PRINCETON UNIVERSITY
FACILITIES DEPARTMENT
DESIGN STANDARDS MANUAL

RELEASE 8.0

MARCH 2010

Princeton University
Office of Design and Construction

SECTION NAME **PAGES**

Introduction **Introduction – 1 to Introduction - 2**

1.0 GENERAL ADMINISTRATIVE PROCEDURES

1.1 University Facilities Organization **1.1-1 to 1.1-5**
Introduction – page 1 / Index of References – page 1 / Facilities Department Organization and Function – page 1 / Facilities Department Organization Chart – page 5

1.2 Sustainable Building Guidelines **1.2-1 to 1.2-13**
Introduction – page 1/ Contacts – page 2/ Index Of References – page 2 / Outline of Process- page 3/ Sustainable Building Design Process- Chart-page 5 Life – Cycle Comparative Studies (LCCS) – page 7/ Life Cycle Cost Analysis – page 8/ Social and Environmental Impact Assessment – page 9/ Material Selection – page 11 / Waste Management – page 11 / Site Planning – page 12

1.3 Project Responsibility Checklist **1.3-1 to 1.3-17**
Introduction – page 1 / Pre-Contractual Phase – page 1 / Pre-Schematic Design Phase – page 3 / Schematic Design Phase – page 5 / Tasks Prior to Design and Development Phase – page 8 / Tasks during Design Development Phase – page 8/Task Prior to Construction Document Phase – page 10/ Tasks During Construction Phase – page 10/ Tasks During Bidding and Negotiation Phase – page 12/Task During Administration Phase – page 14/ Tasks During Project Closeout Phase – page 13/ A/E Fee Proposal Budget Outline – page15

1.4 Regulatory Agencies **1.4-1 to 1.4-7**
Introduction – page 1 / State Review – page 1 / Local Review – page 1 /Contacts - page 2 / Index of References – page 2 / Review Guidelines – page 3 / Procedural Guidelines-Preliminary Design and Design Development – page 3 / Procedural Guidelines-Code Review Applications and Submittals – page 4/ Procedural Guidelines-Organization of Submittal Drawings – page 4 /Procedural Guidelines-Timely Response to Review Comments – page 5/ Procedural Guidelines-Code Variances and Variations – page 5/ Procedural Guidelines-Permit Application to Local Agency – page 6 / Procedural Guidelines-Approved Construction Documents – page 6 / Periodic Testing Requirements – Page 7

1.5 Documentation and Archiving **1.5-1 to 1.5-8**
Introduction – page 1 / Contacts – page 1 / Index of References – page 2 / Code References – page 3 / Room Numbering Requirements – page 3 / Existing Documentation Availability and Distribution – page 3 / Archiving Requirements-Printed – page 3 / Archiving Requirements-Electronic – page 4 / Closeout Documentation Review – page 4 / Summary of Archiving Requirements – page 5 / Formatting of Printed Deliverables-Drawings – Page 7 / Formatting of Electronic Deliverables – page 7 / Existing Digital Data – Page 7 /Positional Tolerance Requirements – Page 8 / Building Information Modeling – Page 8

FACILITIES DEPARTMENT STANDARDS

2.0 OFFICE OF DESIGN AND CONSTRUCTION STANDARDS

2.1 Accessibility **2.1-1 to 2.1-7**

Introduction – page 1 / Contacts – page 2 / Index of References – page 2 / Applicable Codes and Federal Standards – page 2 / University Review Guidelines – page 3 /Design and Procedural Guidelines – page 4 / Guidelines and Requirements for Documentation – page 5 / Other Considerations for Accessible Design – page 6

2.2 Audio-Visual Standards **2.2-1 to 2.2-13**

Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – page 2 /Procedural Guidelines – page 3 / Guidelines and Requirements for Documentation – page 3 / Guidelines for Audio-Visual Equipment – page 4 / Requirements for Testing and Personnel Instruction – page 12 / Requirements for As-Built Drawings and Project Closeout – page 13

2.3 Classroom Design **2.3-1 to 2.3-10**

Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 1 / Review Guidelines – Page 2 / Procedural Guidelines – page 2 /Guidelines and Requirements for Documentation – page 3 / Guidelines for Classroom Design – page 4/ Requirements for As-Built Drawings – page 10

2.4 Dormitory Design **2.4-1 to 2.4-22**

Introduction – page 1 / Contacts – page 1 / Index of References – page 2 / Code References – page 3 / Review Guidelines-General – page 3 / Procedural Guidelines-Approach to Regulatory Agencies – page 4 / Procedural Guidelines-Code Review Applications and Submittals – page 5 / Guidelines and Requirements for Documentation – page 5 / Considerations for Dormitory Design – page 5 /Custodial Closets – page 21 /Signage Requirements –page 22 /Environmental Issues – page 22 / Requirements for As-Built Drawings – page 22

2.5 Furniture, Fixtures and Equipment **2.5-1 to 2.5-8**

Introduction – page 1 / Contacts – page 2/ Index of References – page 2 / Review Guidelines – page 2 / Design Guidelines – page 3 / Requirements for As-Built Drawings and Project Closeout – page 8

2.6 Office of Information Technology **2.6.1 to 2.6-8**

Introduction – page 1 /Contacts - page 1 /Index of References – page 1 / Code References – page 2 /Review Guidelines – page 2 /Procedural Guidelines-Preliminary Design and Design Development – page 3 /Guidelines and Requirements for Documentation – page 3 /Considerations for OIT Systems Design – page 4 / Requirements for As-Built Drawings – page 8

2.7 Security **2.7-1 to 2.7-6**

Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Review Guidelines – page 2 / Procedural Guidelines-Programming and Schematic Design – page 2 / Design Guidelines –"Passive" Security Features – page 3 / Design Guidelines-"Active" Security Features – page 4 /Requirements for As-Built Drawings – page 5

2.8 Environmental Graphics **2.8-1 to 2.8-4**
Introduction – page 1 / Contacts – page 2 / Index of References – page 2 / Review Guidelines – page 2 / Procedural Guidelines-Preliminary Design and Design Development – page 3 / Guidelines for Installation and Performance – page 4 / Guidelines for Door Number Label – page 4

2.9 Site Planning **2.9-1 to 2.9-16**
Introduction – page 1 / Contacts – page 2 / Index of References – page 2 / Code References – page 3 / Design Guidelines – page 3 / Internal Review Guidelines-Buildings – page 4 / Internal Review Guidelines-Landscaping – page 5 / Internal Review Guidelines-Utilities – page 6 /Municipal Review Guidelines-Landscaping – page 7 / Guidelines and Requirements for Documentation – page 7 /Sustainability – page 8 /Considerations for Exterior Design-Circulation – page 8 / Considerations for Exterior Design-Planting Concepts – page 12 / Considerations for Exterior Design-Reunion Sites – page 13 / Considerations for Exterior Design-Lighting – page 14 /General Survey Requirements – page 14 /Requirements for As-Built Drawings – page 15

2.10 Laboratory Design **2.10-1 to 2.10-11**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – page 2 / Procedural Guidelines – page 3 / Guidelines and Requirements for Documentation – page 3 /

Guidelines for Laboratory Design – page 3 / Requirements for As-Built Drawings – page 11

2.11 Graduate Apartment Design **2.11-1 to 2.11-16**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines-General – page 2 / Procedural Guidelines-Approach to Regulatory Agencies – page 3 / Procedural Guidelines-Code Review Applications and Submittals – page 3 / Guidelines and Requirements for Documentation – page 4 / Considerations for Apartment Design – page 4 / Custodial Closets – page 15 /Signage Requirements –page 16 / Environmental Issues – page 16 /Requirements for As-Built Drawings – page 16

3.0 ENGINEERING DEPARTMENT STANDARDS

3.1 Access Control Systems **3.1-1 to 3.1-6**
Introduction – page 1 / Contacts – page 1 / Index of References – page 3 / Code References – page 4 / Review Guidelines – page 2/ Procedural Guidelines – page 3 / Guidelines and Requirements for Documentation – page 4 / Guidelines for System Installation and Performance – page 4 / Requirements for Testing and Commissioning – page 6/ Requirements for As-Built Drawings – page 6

3.2 Automatic Temperature Controls and Energy Management System **3.2-1 to 3.2-10**
Introduction – page 1 / Contacts – page 1 / Index of References – page 2 / Code References – page 4 / Review Guidelines – page 4 / Procedural Guidelines – page 4 / Requirements for Documentation –page 5 / Guidelines for System Installation and Performance – page 5 / Requirements for Automatic Temperature Control System Testing – page 7 / Master BAS Spec Implementation Guidance- page 8/ Requirements for As-Built Drawings – page 10

3.3 Energy Guidelines **3.3-1 to 3.3-13**
Introduction – page 1 / Contacts – page 1 / Index of References – page 2 / Code References – page 3 / Requirements for Documentation – page 3 / Energy Performance Targets-page 5/ Modeling Procedures – page 6 / Envelope Design Guidelines – page 7 /System Performance – page 11/ Daylighting – page 11//Renewal Energy – page 13/ Measurement and Verification-page 13

3.4 Fire Alarm Systems **3.4-1 to 3.4-7**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – page 2 / Procedural Guidelines – page 2 / Requirements for Documentation –page 3/ Guidelines for System Installation and Performance – page 4 / Requirements for Room and Device Designations – page 6 / Requirements for Fire Alarm System Commissioning – page 7 / Requirements for As-Built Drawings – page 7 / Requirements for Spare Parts – page 7

3.5 Lighting Design **3.5-1 to 3.5-6**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 1 / Review Guidelines – page 1 / Procedural Guidelines – page 2 / Guidelines and Requirements for Documentation – page 3 / Guidelines for System Installation and Performance – page 4 / Lighting Controls – page 5/Requirements for As-Built Drawings – page 6 / Requirements for Spare Lamps – page 6

3.6 Utility Guidelines **3.6-1 to 3.6-6**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1/ Code References – page 2 / Review Guidelines – page 2 / Procedural Guidelines – page 3 / Positional and Tolerance Requirements for Existing Conditions Survey - page 3 / Guidelines and Requirements for Documentation – page 4 / Guidelines for System Installation and Performance – page 4 / Requirements for As-Built Drawings – page 5 / Service Requirements for Underground Utilities – page 6

3.7 Fire Suppression – Sprinklers and Standpipes **3.7-1 to 3.7-9**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – page 2 / Procedural Guidelines – page 3 / Guidelines and Requirements for Documentation – page 4 / Guidelines for System Installation and Performance – page 5 / Requirements for Suppression System Testing – page 8 / Requirements for As-Built Drawings – page 8 / Requirements for Spare Parts – page 8

3.8 Fire Suppression – Chemicals **3.8-1 to 3.8-7**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – page 2 / Procedural Guidelines – page 3 / Requirements for Documentation –page 4 / Guidelines for System Installation and Performance – page 4 /Requirements for Suppression System Testing – page 5 / Fire Extinguishers –page 7 / Requirements for As-Built Drawings – page 7

3.9 Telephone **3.9-1 to 3.9-7**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 1 / Review Guidelines – page 2 / Procedural Guidelines – page 2 /Guidelines and Requirements for Documentation – page 3 / Considerationfor Telephone Systems Design – page 3 / Requirements for As-Built Drawings –page 7

3.10 Heating, Ventilation and Air Conditioning Systems Design **3.10-1 to 3.10-23**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 3 / Review Guidelines – page 3 / Procedural Guidelines-Preliminary Design and Design Development – page 4 / Guidelines and Requirements for Documentation – page 5 / Guidelines for System Installation and Performance – page 6 / Requirements for Heating, Ventilation and Air Conditioning System Testing – page 21 / Requirements For As-Built Drawings – page 22/O&M Documentation – page 23

3.11 Plumbing Systems Design **3.11-1 to 3.11-8**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 1 / Review Guidelines – page 1 / Procedural Guidelines –Preliminary Design and Design Development – page 2 / Guidelines and Requirements for Documentation – page 2 / Guidelines for System Installation and Performance – page 3/ Requirements for Plumbing System Testing and Sterilization – page 7/ Plumbing System Electrical Alarm Requirements – page 8 / Requirements for As-Built Drawings – page 8

3.12 Electrical Systems Design **3.12-1 to 3.12-11**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – page 2 / Guidelines and Requirements for Documentation – page 2 / Design Guidelines-General Programming Issues – page 3 / Design Guidelines-Schematic Design Phase – page 5 / Design Guidelines-Design Development Phase – page 6 / Design Guidelines-Construction Documentation of Equipment and Devices – page 7 / Design Guidelines-Emergency Power Systems – page 8 / Procedural Guidelines-Other Design Considerations – page 10 / Procedural Guidelines-Commissioning, Warranty Notification – page 11 / Requirements for As-Built Drawings – page 11

3.13 Commissioning **3.13-1 to 3.13-6**
Introduction – page 1 / Contacts – page 1 / Index of References – page 1 / Review Guidelines – page 2 / Procedural Guidelines – Commissioning Approach – page 3 / Requirements for Documentation – page 4 / Building Commissioning Process – page 5 /Measurement and Verification – page 5 / Requirements for Commissioning Documentation – page 6

4.0 MAINTENANCE AND BUILDING SERVICES STANDARDS

4.1 Communication Closets **4.1-1 to 4.1-2**
Standards for Communication Closets-Building Services; Grounds and Building Maintenance – page 1 / Index of References – page 1 / Communication Closets – page 1

4.2 Corridors **4.2-1 to 4.2-3**
Standards for Corridors-Grounds and Building Maintenance; Building Services – page 1 / Hallways/Corridors/Stairwells

4.3 Custodial Closets and Storage **4.3-1 to 4.3-2**
Standards for Custodial Closets and Storage-Building Services; Grounds and Building Maintenance – page 1 / Custodial Closets – page 1 / Custodial Supply Areas – page 2

4.4 Door Hardware **4.4-1 to 4.4-6**

Standards for Door Hardware-Grounds and Building Maintenance–General – page 1 / Standard: Non Electrified hardware – page 2 /Key Schedule and Core Installations – page 2 / Electrified Hardware and Access Control Considerations – page 3 / Requirements for Mechanical Rooms, Penthouses, Roof Access – page 5 / Millwork and Cabinetry Locks – page 5 / Access Panel Locks – page 5 / Requirements for As-Built Drawings – page 6

4.5 Electrical Rooms **4.5-1 to 4.5-4**

Standards for Electrical Rooms-Building Services; Grounds and Building Maintenance – page 1

4.6 Elevators **4.6-1 to 4.6-6**

Standards for Elevators-Grounds and Building Maintenance – page 1 / Contacts – page 1 / Index of References – page 1 / Codes and Standards – page 1/ Review and Procedural Guidelines – page 2 / Design and Installation Guidelines-General – page 2 / Design and Installation Guidelines-Elevator Machine Rooms – page 3 / Design and Installation Guidelines-Elevator Hoistway and Pit – page 3 / Design and Installation Guidelines-Related Work - page 4 / Requirements for Testing and Training – page 5 / Requirements for As-Built Drawings – page 6 / Non-conformance with Standards – page 6

4.7 Laundry Rooms **4.7-1 to 4.7-2**

Standards for Laundry Rooms-Building Services – page 1

4.8 Mechanical Rooms **4.8-1 to 4.8-5**

Standards for Mechanical Rooms-Building Services; Grounds and Building Maintenance – page 1

4.9 Painting **4.9-1 to 4.9-4**

Standards for Painting-Grounds and Building Maintenance – page 1 / Requirements for As-Built Drawings – page 3/Interior Paint Finish Recommendations for New Building and Major Renovations – page 4

4.10 Masonry, Roofing & Waterproofing **4.10-1 to 4.10-11**

Standards for Roofing-Grounds and Building Maintenance – page 1 / Contacts – page 1 / Index of References – page 1 / Codes and Standards – page 2 / Review Guidelines – page 2 / Guidelines and Requirements for Documentation – page 3 / Guidelines for Installation and Performance-Roofing – page 4/ Guidelines for Installation and Performance-Waterproofing – page 7 / Guidelines for Protection and Maintenance – page 7 / Design Guidelines for Safety in Roofing Maintenance – page 9 / Garden or Landscaping Walls-Exterior Masonry – page 10 / Non-conformance With Standards – page 10 / Requirements for As-Built Drawings – page 10

4.11 Toilet Rooms **4.11-1 to 4.11-6**

Standards for Toilet Rooms-Building Services; Grounds and Building Maintenance – page 1/Index of References-page 1 /Toilet Rooms – page 1

4.12 Waste Removal and Loading Docks **4.12-1 to 4-12.5**

Standards for Waste Removal and Loading Docks–Building Services – page 1/ Index References – page 2 /Guidelines for Installation and Performance – page 1

4.13 Carpentry Standards **4.13-1 to 4.13-7**

Introductions – page 1 / Contacts – page 1 / Index of References – page 1 / Code References – page 2 / Review Guidelines – General – page 2 / Considerations for Design – page 3

1. Introduction

The Princeton University Facilities Organization is a large and diverse group of departments that supports the educational mission of Princeton University. We plan, design and, care for the buildings and grounds, we house and feed our students, and we generate the energy that heats, cools and powers our buildings. We clean the buildings, remove trash, manage faculty and staff housing, and host tens of thousands of visitors every year.

Of the various departments within facilities, four are actively involved in development of university facility design, construction and preservation. The majority of design interaction with professional consulting firms occurs with these four departments: Office of the University Architect, Office of Design and Construction, Engineering and Grounds and Building Maintenance.

2. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

1. Princeton University Campus Directory Information section listing all officers of the University, annually updated September of each year.

2. Princeton University Facilities website
   http://www.princeton.edu/facilities/info/

3. Facilities Department Organization and Function

The Facilities' Department responsibilities and staff complement are described below.
All functions are located in MacMillan Building unless noted otherwise.

Departments/Functions

Office of the Vice President

The Office of the Vice President provides leadership to the numerous departments that comprise the entire Facilities Organization. The OVP coordinates efforts across those departments to ensure that the skills and resources of the Facilities Organization support the University's academic mission. They also support the sustainability mission of the University as they lead the effort to steward Princeton's resources in the most efficient and effective manner.

University Architect

The University Architect provides long-range planning support, including land use, zoning considerations and regional developments; coordinates and participates in Campus architectural development. Other services include environmental graphics and landscape design.

Office of Design and Construction

The Design and Construction Office manages capital projects (whether new construction or renovations) from design through construction phases. They act as liaison between the University department sponsoring the project and the rest of the project team, including designers, subcontractors, and contractors. Other services include coordination of interior design and furniture planning. (about half located at 200 Elm Drive)

Engineering Department

The Engineering Department provides a full range of engineering services including the civil, mechanical, electrical, and environmental disciplines. It also administers utilities and infrastructure construction projects, operates the utility plants, and drives the University's energy and water conservation programs.

Office of Sustainability

The Office of Sustainability coordinates and advocates comprehensive sustainability efforts in university affairs through collaboration with students, faculty, staff, and administrators. The Office works in close collaboration with the Princeton Sustainability Committee (PSC) and its working groups to continue developing Princeton's leadership in addressing the intersection of economics, environment, and culture that defines a sustainable campus. The Office also administers the High Meadows Foundation sustainability fund which supports the research, education, and civic engagement components of the Princeton Sustainability Plan.

Grounds and Building Maintenance Department

Grounds and Building Maintenance maintains the buildings, grounds, roads, and utility distribution systems on the Main and Forrestal Campuses, as well as off-campus graduate housing, faculty and staff housing, and commercial properties. The department operates a transportation garage and fire and security alarms systems and provides operational support for Richardson and Taplin auditoriums.

Life Safety and Security Systems

Life Safety & Security Systems (LSSS) oversees the design, management and administration of the University's campus-wide building access control system (CACS), Fire Systems Management System (FSMS), Campus Video Management System (CVMS) and the Keyless Locking System (KLS). LSSS plays a leadership role in the design and implementation of these installations, and provides project coordination with other university departments and end users. Additionally LSSS is responsible for the development and dissemination of policies, procedures, code compliance and practices as it pertains to the use of the systems. LSSS facilitates continued process improvement through collaboration with all University departments. (main office located at 306 Alexander Street)

Finance Administrative Services

Finance and Administrative Services (FAS) provides the Facilities operating departments with shared services including: budget, finance, materials management, procurement and contract administration, and support for information technology hardware and enterprise systems, including space planning and mapping (Archibus), work order and asset management (Maximo) and construction management (Centric Project and Primavera). FAS also operates the Facilities Service Center, which provides a central point of contact for the campus community, whether in person, by phone, email or via the web. The FSC resolves facilities related questions or problems (including custodial services, repairs, housing, pest control etc.) by direct action or referral.

Building Services

Building Services provides janitorial and logistical support services to academic, administrative, and dormitory buildings on both the Main and Forrestal Campuses. Other services include management of solid waste and recycling stream, replacement of light bulbs up to 10', extermination services, furniture and equipment moving, maintenance of undergraduate student laundry rooms, provision of special setups for commencement and other major events, student storage, warehousing and supply of rental equipment needed for functions and events. (main office located at 180 Alexander Street)

Dining Services

Dining Services provides food services to the Princeton University community. It operates the University dining halls and related facilities for students, faculty, staff, and visitors. This department serves more than 3,000 student contract dinners in addition to operating several cafeteria facilities that rely mainly on cash business, as well as providing catering services for special events, luncheons, receptions, and dinners. (main office located at 26 College Road West)

Housing

With support from the rest of the Facilities organization, the Housing Department handles all aspects of the University's housing program. Currently, Princeton provides housing for over 5000 undergraduates and 1600 graduate students. Housing also manages several hundred units of faculty and staff housing. The Housing Department is responsible for on-campus dormitories, as well as a diverse stock of apartment buildings and single family homes. The department provides comprehensive property management services and monitors the use and condition of University housing facilities and furnishings, with special emphasis on concern for fire and life safety and sanitation. As such, Housing is a primary stakeholder for all work performed in any University dormitory or residential rental unit. Work in Princeton Housing units must be performed according to established protocols for notification and security. (main office located at New South)

Off-Campus Development

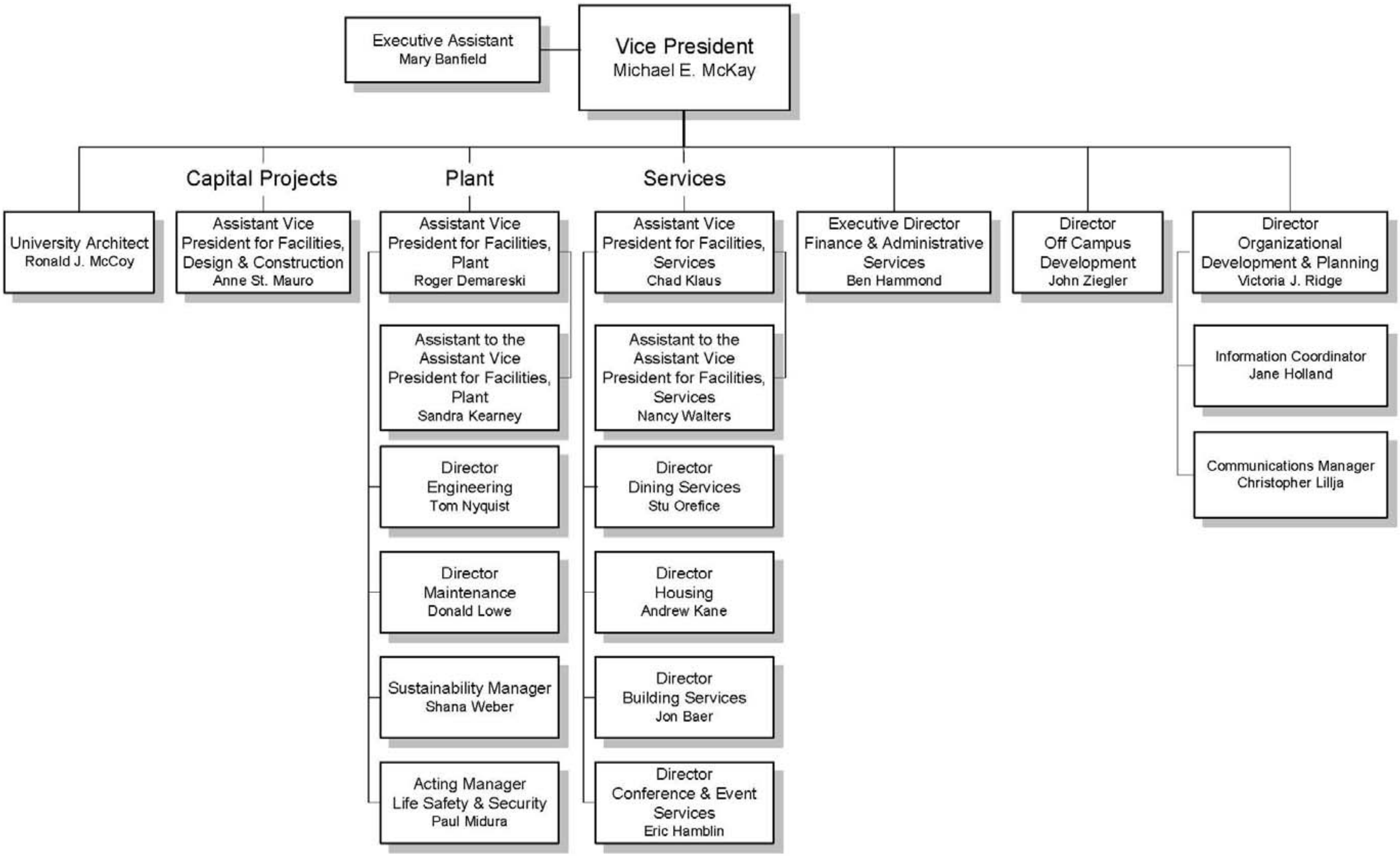
The Office of Off-Campus Development reports to the Vice President for Facilities, and provides property development and project management services for properties located ‘off-campus.’ We seek to leverage our staff through outside partners, and we leverage our real estate assets for their highest and best uses. We entertain traditional project structures as well as those uniquely available on a project-by-project basis. Projects range from administrative buildings, to residential, to multi-user projects.

Conference and Event Services

Conference and Events Services promotes appropriate use of available University facilities in periods of lower usage, especially during the summer months. Coordinates conferences and meetings for official University functions. It administers University policies concerning the use of University resources by external organizations and groups. Conference and Event Services assists University departments sponsoring conferences. (main office located at 71 University Place)

END OF DOCUMENT

Facilities Organization



Last Modified:
Jan 15, 2010

1. Introduction

One of the University's Guiding Principles for Future Expansion, as articulated by the Administration in 2003, is to "build in an environmentally responsible manner - a manner which is sensitive to geography, sensitive to energy and resource consumption and works to sustain strong community relations."

These Guidelines are intended to provide direction and resources for the sustainable design and construction of new buildings and the comprehensive renewal of existing buildings for capital projects at Princeton, in support of the Guiding Principle. The requirements of this process are described in this Section of the PUDS, which is intended to complement other Sections which contain requirements particular to specific building programs or systems. These Sustainable Building Guidelines are summarized as follows:

1. Set goals and benchmarks for each project.
2. Conduct site survey and evaluation of existing conditions.
3. Model various methods of meeting goals and benchmarks and use results to make decisions.
4. Repeat the modeling and analysis as the design is developed to refine decisions.
5. Review and monitor the expected outcome during documentation and construction.
6. Measure the outcome to determine success, and to establish benchmarks for future projects.

Using Life-Cycle Cost Analysis, described in Section 1.2 (6), and Social and Environmental Impact Assessment, described in Section 1.2 (7), an iterative process of recommendation, comparative modeling, decision-making and refinement is intended to enable the University to make better-informed choices regarding expenditures of resources.

These general Sustainability Guidelines describe a process that is intended to be implemented along with the requirements of the Energy Guidelines found in Section 3.3 of the PUDS. Many of the Life-Cycle Comparative Studies described in more detail in Section 1.2 (5) will draw on data and analyses conducted in response to the Energy Guidelines. The Facilities Department Office of Sustainability is a resource for both consultation on sustainable project planning as well as current initiatives underway on campus for sustainable best practices.

The LCCS sustainability process is applicable to projects of all sizes. However, for small scale renovation projects with existing envelopes, and predetermined HVAC system selections, a shortened version of this Life-Cycle Comparative Studies approach is appropriate. On these small scale projects, the Project Manager will assist in determining the limits of the LCCS to apply to the project.

In addition, new construction and major renovation projects will benchmark against the equivalent to a LEED silver rating, exclusive of certification. The University will determine if formal project certification will be sought.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, the Construction Office, or as applicable)

B. Program Manager for Standards MacMillan Building, 609-258-1330

C. Director of Facilities Engineering MacMillan Building, 609-258-5472

D. Facilities Sustainability Manager MacMillan Building, 609-258-1518

E. Institution Recycling Network (IRN) http://ir-network.com/

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

		PDF	MS Word	MS Excel
A	Funding Opportunities for Sustainability	Appendix 1.2-1		
B	Relevant Sustainable Building Guidelines	Appendix 1.2-1		
C	Web Resources for Sustainability	Appendix 1.2-1		
D	Waste Management Resources	Appendix 1.2-1		
E	Life-Cycle Resources	Appendix 1.2-2		
F	Cost Components of Life-Cycle Cost Analysis	Appendix 1.2-3		
G	Building Component Useful Life Data	Appendix 1.2-4		
H	Life-Cycle Comparative Studies Worksheet	Appendix 1.2-5		Appendix 1.2-5
I	Commissioning Process (Cx)	Appendix 3.3-3	Appendix 3.3-3	
J	Outline of MEP Design Intent (Commissioning)	Appendix 3.3-4	Appendix 3.3-4	
K	MEP Basis of Design (Commissioning)	Appendix 3.3-5	Appendix 3.3-5	
L	Final Commissioning Report	Appendix 3.3-6	Appendix 3.3-6	
M	Index of MEP Prefunctional Tests (Commissioning)	Appendix 3.3-7	Appendix 3.3-7	
N	Index of MEP Functional Tests (Commissioning)	Appendix 3.3-8	Appendix 3.3-8	
O	Index of Commissioning Specifications	Appendix 3.3-9	Appendix 3.3-9	
P	Sample of High-Performance Systems Matrix	Appendix 3.3-10		

4. Outline of Process

A. Integrated Design

Buildings are networks of complex systems. Building in a sustainable manner requires consideration of the network as well as the individual systems through an integrated design process. The Project Team will be defined specifically at the outset of each project, and will include university representatives for the client/user, the Facilities Project Manager, the Office of Sustainability, the Design Team, and the Construction Manager. The Design Team will be comprised of all of the project design consultants including the architect, civil, structural and building systems engineers, the landscape architect, and any specialized consultants. All of the members of the Project Team must collaborate to find the beneficial relationships among site and building systems that result in an environmentally sustainable outcome in support of the program. The Design Team must be committed to working through a collaborative process to learn new ways of considering these systems.

In addition, new construction and major renovation projects will benchmark against a LEED silver equivalency, exclusive of certification. The University will determine if formal project certification will be sought.

B. Organizational Meetings

In order to work collaboratively as a Project Team, the Design Team will plan and facilitate workshops and meetings with university representatives specifically to further the integrated design process:

1. **Sustainability Charrette:** During the Pre-Schematic Design phases (Scoping / Feasibility / Programming) the Project Team will meet to establish goals and objectives with respect to sustainable building design, benchmarking and metrics. Ideally this will be done as part of a broader agenda focused on overall project goals including program, campus planning and project-budgeting. If those goals have already been set, a meeting focusing specifically on sustainable design objectives which are mutually supportive of other project goals will be conducted.

2. **Life-Cycle Comparative Study (LCCS) Workshop**: During the Pre-Schematic Design phases, after the Sustainability Charrette, the Project Team will hold an LCCS Workshop. While the Sustainability Charrette will set project intentions and outcome, the LCCS Workshop begins to set focus on the specific paths to those outcomes. The intent of this workshop is for the Design Team to identify the study categories recommended for LCCS, the method(s) of analysis proposed, the social and environmental impacts proposed for evaluation in conjunction with the Life Cycle Cost Analysis (LCCA), and to confirm project parameters and data, including that required to be provided by Princeton. The LCCS Workshop must occur after the Sustainability Charrette in order for the Design Team to make recommendations in support of the Project Sustainability Goals.
3. **Life-Cycle Comparative Study (LCCS) Reviews**: During Schematic Design the Project Team will meet to review the initial findings of the Life Cycle Comparative Studies. The Design Team will prepare the analysis to compare alternatives. The purpose of the review is to enable the Project Team to make decisions based on the Project Sustainability Goals. This process will be repeated before the conclusion of Design Development.

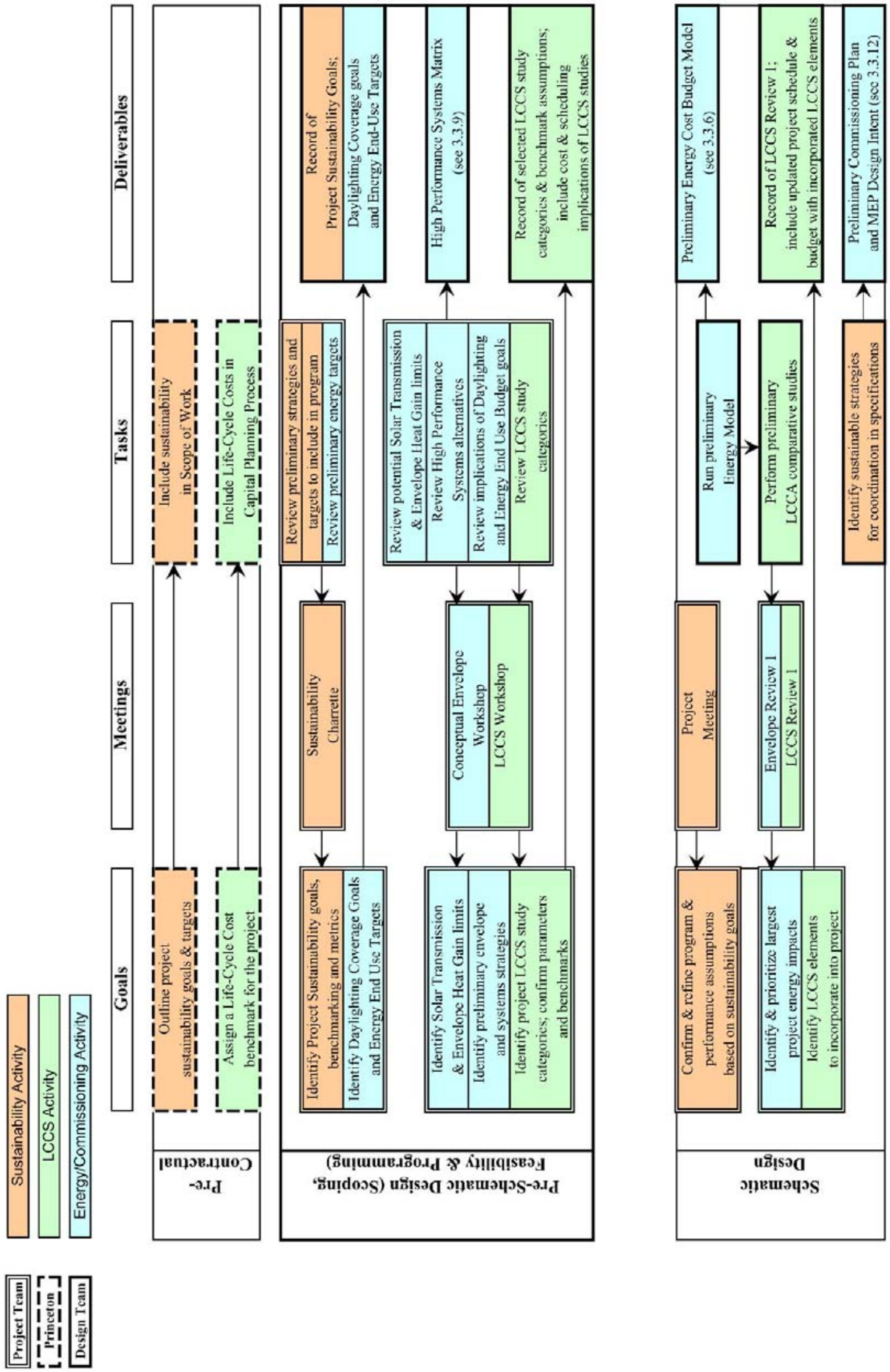
4. **Construction Meetings**: During the Pre-Bid meeting, the Facilities PM and the Design Team will convey project sustainability objectives to bidders. Requirements will be reviewed again at the Pre-Construction meeting and at Pre-Installations meetings for relevant trades.

5. **Best Practices Meetings**: At the conclusion of the project the Project Team will conduct a Best Practices meeting in order to evaluate the process and the initial outcome. A follow-up meeting of the Project Team will be scheduled after one year of occupancy. Subsequent follow-up will be conducted by the university, with other members of the Project Team participating on an as-needed basis.

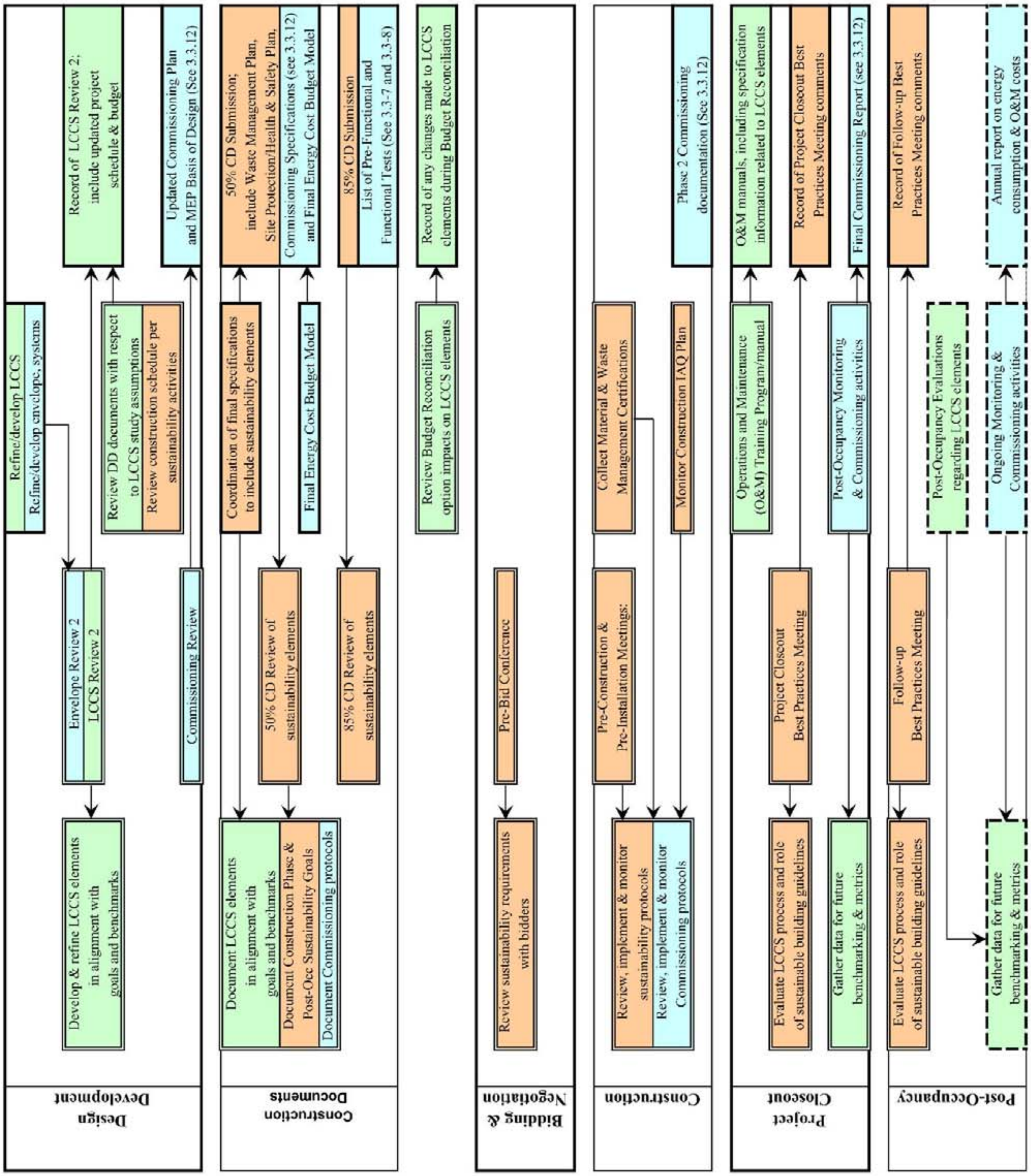
C. Required Documentation

Following is a summary of documentation requirements for the sustainable design and Life-Cycle Comparative Studies (LCCS) process:

1. Record of Project Sustainability Goals from the Sustainability Charrette, including benchmarking objectives and metrics (including the LEED checklist). Include in the project Scoping, Programming or Feasibility Study Report as required.
2. Record of Life-Cycle Comparative Study (LCCS) categories selected, including social and environmental impacts, project parameters and data. Refer to Section 1.2 (5. Life-Cycle Comparative Studies) for LCCS study requirements. Include in the project Scoping, Programming or Feasibility Study Report as required.
3. Record of largest energy impacts & priorities based on preliminary energy model in conjunction with the MEP Design Intent document. Refer to Appendix 3.3-4 for MEP Design Intent documentation requirements.
4. Record of the initial LCCS results in a format as outlined in Appendix 1.2-5 (Sample Life-Cycle Cost Analysis Comparative Studies) in conjunction with the MEP Design Intent document submitted at the conclusion of Schematic Design. Refer to Appendix 3.3-4 for MEP Design Intent documentation requirements.
5. Updated project budget and schedule with LCCS elements incorporated.
6. Record of the refined LCCS results in a format as outlined in Appendix 1.2-5 (Sample Life-Cycle Cost Analysis Comparative Studies) in conjunction with the MEP Basis of Design document submitted at the conclusion of Design Development. Refer to Appendix 3.3-5 for MEP Basis of Design documentation requirements.
7. Final Energy Model report.
8. Records of the Pre-Bid, Pre-Construction and Pre-Installation meetings to be included in minutes or reports of those sessions.
9. Operations & Maintenance manuals, including specification information related to LCCS elements, in conjunction with the Final Commissioning Report. Refer to Appendix 3.3-3 for an overview of the Building Commissioning Process and Appendices 3.3-4 through 3.3-9 for specific documentation requirements for Commissioning.
10. Record of Best Practices meetings recording the discussion and recommending improvements for future projects and processes.



Project Team
Princeton
Design Team
Sustainability Activity
LCCS Activity
Energy/Commissioning Activity
Goals
Meetings
Tasks
Deliverables
Pre-Contractual
Outline project sustainability goals & targets
Include sustainability in Scope of Work
Assign a Life-Cycle Cost benchmark for the project
Include Life-Cycle Costs in Capital Planning Process
Pre-Schematic Design (Scoping, Feasibility & Programming)
Identify Project Sustainability goals, benchmarking and metrics
Identify Daylighting Coverage Goals and Energy End Use Targets
Sustainability Charrette
Review preliminary strategies and targets to include in program
Review preliminary energy targets
Record of Project Sustainability Goals;
Daylighting Coverage goals and Energy End-Use Targets
Identify Solar Transmission & Envelope Heat Gain limits
Identify preliminary envelope and systems strategies
Identify project LCCS study categories; confirm parameters and benchmarks
Conceptual Envelope Workshop
LCCS Workshop
Review potential Solar Transmission & Envelope Heat Gain limits
Review High Performance Systems alternatives
Review implications of Daylighting and Energy End Use Budget goals
Review LCCS study categories
High Performance Systems Matrix (see 3.3.9)
Record of selected LCCS study categories & benchmark assumptions; include cost & scheduling implications of LCCS studies
Schematic Design
Confirm & refine program & performance assumptions based on sustainability goals
Project Meeting
Run preliminary Energy Model
Preliminary Energy Cost Budget Model (see 3.3.6)
Identify & prioritize largest project energy impacts
Identify LCCS elements to incorporate into project
Envelope Review 1
LCCS Review 1
Perform preliminary LCCA comparative studies
Record of LCCS Review 1; include updated project schedule & budget with incorporated LCCS elements
Identify sustainable strategies for coordination in specifications
Preliminary Commissioning Plan and MEP Design Intent (see 3.3.12)



Design Development
Refine/develop LCCS
Refine/develop envelope, systems
Envelope Review 2
LCCS Review 2
Develop & refine LCCS elements in alignment with goals and benchmarks
Review DD documents with respect to LCCS study assumptions
Review construction schedule per sustainability activities
Record of LCCS Review 2; include updated project schedule & budget
Commissioning Review
Updated Commissioning Plan and MEP Basis of Design (See 3.3.12)
Construction Documents
Coordination of final specifications to include sustainability elements
50% CD Review of sustainability elements
Document LCCS elements in alignment with goals and benchmarks
Document Construction Phase & Post-Occ Sustainability Goals
Document Commissioning protocols
50% CD Submission; include Waste Management Plan, Site Protection/Health & Safety Plan,
Commissioning Specifications (see 3.3.12) and Final Energy Cost Budget Model
Final Energy Cost Budget Model
85% CD Review of sustainability elements
85% CD Submission
List of Pre-Functional and Functional Tests (See 3.3-7 and 3.3-8)
Review Budget Reconciliation option impacts on LCCS elements
Record of any changes made to LCCS elements during Budget Reconciliation
Bidding & Negotiation
Pre-Bid Conference
Review sustainability requirements with bidders
Construction
Collect Material & Waste Management Certifications
Pre-Construction & Pre-Installation Meetings;
Review, implement & monitor sustainability protocols
Review, implement & monitor Commissioning protocols
Monitor Construction IAQ Plan
Phase 2 Commissioning documentation (See 3.3.12)
Project Closeout
Operations and Maintenance (O&M) Training Program/manual
O&M manuals, including specification information related to LCCS elements
Project Closeout Best Practices Meeting
Record of Project Closeout Best Practices Meeting comments
Evaluate LCCS process and role of sustainable building guidelines
Post-Occupancy Monitoring & Commissioning activities
Final Commissioning Report (see 3.3.12)
Gather data for future benchmarking & metrics
Post-Occupancy
Follow-up Best Practices Meeting
Record of Follow-up Best Practices Meeting comments
Evaluate LCCS process and role of sustainable building guidelines
Post-Occupancy Evaluations regarding LCCS elements
Ongoing Monitoring & Commissioning activities
Annual report on energy consumption & O&M costs
Gather data for future benchmarking & metrics

5. Life-Cycle Comparative Studies (LCCS)

LCCS Process / Procedural Guidelines

The primary method of Life-Cycle Comparative Studies (LCCS) will be a comparison between two or more alternatives for each of the topics identified for study during the LCCS Workshop. The alternatives should be viable options under consideration for the project. The tools identified in Appendix 1.2-2 (Life-Cycle Resources) may be used to conduct the comparative studies.

Life-Cycle Comparative Studies (LCCS) will be formally documented and reviewed twice during the design process, in the Schematic Design and Design Development phases. However, the principles and knowledge gained by these studies are applicable at any stage in the design process. The Project Team will work together in the preliminary design stages to lay out the schedule and study categories to maximize the value of these studies for each specific project.

Project Benchmarking

As part of the sustainable design process, the Project Team will establish the performance of other University projects as benchmarks against which to measure the subject project. The outcome of the LCCS will be compared against these benchmarks. Over time, these performance benchmarks will establish a broad basis of comparison for new work. The Sustainability Manager maintains a record of previously generated LCCA studies for use on future projects. Project LCCS documentation to be stored on the project Centric Project page.

Study Categories

The following building systems shall serve as the basis for the selection of the comparative studies:

1. Energy Systems
2. Electrical Systems
3. Building Envelope
4. Siting / Massing Strategies
5. Structural Systems
6. Mechanical Systems
7. Water Systems
8. Interior Materials

Six (6) or more Life-Cycle Comparative Studies are required at both the Schematic Design and Design Development phases. At least one (1) of these studies shall be within the Building Envelope category, one (1) within the Energy Systems category, and one (1) from the Interior Materials category. No more than three (3) of the studies shall be conducted within a single study category.

The LCCA of interior materials is of particular interest to the University as they represent a widely expanding area of building and finish components and play a significant role in the overall sustainable characteristics and performance of the project. Designers are encouraged to explore and study and report on the cost-effectiveness of materials within this category.

Certain study categories may be more relevant to particular building types or projects and project-specific priorities will be established at the initial LCCS Workshop in the Pre-Schematic Design phase. However, the above study categories/ building systems do not operate in isolation. The energy model and Life-Cycle Comparative Studies shall be developed with an understanding and acknowledgement of the inter-relationship of building systems on the life-cycle costs and impacts of the project.

Energy Modeling and Design Tools

Energy modeling is a prerequisite to conducting the Life-Cycle Cost Analysis (LCCA) component of the comparative studies. A preliminary energy model will be developed in the Schematic Design phase in order to identify and document the largest energy impacts of the project. Refer to Appendix 3.3-5 (MEP Basis of Design). The energy model will also serve as the platform from which to analyze energy consumption rates of the alternate options in both the Schematic and Design Development phases. The energy model will continue to be refined throughout the design phases. A final run of the model incorporating the selected LCCS elements will be performed and documented prior to the conclusion of Construction Documentation phase.

6. Life-Cycle Cost Analysis (LCCA)

In adopting Life-Cycle Cost Analysis (LCCA) as part of a process of sustainable design and construction, Princeton establishes the life-cycle cost of a building element or system as a unit of measure for decision-making. LCCA requires that the Project Team consider not only the initial construction costs of a building system, but also the long-term costs including utilities, operations and maintenance and, ultimately, disposal or re-use. This methodology takes into account the University's role as the owner of buildings in addition to its role as builder.

The primary goal of implementing this approach is to create transparency in the design and decision-making process so that decisions are made in an informed manner about the whole life-cycle implications of a project. Cost-effective solutions are not inherently sustainable solutions, but decisions based on an understanding of economic performance, when considered in conjunction with social and environmental performance, will result in effective and efficient choices of the greatest value to the University.

In conjunction with Life-Cycle Cost Analysis (LCCA), it is the obligation of the Project Team to explore and highlight the social and environmental impacts of the design strategies that are being analyzed, so that the appropriate balance of these factors, along with economic objectives, can be discussed. The process and documentation procedure for these studies is described in Section 1.2 .7. Social and Environmental Impact Assessment).

LCCA Data and Parameters

Princeton University Standards and Metrics have been established for use in Life-Cycle Cost Analysis. The utilization of these standards is critical to ensure that there is consistency and comparability of life-cycle data across projects as well as to inform decision-making in future projects.

It is almost inevitable that there will be added cost for electric power due to government mandated CO2 emissions reduction legislation. Therefore, a "CO2 tax" shall be included in the energy analysis to account for these anticipated costs. This tax represents the monetary value on the environmental impact of foregoing a proposed supplemental conservation effort to the project. Standard cost information, including utility costs, maintenance costs and building components as well as CO_2 tax for use in the LCCA studies is included in Appendix 1.2-3 (Cost Components of Life-Cycle Cost Analysis) for this data.

7. Social and Environmental Impact Assessment

Life-Cycle Cost Analysis (LCCA) does not directly address the social and environmental life-cycle impacts of design alternatives. These costs and benefits should be presented and evaluated in conjunction with the results of the LCCA studies performed. While tools are available to assist the Project Team in conducting this analysis, it is ultimately up to the Project Team to determine the method of assessment most compatible with project objectives. Below is a list of considerations for social and environmental impact assessment. This list is not intended to be all-inclusive, but to highlight anticipated issues for review and discussion:

Land Use, Water and Ecosystem Quality

Retain open space
Optimize program and development density
- Reduce site disturbance
- Reduce building footprint
Increase flexibility / adaptive reuse potential
Optimize building orientation
-Utilize passive design strategies
- Employ natural ventilation strategies
Reduce heat island effects
- Provide adequate shade coverage
- Select high albedo / light-colored materials
- Select high-reflectance, high-emissivity roofing materials
Reduce automobile use
Promote efficient transportation alternatives
Optimize parking lot location and design
Maximize water use efficiency

- Reduce Potable water use
- Use captured or recycled water
- Employ sustainable landscaping strategies
Minimize Stormwater runoff
- Select permeable paving materials
Increase on-site stormwater filtration
Reduce stormwater contaminants
Employ restorative design strategies

Social & Programmatic Factors

Improve building safety and security
Improve site security
Improve interior acoustic control
Reduce exterior noise pollution
Reduce exterior light pollution
Improve Operational Efficiency
Provide Flexibility of Systems
User Information and Education Value

Materials and Waste

Reduce Solid Waste generation
- Enforce Construction/Demolition Waste Management plan
- Promote existing building reuse
- Select Reused and salvaged materials
- Select Recycled content materials
- Reduce non-renewable resource selection
- Maximize storage/ collection of recyclables
Select rapidly renewable resource materials
Select low-embodied energy materials

Indoor Environmental Quality

Optimize ventilation effectiveness
Employ natural ventilation strategies
Minimize indoor and chemical pollutants
- Select low-emitting materials
- Encourage non-toxic maintenance protocols
- Design separation from exterior pollutants
Provide Carbon dioxide monitoring
Enforce Construction IAQ management
Increase thermal comfort
Improve controllability of systems
Optimize natural daylight & views

Energy and Atmosphere

Reduce fossil fuel depletion
Use Renewable energy sources
Reduce energy-related emissions
- Reduce greenhouse gas emissions
- Reduce ozone-depleting emissions
- Maximize envelope thermal performance
- Integrate daylight/electric lighting controls
- Improve Mechanical systems performance
- Eliminate equipment use of CFC's

Building component and materials options can be assessed using environmental performance database tools such as *Building for Environmental Sustainability* (BEES) and the *ATHENA Environmental Impact Estimator (ATHENA EIE).* Additional database resources for materials selection, such as the *GreenSpec Product Directory*, are listed in Appendix 1.2-2 (Life Cycle Resources).

Life-Cycle Cost Analysis (LCCA) information shall be presented in conjunction with social and environmental impacts to facilitate decision-making. An example of this format is illustrated in Appendix 1.2-5 (Life-Cycle Comparative Study Worksheet).

8. Materials Selection

Conscientious design is the first step towards controlling the generation of solid waste on a building project. Effective design-stage waste reduction strategies include existing building reuse, optimization of building program, envelope and systems energy efficiency, the use of alternative building materials (salvaged, recycled content and rapidly renewable materials), detailing and dimensioning to limit material waste, proper planning for the storage and collection of recyclables, and sustainability-oriented design specification language and contractor requirements.

Durability, maintenance and aesthetics are the primary criteria for materials selection. Over its history, Princeton has developed a number of materials standards which can be referenced throughout the pertinent sections of the *Princeton University Design Standards Manual*. These standards have been developed based on a material's proven ability to meet the programmatic, maintenance and aesthetic performance goals of the University through the test of time and use.

Changing technologies have resulted in a wealth of new materials on the market and the potential for their application in Princeton building projects is encouraged provided adequate evaluation of the primary criteria cited above. Where identified as critical to the support of project goals and objectives, a Life-Cycle Comparative Study (LCCS) of a newly proposed material (in comparison to an existing material standard or precedent) may serve as the basis of this evaluation. Evaluation of the life cycle cost implications of any suggested new material is recommended when not specifically identified for evaluation through the LCCS process or on small-scale projects. The social and environmental impacts of proposed materials selection should also be included in this evaluation. Refer to Section 1.2 (7. Social and Environmental Impact Assessment) for a selected list of potential criteria. Please note that pertinent criteria for materials selection are cited under this subtitle and the other subtitles of section 1.2.7, such as reduction of heat island effects through the selection of high-reflectance, high-emissivity roofing materials listed under Land Use, Water and Ecosystem Quality.

9. Waste Management

Design Specifications and Construction Waste Management
According to the EPA, construction, demolition and land-clearing debris combined comprises at least 24% percent of municipal solid waste. Establishing waste reduction goals and implementing cost-effective Construction Waste Management techniques can significantly reduce this impact and provide economic advantages for projects of all types and scales. Currently, the University's established goal is for the recycling of 95% of all eligible materials post-abatement.

Project specifications shall require the contractor to submit a Construction & Demolition Waste Management Plan for approval by the University at the beginning of the submittal and review period (or earlier when applicable). This plan must include but is not limited to:

- Analysis of the proposed job site waste to be generated, including the types of recyclable and waste materials generated (by volume or weight).

- A list of each material proposed to be salvaged, reused, or recycled during the Project
- A list of proposed recycling facilities to be used in the project
- An outline of proposed Project Waste Management meetings (At a minimum, waste management goals and issues shall be discussed at the Pre-bid meeting, Pre-construction meeting and regular jobsite meetings).
- Materials Handling Procedures for removal, separation, storage, and transportation.
- A Communication Plan for informing subcontractors and crews about the Waste Management Plan, establishing job-site instruction, notification and signage procedures for waste management and providing a methodology for documenting and reporting quantities and types of materials reused, salvaged, recycled, and disposed.
- Proof of distribution times, weights, etc from trucks removing debris from the project site

Other effective specification waste-reduction strategies include the use of bid alternates for undertaking specific recycling measures, the use of language that requires waste reduction, reuse, and recycling to the fullest extent possible and the requirement for an independent on-site waste manager hired to handle all waste recycling and disposal. Useful waste management references for both designers and contractors, including sample specification language, waste management plans and contractor's checklists can be found in Appendix 1.2-1 (Sustainability Resources).

Project specifications and contracts must require proof of delivery to recycling sites in accordance with the University's internal demolition and construction debris recycling goals. Early in the process, demolition contractors should provide the University with a list of proposed recycling facilities intended for use as part of the project recycling plan. Delivery manifests (weight slips indicating the times, dates and locations of these drop-offs) must also be provided so that the University can track where and how much material is being recycled. This will improve the University's assessment of recycling performance and will aid in benchmarking future projects.

Organizations such as the Institution Recycling Network (IRN) are helpful for coordinating with the Construction Manager in order to maximize sorting and recycling opportunities and operations. The CM and design team should meet with the Project Manager and the Facilities Sustainability Manager on campus to discuss the appropriate measures to be taken in this effort.

10. Site Planning

The campus master plan speaks to both campus-wide and neighborhood-specific strategies for
- utility distribution
- stormwater management
- energy efficiency goals/targets
- sustainable landscape strategies and planting materials
- paving materials
- exterior lighting plan
- transportation & parking plan
- potable water use plan

A significant percentage of exterior site work on campus is associated with capital projects. Design teams are thus encouraged to select Life-Cycle Comparative Studies (LCCS) that are both appropriate to project specific goals and might contribute to the overall implementation of the Campus Plan.

The greatest potential for understanding and managing the environmental impacts of a project is through early and multi-disciplinary consideration of site selection criteria, building siting, orientation and massing, water usage, stormwater management and landscaping strategies The Sustainability Charrette (to be conducted during the Pre-Schematic phases) and the Life-Cycle Comparative Studies (LCCS) process are intended to ensure that these critical issues are addressed by the design team in a timely and holistic manner (Refer to Section 1.2.4 Outline of Process).

END OF DOCUMENT

1. Introduction

The project responsibility checklist is intended to assist Project Managers in developing consistent approaches to respective phases of every project. Although not every task herein is listed or necessary, the overall method of project delivery commonly follows this format and serves as the University's standard. Dates are to be inserted by the Project Manager as each task is completed by the University or A/E. Shaded areas indicate the responsible party. Please note that many tasks have a dual responsibility between the University and A/E.

List of Acronyms Used

BIM	Building Information Management
DCA	Department of Community Affairs
EHS	Environmental Health and Safety
FPG	Facilities Planning Group
FPO	Facilities Procurement Office
GIS	Geographic Information Systems
LCCA	Life Cycle Cost Analysis
LCCS	Life Cycle Comparative Study
PACA	President's Advisory Committee on Architecture
PMG	Project Management Group
SPMIS	Space & Property Management Information Systems
SPRAB	Site Plan Review Advisory Board

Tasks During A/E Pre-Contractual Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
1	Establish pertinent project control numbers		(shaded)	
	* Department project number			
	* Contract Administration Office			
	* Account / Grant #			
2	Notice to Proceed Letter through FPO		(shaded)	
3	Determine Basis of Service: A/E		(shaded)	
	* Basic Service Agreements			
	* Designated Services Agreements			
4	Ascertain method contemplated for award of construction contract:		(shaded)	
	* Competitive / Non-Competitive			
	* Lump Sum / Fixed Price			
	* Time and Materials			
5	Review Program requirements with University for completeness and suitability; review development density and building scale proposed	(shaded)	(shaded)	

		A&E	P.U.	N/A
6	Review with University Architect relationship of project to Campus Master Plan			
7	Include sustainability in Scope of Work; outline preliminary sustainability goals and targets (refer to Section 1.2)			
8	Determine University's time schedule for contracting, construction and occupancy			
9	Determine if cost estimating is required (Reference A/E Contract Article VII (d), (8,9))			
	Cost estimate is to be provided by:			
	1. A/E			
	2. CM			
	3. Independent			
	4. Not provided			
10	Assign an LCCA benchmark budget for the project and include in Capital Planning Process (refer to Section 1.2)			
11	Design Services (See "Fee Proposal Budget Outline" attached to the end of this section)			
12	Pre-contractual review meeting for items 1-11			
13	University to reserve the right to review all sub-consultant agreements (non-proprietary design, etc)			
14	Discuss billing format; shall agree with A/E contract			
15	Meet with University Contract Administration Office to discuss A/E agreement, including:			
	a. Standard University General Conditions			
	b. Princeton University Facilities Design Standards Manual			
	c. Standard University Professional Services Agreement (as applicable)			
	d. Project Description			
	e. Requirement for BIM as part of design documentation			
	f. Other			
16	Establish authorized signature for party signing			
17	Complete execution of A/E Agreement, including contract date			
18	Discuss Schedule, cost and need for existing condition survey			
19	Discuss role that Construction Manager may play in survey prior to schematic design phase			

		A&E	P.U.	N/A
20	Initiate project Programming Book to include:			
	1. Approval Sheet			
	2. Project Data Sheet			
	3. Executive Summary			
	4. Value Proposition			
	5. Existing Conditions Assessment			
	6. Program			
	7. Budget			
	8. Schedule			
	9. Project Team and Responsibility Matrix			
	10. Contracts			
	11. Regulatory Issues			
	12. Risk Management			
	13. Appendix			

Tasks During Pre-Schematic Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
21	Review and agree upon budget parameters with respect to any proposed concept designs			
22	Meet with Accessibility Review Committee to discuss requirements for Accessibility Programming Document			
23	Review site sustainability issues in relation to campus master plan			
24	Sustainability Charrette: Project Team education and goal-setting			
	* review site sustainability issues in relation to campus master plan			
	* explore options with respect to life cycle implications			
	* meet with Facilities Sustainability Manager to discuss sustainability issues for project			
	* consider siting, orientation and design parameters/ assumptions			
	* determine Project Sustainability Goals and targets to include in program (refer to Section 1.2)			
25	Record of Project Sustainability Goals (Section 1.2), Daylighting Coverage Goals and Energy End-Use Targets (Section 3.3)			
26	High-Performance Systems Matrix (refer to Section 3.3)			
27	Conceptual Envelope Workshop (refer to section 3.3)			
	* Identify Solar Transmission & Envelope Heat Gain Limits			
	* Identify preliminary envelope and systems strategies			
28	LCCA workshop to determine which LCCA study categories might render the highest cost benefit for the project; verify LCCA parameters			
29	Record LCCA study categories selected and benchmark assumptions to be used			

		A&E	P.U.	N/A
30	Review University commissioning process and commissioning goals (refer to Section 3.13)			
31	Meet with Facilities Engineering Department to review project utility interconnects and regional campus MEP parameters, including OIT (refer to Section 3.6)			
32	Meet with University Energy Plant Manager to ascertain the anticipated utility demands (refer to Sections 3.3 and 3.9)			
33	Consult with PM and University Code Analyst to determine needs for site plan and zoning approvals (refer to Section 1.4)			
34	Review need to discuss zoning issue with University Land Use Attorney and consulting Civil Engineer			
35	Meet with University Code Analyst to ascertain local / state project review jurisdictional issues (refer to Section 1.4)			
36	If classroom design is contemplated, meet with PM and University Registrar to gain oversight during programming (refer to Section 2.3)			
37	If dormitory design is contemplated, meet with PM and University Housing Office to ascertain program review committee constituency (refer to Sections 2.4 and 2.11)			
38	Meet with Associate Director of the Department of Public Safety to determine level of security assigned to project (refer to Section 2.7)			
39	Meet with University Coordinating Architect to determine whether the extent of site intervention requires formal review by Landscaping Policy Committee (refer to Section 2.9)			
40	Meet with University Code Analyst to define code strategies and discuss ADA and NJ barrier-free code interpretations affecting the project (refer to Section 3.1)			
41	Meet with Accessibility Review Committee to review final Accessibility Programming Document			
42	Meet with University Code Analyst to determine code strategies and discuss fire alarm / fire suppression code interpretations affecting the project			
43	Meet with EHS to review hazardous materials and environmental modeling requirements. Baseline radon level testing needs to be recorded and submitted for any project disturbing basement slab or slab on grade conditions (new projects and renovations)			

		A&E	P.U.	N/A
44	Meet with Manager of Facilities Mechanical & Electrical Engineers to ascertain types of MEP systems to be installed (refer to Sections 3.10, 3.11, 3.12)			
45	Meet with SPMIS for archived drawings requirements to be used as background			
46	Discuss need for vehicular traffic analysis around proposed site, including deliveries, accessibility requirements, university grounds vehicular access, etc (refer to Sections 2.9 and 4.12)			
47	Discuss collateral programming issues that relate to adjacent buildings to the site			
48	Assist University with selection of CM * Assist with preparation of project description and schedule * Schedule and attend CM interviews as applicable * Assist with reference checks			
49	Initiate CM pre-construction services contract			
50	Initiate set-up of "Centric Project" website collaboration tool and verify training on procedures and requirements with project team			
51	Confirm that Program requirements have been completed and reviewed with the end user			
52	Meet with University Development Office Representative to determine rendering requirements or other required fundraising documentation, if any			

Tasks During Schematic Design Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
53	Update Programming Book			
54	Project Meetings to determine / refine program and sustainability goals with: * End User * Building Services * Engineering * Grounds and Building Maintenance * Administrative Representative * Dining Services * EHS * Public Safety * Others			
55	Establish Project Schedule, including completion dates for each phase. Provide to owner and consultants			
56	Review requirements for site analysis test pits and testing (such as borings, perc tests, etc.) necessary for proper execution of site work and request such information from the University. Assist University in securing proposals for this work.			

		A&E	P.U.	N/A
57	Review site survey including building, mechanical, electrical and structural surveys			
58	Review all data supplied, including program, budget, legal, site, code, space and special owner requirements. Record all data. Verify design complies with established requirements.			
59	Prepare functional space diagrams			
60	Meet with Facilities Engineering to gather load and performance data associated with proposed MEP systems			
61	Prepare basic design documents to include: * Site plan with diagrammatic indicators showing relationships * Vertical sections through the site as required * Principal floor plans * General descriptive views * Illustrative sketches, models or renderings as required (Reference A/E Contract Article VII (b))			
62	Assemble Major Site Plan approval documents in accordance with SPRAB requirements per University Land Use Attorney's recommendations			
63	Meet with Asst Manager for SPMIS to review methodology for calculating net and gross areas/ ratios in conformance with University requirements			
64	Meet with Asst Manager for SPMIS to review CAD quality assurance			
65	Prepare general description of the project and construction and equipment outlines			
66	Preliminary Energy Cost Budget Model (see section 3.3)			
67	Envelope Review 1 - identify and prioritize the largest project energy impacts			
68	Perform preliminary LCCS comparative studies			
69	LCCS Review 1 of initial comparative study results; select appropriate LCCS elements to incorporate into the project			
70	Record of LCCS Review 1 - include updated project schedule and budget with incorporated LCCS elements (refer to Section 1.2)			
71	Submit Statement of Design Criteria to University for review and comment to clarify expectation of deliverables * Schematic Design documents * A/E Building requirements * Program data * Other			

		A&E	P.U.	N/A
72	Calculate areas and volumes and analyze plan efficiency of the design by usable area, area per person or other method; review programmatic/ performance assumptions to look for opportunities for shared spaces, volume reduction, increased space efficiency, material use and reduction, optimization of water and energy use			
73	If CM is on board, start preparing cost estimates			
74	Prepare Schematic Design documents in conformance with PU Facilities Department Design Standards Manual (latest Release) and the phased submission requirements listed within each respective section.			
75	Submit Schematic Design documents (drawings, descriptions, calculations, outlines and statements of probable construction cost) to University, post to Centric			
76	Submit preliminary Commissioning Plan and MEP Design Intent (see Section 3.13)			
77	Submit civil drawings to Nitsch Engineering for storm water management review			
78	Meet with Life Safety and Security Systems to develop Security Programming Document			
79	Submit documentation that major system equipment has adequate space allotments in all major MEP spaces			
80	Discuss need for PMG meeting with Executive Sponsor and User to review project status, scope, unreconciled budget items, schedule, etc.			
81	Review and update schedule of completion dates for this and all subsequent phases			
82	Determine if PACA review is required			
83	FPG Committee meeting to discuss schematic presentation and authorization to proceed to Design Development			
84	Provide documentation for trustee approval prior to proceeding to Design Development phase			

Tasks Prior to Starting Design Development Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
85	Update Programming Book			
86	Review need for special consultants and confirm that schedule and budget is met			
87	Update list of owner-supplied or existing owner equipment and respective utility requirements to be transferred into new facility			
88	Confirm all systems requiring owner-supplier labor			
89	Meet with Asst Manager for SPMIS and Architectural Engineer for Standards to discuss room numbering strategies			

Tasks During Design Development Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
90	Discuss need for any phasing of project and site logistics; review project schedule to ensure/ include adequate time for sustainability activities (construction monitoring, commissioning, other documentation, training)			
91	DCA "Pre-meeting" to review code issues with University Code Analyst, review Project Code Checklist			
92	Prepare cover sheet to include site/ location plan as well as: * Index of drawings * Directory of consultants with contact information * Building data * Applicable code summary data			
93	Assemble Minor Site Plan or Administrative Waiver approval documents in accordance with SPRAB requirements per University Land Use Attorney's recommendations			
94	Prepare site/ location plan indicating building locations and extent of site improvements			
95	Refine / develop LCCS comparative studies			
96	Envelope Review 2 (see Section 1.2)			
97	LCCS Review 2 - verify alignment with Project Sustainability Goals and benchmarks			
98	Record of LCCS Review 2, include updated project schedule and budget			
99	Submit net and gross area and volume calculations			
100	Prepare area calculations (net and gross) and volume calculations with keyed floor plans			

		A&E	P.U.	N/A
101	Prepare preliminary draft of the Project Manual. Have consultants prepare their portions and coordinate. Identify sustainable strategies / LCCA elements that require coordination/ development in specifications. Solicit CM input for opportunities in construction and delivery of sustainability issues			
102	Confirm front-end documents are coordinated with University's respective standard construction agreements, Standard General Conditions and Facilities Design Standards Manual. Be sure to include the standard University specifications for the following topics: * Elevators * Fire Alarms * Commissioning			
103	Provide timely and coordinated responses to all DD review comments prior to submission of all future Construction Documents.			
104	Identification of alternates generated in review of 100% DD documents.			
105	Review of unreconciled budget items in submissions from Construction Manager and Independent Estimator. Attend Budget Reconciliation meeting with CM.			
106	Committee meeting to discuss DD presentation and authorization to proceed to construction documentation phase			
107	Determine schedule for Owner's pre-purchased items			
108	Site Logistics meeting			
109	Confirm Discipline Review meetings have been completed for Schematic and Design Development Phases			
110	Submit final MEP "Basis of Design" Document and updated Commissioning Plan (see Section 3.13)			
111	Discuss need for PMG meeting with Executive Sponsor and User to review project status, scope, unreconciled budget items, schedule, etc.			
112	FPG Committee meeting to discuss schematic presentation and authorization to proceed to Construction Documentation			

Tasks Prior to Starting Construction Document Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
113	Complete Program Book			
114	Review the project program and verify compliance with the design documents			
115	Review scope of items to be provided by owner or otherwise not included in construction documents			
116	Review Princeton University's instructions regarding issuance of bonds, construction agreement and bid procedures			
117	Review Princeton University's General Terms and Conditions for all construction contracts as they relate to the project-specific general requirements			
118	Meet with University SPMIS Administrator to ascertain all CAD documentation procedures prior to initiation of CDs			

Tasks During Construction Document Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
119	Prepare 50% CDs in conformance with PU Facilities Department Design Standards Manual (latest Release) and the phased submission requirements listed within each respective section			
	* Waste Management Plan			
	* Site Protection / Health & Safety Plan			
	* List of equipment to be commissioned and commissioning specifications			
	* Final Energy Cost Budget Model			
120	Submit 50% CDs to Project Manager for University Tech Teams and post on Centric Projects			
121	Attend all 50% CD Tech Team review meetings and record all minutes and review commentary			
122	Provide timely and coordinated responses to all CD review comments prior to submission of all future documentation			
123	Identification of add/ deduct alternates generated in review of 50% Construction Documents			
124	Review of unreconciled budget items in submissions from Construction Manager and Independent Estimator. Attend Budget Reconciliation meeting with CM			

		A&E	P.U.	N/A
125	Discuss need for PMG meeting with Executive Sponsor and User to review project status, scope, unreconciled budget items, schedule, etc. after 50% CD milestone			
126	Coordination of anticipated site logistics planning			
127	Prepare 85% CDs in conformance with PU Facilities Department Design Standards Manual (latest Release) and the phased submission requirements listed within each respective section. Provide list of pre-functional and functional commissioning tests to be performed (see Appendices 3.3-7 and 3.3-8)			
128	Submit 85% CDs to Project Manager for University Tech Teams and post on Centric Projects			
129	Attend all 85% CD Tech Team review meetings and record all minutes and review commentary			
130	Provide timely and coordinated responses to all CD review comments prior to submission of all future documentation			
131	Identification of add/ deduct alternates generated in review of 85% Construction Documents			
132	Review of unreconciled budget items in submissions from Construction Manager and Independent Estimator. Attend Budget Reconciliation meeting with CM			
133	Attend all Value Engineering meetings to assist in budget reconciliation			
134	Review Contractor's temporary power requirements for coordination with university Engineering Department			
135	Determine alternates to be documented and priced			
136	Review list of potential sub-contractors for project			
137	Prepare documents for filing of permits and approvals			
138	Coordination of final Project Manual			
139	Discuss need for PMG meeting with Executive Sponsor and User to review project status, scope, unreconciled budget items, schedule, etc.			
140	FPG Committee meeting to discuss schematic presentation and authorization to proceed to Bidding & Negotiation Phase			

Tasks During Bidding and Negotiation Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
141	Determine submission requirements for Trustee Finance Committee Approval			
142	Attend Pre-Bid Conference to review contractor responsibilities including: * Waste Management Plan implementation * Materials certificate collection * Health & Safety Plan Implementation * Site Management / Protection * Commissioning data collection * Contractor parking / access to site * Noise Issues * Considerations regarding the Academic Calendar			
143	Evaluation of proposed substitutions and add/ deduct alternates			
144	Review all discipline scope documents prepared by Construction Manager and propose changes			
145	Final logistics plan review with Construction Manager, including review of University temporary offices and power requirements, as well as contractor parking requirements and provisions			
146	Evaluation and documentation of changes made to LCCS elements as a result of the budget reconciliation process			
147	Review of bid lists			
148	Attend all Subcontractor bid openings			
149	Attendance at Descoping of contractor bids			
150	Final determination of items in / out of scope			
151	Review of projected construction schedule			
152	FPG Committee meeting to discuss schematic presentation and authorization to proceed to Construction Administration Phase			

Tasks During Construction Administration Phase

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
153	Pre-Construction Meeting to discuss: * Submittals / Tech Reviews * Construction Document Control Process * Role of Centric Project collaboration tool * Project Sustainability goals and design features * Contractor input - opportunities for construction innovation and efficiencies * Sustainability and Commissioning protocols			

		A&E	P.U.	N/A
154	Post 100% Construction Documents in Centric Projects; update throughout CA to include revised drawings, addenda, etc.			
155	Ongoing Monitoring and Certificate Collection * Construction Waste Management * Construction IAQ Plan * Collect Materials Certifications			
156	Maintain Phase 2 Commissioning documentation (see Section 3.13)			
157	Attendance at regular project site meetings with Construction Manager			
157	Submission of regular Field Observation Reports for ongoing construction contingencies			
158	Response to RFIs, Submittal reviews and building component preconstruction reviews			
159	Ongoing Review of Project Schedule and Expenses			
160	Review and reconciliation of contractor's proposed changes, project change orders and scope changes			
161	Submit individual Change Order review recommendation letters for each proposed CO			
162	Assist University Commissioning Agent in documentation of pre-functional and functional testing			
163	Punch list preparation and follow-up			
164	Inspect project for substantial completion, provide notification to government agencies who require inspection prior to occupancy			
165	Provide FA Testing and Certification Letter in conformance with University standard specifications (refer to Section 3.4)			
166	Provide written certification of substantial completion			
167	Attend acceptance testing for all major building components * UL * ASTM * Other			

Tasks During Project Close-Out

Item #	Task Description	Responsibility & Date Completed A&E	P.U.	N/A
168	Review submitted Operations and Maintenance Manuals/ Programs as required, including any specific information related to LCCA elements (section 1.5)			
169	Review submitted As-Built Documents from CM			
170	Review systems training requirements and attend selected MEP training sessions * Fire Alarm * ATC * Mechanical Systems			
171	Final radon level testing needs to be recorded and submitted to EHS for any project disturbing basement slab or slab on grade conditions (new projects and renovations)			
172	Best Practices meeting to evaluate process, strategies, role of LCCA guidelines and procedures			
173	Record of Best Practices meeting comments.			
174	Provide Final Commissioning Report (see Section 3.13)			
175	Ongoing monitoring, commissioning and Annual Cost documentation of: * Energy Consumption * O&M Costs			
176	Post-Occupancy Evaluations regarding LCCS elements			
177	Follow-up Best Practices meeting and record comments			
178	Schedule end-of-warranty walk-throughs at 1 year post-C of O date			

END OF DOCUMENT

A/E FEE PROPOSAL BUDGET OUTLINE Date: ___________________

	Party Responsible	Baseline Budget	Revised Budget	Committed Amount
A. Site Acquisition				
1. Land costs (off campus)				
2. Survey				
3. Title Insurance				
4. Real estate fees				
5. Rezoning				
6. Legal fees				
7. Others				
B. A/E Fee Structure				
(include MEP structural design)				
1. Design fees				
2. Reimbursables				
3. Construction Admin. fees				
4. Construction Admin.				
reimbursables				
C. Special Consult Fee Structure				
1. Site design fee				
reimbursables				
2. Civil engineering fee				
reimbursables				
3. Interior design fee				
reimbursables				
4. Furniture procurement				
reimbursables				
5. Acoustical fee				
reimbursables				
6. Food service				

A/E FEE PROPOSAL BUDGET OUTLINE Date: ___________________

	Party Responsible	Baseline Budget	Revised Budget	Committed Amount
7. Traffic				
8. Graphics				
9. Landscaping				
10. Zoning/Planning				
11. Lighting				
12. Cost Estimating				
13. Energy				
14. Model Making				
15. BIM Requirement				
16. Other				
D. Special Environmental Consult.				
1. Asbestos	P.U.			
2. Radon	P.U. / A/E			
3. Lead Paint	P.U.			
4. Other				
E. Permitting				
1. Zoning/Planning				
2. Plan review fee – State/Private				
3. Sewer Allocation				
4. Building permit preparation				
5. Other permits – street work,				
barricades, sewer connection,				
soil erosion, etc.				

A/E FEE PROPOSAL BUDGET OUTLINE   Date: ___________________

	Party Responsible	Baseline Budget	Revised Budget	Committed Amount
6. Utility connections	P.U.			
a. Gas	P.U.			
b. Electric	P.U.			
c. Water	P.U.			
d. Steam/Condensate	P.U.			
e. Chilled Water	P.U.			
f. OIT/Telephone	P.U.			
g. Fire Protection Water	P.U.			
F. Miscellaneous				
1. Survey – topographical,				
boundary, utilities and discuss				
need for existing conditions				
survey				
2. Adjacent building damage				
survey				
3. Soils report				
4. Full-size mock-ups				
5. Construction testing laboratory				
inspection				
6. Construction soils inspection				
7. Full-time project representatives				
G. Escalation				
H. Other				
TOTALS				

1. Introduction

The main campus of Princeton University occupies land in two municipalities, the Borough of Princeton and the Township of Princeton, in Mercer County, New Jersey. Each municipality has a building department which is responsible for review and inspection of construction activity within its boundary. Full compliance with Federal, State and Local regulatory requirements on any project is the responsibility of the prime professional of record.

2. State Review

Construction projects in the state are regulated by the New Jersey Uniform Construction Code (NJUCC or simply UCC). The UCC adopts - and modifies - model codes that provide control and standards for construction. These model codes, such as the IBC (International Building Code), the National Standard Plumbing Code, and the National Electrical Code (among others) are listed in subchapter 3 of the UCC.

Fire safety projects may be initiated under the New Jersey Uniform Fire Code (NJUFC or UFC), which is more condensed in scope than the UCC; however, fire safety work is often undertaken as part of a larger project requiring UCC compliance. It is incumbent upon the Designer to become familiar with the UFC and UCC and the applicable sections of adopted subcodes: in part, those design elements that require periodic testing in accordance with those sections.

Construction plan review is also regulated by the UCC and, depending on the size and use of the building, is the responsibility of the local building department or comes under the purview of the New Jersey Department of Community Affairs (DCA), the agency empowered by the UCC.

3. Local Review

Prior to becoming eligible for building permit review, new buildings and building additions typically require approval by a number of municipal and county agencies. Site plans must be reviewed by the Princeton Regional Planning Board, a joint agency of both municipalities. In some instances, site plan review becomes the responsibility of a municipal Zoning Board of Adjustment; both of the Princeton municipalities have municipal zoning offices and boards.

Prior to permitting in local municipalities, construction documents for most Class 1, Class 2, or Class 3 structures require a formal plan review by a State or Local plan review agency. Local agencies sometime use private plan review companies to assist them. Determining which agency will conduct this review shall be determined through consultation with the Project Manager and University Code Analyst.

The Designers must be prepared to offer support in the efforts needed to provide this necessary information to apply for and obtain Permits. The legal intricacies of site plan approval are typically addressed by the University's legal counsel. The Designer must be prepared to offer support in the effort to obtain site plan approval, which might require presentation drawings, providing the University Code Analyst building characteristics information for preparation of a

Fire Protection Plan, appearances at the meetings of the Regional Planning Board or the municipal zoning boards, pre-meetings with a key subcommittee that supports all the agencies, the Site Plan Review Advisory Board (SPRAB), and close coordination with civil/site Engineers, Landscape Architects, and University personnel.

The Project Manager for the University provides direction in the efforts required for site plan approvals, construction permit review and approval, and subsequent contacts with the municipal building departments during construction and closeout.

4. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable)

B. University Code Analyst — MacMillan Building, 609-258-6706

C. University legal counsel — (contact through Project Manager)

5. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

A. Princeton University campus utility plan, cover sheet indicating boundary lines between Borough and Township, in Facilities Engineering Department

B. *Application for Plan Review*, State of New Jersey Department of Community Affairs, Division of Codes and Standards — Public Document

C. *Project Review Application*, State of New Jersey Department of Community Affairs, Bureau of Construction Project Review — Public Document

D. *Variation Application*, State of New Jersey Department of Community Affairs, Bureau of Construction Project Review — Public Document

E. How Do I Develop My Property In Princeton?, Borough of Princeton, Department of Engineering — Public Document

F. *Development Guidelines*, Princeton Sewer Operating Committee — Public Document

G. Site Plan Instruction Packet, Regional Planning Board of Princeton — Public Document

H. Environmental Safety Risk Management Master Plan, 2002 — Consult Project Manager

I. Notice to New Jersey Licensed Architects — Appendix 1.4-1

J. Code Sheet Information Checklist — Appendix 1.4-2

6. Review Guidelines

Initial planning and preliminary design will be conducted through the Office of Design & Construction with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project be submitted to the University for an internal "Tech Team" review process through the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Project Manager

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

7. Procedural Guidelines - Preliminary Design & Design Development

During preliminary design, the Designer is to consult with University Project Manager to ascertain the need for site plan and zoning approvals, and the need for legal counsel for the early stages of a project. The Designer is to cooperate with any adjunct professionals providing assistance to the University, and is to coordinate his work with other disciplines so a cohesive set of documents is produced for local board review.

During preliminary design and design development the Designer is to consult with the Project Manager and the University's Code Analyst to define code strategies and to discuss any code interpretations affecting the project.

The Designer is also to review and incorporate the Code Sheet Information Checklist, refer to Appendix 1.4-2.

8. Procedural Guidelines - Code Review Applications and Submittals

Prior to submitting an application for project review, the Designer will prepare the project application forms, including (where applicable) the DCA's *Project Review Application*, the *Application for Plan Review*, request for "Return to Local" (RTL) letter and the forms for local review. The Designer is to meet again with the Code Analyst to review the application forms and any supporting documentation. All submissions made to the Department of Community Affairs or to the Division of Fire Safety are to be channeled through the University's Code Analyst. Official Applications will be made by the University with the Code Analyst responsible for signing all applications and "RTL" letters. Likewise, all communications during the review process are to be made through the Code Analyst; this individual acts as liaison between the University and the State construction agencies, and is responsible for continuity in the applicability of code issues from project to project. It is imperative that this continuity be maintained.

Insofar as is practicable, only 100% complete documents are to be submitted to DCA for review. The intent is to prevent needless and time-consuming review by the State agency, and review comments brought on by incomplete information. The Designer is to refer to the plan submission checklist in the *Application for Plan Review*.

Documents submitted to DCA are to be signed and sealed; the UCC outlines requirements for original signature and raised seal. The signatory Architect's license number must appear on the Drawings and his/her name must be listed in the drawing title block, and on the cover page of Specifications, Calculations, Detail Books, and Reports. All Drawings must be signed and sealed, as well as specification booklets, structural calculations, ventilation calculations, energy calculations, etc. For DCA Projects, a minimum of three sets of signed and sealed documents are generally required for release; four sets are required for elevator release; a single set may be submitted for DCA project review, with at least two additional sets submitted when the project has been cleared for release.

Upon submittal of the design documents to DCA, a DCA Project Number will be assigned. Once that number is known, all subsequent submissions to DCA must include that number on all documents.

All Architectural and Engineering Firms are required to be licensed to practice their professions in New Jersey. In addition, the firm or firms, as the case may be, must be registered with the New Jersey Treasury Department for state Architects or with the New Jersey State Board of Architects for out-of-state firms, or equivalent for Engineering Firms (refer to Appendix 1.4-1).

9. Procedural Guidelines - Organization of Submittal Drawings

In order to maintain project schedule it is sometimes necessary to request partial release of Drawings from the DCA, and to obtain construction permits from the local agency for discrete parts of the project. The likelihood of this necessity should be discussed early with the University Project Manager and the Code Analyst. In order to facilitate partial release, the Drawings and specifications should be set up with easily separable sections related to the following categories:

A. Footings and Foundations

B. Structural Framework

C. Exterior Building Components

D. Interior Building Components

E. Elevator

F. Other Building Elements

G. Underground & Underslab Utilities

H. Plumbing

I. HVAC & Mechanical

J. Electrical

K. Fire Suppression/Sprinklers

L. Fire Protection/Fire Alarms

10. Procedural Guidelines - Timely Response to Review Comments

During code review, time is of the essence in responding to inquiries and comments from the review agencies. Designers and their consultants are to respond to DCA comments within one week, unless technically infeasible. DCA comments are to be referenced and quoted in responses, to simplify re-review by the agency.

Again, these responses are to be channeled through the University Code Analyst for actual submittal to DCA.

11. Procedural Guidelines - Code Variances and Variations

During the course of code review, or during construction, it often becomes necessary to apply for relief from some requirement of the UCC or a subcode. The Designer will be responsible for preparing such an application (a variance under the UCC, a variation under the NJ Fire Code) in consultation with the Code Analyst. The application is made to the agency responsible for code review. The application typically includes a written narrative outlining difficulties in complying with code requirements, and a description of the proposed alternative with any mitigating features which might offset the code deficiency. The application might include sketches and photos in support of the request for relief. Official application will be made by the University, with the Code Analyst responsible for signing and submitting to the applicable agency.

12. Procedural Guidelines - Permit Application to Local Agency

Permit applications to local municipalities consist of at least two signed and sealed sets of project documents; in the case of documents reviewed by DCA (or a private code reviewer) these sets are the two final release sets from the agency. Documents are submitted to the municipality with completed application forms for each major trade involved in the project (building, fire safety and protection, plumbing, HVAC, electric, elevator).

The Designer shall be responsible for assisting the Project Manager in gathering the required information for permit application, including fixture and device counts, equipment ratings, incoming utility service sizes, etc. to facilitate a complete submission. Permit application, delivery, pick-up, and fee responsibility are determined by the Project Manager and the Code Analyst.

Plumbing, Electrical and Fire Protection sub-code application forms must be signed and sealed by the licensed Contractor responsible for the work; the Designer will cooperate in this procedure as well.

13. Procedural Guidelines - Approved Construction Documents

During construction, site conditions often necessitate changes in the work. Revisions to Drawings are to be submitted to the DCA (or the responsible review agency) for approval, and are to be incorporated into the approved set of Drawings that is to be kept at the job site. It is a UCC requirement that the approved permit release Drawings are kept at the site.

Frequency of Updates:

The State Uniform Construction Code requires all structures to be built from approved Documents at all times. As field changes occur, Construction documents are required to be updated and resubmitted to the Plan Review Authority having jurisdiction for Amended Review and Release. For State DCA projects, the documents are required to be upgraded continuously over the course of the project. As Built Documents, only, are not acceptable, and are not submitted to the State for approval unless specifically requested by the DCA. The same procedure should be followed for field changes on Local Plan Review Projects, but less frequent updates and or submission of As Built Drawings at the end of the job have been allowed by the Local Construction Officials on a case by case basis. Advance permission from the Construction Official is required for this exception to be allowed. Otherwise the documents are required to be upgraded continuously. The Code Analyst can assist the Designer with the exact frequency and packaging requirements for submitting for Amended Releases.

Drawings illustrating revisions must be submitted for review on full sized sheets that can easily be incorporated into and maintained with the full approved set at the worksite.

Changes to documents that have been submitted for Plan Review, or that have already been “Released” for construction, must be reviewed, and approved by the Plan Review Authority Having Jurisdiction. To minimize the time and effort needed to review the document again, all changes must be identified on the documents in a clear manner for the reviewer, and a written narrative describing each change must accompany the submission. A sentence or two is all that is required for each change, provided it adequately conveys the general idea of it to the reviewer.

A courtesy copy of all changes submitted to DCA should also be submitted to the local Permitting Authority if the project is under construction. Failure to do so could result in problems during scheduled or periodic inspections of the work.

Revisions made to documents that have already been "Released" for construction by DCA will be subject to additional Plan Review fees. The cost for such reviews will be calculated on an hourly basis. All additional fees due must be paid in full prior to receipt of the "Amended Release". Reimbursement of costs for changes made to "Released" documents shall be the responsibility of the organization that initiated them unless that organization is Princeton University, or if Princeton University specifically agrees to assume them.

14. Periodic Testing Requirements

Periodic testing requirements of non-commissioned fire related building elements will be determined by the Project Manager and University Code Analyst. A list of required periodic tests will be developed during Design Development and distributed to the Design Team. Beginning with the 50% CD submission, the Design Team shall initiate detailed documentation of the testing procedures (a step by step guide to aide in administering the test). These procedures shall be complete and documented for review by all authorities having jurisdiction.

Outside consultants may be available as needed to help develop these procedures. Consult with the Project Manager should the project require the aide of outside consultants.

END OF DOCUMENT

1. Introduction

The purpose of this section is to develop the requirements for documentation and procedure for archiving all University Project Contract Documents. The documentation requirements involve specific formatting and procedural requirements for Drawing production, particularly related to Computer Aided Drafting (CAD). The archiving requirements pertain to both CAD and printed materials. All these requirements are consistent with Princeton University standard *General Conditions for All Construction Contracts* and the standard *A/E Design Services Contract.* The aforementioned documents provide a basis by which the University may accept or reject the digital deliverables related to a project. These requirements are to be adhered to for all capital projects as well as major and minor renovations.

The consultant or general contractor shall each submit their respective signed copy of the Electronic File Quality Assurance Checklist (Appendix 1.5-1A) along with all digital deliverables including CAD drawings and scans. When an Electronic Quality Assurance Checklist has been signed and submitted, the consultant (architect, engineer, contractor, etc.) is assuring that all materials adhere to the standards and guidelines of Princeton University.

Guidelines have been established for the process of calculating both the net and gross square foot areas of University buildings. The Designer should anticipate the incorporation of these guidelines as they apply to the building program (see Appendices 1.5-4 and 1.5-5).

During the Schematic Design Phase, the Designer must meet with the Facilities Space and Property Management Information Systems (SPMIS) Assistant Manager to review the process for the square foot calculation of areas and classification of operational uses for the various elements of the building program (see Appendices 1.5-6 and 1.5-7).

2. Contacts

A. The Project Manager (in the Office of Design and Construction, the Engineering Department, Grounds and Buildings Maintenance, or as applicable).

B. SPMIS Assistant Manager./ GIS In-Site Planning — MacMillan Bldg. 609-258-0320

C. CAD Archivist - — MacMillan Bldg. 609-258-7685

D. SPMIS Administrator - — MacMillan Bldg. 609-258-6794

E. Manager of CAD Dept./ GIS In-Site Planning — MacMillan Bldg. 609-258-1689

F. Architectural Engineer for Standards — 200 Elm Drive, 609-258-6247

G. GIS Analyst — MacMillan Bldg. 609-258-8205

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

A. Princeton University Standard
A/E Design Services Contract – Article XIV
http://www.princeton.edu/facilities/info/audiences/suppliers/contracts/

B. Princeton University Standard *General Conditions For All Construction Contracts* – Clause F2
http://www.princeton.edu/facilities/info/audiences/suppliers/contracts/

		PDF
C.	Princeton University CAD Standards (Dated March 2010)	Appendix 1.5-1
D.	Princeton University Aerial Mapping Standards	Appendix 1.5-2
E.	Princeton University Building Drawing located in Planning Vault, Office of Design and Construction – MacMillan Building	See Project Manager
F.	National CAD Standard (approved by NIBS, AIA and CSI) Volume 1 & 2 Version 2.0, 2001	http://www.nationalcadstandard.org/
G.	Fire Alarm / Signage Nomenclature Spreadsheet Sample, Princeton University	Appendix 2.8-2
H.	Princeton University Room Numbering Guideline	Appendix 1.5-3
I.	FICM – Facilities Inventory and Classification Manual, Chapter 3 – Building GSF/NASF calculation standards	Appendix 1.5-4
J.	FICM – Facilities Inventory and Classification Manual, Chapter 4 – Room Category and Type Space Standards	Appendix 1.5-4
K.	Princeton University Square Foot Analysis Report for New Buildings	Appendix 1.5-5 (.xls)
L.	Princeton University Square Foot Analysis Report for Existing Buildings	Appendix 1.5-6 (.xls)
M.	Princeton University BIM Requirements	Appendix 1.5-7

4. Code References

A. Uniform Construction Code Form 7-2708 "Application for Certificate of Occupancy" (Requirement for amended Drawings) — Public Document

5. Room Numbering Requirements

It is the intent of all projects to have permanent room numbers assigned during the Design Development Phase. It is the responsibility of the Designer to initiate and complete this process, and the Project Manager's responsibility to gather required approvals. All Drawings shall reference the University approved final room numbering system.

Guidelines have been established for the process to be followed in the assigning of numbers and designations for both net assignable and non-net assignable spaces. The Designer should anticipate the incorporation of these standards into the construction documents for the project and should work with the Project Manager to conform to the system set forth in Appendix 1.5-3.

To facilitate the establishment of room numbers, a meeting with the Architectural Engineer for Standards and Design team should occur before the start of Design Development. This meeting will clarify the appropriate method for assigning room numbers based on previous University Projects.

6. Existing Documentation Availability and Distribution

A. Paper documents available in the Office of Design and Construction vault.

B. Electronic documents are available and accessible in a variety of formats.

1. Contact the CAD Archivist regarding options for transferring of data.
2. Electronic format documents are printable to the Office of Design and Construction Xerox printer, located in the MacMillan Building Plan Vault.

7. Archiving Requirements – Printed

A. For the preparation of As-builts and Close Out Documents there is a requirement of coordination between the A/E and Contractor per *Clause F2* of the *General Conditions For All Construction Contracts* and *Article XIV* of the standard *A/E Design Services Contract.* This procedure is initiated by the A/E providing latest Design information to the Contractor in the field. Once received by Contractor, the following procedures apply:

1. As-Builts – Consists of Contractor or Sub-Contractor produced documentation of work in place of respective systems. Submission requirements may be found in individual Specification sections of the Contract Documents. At a minimum, all systems listed in Specification shall be submitted by the Contractor. Refer to the Summary of Document Archiving Requirements in this section for details.

2. Record Drawings and Project Manual – Consists of A/E-produced versions of the latest Construction Document set sent to the field. The Contractor is required to provide dimensional verification of all Architectural floor plans. Include Sub-Basement, Basement and Roof plan for use by the Contractor for complete production of this Document.

8. Archiving Requirements – Electronic

A. For the preparation of As-built Drawings, the same coordination procedures apply per *Clause F2* of the *General Conditions For All Construction Contracts* and *Article XIV* of the standard *A/E Design Services Contract*. This procedure is initiated by A/E providing latest design information to the Contractor in the field. Once received by Contractor, the following procedures apply:

1. As-Builts – Refer to the Summary of Document Archiving Requirements matrix (below) for electronic scanned image files. Scanned or PDF converted files are both acceptable.

2. Record Drawings and Project Manual – the final issue of Construction Drawings verified in the field by the Contractor per Article XIV and Clause E3 as mentioned above will be electronically transmitted on CD Rom, by the A/E to the University. Refer to Princeton University Guidelines for the Transmittal/Acquisition of CAD Data for electronic transmission formatting requirements. The Project Manual is not typically included in electronic transmission.

9. Closeout Documentation Review

Prior to submission to the University all closeout documentation listed herein as either contractor-produced or A/E-produced shall bear the equivalent review process as all prior submittals to date. This likely requires the A/E certification that the version sent to the University meets requirements of its respective CSI section. Second and third submissions may be necessary for quality assurance.

Summary of Document Archiving Requirements

	1 COPY EACH				
	Paper-ODC Vault (MacMillan)	Paper – Project File (755 Alex.)	Electronic Scanned Image[1,2] of Paper File (Centric Project)	Electronic CAD Drawing[1] (Centric Proj)	Paper – GBM (MacMillan / On-Site[6])
I. AS-BUILT DRAWINGS – *(CM or GC-PRODUCED)*[3]			ascii compliant or .pdf formatted index		
As built requirements are listed at the end of each section of the *Princeton University Design Standards Manual*		**X**	**X**		
In addition, any amended[4] Architectural or Engineering elements including: • Amended reflected ceiling plans with room heights		**X**	**X**		
• Amended building floor plans with actual room numbers, built-in furniture and equipment, and door swings		**X**	**X**		
• As-built room finish schedule annotated with all mfr., colors, model nos., styles, sizes, of all installed finishes including:		**X**	**X**		
a. ceilings		**X**	**X**		
b. floors (for tile include grout details) & stairs		**X**	**X**		
c. trim		**X**	**X**		
d. installed accessories (coat hooks, blackboards, screens, etc.)		**X**	**X**		
e. window treatments		**X**	**X**		
f. all schedules		X	X		
• Amended envelope details: mixed designs, color additives, manufacturers, or masonry suppliers, flashing details		**X**	**X**		
• Actual stone identification and source		**X**	**X**		
• Grout/Caulking – actual mfr., type, color		**X**	**X**		
• Amended window installation details		**X**	**X**		
• Fire Detection		**X**	**X**	**X**	
• Security and Access Control System		**X**	**X**	**X**	
• Fire Suppression		**X**	**X**	**X**	
• Air Temperature Controls		**X**	**X**	**X**	
Final Approved Shop Drawings for:					
• Steel		**X**	**X**	**X**	
• Pre-Cast		**X**	**X**	**X**	
• Duct work		**X**	**X**	**X**	
• Curtain Wall		X	X	X	
• As required by Project Manager		**X**	**X**	**X**	
MEP Coordination Drawings		**X**	**X**	**X**	

Summary of Document Archiving Requirements *(continued)*

	1 COPY EACH				
	Paper- ODC Vault (MacMillan)	**Paper – Project File (755 Alex.)**	**Electronic Scanned Image[1,2] of Paper File (Centric Proj)**	**Electronic CAD Drawing[1] (Centric Proj)**	**Paper – GBM (MacMillan / On-Site[6])**
II. OTHER CLOSE-OUT DOCUMENTS – *(CM or GC -PRODUCED)*[3]			ascii compliant or .pdf formatted index		
Final Approved Submittals & Product Data (PER CSI SECTION)		X	X		
O&M Manuals (PER CSI SECTION)		X	X		X
• Include any final approved submittals for ea. item of product data in O & M manuals.					
Warranties (PER CSI SECTION)		X	X		X
CONSTRUCTION DRAWINGS / SPECS					
Final Approved Signed and Sealed Permit Sets		X			
	1 COPY EACH				
III. RECORD DRAWINGS[5] *(A/E-PRODUCED)*					
Quality Assurance Checklist(s) (Appendix 1.5-1-A)		X	X	X	
Latest Construction Document Issue of:					
• Landscape, Site and Civil Drawings	X		X	X	
• Architectural Drawings	X		X	X	
• Structural Drawings	X		X	X	
• Mechanical Drawings	X		X	X	
• Plumbing Drawings	X		X	X	
• Fire Protection Drawings	X		X	X	
• Electrical	X		X	X	
• Special Consultants	X		X	X	
PROJECT SPECIFICATION MANUAL					
Latest Construction Issue		X			X
	1 COPY EACH				
IV. THIRD PARTY FILE DRAWINGS– *(P.U.-PRODUCED)*					
Architectural – Measured Floor Plans of Completed Work			X	X	
U/G Utilities			X	X	
Site Plan (see section 2.9.10)			X	X	
Land Survey (see section 2.9.16)			X	X	

Footnotes:
[1] Only one copy of the digitals are required
[2] Scanned images may also include converted electronic files in .PDF format
[3] For projects w/out a CM or GC, consult with Project Manager to determine required As-Built documents
[4] "Amended" refers to the As-Built condition conforming to the latest construction document issue.
[5] Collecting and submitting this info from all sub-consultants is the responsibility of the lead Designer under contract.
[6] Project Field Manager to coordinate additional on-site set requirements of GBM

10. Formatting of Printed Deliverables – As Built Drawings

A. Document Identification

1. Project Title
2. Drawing Title
3. Project Location
4. Document Submission Date
5. Name and Address of Subcontractor
6. Contact Name and Telephone Number
7. Revision Dates
8. Scale and North Arrow include the specific reference (NAD83, Grid or Magnetic) to any applicable information such as deed, filed plan
9. Datum and Grid/Ground Scale Factor Notes

B. Document Medium Format - Drawings

Ammonia Free

Unfolded/Rolled

11. Formatting of Electronic Deliverables

A. Document Identification

All requirements for document identification from printed deliverables apply to electronic deliverables. Additional digital requirements are specified in 1.5-1-D.

B. Formatting of Electronic Deliverables

Contact the CAD Archivist for options regarding transferring of data.

AutoCAD™ is the CAD software employed by Princeton University. The AutoCAD™ DWG © format is file format used by Princeton University to store and manipulate CAD drawings. Princeton University utilizes the current version of AutoCAD™ To guarantee the compatibility with Princeton University CAD/CAFM Systems, all CAD files must be in AutoCAD™ file format within 2 releases of the current version. More information regarding file structuring layering can be found in *Guidelines For the Transmittal/ Acquisition of CAD Data Summary* (Appendix 1.5-1) and associated subsections.

12. Use of Princeton University Existing Digital Data

The University strives to be completely digital and therefore have been focused on converting the existing hard copy utility plans to digital CAD drawings. The utility data has been compiled over the Universities CAD Planimetric Base Map which was developed through a Aerial Photography and Orthophotography mission in 1999, supplemented by yearly planimetric updates and GPS collection of additional features both surface and subsurface when exposed for maintenance purposes.

Authorized Users can acquire the latest Princeton University digital campus map by contacting the SPMIS Administrator.

The Princeton University digital campus map conforms to the New Jersey Stateplane NAD 83 US Survey Feet (horizontal datum) and NAVD 88 US Survey Feet (vertical datum).

The Designer shall not base designs on vertical data from any Princeton University supplied source. All vertical and horizontal values shall be independently verified by the consultant.

The University has deployed a differential "GPS Base Station" (Global Positioning System). The Base Station is located on the roof of New South and it broadcasts on FCC approved radio frequencies. The GPS Base Station data can be accessed by all Consultants.

13. Positional Tolerance Requirements for Internal Bldg Conditions, Surveys and As-Builts

All CAD drawing models should be drafted at full scale in architectural units, such that one drawing unit equals one inch.

As-builts should meet or exceed the following:

It is typically required that exterior building dimensions recorded within CAD drawings must reconcile to within one inch of actual building dimensions as measured in the field, and interior building dimensions must reconcile to within one-half inch of actual field dimensions. However, individual project specifications may vary slightly. Confirm dimensional error tolerances for each project with the University Project Manager.

For information regarding external conditions, refer to Section 2.9, Site Planning.

14. Building Information Modeling

The use of building information modeling (BIM) will be utilized where appropriate, as outlined in the scope of services. The use of BIM will enable measurable improvements to the quality of projects and savings in cost and time. It will promote value-added visualization, simulation and optimization technologies (such as renderings, cost estimating, energy modeling and clash detection). The BIM model will also be used after completion to complement, leverage and improve facilities management technologies. The project-specific BIM requirements will be established at the project inception, based on collaboration with the project team, led by the University. The A/E will provide a BIM implementation plan early design phase to establish team protocols and process. In addition to the design phase, the BIM implementation plan will include strategies for use of the BIM model during the bidding, construction and close out phases. The A/E will incorporate these strategies into the contract documents for use during bidding and construction.

END OF DOCUMENT

1. Introduction

Much of Princeton University's historic campus was originally designed in ways which may not have provided for accessible routes and features to all parts of its buildings. Nevertheless, one of the goals of every University project is to enhance and improve the accessibility of the campus and its buildings, and to create accessible routes to and through University facilities, accomplished without assistance or special knowledge.

Moreover, it is the goal of the University that all new construction and renovation be designed and include features to allow for independent use to the highest extent possible of all campus facilities by all individuals regardless of disability. The University is committed to ensuring access for individuals with disabilities, including but not limited to students, employees, occupants, spectators, participants, consumers, or visitors.

Princeton University is subject to regulations under the federal laws known as the Rehabilitation Act and the Americans with Disabilities Act, as well as the New Jersey Law Against Discrimination. Under applicable law, disabilities may include physical, mental, sensory or cognitive impairments or disorders.

The Designer is responsible for meeting all applicable codes as referenced in the New Jersey Uniform Construction Code, as well as all regulations implementing the Americans with Disabilities Act, specifically the ADA Accessibility Guidelines ("ADAAG") as adopted by the Department of Justice. For all projects, in addition to meeting the above referenced codes and standards, project-specific goals identified by the University to enhance and improve the accessibility of the campus and its buildings must be considered and incorporated by the Designer. No modification may be undertaken that makes the campus *less* accessible. It is the University's long term goal to have an accessible campus.

For projects involving ground up construction, the design team shall meet with the University Code Analyst early in the programming phase to discuss accessibility with respect to the project design. New buildings will follow accessibility code requirements to the full extent of both state and federal law; in the event of a conflict, the design must comply with the more restrictive standard.

For renovation work, The Designer shall meet with the University Code Analyst and accessibility consultant as directed by the Project Manager early in the programming phase to discuss the project goals with respect to accessibility. Refer to Section 6 below.

2. Contacts

A. The Project Manager	Office of Design and Construction
B. University Code Analyst	MacMillan Building, 609-258-6706
C. University Accessibility Consultants	NK Architects, Morristown, NJ Contact Project Manager to coordinate

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Princeton University Campus Accessibility Map	Appendix 2.1-1	
B. Princeton University Typical Barrier Free Details	Appendix 2.1-2	Appendix 2.1-2
C. Sample Accessibility Program Document	Appendix 2.1-3	

4. Applicable Codes and Federal Standards

Refer to Princeton University Design Standards Chapter *1.4 Regulatory Agencies* for additional information regarding applicable codes and regulatory procedures

Some of the Codes and Regulations that are of primary importance include but are not limited to:

A. U.S. Department of Justice, Americans with Disabilities Act Accessibility Guidelines (“ADAAG”)

B. New Jersey Uniform Construction Code (NJUCC)
http://www.nj.gov/dca/codes/

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. NJUCC subchapter 7 for barrier-free requirements

E. ICC/ANSI A-117.1 American National Standard for Accessible and Useable Buildings and Facilities

It is the responsibility of the Designer to comply with the currently adopted versions of the applicable codes and current federal standards at the time of submission to NJDCA and/or other authority having jurisdiction. In the event of a conflict between the State and Federal standards, the designer shall design to the more restrictive standard unless directed by the University in writing.

Designers should not simply design to code minimum or maximum dimensions so that installed work will always fall within federal and state guidelines.

5. University Review Guidelines

Initial planning and preliminary design will be conducted through the Office of Design & Construction with the University department responsible for project initiation.

For new construction projects, while all projects shall comply with codes and standards identified earlier in this section, the Designer shall also meet with the University Code Analyst early in the programming phase to discuss the project goals that supplement code requirements with respect to accessibility. The Accessibility Consultant may be included at the discretion of the Project Manager for initial project review. The designer shall then develop an Accessibility Program Document restating the agreed goals and supplemental code requirements for the project.

For renovation projects, the Designer shall meet with the Accessibility Review Committee to discuss the project goals with respect to accessibility. In addition to the client/user, the committee is comprised of the University Program Manager, University Code Analyst, The Office of Disabilities Services, the Design Professional and the University Accessibility Consultant. During this phase, the Designer shall develop an Accessibility Program Document for review by the committee (See Appendix 2.1-3). This document shall be submitted during the programming phase and will serve to determine the scope of the accessibility improvements to be included in the final scope of work for the project.

As all projects move toward the construction documentation and code review phases, it is required that the project be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. The following deliverables and milestone reviews are to be included:

A. Accessibility Program Document(s);

B. Completion of Schematic Design;

C. Completion of Design Development

D. At 50% completion of construction documents;

E. At 85% completion of construction documents;

F. At 100% completion of construction documents, if required, at the discretion of the Project Manager

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives and the University Accessibility Consultant as required by the Project Manager. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

The accessibility consultant will be included in the Accessibility Committee and the Tech Team in the above referenced reviews at the direction of the Project Manager, but at a minimum will be consulted during the Program Document Phase, at the completion of Design Development and at 85% or 100% completion of construction documents.

6. Design and Procedural Guidelines

First and foremost, no alterations may be made to buildings or areas on campus that make the campus *less* accessible.

The Designer must become familiar with the barrier-free requirements in the NJUCC and the sub-code ICC/ANSI A117.1, and should also be familiar with requirements promulgated by the Americans with Disabilities Act (ADA). Refer to Chapters 1.4 (Regulatory Agencies) and 2.9 (Site Planning) for additional information.

As identified above in Section 5, accessibility goals for each project shall be established during the programming or pre-schematic phase of each project. The University's goal for all addition and renovation projects is to provide accessible facilities in areas served by accessible entries and along accessible routes, and to provide those entries and routes whenever feasible as part of the project.

For all projects, new and or renovation, the Designer in conjunction with the Project Manager and the University Accessibility Review Committee, shall meet as required to review all project-specific goals at the pre-schematic phase of the project. The result of the meeting(s) shall include the Accessibility Program Document (See Appendix 2.1-3). This document shall serve to identify and coordinate access considerations with adjacent portions of the building(s) and campus. The content goal of the Accessibility Program Document shall include at a minimum, a review of the following project-specific accessibility goals:

- Connection of the new or existing building with the existing campus accessible routes and or transportation features. These include but are not limited to the Tiger Tram and the Campus Accessibility Map. (See Appendix 2.1-1)
- If applicable, modification of existing entrances to provide -accessible ingress
- Access to Primary Function spaces in the building
- Access to accessible Toilet facilities in the building
- Access to all public services in the building
- Identification of existing non-compliant conditions as related to the Project Program
- If applicable, workplace accommodations as appropriate for the building type
- If applicable, accommodations for Housing

For any project with exterior component(s), zoning or planning approval may be required. This process normally incorporates all accessible features such as exterior ramps, so the Designer should consult the Project Manager at the beginning of the project regarding this process as it can be time consuming and projects are often time-sensitive. Each Project Manager for a project which disturbs an exterior site in any way should meet with the University Architect to determine whether the extent of the disturbance requires formal review by the Landscape Policy Committee, or informal review by the University Coordinating Architect, or whether the University Landscape Project Manager simply needs to be informed so that appropriate site restoration can be undertaken after completion of the project. Refer to Chapter 2.9, section 6 for additional information.

The Designer is responsible (in consultation with the Project Manager) for preparing construction documents and applications for project review by local and State code agencies. Prior to submitting an application for project review, the Designer will meet with the University Code Analyst and will then prepare the project application forms, including (where applicable) the DCA's Project Review Application, the Application for Plan Review and the forms for local review. The Designer is to meet again with the Code Analyst to review the application forms and any supporting documentation.

Should a variation from NJACC code requirements be necessitated by the design of the project, the Designer will be responsible for preparing the application for relief, along with supporting documentation. A variation application will normally be prepared and submitted prior to completion of 100% Construction Documents. It should be noted that there is no process for, nor permission of variation from Federal Standards.

Designers should be cognizant of normal construction tolerances, and as such, exercise appropriate judgment in applying code minimum or maximum dimensions so that installed work will always fall within federal and state guidelines

7. Guidelines and Requirements for Documentation

The Designer shall provide documentation in adequate detail for accessible features such that will allow review agencies to approve the project. Typical information that is inadequately documented includes door sizes and specific related hardware, clearances required for accessible passages, bathroom layouts, operating features, mounting elevations of devices and equipment, etc. Proposed conditions shall be shown to comply with the requirements of the New Jersey Uniform Construction Code and its barrier free subcode, and with ICC/ANSI A-117.1 American National Standard for Accessible and Useable Buildings and Facilities, a referenced subcode to the NJUCC and the Federal standards as identified by the Americans with Disabilities Act.

Survey data (elevation/grade along paths; ground to floor differential; floor to floor measurements, change of level within a story) will prove useful for both design and review. Site plans need to show, at a minimum, the accessible parking spaces needed for the project along with a compliant wheelchair route to each accessible entrance.

8. Other Considerations for Accessible Design

Designers should review the following with the Project Manager and University Code Analyst, to ascertain approaches to accessibility and design features that might be unique to Princeton facilities which are above and beyond the requirements of the Code Requirements, (but never less accessible than that required by the Code Requirements):

Site Related Design Issues:

1. Parking
   - Code required signage
   - Slope and surface
   - Striping
   - Parking accounting
   - Van accessible requirements
   - Accessible connections to buildings and transit
2. Curb Ramps, Curb Cuts & Accessible Routes
   - Tactile surface as required
   - Changes in level and material
   - Handrails
3. Walking / Travel
   - Lighting
   - Site stairs and required handrails
   - Handrails
4. Exterior and Interior Ramps
   - Coordination of Cross Slope with proper drainage
   - Appropriate slope
   - Appropriate lighting
   - Ramp size and cross slope
   - Layout of landings
   - Handrails and associated reduction in clear width
5. Exterior Signage
   - Directional Signage (Wayfinding)
   - Refer to Section 2.8 Environmental Graphics

Building Related Design Issues:

6. Building Entrances
   - Automatic door openers – size & placement
   - Vestibule depth
   - Pull clearances in relation to wall thickness and recess of door
7. Floor Surfaces
   - Flooring material transitions
   - Thresholds
   - Slip resistance

8. Doorways
    - Door width
    - Clear floor space and arrangement
    - Push and pull clearances
    - Landings
    - Clearance related to designed furniture layout
9. Toilet and Bathing Rooms
    - Clear floor space
    - Plumbing fixtures
    - Toilet accessories
    - Toilet vestibule clearances
    - Mounting heights for towel dispensers
10. Elevators
    - Minimizing use of chair/stair lifts
    - Locations that maximize accessiblity to public/common spaces
11. Operational Building Components (See Appendix 2.1-2)
    - Mounting heights
    - Clear floor space
    - Reach range
12. Protruding Objects
13. Clear Floor Areas
14. Interior Signage
    - Braille Requirements
15. Handrails
16. Dormitory/Dwelling Units
    - Clear floor space
    - Furniture layout (fixed and movable)
17. Laboratory Equipment and Features
    - Emergency eyewash, sinks, fume hoods, etc.
18. Classroom Accommodations and Features
19. Business and Office spaces
    - Furniture
    - Clear aisleways
    - Fixed and movable furniture and equipment clearances
    - Path of travel & aisleways
    - Door and fixture clearances

END OF DOCUMENT

1. Introduction

Audio-visual systems and equipment play a fundamental role in classroom design at Princeton University. Designers must be aware of the technological requirements of the educational spaces they are working in, and must consider legacy and future technology needs as well. This document introduces some of the issues a Designer must consider in projects at Princeton.

Properly designed AV systems carefully integrate tel/data systems, room acoustics, lighting, floor, wall, ceiling, structural and architectural elements, seating configurations and sight lines, instructor and student interactivity, the established campus AV standards, and ADA and local code requirements. As such, AV system design should be considered a building system with the same level of planning and preparation of infrastructure as, for example, an HVAC system.

As with other major building systems, programming during the pre-schematic and schematic design phases will inform the project budget, user performance expectations, and the architectural room design. Because the installed costs of AV systems are significant (sometimes as high as 5% of the total construction budget), it is critical that an AV systems program and budget estimate be provided during the initial project budgeting phase.

If the program calls for video-conferencing (Media Services), "Rich Media" streaming equipment or video recording (Broadcast Center), many aspects of the room design will be significantly affected, including room acoustics, lighting design, tel/data specifications, seating, surface colors and finishes.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Classroom Architect — MacMillan Annex, 609-258-0845

C. Manager, Media Services — New South, 609-258-2240

D. Manager, Broadcast Center — Lewis Library, 609-258-3322

E. A/V Consultant — see Project Manager

F. Registrar — West College, 609-258-3361

G. Manager, OIT Network Installation — 171 Broadmead, 609-258-6015

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

A. Princeton University, Media Equipped Rooms
http://www.princeton.edu/mediaservices/PUonly/equipdrms0708.shtm

B. Princeton University, Academic Services website: http://www.princeton.edu/as/

	PDF	AutoCAD
C. Princeton University, classroom technologies website: http://www.princeton.edu/mediaservices/		
D. Audio Visual As-Built Requirements	Appendix 2.2–1	
E. Drawing of typical classroom media equipment cabinet, Office of Design and Construction	Appendix 2.3-2	Appendix 2.3-2
F. Audio Visual Touch Panel Layout	Appendix 2.2-2	
G. Teaching Space Master Plan	Appendix 2.3-4	
H. A/V Master List Spreedsheet	Appendix 2.2-3 (excel)	

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

E. NEC requirements for line voltage and low voltage power and signal

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities "Tech Teams", discipline review meetings will be held with respective University shops, University Project Engineers, and other

Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions may be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The role of the Tech Team review process is to confirm compliance with the current version of the Facilities Design Standards Manual and each respective section and associated appendices.

6. Procedural Guidelines

In consultation with Media Services and the Project Manager, a decision must be made about the level of AV and IT technology desired in the classroom/lecture facilities and in the building itself.

The A/V program should be initiated and developed during schematic design of the building or renovation project. A needs assessment should be performed with the Project Manager, and an evaluation of the effects those needs will have in terms of space requirements and infrastructure demands. In this phase, the Project Manager acts as the primary ‘client’ and source of information, with support from the Manager of Media Services. Depending on the level of connectivity, additional planning support may be provided by Office of Information Technology, O.I.T.

In developing the program, compile a set of display parameters for the project. The parameters should address room layout, optimal seating arrangement, lighting considerations, A/V display and control standards, IT connectivity and methods for mounting, storing and securing all equipment.

7. Guidelines and Requirements for Documentation

Along with the design documents, the Designer is to produce sufficient documentation to allow for code review of the project and for contract bidding of the work. A/V system information will have to be incorporated into the code review sets to an extent that allows the code review agencies to ascertain that the proposed work meets code requirements, where they apply. This typically will include all line voltage wiring and outlets, and diagrammatic layouts of any low voltage power and signal wiring and raceway that falls under the purview of the National Electric Code. Generally, the A/V consultant will provide the Electrical Engineer with this information, which is then included in the electrical drawings prepared for review and pricing.

See Section 1.4 (Regulatory Agencies) for requirements for code review and permits.

The A/V consultant will be expected to advise the A/E team on equipment and seating layout, site lines and floor slopes for optimizing viewing; screen location, elevation, size, and orientation; configuration of the projection booth, if one is to be included; and the interconnection of equipment and control locations. Coordination of the equipment with the structure and infrastructure is critical in producing a successful, sophisticated teaching facility. For clarity’s sake, separate documentation should be included in the construction documents for the A/V work. The equipment locations and power/control wiring, rack elevations, patch panel details, connector plate details and mounting requirements, control diagrams, etc. should all be shown on the A/V drawings. The A/V consultant will submit all conduit runs and sizes, floor- and wall-box locations and sizes, grounding requirements and details, and power requirements to the consulting Electrical Engineer for inclusion in the electrical construction documents in the general construction bid set.

Any information on the necessary separation of power and A/V line wiring runs should be included on both the A/V and electrical contract documents.

Clear information regarding responsibility for A/V system wiring and responsibility for installation of raceways and line voltage systems is critical. Electrical contract drawings and A/V contract drawings must be carefully coordinated by the consulting Electrical Engineer, the A/V consultant, and the lead design consultant.

Requirements for specific areas of documentation are as follows:

Documentation	SD	DD	50% CD	85% CD
AV Design Intent	X			
AV Basis of Design		X		
Space Requirements		X	X	X
AV Functional Diagram			X	X
AV Plans – *Include notes, symbols, finishes for the following: Equipment Rack, Media Equipment, Projection Screens, Data/Video Projecto, Instructor Location Receptacles, Stereo Loudspeaker, Overhead Projector, Other (Rich Meadia, Video recording, Cameras, etc.), Floor Boxes, Lectern, Media Equipment Cabinet, AV Touch panel Layout*		X	X	X
Coordination – *Coordinate AV Plans with the following: Lighting, HVAC, Acoustics, Security, Signage, Door Hardware*				X
Details				X
Outline Specifications		X		
Full-Length Specifications			X	X

8. Guidelines for Audio-Visual Equipment

A. General

1. Provide each A/V station (equipment rack, media cabinet, etc.) with a standard OIT wiring bundle – connections vary depending on tier (1-1/4” conduit, quad AC and 2 gang to OIT only). Floor box to be approved by Media Services, OIT, Project Manager, University Classroom Architect and AV Consultant.

2. Provide dedicated power circuits for A/V equipment. All AV power circuits including in floor boxes, at equipment racks, video projectors and flat-panel displays to be wired on SAME PHASE at the electrical panel serving the space. If requested by the AV consultant or Media Services, provide isolated grounding of AV circuits. Power circuits are to be 120VAC and 20A, minimum.

3. In small classroom/seminar configurations where data/video projection is provided, install desktop connections for A/V signal and control (AC power, data, laptop display and audio and AV control connections). The location will depend on the room configuration, the furniture size and layout, etc., which underscores the need for early planning of the A/V and furniture systems.

B. Requirements for equipment

Media equipment should generally be:

1. Simplified AV Classroom (Tier 1)

   The simplified AV classroom system is required where only laptop and occasional portable video equipment display is required:

   a. Ceiling-mounted data/video projector with security cable

   b. Motorized video projection screen

   c. Wall-mounted stereo loudspeakers

   d. Wall or floor box receptacles, conveniently located for:
      i. Laptop (VGA) and composite video (HDMI) and audio connection to the video projector
      ii. Laptop Ethernet connection to Princeton LAN (OIT) at instructor location
      iii. Duplex receptacle for laptop power via cable cubby
      iv. Floor box, if required, for OIT, laptop interface and quad AC

   e. Wall switch plate with projector and volume controls.

   f. AV control system connection to Media Service RoomView and eControl remote management systems.

   g. Optional, if requested:
      i. 3M Overhead projector, 3000 ANSI lumens minimum, with standard lens and rolling cart

2. Standard AV Classroom (Tier 2)

   The standard AV classroom system is required where permanent source equipment is required in addition to laptop and occasional portable video equipment display:

   a. Ceiling or cabinet mounted data/video projector with security cable

   b. Motorized video projection screen

   c. Wall-mounted stereo loudspeakers

   d. Millwork media equipment cabinet housing:
      i. AV equipment rack with storage drawer and AC surge protection
      ii. DVD player, region free type
      iii. CD player
      iv. Blu-ray DVD Player
      v. Stereo audio amplifier
      vi. AV control system/video router

vii. Security rack covers (i.e. program amp, AC surge protection)
viii. Auxiliary RGB
ix. Networkable AC surge protection

e. Instructor location receptacles, conveniently located for:

i. Laptop (VGA) and composite video (HDMI) and audio connection to the video projector

ii. Laptop Ethernet connection to Princeton LAN (OIT)

iii. Duplex receptacle for laptop power

iv. AV control system with small touch panel, programmed to conform to Princeton layout standard.

v. AV control system connection to Media Service RoomView and eControl remote management systems.
vi. Floor box for OIT, laptop interface and quad AC

f. Optional, if requested or appropriate:
i. 3M overhead projector, standard lens, 3000 ANSI lumens minimum, and rolling cart

3. Lecture Hall (Tier 3)

A lecture hall AV system is required where speech support sound system is required. A lecture hall configuration may include:

a. Lockable, sound-isolated projection booth with:
i. Independent HVAC zone and in-booth controls
ii. Dimmable track lighting over the counter
iii. Unobstructed sightlines to audience seating, front wall and teaching areas.
iv. Unobstructed sightlines for counter and ceiling-mounted projection equipment with 6' standing clearance in front of booth.

b. Audio visual equipment at front of room location (rack or lectern).

c. Programmable light dimming system with multiple preset scenes and luminaire zones coordinated with various front-wall projection screen and writing board configurations.

d. One or more data/Video projectors ceiling-mounted within the projection booth. The brightness and resolution of the display(s) are to be determined by the AV consultant or by specific request by the users.

e. Motorized video projection screen(s) flush-mounted in the ceiling. Wall-mounted high-performance stereo loudspeakers

f. Speech support sound system including wired and wireless microphones, distributed loudspeakers flush-mounted in the ceiling. Under-balcony loudspeakers may be required in some venues. Wireless microphones must include at least two handheld and two lapel/belt pack microphone combos on separate channels.

g. ADA-compliant assistive listening system, infrared type with full coverage to entire audience area with transmitters for 4% of seat count, minimum.

h. Rear-wall audio output receptacle

i. Millwork lectern configured to accommodate:
   i. Wired gooseneck microphone
   ii. Princeton-provided PC, mouse and keyboard (keyboard drawer required)
   iii. Laptop audio and video connections (VGA and HDMI) to the display system
   iv. Laptop power and data connections to the Princeton LAN (OIT)
   v. Intercom phone to the projection booth
   vi. Reading lamp
   vii. Clock/timer
   viii. DVD/VCR combo unit
   ix. AV control system touch panel
   x. FSR floor box(es) and detachable multi-pin connector(s) required for lectern connection to AV system
   xi. Wireless microphones, with designated storage location

j. AV equipment racks, housing:
   i. DVD player, region free type
   ii. CD player
   iii. Digital audio recorder
   iv. NTSC HD TV tuner
   v. Stereo and speech audio amplifier(s)
   vi. AV control system hardware
   vii. Video amplification, routing, and processing equipment
   viii. Audio output plate (and patching if requested)
   ix. Storage drawers
   x. Networkable AC surge protection
   xi. Wire management hardware
   xii. Blu-ray DVD player

k. AV control system with one or more large touch panels, programmed to conform to Princeton layout and graphic standards. In addition to the AV controls indicated in the Princeton standard, touch panels may require:
   i. Video preview capability
   ii. Computer viewing capability
   iii. Control of lighting presets, motorized projection screens, drapery, shades and writing boards, as determined by the Princeton project manager and AV consultant.

l. AV control system connection to Media Service Room View and eControl remote management systems.

m. 3M overhead projector, standard lens, 3000 ANSI lumens minimum and rolling cart.

n. Optional, if requested or appropriate:
   i. Subwoofer and/or surround sound loudspeakers
   ii. Infrastructure for 16mm film and 35mm slide projector(s)

iii. Digital document camera and cart
iv. Ceiling-mounted camera located in the ceiling above lab benches
v. Rich Media web recording and distribution system and associate a/v outputs
vi. Rear wall confidence monitors
vii. Auxiliary laptop, video, audio and AV control system connection locations'
viii. Video recording capability

4. Specialty Rooms (can be Tier 4)

   Specialty AV systems include spaces that do not fall into the types outlined above, and may include:

   a. Sound systems for theatrical or musical performance, background music, sound masking, paging, intercom, or other specialized applications.

   b. Display and sound systems for video conferencing, immersive or 3D visualization, security monitoring, portable use, outdoor events, and digital signage or recreational displays for student lounges, cafes, common areas, etc.

   Specialty systems may have significant impact on the physical and architectural design as well as the structural and electrical infrastructure and acoustical attributes of the space (and building) and will require significant planning and design coordination between the architect, structural, electrical, mechanical and audiovisual systems engineers.
   To avoid unnecessary architectural redesign expenses, these systems must be evaluated, programmed and budgeted during the schematic design phase.

5. Legacy Equipment

   Infrastructure for legacy equipment (rack space, audio/video interfacing and routing, power, conduit, junction boxes, and receptacles) must be provided where requested. This includes:

   a. 16mm and 35mm film projection

   b. 35mm slide projection

   c. Transparency overhead projection

   d. Multi-region or NTSC VHS videotape display

   e. Audio cassette playback

   Designers can inquire about the availability of legacy devices and support with the Princeton Media Services Department at (609) 258-2240.

6. Portable Equipment:

   Portable equipment systems dedicated to a facility such as cart-based projection and sound systems are discouraged. Portable equipment requires secure storage, is prone to theft and abuse, and requires user expertise or technical support to operate. As such, portable equipment may fall into disuse and is a generally poor investment.

   Where no alternative exists, the Princeton Project Manager must assure that support personnel are available to deliver, remove, manage and maintain the equipment as needed by the users.

C. Projection Rooms (Tier 3/4)

During Schematic Design the layout of any projection rooms should begin. As the project scope is developed, A/V equipment should be planned and enumerated, and the projection room developed as well.

Except where room configuration prevents adequate space allotment to a projection area, standard (front) projection is preferred to a rear projection system.

Projection rooms become the operational center of a lecture facility, and virtually all controls for systems should be in (or duplicated in) the projection room. Critical controls must be near at hand to the projectionist. The projection room should include the following systems and characteristics:

1. Lighting and controls

a. The projection room itself is to have two separate lighting systems, an energy efficient system (lighting levels at floor level per IES and PU Standards) for work in the room, and a dimmable system for use during projection. The dimmable system is typically a track lighting system for maximum flexibility. Controls for this system need to be near the projectionist's work position.

b. The main dimming controls for the lecture room need to be in the projection room, again near to the projectionist's work position. The University standard for lecture room dimming controls is Lutron's GraphicEye system.

The dimming panel itself need not be in the projection room and in fact will add to the space required for the room and to the heat load in the room. If the dimming panel *is* installed in the projection room, code-required clearances must be provided, without impinging on space required for projection equipment.

Additional locations for lecture room dimming controls are near the lectern where pre-set scenes and an on/off control should be provided, and at all entrances to the room, where on/off controls should be installed.

The need for an emergency override switch for the lecture room system should be reviewed with the University's code analyst; one location for such an emergency switch should be at the projectionist's work station.

2. HVAC and controls

The projection room needs adequate ventilation and cooling, both for the equipment and for the operator. If feasible, the room should be on its own zone, with its own controls. Cooling load calculations should include all equipment, panels, and controls, and allowance for two operators.

3. Electrical provisions

<u>All</u> conduit and raceways for power and line/data/signal necessary for the A/V system are to be provided and installed by the electrical subcontractor as part of the general

construction for the project.

Circuiting for projection room and equipment should be dedicated to that purpose. A separate power panel for the room, placed in the room, should be considered. Circuits should be provided with isolated ground to avoid the possibility of interference from any other source in building.

The projection counter should be outfitted for its full length with plugmold, either mounted above the counter or below with grommets or slots for equipment cords.

Controls for lighting, screen, any masking, and any window shades or draperies should have manual overrides, both in booth and at speaker's position.

If occupancy sensors are included, they should be designed to coordinate with room use.

4. Connectivity (dependant on the equipment specified)

   a. Ethernet connections to include, two at each equipment rack, two at the counter and two at the lectern.
   b. Campus TV connection for each TV tuner in projection room (Tier 3/4).
   c. Campus telephone in projection room, near operating controls.

5. Glazing

   Standard plate glass is to be used for projection room wall, sized to accommodate all equipment in a side-by-side configuration. Tinted glazing should not be used, due to complications with color rendition of projected images. Glazing should be sloped to prevent reflection back to projectionist, without causing undue refraction (approximately five degree slope toward projector).

6. Finishes

   a. Flooring: rubber tile is preferred; carpet is not an appropriate finish.

   b. Ceiling: acoustic tile is preferred. Color may be muted, but not black. Lighting used during projection should be positioned to avoid affecting the projected image or the lecture space, and so reflection from the projection room is minimized (reducing the need for dark colors in the projection room).

   c. Walls: as with the ceiling, color may be muted, but not black. Light reflection should be controlled during projection. It should be remembered that the greater proportion of time in a projection room will be spent in setting up equipment and presentation material and in maintaining equipment, so it is important that the room function well as a work space as well as a projection space.

   d. Counters: counters should be wide enough to accommodate all planned equipment set up side-by-side. Consideration should be given to the need for additional equipment in the future. Counters must be deep enough to accommodate the equipment installed on them, with additional depth to allow for power plug configurations and any A/V connections and wire runs. Counters should have provisions incorporated for wire management, including grommets for wire penetrations, or finished wireway slots.

Counters *must* be strong enough to support equipment, and should be durable enough to support those who might lean on it during equipment installation and wire-up. Counter must be strong enough to prevent any shaking of image on screen during projection.

Provide open storage under counter; provide adequate storage at or near counter for equipment operating manuals.

7. Equipment rack

   Provide equipment racks to hold all AV equipment, routing and distribution, patch panels, monitoring, storage drawers, etc. OSHA clearance of 30" behind stationary racks to allow access for service and maintenance is required.

8. Miscellaneous features

   a. Monitor speaker (sufficient to be heard over projector fan noise) so projectionist can monitor sound quality in lecture room; speaker should be driven by ceiling microphones, speech and program sources.

   b. Coordinate equipment security with Media Services including specific lock and keying requirements.

D. Lecterns

1. Sufficient area for open three-ring binder, microphone, lighting controls (if not wall mounted), A/V and projection controls or velcro-mounted remote, laser pointer, aimable lectern light and dimmer, clock timer, water glass or bottle. A duplex power outlet should be mounted on the lectern, with a grommetted opening on the lectern top to allow access to the outlet if it is mounted below.

2. Connectors for all accessories including designated storage locations.

3. Provisions for lectern computing (OFE) where room has A/V control system.

E. Power, A/V, and data boxes

Floor boxes are typically used to provide power and A/V connection to free-standing furnishings such as lecterns and conference/discussion tables. To provide maximum flexibility, several floor boxes are often provided to allow a variety of presentation configurations at the front of a lecture facility.

Because of the need to separate line voltage outlets from low voltage and signal wiring, and because of the need for maximum flexibility, the floor boxes are often quite large. Space must be allowed within the box for the various plugs and connectors for power, A/V, and data; A/V connections will be terminated in the floor box. The box must be deep enough to allow the cover to close over the connectors and the necessary strain-relief fittings needed on wires leaving the floor box. The requirements for services to the floor boxes should be reviewed with Media Services, OIT, and Facilities Engineering to insure that the correct type of box and the configuration is specified and shown on electrical contract drawings.

The Designer must also review the need for physical separation of line and voice wiring conduit runs from those for power or devices that might cause interference across the lines. This separation requirement, and the proper floor box configuration and location, must be coordinated in design and construction, to guarantee proper system operation at occupancy.

F. Connectivity

The Designer should also be aware of, and should consult with the Project Manager on, the need for providing power, data, and A/V connections at the instructor location. Because of the complexity of the A/V requirements for lecture facilities and projection rooms, it is mandatory that a coordination meeting be held with all trades at construction kickoff to review the projection room layout and floor box locations. The meeting will be set up by the construction manager, and attended by general construction, HVAC, and electrical job superintendents, with the University's Project Manager, and representatives of the Architect, the Design Engineer, and the A/V consultant.

The trades will produce coordination drawings for the projection room and the presentation end of the room, under the construction manager's oversight. A second meeting will be held just prior to the start of rough-in for the systems, with the same parties in attendance.

9. Requirements for Testing and Personnel Instruction

The AV Consultant is to submit the AV Master List Spread Sheet prior to testing (see appendix 2.2-3)

A final acceptance test will be conducted by the A/V consultant, with the installer and a representative of Media Services present during testing.

Initial training of personnel in the operation of A/V equipment and systems will be conducted by the installer; subsequent training will be provided by Media Services.

Until these items are completed and accepted by the University, events are not to be scheduled in the space.

10. Requirements for As-Built Drawings and Project Closeout

The A/V consultant is responsible for checking the accuracy of as-built drawings prepared by the systems installer, the Electrical Subcontractor, and the Construction Contractor.

The A/V consultant is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the A/V installer, the Construction Contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. The A/V consultant will verify during these regular meetings that the contractor is maintaining record drawings to convert to as-builts.

See Appendix 2.2-1 and Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

Classrooms are the heart of Princeton University's mission. The classroom Designer must be aware of the needs of the particular users, the ways the classroom will and might be used, and the technical needs of the department involved and the technical requirements of the space itself.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance Department, or as applicable).

B. University Classroom Architect — MacMillan Annex, 609-258-0845

C. Registrar — West College, 609-258-6191

D. Manager, Media Services — New South, 609-258-2240

E. Chair, Faculty Committee on Classrooms and Schedule — (through Project Manager)

F. Manager, OIT Network Installation — 171 Broadmead, 609-258-6015

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Illuminating Engineers Society of North America, website	www.iesna.org	
B. Princeton University, media Equipped rooms	http://www.princeton.edu/mediaservices/media-rooms/	
C. Drawing of Typical Lecture Room Lectern, Office of Design and Construction	Appendix 2.3-1	Appendix 2.3-1
D. Drawing of Typical Classroom Media Equipment Cabinet, Office of Design and Construction	Appendix 2.3-2	Appendix 2.3-2
E. Audio Visual Touch Panel Layout	Appendix 2.2-2	
F. 2008 Teaching Space Master Plan	Appendix 2.3-4	

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. NJUCC subchapter 7 for requirements for accessibility

E. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

F. See Section 1.4 Regulatory Agencies for additional information

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. During the Programming Phase

B. Completion of Schematic Design;

C. Completion of Design Development

D. At 50% completion of construction documents;

E. At 85% completion of construction documents;

F. At 100% completion of construction documents, if required, at the discretion of the Tech Team

Note that at 85% completion the Designer should submit representative lighting calculations for review, including horizontal calculations for instructional rooms, and vertical readings for chalkboards, etc.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented.

The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

Early in the programming phase of the project, the Project Manager will review the proposed project with the University Registrar. Often before inception of a project, an academic department will have made requests and recommendations to the Registrar, so that there is a clear idea of how many classrooms will be needed, the sizes, and the types. The Faculty Committee on Classrooms and Schedule, working through the Provost's Office, has University-wide responsibility for classroom space on campus, and will provide oversight in the programming phase. The Project Manager, with the Designer, should meet with the Registrar to confirm the requirements for classroom space in preliminary programming.

The Project Manager remains the Designer's primary contact and source of information. The Project Manager will involve other University sources in the project, including the University Classroom Architect in the Office of Design and Construction, the project representatives for the Facilities Engineering Department, and Media Services and OIT personnel.

Meetings with the academic department/end user, Registrar, Media Services and the University Classroom Architect for the project will be arranged by the Project Manager.

7. Guidelines and Requirements for Documentation

Along with the Design Drawings, the Designer is to produce sufficient documentation to allow for code review of the project and for contract bidding of the work. See Section 1.4 (Regulatory Agencies) for requirements for code review and permits.

In addition to the documentation required for the permitting and construction of the project, the Designer will (if specified in the contract for services) provide bidding documents for fixed classroom furniture and for the audio-visual systems in the building. These should be separate documents prepared with the furniture and A/V consultants and coordinated with the electrical contract documents (for conduit runs, junction and floor box selection and placement, lighting, power, etc.). See Sections 2.2 (Audio-Visual Standards) and 2.5 (Furnishings, Fixtures, and Equipment) for additional information.

Requirements for specific areas of documentation are as follows:

Documentation	SD	DD	50% CD	85% CD
Classroom Design Intent	X			
Classroom Basis of Design		X		
Space Requirements		X	X	X
Projection Booth - *Coordinate requirements early*	X	X	X	X
Classroom Plans – *Include notes, symbols, finishes for the following: Furnishing, Equipment Rack, Projection Screens, Chalkboards, Lighting, Floor Boxes, Lectern, Media Equipment Cabinet.*		X	X	X
Coordination - *Coord. Classroom Plans with the following: Lighting, HVAC, Acoustics, Security, Signage, Door Hardware*				X
Details				X
Outline Specifications		X		
Full-Length Specifications			X	X

8. Guidelines for Classroom Design

A. General Approach

Classrooms in the project should be the primary focal point of the Designer. Meeting the educational goals of the academic department and those for the project should be the guiding principle for the Designer.

Classrooms discussed under this section will be typical instructional and lecture spaces. Specialized facilities, such as laboratory classrooms, should be reviewed with the Project Manager and the academic department/client to determine programmatic needs and parameters.

There are different requirements for classrooms depending on whether seating is to be fixed or movable, and also depending on the educational approach to be used in the classroom. Detail is extremely important to the success of a classroom space; it is incumbent upon the Designer to ascertain the needs of the various classroom types in a project, to thoroughly understand the requirements for the systems to be incorporated into the classrooms, and to detail the space around those needs and requirements.

Area requirements are affected by the teaching style anticipated for the room; the Designer must ascertain and understand the users' needs. Is the room to be used in a straight-on instructional style?; is it to be an interactive classroom?; is it to be a collaborative arrangement?; are preceptorials held in the space?

B. Space Requirements

1. Area/Volume

As a rule of thumb, if an instructional space is to have fixed seating it will require 15 square feet of space per student (not including space required for A/V or other specialized equipment). If a classroom is to be provided with moveable seating the minimum area allowance per student rises to between 20 and 25 square feet for typical instructional space and between 25 and 30 square feet for seminar or preceptorial use. (In preliminary design it may prove useful to establish *target* standards of 25 to 30 square feet per student in typical classrooms and to aim as high as 50 square feet per student in media-rich facilities.)

If possible, instructional rooms should have a minimum ceiling height of 10'-6". This will allow inclusion of indirect lighting in the space, with proper throw for the fixture and clearance from the floor. Larger rooms should allow for proper proportioning of rooms, of course, for aesthetic as well as acoustic considerations.

2. Layout

a) Instructive: generally designed with seating facing a podium, lectern, or instructor's desk;

b) Collaborative: laid out in an open circular, elliptical, rectangular, or U-shaped fashion;

c) Interactive: laid out in a variety of shapes, with groupings of two or more seats at a common workstation.

Allow adequate space in the front of each classroom for the instructor and for overhead projection.

3. Location/Orientation

Classrooms should not be isolated in a building but should be near or on public spaces such as lobbies and major hallways. Amenities such as bathrooms should be nearby.

Classrooms should be oriented to take advantage of natural lighting (with consideration for controlling sunlight and glare). Operable windows are desirable but must be in conformance with the intent of the project and space, and must be accounted for in the HVAC design.

It is preferred to have room entrances located away from the front of classrooms; students arriving late should be able to sit down without disrupting class in progress. In large lecture halls, the use of an entry vestibule is desirable to control external noises and light.

C. Finishes

Acoustic considerations should be the primary concern in finishes for classrooms. Acoustic control between classrooms is also important, so that sound transmission classification (STC) ratings of structural components and finishes should be taken into account when selecting materials and systems.

1. Walls and Doors
There is no 'standard' wall material or finish, but the Designer must remember that the facility needs to be finished in a way that allows for normal cleaning, upkeep, and maintenance. See Section 4.9 (Painting) for additional information. Chair rail trim is encouraged where moveable tablet-arm chairs are to be used, or where stacking chairs provide extra seating in a room.

The Designer should attempt to incorporate breaks, reveals, or other architectural details to divide large expanses of painted surface, particularly in the vertical direction. This is especially true in high traffic areas, areas using high pigment paints, or locations that are especially subject to abuse.

Doors into classrooms should be provided with vision panels to allow students to see if room is in use.

2. Floors

In smaller classrooms, it is common to use vinyl composition tile, linoleum, or carpet. Proximity to the building entrance and out-of-doors may affect the choice between carpet or tile. Carpet is common in lecture rooms; the Designer must detail material interfaces where carpet meets floor, where carpet runs to or under seating, and at fixed equipment such as lecterns (with A/V and power outlet receptacles), etc. The Designer must make an informed decision based on the use of the space, anticipated traffic patterns, type of substrate, frequency of cleaning and maintenance and ease of replacement; all these factors must be taken into consideration.

In larger spaces, detail the location of carpet seams carefully to avoid the possibility of ragged edges and subsequent problems with upkeep and excessive wear. If a section of the carpet must be replaced, the seaming should not be immediately obvious.

3. Ceilings

Concern for proper acoustics should prevail in selection of ceiling materials. For acoustic tile ceilings, the overwhelming preference is for suspended lay-in ceilings, 2x2 or 2x4. Concealed-spline ceilings should not be specified, unless there is a special condition that must be accounted for; review with the Project Manager and the Director of Maintenance before including concealed-spline ceilings in a project. Generally, concealed spline ceilings are appropriate only in locations without ceiling access requirements.

With the increasing importance of A/V and data systems in classrooms (and the emergent nature of the technologies involved), the Designer is encouraged to create terminal points that are as flexible as possible. Serious consideration should be given to under-floor access for boxes serving A/V, data, and power at locations such as lecterns. If the classroom is above grade level, this access can be provided from the ceiling below, provided the ceiling is not constructed with fine finishes which cannot be disturbed.

D. Furnishings

1. Seating

Seating should be relatively comfortable, should be durable and easily maintained, and should be replaceable, without extraordinary effort.

Classrooms will typically be fitted with tablet arms; the tablets should be oversized, if possible. Seminar seating may be armchairs or be armless, depending on space constraints and departmental preference. Fixed lecture seating will typically include retractable tablet arms, preferably oversized. Laminate facing is preferred on the tablets (not veneer), and painted edges to exposed plywood. At least 10% of tablets should be positioned for left-hand use.

When using fixed furniture, include required spacing provisions from the New Jersey Uniform Construction Code. Leave spaces, with companion seats, to meet the requirements of New Jersey's barrier-free subcode, and attempt to comply with federal ADA requirements. See Section 1.4 (Regulatory Agencies) for additional information. Provide 5% "Attic stock" for tablets, brackets, seat springs, etc.

2. Tables

Tables may be fixed or movable, depending on the way any required power or data connections are to be handled. Tables that integrate power and data must be thoroughly reviewed by the University's OIT office and approved prior to inclusion in a project. Method of delivering power and data to tables, and the distribution details involved, must also be reviewed with OIT. Tables that include infrastructure wiring (i.e.: instructors table) must be mounted to the floor.

For seminar or conference use, provide a minimum of twenty-seven to thirty inches of table length per person. Typically a residential college seminar room requires seating capacity for 15 students plus one instructor (at head of table). For department seminar rooms, the requirements may be more lenient.

3. Lectern and Equipment Cabinets

While the lectern may be seen by the Designer as a focal point in a small lecture facility and as an interesting design opportunity, first and foremost the lectern must serve its function. Likewise, the projection booth for a lecture facility, and the equipment cabinet provided many classrooms must operate properly. See Drawings for lectern, and for equipment cabinet, Appendices 2.3-1 and 2.3-2. See Section 2.2 (Audio-Visual Standards) for additional information.

If applicable, make sure the lecturn/equipment cabinet accomodates the wiring and ventilation requirements of all equipment being housed within. Coordination of all cutout within the lecturn or equipment cabinet is important. Coordinate with Media Services as well as the AV Consultant during design as well as shop drawing phases of the project.

4. Chalkboards, marker boards, display boards

Requirements for instructional boards should be reviewed with the Project Manager, the Architect/Planner for Classrooms, and with the academic department or Registrar's Office. The Designer must coordinate the locations and installation of chalkboards with any projection screens planned for the project. Installation of chalkboards is the standard practice in classrooms, seminar rooms, and lecture halls. Markerboards cannot be properly maintained by the Registrar's Office, and thus are generally not used.

A typical coordination sketch should be prepared, including switch locations for lighting and screens, and any A/V controls and data and communications outlets.

Fixed boards are a non-proprietary product, and can be provided by Claridge, Greensteel, etc. Sliding chalkboards are to combine a fixed board and a single slider (unless otherwise directed by the Project Manager) and are to be supplied by Educational Equipment of Ohio.

Black or charcoal color is standard; provision of map rail is to be at direction of Project Manager.

5. Projection screens

Screens for video, data, slide, and film projection should be specified by the Audio/Visual consultant, but should be included in general construction specifications for installation by the builder. Screen location, quantity and size must be coordinated with chalkboards and pendant light fixture mounting heights.

6. Window treatment

   Review need for sunlight filtering in classrooms, and for room darkening for projection. Standard room darkening shades are produced by Mecho Shade, and may be manual or motorized; if motorized, coordinate controls with A/V equipment locations and instructor's furnishings.

E. Lighting

1. General

   Lighting should be even across the room, with a maintained light level per IES and PU Standards on the work surface. A combination of lighting zones, dimmable fixtures, and controlled daylight in the room is ideal. Fixtures should control glare and should not produce veiled reflection in the room or on equipment. Indirect/direct fixtures are favored.

   If a room is multi-functional, take into account in the lighting design the various tasks that are to occur in the different sectors of the room.

   If a space has a ceiling above 12' in height, the project team shall review all access requirements for light fixture maintenance and incorporate any fixed requirements such as access panels, cat walks, etc. into the documents.

   Emergency lighting shall be installed in each classroom with occupancy of more than 50 people.

2. Chalkboards

   Chalkboards should be lit to produce lighting levels per IES and PU Standard, across the board, without glare or bounce.

3. Special Features

   Much of the public space lighting on the University campus is controlled by occupancy sensors. Typically, at least one light in a space will not be controlled by the sensor but will be on an emergency circuit (review this requirement in rooms that are to be totally blacked out for projection). The occupancy sensor is to be wired so that it can be bypassed with a conventional light switch. If occupancy sensors are to be included in a project, the operation should be carefully coordinated with the room use.

   Review the need for daylight control and for blackout capability in classrooms.

4. Lighting Types

   For instructional spaces (as with interior lighting in general) energy efficient lighting is standard for Princeton. Indirect/direct lighting is preferred for its even quality. For any needed downlighting or highlighting, energy efficient fixtures are preferred over incandescent.

   To minimize the need for storing a large variety of replacement tubes and bulbs, Designers should attempt to use two- and four-foot tubes as a standard, and PL tubes with a common base configuration throughout a project.

If fluorescent tubes are selected, consider similar lamp types and bases. Programmable start electric ballasts are standard and, where applicable, should be dimmable to 10% without flickering.

5. Lighting Controls

In general, the Designer should attempt to provide for separately-controlled lighting over the seating area of a classroom or lecture room, over the display end of the room, and for presentation areas such as lecterns, podiums, daises, etc. Lighting at the display end should be zoned for multi-media presentations allowing for a variety of chalkboard and projection scenarios.

Adequate lighting for safety should be controlled at entrances to rooms, with system controls at the instructor's position and at the A/V operator's position, if the room is provided with fixed equipment. Lighting should be zoned, where applicable for increased media sophistication. Lighting over seating should be sufficient for taking notes during media presentations.

The Designer should review the need for lighting control with the Project Manager; the standard control is a Lutron GraphicEye, typically providing four preset lighting scenes.

F. Power

The design team is to provide adequate power for general use and for audio/visual equipment needs in classrooms. The Designer should also be aware of, and should consult with the Project Manager on, the need for providing power and data outlets at each fixed seat in new and renovated lecture facilities and to classroom furniture such as seminar tables.

G. Equipment

Audio/Visual equipment should be specified by the Audio/Visual consultant; the Designer must coordinate construction Drawings - Architectural, Electrical, and HVAC in particular - to provide the necessary and proper shell and support for the physical installation of equipment. Special care should be taken to provide adequate and 'clean' power for equipment, flexible and effective raceway and conduit for A/V, data, and communication lines throughout the facility, code-required clearances and proper operating areas for equipment, and adequate cooling and ventilation for equipment and operator loads.

Control of lighting and any light control features within the classroom is also important; see Section 2.2 (Audio-Visual Standards) for information.

H. HVAC

The design team must provide adequate heating, cooling, and fresh air to classroom and lecture spaces, and must do so without intruding on the classroom mission. Careful selection and placement of equipment, and attention to the design of delivery systems are important to the success of instructional spaces.

I. Acoustics

Design team should use ANSI standard S12.60-2002 titled “Acoustical Performance Criteria, Design Requirement, and Guidelines for Schools” as a guideline. This benchmark for acoustical performance is as follows:

CLASSROOMS	Background Noise Level	Reverberation Time at 500 Hz, 1 kHz, and 2 kHz
Less than 10,000 ft^3	Less than 35 dBa	Less than 0.6 seconds
Between 10,000 And 20,000 ft^3	Less than 35 dBa	Less than 0.7 seconds
Greater than 20,000 ft^3	Less than 35 dBa	Not applicable

Regarding background noise levels, the following limits should be adhered to:
< L35 dBa new classrooms, NC 30.
35-42 dBa□ renovated classrooms, NC 30-35.

J. Security

Review the need for security control of classrooms with Project Manager. The University employs access control, as part of a campus-wide system, at the entrances of many of its buildings, and to some interior spaces as well. Consider A/V equipment requirements when reviewing classroom security.

K. Signage

Determine the signage requirements for the space. Note the University has a no eating / drinking policy for its classrooms and should be taken into account for the signage package.

9. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the construction contractor and any systems installer.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

Princeton University has over forty undergraduate dormitory buildings, built between 1886 and the present in a wide variety of Architectural styles and configurations. There are six residential colleges on campus, designed for freshman and sophomore housing and social accommodations. The residential colleges account for more than half the undergraduate population, with over twenty-four hundred bed spaces in twenty-four dormitories. Upperclass housing accounts for the balance of the undergraduate dorms, with just over two thousand five hundred bed spaces in twenty one dormitories.

Graduate student housing consists of approximately two hundred bed spaces within the original Graduate College. The complex known as the New Grad College houses an additional two hundred thirty-eight students. There are also a number of wood-frame housing annexes for approximately eighty-eight graduate students and thirty upperclass students.

The Designer should be aware that undergraduate dormitories are occupied by students nine months of the year, while graduate dormitories are occupied year-round. Undergraduate dormitories also provide housing for summer events and sports camps, so access for survey and planning purposes must be coordinated with the Housing Office and Conference Services during summer months. (Note that italics will be used to indicate statements that apply only to dormitory renewal design work.)

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst	MacMillan Building, 609-258-6706
C. Associate Director for Student Housing	New South Building, 609-258-2517
D. Manager for Graduate Housing	New South Building, 609-258-2691
E. Director of Housing	New South Building, 609-258-3469
F. Deputy Director of Housing Operations	New South Building, 609-258-1908
G. University Architect	MacMillan Building, 609-258-3356
H. Director of Facilities Engineering	MacMillan Building, 609-258-5472
I. Associate Director of Grounds and Building Maintenance	MacMillan Building, 609-258-3591
J. University Fire Marshall	200 Elm Drive, 609-258-6805
K. CAD Archivist	MacMillan Building, 609-258-1838

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Interim Fire Code Reports (for each building, by various consultants	Consult Project Manager	
B. Existing Conditions Reports (for buildings in the dorm renewal process, by various consultants)	Consult Project Manager	
C. Dormitory Renovation Study, Volumes I & II, dated January 2000	Appendix 2.4-1	
D. Standard 36 Month "PERC" Schedule, Office of Design and Construction	Appendix 2.4-2	
E. Princeton University Master Technical Specification for Fire Alarm Systems to be installed in Non-High-Rise Residential Buildings, Wayne Moore, P.E., of Hughes Associates	Appendix 3.4-1	
F. Princeton University Standard for Lighting Levels, Facilities Engineering Department (FUTURE)	Appendix 3.5-1	
G. Record Drawings of University Buildings	Consult CAD Archivist	Consult CAD Archivist
H. Memo: Standard Dormitory Paint Colors (dated 1/18/2000, by the Committee for Standard Dormitory Paint Colors	Appendix 2.4-3	
I. Fire Alarm / Signage Nomenclature Spreadsheet Sample, Princeton University	Appendix 2.8-2	
J. Plan of Minimum 4-person suite size for a University Dormitory. 2 sheets (dated 04/15/2004).	Appendix 2.4-4	Appendix 2.4-4
K. Terrazzo Shower Base Installation Detail 4.13-3	Appendix 4.13-3	Appendix
L. Typical Full Service Graduate Student Suite Kitchenette	Appendix 2.4-5	Appendix 2.4-5

M. PU Fire Extinguisher Use Matrix Appendix 3.8-2

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

E. International Building Code (in edition adopted and modified by NJUCC); dormitories are typically R-2 use group

F. NFPA 101 - Life Safety Handbook

G. NFPA 13, 13R - Sprinkler System Installation Guidelines

H. NFPA 72 - National Fire Alarm Code

I. See 1.4 (Regulatory Agencies) for additional information

5. Review Guidelines – General

Initial planning and preliminary design will be conducted thru the Office of Design & Construction with the Housing Office. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards.

For dormitory renewal projects, planning begins at least two years in advance of construction. Planning for new construction may take a similar course. As the project moves toward the construction documentation and code review phases, it becomes important that the project be reviewed with the Housing Office, the Engineering Department, the Grounds and Building Maintenance Department, the Office of Design and Construction, Office of the University Architect, Conference Services, the Department of Public Safety and to any department affected by the work.

For new dormitory projects, and for the dorm renewal program, each project has a specific review committee. The committee is made up of representatives from the Office of the University Architect, Office of Design and Construction, the Facilities Engineering Department, Grounds and Building Maintenance, the Housing Office, and the office of the Vice President for Facilities. Additionally, committee members come from the Office of the Dean of Undergraduate Student Life and from the Office of the Vice President and General Counsel for the University.

Meetings are held regularly during the pre-construction phase of a dormitory design project. All decisions regarding programming and design require a consensus of the full representation of the review committee.

After preliminary design is complete, additional departments may be brought into the design development and construction planning phases. Departments such as Public Safety, Dining Services, and Building Services may be included in the review process, and may act as in-house consultants for specific aspects of the project.

During this pre-construction phase mockups are constructed (and may include complete full-scale models of rooms) to aid the review committee in selecting room finishes and accessories, window types, light fixtures, heating units, piping enclosures, etc. Every visible finish and system component is designed, constructed, tested, and reviewed. Mockups are also used to test the effectiveness of cleaning methods on building stone and other finishes to remain in place. A significant amount of effort is necessarily put into the design and documentation of mockups, for they are the tools that lead to final design decisions and to the aesthetic that ultimately forms the project. Mockups are typically constructed during the summer of the year prior to the project's construction start date, and lead into final construction documentation for the project.

During the process of design, plans are to be submitted for review by Facilities departments at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, Housing, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines - Approach to Regulatory Agencies

During preliminary design, Designer is to consult with University Project Manager to ascertain the probable need for site plan and zoning approvals. Altering the outside of the building often triggers the need for community review. Exterior alterations to buildings may require local zoning/planning review and approval. Consult with Project Manager and see description of zoning and planning issues in Section 1.4 (Regulatory Agencies).

During the early stages of design the Designer is to consult with the Project Manager and the University's Code Analyst to define code strategies and to discuss any code interpretations that might affect the project. Some design decisions may require relief from strict code requirements as interpreted by the State and local code reviewers. The design team is responsible for formulating the relief request (variation or variance) and providing support documentation for the request, including any alternatives for providing life safety in lieu of code conformance.

7. Procedural Guidelines - Code Review Applications and Submittals

Prior to submitting an application for project review, the Designer will prepare the project application forms, including (where applicable) the DCA's Project Review Application, the Application for Plan Review and the forms for local review. The Designer is to meet again with the Code Analyst to review the application forms and any supporting documentation.

All submissions made to the Department of Community Affairs or to the Department of Fire Safety are to be channeled through the University's Code Analyst. Likewise, all communications during the review process are to be made through the Code Analyst; this individual acts as liaison between the University and the State construction agencies, and is responsible for continuity in the applicability of code issues from project to project. It is imperative that this continuity be maintained.

Insofar as is practicable, only 100% complete documents are to be submitted to DCA for review. The intent is to prevent needless and time-consuming review by the State agency, and review comments brought on by incomplete information. The Designer is to refer to the plan submission checklist in the Application for Plan Review; see Section 1.4 (Regulatory Agencies).

8. Guidelines and Requirements for Documentation

Along with the design documents, the Designer is to produce sufficient documentation to allow for code review of the project and for contract bidding of the work. Preparation of contract specifications is to be done in conjunction and in cooperation with the University's Contracts Office; the "front end" of specifications is typically prepared by the Contracts Office, and integrated with the project specifications by the Designer.

See Section 1.4 (Regulatory Agencies) for requirements for code review and permits, including the organization of construction Drawings and documents for timely release of permits.

9. Considerations for Dormitory Design

A. General Approach

1. In new construction and in dormitory renewal projects, providing opportunities for interaction between students and facilitating the development of a feeling of collegial unity is encouraged. However, the mix of social spaces with living spaces, the density of bed spaces in living spaces, the inclusion of educational spaces in a dormitory, and the type and number of support/utility spaces in a dorm, along with other design considerations, is highly dependent upon the purpose the dormitory serves.

   In residential colleges, the density within units is typically higher; a higher percentage of space may be given over to social and educational programs within the building; and service-type spaces may be shared among a group of buildings. Consideration is given to the provision in each college of communal study space, lounge, kitchenette, game and vending room, and a variety of arts-related rooms such as theater, music room, and darkroom. The design review committee will provide direction for the Designer regarding the mix of spaces.

In upperclass dormitories the individual's living space is typically larger (in terms of square feet per occupant) than in the residential colleges, and providing a variety of living arrangements is a desirable goal. Single-occupancy rooms are popular, with two-room doubles and three-room quads sought after as well. Students are typically self-directed in their studies at this point and, for some, privacy for work is an overriding concern. Along with providing a wide choice of living arrangements, each upperclass dormitory will typically contain a full complement of service and support spaces such as laundry, kitchen, and lounge.

The Graduate College dormitory buildings at Princeton serve much the same function as the residential college dorms, although the independence and relative maturity of graduate students affect design considerations.

2. The initial step in a dormitory renewal project is to determine a preliminary scope of work and to conduct a full-scale survey of the building. This survey should be performed after discussions with the Project Manager and the University's Grounds and Building Maintenance Department, to assemble available information on systems in the building, and to gain insight on any known defects in a building. In interviews prior to surveying a building, the Designer can be advised of any environmental issues that might affect the project; see section 10 below for additional information on this subject. A report on existing conditions is produced from the survey, including information on the building finishes, envelope, and systems. The report will be presented to the review committee, which may make suggestions for revisions or modifications before a final version of the report is produced.

   The report is used as a tool to develop the building program and to guide the professional in the schematic design process. Input from the design review committee is critical at this point in the process. The committee will prescribe the desired bed count, the mix of singles, doubles, and quads, the bathroom fixture ratio, etc. Additional survey work may be needed to measure critical areas after initial planning and design is completed. Some core samples of building systems may be required to ascertain existing construction, and investigative demolition might be carried out in this effort.

   Because space is at a premium in dormitories, it is important during the early phases of design that thought is given to "capturing" underutilized space in the building -- basement or attic space that can be economically converted to living or social spaces without the cost of constructing foundation and shell.

3. After schematic plans are approved by the review committee, the Designer is to provide a furniture layout plan, which will be used to develop the design of electrical and mechanical systems in the dorm rooms. This step is important in developing plans for new construction as well as in dormitory renewal.

   As electrical and mechanical systems are developed for the building (with the chases, duct shafts, etc. that these systems require), the Designer will need to coordinate the mechanical systems with the furniture layout. The intent is to produce a plan that integrates building systems into the overall layout, without sacrificing utility and comfort to aesthetics, or vice versa. The review committee will be presented with the final building layout and furniture plan for approval before the project is carried into the Construction Documentation Phase.

4. Room Numbering Requirements

   It is the intent of all projects to have permanent room numbers assigned during the Design Development Phase. It is the responsibility of the Designer to initiate and complete this process, and the Project Manager's responsibility to gather required approvals. All Drawings shall reference the University approved final room number system.

   See Appendix 2.8-2 for a sample spreadsheet for coordinating this process and Appendix 1.5-3 for room/space numbering system guidelines.

B. Exterior

1. Accessibility

   Some of Princeton's dormitories were originally designed in ways that make it nearly impossible to provide barrier-free access to all parts of a building. Nevertheless, one of the goals of the dorm renewal projects is to create accessible routes to as many dormitory spaces as is reasonably possible, and to create accessible social and support spaces. (See Accessibility Section 2.1)

   The project review committee will advise the Designer on the level of accessibility desired in the project, based on options presented by the Designer and influenced by campus-wide accessibility needs.

   Code minimums must be met for accessible and adaptable units within a dormitory, code requirements for mounting heights of switches and controls are to be met by the design, and placement of special devices such as audible-base detectors and strobe alarms are to be carefully planned. For more technical information see Section 3.4 (Fire Alarms).

2. Safety/Security

   Consideration for both vehicular and foot traffic is to be given to the routes into and along buildings, so that cul-de-sacs and dead-ends are eliminated. (The same considerations should apply to interior circulation.)

   Exterior lighting should be sufficient to provide safety and security to passers-by and to building occupants. NJUCC/ICC code requires emergency lighting of egress paths on the exterior of dormitories.

3. Site Accessories

   Card access and telekey phones are to be installed at dormitory entries. See Section 3.1 (Access Control Standards). The Designer is to consult with the Project Manager to assess the need for exterior emergency phones.

Consideration should be given to site furnishings, particularly bike racks, picnic tables, benches, shuttle stops, bollards, etc.

4. Finishes

Exterior finishes are of paramount importance in the perception of the quality of buildings at Princeton University. The exterior envelope of the dorm should be studied carefully during the building survey, and the existing conditions report should concisely describe the findings of the survey.

Envelope components that must be considered in the study include walls, copings, parapets, chimneys, and decorative and trim masonry; flashings, gutters, leaders, leader boxes and roof; windows, louvers and vents, doors, door accessories, entry steps, handrails and paving.

5. Site Utilities

When a building is a candidate for renewal, the Facilities Engineering Department may decide to take the opportunity to replace services into the building or site utilities near the building. New buildings also require extensive investigation for utility work. The Designer will be asked to enumerate and evaluate the utility loads for heating, cooling, electrical, and similar systems in new and renewal work, as well as the effects on water supply, sanitary, and storm lines on and around the site. The Designer will need to coordinate the efforts required for documentation, review and construction of this work, and may be requested by the Engineering Department to provide design services for the utility work. See Section 3.6 (Utilities Guidelines).

C. Interior Circulation

Interior circulation must provide reasonable access to all areas of the dorm and must, at a minimum, meet the requirements of the building and life-safety codes in effect in New Jersey see Section 1.4 (Regulatory Codes).

1. Entries

Entries must be carefully and skillfully treated to enhance the Designer's intent.

The Designer should integrate a number of standard elements into the design for each entry. These include:

a) Card access on entry doors (see Section 3.1 Access Control Standards). Door entry hardware (VonDuprin rim-type panic device) is modified to incorporate electric release mechanism, or interlocked electric strike

b) Scrub mats or walk-off mats at the entrance, in a durable, cleanable, easily maintained material; the design should feature mats which can be easily replaced and slip resistant. See Appendix 2.4-5

c) Message boards, such as tackboards (meeting code requirements for finishes); a variation on the standard types may be developed, either metal-framed or trimmed in wood.

d) Specify durable, cleanable wall and floor finishes.

2. Stairs

a) There is no "standard" stair material. The Designer may choose a durable and inherently safe material from wood to stone, to reflect the building aesthetic.

b) Doors and hardware must meet code requirements for size, operation, fire rating, and temperature rise. Doors and frames should be of a durable construction to withstand the wear and tear of daily use by students and custodial staff. Smoke detector-activated hold-open devices are often used on stair/corridor doors to reduce wear and tear, and to create a more open appearance.

Princeton University standard hardware set for stair doors leading to corridors is a cylindrical passage set by Best Locking Systems; Precision non-electromechanical panic devices are standard for interior stairwell doors and, as noted above, VonDuprin or Precision (access-controlled) panic devices are the standard for exterior entry doors. Refer to Section 4.4 (Door Hardware) for additional details.

c) Guards, balusters, and handrails should be designed consistent with safety codes to enhance the finished appearance of the stairway

d) Specify durable wall and floor finishes that are easily maintained

e) Meet minimum lighting requirements, including exit and emergency lighting; use lighting to enhance design

f) Dry standpipes are preferred as a fire safety feature but may not be required in all cases. In a dormitory renewal project, a Designer should assume that, if standpipes existed in the building prior to the renewal project, standpipes will be required as part of the renewal work.

If including a standpipe in the building presents a major problem (due to space constraints, e.g.) the University may appeal to the State to remove the standpipe. The decision to file an appeal requires the approval of the AVP for Facilities, Design and Construction and the AVP for Facilities, Plant.

Those buildings that do not have a pre-existing standpipe can be evaluated on a case-by-case basis. The AVP for Facilities, Design and Construction and the AVP for Facilities, Plant will make the final decision on the inclusion of standpipes in such a case.

All dormitory standpipes will be dry systems charged using a post-indicator valve located near the fire department connection outside the building.

g) Fire Extinguishers – The design of the fire extinguisher in hallways/corridors shall be incorporated with the overall stair design and enclosed in a fire-rated cabinet as required. See Appendix 3.8-2

3. Hallways/corridors

a) Specify durable wall and floor finishes; research requirements for fire ratings in corridors, provide listed assemblies where needed. At a minimum, use reinforced gypsum board for walls, with skim-coat finish. (Gypsum board walls with taped finishes are not to be used in dormitory halls.)

   The project design review committee will advise the Designer on the use of appropriate finishes in corridors.

   There should be some form of base in corridors for housekeeping purposes, compatible with floor finish; tile, stone, wood, rubber; review with Project Manager.

   Princeton University employs a range of standard colors for use in dormitories; consult with the Project Manager.

   The Designer should attempt to incorporate breaks, reveals, or other architectural details to divide large expanses of painted surface, particularly in the vertical direction. This is especially true in high traffic areas, areas using high pigment paints, or locations that are especially subject to abuse.

   Fire Extinguisher – The design of the fire extinguisher in stairs shall be incorporated with the overall stair design and enclosed in a fire-rated cabinet as required. See Appendix 3.8-2.

b) In rated corridors, doors and hardware must meet requirements for fire assembly and accessibility. Princeton University employs a standard dorm room-to-corridor cylindrical lockset, a storeroom function lever-handle lockset, as well as standard hinges, closers, etc. See Section 4.4 (Door Hardware). For corridor doors leading to public or social spaces, consider using smoke detector-activated hold opens.

c) Ceilings: consider routing of utilities early in design; if corridor ceilings are to be used for utilities, ceilings must be accessible. Minimizing MEP systems above ceilings is desirable. Appearance is important, and utility runs must be thoroughly planned and documented to minimize the need for multiple access doors in hard-finished ceilings. See Section 4.2 (Corridors).

d) Lighting: must meet Code mandated minimum levels, and must meet University standard levels. Hallways should have lights that are lit 24/7/365, and may be lighted with ceiling lights, wall sconces, or a combination of both. The type of lighting may be dependent on the style of the building. The Designer is responsible for insuring that all components of lighting - lenses, lamps, ballasts, wiring connections, etc. - are readily accessible for maintenance of fixtures. All fixtures should also be easily procurable, should the University need to get replacements. See Section 3.5 (Lighting Design). Code minimums for emergency egress lighting levels must be met for the entire egress pathway.

   Any surface mounted exit sign mounted on edge below 9’-0” requires redundant support along a second edge or side, preferably located at a wall/ceiling intersection.

e) Sprinklers: sprinkler heads are to be concealed in corridors if possible; if sidewall sprinklers are to be used, ONLY concealed type are to be used.

f) Accessories - message boards, drinking fountains with insta-hot water dispensers

g) Security and safety concerns - dead-ends, remote areas, emergency phone location

h) Air handlers and other mechanical equipment placed in eave spaces off corridors require sound insulation, vibrant isolation and low db rating.

i) Trash Collection – The Designer shall evaluate locations and methods for trash collection and/or removal from each hallway. This includes possible design of trash chutes or permanent Trash Room.

j) Electrical Outlets – Maximum 25' on center dedicated 20 Amp circuit per corridor or stair.

k) Drinking fountains comply with code for quantity and accessibility requirements. In addition provide University standard Insta-hot water dispenser at each location. See Section 3.11 Page 4. Consideration should be given to protection of finishes in locations where drinking fountains are designed.

D. Bathrooms

1. Fixture Requirements

Princeton University has dormitories with multiple-fixture bathrooms serving entire floors or areas of dorms, and also has dormitories that have private or semi-private shared single-fixture bathrooms. This section deals primarily with multiple-fixture bathrooms. The project team shall also review gender-neutral toilet and shower requirements for new dormitory construction projects.

At a minimum, requirements of NJUCC and National Standard Plumbing Code must be met for number of fixtures (including drinking fountains); however, Princeton University Housing Office has developed the following ratios as a desirable minimum goal in dormitories:

a) students per shower: 5.5/1
b) students per toilet: 5.5/1
c) students per lavatory: 4.5/1

Bathtubs are generally not installed in dorms at Princeton. Individual precast terrazzo shower bases are typically specified for both gang and private baths. The Designer is to be conscious of waterproofing requirements for these bases at all wall, floor and drain locations, especially where occupied spaces may be below the showers.

At least one floor drain should be installed in each bathroom, more if layout dictates.

Floor drains should be installed in each barrier-free shower and directly outside of the hc shower compartments. Use only University approved integrated drainers and tailpieces per Section 3.11 (Plumbing Systems Design). Pitch tile towards drain.

In bathrooms that are not adjacent to a janitor's closet with a service sink, hot and cold hose bibbs should be installed for custodial use. The hose bibbs should have key stops rather than handles. The preferred location is under a lavatory, approximately 18" above the finish floor.

Generally floor mounted toilets are preferred in concrete or steel construction. This approach is preferred for both new and renovation construction.

2. ADA and Adaptability Requirements

   The Designer must become familiar with the barrier-free requirements in the NJUCC and the sub-code ICC /ANSI A117.1. *In renovations, the University's goal is to have accessible bathrooms in areas served by accessible entries and along accessible routes. The project design review committee will review the proposed location and layout of accessible baths on a case-by-case basis, for continuity with the University's Accessibility Standards per Section 2.1*

3. Security

   Bathroom entry doors are equipped with combination-lock hardware to provide a measure of security within the dorms. See Section 4.4 (Door Hardware).

4. Finishes

   Provide washable finishes; floors are typically ceramic tile or stone with colored grout, as are walls to at least the height of mirrors.

   Materials must be water-resistant; at a minimum, use water-resistant gypsum board for walls and ceilings. A smooth plaster finish is preferred. Plan carefully for access doors that are often needed in bathroom walls or ceilings; minimum 12" square doors are standard, with screwdriver operation unless below 8'-0" above finished floor, in which case Best cylinder locks are to be installed.

5. Lighting and Power

   Provide area lighting for the room, and (generally) a light at each fixture or compartment. Motion detectors may be used for control of selected light fixtures, with at least one unswitched fixture per room on an emergency circuit, preferably over lavatories/ mirror. Provide ground-fault-interrupted receptacles at lavatories, one centered between every two lavatories, or at individual fixtures. Provide back-box and power for electric hand dryers in the vicinity of the lavatories, where towel dispensers are to be located.

   Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conductor equipment.

6. Partitions

   Provide toilet partitions with doors, shower stalls with curtains or doors, and a drying area which is, at a minimum, screened. Princeton traditionally used marble for partitions, but most recently has used the Solid Color Reinforced Composite (SCRC) type. Metal partitions have been found to be too susceptible to damage and corrosion and are generally not used, although stainless steel has been used successfully.

7. Accessories

   a) Vendors for Building Services provide many of the accessories used in Princeton's dormitories, including soap and paper towel dispensers and large-roll toilet tissue dispensers. Building Services provides shower curtains for the dorm bathrooms. Consult Project Manager and Building Services for current information.

   b) The following need to be specified by the Designer: robe and towel hooks; large volume trash disposal units; feminine napkin disposal units; surface mounted soap dishes for shower stalls; mirrors (typically standard units, individually framed for ease of replacement, often with attached stainless steel shelves).

   c) Hot and cold hose bibbs may be required, as noted above.

   d) The University may install electric hand dryers in multiple-fixture bathrooms in lieu of paper towel dispensers. Paper towel dispensers may be temporarily installed over dryer outlets, until the decision on hand dryers is finalized.

E. Social spaces/"public" common rooms

The mix of social spaces in a dormitory often depends on whether it is in a residential college or if it is an upper-class dorm, whether some similar spaces are provided nearby, etc., and should be determined in the preliminary design phase in consultation with the review committee for the dormitory.

If a social space is proposed above or near a dormitory room, specific approval for the location is required from the review committee.

Some comments on typically provided amenities follow.

1. Lounges

   a) The size, shape, and number of lounges should be planned carefully. A lounge should be provided with a kitchen or kitchenette if possible. The Project Design Review Committee will determine whether a kitchen or kitchenette is to be included in a project.

   b) When approved by the design review committee, a combination TV/DVD is to be installed in lounges. The TV location is to be supplied with an OIT wiring bundle and is to be equipped with an alarm. Consult Media Services for current model.

   c) Provision should also be made for wired and wireless data communications.

d) Vending area is to be provided with an OIT wiring bundle.

Designer is to consider heat produced by vending machines in calculating the HVAC requirements for lounge areas.

e) Social spaces are considered special areas, and the normal constraints on paint colors do not necessarily apply to these spaces. Consult with the Project Manager.

2. Kitchens/Kitchenettes

a) Snack kitchenettes are installed in dormitories for the purpose of providing students unrestricted access to limited kitchenette facilities.

Snack kitchenettes are to be designed around standard appliances such as a full- or half-sized refrigerator provided by the Housing Office (with project funding). A stove or cooking surface shall not be installed in snack kitchenettes. A microwave oven should be installed. Cabinets and countertops should be included. An instant hot water dispenser with sink fixture should be included. Consult with Housing for current standard appliances.

b) The full-service kitchenettes may be installed in residential college dormitories. They would be installed for the purpose of providing undergraduate students limited access to full-service kitchenette facilities. These kitchenettes may be located adjacent to spaces that could be used for meal seating.

The full-service kitchenettes will contain the following items:

- Freestanding electric range with four burners and an integral oven;
- Hood suspended above the range with an integral recirculating fan. Although direct venting to the building exterior is preferable, this requirement shall be reviewed by the Tech Team on a project-specific basis. Designer shall take note to locate any required Fire Alarm Smoke Detectors as far away from this location as allowed by code.
- Microwave oven (not a combination range hood unit), countertop or shelf mounted
- Sink with a bin, or bins, that is sufficiently sized for cleaning cooking utensils and equipment;
- Kitchen faucet;
- Instant hot water dispenser installed on the sink;
- Freestanding full-size refrigerator and freezer unit, without an automatic ice-maker/dispenser;
- Overhead and under-counter cabinets, flush panel doors preferred with minimal hardware;
- Cubbies for storage; and
- Garbage disposals will not be installed.

The full-service kitchenettes will be located in secured rooms. The kitchen facilities will be secured by lockable doors or integral appliance keyed control device. Consult with Housing for appliance information.

c) Full-service kitchens located in Upper-class Student Dormitories; commonly known as “co-op kitchens. These full-service kitchens are located in unaffiliated upper-class dormitories. They are used for daily preparation of meals for upper-class students that do not have a meal contract.

Dormitory food preparation areas require discussion of the requirements for hood suppression at cooking sources. Generally, the hood suppression requirement is a function of the type of usages programmed for the dormitory considered. This discussion must occur in conjunction with the Housing Office and University Code Analyst. Generally, direct-vented hoods over ranges are required in addition to a residential-grade hood suppression system.

Storage cubbies should be planned into the cabinetry, for storage use by individuals in the kitchen. Cubbies should have doors with standard “Best” 5L7RD2 locks (see Section 4.4: Door Hardware). If space allows, an eating area should be planned as part of the kitchen function.

d) Full-service Graduate Student Suite Kitchenettes. These full-service kitchenettes are installed in graduate student suites located within residential college dormitories. They are installed for the purpose of providing graduate students kitchenette facilities that would be used for daily meal preparation.

The Graduate Student Full-service Kitchenette will contain the following items:

- Freestanding electric range with four burners and an integral oven;
- Hood suspended above the range with an integral recirculation fan. The designer shall take note to locate any required Fire Alarm Smoke Detectors as far away from this location as allowed by code.
- Microwave oven (not a combination range hood unit), shelf mounted If possible
- Sink with bin, or bins, that is sufficiently sized for cleaning cooking utensils and equipment;
- Kitchen faucet;
- Instant hot water dispenser installed on the sink;
- Freestanding full-size refrigerator and freezer unit, without an automatic ice-maker/dispenser;
- Overhead and under-counter cabinets, flush panel doors preferred with minimal hardware;
- Garbage disposals will not be installed; and;
- Counter Space: refer to Appendix 2.4-5 for university minimum standard.

Housing to supply current appliance information.

3. Laundries

Laundry facilities are to be included in each dormitory. Access to the laundry room is to be through the interior of the building. Particular attention must be paid to the "nuisance factor" of a laundry room - the effect of noise and heat on nearby rooms. See Section 4.7 (Laundry Rooms).

Laundry rooms are to have easily maintained and durable floor finishes and need to include a floor drain.

Typically, laundry rooms will contain the following:

a) Heavy-duty washers, not coin operated. Consult Building Services for current model.

b) Stacking electric dryers, not coin operated, with individual vents running to a plenum located at the discharge point. Generally, the individual vents consist of 4" diameter sheet metal duct. The Designer shall take care to assure lint build-up and removal within these vents in addressed in the design. (Steam dryers are preferable to electric if steam is available and space allows for the larger machines and access area.) Plan to install one dryer for each washer in the laundry room. Consult Building Services for current model, and for clearance requirements for maintenance of units; see Section 4.7 (Laundry Rooms) and Appendix 4.7-3.

c) Motion sensor-activated light fixtures for general lighting (with an unswitched light in each area).

d) A fixed table or counter with hanging rod for folding, with built-ins for bins

e) Large-volume trash receptacles

f) An adjacent waiting/study area is desirable; visual connection with adjacent space or corridor is desirable.

g) Room ventilation system is necessary

h) An emergency phone should be installed in the laundry area. (A panic button may be necessary for remote location.)

i) For design purposes plan 1 washer for every 25 students and 1 dryer (stacked) for every one washer.

j) Floor mounted laundry sink with a hose bib for janitorial purposes

k) Coordinate installation of "Laundry View" laundry monitoring system with OIT

F. Living Units

1. Living/study/common rooms

a) Space Requirements

Area: quad, 400 square feet minimum in a renewal project, and 450 square feet minimum in new dormitories. Approximately 180-200 square feet should be devoted to the common room of quads. Refer to Appendix 2.4-4.

b) Layout

Based on positioning of standard University furniture (e.g. desks, bookshelves) with consideration for student-provided couch, chairs, entertainment units, etc. The option of having all beds un-bunked with two desks along one side of the common room (or) the option of all desks in the bedrooms with the beds bunked shall be considered.

c) Location/Orientation

Provide entry to common room off corridor; common room is to provide main access to living unit (entry to suite is not to be through bedroom)

d) Finishes

1) Walls: durable finish; skim-coated impact resistant gypsum board or plaster on gypsum lath.

2) Floors: durable finish such as, wood strip flooring, vinyl tile or approved equal. For wood flooring, finishes must meet New Jersey requirements for volatile organic compounds (VOC). (4-coat) water-based finishes have proven suitable for private rooms.

3) Ceilings: typically gypsum board or plaster; if utilities are run in ceilings or in soffits in rooms, carefully planned access panels may be required for valves, junction boxes, etc. Refer to Section 4.4 for specifics regarding access panel requirements.

e) Doors and hardware: rated doors and hardware may be required for corridors; unrated doors may be used for doors interior to living units. Best Lock cylindrical sets are standard. Door viewers shall be installed at all corridor doors.

f) Windows: dormitory renewal projects often include the reconstruction or replacement of windows original to the building. During the building investigation enough information should be gathered on the condition of windows to determine whether rehabilitation/reconstruction is a viable option, based on cost/life cycle.

New buildings should incorporate new window technology for energy performance and for ease of maintenance. Within these basic guidelines, a wide variety of types and designs are available.

Regardless of building type, the following requirements apply:

1) Ventilating sash: habitable rooms require natural ventilation if a mechanical ventilation system is not being installed in the building.

2) Screens: all operable sashes require screens, and windows at grade or first floor must be fitted with heavy-duty (.020 wire gage fabric) screens for security. Emergency egress requirements must be met by screens and windows; coordinate with building egress plans. Include positive latch from inside of room only.

3) Shades: all windows in living units are to be supplied with shades. Simple spring-loaded roll-up shades are standard on campus. Evaluate window trim and screen operation to avoid conflict with shade operation. Princeton University utilizes a custom shade fabric for its dorms. The shades may be purchased through the University shade shop, or shade fabric may be purchased (via the University supplier) and supplied to any shade vender.

g) Utilities: building systems are typically replaced in dorm renewal. System piping and equipment, ductwork, etc. must be carefully planned and routed to produce an integrated design for the building.

1) Heating/cooling: buildings are typically heated using hot-water radiation driven by the campus steam system. *In older buildings with window seats in common rooms, the heating element is often housed in the window seat. Careful attention should be given to requirements for insulation for piping run in exterior walls (i.e. 2" min. fiberglass).*

   Ventilation with heated make-up air is generally provided for bathrooms, laundry rooms, and other spaces with ventilation requirements. Dormitories are not generally air-conditioned.

2) Power: *wiring is typically replaced in dorm renewal projects, with one power circuit per room. Wiring should be totally concealed. The number of duplex power outlets is increased to meet current code levels ($\leq$ 12 feet apart) and the needs of student life*. Outlet location should be carefully coordinated with furniture plans. A quad outlet should be installed at OIT jack locations.

   For both new construction and Dormitory renovation consideration should be given to increasing this requirement to one power circuit per student, (i.e. 2 circuits per double occupancy, 4 circuits per Quad, etc.). This decision shall be made in conjunction with Facilities Engineering after determining if localized A/C units may be installed in the Living Unit.

   Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conductor equipment. See Appendix 3.12-9 for acceptable use of MC cable in dormitories.

3) Lighting: wall sconce fixtures are currently used for lighting in the living units

in dorms, typically three or four fixtures in a Study Room. One lighting circuit per suite is standard. Review standard fixture with Project Manager to ascertain requirements for backboxes, conduit, switching, etc. Of primary concern for proper light distribution is the mounting height.

For rooms with 8' to 9' ceiling heights, the top of the sconce fixture should be mounted even with the top of door casings, but never less than 18" below the ceiling for best light distribution. For ceiling heights above and below these heights, engineering photometrics should be used in combination with interior elevation studies to achieve the optimal photometric and aesthetic combinations. Avoid placement of these fixtures under soffits, exposed beams, valance heating units, near windows, fireplaces and doors. Mock-ups of typical Student Room lighting schemes are required to confirm final design layout. All fixtures should also be easily procurable, should the University need to get replacements.

4) OIT: one two-port data outlet with two phone outlets constitutes a standard OIT outlet. One OIT outlet per room is standard, with adjacent quad power receptacle.

h) Furnishings: the Housing Office, in concert with the Office of the University Architect, will provide information to the Designer on furniture sizes, manufacturers, etc. Currently furniture is supplied in plywood with a clear finished red oak veneer; furniture may be plywood base or solid wood, but no particle-core board or pressed-board is to be used.

A standard set of furniture includes a desk chair, desk, bed, dresser and a bookcase. Wardrobe units are provided for rooms without closets or built-in wardrobes; wardrobe units are customized only to size appropriate cut-out to accept wall base. Bookcases are provided for rooms without shelving and for rooms not meeting the minimum nominal requirement of six linear feet of built-in shelving. Wardrobes are to be secured to the wall. Bookcases shall consist of a minimum 6' linear feet of shelving to fit on top of chest or desk or on the floor. See Section 2.5 (FF&E)

Furniture should be specified with felt footpads to prevent scratching of newly-finished floors.

2. Sleeping rooms

a) Space Requirements

1) Area: single room, 100 – 120 square feet minimum
double, 180 – 200 square feet minimum
quad sleeping rooms: 120-140 square feet, double occupancy, including built-in closet or wadrobe unit

2) Layout: based on positioning standard University furniture, *without* consideration for using bunkbeds in double-occupancy rooms.

3) Location/Orientation: entry from common room/study.

b) Finishes: the same considerations listed for common rooms apply to individual sleeping rooms.

c) Doors and hardware: unrated doors with passage or privacy hardware may typically be used for doors interior to living units. Sleeping rooms entered from a rated corridor will require rated doors, frames, and hardware, including closer.

Bedroom doors in suites are equipped with privacy locks, as are bathrooms within units.

Best Lock cylindrical sets and LCN closers are standard for both rated and unrated doors.

The Designer is advised to review requirements for fire-rated enclosures (and the lessening of requirements) in dormitories with full fire-suppression systems. Door viewers shall be installed at all corridor doors.

d) Windows: the same considerations for common rooms apply to sleeping rooms.

e) Utilities:

1) Heating/cooling: as with common rooms, heating is usually provided by radiators fed by hot water converted from campus steam in the building's utility room. Individual HVAC controls are to be installed in each living unit; programmed temperature sensors are used in public spaces and bathrooms

Placement of student rooms over or near the building's steam-to-hot-water converter can be problematic.

Air conditioning is not typically supplied to the dormitories on campus, although new dormitories may utilize systems that provide air conditioning. *Consider an additional power circuit if localized air conditioning is to be installed in sleeping rooms*

2) Power: duplex outlet placement should meet code requirements *(≤ 12 feet apart).* Coordinate placement with proposed furniture layout; in rooms that are not in accessible areas, outlets should be mounted at 11'' (at renovations only) above floor to avoid possible conflicts with bed frames. For new construction, locate duplex outlets away from typical bed locations wherever possible. Provide quad power outlet at OIT outlet.

Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conductor equipment. See Appendix 3.12-9 for acceptable use of MC cable in dormitories.

3) Lighting: two wall sconce fixtures for each bedroom is typical, although larger bedrooms may warrant additional fixtures. For single and double occupancy rooms, one lighting circuit per four rooms is standard.

For rooms with 8' to 9' ceiling heights, the top of the sconce fixture should be mounted even with the top of door casings, but never less than 18” below the ceiling for best light distribution. For ceiling heights above and below these heights, engineering photometrics should be used in combination with interior elevation studies to achieve the optimal photometric and aesthetic combinations. Avoid placement of these fixtures under soffits, exposed beams, valance heating units, near windows, fireplaces and doors. Mock-ups of typical Student Room lighting schemes are required to confirm final design layout. All fixtures should also be easily procurable, should the University need to get replacements.

4) OIT: one two-port data outlet with two phone outlets constitutes a standard OIT outlet. One OIT outlet per room is standard. The University runs a standard cable bundle to each outlet, including voice, data, cable TV, and fiber optic; see Section 2.6 (Computer Information Technology).

5) Smoke detection: locate heads away from possible sources of interference or damage such as doors, wardrobes, ceiling-mounted bike hangers, bunkbeds, light fixtures, etc. Detectors must be 36” minimum from air supply outlets.

6) Fire suppression: concealed heads are preferred, either ceiling-mounted or sidewall type. If a dry standpipe is run adjacent to a room, access doors for inspection of the standpipe might be required within the room.

f) Furnishings: as listed above, the standard set of furniture for each occupant is a desk chair, a desk, a bed, dresser; wardrobe and bookcase where not built in.

Each bedroom should have a closet, a built-in wardrobe, or a moveable wardrobe unit that is secured to the wall; the choice is a programmatic decision, and should be made in consultation with the project design review committee.

Because of possible requirements for sprinklers within closets, the Designer should carefully review the issue of closet vs. wardrobe with the Project Manager and the University Code Analyst.

10. Custodial Closets

Each dormitory will require a custodial storage room of approximately 100 square feet (and possibly larger in larger buildings) for paper products and cleaning supplies and equipment. Exact janitorial requirements for each building are a program issue to be resolved during design development. Refer to Section 4.3 Custodial Closets and Storage for more information.

Buildings up to 10,000 square feet will require at least one janitor’s closet of approximately 35 square feet, and one of equal size on each additional floor level of the building.

Buildings up to 50,000 square feet will require two to three janitor closets, a minimum of one per floor level.

Buildings up to 100,000 square feet will need three to four janitor’s closets minimum, at least one per floor level; larger buildings should be programmed for additional closets at the rate of one per 25,000 square feet.

11. Signage Requirements

Prior to submitting signage design package the designer shall meet with the project manager to determine required locations and signage types. Generally, interior signage for dormitories shall include:

A. Emergency Room Evacuation Signage - To be located immediately adjacent to room side of corridor door handle, indicating direction of all legal exits and installed with tamper proof screws.

B. Room Identification Signage - To be located on corridor side at entrance to each suite. Includes room number, ADA Braille requirements, name slot and message board. Each room I.D. sign shall be designed individual to each project and reviewed with Housing. 10% attic stock shall be specified for each type of signage in the project.

C. Stair Egress Signage - Denotes level and levels down to exit. Assigns a stair number and includes ADA Braille requirements.

D. Common Area Signage - Includes room name, number and ADA Braille requirements.

E. Elevator Signage – In accordance with ANSI A17.1 requirements.

F. Electrical Signage – In accordance with NEC requirements.

G. Fire Protection Signage – In accordance with NFPA requirements.

12. Environmental Issues

Prior to undertaking renovation work in an existing dormitory, the University will arrange for a survey of the building to determine the possible presence of hazardous materials. The University will engage a separate consultant for any remedial consultation deemed prudent as the result of this survey, and will attempt to abate any hazardous material prior to the start of construction, using a separate contractor qualified to perform the abatement work.

13. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the construction contractor and any systems installer.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record drawings to convert to as-builts. See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

Early in the project, the method to be used for delivery of interior design services should be established. The project Designer should come to an agreement with the University's Project Manager determining responsibility for furnishings: whether design is to be done under the project Designer's contract, whether a separate design professional will be engaged, or whether the University will assume responsibility for the design and purchasing of furnishings under another arrangement. The scope and budget for furnishings must be established early on so the furniture systems will fall into its proper sequence in the project schedule. A first step in the process may be conducting an inventory of the client's existing furniture and equipment, with an evaluation recommending re-use or replacement.

Furniture fit-out for construction and renovation projects of a sizeable nature requires a level of coordination with site activities and conditions that is not addressed in the scope of the University's standard purchasing documents. For this reason, the furniture specifications are amended and released by the ODC Interior Design Project Manager; or through the Facilities Procurement Office if significant custom casework is involved; or through the contracted Construction Manager where workstations interface with laboratory and complex building systems, making it possible to track the progress of the furniture as it relates to the completed construction and project as a whole. The General Conditions of the Contract, Appendix 2.5-4, are amended as needed by Supplementary Conditions for Furniture, Furnishings, and Equipment prepared for specific projects. The Contract Administrator will request the preparer of the furniture package to provide a Unit Price Schedule in an agreed upon format for inclusion with the Contract Bid Form.

Designers are not necessarily limited to using lines and manufacturers that are available through Purchasing Contracts, but are encouraged to familiarize themselves with the available pieces and consider them for inclusion in a given project. Increasing attention should be given to specifying office furniture from the same parent manufacturing or procurement source so that multiple contracts are not required to implement a project.

Princeton University has purchasing contracts with Herman Miller Inc. and Steelcase Inc. that encompass seating, steel, and wood casegoods, panel systems, and tables. Competitive furniture products manufactured by Knoll International and Teknion are installed on campus in fewer quantities but available through purchasing contracts have been bid and installed at several university buildings and are acceptable alternates. Classroom furniture is available from these manufactures as well; however, KI-Krueger International is offered on contract to specifically address this need. Dormitory casegoods and beds are procured under contract with John Savoy and Son, Inc. Dormitory desk chairs are procured under contract with Sauder Manufacturing Company. The University's Project Manager for Interior Design can be contacted for information regarding representatives and vendors.

It is not unusual to have three furniture vendors performing installation work on a project that includes library custom furniture, wood and steel office and classroom products, and ergonomic seating; however multiple sources for office furniture products increase not only the complexity of the specification and award process, but the administration and successful coordination with the general contract for construction. Aside from the economic benefits, maintaining continuity of design over time will need to be possible, as the client/user replaces or supplements furnishings through the Purchasing Office.

2. Contacts

A. The Project Manager (in Office of The University Architect, Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B.	Interior Design Project Manager	MacMillan Building, 609-258-3504
C.	Assistant Buyer, Purchasing Department	701 Carnegie Center, 609-258-5887
D.	Contract Administration Office	MacMillan Building, 609-258-6752

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

		PDF
A.	F F & E Services Checklist, Princeton University Office of University Architect	Appendix 2.5-1
B.	NFPA 260, Fabric Specifying Guide	Public Document
C.	General Conditions of the Contract, Princeton University Contracts Office	Appendix 2.5-4
D.	Standard University Dormitory Casegoods Purchasing Contract	Appendix 2.5-6
E.	Reference List of Contacts for Replacement and Supplemental Furniture	Appendix 2.5-7
F.	CAL 133, California Technical Bulletin, Fabric Open Flame Burn Test	Public Document

4. Review Guidelines

Furniture plans are often begun when project planning - and even construction documents - are well along toward completion. (This is not always the case; see comments in Section 2.4 Dormitory Design). The Interior Designer may or may not be a consultant to the principal Project Designer. Review of furnishings for non-dormitory projects will typically begin with a preliminary design, will continue through design development, and culminate in a furniture order. Installation may be months beyond the actual order.

The Designer is expected to review the proposed design with the University's Project Manager, with the departmental representatives (department chair and department manager, eg.), and any adjunct professionals.

Since furnishing selections might involve colors, finishes, fabrics, carpets, etc., no definitive number of review sessions can be laid down in general terms. The Designer must be prepared to work on a coordinated effort with the other professionals involved in the project, and must respond to the needs and wishes of the client/user while maintaining a clear understanding of schedule and budget. The furnishing project cannot be done on its own schedule, but must be timed to fit with the overall project schedule.

The Designer should be aware of the probable need to provide full-scale samples of furniture for client review. This is particularly true if furniture not in standard use at the University is proposed. Full-scale mockups must be provided during the early construction phase so that purchase decisions can be made without adversely affecting the end date of the project.

The Designer will be expected to participate in coordination efforts during the mock-up phase, to incorporate utilities such as power and data wiring. In addition, the Designer may be requested to provide coordination services to administrate the move of furniture and occupants, and in some cases, arrange an interim move so that existing space can be renovated.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

5. Design Guidelines

There is no real "standard" office, classroom, or lab at the University although there are furnishing needs common to many uses. Depending on the department or discipline, there may be a greater or lesser need for pieces such as shelving or filing cabinets, work tables or computer stations, etc. Some of the common elements follow.

Finishes are dependent on a number of factors - budget, client taste, Designer aesthetic, etc. and may be different for different functions and positions within a department. Public spaces should reflect the nature of the building's architecture, while private spaces may vary from such design constraint and take on a more personalized character.

A. Work Spaces / Office Spaces

The Designer should consider the following in specifying furniture for work areas:

1. Ergonomic chair

2. Desk or work surface (adjustable as needed, computer-compatible):

   a. L shape desirable for computer usage, U more so, if space allows;
   b. wire management system, horizontal and vertical, with properly sized and located grommets or other fittings required for connectivity;

c. an acceptable security system or method for protection of electronic devices and other personal possessions;
d. layout and fit of furniture must not block access to power, data, and HVAC controls and filters and other utilities;
e. all desks to come equipped with drawer locks. See Section 4.1 (Door Hardware).

3. Computer accessories:

    a. ergonomic keyboard;
    b. ergonomic mouse pad or tray;
    c. monitor stand or support (depth of work surface should allow correct placement);
    d. CPU support;
    e. document stand or holder
    f. mobility of components and access to components should be considered;
    g. coordination of access to surge suppression and power backup devices.

4. Task lighting should be considered in conjunction with layout and overall lighting design.

5. Shelving or bookcases, freestanding or secured to structure (with provision of architectural blocking). Designers should be aware of the need for shelving in University projects; extent of shelving is beyond the industry norm. Designer should also be aware of the restrictions on height of shelving in projects that include sprinkler systems.

6. Filing and storage cabinets, undercounter or freestanding. Keying of cabinetry should be included as part of its order. See Section 4.4.5 for information on preferred lock types.

7. Need for seating area or meeting table.

8. Tack boards, marker boards, and occasionally chalkboards.

9. Coat hooks

B. Dormitory Furnishings

See Section 2.4 (Dormitory Design) for information.

Some standards have been established for dorm renewal projects - consult with Project Manager.

Standards for study spaces are currently in development.

C. Classroom Furnishings

See Section 2.3 (Classroom Design) for information.

D. Library Furnishings

The following considerations should apply in specifying library equipment and furnishings:

1. Circulation, Reference and Control Desks

   a. Circular configuration preferred in some locations;
   b. Provide dual-height standing and sitting surfaces (refer to ADA standards and see Section 1.4 Regulatory Agencies);
   c. Accommodate computer CPU and peripherals (flat screen monitor may be used);
   d. Accommodate printer and supplies,
   e. Accommodate telephone and directories;
   f. Provide pencil and money drawers;
   g. Provide file cabinets below; use mobile pedestals if appropriate;
   h. Provide space for book trucks;
   i. Provide built-in task lighting, if possible;
   j. Provide doors to limit access;
   k. Design structure and supports to allow movement under and around work surfaces to the greatest extent possible;
   l. Locate reference and reserve books nearby.

2. Reading tables

   a. Built-in lighting;
   b. Table-top data and power connections; consider lamp base as possible location;
   c. Durable wood chairs (unless adjustable task chairs are requested).

3. Study carrels

   a. Knockdown construction is preferred for ease of relocation by pallet truck and reassembly.Readily available, sustainable, and maintainable wood species and finishes are required ;
   b. Built-in lighting;
   c. Table-top data and power connections;
   d. Durable wood chairs (unless adjustable task chairs are requested);
   e. Storage, to include bookshelf and occasional file drawers; bookshelves should not interfere with laptop computers;
   f. Signage (with slide-in replaceable occupant name card). Confirm this requirement based on assignable vs. non-assignable carrels.

4. Shelving

   a. Adjustable shelving units, fixed in place (may include media and CD holders and microfilm carriers); 3 foot wide shelves, 7 foot high, 7-9 inches deep;
   b. Mobile/compact shelving; mechanical preferred over electrical;

c. Periodical shelving, sloped for display;
d. Newspaper racks and shelves;
e. Shelving for oversized or odd-shaped articles.

5. Reference computer terminals and clusters

   a. Accommodate CPU and peripherals, with flexibility for equipment changes;
   b. Include wire management system with accessible connections;
   c. May be systems furniture, if appropriate.

6. Other computer use areas

   a. Review requirements for number and type of computers/peripherals with Project Manager, client user, and OIT;
   b. Accommodate CPU and peripherals, with flexibility for equipment changes;
   c. Provide work surface- or table-top data and power connections, with wire management;
   d. Provide durable wood chairs (unless adjustable task chairs are requested);
   e. Provide workspace on table for books, etc.

7. Display cases

   a. Review need for display cases for normal use and special exhibits with client user and Project Manager;
   b. Review requirements for any necessary climate control or security features in display cases.
   c. Review need for cabinet locks with client user. See Section 2.5 (Furniture, Fixtures and Equipment), 10 (H) and Section 4.4.5.

8. Book drop

   a. Review size requirements with Project Manager and client;
   b. Determine whether CD slot and storage are needed;
   c. Review additional special considerations -- oversize books, music scores, etc.;
   d. Consider locations both inside and outside Library.

9. Copy area

   a. Review requirements for number and size of machines;
   b. Provide capability for coin and credit card use; review possibility of student ID card use for operation;
   c. Review need for connectivity with CIT, client user, and Project Manager;
   d. Provide for paper and toner storage in copy area.

10. Security system

a. Review requirements and options for security with client user, Project Manager, and Facilities Engineering Department. 3M system for book security is standard.
b. Coordinate location of security reader to provide proper distance from steel framing and other possible sources of interference.
c. Confirm stairwells or exit door locations do not compromise security plan.

E. Lab Furnishings

Lab furniture is a very complex design issue -- consult with Project Manager for guidance at the beginning of the design process.

F. Furnishings for Meeting Spaces

1. Coordinate table placement with power and data connections; provide table-top connectivity;

2. Determine type of seating to be used -- stacking/non-stacking, ganged, task seating, etc.;

3. Review need for power and data connections, A/V equipment and screens at presentation wall.

G. Furnishings for Lounge Spaces and Lobbies

Because lounge spaces and lobbies are often areas that are closely tied to the architectural aesthetic of a building, the Designer may place special emphasis on coordinating the furniture and fixtures with the architectural character of the space.

In planning a lobby or building entry space, the Designer should allow for the practical necessity of providing direction to the general public: a directory, either standard display or electronic, should be included; key plans of the building could be useful; any display boards for special events that are held in the building should be integrated with the room design.

H. Cabinet and Furniture Locks

Confirm the requirement for individual locks for all contract furniture. Wherever possible, specify Best deadbolt cabinet locks as primary choice; "National" or CCL cabinet locks are also acceptable for heavy-duty wood applications, and for any custom millwork furniture. See Section 4.4.5 (Door Hardware, Millwork and Cabinet Locks) for more information.

I. Carpet

The University has a purchase agreement with a number of manufacturers for broadloom and modular carpeting goods; manufacturers include Mohawk (World Contract, Mohawk Commercial, Bigelow, Karastan Contract, Durkan, and Harbinger), J&J Industries, Shaw, Milliken, and Interface. Term contracts are also in effect for several dealer/installers in the local market area, if such services are needed on a project.

Whenever possible, the use of 100% solution-dyed nylon fibers is encouraged. Face weights should be a minimum of 26 ounces, and generally at or above 28 ounces. Consideration must be given to the use of soil-hiding patterns and colors for carpeting being specified for student living and social spaces.

When a padded application is warranted, it is recommended that an attached-backing system such as Mohawk's "Enhancer Back" be utilized in lieu of carpeting stretched over a foam or jute pad.

Modular carpet tiles are a desirable alternative to broadloom in certain installations such as locker rooms, library shelving areas, food service locations, and office area with numerous systems-style workstations. Cushion-backed tiles, as compared to lower-profile PVC-backed tiles, offer increased foot comfort and are believed to lengthen the life of the carpet product. The University recommends the use of modular carpet products from Milliken, Mohawk, Interface, and Shaw.

J. Wall Coverings

Vinyl wall coverings are discouraged because of the difficulty in properly repairing damage to the finish.

6. Requirements for As-Built Drawings and Project Closeout

Contractor/Vendor at the end of the project to supply in electronic format as-built furniture installation plans indicating all wall mounted components, systems furniture and freestanding case goods, locations of work surface supports, integral lighting and power and data accommodation. Product identification and dimensions are to be included on the plans, as well as walls, window and door openings, and elements requiring access such as HVAC units, power and data receptacles. Office and workspaces, meeting, and library furniture installations are critical areas; public spaces with freestanding loose furniture such as seating or dining furniture are not critical in terms of installation Drawings.
All furniture, provided for all furnished spaces, is to be included in an electronic schedule of furniture and accessories indicating manufacturers, product numbers, finishes, colors, and quantities. Also required are lamp specifications for relamping task and ambient fixtures. Information is to be formatted so that it can be tied to locations, and make it possible to derive the contents on a room-by-room basis. One hard copy with actual finish samples and vendor contacts to be provided for project library.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

The main campus of Princeton University is crisscrossed by a network of data and communication lines which have been installed and are maintained by the University. The three types of cables which comprise the network are telephone, which originates in Palmer Hall/Frist Student Center; data, originating at 87 Prospect, the Computing Center; and video, which is also located at 87 Prospect .

Office of Information Technology (OIT) operates and maintains this system throughout campus, and provides services to extend and revise the system for the University.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Manager of Hardware Support 171 Broadmead, 609-258-6042

C. Manager of Network Installations 171 Broadmead, 609-258-6015

D. Manager of Telecommunication Technical Operations 171 Broadmead, 609-258-6655

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. *Horizontal Distribution*, Siemon Cabling System Training Manual IS-1821-01 (in current version)	Appendix 2.6-1
B. *Backbone Distribution*, Siemon Cabling System Training Manual IS-1821-01 (in current version)	Appendix 2.6-2
C. Telecommunications Room, Siemon Cabling System Training Manual IS-1821-01 (in current version)	Appendix 2.6-3
D. *Equipment Room*, Siemon Cabling System Training Manual IS-1821-01 Rev H (in current version)	Appendix 2.6-4
E. *Entrance Facilities*, Siemon Cabling System Training Manual IS-1821-01 Rev H (in current version)	Appendix 2.6-5
F. *Installation Practices*, Siemon Cabling System Training Manual IS-1821-01 Rev H (in current version)	Appendix 2.6-6

G. *Normative Annex A*, Siemon Cabling System Training Manual IS-1821-01 Rev H (in current version) — Appendix 2.6-7

H. Face Plate Detail Drawing, OIT — Appendix 2.6-8

I. Elevator Phone Mounting Detail, Telephone Office — Appendix 2.6-8

J. Cut Sheet of Elevator Phone, Telephone Office — Appendix 2.6-8

K. Cut Sheet of Emergency Phone, Telephone Office — Appendix 2.6-8

4. Code References

A. New Jersey Uniform Fire Code (NJUFC)

B. International National Building Code

C. National Electric Code

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines - Preliminary Design and Design Development

During preliminary design, Designer is to consult with University Project Manager to ascertain the requirements for tele-data use and installation. The Designer is to cooperate with any adjunct professionals providing assistance to the University, and is to coordinate his work with other disciplines so a cohesive set of documents is produced for the tele-data work.

During preliminary design and design development the Designer is to consult with the Project Manager and with OIT to define system distribution strategies and to discuss any obstacles that might be existing in a building, or problems inherent in a particular design or structural system.

OIT will provide information on design requirements for point-of-entry (POE), building distribution frame (BDF), and intermediate distribution frames (IDFs). This information will be based on the number of outlets anticipated for the project, the length of wiring runs in the project, the distance of terminations from POE, BDF, and IDFs, and any other pertinent information. See Appendices 2.6-3, 2.6-4, and 2.6-5 for thorough review of design considerations for these facilities.

7. Guidelines and Requirements for Documentation

The preferred approach to documenting OIT requirements for a project is to have Drawings dedicated to OIT design and construction. These Drawings should be coordinated with the electrical Drawings (the electrical contractor will typically install the raceway system for OIT work), with the Architectural Drawings for inclusion of closets, backboards, etc. that support OIT work, and the Drawings for any other trades affected.

See Section 1.4 (Regulatory Agencies) for requirements for code review and permits, including the organization of construction Drawings and documents for timely release of permits.

At a minimum, the following are to be provided at the indicated phase:

Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Floor Plans - *BDF &IDF*	X	X	X	X
Floor Plans – *System "Backbone"*		X	X	X
Floor plans - *showing horizontal and vertical routes of raceways*			X	X
Floor plans - *showing locations of all devices*			X	X
Conduit riser Diagram *showing all devices*		X	X	X
Symbols & Notes		X	X	X
Outline Specifications		X		
Specifications			X	X
Details			X	X

8. Considerations for OIT Systems Design

Industry standard guidelines (see references for Siemon Design Manual) are to govern the installation of equipment, raceways, wiring, outlets, etc., and govern distances of runs between terminations and BDF/IDF. Princeton University does not use consolidation points.

Specific requirements for portions of the system are as follows:

A. Point of Entry

1. Minimum of three 4" conduits into building (1 telephone, 1 data and video, 1 spare). These are minimum requirements, and should be reviewed in preliminary design with Project Manager and OIT.

2. Conduit between POE and BDF to be (3) 4" minimum.

3. Telephone to have surge protection within 50' of POE (may be extended if cable is in conduit outside building; review with Telephone Office);

4. Provide adequate work light (4" fluorescent preferred) and general purpose power outlet and four (4) dedicated quad receptacles, one circuit per quad in closet. Two (2) quads are to be placed on emergency power supply; two (2) quads on standard building power.

5. All closets are to be ventilated and cooled as necessary to maintain a room temperature not exceeding 78 degrees F. Two complete air exchanges per hour as required.

B. Building Distribution Frame (BDF)

1. Conduits between BDF and each IDF in building are to be, at a minimum, two 4" conduits to create a "building riser system."

2. Wiring between BDF and IDF to be home runs, for fiber, telephone and (2) Cat. 5c.

3. Provide adequate work light (4" fluorescent preferred) and general purpose power outlet and four (4) dedicated quad receptacles, one circuit per quad in closet. Two (2) quads are to be placed on emergency power supply; two (2) quads on standard building power.

4. BDF is to be ventilated. Two complete air exchanges per hour.

5. Base closet size = 12' 0" x 12' 0".

C. Intermediate Distribution Frame (IDF)

1. OIT to provide area requirements for closets based on cable count; see section 4.1 Communications Closets for additional information. Base closet size = 12'0"x12'0".

2. If project includes emergency power installation in building, provide emergency power to IDF (include IDF power outlets in emergency load calculation).

3. Provide adequate work light (4” fluorescent w/ guard preferred) and power outlets in closet (1 duplex outlet per 24 station cables, plus additional work outlet): provide four dedicated 20A circuits minimum to IDF.

4. Evaluate equipment heat load and provide adequate ventilation and cooling as necessary to maintain a room temperature not exceeding 78 degrees F. At a minimum, provide exhaust ventilation with tempered make-up air based on closet size and volume; allow a minimum of two air changes per hour. Review anticipated equipment heat load and configuration of equipment with OIT prior to calculating HVAC requirements.

5. Cable design length, including service loops, cannot exceed 295’, station terminal to IDF terminal.

6. No other services are to share IDF closet space, or to require access in closet (e.g., no electrical pull or junction boxes, no valves for piping, no mechanical equipment, etc.).

7. Closets are to be keyed to the University’s EM system.

8. Ceiling clearance of 8’ 0” maintained throughout the closet.

D. Individual Outlets (Stations)

1. OIT’s 5/8” diameter standard bundle to each outlet: cat 5e cable with fiber optics, CATV, and telephone. For data-only applications, OIT’s high-density bundle: cat 5e cable with fiber optics.

2. 1” EMT conduit from outlet to access point, such as lay-in ceiling tile with a designated cable path back to the IDF/BDF ; all turns are to be made with sweeps (no LBs in run and must be in accordance with Siemon Guidelines for bending radius). If 1” EMT is not practical, provide written argument detailing difficulties and suggested alternative solution. NOTE: Flexible conduit may not be used without OIT review and approval.

3. Floor Boxes
   a. Walker 880 Series for data/phone.
   b. Steel City 655 Series for data/phone.
   c. FSR Series for data/phone/AV

   Note: All floor boxes will have a 1 ¼” conduit installed with an isolated 2-gang spot specifically dedicated for the data/phone.

4. Conduit, Cable Tray & Junction Box Cable Capacity Chart

Std or Hi Density Cable				**Wireless Cable**		**NEMA JB's**	
EMT	**Cables**	**Flex Tray**	**Cables**	**ENT**	**Cables**	**Cond**	**JB**
1"	1	2 X 2	8	1 ½"	1	1 ½"	6X6X4
1 ¼"	2	2 X 4	16	2"	2	2"	6X6X6
1 ½"	3	2 X 6	24	3"	3	2 ½"	12X12X6
2"	4 to 6	2 X 8	32	4"	4	3"	14X14X6
2 ½"	7 to 9	2 X 12	40			3 ½"	20X20X8
3"	10 to 12	2 X 16	48			4"	24X24X8
3 ½"	13 to 15	2 X 18	56				
4"	16 to 18	2 X 20	64				
		2 X 24	72				

Note:
Cable counts depend on conduit length & bend radius
All Conduits shall have a pull string & bushings provided by the installer

5. Minimum bending radius is governed by cat 5e and fiber optic requirement, in accordance with the Siemon Specification.

6. Maximum 270º from any pull point.

7. Face plates to be by Siemon.

E. System Wiring

1. For data, cat 5e wiring by Belden, Berk-Tek, BICC General Cable, Champlain, Commscope, Mohawk/CDT, or Optical Cable Corporation.

2. For video, 5704R cable by General Cable.

3. For voice, cat 5e cable by General Cable.

4. For fiber optics, Siecor cable.

5. Plenum-rated cable shall be used if cables are run without UL-listed conduit in ceiling space or other space subject to use as return or supply air plenum.

6. Installers are to be Certified Siemon Installer.

- Awarded installer shall provide updated certificate and have a minimum (1) Siemons Certified Installer (technician) at <u>all</u> times per awarded project.

- OIT supplies all cable and termination materials.

F. System Distribution

1. Raceways, cable trays, conduits, shall be utilized; review method of distribution with OIT during the schematic design phase.

2. Cable shall be properly supported (cat 5e requirements); raceways and trays shall be properly supported from the building structure

3. Any fireproofing material removed from the structure during installation of raceway system shall be replaced in kind.

4. System components penetrating fire-rated assemblies shall be fire-stopped to meet requirements for rated assembly breached; UL listed fire-stop systems by Hilti or 3M shall be utilized. Review system to be used with the University Project Manager prior to undertaking work.

G. Wireless Distribution

OIT views Wireless Ethernet a complimentary service to hard wired Ethernet, not a replacement. OIT wireless application consists of three designs.

1. Wireless Access Point located in wiring closet with wireless antenna located at remote location.

2. Wireless Access Point and wireless antenna located at remote location attached to OIT standard cable package to network access.

3. Wireless Access Point located in wiring closet attached to radiant cable system. Radiant cable is distributed throughout building using data infrastructure.

4. Confirm that no 2.4 GHZ fluorescent lighting (Fusion lighting) is designed for the Project. This will cause the data wireless system to function with this band of interference.

Typically designs 1 & 2 are used to localized wireless distribution. Design 3 is used to complete building coverage.

9. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the construction contractor and any systems installer.

As-built documents shall include all routing details, wall and floor box locations, and wireless antenna locations.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

See Section 1.5 (Documentation and Archiving)

END OF DOCUMENT

1. Introduction

Princeton University maintains a campus that is open to the surrounding community. The University encourages interaction between members of the University and the community. Given those facts, providing for the security and safety of students, faculty, staff, and the general public can be challenging.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst	MacMillan Building, 609-258-6706
C. University Manager of Grounds	MacMillan Building, 609-258-7150
D. University Architect	MacMillan Building, 609-258-3356
E. Associate Director of Public Safety	200 Elm Drive, 609-258-3132
F. Manager, Life Safety and Security Systems	306 Alexander, 609-258-4992

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Exterior Pole Lamp Details (3), Facilities Engineering Department	Appendix 3.5-2	
B. Exterior Emergency Telephone Detail	Appendix 2.6-11	
C. Elevator Emergency Telephone Detail	Appendix 2.6-9	
D. University Building Fire Safety and Security Guiding Principles	Appendix 2.7-1	
E. Princeton University Typical Plan/Elevation Security/ADA Features Layout	Appendix 3.1-1	Appendix 3.1-1
F. Princeton University Typical Building Processor Cabinet with UPS Diagram	Appendix 3.1-2	Appendix 3.1-2
G. Princeton University Typical Single Door Detail(s) (5pp)	Appendix 3.1-3	Appendix 3.1-3
H. Princeton University Typical Double Door Detail (s) (4pp)	Appendix 3.1-4	Appendix 3.1-4
I. Crime Prevention Through Environmental Design (CPTED) Guidelines	http://www.cpted.net/home.html	

J. Appendix to Security Evaluation Report
Final Kroll Report appendix 'A' dated 10/31/02 — Appendix 2.7-2

K. Campus Video Management System — Appendix 2.7-3

L. Security Programming Document — Appendix 2.7-4

4. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction with Life Safety and Security Systems (LSSS) for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Project Manager

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

5. Procedural Guidelines – Programming and Schematic Design

During schematic design, Designer is to consult with University Project Manager and the Associate Director of Public Safety and the LSSS Manager to ascertain the level of security needed for a building, that required for specific building areas, and that needed in the area around a building. A project Security Programming Document will be reviewed at this meeting and give the projects its security baseline to follow. These issues may include but are not limited to the following:

1. Discussion and coordination of user requirements.
2. Card Access Control System (CACS) design.
3. Transition from mechanical (keyed) lock sets to CACS.
4. Fire Safety Security Monitoring System (FSMS) building.

5. Fire alarm testing to the public safety Computer Graphics Response Monitoring Systems (CGRMS – soon to be replaced by Simplex TSW alarms monitoring system).
6. Card access system training requirements.
7. Keyless locks
8. Campus video management system
9. Blue light phones

During schematic design and design development the Designer is to consult with the Project Manager and the University's Code Analyst to discuss any code issues that have an impact on the planned security features of the project. The Security Programming Document shall be used to lay out the proposed security priorities.

In certain situations, direction from the Facilities Department "Security Advisory Group" (SAG) may be necessary to resolve project security priorities within the current campus environment. SAG provides the necessary policy oversight, leadership and guidance on physical security matters of institutional importance as they relate among similar building occupancy types.

6. Design Guidelines - "Passive" Security Features

In designing the project, the professional should be aware of features that can be included to enhance safety in and around the building, and should also be aware of problematic conditions that might make a project inherently less safe. Some of the features to consider follow below. Additional design guidelines can be found on the CPTED web site: http://www.cpted.net/home.html

A. Landscaping

Use landscaping to enhance a design, but avoid creating heavy cover, dark areas, and isolated areas

B. Path Routing

Design paths with sufficient lighting, and avoid cul-de-sacs and dead-ends

C. Building Configuration

1. Exterior

   Take care in the building layout to avoid, or at least to compensate for such features as:

   a) Alcoves
   b) blind corners
   c) enclosed courtyards

2. Interior

   Inside the building, care should be taken in design of exit paths for fire safety, personal protection, and prevention of theft of property. The location and travel paths for the following are particularly important.

   a) entry configuration
   b) hallway configuration

c) common spaces / public spaces (avoid uses which compromise access security in buildings)
d) emergency exits

For building typologies such as Libraries and Museums, the Designer shall consider the threat of "snatch and run" in areas of valuable material. It is desirable to have egress doorways located in direct view of occupied staff locations and/or be equipped with remote monitoring and alarm devices approved by the University.

The Designer is to review the building layout and the construction staging plan with the construction manager, Project Manager and the systems administrator in the Department of Public Safety, prior to start of construction.

7. Design Guidelines - "Active" Security Features

The Designer should pursue solutions that will enhance the safety of the project, both during construction and subsequent occupancy. Refer to the approved Security Programming Document for guidance.

During the security programming review consider the following with for appropriate locations/ applications with the Department of Public Safety:

A. Exterior

1. Lighting

   See Section 3.5 (Lighting Design).

2. Fences/walls/enclosures

   Site logistics are to be planned by the Designer, working with the Project Manager and construction manager; logistics will be reviewed by Public Safety and Grounds.

3. Security telephones

   Security telephones are placed strategically around campus, so that one should be in sight at all times. See Section 3.1 (Access Control Systems).

4. Security cameras (CVMS)

   Security cameras may be placed at selected areas of campus, where required. Any proposed use should be reviewed with Life Safety and Security Systems and Public Safety. See Appendix 2.7-3.

B. Interior

The emerging standard at Princeton University favors "smart" buildings with selective access systems, doors that can be locked and alarmed, electronic latches for nighttime security, and systems that will report to Public Safety through fire alarm and security systems. A number of control and protective methods are used, some highly technical, others less so.

1. Card access, using identification cards

    a) Proximity ("prox") cards for activation of locking hardware on dormitory entries and selected other buildings and areas. See Section 3.1 (Access Control Systems).
    b) Hotel-style card locks. The Designer should consult with Life Safety and Security Systems to determine if keyless locks should be considered on a project-by-project basis. The intended use is for interior doors such as dormitory rooms and bathrooms. A University ID card is to be the "key" that will operate the off-line electronic lock system.

2. Code access, using PIN keypads

3. Combination locks in specific areas (Trilogy electronic locks, non-alarmed, for use in dormitory bathrooms, and special-use areas such as computer rooms)

4. Although security cameras are generally not used, they may be placed at selected areas of campus, where required. Any proposed use should be reviewed with Life Safety and Security Systems and Public Safety. See Appendix 2.7-3.

5. Window screens (in residential buildings; heavy-duty frame and screen on ground-level and first-floor rooms; must be lockable but operable). All screens should be either lockable or be provided with heavy duty magnetic operators.

6. Duress buttons/ emergency phones (in areas used intermittently or at odd hours, such as laundry rooms, remote social areas in dorms, and at building entries)

7. Lighting, both normal lighting and motion-activated

8. Maintenance-only access to special uses/areas (roof hatches and windows to roofs, unprotected balconies, primarily in residential uses)

9. Maintenance-only access to service/mechanical areas (see Section 4.4 Door Hardware)

10. Use of magnetic door hold opens on rated door assemblies along required egress paths.

Many of the features that provide safety to building occupants, and to the public in general, can be arrived at simply through the process of thoughtful design, and the employment of common-sense solutions.

8. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the electrical and security contractors.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include, as a minimum, security/utility/environmental and other alarms layout plan with all other system interfaces, components, equipment schedule and riser Diagrams.

Card Access Control System (CACS) Acceptance Test Procedure (ATP) will be included with As-Built Drawings.

The Project Manager is responsible for distributing copies of the as-builts to the appropriate University representatives for review prior to project closeout. These representatives include members of the Life Safety and Security Systems and Grounds and Building Maintenance Departments.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

Environmental graphics includes both interior and exterior signs or lettering that are project specific, as well as campus-wide sign systems for wayfinding and information. Project Designers are encouraged to retain the services of a Graphic Designer for all project specific signage and to coordinate their work with emerging campus-wide sign systems designed by others. (See Wayfinding below).

Exterior Building Signage:

Typically each building project requires at least two types of exterior signs: 1) a building identification sign (building ID) showing the officially recognized name of the building, and 2) information signs for ADA routes, service deliveries, parking, etc. Generally, the building identification sign should be located near the primary entrance and its design integrated into the architectural elements of the building façade. The Princeton University Wayfinding Signage Handbook, (Appendix 2.8-1), shows several examples of appropriate use of materials and typography for exterior building identification; these include carving directly into the building's stone, pin-mounted metal lettering, vinyl lettering on glass and various metal plaques. There are many existing precedents on campus Informational, regulatory and traffic signage are also included in the Princeton University Wayfinding Signage Handbook, Appendix 2.8-1.

Interior Building Signage:

Although governed by ADA and NJUCC guidelines, interior signage should be project specific in its scope and should be designed to complement the architectural style of the particular project.

Dedicatory Inscriptions:

In addition to the design of interior building signage, graphic design services may also include design of a dedicatory, commemorative, or memorial inscription or plaque, as part of the project. Whenever possible the requirements for same will be provided to the project team during the schematic design phase

Print Graphics:

If needed, editorial and design guidelines, (Logos, typefaces, etc.), are available from the Communications Office online. See www.princeton.edu/pr/

Wayfinding:

Princeton University is currently moving from a conservative use of exterior environmental graphics to the deployment of a comprehensive, yet discreet, Campus Wayfinding Program. The program consists of campus–wide directional and informational sign system, campus maps and directories, geared primarily for campus visitors. Wayfinding signage will be designed by the University's Graphic Design Consultant and will be implemented over time. Campus wayfinding is generally independent of project specific signage but may in some instances be used to supplement exterior building identification.

2. Contacts

A. Project Manager (in Office of Design and Construction, Office of the University Architect, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B.	Landscape Project Manager	200 Elm, Drive, 609-258-8338
C.	Graphics Coordinator	200 Elm Drive, 609-258-5176
D.	University Coordinating Architect	MacMillan Building, 609-258-1189
E.	Architectural Engineer for Standards	200 Elm Drive, 609-258-6247

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

		PDF
A.	The New Jersey Uniform Construction Code (With sub codes dealing with ADA requirements, safety and occupancy requirements, etc.)	Public Document
B.	The New Jersey Uniform Fire Code (subchapter 4 requirements for safety and way finding)	Public Document
C.	Princeton University Wayfinding Signage Handbook	Appendix 2.8-1
D.	Fire Alarm/Signage Nomenclature Spreadsheet sample, Princeton University	Appendix 2.8-2
E.	Uniform Traffic Control Device Manual, Federal Highway Safety Administration	Public Document
F.	Room/ Space Numbering System Guidelines	Appendix 1.5-3

4. Review Guidelines

Documentation for interior signage typically comes late in a construction project, and review is generally limited to the Project Manager, the University Coordinating Architect, and representatives of the client department.

If the Project Manager determines that a consultant independent of the design firm will be used for signage, then the signage is usually shown on plans specifically drawn for that purpose; otherwise the signage will be included on the construction documents as shown in the chart shown on page 3 of this section.

Typically, signage proposals will be reviewed in preliminary form, and may proceed directly to the final plans, depending on the complexity of the project.

Designers shall provide timely and coordinated responses to all review comments. Preferably, with the assistance of the Project Manager, review meetings should be held with respective internal contacts as identified by the Project Manager to facilitate this process. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions may be discussed and documented. If these review meetings are not held, or if any non-compliant design or component is selected, the A/E shall provide the University written documentation of respective changes prior to submission of the next round of documents.

Required Documentation	SD	DD	50% CD	85% CD
Compliant Room Number Designations (per Appendix 1.5-3)		X	X	X
Interior Signage Schedule				X

5. Procedural Guidelines - Preliminary Design and Design Development

The Project Designer should determine at the beginning of the project, in consultation with the University Project Manager, whether a Graphics Consultant will be used on the project and what the scope of graphic services will be for the project. The University, with the help of the Designer, will establish a budget for the graphics work.

During preliminary design, Designer is to consult with Project Manager to ascertain the level of signage needed for a building, that required for specific building areas, and that needed in the area around a building. The Designer is to develop a code-conformance schedule, outlining the minimum signage to meet code requirements.

The building signage should take its cue from the form and style of the building itself: the signage should complement the architecture of the building.

To facilitate the establishment of room numbers, a meeting with the Architectural Engineer for Standards, SPMIS Assistant Manager and Design team should occur before the start of Design Development. This meeting will clarify the appropriate method for assigning room numbers based on Appendix 1.5-3. Compliant room number designations, including all mechanical rooms and circulation spaces, are due as part of Design Development Submission, see Appendix 1.5-3

The Graphics Consultant may be asked to provide assistance to the University Project Manager and the project Designer in determining the scheme for room numbering. This numbering scheme may include nomenclature for the building fire alarm system; this nomenclature is developed in coordination with the Department of Public Safety.

While in development, Designer is to review plans with the Project Manager, the client/user, Public Safety, and any other parties that might be affected by the proposed installation. During development, full-scale mockups should be temporarily installed on site and in context to aid in the final review of signage design.

In the final design, a sign schedule is to be created, with sign types listed on a room-by-room basis, with floor plans keyed into the schedule. Typical elevations showing mounting heights and relative location of sign types are to be prepared, as is a written specification that will allow accurate pricing of the signage and installation.

6. Guidelines for Installation and Performance

A. Signage for room numbers is considered permanent, should comply with ADA and NJ barrier-free requirements.

   Names that may be attached to or be a part of a room number sign should be easily adaptable and changeable. Window signs, for example, allow the client/user to maintain the signs in the building. To this end, a limited graphics computer program is to be provided the client, which will allow the creation of new sign inserts in the Designer's selected typeface and format.

B. Interior signage is typically installed using a silicone sealant, with double-faced foam tape providing temporary adhesion.

C. For exterior signage, concealed fasteners are preferred. Through-bolts are not to be used unless no other option is available, and then only with permission from the Project Manager. Embedded anchors are typically used on masonry.

D. Building identification is often hand-carved into the masonry of a building facade. An alternative is a plaque of carved stone, set into the building walls or anchored with concealed fasteners. Cast metal and porcelain enamel are also acceptable options.

E. Dormitory signage (interior) See Section 2.4.

7. Guidelines for Door Number Labeling

For maintenance purposes, the University requires individual door numbering labels at specific locations. These requirements shall be indicated on final construction documents in table format for the following doors:

A. Exterior Card Access Doors: Each door with access control (CACS) hardware shall receive a clear vinyl label with ½" high black "New Baskerville Roman" lettering and numbering. These labels are to be adhered to the frame directly above the center of the door from the exterior.

B. Interior Mechanical and Electrical Room Doors: The interior sign package often includes room signage / numbering for most mechanical and electrical rooms. However, for mechanical and electrical rooms with doors that may not include standard interior signage, each door with access to any type of MEP device shall include a phenolic or plastic plate with etched ¼" characters in vertical orientation (top to bottom) of the same color to match the door frame. These numbering plates are meant to be mounted on the exterior side of the frame and re-painted to match the frame over time.

END OF DOCUMNET

1. Introduction

Princeton University began as the College of New Jersey in 1746 in Elizabethtown in the parsonage of the first president, Jonathan Dickinson. The College moved to Princeton ten years later to move into Nassau Hall and occupy the field surrounding, a total of four and a half acres. That first plot has grown to a campus of over 660 acres today, with holdings in excess of 2,000 acres. The College expanded greatly in the 1870s under president James McCosh, a Scot who brought with him from Britain a love of the English garden, and who first applied some of the gardening concepts to what at the time was a rather austere campus.

In 1912 Beatrix Jones Farrand began what was to be a propitious association with the University, when she was brought in to work on the project to create the Graduate College, with Architect Ralph Adams Cram. Farrand became the University consulting Landscape Architect and was associated with the University for some thirty years. She was responsible for the initial landscape design that helped shape what is today the Historic Campus, and her basic design principles are still evident - emphasize rather than conceal architecture; simplify and unify with careful, controlled planting; and select materials with a view to the seasonal use of the campus.

The campus has historically grown as a series of plazas or quadrangles connected by walkways. Today the main campus reflects that historic growth, and is organized along two east-west axes - McCosh Walk near the north end of campus, and Goheen Walk farther to the south. North-south paths are generally discontinuous. Elm Drive is the primary vehicular path through the central campus and connects the north and south campus entrances.

The lasting impression that the campus has on visitors centers on the attention given to open spaces. Careful design of outdoor spaces provides the continuity of experience for the campus. In 2008 the University published the Princeton Campus Plan (Appendix 2.9-12) as well as a 10-year Landscape Master plan to assist in determination of how it could accommodate significant academic expansion while preserving the historic beauty and walkability of the Campus. This plan breaks down the scale of the campus through the identification of “campus neighborhoods: to assess local site relationships within the vibrant diversity of the campus as a whole. Consulting architects are encouraged to become familiar with the Campus Plan and embrace its five guiding principles within each respective project design:

- Maintain a pedestrian-oriented campus
- Preserve the park-like character of the campus
- Maintain campus neighborhoods while promoting a sense of community
- Build in an environmentally-responsible manner
- Sustain strong community relations

Site Planning implementation and corresponding internal review procedures for each project can be found later in this section; item 6.

2. Contacts

A. The Project Manager (in Office of Design and Construction, Office of the University Architect, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B.	Landscape Project Manager	200 Elm Drive, 609-258-8338
C.	Coordinating Architect	MacMillan Building, 609-258-1189
D.	Manager of Grounds	MacMillan Building, 609-258-7150
E.	Manager, Civil Engineering	MacMillan Building, 609-258-6681
F.	GIS Analyst	MacMillan Building, 609-258-8205

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

		PDF
A.	Campus Utility Maps in Facilities Engineering	Consult Project Manager
B.	Campus-wide Tree Survey, 1987and 2000, By Paul Cowie & Associates	Consult Project Manager
C.	Princeton University Campus Accessibility Map	Appendix 2.1-1
D.	Historic Campus Master Plan , 2000	Appendix 2.9-2
E.	Site Materials List & Manual	Consult Project Manager
F.	Outdoor Lighting Master Plan	Appendix 2.9-15
G.	Campus Fire Lane and Limited Access Areas Map	Appendix 2.9-5
H.	Map of University-Owned Roadways	Appendix 2.9-6
I.	Exterior Pole Lamp Details, Facilities Engineering Department	Appendix 3.5-2
J.	Environmental Safety Risk Management Master Plan, 2002	Consult Project Manager
K.	Reunion Sites	Appendix 2.9-8
L.	Site Details	Appendix 2.9-9 (PDF / ACAD)
M.	General Survey Requirements	Appendix 2.9-10
N.	Monument Detail	Appendix 2.9-11

O. Princeton Campus Plan – "The next 10 years and beyond" 2008 — Appendix 2.9-12

P. Standard University Handrail Details — Appendix 2.9-13

Q. Standard University Outdoor Furniture — Appendix 2.9-14

4. Code References

A. New Jersey Uniform Construction Code (NJUCC) - see Section 1.4 (Regulatory Agencies)

B. ANSI/CABO A-117.1 (Barrier-Free Guidelines)

C. Shade Tree Ordinance, Borough of Princeton

D. Tree Removal Ordinance, Township of Princeton

E. Code of Laws, Volume II, Land Use, Borough of Princeton

F. Land Use Ordinance, Township of Princeton

G. Mercer County Soil Conservation Report

5. Design Guidelines

Beatrix Farrand, the pioneering Landscape Architect responsible for much of the success of the historic area of Princeton's campus, believed that the campus is first and foremost the grounds and the landscape. A hallmark of design at Princeton is the careful placement of buildings within that campus context. On occasion, existing buildings have been moved to create just the right relationship of a new building to its immediate surroundings.

In this context, it is appropriate to think of buildings as backdrops to the exterior spaces that are, ultimately, the cohesive factor in experiencing Princeton's campus.

Buildings may give form to the exterior space, they may frame an exterior space, or they may create circulation patterns for exterior space. Overall, the following concepts should be adhered to in the site planning aspects of project design:

A. Hierarchy of Spaces

There should be a hierarchy of spaces which building placement and plantings should reinforce and enhance. The most successful exterior areas on campus rely on a hierarchy of spaces - the intimate ambulatory providing a vista through an archway to a grand courtyard, for example. The open spaces are defined by sequence, making the connections essential and the use of axis - or cross-axes - a major design consideration

B. Sequence

A design goal in developing Princeton's outdoor spaces is to create a sense of continuity between spaces, where major spaces are enhanced by the sequence of moving through secondary spaces, where there is a play of expansion and contraction, of light and shade.

The campus is typically experienced by moving through exterior spaces, minor spaces leading to major spaces by means of connectors.

C. Connection

It can be argued that, while the grand spaces may be the most beautiful aspect of the campus plan, the connections or paths of travel are what provide the sense of campus. The connections provide the views, the vistas, and the experience of coming upon or into the artfully arranged courtyards and quadrangles.

D. Continuity

The buildings at Princeton are remarkably diverse, yet the campus is still perceived as cohesive. It is a challenge to the Designer to work within that established context: to impose what might be a unique volume upon an existing array of solids and voids, and to have that volume - and the means of going through and around it - become a seamless part of that whole.

6. Internal Review Guidelines - Buildings

Each Project Manager for a project which disturbs an exterior site in any way should meet with the University Coordinating Architect to determine whether the extent of the disturbance requires formal review by the Landscape Policy Committee, or informal review by the University Coordinating Architect, or whether the University Manager of Grounds simply needs to be informed so that appropriate site restoration can be undertaken after completion of the project. In the latter case, the Coordinating Architect will, in consultation with the University Manager of Grounds, and the Landscape Project Manager, determine if the charges are funded by a Major Maintenance account, or by the project account. If the Coordinating Architect determines that a review is required, he will establish a review time, either during an informal Landscape Coordinating Committee meeting or at some other convenient opportunity.

The purpose of the review is to determine the appropriate scope and design concept for all site work. The expectation is that the Architect and University Coordinating Architect will come to a complete agreement on each matter. If it is not possible for all to agree, differences will be resolved by the Landscape Policy Committee, which meets monthly. All final site plans should be reviewed by the Landscape Policy Committee before implementation.

The University Coordinating Architect has the responsibility of insuring that the scope and concept for all sitework has been approved.

After preliminary design is complete, additional departments may be brought into the design development and construction planning phases. Departments such as Public Safety and Building Services may be included in the review process, and may act as in-house consultants for specific aspects of the project.

During the process of design, plans are to be submitted for review by Facilities departments at:

A. Completion of Schematic Design; Existing Conditions Survey must be completed by schematic design. Refer to this section, item 16 for more information.

B. Completion of Design Development; Proposed plant material should be represented on drawing at 70% of size at maturity. Sections should show scale, form, and opacity of proposed trees.

C. At 50% completion of construction documents

D. At 85% completion of construction documents

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

7. Internal Review Guidelines - Landscaping

The Landscape Policy Committee conducts long-range campus site planning and initiates and/or reviews all projects affecting the exterior of the campus. Initial planning and preliminary design is typically coordinated with this Committee, which has monthly meetings and weekly work sessions. Smaller Grounds-related projects may move immediately into design and documentation; the bulk of these guidelines may not be applicable to such small projects.

The University also employs a landscape consultant to help plan and document Princeton's landscaping projects. This consultant should be considered a member of the design team, and should be consulted on all issues regarding landscaping and site planning.

The Landscape Policy Committee will review the proposed location and layout of buildings, walks, drives, plantings, etc. for continuity with the University's master plan and for other University goals, such as improving accessibility. It is in the project scope to provide accessible routes within the project site and to connect these to accessible paths outside of the project site. The Project Manager may bring in an outside consultant to review & comment on the design to ensure compliance with current state and federal ADA requirements. See section 2.1-5 for additional information.

As with a building project, when preliminary design is completed additional departments may be brought into the design development and construction planning phases. Special consultants may also play a part in the final design and review of projects.

8. Internal Review Guidelines - Utilities

At initiation of programming, it is useful to begin informal discussions about site utilities with the Facilities Engineering Department's Utility Coordinator. This department maintains the campus utility plans and can also be a source of general knowledge about utilities the University can provide about methods for involving agents for public utilities in the project.

Prior to the design of utilities, a site survey shall be completed to document horizontal and vertical locations of all utilities within the boundary of project site Refer to Appendix 2.9-10 for additional information. Facilities Engineering can provide assistance in locating utilities for each project.

Often, the University will contract separately for the site utilities for a project; coordination and clarity in construction documents is important to this end.

Likewise, the University, with proper support from the design team, will often make application to local utilities for the needed services. The approach taken varies from project to project, and the approach needs to be reviewed and confirmed early in a project. The Designer should consult with Facilities Engineering regarding lead times required for the application to public utilities and actual installation of the utilities.

On main campus, the University's network of utilities provide much of the service for buildings; off campus, availability of University utilities is less likely; the site must be reviewed with Facilities Engineering. In general, the following prevails on main campus.

A. Utilities that can be provided by the University include:
   1. Steam and condensate
   2. Chilled water
   3. Pressurized air (localized areas)
   4. Electric power
   5. Emergency electric power (University regional emergency generators)
   6. Storm drainage
   7. Fire protection water (University regional fire pumps)
   8. Voice and data communications

B. Utilities that are provided by public or private agencies include:
   1. Sanitary sewer
   2. Domestic water
   3. Fire protection water (non-pumped)
   4. Natural gas

   Utilities must be provided separately for each building; utility company regulations prohibit feeding one building through another. The route for utilities must be outside any building's footprint. The utilities will not allow a building to be built over an existing service route, but would require that the service be re-routed.

Please see Section 3.6 (Utility Guidelines) for additional information.

Please see this section; item 13-D, for layout of trees over utilities.

The Designer should note that the University maintains two regional storm water detention facilities for projects on main campus. Storm water runoff is a concern to local, county, and regional authorities, and is closely reviewed in the planning, permitting, and construction phases of a project. The amount of hardscape in a project directly affects the storm water detention requirements, and must receive appropriate attention in the design phase.

9. Municipal Review Guidelines - Landscaping

Building projects, major landscaping projects, and landscaping projects undertaken in conjunction with building construction, are likely to require review by a number of municipal and county agencies. Site plans must be reviewed by the Princeton Regional Planning Board, a joint agency of both municipalities. In some instances, site plan review becomes the responsibility of a municipal Zoning Board of Adjustment; both of the Princeton municipalities have municipal zoning offices and boards.

The legal intricacies of site plan approval are typically addressed by the University's legal counsel. The Designer must be prepared to offer support in the effort to obtain site plan approval, which might require presentation Drawings, appearances at the meetings of the Regional Planning Board or the municipal zoning boards, pre-meetings with a key subcommittee that supports all the agencies, the Site Plan Review Advisory Board (SPRAB), and with municipal officials and professionals.

SPRAB takes the leading role in landscape review for the municipalities, and can have a major impact on the details of a site plan. This board is well regarded in the municipalities, and approval by SPRAB can ease the passage of a project through the subsequent hearings before the Planning or Zoning Boards.

To expedite the review and approval of a project at the local level, close coordination with civil/site Engineers, Landscape Architects, and University personnel is required of the landscape Designer.

See Section 1.4 (Regulatory Agencies) for additional information.

10. Guidelines and Requirements for Documentation

As noted above, the University maintains campus utility maps that can be used as the starting point for site survey information. Auto CAD planimetric data covering the campus can be obtained through Facilities Engineering to supplement the campus utility maps.

Site planning and development documents are generally prepared well in advance of construction Drawings for a given building, at a time when the size, shape, and volume of a building may be finalized, but the details may be in flux. The site documents are used in obtaining permission to proceed into construction from the local planning and zoning agencies, and from county bodies such as the Mercer County Soil Conservation Agency.

The local agencies have checklists for project documentation, and these play a crucial role in successfully moving a project through preliminary review. A project will not be scheduled for a site plan hearing (except in concept) until the project has been deemed complete by the board of jurisdiction; that is, until each item on the checklist has been successfully addressed and documented. As an example, a typical site development application, classified as a “major” site plan, must provide documentation on each of the following:

A. Site plan, with existing and proposed site features
B. Fire protection plan
C. Variance appeals, if applicable
D. Site survey (see this section item 16.)
E. Drainage and utility plan
F. Landscaping, lighting, and signage plan
G. Soil map
H. Building Drawings
I. Soil erosion and sedimentation control plans
J. Environmental information statement

There is a sublist of required information for each of these checklist items, outlined in the respective land use ordinances for the Borough of Princeton and the Township of Princeton. The Designer, working with the Project Manager, University legal counsel, and other University consultants must address each of the requirements of the checklist to move the project forward.

Required Documentation	SD	DD	50% CD	85% CD
Key Map	X	X	X	X
Vicinity Map	X	X	X	X
Existing Conditions Survey	X	X	X	X
Site Utility Plan	X	X	X	X
Preliminary Site Plan	X			
Preliminary Landscape	X			
Overall Site Plan		X	X	X
Demolition and Removals		X	X	X
Grading		X	X	X
Site Lighting		X	X	X
Soil Erosion and Sediment Control		X	X	X
Construction Details		X	X	X
Outline Specifications		X		
Full-Length Specifications			X	X
Fire Protection Site Plan			X	X
Landscape Layout		X	X	X
Landscape Materials		X	X	X
Planting Plan		X	X	X
Planting Schedule		X	X	X
Accessibility Plan		X	X	X
Site Details		X	X	X
Planting Soils Plan			X	X

See Section 1.4 (Regulatory Agencies) for additional information.

11. Sustainability

One of the University's Guiding Principles for Future Expansion, as articulated by the Administration in 2003, is to "build in an environmentally responsible manner - a manner which is sensitive to geography, sensitive to energy and resource consumption and works to sustain strong community relations." These Guidelines are intended to provide direction and resources for the sustainable design and construction of new buildings and the comprehensive renewal of existing buildings for capital projects at Princeton. The requirements of this process are described in Section 1.2 of the DSM.

A new campus master planning effort has been initiated in the fall of 2005 and is currently investigating both campus-wide and neighborhood-specific sustainability strategies for

- utility distribution
- storm water management
- energy efficiency goals/targets
- sustainable landscape strategies and planting materials
- paving materials
- exterior lighting plan
- transportation & parking plan
- potable water use plan

A significant percentage of exterior site work on campus is associated with capital projects. Design teams are thus encouraged to select Life-Cycle Comparative Studies (LCCS) that are both appropriate to project specific goals and might contribute to the overall development of the Campus Plan. The design team shall coordinate with the Master Planning team to identify potential studies and for updated information on the progress of the Campus Plan through the Office of the University Architect.

The greatest potential for understanding and managing the environmental impacts of a project is through early and multi-disciplinary consideration of site selection criteria, building siting, orientation and massing, water usage, storm water management and landscaping strategies The Sustainability Charrette (to be conducted during the Pre-Schematic phases) and the Life-Cycle Comparative Studies (LCCS) process are intended to ensure that these critical issues are addressed by the design team in a timely and holistic manner (Refer to Section 1.2.4 Outline of Process).

12. Considerations for Exterior Design - Circulation

Open space priorities are a major concern of the Landscape Policy Committee and should be the starting point in site plan development. Designers should strive to enhance the experience of the open spaces while guiding people through those spaces. Careful consideration must be given, then, to laying out walks and drives, to the way such paths intersect, and to the materials of the paths themselves.

The Designer should address building service issues as an integral part of the site design in order to produce a comprehensive plan that will augment - or improve - existing services. Planning should include delivery routes, loading areas and trash storage locations.

Although Princeton tries to minimize vehicular traffic in the main campus area, there are undeniable requirements for access to each building such as trash and recycling pickups, mail delivery and pickup, delivery of supplies, furniture delivery, shop vehicles for normal maintenance of a building, etc. Certain academic disciplines may require frequent delivery of equipment or materials, and dining facilities, for example, have extremely heavy service requirements. There are periods of the year -- move-in and move-out days in the dormitories, Reunions and Commencement - when unusual and unusually heavy traffic patterns are the norm, and universal access to campus areas is needed. Additionally, emergency access to a building must be provided for fire department and medical vehicles. Thus it is important to address service access in the early stages of design.

On campus, circulation paths fall into several different categories, depending on use:

A. Vehicular Circulation

1. Primary: characterized by full-width travel lanes, curbing, and raised sidewalks; typical of the main drive through campus (Elm Drive) and of the streets owned by the University. Usually paved with asphalt, with granite or Belgin block curbs, and concrete sidewalks.

2. Secondary: these are typically pathways that serve both vehicular and pedestrian traffic, characterized by an asphalt center section, with additional width to either side in a different or contrasting paving material, set flush with the asphalt but defining the pedestrian space. The approach drive to Prospect House (1996) is an example.

   Secondary vehicular pathways often serve as fire lanes, and must provide an eighteen-foot wide lane of stabilized base at a depth sufficient for fire truck criteria; refer to Appendix 2.9-5 (Campus Fire Lane Map) for locations, and review requirements with Project Manager.

3. Tertiary: these are primarily pedestrian paths that can be used occasionally by service vehicles. Access is controlled by removable, lockable bollards spaced six feet on center (allowing for snow removal equipment to pass, but excluding normal vehicles). Minimum width for tertiary paths is four feet.

B. Pedestrian Circulation

Introduction

Historically, Princeton walks featured a four-foot wide bluestone path to which gravel borders were later added for increased width. The arrival of larger and heavier vehicular traffic resulted in gradually replacing the gravel borders with asphalt. Overall width of the walks with asphalt borders increased at varying locations to between eight and fourteen feet.

In 1996, a successful variation of the bordered walk was introduced using two types of concrete unit pavers, without asphalt borders. These walks have four- to six-foot wide center sections of large-module concrete pavers or bluestone, bordered by bands of small-module pavers of a different color. In heavily traveled areas, such walks are edged in low bluestone curbing to protect adjacent lawns. Examples can be seen in McCosh/Dickinson courtyard and around Prospect House's south garden.

Recent walk designs for the Historic Campus continue this system using bluestone as the center path material, flanked by borders of small-module concrete or cobblestone pavers. Note that rough cobblestone pavements are best used for pathway borders and corners, where they effectively reinforce path shoulders, rather than for the center portion of the pathway walking surfaces. Rough or heavily textured pavements should not be placed where they will interfere with pedestrian or accessible routes to doors and entryways.

For walks seven feet wide or narrower, a single paving material without borders is recommended. In such cases bluestone, brick, or concrete pavers are among the possible material choices.

1. Primary paths: as noted above, the main campus pedestrian arteries such as McCosh Walk and Goheen Walk, also serve as tertiary vehicular paths and are twelve to fourteen feet in width.

   The Designer should consult with the Project Manager and review the Campus Fire Lane Plan for requirements for a particular project. If a walk must be designed to carry emergency vehicles, there *may* be some increase in traffic-bearing capacity over normal University design, and the stabilized width most certainly will be increased. A common design variation is to provide the increased width using stabilized base and structural soil, which can be then be planted with grass or mulched.

2. Secondary paths: secondary walks may lead from the main campus walks into buildings, may occur within courtyards, or simply cross open areas. These paths are constructed of durable materials such as stone, concrete pavers, or brick laid over compacted stone or quarry blend sub-bases, with a variety of bases, such as concrete, asphalt or sand, depending on the proposed paving material and the traffic expectations. With the exception of walks leading into buildings (which may be as wide as the building entry or form an entry plaza), these secondary walks are typically five to six feet wide. If vehicular traffic is anticipated on a secondary walk, bands of unit pavers will be installed on either side of the walk, to increase the total width to eight to ten feet.

3. Tertiary paths: tertiary walks are really paths that lead to secondary entrances in buildings, or crisscross a green area. They are designed for foot traffic across open areas (or are sometimes installed after a traffic pattern has been established). The material may be permanent in nature, such as bluestone, less permanent such as concrete or asphalt, or may be renewable, such as compacted stone dust, stabilized gravel systems or wood chips. Minimum width for tertiary paths is four feet.

4. In order to accommodate some changes in elevation, steps may have to be incorporated into the design. Steps should be designed with a change in materials, or color change, to alert the pedestrian of the difference in grade.

   For all walks and some drives, the Designer should review any areas that need special treatment, such as snow-melting equipment or weather protection. The Designer needs to keep in mind that all walks and paths at the University are cleared of snow using mechanical means (as far as possible) so access for the equipment is important, as is the placement and finish of the path.

An emerging challenge in site design has to do with the use of steps and plazas by roller-blade enthusiasts, skateboarders, and stunt bicyclists. This activity has abused a number of elegant site amenities - stone-capped walls, memorial benches, handrails, and the like. While a punitive policy of public space design should not result, the Designer should be aware that what some would view as amenities become attractive nuisances for others.

Along with circulation needs, the Designer should be aware of various parking needs - for employees, visitors, and the disabled. Quite often, parking will be accommodated "off site," in one of the University lots or garages. Nevertheless, it must be demonstrated that parking requirements will be met by some means before a project will receive site plan approval. The Designer should be prepared to compose a plan, working with the Project Manager, the Office of Public Safety, and other University consultants, outlining parking requirements and provisions for use in the site plan review process at the municipal level.

13. Considerations for Exterior Design - Planting Concepts

The following concepts should guide the Designer in both building and landscaping projects on campus at Princeton:

Note: While following the concepts listed below the Designer must co-ordinate with the layout of proposed utilities throughout the project and make adjustments to the plantings as necessary.

A. There is a hierarchy of open spaces which the planting (and any building) should reinforce and enhance.

1. The size of outdoor spaces should determine the scale of the planting, i.e. large spaces should contain large trees, while small spaces should have flowers, vines and groundcovers, shrubs, and small trees.
2. Smaller, more defined spaces should be characterized by distinctive planting (color, scale, texture).
3. Large spaces should be defined by "structural" tree planting (e.g. perimeter planting and entrance definition).
4. Vistas should be demarcated by tree plantings where possible.
5. General foundation planting should be avoided. Plantings at buildings should emphasize and enhance the character of the architecture. Plantings within the landscape should define spaces.

B. Spatial sequences through the campus should be defined and enhanced.

1. Major entrances should be identified by planting.
2. The campus perimeter should be strengthened with planting.
3. Major campus axes should be defined by planting, as at McCosh Walk.

C. Plantings should provide solutions for various functional needs.

1. Provide shade for events and for outdoor use areas:

    a) Commencement
    b) Reunions
    c) Outdoor gathering places

2. Conceal unattractive use areas:

    a) Parking and loading areas
    b) Refuse handling and recycling areas
    c) Service areas

D. Layout of trees over subsurface utilities:

1. Trees shall be located with an offset distance equal to 3 x the diameter at maturity plus two feet for most subsurface utilities and an offset distance equal to 3 x the diameter at maturity plus six feet for gas, and public utilities such as water.

2. Conditions caused by backfilling of utilities should be examined before final location of trees.

E. Maintenance Periods for Landscape Plans

1. A one year maintenance period for lawns and plant material shall be specified as part of the Acceptance and Maintenance section of the project specifications.

F. Irrigation

1. When purposing irrigation for the site, factors such as area of planting beds, lawns, type of soils, and establishment period should be carefully considered in the design of the irrigation plan. All irrigation installations should be installed with a trace wire in order to enable the location of the underground piping during utility markouts. It is the goal of the University to be able to monitor all irrigation systems and water usage from one point. The Designer should check with the Project Manager when specifying the controller for the irrigations system to insure that it is compatible with the Princeton University systems used on campus.

In choosing planting material for a project, the Designer should bear in mind that diversity of material and careful spacing of plantings are important factors. Diversity provides not only the opportunity for a pleasant variety of color and shade, but also insures that if disease strikes a particular variety, the entire bed is not lost.

The Designer should take care that no invasive species are used in site landscaping

14. Considerations for Exterior Design-Reunion Sites

Princeton's Alumni reunions date back to the University's earliest years. Many courtyards on campus are designated as reunion sites, see appendix 2.9-8. Individual Alumni classes set up large tents for Reunion Weekend which is held each year around June 1st. A reunion site may be used each year by a large number of people concentrated in a relatively confined area. Special design considerations such as open areas for tents, shade, drainage, soil compaction and access should be incorporated when a project site is proposed to be used as a future reunion site.

15. Considerations for Exterior Design - Lighting

Lighting should be carefully considered in the design of the site. Thought needs to be given to lighting for foot travel and safety around the site, but glare needs to be controlled and over-lighting is to be avoided. A consistent, if low, level of lighting will provide a sense that the site is well lighted and safe (an average of .1 to .2 footcandles for exterior lighting is considered sufficient).

The local municipalities have requirements for the type of exterior lighting to be used, although waivers can be sought from those requirements; the Designer should discuss the exterior lighting with the Project Manager. The use of metal halide or QL lamps is encouraged. Fixtures using high-pressure sodium lamps are being phased out.

The University has several standard light poles and fixtures in use throughout campus (see Section 3.5 Lighting Design and Appendix 2.7-1). Be aware that bollard lights have generally been found ineffective for University site lighting needs. Review requirements for burial of power lines for lighting with Facilities Engineering.

Photometric Diagrams of any proposed site and exterior building lighting must be presented as part of a site plan application. The New Jersey Uniform Construction Code requires that exitways be lighted (with emergency power backup) to the exterior of the building and at the exterior of the exitway; these lights should be accounted for in site plan applications.
The Designer should review site lighting proposals with the Project Manager and the project design review committee. Discuss the desirability of providing exterior building lighting and lighting of any site features such as steps, ramps, or stairways. Review the University's policy on motion-sensor activated lighting.

16. General Survey Requirements

For all projects which require existing conditions survey, the Designer shall obtain the required survey early in the project, and prior to design of utilities. The existing conditions survey must be completed at Schematic Design. See this section, items 6 and 10.

In addition to the required survey content, each survey will have specific characteristics. The following general list covers specific features which should be added if they are consistent with the original survey purpose.

Boundaries
Boundary and other roads
Interior features

Trees and Foliage
Utilities
Topography

See Appendix 2.9-10, General Survey Requirements for more information.

If a project requires a tree survey, the survey should be reviewed by the Manager of Grounds for identification of invasive species.

All survey drawings are required to meet CAD Standards and digital submissions requirements. See section 1.5 Documentation and Archiving.

Princeton University strives to be completely digital and therefore has been focused on converting the existing hard copy plans to digital CAD drawings. The University created a CAD Planimetric Base Map which was developed through an Aerial Photography and Orthophotography mission in 1999, supplemented by yearly planimetric updates.

Upon request, Princeton University shall provide the Consultant with the most update available drawings deemed to be of use to the Project. Princeton University will provide any CAD drawings in either the current version of AutoCAD or the version being currently utilized by the University. It is the responsibility of the consultant to perform any necessary conversions to utilize the data.

Requirements for geodetic control monuments are as follows.

Installation of permanent monuments should be considered in the design of the site. At a minimum, permanent monument should be installed on the north, east, south, and west sides of the site. See appendix 2.9-11 for monument detail.

The permanent monuments should be surveyed by a Licensed Professional Surveyor in the State of New Jersey. Upon completion of the project, the monuments should be included in the as-built drawings.

Preservation of Geodetic control points

All geodetic control monuments, (horizontal and vertical) such as discs and official benchmarks within the project site must be carefully protected and must not be disturbed by any construction activity.

Where such markers are located within new construction and are in imminent danger of destruction, the contractor shall retain a licensed land surveyor to ensure the markers' relocation prior to disturbing the original markers, in accordance with the manual for mark preservation being prepared by the National Geodetic Survey of the National Oceanic and Atmospheric Administration, Geodetic Mark Preservation Guidebook.

In case of accidental destruction of a geodetic monument, the contractor shall be responsible for the cost incurred by the owner/agent for replacement of the point, in accordance with existing standards.

17. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the contractors.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designed will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include, as a minimum, the following site features:

- Signs
- Fencing
- Bollards
- Sculptures
- Fixed seating
- Planters
- Bike racks
- Lighting locations
- Conduit runs
- Controls and circuiting
- Monuments
- Irrigation

The Project Manager is responsible for distributing copies of the as-builts to the appropriate University representatives for review prior to project closeout. These representatives include members of the Facilities Engineering and Grounds and Building Maintenance Departments.

See Section 1.5 (Documentation and Archiving)

END OF DOCUMENT

1. Introduction

Laboratories are critical to Princeton University's mission in the 21st Century. The laboratory Designer must be aware of the needs of the users, the ways the laboratory will and might be used, and the technical needs of the department involved and the technical requirements of the space itself. Critical to the success of the project will be the early involvement of the University Facilities Engineering and Ground & Building Maintenance Departments.

Establishing parameters for energy consumption and sizing of utility services and distribution is of paramount importance to the University. These parameters must be established early in the project, (Pre Schematic phase), applying established benchmarks, projected usage with demand & diversity factors. The Project Manager will meet with the academic department/end user, the Design Team and Facilities Engineering to establish these parameters which will be included in the Basis of Design.

The Designer should keep in mind that laboratory design is a highly specialized field. Adequate research, programmatic development and due diligence are essential to their successful design and construction. Codes and guidelines referred to in this (or any other) section of the Standards Manual are not to be assumed as comprehensive. It is incumbent upon the Designer to properly investigate the specific requirements of the lab to ensure compliance with all local, state, and national codes and regulations.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance Department, or as applicable).

B. Program Manager - Sciences — MacMillan, 609-258-9483

C. Manager, Mechanical Engineering — MacMillan, 609-258-3934

D. Director of Facilities Engineering — MacMillan, 609-258-5472

3. Index of References

http://www.princeton.edu/facilities/design_construction/princeton_university_desi/

	PDF	AutoCAD
A. Princeton University - Laboratory Functional and Technical Criteria Checklist	Appendix 2.10 - 1	
B. EH&S Appendix D: Health & Safety Design Considerations for Laboratories http://web.princeton.edu/sites/ehs//labsafetymanual/appd.htm		
C. Labs21 www.labs21century.gov		

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. NJUCC subchapter 7 for requirements for accessibility

E. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

F. See Section 1.4 Regulatory Agencies for additional information

G. ANSI – Z9.5-2003 Laboratory Ventilation

H. ASHRAE 90.1 Energy Standard 2004

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, Environmental Health & Safety Representative, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented.
The Designers shall provide timely and coordinated responses to all review comments.
The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

Early in the programming phase of the project, the Project Manager will review the proposed project with the University Facilities Engineering department. The Project Manager, with the Designer, should meet with the Vice Provost of Space Planning to confirm the requirements for laboratory space in preliminary programming. If animals are involved in the usage of the laboratory, the Project Manager and Designer, should meet with the University Lab Animal Resources Group to determine any special requirements.

The Project Manager remains the Designer's primary contact and source of information. The Project Manager will involve other University sources in the project, including the Program Manager for Sciences in the Office of Design and Construction, the project representatives for the Facilities Engineering Department, Grounds & Building Maintenance, EHS, and OIT personnel.

Meetings with the academic department/end user for the project will be arranged by the Project Manager.

7. Guidelines and Requirements for Documentation

See Section 1.4 (Regulatory Agencies) for requirements for code review and permits, including the organization of construction Drawings and documents for timely release of permits.
At a minimum, the following are to be provided at the indicated phase:

Along with the Design Drawings, the Designer is to produce sufficient documentation to allow for code review of the project and for contract bidding of the work. See Section 1.4 (Regulatory Agencies) for requirements for code review and permits.

In addition to the documentation required for the permitting and construction of the project, the Designer will (if specified in the contract for services) provide a Statement of Design Criteria during the schematic design phase and a written Basis of Design (B.O.D.) document during design development.

These documents are intended to establish the general design criteria against which the technical and design specifications for the final project will be measured.

8. Guidelines for Laboratory Design

A. General Approach

Meeting the educational and research goals of the academic department and those for the project should be the guiding principle for the Designer. Laboratory design should be reviewed with the Project Manager and the academic department/client to determine programmatic needs and parameters.

There are different requirements for Laboratories, teaching and research, depending on the educational approach to be used in the laboratory. Detail is extremely important to the success of laboratory space; it is incumbent upon the Designer to ascertain the needs of the various laboratory types in a project, to thoroughly understand the requirements for the systems to be incorporated into the laboratories, and to detail the space around those needs and requirements. Based on these meetings a "Statement of Criteria" will be developed.

Establishing parameters for energy consumption and sizing of utility services and distribution is of paramount importance to the University. These parameters must be established early in the project, pre schematic, applying established benchmarks, projected usage with demand & diversity factors. The Project Manager will meet with the academic department/end user, the Design Team and Facilities Engineering to establish these parameters which will be included in the Basis of Design.

B. Space Requirements

Layout – General Requirements

- Laboratory space should be separate from offices and common space.
- Laboratories should be oriented such that a common service corridor can serve two laboratories (lab, service corridor, lab)
- Occupants should not have to go through a laboratory space to exit from non-laboratory areas.
- Fire-rated hallway doors should have magnetic hold-open devices
- Each door from a hallway into a lab should have a view panel and be at least 36" wide
- Mechanical and Electrical devices shall be readily accessible

Laboratories should be oriented to take advantage of natural lighting (with consideration for controlling sunlight and glare). Operable windows are acceptable in office areas, but not laboratory space. This desire must be balanced against the Energy Modeling goals established for Sustainability, therefore operable windows must be in conformance with the intent of the project and space, and must be accounted for in the HVAC design.

C. Finishes

Acoustic considerations should be the primary concern in finishes for laboratories. Acoustic control between laboratories is also important, so that sound transmission classification (STC) ratings of structural components and finishes should be taken into account when selecting materials and systems.

1. Walls and Doors
   There is no 'standard' wall material or finish, but the Designer must remember that the facility needs to be finished in a way that allows for normal cleaning, upkeep, and maintenance. See Section 4.9 (Painting) for additional information.

The Designer should attempt to incorporate breaks, reveals, or other architectural details to divide large expanses of painted surface, particularly in the vertical direction. This is especially true in high traffic areas, areas using high pigment paints, or locations that are especially subject to abuse.

Doors into laboratories should be provided with vision panels to allow students to see if room is in use.

2. Floors

Wet chemical laboratories should have chemically resistant coved flooring using sheet goods rather than tile, particularly in areas where fume hoods are located.

Finished flooring shall be installed throughout the laboratory to accommodate flexible laboratory conditions and room modifications.

Preferably, floors shall be level with no floor drains to accommodate flexible laboratory conditions and room modifications.

Floors in predominantly wet areas shall be non-slip and floor drains are preferred

3. Ceilings

Concern for proper acoustics should prevail in selection of ceiling materials. If acoustic ceilings are to be used, the preference is for a removable tile system framed on a unistrut support system. Concealed-spline ceilings should not be specified, unless there is a special condition that must be accounted for; review with the Project Manager and the Director of Maintenance before including concealed-spline ceilings in a project. Generally, concealed spline ceilings are appropriate only in locations without ceiling access requirements.

4. Window treatment

Review need for sunlight filtering in laboratories. Standard room darkening shades are produced by Mecho Shade, and may be manual or motorized.

Room Darkening vs. Solar Controls - Solar controls to support the HVAC needs must be considered for both the exterior and interior of the laboratory space.

D. Furniture and Fixtures

Work surfaces should be chemical resistant, smooth, and readily cleanable.

Work surfaces, including computer areas, should incorporate ergonomic features, such as adjustability, task and daylighting conditions, and equipment layout.

Benchwork areas should have knee space to allow room for chairs near fixed instruments, equipment or for procedures requiring prolonged operation.

Handwashing sinks for particularly hazardous chemicals or biological agents may need elbow or electronic controls.

Casework in Teaching Laboratories shall conform with ADA requirements. Casework in non-teaching (research) laboratories shall be adapted to the requirements of the individual users.

Limit the number of cup sinks in the laboratory (including in fume hoods) in order to avoid dry traps and the ensuing odors.

Ensure autoclaves have adequate space for use, maintenance and materials storage.

E. Lighting

1. General

Daylighting shall be maximized where possible for user comfort. Lighting should be even across the room, with a maintained light level for work surfaces in accordance with IES standards. Non - laboratory space shall follow IES standards. A combination of lighting zones, dimmable fixtures, and controlled daylight in the room is ideal. Fixtures should control glare and should not produce veiled reflection in the room or on equipment. Indirect/direct fixtures are favored.

If a room is multi-functional, the Designer shall take into account in the lighting design the various tasks that are to occur in the different sectors of the room.

If a space has a ceiling above 12’ in height, the project team shall review all access requirements for light fixture maintenance and incorporate any fixed requirements such as access panels, cat walks, etc. into the documents.

2. Special Features

Much of the public space lighting on the University campus is controlled by occupancy sensors. Typically, at least one light in a space will not be controlled by the sensor but will be on an emergency circuit (review this requirement in rooms that are to be totally blacked out for projection). The occupancy sensor is to be wired so that it can be bypassed with a conventional light switch. If occupancy sensors are to be included in a project, the operation should be carefully coordinated with the room use. Occupancy sensors should include additional contacts for integration with HVAC systems.

Review the need for daylight control.

3. Lighting Types

For instructional spaces (as with interior lighting in general) energy efficient lighting is standard for Princeton. Indirect/direct lighting is preferred for its even quality. For any needed downlighting or highlighting, PL-type energy efficient fixtures are preferred over incandescent fixtures. No halogen lighting may be specified.

To minimize the need for storing a large variety of replacement lamps, Designers should (if fluorescent lamps are used) attempt to use two- and four-foot tubes as a standard, and PL tubes with a common base configuration throughout a project.

F. Storage

1. Cabinets for chemical storage should be of solid, sturdy construction and vented as required. Hardwood or metal shelving is preferred.

2. Consider centralized space for any chemical and biological or radioactive waste storage.

3. Flammable liquid storage is not typically allowed below grade or near a means of egress; refer to applicable codes. The NJ Fire Code imposes limits on the quantity of chemicals stored in a building. There are individual limits for each of various types of chemicals, including flammable liquids, gases, acids, oxidizer, poisons, etc. The storage limit quantities are also based on location, such that storage is more limited below grade and above the ground level.

4. The requirements for the use and venting of flammable liquid storage cabinets shall be in accordance with current code requirements.

5. Laboratories using compressed gases should have areas designated for cylinder storage and be equipped with devices to secure cylinders in place.

6. Provide space for chemical waste collection containers other than in fume hoods and sinks.

7. Provide space for storage of supplies and combustible materials, e.g., boxes of gloves, spill kits, boxes of centrifuge tubes, etc.

G. HVAC / Plumbing

1. Ventilation rates are typically 8-10 air changes per hour minimum for occupied spaces and 4 air changes per hour minimum when unoccupied, but may vary based on room use/ program. Ventilation rates shall be reviewed with Facility Engineering. Where feasible, high performance hoods are preferable to standard hoods.

2. A VAV system is preferred for laboratories

3. Unless otherwise specified (e.g., clean rooms), air pressure in the laboratory should be negative with respect to the outer hallways and non-laboratory areas.

4. If a space has a ceiling above 12' in height, the project team shall review all access requirements for HVAC equipment maintenance and incorporate any fixed requirements such as access panels, cat walks, etc. into the documents.

5. Any RODI should be Orion type White line – Socket Fusion in wall and mechanical fittings where exposed.

6. Acid waste pipe for DWV shall be Orion (Blue) pipe. Heat welded when concealed in walls, heat welded or mechanical fitting where exposed in labs.

H. Fume Hoods

1. Restricted bypass style fume hoods should only be used in laboratories with constant volume exhaust systems. Newer ventilation systems generally allow for lower ventilation rates. Though these rates must be reviewed by EHS and the department for approval and verification.

2. Fume hoods should have recessed work surfaces to control spills.

3. The location of fume hoods, supply air vents, operable windows, laboratory furniture and pedestrian traffic should encourage horizontal, laminar flow of air into the face of the hood, perpendicular to the hood opening. Hoods should be placed away from doors and not where they would face each other across a narrow isle. Air velocity caused by supply vents should not exceed 25 feet per minute at the face of the hood.

4. Hoods shall have an Auto-Sash closing device and a face velocity of 60 – 100 linear feet per minute with the auto-sash fully open or at its standard configuration (e.g., at the stopper height). For velocities less than 100 FPM, review and approval by both EHS and the manager of mechanical engineering are required.

5. Each hood must have a continuous monitoring device, such as a magnehelic gauge. The device should display either air velocity or static pressure, and have an audible alarm.

6. Noise from the fume hood should not exceed 65 dBA at the face of the hood.

7. Fume hood exhaust ducts should be metal and not contain fire or smoke dampers.

8. Hoods for perchloric acid require stainless steel construction and a wash-down system and a dedicated, isolated fan.

9. Hoods requiring filters (such as those for some radioisotopes or biological materials) should be designed and located such that filters may be accessed and changed easily. For particularly hazardous filtration (such as those for some radioisotopes or biological materials), a bag in/ bag out system is strongly advised.

10. Single vertical sliding sashes are preferred over horizontal or split sashes.

11. Debris screens should be accessible and placed in the hood exhaust plenum.

12. Receptacles shall be GFCI, standard.

13. Provide atmospheric vacuum breakers for cup sinks as require by code. Ensure they are accessible for maintenance.

14. Consider alternative to fume hoods based on the intended operations. Ventilated enclosures, glove boxes, nanotechnology benches, downdraft tables, slot hoods and fume extractors may be effective and more energy-efficient.

15. Provide emergency ventilation purge buttons at the laboratory exits for use in the event of a spill or release. The style of the button should minimize potential for accidental activation and allow for cancelling the purge without the need for a key.

I. Eyewash & Safety Showers

All Eyewash & Safety Shower locations must be reviewed and approved by the University EH&S group.

1. Laboratories using hazardous materials must have an eyewash and safety shower within 100 feet or 10 seconds travel time from the chemical use areas.

2. Eyewashes and safety showers should have plumbed drains where possible.

3. Eyewashes and safety showers should be standardized within a laboratory building.

4. Flooring under safety showers should be slip-resistant.

5. Safety showers should have privacy curtains.

6. Safety Showers shall be piped with tempered water; use Lawler 911 mixing valves

7. Water service to emergency shower / eyewash should be discussed with code official in early stages of project in order to confirm the use of non lab (potable) water.

J. Safety

1. Utility shut-off controls should be located outside the laboratory.

2. Environmental chambers where evacuation or other alarms cannot be heard should be equipped with strobe lighting or additional alarms.

3. The requirements for monitoring and control of Laboratories using highly toxic gases shall be reviewed with EH&S.

4. Include "Laser in Use" signs at all entrances to labs with lasers.

K. Power

1. Laboratories should have a sufficient number of electrical receptacles to eliminate the need for extension cords and multi-plug adapters.

2. Each laboratory shall have a dedicated panelboard located in an unobstructed accessible area.

3. Laser laboratories should have power interlocks for the laser to be tied into the "Laser On" light (installed at the entrance to the laboratory).

4. Laboratories with lasers and/or high voltage equipment should have an emergency power-off switch installed near the laboratory exit and not over the laser table.

L. Security

Review the need for security control of laboratories with the Project Manager. The University employs access control, as part of a campus-wide system, at the entrances of many of its buildings, and to some interior spaces as well.

Laboratories classified by Environmental Health and Safety as Security Protection Level 2 (high value equipment or security-sensitive materials) or higher may require additional security measures, such as card access, intrusion alarms, cameras, etc.

M. Clean Rooms

The use of a Design – Build vendor for clean rooms is preferred. This sub consultant to the primary designer approach is a function of the clean room requirements.

N. Animal Care and Use Facilities

Animal care and use areas must meet Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) International guidelines. This includes guidance on materials of construction, ventilation design, security and more.

Any renovation or new construction to house or study animals used in research need to be planned with the research and the animals in mind. Principal Investigators (PI's), the Attending Veterinarian, the Director of Laboratory Animal Resources (LAR) and his staff need to be involved from the earliest concepts to the detailed planning. Since regulatory oversight of all research activities, including housing of animals, has to be approved by the Institutional Animal Care and Use Committee (IACUC), that committee should also be consulted from design until commissioning. Depending on the species, multiple regulations and/or guidelines may apply. While AAALAC has an excellent **Handbook of Facilities Planning**, many other guidelines exist for classical laboratory animals, birds, fish, farm animals, exotic animals, wildlife and others. Additional concerns when building animal care space is occupational health and safety of animal care staff and research personnel, as well as different levels of bio-containment or bio-exclusion of the species and type of research being conducted. Special consideration needs to be given to space for storage and logistics and separation of clean and dirty traffic flows and impact on the surrounding activities.

O. Radioactive Materials Laboratories

For laboratories using radioactive material

1. Eating and drinking areas must be physically separated and conveniently located.
2. Allow for separate storage of radioactive materials.
3. Consider designing the laboratory to allow separation of radioactive materials use from other laboratory spaces.

9. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of As-built Drawings prepared by the construction contractor and any systems installer.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record drawings to convert to as-builts.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

Princeton University has several large apartment complexes housing graduate students. The student population is approximately two thousand two hundred and students typically reside in these units twelve months a year. These units vary from high-rise construction to wood frame housing. *(Note that italics will be used to indicate statements that apply only to apartment renewal design work.)*

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst	MacMillan Building, 609-258-6706
C. Associate Director for Student Housing	New South Building, 609-258-2691
D. Deputy Director for Housing Operations	New South Building, 609-258-1908
E. Director of Housing	New South Building, 609-258-3469

3. Index of References

http://www.princeton.edu/facilities/design_construction/princeton_university_desi/

	PDF	AutoCAD
A. Interim Fire Code Reports (for each building, by various consultants	Consult Project Manager	
B. Existing Conditions Reports (for buildings in the dorm renewal process, by various consultants)	Consult Project Manager	
C. Princeton University Master Technical Specification for Fire Alarm Systems to be installed in Non-High-Rise Residential Buildings, Wayne Moore, P.E., of Hughes Associates	Appendix 3.4-1	
D. Record Drawings of University Buildings	Consult CAD Archivist	Consult CAD Archivist
E. Memo: Standard Dormitory Paint Colors (dated 1/18/2000, by the Committee for Standard Dormitory Paint Colors	Appendix 2.4-3	
F. Fire Alarm / Signage Nomenclature Spreadsheet Sample, Princeton University	Appendix 2.8-2	

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable codes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

E. International Building Code (in edition adopted and modified by NJUCC); apartments are typically R-2 use group

F. NFPA 101 - Life Safety Handbook

G. NFPA 13, 13R - Sprinkler System Installation Guidelines

H. NFPA 72 - National Fire Alarm Code

I. See 1.4 (Regulatory Agencies) for additional information

5. Review Guidelines - General

For apartment renewal projects, planning begins at least two years in advance of construction. Planning for new construction may take a similar course. As the project moves toward the construction documentation and code review phases, it becomes important that the project be reviewed with the Housing Office, Facilities Engineering, Grounds and Building Maintenance, the Office of Design and Construction, Office of the University Architect, the Department of Public Safety and to any department affected by the work.

For new construction each Housing project has a specific review committee. The committee is made up of representatives from the Office of the University Architect, Office of Design and Construction, the Facilities Engineering Department, Grounds and Building Maintenance, the Housing Office, and the office of the Vice President for Facilities. Additionally, committee members come from the Office of the Dean of the Graduate School and the Office of Off Campus Development. Finally there is student representation from the Graduate Housing Policy Committee.

After preliminary design is complete, additional departments may be brought into the design development and construction planning phases. Departments such as Public Safety may be included in the review process, and may act as in-house consultants for specific aspects of the project.

During this pre-construction phase mockups are constructed (and may include complete full-scale models of rooms) to aid the review committee in selecting room finishes and accessories, window types, light fixtures, heating units, piping enclosures, etc. Every visible finish and system component is designed, constructed, tested, and reviewed. Mockups are also used to test the effectiveness of cleaning methods on building stone and other finishes to remain in place. A significant amount of effort is necessarily put into the design and documentation of mockups, for they are the tools that lead to final design decisions and to the aesthetic that ultimately forms the project. Mockups are typically constructed during the summer of the year prior to the project's construction start date, and lead into final construction documentation for the project.

During the process of design, plans are to be submitted for review by Facilities departments at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, Housing, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines - Approach to Regulatory Agencies

During preliminary design, Designer is to consult with University Project Manager to ascertain the probable need for site plan and zoning approvals. Altering the outside of the building often triggers the need for community review. Exterior alterations to buildings may require local zoning/planning review and approval. Consult with Project Manager and see description of zoning and planning issues in Section 1.4 (Regulatory Agencies).

During the early stages of design the Designer is to consult with the Project Manager and the University's Code Analyst to define code strategies and to discuss any code interpretations that might affect the project. Some design decisions may require relief from strict code requirements as interpreted by the State and local code reviewers. The design team is responsible for formulating the relief request (variation or variance) and providing support documentation for the request, including any alternatives for providing life safety in lieu of code conformance.

7. Procedural Guidelines - Code Review Applications and Submittals

Prior to submitting an application for project review, the Designer will prepare the project application forms, including (where applicable) the DCA's Project Review Application, the Application for Plan Review and the forms for local review. The Designer is to meet again with the Code Analyst to review the application forms and any supporting documentation.

All submissions made to the Department of Community Affairs or to the Department of Fire Safety are to be channeled through the University's Code Analyst. Likewise, all communications during the review process are to be made through the Code Analyst; this individual acts as liaison between the University and the State construction agencies, and is responsible for continuity in the applicability of code issues from project to project. It is imperative that this continuity be maintained.

Insofar as is practicable, only 100% complete documents are to be submitted to DCA for review. The intent is to prevent needless and time-consuming review by the State agency, and review comments brought on by incomplete information. The Designer is to refer to the plan submission checklist in the Application for Plan Review; see Section 1.4 (Regulatory Agencies).

8. Guidelines and Requirements for Documentation

Along with the design documents, the Designer is to produce sufficient documentation to allow for code review of the project and for contract bidding of the work. Preparation of contract specifications is to be done in conjunction and in cooperation with the University's Contracts Office; the "front end" of specifications is typically prepared by the Contracts Office, and integrated with the project specifications by the Designer.

See Section 1.4 (Regulatory Agencies) for requirements for code review and permits, including the organization of construction Drawings and documents for timely release of permits.

9. Considerations for Apartment Design

A. General Approach

1. In new construction and in renewal of Princeton's apartments the mix of social spaces with living spaces, the density of apartments and the type and number of support/utility spaces in an apartment complex, along with other design considerations, is highly dependent upon the purpose the community and who the apartment serves.

   Graduate apartment complexes are generally high density and the premium space may not be able to be given over to social and educational programs within the building; and service-type spaces may be shared among a group of buildings.

   All graduate apartments will typically contain a full complement of service and support spaces such as laundry, kitchenette (with sink, outlets, refrigerator and microwave), public restroom, computer cluster, and a community room.

2. *The initial step in an apartment renewal project is to determine a preliminary scope of work and to conduct a full-scale survey of the building. This survey should be performed after discussions with the Project Manager, the Housing Office, on-site superintendant and the University's Grounds and Building Maintenance Department, to assemble available information on systems in the building, and to gain insight on any known defects in a building. In interviews prior to surveying a building, the Designer can be advised of any environmental issues that might affect the project; see section 10 below for additional information on this subject. A report on existing conditions is produced from the survey, including information on the building finishes, envelope, and systems. The report will be presented to the review committee, which may make suggestions for revisions or modifications before a final version of the report is produced.*

The report is used as a tool to develop the building program and to guide the professional in the schematic design process. Input from the design review committee is critical at this point in the process. The committee will prescribe the desired bed count, the mix of singles, doubles, and quads, the bathroom fixture ratio, etc. Additional survey work may be needed to measure critical areas after initial planning and design is completed. Some core samples of building systems may be required to ascertain existing construction, and investigative demolition might be carried out in this effort.

3. After schematic plans are approved by the review committee, the Designer is to provide a furniture layout plan, which will be used to develop the design of electrical and mechanical systems in the apartments. This step is important in developing plans for new construction as well as in dormitory renewal.

   As electrical and mechanical systems are developed for the building (with the chases, duct shafts, etc. that these systems require), the Designer will need to coordinate the mechanical systems with the furniture layout. The intent is to produce a plan that integrates building systems into the overall layout, without sacrificing utility and comfort to aesthetics, or vice versa. The review committee will be presented with the final building layout and furniture plan for approval before the project is carried into the Construction Documentation Phase.

4. Apartment Numbering Requirements

   It is the intent of all projects to have apartment numbers assigned during the Design Development Phase. It is the responsibility of the Designer to initiate and complete this process, and the Project Manager's responsibility to gather required approvals. All Drawings shall reference the University's approved numbering system and the United Stated Post Office requirements for street addresses.

   See Appendix 2.8-2 for a sample spreadsheet for coordinating this process and Appendix 1.5-3 for room/space numbering system guidelines.

B. Exterior

1. Apartment Accessibility

   One of the goals of the apartment renewal projects is to create accessible routes to as many apartment spaces as is reasonably possible.

   The project review committee will advise the Designer on the level of accessibility desired in the project, based on options presented by the Designer and influenced by campus-wide accessibility needs. See Section 2.1 for a description of this process.

   Code minimums must be met for accessible and adaptable units within each apartment building, code requirements for mounting heights of switches and controls are to be met by the design, and placement of special devices such as audible-base detectors and strobe alarms are to be carefully planned. For more technical information see Section 3.4 (Fire Alarms).

2. Safety/Security

Consideration is to be given to vehicular and foot traffic routes into and along buildings, so that cul-de-sacs and dead-ends are eliminated. (The same considerations should apply to interior circulation.)

Exterior lighting should be sufficient to provide safety and security to passers-by and to building occupants. NJUCC/BOCA code requires emergency lighting of egress paths on the exterior of dormitories.

3. Site Accessories

Intercoms with magnetic/electric releases are preferred to be installed at apartment entries. See Section 3.1 (Access Control Standards). The Designer is to consult with the Project Manager to assess the need for exterior emergency phones.

Consideration should be given to site furnishings, particularly bike racks, children's play areas, passive recreation, shuttle stops, storage, smoking areas, picnic areas, etc.

4. Finishes

Exterior finishes are of paramount importance in the perception of the quality of buildings at Princeton University. The exterior envelope of the building should be studied carefully during the building survey, and the existing conditions report should concisely describe the findings of the survey.

Envelope components that must be considered in the study include walls, copings, parapets, chimneys, and decorative and trim masonry; flashings, gutters, leaders, leader boxes and roof; windows, louvers and vents, doors, door accessories, entry steps, handrails and paving.

5. Site Utilities

When a building is a candidate for renewal, the Facilities Engineering Department may decide to take the opportunity to replace services into the building or site utilities near the building. New buildings also require extensive investigation for utility work. The Designer will be asked to enumerate and evaluate the utility loads for heating, cooling, electrical, and similar systems in new and renewal work, as well as the effects on water supply, sanitary, and storm lines on and around the site. The Designer will need to coordinate the efforts required for documentation, review and construction of this work, and may be requested by the Engineering Department to provide design services for the utility work. See Section 3.6 (Utilities Guidelines).

C. Interior Circulation

Interior circulation must provide reasonable access to all areas of the apartment and must, at a minimum, meet the requirements of the building and life-safety codes in effect in New Jersey see Section 1.4 (Regulatory Codes).

1. Entries

Entries must be carefully and skillfully treated to enhance the Designer's intent. The Designer should integrate a number of standard elements into the design for each entry. These include:

a) Card access on building entry doors (see Section 3.1 Access Control Standards). Door entry hardware (VonDuprin rim-type panic device) is modified to incorporate electric release mechanism, or interlocked electric strike to accommodate door intercom and release system.

b) Scrub mats or walk-off mats at the entrance, in a durable, cleanable, easily maintained material; the design should feature mats which can be easily replaced and slip resistant. See Appendix 2.4-5

c) Lockable safety glass case message boards, such as tackboards (meeting code requirements for finishes); a variation on the standard types may be developed, either metal-framed or trimmed in wood.

d) Specify durable, cleanable wall and floor finishes.

e) Mailboxes, front loaded, keyed to individual apartments

2. Stairs

a) There is no "standard" stair material. The Designer may choose a durable and inherently safe material from wood to stone, to reflect the building aesthetic.

b) Doors and hardware must meet code requirements for size, operation, fire rating, and temperature rise. Doors and frames should be of a durable construction to withstand the wear and tear of daily use by students and custodial staff. Smoke detector-activated hold-open devices are often used on stair/corridor doors to reduce wear and tear, and to create a more open appearance.

Princeton University standard hardware set for stair doors leading to corridors is a cylindrical passage set by Best Locking Systems; Precision non-electromechanical panic devices are standard for interior stairwell doors and, as noted above, VonDuprin or Precision panic devices are the standard for exterior entry doors. Refer to Section 4.4 (Door Hardware) for additional details.

c) Guards, balusters, and handrails should be designed consistent with safety codes to enhance the finished appearance of the stairway

d) Specify durable and easily maintainable wall and floor finishes

e) Meet minimum lighting requirements, including exit and emergency lighting; use lighting to enhance design

f) *In an apartment renewal project, a Designer should assume that, if standpipes existed in the building prior to the renewal project, standpipes will be required as part of the renewal work.*

If retaining a standpipe in the building presents a major problem (due to space constraints, e.g.) the University may appeal to the State to remove the standpipe.

The decision to file an appeal requires the approval of the AVP for Facilities, Design and Construction and the AVP for Facilities, Plant.

Those buildings that do not have a pre-existing standpipe can be evaluated on a case-by-case basis. The AVP of the Office of Design and Construction will make the final decision on the inclusion of standpipes in such a case.

All apartment standpipes will be dry systems charged using a post-indicator valve located near the fire department connection outside the building.

g) Fire Extinguishers – The design of the fire extinguisher in hallways/corridors shall be incorporated with the overall stair design and enclosed in a fire-rated cabinet as required. Interior common corridors that serve apartments should be equipped with ABC extinguishers. See Appendix 3.8-2

3. Public hallways/corridors

a) Specify durable wall and floor finishes; research requirements for fire ratings in corridors, provide listed assemblies where needed. At a minimum, use reinforced gypsum board for walls, with skim-coat finish. (Gypsum board walls with taped seams are the preferred wall finish in apartment halls.)

The project design review committee will advise the Designer on the use of carpet or hard-surface finishes in corridors.

There should be some form of base in corridors for housekeeping purposes, compatible with floor finish; tile, stone, wood, rubber; review with Project Manager.

Princeton University employs a range of standard colors for use in apartments; consult with the Project Manager.

Fire Extinguisher – The design of the fire extinguisher in stairs shall be incorporated with the overall stair design and enclosed in a fire-rated cabinet as required. See Appendix 3.8-2.

b) In rated corridors, doors and hardware must meet requirements for fire assembly. Princeton University employs a standard apartment-to-corridor cylindrical lockset, a storeroom function lever-handle lockset, as well as standard hinges, closers, etc. See Section 4.4 (Door Hardware). For corridor doors leading to public or social spaces, consider using smoke detector-activated hold opens.

c) Ceilings: consider routing of utilities early in design; if corridor ceilings are to be used for utilities, ceilings must be accessible. Minimizing MEP systems above ceilings is desirable. Appearance is important, and utility runs must be thoroughly planned and documented to minimize the need for multiple access doors in hard-finished ceilings. See Section 4.2 (Corridors).

d) Lighting: must meet Code mandated minimum levels, and must meet University standard levels. Hallways should have lights that are lit 24/7/365, and may be lighted with ceiling lights, wall sconces, or a combination of both. Apartments, also, may be lighted with ceiling lights, wall sconces, or a combination of both. The type of lighting may be dependent on the style of the building. The Designer is responsible for insuring that all components of lighting - lenses, lamps, ballasts, wiring connections, etc. - are readily accessible and non-custom, for maintenance of fixtures. See Section 3.5 (Lighting Design). Code minimums for emergency egress lighting levels must be met for the entire egress pathway.

Any surface mounted exit sign mounted on edge below 9'-0" requires redundant support along a second edge or side, preferably located at a wall/ceiling intersection.

e) Sprinklers: sprinkler heads are to be concealed in corridors if possible; if sidewall sprinklers are to be used; ONLY concealed type are to be used.

f) Security and safety concerns - dead-ends, remote areas, emergency phone location

g) Air handlers and other mechanical equipment placed in eave spaces off corridors require sound insulation, vibrant isolation and low db rating.

h) Trash Collection – The Designer shall evaluate locations for dumpsters on site. Provisions for recyclable materials containers should be reviewed on each project. Currently residents bring their trash and recyclables to exterior bins.

i) Electrical Outlets – Maximum 25' on center dedicated 20 amp. circuit per corridor or stair.

D. Social spaces/"public" common rooms

The mix of social spaces in an apartment building or complex should be determined in the preliminary design phase in consultation with the review committee.

If a social space is proposed above or near an apartment, specific approval for the location is required from the review committee.

Some comments on typically provided amenities follow.

1. Lounges / Computer Clusters / Multipurpose

a) The size, shape, and number of lounges, computer clusters and laundry rooms should be discussed with the committee in the conceptual phase.

b) Provision should also be made for wireless data communications.

c) Vending area is to be provided with an OIT wiring bundle.

Designer is to consider heat produced by vending machines in calculating the HVAC requirements for lounge areas.

d) Social spaces are considered special areas, and the normal constraints on paint colors do not necessarily apply to these spaces. These spaces should be child friendly. Consider the storage needs of these spaces, storage for things like toys and yoga mats are commonly needed. Consult with the Project Manager.

e) All apartments and common areas should have wireless technology as well as be outfitted for hard wired telephone, cable and Dormnet.

2. Laundries

Laundry facilities are to be included in each apartment complex. Access to the laundry room is to be through the interior of the building. Particular attention must be paid to the “nuisance factor” of a laundry room - the effect of noise and heat on nearby rooms. See Section 4.7 (Laundry Rooms). Classrrom function locksets are required at Laundry Room Doors.

Laundry rooms are to have durable floor finishes and need to include a floor drain.

Typically, laundry rooms will contain the following:

a) Commercial grade washers that are energy efficient, coin or card operated.

b) Stacking electric dryers, coin or card operated, with individual vents located at the discharge point. Plan to install one dryer for each washer in the laundry room. Consult Building Services and the Housing Office for clearance requirements for maintenance of units; see Section 4.7 (Laundry Rooms) and Appendix 4.7-3.

c) Motion sensor-activated light fixtures for general lighting (with an unswitched light in each area).

d) A fixed table or counter with hanging rod, for folding with bins

e) Large-volume trash receptacles

f) An adjacent waiting/study area is desirable; visual connection with adjacent space or corridor is desirable.

g) Room ventilation system is necessary

h) An emergency phone should be installed in the laundry area. (A panic button may be necessary for remote location.)

i) For design purposes plan 1 washer for every 25 occupants and 1 dryer (stacked) for every one washer.

j) Plan one utility sink per laundry room

E. Living Units

1. Living/study/common rooms

a) Space Requirements

Apartment space requirement should meet the DCA or Local Codes. This should be closely reviewed by the Office of Design and Construction and the Housing Department

b) Layout

The positioning of the living/kitchen room can be opened if this scenario provides the best use of space. In efficiency apartments, there should be a reasonable amount of distance from where one might position a bed in relation to the actual kitchen area. In one bedrooms and larger, the living area should remain separate from the sleeping space. Wherever possible, the bathroom should be accessed from the living room or from a corridor.

c) Location/ Orientation

When possible, the apartments should be accessed from a protected interior corridor.

d) Finishes

1) Walls: durable finish; skim-coated impact resistant gypsum.

2) Floors: durable finish; wood strip flooring, vinyl tile or approved equal. For wood flooring, finishes must meet New Jersey requirements for volatile organic compounds (VOC). (4-coat) water-based finishes have proven suitable for private rooms.

3) Ceilings: typically gypsum board or plaster; if utilities are run in ceilings or in soffits in rooms, carefully planned access panels may be required for valves, junction boxes, etc. Refer to Section 4.4 for specifics regarding access panel requirements.

e) Doors and hardware: rated doors and hardware may be required for corridors; unrated doors may be used for doors interior to living units. Best Lock cylindrical sets are standard. Door viewers shall be installed at all apartment doors.

f) Windows: Apartment renewal projects often include the reconstruction or replacement of windows original to the building. During the building investigation enough information should be gathered on the condition of windows to determine whether rehabilitation/reconstruction is a viable option, based on cost/life cycle.

New buildings should incorporate new window technology for energy performance and for ease of maintenance. Within these basic guidelines, a wide variety of types and designs are available.

Regardless of building type, the following requirements apply:

1) Ventilating sash: habitable rooms require natural ventilation if a mechanical ventilation system is not being installed in the building.

2) Screens: all operable sashes require screens, and windows at grade or first

floor must be fitted with heavy-duty (.020 wire gage fabric) screens for security. Emergency egress requirements must be met by screens and windows; coordinate with building egress plans. Include positive latch from inside of room only.

3) Shades: all windows in living units are to be supplied with shades. Simple spring-loaded roll-up shades are standard on campus. Evaluate window trim and screen operation to avoid conflict with shade operation. Princeton utilizes a custom shade fabric for apartments. The shades may be purchased through the university shade shops, or shade fabric may be purchased (via university suplplier) and supplied to the shade vendor.

g) Utilities: System piping and equipment, ductwork, etc. must be carefully planned and routed to produce an integrated design for the building. Placement of apartments over or near the building's steam-to-hot-water converter can be problematic.

1) Heating/cooling: heating is usually provided by heat pumps. Individual HVAC controls are to be installed in each apartment.

Ventilation with tempered make-up air is generally provided for laundry rooms and other spaces with mechanical ventilation requirements. Air-conditioning is generally provided in new graduate apartments and major renovations. If a heat pump system is selected for HVAC, consideration should be given for alternative cooling systems such as geo-thermal wells for concurrent implementation or at a future date.

2) Power: *wiring is typically replaced in renewal projects, with one power circuit per room. Wiring should be totally concealed. The number of duplex power outlets is increased to meet current code levels ($\leq$ 12 feet apart) and the needs of apartment life*. Outlet location should be carefully coordinated with furniture plans. A quad outlet should be installed at OIT jack locations.

For both new construction and apartment renovation each apartment should be supplied with its own circuit panel box and provide switched outlets where appropriate. This decision shall be made in conjunction with Facilities Engineering after determining if localized A/C units may be installed in the Living Unit.

Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conductor equipment.

3) Lighting: at least one switched outlet should be provided in the living and bedrooms. Review standard fixture with Project Manager to ascertain requirements for backboxes, conduit, switching, etc. Of primary concern for proper light distribution is the mounting height.

Mock-ups of typical apartment lighting schemes are required to confirm final design layout. All fixtures should also be easily procurable, should the University need to get replacements.

4) OIT: the presence one two-port data with cable TV outlet with one phone outlet constitutes a standard OIT outlet. One OIT outlet per room is standard, with adjacent quad power receptacle. The OIT package should be reviewed which will include the current standard.

2. Sleeping rooms

a) Doors and hardware: unrated doors with passage or privacy hardware may typically be used for doors interior to sleeping rooms.

Bedroom doors in apartments are equipped with Best Lock privacy locks, as are bathrooms within units.

The Designer is advised to review requirements for fire-rated enclosures (and the lessening of requirements) in dormitories with full fire-suppression systems. Door viewers shall be installed at all corridor doors at both ADA and non ADA heights.

b) Windows: the same considerations for common rooms apply to sleeping rooms.

c) Utilities
In general, individual unit metering is preferred for incoming electrical service, and if required, gas service. Water service is not individually metered by unit on most projects.

1) Heating/cooling: as with common rooms, heating is usually provided by heat pumps. Individual HVAC controls are to be installed in each apartment.

Air-conditioning is generally provided in new graduate apartments and major renovations. *For small renovations where through-wall air conditioning is considered, provide an additional AC power circuit to be installed in sleeping rooms adjacent to the proposed unit location.*

2) Power: duplex outlet placement should meet code requirements *($\leq$ 12 feet apart).* Coordinate placement with proposed furniture layout; in rooms that are not in accessible areas, outlets should be mounted at 11'' (at renovations only) above floor to avoid possible conflicts with bed frames. For new construction, locate duplex outlets away from typical bed locations wherever possible. Provide quad power outlet at OIT outlet.

Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conductor equipment.

3) Smoke detection: locate heads away from possible sources of interference or damage such as doors, light fixtures, etc. Detectors must be 36" minimum from air supply outlets. Cooking areas and bathrooms are to be avoided.

4) Fire suppression: concealed heads are preferred, either ceiling-mounted or sidewall type. If a dry standpipe is run adjacent to a room, access doors for inspection of the standpipe might be required within the room.

3. Bathrooms

a) Fixture Requirements

Princeton University generally has apartments with private single fixture bathrooms.

Generally floor-mounted toilets with lids are preferred in concrete or steel construction. This approach is preferred for both new and renovation construction.

Soap dishes should be built into the wall of the lavatory and tub/shower area. Tubs should comprise a high percentage of the bathrooms; shower units are to be installed to meet code required minimums. Bathrooms should have mechanical ventilation.

b) Finishes

Provide washable finishes; floors are typically ceramic tile or stone with colored grout, as are walls to at least the height of mirrors.

Materials must be water-resistant; at a minimum, use water-resistant gypsum board for walls and ceilings. A smooth plaster finish is preferred. Plan carefully for access doors that are often needed in bathroom walls or ceilings; minimum 12" square doors are standard, with screwdriver operation. Consider resident quality – unobtrusive location.

c) Lighting and Power

Provide ambient lighting for the room and an additional sconce fixture by the lavatory/mirror. Provide ground-fault-interrupted receptacles at lavatories. Provide back-box and power for electric items.

Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conductor equipment.

d) Bathtub/Shower Combination Units

These units should include tile surrounds or have an insert. Shower units should have soap holder shelf built into the unit. Windows should not be located within the tub/shower area

e) Accessories

1) The following need to be specified by the Designer: robe and towel hooks, towel bars, medicine cabinets (or mirror), and residential toilet paper holders.

2) The University may install electric hand dryers in bathrooms in lieu of paper towel dispensers in common bathrooms located within the complex.

4. Kitchens

a) Full-service Graduate Student Apartment Kitchens. These full-service kitchens are installed in graduate student apartments. They are installed for the purpose of providing graduate students kitchen facilities that would be used for daily meal preparation.

The Graduate Student Full-service Kitchen will contain the following items:

- Freestanding 30” electric range with four burners and an integral oven;
- Hood above the range with an integral recirculation hood. Option: exterior ventilation. The designer shall take note to locate any required Fire Alarm Smoke Detectors as far away from this location as allowed by code.
- Microwave oven (not a combination range hood unit), usually on countertop;
- Sink with bin, or bins, that is sufficiently sized for cleaning cooking utensils and equipment;
- Kitchen faucet;
- Mechanical Ventilation;
- Freestanding full-size refrigerator and freezer unit, without an automatic ice-maker/dispenser, white, 16 cubic feet;
- Overhead and under-counter cabinets;
- Garbage disposals will not be installed;
- Minimum of 24” or 26” width of available open counter space with a 4” high backsplash or cabinet to counter finish;
- The flooring finish is to be a durable material and is a function of the floor substrate, linoleum preferred;
- There should be a minimum of 4 electrical outlets to accommodate small appliances; and;
- Cabinets should have at a minimum wooden frames and doors. Knobs are discouraged, flush panel doors are preferred.

Housing to supply current options for finish and appliance information.

10. Custodial Closets

Each apartment building, depending on layout, will require a custodial storage room of approximately 35 square feet (and possibly larger in larger buildings) for paper products and cleaning supplies and equipment for floors with social spaces and common rooms. Exact janitorial requirements for each building are a program issue to be resolved during design development. The closets should include utility sinks. Refer to Section 4.3 Custodial Closets and Storage for more information.

11. Signage Requirements

Prior to submitting signage design package the designer shall meet with the project manager to determine required locations and signage types. Generally, interior signage for apartment buildings shall include:

A. Emergency Room Evacuation Signage - To be located immediately adjacent to room side of corridor door handle, indicating direction of all legal exits.

B. Apartment Identification Signage - To be located on corridor side at entrance to each apartment. Includes room number and ADA Braille requirements. Each room I.D. sign shall be designed individual to each project.

C. Stair Egress Signage - Denotes level and levels down to exit. Assigns a stair number and includes ADA Braille requirements.

D. Common Area Signage – Includes door number and ADA Braille requirements.

E. Elevator Signage – In accordance with ANSI A17.1 requirements.

F. Electrical Signage – In accordance with NEC requirements.

G. Fire Protection Signage – In accordance with NFPA requirements.

12. Environmental Issues

Prior to undertaking renovation work in an existing apartment, the University will arrange for a survey of the building to determine the possible presence of hazardous materials. The University will engage a separate consultant for any remedial consultation deemed prudent as the result of this survey, and will attempt to abate any hazardous material prior to the start of construction, using a separate contractor qualified to perform the abatement work.

13. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the construction contractor and any systems installer.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts. See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

The University requires that all exterior doors of dormitory buildings and selected doors for non-dormitory buildings are included as part of the campus-wide access control system. This System is proprietary and is monitored by the Department of Public Safety located at 200 Elm Drive, and administered by Facilities Life Safety and Security Systems. During Schematic Design phase of a project, a determination must be made commensurate with the risks posed by the intended occupancy or use regarding the need for, or desirability of including interior door access control and/or intrusion alarm systems and/or ADA power assisted exterior doors. Reference Section 2.7 (Security) for a review of this process.

The Project Manager, Department of Public Safety Representative, Facilities Life Safety and Security Systems Engineer, University Code Analyst and CACS (Campus Access Control System) Designer shall determine the doors that get monitored only and the doors that shall be equipped with additional security devices such as an access control reader and the doors that require power assist. The final configuration shall be reviewed by the Facilities Life Safety and Security Systems Engineer and Code Analyst for approval. The A/E is responsible for the design and specification of the conduit system, door hardware and door and door frame electrical pathway. The University Systems Integrator, shall prepare the final system wiring diagrams with details and location of access control devices. These wiring diagrams will be included in the A/E design documents.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst — MacMillan Building, 609-258-6706

C. Life Safety and Security Systems Engineer — 306 Alexander, 609-258-6683

D. Maintenance Lock Shop Supervisor — MacMillan Building, 609-258-2483

E. Maintenance Alarm Shop Supervisor — 306 Alexander, 609-258-3989

F. Card Access System Administrator — 306 Alexander, 609-258-3137

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Princeton University Typical Plan/Elevation Security/ADA Features Layout	Appendix 3.1-1	Appendix 3.1-1
B. Princeton University Typical Building Processor Cabinet with UPS Diagram	Appendix 3.1-2	Appendix 3.1-2
C. Princeton University Typical Single Door Detail(s) (5pp)	Appendix 3.1-3	Appendix 3.1-3
D. Princeton University Typical Double Door Detail(s) (4pp)	Appendix 3.1-4	Appendix 3.1-4
E. Index of MEP Pre-Functional Tests (CACS Commissioning)	Appendix 3.3-7	Appendix 3.3-7 (MS Word)
F. Index of MEP Functional Tests (CACS Commissioning)	Appendix 3.3-8	Appendix 3.3-8 (MS Word)
G. Security Programming Document	Appendix 2.7-4	

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. International Building Code – Chapter 10 Hardware

C. NFPA 101 – Life Safety Code

D. ICC/ANSI-117.1

E. National Electric Code (NEC) NFPA 70

F. Americans with Disability Act Accessibility Guidelines (ADAAG)

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Life Safety and Security Systems with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the

University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

The university utilizes a proprietary access control system. The designer is to provide construction documents that conform to the current components and operational features of this system, including required pathways, wiring diagrams and device specifications. At Design Development, the Designer shall meet with Project Manager, Facilities CACS Tech Representative and Department of Public Safety Representative to ascertain the type of building(s) and the extent of access control points. The requirements for the construction documents will be based on this meeting.

The A/E should consult the Security Programming Document for CACS programming requirements. Also during design development the CACS sub-consultant shall consult with the Project Manager and the University's Code Analyst to define code strategies and to discuss any code interpretations affecting the project. For residential buildings, the Housing Office will be involved with all locations of access control points. All ADA requirements shall be defined during this process. In addition, the CACS Tech Team members shall also include the Facilities Life Safety and Secuirty Systems Engineer, Card Access System Administrator, and the Facilities GBM Lock Shop Supervisor.

7. Guidelines and Requirements for Documentation

Sufficient documentation shall be prepared for code review of the access control project and contract bidding of the work. Separate floor plans, riser diagrams, and details shall be prepared for all CACS construction documentation. This documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Notes & Symbols		X	X	X
Floor Plans – CACS devices		X	X	X
Floor Plans–Raceway Routes			X	X
CACS Riser Diagrams			X	X
CACS Door & Hardware Schedule			X	X
Details – equipment Connections			X	X
Vertical Sections as required				X
CACS Specifications			X	X

8. Guidelines for System Installation and Performance

A. Reportability

1. The access control system communicates between the building processor located in the remote processor cabinet (RPC) and the host computer located at Office of Information and Technology (OIT) Facilities at 87 Prospect Street via a standard 5/8” bundle. This bundle includes a *private* network fiber line as well as other general purpose copper and fiber network communications. . The Designer shall incorporate the Processor Cabinet and an empty OIT conduit/receway for this requirement in the design.

B. New Construction and Renovation

1. All access control devices and junction boxes shall be accessible in accordance with the National Electric Code.

2. Raceways in finished areas shall be concealed where possible.

3. In the event that exposed raceway must be employed, the Designer shall review the approach to the layout of the raceway and shall specify the appropriate material with the Facilities Life Safety and Security Systems Engineer.

4. All electromechanical door hardware shall be reviewed and approved by the Facilities Life Safety and Security Systems Engineer prior to installation by a **certified installer,** qualified by the manufacturer. Doors shall be tested with electrical actuation of the hardware to provide proper adjustment. Testing equipment will be the responsibility of the **certified installer**. Commissioning of all electromechanical

hardware will be documented and submitted to the Facilities Life Safety and Security Systems Engineer. (See Commissioning Tests in Appendices 3.3-7 and 3.3-8)

C. Accessibility Considerations

1. Standard size reader or larger accessible type

2. Assisted door opener or fully automatic. For doors > 2" thick, evaluate and choose opener whose closer may be integrated with access control system.

3. Placement of card reader and/or accessible paddle, coordinate with swing of door

4. Consult with Section 2.1 (Accessibility) at the programming phase for additional requirements

D. Interface between Access Control and Fire Alarm Control Panel

1. Doors equipped with delayed egress features and or magnetic hold-open devices shall have appropriate "supervised" wiring provided from the building fire alarm panel release function.

E. Requirements for Access Control Panel Locations

1. The building access control processor cabinets (RPC's) are preferably located in mechanical equipment rooms or electrical vaults that are in dry locations.

2. Data communication lines as well as emergency power and lighting requirements shall be provided at the (RPC) location in accordance with the University's typical installation detail.

F. Signage

Each door that is monitored and/or controlled by the card access system has a unique electronic address. This electronic address corresponds to a door number (assignment) on the Construction Documents. Each door that is monitored and/or controlled by the card access system shall be labeled with the door number. See Section 2.8, Environmental Graphics, for door labeling requirements. The construction documents shall include a table of all door labeling requirements for the CACS System. Exterior door numbers are determined no later than the 50% CD phase. A three (3) digit number will be assigned by the Facilities Life Safety and Security Systems Engineer. Signage shall be provided at each door in accordance with the CACS requirements,

G. Operational Performance (Doors)

Doors shall be reviewed for proper operation as a single entity, to insure compatibility of all installed components. Components shall include, but are not limited to CACS hardware, hinges, sweeps, etc

H. Spare Parts

One spare unit shall be provided for every (10) of the same type of Electromechanical Access Control hardware devices installed. In addition, one spare unit shall be provided for every unique, none standard, Electromechanical device installed. Include spare part requirements in all specifications. Coordinate with door hardware attic stock.

9. Requirements for Testing & Commissioning

A. Commissioning

1. Commissioning shall be performed in accordance with section 3.13 of this manual
2. The extent of Commissioning shall be determined during the schematic design phase of a project, either using in-house, or a four party commissioning agent.
3. Tech Team representatives from Facilities Life Safety and Security Systems Engineer and Grounds Building Maintenance shall be an integral part of the commissioning process
4. The procedure for testing shall be followed closely in accordance with the Project Specifications and Pre-Functional and Functional tests as outlined in section 3.13 of this manual

10. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the access control contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the Contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. The Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

Electronic CAD files with separate layers for access control along with separate CACS drawings shall be submitted with as-builts and include requirements listed in Section 3.1.7. The Alarm Shop shall receive a set of Drawings and a Centric link to AutoCAD format Release 2000 or higher.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

3.2 Automatic Temperature Controls and Energy Management System

1. Introduction

Princeton University Facilities Engineering has been procuring, designing, installing, and maintaining automated HVAC control systems since the 1960's. Currently, Facilities Engineering maintains a single control center for the monitoring and control of most campus building mechanical, heating and cooling systems. The depth and level of control within these systems varies with the date of installed equipment, type of controls and communication capabilities. Moving forward, systems will employ server based direct digital control systems connected through the campus network. These will be MS Windows Server –based Energy Management Systems utilizing Automated Logic (ALC) WebCTRL or Siemens Insight software. Both systems provide the University with the ability to manage building environmental conditions and energy costs through web clients (ALC WebCTRL or Siemens Apogee Go) at any network connected computer.

Princeton University has a variety of automatic temperature control devices from pneumatic to electronic and Direct Digital Control (DDC). The DDC panel is a microprocessor based module that provides a wide variety of HVAC control and monitoring capability in a standalone or network environment using closed-loop, direct digital control. Some of the older systems still use pneumatic receiver controllers and most of the large buildings have compressed air systems to serve pneumatic actuators. Over the years through renovation and upgrade work hybrid combinations of pneumatic, electronic and DDC systems have come in to existence. The majority of new HVAC equipment, however, has electronic application controllers and zone controllers. The zone controllers in occupied spaces are typically electronically actuated DDC with adjustable zone sensors for the occupant. The benefits of DDC have made it the standard for all future projects.

The current energy management system consists of hundreds of DDC panels that communicate back to the Central Supervisory Control System (CSCS). These DDC panels are either wired directly to MacMillan Building or utilize campus Ethernet. All future controls network connectivity will be through campus Ethernet.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Campus Energy Manager — MacMillan Building, 609-258-9008
Facilities Engineering

C. Controls Engineer — MacMillan Building, 609-258-5890
Facilities Engineering

D. Maintenance Control Shop Supervisor — MacMillan Building, 609-258-5082
Facilities Engineering

3. Index of References
http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	MS WORD
A. Master Technical Specification for Building Automation Systems	Appendix 3.2-1	Appendix 3.2-1
• Section 15950 – Building Automation System (BAS) General • Section 15951 – Building Automation System (BAS) Basic Materials, Interface Devices and Sensors • Section 15952 - BAS Operator Interfaces • Section 15953 - BAS Field Panels • Section 15954 - BAS Communication Devices • Section 15955 - BAS Software and Programming • Section 15958 - Sequences of Operation • Section 15959 - BAS Commissioning		AutoCAD
B. Symbols	Appendix 3.2-2	Appendix 3.2-2
C. Recirc AHU with Preheat, Chilled Water, Humidifier, VAV, Economizer & Return Fan	Appendix 3.2-3	Appendix 3.2-3
D. 100% Outside Air AHU with Preheat, Chilled Water, Humidifier, & VAV	Appendix 3.2-4	Appendix 3.2-4
E. Recirc RTU with Preheat, DX, VAV & Economizer	Appendix 3.2-5	Appendix 3.2-5
F. Recirc AHU with Preheat, Chilled Water, Humidifier, CAV, Economizer & Return Fan	Appendix 3.2-6	Appendix 3.2-6
G. 100% Outside Air AHU with Energy Recovery Wheel with Preheat, Chilled Water, Humidifier, VAV & Exhaust Fan	Appendix 3.2-7	Appendix 3.2-7
H. Kitchen Exhaust / Makeup	Appendix 3.2-8	Appendix 3.2-8
I. Clean Room	Appendix 3.2-9	Appendix 3.2-9
J. Bathroom Exhaust	Appendix 3.2-10	Appendix 3.2-10
K. Steam to Hot Water Converter	Appendix 3.2-11	Appendix 3.2-11

	PDF	AutoCAD
L. Process or Secondary Chilled Water	Appendix 3.2-12	Appendix 3.2-12
M. Glycol Heat Recovery	Appendix 3.2-13	Appendix 3.2-13
N. Snowmelt	Appendix 3.2-14	Appendix 3.2-14
O. Boiler Hot Water System	Appendix 3.2-15	Appendix 3.2-15
P. Control of Smoke Purge Interface	Appendix 3.2-16	Appendix 3.2-16
Q. Single Duct VAV Cooling Only	Appendix 3.2-17	Appendix 3.2-17
R. Single Duct VAV with Reheat Coil	Appendix 3.2-18	Appendix 3.2-18
S. Chilled Beam Control	Appendix 3.2-19	Appendix 3.2-19
T. Fan Coil Unit	Appendix 3.2-20	Appendix 3.2-20
U. Fan Powered Box	Appendix 3.2-21	Appendix 3.2-21
V. Cabinet Unit Heater	Appendix 3.2-22	Appendix 3.2-22
W. Hot Water Reheat Coil	Appendix 3.2-23	Appendix 3.2-23
X. Lab Flow Tracking	Appendix 3.2-24	Appendix 3.2-24
Y. Lab Flow Tracking With Fume Hood	Appendix 3.2-25	Appendix 3.2-25
Z. CRAC Unit	Appendix 3.2-26	Appendix 3.2-26
AA. Heat Pump	Appendix 3.2-27	Appendix 3.2-27
BB. VAV Zoned by Occupancy Sensor	Appendix 3.2-28	Appendix 3.2-28
CC. Heat Only Dorm Themostat Control	Appendix 3.2-29	Appendix 3.2-29
DD. Valence Heat / Cool Unit Thermostat Control	Appendix 3.2-30	Appendix 3.2-30
EE. Steam & Chilled Water Monitoring	Appendix 3.2-31	Appendix 3.2-31
FF. Compressed Air System	Appendix 3.2-32	Appendix 3.2-32
GG. Air Volume Traverse Station	Appendix 3.2-33	Appendix 3.2-33
HH. Wire & Cable Riser for Thermostats	Appendix 3.2-34	Appendix 3.2-34
II. Wire & Conduit Illustration	Appendix 3.2-35	Appendix 3.2-35
JJ. ATC Responsibility Checklist	Appendix 3.2-36	Appendix 3.2-36

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. ASHRAE 62- 2004

C. ASHRAE 90.1-2004

5. Review Guidelines

Initial planning and preliminary design will be conducted through the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process through the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is ~~if~~ to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

The Designer shall meet with the Project Manager and Controls Engineer to ascertain the number and location of control points in the Building.

The Designer is to familiarize himself with system requirements and plan the system functions (sequence of operations), equipment and raceway layout.

See also Building Commissioning Process in Section 3.13 and the Master Technical Specification for Building Automation Systems for further details.

7. Requirements for Documentation

Along with the specifications, the Designer is to produce sufficient documentation to allow competitive bid of the Automatic Temperature Control work. Confirm room numbering of Drawings with Section 3.4 *Fire Alarm Systems* and 2.8 *Environmental Graphics.* This documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent (define seasonal environmental parameters)	X			
MEP Basis of Design (control strategy)		X		
Floor plans showing locations of all devices including thermostats or sensors that are part of or connected to the system;			X	X
Sequence of operation, including set-points and alarm limits.			X	X
Control Diagram / Flow Diagrams			X	X
Points list for every sequence or unit using owner approved point names.				X
PU Standard Installation Details		X	X	X
Full Length Specifications (refer to Appendix 3.2-1)			X	X

Show all dedicated power and dedicated communication cabling in conduit on the electrical series Drawings, in either plan or riser diagram format (shown as power and ATC communication), per the direction of the Controls Project Engineer.

Mounting heights for thermostats shall be in conformance with both ADA and Manufacturer's recommendations. Temperature sensors however shall be installed strictly per Manufacturer's recommendations. If the work is done as part of a renovation, existing switch mounting heights should also be considered. See the Master Technical Specification for Building Automation Systems for further details.

8. Guidelines for System Installation and Performance

A. General Approach

1. Hardware and software shall include point database, graphical system display and network interface to a central supervisory control system at the MacMillan Building. Include 20% spare capacity for hardware and software.

2. ATC contractor shall supply all control point designations to the Owner and shall program all sequences of operation into the energy management system. Include energy analysis software variables of information with real-time energy evaluations that reflect the design load calculation. Tracking and trending energy usage of chilled

water, Kwh and steam is typically the first real-time energy evaluation performed. These evaluations provide useful input to peak demand control strategies.

3. All hydronic valves shall be protected from system flush with a separate spool piece including VAV units and fan coils.

4. Bids shall be received from both Siemens Building Technologies and ~~Carrier~~ Automated Logic Corporation. University Controls Engineer to review scope document prepared by Construction Manager and Design Engineer prior to bidding. Design Engineer will participate in bid review meetings.

B. Utility Metering

Meters shall be sized to read at mid-point for the nominal designed system load.
Meters shall not be sized for maximum capacity of the installed system.
CHW and Steam Meter locations shall be clearly shown on piping drawings with manufactures piping recommendations noted, a separate detail shall also be shown.
CHW and Steam Meters shall be provided and wired by ATC contractor and installed by Mechanical contractor.

The totalization of utilities consumption (kW, steam flow/BTU's, chilled water flow and Ton-hours) will be accomplished as follows:

Pulse counting devices shall interface with the building electric meters, and shall send sufficient data to the controller to calculate instantaneous kW @ 0.5%. The chilled water metering shall include a 4-20mA signal to the DDC system that indicates flow in GPM and the DDC will calculate the actual Tons, based on the supply/ return chilled water sensors. The Steam flow metering with flow processor shall include a 4-20mA signal to the DDC system that indicates either pressure and/or temperature compensated flow in lbs/hour. The DDC system will have the capacity to send the meter data recorded to a historical database for daily, monthly and yearly reports.

In addition, utility meter data is provided over Ethernet to the Universities Energy Management / Fuel Dispatch program which is currently Icetec.

C. Training

State the hours for each type of training session to be provided. A minimum of 8 hours for each DDC Panel installed and 2 hours for each Application Controller type installed. Two separate training sessions for two separate groups will allow onsite training of one group while the other group is able to respond the normal work requests.

D. Central Supervisory Control System (CSCS) at MacMillan – Front End

- Historical Data Collection – Standard data collection capabilities applicable to all data points. A minimum historical trend would include all analog points, every ten minutes.

- Information Reporting – The trend capabilities allows data to be transferred to MS Excel.

- Alarming Monitoring – Operators are notified of an "out-of-normal" condition. Alarms can be sent to a screen, printer. Alarms can have different priorities and messages can be directed to different locations depending on the severity of the alarm, allowing early warning notification for out-of-spec conditions.

- Preventative Maintenance – Collection of equipment runtime allows maintenance to be performed on a "Just-in-Time" or predictive basis instead of incurring unnecessary and preventable costs due to a machine breakdown. Alarming functions can even notify the appropriate maintenance crew when service is requested. Run time information and alarms can also be transferred to a Maintenance Management package to produce work orders.

- Equipment Scheduling – Normal operating hours and special events can be programmed ahead of time so that an operator need not be on-site to turn on equipment and adjust set points for planned events.

- Control Sequence Programming – The ALC or Siemens programming code can be used to automate complex building HVAC systems, sustain strict environmental conditions and optimize control functions and applications for most of the Facilities

9. Requirements for Automatic Temperature Control System Testing & Commissioning

Testing procedures shall be in conformance with the Master Technical Specification for Building Automation (Appendix 3.2-1) In general the format consists of a milestone procedure layering increasing university involvement as the project transitions into occupancy and closeout. These milestones integrate the commissioning process (if contracted) and are conducted in the following order

A. ***Prefunctional Commissioning Testing* –** Spot verification of system supervisory equipment, pathway & wiring, individual component installation and functionality. (*Deliverables per PreFunctional Commissioning Log* -see Section 3.13)

B. ***Point –to – Point Checkout* –** Comprehensive control point functionality review conducted for verification of signal and device response. This shall be done in two (2) stages:

   1. ATC subcontractor verification
      (*Deliverable* – Mfr standard start-up test)

   2. ATC subcontractor with P.U. Shop & Design Engineer
      (*Deliverable* – Reviewed/Approved Mfr start-up test)

C. ***Sequence of Operation Confirmation* –** Comprehensive validation of the control logic for the completed system, typically conducted **after balancing report has been reviewed and accepted.** This shall be conducted by the ATC subcontractor and representatives from Facilities Engineering to confirm the system design parameters have been achieved. This shall be done in two (2) stages:

   1. ATC subcontractor verification

(*Deliverable* – Mfr standard Sequence of Operation Check)

2. ATC subcontractor with P.U. Shop & Design Engineer
   (*Deliverable* – Reviewed/Approved Sequence of Operation Check)

D. ***Functional Commissioning Testing –*** Cross -disciplinary review of the validated ATC system and its related components such as heating/cooling modes, FA/FP supervisory controls, and occupancy controls. Functional testing is conducted by the Commissioning Agent in conjunction with the ATC subcontractor, PU Shops and Facilities Engineering.
(*Deliverables per Functional Commissioning Log- see Section 3.13)*

System Prefunctional and Point-to-Point checks can be tested incrementally if agreed in advance. However, Sequence of Operation checks and Functional Commissioning cannot be conducted without the reviewed and accepted Air Balancing report.

10. Master BAS Specification Implementation Guidance to the Design Engineer

These Guide Specifications set forth guidelines to assist the designers of building mechanical systems in specifying and procuring the controls for those building systems. This document provides tools for the designer to specify the appropriate level of control system quality for reliable control.

Decision-making guidance to the design A/E is provided throughout these specifications (Appendix 3.2-1) in the form of 'Editor's Notes' so that the A/E may make prudent decisions and specify the most effective requirements for the system being installed and for those that have to use them. It is ultimately the designer's job to assess the systems to be controlled and the environments in which they will be installed, commissioned, and operated and utilize the appropriate elements of this specification.

Edits to each specification section shall be performed in Microsoft WORD software. All editing shall be performed using the 'Track Changes' options with all changes not accepted. This allows Princeton to review all changes proposed to the Master Documents.

These Guide Specifications apply the following principles to the control systems in the order they are presented:

- **Principle 1 – The control system must first and foremost provide effective and reliable control, commensurate with the systems it is controlling**. Obviously the types, complexities and the criticalities of the systems being controlled will dictate the quality/power of the control system that should be applied to them. The ultimate quality of the control system is primarily dictated by the components that sense, execute logic for, actuate, and document the systems they are controlling. These components are generally specified in Master Sections 15951 (BAS Basic Materials, Interface Devices, And Sensors), and 15953 (BAS Field Panels). This specification applies the concept of an "Application Category" for controllers whereby the performance requirements of the controllers are grouped into categories, and the Specification must remain unchanged.

- **Principle 2 – The manufacturer and installer must be highly qualified with extensive experience and must be committed and bound to thorough Commissioning (Cx)**. While the control system power/quality is very important, equally or more important is the expertise and commitment of the installing contractor and their collaboration with the overall commissioning team. Section 15950 (BAS – General) provides for qualifications of both the installer and manufacturers of the systems. Section 15959 (BAS Commissioning) dictates a high standard for the Commissioning of the system by the installer.

- **Principle 3 – The control installation must be fully documented as consistently as practical with nothing required to fully operate and maintain the system withheld from the University.** The system must always be put in the context of how it will integrate with existing systems and implemented and documented using standard approaches wherever possible. Point naming conventions, programming logic, network configuration requirements, security information, etc. must be strictly adhered to and wholly documented. No element for the continued operation and maintenance of the control system may be withheld in any way. No part of the installation may be considered confidential or proprietary information. This specification requires applicable documentation throughout.

- **Principal 4 - Require sufficient instrumentation.** The designer must require instrumentation to support both the sequence of operations, and the data acquisition capability to support equipment performance monitoring and building diagnostics analysis. A listing generally establishing minimum instrumentation requirements is included with the specifications. This identifies minimum instrumentation for common types of system. The designer is responsible for requiring additional instrumentation as necessary to support the sequence of operations, or to supplement data acquisition capabilities when the nature of the equipment or systems to be installed makes this sensible. Additional higher end devices shall be specified for control of critical systems or areas in a facility. It is the responsibility of the design engineer, in consultation with Princeton University Facilities Engineering, to specify the appropriate products for the application.

Conclusion:
Application of these Principles to a given project requires the designer to research/consider the project-specific environment and requirements and to edit this specification appropriately. The specific decision depends on a number of other important variables, including the specific HVAC control applications being served, the critical nature of the area or facility being served, the quality and capabilities of the local installer, and operator capabilities. Only those items listed in Blue Italic Text are to be modified, all other items in the specification are to remain unchanged unless prior, explicit permission has been obtained from properly authorized Princeton University Facilities Engineering representatives. The designer is cautioned to apply or find the appropriate level of expertise to complete this specification - otherwise, the result could be a specification with inadequate and contradictory requirements that cannot be enforced.

This specification extensively references detailed control drawings, detailed sequences of operation, point lists, etc. The A/E and design team must provide and incorporate these into the design documents.

11. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the ATC and Mechanical contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation.

Shop Drawing information in a sectionalized 8 1/2" x 11" three-ring binder with a Table of Contents listing all sections. An electronic "PDF" version will accompany the submittal for use by the Engineering Department. The contractor shall update all submittals to an as-built document for use by the University for operation and maintenance of the system. Provide a "PDF" version of the as-built blinder on the Facilities Engineering Front-End server that is linked to the Graphic Display. Provide a printed copy and "PDF" of each specified report demonstrate the reported data is accurate and complete. Provide an as-built document in each ATC Panel showing each system controlled by the ATC Panel, HVAC balancing reports, ATC conduit runs, boxes and devices with numbers, HVAC control schematic Drawings. All drawings shall be on AutoCAD 2000 or higher.

See Section 1.5 (Documentation and Archiving) and the Master Technical Specification for Building Automation Systems for further details.

END OF DOCUMENT

1. Introduction

As part of the University's overall commitment to sustainable campus development, Princeton's goal is to reduce carbon emissions to 1990 levels by the year 2020, without the purchase of carbon offsets. Improving building energy efficiency is a major means to reach 1990 carbon emissions levels and is targeted to contribute to approximately 35% of the required reduction. In addition to the energy standards for new construction and major renovations outlined in this section, a program of aggressive energy efficiency retrofit measures for campus infrastructure and existing buildings will supplement the targeted reduction.

While the University does not require LEED certification for projects, the equivalent to a LEED silver rating is sought as a measure of industry benchmarking. This approach is enhanced by a commitment to Life Cycle Cost Analysis (LCCA) as a more objective and quantitative approach to making informed design decisions. This process is outlined in Section 1.2, Sustainable Building Guidelines.

This Energy Guidelines section outlines targets for energy performance, as well as analysis and reporting requirements for all project design phases of major design projects, involving both new buildings and major renovations. Identification of energy efficiency measures, whole building energy simulation, building envelope design or upgrade, daylighting design, renewable energy, measurement & verification, and commissioning, are addressed. Small scale renovation projects, defined as those with existing envelopes and predetermined HVAC systems shall incorporate an abbreviated effort, while still considering appropriate energy efficiency measures.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, the Construction Management Office, or as applicable)

B. Director of Engineering — MacMillan Building, 609-258-5472

C. Energy Plant Manager — MacMillan Building, 609-258-3966

D. Controls Engineer — MacMillan Building, 609-258-5890

E. Campus Energy Manager — MacMillan Building, 609-258-9008

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

		PDF	MS Word/Excel
A	LEED Green Building Rating System Version 2.2 dated October 2005	Appendix 3.3-1	Appendix 3.3-1
B	New Jersey Higher Education Partnership For Sustainability - Mission Statement (NJHEPS)	Appendix 3.3-2	Appendix 3.3-2
C	Commissioning Plan	Appendix 3.3-3	Appendix 3.3-3
D	Outline of MEP Design Intent	Appendix 3.3-4	Appendix 3.3-4
E	MEP Basis of Design	Appendix 3.3-5	Appendix 3.3-5
F	Final Commissioning Report	Appendix 3.3-6	Appendix 3.3-6
G	Index of MEP Pre-Functional Tests	Appendix 3.3-7	Appendix 3.3-7
H	Index of MEP Functional Tests	Appendix 3.3-8	Appendix 3.3-8
I	Commissioning Specifications	Appendix 3.3-9	Appendix 3.3-9
J	High-Performance Systems Matrix	Appendix 3.3-10	Appendix 3.3-10
K	US Department of Energy Building Energy Codes Program Compliance Website	Appendix 3.3-11	-
L	ASHRAE 90.1-2004 Appendix G Guidance Document	Appendix 3.3-12	-
M	Utility and Carbon Rate Structure	-	Appendix 3.3-13
N	Input and Output Reporting Spreadsheet	-	Appendix 3.3-14
O	Fan Power Calculation Spreadsheet	-	Appendix 3.3-15
P	Standard Utilization Schedules	-	Appendix 3.3-16
Q	Glazing Factor Calculation Spreadsheet	-	Appendix 3.3-17
R	EPA Energy Star Buildings Website	Appendix 3.3-18	-
S	Energy Guidelines Deliverable Requirements	Appendix 3.3-19	-

4. Code References

A. International Mechanical Code - New Jersey Edition (2006)

B. International Building Code – New Jersey Edition (2006)

C. International Energy Conservation Code – New Jersey Edition (2006)

D. ASHRAE Standard 90.1-2004 and ASHRAE Standard 90.1-2007

5. Requirements for Documentation

Project Team reviews of issues relating to energy use and building energy systems will occur within the larger context of the Life-Cycle Comparative Studies (LCCS) process (see Section 1.2 Sustainable Building Guidelines) and, for new buildings, in a focused manner at the Envelope Reviews during the Pre-Schematic, Schematic and Design Development phases. Project documents, as indicated below, shall be submitted for review by the Office of Design and Construction, Engineering and the Maintenance Department at specified design milestones.

Pre-Schematic Design:

Activity	Schedule	Goals	Design Team Responsibilities
Sustainability Charette	During pre-schematic design	Identify energy target category for project (e.g. new construction, major renovation, etc.). Identify daylighting coverage goals.	Submit report summarizing target category, massing model, energy efficiency measures for study, and envelope concept.
Massing Energy Model	During pre-schematic design	Develop a preliminary energy model based on conceptual massing. Use ASHRAE maximum allowable lighting, envelope, and HVAC parameters. Use the energy model to identify target areas for energy savings.	
LCCS Workshop	During pre-schematic design after development of Massing Energy Model	Identify group of energy efficiency measures to study.	
Conceptual Envelope Workshop	During pre-schematic design after development of Massing Energy Model	Identify basic envelope strategy and peak heating and cooling load targets, as per Envelope Design Guidelines.	

Schematic Design:

Activity	Schedule	Goals	Design Team Responsibilities
LCCS Review 1	Beginning of schematic design	Review energy efficiency measures to develop during schematic design.	Submit MEP Design Intent Document (see Sec 3.13)
Envelope Review 1	100% schematic design	Demonstrate prescriptive or trade-off envelope compliance. Review daylighting strategy, perimeter thermal comfort, and perimeter HVAC strategy.	Submit Preliminary COMcheck report.
SD Energy Model	100% schematic design	Develop ASHRAE 90.1-2004 Appendix G compliant model with all three baselines. If lighting is not designed yet, set targets for lighting power densities.	Submit input/output spreadsheet with zoning diagram.
Daylight Review 1	100% schematic design	Glazing factor calculation for typical rooms.	Submit glazing factor calculation spreadsheet OR report of results from daylight model.

Design Development:

Activity	Schedule	Goals	Design Team Responsibilities
LCCS Review 2	Beginning of design development	Identify which energy efficiency measures should be kept and which should be discarded, based on the 100% SD energy model. Identify additional measures, if appropriate.	Submit MEP Basis of Design (see Section 3.13)
Envelope Review 2	100% design development	Demonstrate prescriptive or trade-off envelope compliance. Review daylighting strategy, perimeter thermal comfort, and perimeter HVAC strategy.	Submit updated COMcheck report.
DD Energy Model	50% design development	Develop ASHRAE 90.1-2004 Appendix G compliant model with all three baselines. Check progress against energy targets. Test any additional measures identified in LCCS Review 2. Test a minimum of six energy efficiency measures individually.	Submit updated input/output spreadsheet with zoning diagram.
Daylight Review 2	100% design development	Glazing factor calculation for typical rooms OR daylight simulation.	Submit updated glazing factor calculation spreadsheet OR report of results from daylight model.

Construction Documents:

Activity	Schedule	Goals	Design Team Responsibilities
CD Energy Model 1	Beginning of construction documents	Develop ASHRAE 90.1-2004 Appendix G compliant model with all three baselines. Check progress against energy targets. Model only what has been kept in the design after any value engineering exercises.	Submit updated input/output spreadsheet with zoning diagram.
CD Energy Model 2	85% construction documents	Develop ASHRAE 90.1-2004 Appendix G compliant model with all three baselines with no approximated values.	Submit updated COMcheck report, zoning diagram, input/output spreadsheet, fan power spreadsheet, glazing factor calculation spreadsheet and final energy modeling report.

6. Energy Performance Targets

The objective of setting energy performance targets is to encourage design teams to develop well integrated energy efficient buildings without restricting their creativity by prescribing specific technical solutions.

New projects connecting to central chilled water or steam should aim to achieve steady load patterns of utility usage through designs that promote higher thermal capacity, utility conservation and effective contextual response to the surrounding environment. The early timing of this effort is critical in order to have the best chance of effective decisions during the construction documents phase. For renovation projects, envelope and MEP system enhancements should achieve similar goals.

This section sets energy targets for new construction and major renovation projects.

Procedures for demonstrating and calculating these reductions are included in the following section: "Modeling Procedures."

New Construction Energy Performance Targets (≥ 20,000 ft²)

- Relative Targets – Energy Cost
  - **Four models** shall be created in total to calculate energy cost savings: one "Proposed" model of the building as designed, and three "Baseline" models against which to compare these results. The three baseline models will be used to break out building side energy efficiency measures from campus plant energy efficiency measures.

Baseline Model Number	Description	Baseline Cooling Plant	Baseline Heating Plant	Utility Rate (Appendix 3.3-13)
Baseline - 1	ASHRAE 90.1 Baseline Model	Cooling as per ASHRAE 90.1-2004 Appendix G	Purchased steam	Rate Structure 1
Baseline - 2	Cost Neutral Plant Model	Purchased chilled water	Purchased steam	Rate Structure 2
Baseline - 3	PSEG Baseline & Additional Measures*	Cooling as per ASHRAE 90.1-2004 Appendix G	Gas-fired boiler with minimum efficiency per ASHRAE 90.1-2004	Rate Structure 3

* see Section 7 below.

  - Results of all four models (one "Proposed" and three "Baseline") shall be reported using the templates described in the following section, "Modeling Procedures."
  - All new projects shall target a 50% annual energy cost savings when comparing the "Proposed" building model to "Baseline – 1". Although this is an ambitious goal, depending on building size and programming, many projects have an opportunity to apply innovative strategies to reduce energy usage if discussed early in the design process and combined with Life-Cycle Comparative Study (LCCS) activities. During the Sustainability Charette in Pre-Schematic Design, the design team should determine appropriate energy goals for the project in consultation with the Princeton University Project Manager and Facilities Engineering staff. Princeton University is striving to set project goals that spur innovation without distracting a design team with unrealistic benchmarks. The design team should be aware that Princeton University is driving for and desires actual energy use savings and the limitations of ASHRAE 90.1 can sometimes prevent the use of certain strategies if credit is not

given within the framework of the standard. Discussions among the design team should occur regarding interpretations of the standard and the potential impact on modeling efforts and predicted savings. Strict percentage improvement figures, although attractive for simplicity, do not always paint the complete picture especially when comparing different building types or even different sizes of the same building type. Certain projects may be better served with a comparison of energy use intensity to other similar buildings in the Energy Star Target Finder or Labs21 energy metrics databases. (Project teams should bear in mind that, although Princeton does not currently pursue formal USGBC LEED certification, a model of the proposed building as compared to a strict ASHRAE-90.1 baseline building (Baseline-1) would be required for any potential USGBC submissions as other benchmarking strategies are currently inapplicable to achieve credits.)
    - For projects using a local cooling plant, instead of campus chilled water, Baseline-2 does not need to be run.
    - Rate structures available at the start of a project will be used until project completion. Updates of the rates during the project shall not be reflected.
- Relative Targets – Carbon
    - Carbon savings shall be calculated using the rate structure found in Appendix 3.3-13.

- Energy Star Target Finder Performance
    - Compare the energy performance of the proposed building to targets set by the EPA Energy Star buildings program.

New Construction Energy Performance Targets (< 20,000 ft²)

- Projects shall follow guidance provided by the ASHRAE Advanced Energy Design Guides available for free on the ASHRAE website. Projects may alternatively follow the modeling guidance required for new construction greater than 20,000 ft².

Major Renovations

- Targets – Energy Use
    - Demonstrate either through energy simulation or through measured energy use that performance of the project meets the criteria for an EPA Energy Star rating of at least 75 using the EPA Target Finder tool.
    - For building types not addressed by Target Finder, demonstrate a 50% source energy savings over the existing building's source energy use.
    - Baseline performance of the existing building may be derived from past energy use data available from Princeton University Facilities.

7. Modeling Procedures

Introduction

- Energy modeling shall be carried out according to the procedures contained in this section.
- Results from modeling will be used to track performance in comparison to the targets set in Section 6.
- These guidelines have been written in an effort to achiever greater consistency in modeling and reporting across University projects.

Modeling - New Construction and Major Renovations

- The baseline case shall be established according to the Princeton University ASHRAE 90.1-2004 Appendix G guidance document (Appendix 3.3-12). This document is meant to be used alongside the actual standard and provides clarifications tailored to the University's campus infrastructure, building types, and climate.
- To streamline comparison and development of modeling inputs and outputs between projects, several supplements are provided and are required for use according to the project deliverables table listed in Section 5. The front tab in each sheet provides instructions for use.
    - Utility and Carbon Rate Structure (Appendix 3.3-13)
    - Input and Output Reporting Spreadsheet (Appendix 3.3-14)
    - Fan Power Calculation Spreadsheet (Appendix 3.3-15)
    - Standard Utilization Schedules (Appendix 3.3-16)
    - Glazing Factor Calculation Spreadsheet (Appendix 3.3-17)

Additional Measures – Savings in areas not governed by ASHRAE 90.1

- There may be measures in a project design that are above and beyond standard practice and that will result in energy savings that will not be captured by a standard ASHRAE 90.1 Appendix G evaluation. This guideline allows for the inclusion of some of these measures, approved on a case-by-case basis with the Princeton Project Manager in Baseline 3. Examples include:
    - Reduction of minimum ventilation rates in labs from 6ach to 4ach
    - Reduction in process loads by use of efficient receptacles
- This guideline allows for the inclusion of these savings by modifying the parameters in Baseline 3 to reflect "standard practice" baselines. The baseline performance for each measure must be approved by the Princeton Project Manager during the LCC process.
- This guidance is separate from that offered in ASHRAE 90.1 G2.5 – Exceptional Calculation. An exceptional calculation can be done for a measure that is traditionally allowed in ASHRAE 90.1 with a specified baseline (such as natural ventilation, complex system types, demand controlled ventilation etc.) but that modeling software cannot calculate directly. This allowance for "Additional Measures" is a departure from the ASHRAE 90.1 baseline to demonstrate the magnitude of savings for certain measures where the design goes above and beyond standard practice.
- A library of approved measures and agreed-upon baselines from past projects is in development.

8. Envelope Design Guidelines

Introduction

- Energy, comfort, and daylighting performance of the building envelope must be considered early on in the design process. Many lower energy HVAC systems require that building envelope loads be well controlled.
- The goal of this guidance is to ensure that building envelope components comply with ASHRAE 90.1-2004 without trade-offs with other building systems, such as lighting, HVAC, or service hot water heating.

Definitions

- Skylight: a fenestration surface having a slope less than 60 degrees from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.
- Vertical fenestration: all fenestration other than skylights. Trombe wall assemblies, where glazing is installed within 12 in. of a mass wall, are considered walls, not fenestration.

Process

- COMcheck (http://www.energycodes.gov/comcheck/ez_download.stm) shall be used to demonstrate envelope code compliance at three stages in the design process:
  - 100% Schematic Design
  - 100% Design Development
  - 85% Construction Documents

Opaque Building Envelope Components

- Opaque element U-values should be derived from ASHRAE 90.1-2004 Normative Appendix A. For assembly types not listed in Appendix A, provide calculations for envelope thermal performance. Otherwise, use maximum allowed ASHRAE 90.1-2004 U-values for load and energy modeling.

TABLE 5.5-5 Building Envelope Requirements For Climate Zone 5 (A,B,C)

	Nonresidential		Residential		Semiheated	
Opaque Elements	**Assembly Maximum**	**Insulation Min. R-Value**	**Assembly Maximum**	**Insulation Min. R-Value**	**Assembly Maxi-mum**	**Insulation Min. R-Value**
Roofs						
Insulation Entirely above Deck	U-0.063	R-15.0 ci	U-0.063	R-15.0 ci	U-0.173	R-5.0 ci
Metal Building	U-0.065	R-19.0	U-0.065	R-19.0	U-0.097	R-10.0
Attic and Other	U-0.034	R-30.0	U-0.027	R-38.0	U-0.053	R-19.0
Walls, Above-Grade						
Mass	U-0.123	R-7.6 ci	U-0.090	R-11.4 ci	U-0.580	NR
Metal Building	U-0.113	R-13.0	U-0.057	R-13.0 + R-13.0	U-0.123	R-11.0
Steel-Framed	U-0.084	R-13.0 + R-3.8 ci	U-0.064	R-13.0 + R-7.5 ci	U-0.124	R-13.0
Wood-Framed and Other	U-0.089	R-13.0	U-0.089	R-13.0	U-0.089	R-13.0
Wall, Below-Grade						
Below-Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors						
Mass	U-0.087	R-8.3 ci	U-0.074	R-10.4 ci	U-0.322	NR
Steel-Joist	U-0.052	R-19.0	U-0.038	R-30.0	U-0.069	R-13.0
Wood-Framed and Other	U-0.033	R-30.0	U-0.033	R-30.0	U-0.066	R-13.0
Slab-On-Grade Floors						
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
Heated	F-0.840	R-10 for 36 in.	F-0.840	R-10 for 36 in.	F-1.020	R-7.5 for 12 in.
Opaque Doors						
Swinging	U-0.700		U-0.700		U-0.700	
Non-Swinging	U-1.450		U-0.500		U-1.450	
Fenestration	**Assembly Max. U (Fixed/ Operable)**	**Assembly Max. SHGC (All Orientations/ North-Oriented)**	**Assembly Max. U (Fixed/ Operable)**	**Assembly Max. SHGC (All Orientations/ North-Oriented)**	**Assembly Max. U (Fixed/ Opera-ble)**	**Assembly Max. SHGC (All Orientations/ North-Oriented)**
Vertical Glazing, % of Wall						
0-10.0%	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.49 $SHGC_{north}$-0.49	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.49 $SHGC_{north}$-0.49	U_{fixed}-1.22 U_{oper}-1.27	$SHGC_{all}$-NR $SHGC_{north}$NR
10.1-20.0%	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.39 $SHGC_{north}$-0.49	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.39 $SHGC_{north}$-0.49	U_{fixed}-1.22 U_{oper}-1.27	$SHGC_{all}$-NR $SHGC_{north}$NR
20.1-30.0%	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.39 $SHGC_{north}$-0.49	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.39 $SHGC_{north}$-0.49	U_{fixed}-1.22 U_{oper}-1.27	$SHGC_{all}$-NR $SHGC_{north}$NR
30.1-40.0%	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.39 $SHGC_{north}$-0.49	U_{fixed}-0.57 U_{oper}-0.67	$SHGC_{all}$-0.39 $SHGC_{north}$-0.49	U_{fixed}-1.22 U_{oper}-1.27	$SHGC_{all}$-NR $SHGC_{north}$NR
40.1-50.0%	U_{fixed}-0.46 U_{oper}-0.47	$SHGC_{all}$-0.26 $SHGC_{north}$-0.36	U_{fixed}-0.46 U_{oper}-0.47	$SHGC_{all}$-0.26 $SHGC_{north}$-0.49	U_{fixed}-0.98 U_{oper}-1.02	$SHGC_{all}$-NR $SHGC_{north}$NR
Skylight with Curb, Glass, % of Roof						
0-2.0%	U_{all}-1.17	$SHGC_{all}$-0.49	U_{all}-1.17	$SHGC_{all}$-0.49	U_{all}-1.98	$SHGC_{all}$-NR
2.1-5.0%	U_{all}-1.17	$SHGC_{all}$-0.39	U_{all}-1.17	$SHGC_{all}$-0.39	U_{all}-1.98	$SHGC_{all}$-NR
Skylight with Curb, Plastic, % of Roof						
0-2.0%	U_{all}-1.10	$SHGC_{all}$-0.77	U_{all}-1.10	$SHGC_{all}$-0.77	U_{all}-1.90	$SHGC_{all}$-NR
2.1-5.0%	U_{all}-1.10	$SHGC_{all}$-0.62	U_{all}-1.10	$SHGC_{all}$-0.62	U_{all}-1.90	$SHGC_{all}$-NR
Skylight without Curb, All, % of Roof						
0-2.0%	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-1.36	$SHGC_{all}$-NR
2.1-5.0%	U_{all}-0.69	$SHGC_{all}$-0.39	U_{all}-0.69	$SHGC_{all}$-0.39	U_{all}-1.36	$SHGC_{all}$-NR

Figure 1 ASHRAE 90.1-2004 Table 5.5-5 – Building Envelope Requirements for Princeton, NJ

Fenestration

- Fenestration components must meet the rating requirements of ASHRAE 90.1 Section 5.8.2.
- U-values provided by glazing manufacturers are often center-of-glass values and do not include the effect of edge spacers, framing, or local thermal bridging.
- U-values provided by glazing manufacturers for skylight applications are often center-of-glass values not corrected for slope. Insulating glass units experience a significant decrease in thermal resistance when sloped, due to increased convection in the gas cavity.
- During schematic design and up to 50% design development, use Table 4 from the 2005 ASHRAE Fundamentals Handbook (U-Factors for Various Fenestration Products) to estimate U-values.
- In the absence of credible thermal performance data, ASHRAE 90.1 Table 5.5-5 maximum U-values and SHGC's (40% vertical fenestration, 5% skylight) must be used for load and energy modeling.

General Guidance

Energy Code

- Consider that ASHRAE 90.1 Appendix G allows no greater than a 5% skylight-to-roof ratio in the baseline model.
- Consider that ASHRAE 90.1 Appendix G allows no greater than a 40% vertical fenestration-to-above-grade wall ratio in the baseline model.

Thermal Comfort

- Building envelope systems for shallow plan rooms (e.g. enclosed offices) should be evaluated carefully. During peak cooling conditions, solar radiation may lead to significant local heating discomfort. During peak heating conditions, downdrafts and low fenestration surface temperatures may lead to significant local cooling discomfort.

HVAC

- Careful control of building envelope gains and losses is required for use of lower energy systems, such as active chilled beams, radiant systems, and displacement ventilation. High solar gains in shallow plan spaces may result in excessive supply airflow requirements (> 2 cfm/ft^2).

Visual Comfort

- Use of significant amounts of vertical fenestration and/or skylight may result in local glare issues. Where occupants will be using visual displays (e.g. TVs, LCDs, etc.), consider the impact of high levels of natural daylight.

External Shading

- External shading devices should be considered as a means to reduce direct solar gain.
  - South facing – overhangs.
  - West and east facing – vertical fins.
  - North facing – external shading not required.
  - Skylight – consider north facing clerestory windows, as an alternative.

Summary of Submission Requirements

- COMcheck Envelope Compliance Form (ASHRAE 90.1-2004).

9. Systems Performance

Air conditioning in the dormitories is not normally operated from Labor Day to Memorial Day. The design team must ensure that the building maintains relatively comfortable living conditions during this period when the air conditioning is not operating.

High-Performance Systems Matrix
A list of energy efficiency measures to consider is provided in Appendix 3.3-10. This list is not meant to be all inclusive, but highlights a range of measures that have been evaluated on past Princeton University projects. Design teams are required to develop a customized high-performance systems matrix as per the Sustainability guidelines.

10. Daylighting

Daylighting will be utilized as a primary light source in all new buildings for both energy savings as well as improved indoor environmental quality. The success of daylighting design depends largely on the building floor to ceiling height, the cross-sectional depth of the building, the window head height above the finished floor and the visible transmittance of the glazing. In general, the shallower the depth and the higher the ceiling, the greater the building area covered by natural light.

Correct building orientation and window treatments are synergistic strategies for effective daylighting. Mitigation of glare and luminance contrast is critical to creating a comfortable daylit environment. Passive daylighting measures such as clerestories, atria, light wells, and light shelves are recommended to mitigate glare and heat load in the building envelope.

A. Daylighting Coverage Goals

Project-specific Daylighting Coverage Goals will be identified at the Sustainability Charette during the Pre-Schematic Design phase of a project. Typical guideline performance targets are as follows:

	Daylighting Illuminance at Work Surface	**Space Coverage** (unless otherwise noted at project inception).
Spaces Occupied for Critical Visual Tasks These spaces include offices, conference rooms, classrooms, libraries, auditoriums and laboratories.	25 -50 fc	75%
Lighted Transitory Spaces These spaces include informal break-out spaces, meeting spaces and corridors at least 10ft in width with seating.	15-25 fc	(can contribute to 75% of space coverage for Critical Visual Task Areas)

B. Glazing Factor Calculations and Computer Daylight Simulation

During the design phases, daylighting issues shall be reviewed at the Envelope Reviews and, where relevant to selected LCCS study categories, at LCCS Reviews.

Fulfillment of the project Daylighting Coverage Goals should be confirmed through Glazing Factor Calculations at the conclusion of Schematic Design and Design Development phases, when deemed appropriate for primary or typical spaces, computer simulation. A calculation should be completed for each typical space type. Regularly occupied spaces appropriate for daylight should demonstrate a minimum glazing factor of 2% in the daylit areas occupied for critical visual tasks and a minimum glazing factor of 1.2% in the daylit transitory spaces. The glazing factor is calculated as follows:

$$\text{Glazing Factor} = \frac{\text{Window Area [SF]}}{\text{Floor Area [SF]}} \times \text{Window Geometry Factor} \times \frac{\text{Actual } T_{vis}}{\text{Minimum } T_{vis}} \times \text{Window Height Factor}$$

Glazing Type	Glazing Orientation	Geometry Factor	Minimum Tvis	Height Factor
Windows				
Window area > 7'-6" aff	vertical	0.1	0.7	1.4
Window area 2'-6" - 7'-6" aff	vertical	0.1	0.4	0.8
Skylights				
Vertical clerestory monitor	vertical	0.2	0.4	1
Sawtooth monitor	sloped	0.33	0.4	1
Horizontal skylight	horizontal	0.5	0.4	1

A spreadsheet is provided as Appendix 3.3-17 for glazing factor calculations.

Conformance to daylighting goals shall also be demonstrated through post construction field measurement. See Section 3.3.12 (Measurement and Verification).

11. Renewable Energy

The design team should consider the use of on-site renewable energy on projects. Life-Cycle Comparative Studies (LCCS) will be used to determine appropriate systems. LCCS analyses should incorporate all available rebates and incentives. These may include programs such as the New Jersey Clean Energy Program. Refer to Appendix 1.2-1 Sustainability Resources, Funding Opportunities for Sustainability. Renewable energy includes: wind, solar power, solar thermal and solar hot water heating systems. Ground-source heat pump systems do not fall under this category, but rebates may still apply.

12. Measurement and Verification

Measurement and verification will continually confirm that all building systems are operating as intended and will provide data to inform further operational improvements. Monitoring equipment should be used for end-uses such as lighting systems, motor loads, and HVAC equipment. Data from this equipment will be analyzed and appropriate adjustments made to verify that systems are meeting the energy performance requirements set forth by the design team. Projects shall comply with the requirements of Section 3.2 (Automatic Temperature Controls and Energy Management System) and with the project Commissioning Plan as described in standards section 3.13 Commissioning.

END OF DOCUMENT

1. Introduction

The buildings on the main campus of Princeton University are typically protected by fire alarm systems that include automatic smoke and heat detectors, manual pull stations, and audible and visual alarm devices. Special devices, such as duct detectors, suppression system tamper and flow alarms and door hold-opens are also incorporated into the alarm systems. Some off-campus (mostly small residential) Buildings may utilize single-station hardwired devices. The decision to use any such non-addressable alarm system must be made in consultation with the University Code Analyst.

The University currently employs an addressable analog alarm system and others, connected via telephone lines and radio communicator to a proprietary system in the University's Office of Public Safety at 200 Elm Drive.

The use of addressable analog alarm systems on all University projects shall be determined through consultation with the University Code Analyst. This process applies to residential applications and projects with program elements containing hazardous, combustible or other dangerous materials.

Current acceptable manufacturer for the University's alarm systems are Simplex Time Recorder Co.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst	MacMillan Building, 609-258-6706
C. Manager of Electrical Engineering	MacMillan Building, 609-258-5475
D. Facilities Site Protection Manager	306 Alexander Street, 609-258-5270
E. University Fire Marshall	200 Elm Drive, 609-258-6805
F. Facilities Mechanical Systems Coordinator, Life Safety and Security	306 Alexander Street, 609-258-3659

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	MS Word
A. Master Fire Alarm Technical Specification	Appendix 3.4-1	Appendix 3.4-1
B. Fire Alarm/Signage Nomenclature Spreadsheet Sample, Princeton University	Appendix 2.8-2	

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable sub codes and sub code sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

E. NFPA 70 - National Electrical Code

F. NFPA 72 - National Fire Alarm code

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, the University Code Analyst and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

The Designer is to first review the Princeton University Master Technical Specifications for the project, and is to proceed into design guided by that specification. Any variations proposed by the Designer from the master spec are to be reviewed with the University's Project Manager, Code Analyst and Mechanical Systems Coordinator of Life Safety and Security, and, if the change is to be incorporated, reviewed with the author of the Specifications, Hughes Associates (through the Mechanical Systems Coordinator).

The Designer is to meet with the Mechanical Systems Coordinator of Life Safety and Security during the preliminary design phase to familiarize themselves with system requirements. During preliminary design and design development the Designer is to consult with the Project Manager and the University's Code Analyst to define code strategies and to discuss code any interpretations affecting the project.

7. Requirements for Documentation

Along with the specifications, the Designer is to produce sufficient documentation to allow for code review of the alarm project and for contract bidding of the work. This documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Floor plans showing locations of all devices that are part of or connected to the system;		X	X	X
A complete riser Diagram showing all devices that are part of or connected to the system;			X	X
Final Room number designations		X	X	X
Specifications		X	X	X
Details of fire alarm equipment connections and mounting requirements;				X
Details of connections between fire alarm system and any special devices, and connections between alarm system and telephone system, with mounting details.				X
Details for a sequence of operations (selective signaling, control by event, etc.)				X

Separate Floor Plans are required for Fire Alarm Plans. The drawing number or sheet label shall use FA as the prefix.

The Designer is to coordinate reflected ceiling plans with all trades.

8. Guidelines for System Installation and Performance

A. Reportability

1. Fire alarm control panel is to report to location at Department of Public Safety via telephone lines or radio communicator; Contractor will provide the communications interface for point I.D. at panel.

2. Designer to consult with Mechanical Systems Coordinator of Life Safety and Security for details for mounting the communications interface and for related wiring to be provided by contractor.

B. New Construction and Renovation

1. All fire alarm devices and junction boxes shall be accessible and mounted at heights compliant with NFPA. If an existing box location is to be reused, the height shall be discussed on a case-by-case basis.

2. Raceways in finished areas are to be concealed where possible. During programming and preliminary design raceway layout is to be reviewed with University Project Manager and manufacturer's rep; raceway layout is to be approved by University prior to design development phase.

3. In the event that exposed raceway must be employed, Designer is to review the approach to be taken to running raceway, and is to specify the appropriate material.

C. Consideration for the Hearing Impaired

1. In order to provide for variety in the housing stock available for the hearing impaired, the University typically outfits a number of rooms over and above the number required by Code. The Housing Office and the Office of the Dean for Student Life provide information for Designers on the number and location of rooms needed.

2. Special wiring arrangements are required for the strobe unit in hearing impaired rooms: the device must activate in "first alarm condition" and must be wired as separate homerun to the fire alarm control panel.

D. Magnetic Hold-Open Devices

1. In dormitories, all doors from corridors to stairs, and doors dividing corridors from public spaces are typically outfitted with smoke detector-activated hold-open devices. Other doors subject to chocking shall be evaluated for installation of smoke detector-activated hold open devices.

2. Princeton University prefers wall-mounted devices (over floor-mounted or devices for closers.

3. All locations of proposed hold-opens are to be reviewed with Princeton University, including Building Services, Facilities Department, and User during the design development phase.

4. To accommodate accessibility, connect hold opens to activate within 5' of a detector in alarm, plus the next adjacent door in sequence (in applicable), unless otherwise directed by the tech review team.

E. Special Requirements Due to Location

Designer is to coordinate selection of detector type with awareness of environmental conditions in the rooms protected, with special emphasis on the presence of heat-producing equipment, supply diffusers and return-air grilles, and other equipment that might prevent the proper long-term operation of the fire alarm devices.

F. Beam Detectors

Due to high maintenance requirements, beam detectors are only to be used in special cases, typically atriums and other spaces where a smoke detector would otherwise be above 15 feet in height. Review any proposed installation of beam detectors with University personnel during design programming phase.

G. VESDA System

Due to high maintenance requirements, a VESDA system shall only to be used in special cases, typically atriums and other spaces where a smoke detector would otherwise be above 15 feet in height. Review any proposed installation with the Mechanical Systems Coordinator of Life Safety and Security during design programming phase.

H. Smoke Control System

If a smoke control system is required every effort should be made to make the system fully automated (once an activated system is no longer required). The order of operations will need to be reviewed with the Mechanical Systems Coordinator of Life Safety and Security and the University Code Analyst. See Section 1.4 (Regulatory Agencies) item 14.

I. Interface Between Fire Alarm Control Panel and Other Equipment

In addition to providing alarm notification to the proprietary supervising station at 200 Elm Drive, fire alarm control panels are often used to supervise building systems and report failures of critical building systems, such as environmental/ HVAC systems, sewage ejectors, refrigeration equipment, etc. Review any additional requirements with the Project Manager. CACS is the preferred reporting platform for non-fire alarm related building items.

J. Requirements for Fire Alarm Control Panel Locations

1. Fire alarm control panels (FACPs) are to be located in proximity to other equipment controls, preferably in mechanical equipment rooms or electrical vaults. FACPs are only to be installed in dry locations.

2. All wiring leaving the FACP shall be labeled as to its purpose.

3. One OIT outlet shall be installed with each panel that reports to the proprietary system at 200 Elm Drive.
4. A duplex A/C power convenience receptacle is to be installed below the panel.
5. A four-foot fluorescent fixture is to be installed over the FACP with an on – off toggle switch in close proximity.

9. Requirements for Room and Device Designations

It is the intent of all projects to have permanent room numbers assigned during the Design Phase. It is the responsibility of the Consultant to initiate and complete this process, and the Project Manager's responsibility to gather required approvals. All Drawings shall reference the University approved final room number system as per Appendix 1.5-3.

The Room number assignments must be coordinated with the building signage and FA System nomenclature designations. A sample spreadsheet for coordinating this can be found in Appendix 2.8-2. In summary the process is as follows:

- Consultant develops final room numbers during Design Development
- FA vendor determines device nomenclature using above information and prepares a submittal for review
- Consultant & PM verify nomenclature is consistent with Public Safety requirements. This can be done through the Mechanical Systems Coordinator of Life Safety and Security at 258-3659
- After approval, vendor inputs device nomenclature into FA panel

The PM and Consultant also are responsible for coordinating the approved device nomenclature with the approved building signage package. Avoid conflicts with installed signage and the approved FA room number designations.

After the final fire alarm nomenclature is developed, the Electrical Contractor is also responsible for producing laminated, secured to a wall, fire alarm floor plans showing all devices with point I.D. numbers and fire alarm nomenclature. These Drawings shall be done at such a scale as to be easily readable by those responding to alarm calls, and sized to fit in the immediate vicinity of the fire alarm panel.

10. Requirements for Fire Alarm System Commissioning

- Commissioning shall be performed in accordance with Section 3.13 of this manual and the requirements of the Master Fire Alarm Technical Specification per Appendix 3.4-1
- The extent of Commissioning shall be determined during the schematic design phase of a project, either using in-house (Single Party), or a Four Party commissioning agent.
- Tech Team representatives form Engineering and Grounds Building Maintenance shall be an integral part of the commissioning process
- The Designer is responsible for conducting the final acceptance test with the fire alarm system representatives and the fire alarm contractor.

- Room numbers are to be on all building doors prior to final testing, executed in script on fire-resistant masking tape acceptable to the University Project Manager.
- The Designer is responsible for witnessing and approving the acceptance test. The Designer shall certify the printout of the test data, including the point I.D. readout at 200 Elm Drive, and shall deliver a signed and sealed copy to the municipal building official as part of the occupancy permit process, if allowed by the municipality.

11. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the fire alarm contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

The as-builts are to include the following as a minimum:

- Fire alarm identification points, location and nomenclature
- Fire alarm layout plan (complete with all other system interfaces and all components)
- Equipment schedule
- Final as-builts shall be submitted on AutoCAD Release 2000 or higher and include conduit/wire runs showing splice locations.
- Copy of the Fire Alarm Program File from installation vendor.
- Sequence of operation matrix

See Section 1.5 (Documentation and Archiving).

12. Requirements for Spare Parts

Refer to the Master Technical Specifications for spare parts requirements.

END OF DOCUMENT

1. Introduction

These guidelines apply to Academic, Administrative and Residential Buildings on Princeton's campus. Energy efficient lighting is the preferred light source for most Buildings and lighting applications. Incandescent lighting is generally not preferred and would need to be approved on a case-by-case basis.

Lighting design needs to be based not only on lighting levels but quality and perceived color rendition for the occupants.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Manager of Electrical Engineering — MacMillan Building, 609-258-5475

C. Foreman of Electrical Maintenance Shop — MacMillan Building, 609-258-3991

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Future	
B. Princeton University Standard Exterior Pole Fixture (3pp)	Appendix 3.5-2
C. SPI Lighting – 2441 Standard Fluorescent Dormitory Room Wall Sconce	Appendix 3.5-3

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. National Electric Code

C. IES Lighting Handbook – 9th Edition

D. Federal Energy Policy Act of 1992 (EPACT)

E. ASHRAE/IESNA-90.1 2004

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal “Tech Team” review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

The Designer shall meet with Project Manager, Design Architect and End User to develop lighting types for all spaces. During this time, the Designer is encouraged to investigate emerging technologies of fixtures, lamps and lighting methods. Generally, full scale mock-ups of emerging technology fixture selections require input and approval by the University Architect and Facilities Engineering. These prototypes will be previewed for color rendition, energy consumption, light output, aesthetic appeal, lamp maintenance and established manufacturers, along with conformance with applicable local ordinances.

Lighting fixture types should be reviewed on a case-by-case basis. When suspended ceilings (10’-0” or above) can be utilized, pendant mounted indirect/direct fixtures are preferred.

In Academic/Administrative Buildings with low ceilings (10’-0” or below), or no ceilings, direct lighting is preferred.

Designer will be required to provide light level calculations and energy efficiency as it relates to typical spaces for review and compliance with established standards (IES Standard) of light level quality. Coordinate any dimming requirements with end user.

Preferred type of Room lighting (where applicable):

1. Classrooms – Pendant mounted Indirect/Direct energy efficient fixture when ceiling height allows.

   Emergency lighting shall be installed in each assembly space with occupancy of more than 50 people.

2. Administrative Areas and Offices – Pendant mounted Indirect/Direct energy efficient fixture or recessed energy efficient fixture. Consider accent lighting. Accent lighting on perimeter walls should be considered.

3. Student Dormitory Rooms (Studies and Bedrooms) – Indirect energy efficient wall sconce. See Appendix 3.5.3. See Section 2.4 – Page 19 for acceptable mounting locations and heights.

4. Laboratory Rooms – Pendant mounted Indirect/direct energy efficient fixture

5. Mechanical Spaces – Linear industrial protected reflector energy efficient fixture

6. Public Spaces –Energy efficient /Decorative based on use of space, quantity and configuration.

7. Guidelines and Requirements for Documentation

Along with the specifications, the Designer is to produce sufficient documentation to allow for code review of the lighting system and for contract bidding of the work. This documentation shall be coordinated with all trades and will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
Notes & Symbols		X	X	X
Lighting Plans		X	X	X
Location and type of control device. Provide operating logic description for occupancy sensors, day/night controls and dimming systems.			X	X
Panelboard Schedules			X	X
Lighting Fixture Schedule including; Manufacturer dimensions, model numbers, number of lamps, type of lamps, watts/fixture, volts, mounting characteristics and color/finish.			X	X
Specifications including product data sheets for each proposed lighting fixture		X	X	X
Details				X
Coordinated Architectural reflected ceiling plan and Engineering lighting plan showing location and types of all fixtures.				X

8. Guidelines for System Installation and Performance

A. New Construction and Renovation

1. Design shall facilitate ease of fixture maintenance and replacement of lamps. All fixtures and junction boxes shall be accessible.

2. Raceways in finished areas are to be concealed where possible.

3. Ceiling heights over 15 feet shall be reviewed by Project Manager and Electrical Maintenance Shop Foreman to address lamp access.

B. Lamps and Ballasts

1. If selected, 4'-0" fluorescent lamps shall be T8 and a color temperature of 3500º K and low-mercury content. For special use areas, other color alternatives shall be considered. Lamps shall be manufactured by Oshram/Sylvania, General Electric or Philips. T5 Hi output lamps are acceptable.

2. Minimize the number of different types of lamps per building.

3. Ballast shall be programmable start two, three or four lamp ballasts as appropriate. If two (2) lamp fixtures are mounted in tandem, utilize four-lamp ballast. PL lamps shall have electronic ballast. Preferred dimming ballast by Lutron.

4. The range of dimming ballasts should typically be 100% to 10% for all dimmable fixtures.

5. Consideration shall be given for lamp replacement. A minimum of ¼" around the edge of the lamp for hand clearance is preferred for lamp replacement.

C. Exterior Lighting

1. Campus-wide gas style post lamp (208 volts) to be used in the older section of Campus for both street and walkway lighting. This type of fixture is proprietary. Typical configuration is a 85 watt induction lamp, spaced 60' to 70' apart.

2. Non-Main Campus "shoe box" fixture to be used in parking and roadway areas, voltage shall be 480v. Manufactured by Sterner or approved equal. Consider LED Pole Light type fixtures, Check with Landscape coordination committee, Section 2.9, 10F

3. Bollard fixtures. Locations are driven by Landscape Coordination Committee (LCC). Consider the use of LED fixtures.

4. The control of exterior lighting shall be through a photocell with a Two Position "Test- Auto" keyed by-pass switch, maximum height 6'-0". Locate photocells on north face of Building. Consider motion-sensing for instantaneous-on exterior fixtures.

D. Exit Signs

1. Sign shall be red LED with diffuser panel, such that LED sources are not directly visible.

2. Any surface-mounted exit sign mounted on edge below 9’-0” requires redundant support along a second edge or side. Preferably located at a wall/ceiling intersection.

E. Emergency Lighting Circuiting

1. Emergency Lighting levels in egress paths shall be in accordance with the NEC. In each stairwell connect a minimum of ½ of the fixtures to the emergency system and the other ½ to normal power. In each bathroom connect an un-switched fixture over the sink to the emergency system; avoid using any fixtures located by the door. Each mechanical and electrical room should have one or more fixtures connected to the emergency system. These fixtures should be controlled by a switch with a pilot lit handle located closest to the door buck where the space is entered.

9. Lighting Controls

In general, lighting controls should be considered for energy requirements and to meet dimming requirements. The Designer should locate the lighting properly so as to not create needless maintenance, under-use of fixtures, or unreasonably high initial or life cycle costs. Based on these criteria, the University has identified several areas where controls have been successfully incorporated into the design.

A. Dimming Controls – typically suggested in the following spaces:

1. Classrooms (See section 2.3)

2. Audio/ Visual areas

3. Dining Halls and other large gathering spaces

B. Occupancy Sensors

1. Typically occupancy sensors will be located in Restrooms, Offices, Classrooms, Hallways, Laboratories, Library book stacks, and Locker Rooms. Review these and any other locations with Project Team. Include manual override feature for offices and classrooms.

2. Sensors will activate the lighting by a person taking a 1/2 step or the turning of a page. Contractor will be required to adjust the initial start-up of each sensor. Light shall remain lit for 15 minutes after occupant has left.

C. Daylight Requirements

1. Designer to review with Design Team when and where daylight sensors can be used.

2. Daylighting will be utilized as a primary light source in all new buildings for both energy savings as well as improved indoor environmental quality. Project specific Daylighting Coverage Goals are outlined in Section 3.3.7 (Energy Guidelines).

10. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the contractor. Designer shall verify all branch circuiting (lighting and power) has been shown in its entirety including conduit runs, number of wires in each conduit and panel/circuit numbers.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation.

Designed will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

See Section 1.5 (Documentation and Archiving).

11. Requirements for Spare Lamps

10% of the total number of lamps in proportion with the various types shall be provided for spare storage. Location will be determined by the Project Manager. Included with this submittal shall be a written list of fixture descriptions and their corresponding lamp type. This shall be supplemented with a copy of the approved light fixture schedule with respective room numbers designated for each fixture type.

END OF DOCUMENT

1. Introduction

The University's Facilities Engineering Department holds the responsibility for administering and planning the utility systems and infrastructure for the Campus. Utilities that can be provided by the University include steam and condensate, chilled water, pressurized air (localized areas), electric power, emergency power from regional generators, storm drainage, and fire protection from regional fire pumps. Voice and data communication is provided by Princeton University's Office of Information Technologies. A summary of service requirements for utilities is provided as an attachment to this section. Planning for utility requirements to support projects must start in the programming stages to insure the work is coordinated with ongoing projects and there is adequate capacity to support the project.

The Campus has its own telephone and computer communication systems.

Designers must contact the Facilities Engineering Department during the Programming or Schematic Design phases to review all project utility interconnects. Applications for tie-ins to all non-University owned utilities will flow through the Utility Coordinator. The Designer is expected to assist Facilities Engineering with any required project data, load calculations or site conditions effecting such applications.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Utility Coordinator — MacMillan Building, 609-258-6682

C. Landscape Project Manager — 200 Elm Drive, 609-258-8338

D. Director of Engineering — MacMillan Building, 609-258-5472

E. Energy Plant Manager — MacMillan Building, 609-258-3966

F. Manager, Electrical Engineering — MacMillan Building, 609-258-5475

G. Manager, Telephone Technical Operations, Telecommunications Office — Frist Campus Center, 609-258-6626

H. Manager, Hardware Support, OIT — 171 Broadmead, 609-258-6042

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Utility Mark-out for Existing Conditions Survey Procedure	Appendix 3.6-1
B. Utility Mark-out Procedures for Excavation	Appendix 3.6-2

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. ANSI/ASME B31.1 Power Piping

C. ANSI/ASME PTC 25.3 Safety & Relief Valves

D. National Electric Code

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

See Matrix at end of this section.

Additional requirements for specific areas of documentation are as follows:

Required Documentation	SD	DD	50% CD	85% CD
Key Map	X	X	X	X
Vicinity Map	X	X	X	X
Existing Conditions Survey	X	X	X	X
Site Utilities Plan	X	X	X	X
Preliminary Site Plan	X			
Overall Site Plan		X	X	X
Demolition and Removals Plan		X	X	X
Grading Plan		X	X	X
Site Lighting Plan		X	X	X
Soil Erosion and Sediment Control		X	X	X
Construction Details		X	X	X
Outline Specifications		X		
Full-Length Specifications			X	X
Fire Protection Site Plan			X	X

6. Procedural Guidelines

The Designer shall meet with Project Manager, Utility Coordinator, Energy Plant Manager, Director of Engineering to ascertain the type of building(s) and the anticipated utility demands.

During programming and preliminary design and design development the Designer is to consult with the Project Manager, Utility Coordinator, Energy Plant Manager, and Director of Engineering.

Existing Conditions mark out procedure is as follows:

If there is a need for existing utility mark-out during the design phase, the A/E may contact the Landscape Project Manager who will coordinate through the Facilities Engineering Utility Coordinator to have the utilities staked out. Refer to Appendix 3.6-1 for additional information.

Excavation mark out procedure is as follows:

Princeton University is registered with the State of New Jersey “One-Call System”. All contractors prior to excavation on any University project shall contact New Jersey “One-Call System” at, 1-800-272-1000. Refer to Appendix section 3.6.-2 for additional information.

7. Positional and Tolerance Requirements for Existing Conditions Surveys

At the beginning of a project the existing conditions survey should be started early in the process and shall be completed by the of schematic design submission. All existing conditions surveys indicating the location of Surface Utilities or surface accessible indications of underground utilities (i.e. Manholes, valves, inverts within manholes, vents, etc.) must locate the utilities to within 0.01 of a foot, horizontal and vertical.

It is understood that the underground utilities without visible surface structures are not able to be located at this accuracy at the time of a survey, unless trench or other means of excavation is at time of survey. Where subsurface utilities are not exposed for location, industry standards for location are acceptable with appropriate layer indication within AutoCAD ™ file.

However, if a trench or other excavation is planned during the course of a project, it is expected that the actual location of subsurface utilities will be obtained and included in subsequent revisions of the plans.

8. Guidelines and Requirements for Documentation

As early as possible in the programming stage, the Designer is to produce sufficient documentation to allow for utility system planning and interconnection with the existing infrastructure. This documentation will include, as a minimum:

A. Provide a table indicating building peak, average, and minimum utility demands including: electric demand in kW, steam flow in M#/hr, chilled water flow rate in gallons per minute, and total chilled water capacity in tons, firewater and domestic water flows. Generally there is one combined water service entrance per building for both domestic and fire protection water. The exception being fire protection water is provided by a Princeton owned regional fire pump.

B. Anticipated annual building energy use. (steam, electric and chilled water)

C. Building location and footprint.

D. During preliminary design, a drawing conveying all utility interface points and a table listing required capacities at the building envelope shall be submitted.

E. Provide invert elevations of all gravity drain piping especially foundations and exterior below grade stairs.

F. Designer may be required to calculate sewage flow requirement needed for sewer connection permit. Check with Project Manager.

9. Guidelines for System Installation and Performance

The Facilities Engineering Department typically performs the installation of most campus utilities. This shall be confirmed during preliminary design. Requirements for design services shall evolve from this meeting.

A. All tie-in points for utilities shall be coordinated with Facilities Engineering Department.

B. Indicate on Documents all connections to Building. i.e., direct burial, tunnel, etc.

C. Special attention should be paid to preserve any geodetic monuments. See section 2.9 Site Planning, item 16.

10. Requirements for As-Built Drawings

A. All points of interface with campus utility infrastructure must be documented on the related building Drawings and schedules. Confer with Facilities Engineering at closeout for delivery of reviewed as-built site plans to facilitate updating University utility maps. This shall include but not be limited to: all utilities (including phone & data) enter building (location & shutoffs, etc.), area draining, outdoor irrigation layout and controls location.

B. The table listing all campus utility interface points and required capacities at the building envelope shall be updated with other project Drawings.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

SERVICE REQUIREMENTS FOR UNDERGROUND UTILITIES

	STEAM	CONDENS.	CHILLED WATER	DOMESTIC WATER	FIRE PROTECTION	ELECTRIC OFF CAMPUS	ELECTRIC ON-CAMPUS COGEN
Ownership	PU	PU	PU	NJ AMERICAN WATER	NJ AMERICAN WATER/PU	PSE&G	PU
Design Responsibility	PU	PU	PU	PU/AE	NJ AMERICAN WATER/PU	A/E	PU
Demand Calcs. by	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Point of Interface	INTERIOR	INTERIOR	INTERIOR	EXT.	INTERIOR	REVIEW	INTERIOR
Permit or Application Requirement	NO	NO	NO	YES	YES	YES	*YES*
Redundancy	NO	NO	NO	NO	NO	NO	YES
Existing u/g Locations on File?	YES	YES	YES	YES	YES	NO	YES

	EMERGENCY ELECTRIC	SEWER SANITARY	SEWER STORM	GAS	DATA OIT	DATA VOICE	DATA ATC	DATA SECURITY
Ownership	PU	PSOC/PU	BORO/TWSP/PU	PSE&G	PU	PU/ VERIZON	PU	PU
Design Responsibility	PU	PU	PU	PU	PU	PU	PU	PU
Demand Calcs. by	PU	PU CONSULTANT	PU CONSULTANT	A/E	N/A	N/A	N/A	N/A
Point of Interface	INT.	EXT.	EXT.	EXT.	INT.	INT.	INT.	INT.
Permit or Application Requirement	*YES*	YES	YES	YES	NO	NO	NO	NO
Redundancy	NO	NO	NO	NO	NO	NO	NO	NO
Existing u/g Locations on File?	YES	YES	YES	YES	NO	REVIEW	REVIEW	REVIEW

1. Introduction

Princeton University is increasing the number and quality of fire suppression systems throughout its campus. In addition to the benefits derived from sprinkler system installation in new construction, the University is likewise upgrading its firecode compliance through similar installations in renovation projects. The University Code Analyst maintains a record of all NJUCC Firecode compliancy records for each building (see Appendix D).The Designer is encouraged to incorporate the opportunity to upgrade the firecode compliancy of each project by considering full fire suppression during design

The requirement for standpipes in dormitories is addressed by the referenced codes of the UCC (Uniform Construction Code) and UFC (Uniform Fire Code).

The University has regional fire pumps to serve dedicated fire mains on campus to various buildings. Consult with the Director of Engineering and Code Analyst for water service location.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst — MacMillan Building, 609-258-6706

C. Facilities Site Protection Manager — 306 Alexander, 609-258-5270

D. Director of Engineering — MacMillan Building, 609-258-5472

E. University Fire Marshall — 200 Elm Drive, 609-258-6805

F. Manager Underground Services — New Jersey American Water, 908-301-3422

3. Index of Reference

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Application for Domestic Water Appendix 3.7-1	
B. Application for Fire Service Appendix 3.7-2	
C. Isometric Riser Diagram for Sprinkler System from a Private Main	Appendix 3.7-3
D. Environmental Safety Risk Management Master Plan, 2002	Consult Project Manager

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. IBC (International Building Code), NJ Edition

C. NFPA 24 – Private Fire Service Mains

D. NFPA 13 - Installation of Sprinkler Systems

E. NFPA 13D – Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

F. NFPA 13R – Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height

G. NFPA 14 – Standpipe and Hose Systems

H. NFPA 20 – Stationary Pumps for Fire Protection

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal “Tech Team” review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

During preliminary design and design development the Designer is to consult with the Project Manager, University's Code Analyst and University Fire Marshall to define code strategies and to discuss any code interpretations affecting the project. The Designer is to review system requirements with the Project Manager and research existing infrastructure and capacities near the project area prior to laying out the new system.

The Designer, with the Project Manager, is to request from the Code Analyst any available hydrant or pump test data. In the absence of such data, the Designer shall request that the water utility, New Jersey American Water test hydrants in the project vicinity to obtain the flow test data needed to design the system.

In early review with the Project Manager and the University Code Analyst, a decision will be reached whether to proceed with a proprietary design, including full calculation, design, and dimensioned layout of the system, or whether a performance specification will be used for the project. This shall be determined prior to establishing the Design Fee. The preference of the University is to have the designer provide a fully researched and documented design. Failure to confirm the type of design with the Project Manager will mean that it should be a proprietary design by default.

In consultation with the Project Manager and Code Analyst, the Designer is to determine the type of sprinkler system to be used in the building or part of a building. Depending on the use of a building or spaces within the building the following systems might be used:

A. Wet Pipe System

B. Dry Pipe System

C. Preaction System

D. Deluge System (see following Standards Section for special suppression)

E. Standpipes

When Pre-action or Deluge Systems are selected for use in buildings equipped with standard University addressable fire alarm systems (Simplex), the initiating devices and related components shall be the same manufacturer and Model as the building system, unless otherwise directed by the Site Protection Group. Release Modules, UL Listed for the specific operations designed, shall be used in lieu of packaged systems when possible.

The Designer, with the Project Manager and Code Analyst, must also determine whether additional suppression methods or equipment is necessary for the project; these may include:

A. Wet Standpipe System

B. Dry/Manual Standpipe System

C. Fire Department Connection

D. Fire Pump

To provide some guidance on this issue, the intent will be to keep standpipes in all buildings that have standpipes before a renovation.

Those buildings that do not have a pre-existing standpipe can be evaluated on a case-by-case basis with the understanding that standpipes are preferred but might not be required. The Director of Office of Design and Construction or the Vice President for Facilities in conjunction with the Code Analyst will make the final decision.

All Dormitory standpipes will be dry and charged using a post indicator valve located near the fire department connection to prevent unauthorized use and/or vandalism. The sprinkler and standpipe systems shall be designed so the fire department can pump in to both systems through the F.D.C. (fire department connection) independent of the PIV being open. A Variation is required from the Authority Having Jurisdiction (AHJ) to do this as a matter of protocol.

7. Requirements for Documentation

Along with the specifications, the Designer shall produce sufficient documentation for a code review of the suppression project and for contract bidding of work. If a proprietary design is the approach chosen by the University, the documentation will include, as a minimum:

Required Documentation	**SD**	**DD**	**50% CD**	**85% CD**
Notes & Symbols		**X**	**X**	**X**
Site Plan for utility conn & PIV locations		**X**	**X**	**X**
Floor Plans – device locations			**X**	**X**
Riser Diagram			**X**	**X**
Specifications			**X**	**X**
Floor Plans – dimensioned piping routes				**X**
Hydraulic Calculation				**X**
Details – alarm equip conn & mounting				**X**
Hanger locations				**X**
Seismic Restraint details				**X**

The Designer shall coordinate reflected ceiling plans with all trades. All plans, specifications, hydraulic calculations, shop drawings, etc. shall be signed and sealed by a professional Engineer or Architect licensed in New Jersey. All contractor prepared documents and permit applications shall bear the license and certification number of the Contractor.

8. Guidelines for System Installation and Performance

A. General Approach

1. Construction Permits are required for all work unless specifically excluded by Section 5:23-2.7, or other Section of the State Uniform Fire Code (UCC).

2. Amended Construction Permits are required for all work not installed per the approved plans released by the Authority Having Jurisdiction

3. Refer to Section 1.4 of this Standard, "Regulatory Agencies", for the administrative requirements of System Installation and Performance.

4. All work and installation of fire protection and alarm systems shall be performed by Contractors licensed and certified by the state of New Jersey DCA.

5. All sprinkler system components shall be UL listed in accordance with NFPA Sprinkler Requirements.

6. Sprinkler piping is to be concealed where possible in finished areas.

7. In areas with finished ceilings, use concealed pendant heads, unless otherwise approved by the Project Manager in conjunction with the Code Analyst. Typically, provide factory-finished heads of a color to match ceiling finish.

8. When sidewall sprinklers are used, flush heads are required for exposed installations. Concealed (flat cover) sidewall heads shall be used in finished walls and soffits unless otherwise approved by the Project Manager in conjunction with the Code Analyst. Consult with University Code Analyst for location and types of sprinkler heads.

9. Install dry pipe valves in basement or lowest level of the building with proper means for drainage, unless not physically practical (as confirmed by the Facilities Site Protection Group).

10. Install PIV's for Private Fire Mains. The PIV shall be a lockable control valve, or a OS& Y valve with a Tamper Switch in a pit and installed in accordance with NFPA 24.

11. Provide additional sprinkler coverage, as required, in areas obstructed by surface mounted equipment, i.e. lights, projection screens, fan coil units, etc.

12. Air compressors need to fully charge the system within 30 minutes.

13. For Fire pumps, the straight length of pipe into the suction of the pump, must be 10 times the diameter of the pipe.

14. Check valves are to be installed on feeds to new building fire protection systems, especially when fed from a fire pump that supplies more than one (1) building.

B. Piping

1. The following types of piping are acceptable for use:

    a) Schedule 40 Steel, screwed or grooved; galvanized for exterior applications, dry and pre-action systems;

    b) Type K or L copper (for underground, type K only);

    c) Schedule 40 CPVC (with University Code Analyst and sprinkler shop supervisor approval prior to design);

    d) Cement-lined Ductile Iron (for underground use only).

2. Drain lines, inspector's test valves, and fire pump test headers for sprinkler systems are to be piped to the exterior to a location approved by the University Facilities Site Protection Manager.

3. Drain valves, control valves and inspector's test valves are to be readily accessible for maintenance and test personnel: valves are to be accessible from floor level (not to exceed 7'-0" A.F.F.) and are not to be blocked by piping, fixtures, ductwork, or the like. Review proposed locations with University Facilities Site Protection Manager prior to beginning system installation.

4. Adjustable drop nipples shall be UL or FM approved.

C. Heads

1. Sprinkler heads are to be Bellville spring seal type, such as those manufactured by Viking or equal. Sprinkler heads relying on O-rings for seal are NOT to be used.

2. Concealed pendant heads are to be used in finished ceilings.

3. Concealed sidewall heads are to be used in finished walls and soffits.

4. Listed sprinkler head cages shall be installed for all heads mounted 7' or lower or subject to mechanical damage.

D. Valves

1. Control valves shall be equipped with a port to monitor street side of system. Valves to be by Kennedy (OS&Y) and Kennedy for butterfly valves.

2. Double-check valve and RPZ/backflow preventers are to be by Ames.

3. Dry system activation valves are to be by Viking or Victaulic.

4. Alarm check valves are to be by Viking or Victaulic.

5. PIV's shall be Kennedy, lockable, with no supervisory provisions.

E. Flow Indicators and Supervisory Devices

Flow and tamper switches and any additional supervisory devices are to be manufactured by Potter.

All flow and Supervisory devices shall initiate a building alarm, and report the condition to the Public Safety Dispatch Desk through the building fire alarm system-signaling unit. (Simplex).

F. Inspectors Test and Drain

Drain shall be AGF model 1000. Install a valve at the lower end of the main line to remove air from system.

G. Standpipes

1. Include post-indicator valve on all manual dry systems for all R2 Dormitory Projects.
2. Install a locking device on exterior valve (not a tamper switch).
3. At entry point, install OS&Y valve with an auxiliary port for testing; provide 1/2” ball valve with capped outlet on test port.
4. For Manually Dry Standpipes: Note that if piping is concealed in building it must be visually accessible for inspection (by mirror and light at the least). Plan and provide access doors with the appropriate fire resistance rating in building finishes as necessary to provide for inspection.
5. Provide valves at the base of risers. All valves must be accessible (public areas) and must drain to exterior of building at grade level. All drain valve location must be reviewed.

H. Backflow Preventor

1. Ames Silver Bullet
2. When chemical treatment is utilized, an Ames RPZ backflow preventer shall be installed.

I. Fire Department Connections (F.D.C.)

1. Guidelines require that fire department connection be within fifty feet of a fire hydrant, and outside the exterior collapse zone of the building served. After determining preferred location, review location with the local Fire Official, and obtain approval.
2. Pipe threads for connection of fire department equipment shall be NST (National Standard Thread)
3. 2 1/2” outlets of proper number to match system demands, unless directed by the Fire Department to install 5” Storz large diameter hose outlets.

4. The F.D.C. shall be UL listed.

J. Air Compressors

1. For dry and pre-action systems, air compressors are to be by General unless otherwise directed by the University Facilities Site Protection Manager.

K. Microbiological Influenced Corrosion (MIC) Treatment

1. MIC chemical treatment shall be installed as directed by the Site Protection Group. The SPG shall determine the manufacturer of the chemical treatment system to be used.

9. Requirements for Suppression System Testing

The system is to be ready for testing prior to scheduling a test with the local enforcement agency. A pre-test is to be conducted prior to scheduling the official test for approval. The system shall be ready for inspection.

The procedure for testing shall be followed closely in accordance with NFPA 13. A Representative(s) of the University Facilities Site Protection Group shall be present for the hydrostatic and acceptance tests of the system, and the local Fire Subcode Inspector.

The contractor will be responsible for the acceptance test for the local enforcing agency, and for any remedial work and re-testing required. Contractor is responsible for draining systems as needed for test or repair, and for recharging system so they are left in operating condition. Hydraulic calculation placards shall be installed at main sprinkler risers prior to acceptance testing.

10. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the Fire Suppression Contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the Contractor is maintaining record Drawings to convert to as-builts.

The as-builts are to include the following as a minimum: layout plan complete with all other system interfaces and all components, riser Diagram, equipment schedule, hydraulic calculations, etc.

The University Project Manager is responsible for distributing copies of the as-builts to the appropriate University representatives for review prior to project closeout. In addition to posting of all as-built documents to Centric Project, a hard copy and electronic copy (CD) shall be provided to the Facilities Mechanicl System Coordinator for Life Safety and Security.

See Section 1.5 (Documentation and Archiving).

11. Requirements for Spare Parts

A spare head cabinet(s) is to be provided near the entry point of the sprinkler system to be determined by the University Facilities Site Protection Group. A minimum of six replacement heads, or each type used in the system, are required to be provided with the cabinet. The proper sprinkler head wrench(s) for replacement of heads will be required. Include spare part requirements in all specifications.

When dry heads are installed and there are more than three (3) pieces of the same length, the Contractor should provide a spare head to match.

END OF DOCUMENT

1. Introduction

Fire suppression chemical installations today range from protecting rare book collections in Firestone Library and the painting storage rooms in the Art Museum, to providing life safety in more typical locations such as an exhaust hood in a Dining Services food preparation area.

Dormitory food preparation areas require discussion of the requirements for hood suppression at cooking sources. Generally, the hood suppression requirement is a function of the type of usages programmed for the dormitory kitchen considered. This discussion must occur in conjunction with the Housing Office and University Code Analyst.

Chemical fire suppression systems also include hand-held extinguishers, distributed in buildings. Note that the local fire code official has jurisdiction regarding the placement of fire extinguishers.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst — MacMillan Building, 609-258-6706

C. Facilities Mechanical Systems Coordinator, Life Safety & Security — 306 Alexander Street, 609-258-3659

D. Director of Engineering — MacMillan Building, 609-258-5472

E. University Fire Marshall — 200 Elm Drive, 609-258-6805

F. University Safety Engineer — Office of Env. Health and Safety, 609-258-5849

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Environmental Safety & Risk Management (ESRM) Seeler·Smith & Associates, Inc., 2002	See Project Manager
B. Princeton University Fire Extinguisher Use Matrix	Appendix 3.8-2

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. New Jersey Uniform Fire Code (subchapter 4 for retrofit requirements)

E. IBC (International Building Code)

F. NFPA 10 - Portable Fire Extinguishers

G. NFPA 11A - Medium- and High-Expansion Foam Systems

H. NFPA 12 - Carbon Dioxide Extinguishing Systems

I. NFPA 12A - Halon 1301 Fire Extinguishing Systems

J. NFPA 15 - Water Spray Fixed Systems for Fire Protection

K. NFPA 16 - Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems

L. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations

M. NFPA 2001 - Clean Agent Fire Extinguishing Systems

N. UL 300 - Kitchen Systems

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented.

The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

During Preliminary Design and Design Development the suppression Designer is to consult with the Project Manager, University's Code Analyst and University Fire Marshall to define code strategies and to discuss any code interpretations affecting the project. The Designer is to review system requirements with the Project Manager and research existing infrastructure and related systems near the project area prior to laying out the new system.

When a Clean Agent Suppression System is selected for use in buildings equipped with standard University addressable fire alarm systems (Simplex), the initiating device shall be the same manufacturer and model as the building system. Release modules, UL Listed for the specific operations designed, shall be used in lieu of packaged systems when possible. The actuator for releasing the Clean Agent suppressant shall be a solenoid type, compatible and listed for use with the building fire alarm system Releasing Module, and capable of reuse after reset.

Kitchen Hood Suppressions Systems shall be UL Listed, and designed to provide suppression commensurate with the type of cooking proposed. The system shall be equipped with a proprietary control panel from the manufacturer, and shall be interconnected to the main building fire alarm panel (Simplex), when available. In all cases, the system shall be compliant with State Uniform Construction Code.

In consultation with the Project Manager, the Designer is to determine the type of suppression system to be used in the application. Depending on the use of a building or spaces within the building the following systems might be used:

A. Carbon Dioxide Gas (for renewal of existing systems)

B. Halon 1301 Gas (for renewal of existing systems)

C. Halon 1211 Gas (for renewal of existing systems)

D. FM 200, Inergen, or the "FE" line of clean agent fire extinguishers (laser labs)

E. Dry Chemical/Ansul (kitchen hoods and some labs)

F. Wet chemical range hood systems

G. Water misting systems

H. Hand-held extinguishers (in general use)

The Designer, with the Project Manager, must also determine whether additional suppression methods or equipment is necessary for the application or the particular project.

7. Requirements for Documentation

Along with the specifications, the Designer shall produce sufficient documentation for a code review of the suppression project and for contract bidding of work. If a proprietary design is the approach chosen by the University, the documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
Notes & Symbols		X	X	X
Site Plan for utility conn & PIV locations		X	X	X
Floor Plans – device locations			X	X
Fire Extinguisher Cabinet Locations			X	X
Specifications			X	X
Floor Plans – dimensioned piping routes				X
Hydraulic Calculation				X
Details – alarm equip conn & mounting				X
Hanger locations				X
Seismic Restraint details				X
Sequence of Operation for Clean Agent				X

The Designer shall coordinate reflected ceiling plans with all trades. All plans, specifications, hydraulic calculations, shop drawings, etc. shall be signed and sealed by a professional Engineer or Architect licensed in New Jersey. All contractor prepared documents and permit applications shall bear the license and certification number of the Contractor

8. Guidelines for System Installation and Performance

A. General Approach

1. Construction Permits are required for all work unless specifically excluded by Section 5:23-2.7, or other Section of the State Uniform Fire Code (UCC).
2. Amended Construction Permits are required for all work not installed per the approved plans released by the Authority Having Jurisdiction
3. Refer to Section 1.4 of this Standard, "Regulatory Agencies", for the administrative requirements of System Installation and Performance.
4. All work and installation of fire protection and alarm systems shall be performed by Contractors licensed and certified by the state of New Jersey DCA.
5. UL listed systems and components are to be used.
6. "Matched" systems shall be utilized when possible, e.g., listed kitchen hood used in conjunction with make-up air unit tested as part of manufacturer's system.

7. Complete system is to include all “options,” e.g., breathing apparatus for CO_2 systems; seals, HVAC interlocks, dampers and controls, purge systems, alarm tie-ins, etc. for systems as applicable.

B. Piping

The following types of piping are acceptable for use:

1. Schedule 40 Steel, screwed or grooved (only if approved and must be listed); galvanized for exterior applications and kitchens;

2. Cleanable surface within hood and exposed in kitchen: stainless steel or chromed. (NSF approved)

C. Heads

1. Match the UL listed system

D. Valves

1. Control valves - Milwaukee with tamper switch

E. Tanks

1. All clean agent tanks shall be fitted with liquid level indicators. If agent stored in tank prohibits the use of liquid level indicators, provide and alternative means of measuring agent quantity (other than weighing).

F. Supervisory Devices

Supervisory devices or shut off valves are to be manufactured by Milwaukee (shut-off tamper combination). If there is an over-riding reason not to use the preferred manufacturer, Designer will review requirements with University Code Analyst.

G. Supervision and Reportability

Suppression systems shall be tied into the building fire alarm system panel (Simplex) and will report to the University’s proprietary system. In a building that has no fire alarm panel, one shall be designed unless in the opinion of the University Code Analyst a panel is not required. In addition, shunt trip devices may be required to disable other surrounding electric appliances when the suppression system activates. Shunt trip breakers shall be designed to disable only associated devices under kitchen hood, and not other equipment in the space.

9. Requirements for Suppression System Testing

The system is to be ready for testing prior to the suppression contractor’s scheduling of a test with the local enforcement agency. A pre-test is to be conducted prior to bringing code official on site for testing, so that system is leak-free and otherwise ready for inspection.
The procedure for testing shall be followed closely in accordance NFPA. Representatives of the University Facilities Site Protection Group are to be present for the hydrostatic tests of systems. Project Manager is to be present for any pressure testing of room-sealant systems.

The contractor will be responsible for the acceptance test for the local enforcing agency, and for any remedial work and re-testing required. Contractor is responsible for draining systems as needed for test or repair, and for recharging systems so they are left in operating condition. If suppression system is tied in to building fire alarm system, representatives of the Maintenance Alarm Shop are to be present.

10. Fire Extinguishers

The New Jersey Uniform Fire Code governs (refer to NFPA 10) the placement of fire extinguishers in buildings. The Designer should review Fire Code requirements for extinguishers and carefully plan for them in the project; however, the local Code Official has jurisdiction regarding placement of extinguishers under the code. Designers should review proposed locations with the University Code Analyst prior to finalizing plans.

See Appendix 3.8-2 for recommended types of extinguishers for particular uses and locations.

The preference for mounting extinguishers is in cabinets recessed into hallway walls (and in other required room locations). Cabinet doors shall have glass panels so extinguishers are visible. If the building is to have standpipes, the preference is to house extinguishers in a combination extinguisher/standpipe cabinet. Doors without vision panels shall have proper signage identifying the standpipe and extinguisher.

11. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the fire suppression contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include plans, details, sequence of operation of any tie-ins to other systems, such as fire alarm, electric, plumbing, and HVAC systems.

The University Project Manager is responsible for distributing copies of the as-builts to the appropriate University representatives for review prior to project closeout. In addition to posting of all as-built documents to Centric Project, a hard copy and electronic copy (CD) shall be provided to the Facilities Mechanicl System Coordinator for Life Safety and Security.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

The Main Campus of Princeton University is crisscrossed by a network of communication lines which have been installed and are maintained by the University. The lines originate in 112 Frist Campus Center and distribute out. Off Campus, lines are fed through OSNA lines provided by Verizon.

2. Contacts

A. The Project Manager (in Office of Design and Constrution, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. HWS Telecommunications Manager 609-258-6655

C. Manager of Hardware Support Telecommunications
Assistant Manager Technical Operations 609-258-6042

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Elevator Phone Mounting Detail	Appendix 2.6-9
B. Cut Sheet of Elevator Phone	Appendix 2.6-10
C. Cut Sheet of Emergency Phone	Appendix 2.6-11
D. Future	Appendix 3.9-1
E. Specifications for Telephone Terminations, dated 6/6/02	Appendix 3.9-2

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. National Electric Code

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines - Preliminary Design & Design Development

During preliminary design, Designer is to consult with University Project Manager to ascertain the requirements for communication use and installation. The Designer is to cooperate with any adjunct professionals providing assistance to the University, and is to coordinate his work with other disciplines so a cohesive set of documents is produced for the communication work.

During preliminary design and design development the Designer is to consult with the Project Manager and with University Telecommunications Office to define system distribution strategies and to discuss any obstacles that might be existing in a building, or problems inherent in a particular design or structural system.

University Telecommunications Office/OIT will provide information on design requirements for point-of-entry (POE), building distribution frame (BDF), and intermediate distribution frame (IDFs). This information will be based on the number of outlets anticipated for the project, the length of wiring runs in the project, the distance of terminations from POE, BDF, and IDFs, etc.

All new Buildings shall receive 2 pairs per phone station plus 25% spare capacity. Designer must specify type of lines required for off-Campus Buildings. Specify voice grade or alarm/ data grade. Alarm grade wiring off Campus may be incompatible with University fire alarm reporting system due to variation in line voltages.

7. Guidelines and Requirements for Documentation

The preferred approach to documenting telephone needs and work for a project is to have Drawings combined with OIT design and construction. These Drawings should be coordinated with the electrical Drawings (the electrical contractor will typically install the raceway system for OIT/Telecommunications work), with the Architectural Drawings for inclusion of closets, backboards, etc. that support OIT/Telecommunications work, and the Drawings for any other trades affected.

See Section 1.4 (Regulatory Agencies) for requirements for code review and permits, including the organization of construction Drawings and documents for timely release of permits.

At a minimum, the following are to be provided at the indicated phase:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Floor Plans - *BDF & IDF*	X	X	X	X
Floor Plans – *System "Backbone"*		X	X	X
Floor plans - *showing horizontal and vertical routes of raceways*			X	X
Floor plans - *showing locations of all outlets*			X	X
Conduit riser Diagram *showing all outlets*		X	X	X
Symbols & Notes		X	X	X
Outline Specifications		X		
Specifications			X	X
Details			X	X

8. Considerations for Telephone Systems Design

Industry standard guidelines govern the installation of equipment, raceways, wiring, outlets, etc., and govern distances of runs between terminations and BDF/IDF.

Specific requirements for portions of the system are as follows:

A. Specialized Phone Circuits (see attached Diagram)

1. Fire Alarm Reportability (at fire alarm control panel)
   (3 lines) 2 Data
   1 Analog

2. Access Control System (at remote processing cabinet)
   (3 lines) 1 Data
   1 Voice
   1 Voice Line for each blue light phone

3. Elevator (at Elevator Machine Room)
   (1 line) 1 Voice

4. ATC – Automatic Temperature Control Panel
   (2 lines) 1 Data
   1 Voice

5. Public Phones
   1 Voice for each phone

B. Point of Entry

1. Minimum four 4" conduits into building (1 tele., 1 data and video, 2 spare).

2. Conduit between POE and BDF to be 3" minimum, 4" preferred

3. Conduit Bending/Radius for 4" Conduit & Larger:

   - 36" radius minimum (only if required in tight place)
   - 48" radius (preferred)
   - 60" radius (preferred when filling with innerduct)

   No more than 3 – 90 degree bends in any run between manhole to Buildings, manhole to manhole or point to point.

4. Telephone service feed cable (gel filled) must be protected no more than 50 ft. from POE (Protection can exceed 50 ft. If cable in building is placed in conduit from the POE to the point of protection i.e.; BDF).

5. Provide adequate work light (4' fluorescent preferred) and power outlet in closet.

C. Building Distribution Frame (BDF)

1. Conduit between BDF and IDF to be two 4" conduit each to create "building riser system"

2. Wiring between BDF and IDF to be home runs

3. Provide adequate work light (4' fluorescent preferred) and power outlet in closet.

D. Intermediate Distribution Frame (IDF)

1. OIT/telephone to provide area requirements for closet based on cable count

2. Emergency power to be provided to IDF

3. Provide adequate work light (4' fluorescent w/ guard preferred) and power outlets in closet (1 duplex outlet per 24 station cables, plus additional work outlet): provide two 20A circuits minimum to IDF

4. Evaluate equipment heat load and provide cooling as necessary

5. Cable design length cannot exceed 295', station terminal to IDF terminal

6. No other services are to share IDF closet space, or pass through closet.

7. Closets to be keyed to EM core system

E. Individual Outlets (Stations)

1. 5/8" Diameter bundle to each outlet; High Density bundle – Cat. 5 and fiber optics; Standard bundle – Cat. 5, fiber optics, CATV and telephone

2. 1" EMT conduit from outlet to access point, such as lay-in ceiling tile; no LB's in run (if 1" EMT is not practical, provide written argument detailing difficulties)

3. If an additional station cable is run to Room, a 1 1/4" EMT conduit shall be installed.

4. Minimum bending radius is governed by Cat. 5 requirements: 4"

5. Face plates by Siemons.

F. System Wiring

1. For data, video commscope #5740R, and voice, Cat. 5 wiring by Chumplain Cat. 5e.

2. For fiber Siecor Corp.

3. Plenum-rated cable is to be used if cables are to be run without UL conduit in ceiling space or other space subject to use as a return or supply air.

4. No consolidation points utilized.

G. System Distribution

1. Raceways, cable trays, conduits, mounting hooks are to be utilized; review method of distribution with OIT/telephone during preliminary design.

2. Cable is to be properly supported (cat 5 requirements) in trays, by hooks, etc. along run; raceways, trays, etc. to be properly supported from building structure. Conduit is not to be cascaded.

3. Any fire-proofing material removed from structure during installation of raceway system is to be replaced in kind.

4. System components penetrating fire-rated assemblies are to be fire-stopped to meet requirements for rated assembly breached; UL listed fire-stop systems by Hilti are to be utilized. Review system to be used with University Project Manager prior to undertaking work.

H. Elevator Cabs

All cabs must be equipped to accept an elevator telephone as specified by the Telecommunications Office. Accommodation for mounting the telephone must include holes tapped to accept standard mounting 10 x 32 machine screws. If other than standard color faceplate (stainless steel) is requested special order sets must be ordered in groups of two. Also, add a standard size threaded hole tapped to accept a 10/32 x 1” security screw.

I. Elevator Machine Room

A standard Princeton University Office of Information Technology bundle shall be run to the elevator machine room. The bundle shall be installed in a 1” conduit and terminate in a 4” surface mounted outlet box with a Princeton University standard connection jack installed. An empty 1” conduit shall be run from the outlet box to the elevator control panel.

J. Fire Alarm Panel

A standard Princeton University Office of Information Technology bundle shall be run to the main Fire Alarm Panel. The bundle shall be installed in a 1” conduit and terminate in a 4” surface mounted outlet box with a Princeton University standard connection jack installed.

The outlet box shall be located within 18” of the Fire Alarm MUX pad. An empty 1” conduit shall be run from the outlet box to the MUX pad.

K. Automatic Temperature Control Panel

A standard Princeton University Office of Information Technology bundle shall be run to the Main Automatic Temperature Control Panel. The bundle shall be installed in a 1” conduit and terminate in a 4” surface mounted outlet box with a Princeton University standard connection jack installed. The outlet box shall be located within 18” of the Automatic Temperature Control Panel. An empty 1” conduit shall be run from the outlet box to the Automatic Temperature Control Panel.

L. Access Control

A standard Princeton University Office of Information Technology shall be run to the Access Control Panel. The bundle shall be installed in a 1” conduit and terminate in a 4” surface mounted outlet box with a Princeton University standard connection jack installed. The outlet box shall be located within 18” of the Access Control Panel. An empty 1” conduit shall be run from the outlet box to the Access Control Panel.

M. Switchgear Rooms
A standard Princeton University Office of Information Technology bundle shall be run to the Electrical Switchgear Room. The bundle shall be installed in a 1” conduit and terminate in a 4” surface mounted outlet box with a Princeton University standard connection jack installed. An empty 1” conduit shall be run from the outlet box to the switchgear metering section.

N. Emergency Power Transfer Switch
A standard Princeton University Office of Information Technology bundle shall be run to the Emergency Power Transfer Switch. The bundle shall be installed in a 1” conduit and terminate in a 4” surface mounted outlet box with a Princeton University standard connection jack installed. The outlet box shall be located within 18” of the Emergency Power Transfer Switch. An empty 1” conduit shall be run from the outlet box to the Emergency Power Transfer Switch.

9. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the construction contractor and any systems installer.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

3.10 Heating, Ventilation and Air Conditioning Systems Design

1. Introduction

Each Project is assigned a Facilities Engineering representative to track the progress of all Mechanical design and construction issues. All issues pertaining to system programming, selection and performance are reviewed with the Facilities Engineering representative. The Design Engineer is encouraged to initiate and sustain open communications throughout the Project to achieve that end.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Manager of Mechanical Engineering — MacMillan Building, 609-258-3934

C. Maintenance HVAC Shop Supervisor — MacMillan Building, 609-258-3446

D. Director of Engineering — MacMillan Building, 609-258-5472

3. Index of Appendices

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Princeton University Pipe Support Detail, dated March 10, 2006	Appendix 3.10-1	Appendix 3.10-1
B. Princeton University Building Pipe Entrance Detail, dated March 10, 2006	Appendix 3.10-2	Appendix 3.10-2
C. Princeton University Single Steam Coil Piping Detail, dated March 10, 2006	Appendix 3.10-3	Appendix 3.10-3
D. Princeton University Single Steam/Hot Water Converter Piping Detail, dated March 10, 2006	Appendix 3.10-4	Appendix 3.10-4
E. Princeton University Steam Condensate Pump Detail, dated March 10, 2006	Appendix 3.10-5	Appendix 3.10-5

		PDF	AutoCAD
F.	Princeton University Flash Tank Detail, dated February 13, 2003	Appendix 3.10-6	Appendix 3.10-6
G.	Princeton University Parallel Steam PRV Station with, Safety Shut-off Valve (Pneumatic), dated March 10, 2006	Appendix 3.10-7	Appendix 3.10-7
H.	Princeton University Chilled Water Coil Piping Schematic, dated March 10, 2006	Appendix 3.10-8	Appendix 3.10-8
I.	Princeton University Plate and Frame HX Detail, dated March 10, 2006	Appendix 3.10-9	Appendix 3.10-9
J.	Princeton University Pump Piping Detail, dated March 10, 2006	Appendix 3.10-10	Appendix 3.10-10
K.	Princeton University Expansion Tank/Make-up Water/Air Separator Piping Detail, dated February 13, 2003	Appendix 3.10-11	Appendix 3.10-11
L.	Princeton University VAV Box Detail, dated March 10, 2006	Appendix 3.10-12	Appendix 3.10-12
M.	Princeton University Hot Water Reheat Coil Detail, dated March 10, 2006	Appendix 3.10-13	Appendix 3.10-13
N.	Princeton University Multiple Steam Coil Piping Detail, dated March 10, 2006	Appendix 3.10-14	Appendix 3.10-14
O.	Princeton University Multiple Steam/Hot Water Converter Piping Detail, dated March 10, 2006	Appendix 3.10-15	Appendix 3.10-15
P.	Princeton University Medium Pressure Drip Trap, dated March 10, 2006	Appendix 3.10-16	Appendix 3.10-16
Q.	Princeton University Cooling Coil Condensate Drain Detail, dated March 10, 2006	Appendix 3.10-17	Appendix 3.10-17
R.	Princeton University Fan Coil Unit, dated March 1, 2010	Appendix 3.10-18	Appendix 3.10-18
S.	Princeton University Pipe Sleeve Thru Floor Plan, Dated March 1, 1999	Appendix 3.10-19	Appendix 3.10-19

		PDF	AutoCAD
T.	Air Handler Filter Dated April 1, 2004	Appendix 3.10-20	Appendix 3.10-20
U.	Pressure Powered Pumps Dated April 1, 2004	Appendix 3.10-21	Appendix 3.10-21
V.	Side – Stream Shot Feeder Dated March 10, 2006	Appendix 3.10-22	Appendix 3.10-22
W.	Multiple Room Valence Piping Schematic Elevation, dated March 1, 2010	Appendix 3.10-23	Appendix 3.10-23
X.	Commissioning Specifications	Appendix 3.3-9	Appendix 3.3-9 (MS Word)

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. International Mechanical Code

C. ASHRAE 62.1 -2007

D. ASHRAE 90.1 Energy Standard, 2004

E. BOCA National Energy Conservation Code

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for verification of an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The A/E shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines

The Designer shall meet with the Project Manager and Facilities Engineering Project Technical Representative (PTR) to ascertain the number and types of systems to be installed in the building. A formal process for documenting this data can be found in the Building Commissioning Standards in Section 3.3 (Energy Guidelines). Designs must meet the requirements of Section 1.2; Sustainability Guidelines and Section 3.3; Energy Guidelines.

A. Design Conditions

1. Summer Outdoor 90ºF/74ºF (ASHRAE 1%); for critical spaces and labs 89ºF/78ºF (ASHRAE 0.4%)

2. Winter Outdoor 10F (ASHRAE 1%)

3. Indoor Design conditions are 72ºF (winter) and 75ºF (summer) for comfort conditions. The Facilities operation policy is to operate the systems to provide a minimum of 68ºF in winter and a maximum of 78ºF in summer to occupied spaces.

4. Non-laboratory indoor relative humidity shall be maintained within the ASHRAE recommended thermal comfort zones, roughly between 20% (winter) and 60% (summer).

5. Laboratories shall be designed to maintain 74ºF (±2 ºF) with 30% winter and 55% summer humidity, unless the research program requirements are different. These differences should be documented in the basis of design records.

6. Design for 60ºF (Winter) in Mechanical Equipment Rooms and non-occupied space. Provide mechanical ventilation for these spaces where temperatures may exceed 85ºF. Provide ventilation air per ASHRAE Standard 62.1-2007. Mechanical Equipment Room cooling is only provided by exception with the approval of the Facilities Engineering Project Technical Representative

7. Review and document in "Basis of Design" the desired NC (decibel ratings) for all spaces in building or where HVAC equipment is to be placed adjacent to occupied spaces.

8. Attics shall not be heated without prior approval from Facilities Engineering Project Technical Representative (PTR).

B. HVAC Zoning

1. Thermostats – Avoid placing thermostats or sensors on outside walls, in direct sunlight, in the way of potential obstructions such as filing cabinets, or in supply air path.

2. Dormitories shall be designed to have tenant accessible zone control for each living unit (i.e. one zone per suite or one zone per room).

3. Offices with similar load profiles on the same exposure, and floor, may be placed on a common zone as a cost saving measure. Review with Engineering.

4. Each Conference Room and Classroom must be unique zones separated from all surrounding spaces.

C. Considerations for Maintenance

1. Design shall allow for adequate and safe access to all mechanical equipment. Where appropriate in construction documents, indicate areas to be kept free of obstructions for service access, including replacement of equipment. Equipment requiring routine maintenance should preferably be mounted at or near the floor. Consider if rigging is required and provide adequate path width to building exterior. Equipment in ceilings should be accessible with an 8-ft. ladder. For heavy equipment mounted above the floor, provide access for rigging equipment. Where the opportunity arises, install equipment above hallway ceilings rather than above office or classroom space. Coordinate work with Architect to provide maintenance access including adequate access doors and clearances. Where possible consider the use of lay-in ceilings, which permit greater maintenance access and more flexibility for future system renovations. Where hard ceilings are required, review access door locations with the Architect & Engineer

2. Coordinate all MEP design work with structural system early in the design process, to ensure piping systems are drainable, properly pitched, and that piping and ductwork offsets are not excessive. Coordinate placement of louvers, plenums, and other wall/roof penetrations with structural system. The Designer is responsible for providing a workable MEP design that demonstrates a thorough coordination between disciplines.

3. Locating of equipment on roofs should be minimized. When it is required, provide adequate & safe access for maintenance.

7. Guidelines and Requirements for Documentation

Along with the Specifications, the Designer is to produce sufficient documentation to allow for code review of the HVAC project and for contract bidding of the work.

Specifications shall include the requirements listed in these Design Guidelines and Appendices. Delete equipment and references not applicable to the project.

The Design documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Notes & Symbols	X	X	X	X
Floor Plans – Major Equipment	X	X	X	X
Floor Plans–Ductwork & Dampers			X	X
Floor Plans–Piping			X	X
One Line Diagrams Air Flow & Piping		X	X	X
Equipment Schedules			X	X
Details – equipment & piping Connections			X	X
Ventilation Schedule Compliance				X
Vertical Sections as required				X
Mechanical Specifications			X	X

Coordination Drawings field produced by Contractor(s) – Facilities Engineering Department will review 3/8" scale Coordination Drawings of all equipment to be installed in Mechanical Rooms. This will be done as a concurrent Shop Drawing submittal or as part of a Coordination Meeting(s) which includes University participation.

8. Guidelines for System Installation and Performance

A. Campus Utilities

1. Campus Chilled Water System

a. General
The campus chilled water plant contains all chillers, distribution pumps, expansion tank, and chemical treatment equipment. Wherever possible, use campus chilled water as the preferred method of cooling and dehumidification.

b. Design Pressure
Available differential pressures vary throughout the campus ranging from 100psi to 10psi at remote buildings. Peak supply pressure varies from 200psig near the plant to 135psig at remote buildings. Return pressures vary upwards from 100psig at plant. Control valves must be capable of tight shutoff against 150psid differential. Control valve body ratings to be 250# class where used on plant-chilled water. Use 300 psi class butterfly valves at building entrance. All other CHW isolation valves may be 150# rated.

c. Chilled Water Design Temperatures

Equipment using campus chilled water should be selected at 45ºF entering water temperature from April through October, 50ºF from November through March. Chilled water coils and plate and frame heat exchangers in buildings with significant air recirculation should be designed for a minimum of 20ºF temperature rise (i.e. 45-65). Chilled water coils in systems using 100% outside air should be designed for a minimum of 24° temperature rise.

d. Building Distribution Systems

The use of primary chilled water is generally reserved for air handling units and plate and frame heat exchangers producing secondary chilled water. Branch connections to mains shall be made at or above horizontal midline of piping. The use of booster pumps must be reviewed with Engineering. Three way valves or uncontrolled flow on primary chilled water are not permitted. FCI (Flow Control Industries) or Belimo pressure independent control valves should be used where appropriate (when using pressure independent valves, do not use circuit setter). Buildings that use multiple cooling terminal units such as fan coils must use a secondary chilled water system.

e. Design Velocities

Water velocity within occupied areas of buildings should be less than 6 fps. Provide consideration for future expansions of chilled water demand.

2. Campus Steam/Condensate System

a. General

Steam is distributed through a network of low (nominally 15psig) and medium pressure mains (currently 65-100psig) to most buildings on campus. Condensate is collected and returned to the Cogeneration Plant. Utilities are generally installed by Princeton University from exterior up to "house" valves inside the building and project work should include extending from this point. Where project conditions require contractor to provide exterior utilities, discuss with the Facilities Engineering Project Technical Representative (PTR) the details on tunnel design, insulation, inverts, etc.

b. Pressure Regulating Valve Stations

Medium pressure steam entering a building is reduced to low pressure (between 5 and 15psig) steam for distribution within building. Existing buildings served only by low-pressure steam mains and remote from plant may have entering pressures as low as 5psig. PRV station control valves shall be Leslie model GPK and/or model DDBOY. Note that the preferred method or overpressure protection is a Normally Closed Safety Shut-off Valve, rather than a relief valve. See details for piping arrangement.

c. Building Steam/Condensate Distribution Systems

- Steam shall be used for preheat coils, hot water converters and domestic hot water generators. Design pressure entering heat transfer devices is nominally 2psig. Air unit steam coils in contact with mixed or outside air, shall be non-freeze type. Mount coils high enough to permit complete drainage of tubes by gravity thru the trap and to the condensate receiver! For floor mounted air handling units, this may require raising the unit off the floor, installing the coils above the floor of the unit, or providing trenches in Mechanical Room floor. Steam traps and the equipment they serve must both be within the same room. Consultant should make sure this is clear on Construction Drawings. Provide drip traps at all low points in piping. Traps should drain by gravity to condensate pump sets. Do not design traps to lift. Low-pressure traps shall be Spirax Sarco F&T model FT-15 with non-asbestos gaskets. Steam traps for service between 15 and 125 psig shall be Spirax Sarco F&T model FT-125, Sarco thermodynamic trap model TD-52, or bucket trap Sarco type B. Discuss with project Technical Representative the use of orifice traps in lieu of F&T and thermostatic traps. Branch connections to steam mains shall be made at or above horizontal midline of main piping. Do not provide trap bypasses or double trapping. Engineers shall size steam traps on Design Documents.

- Condensate pumps shall be duplex type Domestic ITT Model CB/CBE or Skidmore low NPSH type rated for 210ºF condensate with steel or cast iron receivers. Do not specify package unit starters for condensate pumps. Motor starters shall be purchased by Electrical Contractor. For condensate piping systems, use eccentric reducer as required with bottoms of piping level. Review with Engineering the possible use of Spirax Sarco pressure powered pumps where flooding of pumps is possible (i.e. Basement Mechanical Rooms) and where medium pressure steam or compressed air is available. Where steam is used as a pumping medium, vent must be routed to building exterior. No fluids from any other source may be introduced to the steam condensate system.

- Steam vacuum breakers shall be Johnson Corp. (Three Rivers, Michigan) ¾" stainless steel body, ball and spring with ½" FPT tapping at inlet. See detail drawing.

- Modifications to existing building steam heating systems shall use steel fin tube convectors and self-contained Macon control valves where zone control is required. Where feasible, use hot water for comfort heating.

B. Piping and Piping Accessories

1. Piping Materials

System	Piping Material	Fitting Material	Strainer (stm. Rating)
Hot Water Heating & Secondary Chilled Water Systems 2" and smaller	Type L Copper Sch. 80 Steel See Note (1)	Wrought copper with 95-5 solder 125# Cast iron threaded	Sarco bronze model BT or TBT Or Cast iron Model IT
Hot Water Heating & Secondary Chilled Water Systems 2-1/2" and larger	Sch. 40 Steel	Std. Weight Butt welded steel	Sarco cast iron Model IT
Low & Medium Pressure Steam 2-1/2" and above	Sch. 40 Steel (Std Weight 12"+)	Std. Weight butt welded	Sarco Cast iron Model CI-125 Flanged 125#
Low & Medium Pressure Steam 2" and smaller	Sch. 80 Steel	125# Cast iron threaded	Sarco Cast iron Model IT
Steam Condensate 2-1/2" and larger	Sch. 80 Steel	Hvy. Weight butt welded	Sarco Cast iron Model CI-125 Flanged 125#
Steam Condensate 2" and smaller	Sch. 80 Steel	125# Cast iron threaded	Sarco Cast iron Model IT
Primary Chilled Water 2" and smaller	Type L Copper (preferred) Sch. 80 Steel See Note (1)	Wrought copper with 95-5 solder 250# Malleable iron threaded	Sarco bronze model BT or TBT Sarco Cast iron Model IT (250# rated)
Primary Chilled Water 2-1/2" and larger	Schedule 40 Steel	Std. Weight butt welded	Sarco Cast steel Flanged 150#
AC Condensate	Type L Copper or PVC Sch. 40	Copper or Solvent weld PVC	N/A

Table Notes

(1) Piping shall be type L copper, except where a minor modification to an existing steel piping system is required. Review with Princeton Engineering.

2. Strainers

   Use Y type strainers as shown above. Screen shall be stainless steel with mesh size as follows:

   - Steam service - .032" perforation (20 mesh)
   - Hydronic chilled water heating systems and steam condensate service 0.125" perforation

3. Hydronic Piping Systems

   Use Amtrol or equal diaphragm type expansion tanks. Provide a Watts series 007 backflow preventer at the makeup water line. Provide isolation valves at all control valves and equipment requiring maintenance. Layout piping to avoid or minimize air pockets. Provide and indicate, on contract drawings, sectionalizing valves, including drains, to isolate areas of main and sub-main piping runs, for servicing work and future tie-ins, for example at floor take-offs from main. See Appendix 3.10-1 for pipe support details.

4. Fittings

   Where use of dissimilar materials is unavoidable, review with Engineering Department. Use 150# brass couplings, Victaulic "dielectric waterway", or dielectric flanges. These fittings may be used only in where they are accessible for inspection, preferably in Mechanical Rooms. Dielectric unions are prohibited. For ¾" to 2" diameter branch connections to steel mains use thread-o-lets, or 3000# forged couplings, welded nipples are not permitted. For steel branch connections 2-1/2" diameter or above, use new tees. Use tees for all copper branch connections. All steel nipples (6" or less in length) shall be schedule 80. Close nipples are prohibited. Connections to equipment should be made with unions (up to 2") or flanges (2-1/2" and up).

5. Flange Gaskets

   For all steam and steam condensate gaskets, use "Flexitallic" spiral-bound temperature-sensitive gaskets or Gar-Lok "Flex-Seal". For hydronic service only, use Klingersil "Green Ring", model C-4401.

6. Valves

   Provide isolation valves to permit service of equipment without draindown of system. Use valves at coils, traps, control valves, strainers, etc. Provide isolation valves and riser drains at the base of each main distribution risers. Provide stem extensions as required to clear insulation.

   Ball valves shall have stainless steel ball and stem, TFE seats.

   Butterfly valves shall have gear operator for sizes 6" and above. Provide chain operators for butterfly valve mounted 10ft. above floor or higher.

   Gate valves and plug valves may not be used on any system

Butterfly valves for chilled water at building entrance shall be 300# rated Jamesbury (830L-11-22HBMT or 830L-11-2236ZX) or 300# Adams MAK. Butterfly valves at Building entrance for steam to be 300# Adams MAK.

Isolation valves shall be specified in accordance with the following table:

System	Pipe Sizes 2" and Smaller	Pipe Sizes 2-1/2" and Larger
Steam and Condensate	Full port ball valve Apollo 82-100 series,	High performance lug type butterfly valve Jamesbury 815L-11-22 HBMT or 815L-11-2236XZ
Primary Chilled Water	Conventional port Ball valve Apollo 70-100/200 series	Jamesbury butterfly (as above) Apollo 88A-100 Series
Heating Hot Water, Secondary Chilled Water	Conventional port Ball valve Apollo 70-100/200 series	Jamesbury butterfly (as above), Apollo 88A-100 Series

7. Air Vents/Drains

Provide manual ball valve vents and drains (Apollo 70 series stainless ball and stem) at all local high/low points, and pitch piping towards drains so that system may be completely drained and purged of air. Provide automatic air vents with ball isolation valves at major piping risers and elsewhere as necessary. Pipe auto vents with (soft) copper tubing to suitable sanitary waste connection point. Pipe manual vents clear of riser insulation. Major drain locations shall have hose adaptors. Automatic air vents shall be per table below.

System	Automatic Air Vent Type
Primary Chilled Water	Spiro Therm 300#
Hydronic (other than PCHW) Systems and Equipment	Spirotherm 150#

8. Pressure Gages

Provide gages where shown on details, with 4" minimum dial. Select gage range to read near center of range during normal conditions. Provide isolation ball valve at each tap. Where differential pressure measurement is required, use single gage with isolation valves on upstream and downstream taps. P&T plugs are not permitted. Gage cocks are not permitted. Use siphon tubes and snubbers on steam service. Gages are to be visible from the floor.

9. Thermometers

   Provide 5” dial adjustable angle thermometers with stainless steel wells (not brass) at building entrance and other locations useful for balancing and troubleshooting. See detail drawings.

10. Balancing Valves

    Where balancing flowmeters are required, use B&G, Taco or Tour & Anderson circuit setters. Do not use circuit setters as a positive shutoff device. For larger pipes, a butterfly valve with memory stop is acceptable as a balancing device, but should have a second butterfly valve as a shutoff device. Triple duty valves are not permitted. Circuit setters must be selected to measure flows accurately at the design flow rates. In some locations “low flow” circuit setters similar to B & G “RF” series, or reduced piping sizes would be required.

11. Control Valves

12. Pressure Transmitters

    For input to DDC system use Robertson-Halpern for hydronic systems, Modus for air systems (control), Dwyer 605 (monitoring only).

13. Flowmeters

    Steam and Campus Chilled Water flows are to be metered at building utility entrances and connected to campus BMS. Provide local readout capability. Inline meters shall have isolation valves. Meter bypass is not required. Meter sizing must be reviewed with PTR. They are typically one size smaller than line size in order to measure typical flows. The design must allow for the required entry and exit conditions.

    a. Steam Meters
       Steam usage shall be metered using EMCO Vortex Shedding Flowmeter connected to the BMS at the MacMillan Building. Observe manufacturer’s installation piping configuration design guidelines. Meter body to be insulated.

    b. Chilled Water Meters
       Chilled water shall be metered using Toshiba Magnetic Flowmeters model LF400 with LF410 (wafer) or LF430 (flanged), Siemens Magnetic Flowmeter, or Controlatron Ultrasonic Flowmeters. Meters shall be connected to the BMS at the MacMillan Building.

14. Standard Controls Details

    See Section 3.2 (Automatic Temperature Controls) for Design Guidelines.

15. Expansion Joints

    Avoid the use of expansion joints. Design piping with sufficient offsets to absorb expansion. Where their use is unavoidable, review with Engineering and provide service valves and drain connection.

16. Water Treatment

    Flush new piping until water runs clean, remove and clean strainers. Remove temporary strainers and install new prior to system turn over.

    For all new closed loop hydronic systems, water treatment will be (and provided by) our current campus wide sole source vendor (as specified by Ondeo Nalco Chemical Company) subcontracted through the Mechanical Contractor. Water treatment required due to modifications of existing closed loop hydronic systems will be arranged by Princeton University. Steam piping does not need to be flushed. When first energized, each strainer must be blown down. New condensate piping shall be cleaned by flushing condensate through the receiver tank to drain (12 hour minimum).

C. Mechanical Equipment

1. Equipment Mounting

    Floor mounted pumps, heat exchangers and air units shall be installed on 4" high concrete pad. Steel equipment supports subject to moisture shall be treated with rust inhibiting paint. Equipment (with moving parts) installed below noise sensitive spaces shall be floor mounted, not hung. Provide adequate service area around equipment.

2. Pumps

    Base mounted pumps shall be B & G series 1510 or Taco. Where vibration isolation is required, use spring isolators at base and American Boa flex connections on piping. All pumps shall have mechanical seals. In-line pumps shall be Taco or B&G series 60, 80 or 90. Pumps used on primary chilled water in buildings near the chilled water plant must have a pressure rating of 250#. B & G PL series may be used for pumps below ½ hp.

3. Converters

    Steam heating hot water service shall be shell and tube by B&G or Taco. Tubes shall be Cu/Ni. Alternatively, plate and frame heat exchangers may be used.

4. Plate and Frame Heat Exchangers

    For Secondary Chilled Water service shall be 304 stainless steel plate, EPDM gaskets, rated and labeled for minimum 200psig operating pressure when used with Primary Chilled Water. Review with Engineering the possibility of providing frame space for future capacity increases. Approved manufacturers are; APV, Mueller, ALFA Laval. Steam to HW exchangers may be considered where appropriate.

5. Electric Heat

   The use of electric heat is generally prohibited, but may make economic sense in some applications. Proposed use must be reviewed with the Facilities Engineering Project Technical Representative (PTR).

6. Fin Tube Convection

   For perimeter hot water systems use copper tube, aluminum fin convection units. Use heavy gauge covers in public spaces and dormitories. Basis of design shall be Vulcan or Sterling. Runtal steel convection units may also be used. Allow adequate access to service and control valves. Specify in-place mock-ups for review by Design Team.

7. DX Systems

   Piping shall be flare fittings for copper sizes 7/8" and smaller, brazed copper for larger piping. For systems over 5 tons, provide low ambient control, suction accumulator, filter dryer, sight glass/moisture indicator, liquid line solenoid valve and refrigerant service valves. These are typically used when central chilled water is not available. Provide Energy Star rated products where applicable.

8. Motors

   Motors below 1/2hp (in fan coils) shall be 120v single phase. Motors below 1/4hp shall be PSC type. Motors 1/2hp and above shall be 3 phase, premium efficiency type. Starters shall be mounted in Motor Control Center where practical. Motors used on VSD applications must be constructed specifically for that duty and shall be reviewed by the Facilities Engineering Project Technical Representative (PTR). See Electrical Specifications Appendix 3.12-1.

9. Variable Frequency Drives (VFD)

   VFD's shall be specified by the Electrical Engineer. Review requirement for drive bypass with Princeton Engineering. Drives below 5 hp are generally not practical. See Appendix 3.12-2, as provided by the Electrical Contractor. The only exception is drives on factory assembled domestic water pressure booster systems, which may be provided by the Mechanical Contractor.

   Where not part of prepackaged unit the Electrical Engineer shall specify. See Section 3.12 and Appendix 3.12-2.

10. Fan Coils

   Fan Coils for use in occupied spaces shall be selected at low speed, or medium speed if extra capacity is needed. To minimize noise, fan coils should be ducted and installed behind an acoustic barrier such as lay-in ceilings or cabinetry. For spaces with NC 35 or lower ratings, use of fan coils will require a mock-up during construction that will be reviewed by Princeton Engineering. During layout & design, carefully consider accessibility of components requiring maintenance. Coordinate location with other trades and expected furniture placement. Controls components, including speed switches shall be provided by the controls contractor. Provide extended drain pan and / or cabinet as needed to permit adequate room for valves and insulation.

11. Valence Units

Valence units shall consist of a heat transfer element, support structure, architectural enclosure, mounting brackets, stainless steel pan with external closed cell insulation, valves fittings, and condensate drain connection. Heat transfer element shall consist of minimum 5/8" copper tubes and 0.10" aluminum fins with minimum spacing of 6 per inch. The element shall be supported by 12 gauge aluminum members along both sides. Wall brackets shall not be greater than 12ft. apart. For longer enclosures, an intermediate cantilever bracket shall be mounted to the outside wall.

The enclosure shall be minimum 0.030" aluminum. Enclosure shall be finished with semi gloss baked on enamel, the color and paint to be specified by the owner. The ceiling baffle shall be aluminum painted to match the enclosure and designed to fit tight against the ceiling. The drain fitting shall be connected to a 3/4" schedule 40 PVC drain piping system with stainless steel clamps. The invert of the drain pipe in the wall must be no higher than the lowest point of the drain pan.
Provide valves, and other hydronic specialties in piping in accordance with Appendix detail 3.10-23. Acceptable manufacturer is Sigma Corp.

D. Air Distribution Systems

1. Indoor Air Quality

Comply with latest version of ASHRAE Standard 62. Provide to Princeton Engineering, backup design assumptions and calculations to verify that design meets this standard. Design systems to make use of outside air for "free" cooling where economically viable.

2. Humidification

Where humidifiers are used provide stainless steel duct section minimum 2ft. upstream and 6ft downstream of manifold. (Provide stainless steel access door for inspection.) Provide duct configuration as recommended by manufacturer for proper steam absorption. Drain bottom of humidifier duct section by pitching or cross breaking to drain fitting. Use Armstrong series "AM" with modulating Honeywell pneumatic control valve operator and temperature switch to prevent operation before condensate is drained. Do not oversize humidifiers. Humidifier shall not be placed directly up steam of the fan drive

3. Air Handling Units

Air handling units (nominally over 2,000 cfm) shall be double wall construction, with internal fan and motor vibration isolation. Belt-drive motors should be mounted on screw driven adjustable base. Include gasketed doors with large handles spaced for adequate access for service and controls installation. All power & Control wiring shall be in conduit or liquid-tight conduit and junction boxes. Exposed wires, cables, and splices shall not be allowed.

For units 20,000 cfm and above specify vapor proof lighting inside access sections factory wired to an external switch. Include access sections between coils for inspection and sensor installation. Provide gasketing or safing of all pipe and conduit penetrations. Contractor shall furnish & install fixed pitch sheaves on fans after balancing. All electrical equipment and wiring inside air handlers shall be supplied in accordance with the NEC for inside plenum installations. Acceptable manufactures include but are not limited to:

For Laboratory areas:
Ventrol, Ingenia, Air Enterprises, Haakon

For other services:
Carrier 39 series, York Solutions, Trane Climate Changer

4. Dampers

For outside air service shall be low leakage type with vinyl blade edge and stainless steel spring gasketing at jambs. Provide access doors for inspection and servicing. Provide damper shaft extensions, including for dampers mounted in air handling units, as required to mount operators outside of airstream. Duct mounted dampers should be provided by the Controls Contractor.

5. Coils

   a. Chilled Water coils shall have copper tubes 5/8” x 0.025” minimum wall thickness, 10 row maximum depth, with aluminum fins 0.008” minimum thickness, mechanically bonded to tubing. Maximum fin density is 12 fpi. Coil casing shall be stainless steel. Drain pans shall be stainless steel, pitched to completely drain condensate from pan. Chilled water coils exposed to mixed or outside air shall be freeze protected by freeze pump for laboratory, auditorium, or equipment requiring year round cooling. Freeze pumps to be fed by emergency power. Use “dry lay-up” system for other mixed or outside air-cooling coils. See Appendix 3.10-8 for details. Maximum design coil face velocity shall be 500fpm or lower to provide for a future air quantity increase.

   b. Steam Coils in contact with mixed or outside air shall be non-freeze type with 1-1/8” O.D. x 0.035” outer tube and 5/8” x 0.025” inner tube with galvanized casings. Mount coils high enough to permit complete drainage of tubes by gravity. For floor mounted air handling units, this may require raising the unit off the floor, installing the coils above the floor of the unit, or providing trenches in Mechanical Room floor. Steam traps and the equipment they serve must both be within the same room. **Air handlers and their steam coils must be designed so that the steam trap inlets are a minimum of 15” below the coil discharge connection.** Condensate piping must pitch from trap outlet continuously towards inlet of receiver. Consultant should make sure this is clear on Construction Drawings. Where modulating control of coil discharge is required, use 1/3, 2/3 control valves or “Wing” coil. Avoid face and bypass arrangements. Provide adequate space for coil pull. Where appropriate, consider blenders as an alternative to pre-heat coils.

c. Reheat Coils shall be hot water where possible, with 5/8” x .025” wall and galvanized casing. Provide access doors to inspect upstream coil face.

6. Air Conditioning Condensate

Shall be piped to Sanitary Sewer system with air gap, except for Buildings in Princeton Boro, where a Local plumbing ordinance requires plumbing this to the storm system. Provide sloped drain pans, properly configured drain traps and low face velocities to prevent carry over from coil face. Consider recovering condensate for other building uses.

7. Filters

Pre-filters for outside air shall have a minimum (dust spot) efficiency of 35%, similar to Farr 30/30. Provide bag type final filters, as required to meet project requirements. Provide adequate access for filter service.

8. Fans

Provide proper inlet and discharge conditions to avoid problems with system effect. After air balancing, **Contractor shall install fixed sheaves**. Volume control on VAV systems shall be accomplished by using variable speed motor drives.

9. Air Mixing

Where air mixing is required, provide air blenders or demonstrate to the Facilities Engineering Project Technical Representative (PTR) that inlet geometry allows for thorough air mixing before contacting coils.

10. Ductwork

Ductwork shall be constructed per latest version of applicable SMACNA duct design guidelines. All ductwork shall be seal class A. For work in occupied buildings, field applied sealants must be free of noxious fumes (water based). Design Drawings must indicate duct pressure classifications and leakage class. Galvanized duct thickness shall be as prescribed by SMACNA, except 24 gage shall be the minimum thickness permitted. For moisture laden air (laundry, shower, etc. exhaust) use aluminum grills and registers, aluminum or stainless steel duct, pitched to drain condensate. For dishwasher exhaust use stainless steel. Discuss requirements for duct testing with the Facilities Engineering Project Technical Representative (PTR).

11. Noise Control

The use of duct liner shall be minimized and reviewed by Princeton Engineering. Where used for noise control, it should be double wall construction with perforated internal liner, or where double wall construction is not possible, the lined duct should be considered to be an item requiring maintenance. Liner shall have mold resistant acrylic coating on airstream side. Use metal nosings to protect upstream edges of liner. Provide access doors upstream of all reheat coils, fan-powered boxes, and VAV boxes to permit inspection and cleaning of coils. Sound traps shall be sized for a maximum velocity of 1200fpm.

12. Balancing Dampers

    Balancing dampers shall be provided at all branch take-offs rather than at diffusers to minimize noise.

13. Fire Dampers / Fire & Smoke Dampers

    Use style B dampers (blades out of airstream) wherever possible. Provide access doors for inspection and replacement of links. The use of Fire & Smoke Dampers should be minimized. Review quantity & location of Fire & Smoke Dampers with the Facilities Engineering Project Technical Representative (PTR) and Code Consultant.

14. Heat Recovery

    For large conditioned exhaust airflows, examine the feasibility of providing heat recovery to make-up air. Where payback is marginal, provide access for future recovery system. Consult with the Facilities Engineering Project Technical Representative (PTR) to ensure analysis conforms to Princeton University standards.

15. Flexible Duct

    Maximum length of flex duct sections shall be 6ft. Provide proper support to avoid kinking duct.

16. Louvers

    Inlet louvers shall be designed at not more than 500fpm over net free area. Provide 1/4" mesh screen. Coordinate with site plan to avoid placement near or downwind from odor sources, or large deciduous trees. Coordinate with structural system so that airflow through louver to filters/coils is unobstructed. Avoid air inlets near ground level, due to excessive maintenance required to keep them free of debris. Where this is unavoidable, review with the PTR.

17. Duct VAV Boxes

    Sound attenuators and lined duct must be protected from dirt and debris until installed. Provide factory installed access door to inspect reheat coil and damper operation. Install VAV boxes such that all control components and valves have adequate access.

E. Insulation

   Designer shall coordinate with Architect to insure that there is sufficient access around piping and ductwork in the field to install and seal joints on insulation system. It is crucial that systems operating at temperatures below ambient dewpoint have continuous unbroken vapor barriers. Where access is limited indicate sequence of construction on Design Documents (i.e. pre-installing insulation). This is of critical importance and must also be monitored in the field during construction. See Appendix 3.10-1

1. Piping Insulation

   Table below is adapted from ASHRAE Standard 90.1 - 2004. Use fiberglass with premolded or Zeston covered fittings. Cold piping must have a continuous vapor barrier. Pipes shall be suspended using hangers, inserts and shields outside insulation. The use of elastomeric insulation must be reviewed with the PTR. Where piping is installed less than 2 feet above floor and subject to damage cover with continuous PVC or aluminum jacket.

TABLE 6.8.3 Minimum Pipe Insulation Thickness[a]

Fluid Design Operating Temp. Range (°F)	Insulation Conductivity		Nominal Pipe or Tube Size (in.)				
	Conductivity Btu·in./(h·ft²·°F)	Mean Rating Temp. °F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Heating Systems (Steam, Steam Condensate, and Hot Water)[b,c]							
>350	0.32-0.34	250	2.5	3.0	3.0	4.0	4.0
251-350	0.29-0.32	200	1.5	2.5	3.0	3.0	3.0
201-250	0.27-0.30	150	1.5	1.5	2.0	2.0	2.0
141-200	0.25-0.29	125	1.0	1.0	1.0	1.5	1.5
105-140	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Domestic and Service Hot Water Systems							
105+	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
Cooling Systems (Chilled Water, Brine, and Refrigerant)[d]							
40-60	0.22-0.28	100	0.5	0.5	1.0	1.0	1.0
<40	0.22-0.28	100	0.5	1.0	1.0	1.0	1.5

a For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:
$T = r\{(1 + t/r)^{K/k} - 1\}$
where T = minimum insulation thickness (in.), r = actual outside radius of pipe (in.), t = insulation thickness listed in this table for applicable fluid temperature and pipe size, K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in.[h·ft^2·°F]); and k= the upper value of the conductivity range listed in this table for the applicable fluid temperature.
b These thicknesses are based on energy *efficiency* considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.
c Piping insulation is not required between the control valve and coil on run-outs when the control valve is located within 4 ft of the coil and the pipe size is 1 in. or less.
d These thicknesses are based on energy *efficiency* considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

Table taken from ASHRAE 90.1-2004

2. Ductwork Insulation

   Exposed ductwork in mechanical spaces or other areas of heavy traffic, shall be insulated using fiberglass board with minimum 4.2#/c.f. density and foil facing. Joints shall be taped with foil tape. Secure board with field glued pins and speed washers. Pins to be clipped flush after washer installation. Where ductwork is concealed and protected from damage use duct wrap blanket secured with pins and washers. Do not use lined ductwork within 10’ of humidifier.

3. Equipment Insulation

   Designs shall include removable blanket insulation on Steam PRVs, pressure powered pump bodies and flash tanks.

F. Piping and Ductwork Identification

1. For all ductwork and piping, provide identification and directional flow arrows at intervals not greater than 20 ft. Ductwork ID should be stenciled showing system number. Piping ID should be adhesive film type with full circumference flow arrows.

2. Equipment Identification: steamtraps, major valves and scheduled equipment shall have permanent stamped metallic or phenolic ID plates which must be easily visible after installation is complete.

G. Control Compressed Air Systems

Princeton University prefers Quincey duplex reciprocal air compressors with Hankinson air dryers and water separators as needed. See also Section 3.2 – Automatic Temperature Controls and Energy Management Systems.

H. Laboratory Systems

1. Laboratory Waste Systems

   Piping shall be Enfield, Orion or Fischer polypropylene with mechanical or socket welded heat fusion joints. Do not use fuse-seal joints Provide unions at traps.

2. De-ionized Water

   De-ionized water system use Hydro Services, Inc. processing equipment. Piping is polypropylene with mechanical unions (where exposed) or socket welded joints (where concealed). Piping must be supported in a continuous channel. Shutoff valves are polypropylene ball valves.

3. Process Cooling Water

   Also referred to as Laser Water Systems. These systems are recirculating 100mohm de-ionized water loops cooled by Primary chilled water. Piping is PVC schedule 80. Supply water temperatures are typically 60ºF. Insulation is required where piping is exposed to wet bulb temperatures above chilled water temperature.

4. Laboratory Compressed Air

   Various science buildings have central laboratory compressed air systems. Compressed air systems shall be Beacon Medaes Model LPS-15Q – SD240-H single point scroll air compressor system. The system shall have the number of 15 horsepower compressors needed for the system plus spare capacity to allow future compressor overhauls or replacements. Piping shall be copper Type L.

5. Nitrogen

   There are several different N2 systems on campus of varying levels of purity and pressure. Unless otherwise indicated use 304 or 316L stainless steel tubing with Swagelock tube fittings. Tubing and fittings to remain capped and sealed until installed.

6. Vacuum

Various science buildings have central laboratory vacuum systems. The vacuum system shall be a Nash self-contained, oil-less, fully re-circulated, water sealed vacuum packaged unit as manufactured by Gardner Nash. The system can be duplex, triplex, quad-plex, etc. as needed to provide ample vacuum capacity with spare capacity when repairs must be made to a vacuum pump. Vacuum piping shall be copper Type L. Valves shall be ball valves per hydronic specifications.

7. Laboratory Exhaust Systems

Ductwork may be galvanized steel, unless the extra cost of stainless steel or PVC coated steel can be justified. New fume hood systems shall be face velocity controlled using variable volume exhaust boxes. Occupancy sensor setback and/ or automatic sash repositioning should be considered. Exhaust boxes and all moving components shall be stainless steel. Provide general exhaust boxes in parallel with variable volume hood exhaust boxes. Fume hoods should be provided with Magnahelic gages reading local suction pressure. During balancing, readings must be taken correlating suction pressure with proper face velocity. Heat recovery shall be considered based on cost factors provided by Princeton Engineering.

I. Underground Utilities

See Section 3.6; for information on campus utility systems. Review project impact on utilities with the PTR. Consultants must update the PTR on estimated utility loads during various design phases in order to assist University utilities planning functions.

J. Temporary Heating and Cooling
The use of new equipment, to provide heating, cooling, or ventilation during construction must be reviewed with project team during design so that the appropriate steps are taken to protect the equipment and minimize energy use. During construction, the Construction Manager shall present a plan for the use of this equipment and campus utilities for review by the Project Team. The equipment must be turned over to the University at occupancy in like new condition with full warranty, extending from the occupancy date. Steam and chilled water usage must be metered during periods requiring temporary heating and cooling. Include these requirements in project specifications.

9. Requirements for HVAC System Testing & Commissioning

A. Testing, Adjusting, Balancing

Consulting engineer shall consider and review with Princeton during design, the necessity of expanding the scope of traditional TAB work to include the likes of vibration/sound testing, or IAQ testing. The TAB Contractor shall be hired directly by the Construction Manager. Specifications shall indicate that before TAB work begins, TAB contractor shall meet with Owner & Design Engineer to develop and approve TAB strategies, procedures and reporting format. TAB reports shall be reviewed and approved by Design Engineers to verify that the design intent has been met. As these reports are essential tools for Facilities during troubleshooting, the reports shall include single line schematic diagrams showing locations of HVAC system components, balancing devices, measurement locations. Also include make, model and settings for drive components. Balancing devices shall be marked by the Balancer to indicate final settings.

Specifications shall provide a minimum ½ day service from Balancing Contractor to demonstrate and reproduce measurements shown in balancing report. The system measurements will be selected by the Facilities PTR.

1. If recheck yields measurements that differ from the final report measurements by more than the tolerances allowed, the measurement shall be noted as "FAILED".
2. If the number of "FAILED" measurements is greater than 10% of the measurements checked during this final inspection, the balancing report shall be rejected.

B. Piping Testing

Test new hydronic systems or modified sections of existing systems with water at 1.5 x design operating pressure for 1 hr. (Small sections of steam piping may be tested with campus steam, provided there are isolation valves for modified sections.) Engineering shall be notified 2 days before scheduled test so that we have the opportunity to witness tests. See also Building Commissioning Standards Section 3.3. Test pressures are to be specified by the A/E.

C. Commissioning

1. Commissioning shall be performed in accordance with section 3.13 of this manual
2. The extent of Commissioning shall be determined during the schematic design phase of a project, either using in-house, or a four party commissioning agent.
3. Tech Team representatives from Engineering and Grounds Building Maintenance shall be an integral part of the commissioning process
4. The procedure for testing shall be followed closely in accordance with the Project Specifications and Pre-Functional and Functional tests as outlined in section 3.13 of this manual

10. Requirements for As-built Drawings

The Designer is responsible for checking the accuracy of as-built drawings prepared by the Mechanical Contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the Contractor and University personnel to review progress and to ascertain that the Contractor is keeping accurate records of systems installation. Designer will verify during these regular meetings that the Contractor is maintaining record drawings to convert to as-builts.

The mechanical/HVAC As-Built Drawings shall include the following information as a minimum:

1. All major pieces of equipment accurately located.
2. Location and identification (valve chart) of major isolation valves, vents and drains, including sub-main isolation valves.
3. Location of control valves and balancing valves.
4. Access panels and access doors.
5. Sheetmetal dampers, fire dampers, filters and flow measuring stations.
6. Main runs of piping with labels and flow arrows.

See Section 1.5 (Documentation and Archiving).

11. O & M Documentation

In addition to the requirements shown in Section 1.5 (Documentation & Archiving) and Section 4.8 (Mechanical Rooms), O&M documentation for Mechanical equipment shall include the following;

Approved submittals

1. Performance curves for fans & pumps showing design operating points.
2. Written sequence of operation
3. Maintenance information including safety & performance information, start up & shutdown procedures, detailed servicing requirements.
4. Other project specific information determined by the PTR and design team

Information provided by the contractor shall be reviewed and supplemented as required by the design engineer.

END OF DOCUMENT

1. Introduction

Each Project is assigned a Facilities Engineering representative to track the progress of all Plumbing design and construction issues. All issues pertaining to system programming, selection and performance are typically derived through the assistance of this representative. The Design Engineer is encouraged to initiate and sustain open communications throughout the Project to achieve that end.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Manager of Mechanical Engineering — MacMillan Building, 609-258-3934

C. Supervisor of HVAC/Plumbing Shop — MacMillan Building, 609-258-3446

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Princeton University Instantaneous Domestic Water Heater Piping Detail, dated February 15, 2002	Appendix 3.11-1	Appendix 3.11-1
B. New Jersey American Water Service Entrance Detail	Appendix 3.11-2	
C. Commissioning Specifications	Appendix 3.3-9	Appendix 3.3-9 (MS Word)

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. National Standard Plumbing Code

C. National Fuel Gas Code

D. Princeton Borough AC Condensate Discharge Ordinance — Public Document

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development;

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Procedural Guidelines - Preliminary Design and Design Development

During preliminary design, designer is to consult with University project manager to ascertain the requirements for plumbing use and installation. The designer is to coordinate his work with other disciplines so a cohesive set of documents is produced for the mechanical/plumbing work. The Designer is reminded to refer to Section 3.13 Commissioning for requirements, including submittals for schematic and design development phases, particularly as they relate to design intent and Basis of Design.

During preliminary design and design development the designer is to consult with the project manager and with University Engineering Department to define system distribution strategies and to discuss any obstacles that might be existing in a building, or problems inherent in a particular design or structural system.

7. Guidelines and Requirements for Documentation

Along with the Specifications, the designer is to produce sufficient documentation to allow for code review of the plumbing system and for contract bidding of the work.

Specifications shall include the requirements listed in the Princeton University Design Guidelines and Princeton University Engineering Specifications. Delete equipment and references not applicable to the project.

The Design documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Notes & Symbols	X	X	X	X
Floor Plans – Plumbing Equipment		X	X	X
Floor Plans–Piping Routes			X	X
Riser Diagrams Sanitary & Vent Piping			X	X
Riser Diagrams Domestic Water Piping			X	X
Plumbing Fixture Schedule			X	X
Details – equipment & piping Connections			X	X
Vertical Sections as required			X	X
Plumbing Specifications			X	X

Coordination Drawings field produced by Contractors – Facilities Engineering Department will review 3/8" scales Coordination Drawings of all equipment to be installed in Mechanical Rooms. This will be done as a concurrent Shop Drawing submittal or as part of a Coordination Meeting(s) which includes University participation.

8. Guidelines for System Installation and Performance

A. Domestic Water Systems

1. City water meter at building entrance will be provided by New Jersey American Water Co. See Appendix 3.11-2. Use Watts 909 backflow preventer, 2" & smaller, Ames Silver Bullet for sizes 2 ½" & larger, where required by codes (no substitutions). Trap primers should be avoided, use deep seal traps where possible. Use Watts for domestic water pressure reducing service. Use Goulds Aquavar pumps for domestic pressure booster systems. Use Johnson vacuum breaker (stainless steel). The University Mechanical Engineer shall specify to the designer the model(s) of Watts backflow preventor(s) and/or pressure reducing device(s) for each project.

B. Domestic Hot Water Systems

1. Wherever possible consistent with demand, use campus steam for hot water generation. Use ACE Boiler Company semi-instantaneous water heaters with Cu-Ni tubes, single wall design, Powers pneumatic control valve, Sarco traps, Taco circulator. See piping detail. Include recirculation loops where feasible. For low demand remote usage where steam usage is impractical, use electric heaters as specified below. Avoid the use of mixing valves.

C. Sewage Ejectors

1. Sewage ejectors shall be Metropolitan "MPC" close coupled. Sump pumps shall be Metropolitan "MPC" or Hydromatic "SP". Provide adequate floor drain coverage with proper floor slope in mechanical spaces. Provide hose bibs in mechanical rooms for use during maintenance. High temperature sump pumps for steam condensate pits to be Zoller M3098 or Little Giant HT10.

D. Plumbing Fixtures & Accessories

Variations from approved products below will require review with Engineering:

Lavatories – American Std. "Lucerne" American Std. #0355.012 or "Roxalyn" #0195.073 as required for wall hung installations. Use Wolverine #53336 stop-valve – no key type stops permitted.

Lavatory Faucet – American Std. #5402.142H blade handles, 4" o.c. or #5401.142H.002 with pop-up drain for residential applications. Where "touchless" (motion sensor) type faucets are used, specify Sloan EFB 650-0607.

Kitchen Sink – Single bowl 18ga. Elkay #2521 with American Std. #6279000.002 faucet with spray, #4175500.002 faucet without spray, or #4175501.002 single lever kitchen faucet. Use Elkay LK-99 or Wolverine drain assembly #807.

Aerators – 1 gallon/ minute maximum – Neoperl

Lavatory/Sink Traps – McGuire #8902 P-trap

Slop Sink Faucet – American Std. #8344.112 with vacuum breaker

Sink Drains – Grid type only for campus buildings – McGuire #155-A.

Instantaneous Hot Water Heater – Are to be installed in all kitchen sinks and water fountains, where requested. ISE (In-Sink-Erator) "Instahot" H-770-10 (or H990 for handicap service) under sink type

Water Fountain – Oasis # M8CR series (supply spare parts) and handicapped.

Bottled Water Fillers – Oasis Aqua Pointe,

Tub – Americast by American Standard

Shower Base – Terrazo base with internal drain

Shower Stall – Consider one-piece unit as alternative for residential applications (Best Bath or approved equivalent).

Shower Valve –Delta R100000 UNWS with trim kit T17030. If exposed in shower compartment, include shroud for protection of pipes.

Shower Head –Nigara Conservation 1.5 gpm shower head manufactured by Sustainable Solutions International

Urinals –Use Sloan model WEUS-1000.1001-0.13

Water Closets – Floor mount: Sloan 1.28 flush WETS 2000.1001 or ADA equivalent; Wall hung: Sloan 1.28 flush WETS 2050.1001 or ADA equivalent all with Sloan #111 flush valve and Zurn "EZ Flush" automatic flush operator.

Water Closet Seat – Church or Bemis

Water Heaters – A.O. Smith. The University Mechanical Engineer shall specify to the designer the model(s) of water heater(s) on the project.

Water Hammer Arrestors – Smith or Amtrol

Floor Drains – Smith, Zurn or Josam nickel bronze or stainless, to be installed in all commercial bathrooms per National Standard Plumbing Code

Grease Trap – Selection is based on specific Project requirements, either MIFAB Stainless Steel, MI-G or MI-G-L series, or Thermaco Big Dipper

Stop Valves – Wolverine

Wall Hydrant –Jay R. Smith non-freeze

Flanges – 150# brass sweat flanges

Trap Adaptor – At all "P" Trap at disflange install a "TA" Install trap adaptors on all lavatories, sinks, water fountains, etc.

Thermometer – Dial type with stainless steel wells

Laundry Washing Machine Hoses – 6' braided stainless steel.

Laundry Box – Water-Tite Box – Watts valve mounted in box; model #W2800

E. Plumbing and HVAC Valves – refer to Apollo Index Sheet for sizing

System	Pipes 2" or smaller	Pipes 2 ½" or larger
Domestic Hot & Cold Water	N/A	Flanged Ball Valve 2 ½" and up; Part # 88-A249-01
Domestic Hot & Cold Water	Solder Full Port; 3 Piece Part # 82-240-01	N/A
Domestic Hot & Cold Water	Threaded Full Port; 2 Piece Part # 77-140-01	N/A
Domestic Hot & Cold Water	Sweat Full Port; 2 Piece Part # 77-240-01	N/A
Domestic Hot & Cold Water	Sweat Standard; 2 Piece Part # 70-200-01	N/A
Heating Hot Water	Threaded Full Port; 3 Piece Part # 82-140-01	N/A
Heating Hot Water	Solder Full Port; 3 Piece Part # 82-240-01	N/A
Heating Hot Water	Threaded Full Port; 2 Piece Part # 77-140-01	N/A
Heating Hot Water	Sweat Full Port; 2 Piece Part # 77-240-01	N/A
Heating Hot Water	Threaded Standard; 2 Piece Part # 70-140-01	N/A

F. Plumbing Piping Materials

Note: Pro-press fittings are not to be used by outside contractors.

System	Piping Material	Fitting Material
Domestic Hot & Cold Water (Above Ground)	Type L Copper	Wrought copper with water safe solder
Sanitary Waste, Storm (Above Ground)	Cast Iron, hubless, service weight, or PVC DWV	C.I – No Hub extra heavy couplings or PVC DWV
Sanitary Vent (Above Ground)	C.I. hubless, service weight or PVC DWV	C.I. w/stainless stl. Clamp or PVC DWV
Sanitary Waste, Vent, Storm (Below Ground within building and 5ft of exterior wall)	C.I. extra heavy weight, hub and spigot, neoprene gasket OR D.I. with rubber gasket, hub and spigot, or SDR21PVC, or PVC DWV	C.I – No Hub extra heavy couplings D.I Neoprene Push Joint, DWV glue fittings
Domestic Water 3" and larger (Below Ground)	Ductile Iron, rubber gaskets, ¾" rods	Ductile or gray iron
Domestic Water 2" and smaller (below ground)	Copper Type K, bituminous coating	Cast Bronze, or Wrought Copper Brazed or Compression Joint
AC Condensate	Type L Copper or PVC sch. 40	Copper or Solvent weld PVC
Natural Gas 2" and smaller 2 ½" and larger	 Schedule 80 steel Schedule 40 steel	 Threaded Malleable Welded

9. Requirements for Plumbing System Testing, Sterilization & Commissioning

A. At the completion of all piping work, and before any insulation is applied, all piping shall be tested in accordance with the following schedule:

Service	Duration	Pressure
Domestic Water Service Piping	(4) hours	100 psig
Cold Water Piping	(4) hours	100 psig
Hot Water Piping	(4) hours	100 psig
Hot Water Return Piping	(4) hours	100 psig
Sanitary Sewer Lines	(1) hour	10' of water

B. All new water piping and equipment shall be thoroughly flushed to remove foreign material. A University approved plumbing Disinfection Company shall be hired to sterilize all plumbing piping in accordance with the National Standard Plumbing Code.

C. Commissioning

1. Commissioning shall be performed in accordance with section 3.13 of this manual

2. The extent of Commissioning shall be determined during the schematic design phase of a project, either using in-house, (Single Party) or a Four party commissioning agent.

3. Tech Team representatives form Engineering and Grounds Building Maintenance shall be an integral part of the commissioning process

4. The procedure for testing shall be followed closely in accordance with the Project Specifications and Pre-Functional and Functional tests as outlined in section 3.13 of this manual

5. Witness and sign off for floor drain flow testing.

6. Where tying into a sewer main, an additional video of the line is required from the building perimeter to the connection point with the sewer main.

10. Plumbing System Electrical Alarm Requirements

The University Plumbing Shop requires the alarming of certain critical plumbing system areas. The following areas may have alarm and/or standby electrical power requirements:

- Elevator Sump Pumps
- Storm Sump Pumps
- Sewage Ejectors
- Area Drains

Refer to Sections 3.1 (Access Control) and 3.12 (Electrical).

11. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built drawings prepare by the Plumbing Contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the Contractor and University personnel to review progress on the system and to ascertain that the Contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the Contractor is maintaining record drawings to convert to as-builts.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

1. Introduction

The Facilities Electrical Engineering Department shares responsibility for programming selection and performance review of the various electrical disciplines with its staff and the Grounds and Building Maintenance Electric Shop. The Electrical Designer is encouraged to contact each respective discipline Engineer to ascertain required information. This approach should continue through final closeout.

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Manager of Electrical Engineering	MacMillan Building, 609-258-5475
C. Electric Shop Supervisor – Grounds and Building Maintenance	MacMillan Building, 609-258-3991
D. Electrical Planner - Grounds and Building Maintenance	MacMillan Building, 609-258-9399

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Switchgear Package – Typical single end and double end	Appendix 3.12-3	
B. Campus Area Emergency Generator Power Plan	See Manager of Electrical Engineering	
C. New Jersey One-Call Memorandum	Appendix 3.12-5	
D. Arc Flash Label Types	Appendix 3.12-6	
E. Event Power	Appendix 3.12-7	
F. 5kv Switch Box	Appendix 3.12-8	
G. Use of MC Cable for Offices & Dorm Rooms	Appendix 3.12-9	Appendix 3.12-9
H. Commissioning Specifications	Appendix 3.3-9	Appendix 3.3-9 (MS Word)

4. Code References

A. New Jersey Uniform Construction Code (NJUCC)

B. National Electrical Code (NEC)

C. IBC (International Building Code)

5. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design;

B. Completion of Design Development

C. At 50% completion of construction documents;

D. At 85% completion of construction documents;

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

6. Requirements for Documentation

Along with the Specifications, the Designer is to produce sufficient documentation to allow for code review of the electrical project and for contract bidding of the work.

Specifications shall include the requirements listed in the Princeton University Design Guidelines and Princeton University Engineering Specifications. Delete equipment and references not applicable to the project.

The documentation will include, as a minimum:

Required Documentation	SD	DD	50% CD	85% CD
MEP Design Intent	X			
MEP Basis of Design		X		
Notes & Symbols	X	X	X	X
One Line or Riser Diagram - Power	X	X	X	X
Power Plans		X	X	X
Lighting Plans		X	X	X
Fire Alarm Plans		X	X	X
OIT Plans		X	X	X
Fire Alarm Riser Diagram		X	X	X
Security Plans			X	X
Equipment Schedules			X	X
Panelboard Schedules			X	X
Lighting Fixture Schedule			X	X
Electrical Specifications			X	X
Details				X
Vertical Sections as required				X
Short Circuit and Coordination Study, Arc Flash Study				X

7. Design Guidelines – General Programming Issues

A. Criteria for building load evaluation including elevators

- Design to NEC
- Compare peak demands to projected load
- Determine proper service and feeder protection in conjunction with Manager of Electrical Engineering

B. Existing Site Utilities Review

- Use existing site Utility layout in order to optimize the best possible feeder location and minimize relocations.
- Coordinate feeder location with architectural design process.

C. Service Entry Points

- Locate substation near service entry point to minimize cable runs.
- Separate OIT communications cable entry point from electric service entry point.
- Basement is preferable for Mechanical/Electrical Equipment Rooms. Should Designer not be able to accommodate, state reason.

D. Utility vs. Princeton University Distribution System

- Size of Building and location affect decision.
- Timing of maximum load (day vs. night)
- Location of other site utilities
- If Building will be on University power, Designer needs to specify a Princeton University approved electric meter. See Appendix 3.12 - 3
- All of the above need to be discussed with Manager of Electrical Engineering.

E. Emergency Service Needs Assessment

- At minimum, emergency power required by Code (Lighting)
- Discuss whether emergency power comes from local (within building) or regional source.
- Discuss which equipment receives emergency power - life safety or standby.
- Mechanical sump pumps and freeze pumps shall be on standby emergency power.
- Discuss fire pumps on emergency generator with Facilities Engineering Department.
- Avoid elevators on emergency generator if possible. If multiple elevators are required on emergency power, sequence such that only one elevator at a time operates to reduce the load on the generator

F. Event Power Needs Assessment

- Contact Grounds and Building Maintenance Electric Shop supervisor to assess whether event power is needed for exterior events and lighting.
- If power is required it usually will be recessed on the exterior of the Building with a brass box cover. Verify if in-ground location may be preferable.
- If event power is deemed necessary, the main distribution panel shall accommodate these requirements.

G. Daylight Harvesting Assessment

- Dim lighting in Atriums or other areas where daylight provides necessary light levels. Use occupancy sensor in conjunction with photocell to achieve this function. See Section 3.5 Lighting Design for additional information.

H. Specialty Power Assessment (UPS, Surge Protection, etc.)

- TVSS required on building incoming electrical service and on power panels serving sensitive electronic equipment.
- Assess with all users and Engineering Department representative which systems require computer grade power (UPS). (Normal power supplied from the campus electrical distribution system is utility grade.)
- Determine which systems need to be on UPS or standby emergency generator power.

I. Neutral Line Loading/Harmonic Current Assessment

- Determine 'K' rating. If high (areas of many computers) size neutral accordingly.
- Neutral shall be doubled for loads with significant third harmonic content.
- Separate neutral conductor for all circuits. No shared neutrals.

8. Design Guidelines – Schematic Design Phase

A. Power Distribution Configuration

- Determined by type of Building
- Residential – 120volt
- Non-Residential – 277volt lighting 480volt equipment
- Voltage class based on Building typology, residential vs. non-residential.

B. Service Point Design

- Generally deep Basements come in with feed overhead and include junction box on wall.
- First Floor or shallow Basements come in with feed below slab.
- If on PSEG power grid, follow their design criteria.

C. Double vs. Single Ended Services

- Where continuity of power is required (such as Laboratory Buildings, large Buildings, Computer Centers, area substations), service shall be double ended.

D. Switchgear Lineup Determination

- 5kV systems bring (2) feeders into Building (A&B) using a primary selective scheme.
- Reference Appendix 3.12-3
- Preference is for a line-up of switchgear.
- No secondary fused disconnects.
- Install switchgear on housekeeping pads. Switchgear/substations installed below grade in vaults or directly underground (plazas, etc.) shall have drip pans installed over the switchgear.

E. Transformer Types

- Discuss efficiency and temperature rise requirements
- 5kV Substation – liquid filled silicone transformer
- Low Voltage Transformers shall be – dry type, 115° rise, Transformer efficiency shall meet or exceed DOE CSL-3 ratings.

F. Electrical Room Locations (see Section 4.5 Electrical Rooms for additional requirements)

- Basement preference vs. upper Floors
- If multiple Electrical Rooms required, disburse on multiple Floor Levels.
- Discuss during programming
- Design for future expansion including sleeves and/or spare conduits.
- Maintain all working clearances (spaces about electrical equipment) in accordance with NEC.

9. Design Guidelines – Design Development Phase

A. Separate Subpanel Feeds vs. Riser Panels

- No riser panels without University approval.

B. Subpanel Distribution through Building

- Minimize distance between panels for future circuit expansion requirements.
- Review normal and emergency panel locations during Design reviews.
- Review locations with Architect as well for aesthetic continuity.
- Preference for horizontal vs. vertical circuit distribution.

C. Requirements for Spare Circuits

- 20% spare capacity minimum per panel (30% at main distribution panels).
- All spaces equipped to accept circuit breakers including distribution panels.
- Lighting panels fully equipped with breakers; no "blank spaces".

D. Conduit vs. Greenfield or ENT With THHN Stranded Wire Pathway Parameters

- Specify conduit to individual rooms, or to individual devices.
- If room has accessible space/hollow wall, Greenfield or ENT raceway is then allowable.
- For non-residential buildings the preference is to not allow for MC cable.
- When MC cable is used for wiring to receptacle the following shall apply:
  Each room or office shall have two feeds (whips) per circuit into the room. Each cable entering the room shall feed half of the receptacles on that circuit in the room (office). Use stranded conductor cable only. (See Appendix 3.12-9 Use of MC Cable)
- Use MC cable for whips and for "fishing" in existing walls. Use stranded conductor cable only.
- Use steel set screw fittings for all EMT and Greenfield connections. Die-cast type fittings will not be allowed.

10. Design Guidelines – Construction Documentation of Equipment and Devices

A. Wire and Cable

- Wet locations/below grade – 600volt to be U.S.E.-2.
- All wire #14 and larger shall be copper stranded, type THHN
- No pole lights shall be fed with UF cable, use 1¼” PVC with U.S.E. – 2 wire.
- 5kV feeder cable type MV-105 copper minimum 500KCMIL full copper taped shield. 5/8kV rating manufacture shall be by “Okonite”.

B. Panel boards and Fuses

- Fuses only for control, not power circuits.
- All panelboards shall be circuit breaker type, 225 Amp. bus minimum.
- Lighting panels shall be plug-in type only, 225 Amp. bus minimum.
- Panel trim (lockable) shall have “door-in-door” construction.
- No aluminum bus
- General Electric, Square D, Siemens

C. Receptacles and Devices

- Discuss color with Design Team and Grounds and Building Maintenance Department (GBM) to standardize in Building.
- Emergency receptacles – red
- Isolated ground receptacles – orange
- Cover plates standardize to ivory/brown/stainless steel, or as agreed to by GBM.
- Non-metallic cover plates shall be nylon not plastic.
- Dormitory Bathrooms shall have nylon plates and screws.
- Receptacles rated at 15amp. (as part of a 20amp circuit), may be specified for branch receptacle circuits. In this case the minimum gauge wire shall be #12 copper stranded.
- Mounting heights – may vary in renovation work. Requires field verification during layout.
- Receptacles in laboratory buildings shall be labeled with panel and circuit feeding receptacle.

D. Motors and Drives

- Variable frequency drives should be utilized for energy savings or system control requirements. Use GE AF600FP or Yaskawa Series E7. Bypass and alternating capability requirements should be reviewed by PU Engineering. All VFDs should have integral MCP disconnects, door-mounted keypad, HOA/bypass selector switches, and direct communications interface to Siemens APOGEE system. Line and output reactors should be used per manufacturer recommendations.

- Motors 3-phase for 1/2hp and above. For fraction HP motors in fan coil units single-phase allowable.
- Pump motors shall be 3-phase (480volt if available) with premium efficiency.
- Motors on 208volt shall be rated at 200volts (not 230volts)
- Motors for use on drives shall meet NEMA Design Standards Part 31. Definite purpose motors for use on inverters should withstand repeated voltage peaks of 1600volts with rise times of 0.1 mircoseconds and greater.
- All starters shall be minimum size #1 with hand - off – auto and red run lights (Use NEMA starters), no IEC type starters, use motor circuit protectors, no fuses. Motor starters shall be purchased by Electrical Contractor. GE Series 300 Starters preferred. Consult Engineer for package unit with starters.

E. Motor Control Centers Parameters

- An MCC shall be specified in areas where 3 or more starters are located.
- MCC shall be used for distribution centers, if a main distribution panel is not available.
- Elevators fed from MCC should not have starter, only breaker.
- Install MCC units on housekeeping pads.
- Protect all MCC's from direct sprinkler discharge.
- GE Series 9000 preferred.

F. Hand Dryers

- Preferred in Buildings of large public access.
- Hands-free type
- Acceptable manufacturer, World Driers

G. Arc Flash Studies

- If available, existing arc flash studies will be provided to the Designer for modification in conformance with final design. If no study exists, the Designer must perform their own study per NFPA and IEEE standards and submit to the Facilities Manager of Electrical Engineering for review.

11. Design Guidelines – Emergency Power Systems

A. Fuel System Requirements

- Diesel fuel only.
- Base tanks preferred.
- Supplemental fuel filter shall be supplied.
- Fill location to be accessible by truck.
- Preferred to be within Building/discuss early with all parties.
- Fuel vent shall have a line whistle.
- Fill cap shall be manufactured by Scully.

B. Generator Equipment

- Metering
- Blockheater
- Load Banks
- Sound Attenuation

C. Exhaust Issues – Location, Noise, Exercising

- Location to be determined early during programming.
- Exercising time may impact location of unit.
- Exhaust system shall use a critical grade muffler and welded iron pipe.

D. Transfer Switches

- Zenith with MX250 controls, A1-E contact, and Modbus TCP/IP interface for remote monitoring capability. The minimum size ATS should be rated at 80 amps.
- Conduits for communication to fire alarm panel with 6 conductors and to the campus electric SCADA via OIT outlet in switchgear room.
- Critical applications (Labs, Computer Centers) use transfer switch with by-pass switch for maintenance.

E. Connected Items on Emergency System

- Half stairwell fixtures on EM Power – half on Normal Power, connect diagonally.
- One fixture over each bathroom sink.
- All outdoor egress fixtures, use non-HID lamps.
- Select receptacles in mechanical and electrical spaces – use red devices.
- Fire alarm and card access systems.
- Elevator cab and Machine Room lighting.
- Labs – one fixture by each entrance door.
- Use only fluorescent and incandescent light sources on EM systems, no HID lamps with quartz restrike designs.

F. Transformers and Panelboard Requirements

- Install in locked locations. Install emergency service labeling on equipment.

12. Procedural Guidelines – Other Design Considerations

A. Requirements for Labeling

- All equipment to be labeled with engraved lamacoid fastened with mechanical fasteners.
- Each label shall include; panel designation, voltage and where panel is fed from. (black background with white lettering for normal panels and red background with white lettering for emergency panels.)
- Panel directory labeling to be done after final Room number designations established. (See Appendix 2.8-2 "Room Name Spreadsheet".)
- All electrical distribution equipment shall be labeled per the accepted arc flash analysis (See Section 3.12.10.G). Equipment shall include (but not be limited to) switchgears, switchboards, panel boards, motor control centers and transformers. Specify per Appendix 3.12-6 for standard University label types.

B. Maintenance Accessibility

- All fixtures in stairwells shall be accessed with a ladder, without requiring scaffolding.
- All Electrical Rooms shall be designed and utilized for electrical equipment. Storage for other use is not permitted.
- Allow space for removal and replacement of equipment.

C. Keys and Security Issues

- All cores by Princeton University. All mechanical and electrical spaces EM core. All Generator and Elevator Rooms AS core. Substations and HV Distribution Buildings use HV core.
- Determine need to secure equipment not located in separate Electric Rooms.

D. Snow Melting

- DDC point required from snow melting panel to Building Automation System (BAS).
- The Contactor for snow melting shall have a 3 position switch "hand-off-auto".
- Install current transformers to verify function and feedback indicating status.

E. Vehicle Battery Charging Stations

- Typically at Dormitory or other entryways.
- Discuss need for exterior outlets to charge vehicles with GBM.
- Recessed brass box with cover flush with masonry.
- Each charging location shall have a dedicated 20amp. duplex GFI receptacle.

13. Procedural Guidelines – Commissioning, Warranty Notification

A. Commissioning

- Commissioning shall be performed in accordance with section 3.13 of this manual
- The extent of Commissioning shall be determined during the schematic design phase of a project, either using in-house, (Single Party) or a third party commissioning agent.

- Tech Team representatives form Engineering and Grounds Building Maintenance shall be an integral part of the commissioning process
- The following electrical systems will be included in the commissioning process
  - Power Distribution
  - Fire Alarm & Smoke Detection
  - Auto Temp Controls
  - Lighting
  - Generators
  - UPS
  - Motors & Drives
  - Grounding

B. Warranty Period Notification

- Establish/notify Shops of date of substantial completion. If multiple phases are constructed, Contractor to provide comprehensive list of all dates per individual piece of equipment. Typically, this is a one-year process.

14. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of As-built Drawings prepared by the Construction Contractor and any systems installer.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the Contractor and University personnel to review progress on the system and to ascertain that the Contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the Contractor is maintaining record Drawings to convert to As-Builts.

Provide Switchgear Drawings on AutoCAD disk Release 2000 or later. See also as-built requirements in Section 1.5 (Documentation and Archiving), and Section 4.5 (Electrical Rooms).

END OF DOCUMENT

1. Introduction

Princeton's commissioning process is a quality assurance program for new buildings or major renovations. This process is designed to ensure buildings meet the needs of the University, and are built and operated as intended by the design team. The process focuses on environmental quality, LEED, "Green Design", Indoor Air Quality, resource and conservation strategy, energy requirements, options for minimizing energy usage and life safety considerations.

If commissioning is a required A/E service, then, depending on the project, the University will implement one of two (2) possible commissioning models:

- Single Party – relies on the University MEP Project Engineer (Commissioning Agent) to perform the commissioning functions as specified within the A/E contract documents.
- Four Party – requires the participation of the Design professional, a Commissioning Agent, the Construction manager, and the University

2. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, the Construction Management Office, or as applicable)

B. University MEP Project Engineer — 200 Elm Drive, 609-258-8589

C. Program Manager of Standards — 200 Elm Drive, 609-258-1330

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

		PDF	MS Word
A	Commissioning Plan	Appendix 3.3-3	Appendix 3.3-3
B	Outline of MEP Design Intent (Commissioning)	Appendix 3.3-4	Appendix 3.3-4
C	MEP Basis of Design (Commissioning)	Appendix 3.3-5	Appendix 3.3-5
D	Final Commissioning report	Appendix 3.3-6	Appendix 3.3-6
E	Index of MEP Pre-Functional Tests (Commissioning)	Appendix 3.3-7	Appendix 3.3-7

F	Index of MEP Functional Tests (Commissioning)	Appendix 3.3-8	Appendix 3.3-8
G	Commissioning Specifications	Appendix 3.3-9	Appendix 3.3-9
H	Commissioning Specifications – Fire Alarm 13995FA	Appendix 3.13-1	Appendix 3.13-1
I	Commissioning Specifications – Fire Protection 13999FP	Appendix 3.13-2	Appendix 3.13-2
J	Commissioning Specifications – Mechanical 15995M	Appendix 3.13-3	Appendix 3.13-3
K	Commissioning Specifications – Electrical 16995E	Appendix 3.13-4	Appendix 3.13-4
L	Master Technical Specification for Building Automation Systems (Section 15959 – Commissioning)	Appendix 3.2-1	Appendix 3.2-1

4. Review Guidelines

Initial planning and preliminary design will be conducted thru the Office of Design & Construction and Facilities Engineering with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Documents are to be submitted for review at:

A. Completion of Schematic Design (Design Intent Document)

B. Completion of Design Development (Basis of Design Document)

C. At 50% completion of construction documents; (Commissioning Plan & Specifications)

D. At 85% completion of construction documents; (ATC Points list & Sequence of Operation)

E. At 100% completion of construction documents, if required, at the discretion of the Tech Team.

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process if to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

5. Procedural Guidelines – Commissioning Approach

Design Phase

During preliminary design, the University Project Manager and the University MEP Project Engineer (Commissioning Agent) will ascertain the requirements for Commissioning, single party or four parties. The Designer shall cooperate with any adjunct professionals providing assistance to the University, and coordinate their work with other disciplines to produce the required commissioning documents.

1. Single Party Commissioning – The University has developed an internal single party commissioning process compatible with most Construction Management (CM) contractual projects. An internal (University) Commissioning Agent is provided thru the Office of Design & Construction to assist the A/E thru this process. This process is preferred unless the MEP project scope requires the full time on-site participation of a Commissioning Agent, with specialized monitoring and testing equipment. The latter is generally limited to Laboratory buildings and specialized plant related projects.

The Commissioning Model is outlined in Appendices 3.3-3 thru 3.3-9. If Single Party Commissioning is chosen, the designer is required to provide the following, during the respective design phases indicated:

- Project Summary & Design Team Members – (Schematic Design Phase)
- MEP Design Intent (Appendix 3.3.4) (Schematic Design Phase)
- Basis of Design (Appendix 3.3.5) (Design Development Phase)
- Commissioning Specifications (Appendix 3.3.9) (50% Construction Document Phase)
- Final List of PreFunctional and Functional Tests (85% Construction Document Phase)

Commissioning specification Appendix 3.3-9 includes most of the contract documentation required for single party commissioning. The designer should use the applicable specifications, in Appendices, as part of the project documentation. Additional Master Technical specifications for Building Automation Commissioning is available in Appendix 3.2-1 – Section 15989)

2. Four Party Commissioning – requires the participation of the Design professional, a Commissioning Agent, the Construction Manager, and the University.

This approach is generally limited to Laboratory buildings and specialized plant related projects.

If a Four Party approach is chosen for a project, an RFP will be developed during preliminary design for the services of a consulting Commissioning Agent The chosen Commissioning Agent shall submit a copy of there procedures and commissioning documentation for review and approval by the University.

The designer is required to coordinate all required commissioning documentation with the chosen Commissioning Agent and the requirements of the University Tech Teams. Modifications to Appendices 3.3-3 thru 3.3-9, plus ATC Master Technical Specification for BAS from Appendix 3.2-1, are a function of the individual program requirements, complexity of the MEP system and other project – specific factors.

The commissioning agent shall be involved strategically throughout the project from Design Development through the warranty phase. The primary role of the commissioning agent, during the design phase, is to review the A/E detailed commissioning specifications prior to each Tech Review, while the secondary or optional role of the commissioning agent is to review the design to ensure it meets Princeton University's objectives.

Construction Phase (Single Party & Four Party)

During the Construction Phase of a project, the commissioning agent, whether single or four party, will develop and coordinate the execution of a testing plan, which includes observing and certifying all systems' performance to ensure that the systems are functioning in accordance with the Princeton University's Design Standards, the project requirements and the contract documents. The documentation developed during the design phase will be periodically updated to meet current project requirements.

In addition to the documents developed during the design phase, the following documentation is required;

- Commissioning schedule
- Submittal Log
- Issues Log
- Progress Reports and Site Observations
- List of Pre-Functional Tests
- List of Functional Tests
- Pre-Functional Tests (Appendix 3.3-7)
- Functional Tests (Appendix 3.3-8)
- Final Commissioning Report (Appendix 3.3-6)

In addition to the above listed requirements, the commissioning agent shall review the O&M Manuals and record of Project Closeout Best Practices Meeting Comments. The commissioning agent may be required to perform follow up testing post occupancy – after the first heating or cooling season depending on the completion of the project.

6. Requirements for Documentation

Project Team reviews of issues relating to commissioning will occur within the larger context of the design reviews conducted throughout the project Documents, including the Commissioning Plan and other noted documents, shall be submitted for review by the Office of Design and Construction, the Maintenance Department and the Engineering Department at specified design milestones.

See required documentation on the following page.

The documentation will include, as a minimum:

Required Documentation (Design Phase)	SD	DD	50% CD	85% CD
Commissioning Plan	X	X	X	X
MEP Design Intent	X	X	X	X
MEP Basis of Design		X	X	X
Outline Specifications		X		
Full-LengthSpecifications			X	X
List of Eq't to be Commissioned:				
• Major Equipment		X	X	X
• Remaining Equipment			X	X
List of Pre Functional Tests				X
List of Functional Tests				X

7. Building Commissioning Process

The Commissioning Process will include, but is not limited to, the following Mechanical, Electrical and Plumbing (MEP) systems.

Mechanical	Electrical	Plumbing
Hot Water	Power Distribution	Fire Suppression
Chilled Water & Condenser Water	Fire Alarm & Smoke Detection	Storm & Sanitary Drainage
Steam & Condensate	Auto Temp Controls	Domestic Water
Water Treatment	Lighting	Piping Specialties
Air Handling	Generators	Exp Joint & Loops
Exhaust	UPS	Pipe Flushing & Cleaning
Auto Temp Controls	Motors & Drives	Water Balance
Unit Heaters	Grounding	
Air Balance		
Vibration		

8. Measurement and Verification

Measurement and verification will continually confirm that all building systems are operating as intended and will provide data to inform further operational improvements. Monitoring & measurement equipment should be used for lighting systems, motor loads, and HVAC equipment. Data will be analyzed, recorded on the Pre-Functional & Functional Test forms and appropriate adjustments made to verify that systems are meeting the energy performance requirements set forth by the design team.

9. Requirements for Commissioning Documentation

The commissioning agent is responsible for providing the following documentation at the indicated project milestones

Construction, Project Closeout and Post-Occupancy:

A. During the Construction phase - Phase 2 Commissioning Plan documentation shall be maintained as described in Appendix 3.3-3 Commissioning Plan.

B. At Project Closeout - Pre-Functional Tests (See Appendix 3.3-7), Functional Tests (See Appendix 3.3-8), Final Commissioning Report including review of O&M Manuals (See Appendix 3.3-6) and record of Project Closeout Best Practices Meeting Comments.

C. Post Occupancy - record of Project Closeout Follow-up Best Practices Meeting Comments.

END OF DOCUMENT

Standards for Communication Closets-
Building Services
Grounds and Building Maintenance

The need for communication closets must be addressed in the early stages of design in a Building project. Designer shall meet with the Project Manager, OIT and Telephone Departments to determine the number and size of the closets. This will be determined by the location and number of outlet devices in the Building.

1. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Siemon Telecommunications Room Guidelines, Dated 1-1-2000	Appendix 4.1-1

2. Communication Closets

Princeton University designates Communication Closets as either BDF (building distribution frame) or IDF (intermediate distribution frame). BDF is the initial entry point for communication wiring into the building which takes "entry" cables for telephone and data wires and decentralizes them into "feed" cables sent to IDF Closets for further processing into individual "station" cables sent to respective Rooms. BDF Closets may also be considered IDF or have "station" cables running to them if there is a minimal load required in the building. For larger loads, several IDF Closets may be required in addition to the main BDF Closet. An important consideration is that no more than 295' of cable is allowed between termination points and the IDF Closet location, including all bends.

A. Construction and Fire Rating: Review need for fire-rated enclosure and door assembly, including door closer

B. Finishes

1. Walls – Masonry: Block/Gyp Bd. – Water protection on outside wall for new construction. Existing construction, water seal exterior wall .

2. Floor – Concrete, Sealed or Finished Floor

3. Ceiling – Exposed structure is preferred. If rated ceiling is required; plaster ceiling should be specified.

4. Door – 36" minimum width; outward swinging doors are preferred to preserve floor space

C. Utilities/Equipment

1. Power – Quad receptacles with (4) dedicated 20 amp. circuits – 18" A.F.F. (new) may be higher than 18" A.F.F. (renovation). Two (2) quads are to be placed on emergency power supply; two (2) quads on standard building power. No separate UPS required.

2. Lighting – All lighting shall utilize energy efficient fixtures. If selected, fluorescent lamps shall be T8 with a color temperature of 3500ºK. Lighting shall be switched at each door into room.

3. Ventilation – Exhaust ventilation with make-up air based on size of closet and careful evaluation of total equipment heat load and its configuration/concentration within the closet. Coordinate all HVAC issues with OIT. (2 air changes per hour minimum)

4. Piping, etc. – Maintain headroom of 9'-0"; piping, conduit, ductwork, etc. to be installed above that level.

5. Detector – Smoke detection may be required; review use.

6. Sprinklers – Provide upright pendant with wire cage in Buildings with suppression.

D. Equipment Requirements (BDF or IDF)

1. New construction – No other systems, storage or Janitor's equipment allowed in these rooms.

2. Renovation – Coordination with other utilities during renovation projects is essential.

- Eliminate high voltage (440 volts or higher) including pass thru lines. OIT cable/raceway must have a minimum of 10' clearance from high voltage systems.
- Avoid installation of OIT cable near or thru Elevator Machine Rooms.
- OIT termination panels should have a minimum of 20' clearance from high voltage systems.

3. Overhead Cable Tray – "Chadsworth" ladder rack. Location and type based on cable into room with dropdown at appropriate point.

4. Floor-mounted Racks (Preferred) – Minimizes cross-connections (patch cords) between equipment. Must be floor bolted for certification. Typically used for video boxes, UPS and surge protectors.

5. Wall-Mounted Racks – For telephone cut-down blocks. Locate closer to door to minimize OIT interference.

E. Miscellaneous

1. Door lock – Door lock shall be keyed with University EM core in a "Best" cylindrical lock.

2. Consolidation Points – Not used. Ignore Siemon requirements.

END OF DOCUMENT

Standards for Corridors-
Grounds and Building Maintenance
Building Services

Hallways/Corridors/Stairwells

A. Construction and Fire Rating

Building use and occupancy load on corridors affect the fire rating requirements for a corridor or hallway. The New Jersey Uniform Construction Code (UCC), the New Jersey Uniform Fire Code (UFC), and the International Construction Code (ICC) must be reviewed for these requirements. Note that the installation of a fire suppression system in a building may reduce the requirements for fire rating of exit components; consult NJUCC and BOCA.

B. Finishes

Must meet requirements of UCC, UFC, and IBC (as applicable); maintainability and appearance over time are key concerns.

Finishes are project specific and should be determined within the context of the building design, and with the consensus of the project team and the University's review committee. Consideration should be given to the application of green wall, floor, ceiling and trim finishes. Final decisions for each product shall be determined through applying a Life-Cycle Cost Study (LCCS) in conformance with Section 1.2 (Sustainability). Preferences for finishes from a maintenance and housekeeping perspective are:

1. Walls - masonry: brick, ground-face or painted block, glazed block, ceramic or stone tile, plaster-finished masonry;

   frame: with plaster finish over lath, rock-lath, Imperial board, or abuse-resistant gypsum board decorated with a level 5 finish in corridors and common spaces (refer to Appendix 4.13-2). The Designer should attempt to incorporate breaks, reveals, or other architectural details to divide large expanses of painted surface, particularly in the vertical direction. This is especially true in high traffic areas, areas using high pigment paints, or locations that are especially subject to abuse.

   To avoid cracking above door frames along corridors, include a control joint at door hinge side, refer to ASTM C840 System XIII

2. Floors - masonry: concrete, terrazzo, stone, quarry or ceramic tile (all properly sealed to resist staining);

   vinyl composition tile, rubber tile;

   carpet (in a color and pattern that can hide wear);
   wood: oak, maple, or vertical grain Heartwood Southern pine strip flooring with (VOC-compliant) water-based finish for halls and corridors. Parquet floors have been problematic at Princeton.

entrance mats: specify polypropylene carpet-type walk-off mats with flexible vinyl backing.

3. Ceilings - exposed masonry, steel, or wood (meeting code requirements);

concealed spline acoustic tile (in areas with no, or very low, requirements for access above ceilings);

lay-in acoustic tile (in non-dormitory use);

framed plaster (preferred) or gypsum board, with all required access panels indicated on reflected ceiling plans and MEP plans where minimal systems exist; all public-area access panels below 9'-0" A.F.F. are to have Best cylindrical locks (refer to section 4.4).

4. Trim - There should be some form of base in corridors for housekeeping purposes, compatible with floor finish; tile, stone, wood, rubber; review with Project Manager.

Rubber base in 4'-0" lengths is preferred over vinyl base, where appropriate.

C. Utilities

All utility piping and conduits should be concealed within finishes. Points requiring access should be 'centralized' as much as possible -- group valves, junction boxes, etc. near one another to minimize the need for multiple access doors or panels.

Designer is to produce typical corridor cross-section Drawings to illustrate all typically required coordination of piping, duct, and conduit runs, and installation of devices. Maximize ceiling heights while providing for utility runs.

1. Power Outlets - Maximum 25' between outlets in corridors; provide outlets in stairs at each floor level. 20 amp. dedicated circuit per corridor.

2. Lighting - Recessed in ceiling or wall-mounted sconces; standardize lamp types (26 Watt quad fluorescent, e.g., w/ common base configuration) to minimize need for storing multiple replacement types. Coordinate normal ambient lighting with emergency lighting; use campus emergency power network where available for emergency lighting. A list of replacement lamps is to be included in the closeout documentation required of the contractor.

3. Ventilation - Determine requirements and need for heating and ventilation in corridors early in project; review with Project Manager.

Plan duct runs for ventilation and make-up air and coordinate with ceiling installation and other utilities. Consider impact of duct distribution on structural frame depth in corridor.

New Jersey code review agencies normally request a written ventilation schedule showing compliance with fresh air requirements on the approved Drawings. Make-up air is generally required to be tempered.

4. Fire Alarm - Provide required smoke detection, pull stations, and alarm signaling devices. Maintain required clearance between smoke detectors and HVAC supply diffusers. Coordinate device placement with other corridor systems and with architectural finishes by preparing elevation Drawings showing pull stations, horn/strobes, hold-open devices, exit fixtures, etc. with other required devices, systems, and elements.

5. Sprinklers - Concealed pendant heads preferred; concealed sidewall heads are an option.

   In new construction and major renovation, exposed piping and exposed sidewall heads are not acceptable.

6. Extinguishers - Coordinate location of hand-held fire extinguishers with standpipe hose cabinets. Provide recessed cabinets for storage of extinguishers. Review proposed locations with Project Manager, and with local fire official as directed.

D. Doors and Hardware

Stair openings typically require rated assemblies (frame, door, and hardware); doors must meet temperature-rise requirements. Provide detector-activated wall or floor hold-opens on stair doors and smoke doors to eliminate use of wedges and chocks. Coordinate hold-open devices with fire alarm system design.

Review the need for rated assemblies in corridors in buildings with fire-suppression systems.

See Section 4.4 (Door Hardware) for requirements for hardware in corridors.

E. Miscellaneous

Designer should be aware of security and safety concerns: limits on dead-end corridors in codes; control of access to remote areas; provision of emergency phones in appropriate areas.

Review the need for signage and accessories such as message boards in corridors.

Drinking fountains are required by code, and water chillers are desirable; consider the possible inclusion of hot-water dispensers with water chillers. Water resistant floor materials should be used at drinking fountain locations. Consider use of stainless steel splash guards at wall surfaces as well.

END OF DOCUMENT

Standards for Custodial Closets and Storage-
Building Services
Grounds and Building Maintenance

The need for space for custodial purposes must be addressed in the programming phase of design in a building project. It is important that early design review of custodial closets in storage rooms occur with the Director of Building Services (609) 258-3713. Each building will require a custodial storage room of approximately 150 square feet (and possibly larger in larger buildings) for paper products and cleaning supplies and equipment. Ideally, custodial storage rooms should have a door width of 40" or greater to allow for passage of larger cleaning machines. These closets are not to be programmed with building mechanical and electrical spaces. Exact janitorial requirements for each building are a program issue to be resolved during design development.

Buildings up to 10,000 square feet will require at least one janitor's closet of approximately 35 square feet, and one of equal size on each additional floor level of the building.

Buildings up to 50,000 square feet will require two to three janitor closets, a minimum of one per floor level.

Buildings up to 100,000 square feet will need three to four janitor's closets minimum, at least one per floor level; larger buildings should be programmed for additional closets at the rate of one per 25,000 square feet.

Buildings requiring a Custodial Office shall receive an OIT outlet in the office adjacent to a two-gang electrical outlet, in accordance with Section 2.6.

1. Custodial Closets

A. Construction and Fire Rating: review need for fire-rated enclosure and door assembly, including door closer.

B. Finishes

1. Walls - masonry: brick, block, glazed block, ceramic tile

   frame with plaster finish: smooth finish, gloss painted finish

   frame with level 4 GWB finish, gloss painted finish

   NOTE: stainless steel backsplash above floor receptor

2. Floor - concrete (properly sealed), terrazzo, ceramic or quarry tile

   coved base to match floor; no floor drain required

3. Ceiling - exposed structure is preferred if rated ceiling is required, plaster finish should be specified

C. Utilities/Equipment

1. Receptor - floor receptor with raised rim is preferred, 36" square, with 24" high stainless steel backsplash wall-mounted sink only; if receptor cannot be used faucet with hose connection, short length of hose; provide water-tight connection at receptor

2. Power - GFI receptacle on wall away from water supply

3. Lighting - 4' utility fluorescent w/ guard at ceiling, wall switch

4. Ventilation - exhaust ventilation with make-up air; review requirements for tempering make-up air

5. Piping, etc. - maintain headroom of 90"; piping, conduit, ductwork, etc. to be installed above that level.

6. Detector - smoke detection may be required; review use

7. Sprinklers - provide upright pendant with wire cage in buildings with suppression

8. NOTE - in dormitory bathrooms not within vicinity of a janitor's room, provide hose bibbs with hot and cold water under lavatory. Use hose bibbs with key stops.

D. Miscellaneous

Accessories - in one closet per building (typically), install cleaning chemical dispenser over receptor

friction-type mounting brackets for mops, brooms, etc. on wall over receptor (not under chemical dispenser)

12" - 14" stainless steel shelving high on third wall, 8' total if possible

2. Custodial Supply Areas

A. Construction and Fire Rating (same concerns as with janitor's closets)

B. Finishes - durable finishes, painted walls and ceiling

C. Shelving - provide metal shelving, 16" deep minimum, 48' length (+/-), provide a minimum of 22" clear between shelving; maintain required clearances for sprinklers

D. HVAC - meet minimum requirements for heating and ventilation

END OF DOCUMENT

Standards for Door Hardware - Grounds and Building Maintenance

1. General

Early in the planning stages of the project, the Designer must meet with the University Project Manager and with Facilities Grounds & Building Maintenance Department Lock Shop Supervisor to review both the design standards and the program needs for locks and hardware in the proposed project.

Also early in the project, a determination must be made regarding the need for or desirability of including a card access system in the building. If card access is to be part of the building program, that system must be designed to meet University standards (see Section 3.1 Access Control Standards). It must also be determined whether Facilities Grounds & Building Maintenance's Lock Shop or Best Locking Company will be supplying and/or installing the cores and providing the operating keys. All locksets are to be cylindrical unless otherwise recommended by the projects security consultant in writing for review by the project team.

Due to the historically high incidence of errors in hardware schedules, every effort must be made by the designer to have a "first pass" of the door hardware schedule and hardware specifications prepared by the issuance of 50% construction document submission. A complete hardware schedule with full hardware set specifications is required for the 85% construction document submission.

Documentation will include, at a minimum:

Documentation	SD	DD	50% CD	85% CD
Door Schedule		X	X	X
Details – *Head, jamb and sill conditions*			X	X
Security Layout - Plan/Elevation			X	X
Outline Specifications		X		
Full-Length Specifications – *First pass with hardware sets, manufacturers, etc.*			X	X
Full-Length Specifications – *Complete*				X

Prior to shop drawing submission, a hardware coordination meeting is to be scheduled with the Project Manager, User groups, Facilities Lock Shop Representative and Construction Manager to discuss project-specific issues related to lock functions, coordination, and delivery.

Princeton University utilizes hardware from a number of manufacturers; because of ongoing maintenance needs, and normal modifications within buildings, it is important that the Designer specify the standard manufacturers.

2. Standard: Non Electrified Hardware

For renovation work, the Designer shall not reduce the level of quality or service provided by existing hardware when specifying replacements without prior approval by the Tech Team.

A. Cylindrical Locks - Best Locking Company, 7-pin removable core, #14 heavy duty lever handle as a standard; the majority of locksets used in projects on campus are to be of the cylindrical type. Any deviation must have the approval of the Facilities Grounds & Building Maintenance Lock Shop Supervisor.

B. Panic devices - non-electrically operated - Precision. Exposed vertical rods (not concealed) are to be used at paired doors. Non-electrified Von Duprin panic devises may be used for architectural uniformity purposes.

C. Panic Device Function – to be established on a door-by-door basis by hardware supplier in conjunction with the Lock Shop Supervisor (and Facilities Life Safety and Security Systems Engineer where electronic card access applies).

D. Combination locks - 'Trilogy' battery powered programmable lockset by Alarm Lock is currently being used. These are typically installed by the university Lock Shop, but are to be specified by the Designer. Refer to Facilities Life Safety and Security Systems and the University's Keyless Lock Program for an update on specific recommendations.

E. Hinges - Stanley, full-ball bearing type, brass for exterior, steel for interior. The hinges for all doors with access control and/or any type of closer are to be of the brass type with ball bearings and non-removable pins, or approved non-electric continuous type (in special cases).

   Pemko heavy duty or Roton heavy-duty non-electric continuous type (see section 3.1 Access Control Standards)

F. Closers - LCN overhead (4041)
   Rixson recessed floor closer #27. Specify heavy-duty for doors $\geq$ 2½" thick.

G. Miscellaneous - door bumpers by Ives, Rockwell; security peepholes by Ives; dead stops by Glynn-Johnson

3. Key Schedule and Core Installations

Where it has been established that the cores will be combinated and installed by Best Locking Company, the Project Manager is to arrange a meeting with the Designer, the departmental representative for the project, the Facilities Grounds & Building Maintenance Lock Shop Supervisor, and a representative from Best Locking Company during the shop drawing submittal phase of the project. The purpose of the meeting is to determine requirements for lock function, keying and for levels of master keying and sub-masters, and any access control issues.

Room numbers are to be finalized prior to this meeting, and the numbering and room designations used in the key schedule are to be consistent with those used in fire alarm nomenclature (see 3.2 Automatic Temperature Controls and 3.4 Fire Alarm Systems). Best

Locking Company (or Facilities Grounds and Building Maintenance Lock Shop, if contracted) is to prepare the key schedule for review by the other parties, and is to proceed with setting up lock cores upon receipt of the approved key schedule.

During or before this meeting of the project, whichever group is contracted to combinate and install the cores shall be given sufficient notice to schedule the installation of the cores in the finish hardware. It is critical that the specification require that the contractor retain all factory-supplied lockset tailpieces needed for lock core installation; tailpieces are to be turned over to the contracted party for core installation.

Specifications are to include requirements for employing only experienced, qualified mechanics for installation of finish door hardware.

4. Electrified Hardware and Access Control Considerations

Refer to Section 2.7 Security for guideline to establish general security goals for the project.

See Section 3.1 for Access Control Systems guidelines. If an access control system is required, all exterior doors, including mechanical room and mechanical penthouse doors which allow access to other parts of the building, must be incorporated into the CACS design. Inclusion of access control hardware may limit door design possibilities. Card readers are generally installed on the building exterior, with conduit and door/frame preparation integrated with the envelope design. While desirable for ease of system maintenance, card access readers installed in vestibules may pose a security concern, depending on the design of the vestibule. Review proposed installation with Project Manager and the systems administrator from Life Safety and Security Systems and the Systems Engineer for Life Safety and Security Systems.

Campus Access Control System (CACS) Hardware Specifications – Electro-mechanical as follows:

A. Panic Hardware

All electro-mechanical Panic Hardware shall be manufactured by Von Duprin. Exceptions, e.g., Blumcraft may be considered based on Architectural design constraints.

1. Panic Bar with Electric Trim Release (24V Fail -Secure Operation)

   This type of hardware has the locking function in the outside lever trim. Electrical solenoid activation releases the locking mechanism allowing the lever handle to withdraw the door latch. This type of locking hardware is standard on all exterior dormitory doors. Key override shall be "Night Latch" function (NL). " Request to Exit" switch shall be provided (RX-LC).

   Door mounting configurations shall be RIM or Surface Vertical Rods (SVR).
   - Typical RIM model number: RX-LC98L-E996-US26D-3'
   - Typical SVR model number: RX-LC9827L-E996-US26D-3'x7'

   A Von Duprin Power Transfer Device (EPT-10) shall be included with each panic bar installation. SVR type installations will require a "Panic Threshold", e.g., NGP 800 series.

   Panic bar, trim styles and finishes to be specified by the Architect.

2. Panic Bar with Electric Latch Retraction (24V Fail-Secure Operation)
   This type of hardware has the locking function in the bar. A special high current power supply is required to retract the door latch. This allows for the use of standard pull handles as outside trim. Commonly used on the exterior doors of Administrative and Academic buildings. Required on all ADA motorized doors. Key override shall be "Night Latch" function (NL)." Request to Exit" switch shall be provided (RX-LC).

   Door mounting configurations shall be RIM or Surface Vertical Rods (SVR).
   Typical RIM model number: RX-LCEL98NL-US26D-3'
   Typical SVR model number: RX-LCEL9827NL-US26D-3'x7'
   The following equipment shall be included with each EL panic bar installation:
   a) Von Duprin Power Supply (PS873-2)
      Double leaf doors only require one power supply.
   b) Von Duprin Power Transfer Device (EPT-10)
   c) SVR type installations will require a "Panic Threshold", e.g., NGP 800 series.

   Panic bar, trim styles and finishes to be specified by the Architect.

3. Panic Bar with Delayed Egress function
   This type of hardware has all the same requirements of a standard Latch Retraction panic bar but with a "Delayed" action release scheme when exiting. Building code requires that the hardware must be interconnected with the Fire Alarm System for immediate release in case of fire.

   Door mounting configurations shall be RIM or Surface Vertical Rods (SVR).
   Typical RIM model number: CX98L-07-US26D-3'
   Typical SVR model number: CX9827L-07-US26D-3'x7'
   The following equipment shall be included with each CX panic bar installation:
   a) Von Duprin Power Supply (PS873-2)
      Double leaf doors only require one power supply.
   b) Von Duprin Power Transfer Device (EPT-10)
   c) SVR type installations will require a "Panic Threshold", e.g., NGP 800 series.

   Panic bar, trim styles and finishes to be specified by the Architect.

B. Mortise Lockset Hardware (24V Fail-Secure Operation)

Electrified mortise locksets are the preferred hardware for all Access Controlled doors that don't require panic egress. Key override shall be "Night Latch" function (NL). " Request to Exit" (RX) switch shall be provided as well as a "Door Status" monitor switch (DSM). The manufacturer of choice shall be SCHLAGE - RXL9080BEU series, and modified by COMMAND ACCESS TECHNOLOGIES as typical model #ML180.

Trim styles and finishes to be specified by the Architect.

C. Cylindrical Lockset Hardware (24V Fail-Secure Operation)
Electrified cylindrical locksets are only to be used on Access Controlled doors in place of the mortise type when there are specific Architectural constraints.
Key override shall be “Night Latch” function (NL). ” Request to Exit” (RX) switch shall be provided. The manufacturer of choice shall be SCHLAGE - RXND80BEU series, and modified by COMMAND ACCESS TECHNOLOGIES as typical model #CLN80BEU-RHO-626-24V-REX.

Trim styles and finishes to be specified by the Architect.

D. Motorized Door Operators (ADA)
The LCN 4600 series is the overhead operator of choice.
Exceptions, e.g., Horton may be considered based of Architectural design constraints. Concealed underground operators will be considered only as a last resort and must be reviewed/approved by the Life Safety and Security System Engineer.

5. Requirements for Mechanical Rooms, Penthouses, Roof Access

Specify cylindrical lockset with storeroom function. If padlocks are to be used (on roof hatches, e.g.), specify Best Locking interchangeable-core padlocks; use weathertight locks for exterior application.

6. Millwork and Cabinetry Locks

Specify “Best” deadbolt or dead latch cabinet locks for custom dormitory cabinetry or millwork. Use Best 5L7RD2 for all custom applications which includes interchangeable cores.

Specify “National”, “CCL”, “Olympus” or “Best” deadbolt cabinet locks for non-dormitory applications of custom and, wherever possible, contract furniture. Use National C8173, CCL 0737, or Best 5L7RD2.

Media Services lecterns and media cabinets are to be keyed with the *media module (915).*

7. Access Panel Locks

Access panels are commonly used for the maintenance of building utilities and are typically required to be locked. Those which exist in maintenance (non-public) areas do not require locks; those in public spaces are required to be lockable. Exceptions may be made in the case of very high ceilings (above 9’-0” A.F.F.) or other unusual locations and should be reviewed by the Building Maintenance Tech Team Coordinator.

Depending on the access panel manufacturer, locks should be either Best rim cylinder (model 1E72) or mortise cylinder (model 1E74).

8. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the contractor.

On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include as a minimum: Door & Hardware schedule with all installed items (mfg. model, finish), details of doorways (sections).

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

Standards for Electrical Rooms -
Building Services
Grounds and Building Maintenance

Electrical Rooms must be considered in the early stages of the Design Phase, and consideration must be given to location, size and number of Electrical Rooms. Service Entrance to Building usually determines location for Transformer Vault. All Transformer Vaults must remain free of other systems not associated with electrical distribution systems.

Main distribution with switchgear shall be designed in a separate room if the building program allows the space and location.

1. Design Review – Facilities Engineering Department and Maintenance Department shall review electrical systems at the following phases.
   a. Design Development – Major Equipment to be Shown
      - Switchgear
      - Transformers
      - Distribution Panels
      - Generator
      - Motor Control Centers
      - Automatic Transfer Switches
      - Feeder Distribution

   b. 50% CD – Major Equipment to be Shown
      - Schematic Phase Equipment Plus:
      - Branch Panels
      - Panel Schedules

2. Room Construction
   a. Walls: Masonry, Block/Concrete: Preferred for transformer and switchgear.

      Gypsum Wall Board: Can be used for Distribution Closets.

   b. Floor: Concrete: Preferred. Concrete slab in Basement shall be sealed. Above grade epoxy seal slab. Check with Project Manager for any

      other proposed floor construction/finish.

      Sleeves in slabs above grade shall be raised 1”.

      See Appendix 4.11-2 for pipe sleeve and firestopping requirements based on wall/floor materials.

   c. Ceiling: Exposed structure or if sound attenuation is a consideration, sheetrock with insulation above.

d. Door: 36” minimum size. Transformer/Switchgear Vaults size as dictated by code requirements.

Door lock shall have University core “EM”. Area Substation, Elevator Machine Rooms and Generator Rooms shall be cored with “AS”.

3. Distribution of Electrical Rooms
   a. Location: Careful consideration shall be given to Transformer Vaults and Switchgear Rooms. If the building program allows, locate away from program space.

   b. Quantity: Minimum (1) panel per floor and each panel shall serve that floor.

   No feed-through or riser panels. (Individual feeds required to each panel)

4. Clearances Between Equipment
   a. Code Minimums: 3’-0” minimum for branch distribution panels. Transformer Vaults and Switchgear Room clearances vary. Refer to code requirements.

   b. Working Clearances: Consider back access for equipment, code driven requirements.

   Dry type transformers, floor mounted. Use cork pads for vibration isolation.

   c. EMF: Locate Transformer Vaults and switchgear away from program spaces. Project Manager to coordinate with program.

5. Housekeeping Pads
   a. Size/Strength: 4” high, rounded edges, minimum 2500psi. Doweled to existing slab. Include WWF for reinforcement.

   b. Type of Equipment on Pads:
      – Generators
      – Motor Control Centers
      – Transformers
      – For multiple pieces of switchgear lay channel frame on edge and pour concrete around.

6. Equipment Mounting
   a. Recessed/Surface:
      – Surface mount in Mechanical Rooms
      – Recessed in finished areas. (Spare conduits run to above ceiling. Enough conduits to fill-out spare circuits. Box or trough at end of conduit stubs. Must be accessible)

   b. Unistrut Channel – On exterior walls or existing walls not plum.

7. Coordination Between Other Services

    a. HVAC

    - Equipment
    - Ductwork
    - Piping

    Not allowed in Transformer/Switchgear Rooms

    b. Sprinkler Piping (Protect critical electrical equipment from water damage)

    c. Elevator Equipment Rooms and Shaft – No other equipment not associated with Room or Shaft.

    d. OIT – Provide standard OIT station outlet at any new Switchgear and transfer switch for SCADA requirements.

8. Heating and Ventilation Requirements

    a. Exhaust/Ventilation. Review code requirements to meet standards. Maintain ambient outside temperature or 55º in Winter.

9. Lighting Type, Convenience Receptacles and OIT outlets

    a. All lighting shall be utilize energy efficient fixtures. If selected, fluorescent lamps shall be T8 with a color temperature of~~,~~ 3500ºK. Lighting shall be switched at each door into room. T5 high-output lamps are also acceptable.

    b. At least one light shall be circuited to the emergency panel. Light shall be switched and handle shall be lighted in the "Off" position. Locate switch closest to door frame.

    c. One 20 Amp. convenience receptacle per 150 sq. ft. floor space or not more than 25 feet apart. One receptacle (red) on emergency circuit in Main Mechanical Rooms, Switchgear Rooms. Each space shall have a minimum of one receptacle or more.

    d. At least one OIT outlet required for connecting selected equipment to the campus electric SCADA system.

10. Scaled vertical section cut(s) at major horizontal distribution pathways (such as horizontal pipe chases and above congested hallway ceilings), showing a coordinated depiction of all MEP systems at multiple locations;

11. Refer to Section 3.12 (Electrical Systems Design) for allowable electrical pathway and conduit equipment.

12. Requirements for As-Built Documentation

a. On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

b. The as-builts are to include the following as a minimum:

- Switchgear and related switches
- Electrical riser Diagrams
- Electrical power and lighting floor layout plans with conduit and circuits shown as-built.
- Electrical fixture schedule with actual mfr. data.
- Electrical panel schedules including mfr. data.
- Motor Control Center schedule

END OF DOCUMENT

Standards for Elevators - Grounds and Building Maintenance

The following standards set forth the criteria to be utilized by Designers for the installation of new elevators at Princeton University. The standards have been prepared for use by Designers to properly specify in-ground hydraulic elevators and geared traction elevators in a manner satisfactory to Princeton University. The Technical Guide Specifications for hydraulic and geared traction elevators in Appendix 4.6 shall be utilized to prepare the Contract Specifications for the elevators. The Technical Guide Specifications are available through the Index of References (below). Although the standards apply specifically to new elevators, they should be used as a reference for upgrading existing elevators as well.

1. Contacts

A. The Project Manager (in Office of Design and Construction, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. University Code Analyst — MacMillan Building, 609-258-6706

C. MEP Systems Manager — MacMillan Building, 609-258-7099

D. Elevator and Electrical Shop Supervisor — MacMillan Building, 609-258-3991

2. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	MS Word
A. Section 14212 Technical Guide Specifications for a Conventional In-Ground Hydraulic Elevator at Princeton University, (dated June 1, 2009)	Appendix 4.6-1	Appendix 4.6-1
B. Section 14200 Technical Guide Specification for a Geared Traction Elevator at Princeton University (dated June 1, 2009)	Appendix 4.6-2	Appendix 4.6-2
C. Elevator Emergency Telephone Detail	Appendix 3.9.2	

3. Codes and Standards

A. New Jersey Uniform Construction Code (NJUCC)

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. NJUCC subchapter 12 for requirements for elevator safety

E. IBC (International Building Code)

F. ASME A17.1 Elevator and Escalator Code

G. NFPA 70 - National Electrical Code

4. Review and Procedural Guidelines

Early in design development the Designer should arrange a meeting with the Project Manager, the MEP Systems Manager in Grounds and Building Maintenance, the Elevator and Electrical Shop Supervisor in Grounds and Building Maintenance and the University elevator consultant to discuss the programmatic requirements of the proposed elevator, and to begin to set technical requirements. The meeting should be followed up with a review session with the same attendees and the University's Code Analyst.

At 50% completion of contract documents for the project - when the second round of internal reviews generally takes place for a new building or renewal project -- the mechanical design of the elevator should be nearly complete and the architectural and MEP coordination required for the installation of the elevator should be near completion as well. The elevator documentation should be included with the contract documents in the 50% review.

Shop Drawings are to be submitted to the construction manager, who is to forward the submission to the University's Project Manager. Note that elevator plan review and inspections in Princeton Borough and Princeton Township are performed by the State DCA Elevator Safety Unit.

The University's Project Manager will turn the shop Drawings over to the University Code Analyst who makes the official review submittal to the State DCA. Shop Drawings for permit review must be signed and sealed by a licensed professional Engineer (or Architect).

A copy of the shop Drawings is also to be provided to the Project Manager for review by the MEP Systems Manager and the Elevator and Electrical Shop Supervisor.

5. Design and Installation Guidelines – General

A. Elevators shall service all floors of a building. Access to floors may be limited, if necessary, by key switches or access control card readers. Review requirements for limiting access with Project Manager.

B. Two- to Six-Floor Structures, maximum rise of sixty feet: Use of an in-ground hydraulic elevator or geared traction elevator is required.

C. Seven-Floor Structures and above, or greater rise than sixty feet: Use of a geared traction elevator is required.

6. Design and Installation Guidelines - Elevator Machine Rooms

A. Elevator machine room walls shall be constructed in accordance with the requirements of the IBC.

B. The Elevator Mechanical Room shall be adequately ventilated and accessed by means of an outwardly swung fire rated door measuring at least 3'-0" x 7'-0". The door must be outfitted with a spring closer and lockset. The lockset installed on the Elevator Mechanical Room doors shall be keyed like the University's other Elevator Machine Rooms and shall automatically lock when closed.

C. Non-elevator related equipment; piping and conduit shall not be located in or run through the elevator mechanical room.

D. The elevator mainline electrical disconnect and the mechanical room light switch must be located adjacent to the mechanical room door and arranged so they may be accessed without entering the room.

E. Clearance shall be provided for all control panels and equipment cabinet doors to open at least 90 degrees, and at least a three feet area free of obstructions shall be provided in front of control panels and equipment cabinets. Access to hydraulic pump units and geared traction machines shall be adequate for maintenance and shall meet code requirements.

F. The mechanical room must be provided with a minimum of one wall mounted ten- pound fire extinguisher. The extinguisher is to be mounted adjacent to the door on the exterior of the Elevator Control Room.

G. Provide 30-foot candles of fluorescent lighting in elevator machine rooms. Lighting shall be positioned so it will not create shadows while service personnel are working on major equipment items.

H. Two elevator hoistway door keys shall be provided in a key case or box mounted to the wall in the elevator machine room, located in close proximity to the main power disconnect.

I. Paint elevator mechanical room floors with two coats of light gray semi-gloss oil based paint. Paint elevator room walls and ceiling with two coats of white paint.

J. Elevator Machine Rooms are required to be ventilated and cooled as necessary to maintain a room temperature not exceeding 78 degrees F or lower as recommended by the equipment manufacturer. Utilize chilled water if available or specify "stand alone" unit.

7. Design and Installation Guidelines - Elevator Hoistway and Pit

A. Hoistway walls shall be constructed in accordance with the requirements of the IBC

B. A pit ladder is to be installed.

C. Non-elevator related equipment, piping and conduit shall not be located in or run through the elevator hoistway or pit.

D. All lighting shall utilize energy efficient fixtures. If selected, a 3500K color temperature fluorescent light fixture (Kenall Model R848-2-32-EB1-120-KO only) with two 4 foot long T-8 tubes on the hoistway wall at each Floor Level, in the refuge space at the top of the hoistway and in the elevator pit. Light fixtures must have lense covers. The lighting shall be operable from a switch located in the pit and at the top floor.

E. A duplex GFCI electrical receptacle is to be installed three feet above the finished pit floor for use by elevator mechanics.

F. Provide a 24" by 24" deep sump pit in the elevator pit with a rigid aluminum grating. Install an oil-sensing sump pump in the sump pit. The effluent from the sump pit shall be piped to a mechanical room and directed to a floor drain connected to the sanitary sewer system via a funnel type floor drain cover plate. Note the discharge must be into open air; sump pit effluent piping must be piped into the sewer system by means of an indirect drain. (This requirement may vary depending on municipality.)

G. Single Non-GFCI receptacles on independent dedicated circuits must be installed for the sump pump and elevator scavenger pump (hydraulic elevators) coordinated to the location of the pump equipment.

H. Provide alarm signal wire to Engineering Department Energy Management section to alert personnel of a shutdown of the sump pump due to oil in the sump.

I. Ensure proper venting of the elevator hoistway in accordance with ASME A17.1 Elevator and Escalator Code.

J. Ensure proper refuge space is provided on top of the car enclosure in accordance with ASME A17.1 Elevator and Escalator Code.

K. Paint elevator pit floor and walls (up to the sill) with two coats of light gray semi-gloss oil based paint. Paint all exposed metal in hoistway (except guide-rails) with two coats of rust inhibitive paint.

8. Design and Installation Guidelines - Related Work

For proper installation of an elevator, appropriate related work must be included in the project. The following list, not necessarily all-inclusive, contains some of the work needed to be included in other sections of a project specification.

A. Smoke and heat detectors shall be installed per the American National Safety Code for Elevators, ANSI A17.1 (latest edition accepted by the State of New Jersey) and interconnected with the fire fighter provisions of the elevator's control system. Smoke detectors shall be installed at the top of the shaft, in the elevator machine room and at the interior elevator lobbies and shall be the sole devices to initiate Phase I Elevator Recall.

Heat detectors shall be installed in Elevator Machine Room, at top of hoistway and in hoistway pit.

B. A shunt trip circuit breaker shall be provided on the main power feed to the elevator any time the hoistway and or elevator machine room is sprinklered. Anytime the elevator hoistway or machine room is sprinklered, a rate of rise/fixed temperature heat detector shall be installed in close proximity to each sprinkler head and wired to the main power shunt trip circuit breaker. Activation of a heat detector shall cause the main power to the elevator to disconnect.

C. Fire service key switches will be available at each elevator inside of key lock boxes. Fire department will have key to lockboxes (all keyed alike).

D. Cab Telephones – All cabs must be equipped to accept an elevator telephone as specified by the elevator guide specifications, which have been coordinated with the Telecommunications Office. Accommodation for mounting the telephone must include holes tapped to accept standard mounting machine screws.

E. The preference for cab lighting is 4' T-8 fluorescent fixtures connected to the emergency system.

9. Requirements for Testing and Training

A. The elevator subcontractor is responsible for conducting the final acceptance test with the local or State inspector, with a representative of the University's elevator maintenance shop in attendance. Project Manager is to be advised of the schedule for inspection and testing.

The procedure for testing shall be followed closely in accordance with code requirements.

The construction manager is responsible for witnessing and approving the acceptance test. The elevator subcontractor shall certify the report of the test data, and shall deliver a signed and sealed copy to the Project Manager prior to final payment.

B. At a minimum, prior to seeking final acceptance of the completed project as specified by the contract documents, the contractor shall conduct a four (4) hour training program on-site with University elevator maintenance personnel. The session shall provide instructions on the proper safety procedures to be utilized in assisting passengers that may become entrapped inside the elevator car. The session shall also provide instructions on the use of each control feature and its correct sequence of operation. Control features covered shall include, but not be limited to, the following:

1. Independent service operations;

2. Emergency fire recall operations, Phase I;

3. Emergency in-car operations, Phase II;
4. Emergency power operations, if applicable;
5. Emergency communications equipment;
6. Security operating features;
7. Interactive systems management, if applicable;
8. Remote monitoring/controls, if applicable.

10. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings and documentation prepared by the elevator contractor. On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include details of any tie-ins to other systems, such as fire alarm and electric systems, including elevator shaft wiring and details. At the time of final testing, the contractor is to turn over to the Project Manager three copies of the bound maintenance manual and operating instructions. The manual is to contain wiring Diagrams, parts list, list of recommend spare parts, and list of manufactures of major components of the elevator, along with operating and maintenance recommendations.

The Project Manager is responsible for distributing copies of the as-builts to the appropriate University representatives for review prior to project closeout and final payment. These representatives include members of the Facilities Engineering and Grounds and Building Maintenance Departments.

See Section 1.5 (Documentation and Archiving).

11. Non-conformance with Standards

Any requests for exceptions to elevator standards at Princeton University shall be presented to the Project Manager, with written argument detailing the reasons for the requested exception. The Project Manager will review the request with the MEP Systems Manager, University Code Analyst, the Elevator and Electrical Shop Supervisor, and with the University's elevator consultant if deemed appropriate. The exception will be granted only if such action is in the best interests of the University.

END OF DOCUMENT

Standards for Laundry Rooms - Building Services

These standards apply specifically to laundry rooms in dormitories and similar residential facilities; departments, such as Athletics, which include laundry facilities, establish standards individually. The Designer should consult with the client-department for applicable requirements.

Laundry facilities are included in each upper-class dormitory and in residential colleges. Access to the laundry room must be through the interior of the dormitory. Particular attention must be paid to the “nuisance factor” of a laundry room - the effect of noise and heat on nearby rooms.

Laundry rooms are to have durable epoxy floor finishes or stained and sealed concrete and must have adjustable floor drains in proximity to washers and in any other critical area.

Typically, laundry rooms will contain the following:

A. Heavy-duty washers, *not coin operated in dormitories*. Number will vary with space available, but there should not be fewer than three washers. See Appendix 4.7-1 for current model cuts; current model is MAYTAG "Neptune" high efficiency front-loading non-coin washer Model # MAH22PNDWW. The ratio of students to washers/dryers is 25-1.

   Recessed combination supply and drainage boxes should be used, with integral shut-off valves for hot and cold water lines; Watts Water –Tite with the valves mounted in the box Model # W2800. Standpipe should not be set lower than 34” above floor or base of washer. Washing machines should sit on a 4” base.

B. Stacking electric dryers should be used. Current model is MAYTAG stacked, non-coin, digital timer 240V/60 Hz-flat front Model # MLE24PR (This requires two (2) - 30 Amp outlets at each stack); see Appendices 4.7-2 and 4.7-4 for current model cuts.

   Gas dryers are not used in dormitories, due to requirements for carbon monoxide monitoring in installations in residential occupancies. *The dryers should not be coin operated in dormitories.*

   A bulkhead should be designed around ganged dryers to alleviate visual, acoustic, and safety concerns. 4’ of maintenance and access space is needed behind the dryers.

   Dryers should be fitted with individual vents running to a plenum located at the discharge point. There should be no additional screening added between the dryer and the plenum. All plenums must be accessible for cleaning. Discharge hoods should be fitted with gravity louvers if possible; even large-mesh screening tends to become clogged with lint.

   Care should be taken to avoid discharging vents near student room windows.

Plan to install one electric dryer (stacked) for each washer in the laundry room. Please note that one stack dryer is actually = two dryers. Consult Building Services to confirm current model numbers, and for clearance requirements for maintenance of units.

Laundry storage "cubbies" will be installed at a 1:1 ratio with dryers. The dimensions should be approximately 2'w x 2'h x 2.5'd. Additionally, a white board will be mounted in each laundry room, the dimensions should be approximately 3'hx 5'w.

See Appendix 4.7-3, Typical Ganged Dryer Exhaust Isometric.

C. A fiberglass floor-mounted laundry sink with a hose bib should be provided in the facility.

D. Motion sensor-activated light fixtures should be used, with an unswitched fixture in each room, on the emergency lighting circuit. Standard fluorescent fixtures should be used (T8 tubes, 3500K; see Section 3.5 Lighting Design).

E. A fixed table or counter with hanging rod for folding, with built ins for bins

F. Large-volume trash receptacles

G. Waiting/study area is desirable; visual connection with adjacent space or corridor is desirable.

H. Room ventilation system is necessary; review requirements for tempered make-up air for ventilation and dryer exhaust.

I. An emergency wall phone should be installed in the laundry area. (A panic-button may be necessary for remote location; review with Project Manager and Department of Public Safety.)

J. A fire extinguisher in an extinguisher cabinet; recessed cabinets are preferred. See appendix 3.8-2.

K. A university standard roll-type paper towel dispenser and a university standard soap should be intalled in each Laundry Room. These dispensers are supplied by Princeton University and to be installed by the contractor.

L. Coordinate installation of Laundry View laundry monitoring system with OIT

M. Attention to detailing of a shelf like structure that prevents items from falling and accumulating behind the machines is preferred.

END OF DOCUMENT

Standards for Mechanical Rooms -
Building Services
Grounds and Building Maintenance

Mechanical Rooms must be considered in the early stage of the Design Phase, and consideration must be given to location, size and number of Mechanical Rooms. Adequate Mechanical Room space will be achieved only through regular review of the required spaces. All equipment must have enough space around it for maintenance work.

1. Design Review – Facilities Engineering Department shall review Mechanical Rooms and associated systems at the following phases.

   a. Schematic Phase – Major Equipment to be Shown on Final Schematic Layouts

   - Air Handlers, Fan Coil Units
   - Air Compressors
   - Heat Exchangers
   - Pumps
   - Water Heaters/Converters
   - Condensate Handling Systems
   - Backflow Preventors
   - Fire Pumps
   - Building Services Backflow Preventor

   b. Design Development – Major Equipment to be Shown on Final Design Development Submission

   - Schematic Phase Equipment Plus
   - Large Bore Piping 4" and Above
   - Ductwork Sizing
   - Wall-Mounted Equipment and Controls

   c. Construction Documents

   - Remainder of Equipment, Piping and Distribution
   - Scaled vertical section cut(s) at major horizontal distribution pathways (such as horizontal pipe chases and above congested hallway ceilings), showing a coordinated depiction of all MEP systems at multiple locations.

   d. Coordination Drawings – Field Produced by Contractor (s)

   - Facilities Engineering Department will review 3/8" scales coordination Drawings of all equipment to be installed in Mechanical Rooms. This will be done as a concurrent Shop Drawing submittal or as part of a

Coordination Meeting(s) which includes University participation.

2. Room Construction

   a. Walls: Masonry, Block/Concrete – Preferred wall system. Check with Project Manager if other materials are to be used. Specify fire safing systems and sleeving per attached schedule.

   b. Floor: 6” Concrete – Sealed in Basement, epoxy painted or broadcast slabs above grade.

   c. Ceiling: Exposed structure (no ceiling)

   d. Door: Metal or kickplate on push side. Minimum 36” width. Double doors at Major Equipment Rooms.

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

3. Distribution of Mechanical Rooms

   a. Location and Quantity: Related to Site Conditions and Program

   - Basement – Preferred for heating equipment.
   - Penthouse – Noise consideration for spaces below Penthouses. Equipment Rooms in Penthouses must have elevator rooftop access.

4. Clearance Between Equipment – All final equipment designs must demonstrate that equipment clearances have been considered and function per the equipment layout.

   a. Code Minimums – Electrical Panels 3’-0” clearance. Mechanical equipment refer to manufacturer recommendations. Review all clearances during Schematic Phase.

   b. Working Clearances – Fans, 2’0” clearance to bearings/belts/motors. Refer to manufacturer clearance recommendations for:
   - Coil removal
   - Filter replacement
   - Tube bundle replacement for heat exchangers

   Minimum 2’ to 3’ clearance around pumps and compressors

5. Equipment Mounting – Discuss floor vs. ceiling mounted during Design Development.

Do not hang equipment from wood frame construction. Basement area and all equipment should be floor mounted to eliminate vibration above.

Mount air handling units high enough to allow for adequate condensate pitch to drain.

Check seismic requirements.

a. Unistrut Channel – Bolt to pads where possible.

Consolidate near, like systems.

b. Housekeeping Pads – 4” high, rounded edges, minimum 2500 psi. Doweled to existing slab. Include woven wire fabric for reinforcement.

Install concrete curbs around duct penetrations or multiple pipe penetrations.

Sleeves shall be 1” above slabs, for vertical pipe penetrations.

See Appendix 4.11-2 for pipe sleeve and firestopping requirements based on wall/floor materials.

6. Coordination Between Other Services

a. Electrical – Motor Control Centers shall be in Mechanical Rooms. Coordination for MCC/starters by Electrical Contractor. Electrical Contractor shall provide all starters. This coordination must be shown on electrical documents.

b. Telephone – (1) house phone per Building in Major Mechanical Room.

c. OIT – Must be kept away from high voltage (440 volts and over). OIT closets shall be dedicated for OIT equipment only.

7. Heating & Ventilating Requirements

   a. Exhaust/Ventilation. Review code requirements to meet minimum standards. Equipment heat loads and make-up air requirements must be considered.

8. Lighting Type and Convenience Receptacles

   a. All lighting shall utilize energy efficient fixtures. If selected, fluorescent lamps shall be T8 with a color temperature of 3500ºK. Lighting shall be switched at each door into room.

   b. At least one light shall be circuited to the emergency panel. Light shall be switched and handle shall be lighted in the "Off" position.

   c. One 20 Amp. convenience receptacle per 150 sq. ft. floor space or not more than 25 feet apart. One receptacle (red) on emergency circuit in Main Mechanical Rooms and Switchgear Rooms.

      50 Amp. 208 volt 3-phase dedicated receptacle circuit in Penthouse Equipment Rooms for welding purposes.

      Type of receptacle shall be NEMA approved.

9. Miscellaneous

   a. Floor Drains – In all Mechanical Rooms

   b. Install floor trenches in Basement Mechanical Rooms where needed for; condensate drains from air handlers and steam condensate drains.

   c. Provide hose bib in all Mechanical Rooms (key stop).

   d. Provide fire extinguisher in all Mechanical Rooms, preferably within a glass-fronted cabinet, recessed preferred.

   e. Provide Mechanical Room ventilation.

10. Requirements for As-Built Documentation

   a. On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

   b. The as-builts are to include the following as a minimum:
      - Scaled layouts based on coordination Drawings.
      - Sump pump details (mfg., serial number).
      - Exterior hose bib locations.
      - Waste, water and vent riser Diagrams.

- Storm water and roof drain riser Diagram.
- Schedule of plumbing components including backflow preventers (mfg., model number, size).
- All HVAC Drawings with final component (including motors) sizes and locations (unit mfg. an model #, serial #).
- HVAC components in each room labeled with source number (Valve Tagging Chart).
- HVAC piping riser Diagram.

END OF DOCUMENT

Standards for Painting - Grounds and Building Maintenance

Paint finishes, once a new building or a renovation project has been completed and occupied, may require frequent maintenance if a building is to be kept presentable. The frequency of maintenance depends on the type of facility, the quality of the finishes, and the nature of use - or abuse - the occupants subject the building to. Regardless of the frequency of maintenance required, the task of repainting a space or a building most often falls to the Maintenance Paint Shop, rather than to a contractor.

It is important for the Designer to know that Princeton's Paint Shop stocks a limited number of paint colors, has the capability of mixing a fairly wide range of colors, but should not be expected to provide an infinitely varied palate. The University employs a number of standard colors that are to be used for "common" spaces such as corridors, offices, classrooms, laboratories, dormitory rooms, and the like. The Designer is normally allowed greater latitude in selecting colors for "special" spaces such as lobbies, lecture halls, lounges, and similar spaces.

The Designer should attempt to incorporate breaks, reveals, or other architectural details to divide large expanses of painted surface, particularly in the vertical direction. This is especially true in high traffic areas, areas using high pigment paints, or locations that are especially subject to abuse. Consider locations of items such as trash / recycling containers relative to accent paint locations, as these areas are subject to frequent marring and require a higher degree of maintenance.

Regardless of the colors used in a project, the Designer is expected to produce a color schedule for approval by the University (through the Project Manager). This schedule is to be updated at the end of the project and converted into a record of color selections that is turned over the Maintenance Paint Shop foreman. Record should be provided on the as-built Room Finish Schedule, updated per project conditions, as well.

Unless otherwise requested in writing by the Facilities Grounds & Building Maintenance Paint Shop Supervisor, all excess paint shall be removed from the construction site.

1. Interior

   The Designer should be aware of New Jersey's requirements for minimizing the volatile off-gassing compounds (VOCs) in products such as paint finishes, and should specify products accordingly. The preferred manufacturers used for paint are; M. A. Bruder (MAB), Benjamin Moore or Sherwin-Williams.

   A. Preferred finishes: see the chart below titled "Interior Paint Finish Recommendations for New Buildings and Major Renovations."

   B. Refer to Appendix 2.4-3 Memo: Standard Dormitory Paint Colors dated 1/18/2000 for dormitory projects.

C. In areas of heavy traffic, such as hallways and corridors, consider the use of a wainscot finish (with or without appropriate trim), which would allow for an easily cleaned and maintained finish on the lower surface, and lower-luster finish on the upper, reflective area.

D. For wood flooring, finishes must meet New Jersey requirements for volatile organic compound compliance. Water-based finishes have proven suitable for private rooms, but oil-based finishes wear better, and should be specified for public spaces such as corridors. Meet or exceed manufacturer's recommended minimum number of coats. To achieve color match, consider staining prior to the application of water-based protective coatings.

E. Interior wood finishes require careful review of sanding and sealer procedures as they relate to staining and finish coating. Long-term UV protection is essential.

F. If interior walls are exceptionally high (such as atriums or loft areas), consider the installation of a "break" in the upper wall, such as a picture rail or second contrasting color, to allow for less maintenance painting over time.

2. Exterior

A. Proper preparation, cleaning, and priming of surfaces are essential to a durable exterior paint application. Proper techniques should be specified and stressed during construction.

B. Exterior wood: for exterior wood trim, doors, and windows painting is preferred over a clear finish with stain; high-gloss or semi-gloss preferred for longer life of finish and substrate. If a clear finish is specified, a gloss spar varnish should be used; satin or matte finishes exposed to the elements typically require refinishing within the year.

C. Exterior metal: again, proper preparation is critical, as is the primer. Insure that primer is compatible with the finish specified. Gloss finishes are preferred on metal as well as wood for longevity of finish.

3. Special Coatings

Long-lasting exterior finishes are encouraged, and special coatings may be specified as part of a planned low-maintenance building project. Among the special coatings that can be used are anodized finishes, tnemic paints, and epoxy paints. Shop-applied special finishes are preferred to site-applied, due to better control of conditions.

Exterior metals must be coated if not naturally weather-resistant such as copper and brass. Steel should be galvanized prior to receiving finishes, unless the specifications for a special coating will not permit galvanizing.

Regardless of finish used, manufacturers' instructions for on-site application and touch-up of finishes are to be followed. As part of the submittal process, those instructions are to be provided to the Project Manager, with a copy for the Maintenance Paint Shop foreman.

4. Requirements for As-Built Drawings

Prior to completion of construction and occupancy, the painting subcontractor is required to provide the university Paint Shop a detailed schedule of actual paints used in each space of the project, including manufacturer, color name or formula, sheen applied, etc.

Additionally, provide an electronic version of the final room paint schedule as part of the "As-Built" documentation for the project.

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

Interior Paint Finish Recommendations For New Buildings and Major Renovations

Building Type	Walls						Ceilings
	Plaster/ Veneer Plaster	Taped Sheetrock	Brick/ Masonry	C.M.U.	Painted Wood (1)	Stained Wood	
Dormitories (2)							
Halls	eggshell	N/A	stain or semi (3)	semigloss	semigloss	satin	flat
Public Spaces	eggshell/semi	N/A	stain or semi (3)	semigloss	semigloss	satin	flat
Student Rooms	eggshell	N/A	N/A	semigloss	semigloss	satin	flat/eggshell
Bathrooms (4)	semigloss	N/A	N/A	semigloss	semigloss	satin	semigloss (5)
Academic/Administrative							
Halls	eggshell	eggshell	stain or semi (3)	semigloss	semigls/satin	satin	flat
Public Spaces	eggshell	eggshell	stain or semi (3)	semigloss	semigls/satin	satin	flat
Classrooms	eggshell	eggshell	stain or semi (3)	semigloss	semigls/satin	satin	flat
Offices	flat	flat	stain or semi (3)	semigloss	semigls/satin	satin	flat
Bathrooms (4)	semigloss	semigloss	N/A	semigloss	semigls/satin	satin	semigloss (5)
Laboratories/Research Facilities							
Halls	eggshell/semi	eggshell/semi	stain or semi (3)	epoxy/semi	semigls/satin	satin	eggshell
Public Spaces	eggshell/semi	eggshell/semi	stain or semi (3)	epoxy/semi	semigls/satin	satin	eggshell/semi
Laboratories (6)	epoxy/semi	epoxy/semi	N/A	epoxy/semi	semigls/satin	satin	eggshell/semi
Lecture & Classrooms	eggshell	eggshell/flat	stain or semi (3)	epoxy/semi	semigls/satin	satin	eggshell/semi
Bathrooms (4)	epoxy/semi	epoxy/semi	N/A	epoxy/semi	semigls/satin	satin	semigloss (5)

(1) Consider oil base for painted wood to increase durability

(2) See memo dated 1/18/2000 from Committee for Standard Dormitory Paint Colors (to Jon D. Hlafter) regarding dormitory paint colors; see Appendix 2.4 – 3.

(3) Recommend leaving brick and masonry in natural finish, unless there is an aesthetic concern or, for existing masonry, there is an excessive amount of soil, stain, or mismatched patching.

(4) Use Zinzer mildew-resistant paint in bathrooms with showers

(5) Smooth ceiling finishes only are to be used in bathrooms

(6) Use Latex-based paint for areas with lab animals that might be affected by volatile paints

Standards for Masonry, Roofing and Waterproofing - Grounds and Building Maintenance

These standards apply to new and replacement roofs for academic, administrative, athletic, and residential buildings on Princeton's campus. For buildings off campus, the Designer should consult with the Project Manager or the Facilities department involved for requirements.

1. Contacts

A. Project Manager for department initiating project

B. Project Manager, Building Envelope; MacMillan Building, (609) 258-6607

C. Preservation Architect, Building Envelope; MacMillan Building, (609) 258-0499

D. Office of Environmental Health and Safety (for on-site safety); (609) 258-5294

2. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF	AutoCAD
A. Built Up Roofing, Construction Details	Appendix 4.10-1	Appendix 4.10-1
B. Detail of Ridge for Slate Roofs (3pp)	Appendix 4.10-2	Appendix 4.10-2
C. Rooftop Drainage Requirements and Details	Appendix 4.10-3	Appendix 4.10-3
D. Typical Flashing Details (wall/roof, curb/roof) (2pp)	Appendix 4.10-4	Appendix 4.10-4
E. Tremco Roofing Reference Guide, 3rd Edition	Appendix 4.10-5	
F. Roofing for the Design Professional, Tremco Roofing Division	Appendix 4.10-6	
G. Contractor Safety Advisory, by the Office of Environmental Health and Safety, Princeton University	Appendix 4.10-7	
H. Stone Parapet Cap with Mortar Joint	Appendix 4.10-8	Appendix 4.10-8
I. Through Wall Flashing at Parapet Details	Appendix 4.10-9	Appendix 4.10-9
J. Typical Ornamental Coping Detail	Appendix 4.10-10	Appendix 4.10-10
K. Sheet Metal Coping	Appendix 4.10-11	Appendix 4.10-11
L. Garden Wall Stone Cap with Mortar Joint	Appendix 4.10-12	Appendix 4.10-12

	PDF	AutoCAD
M. Below Grade Waterproofing – Concrete and CMU Foundations	Appendix 4.10-13	
N. Below Grade Waterproofing - Rubble Stone Foundations	Appendix 4.10-14	
O. Selected Sarnafil Details	Appendix 4.10-15	Appendix 4.10-15
P. Roof Penetration Details	Appendix 4.10-16	
Q. Below Grade Penetrations	Appendix 4.10-17	

3. Codes and Standards

A. New Jersey Uniform Construction Code and adopted subcodes unless superseded by other NJUCC references (see section 1.4 Regulatory Agencies): http://www.state.nj.us/dca/codes/. Note that the subcodes contain references to material and construction standards that must be met to comply with the NJUCC. These standards, promulgated by such groups as the American Concrete Institute, the American Institute of Steel Construction, the American National Standards Institute, ASTM International, et al. are included in the "Referenced Standards" chapter of the International Building Code.

B. Various standards by the U. S. Occupational Safety and Health Administration (refer to Appendix 4.10-7 for information)

C. NRCA Roofing and Waterproofing Manual

D. SMACNA Architectural Sheet Metal Manual (details for soldered lock-seam joints, e.g.)

4. Review Guidelines

Initial planning and preliminary design of a project may be conducted with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it becomes important that the project be submitted to the Engineering Department, the Grounds and Building Maintenance Department, the Office of Design and Construction, and the Department of Public Safety for review of compliance with University standards. Proposed roofing systems, in particular, are to be reviewed with the Preservation Architect/Building Envelope and the PM/Building Envelope in the schematic design phase when the roof shape and general type are determined.

Any proposed plazas, terraces, or balconies over occupied areas, all green roofs and roof gardens are to be reviewed as roofing projects by the University Grounds and Building Maintenance Department. Similarly, any below-grade building or a portion of a building constructed with a ceiling/roof structure waterproofed to prevent water infiltration is to be reviewed as a roofing project.

Roof plans are to be reviewed with the departmental Project Manager and the Project Manager for Building Envelope early in the project in order to locate areas of particular concern and agree upon an approach to best address them. Through-wall flashing for the project is also to be reviewed with the PM/Building Envelope.

The design approach for the exterior envelope is to be reviewed during schematic design with the departmental Project Manager and the Preservation Architect. Proposed techniques for waterproofing and flashing cavity backup wall and/or the drainage plane for rainscreen systems are to be presented by the designer for review and discussion.

5. Guidelines and Requirements for Documentation

Along with the specifications, the Designer is to produce sufficient documentation to allow for internal review, any required code review of the roofing project, and for contract bidding of the work. This documentation will include, at a minimum:

A. Roof plans showing roof layout and drainage, and any projections through the roof or equipment mounted on the roof; plans for any waterproofing work in the project;

B. Project-specific details of the roofing/waterproofing systems and any modifications required for the new work;

C. Details of flashing systems, details of each flashing type required for the project, and details of any roof penetrations or below-grade penetrations;

D. Details showing U.L. assemblies required to meet fire rating requirements for roofing system.

E. Roofing and flashing shop Drawings are to be submitted to the PM/Building Envelope in the normal course of submittals during a project. Shop Drawings for any roofing accessories, such as skylights and hatches, are also to be submitted to the PM/Building Envelope. Shop drawings for wall flashings and flashings for stone trim, windows, architectural features, etc. are to be submitted concurrent with submittals for masonry materials and other envelope materials.

   Designers are to respond to review comments of University personnel, either in revision of documents to comply with comments, or in writing if there is an overriding rationale in not complying with University standards.

Requirements for specific areas of documentation are as follows:

Documentation	SD	DD	50% CD	85% CD
Roof Plans – *General*	X	X	X	X
Roof Plans – *Location of drains*		X	X	X
Roof Plans – *Locations of equipment and projections*		X	X	X
Details – *Parapets and copings*			X	X
Details – *Through Wall Flashing*			X	X
Details – *Sheet metal or other*				X
Below Grade Waterproofing			X	X
Utility Penetrations				X
Outline Specifications		X		
Full-Length Specifications			X	X

6. Guidelines for Installation and Performance – Roofing

A. Installation

Of prime importance to the University is the quality of the initial roof installation and the provision of a long life warranty for any roofing system installed on campus. For flat roofs in particular, and for waterproofing systems used under plazas and for green roofs, it is imperative that the roofing manufacturer provide full-time supervision during the roofing work, and that a twenty-year system warranty be provided to the University upon completion. Standards for roofing include the following:

1. Flat Roofs (Conventional): the University Grounds and Building Maintenance overwhelmingly supports the use of petroleum-based built-up roofing systems on flat roofs. The use of single-membrane systems is discouraged, and must be explicitly approved by the PM/Roofing before being allowed for a project.
   A four-ply built-up system with a two-ply vapor barrier (where appropriate) is the University standard for a low-slope roof.

   a) Hot System: a hot-applied system but may not be suitable for use on existing or new buildings where fumes during installation might affect occupants or those nearby. If a hot-applied system is to be used, Therm-50 with hypalon flashing by Tremco meets Princeton University requirements for maintainability.

   b) Cold System: Burmastic-200 with hypalon flashing by Tremco meets Princeton University requirements for maintainability and is the preferred system for flat roofs.

   c) Surfacing: White aggregate surfacing meeting the manufacturer's specifications is to be applied as part of the roofing system. ½" arctic white granite chips from the George Schofield Co. provide the desired level of reflectivity. Exposed surfaces of hypalon flashings are to be covered with Double Duty Aluminum, a reflective coating.

2. Green Roofs: vegetation-covered roofs, whether employing loose growth medium or trays, are to be treated in a similar manner to plazas, balcomies, etc. Grounds and Building Maintenance recommends loose-laid single-ply PVC membrane, such as that produced by Sarnafil. See requirements for waterproofing systems and review proposed product with the Project Manager and the Roofing Shop. Refer to Appendix 4.10-15 for approves Sarnafil installation details.

3. Below-grade structures: See requireemtns for waterproofing systems and review proposed product with the Project Manager, Building Envelope. When applying a horizontal membrane over below-grade structure (particularly in cases where plantings or "soft" cover are planned as a top surface) a 4" concrete protection slab should be applied over drainage mat and filter fabric, which in turn is installed over the waterproofing layer. This will ensure protection of the treated areas from penetration by fencing, tent spikes or the like. The added depth of the slab should be taken into consideration when planning grades and planted areas.

4. Structure, Accessories, Miscellaneous:

   a) Roof decks: concrete is the preferred decking material, sloped to drain. If sloped concrete cannot be used, concrete with tapered insulation or another material meeting the construction classification required for the building may be considered. Consult with the Project Manager.

      If there is a mechanical penthouse in the project, the floor of the penthouse should be concrete; a steel roof or roof deck is acceptable over the penthouse.

   b) Insulation: Roof insulation is to be part of the roofing system and is to be covered by the roofing warranty. Point loading and uniform loading requirements must be considered in the choice of insulation material and method of installation. Insulation should be 2" thick minimum, R-19 minimum (or greater to meet code requirements for energy conservation). Insulation is to be installed in two layers with staggered joints; insulation is to be fastened to vapor barrier using 'fastenfree' adhesive, and successive layers of insulation are to be fastened with the same adhesive. Ioscyanurate insulation should be covered with ½" minimum DensDeck (or equal). On flat decks, insulation is to be tapered to roof drains; drains are to be installed in 4'-0" x 4'-0" sumps to provide positive flow to the drains

   c) Do not use pressure treated wood blocking, use Douglas fir, or where damp conditions are anticipated, wood blocking is to be cedar to prevent decay. Alternately, consult with roofing Tech Team representative for project specific options.

   d) Through-wall/counter flashing is to be receiver-type to allow for re-roofing. Flashings are to be locked and soldered at seams and corners. Flashings at roof penetrations, curbs, and transitions should extend up a minimum of 8" above the surface of the roof. Copper and Freedon Gray copper are the preferred material for flashings; 20 oz weight is standard. Coordination of through-wall flashing is very important. For through-wall flashing, details shall eliminate the need for sealants; sealants or caulking are *not* to be relied on for water-tightness.

At parapets all drains shall have an overflow scupper to divert water off the roof in times of drain blockage. Overflows shall be 2”, minimum, below lowest point of base or wall flashing.

e) Copings: Metal copings should be designed to allow for expansion without bending or flexing. Expansion joints should be installed within four feet of corners and at every third joint along walls (at twenty feet on center +/-). Use loose-locked-and-caulked joints or use splice joints for expansion. All other joints are to be locked and soldered. Copper and Freedom Gray copper are the preferred material for copings; 20 oz weight is the standard.

f) Installation of equipment on a flat roof is to be avoided if possible. Where equipment must be installed on a roof, NRCA design considerations are to be followed. Clearance requirements for ease of re-roofing are to be met; equipment supports are to be detailed so that re-roofing can be easily accomplished. Curbs are to be 8” minimum (12” preferred) and use of pitch pockets is to be avoided. To the extent possible, equipment and supports should be located a minimum of 6’-0” from drains. Prefabricated walks are to be provided with the roof for maintenance access to the equipment and to roof hatches or access points.

g) Warranty: The entire roofing system is to be covered by the manufacturer’s warranty including, without limit, the insulation and any recovery board, the roofing material, the flashings, any through-penetration systems or fabrications, equipment mounting curbs or saddles, etc.

h) Temporary Waterproofing: During construction, a two-ply vapor barrier applied directly to the concrete deck has been used successfully as a temporary roof. Such a surface can bear construction traffic. Any damage must be repaired and completed at the time the permanent roof is installed.

5. Pitched Roofs: The majority of on-campus buildings at Princeton University with pitched roofs are finished with slate. There are a number of buildings at the University that have metal roofs; the typical metal roof at Princeton is standing-seam copper or Freedom Gray copper, with all joints locked and soldered. Finally, there are a few roofs with synthetic roofing materials (terracotta or ceramic tile, e.g.); if a synthetic roof is used, an adequate supply of replacement tiles or shingles should be specified. If synthetic surface roof is proposed, or a metal different from copper, review selection and system requirements with the Project Manager, Building Envelope and the Preservation Architect in the schematic design phase of design.

   a) For new roofs, slate is to be a minimum 3/8” - 1/2” thickness and meet requirements for Vermont slate, S-1 architectural grade. The Designer should note, on repair projects in particular, the thickness of the existing slate to insure that the new material is compatible with the existing.

b) Copper for standing-seam roofs should be 20 oz. Hard drawn. Lead-coated copper has been used extensively in the past at the University, but is now considered problematic; Freedom Gray copper by Revere is an acceptable alternative.

c) Flashings are to be copper (for both slate and copper roofs), 20 oz. minimum for standing vertical flashings, valleys, through-wall flashings, and areas subject to excessive wear. Materials, including slates, shingles, felts, metals, fasteners, etc. are to comply with the requirements of the NRCA Roofing and Waterproofing Manual and the SMACNA Architectural Sheet Metal Manual, and be fabricated and installed in compliance with good practice and the details listed in Appendices 4.10-3 and 4.10-4.

d) Saturated asphalt felts or an approved synthetic underlay with a rosin slip sheet are the typical underlayment for most pitched roofs, with a rosin slip sheet used between felts and metal roofing material. Codes require eaves and other areas subject to the effects of ice dams to be protected with cemented underlayment or waterproofing membrane. A self-adhering, self-sealing membrane is the preferred ice shield.

6. Lightning Protection: The Designer should review with the Project Manager the need for lightning protection on the building. If a system exists, or if a new system is proposed, the Designer should investigate the method of installation, if any, suggested by the roofing manufacturer. The Designer should review the options for installation with the departmental Project Manager and the PM/Building Envelope, and prepare proper details and other installation information for the system. Provide details at and through roof assemblies.

B. Performance

The interest on the part of Princeton University in using the quality materials listed above is in producing a facility that will provide long years of service with a reasonable maintenance effort. The materials listed have in the past produced such results, but only with the proper care taken during the initial installation.

As noted above, roof warranties are to cover the installed system, not simply the roofing material. For membrane roofs, full-time jobsite inspection by the manufacturer’s trained representative is required.

7. Guidelines for Installation and Performance – Waterproofing

A. Plazas, balconies, etc.: for areas, over sub-grade structures, finished with pavers or other traffic surface, Grounds and Building Maintenance recommend a loose-laid single-ply PVC membrane, such as that produced by Sarnafil. Review proposed product with the PM/Roofing. Refer to Appendix 4.10-15 for approved Sarnafil installation details.

This is the preferred method of waterproofing horizontal areas below grade.

B. Below-grade structures: When applying a horizontal membrane over below-grade structure (particularly in cases where plantings or "soft" cover are planned as a top surface) a 4" concrete protection slab should be applied over drainage mat and filter fabric, which in turn is installed over the waterproofing layer. This will ensure protection of the treated areas from penetration by fencing, tent spikes or the like. The added depth of the slab should be taken into consideration when planning grades and planted areas.

C. Below-grade penetrations: for piping, conduit, and similar services, individual sleeves for each pipe are to be installed in new construction, and individual cores for each pipe in existing construction are to be used. Penetrations are to be spaced to allow a minimum of 6" clear area in all directions for proper application of waterproofing assembly; a four-inch conduit, for example, will require a frame approximately 16 inches in diameter. Clear space requirements for adjacent penetrations are allowed to overlap one another.

Space between core or sleeve and conduit or pipe is to be sealed with a mechanical link-type seal. Any deviation must meet with the approval of the Facilities Grounds & Building Maintenance Roofing Shop Project Manager. The exterior wall at the penetration is to be primed and coated with a bitumastic waterproofing membrane, such as Bituthane. The bitumastic is to be formed around the pipe or conduit, and outward 4"(+/-) to allow a stainless-steel clamp to be installed around the extended membrane. Termination bars are to be applied, picture-frame style, to finish the edges of the membrane. Review proposed product and details with the PM/Roofing.

Refer to code requirements as needed for utility penetration spacing where these pass through foundation walls. Where University requirements exceed code requirements, spacing is to meet the more stringent requirement.

D. Concrete or CMU and Rubble stone foundations:

1. Concrete or CMU foundations: when concrete or CMU foundations are part of the waterproofing design, insure proper curing, cleaning and preparation of the wall prior to the application of the bituthane waterproofing system and subsequent mirror drain fabric.

   Refer to Appendix 4.10-13 for requirements for below grade waterproofing of concrete or CMU foundation walls.

2. Rubble stone foundations: when existing rubble stone foundations are part of the waterproofing design, careful evaluation of new waterproofing requirements must be made. Include provisions for sandblasting, parging and mirror drain fabric in addition to approved University material specification of a membrane applied.

   Refer to Appendix 4.10-14 for requirements for below grade waterproofing of rubble stone foundation walls.

E. If masonry work is planned as part of a 'rainscreen' system (or if metal or glass panels are planned as part or a combined masonry/metal/glass rainscreen system, the designer is to review proposed system and proposed waterproofing techniques with PM/Building

Envelope. It is expected that redundant systems will be included as part of the design, so that the failure of the primary water-shedding system will not result in total system failure.

Particular care is to be taken in designing interfaces of masonry anchors and waterproofing membrane and in placement of through-wall flashings to bring any water that penetrates the system out to the exterior. A reliable weep system is to be designed for the wall, including mesh to prevent mortar build-up in the cavity and at the weeps. The designer is to specify water-testing of the weep systems during construction at approximately four foot vertical intervals.

In specifying masonry walls, the designer is to consider the permeability of the veneer or facing material used. If a relatively porous material is to be used to face the building (such as limestone, brownstone, and some types of brick), a nonporous material (such as granite) is to be used as a base course, extending approximately eight inches above finish grade.

8. Guidelines for Protection and Maintenance

A. Roofing specifications are to contain the following statement:
"The Construction Manager, roofing contractor, or any of the contractor's agents shall not move equipment or materials over, or in any way modify the existing roofing that will remain during or after the completion of roofing work unless the roofing is fully protected from damage. It is required that an infra-red roof scan be performed prior to commencement of work so that pre-construction conditions may be recorded, with a second scan performed at the completion of construction to verify the roof has been adequately protected. The Construction Manager will be responsible for repair or replacement of defective material, improper installation, or damage resulting from work preformed through the project prior to the University accepting the roof as completed".

Other forms of testing (other than infra-red) may be deemed acceptable pending consultation with the University's Project Manager of Roofing Trades.

B. All new roofs are to be designed for ready access to all areas during adverse weather conditions with a minimum use of portable ladders or other lift conveyances.

9. Design Guidelines for Safety in Roofing Maintenance

The Designer is to consider requirements for safety in the maintenance of the building in designing the roof for the building. Early consideration is to be given to providing parapet walls for flat-roofed areas so that OSHA recommendations for roof work can be met. Fall protection systems, where needed in the absence of parapet or other structural components, are to be installed in all new construction projects and in major renovation/alteration projects. An alternative may be a built-in system of permanent mounting points for safety railing; see Appendix 4.10-1. The Designer is encouraged to review proposed solutions with the Project Manager and the PM/Building Envelope, along with the Office of Environmental Health & Safety.

The Designer is to be aware that the University considers the installation of safety-line tie-offs insufficient for the promotion of roofing safety.

For slate roofs, a detail has been developed that provides for both venting at the ridge and for securing ridge slates to the assembly. See Appendix 4.10-2. Review with the Project Manager the need for diverters installed over building entries where roof slope is not directed away from entry.

10. Garden or Landscaping Walls – Exterior Masonry

Garden or landscaping walls should have thru-wall flashing under coping caps to prevent water penetration and prematurely destroying the wall. Review proposed flashing details with the Project Manager for Roofing and Masonry (see Appendix 4.10-12). Joints of coping are then pointed (not caulked). On stone walls specify thru-wall flashing near the top of wall under stones, using lead flashing to conform with irregular shapes. If over an occupied space (below) set thru-wall flashing at waterproofing level in addition to coping detail.

11. Non-conformance With Standards

Occasionally the use of new products is found to be in the best interest of Princeton University. Requests by the Designer to use new or non-standard products or techniques will be evaluated based on comparison of the following characteristics:

- Flexibility/Elongation Coefficients
- Durability
- Wear Characteristics under traffic
- Repairability
- Quality Control in manufacture and application
- Warranty - for labor and material covering completed roofing system as installed, including roofing materials, flashings, accessories, etc.

Use of a new product at a specific facility does not mean its use in other similar cases will be automatically approved. An unspecified testing period will be employed for new products.

A Designer who desires to use a non-standard or new product on a project should approach the Project Manager with the proposal. The Project Manager, after review will consult the PM/Roofing on the proposal. In support of his proposal, the Designer should prepare his argument, listing the above characteristics, as applicable, and present a clear and concise rationale for using the non-standard product.

12. Requirements for As-Built Drawings

The Designer is responsible for checking the accuracy of as-built Drawings prepared by the roofing contractor.

The Designer is responsible, at regular intervals during the construction process, for scheduling and attending meetings with the contractor and University personnel to review progress on the system and to ascertain that the contractor is keeping accurate records of system installation. Designer will verify during these regular meetings that the contractor is maintaining record Drawings to convert to as-builts.

On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include, as a minimum, roof plans with:

- Location of roof drains and expansion joints
- Flashing details
- Location of roof hatches (including mfg., model and serial number)
- Roofing System sections (including mfg., product number)

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

Standards for Toilet Rooms -
Building Services
Grounds and Building Maintenance

Toilet rooms will typically be designed as part of the core building space in new construction. Location of bathrooms in alteration or renewal projects may be limited by building configuration or utility location, but should nevertheless be located for easy access in a logical location in the building.

1. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Future	Appendix 4.11-01
B. Pipe Sleeve and Fire Stopping Requirements	Appendix 4.11-02
C. Terrazzo Shower Base Detail	Appendix 4.13-3

2. Toilet Rooms

Note that the University preference is to establish permanent room numbers for a building that are used on the construction documents. The Designer should review the proposed numbering scheme for the building with the Project Manager to be sure that the scheme is consistent with other campus buildings. Bathrooms should be included in the numbering scheme, to allow for easy reference in later maintenance work. Room numbers may include suffixes of 'F' and 'M' or 'Women' and 'Men.' Dormitory bathrooms are gender-neutral in design, and may be designated for males one year and females the next, so physical room numbers for dormitory bathrooms should be only semi-permanent.

The minimum number of plumbing fixtures required for a project can be determined by the New Jersey Uniform Construction Code and the National Standard Plumbing Code. The code-mandated minimum count is just that - the minimum. The Designer, working with the Project Manager and the end user, is to determine the number of fixtures that should reasonably be included in the project.

The Designer should consider acoustic isolation techniques in the choice of walls surrounding bathrooms, and in piping materials and enclosures. This is particularly important in dormitories, where high bathroom usage can be a nuisance factor for adjacent rooms.

Ideally, there will be women's and men's facilities on each floor of a building. Moreover, these facilities will be accessible and barrier-free. In some instances, a building may be too small to have facilities for each sex on each floor. A review of the proposed use of each space, and the disposition of staff, should then be done in order to place facilities in the most useful locations.

In some cases, single-fixture unisex toilet rooms may be adequate and appropriate for a project. Single-fixture toilet rooms should be designed to be barrier-free.

A janitor's closet should be located in the vicinity of toilet rooms. See Section 4.3 (Custodial Closets and Storage) for additional information.

The Designer should review the requirements of the plumbing code for other fixtures such as drinking fountains. See Section 1.4 (Regulatory Agencies) for information regarding codes.

Princeton University has developed a specification for plumbing and mechanical work on campus; see Appendix 4.11-1.

Bathroom Design Considerations

The following list includes items that the Designer should take into consideration when planning a project that includes toilet rooms:

1. Construction and Fire Rating

   Review need for fire-rated enclosure and door assembly, including door closer.

   See Appendix 4.11-2 for pipe sleeve and firestopping requirements based on wall/floor materials.

   In fire-rated walls of bathrooms, review placement of any recessed fixtures or accessories for compliance with required assembly rating.

2. Fixture Requirements

   This section deals primarily with multiple-fixture bathrooms.

   At a minimum, requirements of the NJUCC and National Standard Plumbing Code must be met for number of fixtures (including drinking fountains). It is prudent to maximize the fixture count of bathrooms in academic spaces, particularly if large lecture facilities are provided that might be used by the general public for special events. The same is true of any buildings that include performance spaces. The code-required minimum fixture number is often unrealistically low for number of toilets and lavatories in particular, and the Designer should review the user's preferences during the programming phase.

   For dormitory bathrooms, Princeton University Housing Office has developed the following ratios as a desirable goal: students per shower – 5.5/1; students per toilet – 5.5/1; students per lavatory - 4.5/1. Bathtubs are generally not installed in dorms at Princeton.

   At least one floor drain should be installed in each bathroom, more if layout dictates. Floor drains should be installed in each barrier-free shower.

In bathrooms that are not adjacent to a janitor's closet with a service sink, hot and cold hose bibbs should be installed for custodial use. The hose bibbs should have key stops rather than handles. The preferred location is under a lavatory, approximately 18" above the finish floor.

3. Preferred Fixture Types and Fittings

   See Design Standard Manual Section 3.11 Plumbing. This section contains information beyond that presented here regarding fittings and fixtures for use in University projects.

   a) Toilets - floor mounted preferred, with flush valve (rather than tank). If headroom in room below is problematic or there are other overriding concerns, wall-mounted toilets may be considered. Review with the Project Manager in preliminary design stage.

   b) Urinals - wall mounted, American Standard Linbrook or Washbrook, with Sloan 186-1 flush valve. NJUCC requires low-flow urinals. (Urinals are not typically installed in dormitories, due to the need for flexibility in gender distribution in the buildings [on a yearly basis, a dormitory men's room may become a women's room, and vice versa]).

   c) Lavatories - preferred generally over vanities for institutional-type use; American Standard New Lucerne, Heritage faucet sets, no pop-up drains (strainer only). NJUCC requires low-flow fittings. Provide shelf above each lavatory mounted high enough to permit accessibility to service the faucet.

   d) Showers - a precast terrazzo shower base is preferred, with masonry or frame walls with ceramic tile finish for the surround. One option is to provide a back wall or demising wall to contain valves and piping, with partitions forming the other wall or walls.

      If frame walls are utilized, the substrate should be plaster on metal lath, or cementitious underlay such as USG's Durock or National Gypsum's PermaBase. Consider requirements for rated assemblies if the shower wall is part of a corridor wall.

      Provide shower stalls with curtains or doors, and a drying area which is, at a minimum, screened. Princeton traditionally used marble for partitions, but most recently has used the solid color reinforced composite (SCRC). Metal partitions have been found to be too susceptible to damage and corrosion and are generally not used. Specify soap dishes for shower stalls (preferably ceramic recessed).

      Princeton University Building Services will provide custom-cut shower curtains; Designer should specify length to adequately cover terrazzo curb. Any other special requirements should be brought to the attention of Building Services. Full-length heavy-duty tubular shower rods (typically stainless steel) should be specified for shower stalls. Rods should be securely mounted in retaining cups fastened to shower substrate. Make note of any blocking required for this purpose in frame construction.

The Designer is to be conscious of waterproofing requirements for these bases at all wall, floor and drain locations, especially where occupied spaces may be below the showers. Install underlayments incorporating integral waterproofing membrane and pre-formed inside/outside corners meeting ANSI 118.1. System to match Schluter's "Kerdi/Ditra" or equal. Use only University approved integrated drains and tailpieces per Section 3.11.

e) Wall stops - Wolverine 53336 with integral handle.

f) Valves – See Design Standard Manual Section 3.11 Plumbing,

g) Hose Bibbs – with keyed handles.

h) Floor Drains - See Design Standard Manual Section 3.11 Plumbing,

i) Cleanouts - See Design Standard Manual Section 3.11 Plumbing,

j) Drinking Fountains - See Design Standard Manual Section 3.11 Plumbing,

k) Insta-Hots - See Design Standard Manual Section 3.11 Plumbing, Consider mounting height for maximum container or cup size.

4. ADA and Adaptability Requirements

The Designer must become familiar with the barrier-free requirements in the NJUCC and the sub-code ICC/ANSI A117.1. Some latitude in the provision of and location of barrier-free baths is allowed. The University's goal is to have accessible bathrooms in areas served by accessible entries and along accessible routes, but it may not be practical to make every bathroom barrier-free. The project design review committee will review the proposed location and layout of accessible baths on a case-by-case basis, for continuity with the University's master plan for accessibility.

5. Security

Bathroom entry doors may be equipped with combination-lock hardware to provide a measure of security within buildings. See section 4.4 Door Hardware. This requirement is to be reviewed with University prior to documentation.

6. Finishes

Provide washable finishes; floors are typically ceramic tile or stone, as are walls to at least the height of mirrors. Specify 10% attic stock for each type of tile to be delivered to University shops. This is to include field tile(s), coves, accent and each type of bullnose. Ceramic soap dishes should also be included.

Materials must be water-resistant; at a minimum, use water-resistant gypsum board for walls and ceilings. A smooth plaster finish is preferred. Plan carefully for access doors that are often needed in bathroom walls or ceilings; minimum 12" square doors are standard. Coordinate access panel locking requirements with section 4.4 Door Hardware.

7. Lighting and Power

   Provide area lighting for the room, and (generally) a light at each fixture or compartment. Motion detectors may be used for control of selected light fixtures, with at least one unswitched fixture per room on an emergency circuit. Ideally the emergency fixture is to be located above the sink.

   Provide ground-fault-interrupted receptacles at lavatories, one centered between every two lavatories, or at individual fixtures.

   Provide back-box and power for future electric hand dryers in the vicinity of the lavatories, where towel dispensers are to be located.

8. Partitions

   Provide toilet partitions with doors, shower stalls with curtains or doors, and a shower drying area which is, at a minimum, screened. As noted above, marble was often used for partitions, but most recently solid color reinforced composite (SCRC) dividers have been installed, with some stainless steel products.

9. Accessories

   a) Vendors for Building Services provide many of the accessories used in Princeton's toilet rooms, including soap and paper towel dispensers and large-roll toilet tissue dispensers. Building Services provides shower curtains for the dormitory bathrooms. Consult Project Manager and Building Services for current information.

   b) The following need to be specified by the Designer: trash disposal units (recessed units in academic buildings, large volume baskets in dormitories); feminine napkin disposal units; mirrors (typically standard units, individually framed for ease of replacement, often with attached stainless steel shelves); full-length mirrors can be considered in most uses; surface mounted soap dishes for shower stalls; heavy-duty one-piece tubular shower rods; heavy-duty robe and towel hooks (in dormitories; discuss material and style with Project Manager) Shelves for purses or pocketbooks are often requested in toilet stalls and at lavatories in academic/administrative uses, and should be considered by the Designer.

   c) Hot and cold hose bibbs may be required, as noted above.

   d) The University may install electric hand dryers in multiple-fixture bathrooms in lieu of paper towel dispensers. Paper towel dispensers may be temporarily installed over dryer outlets, until the decision on hand dryers is finalized.

10. Heating and Ventilation

Exhaust ventilation with make-up air is generally needed; review code requirements for providing fresh air, for tempering make-up air, and for providing heat to the bathrooms. In-floor radiant heat has seen limited but successful use in bathrooms, but must be carefully coordinated with fixtures and any subsequent mounting hardware for partitions, etc.

11. Fire Suppression and Fire Alarm/Detectors

Review code requirements for fire suppression and heat detection for the project and in the proposed bathrooms.

12. Requirements for As-Built Documentation

On the as-builts, the contractor is to highlight changes made to submittals and approved documents.

The as-builts are to include the following as a minimum:

- Waste, water and vent riser Diagrams
- Storm water and roof drain riser Diagram
- Schedule of plumbing components including backflow preventers (mfg., model number, size)

See Section 1.5 (Documentation and Archiving).

END OF DOCUMENT

Standards for Waste Removal & Loading Docks - Building Services

Waste removal must be considered in the site planning phase of building design, and consideration must be given to the way materials and equipment are received at a building.

Requirements for loading berths are included in the land use ordinances of both Princeton municipalities, and must be indicated on site plans presented to the local zoning and planning boards. Typically, local officials will expect to review plans for all services during site plan approval; vehicular movement on the site will be reviewed, as will enclosures or screen plantings for dumpsters and recycling containers.

Princeton University is currently reviewing options for controlling traffic in the historic section of campus. Of concern is the size of waste-hauling vehicles and the frequency of pick-up required for recycling and garbage removal. The use of smaller vehicles for trash pickup is planned, and there is consideration of regional compactors to control volume. The Designer should consult with the Project Manager to ascertain the current status of this issue.

1. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

	PDF
A. Standard Recycling Receptacle	Appendix 4.12-1

2. Guidelines for Installation and Performance

A. Waste Removal Services within Building

Trash storage within buildings is minimized.

Access to dumpster areas from within building is important.

Housing and Building Services are trying to end the practice, in dormitories, of the permanent placement of trash containers (from each dorm room) in hallways. Trash chutes have proven to be an effective tool in trash removal and are the recommended method of handling trash removal and recycling. Chutes are to be the type that allows access for cleaning. Other possibilities include the placement on each floor of a trash/recycling ‘center’ that students will be required to use for their trash disposal. Another possibility would be the creation of a trash room(s) in the building, with the requirement that students take their trash there. Such a facility would need to be emptied daily, at a minimum.

The Designer should be prepared to review the possible solutions to trash handling and removal.

The University utilizes a stand recycling bin. “Peter Pepper Products, Inc.” model Nos. 1034 through 1039. (See Appendix 4.12-1).

B. Dumpsters

There is a movement afoot to reduce the number of dumpsters visible on campus, and to reduce the size and visibility of dumpster enclosures. At the same time, as noted above there is a desire to reduce traffic and the size of vehicles that have access to the historic area of campus.

Trucks currently used by Building Services for servicing dumpster areas have a turning radius of forty-five feet; paths to dumpster enclosures should be planned to accommodate these trucks, unless smaller vehicles are to be used.

C. Dumpster Enclosures

As stated, there is a desire to make dumpster enclosures smaller, and to make them less visible. Enclosure to consist of shadowbox type fencing and a pad min of 210 SF (21'x10').

D. Area Trash Compactors

Compactors have been considered as possible means to reducing the number of dumpsters required, and thus the number of vehicle trips required to remove trash and recycling. Compactors would need to be limited to the perimeter of campus, due to the fact that the containers are significantly heavier than a standard non-compacted dumpster, and a full-size removal vehicle is needed. Vehicular access would need to be straight on to the compactor, because the containers are too heavy to be rolled into place for pickup. If a compactor is to be included in a project, the Designer should consider placing it near the loading dock to minimize access needs for the building (although volume of use at the dock might preclude this). Where space permits, install Marathon VIPRL3 self-container compactor. The footprint of the actual unit is 10'w x 5'd x 7.7' h. Additional discussions needed with Building Services Technical Representative prior to purchase and installation. This scenario is best used in complexes wither they could serve to tidy a dock area in creating a smaller footprint in a larger facility/complex with larger trash demands.

Compactors would need to be placed away from dormitories, due to the increased time needed for pickup and stowing over that required for emptying standard dumpsters (10 to 15 minutes versus 5). Student complaints are generated by the current method of emptying dumpsters; it is anticipated that complaints will increase with the increased pickup time. The compactor container would have to be reinstalled in the compactor, with the attendant noise, after being taken to a landfill for disposal.

2. Loading Areas

In academic uses, if there is a custodian dedicated to the new or renovated building, the optimal custodial office location should be determined during the early stages of design. In dormitories, the same is true, but an overriding concern is that the custodian be available and accessible to the students in the building.
The building custodial supply room location should also be given careful consideration based on the needs for access.

A. At-grade Facilities/Loading Berths

1. Area requirements - minimum determined by local zoning ordinances; see Section 1.4 (Regulatory Agencies) for information regarding municipal regulations.

2. Elevator dock/leveler - typical for dining facilities and for science buildings.

3. Access to/from building - with limitations on big trucks in much of main campus, Building Services is turning to small scooters, with 4' by 8' beds (at a minimum). The Designer should discuss the need for any larger vehicular access with the Project Manager, the project design committee, and the Landscape Policy Committee.

B. Loading Docks

1. Area requirements - minimum area requirements at dock may still apply; review local zoning regulations.

2. Height above grade - varies according to truck or trailer type to be used; review needs with Project Manager and client user.

3. Width/Depth/Overhead clearance requirements: consider number of deliveries per hour to determine need for more than a one-position dock. Review unloading techniques and any pallet-moving equipment to be used; insure adequate depth for maneuvering loading equipment and personnel, as well as size of anticipated crates, boxes, etc. for delivery.

   Doors from the dock to the building should be as high as the trailers to be received, if possible. Double doors should be used, to provide at least a six-foot wide opening.

   If overhead clearance is to be less than fourteen feet, review with Project Manager and client user for any precautions to be taken.

4. Automatic dock leveler – locate with proper clearance from any building projection to prevent vehicle damage to building; provide "docking clamp" to secure trailer to dock during loading operations.

5. Access to/from building – full-fledged loading docks require proper approaches and turn-around areas. Turning radius of large vehicles must be accommodated; review requirements with Project Manager and client user.

   In planning the location of a loading dock, the truck approach should be considered carefully. Preference should be given to providing a pull-up space to driver's side to reduce blind spots during the backing-up process. Pull-up space needs to be approximately sixty feet long, if a tractor-trailer combination is to service the building.

   Any railings need to carefully placed so they are not in the back-up path.

   Likewise for bollards and guards. Bollards and railings should be painted a light color so they are visible in low light conditions, or they should have reflective bands on them.

   The loading dock should incorporate a stair to grade (if there is not one provided convenient to the dock within the building). The stair must be placed to avoid conflict with parked vehicles.

6. Material - sealed concrete with a non-slip finish is recommended for the dock surface. The leading edge should have a steel nosing.

   Bumpers should be provided to protect the leading edge of the dock, and the building, if necessary. Lighter colors are preferred, for visibility at night.

7. Lighting: provide adequate lighting at and around the loading dock for safe operation. See Section 3.5 (Lighting Design) for information. Exterior lighting such as that for loading docks will generally be reviewed by the Landscape Policy Committee.

8. Drainage: provide for storm water drainage from the loading area; this is particularly important for areas that are at depressed grade. The drains need to be able to bear the accumulation of dirt and debris that are often generated during the loading process. Trench drains might be considered for greater drain area. Any drain type must be easily cleaned, and cleanouts for the storm drainage piping should be place in the immediate area. Provision should also be made to provide a screening device within the trench drain to limit pipe blockages. For more information, contact the Facilities Grounds and Building Maintenance Roof Shop Project Manage.

9. Coordinate requirements for water and electrical service to the loading dock.

10. Consideration of exterior temperatures shall be given when designing sprinkler systems in loading docks within partially covered areas

C. Off-loading/Storage Area

If a loading area serves more than one building, or if the building storage room is not adjacent to the dock, an off-loading and temporary storage area may be needed. The area should be carefully designed so that it does not turn into a catch-all.

3. Vehicular Access

A. Access by large vehicles to the Historic Campus is to be limited. See Appendix 2.5-2 Campus Delivery Map for access routes for deliveries. Daily delivery and pickup needs for main campus should utilize the perimeter road systems as much as possible.

B. Traveling on or crossing pedestrian paths should be minimized, particularly during backing-up operations.

END OF DOCUMENT

1. Introduction

While the Design Standards Manual covers basic principles of several different project elements and building blocks, considerations for a host of other issues related to the construction and maintainability of facilities continues to develop. The Grounds and Building Maintenance Department's missions concerns the upkeep, maintenance, and continued performance of the buildings on campus. As a result, there is considerable interest in the use of abuse-resistant and sustainable materials as well as methods of assembly which allow for long-term maintenance and corrective procedures.

This section addresses preferred construction practices, material selections and methods of assembly which have repeatedly arisen in carpentry Tech Reviews and reflect the experience gained in maintaining and servicing scores of campus facilities. These items are not intended to be limiting or prescriptive, but rather to eliminate some of the guesswork for the Designer by giving better insight into what the University has found to be successful for its use and demands.

2. Contacts

A. The Project Manager (in Office of Design and Construction, Office of the University Architect, the Engineering Department, Grounds and Building Maintenance, or as applicable).

B. Program Manager – Design Standards 200 Elm Drive, 609-258-1330

C. Architectural Engineer 200 Elm Drive, 609-258-6247

D. Building Trades Coordinator, Architectural Trades MacMillan Building, 609-258-9791

3. Index of References

http://www.princeton.edu/facilities/info/dept/design_construction/

PDF

A. SSMA - Steel Stud Manufacturers Association
http://www.ssma.com/documents/ssmatechcatalog.pdf

B. Recommended Levels of Gypsum Board Finish Appendix 4.13-2

C. Gypsum Association Fire Resistance Design Manual, 19th Edition (or latest) GA-600-2009

D. Terrazzo Shower Base Detail Appendix 4.13-3

E. Tile Council of North America Installation Handbook, 2009 Edition (or latest) http://tileusa.com/publication_main.htm

4. Code References

A. New Jersey Uniform Construction Code (NJUCC) with International Building Code; See 1.4 Regulatory Agencies for additional information

B. NJUCC subchapter 3 for listing of applicable subcodes and subcode sections

C. NJUCC subchapter 6 for requirements in rehabilitated structures

D. NJUCC subchapter 7 for barrier-free requirements

5. Review Guidelines - General

Initial planning and preliminary design will be conducted thru the Office of Design & Construction with the University department responsible for project initiation. As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to the University for an internal "Tech Team" review process thru the Office of Design and Construction for compliance with University standards. Plans are to be submitted for review at:

A. Completion of Schematic Design, if required;

B. Completion of Design Development;

C. 50% completion of construction documents;

D. 85% completion of construction documents;

E. 100% completion of construction documents, if required, at the discretion of the Tech Team

With the assistance of the Project Manager and Facilities Tech Teams, discipline review meetings will be held with respective University shops, University Project Engineers, and other Tech Team representatives as required. The A/E is responsible for documenting minutes of all these meetings. There, review comments or recent revisions will be discussed and documented. The Designers shall provide timely and coordinated responses to all review comments. The purpose of the Tech Team review process is to confirm A/E compliance with the current version of the Facilities Design Standards Manual including each respective section and associated appendices.

Additional requirements for specific areas of documentation are as follows:

Required Documentation	**SD**	**DD**	**50% CD**	**85% CD**
Floor Plans	**X**	**X**	**X**	**X**
Millwork (on plans)		**X**	**X**	**X**
Millwork (details)			**X**	**X**
Partition Types			**X**	**X**
Window Types		**X**	**X**	**X**
Required Documentation	**SD**	**DD**	**50% CD**	**85% CD**
Window Details			**X**	**X**
Screen Details			**X**	**X**
Blocking and Framing Details			**X**	**X**
Wall / Floor Assemblies and Details				**X**
Finish Schedules			**X**	**X**
Color Selections				**X**
Outline Specifications		**X**		
Full-Length Specifications			**X**	**X**

6. Considerations for Design

A. Cold-Formed Metal Framing Assemblies

- 16” centers required
- Cold-formed metal , 20 gage typical
- Refer to SSMA limiting height tables (http://www.ssma.com/documents/ssmatechcatalog.pdf) and provide intermediate bracing as required
- Design assembly to NJUCC

B. Rough Carpentry Requirements

- Fire-resistant wood grounds, furring, blocking, nailers, etc required within rated interior steel stud framed partitions to facilitate fastening of interior wood window and door frames
- Supply specified fastening methods for Tech Team review

C. Millwork Fabrication Requirements

- Specify compliance with AWS (Architectural Woodwork Standard) “Premium Grade” standards
- Specify “Premium Grade” per HPVA material fabrication standards per ANSI/HPVA HP-1-2004

- Edge banding to be hardwood, minimum of 3mm thick thermo-set solid hardwood

- Plywood construction for cabinet carcasses and shelving, typical (no particleboard); veneer core plywood is acceptable complying with American plywood Association PS-1 Standards

- Substrates allowed as follows:

Countertop Material	**Allowable Substrate Materials**			
	MDF	**MR MDF**	**Plywood**	**Combination**
Plastic Laminate	**X**	**X**		**X**
Wood Veneer				**X**
Stainless Steel	**X**	**X**		**X**
Solid Surface	**No Substrate Required**			
Millwork Finish Material (panel products)	**Allowable Substrate Materials**			
	MDF	**MR MDF**	**Plywood**	**Combination**
Plastic Laminate / Melamine	**X**	**X**		**X**
Hardwood Veneer	**X**	**X**	**X**	**X**
Metal Panel	**X**	**X**		**X**
SCRC	**No Substrate Required**			
Millwork Finish Material (casework)	**Allowable Substrate Materials**			
	MDF	**MR MDF**	**Plywood**	**Combination**
Plastic Laminate			**X**	**X**
Plastic Laminate / Melamine				**X**
Hardwood Veneer			**X**	**X**
SCRC	**No Substrate Required**			

Notes for the tables above:

1. “Combination substrate material” refers to an MDF cross-banded softwood veneer cored panel
2. MR refers to Moisture resistant. Use as needed in wet areas.
3. Fire-resistant substrates may be used based on code requirements

D. Millwork Installation Requirements

- Specify compliance with AWI “Premium Grade” standards

- Blocking details and locations are to be indicated clearly on plans / elevations. At millwork installations, standard wood blocking or a manufactured steel stud backing system (i.e.: Dietrich “Danback” or equal) is acceptable.

- Countertops are to be scribed to fit to ensure no gaps remain. Countertops are to be caulked prior to the installation of back/ side splashes. Caulk required at top of back/ side splashes as well.

- Blocking Methods of Application:
  - Light Duty – 20 Gauge Steel Flat Stock per SSMA
  - Medium Duty – 20 Gauge Steel Stud / Track per SSMA
  - Heavy Duty – Wood Blocking
  - Extreme Duty (ie: grab bars / shower seating) – Solid Wood Blocking
- Blocking, anchoring and fastening methods are to be as tested in accordance with applicable ASTM weight rating standards, per applied loads
- All millwork applied to existing construction shall be anchored with methods appropriate for the wall construction as well as the anticipated maximum load requirement of the fixture.
- Toe kicks are to be a minimum of 4" high
- Supply specified fastening methods for Tech Team review

E. Wall Mounted Shelving Installation Requirements

- Specify compliance with AWI "Premium Grade" standards
- Blocking details and locations are to be indicated clearly on plans / elevations. At millwork installations, standard wood blocking or a manufactured steel stud backing system (i.e.: Dietrich "Danback" or equal) is acceptable. 20 gauge steel flat stock is only acceptable for light duty applications (i.e.: toilet accessories, not in support of applied loads)
- Blocking Methods of Application:
  - Light Duty – 20 Gauge Steel Flat Stock per SSMA
  - Medium Duty – 20 Gauge Steel Stud / Track per SSMA
  - Heavy Duty – Wood Blocking
  - Extreme Duty (ie: grab bars / shower seating) – Solid Wood Blocking
- Blocking, anchoring and fastening methods are to be as tested in accordance with applicable ASTM weight rating standards, per applied loads
- All shelving/fixtures and or wall standards applied to existing construction shall be anchored with methods appropriate for the wall construction as well as the anticipated maximum load requirement of the fixture.
- Supply specified fastening methods for Tech Team review

F. Gypsum Wallboard Applications

- Refer to ANSI A 137.1 for standard practices pertaining to onsite storage and handling
- Specify compliance with ASTM C-1396/C-1396M standards of applicable panel type per location criteria
- Specify compliance with ASTM C-1047 for wallboard system accessories standards and specify structural drywall interior trims with co-polymer cores and paper faces. Plastic trims are to be glued, not stapled.
- Refer to Appendix 4.13-2 for requirements for levels of gypsum wallboard finish
- Specify Level 5 decorative wall finishes in dormitory rooms and critical lighting areas including hallways, stairs and common areas where a uniform finish is required
- No lightweight joint compound for finish coats. Avoid level 3 finishes except in mechanical and electrical closets.

G. Ceramic Tile Applications and Shower Installations

- Installation to follow TCNA Tile Installation Handbook (current edition) standards of application
- Where possible, specify pre-formed corners and trim units. Where pre-formed pieces are not available, specify a silicone caulk at inside corners (not grout).
- Grout is typically sanded at floor applications (anything with >1/8" joint) and unsanded at wall applications. Grout should be sealed per manufacturer's recommendations at showers and floors
- Where tile applications meet with a dissimilar material (i.e. doorways), provide a raised saddle (1/4" above floor elevation)
- Substrates are to be mold / moisture / mildew resistant, refer to GA-238-03, guidelines for prevention of mold growth in gypsum board
- Specify adhesive to set tiles $\leq$ 8" x 8" in floor applications and $\leq$ 4" x 4" (nominal) in wall applications
- Consider use of floor drains where possible / feasible
- At all floor penetrations in wet areas use integral water barrier sleeve device such as "Hilti water barrier module", or equal
- Refer to Appendix 4.13-3 for terrazzo shower base details for positive drainage

H. Wood Window Requirements

- Specify compliance with AWI and WDMA "Premium Grade" quality standards for the fabrication, reproduction, repair and installation of wood windows.
- For wood repair, specify structural adhesive putty (no Bondo)

I. Attic Stock

- Specify attic stock requirements for ceramic, ceiling, and carpet tiles based on availability due to color and size. Note that extra tile should be provided for all but the most standard ceramic tiles as dye lots vary and will present difficulties with matching in the future.
- Specify that attic stock be separated out and stored off-site upon arrival at the project. The University's Grounds and Building Maintenance group may be able to assist in the short-term storage of attic stock if needed.

J. Firestopping

- Meet UL 1479 and ASTM 814 fire test standards based on the floor and wall assemblies planned. .
- At fire-rated slab penetrations, there is a preference for the use of integral fire stop sleeve devices such as "Hilti cast-in" (or equal). Refer to Appendix 4.11-2.

END OF DOCUMENT