The University of Iowa Design Standards & Procedures is for use by architects, engineers, interior designers (hereafter referred to as Design Professional) and Commissioning Professionals to ensure the successful delivery of University of Iowa capital projects.

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INTRODUCTION

The University of Iowa Design Standards & Procedures is for use by architects, engineers and interior designers (hereafter referred to as Design Professional) to ensure the successful delivery of University of Iowa capital projects. The document represents the collaboration of many with a rich institutional understanding of building function, building systems, operations, landscaping, and construction. It is important that each project effectively balance the needs of the user, the institution, and the stakeholders at the University of Iowa.

Decisions made during the design period create consequences that have a profound impact on the conduct of University business, future operating budgets, and the quality of the campus environment. Because of this, the University of Iowa has developed a comprehensive facilities strategy for long-term stewardship. This approach looks at how the facility will function for the users and occupants, how the operations staff will effectively care for the facility, what resources the facility will consume over its life cycle, and how and when building systems and components will be renewed.

The focus on the total-cost-of-ownership takes on many forms at the University of Iowa and is reflected in our ambitious energy conservation plan, commissioning program, building renewal planning, and campus master planning. The Design Standards & Procedures reflect choices focused on managing cumulative operational costs, such as routine maintenance, minor repairs, preventive maintenance, custodial services, snow removal, grounds keeping, waste management, and utilities. The document is expected to be updated, and Design Professionals are encouraged to present recommendations related to new products, equipment and alternative designs that may assist in achieving the University’s stewardship and accountability objectives.

Designing for facilities stewardship starts with an understanding of the institution’s qualitative and quantitative priorities. The Design Standards & Procedures exists to assist the Design Professional by setting the minimum institutional requirements for the decision-making involved in projects at the University of Iowa. Additionally, the institution looks for a highly collaborative planning and design process that successfully manages the combination of standards and procedures with the engagement of users, service providers and stakeholders in the pursuit of a successful project for the University of Iowa.

The University values its partnerships with Design Professionals and looks forward to continued success in building The University of Iowa.

The University of Iowa Design Standards & Procedures manual has the following sections:

Section I: Orientation, describes the general business relations between the Design Professional and University.
Section II:  Design Documentation and Deliverables, lists University codes, standards, and design review requirements to assist Design Professionals in planning and estimating work effort.

Section III:  Presents General Design Standards to be used in the design of University facilities.

Section IV:  Presents Outline Specifications and Details to be incorporated in specifications and construction documents.

Appendices follow Section IV with additional information supporting this document.

Design Professionals should visit the University of Iowa Facilities Management website for the most current information contained in this document:  http://www.facilities.uiowa.edu
SECTION I – ORIENTATION

I. THE UNIVERSITY OF IOWA GOVERNANCE
Procurement of architectural and engineering services is governed by Board of Regents policy. Chapter 9 of Board of Regents, State of Iowa Policy Manual outlines specific requirements, procedures and thresholds. The University of Iowa conforms strictly to these requirements and Design Professionals shall not work ahead of governing approvals.

II. AGREEMENTS BETWEEN THE UNIVERSITY AND THE DESIGN PROFESSIONAL
A. For design projects, the University’s Design Project Manager (PM) is the designated Owner’s Representative through the bidding phase of the project. The PM is also the Owner’s Representative for studies and non-construction services. All instructions and approvals come to the Design Professional from the PM. The University’s Construction Project Manager (CPM) replaces the PM as the Owner’s Representative during the construction phase of the project following contract award.

B. The Design Professional shall designate a project manager, who shall represent the Design Professional throughout all phases of the Project, and to whom all communications pertaining to the project shall be addressed. Any change in the Design Professional’s representative during the life of the Agreement between Owner and Design Professional shall be made only after the written request by the Design Professional and written concurrence of the Owner’s Representative. The Design Professional shall provide an experienced project manager capable of effectively coordinating a multi-disciplined architectural/engineering team.

C. The University uses a “Standard Form of Agreement between Owner and Design Professional” as the contract between the Design Professional and the University. Review this document carefully, as the University allows no exceptions to this agreement form. A sample agreement can be found at Facilities Management’s website (http://www.facilities.uiowa.edu). Other University standard agreements may be substituted depending on project scope and desired services.

D. The Design Professional shall provide all basic services as stated in the Design Professional Agreement. On major projects the University may engage quality assurance professional services such as code review professionals, commissioning agents, document coordination consultants and others to ensure compliance with project goals and objectives.

E. The Design Professional may provide additional professional consultant services as determined by the scope of the project. When the Design Professional contracts with other professional consultants for these services, the Owner must approve the professional consultants. A change of professional consultants during the term of the agreement must be approved by the Owner’s Representative.

F. The employment of professional consultants does not relieve the Design Professional from responsibility for the entire project and for the full coordination of services required under the agreement, whether the work is performed by the Design Professional or their consultants.
G. On occasions, the University shall request the Design Professional hire a specialty consultant, and/or a specialty consultant specifically selected by the University, to support and/or supplement the work of the Design Professional. The Design Professional shall be responsible for the performance of the specialty consultant per the terms of the Agreement between the Owner and the Design Professional.

H. Projects within existing facilities shall include an appropriate review of existing conditions as a part of the basic services to assist the Design Professional in this review. The University shall make existing documentation available to the Design Professional upon request.

I. Fee proposals should include the Design Professional’s perception of the University’s project scope of work and recommended scope of services. The Design Professional shall include a proposed fee and estimate of reimbursable expenses, project schedule, and any other University-requested information.
   1. The University shall generally negotiate not-to-exceed fees for all limited/special scope projects and a fixed fee or percentage of construction cost fee for major projects. The PM shall instruct the Design Professional on the expected fee structure and what exceptions may apply.
   2. Reimbursable and non-reimbursable expenses are described in the agreement. Reimbursable expenses must be approved in advance, shall be paid at cost, and must be accompanied by receipts.
   3. The Design Professional’s proposal should identify project milestones, including design review submittals. The PM shall provide the Design Professional with any University schedule requirements.
   4. All design review meetings should be included in the Design Professional’s basic services fee. Also, unless waived by the PM, basic services include, as a minimum, a written bid evaluation, a pre-bid meeting, a pre-construction meeting, construction progress meetings, punch list inspection(s), and a final inspection.

J. Unless a current certificate of insurance is on file with the University, proof of the required insurance specified in the agreement must be submitted for approval with the signed agreement. The University shall not execute the agreement or approve payments without approved insurance.

K. No payments shall be processed unless an executed agreement is on file.

L. The Design Professional must submit requests for amendments to the agreement, or requests for additional fees, prior to proceeding with the services resulting in such requests. Under no circumstances shall additional fees be allowed for services provided during the design phase after award of the prime construction contract.

M. Submit payment requests to Facilities Management Capital Accounting for services performed. Invoices shall be submitted in the Owner’s format (refer to UI FM website). Payment requests submitted by the Design Professional must be accompanied by invoices detailing work completed and must summarize the total bill for services to date, and the amount of the current request.
III. DESIGN PROCESS & APPROVAL

A. Project Management:
1. The University’s Project Manager (PM) is the Owner’s Representative during the design of the project. All instructions and approvals come to the Design Professional from the PM. Services rendered but not requested by the PM shall not be compensated.
2. The University manages the total project budget and requires the Design Professional to design to the construction budget.
3. The PM shall manage internal University approvals and instruct the Design Professional accordingly.
4. The Design Professional must notify the PM of Owner-related delays so as not to impact the design schedule.
5. If the Design Professional believes additional services are requested by the University that are beyond the scope of services defined by the Agreement, the Design Professional must notify the PM and seek approval before proceeding with the services. Additional fees must be negotiated and an amendment to the original agreement processed immediately. This also applies to terminated or suspended work.

B. Meetings and Stakeholders:
1. University projects normally involve many academic, student, and service groups as stakeholders in a project. The PM arranges for and coordinates the Design Professional’s contact with these groups.
2. Project meetings are scheduled by the Owner’s office.
3. Meeting minutes are kept by the Design Professional and reviewed by the PM before issue. Unless otherwise directed by the project manager, meeting minutes should be issued to the PM for review within five working days. Following review by the PM, the Design Professional shall distribute the meeting minutes to all participants.
4. The Design Professional should conduct effective, productive meetings. The Design Professional should review the project budget summary and meeting agendas with the PM in advance.

C. Submittals:
1. The Design Professional should provide timely and complete submittals. The University shall review the Design Professional’s work for program conformance and constructability. The PM is authorized to reject incomplete submittals.
2. The Design Professional is responsible for the management and performance of their professional consultants. Delay of a professional consultant’s part of a submittal is considered an incomplete submittal from the Design Professional.
3. Delay of a project due to incomplete submittals is the responsibility of the Design Professional.
4. Submittal requirements are described in detail in Section II.
5. On projects with construction estimates greater than $100,000, the Design Professional may be required to use Submittal Exchange to electronically review, approve and track required Shop Drawings/Submittals. Subscription costs to Submittal Exchange for Design Professional access shall be included as a reimbursable expense item.

6. The Design Professional shall establish and administer the Submittal Exchange process for the project.

7. The Design Professional shall allow two weeks of University review time between submittal of review documents and the review meeting, unless otherwise directed by the PM. The University considers the milestone achieved only when the review is complete.

8. The University shall supply the Design Professional with an electronic copy of the bid form and special conditions. The PM shall work with the Design Professional to tailor these for the project. The Design Professional shall obtain required bidding documents from UI/FM website before the project is ready to advertise. Ensure that the most current version is utilized.

9. The University requires electronic files of CAD documents including foot-candle levels throughout the design process to interface with Facilities Management software. The Design Professional should coordinate the format and media of the electronic file with the PM.

D. Standard of Care:

1. This document in its entirety, marked sets of review documents by UI staff, and other written instruction to the Design Professional establish an expectation of the standard of care to be employed by the Design Professional in pursuit of the performance of their work.

2. Conflicts between University-provided instructions, documents, codes, standards and other instruments and requirements related to the project shall be brought to the attention of the PM. The Design Professional may be held financially responsible for resolving conflicts that were not brought to the PM’s attention.

3. Marked review drawings and written instructions not incorporated into the design must be documented and approved by the PM.

4. The Design Professional shall be financially liable for deviations from this document, marked review drawings, and written instructions unless deviations are approved in writing by the Design Standards & Procedures Steering Committee. Requests to deviate from these Design Standards on a project-by-project basis may be made by submitting a Deviation Request Form provided in this document, to the appropriate Project Manager.

E. Electronic Documents Guidelines:

1. All contract documents and studies shall be furnished to the University in an electronic format, in addition to a hard copy format.
IV. BIDDING
A. The PM coordinates the advertisement after the final review documents are approved. The PM sets the advertisement date and makes arrangements for the printing of bid documents.
B. The University shall distribute plans utilizing an outside vendor.
C. As directed, reviewed, and approved by the PM, the Design Professional must prepare addenda for distribution by the University related to document interpretation which is then incorporated in the contract for construction.
   1. Addenda are issued prior to the bid opening and are part of the contract documents. Addenda items shall be approved by the PM before issuing. The Design Professional shall prepare and the University shall distribute addenda directly to plan holders. The list of plan holders is maintained by University.
   2. Addenda should be issued at least seven (7) calendar days before the bid date. If addenda must be issued six (6) days or less before the bid date, either the bid date is extended or the Design Professional must verify each plan holder has a copy of the addenda at least 48 hours before the bid opening.
D. The PM, assisted by the Design Professional, shall hold a prebid meeting if required by the agreement. The Design Professional shall describe the project including important facets of the work and schedule. Simple clarifications can be made in response to questions. Other questions shall be recorded and clarified by addenda. Questions requiring interpretations by the Design Professional shall be answered by addenda.
E. To assure an adequate number of bids are received:
   1. The Design Professional shall review the local bidding climate prior to the preparation of bidding documents. The size and composition of projects shall be considered to encourage competitive bidding. If it appears a conflict among projects shall occur in the bidding market, the rescheduling of the bids shall be considered if time permits and if this rescheduling can result in additional bids.
   2. The Design Professional shall review the bidders list after the project has been on the market for seven (7) to ten (10) days to determine if there is adequate interest in the project. The Design Professional shall contact prospective bidders to encourage an adequate level of interest and suggest modifications that may be appropriate to achieve that.
   3. If little interest is shown in the project, the Design Professional shall contact potential bidders and determine the cause.
F. Bid opening: the University shall conduct a public bid opening for all projects with construction estimates exceeding $100,000. The Design Professional shall attend the bid opening if required by the agreement. Otherwise, attendance at a bid opening shall not qualify as a reimbursable expense. Informal bid openings (bids received electronically with non-public bid opening) may be scheduled for projects with construction estimates less than $100,000, in order to expedite project schedule.
G. Bid evaluation by the Design Professional:
   1. After the bids have been received, the Design Professional must prepare a review and analysis, including, but not limited to:
a) An analysis of the bidder’s qualifications to determine if the low bidder is responsible [qualified].

b) If requested by the PM, a thorough analysis of the low bidder’s breakdown of cost against the scope of work to determine if the bid is responsive.

c) An analysis and explanation of the bid spread and its comparison to the Design Professional’s pre-bid construction estimate.

d) An analysis and explanation of why there were variations in the bids.

2. The Design Professional shall provide a letter of recommendation for awarding the construction to the lowest, responsible bidder.

3. The PM must be notified if the Design Professional determines that the apparent low bidder is not qualified.

V. CONSTRUCTION

A. Once the contract is awarded, the University’s primary representative is no longer the PM. Instead, the University Construction Project Manager (CPM) serves as the University’s representative during the construction phase. The term CPM is intended to be general and represent a variety of positions within the University responsible for the management of construction. The titles include, but are not limited to, Senior Construction Project Manager, Construction Project Manager, and Construction Project Specialist.

B. All instructions and approvals come to the Design Professional from the CPM. Additional services rendered but not requested by the CPM shall not be compensated, including site visits.

C. Communications between the Design Professional and the Contractor during construction, including letters, memos, directives, etc., flow through the CPM with the exception of Contractor shop drawings. Shop drawings are submitted directly to the Design Professional by the Contractor, and are returned directly to the Contractor by the Design Professional. The CPM shall review communications with the Design Professional and the Contractor at the pre-construction meeting.

D. Final decisions on finish materials and color selections, not made during the design phase, shall be reviewed with and approved by the CPM before instructions are given to the Contractors for the ordering of material. Submit color schedules and charts in duplicate for CPM review. Submit final approved color schedules in duplicate to the CPM.

E. During the construction period, the CPM shall generally schedule periodic meetings with the Contractor. The Design Professional and their appropriate consultants are expected to be present at these meetings. The Design Professional shall take and distribute minutes of these meetings. Meeting minutes shall be submitted to the CPM for review and approval prior to issuance. Meeting minutes to be furnished no more than 72 hours following meeting. Design Professional shall furnish site observation reports for each site visit.

F. The Design Professional shall review all change order pricing and issue written responses within 5 working days following receipt. Change orders exceeding $10,000 will require a detailed, itemized estimate to include labor, equipment and material; plus applicable overhead and profit margins.
G. The Design Professional may be required to use Owner’s on-line, secure project communications web site for Change Order Management, to enhance communications and storage of contract change document information.

H. The Substantial Completion Inspection shall be scheduled by the CPM. The Design Professional, Owner, and Contractor must inspect the work, system-by-system and room-by-room, if appropriate, make a record of deficiencies or corrections required to fully comply with the contract documents.

I. The Design Professional must prepare a final punch list, by room, system, or area, and send the requested number of copies to the CPM, who shall make them available to the Contractor.

J. Record Documents shall be produced by the Design Professional (from As-Builts/red lines received from the Contractor) and submitted to the CPM at the end of construction and shall include:
   1. Drawings modified to indicate post bid changes, including the Contractor’s field changes.
   2. Project Manual updated to include addenda and post bid contract modifications and changes.

K. Project acceptance: The Design Professional shall provide a letter to the CPM certifying the completion of the project and recommending final acceptance.

L. The University will not make final payment to the Design Professional until all outstanding items, including the Record Documents, have been received.

END OF SECTION I – ORIENTATION
SECTION II - DESIGN DOCUMENTATION AND DELIVERABLES

This section contains planning information to be used by Design Professionals in the planning and development of University facilities.

The criteria represent minimum levels of performance, quality and/or standardization that are sometimes different from those accepted in private and commercial industry. This is in recognition that these facilities must be cost effective over the life of the facility, while supporting the academic, research and service missions of the University.

The planning and development criteria are presented to compliment the General Design Standards (Section III). The Design Professionals must familiarize themselves and be responsible for implementing all criteria and guidelines.

The Design Professional shall plan facilities with consideration given to serviceability, maintainability, and sustainability of these facilities.

The University employs a total-cost-of-ownership decision framework for project designs; considering, on a present value basis, the initial capital cost, annual operating costs, and future expected renewal costs over the life of the facility that will yield the lowest total cost.

I. GENERAL
   A. Design submittals shall, as a minimum includes items in this section and as outlined in the Appendices.
   B. Develop economically justified designs within the prescribed budget and space allocations.
      1. Design to obtain the lowest life-cycle cost consistent with a high quality facility.
      2. The Design Professional shall work to develop a design whereby the Base Bid accounts for approximately 95% of the approved construction budget to allow for budget protection on bid day, as directed by the PM. The balance of the construction budget shall be accommodated with additive bid alternates so that an award can be made utilizing 100% of the approved construction budget.
   C. In order to meet institutional design criteria, the proposed design may be periodically reviewed by the Campus Planning Committee.
   D. Design Professional shall cooperate mutually with the Owner and with any other such Design Professionals that might be employed by the Owner.
   E. Designs shall be in accordance with the applicable Codes and Standards as listed in this section of the manual.
   F. All correspondence between the University and the Design Professional during the design phase shall be through the Design Professional’s project manager and the University PM.
   G. The Design Professional may be required to make presentations to the Board of Regents for the schematic design of major buildings.
H. If construction alternates are included in the design, then alternates shall be additional to the base bid design and shall be listed in order of importance. Unless approved by the PM, no more than four (4) additive alternates shall be allowed.

I. The Design Professional shall consider the University of Iowa’s 20/20 Vision when designing projects: [http://sustainability.uiowa.edu/assets/Uploads/2020-Vision-Ulowa-Sustainability-Targets.pdf](http://sustainability.uiowa.edu/assets/Uploads/2020-Vision-Ulowa-Sustainability-Targets.pdf)

II. BUILDING CODES AND STANDARDS

A. Basic Building Code Policy

1. University facilities shall comply with all applicable codes.

2. University facilities shall be designed with flood protection/mitigation up to the 500’ + 2’-0”. Clarification shall be obtained by the DP through the Owner’s PM if needed.

3. Codes and standards required by accreditation agencies, such as the Joint Commission for Accreditation of Hospitals (JCAHO) shall also be used unless the International Code Council (ICC) requirements are more stringent.

4. In the event that special design features and/or construction systems are not covered in the ICC codes, it shall be approved by the State Building Code Bureau, a division of the State Fire Marshal Office.

5. Codes that apply to University design and construction:
   a) ICC International Building Code and reference standards
   b) ICC International Fire Code
   c) Uniform Plumbing Code
   d) ICC International Mechanical Code
   e) ICC International Energy Conservation Code
   f) NFPA 70 National Electric Code (NEC)
   g) ADA Standards for Accessible Design
   h) NFPA 101 Life Safety Code, 2000 Edition, applicable to only health care providing facilities (UIHC)
   i) American Society of Mechanical Engineers (ASME) Safety Code of Elevators and Escalators A17.1 (1996) and other codes as adopted by The Iowa Division of Fire Safety, Elevator Safety Unit.

6. The following Chapters of the Iowa Administrative Code shall apply to University design and construction:
   a) Public Safety [661], Chapter 5, “Fire Marshal,” (current edition)
   b) Public Safety [661], Chapter 16, “State of Iowa Building Code”
   c) Public Safety [661], Chapter 18, “Parking for Persons with Disabilities”
   d) Labor Services [875], Chapter 72, “Conveyances Installed on or After January 1, 1975”
   e) Chapter 89A, “Elevators” (Iowa Code)

7. Standards that apply to University design and construction:
a) National Fire Protection Association (NFPA) standards including current version of 70E
b) American Society of Heating Refrigeration & Air Conditioning Engineers (ASHRAE)
c) American Concrete Institute (ACI)
d) American National Standards Institute (ANSI)
e) American Refrigeration Institute (ARI)
f) American Society for Testing and Materials (ASTM)
g) Underwriter’s Laboratories, Inc. (UL), Federal Specifications
h) National Electrical Manufacturers Association (NEMA)
i) Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)
j) FM Global Company
k) American Association of State Highway and Transportation Officials (AASHTO)
m) National Institute of Building Science

8. Codes and Standards that apply to Telecommunications:
   a) Occupational Safety and Health Administration (OSHA) safety regulations
   b) Iowa “One Call”
   c) National Electrical Safety Code, (NESC)
   d) National Electrical Code, (NEC)
   e) Building Industry Consulting Service International’s (BICSI)
   f) Telecommunications Design Methods Manual (TDMM)
   g) Electronic Industries Association/Telecommunications Industry Association (EIA/TIA), Building Wiring Standards
   h) National Institute of Building Science

B. Design Procedures

1. The University’s general policy is not to deviate from the adopted codes. Design Professional must certify in writing on the contract document that the project has been designed in compliance with the University applicable codes.

2. The Design Professional shall perform a project code analysis before the completion of design development, preferably during the schematic design phase. The Design Professional shall reference applicable codes and editions and note the occupancy, construction type, egress conditions, and other information necessary. The Design Professional is encouraged to use drawings to illustrate conditions. The code analysis shall note any potential nonconforming construction. The Design Professional may employ a Code Design Professional to augment their design team. Failure of design work to meet the established University basic building codes shall result in redesign at no cost to the Owner; and reimbursement by the Design Professional to the Owner for non-value added modifications.
3. The University may employ an Independent Code Design Professional to review designs for code compliance. This does not relieve the Design Professional from responsibility to design to code. On major projects a follow-up code analysis shall be performed on design development and contract documents submittals.

4. The Design Professional may be required to submit Drawings and Specifications, at schematic and subsequent phases, to the Iowa Department of Public Safety, State Building Code Division for approvals by that office as directed by the PM. The Design Professional shall be responsible for payment of associated fees. Such fees are considered a reimbursable expense.

5. Building permits are not required for construction on the Owner’s property; however, work on buildings off campus (usually leased property) or new construction located in flood plain areas may require building permits or special clearance from governmental agencies. Building permits are required through the State Building Code Division for all state building or significant renovation projects.

6. The Design Professional shall assist the Owner in obtaining all necessary permits.

7. Commissioning shall be performed and/or directed during construction by FM - Utilities & Energy Management. For some projects, Building Envelope, MEP or other specialty commissioning may be required. (Refer to Commissioning Section in this document.)

8. As required by the Iowa State Fire Marshal’s Office, the Design Professional shall assist the University in securing occupancy certificates.
   a) Buildings subject to state inspection shall not be occupied until a Certificate of Occupancy has been issued by the State Fire Marshal’s Office which includes partial or temporary certificates.
   b) The Design Professional shall account for this activity in the project schedule.

C. Variance Procedures

1. Design Professional must request approval to seek code variances in writing through the PM. A code variance request must include:
   a) An explanation of the situation, the applicable codes, and the reason why code compliance is not possible. Copies of referenced codes, informational sketches, drawings, calculations, and supporting material should be attached to the request.
   b) A discussion and recommendation related to the impact on building use and occupant safety.
   c) A discussion and recommendation of equivalent systems available and cost implications of each.

D. Code Change Administration

1. When new editions of applicable codes are adopted during the course of the design, the Design Professional shall seek direction from the PM on whether the new codes apply to the project.
2. The Design Professionals shall list the applicable codes in the Project Manual and on Code check/Fire Life Safety drawings.

E. Environmental Compliance

1. Clean Air Compliance
   a) The construction, installation or alteration of any equipment capable of emitting air contaminants generally requires that a construction permit from the Iowa Department of Natural Resources be obtained prior to the initiation of construction. Exceptions to the pre-construction permit requirements are provided under the rules of the DNR. The following is a partial list of emissions sources which shall require a permit: boilers, emergency generators, incinerators, fuel burning equipment and pollution control equipment. Refer to Iowa Department of Natural Resources (DNR) Air Quality Bureau home page: [http://www.iowacleanair.com](http://www.iowacleanair.com) for more detailed information.
   b) In order to ensure that the project complies with the various environmental regulatory requirements, all permitting and emissions tracking activities shall be coordinated with and completed with the assistance of the PM.
   c) Sources:
      (1) Significant sources that require information for the Title V operating permit and a construction permit.
      (2) Insignificant sources that require information for Title V, only.

2. Spill Prevention Control & Countermeasures (SPCC) 40CFR112
   a) Where this Federal code is applied in designs for the University of Iowa, written notice of such must be made to the Project Manager by the Design Professional before final review of drawings and specifications. This notice shall allow other 40CFR112 requirements to be provided by the University in order to comply with the code.
   b) The intent of this standard is that any “oil” spillage from storage tanks, reservoirs, etc., cannot find its way off of the immediate site through sanitary sewer, storm sewer or surface run-off. Secondary containment for reservoirs is a common component of the requirement.

   a) The University must comply with the National Pollutant Discharge Elimination Systems (NPDES), Phase II, Municipal Separate Storm Sewer System (MS4) requirements. If applicable, the Design Professional must include the following design elements as part of the project.
   b) Construction Site Runoff Control: As part of the University of Iowa’s Municipal Separate Storm Sewer System (MS4), NPDES Permit No. 52-25-0-06, requirements affecting construction fall into two categories.
      (1) Construction sites of an acre or more require a storm water construction permit which requires construction documents. The Project Manager shall be responsible for the preparation of these items.
to be included in the final review documents prior to bidding as well as obtaining the Iowa NPDES Permit No. 2 for the project. Refer also to Owner’s NPDES Permit No. 52-25-0-06 construction activity storm water, erosion, and sediment control standard procedure.

(2) Construction sites less than an acre require the contractor to provide sediment and erosion control measures to prevent sediment from leaving the site. Design Professional shall be responsible for the preparation of construction documents which shall satisfy the intent of the Owner’s NPDES Permit No. 52-25-0-06 and to be included in the final review documents prior to bidding.

c) Post-Construction Storm Water Management: The Design Professional shall endeavor to maintain or minimize storm water runoff to natural waterways or infrastructures. When elements of the plan have hard surfaces which will collect contaminants, appropriate design components shall be included to control discharge to natural waterways or infrastructures.

4. Easements

a) The Design Professional shall advise the PM if the project requires a construction activity that is outside the University’s property line. The PM shall contact appropriate agency to discuss project needs. The Design Professional shall assist the PM in the preparation of any material needed for appropriate submittals that may include easements and traffic control plans.

b) Agencies included but not limited to:

   (1) Iowa Department of Transportation (IDOT)
   (2) City of Iowa City
   (3) City of Coralville
   (4) Cedar Rapids and Iowa City (CRANDIC) Railroad
   (5) Iowa Interstate Railroad

III. STANDARD FLOOR AND ROOM NUMBERING

A. General

1. The Space Planning and Utilization staff within the Office of Planning, Design & Construction is responsible for assigning all building and room numbers. The Design Professional shall provide Facilities Management with an electronic copy of the plan drawings. The renumbering of any room, group of rooms or all rooms within a building, or the initial numbering of rooms within a new building, building addition, or acquired building is subject to the approval of Space Planning and Utilization. Space Planning and Utilization has the authority to require compliance with the guidelines set forth in this policy and, in exceptional situations, approve deviations from the standards. All numbering conflicts and questions are to be resolved with Space Planning and Utilization.
B. Process to Assign and Update Room Numbers

1. At the end of the Schematic Design (SD) phase, the Project Manager provides a floor plan(s) to Space Planning and Utilization. Rooms and other spaces, including exterior entries, on the floor plan(s) shall be numbered in accordance with university conventions and returned to the Project Manager.

2. The project shall use the room numbers provided for the Design Development (DD) documents.

3. If the building/room layout changes at DD or any subsequent phase, the Project Manager and/or Design Professional will request an update to the room numbering plan from the Office of Space Planning and Utilization.

4. In no case should bid documents or Construction Documents (CD) be issued without completing steps 2 and 3.

5. Per the “Standard Form of Agreement” section 15.6, December 2006 Revision – A, the Design Professional should submit CAD drawings of the CDs to Space Planning and Utilization within 10 working days of the award of contract.

6. If changes occur during the course of construction that impact room numbering or entry doorways the Project Manager and/or Design Professional should notify Space Planning and Utilization who will provide new room numbering designations.

7. The Design Professional shall update the CDs with the new room numbering designations including finish and door schedules.

8. The Design Professional shall provide Record Documents with the final room number designations and updated schedules per the “Standard Form of Agreement”.

IV. BUILDING AREA DEFINITIONS

A. Gross Area

1. Gross area is the sum of all areas on all floors of a building included within the outside faces of its exterior walls, including all vertical penetration areas, for circulation and shaft areas that connect one floor to another.

2. Calculate gross area by measuring from the outside faces of exterior walls, disregarding cornices, pilasters, buttresses, etc., that extend beyond the wall faces. Exclude areas having less than a 3-foot clear ceiling height. In addition to internal floored areas, gross area includes excavated basement areas; interstitial spaces (i.e., mechanical floor or walkways), mezzanines, penthouses, attics; garages; covered porches, whether walled or not; inner or outer balconies to the extent of a drip line from a roof or balcony immediately above, whether walled or not, if they are used for operational functions; corridors or walkways, whether walled or not, provided they are either within the outside face lines of the building to the extent of the roof drip line or, if covered, to the extent of their cover’s drip line. The footprints of stairways, elevator shafts, and vertical duct shafts are counted as gross area on each floor through which they pass. Include the top, unroofed floor of parking structures where parking is available.
B. **Net Assignable Area**
   1. Net assignable area is the sum of all areas on all floors of a building assigned to, or available for assignment to, an occupants or specific use. Areas defined as building service (i.e., public rest rooms, custodial supply closets, custodial office/break room), circulation, mechanical (including electrical and telecommunications closets) and structural are not included.
   2. Calculate net assignable area by measuring from the inside faces of surfaces that form the boundaries of the designated areas. Exclude areas with less than a 3-foot clear ceiling height. Do not make deductions for necessary building columns and projections.

C. **Non-Assignable Area**
   1. Non-assignable area is the sum of all areas on all floors not available for assignment to an occupant for specific use, but necessary for the general operation of the building. This includes areas defined as building service (i.e., public rest rooms, custodial supply closets, custodial office/break room), circulation, and mechanical (including electrical and telecommunications closets).
   2. Measure from the inside faces of surfaces that form the boundaries of the designated areas. Exclude areas with less than a 3-foot clear ceiling height.

V. **ENERGY**

A. **General**
   1. The energy conservation criteria contained in this section must be followed by the Design Professional. Consistent with UI sustainability initiatives, the energy conservation criteria contained in this section must be followed by the Design Professional to achieve a high performance building that will:
      a) Reduce the total ownership cost of facilities.
      b) Improve energy efficiency and water conservation.
      c) Provide safe, healthy, and productive built environments.
      d) Promote sustainable environmental stewardship.
   2. Energy Efficiency: For new construction, reduce the energy cost budget by 30 percent compared to the baseline building performance rating per the American Society of Heating, Refrigerating and Air-Conditioning Engineers, (ASHRAE) and the Illuminating Engineering Society of North America (IESNA), latest version of ASHRAE.
   3. The Design Professional shall consider energy conservation in all designs. Principal considerations are first cost, operational cost, maintenance cost, climatic conditions, site configuration, building orientation, building functional arrangement, building envelope, and mechanical systems as applicable to minimize the use of energy.
   4. Compliance with latest version of ASHRAE 90.1 is required. This standard shall be applicable for all new buildings, infrastructure renovations, capital equipment replacement projects, and renovations that alter mechanical and electrical systems.
a) Compliance must be documented at the conclusion of schematic design, design development, and contract document phases.

b) All projects registered with the MidAmerican Energy or Alliant Energy New Construction Program shall demonstrate compliance by the Building Energy Budget method as described in latest version of ASHRAE 90.1. Building registered with the MidAmerican Energy or Alliant Energy New Construction Program shall exceed latest version of ASHRAE Energy Standards by 30%. The modeling results from the MidAmerican Energy or Alliant Energy New Construction Program shall be submitted to the University for review.

c) For projects not enrolled in the MidAmerican Energy or Alliant Energy New Construction Program, that elect to use the Energy Budget Method of compliance, a combination of COMcheck-EX and approved commercial building modeling software shall be used to demonstrate compliance. A computer printout of the modeling report of the base line and the energy conservation measures shall be submitted to the University of Iowa Energy Engineer for review.

d) For Projects using the prescriptive method of compliance, use COMcheck-EZ software to demonstrate compliance to ASHRAE Standard 90.1. Submit the COMcheck-EZ compliance report to the PM for University’s review.

e) If compliance is not achieved, then redesign may be required.

B. **Lighting**

1. Provide foot-candle lighting levels for each space including exterior using approved lighting design software such as AGi32, Lighting technologies Inc., Microlux or any other approved software. Designer shall use the “Lighting Levels Recommendations” found in Section III. Use Iowa Engineering Society (IES) recommendation if spaces are not listed.

2. Provide a table listing watts per square foot for each space and/or for lighting, and for electrical power.

3. Exceptions to latest version of ASHRAE automatic lighting control requirements shall be considered when approved by the PM.

4. Provide justification for any area with unusual lighting levels.

5. Meet IES recommended foot-candle levels and remain within the latest version of ASHRAE 90.1 watts per square foot ranges.

C. **Energy Impact Statement**

1. Provide an Energy Impact Statement in accordance with these standards.

D. **Economic Evaluation of Energy Conservation Opportunities**

1. Investment Payback Calculations and Criteria

In the analysis of an Energy Conservation Opportunity, the simple payback of each investment alternative shall be calculated using:
Payback Period = Annual Energy Saving - Incremental maintenance costs of the ECM - Incremental Capital Cost of the ECM

Table of Investment Payback Criteria:

<table>
<thead>
<tr>
<th>Service Life of ECM (years)</th>
<th>Max payback Period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>20 or more</td>
<td>10</td>
</tr>
</tbody>
</table>

2. The service life shall be determined in accordance with ASHRAE 2003 Applications Chapter 36 “Costs of Owning and Operating Equipment.”

3. Where the expected life of two alternative systems is significantly different from each other, include the replacement cost of the shorter lived system in the analysis.

4. Deliverables: Documentation of required evaluations shall consist of a report with an executive summary, description of evaluation methods and means, analysis results, recommendations, and calculations.

VI. COMMISSIONING

A. General

The objective of commissioning is to establish and document the Owner’s criteria for system function, performance, and maintainability; as well as to verify and document compliance with these criteria throughout design, construction, startup, and the initial period of operation. For the process to work successfully, it is important that the Owner, Commissioning Authority, Design Professional, Contractors, and Operators work together as a team throughout their involvement with the project.

As a quality control and quality assurance process, commissioning is recommended for all University of Iowa projects. The following systems shall be commissioned, as applicable for each project:

Building Envelope: Roof, Windows, Curtainwall Systems, Metal Panel/Exterior Skin
Mechanical: HVAC, Controls, Process Systems, Central Plumbing Equipment
Electrical: Lighting, Lighting Controls, Emergency Generators, Electronic Access, Security Systems, Telecommunications
Life Safety: Sprinkler/Suppression Systems, Fire Alarm
Other: Elevators, Doors

Every project over $1 million dollars shall be commissioned. Other project may require commissioning and shall be reviewed and approved by the University.

The Project Manager shall inform the Design Professional whether the University will act as the University’s Commissioning Authority or whether a Consultant will perform these services.
The Commissioning Authority shall prepare documents such that each Contractor shall understand the commissioning activities required of them for the systems, equipment and materials they install. When equipment and materials are part of a larger system, each Contractor shall be required to commission their portion of the work as part of the overall system commissioning. The commissioning activities/documents shall be incorporated into the contract documents.

Most projects, especially those involving mechanical and electrical systems, will undergo a building commissioning process. The Design Professional shall become familiar with, fully participate in and fully support this process.

B. Commissioning (Cx) Process:

1. New buildings and major building renovations will undergo design-phase and construction-phase commissioning. On a project pursuing LEED Certification, commissioning may include additional activities to earn as a minimum LEED (current version) EA Prerequisite 1, “Fundamental Commissioning of Building Energy Systems” and Credit 3, “Enhanced Commissioning”. Most small projects will undergo construction-phase commissioning only as directed by the Owner.

2. The basic commissioning process is integrated with the phases of construction and should begin as early as schematic design phase (no later than design development) and continue through construction and the warranty period. Commissioning enhances communication among project team members and ensures that they all understand the project goals. This allows the project team to identify problems early, before they can affect later phases of the project and cause delays. A description of each phase and expected commissioning activities are outlined below

3. Design Phase – Commissioning Process
   a) The PM will request an in-house commissioning authority from U&EM or will send out requests for proposals (RFPs) and contract with an outside commissioning firm.
   b) The Commissioning Authority shall assist the Owner in reviewing the Owner’s Project Requirements and Basis of Design documentation for the project. At a minimum, the commissioning authority reviews this information for clarity and completeness.
   c) The Commissioning Authority conducts a scoping meeting to communicate the Owner’s goals, needs, and expectations for building operation and function and to identify commissioning responsibilities in support of this.
   d) The Commissioning Authority begins to develop a commissioning plan. The Commissioning Plan defines the Commissioning Process at various stages of the project, and shall identify roles and responsibilities of the commissioning team members. The Plan also establishes milestones and is continually evolving; it will be enhanced as the design progresses.
   e) The Commissioning Authority shall provide an initial construction phase commissioning plan and commissioning specifications, an issues report,
comments regarding the Owner’s Project Requirements and/or Basis of Design documentation to close out the design phase of commissioning.

f) Design Professional: The Design Professional shall attend the commissioning scope meeting and reviews the initial Commissioning Plan. Design team addresses in writing all findings and recommendations presented by the commissioning authority during formal design reviews. Design team reviews and incorporates the commissioning and related specifications developed by the commissioning authority.

g) The commissioning authority develops detailed commissioning specifications to be included by the design team in the final construction documents. The specifications comprise commissioning-related requirements that will be the contractor’s responsibility, including equipment installation and startup, documentation, and functional testing. In addition, the commissioning authority may recommend enhanced language regarding training, documentation, installation, and system checkout for inclusion in non-commissioning sections of the specifications.

h) The commissioning authority develops the preliminary Construction Checklists. The checklists are completed during construction once manufacturer/equipment specifics can be identified. Checklists typically include equipment/assembly verification, pre-installation checks, installation checks, and any negative responses. Checklists should be kept as short as possible with the questions being worded clearly so that the correct answer is typically yes.

i) The commissioning authority identifies the requirements of O&M staff relative to the systems and assemblies to be installed in the facility.

j) The commissioning authority attends selected design team meetings and formally reviews and comments on the design at various stages of development (ideally at least once during schematic design, design development, and construction document phases). Potential system performance problems, energy-efficiency improvements, indoor environmental quality issues, operation and maintenance issues, and other issues may be addressed in these design reviews, depending on the commissioning authority’s scope and the needs of the project. The commissioning authority ensures that the design follows and meets the original Owner’s Project Requirements. The commissioning authority does not approve the design, but makes recommendations to facilitate commissioning and improve building performance. It is the responsibility of the project manager to evaluate and discuss all findings with the design team and implement those approved.

k) The commissioning authority develops and keeps a record of issues and findings throughout the design phase commissioning process that require further attention, tracking, or correction. The log is updated regularly and submitted to the project manager and the commissioning team for discussion and resolution during design meetings.

l) Commissioning authority attends the pre-bid meeting to answer any commissioning questions and will review addenda for compliance with Owner’s Project Requirements and the Basis of Design.

4. Construction Phase – Commissioning Process

a) The commissioning authority updates the construction phase commissioning plan, which includes a list of all systems and specific equipment and
components to be commissioned, the process to be followed, communications, reporting and documentation protocols, and an estimated schedule for the commissioning process.

b) The commissioning authority coordinates a construction phase commissioning kickoff meeting. The meeting should include the project manager, construction manager, design team, commissioning authority, and respective representatives from the general contractor and mechanical, electrical, controls, and test and balance (TAB) subcontractors. At this meeting, the commissioning authority outlines the roles and responsibilities of each project team member, specifies procedures for documenting commissioning activities and resolving issues, and reviews the preliminary construction phase commissioning plan and schedule. Team members provide comments on the plan and schedule, and the commissioning authority uses these suggestions to help finalize the commissioning plan and schedule.

c) The commissioning authority attends periodic planning and job-site meetings that the general contractor has with their subcontractors in order to remain informed on construction progress and to update parties involved in commissioning. During the initial stages of construction, the commissioning authority may attend regular construction meetings and hold a line item on the agenda. The commissioning authority may coordinate entire meetings devoted to commissioning issues.

d) The commissioning authority may assist the project and construction managers in monitoring the development of Coordination Drawings to ensure reasonable interface between trades.

e) The commissioning authority reviews contractor submittals of equipment to be commissioned in parallel with the design team. The commissioning authority reviews submittals to ensure that the Owner’s Project Requirements and Basis of Design are being achieved. The commissioning authority reviews and comments on each submission, and forwards them to the project manager or designer. Additional information will be requested by the commissioning authority including installation and startup procedures, operation and maintenance information, equipment performance data, and control drawings prior to formal Operation/Maintenance (OM) manual submittals. This data is used by the commissioning authority to become familiar with the systems and to write functional test procedures. Project manager support for obtaining these additional documents from the contractors is critical.

f) The Commissioning Authority shall review all requests for information (RFIs), instructions to contractor (ITCs), and change orders applicable to the commissioned systems in order to address any that may have an impact on commissioning and Owner’s Project Requirements.

g) The commissioning authority develops test procedures that define the means and methods for performing the functional tests. The procedure will include participants required at each test, prerequisites, step-by-step instructions on how to start the test, how to restore the system at test completion, and what observation or measurement must be recorded.

h) The commissioning authority visits the construction site periodically and notes any conditions that might affect system performance or operation. The construction site visits are the primary method used during construction to
verify that the installed systems and assemblies comply with the Owners Project Requirements. A clear, concise, and consistent procedure must be followed for each site visit to properly identify Construction Phase process problems and issues. The site visit procedure uses statistical sampling techniques for verification of the construction checklists and project record documents. Construction observation reports are provided to the project manager.

i) The installation, startup, and initial checkout of the equipment and systems are executed and documented by the contractor on construction checklists provided by the commissioning authority and on manufacturer checklists shipped with the equipment. These checklists are submitted to the commissioning authority to ensure they are complete before functional testing begins. The commissioning authority may witness some of the startup execution and will spot-check selected items on the checklist prior to functional testing.

j) After developing written test procedures, the commissioning authority manages, witnesses, and documents the functional tests, with the actual hands-on execution of the test procedures typically carried out by subcontractors, particularly the controls contractor. Acceptable performance is reached when equipment or systems meet specified design parameters under full-load and part-load conditions during all modes of operation, as described in the commissioning test requirements of the specifications and commissioning plan. Some testing is completed by monitoring system operation over time through the building automation system or data loggers and is not normally completed until a few weeks after occupancy. The commissioning authority does not normally retest systems that have been tested and approved by regulatory authorities. The commissioning authority may prepare test plans for, assist with execution of, and document tests of commissioned equipment overseen by regulatory authorities and should ensure that such tests meet the testing rigor desired by the Owner.

k) The commissioning authority shall monitor the installation of systems and assemblies through site visits so that scheduling of initial training of O&M staff can occur for the purpose of viewing the installation and location of components that may end up being hidden as construction continues. Attendee sign-in sheets should be used to verify that the training was delivered.

l) The commissioning authority develops and keeps a record of issues and findings throughout the construction phase commissioning process that require further attention, tracking, or correction. The issues log is updated regularly and submitted to the project and construction managers and each contractor for discussion and resolution during construction meetings. The log will be used to report all issues found during functional testing, which will then be used to generate a corrective action form and delivered to the contractor. Once the corrective action has been completed and the signed form is returned to the commissioning authority, rescheduling of the functional test will occur.

m) The commissioning process generates a number of written work products during the construction phase of the project. The project manager should receive at least the following products from the commissioning authority:

(1) Updated construction commissioning plan
(2) Updated commissioning schedule
(3) Minutes from commissioning meetings
VIII. ACCESSIBILITY

A. The University of Iowa faces the challenge of providing an inviting, welcome, supportive, and universally accessible environment for all persons. The Americans with Disabilities Act, the 2010 ADA Standards for Accessible Design, Iowa State Building Code Chapter 302-Accessibility of Buildings and Facilities Available to the Public, Iowa Administrative Code Chapter 18-Parking for Persons with Disabilities, the International Building Code (IBC) Chapter 11, and the IBC referenced ICC A117.1 Accessible and Usable Buildings and Facilities shall be used as minimum guides in establishing accessibility design requirements (using the most stringent if there are any differences) and should not be construed to limit Design Professionals from going beyond these requirements and proposing a higher level of accessible design features. Any design or elements thereof that the Design Professional may question as being aligned with the University’s position on universally accessible environments or the ADA’s intent, including identification of potential risks associated with code/law interpretations shall be brought to the attention of the UI Project Manager early in the design phase to allow for UI’s analysis and direction.

B. Building design (including renovations) is to be based on “Universal Design” concepts/criteria to as great extent as possible. Universal Design is defined as: “The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design”. Facilities Management has developed a project scoping and assessment model titled “MAPPS” (Measuring Accessibility Points Plan and Standards). The model includes an extensive checklist of accessibility considerations and provides an excellent framework for scoping a project design and rating, similar to LEED ratings, the relative extent of a universal design. The project team and Design Professionals are encouraged to utilize the MAPPS model to inform the creative and decision making process towards “Universal Design”. The University of Iowa allows for broad participation and collaboration in its efforts to frame accessibility.

C. The following limited list identifies items that have been missed or excluded on various new construction or renovation projects and clarification of interpretation and/or clarity on design direction for specific items as required by the University (which may or may not exceed the minimum code/law requirement):

1. In all new construction, all public entrances to the building shall be designed for universal accessibility. Entrances on an accessible route, including the main entrance, will be provided with one door, or set of doors, that is power operated. If an entrance to the building other than the main entrance is located closer to the parking designated for persons with disabilities, that entrance shall also be power operated.
2. In existing structures, a minimum of one entrance shall provide universal accessibility. That entrance will be power operated. The accessible entrance will be the main entrance unless an alternate entrance provides a better solution. In existing structures, any design for construction in the vicinity of an entrance should evaluate the possibility of making that entrance accessible. Whenever it is physically and economically feasible, all entrances should be made accessible.

3. All accessible parking spaces shall be designed per “universal accessible” criteria as defined in Iowa Administrative Code Section 661-18.3 Exception.

4. All sidewalks leading up to a vehicular roadway or route shall have a truncated dome (per 705 of the 2010 ADA Standards for Accessible Design) installed. The truncated dome shall be Armor-Tile, color: Colonial Red

5. Site steps are discouraged. Design accessible exterior routes without ramps when possible and use alternatives such as sidewalks and proper grading to achieve gentler slopes when possible.

6. During construction, provide adequate and safe detour(s) whenever sidewalks and/or building entrances are closed and blocked. Use audible and visual signage to give advance notification of closures ahead and inform pedestrians of alternate accessible routes. Do not use terms “ADA” or “handicap” on signage and instead utilize terms such as “universal” and “accessible” and the International Symbol of Accessibility (per the 2010 ADA Standards for Accessible Design 703.7). The Design Professional, UI Project Manager and UI Construction Manager shall assess the entire site associated with the project to review all proposed vehicular and traffic way-finding/direction plans.

7. Locate accessible parking signs where they are not obscured by parked vehicles, trees, or other obstructions and as required by Iowa Administrative Code Chapter 18.

8. Avoid or eliminate grates or other openings in traveling surfaces.

9. Ensure that interior stair treads have adequate contrast with stair landings at both the top and bottom of the stairs.

10. Employee spaces used for purposes other than job-related tasks (break rooms, tea rooms, kitchen/kitchenettes, copy rooms, conference rooms, lounges, shower and locker rooms, etc.) are considered “common use” and are required to be fully accessible. Sinks shall be accessible with the requirements for a forward approach.

11. Every public and common use restroom must be accessible as required by 213.1 and 213.2 of the 2010 ADA Standards for Accessible Design.

12. Provisions shall be made for restroom ambulatory compartments as required by 213.3.1 of the 2010 ADA Standards for Accessible Design.

13. Accessible unisex restrooms shall not be used as a substitute for accessible multi-user restrooms; however, can be used “in addition to” as personal care/family assistance facilities.

14. All alterations that could affect the usability of a facility must be made in an accessible manner to the maximum extent feasible. For example, if during renovations a doorway is being relocated, the new doorway must be wide enough and include hardware that meets new construction standards for accessibility.
15. Door and gate closer push/pull force and closing speed shall comply with 404.2.8 and 404.2.9 of the 2010 ADA Standards for Accessible Design.

16. Although areas used exclusively by employees for work are not required to be fully accessible, consider designing such areas to include non-required turning spaces, and provide accessible elements whenever possible. Employees with disabilities are entitled to reasonable accommodations in the workplace; accommodations can include alterations to spaces within the facility. Designing employee work areas to be more accessible at the outset will avoid more costly retrofits when current employees become temporarily or permanently disabled, or when new employees with disabilities are hired.

17. Elements located in circulation paths (such as Automated External Defibrillator devices, fire extinguishers and Digital Media Monitors) shall be within the protrusion limits as required by 307 of the 2010 ADA Standards for Accessible Design.

18. Reception and Service Counters/Millwork are to be designed for universal accessibility and at a minimum, be accessible as required by 904.4 of the 2010 ADA Standards for Accessible Design.

19. Provide furniture configurations that do not create physical barriers to wheelchair users.

20. Clear floor or ground surface space and reach range requirements must meet accessible reach/use criteria per 305 & 308 of the 2010 ADA Standards for Accessible Design. Reach requirements apply to operable parts on accessible elements, to elements located on accessible routes, and to elements in accessible rooms and spaces.

21. Special consideration will need to be given in classrooms for inclusion of specialized equipment for persons with disabilities such as wiring and lighting.
   a) Remote Real Time Captioning - Place an Ethernet connection and an electrical outlet in the front of the room for all auditoria seating 100+.
   b) Lighting for Interpreter - A separate light for a sign language interpreter in all auditoria seating 100+ should be placed adjacent in the front of the room. This light should not spill onto the projection screen and should illuminate the Interpreter from the front. The light control may be located with other controls at the lectern.

22. Preference for accessible seating in lecture halls is fixed table and moveable chairs and/or open space for wheelchairs.

23. Provide entrances to lecture halls that allow wheeled access to the teaching area and consider providing access to multiple seating levels of the classroom when under the occupancy threshold of 221.2.3.2 of the 2010 ADA Standards for Accessible Design in regards to vertical dispersion for an assembly area.

24. Consider providing adjustable tiered height furniture in level floor classrooms to maximize clear sightlines.

25. Visual screens and monitors shall be visible from either a sitting or standing position.

26. An alteration that affects or could affect the usability of or access to an area containing a primary function shall be made so as to ensure that, to the maximum extent feasible, the path of travel to the altered area, including the restrooms, telephones, and drinking
fountains serving the altered area, are readily accessible to and usable by individuals with disabilities, including individuals who use wheelchairs, unless the cost and scope of such alterations is disproportionate to the cost of the overall alteration (all as defined in the 2010 ADA Standards for Accessible Design). Design Professionals are required to include a path of travel accessibility scoping schedule which will include the elements and their associated costs being proposed for incorporation within the project scope. This schedule shall be provided to the UI Project Manager for review during the early stages of design.

27. Hand operated flush controls within accessible toilet stall compartments shall be located on the open side of the water closet except in ambulatory accessible compartments.

28. Accessible toilet stall compartments shall have the toilet paper dispensers installed above the side wall grab bar. The outlet of the toilet paper dispenser shall be 4'-0" above the finished floor and the top of the gripping surface of the grab bar must be 2'-9" minimum and 3'-0" maximum above the finished floor.

29. Recycle and waste collection centers shall be designed to allow for accessible reach ranges and clear floor space area.

IX. SCHEMATIC DESIGN PHASE

A. Board of Regents Schematic Design Report:
The Design Professional may be directed to produce and present a Schematic Design Report to the University's Board of Regents. The report shall be distributed to Board members, University administrators, and other officials and may also be used in conjunction with development activities by the University. It is imperative this document be succinct, accurate, and of professional quality. The following outline should be used in developing the report along with any supplementary directions given by the PM. Provide electronic and printed copies in quantities as directed by the PM.

1. Provide a one to two page Executive Summary summarizing the size and scope of the project, estimated costs, and general programmatic information identifying programs and activities directly benefiting the University.

2. Provide background information on the history of the project; the programs benefiting from the project; and problems it will solve, e.g. space shortages, obsolete facilities, future growth. Describe other parameters affecting definition of the problem, such as master planning issues, existing structural limitations, and site conditions. Typical subheadings might include Project Background, Space Program, Planning Issues and Design Objectives.

3. Where the proposed project is part of a Master Plan or is part of a multi-phase development, include a summary of the planning associated with the total project. The summary should describe how the project fits into the overall objectives and parameters of the master plan, and may include conceptual plans and other available drawings, and projected costs.
4. Include a table of assignable square footage that clearly illustrates the proposed assignments of space.

5. Prepare a presentation rendering(s) at the direction of the PM.

6. Provide a concise presentation of the proposed Schematic Design solution. Narrative should focus on important features of the design addressing the project statement outlined in the introduction. A general description of proposed materials and building systems should also be included as well as planning for future modifications (flexibility) and expansion (expandability). Typical subheadings might include: Site Plan, Interior Design/Building Organization, Architectural Solution, Exterior Design/Building Appearance and Future Expansion.

7. Schematic design drawings should include site plan(s), floor plans, primary elevations, and other drawings necessary to adequately convey important features of the proposed building.

8. Include a Project Cost Estimate, formatted to University guidelines, with approved costs from the PM. See Details in Section II.IX.B.2.

9. Use the following project schedule outline of project schedule milestones (For projects with unknown construction awards and completes (usually due to funding), indicate the construction period in months.):
   a) Design Professional Selection (date)
   b) Schematic Design Approval (date)
   c) Contract Award (if known) (date)
   d) Construction Complete (if known) (date)

B. Schematic Design Submittal

1. Submittal Requirements:
   a) All drawings submitted to the PM shall be dated, show scale and orientation of drawing, and shall carry the title of the project, the Owner’s project job number and the name of the Design Professional. Each project is given an official title which must be used with consistency on all documents. Contact PM for official project title.
   b) Floor plans are to have rooms identified by the Program Room Numbers and Program Room Name. Net and gross area of each floor and total gross area of the building shall be noted on the floor plan drawings.
   c) The Design Professional shall prepare Schematic Design studies illustrating the scale and relationship of project components for approval by the PM. Schematic design drawings must include site plans, floor plans, roof plan, primary elevations, at least one primary building section, and other drawings necessary to adequately convey important features of the proposed building.
   d) The number of Schematic Design options prepared will vary with the complexity of the project. The Design Professional is expected to continue generating options until the requirements of the project are met and a schematic design is approved by the PM.
2. Project Cost Estimate
   a) Submit a written quantitative estimate of construction developed from complete schematic plans and outline specifications.
   b) Break down construction estimate into the major architectural, civil, structural, mechanical, and electrical building components by major divisions of work.
   c) Indicate the Design Professional’s design contingency, if applicable.
   d) Exclude from the construction cost estimate the construction related services and procedures which are performed directly by UI. The PM shall review the scope of work performed by UI departments with the Design Professional.

3. Description of Construction
   a) Provide a project description using the following outline as a guide. This shall include a brief summary of building systems and materials proposed in the schematic design.
   b) Construction, i.e., structural system, wall system, roof design, waterproofing, vertical conveying system, exterior and interior finishes, etc.
      (1) Building controls, plumbing, air conditioning, heating and ventilating systems, ducts, filtration, and piping. Include appropriate code references to be followed in design.
      (2) Electrical services, including voltage, number of feeders, and whether feeders are overhead or underground. Provide a specific description of items to be served by emergency power and describe consideration for special areas.
      (3) Fire detection and protection systems required for intended occupancy of the building.
      (4) Site work issues including exterior utility connections.
      (5) The scope of finishes, furnishings and equipment.
      (6) The scope of communication systems and audiovisual equipment.
      (7) The scope of access and security.

4. Provide estimate for construction period and lead time for special items.

5. Energy Report: Furnish an energy consumption report consisting of calculations (including any computer printouts) and a written summary of the results (clearly indicate assumptions made and used).
   a) Identification of analysis methods. Including loads and building systems analysis.
   b) Building energy consumption.
   c) Energy budget determination.
   d) Methodology of life cycle costing analysis.
   e) Description of major energy conservation features selected, such as building envelope U-values (or R-values), type of fenestration and percent of gross wall area, type of air handling system, reheat systems, automatic system control features, lighting levels and controls, etc.
   f) Estimates of building energy consumption (see below for energy conversion values) are subdivided as follows:
(1) Energy consumption per month by energy type. Including maximum demand per month
(2) Total monthly and annual energy consumption (BTUs)
(3) Annual energy consumption (BTUs) per building system, i.e., lighting, HVAC, hot water, equipment, etc.
(4) Annual energy consumption per square foot of building space (BTU/GSF/year)
(5) Energy conversion values, from 10 CFR Part 436 are:
   - Electricity 3,412 BTU/KWHr
   - Fuel Oil (#2) 137,000 BTU/gallon
   - Natural Gas 1,030,000 BTU/1000 cf
   - Propane 21,560 BTU/lb
   - Coal 24,500,000 BTU/short ton
   - Steam 1,390 BTU/lb
   (adjusted for line loss)
   g) Discuss energy metering: include types of metering and compatibility with existing or projected energy monitoring and control systems (EMCS).

6. The Design Professional shall not proceed to the Design Development Phase until approval has been received from the PM.

X. DESIGN DEVELOPMENT PHASE

A. General
1. Drawings shall show all room and space uses, including location of items of fixed equipment and major pieces of movable equipment whether Owner or Contractor supplied. Structural, mechanical, electrical, communication systems, audiovisual equipment, and access and security shall be developed to a degree that illustrates the building systems, materials, final appearance and nature of the structure of the building.
2. The minimum submittal shall include plans, interior and exterior elevations, sections and details on drawings. Drawings shall be developed with the current version of AutoCAD. Each sheet in the plan set shall have one AutoCAD file which has all layers thawed and visible, and when plotted, shall produce a sheet identical to the respective sheet within the plan set.
3. List major components of the design, including a description of all required equipment.
4. The Design Professional is to verify with the PM review requirements of outside regulatory agencies. The Design Professional may be required at this time to review the design with FM Global and the State Building Code Bureau of the Iowa Department of Public Safety.
5. Tabulate net assignable square foot (NASF) and overall gross square foot (GSF) areas. Show space-by-space comparison of preliminary assignable area with program assignable areas. Tabulate by floor and include totals for the building.
6. Design Professional shall create and submit both full- and half-sized .pdfs.
a) Cost Estimate: Submit a written quantitative estimate of construction developed from complete design development plans and specifications.

b) Show estimated Contractor overhead and profit.

7. Construction Phasing Schedule - Provide a construction-phasing schedule in bar chart and/or outline (narrative) form and/or a phasing floor plan.

B. Design Development Documents

1. Technical Specifications

a) Specifications shall be carefully checked to include all items pertaining to the project and to eliminate inclusion of items not incorporated in the project.

b) The specifications shall include a complete list of extended guarantee items and list of items for which operations and maintenance data are required.

c) References to industry standards shall be checked to verify correct identification of numbers and date of issue.

d) During the review by Owner’s Representative, specifications will be checked thoroughly, but the Design Professional shall not rely upon this in lieu of careful preparation Design Professional review.

e) This manual incorporates certain Owner requirements in the selection of materials and quality of workmanship to be incorporated in the technical sections of the Specifications.

f) The terms “to be,” “must be,” “will be” and “will” are not acceptable when referring to the Contractor. The mandatory “shall” or “shall be” are the only forms with full legal force.

g) Competitive bidding is required by State Law. Throughout the Specifications, the Design Professional shall use a performance type description as far as possible, meeting certain established and recognized industry standards (e.g., ASTM). Where this is not feasible because such standards have not been established, specify three equally acceptable manufacturers or suppliers. This name of one type followed by “or equal” or “or approved equivalent” is not considered to be an adequate specification. As a possible alternative to this procedure, the statement “equivalent to item ‘X’ as manufactured by ‘ABC Company’ “ will be acceptable as a means of establishing the quality desired.

h) For consistency in format the following rules shall be observed:

1. The term “Design Professional”, when it refers to the Architect, Engineer or Landscape Architect who prepares the Documents, shall always be capitalized, and always in the singular.

2. The term “Owner” and “Owner’s Representative” shall always be capitalized, and no other term shall be used in reference to the University as the Owner.

3. Reference to the “Drawings” shall be that, and not to less inclusive term “plans”. “Drawings” shall be capitalized when the reference is to those included in the Construction Documents.
(4) “Specifications” shall be capitalized when reference is made to those trade sections generally so designated, but the term “Specifications” shall not be used when it is intended to include other portions of the Construction Documents.

(5) “General Conditions,” “Supplementary Conditions” and “Special Conditions” are conditions of the Contract and are not parts of the Technical Specifications. See website for the latest versions;  
http://www.facilities.uiowa.edu/pdc/fmspecdocs.html

(6) The term “Contractor” shall be capitalized when used in referring to the prime contractor, but not so used when a subcontractor is meant.

(7) When reference is made to the “Contract” between a Contractor and the Owner, it shall be capitalized.

(8) The term “Contract Documents” shall be used when reference is made to all of the documents so identified in the Contract Between Owner and Contractor and in the General Conditions.

2. Site Plan

a) Overall dimensions of the proposed building(s) or work area including alternatives. Indicate reference to a benchmark and baseline. Show property lines.

b) Location and extent of existing structures on the site within 300 feet measured from the exterior walls of the proposed building or as directed by the PM. Identify structures and streets by proper names.

c) Existing and proposed contours.

d) Show method of general drainage of the site as affected by the proposed building and concepts for mitigating site runoff.

e) Indication of exterior elements; e.g., outdoor facilities, streets, service drives, parking areas, disabled access, paved areas, covered walks, landscape development, stairs, pools, retaining walls, terraces, etc. Include any elements to be demolished. Unless directed by the PM, final landscape design shall be prepared by the University with input from the Design Professional.

f) Section(s) through site, to explain changes in level in the proposed building as related to the site.

g) Underground utilities and structures.

h) Small-scale campus map indicating project location on title sheet.

i) Potential location for utility locations.

j) Snowmelt system feasibility shall be evaluated during early design for main buildings entrances involving steps and/or ADA ramps. This shall apply to all new buildings and any major building renovations involving planned construction at a building entrance involving steps and/or ADA ramps. Priority should be given to snowmelt system applications as follows:

(1) ADA ramps and routes

(2) Main building entrance on the north side with steps or ramps.
(3) Any building entry point with six (6) or more risers to the building entrance.

(4) Truck delivery points where delivery route is sloped.

3. Floor Plans
   a) Locations, sizes, and space numbers of programmed spaces and other required gross areas, including corridors (width), stairs, toilets, custodial closets, ITS rooms, mechanical spaces, storage rooms, etc.
   b) All Floor Plans and Room Finish Schedules shall indicate room numbers.
   c) Location of doors and windows. Indicate door swings.
   d) Overall dimensions of each major area of the building(s).
   e) Location of plumbing fixtures such as lavatories, floor drains, water closets, urinals, service sinks, drinking fountains, fire hose cabinets, fire extinguishers, sprinkler systems, etc.
   f) Indicate principal built-in features such as fixed auditorium seats, kitchen equipment, display cases, casework, counters, shelves, lockers, etc.
   g) Indicate extent of any demolition work, site access, and dust barriers.
   h) Interior signage drawings and details (to scale):
      (1) Locations shown on floor plan keyed by code number. See Appendices.
      (2) Sign schedule referencing location code number, sign type designation, and sign message. See Appendices.
      (3) All sign art shall be created in vector format to be used as mechanical art for sign fabricator.
      (4) All map art shall be created full color in vector format to be used as mechanical art for sign fabricator.

4. Roof Plans and Roof Details
   a) A roof plan and detail of existing conditions (reroof) or other components and penetrations (new).
   b) Photographs of overall roof condition and show locations of inspection openings (reroof project only).
   c) An outline of the method of reroofing.
   d) A narrative report discussing major design features and options (reroof).
   e) Identification of existing components and methods of attachment.
   f) Simple sketches showing method of detailing new system.
   g) Design Professional must submit to the PM calculations used to determine control and expansion joint width and spacing.

5. Elevations and Sections
   a) Exterior elevations for the building must show windows, doors, louvers, solar screening systems, stairs, platforms, retaining walls, etc. Indicate grades, paved areas, etc.
   b) Indicate floor heights and window sill heights.
   c) Include longitudinal and transverse sections for each major area, indicating floor elevations, finish exterior grades, ceiling heights, pipe tunnels, unexcavated areas, basement and areaways, rooflines, parapets, etc.
d) Various floor and grade elevations including those for interior and exterior stairways, walls, terraces, walk, etc.

6. Interior Planning
   a) The following space types must be thoroughly dimensioned to illustrate details clearly:
      (1) Classrooms and lecture halls
      (2) Kitchens and related service areas
      (3) Laboratories and other programmed spaces
      (4) Toilet, shower, and locker rooms
   b) Include an interior finish schedule that indicates, in general terms, floor, wall, and ceiling finishes together with special items of finish.
   c) Indicate location of moveable items of furniture and equipment listed in the space description sheets. Differentiate from built-in furniture and equipment.
   d) Indicate elevations on reflected ceiling plans.

7. Design Summary (Basis of Design)
   a) Provide design summary documentation in an indexed report format with all assumptions and references stated. (Project Manager shall distribute to appropriate FM staff.) Include:
      (1) Architectural design calculations (including occupancy classifications, type of construction, fire resistive ratings, exiting calculations, allowable building height and area, toilet fixture calculations and any unusual provisions or exceptions applicable to the project).
      (2) Structural design calculations (include live load, roof load, snow load, wind load, lateral soils load and seismic load calculations. Also include any unusual provisions, special loads or exceptions applicable to the project).
      (3) Mechanical design calculations (include building loadings, equipment sizing, steam pipe stress analysis, annual energy usage and any unusual provisions or exceptions applicable to the project).
      (4) Electrical design calculations (including fault current calculations, transformer loading, circuit sizing, building energy usage and any unusual provisions or exceptions applicable to the project). See required electrical load calculation worksheets: http://www.facilities.uiowa.edu/dcs/DesignStandards/ElectricalLoadCalculationsJan2009.doc
      (5) Civil design calculations (include storm drainage, sanitary sewer, domestic water service, transportation, and any unusual provisions or exceptions applicable to the project) that demonstrate systems have the capacity to support the project.
      (6) Basis of design equipment and material information (e.g. catalog material, charts, tables, performance curves, etc.).
      (7) Update energy conservation report and life cycle costing.
(8) Verification of compliance with University standards, guidelines, and codes.

8. Design Drawings Format
   a) AutoCAD drawings shall comply with the current AIA/NIBS National CAD Standard layer naming format. Each file shall be complete with any x-ref drawing files or shape files to be bound to the drawing file. Fonts supplied with current version of AutoCAD shall be used. The purge command shall be invoked to delete all unreferenced blocks, layers and line types.

9. Existing Utilities Capacity - Show verified capacity at points of connection to existing utilities.

10. Building Envelope – Show typical configuration and integration of the air and weather barrier into adjacent building envelope materials.

11. Landscape Development Plan
   a) Show all roadways, walks (including ADA), parking lots and other hard surface areas
   b) Show any anticipated snowmelt systems.
   c) Show all existing plant material to remain; including plant material, type, variety, size and condition. Identify any significant plant material to be protected and/or retained on the site.
   d) Proposed landscape plan
   e) Show existing and final site grading and identify any surface water drainage issues that must be corrected as part of the project.

12. Structural Plans
   a) Include the design loadings (dead, live, wind, snow, seismic), material specifications and design stresses (steel, concrete, masonry, soil bearing, etc.) assumed during the design, plus assembly stresses where applicable.
   b) When structures employ a beam-column framework, a grid reference system using alphabetic and numeric symbols shall be utilized. When additions are made to existing structures, the original reference system shall be extended where practical.
   c) Detail junctions between floors, roof, and exterior wall to assure continuity and load path.
   d) Drawings shall clearly dimension and accurately describe non-standard details and construction requirements. Included but not limited to:
      (1) Construction and expansion joint
      (2) Special jacking and lifting procedures
      (3) Protective cover (concrete)
      (4) Anchor bolt material and projection
      (5) Special connection details
      (6) Shoring requirements (including soil nails)
      (7) Construction sequence
      (8) Bolt torque
(9) Concrete reinforcing details
(10) Connection capacity
(11) Water stops, etc.
e) Show type, placement, and location of rebar splices.

13. Mechanical
a) Plumbing Plans
   (1) All required demolition.
   (2) Indicate locations of main wastes and vents, as well as service mains.
       Include water, air, gas, vacuum, etc.
   (3) Indicate pieces of equipment, showing location and required piping connections.
       Include pumps, tanks, backflow preventers, generators, etc.
   (4) Provide equipment schedules for plumbing fixtures.
   (5) Provide isometrics for water, sanitary, and gas piping.

b) Heating, Ventilating, Air Conditioning and Piping Plans
   (1) All required demolition and associated capping of piping and duct runs.
   (2) Indicate service mains, including steam, condensate, compressed air, hot water, chilled water, condenser water, gas, etc.
   (3) Indicate air moving equipment and double line duct runs to all outlets including supply and exhaust fan systems, fume hoods, etc.
   (4) Indicate pieces of equipment, showing locations and required piping connections including pumps, tanks, converters, etc.
   (5) Provide equipment schedules indicating sizes, capacities and operating characteristics.
   (6) Provide air and water flow diagrams for supply and exhaust air, and water distribution systems. Diagrams are to indicate flow rates in mains and branches to assist in balancing.
   (7) Control schematics and sequence of operations.

c) Large Scale Drawings of Equipment Rooms
   (1) Indicate layout of equipment to assure adequate space allowance.
   (2) Include elevations of built-up fan units to assure proper air flow and access to component parts of the units.
   (3) Show pump layout and piping runs.
   (4) Provide room section cuts assuring room accessibility for maintenance personnel.

d) Fire Protection and Detection
   (1) Show pipe runs, sprinkler locations, standpipes, pumper connections, and test connections.
   (2) Show coverage rate of sprinklers.
   (3) Show any special equipment.
   (4) Show control schematic.
   (5) Show fire alarm panel locations.
14. **Electrical Plans**
   a) All required demolition.
   b) Show the power and control layouts on one set of drawings and the lighting layouts on a different set of drawings using standard symbol conventions. Show all conduit sizes and the size and number of conductors. Show electrical and data on one sheet and electrical, data, and furniture/casework on a separate sheet.
   c) Provide single line electrical distribution diagrams showing primary service to substations and secondary service to distribution switchboards, motor control center, and panel boards for power and lighting. Show all conduit sizes and the size and number of conductors.
   d) Indicate the point of connection to external utilities.
   e) Indicate and provide utilization schedule for each load center unit substation, motor control center, distribution and switchboards, telephone equipment rooms, and closets.
   f) Indicate type and locations of lighting fixtures in typical offices, laboratories, corridors, examination rooms, etc., and use a schedule for detail.

**X. CONTRACT DOCUMENTS**

Information in this section shall be used by the Design Professionals in the preparation of the contract documents that consist of the project manual, the drawings, and addenda.

The term “Project Manual” refers to the written portion of the contract documents; Bid form, Uniform General Conditions, Supplementary Conditions, Special Conditions and Technical Specifications.

The term “Drawings” refers to the graphic portrayal of elements included within the scope of the contract documents.

There should be no duplication between portions of the contract documents; instead, they should be complementary.

**A. General**

1. Contract documents shall be complete and ready for seals and signatures.
2. The Design Professional of record and all other appropriate Professional Consultants shall place their individual information blocks with certifications, seals, signatures and dates on the original title page of the Bidding Documents (drawings, specifications and addenda) and shall deliver to the Owner within 14 days of the project’s bid opening. The information block shall include the numbers of the pages or sheets, which are covered by certification.
3. All corrections to drawings and specifications identified during design development and subsequent intermediate reviews shall be completed and incorporated into the bid documents.
4. The Design Professional shall provide a final logic bar chart schedule for project construction and identify the critical path. The schedule shall include purchase and delivery activities and durations for all major equipment and building components.

5. Revised, detailed construction estimates shall be submitted. These estimates shall become the basis for the University estimate to be used at bid opening. The estimates shall include separate estimated costs for any construction alternates included in the bid documents but not part of the base bid.

6. Layering Guidelines
   a) AutoCAD drawings shall comply with the current American Institute of Architects (AIA)/National Institute of Building Sciences (NIBS) National CAD Standard layer naming format. Each file shall be complete with any x-ref drawing files or shape files to be bound to the drawing file. Fonts supplied with the current version of AutoCAD shall be used. The purge command shall be invoked to delete all unreferenced blocks, layers and line types.

7. Drawing Format
   a) The following are minimum requirements for projects involving construction of new facilities and renovations of or additions to existing facilities.
   b) A graphic scale shall be required on all drawings.
   c) Drawing size shall be D size sheets (24” x 36”), unless otherwise directed by PM.
   d) Drawings shall be segregated into disciplines (Architectural, Civil, Structural, Mechanical, Plumbing, Electrical, Interior, Fire Protection Systems, Technology, etc.).
   e) Pertinent information shall be shown only on discipline drawings applicable to that division of work. If information must be located on drawings of a different discipline, drawings shall be cross-referenced.
   f) Schedules for mechanical equipment, electrical equipment, doors and windows, and room finishes shall be included on the drawings.
   g) Manufacturer and product names shall be referenced in equipment schedules.
   h) Symbols and abbreviations used on drawings shall be explained and shown on legends.
   i) Design details, sketches, and drawings shall be shown on the drawings, not in the specifications.
   j) Each drawing sheet shall display the following:
      (1) Advertisement/issue date
      (2) Title of the project
      (3) An individual sheet title
      (4) Alphanumeric number indicating discipline and sheet number
      (5) Scale
      (6) Project number
   k) Title sheet or sheets in each set of drawings shall contain the following:
      (1) Design Professional’s Seal
      (2) Title of the project and project number
(3) Owner’s name: (University of Iowa)
(4) Design Professional’s name
(5) Drawing index (unless directed otherwise by PM)
(6) Site location plan (including street address)
(7) Advertisement/issue date

l) Sections and details shall be numbered and cross referenced.
m) Provide a title sheet or sheets for each bound set. Identify abbreviations and symbols used on the drawings in a key or legend.
n) Provide building code information, such as occupancy and construction type. A life safety plan indicating fire rated walls and means of egress shall be prepared for each level of the building affected by the project.
o) Drawings shall be carefully checked by the Design Professional to achieve coordination between architectural, structural, mechanical, electrical and fixed equipment plans.
p) All Floor Plans and Room Finish Schedules shall have room numbers. All Floor Plans shall have grid line designations noted.
q) Notes and dimensions on the drawings shall be large enough to be easily read. This is especially true if drawings are to be reproduced at half size for bidding documents.
r) DDC control diagrams and sequence of operations are to be included as part of the Construction Drawings.
s) Project construction limits, construction fencing, and Contractor access shall be clearly shown on the site plan drawings. Include any required tree protection or special requirements.
t) Where necessary to control pedestrian traffic the standard post & chain fence shall be used. Refer to Appendices for details.
u) Roofing Construction Drawings:

(1) The roof drawings shall include all features and elements of the roof, including roof slope and drainage, all penetrations and mechanical equipment. The following items should be shown on the roof plans, accurately located and drawn to scale.
   (a) Mechanical units, exhaust fans, vents
   (b) Piping, conduit and related supports
   (c) Roof walkways, screens, hatches and ladders
   (d) Roof drains, overflow drains and scuppers
   (e) Miscellaneous penetrations
   (f) Expansion joints and area divided curbs
   (g) Gutters and downspouts
   (h) Valley, ridges, saddles and crickets.

(2) The drawings shall include as a minimum complete details of roof system and components including:
   (a) Each roof perimeter condition
(b) Each penetration condition, including vent flashing
(c) Each roof-related sheet metal fabrication
(d) Equipment curbs, skylight curbs, and roof hatches
(e) Roof expansion joints and area dividers
(f) Piping & equipment supports.
(g) Typical roof drain and overflow drain including sumps and flashings
(h) Scuppers.

(3) Roof flashing details shall indicate as a minimum following components:
(a) Roof deck and wall substrate and other adjacent materials
   Insulation including separate layers and vapor retarders.
(b) Roof and flashing membrane
(c) Cant strips, if applicable
(d) Flashing attachment, if applicable.
(e) Counter flashing and reglets
(f) Sealants
(g) Wood nailers and blocking, including adequate attachment.

v) Drawings shall include roofing system interface(s) with rest of building
   envelope(s), as well as details indicating how penetrations are to be handled.

w) Structural construction drawings shall include: structural loadings and details
   (floor, roof, cross-sectional, etc.)

x) Mechanical & Electrical construction drawings shall include:
   (1) All ductwork plans are to be shown double lined, 1/4” scale minimum.
   Provide an enlarged plan for all mechanical rooms. All ductwork and
   piping 3” and larger to be shown double lined. Clearly identify locations
   for valves and dampers on drawing plans, sections and installation
   details.
   (2) Completed equipment, lighting and power panel schedules
   (3) All details, cross-sectional and elevation views.
   (4) Air and water flow (balancing) diagrams (For reference only).
   (5) Control schematic, point listing, and sequence of operation (For
       reference only.)
   (6) Show equipment schedules and sequence of operation information on
       mechanical drawings.
   (7) Identify circuits and show equipment schedules on electrical drawings.

y) The Design Professional, at the direction of the PM, shall incorporate drawings
   that illustrate the location of any expected asbestos containing materials.
   Design Professional shall not be responsible for the identification and removal
   of asbestos. Asbestos-containing materials shall not be used.

z) All drawings shall be converted to “.pdf” files using the latest version of Acrobat
   Reader. Pdf files shall be provided to the University’s printing vendor for
   reproduction of bid documents.
8. Project Manual and Specifications
   b) Language of the project manual shall be brief and consistent. Do not repeat information contained in the General Conditions, Supplementary Conditions, or the Special Conditions in any other section. Do not repeat information contained in the specifications (except in equipment schedules).
   c) The end of each technical section shall be marked “End of Section.”
   d) The Project Manual shall have the official Project title, Owner’s Project number, Design Professional’s name and date of issuance on the cover. The date of issue shall be the same date as on the Drawings. The Design Professional’s seal of professional registration in the State of Iowa shall be included in the specifications. Include Volume number if applicable.
   e) No allowances shall be provided in the contract documents unless approved by the PM.
   f) The term “Contractor” shall be used throughout the specifications in the context defined in the General Conditions.
   g) The General Conditions cover all one-year warranties and guarantees. Warranties/Guarantees other than one year shall be stated at the end of the applicable section(s). Do not repeat one year warranties and guarantees in the specifications.
   h) Only the “Owner”, “Owner’s Representative”, “Design Professional”, and “Contractor” shall be referred to in the specifications.
   i) Design Professional shall list all required submittals, shop drawings, operation and maintenance manuals, warranties and certifications required in UI Specifications Division 01.
   j) The geotechnical report, if applicable, shall be included, for reference only, as part of the contract documents.
   k) Specifications shall be developed using the current version of Microsoft Word, with an electronic file submitted to the Owner at completion of the bidding phase and at the completion of the Project.

9. A color board shall be produced, if required.

END SECTION II - DESIGN DOCUMENTATION AND DELIVERABLES
SECTION III - GENERAL DESIGN STANDARDS

This section contains planning information to be used by Design Professionals in the design of University facilities and infrastructure.

The criteria represent minimum levels of performance, quality, and/or standards, which are sometimes different than those accepted in private and commercial industry. This is in recognition that these facilities must survive longer than normal service lives, without undue cost, while still supporting academic, research, and service missions of the University of Iowa.

The individual guidelines are grouped under major headings of Civil, Architectural, Structural, Mechanical, and Electrical. Any conflicts between the requirements in listed reference documents shall be resolved by the Project Manager [PM].

I. CIVIL

The following information is provided as a general guideline in establishing civil engineering design requirements.

A. Subsurface Investigations

1. The University shall be responsible for providing record information of underground utility lines and structures.

2. Contractor shall contact Iowa One-Call for location of utilities. All locates shall be Joint Locates.

B. Soils Investigations

1. If investigative soils analysis is required during project design, University shall retain a soils engineer.

2. The soils engineer, in consultation with the University and the Design Professional, shall determine number, sizes, depth, and proposed location of borings and/or pits. In general, there shall be one boring for every 2,000 square feet of building footprint, with a minimum of four soil borings. To the extent possible, borings should be located near the location of proposed footings/piers.

3. Boring information shall be shown, with dimensions, on a plot plan to be submitted in two (2) copies by the Design Professional to the University at least five (5) working days prior to proposed sampling.

4. The plan shall show:
   a) A graphic scale, north arrow, and location of existing buildings and trees
   b) Above and below ground service/utility lines (both utility company and University-owned)
   c) Pavement areas and established benchmark(s) with elevation(s) noted
d) Existing site features, not specifically mentioned, impacting boring or pit locations.

e) The soils/geotechnical report shall be included as an informational item of the bidding documents in the general requirements, Section I.

C. Site Survey

1. For new construction and major renovations, a complete and thorough site survey shall be conducted prior to design development to identify all existing above and below ground site and utility features on the project site. This survey shall include but not be limited to:
   a) Any active or abandoned utility whether University of Iowa, City of Iowa City or private utility company services.
   b) Adequate topographic information and spot elevations to allow for proper design for drainage.
   c) Location, size and name of all plant material. This information shall be provided to Landscape Services for evaluation of condition and determination of protective measures during construction.
   d) Location and type of all site lighting fixtures.
   e) Location of all structures, parking lots, sidewalks, roads, paths, etc.
   f) Location of all site furniture (benches, signs, fences/barriers, trash receptacles, etc.)

D. Landscaping

1. Landscape Services should be consulted during design development to determine their level of involvement in site design and site restoration work. If Landscape Services accepts any or the entire site design or site construction work a work authorization shall be issued against the project for their services. If Landscape Services elects not to perform this work it shall be part of the project contract. Landscape Services shall provide design review and assist in inspecting landscape construction work.

2. Trees:
   a) Preservation and protection of existing trees and landscape should be a primary consideration in any project.
   b) The Design Professional shall clearly identify any trees or plant materials that are proposed for removal. Proposed removals shall be reviewed and approved by Facilities Management, Landscape Services.

3. Critical Root Zone Protection:
   a) The critical root zone (CRZ) shall be shown for each tree to be protected. That zone is determined using the following formula and criteria:
      (1) The diameter of the tree trunk is measured 4.5 feet above ground level. The diameter in inches is multiplied by 1.5 feet to obtain the critical root zone radius.
(2) Plan notes and specifications shall restrict construction activity within this critical root zone. A sturdy fence shall be installed to define the limits of the CRZ and shall be maintained throughout the construction period.

(3) The soil within this protected CRZ shall not be disturbed in any manner during construction. No equipment, materials, supplies and/or salvage shall be stored or placed within the zone. No filling or cutting of existing soil shall be permitted within the CRZ.

(4) All tree protection fences on projects with an anticipated duration of 8 months or more shall be galvanized chain link fence posts and fabric. Fence height shall be a minimum of 4’-0”.

4. Lawns: Finished lawn areas shall have a finished slope no steeper than one (1) foot vertically to three (3) feet horizontally. Steeper areas shall be covered with ground covers or modified with walls or other treatments.

5. Seed and Sod:
   a) In most cases a preference is given to sod versus seed to provide a more immediate appearance of completion.
   b) Providing adequate turf coverage to allow timely acceptance for National Pollutant Discharge Elimination Systems (NPDES), Phase II, Municipal Separate Storm System (MS4) storm water management permits should be considered in selecting seed or sod.
   c) Determination to seed should be based on when the site shall be available for seeding and its conformity to normally accepted seeding dates. Dormant seeding is not recommended.
   d) If a dormant seeding is proposed due to schedule, a protective barrier must be included to minimize or eliminate soil erosion.
   d) Selection of seed mix should be based on site specific issues and reviewed with Landscape Services.
   e) Projects should include all necessary water maintenance as required by weather conditions for the first three months after installation or to the end of the growing season whichever is first.

6. Selection of landscape plant materials shall be based on plant hardiness and on growth success within the area used. Design Professional should use the Campus Urban Forest Study as a guide to tree selection. All proposed plant material selections must be approved by Landscape Services.

7. A planting schedule shall be provided and timed in relation to planting season and the University’s acceptance of the project.

8. Specific treatments shall be identified for project limit lines or edges.

9. The following planting schedules shall be used:
   a) Spring Planting Schedule:
      (1) Trees (Deciduous and Coniferous Evergreen): Shall be planted between March 15 - June 15. Oak varieties should only be planted in the spring.
(2) Shrubs: same as trees
(3) Ground covers and herbaceous perennials: same as trees
(4) Turf: shall be seeded (sodded) between April 1 and May 31

b) Fall Planting Schedule:
(1) Trees (Deciduous, except Oak varieties): shall be planted between October 1 and November 30
(2) Trees (Coniferous Evergreen): shall be planted between September 1 and October 30
(3) Shrubs: shall be planted between September 15 and November 30
(4) Ground covers and Herbaceous Perennials: shall be planted between September 15 and October 15.
(5) Turf: shall be seeded between August 25 and October 1; shall be sodded between September 1 and November 15

10. During the design process, design options shall prohibit the use of any smooth horizontal or sloped surface adjacent to a paved walk, street or plaza by skateboards and inline skates.

11. Any surface greater than 6” and less than 4’-0” above grade and over 4’-0” in length adjacent to a smooth paved surface shall be designed with skateboard and inline skate damage prevention in mind. This should include retaining walls, handrails, seat walls and site furniture benches, etc. Proposed solutions should complement and be an integral part of the overall site design.

12. All handrails shall be designed in such a way as to prohibit their use for skateboards and inline skates and shall meet all applicable ADA standards.

13. Where necessary to control pedestrian traffic the standard post & chain fence shall be used. Refer to Appendices for details.

E. Roadways, Parking Lots and Walkways
1. All curbs shall be Portland cement concrete.
2. Pavements shall be designed to accommodate the design vehicle for the pavements use. The minimum lane width shall be 10-feet, excluding curb and shy distance (concrete pavements), curb and gutter (asphalt pavements), or striping. Curve radii and intersection radii shall accommodate the design vehicle’s design speed and turning movements.
3. Paved walks less than eight feet wide shall be designed with a cross slope of two percent to facilitate drainage. Walks equal to or greater than eight feet wide shall have a minimum slope of one percent. It is desired to maintain positive drainage away from walks so surface water does not cross them.
4. All sidewalks shall have a minimum width of 6’. Where a sidewalk abuts to a road or driveway, minimum width is 10’. Walks adjacent to roads or driveways shall not have grass strips between sidewalk and road or driveway, unless a minimum 8’ grass strip can be provided. A medium broom finish shall be applied perpendicular to traffic flow. All brooming directions shall be shown on the drawings and described in the specifications.
5. All accessible parking spaces shall be designed per “universal accessible” criteria as defined in Iowa Administrative Code Section 661-18.3 Exception.

6. Parking spaces, other than accessible shall be 8.5’ in width. No compact car spaces shall be permitted.

7. Locations where a parking lot abuts to lawn areas, a mowing strip shall be incorporated into the design of the parking lot. A mowing strip is a strip of pavement, 24” in width, on the lawn side of the curb or parking bumpers allowing the lawn to be mowed while parking spaces are occupied.

8. Preferred material for sidewalks, ramps, and other paved, exterior walking surfaces is concrete. All materials must be slip resistant.

9. All sidewalks leading up to a vehicular roadway or route shall have a truncated dome (per 705 of the 2010 ADA Standards for Accessible Design) installed. The truncated dome shall be Armor-Tile, color: Colonial Red

10. Design shall be in general accordance with AASHTO “GREEN BOOK” — A Policy on Geometric Design of Highways and Streets, latest edition. Exceptions shall be allowed with UI approval where context-sensitive design is warranted.

11. Snowmelt System
   a) Snowmelt systems (if selected) shall provide 24/7 protection from accumulation of snow and ice at major building entrances and ADA ramps.
   b) Snowmelt systems shall circulate glycol under low pressure through closed-loop piping embedded in concrete.
   c) Snowmelt systems should be controlled through the Building Automation System (BAS).
   d) Conceptual design should use a base typical system for 150 Btu-h per square foot with a 10-mph wind at 0 degrees F.

F. Temporary Traffic Control

1. Temporary traffic control shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTDC) Part 6: Temporary Traffic Control (current version).

2. Contract Documents shall include language for Contractor to provide and install temporary construction project signage, with contractor responsible for maintaining as installed through project completion. Signs may be installed on the project fencing or supported independently, depending on site conditions.

G. Sanitary Sewers

1. Sanitary sewers shall be designed in accordance with the standards and requirements of the Iowa Department of Natural Resources and local requirements.

2. Sewer systems shall be designed to carry traffic loads in all locations.

3. Sewer piping installation shall include sand backfill.

4. The minimum service line size shall be 6”. The minimum sewer line size shall be 8”.

5. Pre-cast concrete manholes shall comply with ASTM C478 or ASTM C76, Class 3. Cast-in-place manholes shall be detailed in the construction documents.
6. Cleanouts may be used at the end of a sewer line where the distance to the downstream manhole is 150-feet or less. Cleanouts are required on service lines outside a building footprint and at horizontal or vertical bends in a service line. The deflection should utilize a wye with the cleanout as an upstream extension of the downstream line’s alignment.

H. Storm Drainage
1. This section applies to storm water conveyance systems outside the footprint of buildings. Building systems are covered in the Mechanical Systems section.
2. Trunk storm sewers are defined as the primary spine(s) of the piping system and generally carry the flow from more than one site.
3. Storm water systems shall be designed using the actual time of concentration. The worst case of complete development, per the current Campus Master Plan, or current conditions shall be used for calculation of offsite flow. Minimum storm drainage size 12”.
4. Generally the Rational Formula shall be used for areas under 200-acres. Runoff coefficients shall consider percentage of impervious area and average site grade (slope).
5. Return periods shall be 25 years with actual time of concentration (duration) for all building sites, pedestrian malls, streets, quadrangles, and trunk storm sewers.
6. Return periods shall be ten (10) years with actual time of concentration (duration) for parking lots, park space, and open areas.
7. PM shall establish “return periods” for all other areas. Return period must satisfy governing municipality’s regulations.
8. No ponding is allowed on paved areas. Detention basins shall be labeled on the drawings.
9. Design Professional shall compare above return periods with those required by the local municipality. Coordination with municipality may be required and should be reviewed with the PM. Any discrepancies shall be discussed with the PM.
10. All buildings and structures shall be developed such that no entry of water through entrances, window wells, area ways, basements, drains, etc. shall occur during a minimum hundred year storm. Design should maintain positive drainage away from building entrances.
   a) Connections to building drains shall be designed to prevent surcharge from the storm sewer for the 100-year storm.
   b) Sidewalk grade shall be set to prevent surface from collecting and channeling surface drainage.
11. Particular attention shall be paid to bicycle and wheelchair safety in the design of storm drainage systems. Grate bars shall be placed perpendicular to direction of traffic flow. Grates in pedestrian areas should be sized to avoid catching heels of shoes.
12. Storm drains, except small area drains, shall be reinforced concrete pipe (RCP) conforming to ASTM C76 or AASHTO M170, Class 3 minimum, 12” or larger.
13. Piping for small area drains in courtyards, small yard areas, and building area ways may be 8” or larger.

14. Storm drains less than 36” in diameter shall run on a straight line and grade between structures. Horizontal and vertical bends are permitted in 8” and 10” lines provided a cleanout is included. The deflection should utilize a wye with the cleanout as an upstream extension of the downstream line’s alignment.

15. Comply with the requirements of the National Pollutant Discharge Elimination Systems (NPDES) General Permit No. 2. The University’s Municipal Separate Storm Sewer System (MS4), NPDES Permit requires the control of storm water runoff from long term post-construction sites (MS4, NPDES Permit No. 52-25-0-06, condition II-E). During the design phase, the Design Professional must consider and minimize the post construction storm water runoff in order to prevent or minimize water quality impacts and minimize the quantity of storm water runoff. Best management practices related to both water quality and water quantity shall be considered in the design of all projects, and implemented when practical. Best management practices using storm water detention and retention, grass swales, bio retention swales, riparian buffers and proper operation and maintenance of these facilities shall be evaluated for the preferred method to manage storm water. The PM shall coordinate the review of these designs with the UI’s environmental compliance officer and other campus stakeholders.

I. Water Distribution

1. When additional water loads are to be applied to the water distribution systems, the PM and Facilities Management – Utilities and Energy Management unit must be consulted and an evaluation of the load design requirements and available water distribution facilities and operational needs of the Water Plant and water distribution systems must be completed. The anticipated loads shall be added to our current hydraulic model and determined what is acceptable, and what changes are required.

2. All piping shall conform to AWWA standards and the requirements of the Iowa DNR.

3. All water meters shall be located inside buildings.

4. The material for water distribution systems shall be Class 53 restrained joint cement lined ductile iron pipe wrapped in plastic.

5. Fire hydrants shall be provided in accordance with the requirements of the local fire district or department. Hydrants shall be provided with an auxiliary valve, installed with the streamer directed toward a street or drive. Hydrants shall match existing campus hydrants. See Appendices for detail.

J. Spill Prevention

1. Comply with Spill Prevention, Control and Counter Measures (SPCC) 40CFR112.

2. Any and all oil storage devices must be double walled/vented or have secondary containment per SPCC 40CFR112.7. Oil includes oil of any kind or in any form, including, but not limited to, petroleum, hydraulic oil, fuel oil, vegetable oil, animal oils, sludge oil refuse and oil mixes with wastes other than dredged spoil.
3. The intent of this standard is that any “oil” spillage from storage tanks, reservoirs, etc., cannot find its way off of the immediate site through sanitary sewer, storm sewer or surface run-off.

4. Where this Federal code is applied in designs for the University of Iowa, written notice of such must be made to the PM by the Design Professional before final review of drawings and specifications. This notice shall allow other 40CFR112 requirements to be provided by the University in order to comply with the code.

II. ARCHITECTURAL
The following information is provided as a guide in establishing architectural requirements and should not be construed to limit the Design Professional from proposing more cost effective alternates.

A. General
1. Facilities shall be designed per the latest edition of ADAAG (Americans with Disabilities Act Accessibility Guidelines) and the Accessibility Section in this document.
2. The building, addition, or renovation shall meet all applicable codes.
3. Finished floor height shall be expressed on contract documents as actual elevation based on University of Iowa’s datum, not on an arbitrary one. Floor elevations should be continuous. No height transitions between floor types.
4. Unless otherwise proposed by the Design Professional and approved by the PM, design of animal rooms shall comply with “Federal Regulations, Title 9, Subchapter A, Animal Welfare 43FR56217” and the Public Health Service Regulations contained in DHEW Publications #(NIH)78-23, and the latest ALAC standards.
5. The Design Professional shall plan access for servicing and maintenance of equipment. Minimize rooftop equipment and roof penetrations by consolidating equipment in mechanical rooms. At least one elevator should provide service to mechanical penthouses. Stairs should be provided to access roof areas. No air cooled condensing units should be within any machine rooms.
6. Provide a Knox Box at the entrance where the fire alarm panel is located. Coordinate with UI Public Safety.

B. Fire Protection
1. Facilities shall be constructed of fire resistant materials.
2. Floors and floor/wall assemblies shall at least equal the requirements of the designated User Group/Occupant, as defined in the applicable codes.
3. Doors at facility perimeter shall have a rating commensurate with the wall system in which they are located.
4. Fire Extinguishers are to be selected as follows:
   a) Public areas and laboratories: Amerex B402 – 5 lb multi-purpose (ABC) dry chemical fire extinguisher.
   b) Laboratories: Amerex 322 – 5 lb carbon dioxide (CO2) fire extinguisher.
c) Electrical rooms (where required): Amerex 330 - 10 lb carbon dioxide (CO2) fire extinguisher.
d) Mechanical rooms and high hazard rooms: Amerex B456 – 10 lb multi-purpose (ABC) dry chemical fire extinguisher.

5. The Contractor shall purchase and install the fire extinguishers.

6. Fire Extinguishers and Cabinets
   a) Fire extinguisher cabinets shall be:
      (1) Larson 2409-R2 with full acrylic view (24” H X 9” W X 6” D) that hold a 5 lb ABC, 10 lb ABC or 5 lb CO2 extinguishers.
      (2) Other cabinet manufacturers may be considered; however, they must meet or exceed the size of the Larson 2409-R2 cabinet.
      (3) Cabinets shall be used in all public areas, i.e. corridors, lounges, lobbies, gathering spaces.
      (4) Extinguishers may be hung in laboratories, electrical rooms, and mechanical rooms without a cabinet only when space does not allow for cabinet installation.

C. Building Envelope
   2. Exterior wall insulation may be semi rigid, blanket batt type, glass fiber, unfaced, complying with ASTM C665 and the following ASTM E84 values:
      a) Flame spread less than 25.
      b) Smoke development and fuel contributed less than 50.
   3. Polystyrene insulation board below grade on exterior walls is prohibited. If basement walls need insulation, installation required to be on interior face.
   4. All foundations walls with accessible or occupied space on one side and soil on the other shall be waterproofed below grade.
   5. Drain tiles are to be installed at footings and tied to storm sewer system as allowed by local municipalities. Down spouts shall be tied into storm sewers (in lieu of foundation drain tiles) and shall not discharge on grade.
   6. Crawl spaces shall have concrete floor slabs, floor drains, ventilation and lighting.
   7. Exterior building materials shall be selected to maintain and/or compliment the harmonious nature of the campus. Care shall be given to provide a consistent image to the character of the campus. Materials should be practical, maintenance free, durable, and cost effective.
      a) Exterior walls systems of brick or stone is preferred over metal. Block backup is preferred over the use of steel stud backup.
      b) Exterior insulation and finish systems [EIFS] stucco, and plaster shall not be used as the primary finish of a building or renovation. The allowed use is for small areas or soffits with the approval of the PM.
c) The use of curtain walls, spandrel panels, etc. is generally limited to public and vertical circulation areas. The PM must approve other applications.

8. Exterior Enclosure Performance Requirements:
   a) Materials used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.0002 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 2178.
   b) Materials used for the weather barrier system in the opaque envelope shall be vapor impermeable with a water vapor permeance not to exceed 0.08 perms when tested in accordance with ASTM E96 – method B. Water absorption shall not exceed 0.1% maximum when tested in accordance with ASTM D570.

D. Roofing
   1. The Design Professional shall select roof systems which are suitable for the facility. To evaluate possible systems, the Design Professional shall consider the following design parameters:
      a) Life of the roof system
      b) Initial (first) cost of the roof system and additional building costs required for recommended roof system
      c) Maintenance costs and requirements
      d) Energy costs associated with recommended roof system
      e) Building height/roof slope/wind resistance requirements
      f) Present and future use of building, including specific uses in the building that could affect the roof system
      g) Local environmental issues/contaminants and pollutants
      h) Life expectancy of building
      i) Structural properties of roof superstructure
      j) Type of roof deck
      k) Slope/drainage
      l) Vapor retarder requirements
      m) Roof traffic/access and penetrations
      n) Code/Insurance requirements and restrictions
      o) Aesthetics
      p) HVAC internal pressures
      q) Application issues, such as staging, access, building use and occupancy, etc.

   2. After establishing design parameters, systems should be evaluated by the Design Professional based upon:
      a) Minimum established UI standards
      b) A choice of roof systems with properties that, considering all factors, are best suited to the project
      c) Requirements for a total system warranty
3. The Design Professional shall follow these roofing guidelines when designing the roofing system:
   a) The roofing system and roof covering materials shall meet a minimum 1-60 SH (severe hail) FM Global approved rating. All components shall be FM Global approved both individually and for use in a listed FM RoofNav assembly.
   b) Use only recommended roofing systems as identified in this section and detailed in Section IV.
   c) If systems, such as PVC, TPO, CSPE/Hypalon, mechanically-attached EPDM, APP type modified bitumen are, in the opinion of the Design Professional, the most appropriate system. It shall be evaluated by the project team.
   d) Single-ply ballasted roofs and spray foam roofing system are prohibited.
   e) Light weight concrete shall not be used as a means to create slope on new buildings. On re-roofs, it may be used to repair existing decks.
   f) New buildings should have a minimum ¼” per foot slope and this should be accomplished by sloping the structure.
   g) If an existing roof has less than ¼” per foot slope a serious evaluation shall be done to determine if achieving ¼” per foot is feasible. If additional slope is required on re-roofs, tapered insulation should be used.
   h) Use crickets, saddles, and edge strips to direct water flow away from parapets and penetrations. Backslope is to be confirmed during detailing.
   i) Overflows are required and shall not be piped into the primary roof drain system. Highly visible and dependable systems such as scuppers and “daylighted” drains are preferred.
   j) Provide roof walkways to and around rooftop equipment and other areas as directed by the PM. Use roof mats of a non-slip material.
   k) At the design development phase, a review should be undertaken by the Design Professional to include vapor retarder requirements, deck type, expansion joint locations and details, salvageability of existing roof insulation, drainage, roof access, roof contaminants, fire rating, and wind uplift factors, and all other applicable parameters.
   l) Existing roof decks shall be checked by a registered structural engineer if roof loads are in question.
   m) For re-roof projects, an evaluation shall be done by the Design Professional and the PM to determine if a roof survey by nuclear meter or other means may be performed. Core samples shall be taken and results recorded and evaluated.
   n) Roof access shall be evaluated, and roof access hatches, ladders, means of fall protection, and other components shall be installed as determined by the University.
   o) Avoid complex flashing details. Minimize use of pitch pans or sealant pockets. Maintain minimum 12” flashing height, above finished roof.
   p) Minimize roof penetrations. If structural penetrations are unavoidable, use round structural steel shapes to facilitate flashing. Means of thermal break shall
be accounted for. Equipment supports for rooftop mounted equipment shall be a minimum 14” height. Use prefabricated equipment supports where possible. Equipment support frames or stands shall provide following working clearances:

<table>
<thead>
<tr>
<th>Width of Equipment</th>
<th>Height of Legs (above Finished Roof)</th>
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<tbody>
<tr>
<td>Up to 25”</td>
<td>14”</td>
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<tr>
<td>25-37”</td>
<td>18”</td>
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<tr>
<td>37-49”</td>
<td>24”</td>
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<tr>
<td>49-61”</td>
<td>30”</td>
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<tr>
<td>Over 61”</td>
<td>48”</td>
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</tbody>
</table>

q) A sheet metal contractor shall fabricate and install all roof related sheet metal flashings and trim. No roofing personnel shall be allowed to fabricate or install roof related sheet metal.

r) All sealants used in conjunction with roof related sheet metal shall receive a sealant primer and the sealant color shall match that of the adjacent sheet metal.

s) On re-roofs, evaluate conditions of existing construction at flashing terminations and address deficiencies that would allow water to by-pass roof flashing terminations.

T) On reroofing projects, all abandoned or unused equipment shall be removed. Verify with PM.

E. Doors, Windows, Curtain Walls and Glass

1. Minimum door size shall be 3’0” in width and 7’0” in height. Door heights shall not exceed 8’0” and exterior wood doors are not allowed. All glass doors are not allowed. Revolving, folding, and sliding doors are not allowed.

2. Exterior glass doors shall have wide rails and stiles. Narrow rails and stiles or full glass doors are prohibited. Bottom rail shall be 10” high. Top rail shall be 5” high. Stiles shall be 5” wide.

3. For door and window frames installed in existing structures, the color shall match the color of the existing windows and/or doors. Wood door frames are not allowed without approval by the PM.

4. Replacement windows shall be aluminum. In restoration projects, wood windows may be allowed as approved by the PM.

5. Windows installed in climate-controlled buildings shall be non-operable to maintain a specific air balance and provide security.

6. Wood door veneers other than oak, birch, maple, or cherry need prior approval by the PM. Wood door frames are not allowed.
7. All new construction and major renovations shall use low-E glazing. Glazing on window replacement projects shall be evaluated on a life cycle cost basis to determine viability of the low-E type. Include minimum glass performance values.

8. All exterior glass systems shall be a minimum of insulated, double pane glass with aluminum thermal break frame construction. Polyamide thermal break is preferred over polyurethane poured and debrided type thermal breaks. No steel framing should be exposed to the exterior except where required for fire code.

9. Test Procedures (to be considered)
   a) Air Infiltration Test
   b) Water Resistance Test
   c) Water Spray Test
   d) Uniform Load Deflection Test
   e) Uniform Load Structural Test
   f) Dynamic Water Resistance Test
   g) Condensation Resistance Test (CRF)
   h) Thermal Transmittance Test (Conductive U-Value)
   i) Thermal Transmittance Test (Conductive U-Value)
   j) Sound Transmission Loss

F. Finishes

1. Floor Finishes
   a) Entry: Entry mats required at all main entrances.
   b) Lobby & Public Areas: Hard, durable, slip resistant surfaces requiring minimum maintenance such as ceramic tile, slate, quarry tile, marble chip epoxy filled tile, sealed concrete or terrazzo.
   c) Stairwells: Hard, durable, slip resistant surfaces requiring minimum maintenance. Applied nosing should be one piece full width of riser.
   d) Corridors: Hard, durable, slip resistant surfaces requiring minimum maintenance for entry level areas. Carpet tile may be used in auxiliary corridors.
   e) Restrooms: Ceramic tile or sealed concrete.
   f) Mechanical rooms, custodial closets, storage rooms: Sealed concrete. Any mechanical room floor located above another space shall have a non-slip epoxy coating and all corners, edges, cracks, etc. shall be caulked to prevent leaks.
   g) Classrooms: Hard, durable, slip resistant surfaces requiring minimum maintenance. Carpet tile may be specified with the approval of the PM.
   h) Auditoriums & Lecture Halls: Hard, durable, slip resistant surfaces requiring minimum maintenance. Carpet may be specified for the aisles with approval of the PM.
   i) Computer Labs: Hard, durable, slip resistant surfaces requiring minimum maintenance or carpet tile.
   j) Laboratories: Sheet vinyl, VCT, epoxy or sealed concrete based on program requirements.
k) Offices & Conference rooms: Carpet tile. Broadloom may be specified with the approval of the PM.
l) Food Preparation & Service: Non-slip quarry tile or epoxy coating.
m) Animal Quarters: Epoxy coating.

2. Wall Finishes

a) Consistently wet areas or wash down areas (such as cage and cart wash areas, kitchens, etc.) shall have the following wall system: concrete masonry unit wall with an FM Global approved plastic interior finish material attached to the wall per its approval listing.
b) Mold resistant drywall shall be used in intermittently wet areas (such as restrooms, wash rooms, custodial closets, etc.)
c) Public stairways and corridors in academic buildings should have durable wall finishes.
d) Mechanical rooms shall have masonry or concrete walls.
e) Restrooms shall have a ceramic tile wainscot with a minimum height of 54”. Tile should extend above top of fixtures.
f) Wall covering may be specified with the approval of the PM.
g) Chair rails to be provided in conference rooms, classrooms or similar multi-use spaces to prevent wall damage. Height may be determined by chair selection.

G. Ceiling Systems

1. Provide sound attenuation at partitions and ceilings between major areas. Review criteria for acoustical separation with the PM.
2. Suspended ceiling systems shall be designed with a 2’ x 2’ grid pattern in most areas. Reveal edge tiles may be used in selected areas with approval of the PM. Concealed spline or tongue and groove ceiling systems are prohibited.
3. Drywall ceilings should be limited to consistently wet areas (such as cage and cart wash areas, kitchens, biosafety Level 3 or larger facilities) and soffits in special public areas. Means of access must be maintained to the plenum space and above ceiling devices.
4. Ceiling systems should use noncombustible building materials.

H. Interior Signage

1. General
   a) Signs shall be designed to be updateable to the degree that it doesn't diminish vandal and tamper resistance.
   b) Signage shall adhere to current ADA Standards for Accessible Design.
      (1) Digital displays outside rooms shall include an ADA compliant component.
      (2) Provide direction to accessible seating within auditoriums and tiered classrooms.
   c) Signage shall follow the current edition International Fire Code (IFC).
      (1) All rooms with min. (2) 200 amp breakers or a panel that serves a floor shall be identified as "Electrical Room".
(2) Access door to building generator shall be identified as "Generator".
(3) Any door opening onto a roof shall have a sign reading "Roof Access", including within penthouses.
(4) Any room that has a fire pump, main sprinkler valve, or fire command center shall identify the fire equipment.
(5) All elevator machine rooms shall be identified as "Elevator Equipment".
(6) All mechanical rooms shall be identified as "Mechanical".
(7) All custodial rooms shall be identified as "Custodial".

d) In general, NFPA 704 diamond signs need not be displayed as allowed by variance with Coralville Fire Department or Iowa City Fire Department.
(1) Verify requirements for municipalities other than Iowa City and Coralville with Planning, Design and Construction.

e) Apply NFPA 101 inside-stairwell signs in every stairwell of 3 or more landings.

f) Apply "In Case of Fire Use Stairs, Do Not Use Elevator" signs at all elevators that do not have message applied to call button panel.

g) Open work station signage shall not receive room numbering.

h) Each entrance leading into a facility shall receive an Entrance Number Plaque. This includes entrances from rooftop and balconies into building.

i) Building address shall be placed at the mailing address door only. Address shall include the number and the name of the street. Size of the address shall be a min. of 4" and increase in size per USPS guidelines or city code, whichever is greater. Confirm location with Owner.

k) Design and colors are subject to approval by Owner. Copy shall provide appropriate contrast with background as identified by the ADA guidelines.

l) Every room shall be identified. The minimum signage required shall be a SIGN TYPE ROOM NUMBER.

m) Typical mounting locations shall be as follows unless identified in sign drawings.
(1) Signs shall mount 2" from handle side if door swings away from viewer.
(2) Signs shall be mounted minimum of 12" from handle side if door swings toward viewer.
(3) Signs shall be centered vertically on 60" AFF.
(4) Overhead and projecting sign types shall be placed so that bottom of sign is at least 80" AFF and is above the swing of doors.
(5) If signs can't be mounted using the typical guidelines, review with PM.

n) Departmental policies may require additional signage.

o) See Appendices for sign type details.

2. Sign Types
a) Building Directory
(1) Directory shall be designed to hold modular information inserts (and locator map). It shall permanently identify (level number) (building name). Copy shall be permanently printed.
(2) Directory shall be used as display of destination addresses. Content shall include (public venue, department names, administrative offices) identification and locations within the building.
Destinations shall be listed alphabetically. Provide minimum capacity of 10% greater than the current list of destinations. Locations shall be keyed to (room numbers, map art).

(3) Directory (shall) (shall not) include map artwork.
(4) Map artwork shall be (plan view) (stacked perspective). Artwork shall schematically replicate the footprint of each level. Features to be shown shall be stairs, elevators, restrooms, ADA restrooms, classrooms, vending/cafeterias, building entrances, and department identification. Room number ranges shall be identified. A uniquely shaped and/or colored "YOU ARE HERE" symbol shall be placed in the plan location of the viewer. Map art shall be oriented so that top of map is the direction the viewer is facing.

(5) Map shall be sized to convey information clearly.
(6) Sign shall be located where it can be immediately viewed upon entry into the building from the primary entrance or in major circulation area.

b) Elevator Directory
(1) Elevator Directory shall be designed to hold modular information insert(s). It shall permanently identify (level number). Copy shall be permanently printed.
(2) Directory shall be used as display of destination addresses accessible by the elevator. Content can include (building name, public venue, department names, and administrative offices) identification and floor level locations. Destinations shall be listed alphabetically. Provide capacity of 10% greater than the current list of destinations.
(3) Sign shall be located adjacent to the entrance into an elevator cab. One directory can serve two adjacent elevator cabs.

b) Inside Elevator Cab Directory
(1) Inside Elevator Cab Directory shall be used in addition to Elevator Directory and be designed to hold modular information insert(s). Sign shall be designed in such a way to prevent damage due to tampering.
(2) Directory shall display information as shown on Elevator Directory. Provide capacity of 10% greater than the current list of destinations.
(3) Directory listing shall include all destinations accessible by the elevator.

c) Department Directory
(1) Department Directory shall be designed to hold a single insert or modular inserts. Copy shall be permanently printed.
(2) Directory shall be used as display of destination addresses within the department. Content shall include (program names, faculty/staff) identification and room numbers. Destinations shall be listed alphabetically. Provide capacity of 10% greater than the current list of destinations.
(3) Directory listings shall be typical paper module sizes and shall be in-house updateable or permanently printed individual modules.
(4) Sign shall be located subject to P&DC review.

c) Overhead Directional
(1) Overhead Directional signs shall be used to direct to primary destinations or range of room numbers. Overhead directional signs use shall be limited.
(2) Copy on overhead directional signs shall be minimum of 3" cap height. Copy shall be (self-adhesive vinyl) (silkscreened) (applied cut-out) lettering.

(3) Sign shall not be placed in the vicinity of sprinkler heads and shall not obstruct view to fire exit signage.

(4) Sign shall be (attached to structure) (fastened to drywall/plaster ceiling) (suspended by aircraft cable). Signs shall not be attached to suspended ceiling grid.

f) Wall Mount Directional

(1) Wall Mount Directional shall be used to direct to destinations. Directory shall identify (level number). Destinations shall be listed on (individual modular inserts) (single changeable insert) (using map artwork).

(2) Copy shall be permanently printed.

(3) Modular Inserts shall be (adhered with double-sided urethane foam tape) (attached with tamper-proof mechanical fasteners) (constructed using press-tab/chassis system).

(4) Copy shall be listed according to direction with left destinations listed first, upper destinations second and right destinations third. Destinations in like direction shall be alphabetized.

(5) Map artwork shall be (plan view) (stacked perspective). Artwork shall schematically replicate the footprint of each level. Features to be shown shall be stairs, elevators, restrooms, ADA restrooms, classrooms, vending/cafeterias, building entrances. Room number ranges shall be identified. A uniquely shaped and/or colored "YOU ARE HERE" symbol shall be placed in the plan location of the viewer. Map art shall be oriented so that top of map is the direction the viewer is facing.

(6) Signs shall be placed at decision points.

g) Overhead Identification

(1) Overhead identification signs shall be used to identify primary destinations. Use of overhead identification signs shall be limited.

(2) Copy on overhead identification signs shall be minimum of 3" cap height. Copy shall be (self-adhesive vinyl) (silkscreened) (applied cut-out) lettering.

(3) Sign shall not be placed in the vicinity of sprinkler heads and shall not obstruct view to fire exit signage.

(4) Sign shall be (attached to structure) (fastened to drywall/plaster ceiling) (suspended by aircraft cable). Signs shall not be attached to suspended ceiling grid.

(5) Sign shall be used in conjunction with wall mounted Department Identification.

h) Projecting Flag Identification

(1) Projecting Flag Identification shall be used to provide identification of public areas visually hidden from direct view. An acrylic blade shall be fastened to an aluminum armature.

(2) Graphics on projecting flag signs shall be limited to symbol glyphs. Symbol glyphs include elevator, restrooms, vending and information. Glyphs shall be (silkscreened) (self-adhesive vinyl).

(3) Any copy shall have a minimum of 3" cap height.
(4) Sign shall not obstruct view to fire exit signage.
(5) Sign shall be placed so that bottom of sign is at least 80" AFF and is above the swing of doors. Sign shall be mechanical fastened to wall.

i) Department Identification Plaque
(1) Department Identification Plaque shall be a wall mounted identification sign. Sign shall be scaled progressively larger than room identification signage to provide more significance.
(2) Sign shall use uppercase san-serif ADA spec tactile copy and Grade II Braille for the permanent identification component of the message. Permanent message shall be (department name)(room number). Copy shall provide ADA spec contrast with background.
(3) Supporting copy shall be silk-screened.
(4) Sign face shall be matte.
(5) Sign location shall not be viewable from the exterior of the building.

j) Department Identification Vinyl Lettering
(1) Department Identification Vinyl Lettering shall be a vinyl graphics adhered to glass. Sign shall be scaled progressively larger than room identification signage to provide more significance. Use is subject to Owner review.
(2) If sign is identifying a permanent space, an ADA compliant identification sign shall be mounted adjacent.
(3) Sign location shall not be viewable from the exterior of the building.

k) Room Number
(1) Room Number shall be a wall mounted identification sign.
(2) Sign shall identify rooms by number limited to rooms not requiring supporting room name text. Typical rooms identified by this type are general storage rooms and rooms whose purpose need to be discreet (within building code guidelines).
(3) Sign shall use uppercase san-serif ADA spec tactile number and Grade II Braille for the room number.
(4) Sign face shall be matte.

l) Room Identification
(1) Room Identification shall be a wall mounted general room identification sign.
(2) Sign shall identify rooms by text and room number. Typical rooms identified by this type are rooms and rooms whose purpose need identified for public, staff or public safety purposes.
(3) Sign shall use uppercase san-serif ADA spec tactile number and Grade II Braille for the permanent identification component of the message. Permanent message shall be room number.
(4) Supporting copy shall be permanently printed initial cap/lower case.
(5) Sign face shall be matte.

m) Conference Room Identification
(1) Conference Room Identification shall be a wall mounted identification sign.
(2) Sign shall identify conference rooms by text and room number.
(3) Signs shall incorporate gripper bar paper holder. Gripper bars shall be constructed of extruded aluminum.
(4) Sign shall use uppercase san-serif ADA spec tactile number and Grade II Braille for the permanent identification component of the message. Permanent message shall be room number.

(5) Sign face shall be matte.

n) Office Identification

(1) Office Identification shall be a wall mounted office identification sign.

(2) Sign shall identify rooms by in-house updateable insert and room number. Typical rooms identified by this type are offices and rooms whose purposes change frequently.

(3) Sign shall use uppercase san-serif ADA spec tactile number and Grade II Braille for the permanent identification component of the message. Permanent message shall be room number.

(4) In-house updateable insert shall be inserted into a slot between a clear window on the face and a backer panel. Face shall have thumb notch or similar means for enabling updating.

(5) Signs shall incorporate gripper bar paper holder. Gripper bars shall be constructed of extruded aluminum.

(6) Sign face shall be matte.

o) Open Office Work Station Identification

(1) Each open office work station shall receive an identification sign.

(2) Sign shall identify occupant/use by in-house updateable insert. Typical spaces identified by this type are system furniture offices.

(3) Confirm mounting detail with Owner.

(4) In-house updateable insert shall be inserted into a slot between a clear window on the face and a backer panel. Face shall have thumb notch or similar means for enabling updating.

(5) Sign face shall be matte.

p) Symbol Identification

(1) Symbol Identification shall be a wall mounted identification sign.

(2) Information on sign shall be organized with room number on top, symbol glyph in the middle and supporting text on bottom.

(3) Typical rooms identified by this type are unisex, men and women restrooms and identification of stairwells from within corridors.

(4) Sign shall use uppercase san-serif ADA spec tactile characters and Grade II Braille for the room number and the supporting text.

(5) Glyph shall be placed on 6” area between the number and the copy.

(6) Sign face shall be matte.

q) Large Symbol Identification

(1) Large Symbol Identification shall be a wall mounted identification sign.

(2) Information on sign shall be organized with room number on top, symbol glyph in the middle and multiple lines of supporting text on bottom.

(3) Typical rooms identified by this type are family restrooms, staff restrooms and locker rooms.

(3) Sign shall use uppercase san-serif ADA spec tactile characters and Grade II Braille for the room number and the supporting text. Copy shall provide ADA spec contrast with background.

(4) Glyph shall be placed on 6” area between the number and the copy.
r) Entrance Number Plaque
   (1) An Entrance Number Plaque shall be placed at each exterior door into a facility. Plaque shall be an exterior grade 1/8" 2 ply material with contrasting color layers, Rowmark UltraMatte material or equivalent.
   (2) Numbers shall be assigned by P&DC. "ENT" shall precede all numbers. Copy shall be san-serif font.
   (3) Plaques shall be sized to fit on doorframe, centered over door on outside of facility. Typical size plaque is 1-1/2" x 6" with 1" copy.
   (4) There shall be high contrast between number characters and background.

s) Loading Dock Entrance Number Plaque
   (1) A Loading Dock Entrance Number Plaque shall be placed at each exterior dock leading into a facility. Plaque shall be a 1/8" painted aluminum panel with highly contrasting self-adhesive vinyl copy.
   (2) Numbers shall be assigned by Planning, Design and Construction. "ENT" shall precede all numbers. Copy shall be san-serif font.
   (3) Plaques shall be sized in accordance with specific building criteria, placed adjacent to door. Typical size plaque is 12" x 12" with 4" copy.
   (4) Sign shall be viewable from street.

3. Code Specified Information
   a) Code Specified Information shall be a wall mounted identification sign.
   b) Information, size and layout of sign shall be organized as identified in applicable code.
   c) Typical signs include inside stairwell information.
   d) Sign face shall be matte.

4. Sign Lettering
   a) Architectural Lettering shall be individually cut out letter characters used for identification and way finding as well as special venues, points of purchase, or to integrate into special architectural features.
   b) Letters shall be cut out of acrylic sheet, solid surface material, metal or cast from metal.
   c) When used as identification of a permanent space, an ADA component shall be incorporated or displayed in association with the lettering. When used for way finding, design shall conform to ADA guidelines.
   d) Letter size and typeface shall be selected with consideration of the immediate area.

5. Custom Signage
   a) Custom Signage can be used for special venues, points of purchase, or to integrate into special architectural features.
   b) Donor recognition shall be considered as Custom Signage.
   c) When used as identification of a permanent space, an ADA component shall be incorporated or displayed in association with the Custom Sign.
   d) Custom Signage can be illuminated.
      (1) Illuminated signs shall be UL rated and be installed to conform to all applicable codes. Lamping shall be reviewed by Utilities and Energy Management.
      (2) Signs shall have proper ventilation to prevent heat buildup.
(3) Electrical service shall be concealed.
e) All Custom Signage shall be reviewed and approved by Planning, Design and Construction.

6. Interior Signage Installation
a) Signage installation shall be specified according to all code requirements.
b) Typical wall-mounted sign installation shall be double-sided foam tape and silicone adhesive.
c) Signs exceeding the adhesive strength of double-sided foam tape shall have additional threaded studs adhered into wall surface.
d) Signs mounted to glass shall be backed up with a backer panel of matching size on the second surface of the glass.
e) Signs mounted from the ceiling shall be mounted away from sprinkler heads and shall not obscure site lines to fire exit signage.
f) Signs mounted from suspended ceilings shall be tied off to structure above ceiling. Cable shall be stainless steel and aircraft quality or equal.
   (1) If structure is inaccessible, review alternatives with Owner.
   (2) Hole where cable passes through ceiling tile shall match dimension of suspension system.
g) Architectural Lettering shall be securely mounted with method appropriate to wall surface to inhibit vandalism. Threaded studs shall be used wherever possible and specified to be set in non-shrinking grout.
h) Signs and lettering mounted to limestone or similar natural stone surfaces shall not use silicon adhesive. Double-sided tape or threaded studs shall be set into non-shrinking grout. Verify with Planning, Design and Construction prior to specifying any mounting system that will permanently impact architectural finishes.

I. Conveying Systems
1. All elevators shall be inspected by certified inspectors as required by governing regulations before final acceptance.
2. Passenger elevators are preferred to be high efficiency electric traction. Hydraulic elevators may be considered for less than four (4) stops and when higher load capacities are required.
3. Where an elevator pit is required, the pit shall have a sump pit, a manually operated sump pump with an alarm connected to the building control system, and no floor drain. Spill prevention plan shall be addressed.
4. Elevators shall be wired and equipped with telephone and supplied with a vandal proof instrument. One electrical duplex outlet within 10’ of entry point of the elevator and one electrical duplex outlet within the elevator is required. One GFCI receptacle in the elevator car is required.
5. The Design Professional shall evaluate expected usage of elevator to determine the need for vandalism-resistant construction. Controls shall always be vandalism-resistant.
6. The use of vertical platform lifts and incline stair lifts is prohibited in new construction.
7. Lifts may be used in existing facilities only when the use of an elevator or ramp is not feasible.
J. **Telecommunication Rooms**

1. All telephone and data network topology shall conform to EIA/TIA Building Telecommunications Wiring Standards.

2. **Room Conditions**
   
a) Telecommunication rooms shall not be considered as potential locations for ancillary electrical equipment as well as basic termination of cable/wire/fiber.

b) **Size:** See Section IV.

c) **Ceiling height:** See Section IV.

d) **Location:** minimum of one telecommunication room shall be located on each floor. One room should be allocated for every 10,000 gross square feet of floor area.-Distance limitations or other considerations may require more than one room. Rooms should be located as close to the core of the structure as possible and should be vertically stacked in multiple story buildings. Average cable runs should not exceed 150’ with no single cable run exceeding 295’.

e) **Floor finish:** See Section IV.

f) All telecommunication rooms shall have dedicated year-round cooling systems.

3. **Construction cost shall include installation of telephone/data cabling and conduit/raceways to the main telephone room and to all outlets.**

4. **Access to telecommunication rooms must be coordinated with ITS Infrastructure Group.**

K. **Custodial Work Spaces**

1. **Custodial Work Control Center:** The Custodial Work Control Center shall be located on the ground floor near the Supplies Storage and Delivery room. It is the main gathering place for custodial and maintenance operations activities and shall be 20’ x 20’ for a custodial group of four and increases in length by 2 feet for each additional person above four with a minimum room width of 20’ for any size group. The Custodial Work Control Center shall accommodate all furnishings and appliances. Standards for Custodial Work Control Center are:
   
a) The door shall open outwards.

b) HVAC is required.

c) All custodial spaces shall have fire rated ceilings.

d) Lighting at the 20 foot candle level. The light fixture(s) shall have safety guards.

e) A minimum of four duplex outlets above countertop and two duplex outlets near the floor on each open wall, with one outlet on each wall; all GFCI.

f) Two telecom-data telephones in each.

g) Sealed concrete floor; no carpeting.

h) A 3'-0” door keyed to Schlage B series, restricted keyway system, small format interchangeable core with lock that automatically locks when closed.

i) Plumbing for a built-in 5'-0” kitchen unit with double sink and water supply line to feed ice machine in refrigerator. Storage cupboard below and above sink.

j) Smooth floor transition from hall to room.
2. **Supply Storage and Delivery Room:** This room is the main storage room for cleaning supplies and shall be a minimum of 10’ x 14’ for a four-person custodial group. Increase the room length by 2 feet for each additional person above four. Furnish with the following:
   a) Three 1’-6” wall shelves on adjustable brackets and standards. The bottom shelf should be 2’-6” above the floor. Shelves should be spaced about 1’-8” apart, running the full length of one long wall. One-half of the shelving in this room should be enclosed with doors and locks.
   b) HVAC is required; 60 degree F winter heat minimum.
   c) Lighting at the 20 foot candle level. The light fixture(s) shall have safety guards.
   d) Two duplex electrical outlets (GFCI) on shelving wall.
   e) Sealed concrete floor; no carpeting.
   f) A 3’-6” door keyed to Schlage B series, restricted keyway system, small format interchangeable core, opening outward, with closer, and armor plate, and automatically locks when closed. Armor plate to measure 2” less than door width on single doors and 1-1/2” less than door width on each leaf of pairs.
   g) Smooth floor transition from hall to room.

3. **Equipment Storage Room:** This room is used to store large equipment including vacuums, carpet extractors, carpet drying fans, ladders, etc. A 12’ x 18’ room is required for up to a four-person custodian group. Add 3’-0” to the length for additional custodians up to eight, and another 3’-0” to the length for any group larger than eight custodians. This room should be arranged so there is a path from the door to the sink and the equipment stored here can be parked to one side of this path. Standards for Equipment Storage Room are:
   a) A 2’-6” floor utility slop sink with 6” sides with both hot and cold water blended into a single hose bibb. A 2’-0” Panolam white fiberglass reinforced all panel back splash around the two sides of the sink. The sink should be installed in the rear corner of the room.
   b) A floor sink with strainer basket to empty scrubbers, and the floor should slope to the drain.
   c) Two 1’-0” wide adjustable shelves (9 feet long) on brackets at the rear of the room; bottom shelf 3’-4” above the floor.
   d) Additional plumbing to accommodate a chemical dispensing unit located close to the sink area, with separate cold water hose bibb from the sink to connect this unit. Dispensing unit is hard piped with cold water feed. Install emergency eye wash Guardian model G5026BP with backflow preventer and an 8 ft. flexible stainless steel hose connected to hard piped cold water feed only. The separate cold water feed supplying water serving the chemical storage solution center shall be protected by a watts 289 spill proof vacuum breaker installed at a height 6” (minimum) above the expected point of use of any hoses connected to the water line. All hose connected equipment shall be protected in a similar manner.
e) Minimum of three (3) wall-mounted shelves 4’-0” above the floor to support charging units for the battery-powered machinery.

f) Heated and well-ventilated room to provide for recharging battery-operated machinery.

g) Lighting at the 20 foot candle level. Light fixture(s) shall be equipped with safety guards.

h) One duplex electrical outlet (GFCI) for each charger unit is required; located 4’-0” A.F.F. on the wall next to the battery charger shelves.

i) One duplex electrical outlet (GFCI) near the floor by the door.

j) A 3’-6” door keyed to Schlage B series, restricted keyway system, small format interchangeable core, opening outward, with closer, and armor plate, and automatically locks when closed. Armor plate to measure 2” less than door width on single doors and 1-1/2” less than door width on each leaf of pairs.

k) Sealed concrete floor; no carpeting.

l) 18” high metal plating around walls of room, if drywall is used, to protect walls from equipment. Prefer enamel painted concrete walls.

m) Washer/dryer hook-up (plumbing, electrical, ventilation).

n) Smooth floor transition from hall to room.

4. Custodial Service Room (CSR): There should at least one CSR per floor, or one closet per 20,000 sq.ft. of area. The room should have minimum dimensions of 7’ x 9’, with a door that opens out (unless otherwise required by code). It is preferred this room be located within 50’ of main traffic restrooms. Standards for Custodial Service Room are:

a) Three white painted or laminated 3/4” x 12” deep plywood shelves mounted on adjustable brackets and standards; bottom shelf 30” above the floor, top shelf 60” above the floor.

b) Additional plumbing to accommodate a chemical dispensing unit beside the sink, with separate cold water hose bibb from the sink to connect this unit. Unit should be hard piped, cold water feed only. Install emergency eye wash Guardian model G5026BP with backflow preventer and an 8 ft. flexible stainless steel hose connected to hard piped cold water feed only.

c) Wall bracket to support a 6’-0” step ladder.

d) HVAC is required.

e) Lighting at the 20 foot candle level. The light fixture(s) shall have safety guards.

f) One duplex electrical outlet (GFCI) located on shelving wall.

g) A 3’-6” door keyed to Schlage B series, restricted keyway system, small format interchangeable core, opening outward, with closer, and armor plate, and automatically locks when closed. Armor plate to measure 2” less than door width on single doors and 1-1/2” less than door width on each leaf of pairs.

h) Sealed concrete floor: No carpeting.

i) Smooth floor transition from hall to room.

j) Eye wash stations to comply with all applicable codes.
k) No utility panels, gauges, meters or pipes should be placed in the custodial service room.

l) No personnel access should occur through the CSR to adjoining spaces/rooms.

m) Access to CSR shall be from public hallways.

5. **Heavy Equipment Room:** This room houses rider scrubbers and sweepers. The approach hallways to this room must be wide enough to maneuver the scrubbers in and out of the storage room, and a nearby egress must be large enough to serve the installation and removal of the machinery. The storage room must provide for adequate ventilation for charging batteries. This room must be at least 15’ x 15’. Heavy Equipment Room standards are:

a) One 1’-0” wide adjustable shelf, mounted on the wall 3’-4” above the floor.

b) Additional plumbing to accommodate a chemical dispensing unit beside the sink, with separate cold water hose bibb from the sink to connect this unit. Unit should be hard piped, cold water feed only. Install emergency eye wash Guardian model G5026BP with backflow preventer and an 8 ft. flexible stainless steel hose connected to hard piped cold water feed only.

c) One wall-mounted shelf 4’-6” above the floor, to support charging units for the battery-powered machinery.

d) HVAC is required.

e) Lighting at the 20 foot candle level. The light fixture(s) shall have safety guards.

f) One duplex electrical outlet (GFCI) near the floor by the door.

g) 1’-6” high metal plating around walls of room, if drywall is used, to prevent damage from equipment. Prefer enamel painted concrete walls.

h) Double door opening (two 3’-6”), opening outward, with closer, keyed to Schlage B series, restricted keyway system, small format interchangeable core and armor plate, and automatically locks when closed. Armor plate to measure 2” less than door width on single doors and 1-1/2” less than door width on each leaf of pairs.

i) Sealed concrete floor; no carpeting.

j) Smooth floor transition from hall to room.

k) Fixture(s) shall be equipped with safety guards.

6. **Light Bulb Storage Room:** This room is the main storage room for light tubes, compact bulbs and shall be a minimum of 10’x14’ for a 4 person custodial group. Increase the room length by 2 feet for each additional person above 4. Standards for the Light Bulb Storage Room are:

a) 3’-6” door keyed to Schlage B series, restricted keyway system, small format interchangeable core and armor plate and automatic locks when closed.

b) Three 1’-6” wall shelves on adjustable brackets and standards at the back of the room. The bottom shelf shall be 2’-6” above the floor. Shelves shall be spaced about 1’-8” apart, running the full length of the longest wall.

c) One duplex electrical outlet (GFCI) near the floor by the door.
d) HVAC is required with 60 degree winter heat minimum.

e) Sealed concrete floor: No carpeting.

f) Lighting at the 20 foot candle level.

7. **Loading Dock Facilities**: For new construction and building additions, the Design Professional should review loading dock facility requirements with the PM. Potential needs to be addressed include:

a) Trash dumpster/compactor equipment with appropriate decking, railings and access.

b) Recycling containers (paper, cardboard, fluorescent tubes, cans). All buildings shall have accommodations for recycling containers and material. Those areas can be alcoves, closets, or rooms suitable for such storage, near a building service entrance or preferably at an exterior covered loading dock. Provide either hydro or manual lift and/or catwalks for servicing trash/recycle containers.

c) Truck dock bays (at grade and/or at loading height). May include a recessed lift.

d) Service vehicle parking (two minimum).

e) Receiving area.

f) Holding areas (hazardous materials, chemicals, spent lamp storage).

g) Hydraulic dumpers for dumping waste into dumpster.

h) Keyed hose bibs with easy access, isolated shut-off valve for winter.

i) Two floor drains, one in open areas and one near dumpster locations in enclosed areas.

L. **Maintenance Rooms**

1. **Building Maintenance Work Control Center**: Provide a room to house building control work station, maintenance staffing, and general computer access. This space is separate from the building maintenance work area and the building maintenance material/equipment storage area. The space shall be 20’x20’ for a maintenance group of four and increases in length by 2 feet for each additional person above four with a minimum room width of 20’ for any size group. The Building Maintenance Work Control Center shall accommodate all furnishings and appliances. Standards for Maintenance Work Control Center are:

a) The door shall open outwards.

b) HVAC is required.

c) All spaces shall have fire rated ceilings.

d) Lighting at the 20 foot candle level. The light fixture(s) shall have safety guards.

e) A minimum of four duplex outlets above kitchen countertop and two duplex outlets near the floor on each open wall, with one outlet on each wall; all GFCI.

f) Two telecom-data telephones in each.

g) Sealed concrete floor; no carpeting.

h) Room label in hallway with message collection board or box for FM building personnel.
i) A 3'-0” door keyed to Schlage B series, restricted keyway system, small format interchangeable core with lock that automatically locks when closed.

j) Smooth floor transition from hall to room.

2. Building Maintenance Shop: Provide a 200 sq. ft. room for a work bench, repair tools and equipment, carts, barrels, other supplies adjacent to the Building Maintenance Material/Equipment Storage Room. Standards for Building Maintenance Shop are:
   a) The door shall open outwards.
   b) HVAC is required.
   c) All spaces shall have fire rated ceilings.
   d) Lighting at the 20 foot candle level. The light fixtures(s) shall have safety guards.
   e) A minimum of four duplex outlets above countertop and two duplex outlets near the floor on each open wall, with one outlet on each wall; all GFCI.
   f) Two telecom-data telephones in each.
   g) Sealed concrete floor; no carpeting.
   h) Room label in hallway with message collection board or box for FM building personnel.

   i) A 3'-0” door keyed to Schlage B series, restricted keyway system, small format interchangeable core with lock that automatically locks when closed.

   j) Smooth floor transition from hall to room.

3. Building Maintenance Material/Equipment Storage Room: This room is the main storage room for building maintenance supplies and shall be a minimum of 200 sq. ft. Building Maintenance Material/Equipment Storage Room standards are:
   a) A 3’-6” door keyed to Schlage B series, restricted keyway system, small format interchangeable core opening outward, with closer and armor plate and automatically locks when closed. Armor plate to measure 2” less than door width on single doors and 1-1/2” less than door width on each leaf of pairs.
   b) HVAC is required; 60 degree winter heat minimum.
   c) Three 1’-6” wall shelves on adjustable brackets and standards. The bottom shelf should be 2’-6” above the floor. Shelves should be spaced about 1’-8” apart, running the full length of the longest wall. One-half of the shelving in this room should be enclosed with doors and locks.
   d) Lighting at the 20 foot candle level. The light fixtures(s) shall have safety guards.
   e) Two duplex outlets (GFCI) on shelving wall.
   f) Sealed concrete floor; no carpeting.
   g) Smooth floor transition from hall to room.

4. Attic Stock-Extra Materials Storage Room:
   a) Should be of sufficient size as to allow for shelving storage of attic stock or extra materials for the specific project.

5. Additional maintenance space may be required on a building-by-building basis, for trades’ work areas, attic stock storage, off season storage, supervisor office, etc. Consult with BLS Building Maintenance Manager during schematic design phase to determine special needs based on specific building requirements.
M. Restrooms
1. Toilet partitions shall be either floor supported-overhead braced or floor and ceiling supported.
2. The room (including accessible toilet stalls) shall be designed to meet current requirements of ADA Standards for Accessible Design.
3. One restroom foam all-purpose soap dispenser shall be installed at each washbasin.
4. Built-in waste receptacles are not desired. An alcove is preferred to accommodate a freestanding waste can.
5. Toilet paper dispenser-locking mechanism should not be blocked by ADA handrails.
6. Provide wall mounted water closets for ease of cleaning.
7. Provide floor drains.
8. Centrally located hose bibs for wet cleaning (only if a floor drain is present).

N. Classroom Standards (General Assignment)
These standards must be applied to general assignment classrooms and provide guidance for the design of other instructional spaces. Note: “ITS” here refers to University Information Technology staff responsible for oversight of learning space technology design.
1. General Approach to Classroom Design
   a) To develop rooms with good sight lines and efficient seating layouts, design should proceed from the “inside out”:
      (1) Determine projection screen quantity, size and location; seat size and orientation; and size of the instructor area.
      (2) Draw viewing angles from each screen and insure that all seats fit within them.
      (3) Determine location and width of access aisles.
      (4) Only after these steps, determine where walls should be located.
   b) Designs in which seating capacities are reduced because rooms are too small, or which have inefficient shapes, obstructions, narrow aisles, seats or work surfaces that are too small, or seats placed too close together for comfort are unacceptable.
2. Classroom Types and general features:
   These are standard classroom types. Design details may vary to accommodate the latest best practices for teaching, with approval from Classroom Scheduling.
   a) Seminar room
      (1) Furnished with a large central table or multiple small tables that can be grouped into one central table, along with moveable chairs.
      (2) Designed for up to 22 students.
      (3) Size the room allowing 25 sq. ft. per seat.
   b) Small classroom
      (1) Flat-floor.
      (2) Furnished with moveable tables and chairs.
      (3) Designed for up to 50 students.
(4) Size the room allowing 25 sq. ft. per seat. (Where use of tablet arm chairs has been authorized by Classroom Scheduling, allow 18 sq. ft. per seat.)

c) Large classroom
(1) Tiered floor. Entrances may be located at the room front for disability access.
(2) Furnished with fixed tables and moveable chairs.
(3) Designed for 51-99 students.
(4) Size the room allowing 20 sq. ft. per seat.

d) Lecture hall/auditorium
(1) Sloped or tiered floor.
(2) Furnished with fixed tablet-arm seats. Seats must be labeled for row and number.
(3) Designed for 100+ students.
(4) Size the room allowing 12 sq. ft. per seat.
(5) Include additional circulation and seating outside room to support gathering.

e) TILE (Transform, Interact, Learn Engage) Inquiry-based Learning Space
(1) Flat floor.
(2) Furnished with tables and moveable chairs on casters.
(3) Spaces are designed creatively with primary focus on student and instructor collaboration.

f) Shared Informal Study Space
(1) Individual and collaborative study space available on an unscheduled basis.
(2) Furnished with equipment to support study which may include marker boards, electrical outlets, data ports, USB charging stations, wireless connectivity, fixed internet/email stations.
(3) A mixture of furnishing types to support both individual and group work.

3. Classroom Design Specifics
a) Classroom Placement in the Building
(1) Locate general assignment classrooms as close as possible to the main building entrances, to limit student travel through the building. This is most important for large capacity classrooms.
(2) Group classrooms together on the same floor.
(3) Locate classrooms away from noise-generating equipment and activities, including mechanical systems, elevators, vending, food service, and restrooms. Where classrooms adjoin such spaces, provide noise buffers to prevent class disruption.
(4) Locate restrooms near lecture halls, but with no common wall between restrooms and classrooms.
(5) Appropriate lobby space should adjoin auditoria to provide a gathering area.

(6) Provide corridor seating outside the lecture halls and along the hallways outside classrooms. Design corridors and alcoves creatively to provide informal student spaces with flexible, comfortable furniture to encourage collaboration. Include electrical and charging stations for study or class pass waiting.

b) Classroom Proportions

(1) All seats must be located within a 90 degree viewing angle from the center of the projection screen. That is, within 45 degree horizontal angles from the perpendicular to the center of screens, as shown in the drawing below:

(2) Classrooms should be narrow enough to permit all seats to be within the 90 degree viewing angle from the front wall, but no narrower. Rooms that are too narrow and deep make it hard for students and instructors to interact. Rooms approximately square-shaped tend to provide the best sight lines.

c) Classroom front, in conventional rooms

(1) The distance from the front wall to the first row of seats should be 1-2 times the height of the projection screen. Typical screen height in a flat-floor classroom is 8’, so the first row of seats must be minimum 8’ from the front wall; 10-12’ is preferred.

(2) The multimedia lectern should be placed such that it leaves students an unobstructed view of the writing surface and projection screen. Media should be installed either in the lectern or in a rack near the lectern.

(3) The projection screen should be placed to leave at least a 6’ wide portion of the writing surface visible when the screen is lowered. Placing the screen at a slight angle in the corner opposite the instructor lectern often works well.

(4) Space for a moveable instructor’s table 48”-60” wide x 24” deep, plus an instructor chair must be provided. No instructor’s table is provided in a seminar classroom.

d) Accessibility

(1) Refer to the Accessibility Section within this document.

e) Acoustics

(1) All classrooms should be designed with three acoustic goals:

(a) Prevent external and background noise from affecting the room.

(b) Prevent sounds generated within a classroom from affecting adjacent spaces.

(c) Allow classroom occupants to easily hear class content and dialogue. Voices must be heard easily and accurately. The room
must be designed to foster effective sound transmission not only from a speaker at room front to an audience, but to allow student comments to be easily heard as well.

(2) Classroom acoustics must meet the standards recommended in the ANSI/ASA S12.60-2010 American National Standard Acoustical Performance Criteria, Design Requirements and Guidelines for Schools. Performance standards for background noise and reverberation time are based on this document, including outdoor-to-indoor transmission class ratings and sound transmission class ratings.

c) Background Noise Reduction
(1) Extend all walls to structure above.
   (a) Select building and system components that shall meet the acoustical criteria for classrooms.

d) Reverberance
(1) Low reverberation time (RT) shall improve overall speech intelligibility, as well as reduce echoes and high noise level in the room.
(2) RT is influenced by size of the space and absorption coefficients of the room materials, including upholstered seating which absorbs some room sound.
(3) Absorptive materials in addition to any upholstered seating shall be used to control RT. Acoustical ceiling tile can be considered part of the acoustical treatment.
(4) Where acoustical wall panels are used, placement on the upper half of walls shall obtain optimal results, with the bottom of the panels no lower than 4’ above the finished floor. Ideally, panels shall be placed beyond arm’s reach. If only one wall is to be treated in a conventional classroom, it should be the rear wall. Panel configuration does not have to be continuous – panels may be spread out rather than butted against each other.
(5) The amount of recommended acoustical treatment is based on room size, and may be provided with acoustical ceiling tile or wall panels. Specific recommended quantities are shown in the table below:

<table>
<thead>
<tr>
<th>Room Size, in Square Feet</th>
<th>Recommended Acoustical Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar</td>
<td></td>
</tr>
<tr>
<td>Up to 500</td>
<td>100 sf</td>
</tr>
<tr>
<td>500+</td>
<td>200 sf</td>
</tr>
<tr>
<td>Small Classroom</td>
<td></td>
</tr>
<tr>
<td>Up to 500</td>
<td>200 sf</td>
</tr>
</tbody>
</table>
(6) For auditoriums and lecture rooms, spaces with higher ceilings have higher reverberation times and require the greatest amount of acoustical treatment. Upholstered seating, with its higher sound absorption, is assumed. A curved or angled reflective ceiling surface is essential to evenly disperse sound throughout the room. The angles vary with the height and size of room. Curved ceiling clouds are very effective for dispersing sound. Apply acoustical treatment to walls in lecture halls, located a minimum of 4’ above the finished floor beginning with the back wall. Side wall treatment may be added if the back wall does not provide enough surface at a minimum of 6’-0” A.F.F.

<table>
<thead>
<tr>
<th>Room size (square feet)</th>
<th>Ceiling Height</th>
<th>Recommended Acoustical Treatment (panels with min. NRC of .9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2,500</td>
<td>8’-12’</td>
<td>100 sf</td>
</tr>
<tr>
<td>Up to 3,500+</td>
<td>12’-18’</td>
<td>500 sf</td>
</tr>
<tr>
<td>3,501 - 4,000</td>
<td>15’-20’</td>
<td>800 sf</td>
</tr>
<tr>
<td>Up to 5,000+</td>
<td>20’-40’</td>
<td>1750 sf</td>
</tr>
</tbody>
</table>

6. Projection booth
   a) An enclosed booth with projection shelf and window is the preferred location for projectors in lecture halls/auditoria, to provide easy access for equipment maintenance.
   b) Include adequate cooling for current large venue projection equipment.
   c) Run appropriately-sized conduit from the lectern or AV rack to the booth.
   d) Where an enclosed booth is not possible a securable cabinet may be provided instead.
   e) Acoustically isolate the booth to prevent sound leak into the adjoining classroom.

7. Ceiling
   a) Ceiling height is based on the classroom capacity, depth and design.
   b) Ceilings must be high enough to accommodate the projection screen when the bottom of screen is no lower than 3’-4” above the finished floor and screen height is 1/5 the distance from front wall to last row of seats.
c) Ceiling height requirements may differ for seminar rooms, classrooms, and auditoria within the same building.

d) Plan for easy maintenance access to equipment mounted at or above ceilings.

8. Doors
a) The preferred door location is at the rear of the classroom. In rooms with tiered or sloped floors, place entrances to allow wheeled access to the teaching area and multiple seating areas.

b) Equip new doors with sidelights no wider than 1'-0", in accordance with applicable codes while still maintaining ADA standards. In renovations where sidelights are not possible, clear glass panels must be provided in doors, not to exceed 100 square inches, with the vision panel base no higher than 3'-6" from the floor and top at least 5'-2" from the floor.

c) Doors must operate quietly and provide good sound control.

d) Doors open out to the corridor but must be located so that they do not block corridor traffic. A recessed entrance may suffice.

9. Electrical Systems
a) All conduit and electrical circuits shall have the same ground reference. It is preferable to have two separate grounding conductors, one for telecommunications and one for the building.

b) All electrical circuits serving audio/video equipment should originate from an isolation transformer or a branch circuit panel protected by transient voltage surge suppression equipment.

c) A/V and telecommunication conduits should be coordinated, designed and installed along with other electrical/service pathways/conduits.

d) The number of outlets required in classrooms shall depend on the size of the room. These must be distributed throughout the room for overhead projectors, computer access, and vacuum cleaners, etc. The front teaching wall must have at least one duplex outlet. The number and location of the outlets shall be coordinated with ITS in the design phase of the project.

e) Electrical outlets must be provided in all fixed student tables, with outlets for each pair of seats.

f) Floor boxes should be FSR or equivalent as specified by ITS.

g) Where projectors shall be ceiling-mounted, provide at least one circuit above the ceiling, at a location to be specified by ITS.

10. Flooring
a) On flat floors install a hard, durable, slip-resistant floor requiring minimum maintenance.

b) On sloped and tiered floors sealed concrete in seating areas is acceptable.

c) Carpet is used only when warranted by physical configuration of room or when authorized by Classroom Scheduling. Carpet may be suitable where special use requires a more luxurious floor finish than resilient flooring and operating budgets are sufficient to insure proper maintenance. Where carpet is used, it
should be variegated in color, not solid, in order to hide dirt and wear. On carpeted stair aisles, the edge of stair risers must be easily seen to prevent tripping.

d) In lecture halls, aisle lighting is required.

11. Furnishings

a) Furniture shall be selected for durability, ease of maintenance, and comfort. General assignment classroom furniture must have an appearance distinct from other furnishings in the building. Writing surfaces should be dark colored and resist marks. Where used, tablet arms should be large, ideally able to hold both an 8.5’ x 11” pad and a calculator.

b) In renovations, color and finish of moveable furnishings should be consistent with overall building materials, to permit the use of furnishings across multiple rooms.

c) Any furniture item should be comfortable for use by people ranging in size from the 5th percentile female (4’ 11” tall, 113 pounds) to the 95th percentile male (6’2” tall, 246 pounds). Preferred width for auditorium seats is 23” – 24” on center.

d) Student tables shall be at least 18” deep.

e) Moveable tables shall be equipped with casters. Ensure that each seat station has adequate table surface.

f) Do not include arm rests on moveable student seats. Exceptions require approval from Classroom Scheduling.

g) Caster or chair glide type must match flooring type for the room.

h) Ten percent of all seating must be suitable for left-handed use.

i) Upholstered fabrics are used only on lecture hall and seminar room seating. Fabrics must have heavy-duty stain repellant.

j) A moveable instructor table 48”-60” wide x 24” deep with modesty panel, plus an instructor chair must be provided.

k) Each classroom is furnished with a battery-operated GPS clock, as part of an existing campus clock system.

l) Each room shall have a moveable tabletop lectern or free standing lectern in addition to the multimedia lectern.

m) Provide a trash receptacle in each classroom.

n) Do not provide coat racks.

o) Do not provide pencil sharpeners.

p) Do not provide tack surfaces in the general assignment classrooms, unless approved by Classroom Scheduling.

12. Lighting

a) Light levels and materials are described in Section III - V. Electrical D. Lighting.

b) Lighting must be evenly distributed for reading and writing at the student stations and allow everyone in the room to see each other’s faces easily, in order to foster class discussion.
c) Lighting must provide a level of room darkening to view projections on the front screen that also provides sufficient lighting for note taking.
d) All classrooms shall have no less than two separately controlled lighting areas—seating area and instructional area. The ability to dim both areas shall be provided as standard.
e) Fixtures must be installed to evenly light the front writing surface. These fixtures shall be controlled separately from other room lights. Users must be able to control lighting over screen and writing surface separately, so that lights over the screen can be darkened while leaving the writing surface illuminated.
f) When the classroom is dimmed for projection, some lighting shall be required at the presentation area. Light the instructor lectern surface independently of the classroom, with LED.
g) ITS shall be consulted for any programmable/scene lighting configurations.
h) Where programmable lighting is planned, provide a mock-up for instructor review well before planned installation, allowing time for modifications to product selection.
i) Place back-lit switches at every room entrance that provide at least minimal room illumination so users never need enter a dark room. In windowless rooms, provide a small light at the door.
j) Locate clearly labeled lighting controls on the instructor multimedia lectern, and on the wall nearest to the instructional area. Where programmable lighting is used, controls should be integrated into the multimedia control panel. Duplicate lighting controls should be placed in the projection booth, if applicable.
k) Avoid suspending fixtures from the ceiling, to prevent conflict with ceiling-mounted projectors.

13. Mechanical Systems
a) HVAC equipment mounted in rooms adjacent to classrooms should be isolated for vibration and noise control. Buffer classrooms from the interior noise of mechanical systems, elevators, restrooms, etc.
b) Select system components that meet the criteria under Acoustics.
c) Position ceiling diffusers to avoid conflict with placement of ceiling-mounted projectors.
d) Mechanical system design and installation must provide space for classroom technology components that may require space above finished ceilings or below raised floors. Examples include projection screen troughs, projector mounts, and conduit.
e) HVAC diffusers and intakes should not be placed near or directed at projection screens.
f) The HVAC system that serves classrooms shall operate independently from systems that serve other functions within the same building to allow for year-round classroom service.
14. Technology

a) All new or renovated classrooms shall include a full range of installed multimedia equipment.

b) If a media consultant is retained, ITS must specify all media equipment for general assignment classrooms prior to purchase.

c) All arrangements for installation of classroom technology should be made with ITS.

d) Provide an audio/visual storage closet with storeroom lock in each classroom building for portable media equipment for use in all the building’s general assignment classrooms. This closet must include one data and one electrical outlet.

e) Lectern: If multimedia equipment is rack-mounted in the multimedia lectern, the lectern shall be designed in consultation with ITS. Multimedia lecterns should provide, at a minimum, 15 RU’s for AV equipment and adequate surface space for a 24” LCD monitor, 7” control touch panel, document camera, and 24” of writing space. Wire at least one dedicated 20 amp circuit at the lectern, plus five data outlets and one phone line. Multi-media lecterns should be adjustable to allow for a variety of use positions and shall be accessible to wheel chair users. A phone for hotline calls shall hang on either the lectern or on the wall nearest the lectern.

f) Provide a mock-up of the lectern for instructors to view. Allow sufficient time to permit review and modification before the planned installation.

g) A/V signal pathways, conduit size, and termination points in the general assignment classrooms shall be approved or specified by ITS.

h) There shall be a video/data projector either mounted to the ceiling or in a projection booth, depending on ceiling height and ability to access a ceiling-mounted projector for maintenance. Typically, this means that projectors in lecture halls shall be located in a booth.

i) There shall be a motorized tension projection screen in all general assignment classrooms and lecture halls where screen size is larger than 50”x80.” Screen size, surface and placement shall be specified or approved by ITS. ITS shall normally provide the screen for installation by contractor.

j) As the room deepens the screen height must increase. The bottom of screen shall be no lower than 40” from floor. The screen height shall be 1/5 the distance from front wall to last row of seats.

k) Voice amplification is required for rooms seating 70 or more. All rooms with voice amplification should provide external line level outputs for assistive listening devices and/or mult-boxes. Hearing loop technology may be considered.

l) Networking
(1) Wireless networking – Provide full wireless coverage for all classroom spaces, with the ability to provide reasonable service to a fully occupied room.

(2) Wired networking – Equip all classrooms with a minimum of four active network drops grouped together at the instructor’s podium or at a nearby location approved by ITS.

(3) TILE classrooms require 5 active network drops at the instructor’s station along with 4 network drops for each student table. Additional capacity to expand data service to every seat in a TILE classroom is preferred.

15. Signage
   a) Signs with room number and identifier for room type (e.g., general assignment classroom) shall be located at room entrances.

16. Wall Finishes
   a) Durable wall finish on all walls. All painted surfaces must be washable.
   b) In any classroom with moveable chairs, provide chair rail on both back and side walls to prevent wall damage. Rail height is determined by chair selection.
   c) Apply a durable, easy-to-clean surface such as epoxy paint across the entire front wall below the writing surface.

17. Windows
   a) If windows are present, they should be at the side of the room, and not at the front or back.
   b) Provide light control suitable to support media projection at each window. Roller shades at 3% room darkening are preferred. Some locations may require dual head with blackout roller shades. Light blocking applications should be mounted tightly against frame/wall to reduce light spill.

18. Writing Surfaces
   a) A porcelain-covered steel dry marker writing surface shall be provided in each classroom.
   b) Provide the maximum possible amount of writing surface at the front instruction wall (minimum 12’ width). A continuous tray the full length of the board should be provided for erasers and markers. Additional writing surface on side walls may be appropriate in some configurations.
   c) The board shall be 4’ in height and mounted with the top of the board 86” above the finished floor. In no case shall the bottom of the board be lower than 36” from the floor.
   d) All boards shall have a cork tack strip along the entire top. The strip shall be equipped with map hooks, one per every 2’ of board length.
   e) At least 6’ width of writing surface must be useable when the projection screen is in use.
O. Office Standards  
1. General: Guidelines for office size in new or renovated spaces:  
a) Dean/Vice President: 200-300 sq. ft.  
b) Departmental Exec. Officer: 180 sq. ft.  
c) Faculty private office: 140 sq. ft.  
d) Staff private office: 120 sq. ft.

III. STRUCTURAL  
The following information is provided as a guide for designing structural support systems. All load criteria shall be in accordance with the latest edition of the applicable codes.

A. General  
1. Load criteria for all structural systems shall be noted on the drawings.  
2. Separate additions from existing structures with an expansion joint.  
3. Do not transfer vertical loads through horizontal expansion joints.  
4. Gypsum roof decking shall not be used. Preferred roof decking material is steel or concrete.  
5. All roof decks shall be designed with a minimum slope of 1/4” per foot. Positive slope for drainage shall be provided by the roof deck rather than tapered insulation (except at crickets and around equipment pads).

B. Foundations  
1. Subsurface design requirements shall be based on a current geotechnical investigation from which soil profiles, design parameters, compaction requirements, and foundation design options are established.  
2. In instances where concrete duct banks, steam tunnels, and other concrete masses join foundations walls, steel pins for reinforcing steel anchoring shall be attached to the foundation walls through use of epoxy capsules.

C. Floor Loadings  
1. Floor loadings shall be increased as required to meet equipment loadings and conditions specified by equipment manufacturer.  
2. If live load reduction is used, it shall be in accordance with the applicable codes and must be specified.

D. Roof Loadings  
1. Minimum ground snow load design is 30 psf. The snow load design should also account for drift loading on lower roof surfaces.  
2. Roof service loading shall be increased as required for external equipment, ducting, and supported utility requirements.
E. **Wind Design**
1. Every building and structure shall be designed and constructed to resist prescribed wind effects. Wind load design criteria shall be 90 mph wind load (Exposure B for East and West Campuses, Exposure C for University of Iowa Research Park, Hawkeye and Finkbine Campuses) Importance Factor 1.15.

F. **Precast Concrete Design Criteria**
1. The architect shall specify allowable deflections to be used in the design of the panels to maintain integrity of the panel.
2. Panels shall be designed with adequate structural integrity to permit handling, transportation, storage, and erection.
3. Waterproofing materials are discouraged on new concrete surfaces.

G. **Masonry**
1. Design and construction guidelines and technical notes of the Brick Institute of America (BIA) shall be followed for brick and the Masonry Advisory Council (MAC) for concrete masonry unit (CMU) construction.
2. Use of stone coping for modification to existing facilities with stone coping shall be allowed. Use of stone coping for design effect shall require specific approval from the PM.
3. Masonry units shall not be used for foundations walls below grade.
4. Waterproofing materials are discouraged on new masonry, or stone surfaces. Use shall require PM approval.
5. The Design Professional shall evaluate the expected movement for each wall and require adequate expansion joints to accommodate the movement.

IV. **MECHANICAL**
The following information is provided as a guide for designing mechanical systems. All criteria shall be in accordance with the latest edition of the applicable codes. For mechanical detail drawings, refer to Appendices.

A. **General**
1. Heating and cooling system loads for the purpose of sizing systems and equipment shall be determined in accordance with procedures described in the latest edition ASHRAE Handbook, Fundamentals.
2. Outdoor design conditions shall be selected from the latest edition of ASHRAE Fundamentals Handbook, or from data obtained from the National Climate Center or similar recognized weather source.
   a) Heating design temperature shall be no lower than the 99% dry-bulb.
   b) Cooling design temperature shall be 92F°db, 76F°wb and for cooling towers 79F°wb.
3. Winter humidification shall not be provided for general comfort applications. Humidification shall be provided for 100% outdoor air systems and special collections areas (e.g. museum, rare books.)

4. Ventilation systems shall be designed to provide outdoor air ventilation rates in accordance with section 6.1.3 of the latest edition of ANSI/ASHRAE Standard 62.

5. Supply/return air systems shall be designed in accordance with the latest edition of ASHRAE Fundamentals Handbook. Return air shall be ducted; return air ceiling plenum systems are not permitted. Exhaust/return fans shall be included in the HVAC design; single fan systems are not permitted.

6. Fresh air intakes shall be designed above grade and shall be no closer than 50’ to parking areas.

7. Piping systems shall be designed in accordance with the latest edition of ASHRAE Fundamentals Handbook.

8. HVAC equipment shall have a minimum efficiency at the specified rating condition, not less than the values shown in ASHRAE 90.1. Compliance with minimum efficiency requirement specified for HVAC equipment shall include compliance with Integrated Part-Load Value (IPLV) as well as standard or full-load requirements.

9. Temperature Controls:
   a) New buildings and major renovations shall use a Direct Digital Control (DDC) system and all devices shall report to a central Building Automation System (BAS) within the building, which is networked to the campus BAS.
   b) Minor renovations in buildings with pneumatic zone control are permitted to re-use existing components, but new components shall utilize DDC technology.
   c) Control systems in existing buildings shall be an extension of the existing system. If the existing building controls system is a combination of pneumatic and DDC, the new work shall be DDC and the pneumatic shall be upgraded to match the rest of the building. If consideration is to be given to an alternate manufacturer of the DDC system, the alternate manufacturer would be required to replace all the existing DDC controllers with the manufacturers’ controllers (i.e. integration not permitted).
   d) Zone controls shall be determined based on one room/occupied area per zone. This is to allow the room occupancy sensor to control the occupied/unoccupied mode of each zone controller to maximize energy conservation.

10. Centralized heating and chilled water are preferred systems where available. For 100% outside air requirements, a steam heat exchanger shall be used to incorporate antifreeze protection for preheat coils. Reheat applications shall incorporate a steam to hot water heat exchanger for better temperature control.

11. All penetrations through firewalls, or floor or roof decks shall have firestopping material installed at the penetrations and shall be shown on the drawings.

12. Wall and Ceiling Access Doors:
a) Access shall be supplied and sized for all concealed valves and other equipment that may require operation or adjustment. Access doors shall be placed in a reasonable/safe location. Location points shall be noted if under carpet.

b) Both mechanical and architectural drawings shall note the need for access doors, number of doors needed, and general locations. Exact locations are not desired. Design should require access doors be located to allow access to valves or other equipment. Access panels shall be reasonably placed as not to introduce a threat to safe working conditions.

c) Access doors shall be located before and after all reheat coils.

B. Piping

1. Campus water distribution systems operate at 60-100 psi, which may create the need for pressure reducing stations or other special considerations for specific applications.

2. Facilities Management provides water meter specifications. The Design Professional shall coordinate sizing and location of meters with UI's Utilities and Energy Management. The contractor shall be responsible for installation of meter.

3. Dielectric unions are not allowed in piping systems. Use dielectric couplings or flanges to connect dissimilar piping materials.

C. Equipment

1. Major equipment shall be provided with adequate pressure, temperature, and flow indicators at time of installation to establish unit performance.

2. Equipment shall be provided with bearings lubricated for life by the manufacturer. Where periodic lubrication is needed, specification shall require lubrication points to be readily accessible for lubrication. Remote lubrication systems shall be metal.

3. Electric heating systems shall not be used.

4. Fully operable access doors shall be provided to coils, filters, motors, belts etc.

5. Vibration and sound transmission from mechanical equipment shall not exceed ASHRAE sound criteria design guidelines, Table 42, ASHRAE HVAC Applications Handbook, Chapter 47.

6. All HVAC equipment shall be located to facilitate accessibility, maintainability and replacement.

7. All coils within air handling units, chillers, and heat exchangers shall be capable of being pulled without obstruction of equipment, pipes, conduit, etc., or requiring removal of any other coil in the same unit.

8. All coils within air handling units shall be drainable.

9. All mechanical equipment/systems shall be installed on a 4” minimum concrete housekeeping pad, and where required, steel support framing as required to allow proper housekeeping, drainage, and full access. All sub floors beneath housekeeping pads shall be sealed to prevent leaks through cracks in pads.

10. All motors shall be premium-efficiency.

11. No motors shall be designed to operate in the service factor.
12. Motors shall be designed to operate continuously at all speeds with variable speed drives having carrier frequency of 12 KHZ or higher without large fluctuations in amps drawn at any single speed.

13. Equipment pits, whenever possible, shall be drained by gravity to sanitary lines. Where gravity drainage is not possible, a sump with a pump shall be installed. The sump shall have an alarm installed, connected to the building control system whenever possible, to alert maintenance personnel whenever the water level rises and before the water overflows the pit. Where the building control system is not available, a local alarm shall be installed.

14. All equipment using steam must be designed to the appropriate system pressures and temperatures.

15. No direct-steam humidification systems shall be used.

16. The campus pumped condensate return system operates with low pressure and is gravity flow in many areas.

17. All condensate pumps must be capable of handling high temperature condensate.

18. Condensate tanks must be sized at a minimum of three times the calculated peak flow in gpm and shall have two separate vents.

19. A pressure gauge is to be installed on the system side of the condensate pump discharge check valve.

20. Main Campus condensate pumps shall be duplex electric pumps. University of Iowa Research Park (Oakdale) Campus condensate pumps may operate off of steam pressure.

D. Insulation
1. All insulation shall comply with ASHRAE 90.1.
2. Insulation containing asbestos is prohibited.
3. The following plumbing and piping systems shall be insulated: domestic cold and hot water supply, hot water return lines, chilled water lines, horizontal storm drain lines and roof drain sumps, and exposed waste lines.
4. Provide insulation on equipment, pipes, and ducts where:
   a) Heat transmitted shall significantly affect ambient temperatures in controlled spaces.
   b) Heating or cooling effects shall be significantly affected due to heat flow into or out of pipes or ducts.
   c) Condensation shall occur as a result of surface temperature approaching dew point of the ambient air.
   d) Significant energy loss would result from heat transfer.
   e) External surface temperature is greater than 120F.
5. Continuous vapor barrier on all cold surfaces shall be insulated.

E. Building Plumbing Systems
1. Domestic Water Systems
a) Domestic water heating systems shall be designed in accordance with Chapter 49 ASHRAE Handbook, HVAC System and Applications.
b) All water heaters and hot water storage tanks shall meet efficiencies set forth in the latest edition of ASHRAE/IES Standard 90.1. Water heaters also need to meet the requirements of State of Iowa Administrative Rules Chapters 94 and 95 for state registration purposes.
c) Availability of existing hot water source and cost effectiveness of its use shall be investigated while designing a domestic hot water system for the specific project. Steam is the preferred heat source for all hot water systems.
d) Program requirements for hot water shall be evaluated to determine whether a code variance to eliminate hot water is desirable.
e) Desired temperature for hot water is a maximum of 110°F at the point of usage for normal faucet applications. Other types of usage may require other temperatures (dishwashers, cage washers, etc.) and should be evaluated individually. Where temperatures higher than 110°F are required at certain outlets for a particular intended use, separate heaters or booster heaters shall be installed for those outlets.
f) Where rapid fouling due to heavily mineralized water is anticipated, heated water shall be outside the tube.
g) Instantaneous, tankless water heating systems are preferred whenever feasible.
h) Recirculating pumps in hot water systems shall be constructed of non-ferrous material.
i) Expansion tanks:
   (1) Allowing the pressure relief valve to dump excess water due to expansion is not acceptable.
   (2) All expansion tanks shall be installed with provisions for draining and venting.
   (3) All hot water systems with backflow preventers shall be designed and installed with the most efficient and cost-effective method of thermal expansion.

2. Water Softeners:
a) Water softeners shall supply soft water to domestic hot water systems.
b) Water softening is required on all central hot water systems. Other water shall not be softened except for specific applications requiring softened water.
c) All water softening equipment shall be installed with a test port immediately downstream from the softening equipment.
d) Water softening systems should be designed to supply water at less than 1 grain of hardness. Water supply typically has 7-10 grains of hardness on Main Campus and 25 grains of hardness on University of Iowa Research Park (Oakdale) Campus.
e) The Design Professional shall coordinate through the PM the sizing and specifications of water softeners with UI Utilities and Energy Management - Water Plant.

3. Water Coolers:
   a) All water coolers shall be refrigerated type.
   b) No water cooler shall be more than 36” from cooling unit.

4. Hose Bibbs and Wall Hydrants:
   a) Hose Bibbs and wall hydrants shall comply with (UPC) standards listed in chapter 6 (current version) i.e. ASSE 1001 or CSAB 64.2.1.1.
   b) A hose connection shall be installed on roofs where maintenance of equipment requires washing and in each mechanical room.
   c) Hose connections shall be located on the exterior of each building. A minimum of one hose connection shall be installed on each side of the building. Preferred spacing for hose connections is one every 100’. Were feasible, hose connections should be installed within 15’ of the main entrance to the building. Provide isolation valves on interior feed to deactivate outdoor hose bibs during winter.
   c) All exterior hose connections shall be of the recessed socket type.

5. Backflow preventers:
   a) All domestic water systems shall have Watts 909 backflow prevention devices at the point of building entry. No metering devices, taps, or other fittings shall be located upstream of the backflow preventers. However, if a common supply serves both the domestic water system and the fire protection system, it is preferred the two systems be split outside the building. Install two (2) backflow preventers in parallel, each at 100% capacity, for the potable water systems. Install one (1) FM Global approved double-check assembly on a dedicated fire suppression water system.
   b) All backflow preventers shall be located and configured to allow ready accessibility for maintenance and testing. Minimum clearance is 24” in all directions.
   c) No backflow preventers shall be located more than 4’ above floor level without a platform constructed for access.
   d) Pit installations of backflow preventers shall not be allowed.
   e) Drainage from backflow preventers must be air-gapped and possible by gravity only, either to a floor drain or to surface of the ground.

6. Sanitary Waste and Vent:
   a) All sanitary waste systems shall be designed for a maximum of 140°F material. No material shall be dumped in any sanitary waste system having a temperature of more than 140°F. In some cases this shall require cooling units on waste discharge.
   b) Every piece of equipment requiring indirect waste (backflow preventers, ice machines, autoclaves, etc.) shall be served by a drain at that piece of equipment. More than one piece of equipment can be served by a drain
provided pieces of equipment are close to each other and sizing of the drain provides adequate drainage for the equipment. The preferred method for supplying this drain is by use of a floor drain, but other types of drains are acceptable, depending on the individual situation. In no case shall drainage be accomplished by installing piping across the floor to a central floor drain.

c) Cleanouts shall be located in the wall or on the floor, not above the ceilings.

7. Floor Drains:
a) All mechanical rooms shall have a minimum of one floor drain. More floor drains shall be installed as required to maintain a minimum ratio of one floor drain for every 500 square feet of floor area. These floor drains are in addition to those drains required for equipment.
b) Floor drains shall be designed to drain the floor around them by the force of gravity. Specify in specifications that each floor drain shall be tested to ensure that water on the floor in the area served by the drain is able to reach the drain by the force of gravity alone. The pitch of the floor shall be toward the drain.
c) Floor drains shall be provided in all toilet rooms. Square drains for tile floors, round drains for concrete floors.
d) Floor drains shall have adequate capacity to serve the drainage needs of the area in which they are situated and shall serve the standard drainage needs of the equipment in the area.

8. Storm Sewer Systems:
a) All surface water shall be directed to a storm sewer system. In no case shall storm water be placed in a sanitary sewer system and no mechanical room floor drains shall be connected to the storm sewer system.

9. Special Systems:
a) Emergency Showers and Eyewashes
   (1) Emergency showers and eyewashes shall be provided as required.
   (2) All piping to emergency showers and eyewashes shall comply with ANSI Z358.1 2004.
   (3) In new construction, any situation requiring either an emergency shower or eyewash should have both installed. It is preferred that they be co-located. Drainage for showers and eye washers shall be onto the floor (no floor drain), unless directed otherwise by PM.
   (4) All emergency showers shall have a local alarm to notify persons in the area that the shower is in use.
   (5) Designs for installations of emergency showers or eyewashes should consider the feasibility of providing an alarm connection to the building security system.

10. Fixtures:
a) Plumbing Fixtures
   (1) All water flow control devices shall be of the water conserving type. Waterless urinals are not permitted.
In new construction, all fixtures shall be wall-hung. In existing construction, wall-hung fixtures are preferred if feasible.

Locations of electric water coolers and fixtures with automatic flush valves (battery), with courtesy flush button, shall be noted on electrical and plumbing plans. All plumbing fixtures shall be noted on the architectural drawings.

F. Fire Protection Systems
   1. Sprinkler Systems
      a) All new buildings shall be designed with automatic fire protection systems throughout the building. Automatic fire suppression systems shall be provided as a part of major renovation projects. Wet pipe type system is preferred. Partially renovated buildings shall be considered for automatic wet sprinkler fire protection coverage during the design scope of the project. A project shall be hydraulically recalculated to prevent incorrect information from old hydraulic calculations.
      b) Materials and equipment shall be approved, listed, and labeled by UL or FM specifically for fire protection service. System shall be designed in accordance with NFPA and FM Global for the application intended.
      c) Fire protection systems shall be installed per NFPA IFC, IBC.
      d) Sprinkler shop drawings shall include hydraulic calculations, pipe drawings all drains, isometric drawings, all sprinkler piping, and material/product cut sheets.
      e) Valves shall be located in locations with easy access that do not require additional equipment to access such as a ladder. Zone valves shall be located in a fire protected enclosure (stairwell) at no more than 7 feet from above finished floor level. Each individual floor shall be isolated into its own sprinkler zone. The zone valve serving the floor shall be located on the floor being served. Check valves and zone main drains shall accompany this zone valve. All efforts shall be made to design sprinkler system to drain back to its individual floor zone valve. If auxiliary or test drains are needed, coordinate with UI FM-Fire Safety Department during sprinkler design. Mains shall be run in hallways and corridors.
      f) A pressure gauge shall be installed on the main supply of each sprinkler system, as well as each zone, upstream from the main test valve.
      g) Drainage shall be provided for all test locations that is sufficient to carry the full flow of water that can be expected during testing of the systems. Efforts shall be made to parallel the main drain with the sprinkler riser. Above ground floors shall be designed to drain to the exterior of the building, while below grade floors shall be designed to drain to the exterior, with auxiliary drains installed to handle the remaining trapped water. Drains that are piped to floor drains must be at minimum 6 inch drains that can handle full flow discharge of a fully pressurized sprinkler system. Exterior discharge of water shall be be away from
building entrances or populated areas. This is particularly important at the location for testing the main drain of a system. Sprinkler piping containing ethylene glycol shall be drained to a sanitary sewer.

h) Exterior fire department connections shall be sized according to requirements of the local fire district. The fire department connection (FDC) shall be located as close as possible to a fire hydrant and the main Fire Alarm Control Panel. A Potter-Sash horn/strobe (model #24 #1000055) shall be installed 8 – 10 feet above the FDC for fire department notification.

i) Sprinkler systems shall be monitored by the building’s fire alarm panel and be capable of monitoring and reporting water flow in all zones and tampering with all valves of the system. Fire Alarm Control Panel shall be equipped for sounding a local alarm throughout the building and shall be monitored by an outside agency, either UI Public Safety Department or other central station provider.

j) Where a sprinkler system is to be installed in a non-heated area, a dry pipe system shall be installed rather than a chemical system when possible.

k) Fire pumps: A fire pump room shall have outdoor and direct interior access. If possible, direct outdoor access should be provided. Fire pumps shall be horizontal split-case with diesel engine or electric motor. Fire pump feeder shall originate from its own dedicated outdoor transformer or at a minimum from the load side of the main building transformer ahead of all secondary disconnects. Pump shall be sized to eliminate the need for pressure relief valves. Design shall address any Code needs for an automatic transferred emergency power supply for electric motor driven pumps.

(1) All electric fire pump controllers shall be equipped with automatic transfer switch (emergency power), and the transfer switch shall be equipped with its own listed disconnect means. Fire pump controller shall be wired directly from normal power and emergency power sources with no other disconnects (included molded cases) allowed between controller and power source(s).

G. Refrigerant Cooling Systems

1. General
   a) All mechanical room installations shall comply with ASHRAE Standard 15.
   b) Waste water cooled units are not acceptable.
   c) All roof mounted condensing units shall be designed to 115F outside air temperature.
   d) Low-ambient controls may be required for some applications.

2. Material
   a) All valves shall be full port. Provide isolation valves on each side of driers. Provide check valves on the discharge of compressors. Discharge from all relief valves shall be piped to exterior of the building.
b) Insulate suction and hot gas bypass in all locations and discharge lines if exposed in occupied areas.

H. Water Cooling Systems

1. General

a) Chilled water shall be provided by:

(1) Making use of existing chilled water distribution system and existing chiller;

(2) Providing new chiller, but using the existing distribution system as much as possible; or

(3) Providing new chiller with new chilled water distribution system.

b) The Design Professional shall coordinate through the PM the building central chilled water interface design and anticipated usage with UI Utilities & Energy Management. The Design Professional shall provide for the installation of control equipment and a communications pathway to support central chilled water interface monitoring and control. (Refer to Appendices for chilled water Interface Details) unless otherwise directed by PM.

c) Condensing water systems shall be equipped with automatically controlled water treatment and blow down systems designed to control scale buildup, corrosion, and concentration of dissolved solids. The Design Professional shall coordinate through the PM the water treatment equipment specifications with UI Utilities & Energy Management - Water Plant.

2. Chilled Water Loops

a) All chilled water loops shall be two pipe systems.

b) All chilled water and/or process chilled water systems that require year round use shall be supplied with a winter interface with chilled water pump and pump control sized for the winter load.

c) Criteria for Chilled Water Loads:

(1) Size each unit (heat exchanger, cooler, fan coil, or air handler) connected to the central chilled water system for a minimum inlet temperature of 44°F and a minimum temperature differential of 16°F.

(2) Provide thermometers and pressure gauges on both the inlet and discharge sides of any device connected to the chilled water system. Provide temperature and pressure sensors on both the inlet and discharge sides of devices connected to the chilled water system and tie into the BAS, as directed.

(3) The water velocity in the pipe should not exceed 7 ft/s. Maximum design pressure drop of 4 ft/100 ft of equivalent pipe length.

(4) Consider the impact of any new system on existing chilled water hydraulics. Minimize the required pumping energy, avoid over pressurizing and overflowing any area of the system. It may be necessary to model part or all of the system hydraulics.
(5) Control building pump speed to maintain a minimum pressure differential (5-psid) at the most remote point on the system.

(6) Provide adequate control for every device. Control valves should allow flow to vary across the range required by the heat exchanger, cooler, etc. Do not use three-way or on/off valves. Size control valves for the entire range of flow, consider the maximum pressure drop possible. Do not allow the system pressure to overpower any control valve. Use the flow coefficient provided by the manufacturer to determine the maximum allowable pressure drop for each valve.

(7) If large pressure differentials are unavoidable, use pressure independent control valves in lieu of pressure reducing devices such as circuit setters.

(8) Some applications (large temperature rise, water quality issues) may require separation of the chilled water and the medium cooling the device. Size the heat exchanger for an inlet chilled water temperature of 44°F and a minimum chilled water temperature differential of 12°F. Control chilled water flow to the heat exchanger according to the temperature of the departing chilled water.

(9) Provide an off-season chilled water distribution pump if there are year round chilled water loads and provide appropriate sequence of operation to ensure that chilled water pumps operate to maximize efficiency of the systems.

I. Steam Systems

1. Steam Distribution System
   a) All design work for steam and condensate for Main Campus and University of Iowa Research Park (Oakdale) Campus shall be 175 psig, and 500 degrees F.
   b) Condensing water systems shall be equipped with automatically controlled water treatment and blow down systems designed to control scale buildup, corrosion, and concentration of dissolved solids.
   c) The University of Iowa Research Park (Oakdale) Campus utilizes the same design standards for the steam distribution system as those required for the Main Campus steam distribution system.
   d) Whenever additional steam loads are to be applied to the steam distribution systems, an evaluation of the load design requirements and available steam distribution facilities and operational needs of the steam/power plant and steam distribution systems must be completed.
   e) For applications where it is anticipated that the 20 psig distribution system has adequate or near adequate capacity for the majority of the year, but not adequate during peak load periods, a pressure reducing valve booster station could be connected from the 155 psig distribution system to maintain a minimum line pressure of 15 psig.
f) Heating system shall be equipped with treatment system designed to control scale buildup and corrosion, and boiler blow down control. Condensate treatment shall be included where applicable.

g) Direct buried systems are not preferred. All distribution piping shall be installed in a steam chase, unless otherwise directed by the PM.

h) Steam meters are required for steam system usage points. The Design Professional shall coordinate sizing of meters with the Owner during design.

2. Meters are McCrometer V Cone

a) Meters shall be installed in straight piping. The piping shall be free from bends, reducers, valves, and branch lines for a distance of 4 pipe diameters upstream from the meter and 3 pipe diameters downstream of the meter.

b) Meters shall have flow direction arrows that need to be observed. The meters shall have flanged bodies. Flanges shall be 150# raised face. Meter shall be provided by the Contractor. Design Professional shall consult with the Owner for specifications, sizing, and product numbers and codes.

c) Pressure and temperature taps shall be installed as per the detail in the Appendices.

d) The Design Professional shall furnish pipe size as well as flow information to the Owner for proper sizing of steam meters.

e) Electronics: The sensors in the meter station consist of a pressure transmitter, a temperature transmitter, and a steam flow meter. The Design Professional shall consult with the Owner for specifications, sizing, and product numbers. The sensors require conduit and wiring to a central location. All conduit and conductors shall be provided and installed by the Contractor.

3. Medium and Low Pressure Steam (within building)

a) Medium pressure steam is defined as having 20-85 PSI. Low pressure steam is 20 PSI.

b) All drawings should show drip legs and specifications should require drip legs for all risers.

c) Pressure Reducing Valves (PRV): All PRVs shall be installed with isolation valves. Cashco PRV’s in the distribution system shall not contain a bypass, and pressure gauges shall be located on both sides of the PRV. All PRVs shall be located and configured to allow ready accessibility for maintenance. Provide a minimum clearance of 24” in all directions. No PRV shall be located more than 8’ above floor level. The Design Professional shall evaluate the feasibility of using wall-mounted PRVs.

d) Building systems (AHU, HX) shall be designed for a maximum operating pressure of 15 psig. Sizing of control valves, PRV, traps, etc., shall be based on a delivery pressure setting of 5-7 psig.
J. **Hot Water Pumps**
   1. All pumps shall be installed in easily accessible locations and shall have isolation valves installed on each side of the pump.
   2. All pumps shall have mechanical seals.
   3. Base mounted, centrifugal pumps shall be installed with a pressure gauge manifold and a suction diffuser/strainer. Pipe vibration isolators shall be stainless steel. Design Professional shall evaluate the need for vibration isolation on the pump.

K. **Hot Water Air Venting**
   1. Automatic air vents are not preferred. If used, they must be readily accessible.
   2. Hose bibs shall be installed for manual air vents at all high points of the hot water systems.
   3. Air separators are required on all system. Centrifugal type air separators are preferred.
   4. No pipe system should use custodial rooms as pipe chase.

V. **ELECTRICAL**
The following information is provided as a guide for designing electrical systems. All criteria shall be in accordance with the latest edition of the applicable codes and standards.

A. **General**
   1. Electric service shall be designed and installed to meet or exceed the latest revision of the National Electric Code and the current version of NFPA 70E.
   2. **Arc Flash Analysis**
      a) Design Professional to provide preliminary loading for transformer sizing, proposed secondary voltage, and shall perform fault current/load flow, harmonic, distortion (including neutral current estimate) and Arc Flash Analysis.
      b) The Design Professional shall identify to the Owner how arc flash hazards were reduced or mitigated.
      c) Design Professional shall provide contractor with data to meet compliance with NFPA 70E labeling requirements.
      d) The Design Professional shall also provide breaker sizing and setting requirements for the service protector that shall coordinate with downstream circuits and protective devices in the building.
      e) All new greater than 50 volt panel boards, switchboards, lighting controls, disconnects, motor control centers, local starters, vfd’s or other isolated equipment shall be clearly labeled with incident energy levels and arc flash hazard level with recommended PPE.
      f) Arc flash labels are required at each 50 volt or greater panel board, lighting control, disconnect, motor control center, local starter, vfd or other isolated equipment. At a main circuit breaker where the arc flash study indicated different hazard levels, label as per the highest level arc flash hazard.
When installing or changing equipment, the Design Professional shall evaluate available fault currents and size ampere interruption capacity accordingly.

Arc flash labels shall be a permanently attached, non-aging material with waterproof, abrasion resistant lettering. Minimum required information:

1. Flash Protection Boundary in feet and inches
2. Hazard Risk Category
3. Calculated incident energy in calories per square centimeter (Cal/cm²)
4. Working distance in inches of the calculated incident energy
5. Voltage of equipment
6. Equipment name of identification number
7. Issue date that matches completion of studies
8. Design Professional to provide preliminary loading for transformer sizing, proposed secondary voltage, and shall perform fault current/load flow, harmonic, distortion (including neutral current estimate) and Arc Flash analysis. The Design Professional shall also provide breaker sizing and setting requirements for the service protector that shall coordinate with downstream circuits and protective devices in the building.

3. Main power supplies to new buildings and distribution panels shall be oversized for future requirements. A minimum of 20% spare capacity should be provided within each breaker panel board. Spare capacity is defined as 20% space feeder capacity and 20% spare poles within the panel.

4. Only UL or equivalent approved appliances and equipment shall be specified.

5. Building main transformers are metered at the primary side of the transformer with meters provided and installed by UI Utilities & Energy Management. Additional electric kilowatt-hour meters may be needed within the building to properly account for customer electric power usage. The meter sockets for these self-contained meter sites shall be provided by UI and installed by the contractor, the meter shall be provided and installed by UI. The Design Professional shall also provide a communications pathway (minimum 3/4”) to the electrical meters to support data acquisition systems.

6. When installing or changing electrical equipment, the Design Professional shall evaluate available fault currents and size the ampere interruption capacity accordingly.

7. Demolition and construction drawings shall be depicted separately.

8. Show conduit sizes and routings, along with number and sizes of conductors for feeders, homeruns and complicated circuitry.

9. Show circuit lighting and power outlets on the drawings and identify the panel terminal point for each circuit.

10. Provide a schematic wiring diagram of power and lighting related control circuits on the construction drawings.

11. Provide a riser diagram for each system covered under Division 26.

12. Show electrical schedules for panel boards, distribution boards, motor control centers and related items on the drawings. Connected demand load should be specified.

13. Define symbols in a legend on the drawings.
14. Electrical distribution equipment shall not be located in stairwells.
15. Consider functionality, proximity to lab equipment and maintenance access when locating electrical distribution equipment.
16. The design for buildings that house sensitive laboratory or data processing equipment shall clearly address the power quality requirements and location for the equipment. Separate neutrals, oversized neutrals and isolated grounds shall be installed where necessary.
17. Provide nominal 4-inch-high housekeeping pads for floor mounted equipment. Pads shall extend 4 inches beyond the equipment.
18. Include details of fire-stopping systems to be used. Provide installation practices for fire-stopping materials.
19. Use removable fire-stopping pillows for cable tray penetrations.
20. The Contractor shall test and supervise the initial operation of all secondary building equipment. The Contractor shall demonstrate the equipment to the Owner’s personnel and instruct the Owner’s personnel in operation and maintenance.
21. Exterior and interior surfaces of electrical equipment enclosures shall be wiped or cleaned with a vacuum immediately prior to final acceptance.
22. Accessible elements of disconnecting and protective equipment shall be cleaned with a vacuum before energizing.
23. Scratches on painted surfaces shall be touched up with equipment manufacturer’s standard paint of matching color.
24. Exterior handicapped ramps with electrically heated snow/ice melting systems are not recommended. Any applications shall be reviewed with the Owner.

B. Secondary Circuits (600 Volt or less)
1. All neutral conductors shall be a minimum of full size. The Design Professional shall evaluate the need for oversized neutral conductors.
2. The preferred method for grounding establishing a grounding electrode for equipment and structure is through the use of a buried loop, or in new construction, use of the concrete reinforcing steel. Driven grounds shall not be specified where soil conditions consist of rock. In such conditions, use a counterpoise system or another approved alternative. The grounding electrode should have a resistance to ground in the range of 2-5 ohms. All grounding electrodes shall be tested with the recorded resistance value approved by the Design Professional with two (2) copies provided to the University. All ground systems shall be connected to the primary power system ground mat serving the facility.
3. Building columns, roof steel, and footer steel reinforcing shall be made electrically continuous for grounding purposes. Use of building steel for grounding shall not be allowed unless the steel was designed for this use or grounding capability of the steel was tested and found adequate.
4. Water lines, building steel, and a grounding conductor from existing building shall be bonded together.
5. The Design Professional shall evaluate anticipated building loads for potential harmonic design requirements.

6. No aluminum conductors or busses shall be allowed. All conductors shall be copper.

7. The standard level of quality for distribution is a panel board or a switchboard. In cases where only a few circuits are required for a specific purpose (such as the dedicated panel in an elevator machine room) a load center may be used.

8. Distribution of power, lights, fire alarm, telephone, and miscellaneous signals shall be in conduit. Conduit systems may consist of rigid galvanized steel, IMC, EMT, or a combination of the three as required by applicable codes and standards.

9. All conduit sizes and conductor numbers and sizes shall be shown on the drawings.

C. Lighting

1. Standards & regulations: This section contains design criteria for interior lighting systems. Follow the current IESNA recommendations for lighting design. Comply with the latest edition of the International Energy Conservation Code (IECC), latest ASHRAE/IESNA 90.1, IEEE, FCC & UI Energy Design Guidelines and any subsequent Iowa State requirement the requirement of this section must be coordinated with the UI Energy Guidelines & the use of historical data for optimum design.

2. Ensure that all products conform to the following standards:
   a) ANSI C78.1 (with supplements), Dimensional and Electrical Characteristics of Fluorescent Lamps, Rapid Start Types
   b) ANSI C78.2 (with supplements), Dimensional and Electrical Characteristics of Fluorescent Lamps, Preheat Start Types
   c) ANSI C78.20, Characteristics of Incandescent Lamps of A, G, PS, and Similar Shapes with E26 Medium Screw Bases
   d) ANSI C78.21, Characteristics of Incandescent Lamps of PAR and R Shapes
   e) ANSI C78.1350 through C78.1359, High-Pressure Sodium Lamps
   f) ANSI C78.1375 through C78.1381, Metal Halide Lamps
   g) ANSI C82.1, Specifications for Fluorescent Lamp Ballasts
   h) ANSI C82.2, Methods of Measurement of Fluorescent Lamp Ballasts
   i) ANSI C82.3, Specifications for Fluorescent Lamp Reference Ballasts
   j) ANSI C82.4 (with supplement), Specifications for High-Intensity-Discharge and Low-Pressure Sodium Lamp Ballasts (Multiple-Supply Type)
   k) ANSI C82.5 (with supplement), Specification for High-Intensity Discharge Lamp Reference Ballasts
   l) ANSI C82.6 (with supplement), Methods of Measurement of High-Intensity Discharge Lamp Ballasts
   m) UL 935, Fluorescent-Lamp Ballasts
   n) UL 1029, High-Intensity-Discharge-Lamp Ballasts
   o) NEMA LE1, Fluorescent Luminaires
   p) UL 1570, Fluorescent Lighting Fixtures
   q) UL 1571, Incandescent Lighting Fixtures
r) UL 1572, High Intensity Discharge Lighting Fixtures
s) UL 924, Emergency Lighting and Power Equipment

3. System Design and Performance Requirements

a) Design Criteria

(1) Design lighting systems to achieve required levels of illumination while minimizing energy consumption. Select lamps and luminaires for high efficiency. Interior lighting systems must operate at the highest practical voltage level available. Specify high reflectivity interior finishes achieving the following minimum reflectance:
   (a) Ceilings: 80 percent
   (b) Walls: 50 percent
   (c) Floors: 20 percent

(2) Life Cycle Cost Analysis may be required to determine the most cost effective lighting solution.

b) Incorporate natural day lighting in the design to greatest extent possible to replace or supplement artificial lighting. See Energy Design Guidelines.

(1) Use windows, clerestories, and skylights to admit light into interior spaces. Use control devices, such as blinds, diffusers, and light shelves to control distribution, brightness, and glare.

(2) Do not install lighting in the skylights and when lighting installed in the nearby areas, they must be provided with a separate day lighting a switching arrangement.

(3) Arrange interior lighting systems so appropriate areas can be switched off or dimmed when adequate natural light is present. Where applicable, provide control by the following means:
   (a) Wall switches placed for occupant convenience
   (b) Occupancy sensors with momentary override switch
   (c) Dimming controls, which may include multi-level stepping or switching
   (d) Photo sensors
   (e) Programmable central control systems

(3) Select interior lighting to achieve initial system efficiencies greater than 75 lumens per watt. Efficiencies can be calculated as follows:

(1) Determine the initial lumens output (Initial lamp lumens x ballast factor luminaires efficiency) for the luminaires.

(2) Determine the input watts for each luminaire type.

(3) Calculate the system efficiency for the different spaces lighted by the various lamp/luminaire type in lumen output per watt.

(4) DO NOT rely on the prescriptive measures to meet the required watts per square foot as outlined in these standards. Submit ASHRAE Compliance forms.
(5) Submit illuminance calculations (point-by-point) in typical areas including classrooms, offices, and hallways, and unique areas such as gym, library and cafeterias.

(6) The lighting design shall maximize the use of recessed and direct/indirect 2’x4’ luminaires using linear fluorescent fixtures T8 or T5. T8 & T5 shall be 20,000+hr rated life for at least 90% of all lighting. Exceptions may be acceptable due to architectural considerations. The use of compact fluorescent shall be kept to a minimum and only when approved by UI campus engineering. When used, compact fluorescent shall have “end-of-life” protection.

(7) Lenses, ballasts, fuses, and all other fixture components shall be available for purchase as individual replacement components for maintenance & repair. Fixtures that require an entire unit to be purchased to replace defective parts are not acceptable.

d) Design for prescribed light levels that use realistic maintenance factors based on products actually used. For example, F32T8/835 lamps produce an initial 2950 lumens and have a lumen depreciation of 5%, while the more commonly used F32/T735 lamps produce an initial 2850 lumens and have a lumen depreciation factor of 12%. There is an 8% difference in maintained lumens between the two lamp types. This shall be taken into account since T8 luminaires shall not be cleaned and lamps are replaced at 24,000 to 30,000 hours. When making light level calculations, use a ballast factor of 0.78 for low Watt T8 ballasts, 0.87 for normal output T8 ballasts, 1.18 for high output ballast, and 1.0 for compact fluorescent ballast.

e) Design interior lighting systems to achieve the following levels of illumination, measured in maintained horizontal foot-candles on a working surface located 30 inches above floor level, within a tolerance of plus or minus 20 percent.

f) The following lighting & power density recommendations have been adopted for the common tasks performed in buildings. Lighting levels for various function areas have been identified.

<table>
<thead>
<tr>
<th>Functional Area</th>
<th>Light Level (Foot-candles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditorium (non-classroom)</td>
<td>30</td>
</tr>
<tr>
<td>Classrooms</td>
<td>45</td>
</tr>
<tr>
<td>Standard</td>
<td>50</td>
</tr>
<tr>
<td>High Task-Drafting</td>
<td>70</td>
</tr>
<tr>
<td>Science Labs</td>
<td>50-70</td>
</tr>
<tr>
<td>Home Economics</td>
<td>50-70</td>
</tr>
<tr>
<td>Industrial Arts</td>
<td>50-70</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Locker Rooms</td>
<td>15</td>
</tr>
<tr>
<td>Lounges</td>
<td>15</td>
</tr>
<tr>
<td>Cafeteria Eating Area</td>
<td>15</td>
</tr>
<tr>
<td>Food Preparation</td>
<td>75</td>
</tr>
<tr>
<td>Computer Rooms</td>
<td>35</td>
</tr>
<tr>
<td>Conference Rooms</td>
<td>35</td>
</tr>
<tr>
<td>Hallways/Lobbies</td>
<td>15</td>
</tr>
<tr>
<td>Gymnasium General</td>
<td>30</td>
</tr>
<tr>
<td>Exhibitions/Matches</td>
<td>50</td>
</tr>
<tr>
<td>Library Reading Area</td>
<td>50</td>
</tr>
<tr>
<td>Stacks</td>
<td>30</td>
</tr>
<tr>
<td>Check in/out</td>
<td>75</td>
</tr>
<tr>
<td>Lecture Halls</td>
<td>30</td>
</tr>
<tr>
<td>Offices Private w/o task lighting</td>
<td>50</td>
</tr>
<tr>
<td>Open w/task Lighting</td>
<td>35</td>
</tr>
<tr>
<td>Computer Work</td>
<td>30</td>
</tr>
<tr>
<td>Rest Rooms</td>
<td>15</td>
</tr>
<tr>
<td>Elevators</td>
<td>20</td>
</tr>
</tbody>
</table>

(1) Clarification of Lighting Recommendations

(a) The recommended lighting levels stated above are maintained levels. This represents lighting levels after the fluorescent lamps have depreciated and the fixtures become dirty. Retrofitted or new fixtures initially shall have light levels approximately 25 percent higher than those listed. This assumes existing fixtures are cleaned when retrofitted.

(b) Light levels can be achieved with the associated lighting power densities (installed lighting wattage divided by space square footage) when fixtures are equipped with T-8 lamps and electronic ballasts. Areas that have dark colored ceilings, walls or floors may require higher lighting power densities to obtain the indicated light levels. Dark colors absorb light reducing the lighting system efficiency. As an alternative to adding more light in dark areas, consider painting the ceilings and walls with a
light reflective color. Higher lighting levels and power densities may be justified by the designer.

(c) In occupancies where specialized tasks are performed (for example, at serving areas in dining halls and at mirrors in toilet rooms), the illumination levels listed might not be sufficient for adequate illumination. At such locations, increase the ambient lighting levels as necessary. Ambient lighting may also be supplemented by task lighting with the approval of the PM (the ambient level should not be less than one-third the level at the task).

(d) Lighting levels for Specialized Tasks: Laboratories, shops and work areas where critical or very fine tasks are performed, or areas where poorly printed or reproduced material is used may require higher light levels. These higher levels shall be directed to the task area only. Ambient lighting levels shall not be increased to meet the needs of particular tasks.

(e) As recommended the IES, light levels greater than fifty (50) foot-candles refer to illuminance on the task. In most areas, the average level of general lighting area shall be one-half to one-third the level for the tasks performed in that area.

(f) In general, illumination levels in excess of sixty (60) foot-candles shall be provided by task lighting only.

(g) Lighting Power Density: The designer shall use the foot-candles level's schedule when calculating the Lighting Power Density (LPD) and they should not exceed the ranges outlined below for the different activities. Designers unable to meet these criteria shall demonstrate reasons for exceptions.

<table>
<thead>
<tr>
<th>A</th>
<th>Offices</th>
<th>1.0 - 1.5 watts/sq.ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Classrooms</td>
<td>1.0 - 1.5 watts/sq.ft.</td>
</tr>
<tr>
<td>C</td>
<td>Libraries</td>
<td>1.0 - 2.0 watts/sq.ft.</td>
</tr>
<tr>
<td>D</td>
<td>Laboratories</td>
<td>1.5 - 2.5 watts/sq.ft.</td>
</tr>
<tr>
<td>E</td>
<td>Hallways</td>
<td>0.5 watts/sq.ft.</td>
</tr>
<tr>
<td>F</td>
<td>Bathrooms</td>
<td>0.5 - 1.0 watts/sq.ft.</td>
</tr>
</tbody>
</table>

(f) This should be clarified by noting that 0.2 fc is the minimum acceptable 0.3 fc is the desired minimum. Do not exceed 6:1 uniformity.

(1) Bike rack min ave. 5.0 fc
(2) Building entrance min ave. 5.0 fc
(3) Bus stop min ave. 2.0 fc
(4) Campus edge min ave. 3.0-4.0 fc, Do not exceed 6:1 uniformity
(5) Campus entrance min ave. 17.0 fc, Do not exceed 3:1 uniformity
(6) Emergency entrance min ave. 15.0 fc
(7) Maintenance/ Service min ave. 3.0 fc
(8) Open parking lot High Activity = 0.9 fc, Medium Activity = min ave. 0.6 fc, Low Activity = min ave. 0.2 fc, Do not exceed 4:1 uniformity
(9) Covered parking lot (ramp) min ave. 4.0 – 5.0 fc

g) Arrange lighting throughout all critical areas (including egress areas, assembly occupancies, health care facilities, and public safety operations) so that failure of any single element of the system, such as a lamp, ballast, switch, circuit breaker, or conductor, does not leave any portion of a critical area in darkness or illuminated at less than the levels required by code.

(1) Where only the normal distribution system is available, provide self-contained emergency lighting units connected to an unswitched lighting branch circuit conductor.

(2) Where both normal and alternate distribution systems are available, lighting fixtures must alternate between each source along the entire length of the critical area.

(3) Systems that use a central battery are acceptable only if wired in coordination with the Projects Manager.

h) In lighting calculations, maintenance factors (LLD x LDD) must not exceed 0.65. For high-intensity discharge fixtures, ballast factors must not exceed 0.9.

i) Interior light sources must be fluorescent or compact fluorescent, except as follows:

(1) When installed in high ceiling spaces (over 12 feet) in finished areas where they are not subject to frequent switching, interior light sources must be metal halide, induction lights, T5, or LED fixtures. Designers are encouraged to seek new tested technologies.

(2) When installed in high ceiling spaces (over 12 feet) in unfinished areas, such as warehouses and workshops, interior light sources must be metal halide, induction light, LED or T5 fluorescent.

j) Exterior light sources must be metal halide, induction, LED, or any approved white light source. High pressure sodium is not acceptable unless they are a replacement or to match existing conditions.

k) In areas where variable levels of illumination might be required by multiple users of the space such as classrooms, or for energy conservation purposes, provide multi-level switching or dimming capabilities. Such areas can include auditoriums and lecture halls, classrooms, gymnasiums, laboratories, offices, and workshops. See UI classroom standards.

l) Use day lighting strategies & motion sensors to control lighting in areas subject to extended unoccupied periods during normal hours of occupancy.

m) Use photocell-actuated combination lighting contactors to control exterior lighting systems. Mount manual-automatic selector switches on the contactors.
n) Coordinate luminaire locations with architectural features of space and with adjacent structural and mechanical elements. Installer is responsible to verify the final locations of the light fixtures, controls.

o) Areas in which lighting is critical, such as means of egress, places of assembly, etc., should be provided with multiple lighting circuits fed from both normal and alternate systems so that failure of either source does not require transferring of the load.

p) Because they are subject to accumulations of dirt and debris, avoid indirect systems. In all cases, luminaire design and placement must make it difficult for combustible debris to contact hot portions of luminaires, such as lamps and ballasts. Where the control of glare is a consideration, parabolic louvers are preferred. In rooms where two or more video display terminals are used, fixtures must have a minimum 0.7 visual comfort probability (VCP) value.

q) Avoid custom fixtures, but minor modifications to stock fixtures are acceptable. Custom fixtures are acceptable only when necessary to preserve the architectural character of prominent spaces.

r) Avoid inefficient luminaires. Coefficients of utilization should exceed 0.7 for a room cavity ratio of 1.0.

s) Luminaires recessed in fire-rated construction must be specifically listed for such use.

t) Unless required to suit specific design conditions, such as wet locations, do not specify luminaires for interior spaces that are designed for exterior use.

u) Wire four-lamp fluorescent luminaires for dual-level switching so that one ballast serves the inner pair of lamps and the other ballast serves the outer pair, whether or not such switching is called for in the project. Wire three-lamp fluorescent luminaires for multi-level switching so that the single-lamp ballast serves the middle lamp and the two-lamp ballast serves the outer lamps, whether or not such switching is called for in project. Where three-lamp fixtures are installed in continuous rows, wire them so that the middle lamps in each pair of adjacent fixtures are served by one two-lamp ballast located in either fixture.

v) Ensure that the lighting fixture schedules and the required details are shown on construction documents.

w) Bollards and underground luminaires in sidewalks, roadways and retaining walls are not allowed.

x) Use #12 AWG light fixture whips.

y) Lighting layout take priority over ceiling tiles layout.

z) Minimize the use of 4 lamp fixtures unless approved by PM.

4. Lighting Fixtures (luminaries)

a) Shall be in accordance with NFPA 70, UL 1598 and shall be as shown on drawings and as specified.

(1) Provide light fixture schedules on the drawings..
b) Sheet Metal:
   (1) Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
   (2) Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
   (3) Where lighting fixtures are detailed with minimum 20 gauge housing, minimum 22 gauge housings shall be acceptable provided they have strengthening embossed rib and break formations, which give the equivalent rigidity of a 20 gauge housing.
   (4) When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
   (5) Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, and latches shall function easily by finger action without the use of tools.

c) Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.

d) Lamp Sockets:
   (1) Fluorescent: lampholder contacts shall be the biting edge type or phosphorous bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Contacts for recessed double contact lampholders and for slimline lampholders shall be silver plated. Lamp holders for bi pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one quarter turn of the lamp after insertion.
   (2) Incandescent: Shall have porcelain enclosures and conform to the applicable requirements of UL 496.
   (3) High Intensity Discharge (H.I.D.) shall have porcelain enclosures.

e) Recessed incandescent fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

f) Fluorescent fixtures with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and re-lamping. Vapor tight fixtures shall have pressure clamping devices in lieu of the latches.

g) Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

h) Metal Finishes:
(1) The manufacturer shall apply his standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of prefinished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking.

(2) Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.

(3) Exterior finishes shall be as shown on the drawings.

i) Provide all lighting fixtures with a specific means for grounding their metallic wire ways and housings to an equipment grounding conductor.

j) Light Transmitting Components for Fluorescent Fixtures:

(1) Shall be 100 percent virgin acrylic plastic or water white, annealed, crystal glass.

(2) Flat lens panels shall have not less than 3.8 mm (1/8 inch) of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum unpenetrated thickness and dividing the sum by 2.

(3) Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.

k) Lighting Fixtures in Hazardous Areas: Fixtures shall be suitable for installation in flammable atmospheres (Class and Group) as defined in NFPA 70 and shall comply with UL 844.

l) Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall be designed for lamps as specified.

m) In auditoriums seating 100 or more, a separate light for sign language interpreter shall need to be placed adjacent to the front of the room. The light should not spill onto the projection screen. The light control may be located with other controls at the podium.

n) Do not place any type of light fixtures between the ceiling mounted video projector and the main screen.

o) Ballast factor and T-8 lamps must be uniform throughout the building. If high output lamps and high output ballasts are used, they must be used in the entire building. If standard or low output ballasts are used, they must be used in the entire design.
5. Lamps: Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Lamps manufactured by others shall be accepted provided they meet or exceed the specifications.
   a) UI Standards for Linear Lights
      (1) T-8, 28 watt, 4100 K low mercury is UI standard for linear fluorescent lamps. These lamps shall eventually be stocked by Facilities Management.
      (2) Unless justified by specific design conditions, restrict lamp types to those commonly stocked by Facilities Management. For small renovation projects, fluorescent lamps must be T-8, 28 watts. For other projects, fluorescent lamps must be low mercury T-8, 28 watt, Super T8 energy-saving types in conjunction with programmable electronic ballasts. T5 & LEDs are acceptable. The energy engineers shall work with the designer for the selection.
   b) Do not use energy-saving lamps in cold temperature applications (below 50°F) or where fluorescent emergency lighting or dimming systems are used.
   c) Use incandescent lamps only where other sources are unsuitable.
   d) Where incandescent lamps rated at 130 volts are used on nominal 120 volt systems, base lighting calculations on the assumption that actual lumen output is 75 percent of the output at rated voltage.
   e) Low-pressure sodium and mercury vapor lamps are not acceptable.
   f) Restrict lamp types to those described in this section. The use of 2-foot by 2-foot fluorescent fixtures is discouraged. Such fixtures may be used only with the approval of the PM. Where such fixtures are permitted, use F17T8 lamps. U-shaped lamps are not acceptable.
   g) In new construction and major renovation, no building shall have more than six different lamp types.
   h) Lamps over 48 inch, U-Bend, circline lamps or lamps less than 13 watts should not be used.
   i) Limit the use of incandescent lamps. They must be 130 volt.
   j) Compact fluorescent lamps shall be at least: CRI 80, minimum, [5000 K] 10,000 hours average rated life.
   k) Compact Fluorescent Fixtures: Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated, with a minimum CRI of 80. Ballast shall be high power factor (HPF) and less than 20% THD.
   l) Bare bulb retrofits are not allowed. Replace bare bulbs with suitable light fixtures when possible.
   m) Replace 40-watt incandescent bulbs (495+ lumens) with 11- to 14-watt compact fluorescent bulbs (45+ lumens per watt). Replace 60-watt incandescent bulbs
(900+ lumens) with 15- to 19-watt compact fluorescent bulbs (60+ lumens per watt). Replace 75-watt incandescent bulbs (1200+ lumens) with 20- to 25-watt compact fluorescent bulbs (60+ lumens per watt). Replace 100-watt incandescent bulbs (1750+ lumens) with 29-watt or greater compact fluorescent bulbs (60+ lumens per watt).

n) For reflector type bulb retrofits replace 50-watt incandescent bulbs (550+ lumens) with 17- to 19-watt compact fluorescent bulbs (33+ lumens per watt). Replace 60-watt incandescent bulbs (675+ lumens) with 20- to 21-watt compact fluorescent bulbs (40+ lumens per watt). Replace 75-watt incandescent bulbs (875+ lumens) with 22-watt or greater compact fluorescent bulbs (40+ lumens per watt).

o) Open-tube fluorescent fixtures: shall be provided with self-locking sockets, or lamp retainers (two per lamp). Provide lamps with shatter resistant coating, non-yellowing, nominal thickness of 0.38 mm (15 mils) 15 mils, and with 97 percent (minimum) light transmission.

p) Provide a clear polycarbonate protective sleeve with end caps, over lamp, with 95 percent (minimum) light transmission. The sleeve shall be rated to withstand the thermal profile of the lamp and ballast.

q) Provide HID fixtures with tempered glass lenses when using metal-halide lamps. UL 1598.

6. Metal-Halide Lamps

a) Metal-halide lamp safe operation requires lamps to be turned off at least 15 minutes per week or lamp may rupture near the end of its expected life. Lamp rupture may discharge glass and extremely hot quartz (greater than 900 degrees C) into the surrounding area. Therefore, designs for metal-halide lamps shall include weekly turnoff instructions when continuously operated, 24 hours per day, 7 days per week. These instructions shall be detailed on the drawings for posting at the control locations. For indoor use, color rendition index (CRI) and color temperature (CCT) may need to be specified.

7. Fixtures for Hazardous Locations

a) In addition to requirements stated herein, provide appropriate fixtures for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

8. Exit & Emergency systems

a) Illuminated Exit Signs and Emergency Lighting
   (1) Illuminated EXIT signs shall use Light Emitting Diodes (LEDs) as the source of illumination.
   (2) The housing and faceplate shall be white in color.
   (3) Input power shall be less than 5 watts per face and operate on dual voltage 120/277 VAC.
(4) EXIT signs shall comply with UL 924 and EPA EnergyStar Specifications at the end of 5 years of continual use.

(5) EXIT sign letters shall be red, not less than 6 inches high, and strokes shall not be less than 0.75 inch wide. Luminance contrast shall be greater than 0.8.

(6) At the end of 5 years of continual use (when measured at 0 degrees and 45 degree viewing angles), average luminance shall be greater than 15 candelas/meter, minimum luminance shall be greater than 8.6 candelas/meter, and maximum-to-minimum luminance ratio shall be less than 20:1. Letter illumination shall appear even when viewed in a typical installation. The manufacturer shall replace all defective parts for 5 years from the date of purchase.

(7) Exit signs and emergency lighting shall be provided in accordance with current adopted building and fire codes. Power shall be provided by circuits on an emergency power system or battery backup units. For units requiring a back-up feature, it shall be rated for 90 minutes of use. Lighting shall include AC-On LED indicator light and test switch.

b) Housing and Canopy

(1) Shall be made of white plastic.

(2) Optional steel housing shall be minimum 20 gauge thick or equivalent strength aluminum.

(3) Steel housing shall have baked enamel over corrosion resistant, matte black or ivory white primer.

c) Door frame shall be cast or extruded aluminum, and hinged with latch.

d) Finish shall be white plastic.

e) There shall be no radioactive material used in the fixtures.

9. Fixtures:

a) Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous red Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass. The LED shall be rated minimum 25 years life; maximum of 3.5 watts for single face and 7 watts for double-faced fixtures that do not use diffuser panels in front of the LEDs. LED exit light fixtures that use diffuser panels shall require a maximum of 1.0 watt per fixture for single or double face fixtures.

b) Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.

c) Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall meet the requirements of NFPA 101.

d) Voltages: Fixtures shall be wired for // 120-volt // 277-volt //.

10. Fluorescent Emergency System
a) Each system shall consist of an automatic power failure device, test switch operable from outside of the fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Provide self-testing module mounted adjacent to the fixture. Charger shall be either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity as required to supply power to lamps, the number of lamps shown for each system] for 90 minutes at a minimum of [600][1100][400] lumens per lamp output. Battery shall operate unattended and require no maintenance, including no additional water, for a period of not less than 5 years. Emergency ballasts provided with fixtures containing solid-state ballasts shall be fully compatible with the solid-state ballasts.

11. Self-testing Module
a) Self-testing module for exit signs and emergency lighting equipment shall perform the following functions:
   (1) Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.
   (2) Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.
   (3) Manual test switch to simulate a discharge test cycle.
   (4) Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

12. Ballasts
a) Fluorescent ballasts must be ETL/CBM certified.
b) Fluorescent ballasts that are not used for dimming or cold weather applications must meet or exceed Federal Ballast Efficacy Factor requirements for fixtures intended for use in commercial buildings.
c) Fluorescent ballasts must carry an “A” rating in the manufacturer’s sound classifications; however, ballasts for 800 milliamp lamps may carry “B” rating.
d) Use integrated circuit fluorescent electronic ballasts.
e) Fluorescent ballasts used where ambient temperatures fall below 50°F must be labeled for cold weather operation.
f) Fluorescent ballasts used in dimming applications must be listed for use with the specific dimming controls provided, unless labeled for connection to Class 2 limited energy circuits.
g) Where fluorescent ballast operation shall interfere with radio reception, specify ballasts with radio interference filters.
h) Use weatherproof ballasts only where directly exposed to weather. Use UL Type 2 outdoor ballasts for installation in exterior lighting fixtures.
13. Use regulating, high-intensity discharge lamp ballasts with a minimum starting temperature of -20°F. For interior use, use enclosed, potted-type HID ballasts with the lowest available sound rating.

14. Do not provide luminaries with fuses.

15. Do not provide luminaries with receptacle outlets.

16. Fixtures must be hard-wired. Cord-and-plug connected luminaires are not acceptable, except in high-ceiling HID applications.

17. Self-contained emergency lighting units must operate from a maintenance-free, lead-calcium battery with an automatic charger.

18. Fluorescent lamp ballasts
   a) Where applicable, fluorescent lamps and ballasts shall comply with the National Energy Policy Act of 1992 and shall as a minimum meet the following characteristics:
      (1) Ballast shall comply with UL 935, NEMA C82.11, NFPA 70, unless specified otherwise. Ballast shall be 100% electronic high frequency type with no magnetic core and coil components. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.
      (2) Power factor shall be 0.90 (minimum).
      (3) Ballast shall operate at a frequency of 20,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.
      (4) Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.
      (5) Ballast factor shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).
      (6) Ballast shall be UL listed Class P with a sound rating of “A.”
      (7) Ballast shall have circuit diagrams and lamp connections displayed on the ballast.
      (8) Ballast shall be programmable start unless otherwise indicated, for dimming systems ballast shall be programmed start unless otherwise indicated. Instant start ballasts shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed. Ballasts shall be programmed start unless otherwise indicated. Programmed start ballasts may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.
      (9) Ballasts for compact fluorescent fixtures shall be programmed start.
(10) Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

(11) Do not use 4 lamp electronic ballast.

(12) A source of light other than fluorescent is recommended for areas subject to temperatures below -17 degrees C, 0 degrees F.

(13) Ballast shall be capable of starting and maintaining operation at a minimum of -17 degrees C 0 degrees F unless otherwise indicated.

(14) Electronic ballast shall have a full replacement warranty of 5 years from date of delivery to UI. This warranty shall be in the form of compensating UI for the cost to purchase and install equal ballast or by providing ballast and a reasonable amount for labor base on .5 hour labor.

(15) Ballast shall be dual voltage 120/277V.

b) The electronic dimming ballast shall as a minimum meet the following characteristics:

(1) Ballast shall comply with NEMA C82.11, UL 935, and NFPA 70, unless specified otherwise. Ballast shall provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2.

(2) Ballast dimming capability range shall be from 100 to 5 percent minimum range) of light output, flicker free. Ballast shall start lamp at any preset light output setting without first having to go to full light output.

(3) Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

(4) Power factor shall be 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.

(5) Ballast shall operate at a frequency of 24,000 Hertz (minimum). Ballast shall be compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

(6) Ballast factor at full light output shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

(7) Ballast shall be UL listed Class P with a sound rating of “A”.

(8) Ballast shall have circuit diagrams and lamp connections displayed on the ballast.

(9) Provide series/parallel wiring for programmed start ballasts where available.

(10) Ballasts for compact fluorescent fixtures shall be programmed start.

(11) Ballast shall be capable of starting and maintaining operation at a minimum of - 17 degrees C 0 degrees F unless otherwise indicated.
(12) Total harmonic distortion (THD): Shall be 20 percent (maximum) over the entire dimming range.

(13) Ballasts for T-5 and smaller lamps shall have end-of-life protection circuits as required by NEMA C78.81 and NEMA C78.901 as applicable.

c) Dimming Ballast Controls

(1) The dimming ballast controls shall be a slide dimmer with on/off control. The slide dimmer shall be compatible with the ballast and control the ballast light output over the full dimming range. Dimming ballast control shall be approved by the ballast manufacturer.

(2) Lamp types F32T8 and F32T8/U shall be operated by electronic, high frequency ballasts. All other fluorescent lamp types shall be operated by the standard energy saving electromagnetic core-and-coil ballasts only if electronic ballasts are not available. For these applications, the lamps shall be operated by core-and-coil ballasts where specifically required on the drawings as “core-and-coil”.

d) Ballast package:

(1) Size: The ballast case shall be sized to be physically inter-changeable with standard core-and-coil ballasts and suitable for standard mounting in new or existing lighting fixtures.

(2) Case marking: Mark the ballast to indicate the required supply voltage, frequency, RMS current, current surge during starting, input watts, and power factor at the design center voltage, open circuit voltage, crest factor and efficacy.

19. Fluorescent Lamp Ballast Performance:

a) Light output:

(1) The light output shall be at least equal to that obtained by a Core and coil ballasted system meeting ANSI, NEMA and CBM standards. The comparison test shall be measured in the same fixture at 25 degrees C (plus or minus one degree) ambient room temperature.

(2) Tests shall be made in fixtures designed only for the number of lamps being tested.

(3) For other applications (higher ambients, etc.) the tests should be operated with equivalent lamp wall temperatures plus or minus 4 degrees C.

b) Starting: The ballast shall be capable of starting and maintaining operation of lamps at an ambient temperature of 10 degrees C (50 degree F) or more for an input voltage of plus or minus 10 percent about the center design voltage unless otherwise indicated. The ballast shall never be started in the instant start mode at any temperature.

c) Operation:
(1) The ballast shall safely and reliably operate in a room ambient temperature from 10 degrees C (50 degree F) to 40 degrees C (105 degree F).

(2) The light output shall not vary by more than plus or minus 5 percent for a plus or minus 10 percent variation of the input voltage about the center design voltage. Light output shall remain constant for a plus or minus 5 percent variation of the input voltage.

(3) The ballast shall operate the lamps in a manner that shall not adversely curtail the normal life of the lamp.

d) Transient protection: The ballast shall comply with IEEE C62.41, Cat. A.
e) Flicker: The flicker shall be less than 5 percent and without visible flicker.
f) Noise: The audible noise levels should be equivalent to or better than the Class A rating of CBM certified ballasts.
g) Electromagnetic Interference (EMI) and Radio Frequency Interference (RFI): The EMI and RFI limits shall meet the requirements of the Federal Communications Commission Rules and Regulations (CFR 47 Part 18).
h) Rated life: The ballast shall have a rated life of 10 years or 30,000 hours (based on a 10 hour day).
i) The two-lamp ballast shall safely operate two F32T8 RS, 32- watt lamps or two F32T8/U lamps. The single lamp ballast shall safely operate one F32T8 RS, 32-watt lamp or one F32T8/U lamp.
j) Power factor: Not less than 90 percent.
k) Reliability:
   (1) Labels: Ballasts must be labeled or listed by UL and CBM/ETL.
   (2) Submit, simultaneously with shop drawings, a certified test report by an independent testing laboratory showing that the electronic ballasts meet or exceed all the performance requirements in this specification.
l) Harmonic Distortion: Total harmonic distortion (THD) shall be less than 10 percent.
m) Sound ratings shall be Class A or better, except for ballast sizes which are not available with Class A ratings, as standard products from any manufacturer. Ballasts which are not available with Class A ratings shall have the quietest ratings available.
n) Ballasts for lighting fixtures controlled by dimming devices shall be the electronic, high frequency type as specified herein, equipped for dimming and conform to the recommendations of the manufacturer of the associated dimming devices to assure satisfactory operation of the lighting system.
o) All ballasts serving straight or “U” type lamps shall be mounted by four non turning studs (or captive bolts) equipped with lock washers and nuts or locking type nuts, or by four thread cutting (TC) sheet metal screws which are firmly secured against the fixture body (or wireway) to maximize dissipation of heat.
and minimize noise. Exception: electronic high-frequency ballasts may be mounted at a minimum of two points, one at each end of unit.

p) Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.

q) To facilitate multi-level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.

r) Where three lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single lamp ballast for operation of the center lamp.

20. Ballasts for High Intensity Discharge Fixtures

a) HID Ballasts: UL 1029 and NEMA C82.4 and shall be constant wattage autotransformer (CWA) or regulator, high power factor type (minimum 90%). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

   (1) Designed to operate on the voltage system to which they are connected.
   (2) Designed for installation in a normal ambient temperature of [40] degrees C.
   (3) Constructed so that open circuit operation shall not reduce the average life.
   (4) High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

b) High-Pressure Sodium (HPS) Lamps: HPS are not allowed unless they are intended to match existing installations. UI PM approval is required.

   (1) Shall comply with NEMA 82.4 and UL 1029.
   (2) Shall have individual overcurrent protection sized in accordance with the manufacturer’s recommendations.
   (3) Shall have integral thermal protection where the fixture is recessed in an interior ceiling.
   (4) Shall be the constant wattage, high power factor type or the reactor high power factor type. Capacitors shall not contain PCB (Polychlorinated Biphenyl) fluids or other fluids recognized as hazardous when discharged into the environment.
(5) Shall have not less than Class B sound ratings for interior fixtures, when available. Ballasts which are not available with Class B ratings shall be of the next standard rating.

(6) All ballasts must be high power factor, energy-efficient, multiple-input types, where such products are commercially available.

(7) All fluorescent ballasts must be electronic-type used in conjunction with T-8 lamps. However, energy-saving magnetic ballasts may be used for small renovation projects where adjoining areas use fluorescent fixtures equipped with magnetic ballasts.

c) In small areas, such as toilets or portions of egress areas, where multiple fixtures are not provided, specify two-lamp fixtures with two, single-lamp ballasts so that the failure of one ballast shall not leave the area in darkness.

d) Ballasts must be remote-mounted only when considerations such as noise, temperature, radio-frequency interference, and electromagnetic fields are critical.

21. Lighting Manufacturers

a) Select luminaires that contribute to the aesthetic appeal of University of Iowa facilities while maintaining high standards of quality, energy efficiency, maintainability, and cost-effectiveness. The following manufacturers offer such features. However, this list does not exclude other manufacturers who, based on the experience of Design Professionals, might also produce acceptable luminaires. Do not work on the assumptions of the substitute being acceptable. Substitutes need to be submitted to the PM.

(1) Compact fluorescent downlights:
   (a) Edison-Price
   (b) Halo
   (c) Lightolier
   (d) Prescolite

(2) Decorative compact fluorescent lighting:
   (a) Kamro-Champion
   (b) Lightolier
   (c) Seagull
   (d) Shaper

(3) General fluorescent lighting, including troffers, wraparounds, and industrial fixtures:
   (a) Columbia
   (b) Day-Brite
   (c) Lithonia
   (d) Metalux

(4) Decorative fluorescent lighting:
   (a) Alkco
   (b) Architectural Lighting Systems
(c) Litecontrol

(5) Track lighting:
   (a) Juno, Prescolite, or Ruud (interchangeable on the same track)
   (b) Lightolier
   (c) Staff

(6) Industrial lighting:
   (a) Holophane
   (b) Hubbell
   (c) Lumark
   (d) Sportlite

(7) Lamps:
   (a) General Electric
   (b) Phillips
   (c) Sylvania/Osram
   (d) Link

(8) Emergency Lights:
   (a) Dual-Lite
   (b) Emergi-Lite
   (c) Lithonia

(9) Exit Signs:
   (a) Exitronix
   (b) Hubbell
   (c) Self-Powered Lighting (SPL)

22. Installation Guidelines
   a) General installation requirements: Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers’ directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures shall be independently supported from the building structure by a minimum of four wires[ or straps][ or rods] per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires [or straps] [or rods] per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 19 mm (3/4
inch) 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires [or straps][or rods] for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings shall also comply with the requirements of:

1. Install lamps only in positions indicated in the lamp designation code.
2. Do not install high-intensity discharge lamps with scratched bulbs.
3. Do not energize high-intensity discharge lamps until they are enclosed within fixtures.
4. Bond all ballast cases to the equipment grounding conductor.
5. Luminaires installed in occupancies, such as laboratories and workshops, must be oriented parallel to benches and centered over the edge of the working surface. Space luminaires to maintain a maximum uniformity ratio of 2:1.
6. Use a maximum six-foot length of flexible metal conduit to connect luminaires located in suspended ceilings to branch circuit wiring.
7. Where dual-level or multi-level switching is provided, wire luminaires so that each switch controls corresponding lamps in all luminaires controlled by the switch.
8. Connect emergency lighting and exit sign units to unswitched conductors fed from the same branch circuit serving normal lighting in the protected area.
9. Do not mount emergency lighting and exit sign units higher than 10 feet above the finished floor unless provisions are made for the maintenance of such units.
10. Center exit signs on building elements, such as corridors and doorways.
11. Luminaires must be fitted with swivels or otherwise adjusted so they hang plumb and true. Pendent Luminaires must not be chain hung.

b) Quality Control

1. After the lamps have been in service for 100 hours, obtain foot-candle measurements during periods of darkness at a sufficient number of locations to demonstrate that the design criteria have been met. Submit the results to University of Iowa.
2. Where ballast noise is audible above the normal ambient noise, use sound level meter capable of measuring as low as 35 dBA to test the ballast noise level in accordance with the ballast manufacturer’s specifications. Provide replacement ballasts where ballast noise is excessive. Where heat dissipation is not a concern, a resilient pad may be installed between the ballast and fixture.
3. Test emergency lighting units by opening the circuit breakers that serve normal lighting in the areas protected by the emergency lighting units.
4. Test exit signs by opening the circuit breakers that serve normal lighting in the areas served by the exit signs.
c) Cleaning and Adjusting: Clean and adjust luminaires at the end of the construction period.

23. Support Hangers for Lighting Fixtures in Suspended Ceilings
   a) ASTM A 641/A 641M, galvanized regular coating, soft temper, 2.68 mm (0.1055 inches) diameter, 12 gage).
   b) Select zinc-coated steel wire for all locations except those listed in the note in the paragraph entitled “Wires, for Humid Spaces,” below. When spacing of hanger wires exceeds 1219 mm 4 feet or when heavy lighting fixtures are supported, 8 or 10 gage wire should be specified.
   c) Select stainless steel or nickel copper alloy wire for facilities where high humidity can be expected such as large kitchens, dishwashing areas, etc. Select nickel copper alloy when hangers are used in an indoor pool environment. When spacing of hanger wires exceeds 1219 mm 4 feet or when heavy lighting fixtures are supported, 8 or 10 gage wire should be specified.
   d) Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to UI if more than 15 percent of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

24. Equipment Identification
   a) Manufacturer’s Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer’s name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent shall not be acceptable.

25. Labels
   a) Provide labeled luminaires in accordance with UL 1598 requirements. All luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format “Use Only _______”:
      (1) Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
      (2) Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
      (3) Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
      (4) ANSI ballast type (M98, M57, etc.) for HID luminaires.
      (5) Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.
b) All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

26. Factory Applied Finish
a) Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

27. Lighting controls
a) General Design Criteria: Designers shall consider and design for control schemes to limit the use of the unnecessary operation of the artificial lighting. These include:
   (1) Properly placed & accessible manual switching
   (2) Occupancy sensors
   (3) Dimming controls
   (4) Photo-electric cells for outside lighting
   (5) Electronic time clocks
   (6) Central programmable microprocessor-based lighting control systems

b) Installation guidelines
   (1) Lighting in classrooms must permit a level of room darkening to view various projections on front screen but permit sufficient lighting for note taking. In addition, adjustable lighting with no screen spill is necessary over the instructional area. The needs for dimming depend on size and location of classroom, plus demands of current projection technology.
   (2) All classrooms shall have no less than two separately controlled lighting areas – seating area and instructional area. Provide ability to control lighting levels in both areas. When the classroom is dimmed for projection, some lighting will be required at the presentation area. Special lighting on the equipment rack or technology controls may be needed.
   (3) Multiple switching and split circuiting is preferred to single switching of higher light levels.
   (4) Dimmer or toggle switches should be used rather than “programmed scenes”.
   (5) Control all interior lighting with local switching.
   (6) At every entrance to the room, locate switches to provide at least minimal room illumination so users do not enter a dark room.
   (7) Clearly labeled switch plates for lighting controls shall be located on the wall nearest to the instructional area as design standard. Duplicate lighting controls should be placed in the projection booth, if applicable.
   (8) Control panels and contactors shall be located away from occupied spaces and be accessible such as electrical spaces and corridor ceiling spaces. Latching type relays will be used.
   (9) All rooms except equipment rooms shall have occupancy sensors for lighting A manual override system shall also be used.
   (10) Use infrared sensors with dual technology.
(11) Large common office spaces might use zoned dual-technology control or time-of-day control with a 2-hour override feature.

(12) Occupancy sensors may be used to reduce pathway light levels but “stumble lighting” should be maintained ON. This may be coordinated with emergency lighting requirements.

(13) Occupancy sensors shall operate in series, with an ON/OFF switch having the look and feel of a typical light switch and mounted in a typical light switch location.

(14) Occupancy sensors shall fail ON.

(15) Occupancy sensors shall have time delay adjustments of 10 to 30 minutes before turning lights OFF. Choose delay settings to minimize ON time while limiting the number of starts to less than 12 per day. Provide a statement of occupancy sensor adjustments in the construction documents. When in doubt, use 10 minutes for meeting spaces such as classrooms and 30 minutes for other applications.

(16) Control devices must be readily accessible and located so the occupant can see lights from the controlling switch, with an exemption for controls located remotely for safety or security purposes.

(17) Exterior lighting that is not attached to the building is controlled by UI Utilities and Energy Management and shall NOT be wired into the Building Automation System.

(18) Decorative exterior lighting not intended for 24-hour use shall be controlled and scheduled to turn off at 11:00 PM.

(19) Location of occupancy sensors shall be coordinated with furniture layout, ceiling mounted fixtures and devices, and other features that may impede its operations.

(20) Automatic controllers and time clocks shall maintain time & schedule through a 72-hour power failure.

(21) Careful zoning is essential to optimize the control systems.

29. Photoconductive Control Devices
   a) Photoelectric control devices shall be in accordance with UL 773. Photoconductive control devices for natural daylight and darkness control of incandescent, fluorescent, and mercury-vapor outdoor lighting luminaires shall include a photoconductive cell, thermal actuator, snap-action switch in a weatherproof housing.
   b) Switch mechanism shall consist of a heavy-duty general-purpose precision snap-acting switch. Switch shall be single-pole, single-throw, with a minimum rating of 1,000-watts incandescent-lamp load and 1,200-volt-ampere reactive for vapor-lamp load at rated voltage and frequency.
   c) Time delay in excess of 5 seconds shall be an available option.
   d) Housing for light-sensitive control devices shall be molded from translucent butyrate or acrylic plastic materials and shall be fastened to the base with screws.
   e) Control device, when attached to its mounting, shall be weatherproof and constructed to exclude beating rain, snow, dust, and insects and shall be capable of withstanding 96 percent relative humidity at 50 degrees C 122 degrees F for 48 hours under operating conditions.
f) Light-sensitive control devices shall be physically and electrically interchangeable with three-pole, 3-wire locking plug and receptacle connections to the line, load, and neutral conductors of the lighting circuit. Device shall turn on within the limits of plus 100 to minus 50 percent of its setting, over a range of input voltage from 105 to 130 volts at rated frequency and ambient temperature, and at rated voltage and frequency over a range of temperature from minus 29 to 50 degrees C 85 to 122 degrees F, with relative humidities up to 96-percent throughout the temperature range. Device shall be adjusted to operate within the limits of 9 to 13 lux 0.8 to 1.2 foot-candles, but shall be capable of calibration of the turn-on light level over a minimum range from 5 to 32 lux 0.5 to 3.0 foot-candles, and shall be adaptable for calibration up to 108 lux. 10 foot-candles. Ratio of turn-off light level to turn-on light level shall not exceed 5. Instrument accuracy shall be maintained by proper calibration in accordance with IESNA LM-48.

g) Devices shall be rated at 120 or 277 volts, 60 hertz. Rated ambient temperature shall be 25 plus or minus 5 degrees C.

h) Photoconductive control devices shall be installed in accordance with the manufacturer’s installation instructions.

30. Field Testing
a) Photoconductive control devices shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer. System Operation Tests shall be performed in accordance with referenced standards in this section.

31. Occupancy Sensors
a) UL listed. Occupancy sensors and power packs shall be designed to operate on the voltage indicated. Sensors and power packs shall have circuitry that only allows load switching at or near zero current crossing of supply voltage. Occupancy sensor mounting as indicated. Sensor shall have an LED occupant detection indicator. Sensor shall have adjustable sensitivity and adjustable delayed-off time range of 5 minutes to 30 minutes. Wall mounted sensors shall match the color of adjacent wall plates.

b) Occupancy detection to turn lights on requires ultrasonic and/or infrared sensor detection. Lights shall remain on if either the ultrasonic or infrared sensor detects movement. Infrared sensor shall have lens selected for indicated usage and daylight filter to prevent short wavelength infrared interference. Ultrasonic sensor frequency shall be crystal controlled.

c) An active or passive sensor shall be utilized to control the “On Off” actuation of fluorescent or incandescent lighting loads. It shall provide control of an isolated set of contacts on exposure to a perceived change in environmental conditions indicating the presence or absence of one or more persons. It shall maintain the contacts closed in the presence of continued changes (due to human presence) at similar intensity and rate. It shall open the contacts at a nominal time after the changes cease.

d) Passive Sensor System: Sensor(s) shall react to changes of radiated infrared energy, indicating the activity of one or more human bodies in the area covered.

(1) Range of detection: The sensor(s) shall provide effective coverage of a room, sensing the presence of one or more people in the room in order to turn the lights on. The ceiling mounted sensor’s area of coverage shall be approximately a 4200 mm (14 feet) diameter circle at 1800 mm
(6 feet) away. Provide sufficient units to give full coverage as measured 750 mm (30 inches) above the floor. A field of view adjustment feature shall be provided to allow orientation to various room operating conditions. Coordinate these with the manufacturer’s recommendations.

(2) Sensor placement: Locate the sensor(s) in accordance with the manufacturer’s recommendations to maximize energy savings by avoiding nuisance activation due to sudden temperature or air flow changes. Locate the units within 1800 mm (6 feet) horizontally of work stations or major points of activity, including the center of room entrance doors.

e) Active Sensor System: Sensor(s) shall react to reflective changes to generated ultrasonic radiation (crystal controlled, 24 to 42kHz), indicating the activity of one or more persons in the area covered.

(1) Range of detection: On ceilings below 3600 mm (twelve feet) in height, a single direction sensor shall cover approximately a 9 x 9 m (30 feet x 30 feet) area; a two directional unit a 18 x 9 m (60 feet x 30 feet) area; and a two way corridor unit a total distance of 27 m (90 feet). The sensors shall be equipped with a concealed but accessible sensitivity control to tune the unit to specific room conditions.

(2) Sensor placement: Locate the sensor(s) in accordance with the manufacturer’s recommendations to maximize energy savings by avoiding nuisance activation due to predictable non human motion activities. Give particular attention to work station or major areas of activity and the coverage of room entrance doors.

f) Timing/Function: Shall not be user adjustable. Lighting shall remain on with one or more persons within the covered area. The system shall be factory set to maintain lights on for a minimum of 8 minutes and not longer than 12 minutes after the area of coverage is vacated. For testing purposes, there shall be a means to change the pre set time delay to 30 seconds or less.

g) Control Unit: The system shall have a switching relay(s) capable of switching the fluorescent or incandescent loads as required. Contacts shall be rated at a minimum of 15 Amps at voltages to 277, with expected cycles of operation in excess of 100K. Power derived from a current limiting 24 volt transformer shall power the system and the unit must be packaged for installation on a standard 200 mm x 200 mm (4 inch x 4 inch) NEMA box enclosure. The unit shall be wired through a conventional wall switch to provide an over ride system “Off” and active “Off On” functioning.

h) Field Wiring: The wiring between the control unit and sensor(s) shall be an insulated multi-core cable.

i) Ceiling mounted sensors shall be white. Ceiling mounted sensors shall have 6.28 rad 360 degree coverage unless otherwise indicated.

j) Ultrasonic sensor shall be crystal controlled and shall not cause detection interference between adjacent sensors.

k) Infrared sensors shall have a daylight filter. Sensor shall have a fresnel lens that is applicable to space to be controlled.

32. Remote Control Switching for Indoor Lighting Systems

a) Shall be rated for continuous duty service.
b) Electric contacts shall be precious metal surface.
c) Magnetic contactors and relays shall be electrically operated and mechanically held.
d) Characteristics of the components and the total resistances of the circuits throughout the systems shall be such that the systems will operate satisfactorily in every respect while the branch circuit power supply voltage to each system is within a 105 130 volt range at 60 Hz.
e) Wall switches shall be the momentary contact type suitable for mounting in a single gang outlet box space and compatible with the standard design wall plates as specified.
f) Where shown on the drawings, incorporate the components in panelboards behind separate doors and mount them on sound absorbing materials.
g) Install circuit breaker or fuse protection for the control circuits.
h) Low voltage remote control system shall be DC type, operating at not greater than 30 volts, and meeting the requirements for Class 2 circuits in Article 725 of the NEC.

33. Special Application Requirements:
a) Classroom lighting: Refer to UI General Assignment Classroom Design Standards for more details.
   (1) Educational & classroom spaces at the University of Iowa require use of Audio-visual teaching aids.
   (2) General classrooms lighting should provide 45-65 foot candles at the seta level. Lighting provided for rooms with sloped or tiered floors must take into account the slope to provide consistent foot candles across the entire seating area of the classroom.
   (3) Classroom lighting must have a full range of brightness, from a comfortable reading level to note taking in darkened room. Unless otherwise stated, lighting controls within classroom will be integrated into the UI approved room control systems.
   (4) When the classroom is dimmed for projection, some lighting will be required at the presentation area. Special lighting on the equipment rack or technology controls may be needed.
   (5) Dimmer or toggle switches are preferred; no programmable lighting system should be installed without prior approval from ITS Classroom Technology Services. Where programmable lighting is planned, provide a mock-up for instructor review well before planned installation, allowing time for modifications to product selection.
   (6) In auditoria seating over 100, a separate light for a sign language interpreter will need to be placed adjacent to the front of the room. This light should not spill onto the projection screen. The light control may be located with other controls at the
   (7) Provide dimmable low level lighting from 2 to 8 fc. At desk tops, for note-taking while viewing projected images. Provide switching for 60^ of all luminaires including all perimeter luminaires. Provide dimming for the remaining note-taking luminaires. Dimming shall be accomplished using F32T8/835 lamps and ballasts designed to dim to a 10% ballast factor.
Note-taking lighting levels may be achieved with selected switching of lamp fixtures rather than true dimming. UI staff must review and approve the proposed note-taking lighting system for instructional room.

Place back-lit switches at every room entrance, to provide at least minimal room illumination so users never need enter a dark room. In windowless rooms, provide a small light at the door.

Locate lighting controls with a clearly labeled switchplate on the instructor multimedia lectern, and on the wall nearest to the instructional area. Where programmable lighting is used, controls should be integrated into the multimedia control panel. Duplicate lighting controls should be placed in the projection booth, if applicable.

Lighting should use indirect lay-in fixtures. Avoid suspending fixtures from the ceiling, to prevent conflict with ceiling-mounted projectors.

Fixtures must be installed to evenly light the front writing surface, on its own circuit.

Note-taking light fixtures shall be located only over the seating area. Note-taking luminaires should provide sharp cutoff optics to minimize illumination of walls and project screen.

Switching to permit operation of the general lighting system by the instructor, speaker and/or projectionist. Low voltage relay control is recommended.

Provide independent switching for chalk/maker board and podium lighting as needed.

General lighting should be in or close to ceiling. Pendant luminaires tend to interfere with the viewing of projection screens and video monitors.

Lighting should use indirect lay-in fixtures. Avoid suspending fixtures from the ceiling, to prevent conflict with ceiling-mounted projectors.

Classrooms Auditoriums:
- Spaces designated as “Classroom Auditoriums” may use Owner-provided equipment. Designer shall ensure that the contract documents include appropriate references and details of wireways, wiring and power necessary for this Owner-provided equipment.

Sports and Non-Classrooms auditoriums:
- Fluorescent lighting may be used in most places.
- Metal halide, induction lighting & T5 fixtures must be evaluated.
- Alternate phasing to reduce flickering effect
- Design lighting systems to avoid total darkness following a momentary power outage.

Library Lighting:
- Maintain 50 foot-candles at all study & work surfaces and 15 foot-candles on the vertical surfaces of each stack. Lighting design must be closely related to fixed furniture placement. Study carrels and stacks divide the areas to cubicles and aisles.

Corridors, entrance, and public area lighting:
- Break the circuiting into different categories:
  - “Y” circuits: luminaires located in (non-daylighted) areas requiring operation whenever the building is in use
(2) “Z” circuits: Luminaires located in (daylighted) areas open stairways or exterior areas requiring operation during hours of darkness. “Z” circuits should incorporate daylight sensor controls with manual override where practical.

34. Design Evaluation:
   a) The following information is required to evaluate the design:
      (1) Schematic Design Phase:
          Zones with suggested foot-candle levels are needed for the lighted spaces.
          Provide information on fixtures types to be used
          Energy code requirements and method of compliance
          Lighting control schemes
          Describe day lighting plans.
      (2) Design Development Phase:
          Describe the use of day lighting, outline effectiveness
          Fixtures layout and switching schemes to be used in the different spaces.
          Manufacturer literatures for light fixtures, lamps & ballasts.
          Point-to-Point lighting calculations with factors used in calculations the levels needed at this stage to evaluate the efficacy of the design.
          ASHRAE compliance forms and lighting budgets.
          Submittal shall include an economic analysis considering all costs, energy use, lighting efficiency, maintenance costs, lamp life, foot-candle levels, and watts per square foot connected load.
   b) Construction Design Phase: At this stage a description of all the fixtures to be used must be provided with the schedules circuited with the lighting homeruns. Electrical Panel Schedules, Control diagrams are required for different areas of the lighting design. All schedules, diagrams and sequence of operations must be included on the drawings.
   c) Submittals: Luminaires, lamps and ballast cut sheets shall be submitted with all the lighting control equipment used in the design.

35. Fixture Type & Manufacturers - See Appendices.
36. Control Devices & Manufacturers - See Appendices.

D. Telecommunications
1. Telecommunication Rooms (TR): Minimum size is 10’ by 12’- Size will depend upon quantity and type of horizontal cables being served from the communication room as well as future cable plant expansion expectations. TR’s should be aligned vertically and centrally located to minimize cable footages to work areas (maximum of 295’ horizontal cable distance to work area outlets). ITS EI shall be involved in determining room sizes and locations. Basic design shall include:
   a) Room dedicated to ITS use only
   b) ¾” A/C (A side out) rated plywood on all walls - mounted 6” to 8’ 6” AFF.
   c) Drywall extends to structure
   d) All walls/plywood painted bright white, minimum 2 coats. (SW B49 W2)
   e) No ceiling (open to structure) Ceiling structure to be painted (SW B49 W2)
   f) Lighting
Minimum equivalent of 50 lumen measured 3’ AFF
No dimmer switches and/or occupancy sensor control
One light Fixture tied to emergency power.
Fixtures to be 8.5’ AFF
Coordinate with ITS EI for TR/Light Fixture Layout

Sealed concrete floor

Store room type lock (Secured by AMAG access control or keyed to ITS EI key)
Provide door closer/door sweep
Year round cooling with continuous air flow inside room.
72°F to 80°F
45 – 55% maximum relative humidity
Maintain a positive air pressure with one complete exchange per hour.

No other systems passing through room (major HVAC ducts, plumbing, conduits, etc.)
Minimum of a 100 amp dedicated power panel tied to building generator if possible. (Panel size dependent on size of area and user density being served from TR.) Provide panel surge suppression and minimum of 2 x 20 AMP outlets per data switch (TVSS if panel is not surge protected) and convenience outlets.

Grounding and bonding for communication systems
Equipment rack, ladder racking, and cable management

Telecommunication Pathways: Conduit and raceway pathways shall be sized with the assumption that each outlet box receives two cables although only one cable may be installed during a project. Conduit and raceway for wall phones should be sized to receive one cable.

Secondary pathways must be minimum 1” conduit from work area outlet box to within 24” of nearest cable tray of work area outlet.
Fire rated pathways must be:
Specified Technologies Inc. EZ-Path Fire Rated Pathways or approved equal.
Size of EZ-Path and accessories should be coordinated with Owner and will be based from expected cable density and growth of the pathway.

500/700 Wiremold is not allowed.
2000 Wiremold shall be used in University Housing.
Cable tray: 3” cable tray with 3” rung height may be used in some locations. 18” or wider cable tray may be used in some locations with 6” to 8” rung height. Both side hung and center hung tray may be used as needed. Stacked cable tray may be used as needed. 4” caddy clips may be used if needed. For Cat 6A cables, no sharp/tight radius are allowed and "water falls" will be required. For 1 1/4” EMT conduit or larger will require a custom electrical box (larger than 4 11/16”).

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Trade Size</th>
<th>Siamese Cat 5e 40% fill</th>
<th>Category 6A 40% fill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cables Design</td>
<td>Cables Design</td>
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<tr>
<td>2” caddy clip</td>
<td>35</td>
<td>24</td>
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<tr>
<td>1” EMT conduit</td>
<td>4</td>
<td>5</td>
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<tr>
<td>1 1/4” EMT conduit</td>
<td>7</td>
<td>8</td>
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<tr>
<td>2” EMT conduit</td>
<td>15</td>
<td>19</td>
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</tr>
</tbody>
</table>
2 1/2" EMT conduit & 22 & 33
3" EMT conduit & 35 & 50
3 1/2" EMT conduit & 45 & 65
4" EMT conduit & 60 & 83
2400 Wiremold & 5 & 5
3000 Wiremold & 20 & 15
4000 Wiremold & 30 & 29
6000 wiremold & 50 &
6" x 6" Wireway & 110 &
6" wide, 3" / 4" rung & &
height cable tray center spline top rung & 73/97
9" wide, 3" / 4" rung & &
height cable tray center spline top rung & 110/146
12" wide, 3" / 4" rung & &
height cable tray center spline top rung & 146/195
18" wide, 3" / 4" rung & &
height cable tray center spline top rung & 220/293

3. Grounding and Bonding:
   a) Telecommunication Main Ground Busbar (TMGB)
      (1) Shall be Chatsworth Products Inc. ¼ x 4" x 20" part number: 40153-020
   b) Telecommunication Grounding Busbar (TGB) or approved equal.
      (1) Shall be Chatsworth Product Inc. ¼ x 4" x 12" part number: 40153-012
   c) Telecommunication Horizontal Rack Busbar or approved equal.
   d) Bonding Conductors must be insulated copper.
      (1) One exception is the use of flat, braided, aluminum ground straps utilized for bonding sections of aluminum cable tray.
   e) Bonding conductor size should be determined by NEC.
   f) Interconnecting Bonding Conductor (IC)
      (1) Shall be insulated, copper, No. 3/0 AWG. referred to in TIA/EIA-607 at the Bonding Conductor for Telecommunications.
   g) Telecommunication Bonding Backbone (TBB)
      (1) Shall be insulated, copper, No. 3/0 AWG.
   h) Equipment Bonding Conductor (EK)
      (1) Shall be green colored insulation, copper, No. 6AWG.
   i) Bonding Conductor Terminations
      (1) Two hole compression lugs: Thomas and Betts, “Two Hole Lugs Long Barrel Type” (example catalogue No. 54816BE), high conductivity wrought copper, electro tin plated, or approved equal.
      (2) One hole compression lugs: Thomas and Betts, “Long Barrel One Hole Lugs” (example catalogue No. 54905BE), high conductivity wrought copper, electro tin plated, or approved equal.

4. Data and Voice Horizontal Infrastructure:
   a) Horizontal station cable must be one of the following:
      (1) TE Connectivity TrueNet Category 5E (C5eT) Plenum, Siamese cable. Manufacturer’s part number: TN5ETPX2-WT01-A.
(a) Construction: 24 AWG copper, FEP Teflon insulated solid copper conductors, Siamese-type (two 4-pair groups), twisted pairs, unshielded, ripcord, with Natural colored, plenum rated, jacket, TIA/EIA category 5E, communications cable

(2) TE Connectivity TrueNet CopperTen Four-Pair Augmented Category 6 Plenum cable. Manufacturer part number: 10G-A6TP-BL02
(a) Construction: 23 AWG copper, All 4 pairs 100% FEP, Non-lead, Flame retardant PVC.

b) Install all cables through primary and secondary pathways. Unless otherwise specified, installation methods and techniques shall satisfy ANSI/EIA/TIA-569-A, Commercial Building Standard for Telecommunications Pathways and Spaces.

c) Where cables are supported from building structure they shall be adequately supported such that the cable will not be damaged by normal building use.

d) Superstructure designed and intended to support multiple utilities may be used as a superstructure for communications pathways if the superstructure can physically support the additional load.

e) Provide metallic conduit sleeves for all floor and wall penetrations through which cable must pass.

f) Horizontal station cables shall be home-run from the communication outlet box at the work area to the distribution frame serving the area as shown on the Drawings.

g) Cables shall not be installed or routed in any manner that violates the manufacturer's specifications. The following minimum bend radius and pulling tension shall be applied unless the manufacturer's requirements are more stringent:

(1) The minimum bend radius for 5E Siamese-type cable is 4.2” for cable oriented flat around corners, and 2.1” for cable oriented on edge around corners. Maximum pulling tension is 50 pounds.

(2) The minimum bend radius for TrueNet Copper Ten Four-Pair Augmented Category 6 cable is 2.08” outside diameter during installation and 1.04” installed outer diameter. Maximum pulling tension is 25 pounds.

h) Unless otherwise specified, cables shall be terminated in accordance with ANSI/TIA/EIA-568-A, Commercial Building Telecommunications Cabling Standard, observing the industry standards for terminating color-coded cables for premises and campus environments.

5. Fiber Optic and Copper Backbone and Riser

a) Fiber

(1) Optical fiber riser cable must be Corning MIC Riser Cable. Size will be specified per project.

(a) Multimode application use OM3 50um MM

(b) Single mode application use OS2 SM

(2) Alternate Interlocking Armored MIC Riser cable may be called for.

(3) All fiber must be installed as a home-run. No mid-span splices will be allowed.

(4) A service loop of 10 feet (minimum) shall be provided at both ends of the cable.

(5) Accepted Multimode OM3 50um connector installation
(a) Corning UniCam SC High-Performance Connectors
(b) Multimode fibers shall be directly terminated with Corning UniCam High-Performance OM3 50um SC connectors. The SC connectors shall be mounted in the CCH.

(6) Accepted Single Mode OS2 connector installation
(a) Corning CCH Pigtail Cassette CCH-CS12-59-POORE.
(b) SC Panels are required.
(c) Single-mode fiber shall be fusion spliced to Corning pigtails containing SC connectors. The splice must be mounted in the CJH splice housing using the Corning splice trays and mounting hardware. The SC connector shall be mounted in the CCH.

(7) Accepted Fiber housings are
(a) Corning Closet Connector Housing CCH is a one piece enclosure.
   Accepted Closet Connector Housing CCH Panels: SM OS2  MM OM3 50um
(b) Closet Connector Housing Panel Polarity Orientation: Specific orientation of the adapters is necessary to maintain the correct polarity of the transmit and receive signals throughout the campus. Polarity is achieved by physical key slot orientation of adapters in the fiber distribution enclosures.
(c) Panels with Key Slot Orientation

b) Copper

(1) Copper riser cable must be specified per project by Owner.
   (a) Type CMR, 24 AWG twisted, solid annealed copper conductors insulated with PVC skin over expanded polyethylene, having an overlapped corrugated aluminum shield, fire-resistant FR-PVC plastic jacket, and ANSI/TIA/EIA 568-A, and Category-3 performance rated.
   (b) Copper riser will be rated for the environment in which installed.

(2) Accepted copper splice connecting hardware must be 3M, AT&T, or approved equal.
   (a) Splice connecting hardware shall be 25-pair modular connectors specifically designed for straight splicing applications.
   (b) Splice modules must be designed to accommodate splicing of 22-26 AWG solid copper conductors having Polyvinyl Chloride (PVC) or Polyethylene (PE) insulation
   (c) Splice connectors must be manufactured with solder plated contacts and be unfilled (dry) in controlled environment applications and filled (encapsulated) in moisture or corrosion prone environments.

(3) Accepted copper splice closures must be 3M, or approved equal. Size will be specified per project and defined by specified cable size.

6. CATV Distribution and Horizontal Infrastructure

a) Horizontal drop cable shall be quad shielded 75Ω RG6 that meets all fire codes including plenum space. Horizontal drop lengths shall not exceed 295 feet over RG6.
b) Horizontal cabling between TC’s and outlet/drop locations shall be made as individual home runs. No intermediate splices or couplings may be installed or utilized between the TC and the TV outlet/drop.

c) Individual drops to be grouped by cable length/loss and connected to a multi-port tap with appropriate dB loss level within that outlet’s associated TC. All cables to be terminated using approved compression F style connectors. All horizontal drops to be labeled with outlet location and run length.

d) Distribution feeds less than 500 feet shall be quad shielded 75Ω RG11 that meets all fire codes including plenum space. All RG11 to be terminated using approved F style compression connectors.

e) 75 Ohm port terminators will be installed on all unused tap ports at both remote and head-end. All terminators will be torqued to 20lb/in.

f) All F-Connectors and will be hand tightened and then torqued to 20lb/in.

g) The contractor shall ensure that the CATV System meets or exceeds the following system design criteria at any and all CATV System drops:

1. Minimum signal level: -8 dBmV
2. Maximum signal level: +4 dBmV
3. Carrier to noise ratio: 43 dB (minimum)
4. Humidity: 1%

h) Cable Type

1. Horizontal less than or equal to 295’: West Penn Wire – Q841 Series 6 Quad Shield Plenum and West Penn Wire – Connector is CN-FCP-6QD (Compression Connector)
2. Closet Risers <=500’ West Penn Wire – Q821 Series 11 Quad Shield Plenum and West Penn Wire – Connector is CN-FSN511 (Compression Connector)

i) Riser between closets exceeding the 500’ to be semi-flex .500 (Times Fiber part #T10500J) or fiber optic cable. It will depend on the project requirements and distance/cost.

E. Fire Alarm and Detection Systems

1. Separate fire alarm and detection system drawings shall be prepared. Fire alarm and detection system drawings shall not be incorporated in the electrical or communications drawings.
2. Any proposed changes affecting the fire alarm system must have the approval of PM, in conjunction with the FM Fire Safety Unit.
3. All new FACP shall be Simplex 4100ES. Exception: Use Notifier 3030 for UI Housing projects.
4. Use the University of Iowa Fire alarm Specification; modifications shall be approved by the PM and UI FM - Fire Safety.
5. All systems shall be designed to have the capability of handling a minimum of 20% more “alarm causing” and “signaling devices” without adding additional equipment to the fire alarm control panel (FACP) at a later time.
6. Visual Indicators:
   a) Strobe intensity shall be determined by ADA requirements.
   b) All strobes within site shall be synchronized.
   c) Each strobe circuit shall be capable of being individually controlled in software and shall be sized to include 20% spare capacity for future connection of strobes.
   d) Each fire floor and fire zone shall have individual strobe circuit control.
   e) Smoke Dampers: Select-A-Switch, Model SL53413-6-BG.
   f) Place damper indicator lights in corridors whenever possible. Graph displays are not recommended.
   g) Strobes shall be no more than 100 feet apart, visible from any location in the room, and placement shall be coordinated with furniture and/or art locations. Consult with PM.

7. Beam Detectors: If beam detectors are proposed, design must be reviewed by PM, in conjunction with the FM Fire Safety Unit for appropriate application, maintenance and accessibility. Provide a beam detector test switch for each detector.

8. Each floor shall have a separate conduit feed. All conduits shall be red for the fire alarm and detection system.

9. See NFPA 80, Fig. B-51 (or current edition) as to location and quantity of smoke detectors required.

10. Door magnets shall be powered by 24 volt power source other than the FACP. Powering down the FACP shall not automatically close the fire doors.

11. Duct detectors must be installed when they meet the conditions listed in NFPA 72E and NFPA 90A-14. Duct detector installation shall be minimized where possible. Use one detector per floor per AHU when code allows.

12. Provide a labeled test switch with LED. This test switch shall be installed for each duct smoke detector. This switch shall be installed at a mounting height of 48” to 72” above the floor.

13. Duct smoke detectors shall be used only in duct work larger than 12” in diameter.

14. The fire alarm system shall provide dry contacts as required for direct digital control (DDC) system controls to control HVAC or purge system during alarm.

15. Design Professional shall identify the estimated quantity of dry contacts needed for the fire alarm system on the fire alarm drawings.

16. During design development, Design Professional shall provide an outline of the sequence of operation for auxiliary controls from fire alarm system; i.e., smoke purge, damper control, HVAC control. A complete sequence of operation shall be included in the Contract Documents. If the AHU does not shutdown General Alarm, then high static shall be verified such that it does not shut down the air handler on any alarm. AHU shall auto restart after FACP is reset.

17. The following is a brief guideline to the location of fire alarm equipment:
   a) Fire Alarm Control Panel
(1) Top of FACP shall be 6 feet a.f.f. and shall allow a minimum of 2 feet clear on each side. When multiple FACPs are required, set panels 6 inches apart while maintaining 2 feet clear on each side.

(2) Pre Action Panels: Use Main FACP Simplex 4100ES

(3) Releasing panels – Use only Simplex 4100ES with releasing control. Do not use the main FACP as a releasing panel – requires additional panel.

(4) Key pad controls must be within visual distance of releasing agent location.

b) Photo-electric Smoke Detectors:

(1) Corridors
(2) Custodial rooms
(3) Telephone Rooms
(4) Libraries
(5) Storage rooms
(6) Laboratories (where required) (Heat detectors are preferred, but a variance is required.)
(7) Mechanical rooms (except high temperature areas)
(8) Elevator lobbies

c) Ionization Smoke Detectors:

(1) Electrical rooms and elevator mechanical rooms

d) Duct Smoke Detectors:

(1) Supply Air Handlers greater than 2,000 CFM.
(2) Return Air Handlers greater than 15,000 CFM or when AHU serves more than one floor.

e) Heat Detectors:

(1) Copy centers, vending rooms, kitchens
(2) High temperature mechanical rooms
(3) Labs (A variance is required.)

f) Pull Stations:

(1) At all exits leading to the outside.
(2) At stairwell exits on each floor.
(3) As required by NFPA and fire code official reviews.
(4) Maximum distance between pulls shall be less than 200 feet.

g) Sprinkler Systems:

(1) Fire pump items: pump running, fire pump power, fire pump phase reversal
(2) Jockey pump power
(3) Separate Simplex 4100ES releasing panel is required for releasing other than sprinkler systems (i.e. Novac 1230).
(4) Water flow switches (by fire zone; separate address for each device.)
(5) Tamper switches (by fire zone; separate address for each device.)

h) Coiling Fire Shutters:
18. Signaling devices shall be placed so that they shall provide a sound of 15 dba above the ambient noise level in all areas.

19. Place outside, weatherproof speakers at all major entrances.

20. Place a dedicated weatherproof horn/strobe at fire department hose connect.

21. Show the location of all control modules and test switches on prints. (i.e. fan shutdown modules, damper control modules, etc.)

22. Show the location of all damper indicator lights on prints.

23. Communication for FACP shall have both two copper lines and one six strand fiber optic line run from the telecommunications room to the main FACP panel box.

24. All detection devices must be placed in easily accessible locations. Smoke, heat, audio visual devices, etc. shall be mounted on solid surfaces. When ceiling mounted applications are required, devices shall be mounted such that they have 80% surface coverage or larger. (They shall not be installed in pockets or out of sight areas.)

25. Visual devices shall be a single combo unit when both devices are required. Contractor shall not be allowed to mount a separate visual device and separate speaker next to one another. When speakers are needed over and above the visual requirements they are acceptable.

26. Message Boards should be used only in ADA selected areas.

27. The Contractor shall assume responsibility and control of the building fire alarm system when 10% or greater of the fire detection and notification devices are impacted by a project. The Contractor shall coordinate with UI Department of Public Safety if off site reporting is required. The Contractor shall follow the UI Fire Safety acceptance testing procedures noted in the Fire Alarm and Detection Specification. The building shall be 100% tested with UI Fire Safety prior to completion of the project.

F. Electronic Access Control and Security (AMAG)

1. System Description
   a) The University (excluding UIHC) has standardized on an access/security system as manufactured by AMAG. Specifically, the system is AMAG Symmetry Enterprise for Central Station with Video Management. New/expanded access control and monitoring systems shall be networked with the existing system managed by Facilities Management. Therefore, server(s), central station software, back-up systems, proximity cards, badging station, printer, etc. should not be included. Facilities Management – Building & Landscape Services shall be involved in the planning and design of all AMAG projects.

   b) A room or rooms with sufficient wall space for future expansion shall be identified for installation of SMS (Security Management System) cabinets including Database Units, Door Control Units, & power supplies. The preference is for all equipment to be located in one room that is centrally located in the building. The room should not be in a basement area or where cell or radio communications will not work effectively. Preferred space for installation is in the Telecommunication Room.
c) The Design Professional shall work with PM, users, Public Safety, ITS and FM-Building & Landscape Services to identify doors that shall have electronic monitoring, locks, cameras, and any other SMS equipment.

d) All buildings shall be designed to allow the capability of them being locked down individually from all others.

e) For new buildings and major renovations, as a minimum: all exterior doors shall be monitored/alarmed and main entrances shall have electronic locks/alarms and proximity readers. The Design Professional shall review the condition of existing doors and hardware for conformance with applicable code and advise the Owner of necessary/recommended replacement or upgrades.

f) Departmental requests for additional access controlled doors shall be on a case-by-case basis in coordination with Public Safety and Building & Landscape Services.

g) The following rooms shall have electronic locks: ITS rooms/closets and general assignment classrooms.

h) Proximity readers shall only control one opening. Every entrance door shall be controlled by its own DCU.

i) If biometric devices are needed, hand geometry readers shall be used.

j) At least one “Client” software license or more depending on project needs shall be provided by the project unless the building currently has one. Training on “Client” software shall be provided by Facilities Management.

2. Security Levels

a) For each building and/or area, the PM shall work with the DPS to determine the security level. The security level determines the physical security elements for each building and/or area.

b) There are five security levels, as follows:

(1) Level 1: Low Risk (Public). Unlocked during normal business hours and locked after hours. Examples could include offices, classrooms and storage rooms.

(2) Level 2: Moderate Risk (Routine Operations). Building is unlocked during normal hours, spaces are locked when unoccupied. Examples could include laboratories and mechanical/electrical rooms.

(3) Level 3: Substantial Risk (Specialized Operations). Building is unlocked during normal hours, spaces are locked when unoccupied. Examples could include specialized laboratories and large capacity rooms.

(4) Level 4: High Risk (Security). Building/areas always have restricted access and intrusion detection system.

(5) Level 5: Extremely High Risk (High Security). Building/areas always have restricted access, video recording, and a security system.

c) Building Security Elements for each level:

(1) Level 1: Building is accessible during normal working hours and locked after hours. Exterior doors have alarms that register in the software and self-closers; main entrances and doors that e building have electronic locks and card readers. Scheduled exterior doors have electronic locks. Occupants are responsible for security of interior doors.

(2) Level 2: All items in Level 1, plus self-closers on all interior public corridor doors. Alarms may be required on some interior doors.
(3) Level 3: All items in Level 2, plus electronic locks/card readers and self-closers on selected interior doors, card access on elevators for access to restricted floors, emergency lock down buttons on large capacity rooms. Door alarms may also be local, audible alarms.

(4) Level 4: All items in Level 3, plus intrusion detection system, card reader on main door to exit, some areas would require two-factor authentication to enter.

(5) Level 5: All items in Level 4, plus video recording system and two-factor authentication.

3. Approvals:
   a) Security Management System locations (video, access control, and/or intrusion) must be reviewed and approved by Department of Public Safety prior to project design.
   b) Final installation shall be commissioned and accepted by Facilities Management – Key & Access Services.

END OF SECTION III – GENERAL DESIGN STANDARDS
SECTION IV - OUTLINE SPECIFICATIONS & DETAILS

This section contains information to be used by consultants in the preparation of project specifications.

I. GENERAL
The criteria represent minimum levels of performance, quality and/or standardization that should be enhanced by the consultant and made project specific.

II. SITE WORK

A. Excavation and Backfill
1. Iowa One Call shall be notified 48 hours before any excavation for locates. All locates shall be “Joint Locates.”
2. All activities will be contained within construction boundaries indicated on site plan. Specified excavation requirements, precautions, and protective systems will be observed at all times.
3. Movement of trucks and equipment on University’s property will be in accordance with University’s instructions.
4. Topsoil will be stripped from the construction site and stockpiled in designated area.
5. Trenches will not be backfilled until all required tests are completed and the utility systems, as installed, conform to requirements specified by the contract documents.
6. Rock quantities anticipated to be removed in classified excavation as a part of the base bid will be either stated in Division 2 or on the bid form. Add/deduct unit prices for rock removal will be included on the Bid for Lump Sum Contract Form. Relatively accurate estimates of rock removal are important for defining accurate construction estimates.
7. For purposes of identifying and measuring rock, which may be encountered during classified excavation, the following definitions will be used. The definitions are based on minimum equipment requirements, which must be equaled or exceeded by the Contractor. If the Contractor chooses to use equipment of lesser size, capacity, or power than specified for excavating purposes, the Contractor will assume all responsibility for the cost and method of removal of material resembling rock, which cannot be removed with their equipment. Therefore, contract unit prices submitted by the Contractor for rock excavation will only be applicable if the Contractor’s equipment equals or exceeds equipment requirements specified below:
   a) Open Excavation
      (1) Rock excavation in open excavations will include removal and disposal of any sound and solid mass, layer or ledge, regardless of origin, which cannot be effectively loosened or broken down in multiple passes in opposite directions.
      (2) A late model crawler-type tractor rated with at least 170 net flywheel horsepower, equipped with a hydraulic ripper with one digging point of standard design and size, and with tractor operating in low gear.
b) Pit and/or Trench Excavation
   (1) Rock excavation in trenches and pits will include removal and disposal of any sound and solid mass, layer or ledge, regardless of origin, which cannot be excavated and removed by a 3/4 cubic yard capacity hydraulic backhoe, rated at not less than 90 net flywheel horsepower, and 30,000 pound drawbar pull.

c) Drilled Pier Excavation
   (1) Weathered rock/shale pier excavation is defined as any material that cannot be drilled or removed with conventional earth augers and requires the use of rock augers for drilling.
   (2) Rock excavation is defined as any sound and solid mass, layer or ledge, regardless of origin, which cannot be drilled with conventional earth augers or under reaming tools and requires alternate drilling methods for removal, such as special core barrels, air tools, and/or other methods of rock excavation. (The minimum size drill rig is one with a rated positive crowd force of 37,000 pounds and a continuous torque rating of 25,000 foot pounds).

8. Disposal on University’s designated site (use as directed by the Project Manager PM): Contractor will remove excess suitable fill materials from project site and dispose of materials on the University’s designated site. The distance Contractor will have to haul materials for disposal will be in the contract documents. Contractor will level off fill materials at dump site. Unsuitable fill will be disposed of legally off the University’s property.

9. Disposal off-site (use as directed by PM): Contractor will remove excess suitable and unsuitable fill materials from project site and dispose of legally off the University’s property.

10. Consultant will specify inspection and testing requirements and will include procedures for evaluation of test data. All bearing soil and backfill will be inspected and tested immediately prior to placement of reinforcing steel and concrete and at the discretion of the University’s representative and the soils engineer. University will retain the services of an engineering inspection and testing firm. Contractor will be responsible for coordinating and scheduling inspections.

11. Backfill and subgrade compaction shall conform to geotechnical engineer recommendations. For projects without a geotechnical report, the following criteria shall be specified:
   a) Bearing soil for spread footings, pad footings, and slabs on grade shall be compacted to a minimum of 95% of maximum density at optimum moisture content (-2% to +4%) standard proctor. Excavation to undisturbed soils is not considered adequate.
   b) Backfill for foundations shall be compacted to a minimum of 88% and a maximum of 92% of maximum density under landscaped areas and a minimum of 95% of maximum density under other areas at optimum moisture content (}
2%) standard proctor. Backfill shall be installed in no more than 12” lifts. Specific soils or situations may require smaller lifts.

c) Backfill for trenches should be well graded granular materials ¾” to 1” clean material vibrated in lifts. Provide sand envelope around pipe.

12. Proof rolling shall be specified for areas to be paved and shall conform to the geotechnical engineers’ recommendations. For projects without a geotechnical engineer’s recommendation, the following criteria will be specified:

   a) All areas to be paved that are of sufficient size to permit the required equipment shall be proof rolled prior to placement of the aggregate base course. Proof rolling shall consist of passing/driving a loaded, 20-ton, tandem dump truck over the prepared subgrade soil with a maximum allowable displacement of 1”. Any areas that displace more than 1” shall be compacted until this criterion is met, or those areas may be excavated and backfilled with compacted Type 1 Aggregate for Base. All proof rolling shall be performed in the presence of the University’s Representative.

B. Demolition

1. PM shall designate material removed by demolition that is to remain on the University’s property before completion of final review documents.

2. Materials acquired through demolition, other than those required to complete the construction project and designated for return to University, shall become the property of the Contractor and shall be removed from the site and off University property in accordance with the University’s instructions. The material shall be disposed of in a legal manner.

3. All asbestos materials are to be removed before general demolition.

C. Hazardous Materials

1. PCB containing material may be present in existing fluorescent light fixture ballasts. PCB containing ballasts shall not be discarded in the regular trash or demolition debris. PCB containing ballasts not salvaged shall be removed from the fixture and turned over to the University for disposal at no cost to the Contractor. Fluorescent light fixtures containing non-PCB ballasts may be salvaged. These ballasts must have a label that specifies no PCB, Non-PCB, or PCB Free. The Contractor must properly remove the light fixtures intact and relocate them as directed by the University.

2. Mercury Vapor Fluorescent Lamps may be salvaged if the Contractor removes the fixture without breaking the tube and removes them from the site as directed by the University. If fluorescent tubes are not to be reused, they must be recycled. The Contractor shall remove the tubes fixtures undamaged, pack them securely in tube boxes, and ship them to a fluorescent tube recycler. Fluorescent lamp tubes shall not be discarded in the regular trash or demolition debris. (See Appendices for details)

3. Mold growth may be present existing building materials. Use standard mold remediation (“clean-up”) techniques to properly control and dispose. Report any
unusual or severe mold growth to Project Manager. Reference EPA Publication 402K81001, March 2001.

4. Acid Dilution Underground Tanks shall not be used.

D. **Asphalt and Portland Cement Concrete Paving**

1. Asphalt/Portland cement concrete pavement, shall be designed according to the following guidelines:
   a) Roadway: (rigid and flexible) AASHTO Guidelines for the Design of Pavement Structures (current edition.)
   b) Parking Lot:
      (1) Rigid - Portland Cement Association
      (2) Flexible - The Asphalt Institute
   c) Walkways shall have a minimum compressive strength of 4000 psi for 28 days.
   d) All exposed concrete (including precast concrete) shall be air entrained according to the Chart in Section IV (III Concrete) in this standard.
   e) Flint and chert shall be limited to 1% maximum, by weight of the coarse aggregate, in all exposed concrete (cast-in-place or precast). Lignite shall be limited to 0.07%, by weight of the fine aggregate in all exposed concrete. Some applications may be required to be lignite free (project manager shall advise).

2. Asphalt surfaced parking lots shall have a minimum cross section of 3” of asphalt surface prime coat, 6” of crushed stone Type 1 aggregate for base, and an underlayment of geotextile fabric.

3. Concrete surfaced parking lots shall have a minimum cross section of 6” of concrete and 4” of Type 1 aggregate for base. The concrete shall be portland cement concrete with a heavy broom finish. All joints shall be shown on the plans and shall be sealed with traffic grade caulking.

4. Concrete strengths shall be specified in accordance with actual requirements. Concrete mix shall be specified with minimum cement content, as well as maximum water/cement ratio.

5. Fibers (non-asbestos) can be used in addition to steel to control shrinkage cracking.

6. Design Professional shall specify inspection and testing requirements and shall include procedures for evaluation of test data. The University shall retain services of a testing firm. Contractor shall be responsible for scheduling the tests. Contractor shall be required to notify the University’s representative a minimum of 48 hours prior to all placement of concrete.
   a) Specifications shall require strength, air entrainment, temperature, and slump tests, and shall indicate allowable limits for each measure. Strength tests shall require 4 cylinders (3 to be broken and 1 spare). Test results shall be specified to be sent directly to the Contractor, architect, and the University’s representative.
   b) Concrete shall be tested at the minimum rate of one test for the first 25 cubic yards [CY] placed each day, and one test for each additional 50 CY placed. Concrete may be tested more often at the discretion of the University’s representative.
Test data from concrete cylinder breaks shall be evaluated using procedures of the American Concrete Institute (latest edition of ACI 214) to determine if the compressive strength of the concrete tested is acceptable.

7. All concrete walks and drives shall be constructed on a minimum of 4” of compacted crushed stone base course. Gradation of the crushed stone shall be as required for Type 1 aggregate.

8. Sand shall be from local sources meeting ASTM C-144 for mortar and ASTM C-33 Size 67 for concrete.

9. Driving surface pavement patches for utility cuts shall include 8” of concrete with #4 transverse bars (to the patch centerline) at 18” maximum centers and 2-#4 longitudinal bars. Patch shall extend 1-foot minimum outside the trench. Patch surface shall be concrete with abutting concrete paving or 2” of asphaltic concrete/tack coat with abutting asphalt surface.

10. Joints and Concrete Flatwork
   a) Expansion joints shall be installed to provide for thermal expansion of concrete pavements. Generally expansion joints shall be provided at the PC and PT of curves where the deflection angle is greater than 30° and intersections. If required for load transfers, expansion joints shall be detailed with dowel bars to allow load transfer and expansion of the concrete slabs. Non-extruding expansion joint material shall be used with expansion joints.
   b) Portland cement concrete flatwork shall be isolated from manholes, existing walls, etc., by use of expansion joints.
   c) Contraction joints shall be tooled during finishing or sawed within 18-hours of concrete placement. If the joint edge ravels, stop, do not proceed until concrete has sufficient cure to saw without damage. Refer to 4.3.3 for further requirements.
   d) Construction joints shall be located at expansion joint locations wherever possible. Construction joints at other locations shall be keyed.
   e) All joints shall be sealed with traffic grade, non-asphalt, non-extruding sealant.
   f) Joint spacing and joint detail shall be shown on the drawings.

11. Parking Lot Striping
   a) Paint colors shall be white for general lot striping, yellow for no parking areas, and blue for accessible spaces and areas. Lead bearing substance paints are prohibited.

E. Site Utilities

1. Storm Sewers
   a) Storm sewer pipe shall be reinforced concrete pipe conforming to ASTM C76 or AASHTO M170, Class 3 minimum, and asbestos-free.
      (1) Joints shall be flexible rubber gasket conforming to ASTM C443 or ASTM C361.
      (2) The minimum pipe size for storm drains is 12”.
   b) Area drain piping shall be 8” or larger. Pipe shall be:
(1) Ductile iron conforming to ASTM A746 with cement lining conforming to ANSI/AWWA C104/A21.4, and asphaltic coating on the interior and exterior conforming to ANSI/AWWA C110/A21.10, and asbestos-free.

(2) Polyvinyl chloride (PVC) conforming to ASTM D2241, PVC 1120, DR 21, PR 200 (SDR-21).

c) Perforated pipe for subgrade drains shall be SDR-35 or Schedule 40 PVC. Pipe shall be installed in a geotextile envelope with clean rock. Perforated pipe in a ‘sock’ is not acceptable.

d) Inlets and junction boxes may be cast-in-place or precast conforming to ASTM C478.

(1) Storm manholes (junction boxes) shall use East Jordon Model 1045 non-bolt down. The lid shall be lettered with the words ‘University of Iowa Storm Sewer’ or ‘University of Iowa Storm Drain’.

(2) Structures over 3-feet from lid to lowest flow line shall include steps. Steps shall be Neenah 1980-J, Deeter 1606, M.A. Industries PS2-PF, or equal.

(3) All above and below ground knife-gate valve applications shall be Model KG150SSVIRC as manufactured by Sure Flow Equipment. The valves shall conform to TAPPI TIS 405.8 face to face and shall be tested to MSS SP-81 standards. The valve body shall be full lug style, drilled and tapped to ASME Class 150 and material shall be SA351 CG8M cast 317 stainless steel.

2. Sanitary Sewers

a) Sanitary sewers shall be constructed in accordance with the standards and requirements of the Iowa Department of Natural Resources and local regulatory agencies.

b) Sewer piping installation shall include granular (sand) bedding and backfill within the pipe envelope.

(1) Trench backfill in yard areas shall generally be soil compacted, in continuous layers not exceeding 8” in compacted depth, to 90% Standard Proctor Density.

(2) Trench backfill under pavements shall generally be granular material compacted, in continuous layers not exceeding 8” in compacted depth, to 95% Standard Proctor Density.

(3) Maintain −2% to +4% optimum moisture content for cohesive soils. For cohesion less soils, maintain moisture at less than +4% of optimum moisture content.

c) The minimum service line size shall be 6”. The minimum sewer line shall be 8”.

d) Sewer pipe

(1) Select the appropriate pipe from the choices below. FM-Utilities and Energy Management’s preference is for push joint PVC sewer pipe, but
there are locations where this is not an appropriate choice. Cement sewer pipe shall be used only where absolutely necessary.

(a) PVC cement filled truss pipe.
(b) Ductile iron pipe with restrained joints. See Section on water piping.

e) Manholes and Lids
(1) Manholes shall be precast concrete 4’ inside diameter, unless otherwise noted.
(2) Rings and lids for sanitary sewers shall be East Jordan model number 1045ZPT bolt down assembly. The lids shall be marked, “University of Iowa, Sanitary Sewer”.
(3) Rings and lids for storm sewers shall be East Jordan model number 1045 non bolt down assembly. The lids shall be marked, “University of Iowa, Storm Sewer”.
(4) Rings and lids for grated openings shall also use the 1045 ring, with the appropriate grated lid.
(5) The use of “donuts” to raise the elevation of the elevation of lids shall not be over 12” in height.
(6) Drop piping into manholes may be required.
(7) Bases shall be poured into the bottom of manholes, and a formed invert from pipe to pipe installed to create flow path.
(8) Numbering of manholes is subject to approval by Facilities Management - Utilities & Energy Management.

f) Cleanouts are required on service lines outside a building footprint and at horizontal or vertical bends in a service line. The deflection should utilize a wye with the cleanout as an upstream extension of the downstream line’s alignment.
(1) Cleanout material shall be cast iron.
(2) Frame and casting shall be Neenah R-1976, Deeter 1830, or equal. Casting shall be anchored by a 2’ x 2’ x 8” thick concrete pad, 6” below finished grade. Separate concrete from pipe with two layers of Building Paper.
(3) End of line cleanouts shall use long radius bends and include a concrete cradle under the bends. PVC shall not extend above grade.

3. Waterlines
a) Ductile iron piping shall be class 53 restrained joint piping for all sizes.
b) Pipe shall be cement lined.
c) All changes in direction shall be made with 45°, 22-1/2°, or 11-1/4° bends. 90° elbows shall be used only with Owner’s approval.
d) Acceptable Manufacturers: Griffin - Snap Lok, U.S. Pipe – TR Flex, Clow - Super Locke, or American Pipe-Flex Ring.
e) All water pipe shall be encased polyethylene sheathing; minimum thickness be 8 mils.

f) All field cut joints shall be mechanical joint with Megalug series 1100 restraint. Manufacturer’s field kit shall not be used.

g) Hydrants shall be Mueller Super Centurion 250, Model A-423, open right. Color shall be safety yellow. Installation shall be according to Appendices Details.

h) Valves 14” and smaller shall be Clow F-6100 resilient wedge gate valve or approved equal.

i) Valves 16” and larger shall be gear-operated butterfly valves.

(1) The valves shall be designed, manufactured and tested in accordance with American Water Works Association Standard (ANSI/AWWA C504). Valves shall be proof of design tested in accordance with ANSI/AWWA C504, and certified by ANSI/NSF 61 Drinking Water System Components – Health Effects. Manufacturer shall have a quality management system that is certified to ISO 9001:2000.

(2) Connections:
   (a) Flanged end connections shall fully conform with ANSI B16.1 for Class 125, Class 260 Iron flanges, or AWWA C207 Class D. Both 125 and 250 flanges shall be flat faced.
   (b) Mechanical joint end connections shall fully conform with ANSI/AWWA C111/A21.11.
   (c) Wafer end connection shall be designed for installation between ANSI B16.1 Class 125 Iron flanges or between ISO 7005-2 PN10 or PN16 flanges.

(3) Design:
   (a) Valve shafts shall be of the through-type for sizes 3”-24”. 30” and larger shall be of the stub type design. Shafts shall be locked to the disc by O-Ring sealed taper pins retained with stainless steel nuts. Through-type shafts shall be supplied on 30” and larger valves when specified.
   (b) Valve discs shall be of the solid type without external ribs or vanes to obstruct flow. Resilient seats shall be located on the valve disc and shall provide a 360° continuous, uninterrupted stainless steel body seat ring.
   (c) Resilient seats shall be field adjustable and replaceable and shall not require hypodermic needles or pressure vessels to replace or adjust.
   (d) Sleeve bearings shall be provided in the valve hubs and shall be nylatron or woven Teflon, fiberglass backed. They shall be self-lubricating.
   (e) Thrust bearings shall be provided and shall be adjustable on valves 30” and larger.
(f) Shaft seals shall be of the V-type and shall be replaceable without removal of the valve from the line or the shaft from the valve.

(4) Materials:
(a) Body: Class 150B valve bodies shall be ASTM A126, Class B gray iron or ASTM A536 Grade 65-45-12 ductile iron. Class 250B valve bodies shall be ASTM A536 Grade 65-45-12 ductile iron.
(b) Disc: Valve disc shall be ASTM A536 Grade 65-45-12 ductile iron.
(c) Shafts: Shafts shall be ASTM A276 type 304, or ASTM A564, Type 630 Stainless Steel.
(d) Seat: Resilient seat shall be Buna-N and mate to a Type 316 Stainless Steel body seat ring.
(e) Hardware: All seat retaining hardware shall be Type 316 stainless steel.

(5) Actuation: Manual, electric or cylinder actuation shall be provided as specified.

(6) Options: Optional body material is ASTM A536, Grade 65-45-12 ductile iron. Optional shaft material is ASTM A276, Type 316 stainless steel.

(7) Manufacture: Valve exteriors for above ground service shall be coated with a universal, alkyd primer. Valve exteriors for buried service shall be coated with an epoxy coating. Valve interiors shall be coated with an ANSI/NSF 61 epoxy coating approved for potable water. Fusion bonded epoxy shall be supplied on the exterior and interior when specified.

(8) Valve boxes shall be East Jordan model number; 8550, or approved equal. Valve box lids shall be East Jordan, with the appropriate wording for the system. Wording shall be “University of Iowa, with either Domestic Water, or Fire Protection, or Fire Hydrant”.

j) All bolts shall be core-blue. In some areas the use of nitrile gaskets may be required.

k) All pipes shall be laid in a sand bed and shall have at least a 12” sand envelope.

l) Disinfection procedures shall be stated in specifications to conform to AWWA. Disinfection shall be done before hydro test. Disinfections shall be performed Monday through Thursday, starting at 8-9 AM.

(1) Disinfection (for domestic water only)
(2) Pipes shall be disinfected according to AWWA standards.
(3) Disinfection shall take place over a period of 24 hours (no longer or shorter).
(4) Disinfection shall be performed before hydro testing. Hydro testing shall not begin until bacteria results have been returned from the lab. Contractor should anticipate a 3-working-day turn-around time from the time that the sample is taken until the results are returned.

m) Method of Chlorination:
(1) Tablet Method. The tablet method consists of placing calcium hypochlorite tablets in the water main as it is being installed and then filling the main with potable water when installation is completed.

(2) Placing calcium hypochlorite tablets:

(3) During construction, 5-g calcium hypochlorite tablets shall be placed in each section of pipe.

(4) Also, one tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. The number of 5-g tablets required for each pipe section shall be \(0.0012d^2L\) rounded to the next higher integer, where \(d\) is the inside pipe diameter, in inches, and \(L\) is the length of the pipe section, in feet. Refer to table which shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by a food-grade adhesive. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach all the tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section to indicate that the pipe has been installed with the tablets at the top.

(5) Filling and contact: When installation has been completed, the main shall be filled with water at a rate to ensure that the water within the main shall flow at a velocity no greater than 1 ft/s. Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours and not more than 24 hours. If the water temperature is less than 41ºF, the water shall remain in the pipe for at least 48 hours. As an optional procedure (if specified by the purchaser), water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system. Detectable chlorine residual should be found at each sampling point after the 24 hours period. The results must be reported.

(6) Number of 5-g calcium hypochlorite tablets required for dose of 25 mg/L shall be as per the Owner.

n) Flush (for domestic water only)

(1) Flushing instructions shall be explicit in Drawings, including source of water, outlet point and final destination of water. Also included shall be the requirement for air vents are high points for relieving the air for hydro testing.

(2) The Contractor shall supply all equipment and personnel required to perform the flush.
(3) The Contractor shall make arrangements with FM–Utilities- Mechanical Distribution for supply of water required for flush. Flushing shall be started between 8:00-9:00 AM.

(4) Flushing shall take place for approximately 4 hours.

(5) The Contractor shall install a temporary hydrant at the end of the new mater main for flushing purposes. The temporary hydrant must be a full-sized hydrant.

(6) It is the Contractor’s responsibility to route the flushed water to the nearest sanitary sewer as directed by the Owner (UI Mechanical Distribution and or UI Water Plant).

(7) Clearing the main of heavily chlorinated water. After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use. Chlorination shall be for 24 hours no more, no less, and shall not be started on Friday.

(8) Disposing of heavily chlorinated water. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge shall cause damage to the environment, then a neutralizing chemical shall be applied to the water to be wasted to neutralize thoroughly the residual chlorine. Where necessary, federal, state, provincial, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. Contractor shall coordinate all disposal locations with the Owner (UI Mechanical Distribution and UI Water Plant).

o) Water Sampling (for domestic water only)

(1) Water sampling shall be performed by the Owner’s Representative (Facilities Management – Mechanical Distribution and UI Water Plant). Owner’s Representative shall collect the sample, take the sample to the lab, and notify the Contractor of the results.

(2) The Contractor shall supply any equipment and personnel required to perform the tests.

(3) Water sampling shall take place at approximately 11:30 a.m. (Typically, flushing shall begin between 7:00 a.m. and 8:00 a.m., and sampling shall follow at 11:30 a.m.)

(4) Following the sampling, the Contractor should allow 3 days turn-around time for laboratory processing before hydro test.
(5) Testing shall be completed and passed prior to connecting to any existing lines.

p) Hydro test
(1) Hydro test all piping.
(2) Where possible, hydro test shall be made against capped ends. Test pressure shall be 1.5 times working pressure, and a minimum of 150#.
(3) FM-Utilities & Energy Management, Mechanical Distribution shall witness all hydro tests.
(4) Test shall be for 4 hours. No tests started after 9:00 AM.
(5) Test may only lose 5 psig.
(6) In some cases hydro testing may be required to exceed these pressures to 225 psig. When this requirement is included, piping shall be capped and testing shall not be against a valve, unless the valve is 250# rating, all piping shall be capped by mechanical caps and restraint joints.
(7) Gauges may be required to be University of Iowa provided. Contact Utilities & Energy Management, Mechanical Distribution.

q) Final Connections to Existing Domestic Water Main: Water mains and appurtenances must be completely installed, flushed, disinfected, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Sanitary construction practices must be followed during installation of the final connection, so that there is no contamination of the new or existing water main with foreign material or groundwater.

r) Waterline pipe installation shall include granular backfill (sand) within the pipe envelope. Granular bedding shall be provided.
(1) Provide 5'6" minimum cover.
(2) Trench backfill in yard areas shall generally be soil compacted, in continuous layers not exceeding 8” in compacted depth, to 90% Standard Proctor Density.
(3) Trench backfill under pavements shall generally be granular material compacted, in continuous layers not exceeding 8” in compacted depth, to 95% Standard Proctor Density.
(4) Maintain –2% to +4% optimum moisture content for cohesive soils. For cohesionless soils, maintain moisture at less than +4% of optimum moisture content.

s) All water meters shall be located inside buildings.

t) Valves shall be installed with a vertical piece of cast iron with a cast iron valve box cover, with lid marked ‘Water’. Casting shall be anchored by a 2’ x 2’ x 8” thick concrete pad, 6” below finished grade.

u) Fire hydrants shall be provided in accordance with the requirements of the local fire district or department. Fire hydrants shall be Mueller Super Centurion 250.
v) Waterlines shall be provided with a tracer wire, with outlet at valve boxes, and warning tape.
w) All wall penetrations through walls shall be sealed with Link-seals.
x) All piping shall be anchored to the wall, at wall penetrations.
y) Operation of all valves, both new and existing, shall be by FM-Utilities & Energy Management, Mechanical Distribution. Coordination shall be between FM-Utilities & Energy Management, Mechanical Distribution and Water Plant.
z) Provide post indicator valve (PIV) only when building has a significant hazard (i.e. large quantities of chemicals, etc.)

4. Gas Mains:
a) Gas Mains and services shall have a minimum of 24” of cover.

F. Landscape
1. University shall be notified prior to grade changes during backfilling and prior to the establishment of the “rough grade” (existing grade prior to application of top soil or growing medium for turf or other plants).
2. University shall be notified prior to applying top soil or growing medium for turf or plants for the purpose of establishing the finish grade.
3. Soil or growing medium for turf or plants shall be examined and approved by the University application.
4. Contractor shall stake all plant locations. Landscape Services must approval all taked locations before planting.
5. All baskets, burlap, containers, wires, twine, etc. shall be completely removed from all plant material before planting.
6. Proper planting depth requires the root flare to be slightly above finished grade. Specifications must incorporate language and details to insure proper planting depth.
6. Planters shall be checked for adequate drainage by the University before filling. Planters shall be filled with specific soil mixtures.
5. Landscape plant materials shall be in accordance with the American Association of Nurserymen’s Standards.
6. Landscape installer shall provide typewritten instructions to the University for the maintenance of plant materials for one full year. Instructions shall be submitted upon completion of planting.
7. Landscape plants shall be maintained by the Contractor for a thirty (30) day period following planting.
8. Where necessary to control pedestrian traffic the standard post & chain fence shall be used. See Appendices for details.
G. Site Furnishings
1. Bicycle racks shall be the Bike Rib Linear Rack as manufactured by Function First, Inc. http://www.bikerack.com/.
2. Benches & trash receptacles shall conform to surrounding styles and be appropriate for the site. Selected manufacture & style must be reviewed and approved by Building & Landscape Services. All site furniture must be surface mounted on concrete and all metal painted black. Stone and concrete benches are not recommended.

H. Exterior Signage
1. All new buildings shall have at least one major building identification sign located in close proximity to the main building entrance. Use the Owner’s new building sign standard. The Design Professional shall incorporate a sign location in their design bid documents. Secondary entrances may be signed with a smaller building identification sign if the entrance is open to general public access and has reasonable public exposure. Final locations shall be reviewed and approved by the Owner’s Representative.
2. Signs or lettering applied to an exterior building surface are strongly discouraged. Any proposal for signs or identification lettering (either free standing or on a building surface) that do not conform to the standard campus sign style must be submitted to Campus Planning Committee, Campus Environment Subcommittee for review and approval during the design process.

III. CONCRETE
This section applies to all building systems concrete work and cast-in-place site structural concrete outside building envelopes.

A. Mix Design and Materials
1. Concrete strengths shall be specified in accordance with actual requirements. Concrete mix shall be specified with minimum cement content, as well as maximum water/cement ratio.
2. Flint and chert shall be limited to 1% maximum, by weight of the course aggregate, in all exposed concrete (cast-in-place or precast). Lignite shall be limited to 0.07%, by weight of the fine aggregate in all exposed concrete. Some applications may be required to be lignite free (Project Manager [PM] shall advise).
3. The use of calcium chloride and/or flash in concrete mixes shall not be permitted.
4. All accessories touching the exposed surface of the concrete or come in contact with soil shall be coated with plastic or epoxy to prevent rust.

B. Precast Concrete Standards
1. Fabricator must show compliance with the following codes and standards:
   a) ACI-318 “Building Code Requirements for Reinforced Concrete”
   b) CRSI “Manual of Standard Practice”
c) Prestress Concrete Institute MNL117, “Manual for Quality Control for Plant and Production for Architectural Precast Concrete Products.”

2. The Fabricator shall have a minimum of three (3) years successful experience in the fabrication of precast concrete units similar to the units required for this project. Fabricator shall guarantee the connections and shall submit their design to the Design Professional for review.

3. The Erector shall have a minimum of two (2) years successful experience erecting similar precast units.

4. Shop drawings shall be prepared by a Registered Professional Engineer licensed to practice in the State of Iowa.

C. Testing

1. Design Professional shall specify inspection and testing requirements and shall include procedures for evaluation of test data. The University shall retain services of a testing firm. Contractor shall be responsible for scheduling the tests. Contractor shall be required to notify the University’s representative a minimum of 48 hours prior to all placement of concrete.

2. Specifications shall require strength, air entrainment, temperature, and slump tests, and shall indicate allowable limits for each measure. Strength tests shall require four (4) cylinders (3 to be broken and 1 spare). Test results shall be specified to be sent directly to the Contractor, Design Professional, and the University’s representative.

3. Concrete shall be tested at the minimum rate of one test for the first 25 CY placed each day, and one test for each additional 50 CY placed. Concrete may be tested more often at the discretion of the University’s representative.

4. Test data from concrete cylinder breaks shall be evaluated using procedures of the American Concrete Institute (latest edition of ACI 214) to determine if the compressive strength of the concrete tested is acceptable.

D. Placement

1. Joints and Concrete Flatwork
   a) Contraction joints shall be tooled during finishing or sawed within 18-hours of concrete placement. If the joint edge ravel, stop, do not proceed until concrete has sufficient cure to saw without damage.
   b) Contraction joints shall have a minimum depth of 1/4 of the pavement thickness and a minimum width of 1/8”.
   c) Transverse contraction joints shall be provided at a maximum of 2.5 times the pavement thickness (in inches) in feet for street pavements and 2.0 times for all other pavements.
   d) Longitudinal joints shall have a maximum separation of 12 feet for streets and 9 feet for sidewalks.
   e) The ratio of slab width to length should not exceed 1.67 for street pavements and 1.25 for all other pavements.
f) Some variance in spacing shall be permitted to achieve desired architectural effect.
(1) Concrete flatwork shall be isolated from columns, existing walls, etc., by use of non-extruding expansion joint material.
(2) Base course and underslab drainage system for slabs shall conform to geotechnical engineer recommendations. For projects without a geotechnical report, slabs shall be constructed on a minimum 4” base of 3/4”-1” clean rock with a plastic vapor barrier.
(3) All slabs below grade shall have a sump hole. Provide an electrical outlet by the sump hole. The University shall provide the sump pump.
(4) Slab flatness and levelness shall be within 1/8” in 10’. ASTM E1155 shall not be used to specify flatness and levelness unless the particular use requires a high level of accuracy. Areas having floor drains shall have positive slope to the floor drain. Amount and direction of slope for floor drains shall be indicated on the drawings.

E) Construction joints shall be located at expansion joint locations wherever possible. Construction joints at other locations shall be keyed.

h) Joint spacing and joint detail shall be shown on the drawings.

E. Exposed Concrete
1. All exposed concrete shall conform to the applicable sections of V.B.3A.
2. Exposed concrete intended as a finish material shall be clearly defined in the drawings and specifications. Areas to be addressed should include special formwork, form liners, acceptable defects (if any), surface repairs and surface treatments (i.e.: sandblast, rubbing, etc.)

IV. MASONRY

A. Brick and Block Masonry
1. Design and construction guidelines and technical notes of the Brick Institute of America (BIA) shall be followed for brick and the Masonry Advisory Council (MAC) for concrete masonry unit (CMU) construction. Particular emphasis is placed upon the following BIA sections:
   a) Articles 21, 21A, 21B, 21C/Brick Masonry Cavity Walls.
      (1) Tie Spacing (4.5 square feet per tie, maximum 24” on center vertical, and maximum 36” on center horizontal).
      (2) Movement Joints (Articles 18 and 18A).
      (3) Flashings (placement, protrude 1/4” beyond face of wall and form a drip).
      (4) Weeps (24” on center with tubes, 16” on center with wicks, located above flashings).
      (5) Air Space (2” minimum kept clean of mortar droppings).
b) Article 28B/Brick Veneer Steel Stud Panel Walls

(1) Tie Spacing (2 square feet per tie, maximum 18” on center vertical, and maximum 24” on center horizontal).

(2) Movement Joints (Articles 18 and 18A).

(3) Flashings (placement, protrude beyond face of wall and form a drip).

(4) Weeps (24” on center with tubes, 16” on center with wicks, located above flashings).

(5) Air Space (2” minimum, kept clean of mortar droppings).

2. Brick allowances are discouraged. Allowances shall be specified for brick only if specific selections cannot be made.

3. All brick (including that incorporated into the face of architectural precast panels) shall comply with ASTM C216 and shall have a rating of “no efflorescence” when tested according to ASTM C67.
   a) Lab certification of brick shall be based on samples taken from bricks produced for the project and shall be approved prior to delivery. The University shall retain an independent testing agency that shall randomly test brick delivered to the site for compliance.

4. Brick used as paving material must be paving grade and shall be set in a concrete base with an asphalt leveling course.

B. Stone Masonry


2. Coping stones shall be secured with stainless steel anchors and pins and shall have a continuous lead-coated copper flashing beneath the stones that extends flush to the surface of the wall, but not past the exterior surface. All head joints of coping stones shall have joint sealant installed rather than mortar or grout.

C. Mortar, Flashing, Weep Holes and Anchors


2. All shelf angles, fasteners, and other metal objects incorporated into masonry walls shall be hot dipped galvanized. Fasteners shall be stainless steel.

3. All flashings should extend 1/4” beyond the face of wall. In-wall flashings should be composite copper asphaltic felt. Through-wall flashings shall be stainless steel. Weeps shall be installed above each flashing.

4. Wall ties shall be hot dipped galvanized steel, of a material, construction and movement quality equal to Hohmann & Barnard, Inc., DW10 Box Wall Tie.

5. At load bearing joints of different types of materials (brick and stone, brick and concrete, etc.), mortar shall be raked back a sufficient depth to allow the installation of
backer rod and sealant. Sealant installation details shall comply with the manufacturer’s recommendations.

V. METALS

A. Structural Steel
1. If the AISC “Code of Standard Practice for Steel Buildings and Bridges” is used or referenced, the specifications shall modify that code by deletion of the following sentence in paragraph 4.2.1: “This approval constitutes the University’s acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of their preparation of these shop drawings.”
2. Specifications shall clearly state the responsibility for the design of steel connections. The responsible party must seal the connection designs.
3. Certified (AWS D1.1) welders shall be used on structural work.
4. Design Professional should consider use of twist-off bolts and load indicator washers for field structural connections.
5. Pre-engineered metal building roof purlins shall be adequately braced on the compression flange to resist all design loads. Purlin slide clips commonly used with standing seam systems shall not be considered an effective brace for the purlin. Separate purlin bracing such as threaded rods or sag angles must be provided in addition to the slide clips.

B. Testing
1. Design Professional shall specify inspection and testing requirements and shall include procedures for evaluation of test data. The University shall retain the services of an independent testing firm to test all steel connections. Contractor shall be responsible for scheduling tests. Contractor shall be required to notify the University’s representative a minimum of 48 hours prior to the time testing is needed.
2. Test results shall be specified to be sent directly to the Contractor, architect and the University’s representative.

C. Miscellaneous Metals
1. At exterior guardrails and handrails that are not a significant part of a building’s architecture, construction shall consist of fully welded hot dipped galvanized steel pipe. Infill panels shall consist of vertical balusters. Support posts shall be set in sleeves oversized 1” cast into the walk. Railings shall be painted black with high gloss enamel paint. Non-shrink non-metallic grout shall be used and shall slope to drain.
2. All exterior fasteners shall be stainless steel.
3. Specifications shall require a mock up panel for all welded railings, grilles and similar architectural metal elements.
VI. WOOD & PLASTICS

A. Rough Carpentry
1. Fire retardant lumber, used where required by code, shall be in accordance with American Wood Preservers Association standards.
2. Where wood is in contact with ground or moisture, a material suitable for such application shall be used, however CCA is not recommended.

B. Architectural Millwork and Cabinetry
1. All architectural millwork and cabinetry shall meet Architectural Woodwork Institute standards, and finish shall be free of lead bearing substances.
2. The use of more durable solid surfacing materials for windowsills is encouraged. Plastic laminate on solid wood or exterior grade plywood is acceptable. Standard particleboard is not acceptable.
3. Countertops should minimize seams. Plastic laminate countertops should have a plywood substrate. Sprayed on glue application for plastic laminate is not recommended. Countertops in wet areas shall be constructed with substrate susceptible to moisture.

VII. THERMAL & MOISTURE PROTECTION

A. General
1. Materials used for moisture protection shall comply with specifications contained in the appropriate American Society for Testing and Material standards.
2. All roofing materials shall be asbestos free.
3. Roof manufacturer approval process: All roof systems are pre-approved by the University. This is an internal process, consisting of the following:
   a) Roof manufacturer submits the following information to the PM:
      (1) Roof system technical data
      (2) List of approved regional installers
      (3) List of regional projects completed over the last three years detailing:
         (a) Roof area and cost
         (b) Project University and contact person
         (c) Design Professional firm and contact person
   b) The PM evaluates all aspects of the proposed system.
   c) If necessary, the manufacturer meets with committee to review submitted materials and respond to questions.
   d) The PM approves or rejects the roof manufacturer.
B. Roofs

1. Design Standards include:
   a) FM Global. Determine uplift requirements as per Roof Nav. Attachment methods for roof insulations and roof coverings are detailed for each specific Roof Nav assembly.
   b) Underwriters Laboratory (UL). UL labels are required for each membrane, with top side fire rating meeting ASTM E108 Class A.

2. Design Professionals shall base roof specifications on these University of Iowa’s Design Standards & Procedures.
   a) The systems/manufacturers are prequalified:
      (1) EPDM
      (2) Carlisle Corporation
      (3) Firestone Building Products Company
      (4) Genflex Roofing Systems
      (5) CSPE
      (6) JPS Elastomerics Corporation
      (7) Burke Rubber Company
      (8) CPA
      (9) Duro-Last Roofing, Inc.
      (10) Seal-Dry/USA, Inc.
      (11) PVC
      (12) Sarnifil Corporation (limited application due to proprietary product nature)
      (13) Kee-Seaman Corporation (limited application due to proprietary product nature)
      (14) Built-Up Roofing Systems/Coal Tar
      (15) Allied Signal Inc.
      (16) Koppers Industries Inc.
      (17) Built-Up Roofing Systems/Asphalt
      (18) Johns-Manville
      (19) Tamko Asphalt Products Inc.
      (20) U.S. Intec
      (21) Modified Bitumen SBS
      (22) Garland Company Inc.
      (23) Johns-Manville
      (24) Tamko
C. **Recommended Roof Membrane and Insulation Assemblies**

1. **Built-up asphalt (BUR)**
   a) Membrane: four plies of Type IV glass felts in Type I or Type III asphalt moppings. Coal tar roof assemblies shall be considered with existing no slope roofs or new low slope roofs (less than 1/4” per foot). Type VI felt can be used in lieu of Type IV felt. On nailable substrates, a coated base sheet should be employed with three plies of Type IV. Base sheets should not be utilized under other circumstances.
   
   b) Insulation: R-30 minimum rigid polyisocyanurate or extruded polystyrene (as part of roof manufacturer’s approved system and included in the total system warranty). Mechanically fastened except over concrete deck or vapor retarder. Extruded polystyrene is preferred if approved by the manufacturer.
   
   c) The insulation specified shall be compatible with the application method required and the other materials of the roofing system and shall be included in the total system warranty.
   
   d) It is required that insulation be installed in more than one layer with staggered joints. Use of a recovery board is not considered a layer.
   
   e) Substrate Board: 3/4” thick organic fiberboard or perlite for exterior fire rating Class A. Built-up roofs should never be installed directly over polyisocyanurate. Substrate board to be installed with staggered joints and adhered in asphalt as part of total roof system.
   
   f) Surfacing: flood coat with surface granulating or a fibrated aluminum coating for Class A rating.
   
   g) Base Flashings: mineral surfaced modified bitumen sheets. Polyester fabric and modified mastic applies to top edge and side laps. Where deck-wall movement is likely (metal deck, masonry walls), use SBS type with polyester reinforcement only. Install in two components within 20’ of corners and expansion joints. Avoid APP type at non-nailable substrates. Use SBS type with polyester reinforcement at low profile expansion joints and control joints. Use SBS type with granule surfacing and polyester reinforcement as walkways.
h) Anchor membrane with non-ferrous termination bars and stainless steel fasteners at wall/deck transition. Termination bars to be covered with a reglet and counter-flashing even if not required by manufacturer’s warranty.

2. SBS Type Modified Bitumen Sheet System
   a) Membrane: to consist of a base sheet, interply sheet and cap sheet of SBS type sheets bonded with hot asphalt or approved adhesives. Cold process adhesive is encouraged on main campus facilities. A special fire rated sheet may be necessary to meet Class A requirements. Polyester or fiberglass reinforcement is allowable per manufacturer’s roof systems. Standard test methods for sampling and testing Modified Bitumen material shall comply with ASTM D-5147, D-6162, D-6163, D-6164.
   b) Insulation: R-20 minimum rigid polyisocyanurate or extruded polystyrene (as part of roof manufacturer’s approved system and included in the total system warranty). Extruded polystyrene is preferred if approved by the manufacturer.
   c) The insulation specified shall be compatible with the application method required and the other materials of the roofing system and shall be included in the total system warranty.
   d) It is required that insulation be installed in more than one layer with staggered joints. Use of a recovery board is not considered a layer.
   e) Substrate Board: 3/4” thick organic fiberboard or perlite for exterior fire rating Class A (as part of roof manufacturer’s approved system). Modified bitumen roofs should never be installed directly over polyisocyanurate. Substrate board to be installed with staggered joints and adhered in asphalt as part of total roof system.
   f) Surfacing: ceramic granule surfaced cap sheet, white in color, unless otherwise recommended.
   g) Base Flashings: SBS material furnished and installed per roof manufacturer’s recommendations. Use SBS type with polyester reinforcement only. Install in two components within 20’ of corners and expansion joints. Avoid APP type at non-nailable substrates. Use SBS type with granule surfacing and polyester reinforcement as walkways.
   h) Anchor membrane with non-ferrous termination bars and stainless steel fasteners at wall/deck transition. Termination bars to be covered with a reglet and counter-flashing even if not required by manufacturer’s warranty.

3. EPDM (non-reinforced) - Fully adhered
   a) Membrane: minimum 60 mil thick EPDM non-reinforced sheet. Use pre-manufactured seam products to construct seams as supplied and approved by manufacturer. Minimum field seam width to be 5.5 inches.
   b) Insulation: R-20 rigid polyisocyanurate or high-density fiberboard (as part of roof manufacturer’s approved system and included in the total system warranty). Polyisocyanurate shall have special facers designed for EPDM adhesion and must be approved or manufactured by primary membrane
manufacturer. High-density fiberboard is for overlay system to be used only under special conditions. Attach insulation with mechanical fasteners with caps that lock onto screws over metal and wood decks. Adhere with polyurethane adhesive over concrete and vapor barriers. Substrate must be free of contaminants prior to membrane applications.

c) The insulation specified shall be compatible with the application method required and the other materials of the roofing system and shall be included in the total system warranty.

d) It is required that insulation be installed in more than one layer with staggered joints. Use of a recovery board is not considered a layer.

e) Surfacing: none; use fire rated Class A system for exterior fire resistance.

f) Base Flashings: 60 mil EPDM. Continue field membrane up walls and curbs using non-penetrating attachment methods. Use details that minimize uncured rubber. Termination bars to be covered with a reglet and counterflashing even if not required by manufacturer’s warranty.

g) Substrate Board: (if required) Siliconized gypsum core panel, 1/2” thick.

4. CSPE (reinforced) - Fully adhered

a) Membrane: minimum 60 mil thick polyester reinforced sheet. Use heat welded seams with membrane installed using continuous contact adhesive as supplied and approved by the manufacturer.

b) Insulation: R-20 minimum. Most insulation types are acceptable substrate (as part of roof manufacturers approved system and included in the total system warranty). Obtain written membrane manufacturer approval.

c) The insulation specified shall be compatible with the application method required and the other materials of the roofing system and shall be included in the total system warranty.

d) It is required that insulation be installed in more than one layer with staggered joints. Use of a recovery board is not considered a layer.

e) Substrate Board: (if required) Siliconized gypsum core panel, 1/2” thick.

f) Surfacing: not required

g) Base Flashings: 60 mil thick CSPE or special coated metal and all as supplied and approved by roof manufacturer.

h) Anchor membrane with non-ferrous termination bars and stainless steel fasteners at wall/deck transition. Termination bars to be covered with a reglet and counter-flashing even if not required by manufacturer’s warranty.

5. PVC (reinforced) - Fully Adhered

a) Mechanically Fastened (where applicable)

b) Membrane: minimum 60 mil thick fabric reinforced sheet with heat weld seaming.

c) Insulation: R-20 minimum rigid polyisocyanurate or high-density fiberboard (as part of roof manufacturers approved system and included in the total system warranty).
d) The insulation specified shall be compatible with the application method required and the other materials of the roofing system and shall be included in the total system warranty.
e) It is required that insulation be installed in more than one layer with staggered joints. Use of a recovery board is not considered a layer.
f) Substrate Board: (if required) Siliconized gypsum core panel, 1/2” thick.
g) Surfacing: not required
h) Base Flashings: Membrane coated metal or reinforced sheet and accessories provided by primary manufacturer.
i) Anchor membrane with non-ferrous termination bars and stainless steel fasteners at wall/deck transition. Termination bars to be covered with a reglet and counter-flashing even if not required by manufacturer’s warranty.

6. Slope & Drainage
a) In new construction, the roof shall have a minimum design slope of 1/4” per foot. In reroofing, the roof should have a minimum slope of 1/8” per foot. Tapered insulation may be necessary to achieve required slope. Use crickets, saddles and edge strips (tapered at 2 times slope) to direct water from penetrations and parapet walls.
b) Locate roof drains at projected low points. All roofs shall have overflow systems of either a separate and independent overflow piping system which daylights or overflow parapet scuppers.

D. Metal Roofing-Structural Standing Seam (SSR)
1. Structural metal roofing shall meet UL90 uplift rating. Roofing shall be pre-engineered metal running perpendicular to purlins supports and insulated by a glass batt directly beneath the roofing and over the purlins. Sheets shall have a steel or aluminum core (minimum 22 gage) and corrosion protection provided by a “Kynar” coated finish. Slope should be no less than 1” per foot. Ice guards are required on eaves over sidewalks.

E. Slate
1. Slate material shall be Type S1 slate as specified by ASTM C406 (90-110 year performance life). Natural slate may be installed in slopes as shallow as 3” per foot, provided adhered polyethylene reinforced bitumen sheet underlay is installed (5” per foot slope is preferred minimum). Use copper nails and ridge caps. Ice guards are required on eaves over sidewalks.
2. Use of artificial slate requires PM approval.

F. Asphalt Shingles
1. Asphalt shingles shall be fiberglass seal-tab type with minimum 25-year warranty. Minimum roof slope shall be 4” per foot with one layer of 30 lb. asphalt saturated felt underlay (3” per foot may be used with 2 layers of underlayment). Provide a pre-
finished metal sheet steel drip edge at eaves and gable rakes. Shingles shall be nailed, not stapled.

G. Roof Deck
1. A registered structural engineer shall design roof decks. The Design Professional shall determine expected wind uplift conditions for the building roof and determine suitability of the recommended system for these conditions. Roof deck securement shall be per FM Global Property Loss Prevention Data Sheet 1-29.
2. Roof deck material shall be a minimum 20-gauge metal deck or a cast in place concrete deck. Wood or wood fiber cement decks shall not be used. Slope to drains shall be designed into the structural system whenever possible.
3. Concrete decks shall provide a sufficient drying period to avoid containment of residual water. Lightweight concrete shall not be used.
4. All wood curbs, blocking, subfascias, etc. should be preservative treated material.

H. Vapor Retarders
1. Roof Design Professional shall investigate and recommend whether a vapor retarder is required. Vapor retarders may be necessary when interior relative humidity is expected to rise above 45%, and the outside average January temperature is below 40 degrees F. The vapor retarder is a layer of low permeability material to prevent moisture migration from entering the roofing system. The vapor retarder shall be installed on the warm/humidity side. Vapor retarders can consist of polyethylene sheets, laminated sheets, or multiple courses of asphalt and felts.

I. Roof Replacement
1. When roof replacement is necessary, it should not always require a complete removal of the existing roof. Factors in making a determination of roof replacement vs. roof overlay include:
   a) Moisture content in existing insulation. If more than 20%-30% of the existing insulation is wet, total tear-off is recommended.
   b) Structural analysis is required where a roof overlay results in additional imposed load on the structure. A licensed structural engineer shall confirm roof loading capacity.
   c) Roofing inspection with destructive sampling. A sufficient number of at least 2” diameter core samples should be taken to verify construction of existing roof system. These cores shall indicate signs of deterioration and presence of moisture and delaminations. Core samples may also detect presence of asbestos when submitted to a laboratory for testing. Proper asbestos abatement procedures must be taken to remove this material. All holes left from the sample removal must be repaired with like materials. It is not recommended to take samples from single ply roofing systems, especially if they are still under warranty (a recover installation may require samples).
d) Condition of the existing roof surface. Proper placement of roof overlays may require the use of a substrate board for improved “U” value of roof assembly, prevention of elevation irregularities, and separation of non-compatible materials. Substrate board can prevent elevation irregularities at the board joints.

e) Suitability for attachment: A roof overlay shall employ a substrate board that is mechanically attached to the deck component. If attachment cannot meet code requirements, roof replacement shall be necessary.

J. Roof Warranties & Certification

Roof manufacturer and roof installer shall provide the following items:

1. Roofing Contractor [installer] shall guaranty all materials furnished and work performed under the roofing system contract against defective workmanship for a period of twenty-four (24) months after final completion as provided in the construction documents. The system may include the following components:
   a) Roofing membrane (built-up felts or single-ply), slate, shingles, or metal roofs
   b) Flashing and counter-flashings
   c) Insulation
   d) Vapor barrier
   e) Fasteners and adhesives
   f) Sealants and caulking
   g) Ballast and ballast stops
   h) Walkway mats & pavers
   i) Roof hatches, pitch pans and equipment curbs
   j) Gutters, downspouts, and fascia panels
   k) Roofing accessories, as required making a complete roofing system
   l) Coping

   Note: Warranted roof system components are to be identified in the construction documents. Roof materials and accessories must be part of the approved system.

2. Roofing manufacturer shall provide a total system warranty for the roofing system furnished under this contract against leaks and defective materials and workmanship for a minimum period of fifteen (15) years after final completion as provided in the contract. This warranty shall run concurrently with the roofing Contractor/installer twenty-four (24) months guaranty. This warranty shall cover labor and materials for the complete roofing system and the watertight integrity and performance of the roofing system installed which includes all components identified under the roofing Contractor/installer twenty-four (24) month warranty. Manufacturer shall be liable for full replacement cost of the roof system; therefore warranty shall be a no-dollar limit warranty. The roofing Contractor or subContractor shall provide the University with an Application for a Roof Warranty. Warranty shall not exclude coverage as a result of winds less than 54, 63, or 72 mph (review with project manager).
3. University shall notify roofing Contractor and manufacturer, if repairs covered by the warranty are required, within twenty (20) days of discovery of defects in the roofing system. Upon written notice from the University of any breach of warranty during applicable warranty period due to defective material or workmanship, the affected part of parts thereof shall be repaired or replaced at no cost to the University within thirty (30) days of receipt of notice. Contractor should notify University’s representative when they come on Campus for warranty repairs. Should the roofing Contractor or roof manufacturer fail or refuse to make necessary repairs or replacements, when requested by the University, the University may perform, or cause the necessary work to be performed at the roofing Contractor and manufacturer’s expense.

4. The following are excluded from this warranty:
   a) Roof maintenance
   b) Damage to any part of the building (other than the roofing system) or to its contents.
   c) Damage resulting from any one of the following:
      (1) Cracking, warping, deflection or movement of building foundation.
      (2) Natural disasters such as earthquake, hail, or wind exceeding 54, 63, or 72 mph (review with project manager).
      (3) Accidents, vandalism, or other uncontrollable events.
      (4) Chemical attacks on the membrane from sources not present at time of roofing system installation.
      (5) Excessive movement or deterioration of metal components adjacent to the roof or engaged therein.

K. Roof Installation
1. Roofing Contractor must have the following qualifications:
   a) A minimum of five years of experience in installation of the specified roof system.
   b) Roof manufacturer certification as an installer for specified roofing systems.
   c) Roof foreman and 50% of installing crew are trained and certified in the installation of specified roofing system. In addition, foreman shall be full time at project site through roof completion. In addition, foreman will be full time at project site through roof completion.

L. Roofing Accessories
1. Parapet wall coping shall be constructed with metal selected from one of the following materials:
   a) Sheet metal, 22 or 24 gage, galvanized, factory finished with Kynar 500
   b) Copper, ASTM B370, 16-20 oz.
   c) Aluminum, .032” or .040”, factory finished with Kynar 500
   d) Stainless steel, .018 soft buff
2. Gravel stop/fascias shall be 22 or 24 gauge galvanized, and factory finished with Kynar coated finish.

3. Installation shall be in accordance with SMACNA minimum standards. End laps and side laps shall provide for thermal expansion. Joints shall have cover and backup plates. 
   a) No roofing personnel will be allowed to fabricate or install roof-related sheet metal.

4. Sheet metal roof accessories shall be constructed with metal selected from one of the following materials:
   a) Sheet metal, 20 gage, galvanized, factory finished with Kynar 500
   b) Copper, ASTM B370, 16-20 oz.
   c) Aluminum, ASTM B209, alloy 3003, AA-C22A41 clear anodized finish, minimum 20 gage
   d) Solder, 50/50 ASTM B32

5. Surfacing aggregate shall be clean water worn opaque gravel.

6. Open faced downspouts are not allowed.

M. Joint Sealers

1. The following joint sealer schedule shall be reviewed and edited by the Design Professional and incorporated into the specifications. The following is a description of joint construction and location where joint sealer is typically applied:
   a) All exterior sealants require the use of a sealant primer.
      (1) Multi-Part Pourable Urethane Sealant: Exterior and interior joints in horizontal surfaces of concrete; between metal and concrete, mortar, stone and masonry.
      (2) Neutral-Curing Silicone Sealant (required 20 year warranty): Use in all exterior exposed applications. (Non-Structural for most applications and Structural for SSG Curtain wall glazing applications.)
      (3) One-Part Mildew-Resistant Silicone: Interior joints in vertical surfaces of ceramic tile in toilet rooms, showers, and kitchens.
      (4) Acrylic-Emulsion Sealant: Interior joints in field-painted vertical and overhead surfaces at perimeter of elevator door frames and hollow metal door frames; and gypsum drywall, plaster and concrete or concrete masonry; and all other interior joints not subject to movement.
      (5) Foamed-In-Place Fire Stopping Sealant: Through penetrations in fire-resistance-rated floor and wall assemblies involving multiple pipes, conduits, and other items.
      (6) One-Part FireStopping Sealant: Through penetrations in fire-resistance-rated floor and wall assemblies involving single pipes, conduits where joint widths are narrow and of uniform width.
VIII. DOORS, WINDOWS & GLASS

A. Doors

1. Aluminum exterior doors shall have wide stiles, weather-stripping, and shall be insulated. All doors shall have a center-locking rail. Pairs of doors shall have a Von Duprin keyed removable center mullion Kawneer 560 Insulclad and Kawneer 500 Tuffline shall be used as a standard of quality. Bottom rail to be 10” high, top rail to be 5” high and stiles to be 5” wide.

2. Aluminum entrances and storefronts shall have thermal break construction and comply with American Architectural Metal Association (AAMA) standards. Framing shall also be thermally broken from any interior construction.

3. Hollow metal doors at entries and high usage areas are required to have steel stiffened cores. Exterior and high moisture areas require A60 galvannealed material. Exterior pairs of doors shall have a Von Duprin keyed removable center mullion. High humidity areas require stainless steel material. Full lite doors require tubular stile & rail construction. Polystyrene is prohibited for usage as a door core material. The top edge of exterior doors shall have inverted steel channel closures, installed flush, filled and finished smooth. Exterior door faces shall consist of 14 gage steel and meet Level 4/Model 2 standards. Interior door faces shall consist of 16 gage material and meet Level 3/Model 2 standards. All doors shall be 1-3/4” thick. All door seams shall be continuous welded. Door edges shall be fabricated utilizing beveled edges on hinge and lock stiles. Doors shall be reinforced at hardware mounting locations. Materials and installation shall comply with Steel Door Institute standards ANSI/SDI-100 A250.8-2003.

4. Hollow metal frames in new construction shall be welded and primed. Knockdown frames are not acceptable. “Timely” and “Redi-frames” are prohibited. Exterior and high moisture areas shall be A60 galvannealed and primed. Use stainless steel frames and anchors in high humidity areas. Materials and installation shall comply with Steel Door Institute standards ANSI/SDI-100 A250.8-2003. Frames shall be reinforced at hardware mounting locations. Exterior frames to be 12 gauge. Interior high frequency frames to be 14 gauge. Interior low frequency frames such as office doors to be 16 gauge. Frames that use masonry anchors and are installed prior to masonry walls shall be grouted. Frames shall be filled as the masonry units are laid with mortar of no more than 4” slump using hand trowel methods. Brace frames so that pressure of grout before setting does not deform frames. Grouted frames shall have 6” polystyrene rigid insulation fillers cut to frame profile installed in bottoms of frame to keep grout out of bottom 6” of frame. Grouted frames shall be galvanized and include conduit when electrified hardware components are being utilized. All other frames shall not be grouted.

5. Interior aluminum frames are not allowed.

6. Wood doors shall be 5 ply solid core and comply with WDMA IS 1A & 6A Window and Door Manufacturers Association standards. Crossbands are to be wood-based composites of a minimum thickness of 1/16”. Crossbands and face veneers shall be
laminated to the core with Type 2 interior use glue using the Hot Press process. Crossbands must extend the full width of the door.

a) Non-fire rated wood doors shall be Custom Grade and constructed using WDMA 5 Ply hot press method for laminating door materials. Stiles and rails must be securely bonded to the core and then abrasively planed prior to veneering. Core type to be Structural Composite Lumber Core (SCLC-5). Stiles shall be hardwood, one piece, laminated or veneered. Constructions with laminated edges may use structural composite lumber as an inner stile component. Rails shall be solid wood, structural composite lumber meeting the minimum requirements of WDMA, or medium density fiberboard meeting requirements of ANSI 208.2 (Medium Density Fiberboard for Interior Use). Top Rails shall be minimum 5”.

b) Fire-rated wood doors shall be WDMA 5 Ply construction, using Hot Press method for laminating door materials. Core materials shall be Structural Composite Lumber Core for 1/3 hour rated doors and Mineral Core. Stiles shall consist of manufacturer’s standard laminated edge construction with improved screw-holding capability and split resistance. Both inner and outer stiles cannot contain salt treating. Rails are to be solid wood or other material contained in manufacturer’s fire door approvals. Minimum 5” top rails and 5-1/2” bottom rails. Minimum lock block size shall be 4-1/2” x 10”. Fire ratings shall comply with positive pressure requirements UL 10C/UBC7-2-97, with concealed intumescent.

7. Rolling fire doors and fire shutters activated by fusible link or a local smoke/fire detector or a central smoke/fire alarm system. Doors shall not require a releasing device when activated by an alarm signal. Doors shall maintain an average closing speed of not more than 9” (229 mm) per second during automatic closing. When automatic closure is activated, electric sensing edge and push button are inoperable. Doors shall be fail-safe and close upon power failure. Resetting of spring tension or mechanical dropouts shall not be required. Upon restoration of power, replacement of fusible link or clearing of the alarm signal, doors shall immediately reset by opening with the push button.

8. The use of “Total Doors” or equivalent by Won-Dor requires approval from the PM.

B. Windows

1. Aluminum windows shall have thermal break construction and shall comply with American Architectural Metal Association (AAMA) standards. Framing shall be thermally broken from any interior construction.

2. All operable windows shall be capable of being cleaned from the interior of the building and shall be supplied with a positive locking device. Screens shall not be supplied with the windows. All operating mechanisms shall be heavy-duty, institutional grade construction.
3. In specifying windows, consideration shall be given to replacement of broken glazing. It is preferred that replacement be possible from interior of the building. Other types of replacement require PM approval.

4. Window units shall comply with ASTM E283, E331, and E547. The University shall retain the services of a testing company to perform these tests on installed window units chosen at random by the University. Contractor shall be responsible for retesting units that fail test.

C. Glass and Glazing
1. Exterior windows and exterior glazed doors shall have double glazing, ¼” thick, certified by the Insulating Glass Certification Council (IGCC).

2. All glazing in new windows, doors, storefronts, etc. shall carry a ten year warranty on replacement of defective material.

D. Finish Hardware
1. All door hardware shall be heavy duty institutional grade. Hardware finish shall be either US32D or US26D. All classrooms shall have double cylinder classroom security locksets (excluding electronic locksets). All General Assignment Classrooms shall have electronic access control. All ITS Telecommunication rooms are to have electronic locks, door closers, and access control. Hardware schedule submittals shall be provided in vertical format. One copy of all approved door and hardware submittals shall be provided to Building & Landscape Services upon approval. Hardware specifications shall be provided by a Door & Hardware Institute certified Architectural Hardware Consultant. All openings consisting of electrified hardware shall include a brief detailed narrative in the bid documents explaining the intended design and function of the hardware. Electrified hardware that is to integrate with the University’s AMAG access control system shall be 24V. Electrified hardware that is to integrate with the University’s Millennium access control system shall be 12V. Installation of hardware shall be by a qualified installer with a minimum of five years’ experience in the installation of commercial grade hardware. Manufacturer instructions shall dictate templating and installation.

   a) Hinges to be of full mortise type with concealed bearings. Exterior hinges to be stainless steel. Use non-removable pins on all out-swing doors that are to be secure. Stanley model numbers shall be used as a standard of quality. All hinges shall be ball bearing. Continuous hinges are not allowed. All exterior doors and all mineral core fire doors are to be hung with four (4) hinges.

   b) Door closers shall be LCN 4040XP. Surface mounted parallel arms, mounted on the interior of the opening are preferred. Floor and concealed top jamb mounted closers are not acceptable. Do not use cushion stops. Delayed action may be used in animal care facilities only. Large classrooms or auditoriums shall require LCN 4410MExB80 with scan II motion detector. All LCN 4410 ME door closer require the use of a 4040SE-3210 transformer. All labeled doors with LCN 4410 ME closers shall be connected to the building fire alarm system. All door
closers are to be through bolted. Door closers shall be installed on all custodial, maintenance, and telecommunication rooms.

c) Power operators shall be push plate operated only. Radio frequency type are prohibited. Acceptable manufacturer and model is Record 8100 series only. Actuators are to be located 36” AFF. Actuator switches shall be MS Sedco #614 series.

d) Door stops and holders shall be LCN 7800 series 24 volt wall mount magnetic, LCN 4040SE 24 volt sentronic, or Glynn-Johnson 90/100 series manual. Only use LCN 4040SE electric hold open closers when it is not possible to use wall mount magnetic hold opens. Use Ives WS401/WS402 wall stops. Use Ives FS436/FS438 floor stops only when necessary. All exterior doors shall have overhead and floor/wall stops.

e) Flushbolts shall be Ives manual FB458 or FB30 automatic on metal doors or Rockwood 1960 on wood doors. Constant latching flushbolts shall be Ives FB50. Dust proof strikes shall be provided for flushbolts.

f) Coordinators shall be Timco 3092.

g) Door pulls with an offset design are prohibited. Pulls to be 1 ¼” in diameter with 3/8” diameter through bolts.

h) Locksets and latchsets shall be mortise type. Acceptable manufacturers and models are Yale 8800 CRE/CRR, Sargent 8200 LNJ/LW1J, or Schlage L series 03A/N. See Appendices details for manufacturer for existing buildings and field verify. Push button battery operated access control locks are not allowed without consultation with Building & Landscape Services.

i) Electronic locksets shall have request to exit and latchbolt monitoring switches. Quick connect plug connections are required. Electromagnetic locks are not allowed.

j) Exit devices shall be Von Duprin 98/99, 33A/35A, or 97/95 series. Use 94/95 recessed series cross-corridor applications. Use cylinder dogging on all non-rated devices. Concealed vertical rod exit devices are not allowed on wood doors. Vertical rod devices shall be less bottom rod. In multiple door entries, only one doorway shall be keyed from the exterior.

k) Electronic non-rated exit devices with latch retraction shall have special center case “SD” dogging. Electronic non-rated exit devices with electric trim shall have cylinder dogging. Entrance doors that require a power operator, exit device, and access control shall use Von Duprin LX RX-LC-SD-ELxE996L-XP99L (FSE) exit device. Quick connect plug connections are required.

l) Electric strikes are not allowed.

m) Power supplies for electronic latch retraction panic devices shall have battery backup and be supplied by the Hardware Supplier. All remaining power supplies required for the access control system shall be provided by the Access Control Contractor.
n) Protection plates shall be used on all doors with door closers. Bottom of protection plates are to be mounted 1” from the bottom of the door.

o) Power transfers to be Securitron CEPT Series. Electric hinges may only be used with existing frames.

p) Keying of the cylinders shall be provided by the Owner. All cylinders and cores shall be provided and installed by the Contractor. Keyway and cylinder type for new and existing buildings shall be verified with Building & Landscape Services. Ten (10) keys for each cylinder shall be provided.

(1) All lock cylinders used in ITS Telecommunication rooms and doors receiving access control hardware are to accept Schlage small format interchangeable cores. Cylinder housings, with temporary construction cores, are to be provided and installed by the Contractor. Keying and installation of permanent cores are to be provided and installed by Facilities Management. Permanent cores shall be provided by the Contractor.

(2) All lock cylinders utilized as a key override on access control doors shall accept Schlage small format interchangeable cores. Cylinder housings with temporary construction cores are to be provided and installed by the Contractor. Keying and installation of permanent cores are to be provided by Facilities Management. Permanent cores shall be provided by the Contractor.

(3) All lock cylinders used in Facilities Management electrical, mechanical, elevator, and custodial rooms shall be Schlage B Series, restricted keyway, interchangeable core cylinders provided and installed by the Contractor. Keying and installation of Contractor provided permanent cores shall be by Facilities Management.

(4) Construction keying and cylinders shall be provided by the Contractor and two construction and control keys shall be provided to Facilities Management Key & Access Services.

q) Weather-strip to be Reese 769C with TEK screws and polyurethane rubber. A screw shall be installed one inch or less from the ends of the weather-strip.

r) Sweeps to be Reese 772C with TEK screws and polyurethane rubber. A screw shall be installed one inch or less from the ends of the sweep.

s) Gasketing to be Reese 797; white or black to match color of frame.

t) Thresholds to be Reese S471A with thermal break. Furnish 4” longer than door opening and cope around frame face. Sill conditions to be verified.
IX. FINISHES

A. Gypsum Drywall Systems
   1. Use 5/8” Type X fire code drywall type construction and follow the USG gypsum board construction manual guidelines. Mold resistant drywall to be considered at all moist areas.
   2. Twenty gauge (0.0329”) minimum studs shall be used. Specify both gauge and thickness. Wood studs shall not be used.
   3. Four coats (Level IV) of drywall finishing material (one embed, two fill, and one finish) shall be used in exposed applications. Finish coat and sanding may be omitted in concealed applications.
   4. Demountable panel systems should not be used without PM approval.
   5. Textured finishes shall not be used on drywall ceilings.

B. Acoustical Ceilings
   1. Consideration should be given to the use of ceiling tiles with non-sag warranties in high humidity or unconditioned spaces.
   2. Ceiling grid shall be an intermediate duty exposed grid system conforming to ASTM C635 (1” wide grid). Chicago Metallic 200 Snap Grid should be listed in the acceptable products.
      a) Suspend the ceiling grid directly from the building structure. Do not hang other objects from the ceiling support system. All light fixtures shall be supported independently of the ceiling support system.
   3. Specify ceiling tiles around Armstrong Minaboard fissured tile in 2’x 4’ and/or 2’x2’ size, or equal. Appearance shall be listed as criteria requirement for equal products to allow for coordination with maintenance stock.
   4. Specialty ceiling tiles/systems require PM approval.

C. Paint Finishes
   1. Paint shall be manufacturer’s premium product. Specify the most sustainable paints and coatings available for the particular application.
   2. Wall finish shall be two coats plus primer of latex eggshell or satin paint. Flat paint shall not be used. In public areas, consider semi-gloss paint on veneer plaster or concrete masonry units.
   3. Ceiling finish shall be two coats plus primer of latex flat paint.
   4. Paint finish for door, window, and miscellaneous trim shall be two coats plus primer of latex or alkyd enamel semi-gloss paint.
   5. Stain finish for door, window, and miscellaneous wood trim shall be oil based stain with a urethane topcoat. A medium to high sheen/gloss should be used.
   6. Epoxy paints should be two-part systems.
D. Floor Finishes
1. All vinyl composition tile shall be a minimum of 1/8” thick.
2. Tile installed on slopes or inclines shall be slip resistant.
3. When using epoxy resin floors, apply per manufacturer’s recommendations. Color shall be integral to flooring material, not a surface coating.
4. Particular attention shall be given to specification of preparation of the subfloor.
5. Ceramic tile grout should be pigmented or natural gray. White or near white grout shall not be used. Joints should be sealed with a silicone based product.
6. When specifying vinyl sheet goods, only premium products should be specified with particular attention to given surface preparation and seaming.
7. Ceramic tile base/cove shall be curved rather than a 90 degree angle.

E. Carpet and Base
1. Carpet Fiber: Specify nylon type 6 or 6.6.
2. Carpet Construction: Tufted loop pile.
3. Carpet Color: Multi-color yarn system.
5. Carpet broadloom face weight: minimum 22 ounces.
6. Carpet seaming diagram submittal approval is required prior to ordering material.
7. Resilient base: 1/8” thick vinyl or rubber.
8. Joints: Occur at inside corners where possible and no closer than 24” to an external corner.
9. Base: Rolled base is preferred to 4-foot long sections.
10. Wood Base: Hardwood species only.

F. Wall Finishes
1. All wall covering will be commercial grade. Vinyl wall covering will be Type II. Criteria for selection shall be based on ease of cleaning and serviceability.

X. SPECIALTIES
A. Visual Display & Bulletin Boards
1. Bulletin boards in public areas shall be enclosed.

B. Toilet Partitions
1. Overhead braces shall have anti-grip design. Wall Hung Urinal Screens shall have integral wall mounting flange or continuous wall mounting bracket specified as a “Government Screen”; mounted to solid blocking in the wall.
2. All ceiling supported partitions should have a flip-over latch for closure.
3. All stalls to have Trimco 3071-1x32D hook with through bolts and security Torx head screws.
C. **Interior Signage**
   1. See Section III and Appendices for details.

D. **Toilet & Bath Accessories**
   1. Owner to provide one triple roll Renown toilet tissue dispenser per water closet to be mounted on the left wall of partition (when sitting on the water closet.)
   2. The Owner will furnish Renown foam soap dispensers. Each lavatory shall have one soap dispenser mounted on the wall above the lavatory. Provide enough space between the lavatory and the dispenser to accommodate the opening and filling of the dispenser.
   3. Provide one Airblade electric hand dryer manufactured by Dyson per two lavatories and a minimum of two dryers for three or more lavatories. When one unit is provided the installation height shall be 38” from the floor to the top of the machine. When two units are provided, one shall be installed at 34” and one at 41” from the floor to the top of the machine.
   4. Paper towel dispensers shall NOT be installed without prior approval from FM Building & Landscape Services. Where one electric hand dryer is not practical, Owner will provide rolled paper towel dispensers.
   5. Install electric hand air dryers or paper towel dispensers in a location that will eliminate water dripping on the floor when walking from the lavatory to the dryer or dispenser.
   6. Lavatories shall be installed in countertops and not as separate wall-hung fixtures.
   7. Mirrors, full width of the counter but without a shelf, are preferred.
   8. Provide one double hook on the back wall and/or inside of door to each stall.
   9. A narrow shelf should be located near the entrance of restroom. Coat hooks should be included either below or near the shelf.
   10. Do not use ceramic toilet accessories.
   11. Dual unit sanitary napkin/tampon machines with quarter mechanisms manufactured by Hospeco are preferred. Do not provide recessed units.
   12. Each water closet stall in women’s restrooms shall have a disposal container for sanitary napkins and tampons.
   13. One sharps container shall be installed in each restroom. Manufacturer and model shall be Bemis 3 quart translucent beige #125 020 (no substitute) with wall safe bracket and key. Containers shall be placed in an area unobstructed by obstacles, located within arm’s reach, and installed at a 4’-0” height to the container inlet opening.

E. **Vending Spaces**
   1. Vending Machines Available for Use on Campus by Coca-Cola (UI approved beverage):
      a) Royal 660
         (1) All can machines, non-glass front bottle machine
         (2) Dimensions: 72” H X 37” W X 34” D
         (3) Power: 115 Volts, 12 Amps
      b) Royal 804
         (1) Taller version of Royal 660
(2) Dimensions: 80” H X 37” W X 34” D
(3) Power: 115 Volts, 12 Amps

c) RVV500
(1) Smaller glass fronts, may hold cans or bottles
(2) Dimensions: 72” H X 37” W X 35.5” D
(3) Power: 115 Volts, 12 Amps

d) D5000
(1) Large glass-fronts
(2) Dimensions: 72” H X 52” W X 35” D
(3) Power: 115 Volts, 12 Amps

e) Vendo Vue
(1) Mid-size glass-fronts
(2) Dimensions: 72” H X 41.5” W X 35” D
(3) Power: 115 Volts, 10 Amps

2. All vending machines require extra space to allow for opening/closing of the door, depending on what is adjacent to the machines (i.e. wall, other machines).

3. Machine placement is not only dependent on size, but also on sales volume and availability.

F. Lactation Room Standards

1. Minimum room size is 6’-0” x 9’-0”.

2. May need more than one room per building; depending on the number of building occupants and visitors.

3. It is preferable that the room be accessed directly from the women’s restroom.

4. Sound insulation shall be used walls.

5. Door shall be keyed with storage room function lockset or locking but no key needed.

6. Hard flooring such as ceramic tile or vinyl.

7. Painted walls.

8. Recessed lighting the full length of the counter wall; 30 to 50 foot candles.

9. Lactation room must be ADA compliant.

10. Counter to be 6’ wide x 2’ deep (no lower storage) with a small sink and gooseneck faucet located at one end of the counter.

11. One electrical outlet shall be installed for the pump to plug into. Locate outlet on the side wall of the counter area on opposite end of the counter from the sink.

12. Soap dispenser and paper towel dispenser mounted on the wall next to sink.

13. 4’ high x 6’ wide mirror mounted above the counter.

14. Three prong coat hook installed on wall.

15. Bulletin board: 3’ high x 4’ wide, to be used for posting room schedule, pump directions, posters, photos and the list of lactation rooms on campus. Mount bulletin board on wall so that it can be seen from the seated position.

16. Upholstered non-caster chair with arms.

17. Clock; located on the wall above the mirror.
G. Projection Screens
   1. This section under development - Discuss with PM.

H. Fume Hoods
   1. This section under development - Discuss with PM.

XI. FURNISHINGS

A. Window Treatments
   1. Window treatment should match building standard. Roller shades are preferred. MechoShade Systems shall be used as the standard of quality.
   2. Shade opacity to be reviewed with PM.

B. Auditorium Seating
   1. Whenever fixed seating is installed, attach seat to riser, NOT to floor.
   2. Discuss all auditorium seating with PM.

C. Entry Mats
   1. Roll-up (removable), recessed floor mats will be installed. Use linked tread 3M Nomad type floor mats only in locations where there are no high weight deliveries. Size and exact location of mats should be of sufficient size to handle foot traffic (minimum 12 feet in length), but not to exceed manufacturer’s maximum size recommended for removal and cleaning. Mat well shall not have drains. End trap matting is preferred. Avoid the use of link matting.

XII. CONVEYING SYSTEMS

A. Elevators:
   ASME/ANSI A17.1, Safety Code for Elevators and Escalators. (The version of this code currently adopted by the state of Iowa shall be used.)
   1. The elevator control equipment shall be non-proprietary. Any elevator company shall be allowed to purchase and install this control equipment. All elevator control systems will be such that any elevator repair company is able to troubleshoot, repair, maintain and adjust the control system without the use of proprietary software or proprietary tools.
   2. Telephone Cabinet: A telephone compartment shall be furnished in the car-operating panel to adequately house a Ramtel hands-free style telephone model #R733M. Necessary, shielded wires for the telephone shall be included in the compartment and connected to the car traveling cable. The telephone will be provided by University of Iowa Information Technology Services.
   3. All fixtures will be vandal resistant.
   4. The elevator will have an infrared door reopening device, not a retractable safety edge.
5. All new elevator cars will be provided with wall protection pads and installation hooks for these pads.
6. The elevator car lighting will be fluorescent with electronic ballasts and T-8 lamps.
7. In new building construction, elevator access to basement mechanical spaces and penthouse mechanical spaces will be provided.
8. A 120 volt, 20 amp GFI receptacle will be provided in the elevator car.
9. In new building construction, one elevator will be provided with an inside car dimension of at least 96” x 70” and a door opening width of 48”.
10. Finishes:
   a) Freight elevators: Floor finishes will be textured aluminum or textured steel. Wall finishes will be steel.
   b) Passenger elevators: Floor finish should be entry-mat quality carpet tile. Product should not contain animal hair. Hard surface options include terrazzo and VCT. Rolled goods are not acceptable.
11. All spare parts, manuals, adjusting information, drawings, safety upgrades and software upgrades will be provided to the Owner.
12. The elevator manufacturer will provide to the Owner the following for the maintenance and adjustment of the elevator:
   a) Electronic tools
   b) Electronic copy of all software programs
   c) Adjuster’s Report
13. Product Data: Provide the following information:
   a) Signal and operating fixtures, operating panels and indicators.
   b) Electrical characteristics and connection requirements.
   c) Expected heat dissipation of elevator equipment in machine room
14. Shop Drawings: Include the following on layout drawings:
   a) Buffers and other components in hoistway.
   b) Maximum rail bracket spacing.
   c) Maximum loads imposed on guide rails requiring load transfer to building structure.
   d) Loads on hoisting beams.
   e) Clearances and travel of car.
   f) Clear inside hoistway and pit dimensions.
   g) Location and sizes of access doors, hoistway entrances and frames.
   h) Rail attachment.
   i) Cab design, dimensions and layout.
   j) Hoistway-door and frame details.
15. Operations and Maintenance Manuals: Include all wiring diagrams, adjusting information and fault code information.
16. Elevators shall be installed by the manufacturer or a qualified installer licensed in the state of Iowa.
17. Maintenance and repair service consisting of monthly examinations, adjustments, repairs and lubrication of the elevator equipment shall be provided by the Elevator Contractor for a period of twelve (12) months after the elevator has been turned over for the Owner’s use. This service shall not be subcontracted but shall be performed by the Elevator Contractor. All work shall be performed by competent employees and shall include emergency 24-hour callback service. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the Elevator Contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

a) Emergency Call Back-Response Time: Maximum response time for emergency call-backs shall be limited to fifteen (15) minutes by telephone and sixty minutes (60) or less to arrive on site. Overtime emergency call-back will be limited to thirty (30) minutes by telephone and ninety (90) minutes or less to arrive on site. These call-backs are defined as labor required to free trapped passengers from elevators and/or to make repairs and adjustments to return an elevator to service.

b) Elevator Contractor shall maintain Owner’s complete set of straight line wiring diagrams in good condition. Drawings shall be consistently modified with as-built conditions and reflect any changes or modifications to circuits resulting from control modifications, parts replacement or equipment upgrades made by the Contractor during the term of this contract.

c) Removal of elevators from service by Elevator Contractor shall be coordinated with and approved by the Owner or Owner’s Representative. Owner agrees to permit Elevator Contractor to remove elevators from service for a reasonable time to perform routine preventative maintenance.

d) Owner will not be billed for travel time or mileage expenses for a regular time callback or overtime callback.

18. Prior to the acceptance inspection by the State Elevator Inspector, the Elevator Contractor shall make a preliminary check of each elevator operation (including fire service) with the Owner or Owner’s Representative present. The Elevator Contractor shall determine that control systems and operating devices are functioning properly.

19. Construction use: See Supplementary Conditions – Article 00 73 13 at the following website: www.facilities.uiowa.edu/dcs/elevators.

20. Acceptable manufacturers will have been in operation for a minimum of five (5) years and will be capable of complying with the response time requirements during any warranty and free service period.

21. Electric Traction Elevators

a) Where necessary, machine room, hoistway and lobby spaces must be environmentally conditioned to allow for proper operation of the elevator. Where possible, utilize the building HVAC system to provide this environmental conditioning.

22. Hydraulic Elevators
a) Where necessary, machine room, hoistway and lobby spaces must be environmentally conditioned to maintain acceptable hydraulic fluid temperatures and to allow for proper operation of the elevator. Where possible, utilize the building HVAC system to provide this environmental conditioning.

b) Spill containment will be provided to meet SPCC standards (40 CFR 112).

23. Wheelchair Lifts

a) Lifts shall comply with ADAAG and ASME A18.1 – latest version adopted by the State of Iowa and Addendum 2.10.1a Safety Standard for Platform Lifts and Stairway Chairlifts.

b) Lifts shall be installed such that all lift enclosure walls are securely attached to adjacent walls, structure, or supplemental structural supports as required for stability and proper operation of the unit.

c) The lift platform should be fully enclosed whenever possible. The minimum platform size is 36” x 54”.

d) Lifts shall allow unassisted entry, operation, and exit. Operating controls shall be large push-button or paddle controls.

e) The preferred drive type is recirculating ball screw. The minimum weight capacity is 750 lbs.

XV. MECHANICAL SYSTEMS

A. Piping

1. All piping systems shall be labeled, color coded with the type of service, (for refrigerant piping, indicate the type) and the direction of flow. Lettering shall be placed at intervals of approximately 20’ on straight runs of piping including risers and drops, adjacent to each valve and fitting, and at each side of penetrations of structure or enclosure. Lettering shall be visible from the floor. For pipes 3/4” and smaller, permanent phenolic tags shall be used. Insulated piping shall be labeled as “non-asbestos.” Schedule for banding and labeling of pipe and conduit shall conform to ANSI A13.1.

2. All valves shall be tagged with an engraved brass or plastic tag describing type of service and area controlled by the valve. Provide valve list for all valves located in the mechanical rooms.

3. Provide shut-off valves at all pipe branches and where required to facilitate partial system isolation.

4. All equipment, fixtures, or other appliances attached to any piping system shall have a shut off valve located at the connection to the piping system.

5. All valves shall be located with sufficient room for maintenance or replacement.

6. Manual type air vents shall be installed in water systems at high points in the system.

7. Mechanical joint piping systems (Victaulic) may be used for fire protection systems, in exposed areas, and in other approved locations for chilled water, condenser water, and dual temperature/heating water with gaskets rated to +250 deg F / +120 deg C.

8. Armaflex type insulation shall not be used on dual temperature piping.
9. All underground piping shall have a minimum earth cover of 5’-6” to the top of the pipe.
10. All underground piping systems shall have a #12 AWG copper wire attached to the pipe for a tracing wire. Wire shall be labeled and terminated in an accessible location. No splices in wire allowed.
11. All underground piping systems shall have a non metallic warning tape, with appropriate wording, buried 24” above the top of the pipe.
12. All insulated exterior, exposed piping shall have an aluminum jacket installed to protect the insulation. Jacket shall be weather-resistant, water-proof, smooth surfaced aluminum with a minimum thickness of 0.016”.
13. All insulated interior piping, that is exposed in occupied areas, and is within 6’ of the finished floor, shall have a PVC jacket installed. This jacket shall be painted to match surrounding background.
14. All insulated interior piping that is exposed in mechanical rooms, and is within 6’ of the finished floor, shall have an aluminum jacket installed.
15. Hanger design, application, and installation shall comply to MSS SP-58 and SP-69.
16. Piping systems, unless specified below, shall be tested at a minimum of one and one-half times the expected working pressure, or a minimum of 100 psig and a maximum of the design pressure of the pipe and fittings. Test all systems for a minimum of four hours. When test pressure exceeds 125 psig, test pressure shall not exceed a value which produces a hoop stress in the piping greater than 50% of the specified minimum yield strength of the pipe.
   a) Natural gas: test at twice the working pressure or a minimum of three psig.
   b) Sanitary sewer: test at 10’ of head pressure for no less than four hours.
   c) Sprinkler piping shall be hydrostatically tested for a period of 2 hours at 200 psi, or 50 psi above the maximum system pressure, whichever is greater.
17. Water piping systems shall be cleaned according to AWWA M23.
18. All solder shall be lead free.

B. Piping Penetrations
1. All penetrations of foundation walls shall be leak proofed. Link-Seals are required. Penetrations of foundation walls should be detailed on drawings.
2. All penetrations, except steam tunnels, shall be individual pipes or conduits. Groups of pipes or conduits in a common penetration shall not be allowed.
3. Minimum strength of pipe penetrating foundation walls shall be equal to Schedule 40.
4. All penetrations, except steam, steam condensate, or other high temperature piping, shall be waterproofed in the following manner:
   a) For new construction, the foundation wall shall have a steel sleeve installed that is 2” larger in diameter than the conduit to be installed. For existing construction, the hole shall be core drilled. In multiple duct situations, sufficient space shall remain between the penetrations to maintain the structural integrity of the foundation wall.
b) A rubber seal, equal to Link-Seal, shall be installed in the space between the conduit and the sleeve or drilled hole, near the interior surface of the foundation wall. The same space shall have waterproofing installed on the exterior side of the rubber seal.

5. The point of attachment for steam tunnels shall have a concrete, cast-in-place transition, with water-stopping material cast into the concrete. The water-stopping shall be embedded into the foundation wall according to the manufacturer’s recommendations. Water-stopping material shall be equal to Volclay RX-102.

6. Individual penetrations of steam and condensate lines shall be installed as follows: The foundation penetration shall be an anchor point and shall be reviewed by a structural engineer. The penetration shall be sleeved with a steel sleeve at least 6 inches beyond the penetration. A flange shall be welded to the sleeve and to the pipe on the interior side of the foundation wall with a continuous, waterproof weld. The exterior side of the penetration shall have waterproofing material applied.

C. Building Plumbing Systems

1. Thermometers and gauges
   a) All thermometers and gauges shall have dial faces between 2” and 5” in diameter. All thermometers installed more than 8’ from floor level shall have a minimum dial face of 4” and shall be installed to allow reading from floor level.
   b) All thermometers shall be of the dry well type. All thermometers shall be installed with thermal conductive material in the dry wells.
   c) All thermometers and gauges shall be selected with expected operating conditions near the middle of the range of the device.
   d) Thermometers and pressure gauges shall be accurate to 1% of full scale.
   e) All gauges shall be installed with gauge cocks.

2. Domestic Water Systems
   a) Materials
      (1) No PVC piping shall be used for domestic water systems.
      (2) All pipe and fittings shall be copper, Type L, hard or soft drawn for solder joint connections, ASTM B88. All solder shall be lead-free.
      (3) Unions 2-1/2” and larger shall have flange joints.
   b) Valves
      (1) Gate valves, 4” to 12”, shall be flanged, cast iron, 125 lb., solid wedge, bolted bonnet, OS&Y, Nibco F617-0 or equal. Gate valves 4” and smaller shall not be used. No gate valves shall be used in the building.
      (2) Check valves 2” and smaller shall be soldered, bronze, 125 lb., horizontal swing, Nibco S-413 or equal. Check valves 2-1/2” to 8” shall be flanged, cast iron, 125 lb., bolted bonnet, horizontal swing, Nibco F-918 or equal.
      (3) Ball valves, 3” and smaller, shall be soldered, bronze 125 lb., full port, Nibco S-580 or equal.
(4) Butterfly valves, 6” and larger, shall be gear operated.
(5) Globe valves shall be 2” and smaller.
(6) Strainers, 2” and smaller, shall be threaded, bronze, 250 lb., 20 mesh stainless steel screen, Watts Model 777 or equal. Strainers 2-1/2” to 12” shall be flanged, cast iron, 125 lb., .045” perforated stainless steel screen, Hoffman Model 450 or equal.
(7) Low point drain valves shall be equipped with a hose adaptor fitting.

c) Water softeners
   (1) Specifications for water softening equipment should be based on Water Rite.

d) Backflow preventers
   (1) All backflow preventers shall be reduced pressure principle devices approved by Iowa Department of Natural Resources.
   (2) All backflow preventers shall be Watts.

3. Sanitary Waste and Vent
   a) Pipe and fittings may be cast iron, DWV copper, or DWV Schedule 40 PVC. Copper and PVC may be used above grade only. Cast iron may be hubbed below graded, no hubbed above grade. All piping systems shall be designed for the intended use.
   b) Floor drains
      (1) All floor drains in mechanical rooms and janitor closets shall have a minimum pipe size of 3”, a minimum strainer size of 6½”, and have a removable strainer.

4. Storm Sewer Systems
   a) Pipe and fittings may be cast iron, or DWV schedule 40 PVC. Piping below building floor slabs to 5’ outside the building wall shall be hubbed cast iron.
   b) Provide cast iron cleanouts at grade with a concrete pad.
   c) Foam core or cell core PVC not permitted.

5. Special Systems
   a) Acid waste
      (1) Pipe and fittings may be either glass or CPVC. All materials must be rated and approved for acid waste use.
   b) Distilled and deionized water
      (1) Pipe and fittings shall be Schedule 80 PVC or other plastic piping systems designed specifically for this type of service.
   c) Natural gas
      (1) Pipe and fittings shall be carbon steel, A53 Gr. B or A106 Gr. B, Schedule 40.
      (2) Valves 1” and smaller shall be ball valves, rated for the type of service.
   d) Compressed air and vacuum
      (1) Pipe and fittings shall be Type L.

6. Fixtures
a) All fixtures and related equipment shall be of commercial grade or better.
b) Plumbing fixtures
   (1) All fixtures (sinks, urinals, water closets, etc.) shall be white in color.
   (2) All fixture hardware (faucets, flush valves, etc) shall be chrome color.
   (3) Pop-up drain stoppers shall not be specified for sinks. Strainers only shall be installed (exception: residence halls)
   (4) All water closets shall have check hinges.
   (5) On applications having automatic faucets, infrared proximity sensor type shall be used.
   (6) Water closets shall be wall hung with a 500 lb. minimum load floor mounted heavy-duty rated carrier and shall have an automatic flush valve.
   (7) Lavatory faucets shall be hands free automatic manufactured by Technical Concepts TC (or approved equal) with surround sensor technology.
   (8) Spring return valves on faucets shall not be used.
   (9) All urinal flush valves shall be automatic and side-mount type. Battery operation is preferred. Flush valves shall have a manual override function. Sloan, Zurn or Delaney are acceptable manufacturers.
   (10) All showers shall have anti-scald mixing valves.

D. Fire Protection Systems
   1. All materials and installations shall comply with NFPA, UL and FM.
   2. Minimum FM Global approved Schedule 40 steel sprinkler pipe shall be used for all water-based fire protection piping. Other piping as listed below:
      a) Wet systems – Use schedule 40 black iron piping
      b) Dry systems/Preaction systems – Use schedule 40 galvanized sprinkler piping
      c) MRI/Magnet affected areas – Use copper piping with metal fusible link heads
      d) Piping before backflow preventer – Use cement lined ductile
   3. No flexible sprinkler piping or heads shall be allowed.
   4. If mechanical joint systems are used, fittings shall be equal to Victaulic 005 Firelock Rigid rolled grooved fittings. Mechanical joint systems are to be rolled grooved and shall not be cut grooved. No plain-end fittings shall be used.

E. Refrigerant Cooling Systems
   1. Material
      a) All piping and fittings shall be copper except in an evaporative condenser, where steel piping is acceptable. Use Long radius fittings.
      b) All solder shall be 15% silver solder except on connections to expansion valves, sight glasses, and driers where Starbrite solder is acceptable.
c) For units above 5 tons, use 1” fiberglass insulation. For smaller units, use 1/2” closed cell foam insulation, minimum. All insulation on exterior piping will be protected by an aluminum jacket.

2. Equipment
   a) Compressors
      (1) All compressors shall be supplied with a five (5) year warranty.
      (2) Multiple units are preferred over larger single units.
      (3) All compressors shall be single speed.
      (4) All three (3) phase units shall have adjustable voltage monitors for each phase, with manual reset.
      (5) Provide recycle timers and crankcase heaters with all compressors.
      (6) Provide high and low pressure switches.
   b) All solenoid valves shall have a manual lift stem.
   c) Provide driers on all liquid lines with isolation valves on each side of the drier.
   d) Condensing units, if designed to operate at less than 55ºF, shall be provided with hot gas bypass and with condenser fan cycle control operated from the head pressure.
   e) All coils shall have copper tubes and aluminum fins.

F. Water Cooling Systems

1. Chilled Water Distribution Systems
   a) Disinfection is not required.
   b) Ductile iron piping shall be class 53 restrained joint piping for all sizes.
   c) Pipe shall be cement lined.
      (1) All changes in direction shall be made with 45°, 22-1/2°, or 11-1/4° bends. 90° elbows shall be used only with Owner’s approval.
   d) Acceptable Manufacturers: Griffin - Snap Lok, U.S. Pipe – TR Flex, Clow - Super Locke, or American Pipe-Flex Ring.
   e) All water pipe shall be encased polyethylene sheathing; minimum thickness shall be 8 mils.
   f) All field cut joints shall be mechanical joint with Megalug series 1100 restraint. Manufacturer’s field kit shall not be used.
   g) Valves 14” and smaller shall be Clow F-6100 resilient wedge gate valve or approved equal.
   h) Valves 16” and larger shall be gear-operated butterfly valves.
   i) Valve boxes shall be East Jordan model number 8550, or approved equal. Valve box lids shall be East Jordan with the appropriate wording for the system. Wording shall be “University of Iowa, with either Chilled Water Supply, or Chilled Water Return”.
   j) All pipes shall be laid in a sand bed and shall have at least a 12” sand envelope.
   k) Hydro test: Requirements for hydro testing:
      (1) Hydro test all piping.
(2) Where possible, hydro tests shall be made against capped ends. Test pressure shall be 1.5 times working pressure, and a minimum of 150#.

(3) FM-Utilities & Energy Management, Mechanical Distribution shall witness all hydro tests.

(4) Test shall be for 4 hours.

(5) Test may only lose 5 psig.

(6) In some cases hydro testing may be required to exceed 150# to 225 psig. When this requirement is included, piping shall be capped and testing shall not be against a new or existing valves, unless the valve has a 250# rating.

l) Gauges may be required to be University of Iowa, U&EM Mechanical Distribution provided.

m) All wall penetrations shall be sealed with Link-seals.

n) All piping shall be anchored to the wall, at wall penetrations.

o) Operation of all valves, both new and existing, shall be by the University.

p) Video taping may be required on some projects to check cleanliness of the interior of chilled water piping.

q) All building service piping shall have a strainer and chilled water meter installed at the point of entry into the building. PM shall supply specifications for the water meter.

2. Interior Chilled Water Systems

a) Piping

(1) PVC shall not be used for chilled water systems.

(2) Welded steel systems shall use black steel piping and fittings, ASTM A53, Schedule 40. Minimum pipe size shall be 3/4”.

(3) Copper systems shall use a minimum of Type L copper.

(4) Any threaded black steel pipe shall be schedule 80.

b) Valves

(1) Control valves, for pipe sizes 3” and smaller, shall be globe valves. For pipe sizes larger than 3”, control valves shall be butterfly valves.

(2) Isolation valves, for pipe sizes 2” and smaller, shall be ball valves. For pipe sizes larger than 2”, isolation valves shall be butterfly valves.

(3) Balancing valves 2-1/2” and smaller shall be plug valves. For pipe sizes larger than 2-1/2”, butterfly valves shall be used.

(4) Butterfly valves shall be resilient seated with bronze or stainless steel discs and shall be bubble-tight. All butterfly valves shall be lug-type and gear operated.

c) Victaulic Couplings and Valves

(1) Victaulic Standard Mechanical Couplings, 2 inch (DN50) through 12 inch (DN300): Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-
responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated, heat treated carbon steel track head.

(a) **Rigid Type:** Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.

(b) **Flexible Type:** Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source.

(c) **Flange Adapters:** For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125 / 150 flanges. Victaulic Style 741. For direct connection to ANSI Class 300 flanges, use Victaulic Style 743.

(d) **Butterfly Valves:** 2” (DN50) through 12” (DN300) Sizes: 300 psi CWP (2065 kPa) suitable for bidirectional and dead-end service at full rated pressure.

d) **Insulation**

(1) All insulation shall be fiberglass, flexible unicellular foam, or cellular glass.

e) **Stand alone chilled water systems** shall have a fill and make-up connection installed. A backflow preventer shall be installed at each location. The connection shall be sized to allow the filling of the system in approximately four hours.

f) Stand alone chilled water systems shall have an air separator installed.

3. **Condenser Water Systems**

a) **Material**

(1) Schedule 80 PVC or high temperature (180°F). Fiberglass piping shall be used. Steel fittings or stainless steel (Schedule 10) fittings shall be used at absorption chillers and pumps.

4. **Equipment**

a) **Cooling Towers**

(1) If year around operation is desired, a dry-basin type tower is preferred over sump heaters.

(2) Gravity flow distribution systems are preferred.

(3) All hot water basins shall have easily removable covers.

(4) A five-year warranty shall be provided with each cooling tower.

(5) All cooling towers must have CTI certified performance.

(6) All fans shall be gear/shaft driven with the motor located outside the air stream. No belt driven fans shall be allowed. Designer shall evaluate the use of 2-speed or variable speed fans. All variable frequency drives shall
be installed with a three (3) contactor bypass. Provide visual status indication.

(7) All cooling towers shall have extended lubrication lines.
(8) All cooling towers shall have vortex breakers installed on cold water sumps.
(9) Roof mounted cooling towers that are elevated above the surrounding grade shall have deck installed around the perimeter of the tower.
(10) Provisions shall be made for complete tower drain down, ladders and walkways shall be installed to allow access to tower fans, motors, gear boxes, etc.
(11) Aesthetic qualities of any tower being located in public view shall be evaluated. In most cases, screens shall be required around cooling towers.
(12) Galvanized towers nor galvanized metal within the tower shall be allowed.
(13) Support systems shall be coated steel.
(14) Designer shall consider efficiency losses over time when sizing the cooling tower for a chiller.

b) Chillers
(1) A hand-off-auto switch shall be provided to allow local control or Energy Management Control System (EMCS) control. All control panels shall be provided with interface capabilities for connection to the EMCS for demand control and chilled water reset. Chiller controls shall be digital type controls. For systems larger than 100 tons, controls shall be integrated with the building EMCS.
(2) Provide temperature sensors to be connected to the BAS to measure entering and leaving chilled and condensing water temperatures.
(3) Provide hour meters on electric chillers.
(4) University shall provide specifications for flow meters required for chilled water and condenser water.
(5) Consideration shall be given to sound attenuation when designing the location and installation of a chiller.
(6) Condensate coolers shall be used on absorption chillers.
(7) All connections to chillers shall be flanged.
(8) All cold sections and lines shall be insulated.

c) Pumps
(1) All pumps shall have mechanical seals. Pumps 7 1/2 horsepower and greater shall have mechanical split seals. A standard of quality for mechanical split seals is Chesterton.
(2) All condensing water systems shall have stainless steel strainers installed.

d) Expansion tanks
(1) All expansion tanks shall be located on the suction side of pumps and shall be diaphragm type.

e) Controls
   (1) All equipment shall have a hand/off/auto switch installed to allow manual override of the normal controls.
   (2) Chiller controls shall be digital and shall include the capability to interface with the EMCS for chilled water reset, demand limiting, and remote start/stop.

G. Steam & Hot Water HVAC System

Distribution (Steam)

1. Pressure Reducing Valves
   a) Pressure reducing valves (PRV’s) shall be eccentric plug control valves sized and installed to manufacturer’s specifications. Manufacturer: Cashco Ranger. Consult with FM-Utilities & Energy Management, Mechanical Distribution, for product numbers and codes.
   b) Valve bodies shall be ductile iron. Cast iron is prohibited.
   c) Valves are to be air operated. Pilot operated valves may be allowed under special circumstances. Consult with FM-Utilities & Energy Management, Mechanical Distribution.
   d) PRV’s from the high pressure system shall always be fail-close. Valves on the low pressure system may be fail open, at the discretion of FM-Utilities & Energy Management, Mechanical Distribution, and they shall consult with the maintenance staff of the affected building.
   e) Valves shall provide Class 6 shutoff.
   f) Valves shall have flangeless bodies designed to fit between two raised face flanges. The bodies shall fit between ANSI 300# flanges.
   g) Gaskets shall be Flexatillac.
   h) Pressure reducing stations shall be piped as shown Appendices. The blow down valve shall be piped such that it does not blow on the PRV and can be safely operated while open. No caps or plugs are to be used on the blow down lines, except in building basements.
   i) Where the PRV is smaller than line size, the isolation valves shall be at least one standard pipe size larger than the control valve (up to line size) and 12” of pipe between reducer and flange.
   j) Reducers in PRV stations shall be eccentric, or concentric as needed, to avoid having points where condensate can build up. When eccentric reducers are used, they shall be flat on bottom.
   k) Trapping on pressure reducing stations shall be determined by good engineering design based on station configuration.

2. Steam Trapping Stations
a) Steam traps on mechanical distribution piping shall be only Armstrong #2011 Series. These are inverted bucket traps, with a modular universal body design to allow for easy replacement.
b) Steam traps are to be modular stainless steel inverted bucket traps. Traps shall have orifices appropriate to the pressure of the steam line.
c) Each trap shall have an upstream block valve, test valve, and strainer, a downstream swing check valve, a test valve, and a block valve, as shown in Appendices. There shall be no trap bypasses.
d) Traps shall be piped off of drip legs. Drip leg diameter shall be equal to the pipe size for pipes up to 4” and at least one-half the pipe diameter for pipes over 4”. Length of the drip legs should be 1-1/2 times the diameter of the pipe, with a minimum of 12”.
e) Drip legs shall be equipped with blow down valves on the bottom of the drip leg equal to the smaller of line size or 2”. Blow down valves shall be piped from the bottom of the drip leg cap wherever possible.
f) Blow down piping on drip legs and strainers shall face away from the blow down valve hand wheel and shall not discharge onto electrical equipment.

3. Check Valves
   a) All check valves shall have both bronze or stainless steel seats, and flappers.
   b) Bodies shall be bronze, cast steel or forged steel. Cast iron bodies are not acceptable.
   c) All valves on steam shall be 300# class.

4. Strainers
   a) All strainers shall have bronze, cast steel or forged steel bodies. Cast iron is not acceptable.
   b) Strainers shall have 1/32” screens.
   c) The blow down port of each strainer shall have a pipe nipple with a full port sized gate valve with no cap.
   d) Any strainer on 155 psig steam system shall be 300# class. Any strainer on 20 psig steam system shall be 150# class.
   e) Manufacturers: Armstrong, Sarco, Hoffman, or approved equal.

5. Piping
   a) Piping material shall be chosen according to the following list:
      (1) Steam - All Locations:
          2” & Smaller Schedule 80 A106 Gr B seamless, threaded.
          2-1/2” & Larger Std. Wt A106 Gr B seamless, butt-weld.
      (2) Condensate in Tunnels and Tank rooms:
          2” & Smaller Schedule 80 A106 Gr B seamless, threaded
          2-1/2” & Larger, Schedule 10S A312 Type 304L stainless steel.
      (3) Condensate in Direct Bury Systems:
          2” & Smaller Schedule 40S A312 Type 304L stainless steel threaded or socket weld
2-1/2” & Larger Schedule 10S A312 Type 304L stainless steel.

(4) Depending on surface load and installation method, 2-1/2” and larger pipes may need thicker walls.

b) Piping shall be sloped 1/4” per 10’ of pipe to a drip leg. Pipe shall be sloped down in the direction of steam flow.

c) Trapping stations shall be located every 250 feet on all steam lines, and at elevation changes as needed. Direct bury systems shall require steam vaults to access trapping stations.

d) All piping 2-1/2” and larger shall be butt welded, with no backing ring. Welds shall be visually inspected.

e) All piping 2” and smaller shall be screwed piping. All flanges on screwed piping shall be back welded.

f) All piping 4” and larger on the low pressure or condensate systems, and all piping over 2” on the high pressure system, shall be analyzed with an appropriate stress analysis program by a qualified engineer to properly size and design hangers and anchors to avoid excessive stress in any pipe sections.

g) All piping shall be hydrostatically tested to a minimum of 150# pressure. Test pressure shall be held for 4 hours. Where necessary to test, the piping shall be cut and capped.

h) Piping shall have high point vents to allow complete filling of pipe for the hydrostatic test. These vents shall be removed after hydro testing.

i) Provisions shall be made for a steam blow of new steam piping to clean out debris. Provisions are to be shown on design drawings. Steam blow plans are to be developed in consultation with a licensed engineer.

j) FM-Utilities & Energy Management, Mechanical Distribution shall furnish a steam muffler for the purpose of a steam blow to clean the new steam lines. The Contractor shall pick up the muffler at their storage area and transport to the job site. All connections to the muffler shall be the responsibility of the Contractor. At the completion of the steam blow the Contractor shall disconnect the temporary piping, and make all permanent connections, and return the muffler to the storage area. The steam blow shall be coordinated by FM-Utilities & Energy Management, Mechanical Distribution. Valve operation shall be by the owner and in contact with power plant at all times. FM-Utilities & Energy Management, Mechanical Distribution shall furnish square brass bars to check the cleanliness of the piping. Minimum of 2 blows shall be required. The Contractor and engineer may be required to be on site. The steam valve shall be opened to approximately ¾ open very slowly, and once the valve is open, the valve shall be left to blow for in most cases 15 minutes, at which time the valve shall be closed slowly. This procedure shall be completed as necessary, until the target is clean, and not indication of debris in piping.
k) Provisions for pipe expansion shall be made. Both high and low pressure systems shall be designed for 500° F. Expansion joints (see #18 later in this Section.)

6. Fittings
   a) All pipe fittings shall be as follows:
      (1) 2” & Smaller Threaded forged steel 2000# class.
      (2) 2-1/2” & Larger Standard weight steel butt weld fittings.
   b) Threaded systems shall use unions where appropriate. All unions shall be Nicholson Uniflex Steel/Stainless. Pipe unions shall have replaceable gaskets.
   c) All elbows shall be long radius.

7. Valves
   a) Large Valves (2-1/2” & Larger):
      (1) Manufacturers: Powell, Newco, Velan, Crane or equal.
      (2) 155 psig Steam: 300# class cast steel, butt weld. 20 psig Steam: 150# class cast steel, butt weld.
      (3) Hard faced seat rings.
      (4) All valves on a project shall be by the same manufacturer and the same model.
      (5) Direct-operated valves are preferred over gear-operated valves.
      (6) All valves shall be equipped with operating devices to allow the valves to be operated from the ground.
      (7) Valves may be butterfly, lug style, (300# on HPS, 150# on LPS) Carbon steel body, stainless steel disk, complete with gear operator and locking device and manual hand wheel.
   b) Small Valves (2” & Smaller):
      (1) Manufacturer: NIBCO.
      (2) 155 psig Steam: 300# class screwed bronze. 20 psig Steam: 300# class screwed bronze.
      (3) Rolled in stainless steel seat rings.
      (4) NIBCO Model T-174-SS only. No globe valves
      (5) All valves on a project shall be by the same manufacturer and the same model.

8. Expansion Joints
   a) Manufacturer: ATS. Piston type expansion joint with 12” traverse, for 300# steam at 500 degrees F, weld ends, with no anchor foot. Must be in full compliance with ASTM F 1007 specification. ATS Model TP2W-131-12-350H-BRZ-A.
   b) All expansion joints shall be piston type joints with steel bodies and chromium plated steel slips.
   c) Joints shall have internal and external guides, integral with joint gland and body. Joints shall be equipped with limit stop.
   d) Joints shall not have an anchor foot.
e) Joint shall allow the addition of new packing while joint is in service under full line pressure. The packing ram shall be steel, with no shutoff valve.

f) Joints shall have butt weld ends.

g) Joint travel shall be based on 550° F operating temperature. Joints shall be pre-pressed to allow shrinkage down to 0° F.

h) Drain plugs shall be seal welded shut.

i) Joints shall be installed per manufacturer’s specifications.

9. Safety Valves:
   a) Sized to State of Iowa Codes and ASME Section VIII Unfired Pressure Vessel Code, with a minimum of 10 lb between set point and maximum pressure.
   b) Multiple shall valves may be used in lieu of a single larger valve.
   c) Small safety valves (2-1/2” outlet or smaller) shall be Kunkle Figure 6010 or equal.
   d) The use of PRVs in series instead of a relief valve will not be allowed.
   e) Large safety valves (3” outlet or larger) shall be Kunkle Figure 300 or equal.
   f) Each safety valve shall have an individual vent pipe to outside. Consult with FM-Utilities & Energy Management-Mechanical Distribution on vent routing.
   g) Safety valve generally not to be hard piped to vent line. All safety valves larger than 2” shall have cast drip plates (Kunkle Figure 299 or equal) at the base of the vent pipe, with drain holes piped to a suitable drain.

10. Condensate Pumps
    a) Pumps shall be electric duplex type.
    b) Manufacturers: Sterling, Johnson, ITT, Spirax, Sarco, Clark Reliance or equal. Pump shall be installed per manufacturer’s specifications.
    c) Condensate tanks shall be vented. All condensate pumps shall have two full size vents, one of which shall discharge into the equipment room or basement. Vent discharge location shall be coordinated with FM-Utilities & Energy Management-Mechanical Distribution.

11. Gauges
    a) McDaniel Gauges or equivalent stainless steel gauge.
    b) Face Style: 4” or larger.
    c) Range Selection: 20 psig system gauges shall be 0-30 (psig). Medium pressure (20-90 psig) gauges shall be 0-100 (psig). 155 psig system gauges shall be 0-200 (psig).
    d) Mounting: Standard bottom connection.

12. Vault Design
    a) All vaults shall be designed with enough room to do the work required.
    b) All vaults shall be provided with power and light. Power outlets for sump pump and 30 amp. plug.
    c) All vaults shall have positive ventilation controlled by a thermostat with On-Off-Auto option switch.
d) All vaults shall have either a drain to a storm sewer (preferred) and a permanently installed sump pump and discharge piping.
e) All vaults shall have spring-assisted access Bilco doors. Manhole covers are not acceptable. Doors shall be lockable with a key. In vaults, dead bolts are acceptable in areas where there is a potential for flooding, Pressray shall be used.
f) All vaults shall be cast-in-place concrete.
g) All vaults shall have a Q-door when not in drivable area.
h) All vaults shall have an H-20 J-door when in drivable area. No openings in roadways.
i) All vault doors shall be sized to allow largest equipment in and out.
j) All vaults shall have a painted or galvanized ladder.
k) Power: All vaults shall have at least one 30 amp. outlet and one switched light.
l) Drainage
   (1) All vaults shall have a gravity drain wherever possible.
   (2) All vaults shall have a sump hole at low point, ideally near the entrance. Sump hole shall be 24” in diameter and 24” deep.
m) Ventilation
   (1) Cold Hole (a hole in which no high temperature lines are present):
      (a) A cold hole shall have power and small airflow for humidity control with freeze stat.
   (2) Hot Hole (a hole in which high temperature lines are present):
      (a) A hot hole shall have large power flow with a freeze stat.

n) All vaults may require two separate openings or one opening and grate in Q-door.
o) All small openings in vaults shall be manholes with rings.
p) All wall piping penetrations shall be sealed with link seals.
q) All outside walls shall be waterproofed. Match existing building waterproofing.
r) All vault ceilings shall be waterproofed.
s) All vault supports for process piping and equipment shall be stainless steel.
t) All vault supports for maintainable items shall be galvanized or painted.
u) All vault surface drainage shall be routed away from all openings.
v) There shall be controls for ventilation of all vaults.
w) Power
   (1) All vaults shall have a single speed fan with thermostat control fan to have On-Off-Auto switch in vault.
x) All vault ventilation shall be either in vault or remote louvered penthouses.
y) All vault air ducts to louvered penthouses shall be ductile iron (push joint).
z) Consult with FM-Utilities- Mechanical Distribution for approval of all locking and security devices.
a) All portions of pipe stanchions within 12” of concrete shall be 304L stainless steel.
b) All anchors shall be insulated from floor to ceiling.
c) Any anchoring devices shall be stainless steel.

14. Medium and Low Pressure Steam (Above grade)
   a) Pressure Reducing Valves (PRV)
      (1) Cashco Ranger valves and shall be used as a standard of quality.
   b) Pipe and fittings
      (1) All piping shall be seamless black steel. For supply, piping shall be Schedule 40. For condensate, piping shall be Schedule 80.
      (2) Fittings 2” and smaller shall be threaded cast iron or malleable iron. Fittings 2 1/2” and larger shall be welded, with flanged connections to valves and equipment.
      (3) Valves 2” and smaller shall be 150 lb. rising stem gate valves with a union on one side. Valves 2 1/2” and larger shall be OS&Y gate valves. Globe valves shall be used only for throttling purposes. Globe valves shall be a minimum of 150 lb., and shall be rated for steam.
      (4) All traps shall be protected by a strainer upstream. Isolation valves shall be installed on each side of each trap with blowdown. No integral check valves shall be used.
   c) Strainers shall be Y-pattern, rated for steam, with stainless steel baskets. All strainers shall be installed with a blow down valve.
   d) Safety relief valves shall have piping equal to or larger than tappings of the valve. Discharge shall be piped to a safe point. The discharge shall be piped to exterior of the building. Do not connect vent lines from pressure powered pumps or condensate pumps to a relief vent pipe.
   e) Closed cell foam insulation shall not be used.
   f) All piping exposed in occupied areas, and is within 6’ of the finished floor, shall have an aluminum jacket installed. PVC shall not be used for this jacket.
   g) Heat exchangers shall be ASME approved and shall be installed with relief valves, rated for the service, on both steam and hot water systems. Locate heat exchangers to allow removal of the bundle. Install gauges and thermometers to indicate the following: pressure of entering steam, pressure and temperature of entering water, and pressure and temperature of leaving water. Install expansion tanks on the water side of all heat exchangers with a sight glass and provisions for draining and venting.
   h) All coils shall be tube-in-tube, non-freezing type with a minimum 1” O.D. tubing. Designer shall consider the use of integral face and bypass coils, especially in situations using steam to pre-heat outside air. Provide two steam traps with bypass for all pre-heat coils.
   i) No direct-steam humidification systems shall be used.
   j) Air vent/vacuum breakers shall be installed on steam equipment as required.
k) Pressure powered pump

(1) Pump shall be a pressure powered design, using 60 psig steam to pump low pressure steam condensate.

(2) Pump shall be constructed with a cast iron body, designed for maximum operating pressure of 125 psig at 450ºF. Pump shall include bronze or stainless steel check valves on the inlet and outlet, and connections for high pressure steam and vent. All connections shall be threaded or flanged. The pump shall contain a float operated snap acting mechanism to actuate fill and discharge cycles. All internal components shall be stainless steel.

(3) Pump shall be equipped with a gage glass with brass cocks and manufacturer furnished insulating jacket.

(a) Pressure powered pump/receiver: Provide a condensate receiver inlet reservoir of welded steel construction, mounted above the pump and sized in accordance with the manufacturer’s recommendations for the pump capacity. Condensate receiving tank shall have a drain installed.

15. Medium and Low Pressure (Below Grade)

a) Main Services - Walk Tunnels: Steam lines designated as a main campus steam service by FM-Utilities & Energy Management-Mechanical Distribution shall be installed in walk tunnels for reliability, maintainability and potential to be upgraded. The main service tunnels shall have room enough to transport any required replacement parts between the pipe supports, with clearance space for fingers, heads, and carrying of devices.

(1) Tunnel floors shall be positively sloped towards a drain and sumps with sump pumps and discharge piping installed.

(2) Tunnels shall be ventilated with supply fans controlled by a thermostat with an On/Off/Auto switch.

(3) Tunnel entrances shall be hinged, spring assisted Bilco doors. Tunnel entrances shall not be placed within roadways. Doors shall be key lockable. Dead bolt locks are not acceptable. No key shall be required to open door from inside the tunnel, and an exit lever shall be easily accessible.

(4) At tunnel locations where serviceable items are located, tunnel chambers shall be installed with surface access.

(5) Surface access shall allow hands-free upright entrance wherever possible.

(6) All tunnels shall have lights and outlets for the length of the tunnel on separate circuits. Lights shall be maximum of 30’ apart, with outlets/plugs at same location. Lights shall be on circuits that control every other light. Plugs shall be on a 30 amp. breaker.
(7) No plastic expansion anchors shall be used in the tunnel, including for conduit. PVC or plastic pipe or conduit is prohibited in tunnels or vaults.

(8) Emergency lighting is not required. All tunnel entrants are required to have flashlights.

(9) All tunnel entrances shall have aluminum OSHA notice signs stating “Entry into Utility Tunnels requires approval! Daytime 319-335-5156/319-335-6103; Nights/Weekends 319-335-5137 (page Mechanical Distribution on-call person)” mounted just inside the entrance. These signs shall be furnished by FM-Utilities & Energy Management-Mechanical Distribution.

b) Branch Services - Tunnels or Direct Buried. While no direct buried piping systems are “desirable” to FM-Utilities & Energy Management-Mechanical Distribution, it is recognized that in many cases it is not economically feasible to construct tunnels. Based on the service size, location and other conditions a decision must be made as to type of branch service will be designed. Design of steam and condensate system shall be 500 degrees F.

(1) Pre-Insulated Piping (direct bury): Pre-insulated piping consists of a steel carrier pipe, insulation, outer casing pipe with spray on insulation, and covered by filament wound fiberglass coating. The system is pre-designed by the manufacturer and fabricated off-site. It is assembled in the field like a jigsaw puzzle. Usually has a lead time of 4 to 6 weeks after receipt of order.

(a) Required System: Permapipe Multi-Therm 500.

(b) Acceptable Manufacturer: Permapipe.

(c) Steam and condensate shall be installed in separate casing pipes. Steam is schedule 40 seamless piping and condensate is schedule 10 stainless steel.

(d) Trapping vaults on the system shall be installed as needed. See Section “P” for vault details. Vaults are more than just locations for traps and expansion joints. They also allow places in the system for future tie-ins, valving, and allow adequate troubleshooting of the system.

(e) Provision for pipe expansion shall be made. Expansion joints (Section “H”) in a vault are the preferred method. If expansion loops must be used, consult, FM-Utilities & Energy Management-Mechanical Distribution.

(f) All wall penetrations shall be sealed with Thunderline Linkseals or approved equal.

(g) Casing pipe shall be air pressure tested and soaped at field joints.

(2) Dri-Therm Envelope: Dri-Therm is a fine, white mineral powder designed to enclose piping in a water-repellent insulating envelope. This
consists of a steel carrier pipe bedded and backfilled in 6”-10” of Dri-Therm. Dri-Therm shall assist the project engineer with design. This system is not tolerant of Contractor error. This system may also not be as watertight at wall penetrations.

(a) Steam and condensate pipe may be encased in same Dri-Therm envelope.
(b) The pipe system and supports must be designed by Dri-Therm.
(c) Trapping vaults on the system are to be no more than 250 feet apart. See Section “P” for vault details.
(d) Provision for pipe expansion shall be made. Expansion joints (Section “H”) in a vault are the preferred method.
(e) Full-time engineering supervision is required during installation, as faulty installation cannot be detected by any post-construction test methods.

(3) Insulation: Insulation shall be provided on all pipes, ducts and equipment where:
(a) Heat transmitted shall significantly affect the ambient temperature in spaces requiring temperature control.
(b) Heating and/or cooling ability shall be significantly affected due to heat flow into or out of the pipe or duct.
(c) Condensation shall occur as a result of the material surface temperature approaching the dew point of the ambient air.
(d) Significant energy loss would result from heat transfer justifying the cost of insulation.
(e) Personal injury may result.
(f) Insulation shall not be installed on steam traps and condensate return pumps.
(g) All exterior piping insulation systems shall be specified with a 0.019-inch stainless steel jacket or aluminum jacket.

16. Steam Tunnel Insulation
   a) All steam lines in tunnels shall have the following insulation:
      (1) 850 CertainTeed fiberglass insulation, 3-1/2” thick on high pressure steam; 2-1/2” thick on low pressure steam.
      (2) In addition to the fiberglass insulation with the vapor barrier jacket, the insulation shall be covered with fiberglass cloth and CP-11 vi-cryl mastic. Mastic shall be applied thick enough that cloth pattern shall not be visible.
      (3) Insulation shall be installed in two layers, using staggered joints and seams.
   b) All condensate lines in tunnels shall have the following insulation:
      (1) 1” of 850 CertainTeed fiberglass insulation.
(2) In addition to the fiberglass insulation with the vapor barrier jacket, the insulation shall be covered with fiberglass cloth and CP-11 vi-cryl mastic. Mastic shall be applied thick enough that cloth pattern shall not be visible.

c) At any point in the tunnel where there is an entrance to the tunnel, fan discharge onto the insulation, or grating openings, there shall be a 0.019 inch stainless steel jacket or aluminum jacket installed around all insulated pipes. All seams in the jackets shall be placed facing downward.

d) If the pipe is held in place with a spider guide that does not have sufficient clearance to allow at least 3/4” clearance between the insulation and the outer ring, the following procedures shall be used:

(1) The insulation shall neck down to a single layer approximately 6” before and after the guide.

(2) The top layer of insulation shall be beveled at a 45 degree angle to allow for a smooth transition to a single layer.

(3) The individual pieces of insulation that are placed between the legs of the spider guide shall extend past the spider legs so that they may be bound firmly into place with cloth and mastic wrapped around the pipe.

<table>
<thead>
<tr>
<th>Service</th>
<th>Size</th>
<th>Installation Method</th>
<th>Total Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Pressure steam</td>
<td>Over 20#</td>
<td>2” first layer, 1-1/2” second layer</td>
<td>3-1/2”</td>
</tr>
<tr>
<td>Low Pressure Steam</td>
<td>Under 20#</td>
<td>1-1/2” first layer, 1” second layer</td>
<td>2-1/2”</td>
</tr>
<tr>
<td>Condensate</td>
<td>All Sizes</td>
<td>Vapor Barrier</td>
<td>1”</td>
</tr>
<tr>
<td>Domestic Water</td>
<td>All Sizes</td>
<td>Vapor Barrier</td>
<td>1”</td>
</tr>
<tr>
<td>Hot Water Heating</td>
<td>Over 2”</td>
<td></td>
<td>2”</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>All Sizes</td>
<td>Vapor Barrier</td>
<td>2”</td>
</tr>
</tbody>
</table>

17. Steam Vault Insulation

a) All steam lines in vaults shall have the following insulation:

(1) non-asbestos containing calcium silicate insulation.

(2) In addition, there shall be two layers of insulation with staggered joints and seams.

(3) Jackets shall be 0.019 inch stainless steel or aluminum. All seams shall face downward.

b) All condensate lines in vaults shall have the following insulation:

(1) non-asbestos containing calcium silicate.

(2) Jackets shall be 0.019 inch stainless steel or aluminum. All seams shall face downward.
c) The non-asbestos containing insulation shall meet or exceed the standards of the following brands:
   (1) Johns Manville - Kaylo T-12
   (2) Pabco-Cal Temp
   (3) Manson-Cal-Max
   (4) Temperlite 1200
   (5) Owens-Corning Pink

18. Expansion Joint Insulation
   a) All expansion joints shall have removable/reusable insulation covers that cover the expansion joint from weld to weld. The expansion joint covers are required to meet or exceed the following:
      (1) The outer jacket shall be Steam guard 1-Teflon coated Nomex cloth 7 oz./sq. yard x 0.010” thick.
      (2) The gusset shall be Steam guard 1-Teflon coated Nomex cloth 7 oz./sq. yard x 0.010” thick.
      (3) The inter jacket shall be stainless steel crimped mesh.
      (4) The insulation shall be 2” thick, minimum of 6# density, ceramic wool.
      (5) The sewing thread shall be 3-ply 304 stainless steel and pure Nomex thread.
      (6) The seam fasteners shall be stainless steel lacing “D” hooks with Velcro.
      (7) ID tags shall be 304 stainless steel, embossed lettering.
      (8) All the rest of the hardware shall be 304 stainless steel.
      (9) Hog ring construction shall not be used.
      (10) Provisions shall be made for the packing cylinders to ensure snug fit along the entire expansion joint.

19. Hot Water
   a) Pipe and fittings may be either black steel or copper. Steel should be as described herein. Copper shall be Type L and shall be 3” or smaller.
   b) For University Research Park Hot Water Buried Specs, contact FM - U&EM.
   c) All hot water piping shall be insulated.

20. Pumps
   a) Bell and Gosset shall be used as the standard of quality.
   b) Horizontal in-line pumps shall have a maximum of one horsepower. Vertical in-line pumps shall have a maximum of five horsepower, be mounted within 4’ of the floor, and shall be protected by a strainer. It is preferred all in-line pumps be close-coupled.

H. Air Handling Systems
   1. Air handling units
      a) All units shall have a magnahelic type filter pressure differential indicator installed with a manifold and valves to isolate lines to each side of the filter.
b) Thermometers shall be installed to show temperatures of the mixed, discharge, outside, and return air. Thermometers shall be bi-metal type with a minimum dial face of 4”.

c) All oil and grease lines shall be extended to the exterior of the case.

d) All drain pans shall be stainless steel, externally insulated and bottom drained. Provisions for cleaning shall include either a removable pan or ease of access for cleaning in place. Traps for drain systems shall be sized for the system served. Ensure adequate room for the size of trap required. Adjust the height of the housekeeping pad as required. A 6” minimum height housekeeping pad is preferred.

2. Coils
   a) All coils shall have a minimum of .025” tube wall thickness and 5/8” O.D. minimum diameter.
   b) It is preferred hot water only coils have a maximum of 8 fins/inch. Dual temperature coils are preferred to have a maximum of 10 fins/inch.
   c) All coils shall have copper coils, aluminum fins, and non-ferrous headers.
   d) Coils shall be drainable.
   e) All water coils shall be piped for counter flow.
   f) Balancing valves shall be installed at the coil.

3. Dampers
   a) All dampers that shall be used in a fully closed position shall be low-leakage type. A standard of quality is Ruskin CD60.

4. Fume Hoods and Laboratory Systems
   a) Ductwork
      (1) All fume hood and laboratory exhaust system ductwork shall be constructed with 304 stainless steel and shall be of welded construction unless other materials are required by uses of a particular system. Any plastic laboratory exhaust duct shall be FM Global approved for use without the need for automatic sprinkler protection.
   b) Fume Hoods
      (1) The standard for fume hoods is Fisher Hamilton. Fume hoods will be provided for under the casework contract.

I. Control Systems
   1. Equipment
      a) Air compressors
         (1) All air compressors shall have the following features:
            (a) Crankcase shall be one piece construction. A crankcase with separate, removable oil pan shall not be acceptable.
            (b) Valve assemblies shall be disc and spring type which do not require the removal of the head for replacement. Reed type valves shall not be acceptable.
(c) Crankshaft bearings shall be tapered roller type and shall be serviceable without disassembly of the unit. Journal type bearings shall not be acceptable.

(d) An oil sight glass shall be provided for visual verification of oil level.

(e) Reciprocating air compressors shall be sized with respect to their motor horsepower requirements.

(f) Auto tank drains and hour meters.

(g) Do not mount air dryers on compressors and/or tanks.

(2) Duplex air compressors

(a) Provide tank mounted duplex type air compressor. Compressor shall be two-stage reciprocating oil lubricated suitable for use in a pneumatic control system.

(b) Equip air compressor unit with the following:
   - Low resistance intake air filter
   - A rated ASME relief valve
   - High-pressure ASME horizontal storage tank, with drain test cock
   - Automatic alternator to equalize running time of each motor
   - Magnetic starters with overload protection and on/off switch
   - Belt guards.
   - Refrigerated air dryer sized to reduce dew point of control air supply to 38°F (3.3°C) at 100 psig pressure with an inlet temperature of 180°F (82.2°C)
   - Coalescing filter with replaceable filter cartridge, equipped with differential pressure gauge and auto drain mechanism.
   - Include hour meters on each unit to track run time.

(3) Simplex air compressors

(a) Provide tank mounted high-capacity air compressor. Compressor shall be two-stage reciprocating oil lubricated suitable for use in a pneumatic control system.

(b) Equip air compressor unit with the following:
   - Low-resistance intake air filter
   - High-pressure tank relief valve
   - High-pressure ASME horizontal storage tank with drain test cock
   - Belt guards
   - Unit mounted air cooled aftercooler
   - Provide refrigerated air drier to reduce dew point of control air supply to 38°F (3.3°C) at atmospheric pressure
   - Coalescing filter with replaceable filter cartridge, equipped with differential pressure gauge and auto drain mechanism.
   - Install gauges on all input and output control signal lines at the controller.
c) Sensors
(1) All electronic temperature sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two (2) wire connections. Install using thermo-conductive material in thermo wells.
(2) If application requires a humidity sensor, a high quality unit should be specified. Hy-cal can be used as a standard of quality.
(3) Differential pressure switches, if used for fan status on VAV applications, shall not be Barber-Coleman PC301. All units used shall be repeatable, reliable, and adjustable.
(4) Air flow stations shall be used to measure outside air on all systems. These stations shall be averaging grid type with 90% accuracy that comply with ASHRAE standards for duct traversing.
(5) Freeze-stats shall be sized and configured to provide accurate averaging for the coil and shall have a manual reset. Freeze-stats shall have a dry contact to indicate status and connect to the BAS.

d) Control tubing and wiring
(1) Control tubing shall be seamless copper tubing, Type K or L, ASTM B88, or polyethylene non-metallic tubing, ASTM D2737. Polyethylene non-metallic tubing shall be run within adequately supported rigid enclosure, such as metallic raceways, EMT, or PVC pipe. All tubing shall be supported directly from the building structure with supports at a maximum of 6’ on center. Control tubing shall be routed through conditioned spaces. If such routing is not possible, the system shall be supplied with air dryers and drip legs.

OR

All tubing shall be hard drawn copper except within 2’ of a device, where poly tubing may be used. All tubing shall be supported directly from the building structure with supports at a maximum of 6’ on center. Control tubing shall be routed through conditioned spaces. If such routing is not possible, the system shall be supplied with air dryers and drip legs.

(2) All control wiring for binary inputs and outputs in control panels shall be #12 or #14 stranded wire.

e) Sequence of Operation: The following sequences of operation are to show our preferred controls for a typical system. Where the designer determines these are not appropriate for a specific design, these may be changed. However, every effort shall be made to comply with the intent of these arrangements.

2. 100% Outdoor Air Systems
a) Typical equipment list, in order from outside air intake to exhaust.
   (1) Supply air duct
   (2) Outside air sensor
   (3) Outside air damper, NC, 2 position
(4) Filter rack
(5) Air flow monitor
(6) Heat recovery coil
(7) Heat recovery discharge air temperature sensor
(8) Steam pre-heat coil w/ NO 2 modulating valve and NO modulating valve
(9) Supply fan
(10) Pre-heat coil discharge temperature sensor
(11) Freeze-stat, manual reset
(12) Chilled water coil, NC modulating valve, antifreeze pump
(13) Cooling coil discharge temperature sensor
(14) Heating coil, NO modulating valve
(15) Humidifier, steam NC modulating valve, NC 2 position valve
(16) Heating coil discharge temperature sensor
(17) Smoke detector
(18) Occupant zone
(19) Occupant override
(20) Humidity sensor
(21) Temperature sensor
(22) Exhaust air duct
(23) Smoke detector
(24) Air flow monitor
(25) Heat recovery coil
(26) Exhaust fan

b) Typical point list
(1) Analog inputs
(2) Exhaust fan
(3) Outside air temperature
(4) Heat recovery discharge temperature
(5) Pre-heat discharge temperature
(6) Cooling coil discharge temperature
(7) Heating coil discharge temperature
(8) Zone temperature
(9) Zone humidity
(10) Supply fan air flow
(11) Exhaust fan air flow
(12) 3 heat recovery loop temperatures
(13) Binary inputs
(14) Supply fan status
(15) Exhaust fan status
(16) Heat recovery pump status
(17) Occupant override
(18) Analog outputs
(19) Supply fan speed
(20) Exhaust fan speed. Pre-heat modulating valve
(21) Chilled water valve
(22) Hot water valve
(23) Humidifier valve
(24) Heat recovery loop valve
(25) Binary outputs
(26) Supply fan start/stop command
(27) Exhaust fan start/stop command
(28) Heat recovery pump start/stop command
(29) Pre-heat 2 position valve
(30) Humidifier 2 position valve
(31) Anti-freeze pump
(32) Outside air damper
(33) Direct connected safeties
(34) Freeze-stat
(35) Supply fan smoke detector
(36) Exhaust fan smoke detector
(37) Outside air damper
(38) Pre-heat 2 position valve
(39) Outside air damper limit switch
(40) Supply fan
(41) Exhaust fan

c) Safety and shutdown features

(1) All safety shut downs shall be hardwired into the system.
(2) In the event of a smoke alarm signal from smoke detector (exhaust air duct or supply air duct), the supply and exhaust air fans shall shut down and the outside air dampers shall close.
(3) A manual reset freeze-stat on the upstream face of the cooling coil shall stop supply and exhaust air fans, close outside air dampers and open the modulating preheat valve.
(4) An outside air damper limit switch shall stop supply and exhaust fans when dampers are not open.
(5) The two (2) position humidifier valve shall be closed upon shut down of supply air fan.
(6) For VAV systems, a manual reset high limit static pressure sensor shall be located in the discharge ductwork near the fan discharge. It shall shut down the supply air fan whenever static pressure is greater than the set point.

d) Occupied/Unoccupied cycle

(1) Occupied/unoccupied cycle for the AHU shall be determined by the controller scheduling program.
(2) During occupied cycle, the fans run continuously. During the unoccupied cycle, the fans are off, outside air damper is closed and preheat coil remains in control.

(3) During the unoccupied cycle, a zone temperature sensor shall enable the AHU system if the zone setback set point is reached.

(4) All systems shall have an occupant override button located in the occupied zone.

e) Preheat control

(1) With the outside air below 55ºF, the preheat valve modulates to maintain preheat discharge air temperature set point.

(2) With the outside air below 35ºF, the two (2) position preheat valve opens. The valve is sized for 10 ºF rise at full air flow.

(3) With the outside air above 55ºF, preheat valves shall be closed.

f) Static pressure control for VAV systems

(1) The controller shall maintain the static pressure set point in the supply air ductwork by varying the speed of the fans.

(2) Ramp functions shall be accomplished in the variable frequency drive controls, not in the EMCS controller software.

(3) Building pressure shall be maintained by matching supply air and exhaust air flows, as measured by flow monitoring stations.

g) Chilled water coil control

(1) In the cooling mode (OA>55ºF), the controller shall maintain cooling coil discharge air temperature set point by modulating the cooling coil valve.

(2) In the dehumidification mode (OA>55ºF & Zone RH >60%), the controller shall maintain the dehumidification set point by modulating the cooling coil valve.

(3) In the heating mode (OA<55ºF), the controller shall shut the cooling coil valve.

(4) When OA<35ºF, the antifreeze pump shall be energized.

h) Heating coil control

(1) In the dehumidification mode (OA>55ºF & Zone RH >60%), the controller shall maintain the discharge air temperature set point.

(2) In the heating mode (OA<55ºF), the controller shall maintain the heating coil discharge air temperature set point by modulating the heating coil valve.

i) Humidifier control

(1) In the cooling mode (OA>55ºF), the controller shall shut the modulating humidifier valve and the 2 position valve. The 2 position valve shall be used to stop the flow of steam to the steam jacket and humidifier.

(2) In the heating mode (OA<55ºF), the controller shall maintain the humidification set point by modulating the humidifier valve. The 2 position valve shall open.
j) Heat recovery control
   (1) Energize the heat recovery system when the outdoor air temperature is below 50ºF or above 80ºF.

3. Mixed air systems
   a) Typical equipment list, in order from outside air intake to exhaust.
      (1) Supply air duct
      (2) Outside air sensor
      (3) Outside air damper
      (4) Air flow monitor
      (5) Return air inlet w/ damper in cross connection
      (6) Filter rack
      (7) Supply fan
      (8) Mixed air temperature sensor
      (9) Heating coil, NO modulating valve
      (10) Heating coil discharge temperature sensor
      (11) Freeze-stat, manual reset
      (12) Chilled water coil, NC modulating valve, antifreeze pump
      (13) Cooling coil discharge temperature sensor
      (14) Smoke detector
      (15) Occupant zone
      (16) Occupant override
      (17) Temperature sensor
      (18) Return air duct
      (19) Return air temperature sensor
      (20) Smoke detector
      (21) Return air fan
      (22) Cross connection to supply air duct
      (23) Exhaust air damper

   b) Typical point list
      (1) Analog inputs
      (2) Outside air temperature
      (3) Mixed air temperature
      (4) Cooling coil discharge temperature
      (5) Heating coil discharge temperature
      (6) Zone temperature
      (7) Outside air flow
      (8) Return air temperature
      (9) Supply air static
      (10) Binary inputs
      (11) Supply fan status
      (12) Return fan status
      (13) Occupant override
(14) Analog outputs
(15) Supply fan speed
(16) Return fan speed
(17) Chilled water valve
(18) Hot water valve
(19) Outside air damper
(20) Return air damper
(21) Exhaust air damper
(22) Binary outputs
(23) Supply fan start/stop command
(24) Return fan start/stop command
(25) Anti-freeze pump
(26) Direct connected safeties
(27) Freeze-stat
(28) Supply fan smoke detector
(29) Return fan smoke detector
(30) Outside air damper
(31) High fan static
(32) Supply fan
(33) Return fan
(34) Hot water valve

c) Safety and shutdown features
(1) All safety shutdowns shall be hardwired into the system.
(2) In the event of a smoke alarm signal from either smoke detector (return air duct or supply air duct), the supply and return and exhaust air fans shall shut down and outside air dampers shall close.
(3) A manual reset freeze-stat on the upstream face of the hot water heating coil shall stop the supply, return and exhaust air fans, close outside air dampers and open the modulating heating valve.
(4) For VAV systems, a manual reset high limit static pressure sensor shall be located in the discharge ductwork near the fan discharge and shut down the supply air fan whenever static pressure is greater than the set point.

d) Occupied/Unoccupied cycle
(1) Occupied/unoccupied cycle for the AHU unit shall be determined by the controller scheduling program.
(2) During occupied cycle the fans runs continuously. During the unoccupied cycle, fans are off, outside air damper is closed and heating coil remains in control.
(3) During the unoccupied cycle, a zone temperature sensor shall enable the AHU system if the zone setback set point is reached.
(4) All systems shall have an occupant override button located in the occupied zone.

d) Heating coil control

(1) In the heating mode (OA<55ºF), the controller shall maintain heating coil discharge air temperature set point by modulating the heating coil valve.

(2) In the cooling mode (OA>55ºF), the controller shall shut the heating coil valve.

(3) For single zone systems, zone temperature shall be used to control discharge temperature.

(4) For systems supplying more than one zone, discharge air temperature shall be reset based on outdoor air temperature.

e) Chilled water coil control

(1) In the cooling mode (OA>55ºF), the controller shall maintain cooling coil discharge air temperature set point by modulating the cooling coil valve.

(2) In the heating mode (OA<55ºF), the controller shall shut the cooling coil valve.

(3) When OA<35ºF, the antifreeze pump shall be energized.

(4) For single zone systems, zone temperature shall be used to control the discharge temperature.

(5) For systems supplying more than one zone, the discharge air temperature shall be reset based on outdoor air temperature.

f) Outside air control

(1) When OA<65ºF, modulate outside air, return and exhaust air dampers to maintain discharge air temperature set point.

(2) When OA>65ºF, maintain minimum outside air position.

(3) Air flow monitor shall be used to control minimum outdoor air position.

(4) When no chilled water is available and when outside air is 5ºF less than return air, open outside air and exhaust air dampers to cool and ventilate occupied zones.

(5) When a CO2 monitor is used, maintain the return air set point through a point interface device loop by modulating outside air, return air, and exhaust air dampers.

g) Static pressure control for VAV systems

(1) The controller shall maintain the static pressure set point in the supply air ductwork by varying the speed of the fans.

(2) Ramp functions shall be accomplished in the variable frequency drive controls, not in the EMCS controller software.
XV. ELECTRICAL

A. Distribution

1. Primary transformer/switchgear installations shall be designed using concrete equipment vault for primary electrical equipment to be installed on.

2. Primary Duct Bank Systems (concrete encased)
   a) Duct Banks shall be installed by qualified electrical Contractors.
   b) Provide type “EB” PVC 5 inch duct equal to Carlon #68716 and “EB” PVC 2 inch duct equal to Carlon #68711. Terminate duct with end bells equivalent to OZ/Gedney Type TNS.
   c) After the trench is excavated and properly graded a concrete base shall be installed. The concrete base shall be a minimum of 4 inches thick with rebar reinforcement. Included in the base shall be rebar that shall be used for the purpose of tying down the PVC conduits thus preventing any “floating” of the duct sections when the concrete is installed. Electrical ducts shall be installed by an electrical Contractor.
   d) Steel conduits are required as follows:
      (1) Out of all manholes and buildings for a distance of approximately 10 feet, or as shown on the plans.
      (2) At all construction joints if concrete pours are interrupted.
      (3) Under all surfaces used for motor vehicle travel.
   e) With these exceptions, the raceway system shall consist of Poly-vinyl-chloride(PVC) ducts in sections as noted on the drawings. All sections shall be encased with concrete. PVC shall equal Carlon Type EB, 5 inches = 5.56 inches O.D., and minimum wall .125 inch and 2 inches = 2.37 inches O.D. and minimum wall .06 inch. Each ductbank shall contain a minimum of 1-2” conduit for telemetry.
   f) Base and intermediate spacers shall be Carlon catalog #S288PL and S289PL or equivalent. Spacers shall be provided on maximum 5 foot centers and closer where required. Ducts shall be furnished in minimum 10 foot lengths. Use compound on all duct and conduit couplings. All duct and conduit couplings shall be watertight. After ducts are installed, they shall be tied down to prevent floating. Ties shall consist of reinforcing rods only and must conform to details shown on drawings. All mud and debris shall be removed from ducts, conduits, spacers, etc., before concrete is poured. Tape steel conduit couplings only. Duct run must pitch a minimum of 6 inches per 100 feet with no more than 350 feet between manholes.
   g) Use large sweeps in primary ducts and conduits where primary lines are not straight.
   h) All duct shall be installed in such a manner to prevent accumulation of water.
   i) All conduits shall terminate 2 inches inside walls with end bells in all primary manholes. All conduits shall be evenly spaced and aligned with each other.
j) It is the intent that each section of line (from manhole to manhole or from
manhole to building) shall be poured complete in one operation. No
construction joints shall be permitted between manholes. In case unusual
conditions require a construction joint, furnish and install steel conduit for a
minimum of 5 feet on either side of the joint. Concrete shall be poured at
construction joints per the details indicated on the drawings.

k) The top of the concrete encasement shall be a minimum of 24 inches below
final grade. In special cases, this requirement shall be waived where field
conditions require. However, such conditions must be approved by the
Construction Manager and University Utilities and shall be considered the last
resort in correcting the situation.

l) Concrete
(1) Concrete shall cover the duct a minimum of 3” in all directions, and a
maximum of 6”.
(2) Concrete shall be 4,000 psi and shall have the color additive “Colorcron -
Tile Red” as manufactured by Masterbuilders, Solomon Grind Chemical
Services #140 Red, or approved equal. The color additive shall have a
minimum concentration of 9 lbs. per bag of cement and shall be mixed
throughout all of the duct bank concrete.
(3) Maximum aggregate size shall be 3/4”.
(4) Concrete shall NOT be placed with the aid of a mechanical vibrator.
(5) If trench erosion occurs, use of forms may be required to prevent overly
large masses of concrete.

m) A red warning tape that is a minimum of 6” wide shall be installed 18” above all
duct banks.

n) There shall be a minimum of 3 inches of homogeneous, waterproof concrete
around all ducts and conduits. Encasement shall be poured complete and
continuous from one manhole to another and from manholes to buildings.

o) Minimum reinforcing of the concrete shall be as follows:
(1) Minimum size is #4.
(2) Reinforcing shall be installed longitudinally, at each corner of the duct
(in cross section) and along the top, bottom, and sides at a maximum of
6” on center. All reinforcing steel shall have a minimum concrete cover
of 1½”.
(3) Reinforcing shall be installed latitudinal, as needed to hold the above in
place during placement of the concrete.

p) After duct encasement is placed, and before backfill is installed, pull a mandrel
or leather wipe through the ducts 1/4 inch in diameter less than the ducts. If
this test indicates that there are obstructions or water in the duct system, that
section of the system shall be removed and a new section installed at no
additional cost to the University of Iowa.
q) Duct bank penetrations into manholes shall continue completely through the wall of the manhole and shall use one larger hole rather than several small holes. If above method is not practical, the concrete may stop outside the manhole but must be pinned to the manhole with steel pins to prevent differential settlement.

r) All unused duct shall have a nylon or polypropylene pull string installed for future use. The pull string shall be Greenlee or equal with a minimum of 240 lbs. tensile strength, and shall be rot and mildew resistant. Wire shall not be used.

s) Duct bank penetrations of foundation wall shall comply with the following:

1. Concrete encased duct banks shall terminate at the exterior surface of the foundation wall. The conduit shall make individual penetrations of the foundation wall.

2. All duct banks shall be attached to the foundation wall in one of two manners. In new construction, the reinforcing steel of the foundation wall may be extended into the concrete encasement of the duct bank at the time of placement. Alternately, reinforcing steel may be drilled into the foundation wall and extended into the duct bank concrete. The steel that is inserted into the foundation wall shall be attached through the use of epoxy capsules, similar to those supplied by Hilti.

3. All duct bank conduit within 8’ of the foundation wall penetration shall be rigid steel conduit. The conduit shall be installed with a grade away from the building.

4. The conduit shall penetrate the foundation wall in the following manner:

   (a) For new construction, the foundation wall shall have a steel sleeve installed that is 2” larger in diameter than the conduit to be installed. For existing construction, the hole shall be core drilled. In multiple duct situations, sufficient space shall remain between the penetrations to maintain the structural integrity of the foundation wall.

   (b) A rubber seal, equal to Link-Seal, shall be installed in the space between the conduit and the sleeve or drilled hole, near the interior surface of the foundation wall. The same space shall have waterproofing installed on the exterior side of the rubber seal. Grouting may be used in lieu of Link-Seal at owner’s discretion.

3. Medium Voltage (601 volts - 69,000 volts)

   a) Cable: Medium voltage cables shall be furnished and installed by Facilities Management – Utilities & Energy Management.

   b) Switch Gear: Medium voltage switch gear and primary transformers shall be furnished and installed by Facilities Management – Utilities & Energy Management.
4. Packaged Generator Assemblies
   a) Generator Fire Safety: Generator assemblies should be located outside the building when possible. If generators have to be located indoors, they shall be located in three (3) hour cutoff rooms provided with doorway curbing and emergency drainage.
   b) Generator room fuel day tanks shall be at most 660 gallon, provided with spill containment and leak detection. All fuel piping shall exit the top of the tank.
   c) All fuel piping from the outside of the building for day tank filling and venting shall be hard piped. A high liquid level device shall be provided for day tank overflow protection.
   d) A generator fuel system shall be arranged to automatically shut down upon a fire, detected leak or high day tank level.
   e) All generators 750 KW and larger require a Utility grade relay package.
   f) Consult with Facilities Management-Utilities & Energy Management for information on generator air construction permits and Spill Prevention Control and Countermeasures (SPCC) Plan requirements.
   g) All generator sets shall be located to disperse exhaust fumes (vertical exhausts), vibration and noise without affecting the normal functions of the building and surrounding site.
   h) On-site fuel source shall provide for a minimum of 8 hours of run time.
   i) Generator type shall be evaluated on an individual project basis.
   j) All generators shall have a closed transition transfer switch.
   k) Provide startup services and training for Owner’s personnel by a factory certified service representative. Minimum training time shall be 4 hours.
   l) Acceptable Manufacturers: Any manufacturer with a service center within a 100 mile radius of the University of Iowa is acceptable.
   m) Generator assemblies should be located outside the building.
   n) If generators must be located indoors, they should be located in three hour cutoff rooms provided with doorway curbing and emergency drainage.
   o) Generator room fuel day tanks should be at most 660 gallon, provided with spill containment and leak detection. All fuel piping should exist the top of the tank.
   p) All fuel piping from the outside of the building for day tank filling and venting should be hard piped. A high liquid level device should be provided for day tank overflow protection.
   q) The generator fuel system should be arranged to automatically shut down upon a fire, detected leak or high day tank level.
   r) Diesel fuel for generators shall be limited to a maximum sulfur content of 15 ppm and a minimum centane index of 40 or a maximum aromatic content of 35 % by volume.

5. Battery Equipment
   a) Sealed batteries shall be used for emergency lighting systems when an emergency generator is not available.
b) Provide adequate ventilation and cooling of battery rooms and battery cabinets to maintain full life expectancy.
c) Batteries on racks or in cabinets shall be accessible for maintenance. Vertical access above batteries shall be a minimum of 6 inches.

6. Transfer Switches
   a) All transfer switches shall be the closed transition type.
   b) Provide a minimum of two sets of auxiliary form C contacts for normal and emergency transfer switch positions.

7. Transient Voltage Suppression
   a) Some users may require transient voltage surge suppression. The Design Professional shall review options with the user to determine specific needs.
   b) When suppression equipment protects an entire panelboard, locate this equipment inside the panelboard enclosure.
   c) Provide a disconnecting means to isolate the suppression equipment for repair and replacement.

8. Low Voltage Conductors
   a) Aluminum conductors are prohibited.
   b) The minimum wire size for lighting and power branch circuits is #12 AWG.
   c) The minimum wire size for Class 1 control circuits is #14 AWG.
   d) Any conductors installed in flexible conduit at terminal connections of rotating, vibrating or moveable equipment shall be of stranded wire.
   e) Normal, emergency, life safety, 120/208, and 277/480 shall not occupy the same raceways. Exception: normal and emergency conductors of the same voltage in G4000 wiremold.
   f) Neutral conductor capacity shall be increased as necessary for harmonics.

9. Grounding and Bonding for Electrical Systems
   a) All grounding system conductors shall be copper.
   b) Provide a grounding conductor with all circuits.

B. Secondary Circuits

1. General
   a) Secondary service protector switchgear will be furnished and installed by Facilities Management – Utilities & Energy Management in conjunction with the Contractor.
   b) Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:
      | 208/120 Volts | Phase | 480/277 Volts |
      | Black        | A     | Brown         |
      | Red          | B     | Orange        |
      | Blue         | C     | Yellow        |
      | White        |       | Neutral White or Gray |
      | Green        |       | Ground Green  |
2. Service Entrance
   a) Service entrance switchboards shall have a main circuit breaker.
   b) At the points where conduit penetrates concrete that is in contact with soil, that conduit shall be Schedule 80 PVC conduit bedded in sand. If the PVC is a bend of greater than 45 degrees, the bend shall be completely encased in concrete.

3. Switchboards
   a) Phase, neutral and ground bus shall be copper.
   b) The phase arrangement on three phase bus shall be A-B-C from left to right, top to bottom, front to back as viewed from the front of the switchboard.
   c) Provide a minimum 20% spare, usable space in new switchboards for future increases in electrical requirements.
   d) Provide continuous ground bus the full length of the switchboard.
   e) In existing buildings, new switchboards shall match existing switchboards.

4. Panelboards
   a) Provide five (5) spare conduit stubs from flush panels into suspended ceiling space or other accessible space.
   b) Provide a minimum 20% spare circuit space in new panelboards.
   c) Phase, neutral and ground bus shall be copper.
   d) All panelboards shall have separate neutral and grounding busses. All grounding and neutral wiring shall be terminated on the proper bus.
   e) In existing buildings, new panelboards shall match existing panelboards.
   f) Provide each panel with a clear, plastic covered, typed circuit schedule. The schedule shall identify circuits by room number and location in room using final room numbers provided by the Owner.
   g) Provide a label on the inside of the panelboard door with panel ID and power origin.
   h) Circuit breakers on branch circuit panelboards shall be bolt-on type.
   i) Covers to consist of full-length hinge. (Door within a door)

5. Motor Control Centers
   a) Starters shall have fusible disconnects rather than circuit breakers.
   b) Control circuit voltage shall be 120 volts or less.
   c) Provide a minimum of two auxiliary contacts (1 N.O. and 1 N.C.) in magnetic starters in addition to what is being used.
   d) Design each motor control center section so starter units may be rearranged, removed or added.
   e) Provide a minimum 20% spare, usable space in each new motor control center.
   f) In existing buildings, new motor control centers shall match existing motor control centers.
   g) Acceptable Manufacturers: Square D, General Electric and Cutler-Hammer
6. Electricity Metering
   a) Locate low voltage watt-hour metering (e.g. sidewalk, parking lot, and roadway lighting) near the primary building metering or provide a raceway (3/4 in. conduit minimum) from the low voltage meter to the primary metering location.
   b) Place a disconnecting means ahead of any low voltage watt-hour meter.
   c) All contactors shall be on the load side of low voltage watt-hour meters.
   d) Line voltage must be connected to the line side of low voltage watt-hour meters at all times for the display to function and shall not be tied to building control systems.

7. Fuses
   a) Renewable fuses shall not be used.
   b) As much as possible, equipment should be specified with fuse holders that shall accept fuses dimensionally the same as Class H fuses.
   c) Each project shall supply one set of three spare fuses for each type and size fuse installed.
   d) Designer shall evaluate the need for a box for storage of spare fuses. If a box is installed, it shall be a metal box, designed to store fuses, mounted in a highly visible location, and labeled appropriately.

8. Safety Switches and Circuit Breakers
   a) Safety switches shall be heavy duty.
   b) To provide an immediate and observable point of electrical disconnect, locate a disconnect switch near each piece of fixed electrical equipment.
   c) Tandem branch circuit breakers are prohibited.
   d) Circuit breakers in branch circuit panelboards shall be bolt-on type.
   e) In existing buildings, new enclosed switches and circuit breakers shall match existing enclosed switches and circuit breakers.
   f) All safety switches shall have a durable label permanently attached to the inside of the cover describing the fuse size, type, current limiting ability and devices controlled.
   g) All safety switches intended for use on circuits where current limiting fuses are required shall be specified with rejection clips designed to permit installation of Class R fuses only.
   h) Covers on safety switches shall be provided with a method of opening the cover without opening the switch.
   i) All safety switches shall have a grounding bar.
   j) Safety switches in mechanical rooms shall have NEMA 3R enclosures unless the environment or usage requires a more restrictive enclosure.
   k) Acceptable Manufacturers: Square D, General Electric and Cutler-Hammer

9. Adjustable Speed Drive (ASD)
   a) Variable Frequency Drive (VFD)
(1) The design shall address the effects of VFD input current harmonics on the distribution system. Specify harmonic criteria and require field testing of harmonic performance where appropriate.

(2) Manufacturer shall provide harmonic analysis of the supplied VFD, total harmonics are not to exceed 3%.

(3) Provide VFD’s that are compatible with the motors they control.

(4) Provide bypass switching capability when back-up equipment is not provided. Provide three (3) contactor bypass switching capability when back-up equipment is not provided.

(5) A variable frequency motor controller shall not serve more than one piece of equipment.

(6) In existing buildings, new variable frequency motor controllers shall match existing variable frequency motor controllers.

(7) Provide startup services for the Owner’s personnel by a factory certified service representative. Minimum training time shall be 4 hours.

(8) Where motors are 40 HP and larger, VFD shall be 480 volts with step up transformers as required. Where we are not trying to maintain consistency with existing ASDs.

(9) Acceptable manufacturers: ABB, Toshiba and Square D (Reliance).

b) Drives shall include manual bypass of the VFD for the following:

(1) 480 volt drives 125 HP and larger

(2) 208 volt drives 60 HP and larger

(3) Critical applications

c) Drive Isolation Transformer (where required for changing voltage):

(1) General: factory assembled and tested, air cooled dry type transformer, having characteristics and ratings as indicated. Units shall be designed for 60 Hz service. Transformer shall be a three-phase, Delta Wye, or Delta-Delta unit.

(2) Grounding: the transformer shall operate with an ungrounded delta primary and a grounded wye secondary, or a corner grounded Delta secondary.

(3) Core: Grain Oriented, non-aging silicon steel.

(4) Coils: continuous windings with no splices except for taps.

(5) Insulation system: UL recognized 220ºC. Performance shall be obtained without exceeding 150ºC temperature rise while operating in 30ºC ambient (24 hour average).

(6) Enclosure: constructed of heavy gauge steel with electrostatic applied finish. Enclosure shall be ventilated, drip-proof with lifting holes.

(7) Sound levels shall not exceed 55 db.

(8) Non-linear rating: harmonic rating shall be equal to or greater than the harmonic distortion produced by the supplied VFD, as determined by the harmonic analysis supplied by the VFD manufacturer.
d) VFD Installation:
   (1) For VFD mounting installation detail, refer to the Appendices.
   (2) The intent of the detail is to eliminate moisture infiltration and thermal impact to the VFD.

10. Identification
   a) All switching, protective devices and metering on main distribution panels shall be identified with labels.
   b) Labels shall be adhesive backed vinyl or plastic with ½ inch letters.
   c) Identification labels are required for all distribution equipment from the service through branch circuit panelboards and motor control centers.
   d) The Design Professional shall specify the wording of identification labels.
   e) Label all receptacles on the cover plate with self-adhesive labels. Label shall indicate panel name and circuit number.
   f) All light fixtures shall be labeled with the panel number and circuit number from which they are fed. Place label out of public view. Coordinate label location with the Owner.
   g) All junction box covers shall be labeled with the panel number and circuit numbers contained in the junction box.
      (1) Exposed boxes in finished areas: label on inside of cover.
      (2) Exposed boxes in unfinished areas: label on outside of cover.
      (3) Concealed boxes above accessible ceilings: label on outside of cover.

11. Feeders
   a) All feeders shall have a separate copper grounding conductor installed. In no case shall the conduit or raceway be used as the grounding conductor.
   b) All conduit sizes and conductor numbers and sizes shall be shown on the drawings.
   c) All panelboards shall have separate grounding and neutral busses. All grounding and neutral wiring shall be terminated on the proper buss.
   d) No snap-in breakers shall be allowed. Bolt-in type breakers shall be used. Square D I-Line and GE Spectra Series are acceptable.

12. Branch Circuits
   a) All wiring systems shall be installed using conduit. Flexible wiring systems shall not be used.
   b) A separate grounding conductor shall be installed. Use of the conduit or raceway is not an acceptable grounding method.
   c) All general purpose power circuits shall be a minimum of 20 amps.
   d) No piggyback breakers shall be allowed.
   e) General purpose power circuits in office areas shall not have shared neutrals.

13. Conduit and Boxes
   a) Conduit shall be supported from the building structure. Attachment to other pipes, conduits, ductwork, etc. shall not be allowed.
b) Non-metallic conduit or boxes shall not be used except in wet locations. In cases where it is used, conduit 2” and smaller shall be a minimum of Schedule 80.

c) Conductors carrying more than 150v to ground shall not be installed in conduits with conductors carrying less than 150v to ground.

d) Schedule 80 PVC conduit shall be utilized anywhere conduit emerges from concrete or where conduit may receive physical abuse.

e) EMT shall not be used outdoors, in wet locations, in floor crawl spaces, or below 5’ AFF.

f) For Branch Circuits, the minimum conduit size shall be 3/4”.

g) For Feeders, conduit is to be sized at least one size above the NEC requirement of wire being installed or anticipated to be installed, with minimum size of 1”.

h) PVC conduit may be used for underground electric circuits less than 600 volts that are:
   (1) Under paved areas and areas scheduled to be paved.
   (2) Next to permanent buildings, under formal planting beds and in extremely high ` areas that would be difficult to excavate due to regular heavy use.
   (3) A red plastic tracer tape is to be buried 18” above the cable or conduit in all installations.
   (4) PVC conduit for Blue Cap phones and parking gates shall be sized a minimum of 1”.

i) PVC conduit shall be Schedule 40 minimum weight and to be designed for electric application with all connections solvent welded.

j) All metallic fittings shall be compression type rated for ground connection.

k) Thin wall indenter fittings are prohibited.

l) All fittings shall be galvanized steel or malleable iron.

m) The use of flexible metal conduit shall be limited to recessed lighting fixtures. Six foot length maximum.

n) Liquid Tight flexible metal conduit shall be used to connect rotating, vibrating or moveable equipment.

o) Empty conduits shall have nylon pull cords installed with temporary caps or plugs.

p) Raceways, boxes and their supports shall be compatible with the atmosphere of the area in which they are installed.

q) To reduce sound transmission, wall outlet boxes shall not be installed back-to-back in partitions.

r) The minimum trade size conduit for lighting and power branch circuits shall be ¾ inch.

s) The minimum size for flexible metal conduit shall be ½ inch.

t) Maintain a 6-inch minimum from top of ceiling tile support grid to any raceway.

14. Hangers and Supports

a) Lead, fiber, wood and powder actuated anchors are prohibited.
b) Bolted conduit clamps are prohibited below 8 ft. in public areas.

15. Devices
   a) All receptacles and switches shall have a minimum rating of 20 amps and shall be heavy duty specification grade. A standard of quality for switches is Leviton #1221 and for receptacles is Hubbell #5362-I or Leviton #5362A-1.
   b) Minimum quality of devices shall be specification grade.
   c) Receptacles and switches shall be side and back wiring type. Any wire connection shall be screw clamp or wire nut type.
   d) Receptacles must be provided on the ground floor of all stairwells and in all elevator lobbies.
   e) Provide lighting and GFCI receptacles in all pipe spaces, pipe shafts, duct shafts, attic spaces, tunnels and mechanical equipment rooms.
   f) General purpose receptacles shall be rated 20 amps.
   g) Wall switches shall be rated 20 amps at 120/277 volts.
   h) In corridors, large assembly areas and other areas where floor maintenance equipment is used, locate receptacles so a 25 foot cord shall reach any part of the floor. If the length of wire serving these receptacles exceeds 100 ft., use #10 AWG.
   i) Provide at least one duplex receptacle where floor maintenance equipment is needed and receptacles are not otherwise available for floor maintenance equipment.
   j) In areas requiring to have ground fault interrupting capability, it is preferred GFI receptacles be used rather than GFI breakers.
   k) Designer shall evaluate the need for steel, nylon or other special types of covers, depending on the usage of the area.
   l) The preferred mounting heights, above finished floor, are 48” for switches, and 18” for receptacles.
   m) 120 volt receptacles shall be installed ground up.
   n) Duplex Receptacles – Isolated grounding type for telecommunications equipment shall be Pass and Seymour IG5362. Premium specification grade, 20 amp 125 volt NEMA 5-20R. Dedicated neutral and dedicated isolated ground for each device.
   o) Plugmold strips for telecommunications equipment shall be Wiremold V24GB306. Premium specification grade, 20 amp, 125 volt NEMA 5-20R receptacles.
   p) Plugmold pigtails for telecommunications equipment shall be Pass and Seymour S266-X. 12/3 type SJOW cord, 20 amp plug, NEMA 5-20P.

C. Lighting
   1. Interior Lighting
      a) See “University Lighting Standards” for design requirements, Section III.
      b) Provide a manual over-ride switch with all occupancy switches.
c) Ballasts shall be located so they are easily accessible for maintenance.
d) Remote-mounted ballasts shall be located in an accessible, cool, dry location with adequate ventilation. Each ballast shall be labeled to correspond to its fixture location.
e) Provide convenient lighting controls (3-way, 4-way switches) in long corridors, auditoriums and other vast areas.
f) In new construction, no building shall have more than 6 different lamp types.
g) Locate all lighting fixtures where they can be accessed and maintained without the use of scaffolding.
h) Metal halide luminaries shall have tempered glass or high impact safety lenses.
i) Lamps shall be “Low Mercury”.
j) Provide individual fixture disconnects for all lighting fixtures.
k) Remove and dispose of ballasts that contain PCB per Facilities Management requirements.
l) The Contractor shall examine existing ballasts that are to be removed from service. If it is not clearly indicated on the ballast that it does not contain PCB, it shall be assumed to contain PCB.
m) Remove and dispose of all fluorescent lamps per Facilities Management requirements.

2. Central Dimming Controls
   a) Refer to “University Lighting Standards” for requirements.
b) Provide startup, demonstration and training for Owner’s personnel by a manufacturer’s representative. Minimum training time shall be 4 hours.
c) Provide the Owner with a detailed written description of the sequence of operation and control modes of all dimming systems.

3. Exit Signs
   a) Light emitting diode (LED), high intensity type lamps shall be used in exit signage.

4. Exterior Lighting
   a) See “Campus Lighting Amendment Strategy” for design requirements.
b) Bollard and underground luminaires in sidewalks, roadways and retaining walls are prohibited.
c) Sidewalk, street and parking lot lighting shall not be connected to the building automation system.
d) Sidewalk, street and parking lot lighting shall be photo cell controlled and metered separately. Photocell shall be used to control a lighting contactor and lighting meter shall be installed ahead of the contactor.
e) Photometric data for sidewalk, street and parking lot lighting shall be submitted for approval by the Facilities Management – Utilities & Energy Management Engineers.
f) All exterior lighting levels shall comply with the latest editions of the Illuminating Engineering Society (IES) Lighting Handbook and ASHRAE/IES 90.1.
See “Campus Lighting Amendment Strategy” for design requirements. Also see “University Research Park Lighting Standards.”

g) All lamps shall be metal halide, induction, LED or any other source with white light. Other types of lamps may be used only with the approval of the University if color rendition is critical to the activity anticipated for the area (baseball or tennis games, etc.). Incandescent and HPS lamps shall not be used.

h) Wiring for exterior light fixtures shall be installed in Schedule 40 PVC conduit, 2-inch minimum.

i) Poles
(1) See “Campus Lighting Amendment Strategy” for design requirements. Any substitutions require approval of Facilities Management - Utilities & Energy Management.

j) Photocells shall be used as the primary control system.

k) For major construction projects displacing exterior lighting, the design shall include temporary lighting around the perimeter of the project during construction. The Contractor should be encouraged to maintain lighting within the limits of the project to increase security and safety. Temporary lighting does not need to meet this standard for fixture type, lamp type, etc., but should supply appropriate lighting levels for the areas adjacent to the project site.

D. Telecommunications

1. General

   a) This section outlines minimum standards and requirements of The University of Iowa Information Technologies Services (ITS), Special Projects –IT Physical Infrastructure Group for new construction, rewiring, and renovations of buildings.

   b) All designs must be reviewed and approved by the IT Physical Infrastructure Group.

   c) If any variances exist with the material in this standard, the most demanding requirement shall apply.

   d) For Telecommunications Detail Drawings, refer to web page at: http://facilities.uiowa.edu/PD&C/designstandards/July1DSPwebpa_MMtmp63ac6f91/July1DSPwebpage.html.

2. Outside Plant - Underground

   a) Conduits: All exterior underground conduits used for telecommunications applications shall be 4-inch NEMA TC-6 type EB PVC plastic duct encased in concrete.

   b) A minimum of six 4-inch ducts shall be installed between manholes and a minimum of three 4-inch ducts shall be installed into a building. All conduits are to be encased in a 3-inch concrete envelope as shown in Telecommunications Detail Drawings, figures 3-1and 3-1A.
c) Conduit shall be placed at a minimum depth of 30-inches below ground level to the top of the structure. Under roadways depth will be a minimum of 36-inches. Cover and concrete encasement will contain 1/2-inch deformed steel reinforcing bars as shown in Telecommunications Detail Drawings, figure 3-1.

d) Changes in direction either vertical or horizontal, shall be accomplished with bends of the appropriate angle (90, 45, 22.5 or 11 degrees) to provide a smooth transition and mild pulling radius. The aggregate total of bends between structures (i.e., manhole to manhole, manhole to pole, building or pad) shall not exceed 180 degrees. All bends shall have a minimum radius of 60 inches.

e) Special circumstances may utilize conduits of different size or composition. All variations must be reviewed and approved by TNS Infrastructure.

f) Conduit joints shall be joined utilizing a good quality solvent cement (i.e., Carlon Co.). Joints shall be staggered in their placement. Conduits shall be spaced 2-inches apart both vertically and horizontally as shown in Telecommunications Detail Drawings, figures 3-1 and 3-1A.

g) Upon completion of a duct structure all conduits shall be tested by drawing an appropriately sized slug or mandrel through each duct to assure the integrity. A pull line with a minimum tensile strength of 300 pounds and composed of a non-degradable material shall be placed in all conduits.

3. Building Entrance Conduit

a) Conduit from a manhole to a building shall consist of a one by three flat configuration of three 4-inch PVC conduits encased in concrete as shown in Telecommunications Detail Drawings, figure 3-1A. Dependent on approval of TNS Infrastructure, it may be acceptable in the case of smaller buildings to place three 2-inch HDPE conduits.

b) At the point of entry, into either a building or manhole wall, steel reinforcing bars shall be placed along the conduit within the concrete to extend within the foundation or manhole wall. This reinforcing is to extend a minimum of four inches into the wall and five feet in the conduit structure. This is to eliminate the potential of the conduit shearing where the two structures meet. See Appendices for details.

c) The four 5-inch conduits shall terminate inside the room equipped with bushings. All conduits shall be sealed with rubber conduit plugs, Jackmoon U.S.A. Inc., Part No. 50D535U, Carlon Telecom Systems, Part No. MAEPG8, General Machine Products Co. Inc., Part No. 66638 or TNS Engineering approved equivalent. The 5-inch conduit entering the building beyond the point of penetration shall be installed in compliance with the National Electrical Code (NEC).

4. Telecommunication Manholes (Precast)

a) Precast Manholes

(1) The standard manholes for campus applications shall be precast concrete, Minimum size 5-foot wide, by 8 foot long, by 7 foot head
room, industry standard type 38Y, available in type A (Telecommunications Detail Drawings figure 4-1) and type J, L, and T (Telecommunications Detail Drawings, figure 4-2). Local conditions may dictate a different size or configuration of manhole, in which case, it must be approved by TNS Infrastructure.

(2) Manholes must be set with a minimum 2-foot of cover to top of the concrete roof, and where possible, placed off of roadways in grass plots, medial strips or lawn areas.

b) Cast in place manholes

(1) Certain locations may require a cast in place manhole. All cast in place manholes must meet the American Association of State Highway and Transportation Officials (AASHTO) specifications.

(a) All conduits entering or leaving manholes shall be placed at basically the same elevation and placed in such a fashion as to permit pull through type cable placement, see Telecommunications Detail Drawings, figure 4-3.

(b) Provide one 30 inch Type “B” Neenah # R-1750-C1B, cast iron frames and covers, ladder and racking as specified in the equipment section of this standard. See Telecommunications Detail Drawings, figure 4-8.

(c) Provide a 12 inch round or 12-inch square by 8-inch deep sump hole in the floor under the lid. The floor shall slope to the sump hole.

c) Telecommunication Manhole Equipment

(1) All manholes shall be equipped with 30-inch cast iron frames and covers. The castings shall be set in concrete collars parged to seal. Manholes shall be racked with all galvanized hardware as shown in Telecommunications Detail Drawings, figures 4-4, 4-5 and 4-6.

(2) Cast in place and nonstandard manholes shall have inserts cast in the walls at the spacing shown in Telecommunications Detail Drawings, figure 4-5.

(3) Provide pulling in irons cast in the walls directly opposite the various duct entrances as shown in Telecommunications Detail Drawings, figure 4-7.

(4) All manholes shall be equipped with a free standing galvanized steel ladder with anti-slip steps, of the appropriate length to extend from the floor to a point in the collar just below the lid as shown in Telecommunications Detail Drawings, figure 4-8.

d) Frame and Cover Adjustments

(1) From time to time the elevations of the manhole casting may change to accommodate paving and surface reconstruction. This may require removing the frame and cover and building up the collar or brick and
resetting the frame. In some cases the raising operation may be accomplished through the use of manhole extension rings (cast iron or steel). These rings must be ordered to fit the appropriate diameter (36-inch, 30-inch, or 27-inch) and the appropriate rise required (1 1/2-inch, 2-inch, or 3-inch).

(2) It is required that an epoxy-based cement be used on the contact surfaces of the extension ring. It is also required that TNS Infrastructure be involved in the determination of utilizing extension rings or requiring the frame to be reset.

5. Building Distribution Requirements
   a) Telecommunication Rooms
      (1) General. Each building shall have at least one dedicated telecommunication room. The requirement for a single telecommunication room is based on the premise that the cable distance from the furthest jack location to the room cannot exceed 90 meters. When there are multiple telecommunication rooms within a building they shall be connected with a minimum of two 4-inch conduits with pull wires. If the rooms are stacked, sleeves may be provided between the floors. All sleeves shall be equipped with fire stopping.
      (2) The horizontal cable distance cannot exceed 90 meters (295 ft.) from the ADC HighBand to the telecommunication outlet faceplate.
      (3) The minimum required square footage of the telecommunication room is determined by multiplying the assignable square footage for the building by 0.0075. The minimum is 150 square feet with a minimum width of 7 feet and a minimum ceiling height to structure. A false ceiling shall not be provided.
      (4) The room shall be equipped with a door, 3 foot 0 inches by 6 foot 8 inches minimum size, that opens out into a public hallway and is fitted with a mechanical/electric lock connected to an electronic card swipe (compatible with current U of Iowa system) or approved by TNS Infrastructure.
      (5) Floor loading must be able to sustain 250 lb. per square foot.
      (6) Telecommunication room space shall be dedicated to the telecommunication function ONLY. Telecommunication rooms shall not be shared space with electrical, mechanical or custodial facilities.
      (7) Telecommunications rooms shall be free of all plumbing and mechanical not designated for that room.
      (8) Floors, walls, and ceiling shall be treated to eliminate dust. Finishes will be bright white in color to enhance the room lighting.
      (9) All walls shall be covered with rigidly fixed 3/4 inch A-C plywood, void free and extend from 6 inches above the finished floor (AFF) to 102 inches AFF and capable of supporting the attached equipment. Plywood
shall be treated as follows: Initially seal the plywood with one coat of Sherwin Williams, part No. B49 W 2 wall and wood primer.

(10) Refer to Telecommunications Detail Drawings, figure 5.1 for a typical Telecommunications Room layout.

b) Telecommunication Room environmental requirements

(1) Temperature range shall be designed to be from 65 to 75 degrees with a humidity range from 30 to 55 percent relative. The expected heat dissipation may vary between 2,500 to 5,000 BTUs per hour per device. Anticipated heat loads will be determined by TNS and provided to the DP. The above-specified environmental requirements must be able to be maintained 24 hours per day, 365 days per year.

c) Telecommunication Room Electrical

(1) Lighting shall be a minimum of fifty foot candles, measured 3 feet above the finished floor in the middle of the aisles between the racks. The lighting is to be controlled by one switch located near the entrance door to the room. Lighting fixtures will not be powered by the same circuit as the other outlets in the room. Power into the room shall be a minimum of a 100 amp breaker box with TVSS built into the panel.

(2) Number of circuits and locations will be determined at the time of the design as load requirements are determined.

(3) These outlets are to be mounted 8 inches AFF to keep them under the plywood.

(4) If the building is equipped with emergency power, consideration should be given to connecting the equipment outlets to the emergency power system. The exact location of emergency power outlets will be determined by the TNS. If an Uninterruptible Power System (UPS) is present or planned it should be planned to connect to the emergency power system if present.

(5) The telecommunication rooms shall be equipped with smoke detectors. If a building alarm system is present, the telecommunications room shall be connected to it. If a building alarm system is not present, an audible and visual alarm shall be provided outside of the telecommunications room door.

d) Telecommunication Room Grounding Requirements

(1) Telecommunication rooms will be grounded in accordance with the EIA/TIA-607 Standard.

(2) A Telecommunications Main Grounding Busbar (TMGB), shall be installed in the telecommunications room.

(3) The TMGB shall be bonded to the building electrical service entrance ground. Connections to the TMGB shall be made via two hole compression connectors. The size of this green covered copper conductor, and corresponding connector, shall be as follows:
Up to 50ft. #6 AWG(solid)
Up to 50ft. #6 AWG (stranded)
50ft. to 100ft. #4 AWG
100ft. to 150ft. #2 AWG
150ft. to 200ft. #1/0 AWG
Greater than 200ft. #3/0 AWG

(4) The connector shall be secured to the bus bar with two silicon bronze bolts, each with two washers, one lock washer and nut.

(5) In buildings that have additional telecommunication rooms, a Telecommunication Grounding Bus bar (TGB), as described in ANSI/TIA/EIA-607, shall be installed and bonded to the TMGB in the main telecommunications room using # 3/0 AWG.

6. Telecommunication Outlets
   a) Whenever possible, outlets shall be flush mounted. In existing buildings when walls cannot be fished, surface outlets will be acceptable.
   b) A flush outlet shall consist of a double gang, 2 and 1/8 inch deep outlet box of steel, with a 1 inch conduit from the box to above an accessible ceiling, wire tray, pull box or telecommunication room. If a plaster ring is used it should be a single gang plaster ring so that a single gang faceplate as described elsewhere in this document can be installed.
   c) A non-flush outlet shall consist of a single gang 2 and 3/4 inches deep surface mounted metallic or nonmetallic box with surface raceway to above an accessible ceiling or the telecommunications room. A single gang faceplate as described elsewhere in this document is to be installed. This raceway shall be sized appropriately to accept the total number of wire combinations that may be run through this raceway at 40 percent fill.
   d) Outlets shall be mounted at a height to match the existing outlets in the building.
   e) All surface raceways shall be run level and plumb in a neat manner and shall be fastened to the surface with screws or fasteners designed for the purpose. Adhesive fastening is unacceptable.
   f) Wiremold boxes shall be 2400 with knockouts for the deep box on all 4 sides of the box, part number E61283. Mounting of 2400 wiremold boxes shall be vertical, rather than horizontal.

7. Telecommunication Wiring
   a) Wiring for new or renovated buildings shall be Siamese ADC Category 5E, unshielded, twisted pair wire. This wire shall be UL Listed as to appropriate fire rating and ETL verified Category 5E for electrical performance. The ratings are to be identified on the exterior sheath.
   b) A minimum of one Siamese ADC CAT5E cable shall be installed to each outlet in a lab, classroom, office or other area, to the telecommunication room.
c) The horizontal cable distribution distance cannot exceed 90 meters (295 ft.) from the ADC High Band to the telecommunications outlet faceplate.
d) ADC is the only acceptable manufacturer.
e) For fire rating: Underwriters Laboratories Inc.

8. Telecommunication Faceplates
   a) Faceplates will be ADC single gang with 4 openings.

9. Wire Termination
   a) The Cat 5E wire at the outlet shall be terminated on a ADC jack or better wired using 568A wiring, and installed in an ADC faceplate.
   b) At the faceplate the Cat 5E wire is to be labeled with a non-degradable permanent labeling material by Brady or TNS approved equivalent.
   c) The jack numbers are to be recorded on an as-built drawing and two copies turned over to the TNS Infrastructure Group.

10. Coaxial Cable Termination
    a) Video cable, where specified, will be terminated on the same faceplate as the voice and data jacks. The cable will terminate with Thomas & Betts Snap-N-Seal® Compression Connector for 6 Series SCTE specification drop cables including 60% braid. The connector shall be compatible with the manufacturer and part number of the coaxial cable. The terminated cable will be attached to an “F” type female to female splice (Barrel) connector in the faceplate. The splice shall be prevented from rotating in the faceplate by the addition of a nut and washer (i.e. D flat or hex indentation in the faceplate adapter.) The splice or barrel will be of sufficient length that after installation in the faceplate with nut and washer that enough splice is exposed to install an “F” connector such that the rotational part of the connector does not bottom out before the ferrule tightens to the splice.
    b) Each video cable will be terminated in the telecommunications room with Thomas & Betts Snap-N-Seal® Compression Connector for 6 Series SCTE specification drop cables including 60% braid. It shall be compatible with the manufacturer and part number of the coaxial cable. Each terminated cable will be attached to an “F” barrel in a wall mounted 96 port bottom hinged panel.
    c) A #10 ground wire will be run from each panel to the Telecommunications Grounding Busbar (TGB) in the room.
    d) The coaxial cable is to be labeled as defined in section H (above) at both the faceplate and the panel in the telecommunications room.

11. Equipment Racks
    a) Relay racks shall be self-supporting, aluminum, 19 inches wide by 84 inches high and have a 1 1/4 inch by 1/2 inch hole pattern.
    b) Each relay rack shall have a TNS approved vertical and horizontal wire managers attached when installed.
c) Refer to the telecommunication room layout, Telecommunications Detail Drawings, figure 5-1, for suggested configuration of relay racks within the room.

d) Electrical power requirements are defined in section c) Electrical.

e) All equipment racks shall be grounded to the grounding bar in the telecommunications room with a #6 copper ground wire as per EIA/TIA standards.

12. Pathways for Multiple Horizontal Cables
a) Pathways to collect multiple horizontal cables from the outlet to the telecommunications closet shall be conduit, cable tray or 'J' hooks. Conduit shall be sized in accordance with the NEC for maximum 40 percent fill. Pull or junction boxes shall be located so that the aggregate bends do not exceed 180 degrees. All pull junction boxes shall be accessible. Cable tray shall be sized according to the cable counts and bottom spline. ‘J’ hooks shall be caddy CAT21 (maximum 15 cables) or caddy CAT32 (maximum 25 cables).

13. Acceptance Testing
a) Whenever possible, 5.9 Acceptance Testing All Cat 5E wire runs shall be link and channel tested to include the jack at the faceplate and the terminal block using test parameters as outlined in TIA/EIA, Bulletin TSB-67. This test shall be completed with a test set that complies with bulletin TIA/EIA/TSB-67, Accuracy Level II. Results will be loaded onto CD and submitted to TNS Engineering for approval.

b) Information will be recorded on the attached matrix showing faceplate, room, and jack numbers.

c) Contractor shall provide a complete set of as-built drawings upon completion of final testing and installation. Drawings shall be provided in both hard copy and disk format, AutoCAD R14. This is to include CAD floor plans indicating outlet locations, numbers and drawings with equipment locations within the rack(s).

14. Telecommunication Outlet Requirements and Locations
a) Offices: Each office shall have two outlets per 100 square feet, and a minimum of two outlets. Each telecommunication outlet shall contain at a minimum one CAT5E Siamese cable. Where possible, when multiple outlets are to be placed on the same wall surface area they should be combined into one multiple outlet (2 CAT5E Siamese cables) to reduce installation costs.

b) Laboratories: Each lab will contain a minimum of two outlets. Each outlet shall contain one Siamese Cat 5E cable. Additional outlets may be required depending on the room use and application.

c) Residence Halls: All layouts must be reviewed and approved by Residence Services. Each resident room shall contain one Cat 5E jacks, one Cat3 jack for voice per student and 1 coax jack per room. The location shall suit the room layout. Where possible, services shall be located in a single outlet. Each lounge area shall have at least one outlet. The outlet shall contain two Cat 5E jacks and
one coax jack. Dependent on the size and layout of the lounge, additional outlets may be required.

15. Coaxial Cable – Intra-building
   a) Coaxial cable shall be of the type Com Scope - Part No. F1111VR or approved TNS Engineering equivalent.
      (1) Specifications: Intra-building coaxial cable RG-6 must meet the following standards:
          (a) Foam dielectric
          (b) Bonded-foil type
          (c) 18 AWG Copper-covered steel center conductor
          (d) Inner-shield aluminum tape bonded to the dielectric
          (e) Outer shield of at least 60% aluminum braid
          (f) Outer shield of polyvinylchloride or polyethylene
          (g) Cable jacket will be minimally marked CATVR
      (2) Electrical characteristics:
          (a) Nominal impedance 75 ohms + or - 2 Ohms
          (b) Maximum attenuation from 5 to 750 MHz 5.65 dB/100 feet.
      (3) Acceptance testing:
          (a) All Coaxial cables are to be tested to verify length and dB loss. A printed copy of the results will be turned over to TNS Engineering with as built drawings for approval.

16. Fiber Performance Specifications
   a) Singlemode Fiber: core diameter of 8.3 microns cladding diameter of 125 microns maximum attenuation of:
      (1) 0.44 dB/Km @ 1310 nm
      (2) 0.35 dB/Km @ 1550 nm
      (3) zero dispersion wavelength of 1310 nm + or - 10 nm
   b) Multimode Fiber:
      (1) graded index, dual window core diameter of 62.5 microns
      (2) cladding diameter of 125 microns
      (3) numerical aperture of 0.275 maximum attenuation of:
          *3.75 dB/Km @ 850 nm
          *1.50 dB/Km @ 1300 nm
      (4) minimum bandwidth of:
          (a) 160 MHz-Km @ 850 nm
          (b) 500 MHz-Km @ 1300 nm
   c) Loosetube Fiber Cable
      (1) General:
          (a) PE or PVC sheath with water blocking gel or tape
          (b) Non-metallic strength member
          (c) Non-armored
          (d) Suitable for underground (in conduit) and aerial installation
(e) Cable sheath rated and marked OFNR for riser applications per NEC

(f) Distances shall be marked on the outside in feet/meters in such a way that normal installation does not rub them off or make them unreadable

(g) six or twelve fibers per buffer tube filled with water blocking gel

(h) Use standard color codes on sub buffers per EIA/TIA SPECIFICATION 598:
   a.) blue   g.) red
   b.) orange  h.) black
   c.) green  l.) yellow
   d.) brown  j.) violet
   e.) slate  k.) rose
   f.) white  l.) aqua

Note: Sub buffers are to be colored.

(i) Printing of the color name on the sub unit is NOT acceptable.

(j) Have a pull string installed to facilitate removal of the outer sheath. Note: a pull string of kevlar is NOT acceptable.

(2) Innerduct is to be installed as follows:

   (a) In a clear 4 inch conduit, three each 1.85 inch nominal
   (b) tight buffered
   (d) buffer outer diameter of 0.9 mm.
   (d) nonmetallic strength member
   (e) fire-rated OFNP or OFNR for inside rated cable per NEC
   (f) distances marked on the outside of the fiber in feet
   (g) Use standard color codes on sub buffers per EIA/TIA SPECIFICATION 598:
      a) blue   g) red
      b) orange  h) black
      c) green  i) yellow
      d) brown  j) violet
      e) slate  k) rose
      f) white  l) aqua

Note: Sub buffers are to be colored. Printing of the color name on the sub unit is NOT acceptable.

   (h) Have a pull string installed to facilitate removal of the outer sheath.

   (i) Note: a pull string of kevlar is NOT acceptable.

d) Installation

   (1) The number and type of fiber will be specified by TNS Engineering
   (2) Fiber shall be installed in innerduct within conduits.
   (3) Multiple fibers shall be pulled in the same innerduct whenever possible.
(4) Fiber shall be installed in one continuous piece unless prior approval is given by TNS Engineering.
(5) Any excess fiber shall be coiled neatly and secured to a wall above the plywood backboard so it is out of the way of normal traffic and is not subject to unusual flexing.

17. Fiber Termination, Splicing and Testing
   a) Fiber will be terminated in a patch panel at each end to facilitate cross-connections. Fiber will be terminated with the following type connectors:
      (1) Interbuilding multimode fiber is to be terminated with “SC” connectors.
      (2) Interbuilding singlemode fiber is to be Fusion Spliced with SC Ultra polish pigtails.
         (a) Fiber may be terminated with pigtails(sm) or directly terminated(mm) with the appropriate connector.
         (b) Fiber may be spliced using fusion splices. All fusion splices are to be placed in splicing trays in an appropriate housing.
   b) Fiber testing
      (1) TNS Engineering will be provided with the following documentation:
         (a) OTDR trace from each end at 850 nm or 1300 nm 1310 nm 1550 nm.
         (b) Power meter loss measurements in both directions at a wavelength of 850 nm or 1300 nm 1310nm 1550 nm.
         (c) A printed copy of all fiber cable test results will be turned over to the PM and TNS Engineering for approval.
         (d) Contractor will provide a complete set of as-built drawings upon completion of final testing and installation.

18. Wireless Ethernet
   a) Wireless Ethernet shall be included within the project scope. Cost/Quantity estimates will be provided by ITS-TNS. Wireless connectivity does not replace wired connections, but is used to supplement connectivity.

E. Pathways (interior)
   1. Sections of conduit shall be no longer than 100’ and must not have more than 2 bends between pull points or pull boxes with individual bends not to exceed 90. Inside bending radius must be at least 6 times the inside conduit diameter for conduit 2” or less and at least 10 times the conduit diameter for conduit greater than 2”. Pull boxes should be placed directly after a bend or sized accordingly if the pull box is located at the bend.

F. Fire Alarm and Detection Systems
   1. Fire Alarm Control Panel
      a) Fire alarm panel shall be an intelligent analog system with voice.
         (1) Basis of Design: Simplex 4100ES (Exception: UI Housing Projects)
         (2) No other substitutions shall be allowed.
a) Provide all hardware devices and software for off-line programming, complete with manuals and software files, to the Owner.
b) Battery Back-up: Capable of supplying a minimum of 24 hours of operation in normal condition followed by no less than 15 minutes of alarm.
c) All circuits shall have the capability of handling a minimum of 20% more equipment.
d) A separate “SLC” circuit shall be installed per floor. Exception: Approved by the UI Fire Safety Department.
e) The FACP shall not be used as a releasing panel. For a releasing panel use a Notifier NSF320 panel.

2. FACP Bypass Switches:
a) Access Level 3
   (1) City disconnect (For both alarms & troubles)
   (2) Audio by-pass
   (3) Visual circuit by-pass
   (4) Electronic door latches/locks
   (5) Air handler by-pass
b) Access Level 1
   (1) Dampers by-pass
   (2) Elevator by-pass
   (3) Fire Door by-pass
   (4) Provide separate fan shutdown switches for each air handler.
   (5) Smoke purge by-pass (where applicable)

3. Voice Control Point Switches:
a) “All Clear” message.
b) “Weather Alert” message
c) “All speaker” talk switch.
d) Audio zone momentary contact switches to manually select the following individual speaker circuits:
   (1) Each elevator car.
   (2) Each stairwell separately.
   (3) Each building level and approved fire zone.
   (4) Outside speakers.

4. LED Lights
a) Only fire alarm zone lights and “device type” lights shall annunciate with a red LED. Device type, address and exact location shall annunciate on the digital readout.
b) Any by-pass, disable, or trouble condition shall annunciate with an amber LED, a trouble sounder and annunciate on the digital readout.
c) When speakers or phone circuits are active, green LEDs shall annunciate the appropriate speaker circuits. Individual speaker circuits shall be capable of being
activated without a pass code even if the panel is not in the alarm condition. Individual speaker control shall be possible with loss of A/C power.

5. System Resets
   a) A fire alarm resets shall require a security level access level of 3.
   b) Equipment that has been by-passed in software shall not change state of condition during a “reset”

6. Photo Electric Smoke Detectors
   a) Photo-electric detectors shall provide a solid red LED on the detector or base when the device is in the alarm condition.
   b) Smoke detectors shall be analog, low profile.

7. Heat Detectors
   a) Heat detectors shall be restorable and provide a red LED on the detector or base when the device is in the alarm condition.
   b) Heat detectors shall be analog addressable unless they are high temperature devices.
   c) All detectors shall be magnet testable.

8. Beam Detectors
   a) All beam detectors shall have a transmitter and a mirror. (No receiver.)
   b) All beam detectors shall have a key or magnet test station.

9. Duct Detectors
   a) Duct detectors must be installed when they meet the conditions listed in NFPA 72E and NFPA 90A-14, Sec. 4-2 through 4-4.
   b) Provide a labeled test switch with LED. This test switch shall be installed for each duct smoke detector. This switch shall be installed at a mounting height of 48” to 72” above the floor.
   c) Duct smoke detectors shall be used only in duct larger than 12” in diameter.

10. Electronic Door Hold-Open
    a) Electronic door hold-opens shall be 24 volt DC.
    b) No electronic door hold-opens with built-in smoke detectors shall be accepted.
    c) Door hold opens shall not close on loss of power to the FACP.

11. Telephone Communicators
    a) The DACT within the fire panel shall be used.

12. Remote Hand Sets (If applicable)
    a) Provide five (5) phone hand sets w/cabinet to be located adjacent to the main fire alarm control panel.

13. Pull Stations
    a) All pull stations shall be addressable.

14. Sprinkler Horn/Strobe
    a) Provide Potter Sash-24 #1000055 Sprinkler Siren/Strobe
    b) Locate this device directly above the fire department sprinkler connection on the exterior of the building.

15. Audio System
a) Amplifiers shall be a minimum size of 100 watts, except in dual channel applications where the elevator channel may use 25 watt amplifiers. Amplifiers shall have redundant back-up amplifier(s) that automatically transfer. They shall be sized using calculations of:

1) One (1) watt per interior speaker. (In restrooms and small rooms set taps at \( \frac{1}{4} \) watt.)

2) Two (2) watts per outside and mechanical room speaker.

3) Each audio amplifier shall be sized to include 20 percent spare capacity for future connection of audio speakers.

16. Visual Indicators
a) Strobe intensity shall be determined by ADA requirements.
b) All strobes within site shall be synchronized.
c) Each strobe circuit shall be capable of being individually controlled in software.
d) Smoke damper indicator lights:
   1) Use only SELECT-A-SWITCH, Model SL53413-6-BG.

17. Back Boxes
a) Finished back boxes shall be provided by equipment supplier for any surface-mounted pull stations or signaling devices.
b) Fire alarm control panel cabinets shall be mounted at 6’-0” to the top of the cabinet. There shall be a 6-inch spacing between cabinets.
c) Panel door locks shall be front mounted.
d) Telephone Communicator
   1) Shall send the following signals to the University of Iowa Police Dispatch Office.
      a) Alarms (Zone 1)
      b) Troubles (Zone 3)
      c) Supervisory (Zone 4)
   2) The DACT trouble signal shall track the FACP trouble piezo.
   3) Provide a 3/4” conduit with pull string from the fire alarm control panel to designated telephone switch room.

18. Electrical Requirements
a) Minimum Wiring Size and Color Standard: Please see Appendices.
b) When conventional wiring is used, it shall be solid, THHN.
c) Line voltage (120VAC) shall be run in separate conduit.
d) All devices being controlled by the fire alarm control panel (i.e., dampers, doors, etc.) shall be operated by the use of control modules and not by relay type devices in detector bases or relay cards. No auxiliary equipment shall be directly connected to an addressable control module. 24 vdc power must be supervised at each device. Each control module shall activate a supervised 24 vdc relay with red LED when in the “alarm” state.
e) Provide locking breaker on 120 VAC power source and label “Fire Alarm.”
f) Fire alarm control panel power shall be supplied dedicated circuit(s).
g) An SOU shall be installed within the fire alarm control panel to disconnect 120 volt power. An SOU(s) shall be installed within the fire alarm control panel to disconnect all battery power.

h) A duplex receptacle, on a circuit separate from the fire alarm panel, shall be installed under the main fire alarm panel.

i) No spare conductors shall be in conduit or junction boxes.

j) 3M #130C rubber tape shall be used to insulate all grounding shields.

k) Surface wire mold shall not be specified unless approved by FM Fire Safety. If specified it shall not be no smaller than 700 size.

l) All junction and pull boxes shall be a minimum size of 4 11/16” square by 2-1/8” deep.

m) No box extensions shall be permitted on new work.

n) All fire alarm devices, junction and pull boxes shall be installed so they are easily accessible without removing light fixtures, equipment, conduits, junction boxes or other items.

o) No splicing shall be allowed in device mounting boxes.

p) “End of Line Resistors” shall be located at the device that is farthest away from the panel or module.

q) All devices being controlled by the fire alarm control panel (i.e., dampers, doors, etc.) shall be operated by the use of control modules and not by relay type devices in detector bases or relay cards. No auxiliary equipment shall be directly connected to an addressable control module. 24 vdc power must be supervised at each device. Each control module shall activate a supervised 24 vdc relay with red LED when in the “alarm” state.

r) Each floor shall have a separate riser conduit feed.

19. Detectors

a) All detectors shall be placed so that they are easily accessible without special equipment. (i.e. scaffold)

b) Detectors shall be placed so that they can be tested directly from the floor level.

c) Smoke detection is required as per NFPA 90A-14, Sec. 4-2 through 4-4.

d) If beam detectors are proposed, design must be reviewed by UI-Fire Safety Department for appropriate application, maintenance and accessibility.

e) Each detector shall be on a separate address.

f) Place detectors no closer than three (3) feet for air diffusers.


G. Electronic Access Control and Security (AMAG)

1. The room for the SMS (Security Management System) equipment shall have: wall covering consisting of ¾” sanded one side fire rated plywood with a painted finish; an Owner provided Ethernet port on the wall adjacent to the Database Unit cabinet; and 120V power direct wired into an outlet strip (outlet strip provided by the SMS Contractor, circuit installed by a State licensed electrician). Equipment shall be installed
in location and manner that will allow convenient access for maintenance and inspection. The door to this room shall have an electronic lock, alarms, and card reader. If installed in an ITS space, the use of the ITS electrical panel is permissible and shall be identified.

2. Door devices:
   
a) Power supplies other than for electric latch retraction panic devices shall be manufactured by Securitron similar to BPSM-24-10 with B-24-4 battery backup. Power supplies other than those required for electric latch retraction panic devices shall be provided by the Access Control Contractor. Power supplies required for electric latch retraction panic devices shall have battery backup and be provided & installed by the Contractor in a location of close proximity to the door that will not interfere with usage of doors while providing maintenance on the power supply.

   b) All SMS power supplies require 120V power from dedicated circuits. All plug-in transformers shall be located at the security control panels. Secure all low voltage plug-in transformers to outlet with screw or strap.

   c) Communication cable for openings requiring card readers shall be in a yellow jacket; plenum rated, & continuously labeled “ACCESS CONTROL CABLE” similar to CSC model #112115. Cabling for openings requiring door monitoring only shall be similar to CSC model #110200. Cable other than the continuously labeled “Access Control Cable” shall be labeled at all entry and exit points of cable trays.

   d) All wire and cable from the processors to all devices at each door shall be “home-run” unless otherwise specified. Communication cable is to be supported by ITS cable trays when available. The Design Professional shall determine the impact on cable tray and conduit capacity during the Design Development stage of the project and shall review with an ITS representative to determine if the project is permitted to use the cable trays or conduits. If conduit capacity is filled to more than a 60%, installation of a same sized conduit is required. When cable trays are not available, or have inadequate capacity, J-hooks spaced at a maximum of four feet or conduit may be used. When cable is in occupied visible space it shall be in conduit. Exposed conduit in occupied spaces shall be painted to match adjacent surfaces. If existing pull strings are used they shall be replaced or retied as necessary. Conduit shall be minimum ¾” with pull boxes every 50’ at minimum. Refer to other sections of this Manual for additional requirements on raceways and firestopping. The use of an ITS closet as a pass- thru will not be permitted unless the door has access control installed. Use a j-hook route to route around the ITS closet if door is not scheduled for AMAG installation.

   e) All building access control points, excluding elevators, shall have a storeroom/night latch function lock with key override, which shall be keyed under the Facilities Management access control override master key system by
FM Key & Access Services personnel. All component hardware shall be 24 Volt. Electronic mortise locks & panic devices shall have a keyed cylinder and be fail secure on all exterior doors. Panic devices shall utilize electronic trim and when required to integrate with power door operators will also have electronic latch retraction.

f) All exterior doors (including overhead doors) shall have door position switch monitoring. All exterior & interior doors that are to receive access control shall have door position switch monitoring, latch bolt hardware monitoring, and integral hardware request to exit switches. When integral hardware request to exit switches are not feasible, motion detectors similar to Bosch DS160 series may be utilized. Door position switches for steel doors shall be 1” diameter recessed, similar to GRI model #184-12. Door position switches for wood doors shall be 3/8” diameter recessed, similar to GRI model 2020-12.

(1) All exterior doors on a project shall be either monitored or controlled.
(2) Exterior doors that are monitored shall have door position switch, latch bolt hardware monitoring, and request to exit. Doors shall have no hardware on the exterior of the door – these are “Exit Only” doors.
(3) Exterior doors that are controlled shall have key over-ride. At least one card reader shall be provided for an entrance with multiple openings.

g) Utilization of a reader port shall be required on doors that are electronically controlled and monitored, regardless of if they have a reader of not.

h) Door position switch monitoring and latch bolt monitoring shall be wired separately, such that the system will indicate whether the door is held open or the latch is retracted. We do not want a general “door alarm”.

i) Electronic strikes are not to be used unless existing conditions make it unfeasible or cost prohibitive for alternative hardware. Electronic strikes are not to be used on fire rated openings.

j) Power transfers (by Contractor) are to be Securitron CEPT-10 unless existing conditions make it unfeasible or cost prohibitive and require electric hinges or door loops.

k) Card readers shall be Symmetry RP40 proximity type wall mount or Symmetry RP15 micro proximity frame mount. Color shall be charcoal gray. Mounting height shall be 36” AFF to centerline. WIM’s shall be provided as required.

l) The green and red LED’s on the prox readers shall be wired such that the green LED lights up when a valid card is presented and the red LED lights up when an invalid card is presented.

m) Devices shall be wired such that the system can differentiate between a trouble signal and a cut wire.

n) Hand geometry readers shall be Schlage Recognition Systems Handkey with enrollment stations as necessary.
o) Elevator nodes shall be located in the elevator equipment room. Elevator readers shall be located in the cab instead of the lobby. Control of call buttons only needs to be approved by FM-BLS and DPS.

3. Video systems
   a) Cameras shall be IP cameras and manufactured by Axis. Cameras shall be compatible with the current version of the AMAG Symmetry software. Cameras can be either fixed or Pan, Tilt and Zoom (PTZ) depending on the application.
   b) A data jack (Cat 5E) or greater will be provided for each IP camera installed back to an ITS closet.
   c) The location of the recording equipment shall be identified for each project. Most likely it will reside in the ITS data center depending on location of the camera project.
   d) Video recording for IP cameras shall be on a server managed/maintained by ITS.
   e) The camera project shall purchase a video license through Facilities Management for each camera and server that is part of the project.
   f) Cameras/video equipment shall be furnished and installed by UI – ITS. Responsibilities need to be clearly defined on the project documents – which work is by the Contractor and which is by ITS. (Contractor is responsible for the conduit work and ITS is responsible for the cabling and installation of the cameras).
   h) Design Professional shall present a complete set of documents for camera locations and specification of equipment

4. Security alarm/intrusion alarm systems:
   a) Shall be as determined by Department of Public Safety (DPS).
   b) Shall either utilize AMAG or a system approved by DPS.
   c) If AMAG is used, the area that is protected by the security system shall be set up as its own company within the software.

5. All large occupancy spaces such as classrooms and auditoriums that are desired to have auto-lock and auto-unlock features through the access control system shall also have emergency locking push-button switches located on the interior side of the room near the door. If more than one door enters the room, one button shall lock all doors. The switch shall be custom labeled “PUSH TO LOCK DOOR” and manufactured by Safety Technology International series 2000.

6. Vendor identification information is permitted on access control system panels only.
7. When penetrating a fire wall for passage of cables and/or conduit, always provide a fire stop system that complies with code and the local authority having jurisdiction.
8. Do nothing to modify a UL or WH fire rated door or frame that would void the label or fire rating.
9. The Design Professional shall develop a sequence of operations narrative and it shall be included on the drawings. The drawings shall also include a door schedule for all monitored and controlled doors and a camera schedule. Schedules shall identify the door/room served, functionality, type of device(s), and location.
10. Shop drawing submittals shall include product data, system block diagram(s), door details, controller schedule, door schedule, and camera schedule. Schedules shall reference project room numbers, door numbers, and equipment numbers, as applicable. Company names, door names, and other programming names shall be approved by FM-B&LS prior to programming.

11. Project record documents shall include updated copies of all items submitted as shop drawings, a floor plan showing equipment locations and wiring pathways, and operations & maintenance manuals.

12. System startup: Contractor shall conduct a 100% device check-out prior to Owner’s demonstration/training. Record drawings shall be provided to the Owner prior to Owner’s demonstration/training. The Contractor shall meet with the Owner’s representatives to walk the project, look at each SMS room, demonstrate that the hardware/programming is set up as designed, and provide a system overview. Depending on the size of the project, this should take between two and eight hours.

13. Keying: Owner will provide and install new removable cores after completion of SMS conversions and new installations. Cylinder housings shall be provided by the Contractor. Contractor shall maintain and allow access of doors receiving the SMS throughout the project by utilization of the existing building key system or construction key system as applicable. Contractor to provide 2 copies of construction keys and 1 copy of construction control key to Key and Access Services shop as soon as construction cores are installed.

END OF SECTION IV – OUTLINE SPECIFICATIONS & DETAILS
AHU CONDENSATE DRAIN DRAW-THRU AND BLOW THRU DETAIL

DRAIN PAN TRAP DETAIL FOR DRAW-THRU UNIT

H' DIMENSION TO BE MINIMUM OF 1\(\frac{1}{2}\)" PLUS TOTAL STATIC PRESSURE

DRAIN PAN TRAP DETAIL FOR BLOW-THRU UNIT

H' DIMENSION TO BE MINIMUM OF 1\(\frac{1}{2}\)" PLUS TOTAL STATIC PRESSURE
## BUILDING FIRE ALARM SYSTEM DETAILS

**SIMPLEX 4100 U**

- Adler Journalism and Mass Communication Building
- Art Building West
- Beckwith Boat House
- Boyd Law Building
- Cambus Maintenance Facility
- Campus Recreation and Wellness Center
- Carver-Hawkeye Arena
- Chemistry Building
- Chilled Water Plant 2 (West)
- 111 Church St
- 700 S. Clinton St.
- College of Public Health Building
- Communications Center
- Dental Science Building (West Wing)
- Eckstein Medical Research Building
- Engineering Research Facility
- English Philosophy Building
- Gilmore Hall
- Hancher, Voxman, Clapp
- Hardin Library for Health Sciences
- Pappajohn Biomedical Discovery Building
- Hydraulics Wave Basin Facility
- Iowa Memorial Union
- Jefferson Building
- Jessup Hall
- Kinnick Stadium
- Library (Main)
- Lindquist Center South
- Lindquist Center North
- Maclean Hall
- Madison Street Services Building
- Medical Laboratories
- Music West - Interim Building
- Nursing Building
- Information Technology Facility
- Oakdale Environmental Management Facility
- Oakdale Power Plant
- Multi Tenant Facility (Pod A-B)
## BUILDING FIRE ALARM SYSTEM DETAILS

### SIMPLEX 4100 U
- STATE HYGIENIC LABORATORY
- STUIT HALL
- PHILLIPS HALL
- POMERANTZ CENTER
- POWER PLANT
- RECREATION BUILDING
- RIVERSIDE RECITAL HALL (ST. THOMAS MOORE)
- STUDIO-ARTS
- SEASHORE HALL
- SPENCE LABS
- THEATRE BUILDING
- UNIVERSITY CAPITOL CENTER
- UNIVERSITY SERVICES BUILDING
- VAN ALLEN HALL

### SIMPLEX ZONE PANELS
- MEDICAL RESEARCH CENTER
- NORTH CAMPUS PARKING AND CHILLED WATER FACILITY
- OAKDALE STUDIO A
- SUBSTATION U
- SUBSTATION L

### NOTIFIER AFP200'S
- ART BUILDING
- BECKER COMMUNICATION STUDIES BUILDING
- CALVIN HALL
- CARVER RIVER RESEARCH AND EDUCATION FACILITY
- DEY HOUSE
- HALSEY HALL
- HOSPITAL PARKING RAMP 1
- HOSPITAL PARKING RAMP 2
- HOSPITAL PARKING RAMP 3 WILL BE CHANGED TO A SIMPLEX 06/12
- MOSSMAN BUSINESS SERVICES BUILDING
- MELROSE AVENUE PARKING FACILITY
- NEWTON ROAD RAMP
- OAKDALE WASTE STORAGE FACILITY (AT OAKDALE ENVIRONMENTAL MANAGEMENT FACILITY)
- INSTITUTE FOR RURAL AND ENVIRONMENTAL HEALTH LAUNDRY
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<td>MEDICAL EDUCATION BUILDING</td>
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# BUILDING FIRE ALARM SYSTEM DETAILS

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<tr>
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<td>ECKSTEIN MEDICAL RESEARCH BUILDING</td>
</tr>
<tr>
<td>MEDICAL EDUCATION RESEARCH FACILITY</td>
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</table>
1. INSTALL PIPING AND UNIONS TO ALLOW FOR COIL REMOVAL.
2. 2-WAY CONTROL VALVE.
3. PIPE MULTIROW COILS FOR COUNTER FLOW THROUGH COIL.
4. CALIBRATED BALANCE VALVES TO BE SIZED TO PROVIDE FINAL BALANCE AT MID-RANGE OF VALVE WITH A HEAD LOSS OF 5 FT.
CHILLED WATER BUILDING INTERFACE DETAIL (WITH OFF SEASON COOLING REQUIREMENTS)

1. Automatic air vent model #813 Watson-McDaniel Air Eliminator, ¾” NPT and ball valve. Install at high point inside building.
2. Isolation valve.
3. Pressure gauge, ¾” NPT and ball valve.
4. Pressure transmitter, Foxboro Model IGP10-A22DIF ½” NPT and ¾” NPT ball valve.
5. Stainless steel temperature gauge to be ½” NPT, 5” Face, Everyangle, 30°F – 130°F ASHCROFT or equivalent. ½” NPT stainless steel well to penetrate halfway through pipe.
6. Temperature transmitter with ¾” NPT stainless steel well, ABB controls, model TTH30D, 3 wire, 100 OHM Platinum rtd. Well to penetrate halfway through pipe.
7. ¾” NPT vent ball valve and cap
8. ¾” NPT drain valve, ball valve and cap
9. Chilled water meter, provide minimum straight lengths of pipe as indicated. Schlumberger industries, Neptune HP turbine water flow meter with strainer (no substitutions) and tricon/e transmitter, (4-20 mA), 24V DC supply with direct readout in 100’s. Meter size to be ___” diameter. Direct read out in 100’s. Mount strainer inverted, with bottom insertion.
10. Normally open, ___” diameter control valve, V notch type with electric motor operator, 4-20mA signal with position feedback. Valve to be KTM with EPI2 Keystone actuator with mounting bracket.
11. Pipe bridge size to match control valve, minimum length to be 7 pipe diameters.
12. Chilled water building pump (to be approved by the Owner.)
13. Provide one Veris Industries H908 current switch for each chilled water pump to provide monitoring by the PLC.
14. This pipe section is to match larger diameter of meter or valve. Add reducer/increaser if necessary to match smaller device.
15. Chilled water process pump (to be approved by the Owner.)

Note: All vents, drains, wells and pressure taps not to be spaced less than 8” on center (unless approved by the Owner. Exact location of wells, traps, etc. to be determined by FM personnel.)
CHILLED WATER BUILDING INTERFACE DETAIL

1. Automatic air vent model #813 Watson-McDaniel Air Eliminator, ¾” NPT and ball valve. Install at high point inside building.
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Note: All vents, drains, wells and pressure taps not to be spaced less than 8” on center (unless approved by the Owner. Exact location of wells, traps, etc. to be determined by FM personnel.)
COMMISSIONING DEFINITION DETAILS

Acceptable Performance – A component or system that is able to meet the specified requirements under all ranges of actual loads.

As-built Documents – Documents prepared by the Contractor that accurately represent the actual installed conditions, equipment, and systems, such as drawings, computer graphics, equipment data sheets, operation manuals, and maintenance manuals.

Basis of Design (BOD) – A document that records the concepts, calculations, decisions, and product selections used to meet the Owner’s project requirements. It may include weather data, interior environmental criteria, other pertinent design assumptions, cost goals as well as reference to applicable codes, standards, regulations, and guidelines. The document may also include narrative descriptions and lists of individual items that support the design process.

Certificate of Readiness – A document stating that all equipment, systems, and controls have been correctly installed; operated as specified, tested, adjusted, and balanced; and are verified as ready for functional performance testing and other acceptable procedures.

Checklists – Verification checklists that are developed and used during all phases of the commissioning process to verify that the Owner’s project requirements are being achieved. This includes checklists for general verification, plus testing, training, and other specific requirements.

Commissioning (Cx) Process – A systematic, quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner’s project requirements and Basis of Design.

Commissioning Authority (CxA) – The designated person, company, or agent who leads, plans, schedules, and coordinates and implements the Commissioning process.

Commissioning Plan – A document that defines the commissioning process at various stages of project development. It outlines the organization, schedule, allocation of resources, and documentation requirements. The plan is continually evolving and is expanded as design and construction of the project progresses.

Commissioning (Cx) Process Progress Report – A written document prepared by the Commissioning Authority that details activities completed as part of the Commissioning Process and significant findings from those activities, which is continuously updated during the course of the project; usually incorporated into the Commissioning Plan, as an ongoing appendix.
**Commissioning Process Report** – A document that records the activities and results of the Commissioning process; usually developed from the final Commissioning Plan with all of the Commissioning documents attached.

**Commissioning Team** – The individuals who through coordinated actions are responsible for implementing the Commissioning Process. The Commissioning Team will evolve as a project progresses. During successive phases, the active membership of the Commissioning Team will shift to meet the unique requirements of each phase.

**Construction Checklist** – A form used by the contractor to verify that appropriate components are on-site, ready for installation, correctly installed, and functional. (See Checklists also.)

**Coordination Drawings** – Drawings prepared by the Contractor showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings should graphically illustrate and dimension manufacturer’s recommended maintenance clearances.

**Corrective Action Form** – A form used to identify and describe deficiencies discovered during the construction phase, and to assign responsibility, track the deficiency by use of the Issue Log, and verify that corrective action was taken.

**Functional Performance Testing** – The process of determining the ability of systems to deliver the services in accordance with the Owner’s project requirements, such as the HVAC system being able to deliver heating, ventilating, and air-conditioning services. Performed by the Contractor – Witnessed by the Commissioning Authority.

**Issues Log** – A formal and ongoing record of problems or concerns and their resolutions prepared and maintained by the Commissioning Authority.

**Owner’s Project Requirements** – A document that details the functional requirements of the project and expectations of how it will be used and operated. This includes project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. (The term Design Intent is used by some Owners for this aspect of the process.)

**Test Procedure** – A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

**Training Plan** – A document prepared by the Commissioning Authority that details the expectations, schedule, budget, and deliverables of the Commissioning activities related to training operation and maintenance personnel, users, and occupants.

**Verification** – The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner’s Project Requirements.
CONDENSATE RETURN UNIT DETAIL

NOTES:

1. PROVIDE TWO SEPARATE VENTS DIRECTLY FROM RECEIVER TANK. AT LEAST ONE MUST VENT INTO MECHANICAL SPACE; THE OTHER MAY VENT TO OUTSIDE.

2. VENT PIPING TO MATCH UNIT OUTLET SIZE.
## CONTROL DEVICES AND MANUFACTURER DETAILS

<table>
<thead>
<tr>
<th>SENSOR TYPE</th>
<th>SENSOR TECHNOLOGY</th>
<th>LOCATIONS</th>
<th>COVER AREA (SQ-FT)</th>
<th>RECOMMENDED MANUFACTURER</th>
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<td>3100</td>
<td>HUBBELL</td>
</tr>
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</table>
DUCT SYSTEM DETAIL

- MAIN DUCT OVER CORRIDOR
- WALL
- SLEEVE THROUGH CORRIDOR WALL
- HEATING COIL
- LOW PRESSURE SUPPLY DUCT
- SOLID ELBOW (TYPICAL)
- FLEX DUCT
- CEILING DIFFUSER
- LIMIT FLEX DUCT TO 36" IN LENGTH
- 45° TAKE OFF WITH BALANCING DEVICE
- VAV BOX
- SOLID DUCT
- BALANCING DAMPER EACH TAKEOFF
DUPLEX BACKFLOW PREVENTER STATION DETAIL

FOR DOMESTIC WATER:
WATTS #909 BACKFLOW
PREVENTER W/ AIR GAP VENT DRAIN

FOR FIRE PROTECTION WATER:
WATTS #709 BACKFLOW
PREVENTER W/ AIR GAP VENT DRAIN

CW

STRAINER W/ BLOWDOWN

TO FLOOR DRAIN

HOSE BIBB
END OF MAIN DRIP STATION PIPING (BUILDING) DETAIL

LAST BRANCH TAKE OFF

CONDENSATE RETURN LINE

MAIN STEAM SUPPLY LINE

CONCENTRIC REDUCER

CHECK VALVE

1/2" TEST STATION ASSEMBLY

UNION (TYP.)

STEAM TRAP

EXCENTRIC REDUCER

STRAINER ASSEMBLY

GATE VALVE (TYP.)

DRIP LEG ASSEMBLY

1/2" BLOW DOWN
NOTES: 1. TYPICAL FUMEHOOD INSTALLATION INDICATED, REFER TO PLANS AND FUME HOOD SUPPLIER SHOP DRAWINGS FOR SPECIFIC REQUIREMENTS.
2. LAB UTILITY FIXTURES FURNISHED AND PRE PIPED BY FUMEHOOD SUPPLIER.
   ACID WASTE AND VENT PIPING BY CONTRACTOR.
3. CONTRACTOR IS RESPONSIBLE FOR ALL FINAL CONNECTIONS AND INDICATED VALVING.
4. PIPE VACUUM BREAKER ON OUTLET SIDE OF CW VALVE. ROUTE PIPING IN THE SIDE WALL OF FUMEHOOD. MOUNT VACUUM BREAKER ON EXTERIOR OF FUME HOOD ON THE SIDE OF FRONT CORNER POST IN AN ACCESSIBLE LOCATION, BELOW CEILING.
5. CONFIRM LOCATION OF UTILITY CONNECTION SHOWN ON PLANS WITH ARCHITECTURAL AND APPROVED CASework SHOP DRAWINGS.

NOTES TO DESIGNER:
1. WHEN ONE SIDE OF HOOD IS AGAINST A WALL OR OBSTRUCTION LOCATE ALL LAB UTILITY FIXTURES AND CONTROLS ON THE OPEN SIDE.
2. PROVIDE A MINIMUM AIRFLOW OF 40 CFM PER LINEAR FOOT OF HOOD WIDTH (NFPA 45), COORDINATE WITH FUME HOOD MANUFACTURER AND FUME HOOD CONTROL REQUIREMENTS.
HOT WATER (GLYCOL) PREHEAT COIL PIPING DETAIL

1. Install piping and unions to allow for coil removal.
2. Branch lines to be off bottom of supply/return mains.
3. Pipe multirow coils for counter flow through coil.
4. Calibrated balance valves to be sized to provide final balance at mid-range of valve with a head loss of 5 feet.
HOT WATER PREHEAT COIL PIPING (2-WAY VALVE) DETAIL

1. Install piping and unions to allow for coil removal.
2. Branch lines to be off bottom of supply/return mains.
3. Pipe multirow coils for counter flow through coil.
4. Balance valves to be sized to provide final balance at mid-range of valve with a head loss of 5 feet.
**HYDRANT DETAIL**

**Hydrant** (Mueller Super Centurion 250, Federal Safety Yellow, Model A-423 Open Right, 6" D 150 Shoe)

- Radial Clear Space
- Main Trench
- Adjustable Cast Iron Valve Box
- Thrust Block
- Water Main

**Details**:
- Hydrant Drain Openings
- Thrust Block
- Locking Spool or Restraint Joint
- 8" Gate Valve
- 12" Sand Envelope
- 12" x 12" x 4" Concrete Pad
- 12" Sand Cover
- 7 Cubic Feet Backfill w/ clean concrete stone to 18" above bottom of hydrant stand pipe
- 12" gravel with 4 mil plastic sheeting
- 3" radial clear space
- To conform to manufacturer's specifications
- Word "water" on cover
FIGURE 1 – SIGN LOCATION PLAN
## INTERIOR SIGNAGE DETAILS

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**FIGURE 2 – SIGN SCHEDULE**
INTERIOR SIGNAGE DETAILS

EXHIBIT 1 – SIGN TYPE DIRECTORY

EXHIBIT 2 – SIGN TYPE ELEVATOR DIRECTORY
INTERIOR SIGNAGE DETAILS

EXHIBIT 3 – SIGN TYPE DEPARTMENT DIRECTORY

EXHIBIT 4 – SIGN TYPE DEPARTMENT DIRECTORY
INTERIOR SIGNAGE DETAILS

EXHIBIT 5 – SIGN TYPE OVERHEAD DIRECTIONAL

EXHIBIT 6 – SIGN TYPE WALL MOUNT DIRECTIONAL
INTERIOR SIGNAGE DETAILS

**EXHIBIT 7 – SIGN TYPE WALL MOUNT DIRECTIONAL**

**EXHIBIT 8 – SIGN TYPE WALL MOUNT DIRECTIONAL**
EXHIBIT 9 – SIGN TYPE PROJECTING FLAG IDENTIFICATION

EXHIBIT 10 – SIGN TYPE DEPARTMENT IDENTIFICATION PLAQUE
EXHIBIT 11 – SIGN TYPE ROOM NUMBER

EXHIBIT 12 – SIGN TYPE ROOM IDENTIFICATION
INTERIOR SIGNAGE DETAILS

EXHIBIT 13 – SIGN TYPE CONFERENCE ROOM IDENTIFICATION

EXHIBIT 14 – SIGN TYPE OFFICE IDENTIFICATION
INTERIOR SIGNAGE DETAILS

EXHIBIT 15 – SIGN TYPE OPEN OFFICE WORK STATION IDENTIFICATION

EXHIBIT 16 – SIGN TYPE SYMBOL IDENTIFICATION
INTERIOR SIGNAGE DETAILS

EXHIBIT 17 – SIGN TYPE LARGE SYMBOL IDENTIFICATION

EXHIBIT 18 – SIGN TYPE ENTRANCE NUMBER PLAQUE
INTERIOR SIGNAGE DETAILS

EXHIBIT 19 – SIGN TYPE LOADING DOCK ENTRANCE NUMBER PLAQUE

EXHIBIT 20 – SIGN TYPE CODE SPECIFIED INFORMATION
## LIGHTING FIXTURE TYPES AND MANUFACTURER DETAILS

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| PARABOLIC - HIGH PERFORMANCE, RP-1 RATED               | CLASSROOMS  
OPEN OFFICE AREAS               | LINEAR T8’S     | COLUMBIA LIGHTING  
LITHONIA LIGHTING  
LIGHTOLIER LIGHTING |
| PARABOLIC – STD. 3” LOUVER                              | PRIVATE OFFICES  
GENERAL LIGHTING               | LINEAR T8’S     | COLUMBIA LIGHTING  
LIGHTOLIER LIGHTING  
LITHONIA LIGHTING |
| PARABOLIC - STACK LIGHTING, SYMMETRICAL AND ASYMMETRICAL LIGHTING | LIBRARY STACKS  
CONFERENCE ROOMS               | LINEAR T8’S     | COLUMBIA LIGHTING  
METULAX  
LIGHTOLIER LIGHTING  
LITHONIA LIGHTING |
| PARABOLIC - SLOT                                       | CORRIDORS WALLS  
RESTROOM WALLS               | LINEAR T8’S 2’,3’ AND 4’ ONLY | COLUMBIA LIGHTING  
ALERA LIGHTING  
FOCAL POINT  
NEO-RAY LIGHTING |
| VIDEO CONFERENCE WALL WASHER                           | CLASSROOMS  
CONFERENCE ROOMS               | LINEAR T8’S     | COLUMBIA LIGHTING  
FOCAL POINT  
NEO-RAY LIGHTING |
| RECESSED LINEAR WALL WASHER                            | CLASSROOMS  
CONFERENCE ROOMS  
CORRIDORS               | LINEAR T8’S AND BIAX | COLUMBIA LIGHTING  
METULAX  
LIGHTOLIER LIGHTING  
ELLIPTIPAR LIGHTING |
| RECESSED INDIRECT - CENTER BASKET                       | CLASSROOMS  
OPEN & PRIVATE OFFICES  
CORRIDORS               | LINEAR T8’S AND BIAX | COLUMBIA LIGHTING  
METULAX  
ALERA LIGHTING  
ZUMTOBEL STAFF  
LIGHTOLIER LIGHTING |
| RECESSED INDIRECT – SIDE BASKETS                        | CLASSROOMS  
OPEN & PRIVATE OFFICES  
CORRIDORS               | LINEAR T8’S AND BIAX | COLUMBIA LIGHTING  
METULAX  
ALERA LIGHTING |
| PRISMATIC LENSED TROFFER                                | SMALL ROOMS  
CORRIDORS               | LINEAR T8’S     | COLUMBIA LIGHTING  
LITHONIA LIGHTING |
| PRISMATIC WRAP FIXTURE                                 | STAIRWELLS  
MECHANICAL AREAS  
UTILITY/ STORAGE AREAS  
CORRIDORS               | LINEAR T8’S     | COLUMBIA LIGHTING  
METULAX  
LITHONIA LIGHTING  
LIGHTOLIER LIGHTING |
| LINEAR SURFACE WALL MOUNT                               | STAIRWELLS  
COPIER ROOMS  
UTILITY/ STORAGE AREAS               | LINEAR T8’S     | COLUMBIA LIGHTING  
METULAX  
LIGHTOLIER LIGHTING  
LITHONIA LIGHTING |
| UNDER CABINET LIGHTING                                 | TASK LIGHTING  
AT DESK OR COUNTERS               | LINEAR T8’S     | COLUMBIA LIGHTING  
METULAX  
ALKCO LIGHTING  
LIGHTOLIER LIGHTING  
LITHONIA LIGHTING |
| INDUSTRIAL (DIRECT AND INDIRECT COMPONENTS)             | STAIRWELLS  
MECHANICAL AREAS  
UTILITY/ STORAGE AREAS  
CORRIDORS               | LINEAR T8’S (4-FOOT LAMPS ONLY) | COLUMBIA LIGHTING  
METULAX  
LITHONIA LIGHTING |
| COVE LIGHTING (NON REFLECTOR) STAGGERED STRIP           | CORRIDOR  
LOBBY LIGHTING               | LINEAR T8’S     | COLUMBIA LIGHTING  
METULAX  
LIGHTOLIER LIGHTING  
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# Lockset Types by Building

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POST AND CHAIN FENCE DETAILS

Single Chain

NOTE: POST HEIGHT & CHAIN SAG TEMPLATES TO BE USED

Double Chain
PRESSURE REDUCING STATION DETAIL

1. Control valve to be wafer style Cashco Ranger.
2. Block valves to be gate valves:
   a. 2” and smaller – Powell Model #2377;
   b. Larger than 2” – Welded steel.
3. Strainer to be bronze for 2” and smaller, steel for larger than 2”. (No cast iron.)
4. Relief valve sized to pressure reducing valve. Extend through roof.
5. Eccentric reducer

NOTE: Two PRV’s in series is not acceptable.
Notes:
1. Install piping to allow for ease of coil removal.
STEAM PRESSURE TAPS DETAIL
STEAM TRAPPING STATION DETAIL

Notes:
1. All fittings shall be 3000#.
2. Refer to standards for drip-leg specifications
3. No welded fittings allowed on trapping stations.
TELECOMMUNICATION CABLE OUTLET DETAIL

NOTE:
CONDUIT SHALL BE CONTINUOUS FROM OUTLET BOX THROUGH WALL TO CABLE TRAY OR PULL BOX IN CORRIDOR.
NOTE:
Mount bracket to wall vertically.
Notes:
5 Controls to be provided by Contractor for factory installation or installed in field as determined by project specifications.
6 EVAV similar, less RHC and access doors.
7 See plans for proper hand of controls and reheat coil connection.
8 Damper shaft to include permanent slot indication of damper position.
9 Multi-point center averaging velocity sensor to be provided for all terminals.
VERTICAL FIRE/SMOKE DAMPER DETAIL

NOTES
1. ACTUATOR
2. DAMPER
3. HVAC DUCT
4. SLEEVE, 16 GAUGE
5. CAULKING MATERIAL (MAY BE ON EITHER SIDE OF DAMPER FRAME)
6. MOUNTING ANGLES
1-1/2" X 1-1/2" X 20 GAUGE (MINIMUM)
7. S-JOINT/DUCT MATE. SLEEVE TO DUCT CONNECTION (BREAK-AWAY)
8. PROVIDE ACCESS DOOR(S) TO ALL INTERNAL COMPONENTS AND TO PROVIDE VISUAL INSPECTION.