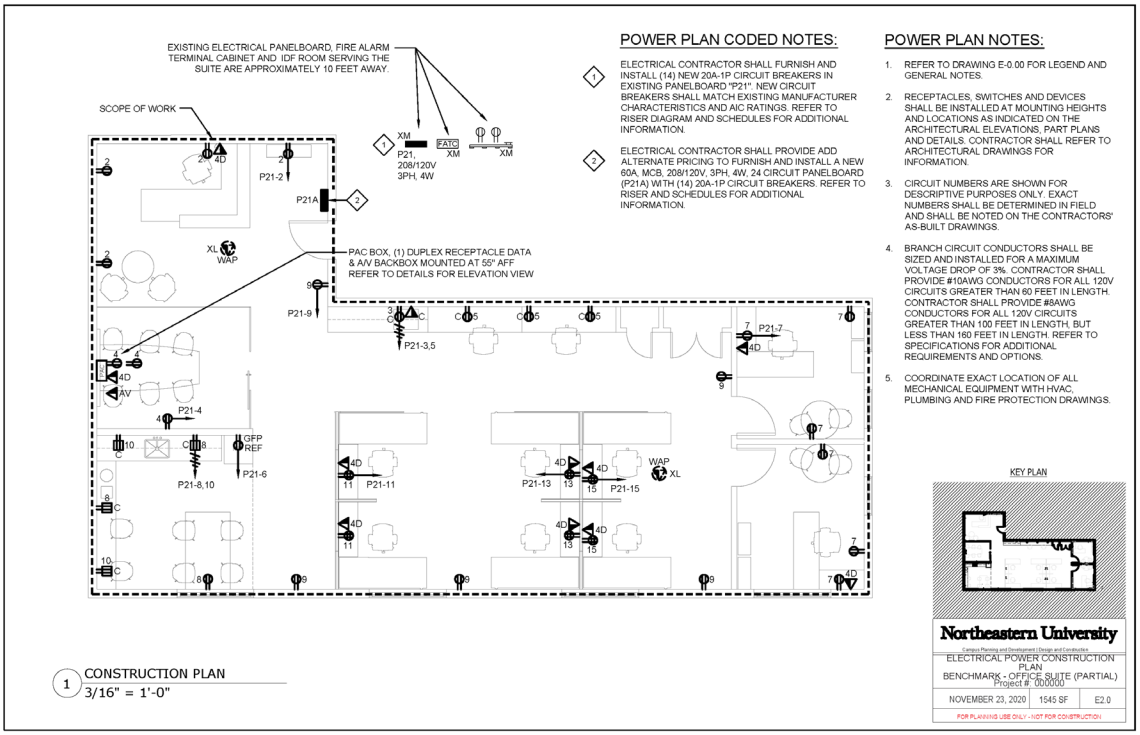
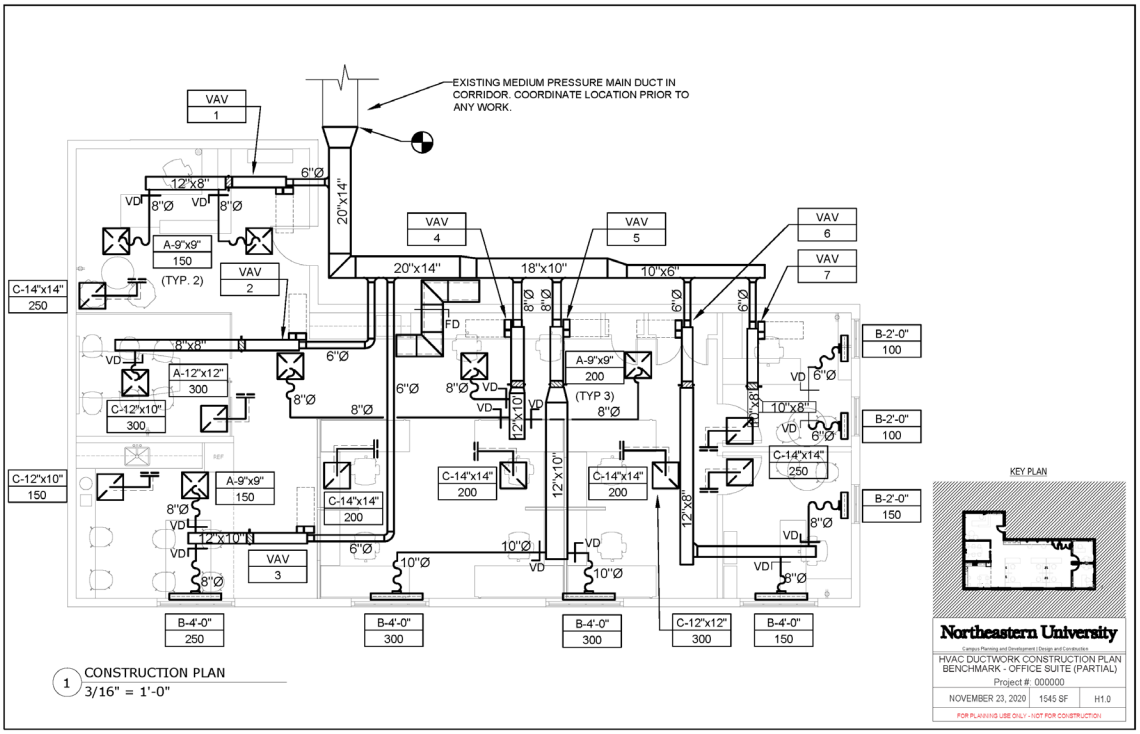
A.2.7 Electrical Power Plan



A.2.8 HVAC Ductwork Plan



A.3 BENCHMARK - CLASSROOM RENOVATION

A.3.1 Classroom Prototype Standards - The classroom prototype includes specific features and requirements which comprise the space standards, as identified below. The classroom benchmark Phase 1 Assessment and selective drawings that relate to these standards are included for reference in the paragraphs that follow. Classroom prototype requirements include the following:

- Carpet tile flooring
- Vinyl wall base
- Painted walls
- Wood door(s) with vision lite, with hollow metal frame
- CBORD AD-400 lock at each door (by NU)
- Horizontal sliding white board
- Classroom supply box (millwork)
- Sheer roller shade window treatments
- Lectern with NUFLEX AV system (by NU)
- NUnet at lectern (by NU)
- Electrically integrated clock
- New furnishings (by NU)
- Power in floor at lectern
- Quad power outlets (approximate 12" o.c., or supplement existing in a renovation project)
- Quad floor outlets below seating area (approximate 12" o.c.)
- 2' x 2' Acoustical Ceiling Tile
- Dimmable 2' x 2' LED light fixtures
- Dimmable light switches (2)
- Electrified AV projector recessed in ceiling (projector by NU)
- Electrified ceiling projector screen recessed in ceiling (screen by NU)
- Speakers in ceiling (4)
- Microphones in ceiling (6)
- Wireless access point (1)
- Flex-drop sprinkler heads
- All infrastructure for MEP systems is assumed to be within 10 feet from the space and in good condition.

Northeastern University
Facilities Management
Campus Planning and Real Estate

PHASE 1

PHASE 1 PROJECT ASSESSMENT

Project Name: Classroom Benchmark

The purpose of the Phase 1 Assessment is to initiate a potential project, spend a limited amount of funding to better define the cost, scope, schedule, and execution requirements prior to a full commitment to the project by the University. This first assessment also facilitates discussions regarding the viability of the project, as well as potential alternatives by the University's Senior Leadership Team at a formative stage of development based on a rough order of magnitude cost estimate that will be refined during the next Phase 2 Assessment.

Project Purpose and Necessity
The purpose of this project is to identify a benchmark for a gut renovation & aesthetic upgrade, to be used in project estimating, and to which future projects can be compared as a price point. This project is for a typical classroom in need of an aesthetic refresh.

Project Scope and Description
• The project scope is a 1000sf classroom with flexible furniture, a lectern, and a projector/screen.

Proposed Project Location(s)		
Building	Room Number	Square Feet
Benchmark	100	1,000sf

Existing Conditions Analysis
• Flooring will require abatement throughout • New sprinkler piping and flex heads required throughout • Existing AV equipment to be replaced • (1) new fire strobe required • Existing lights to be replaced one-for-one • New mechanical HVAC equipment, ductwork, covers, and all applicable accessories within the project limit required; hookup within 10' of space.

Project Assumptions
The following scope **is included** within the Phase 1 Assessment Scope: • Construction (Full GC Fees) • MEP/FP Upgrades • Engineering Services
The following scope **is not included** within the Phase 1 Assessment Scope: • Architectural Services • Building System Upgrades

Enabling Scope
• Classes will have to be relocated during construction.

Project Risks
• Construction noise may disrupt surrounding offices and classrooms.

Project Opportunities
• This classroom will be outfitted with an updated AV system, compatible with NUFlex technology

	Primary Characteristic	Secondary Characteristic		
Estimate Class	Level Of Project Definition	Purpose of Estimate	Methodology (Estimating Method)	Expected Accuracy Range
Class 5	0% to 2%	Concept Screening	Top Down Estimating (rough order of magnitude; cost per SF; and apportion of estimate)	± 20% - 50%
Class 4	1% to 15%	Study or Feasibility	Top Down Estimating (rough order of magnitude; cost per SF; and apportion of estimate)	± 15% - 50%
Class 3	10% to 40%	Budget Authorization, or Control	Bottom Up Estimating (Semi-detail unit cost with assembly level line items)	± 10% - 30%
Class 2	30% to 70%	Control or Bid Reconciliation	Bottom Up Estimating (Detail unit cost and detail take-off)	± 5% - 20%
Class 1	50% to 100%	Check Estimate or Bid Reconciliation	Bottom Up Estimating (Detail unit cost and detail take-off)	± 3% - 15%

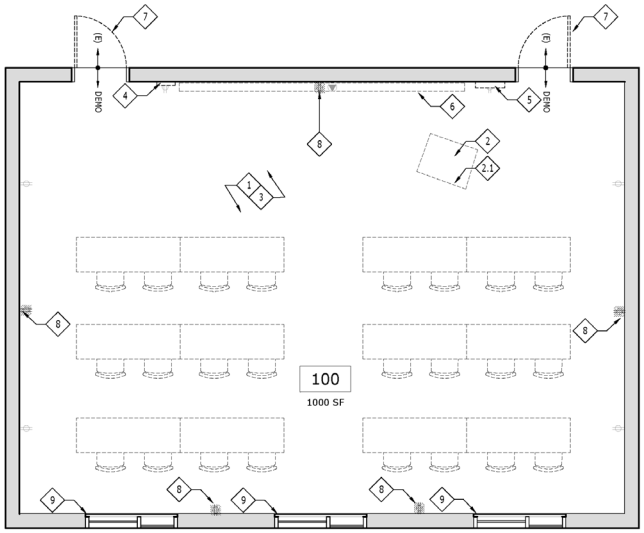
Estimated Project Schedule	
Upon Phase 1 Assessment approval, it is expected the project will take **12-18 weeks** (assessment through occupancy)	
Schedule Assumptions	
Programming & Feasibility (Phase 1 Assessment)	2-4 weeks
Pre-Design (Phase 2 Assessment)	1-2 weeks
Design	2-4 week

Bid/Award	4-6 weeks
Construction	2-4 weeks
NU Install/ Move-In	1-2 weeks
Closeout	4 weeks

Phase 1 Assessment Attachments
• Test Fit Plan(s) • MEP/FP Narratives from the MEP Engineer

Phase 1 Assessment Approval	
Note: All work related to project is on hold until project team's receipt of signed and approved Phase 1 Assessment	
Project Requestor	**Signature**
Funding Authority	**Signature**
Proposed Funding Source(s)	
Amount	**Source(s) / Index Number**

A.3.3 Demolition Plan

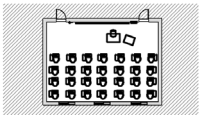


1 DEMOLITION PLAN
1/4" = 1'-0"

GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION.
- ASSUME HAZARDOUS MATERIAL TESTING & ABATEMENT THROUGHOUT (BY NU).
- G.C. TO VERIFY ALL DIMENSIONS.
- REMOVE ANY TAGGED WALL MOUNTED ITEMS (BY GC).
- REMOVE ALL ABANDONED/UNUSED/OLD CONDUIT, DEVICES & EQUIPMENT (BY GC).
- MEP/FP DRAWINGS TO BE PROVIDED.

DEMOLITION NOTES:
1. DEMO EXISTING FURNITURE (BY NU).
2. DEMO EXISTING LECTERN. (BY NU).
2.1. DEMO EXISTING AV (BY NU).
3. DEMO EXISTING FLOORING AND BASE (1,000 SF).
4. DEMO EXISTING INTEGRATED CLOCK.
5. DEMO CLASSROOM SUPPLY BOX.
6. DEMO EXISTING WHITEBOARD (16'-6" LF).
7. DEMO EXISTING DOOR AND HARDWARE, FRAME TO REMAIN (2 TOTAL).
8. DEMO EXISTING POWER DUPLEX OUTLET (5 TOTAL).
9. DEMO EXISTING WINDOW SHADES (3 TOTAL).

KEY PLAN



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BENCHMARK ASSESSMENT - CLASSROOM		
Project #: 190275		
OCTOBER 1, 2020	1,000 SF	D1.0

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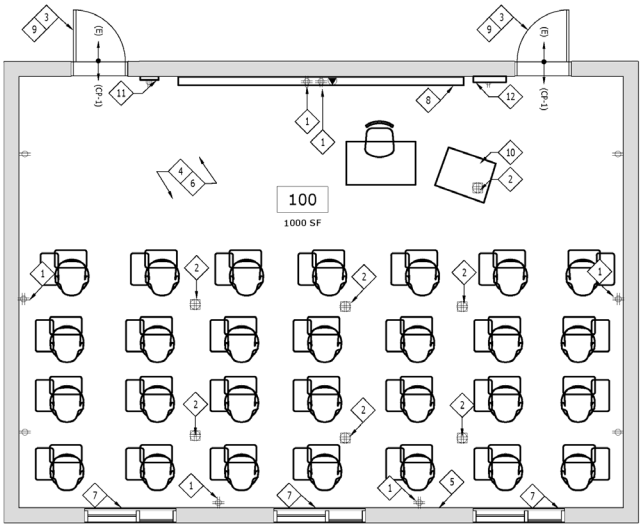
A.3.4 Construction Plan

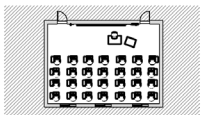


1 CONSTRUCTION PLAN
1/4" = 1'-0"

GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION.
- ASSUME HAZARDOUS MATERIAL TESTING & ABATEMENT THROUGHOUT (BY NU).
- G.C. TO VERIFY ALL DIMENSIONS.
- REMOVE ANY TAGGED WALL MOUNTED ITEMS (BY GC).
- REMOVE ALL ABANDONED/UNUSED/OLD CONDUIT, DEVICES & EQUIPMENT (BY GC).
- MEP/FP DRAWINGS TO BE PROVIDED.

CONSTRUCTION NOTES:
1. INSTALL NEW ELECTRICAL QUAD OUTLET AT 18" AFF (6 TOTAL).
2. INSTALL NEW FLOOR CORE WITH INTEGRATED POWER (BY GC) AND NUNET (BY NU) (7 TOTAL).
3. INSTALL NEW WOOD DOORS WITH VISION KIT (2 TOTAL).
4. PATCH AND PAINT (P-1) THROUGHOUT PROJECT LIMIT (120 LF).
5. INSTALL NEW WALL TREATMENT (WP-1) (35 LF) ($XXX)
6. INSTALL NEW CARPET (CP-1) AND BASE (VB-1) THROUGHOUT (1,000 SF).
7. INSTALL NEW SHEER ROLLER SHADE WINDOW TREATMENTS (3 TOTAL).
8. INSTALL NEW HORIZONTAL SLIDING WHITEBOARD (16'-6" LF).
9. INSTALL NEW CBORD AD400 LOCK(2 TOTAL) (BY NU).
10. INSTALL NEW NUFLEX AV SYSTEM INTEGRATED INTO LECTERN (ALLOW $100K) (BY NU).
11. INSTALL ELECTRICALLY-INTEGRATED CLOCK.
12. INSTALL NEW CLASSROOM SUPPLY BOX (MW-1).

KEY PLAN



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BENCHMARK ASSESSMENT - CLASSROOM		
Project #: 190275		
OCTOBER 1, 2020	1,000 SF	A1.0

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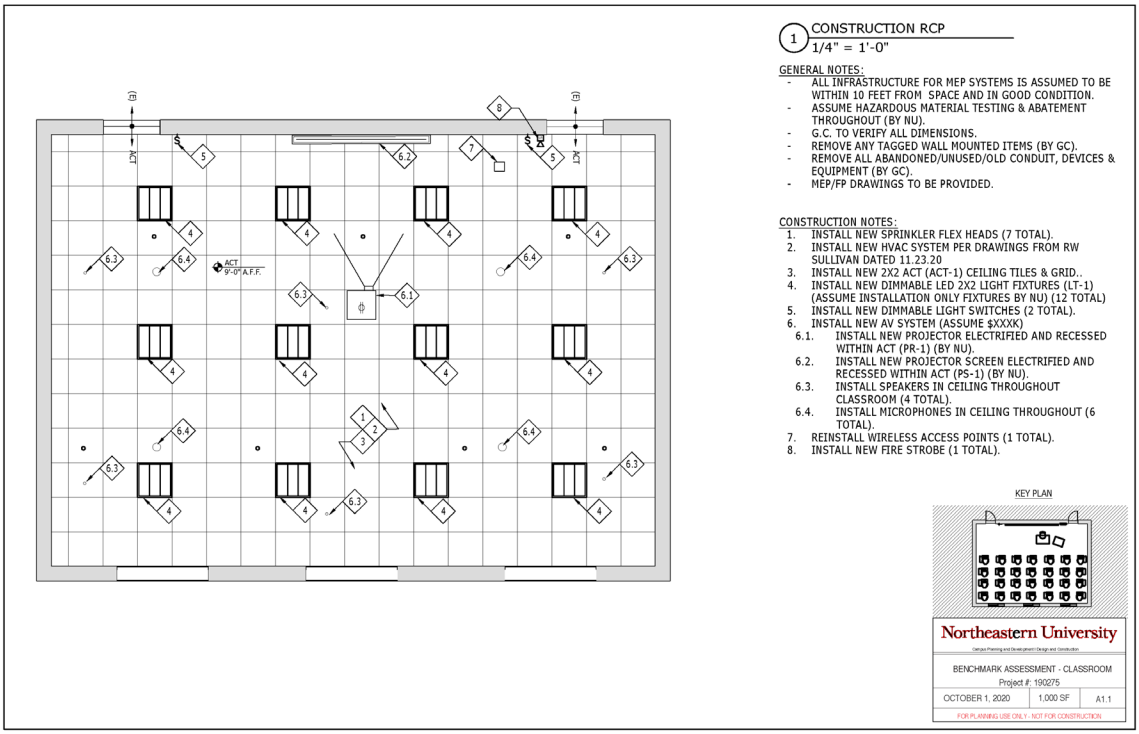
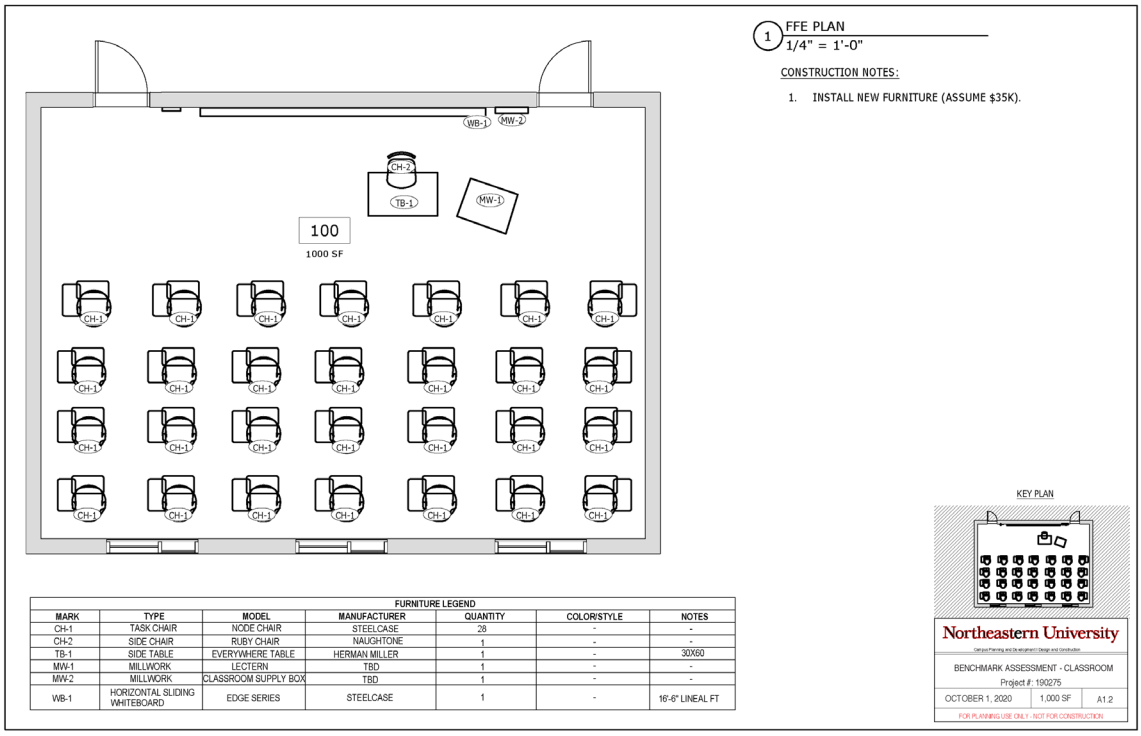
A.3.5 Reflected Ceiling Plan



A.3.6 FF&E Plan



FURNITURE LEGEND

MARK	TYPE	MODEL	MANUFACTURER	QUANTITY	COLOR/STYLE	NOTES
CH-1	TASK CHAIR	NODE CHAIR	STEELCASE	28	-	-
CH-2	SIDE CHAIR	RUBY CHAIR	NAUGHTONE	1	-	-
TB-1	SIDE TABLE	EVERYWHERE TABLE	HERMAN MILLER	1	-	30X60
MW-1	MILLWORK	LECTERN	TBD	1	-	-
MW-2	MILLWORK	CLASSROOM SUPPLY BOX	TBD	1	-	-
WB-1	HORIZONTAL SLIDING WHITEBOARD	EDGE SERIES	STEELCASE	1	-	16'-6" LINEAL FT

A.4 BENCHMARK - WET LAB RENOVATION

A.4.1 Wet Lab Prototype Standards - The wet lab prototype includes specific features and requirements which comprise the space standards, as identified below. The wet lab benchmark Phase 1 Assessment and selective drawings that relate to these standards are included for reference in the paragraphs that follow. Wet lab prototype requirements include the following:

- Appliances - All existing appliances and lab equipment will be removed and stored by NU (renovation project)
- Full height GWB wall system to deck (where new office or support space is created)
- Rubber tile flooring (or seamless sheet resilient flooring otherwise required)
- Rubber wall base
- Painted walls
- 48" wide 1-1/2 leaf wood door(s) with vision lite, with hollow metal frame
- CBORD AD-400 lock at each door (by NU)
- Cabinets, work counters and benches (as required by program)
- Fume hood
- Gas, vacuum, and compressed air turrets at work counters (2 locations)
- Hand sink and associated plumbing with foot pedal controls and eyewash
- Lab sink and associated plumbing with foot pedal controls and RO/DI water
- Emergency shower and eyewash
- Sheer roller shade window treatments
- Room signage (by NU)
- NUnet quads (4) at work counters
- Duplex power wall outlets (supplement existing in a renovation project)
- Quad outlets above work counter (supplement existing in a renovation project)
- Painted exposed structure ceiling
- 2' x 2' Acoustical Ceiling Tile (where new office or support space is created)
- Dimmable 2' x 2' LED direct/ indirect troffer light fixtures (where ACT is provided)
- Linear LED pendant light fixtures
- Dimmable light switches (1 per room/ space)
- Flex-drop sprinkler heads
- Service panels at ceiling for compressed air, vacuum, gas and NUNET (assume connections to existing systems in the space
- All infrastructure for MEP systems is assumed to be within 10 feet from the space and in good condition.

Northeastern University
Facilities Management
Campus Planning and Real Estate

PHASE 1

PHASE 1 PROJECT ASSESSMENT

Project Name: Wet Lab Benchmark

The purpose of the Phase 1 Assessment is to initiate a potential project, spend a limited amount of funding to better define the cost, scope, schedule, and execution requirements prior to a full commitment to the project by the University. This first assessment also facilitates discussions regarding the viability of the project, as well as potential alternatives by the University's Senior Leadership Team at a formative stage of development based on a rough order of magnitude cost estimate that will be refined during the next Phase 2 Assessment.

Project Purpose and Necessity
The purpose of this project is to benchmark the cost and scope of a gut renovation and aesthetic refresh of a generic, bio-like research laboratory. The benchmark will serve as a point of reference for future projects, and represents a typical renovation.

Project Scope and Description
The project scope is 825sf, including 20LF of new stud wall construction, and a full aesthetic refresh throughout. The project includes new lighting, flooring, paint; (3) new sinks (one location existing to remain), and installation of one new fume hood.

Proposed Project Location(s)		
Building	Room Number	Square Feet
Benchmark	101	825sf

Existing Conditions Analysis
• Abate floor tile and mastic • Assume new sprinkler heads and piping • Assume new mechanical HVAC equipment, ductwork, run-outs and diffusers. • Assume new plumbing for (2) added sinks, connection within 10' of suite. • Assume new light fixtures • (2) new fire strobes are required

Project Assumptions
The following scope **is included** within the Phase 1 Assessment Scope: • Construction (Full GC Fees) • Full architectural and engineering services
The following scope **is not included** within the Phase 1 Assessment Scope: • Base building MEP/FP upgrades

Enabling Scope
• Occupants will be relocated during construction.

Project Risks
• MEP/FP services are insufficient or remote.

Project Opportunities
• Upgrade of current systems and spaces to support research initiative.

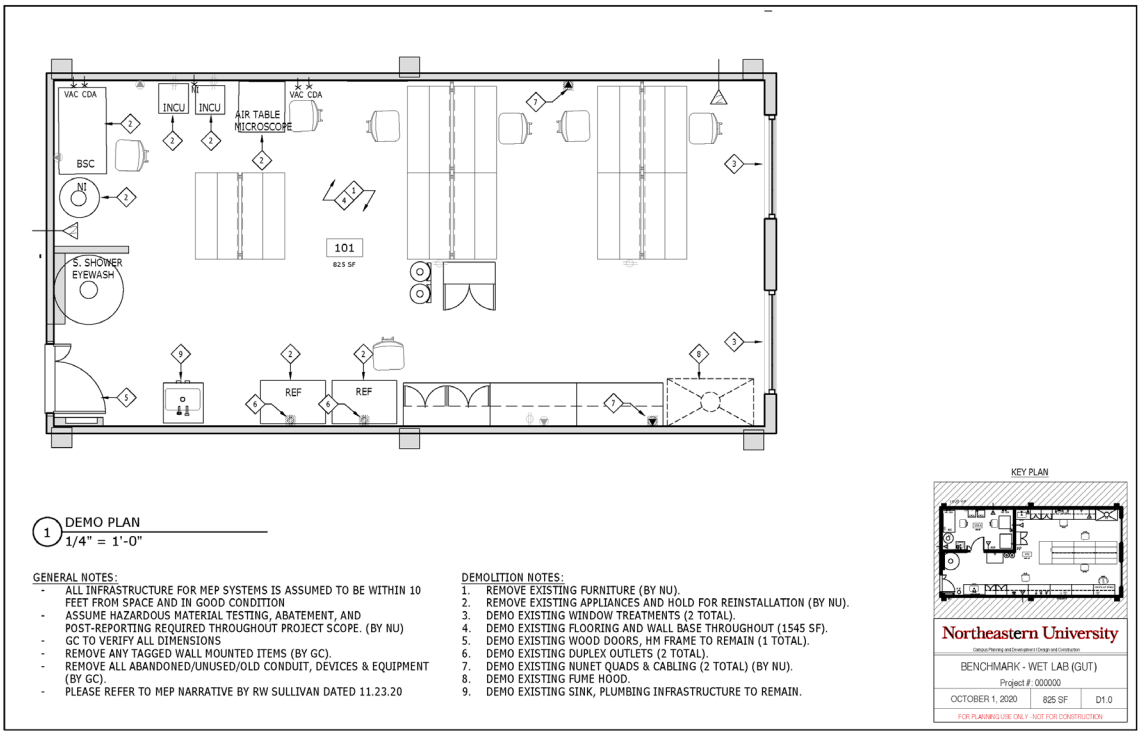
	Primary Characteristic	Secondary Characteristic		
Estimate Class	Level Of Project Definition	Purpose of Estimate	Methodology (Estimating Method)	Expected Accuracy Range
Class 5	0% to 2%	Concept Screening	Top Down Estimating (rough order of magnitude; cost per SF; and apportion of estimate)	± 20% - 50%
Class 4	1% to 15%	Study or Feasibility	Top Down Estimating (rough order of magnitude; cost per SF; and apportion of estimate)	± 15% - 50%
Class 3	10% to 40%	Budget Authorization, or Control	Bottom Up Estimating (Semi-detail unit cost with assembly level line items)	± 10% - 30%
Class 2	30% to 70%	Control or Bid Reconciliation	Bottom Up Estimating (Detail unit cost and detail take-off)	± 5% - 20%
Class 1	50% to 100%	Check Estimate or Bid Reconciliation	Bottom Up Estimating (Detail unit cost and detail take-off)	± 3% - 15%

Estimated Project Schedule	
Upon Phase 1 Assessment approval, it is expected the project will take **38-54 weeks** (assessment through occupancy)	
Schedule Assumptions	
Programming & Feasibility (Phase 1 Assessment)	2-4 weeks
Pre-Design (Phase 2 Assessment)	4-6 weeks
Design	12-14 weeks
Bid/Award	4-6 weeks
Construction	10-12 weeks
NU Install/ Move-In	2-4 weeks
Closeout	4-8 weeks

Phase 1 Assessment Attachments
• Test Fit Plan(s) • MEP/FP Narratives from the MEP Engineer

Phase 1 Assessment Approval	
Note: All work related to project is on hold until project team's receipt of signed and approved Phase 1 Assessment	
Project Requestor	**Signature**
Funding Authority	**Signature**
Proposed Funding Source(s)	
Amount	**Source(s) / Index Number**

A.4.3 Demolition Plan



1 DEMO PLAN
1/4" = 1'-0"

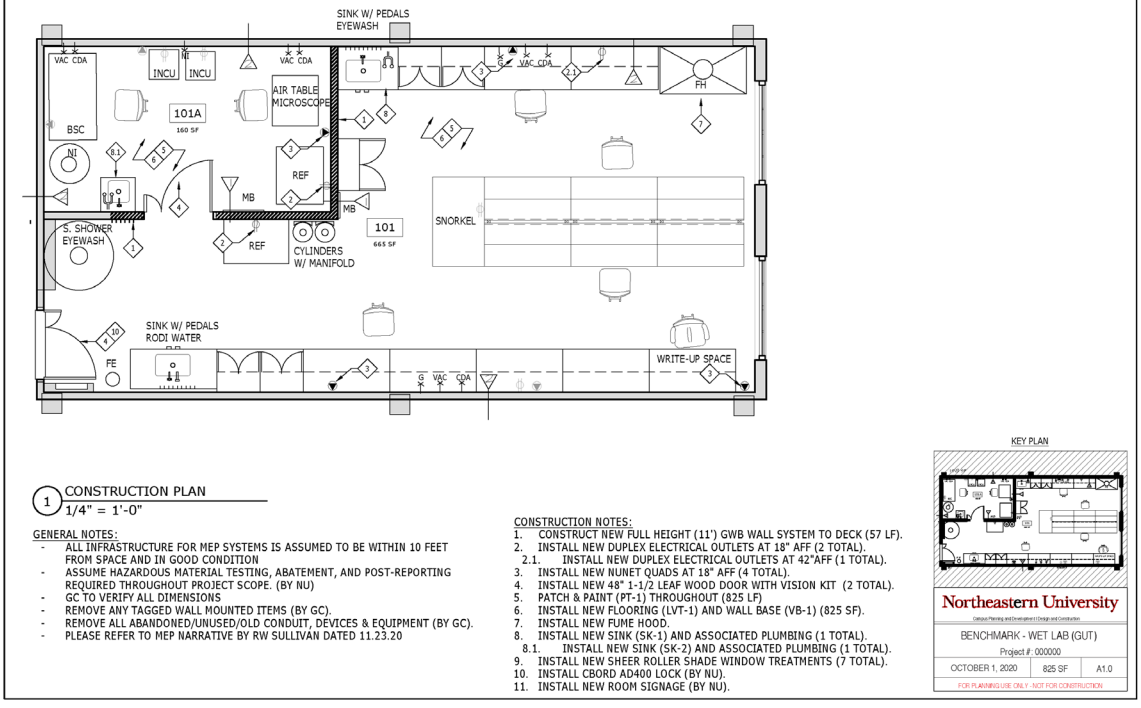
GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION
- ASSUME HAZARDOUS MATERIAL TESTING, ABATEMENT, AND POST-REPORTING REQUIRED THROUGHOUT PROJECT SCOPE. (BY NU)
- GC TO VERIFY ALL DIMENSIONS
- REMOVE ANY TAGGED WALL MOUNTED ITEMS (BY GC).
- REMOVE ALL ABANDONED/UNUSED/OLD CONDUIT, DEVICES & EQUIPMENT (BY GC).
- PLEASE REFER TO MEP NARRATIVE BY RW SULLIVAN DATED 11.23.20

DEMOLITION NOTES:
1. REMOVE EXISTING FURNITURE (BY NU).
2. REMOVE EXISTING APPLIANCES AND HOLD FOR REINSTALLATION (BY NU).
3. DEMO EXISTING WINDOW TREATMENTS (2 TOTAL).
4. DEMO EXISTING FLOORING AND WALL BASE THROUGHOUT (1545 SF).
5. DEMO EXISTING WOOD DOORS, HM FRAME TO REMAIN (1 TOTAL).
6. DEMO EXISTING DUPLEX OUTLETS (2 TOTAL).
7. DEMO EXISTING NUNET QUADS & CABLING (2 TOTAL) (BY NU).
8. DEMO EXISTING FUME HOOD.
9. DEMO EXISTING SINK, PLUMBING INFRASTRUCTURE TO REMAIN.

KEY PLAN

Northeastern University
Campus Planning and Development | Design and Construction
BENCHMARK - WET LAB (GUT)
Project #: 000000
OCTOBER 1, 2020 | 825 SF | D1.0
FOR PLANNING USE ONLY - NOT FOR CONSTRUCTION

A.4.4 Construction Plan



1 CONSTRUCTION PLAN
1/4" = 1'-0"

GENERAL NOTES:
- ALL INFRASTRUCTURE FOR MEP SYSTEMS IS ASSUMED TO BE WITHIN 10 FEET FROM SPACE AND IN GOOD CONDITION
- ASSUME HAZARDOUS MATERIAL TESTING, ABATEMENT, AND POST-REPORTING REQUIRED THROUGHOUT PROJECT SCOPE. (BY NU)
- GC TO VERIFY ALL DIMENSIONS
- REMOVE ANY TAGGED WALL MOUNTED ITEMS (BY GC).
- REMOVE ALL ABANDONED/UNUSED/OLD CONDUIT, DEVICES & EQUIPMENT (BY GC).
- PLEASE REFER TO MEP NARRATIVE BY RW SULLIVAN DATED 11.23.20

CONSTRUCTION NOTES:
1. CONSTRUCT NEW FULL HEIGHT (11') GWB WALL SYSTEM TO DECK (57 LF).
2. INSTALL NEW DUPLEX ELECTRICAL OUTLETS AT 18" AFF (2 TOTAL).
2.1. INSTALL NEW DUPLEX ELECTRICAL OUTLETS AT 42"AFF (1 TOTAL).
3. INSTALL NEW NUNET QUADS AT 18" AFF (4 TOTAL).
4. INSTALL NEW 48" 1-1/2 LEAF WOOD DOOR WITH VISION KIT (2 TOTAL).
5. PATCH & PAINT (PT-1) THROUGHOUT (825 LF)
6. INSTALL NEW FLOORING (LVT-1) AND WALL BASE (VB-1) (825 SF).
7. INSTALL NEW FUME HOOD.
8. INSTALL NEW SINK (SK-1) AND ASSOCIATED PLUMBING (1 TOTAL).
8.1. INSTALL NEW SINK (SK-2) AND ASSOCIATED PLUMBING (1 TOTAL).
9. INSTALL NEW SHEER ROLLER SHADE WINDOW TREATMENTS (7 TOTAL).
10. INSTALL CBORD AD400 LOCK (BY NU).
11. INSTALL NEW ROOM SIGNAGE (BY NU).

KEY PLAN

Northeastern University
Campus Planning and Development | Design and Construction
BENCHMARK - WET LAB (GUT)
Project #: 000000
OCTOBER 1, 2020 | 825 SF | A1.0
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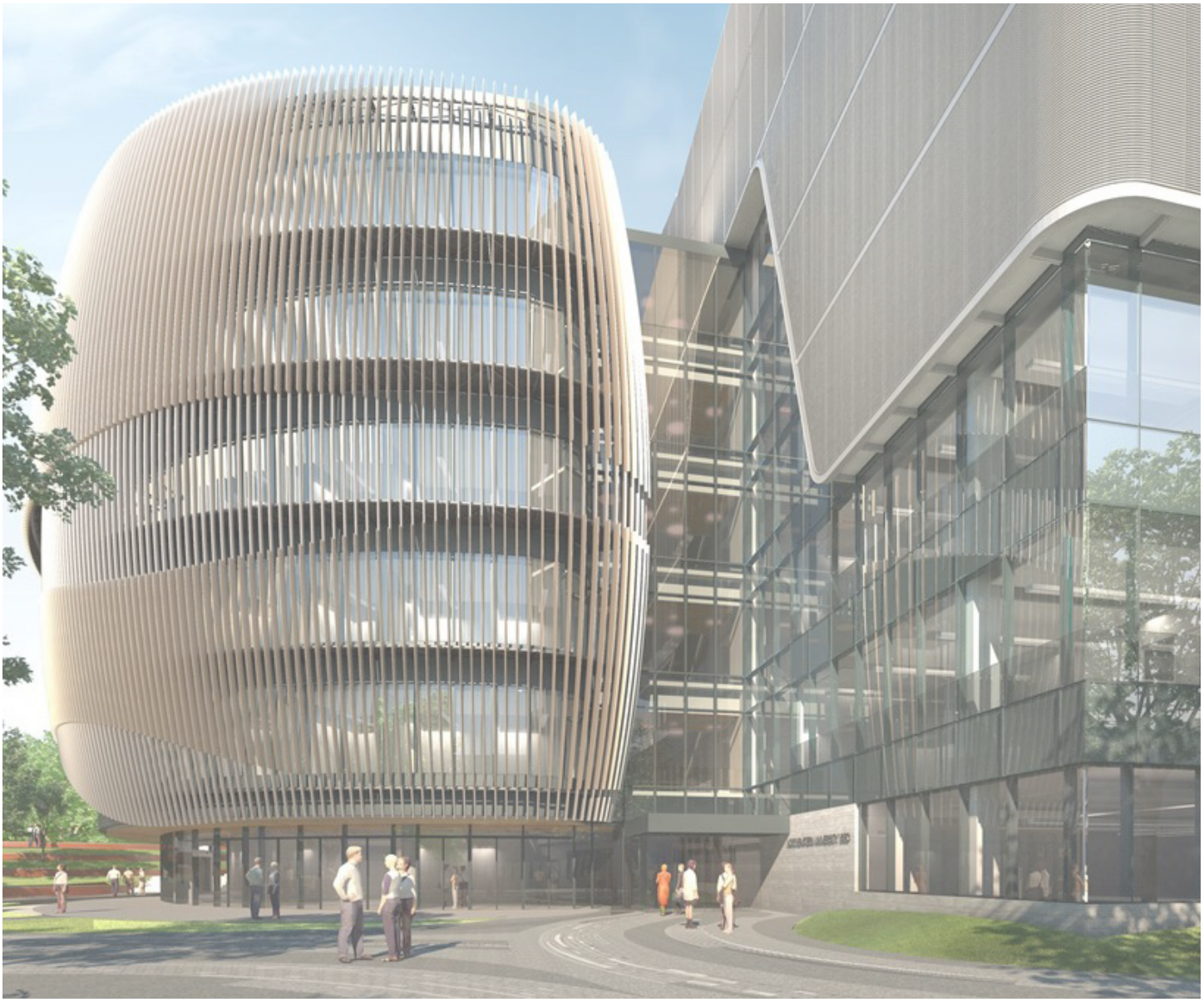

Northeastern University

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