

# The University of Montana

# Design & Construction Campus Policies & Procedures Consultant's Manual

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TO: Architectural and Engineering Consultants, Anticipating working with the University of Montana

- FROM: Hugh Jesse Director of Facilities Services
- SUBJECT: Design & Construction, Campus Policies & Procedures, Consultant's Manual – 2005 Edition

The Facilities Services department of The University of Montana has put together a comprehensive document to assist Architectural and Engineering (A/E) Consultants in becoming familiar with how large construction projects are designed and built on the campus in Missoula, Montana.

This *Design & Construction, Campus Policies & Procedures, Consultant's Manual* reflects well-established practices that the Offices of Planning and Construction and Campus Maintenance follow as well as discusses guidelines and procedures that continue to make the campus one of the best in the country.

This manual should be studied by Consultants' anticipating offering a construction project for bid with the understanding that each project is unique and will require particular specifications that reflect the needs and desires of each respective project team.

It is the goal of the Facilities Services department that this document will help improve the efficiency and quality of future planning and construction efforts. It should be understood that this a 'work-in-progress' document that will be updated as needed.

Respectfully,

Hugh Jesse

Director, Facilities Services



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# The University of Montana

Design & Construction Campus Policies & Procedures Consultant's Manual

> Section A Administrative Procedures & Planning Stages

2006 Edition



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### I. ADMINISTRATIVE PROCEDURES

#### A. Introduction

- This manual shall be used by consulting firms (architect/engineer) when performing work for the University of Montana (University). Consultants shall comply with the requirements of this manual. The manual is divided into four Sections with an Appendix.
  - a. <u>Section A</u>, **ADMINISTRATIVE PROCEDURES** & **PLANNING STAGES**, identifies the state's governing bodies that have authority over university construction projects and the source legal source documents that provide this authority. Following the overview is a brief discussion of a new building project's planning and design stages required by the University.
  - b. <u>Section B</u>, **GENERAL CONSULTANT DESIGN GUIDELINES**; introduces the key participants, concepts and building requirements for the majority of construction projects on campus. The section also presents some general campus design guidelines recommended by the University.
  - c. <u>Section C</u> presents **OVERALL CAMPUS DESIGN STANDARDS** for site preparation, landscaping, mechanical and electrical systems to be used in the design of University facilities.
  - d. <u>Section D</u> presents **CAMPUS STANDARD SPECIFICATIONS** by CSI division, mainly for products but include some general and execution information.
  - e. <u>Section E</u> contains **Appendices** that provide a detailed discussion about specific areas.



#### B. Administration Overview

All building construction projects over \$150,000 must initially be approved by the Montana State Legislature (ref. MCA 18-2-102 (1)). There may be instances when the Governor's Office, the Board of Regents (BOR) of the Montana University System separately or with the Governor's Office, or the Department of Military Affairs, with the consent of the Governor may authorize the construction of a building.

The BOR may authorize the construction of revenue-producing facilities if they are to be financed wholly from the revenue from the facility (ref. MCA 18-2-102 (b) and 20-25-302). And the BOR, with the consent of the Governor, may authorize the construction of a building that is financed wholly with federal or private money if the construction of the building will not result in any new programs (ref. MCA 18-2-102 (c)).

The Consultant must read the proposal that the BOR approved to comply with the Montana Board of Regents of Higher Education's Policy and Procedures Manual: Physical Plant, policy 1003.7 "Authorization for Building Project". This filing should provide minimum criteria of the planned project.

The State of Montana Architectural/Engineering (State A/E) office, a division of the State Administration Office, has administrative jurisdiction over all construction projects on the University of Montana campuses. Delegation of administrative authority is granted to the University by the State A/E for specific projects. Although this authority allows Planning and Construction to administer the daily work on the project, all work is subject to State A/E authority.



### II. STAGES OF PLANNING & DESIGN

### A. FOREWORD

A major goal of the University of Montana (University) Facilities Planning and Construction Office (P&C) is to sustain the design integrity of the nationally recognized University campus environment. Pressure toward this end exists from the campus community of students, faculty, staff, and administrators; alumni of the University; the Board of Regents; and citizens of Missoula and the State of Montana, including the professional design community. In essence, the P&C is charged with monitoring collective project compatibility in terms of design and fit with other campus facilities and the available assets of the University, and to monitor, advise, counsel, and recommend approval of all physical change to the University campus facilities and grounds - whether from outside consultants or internal sources - so that each alteration is compatible with the Master Plan, new design & construction, the recommendations of the Campus Committee for facilities, and executive level campus administrators.

This manual has been prepared for the guidance of Consultants providing architectural and engineering (A/E) services under contract<sup>1</sup> to University through the P&C, the Facilities Services Department (FSD), and the Facilities Project Management Office (FPMO).

For projects where the administrative authority had been delegated to the University, this manual shall be considered an addendum to the Owner/Consultant agreement, the processes, design guidelines, and standards defined herein shall be included as an expansion of the definition of the Consultants services stated in the Owner/Consultant agreement (see Appendix I-A). For projects where the State A/E maintains administrative authority, the Consultant providing A/E services should review both the State A/E Division's A/E Performance & Services Guidelines and the State Standard Owner/Consultant Agreement.

It is recognized that all design standards & guidelines indicated herein are not universally applicable for every project. Further, they do not replace professional design analyses. Consultants are expected to conduct independent evaluations

<sup>&</sup>lt;sup>1</sup> The State of Montana Architectural/Engineering (State A/E) office has administrative jurisdiction over all construction projects on the University campus. Delegation of administrative authority is granted to the University by the State A/E for specific projects



and to discuss recommendations with the University's Project Manager and associated professional staff. Deviations from this manual's indicated preferences must be approved in writing by the Associate Director for Planning and Construction prior to implementation.

Also, it is not intended that each and every standard & guideline be used directly as contract specifications. For simplicity they are devoid of the legal qualifications and language needed by contract specifications. However, there are specific sections which are required exactly as written herein unless approved otherwise in writing by the Associate Director of Planning and Construction.

It is further intended that this manual in its entirety represents a cost effective application of proven systems providing functional facilities that satisfy the University's program requirements and are efficient to operate and maintain. Suggestions for improving specific sections are encouraged and should be addressed to the Project Manager or the Associate Director for Planning and Construction.

#### Definition of terms:

CSI	Construction Specifications Institute
FSD	Facilities Services Department
FPMO	Facilities Project Management Office
EHRM	Environmental Health & Risk Management
UM (or University)	The University of Montana
IBC	International Building Conference
UBC	Uniform Building Code
ADA	American Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
UFAS	Uniform Federal Accessibility Standards
UEC	Uniform Electrical Code
UFC	Uniform Fire Code
MFD	Missoula Fire Department
MBD	Missoula Building Department

#### B. INTRODUCTION

This section contains general planning information to be used by Consultants in the planning and development of University facilities. The criteria represent minimum levels of performance, quality and/or standardization which are sometimes different than 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 and research missions of the University. The Owner's Criteria, as presented here, is a compliment to an expanded discussion in Sections B, C, D, and E, the appendices at the end. The Consultant must be familiar with all University criteria and design guidelines and is responsible for the appropriate implementation thereof. The Consultant must also plan facilities with consideration given to serviceability and maintainability of these facilities.

As mentioned above, new building projects at the University are either administered by the State<sup>2</sup> or it is delegated to the University. In either case, the project will consist of distinct stages as defined in the Owner/Architect Agreement:

1) Conceptual; 2) Programming; 3) Preliminary Planning; 4) Design Development; 5) Contract Documents; 6) Bidding and Award; 7) Construction; 8) Closing and 9) Warranty

The University administered project's stages or phases follow the timeline shown in Figure 1. These would include: Concept, Funding, Development of Owner's Criteria (programming), Architect's Preliminary Report, Preliminary Design, Construction Documents, Bidding and Award, Construction, and Warranty. In either situation, the overall process is the same and would involve the same key campus committees, public involvement, documentation, and review processes. Each includes key milestones of the project such as: Selection of an architect/engineer; Development of the Owner's Criteria (functional & technical programming) with campus committees (headed by the building committee); Preliminary design and cost estimate documents that eventually result in a Construction Documents manual. The process culminates with the actual construction of a new building and commissioning, if applicable and concludes at the end of the warranty period.

<sup>&</sup>lt;sup>2</sup> For state administered projects, the project is divided into phases (Schematic Design, Design Development, Construction Document, Construction Administration and Warranty & Inspection)



#### C. NEW CONSTRUCTION PROCESS

#### 1. CONCEPT – FUNDING ISSUES

The first step of each building construction project begins with an initial concept that can come from a variety of sources. Two main catalysts would be the 'projected' student growth and program needs over the next several decades and individual 'donors' that provide all or a base on which to build the necessary funds. This stage includes review processes involving many entities including the local community, the state legislature and ultimately the Board or Regents (BOR). The latter is especially important if the necessary funds don't match the available funds and additional amounts are requested of the BOR.

A snapshot of future construction plans for new buildings are contained in the University's Master Plan Document. This is updated periodically as conditions change to reflect the latest developments for optimizing the remaining available space on the University Campus.

#### 2. OWNER'S CRITERIA

The Owner's Criteria may be slightly different for each building but generally includes: the stated purpose of the structure, the high-level concept of what it will bring to the University, specifically to a particular college or department within the university, or most recently to a research branch of the University.

Depending on how much effort has been expended on the front-end in the development of the concept, the criteria may contain an expansion of particular desires and general requirements along with design, construction, scheduling, budgetary, operational project needs, specific restrictions and requirements.

Some projects may have completed functional programming and technical programming. The functional programming is intended to thoroughly identify the types of spaces required, proximity relationships, and services requirements. The more developed the functional program is, the better the initial design phase can identify oversights or excesses and whether the project is feasible from a facility development perspective.



Occasionally, a prime consultant will be engaged to develop the functional program. If such is the case, then this consultant will only be given a very brief outline in the beginning.

Normally, a technical program will have been prepared by the Planning and Construction in Facilities Services to compliment the functional program. The technical program will indicate in much greater detail the University's expectations, preferences and requirements insofar as the specific facility is concerned and as it relates to existing campus utilities and services programs. Again, it is expected that the initial design phase will validate all requirements and verify that all such service requirements can be met.

Like with the functional program, a prime consultant may be required to develop the technical program. If such is the case, then it is likely that this consultant will be required to start from the functional program and to expand it to include the basics within a technical program.

For every project, the Consultant will be expected to take the information provided by the University and through research, experience, and expertise develop a Program Document (PD) which will clearly state the Architect's understanding of the project.

#### 3. ARCHITECT'S PRELIMINARY REPORT

The Architect's Preliminary Report (PR) details the Architect's understanding of the Owner's Criteria and identifies any design, construction, scheduling, budgetary, operational or other problems or recommendations.

The PR will include an Architect's Schedule of the complete project and key milestones for the preliminary design stage, the construction document stage, the bidding and award stage, the construction stage and finally the warranty period. This report should clearly demonstrate the Architect's understanding and acceptance of the Owner's Criteria and shall include proposed solutions, if appropriate, addressing each of the identified problems.

#### 4. PRELIMINARY DESIGN and COST ESTIMATE



After considerable discussions occur among the project team that would include the Architect, University committees, student representatives, University's Planning and Construction Management team, the Architect develops and produces a Preliminary Design (PD) for the Project.

This document would include plans that depict each of the basic aspects of the Project, the size, location, and dimensions of each structure on the Project site, a plan showing features of each floor, including every room, location of cabinets, fixtures, walls and partitions, windows, doors and other items deemed necessary to delineate the Architect's preliminary understanding of the Project.

The PD should also include each exterior view of each structure, outline specifications of the architectural, electrical, mechanical, structural, and any other relevant systems or equipment specified. In general, how the plans conform to the Owner's Criteria.

One of the main keys to the eventual success of the preliminary design is the occurrence of reviews sessions between the Owner, interested parties, and the Architect and the documentation trail that follows each session. In addition, the Architect is responsible to review and seek sign-off of the developing project preliminary design manual and cost estimate both at the 65% completion level and 95% completion level with additional entities. These would include: the University's American Disability Access (ADA) Task Force, the general community, via public forum, the historic society, where the building it to be constructed<sup>3</sup>, the University building committee, as well as, other University committees, depending on the location and specifics of each respective building and the Facilities Services maintenance department.

The University has a comprehensive archive of existing facilities drawings, specifications, design computations, maintenance manuals, air balance records, etc. Consultants are fully expected to utilize these resources, in conjunction with a thorough hands-on review of existing conditions, to ensure that alterations of and additions to existing facilities do not over tax existing systems to meet new requirements. The University's Facilities Planning and Construction Office will provide assistance as available to allow consultants to obtain all necessary information germane to the project programs.

<sup>&</sup>lt;sup>3</sup> The Montana University System includes campuses in Missoula, Helena, Dillon and Butte.



#### 5. CONSTRUCTION DOCUMENTS

Before work begins on the Construction Documents, the Architect shall prepare, and submit to the Owner, a written code review (referred to as Architect's Code Review) of the Project. The code review shall consider all aspects of the Project with regard to applicable prevailing regulatory code requirements.

The Construction Documents, including drawings and specifications shall be complete in all aspects, detailing a clear description of the intended work in such a manner that the bidding Contractor(s) can derive a clear and concise understanding of the intended work. The documents, as approved, in the Preliminary Design Manual shall be the basis upon which the Consultant is to prepare the Construction Documents.

In addition to the Construction Documents the Consultant shall provide the following:

- Energy consumption model analysis of cost/benefit of different design considerations (e.g., windows, insulation, envelop, building orientation);
- Energy conservation analysis prepared in the Preliminary Design phase shall be updated and submitted for Facilities Management Offices' review and approval (refer to Appendix II);
- The Consultant shall prepare a updated code analysis which conforms to all pertinent prevailing codes including the IBC and IECC;
- A full description of any ADA non-compliant conditions that may remain after the project is complete;
- Detailed Estimate of probable construction cost, based on the CSI format, by major building component;
- A complete copy of all design calculations used as a basis for the consultant's design decisions for the project's structural, mechanical, electrical, plumbing systems;
- The specifications for this phase shall qualify complete details of all construction features, materials and equipment systems. The specifications shall fully describe all aspects of the materials,



equipment, and installation in such a manner to permit the contractors to prepare concise bids without the need to make assumptions or judgments;

- When specifying materials and equipment, the Consultant shall reference names of not less than three manufacturers that are deemed to be suitable for meeting the desired product quality. Specific exceptions can be found elsewhere in these Design Guidelines.
- The CSI division format shall be utilized.

#### a. Contract Document Drawings

The Contract Document Drawings shall be complete in all aspects, detailing a clear description of the intended work, materials and methods in such a manner that the bidding Contractor(s) can derive a clear and concise understanding of the intended work.

#### b. Contract Document Review Processes

The Consultant shall conduct two formal reviews of the Contract Documents during their development. Those reviews shall be:

- A 65% review shall be conducted at the time the Consultant has each sheet of the documents laid out including:
  - Site work showing: site demolition; improvements; locations of service routes and connections (existing and new); landscaping; planting schedules; staging areas, access routes; etc.;
  - Architectural floor plans, demolition plans where appropriate; elevations, sections, details; schedules; and, other architectural drawings as necessary to clearly define the scope of work;
  - Mechanical systems, equipment schedules, distribution systems and routes, equipment rooms, riser diagrams, diffuser locations, etc.
  - Plumbing systems, piping routes, riser diagrams; fixture schedules, etc;



- Fire suppression systems showing: service entrances; riser diagrams; distribution routes; head locations; control locations, etc.;
- Electrical systems showing distribution panels; riser diagrams; fixture locations; fixture schedules; list of each type of lamps, control devices, outlets;
- Data systems showing service entrances; riser diagrams; distribution layouts; device locations, etc.;
- A detailed definition of the work to be included in the proposed bidding alternates;
- Project manual organized on CSI format, including Division 1, and Boilerplate material provide by the Project Management Office;
- Updated cost estimate.
- A 95% Construction Document review shall be conducted by the Consultant at the time that the Contract Documents are fully drafted, coordinated and ready for final review before publishing for bidding purposes.
- Any final modifications to the documents that may arise from these reviews shall be fully integrated into the bidding documents before publishing the bidding sets.
- The bidding documents shall detail a base bid of approximately 90% of the estimated project cost and shall further define not less than five or more than seven additive alternates that will bring the anticipated bid to 100% of the Consultants estimated project cost.
- Architect's Final Statement of probable cost.
- Sign-off and permission to go to Bid.

#### 6. BIDDING & AWARD



The Consultant shall be responsible for all communications during the bidding phase of the work and shall periodically issue addenda to the Construction Documents, as advertised, modifying the bid documents and clarifying the interpretations of the documents. All communications modifying the documents shall be distributed to all plan holders, in writing, by means of addenda. No addendum shall be issued within 10 days of the advertised date of bid opening.

The Project Management Office, in conjunction with the consultant, shall establish a bidding period of not less than three successive weeks. Bids shall be opened on the prescribed date, time, and place contained in the advertisement. The contract shall be awarded to the lowest responsive bidder. Upon award of the Contract, the Consultant will conduct a Pre-Construction Conference with all participants in the project. Simultaneously with the Pre-Construction Conference the Office of Project Management will issue a notice to Proceed to the successful contractor.

#### 7. CONSTRUCTION ADMINISTRATION

During the Construction Phase of the work the Consultant's administrative responsibilities shall include, but not be limited to, the following:

- Periodic on site observations and verification that the Contractors work is consistent with the intent and substance of the Contract Documents.
  Provide written reports of the Consultants observations noting any deviations or inconsistencies from the Contract Documents;
- Make written recommendations of materials necessary to remediate any deficiencies than may have occurred in the Contractors work; Deficiencies should be defined and the remediation defined, in writing, to the contractor.
- Provide clarification and interpretation, in writing, of the Contract Documents when requested by the Contractor;
- Conduct construction periodic progress meetings including representatives of all parties participating in the current phase of the work; Conduct Change Order review with all parties involved in the current Change



Orders under consideration and make recommendations to the Owner with regards to Change Orders<sup>4</sup>;

- Review and comment on shop drawings and other Contractor Submittals, submittal reviews to include Owner and commissioning agent;
- Submit periodic reports and minutes of all meetings to the Project Management Office and all other pertinent parties;
- Review and report on the Contractors work and progress with respect to the project Schedule;
- Initially approve periodic and final payments owed to the Contractor under the Construction Documents;
- Coordination of, review and comment on the Quality Control program (where applicable);
- The Consultant shall provide and maintain a <u>Change Order/Proposal Log</u> during the construction phase, providing the Project Manager and Facilities Planning and Construction Office (P&C) with an updated copy at each construction meeting. This log shall contain, but not be limited to, the following information:
  - Proposal Request Number;
  - o Change Order Number;
  - o Time Extension Request;
  - o Description;
  - o Reason for Proposed Changed;
  - o Proposal Amount;
  - o Change Order Breakdown;
  - o Demolition;
  - o General Construction;
  - o HVAC;
  - o Plumbing;
  - o Electrical;
  - Schedule Dates and line-item costs for the above items.

#### a. Documents

<sup>&</sup>lt;sup>4</sup> Frequently, the contractor will initiate a Request for Information (RFI). The Consultant needs to keep a log of these, noting reference number, date initiated, action taken and date of final action. The log is to be discussed at each construction meeting.



The University <u>requires</u> "AS-BUILT" drawings on each project. The Consultant shall be responsible for the preparation of record "AS-BUILT" drawings in both hard-copy and electronic format. The Contractor shall be required to provide a marked copy of project drawings to the Consultant indicating all changes made during construction. The AUTO-CAD files and reproducible plans shall be corrected to reflect actual construction and marked "AS-BUILT". Optional methods of construction not used should be omitted from the submittals.

The Consultant shall furnish the following to the Project Management Office:

- One copy of AUTO-CAD files digital media on CD-ROM completely compatible with the current AUTO-CAD version in use by the Project Management Office, in the University CAD Drawing Standard format. This should be a stand-alone disk.
- Project drawings shall be produced in an electronic AUTO-CAD format.
- Furnish one complete copy of all design calculations for the project, including Structural, Mechanical, Electrical and any other similar calculations that may exist;
- One set of high quality, 4 mil, double mat Mylar photocopies of the final corrected tracings, or one set of high quality, 4 mil, double mat Mylar final plotter output.
- Complete record documents shall be submitted to the Project Management Office for review. Review comments shall be incorporated into the final submittal of reproducible record documents.
- Note: The Owner shall reject any As-Builts from the Consultant which are incomplete or inaccurate.

#### 8. WARRANTY (& CLOSE OUT)

Upon receipt of notice by the Contractor that the work (or any defined phase of the work) is, in the Contractors opinion, completed the Consultant's responsibilities shall include but not be limited to the following:

 Review the work, with the Contractor and the Project Manager and prepare a deficiency list of all unsatisfactory work (the Punch List);



- Punch list items shall be organized prior to submission to the Contractor and shall include the Project Management Offices' comments where appropriate. Each Punch List items shall include an estimated cost to remediate and a firm date from the Contractor upon which the work will be completed;
- Upon notice of completion of punch-list items by the Contractor, the Consultant shall review the remediated work and shall submit to the Project Management Office a report of field verification and status of items. This status report will be updated at regular intervals until all punch-list items are resolved to the Project Management Office satisfaction.
- The Consultant shall participate in the Commissioning process if this process is included in the work, including documentation and remediation of non-performing systems;
- Prepare a Certificate of Substantial Completion noting the date of Beneficial Occupancy;
- Verify and approve the completeness of the Contractors training procedures, submittals, and all other Contractor close-out processes;
- Conduct a review of Operating and Maintenance Manuals submitted by the Contractor prior to submission to Project Management Office. These manuals shall include as a minimum, but not be limited, to the following:
  - Table of contents;
  - List of contractors, material suppliers and installers;
  - Copies of all warranties, identifying the name, address, telephone number, and email address of the party underwriting the warrant;
  - List of manufacturers of all equipment with the manufacturers address, telephone number and email address;
  - Shop drawings;
  - Manufacturer catalogue cuts of equipment with clearly indicated type and model used in project with capacity table, parts list and maintenance instructions indicated;
  - Wiring diagrams for controls including updated sequence of operation;



- List of interior furnishings by manufacturer, including color numbers, paint, etc., with maintenance procedures;
- Operating Instructions:
- Fan and Pump curves for the specific equipment on the project;
- Copy of Balance Report and field notes;
- Preventive Maintenance requirements for all HVAC and related equipment;
- Review and approval of all guarantees and warrantees.

The Consultant shall prepare the Certificate of Final Acceptance when appropriate establishing the Warranty Period. The Warranty Period shall be considered as defined in the Construction Documents.

The Consultant shall provide consultation to Contractor and Project Management Office for operational training of University's maintenance personnel. Consultant shall assist Project Management Office in defining correct operational parameters of new mechanical / electrical systems.

The Consultant shall provide a written report (Architect's Final Report) of the condition of the Project, noting any deficiency requiring warranty work by the Contractor and the cure for the deficiency recommended by the Architect.

#### Figure 1 - New Construction Process Timeline





## The University of Montana

### Design & Construction Campus Policies & Procedures Consultant's Manual

### Section B General Consultant Design Guidelines

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## I. KEY PARTICIPANTS, CONCEPTS, AND BUILDING REQUIREMENTS

#### A. Introduction

The following section is intended to provide the Consultant with additional information about key participants in the design process recommended by the University, along with discussions of design concepts and building requirements that form the core of general project guidelines to be followed at the University.

#### B. Key Participants

#### 1. Committees

There are several University committees that the Consultant needs to meet with and include in the project development. They would include: the Committee on Campus and Facilities (CCF), the Building Committee, Americans with Disabilities Act (ADA) TEAM. Also, an important community group to discuss the design plans is the Historical Society.

#### Committee on Campus and Facilities (CCF)<sup>a</sup>

This advisory planning committee consists of a large cross section of University faculty and staff members that meets on as needed basis to provide guidance for the University's long-term campus planning needs.

#### **Building Committee**

<sup>&</sup>lt;sup>a</sup> The Arboretum Committee is a subcommittee of the CCF. The specific charge of this committee is: to plan appropriately to assure development of the Main Campus as the State Arboretum and to facilitate the scientific study and public exhibition of many species of trees and shrubs and to establish and maintain a living collection of plantings for public education, student instruction, scenic beauty, and a natural biological legacy for the citizens of Montana.



This committee includes a small cross section of the campus community. Committee members should have knowledge of various aspects of the specific project needs, represent the disabled community, the student body, and other special interest groups.

A key role of the building committee in a project is to define the project goals and to monitor the progress toward achieving those goals. This is accomplished during the various stages of the project when the committee meets with the Consultant to define the Project goals and review the Consultants work periodically to verify that the goals are met.

#### Americans with Disabilities Act (ADA) Team

This dedicated team consists of University Faculty and Staff members that are charged with monitoring the University facilities, programs, policies, plans, and activities to assure the identification, prevention, and elimination of physical and /or programmatic barriers that interfere with faculty, staff, and student access to and benefit from University programs, facilities, and resources. There is an additional discussion about 'Access for Disabled Persons' in the Appendix.

#### **Historical Society**

The Consultant should meet with the local chapter of the Montana Historical Society to discuss the project during the planning stages.

The University's main campus contains several structures important to the history and heritage of the campus. Large portions of the campus itself have been designated as a historical district. The designation as a historical building or historical site affords these properties special considerations when interior or exterior maintenance, construction, development, and landscaping activities are required.

The University Policy on Historical Buildings is:

"Recognizing both the historical significance of a number of University buildings and the Board of Regents sincere desire to preserve such buildings while still fulfilling the missions of the University."



#### 2. Public Forum

One of the primary goals of all construction projects at the University has always been to keep the public informed throughout the design and construction phases of all projects. With adequate notice, Consultants have regularly scheduled meetings to explain the project goals, solicit input, and provide progress updates. By explaining the project in 'layman's terms' a solid bond is assured between the community and the University, especially with those neighborhoods that border the campus.

#### 3. Codes and Ordinances

Consultants are required to make themselves aware of all applicable codes and ordinances and assure compliance thereto. Deviations must be agreed to in writing by the Project Manager with written concurrence from the related regulatory agency. If a conflict arises between program requirements and codes and ordinances, such conflict must be resolved to the satisfaction of all interested parties prior to completion of the Architect's Preliminary Design stage.

#### C. Design Concepts

This section contains general guidelines affecting the design of University construction. These guidelines are either not covered by the various division CSI format used in section IV of this manual or do not fit easily within just one of the divisions. The guidelines included in this Section are State or Federally mandated requirements and/or University Policies, conventions, or preferences.

#### 1. Design Concepts for Building and Site:

#### **Design for Context**

Each design and construction project on campus, from the renovation of a single classroom to the replacement of a chiller and cooling tower to the construction of a stand alone building, is an addition to the campus. Each improvement is expected to add its own value to the campus. A reasonably successful design respects and preserves the value of adjacent works. An excellent design improves the usefulness of the entire context.

#### **Design for Completeness**

All projects are expected to be complete at their conclusion, meaning that the project generates no need for additional efforts beyond the planned scope. For example, if a design requires a service drive, it is to be included in the scope.



Likewise, a building interior should not be improved without considering the condition of the roof. Any expansion or renovation of heated space must include an assessment of the adequacy of the utilities infrastructure. Above all, the campus maintenance staff is not available to complete projects or provide remedies to problems caused by the project.

#### **Design for Operations**

The University must be considered open for business around the clock every day of the year. All improvements to the campus must be planned to proceed without impeding the University's educational mission. The construction of every improvement must be designed focusing on this basic concept. The issue of time must be recognized in the design schedule as much as in the construction schedule. The issue of construction staging, including, but not limited to, the location of fences, temporary walls, directional signage, and contractor parking, should be considered as important in the plans and specs as the door hardware and circuit breakers, for example.

Maintenance and housekeeping are daily activities in every campus building. The University expects these activities to be carried out in a manner that students and faculty are not aware of the effort. Similarly, buildings and improvements are needed that lend themselves to cost effective utilization of manpower in a discrete manner.

#### Arrangement of Ancillary Uses on the Site

In order to minimize storm damage and emphasize characteristics of buildings, open spaces, and full tree canopies, electrical and telecommunication lines should be located underground. Service areas and loading docks must be sensitive to pedestrian movements and safety.

#### Layout of External Circulation

Parking accommodations are not always required for a project. However, service vehicles, including, but not limited to, refuse trucks, must have access. Similarly, handicapped parking and visitor drop off areas must be provided. When parking is provided off-site, the project site design must include well developed pedestrian and bicycle amenities linked to the larger campus non-vehicular circulation network. Bicycle facilities are to be provided in accordance with the standards presented in the construction standards.



Pedestrian access to buildings must be coordinated with the established network and the location of existing and proposed pedestrian crossings and roadways.

#### **Development of Open Spaces**

Careful and deliberate design of the outdoor space surrounding a building is just as important as the attention given to the indoor spaces. On the University campus the spaces between the buildings have as much to do with the college experience as the classrooms and laboratories. When siting a new facility, the orientation and location must contribute to the definition and establishment of the open space. The hierarchy of space between any adjacent structures, either existing or planned, will be stepped down from the larger open space in the form of secondary passages defining access and egress to the principal open space. Secondary open spaces will also be used for linkages to the broader campus circulation network. Within this context of hierarchies, opportunities to establish localized areas for outdoor study will be examined and implemented with each new project. Trees and other exterior materials will be used to provide spatial definition and hierarchy in these areas and along movement corridors.

#### **Stormwater Management**

On-site retention and detention facilities for stormwater should be designed as natural permanent and aesthetic landscape features.

The University has teamed with the city, county, and Montana DOT to develop a storm water permit and program. This approach allows for a plan that is cohesive in the community and encourages teamwork in meeting the permit requirements which are ultimately to reduce pollution & sediment to water bodies from storm water runoff.

Stormwater from campus reaches the Clark Fork River on campus via two drainage systems. These systems collect the parking lot runoff from the east side of campus, and the Adams center parking lot. The rest of the parking lot drainage on campus is percolated to the ground via sumps. New stormwater systems shall not be directly discharged to surface waters.

#### **Design Concepts for Sustainability**

The University is committed to designing and constructing facilities that are sustainable and aesthetically pleasing. With each sustainable feature, the designer will maintain a balance between cost, function and environment. It is



critical that all new facilities and all existing buildings undergoing renovation be designed and constructed to the highest possible environmental standards to reduce recurring operating costs and minimize environmental impact.

<u>To aid the University in achieving fundamentally sustainable facilities, designers</u> <u>and project managers shall design a sustainability program, using the U.S. Green</u> <u>Building Council's LEED scale, for each project.</u>

Designers should avoid using materials that are harmful to human health, deplete nonrenewable resources, or employ construction practices that cause ecological harm to or around building sites. Architects and University planners are encouraged to utilize the principles of sustainability through the use of such guides as the U.S. Green Building Council LEED system.

There is a discussion of the University's policy on sustainability in the Appendix.

#### **Access for Disable Persons**

Every reasonable effort must be made to ensure that new construction and major renovations meet the needs of our disabled community. All new construction must comply with the Americans with Disabilities Act. A more detailed discussion appears in the Appendix.

#### Indoor Environmental Quality Commissioning Policy

Effective management of indoor environmental quality (IEQ) in buildings is essential to the maintenance of occupant health and satisfaction. Commissioning is an important part of this management. At the University, commissioning is the verification of ventilation design intent, and the development of an IEQ profile for the building describing the building structure, activities, occupancy, and environmental parameters.

The IEQ commissioning process begins at the project design phase, and continues through warranty completion. This process assists building occupants, architects, and engineers in establishing a standard for acceptable IEQ, and in controlling the liabilities associated with building related illness and sick building syndrome.

Buildings at the University are used for a wide variety of purposes. Therefore, the IEQ Commissioning Policy should be considered as minimum



recommendations only. The policy is not designed to assure adequate IEQ in all situations, instead, this is the responsibility of the Project Architect/Engineer.

#### **Energy Conservation**

The University is extremely interested in initiatives in energy management such as sustainable building designs that effect lower operation costs and good stewardship of state funds and natural resources. There is a discussion about the University's Energy policy in the Appendix.

#### Space Layout

The simplest and most effective method of energy conservation is to turn things off when not in use. To this end, spaces with similar occupancy schedules should be grouped together, to the extent possible, on the same HVAC system, to accommodate unoccupied shutdown.

#### **Asbestos**

The use of asbestos, or asbestos based, materials in state-owned buildings is prohibited. There is a discussion about the handling of hazard materials, including asbestos in the Appendix.

#### D. **General Building Requirements**

#### 1. Introduction

The University campus is gradually becoming saturated with buildings of all types. Even though considerable thought is given to retention of open spaces, vistas, etc., it is simply a fact that each new building added to the campus becomes more difficult to site and design in relation to those which already exist so as to not negatively affect them nor be negatively affected by them. Consequently, it is becoming increasingly difficult to provide vehicular access, loading docks, waste handling facilities, outdoor air intakes, exhaust air discharges, etc., that effectively meet the needs of the facility being designed.

The comments to follow are not deviations from the intent or specifics of the aforementioned documents but are intended to emphasize various broad requirements and to focus attention on issues of major overall concern. Since it is likely that most of the future facilities projects will be related to the technical sciences, many of the following comments will carry science facilities overtones. Even if the facility being considered at the moment is not a science building,

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many of the comments are equally applicable but must be considered in proper context.

The University maintains an extensive facilities records vault which contains drawings of all capital construction work that has taken place on the campus and at remote facilities. In addition, 50 scale and 200 scale site drawings have been prepared to record and diagram utility installations. An extensive inventory site surveys and soil borings are included. Consultants are expected to use this resource as appropriate to develop a full understanding of existing conditions as new facilities are designed

#### 2. Serviceability

Every building built on the campus is intended to serve its purpose over a 100 year period. The initial design and construction is only a brief moment in time and cost for the facility. The true value and quality of a building is measured over the years by its ability to adjust to the needs of the end users and the cost of servicing the components and systems within the building – not by how frugally its original design and construction budget was managed.

A building absolutely cannot function if it cannot be serviced. Although it is important to get the "front door" right, it is the "back door" that determines how well the building will work. When building services can be provided to meet all requirements and be virtually transparent to the end users, then the building is most likely a success.

#### 3. Safety & Security

Safety and Security provisions are becoming more complex as concerns for personal safety increase, equipment becomes more sophisticated and costly, as research activities require more careful documentation and controlled management, and security systems of all types become more readily available at reasonable cost. All too frequently such considerations have been overlooked at what could have been the optimum point in the design process, resulting in belated consideration with poor results. More often that not, security requirements conflict directly with convenient access for maintenance, custodial care, and response to emergencies. Early security planning may directly influence the design and location of many strategic mechanical and electrical components to the benefit of all concerned.



It is incumbent upon the owner and the design team to thoroughly consider crime prevention (anticipation, recognition and appraisal of crime risk and the initiation of some action to remove or reduce it) in the development of the overall design of facilities.

The environmental design of facilities must result in a "natural surveillance" characteristic for surrounding areas that will reinforce behavioral patterns of normal users and be a hostile environment for behavioral patterns of abnormal users (those who may be prone to criminal deviancy).

#### 4. Building Approach, Entry, Corridor and Stair Width Guidelines

a. Approach: The approach shall be multipurpose, able to accommodate class break traffic, meeting ADA requirements, and designed to H-20 truck loading. Truck access to main building entries is discouraged, however fire truck and high lift vehicles require it.

b. Entry: Crime prevention through environmental design suggests that entries be visually secure as well as physically secure. Making entries visible and giving them the impression of easy surveillance from offices, etc., is desirable. All entries shall be prepared for electronic cardkey access and door monitoring.

Entries are congregating areas and need to be designed to accommodate class break traffic. Smoking is banned in all campus buildings resulting in entries serving as smoking areas. Entries must meet ADA landing and width requirements. The design should provide for water and dirt to be walked off before entering the building.

c. Corridors: Corridors in university buildings serve a multitude of purposes and are often congested with the movement of supplies, laboratory apparatus recycle materials, contractors doing alteration projects, etc., and the heavy pedestrian flow.

Main Corridors: Desired minimum width: 10'-0" clear of architectural and stationary features.

Primary Corridors: Desired minimum width: 7'-6" clear of architectural and stationary features.



Secondary Corridors within Office Areas: 5'-0" clear of architectural and stationary features.

Elevator Foyer: Desired minimum width: 12'-0" clear of architectural and stationary features. Ground floor, service area, and entry level foyers require larger spaces for traffic cueing.

d. Stairs: Stair usage is encouraged since elevators cannot handle class break traffic. Consequently, stairs must be designed for an extraordinary routine volume of up and down pedestrian movement. Desired minimum width: 5'-0" clear of architectural and stationary features. For fire safety, each floor landing shall provide a 36" by 48" space for wheel chair safe haven.

#### 5. Acoustic Control

Because the human response to noise depends on so many factors (e.g., frequency content, level, repetition rate, etc.) it is difficult to describe an acceptable noise environment. This challenge is two fold for the Consultant: one is the noise level within the building, specifically in the classroom and the second is outside the building, specifically with residents that live adjacent to the campus (reference ASHRAE 'Design Guidelines for HVAC-related Background Sound and Noise). Also, there is a discussion about acoustics in the classroom in Appendix 1. For noise control outside the building the Consultant must design HVAC systems, location and operating conditions that abide by the local ordinances for acceptable levels at the edges of the University's campus. Care must be taken regarding the overall noise levels (both pre & post) as a result of the interactions of new buildings and existing buildings such that the overall level does not increase.

#### 6. Internal Accessibility

One of the most important requirements in science facilities is accessibility to services distribution systems. Pipe and duct shafts shall be provided floor landings or platforms with lighting, electric outlet and doors – not access panels. Suspended ceilings should only be provided where highly desirable in offices, conference rooms, etc. There are a lot of nice looking laboratories in this country that don't have suspended ceilings. Where suspended ceilings are appropriate, they must be lift-out exposed T-bar type systems. Hidden spline



type ceilings are unacceptable. Suspended ceiling material must be able to withstand a lot of handling and be easily cleaned. Where hard finish ceilings are required, extensive access panel provisions must be included, carefully sized and located to provide effective access to the equipment above

#### E. Building Service Requirements

#### 1. Vehicular Access

In order to service any facility it is imperative that service vehicles have direct access to the facility. Such access is often viewed as being in conflict with aesthetics, landscaping, pedestrian access, transportation policy, etc. The fact is, vehicular access for delivery and service vehicles is mandatory – it simply has to be thoughtfully integrated into the overall design philosophy for the building and the site. Early on a decision must be reached as to the amount of service vehicle traffic to be generated by the facility.

Over the years it becomes necessary for service, delivery or construction vehicles to access building in ways different than planned. Pedestrian pathways, plazas, etc., shall be designed for H-20 vehicular loads just the same as all streets.

#### 2. Loading Dock

The loading dock is intended to provide a convenient, all weather location for delivery trucks to load and unload products that cannot be delivered and received conveniently via general purpose circulation areas.

To be satisfactory they must include adequate turn around space for trucks accessing the dock. They must also provide adequate space for simultaneous access of several vehicles.

Since science facilities inherently require frequent delivery of large, heavy items of equipment, loading docks must accommodate truck bed level unloading, allow for highway standard clearances, have level access for maximum length vehicles, etc. The dock and surrounding area must provide a weather protected enclosure for the safety and comfort of the users and the protection of the products being delivered.

A common misuse of loading docks is the belated installation of bottled gas handling facilities. Bottled gas requirements should be considered early and accommodated in a properly protected area adjoining the loading dock (without



sacrificing loading dock capacity). Another intrusion on loading docks results from inadequate planning for service vehicle and short-term load/unload parking.

#### 3. Waste Handling & Recycling

Effective waste management is a growing, costly operation. It cannot be relegated to a few last minute considerations by the design team; it must be carefully considered at the very beginning stages of design. Science facilities invariably have waste which is considered to be hazardous waste which requires special handling by designated regulatory agencies. One should assume that these requirements will become increasingly stringent and restrictive, inevitably resulting in a greater commitment of resources, i.e., funding, or personnel, and space to meet all requirements. Therefore, waste handling provisions must be carefully developed and in such a way as to not negatively affect or diminish the loading dock provisions required for material and equipment deliveries.

A component of waste handling is recycling. As waste disposal costs and social pressures increase, recycling will take on an expanded role in facilities management. Effective recycle management provisions must be included in the loading dock/waste handling area of the facility; this means work space for waste management staff and retention space for segregated waste awaiting routine pickup.

#### 4. Elevators, Vertical Access

Elevators and stairways are required in every facility more than one story high to handle people, material, equipment movement among floors. Early consideration must be given to the scale and potential conflict of equipment, material and waste movement versus passenger movement. Science and medical facilities have particularly complex requirements.

A number of elements are available to the designer to fashion efficient vertical transportation systems. Well designed and properly located stairways and dual purpose freight-passenger elevators are normally required near loading docks, supply rooms, and other marshalling points for material traffic. Dumbwaiters and dual –purpose freight-passenger machines are useful complements to freight elevators and can substitute for freight elevators in special situations.

However, the error of not providing adequate elevator systems is usually considered to be a huge operational penalty by the end users and is one of the


most costly deficiencies to correct in later years. Select the basic performance parameters of number, size and speed of cars as part of the Basic Technical Program. Size and speed requirements will generally dictate the type, whether hydraulic, geared traction, or gearless traction. In some instances, combinations such as double-roped gearless should be considered. In general, hydraulic machines should be specified only for elevators with relatively infrequent use.

For buildings in which elevators and/or escalators are the primary means of vertical access the design criteria shall be as follows:

Maximum projected wait to load, upbound peak = 30 seconds Maximum projected wait to load, downbound peak = 30 seconds Maximum projected wait to load, daytime base = 30 seconds

Different from many owners, University staff maintains nearly all of the campus elevators. Therefore, it is imperative that all elevator system documentation and maintenance equipment be provided to the University. Elevator providers resist releasing certain information and equipment to the owner. The requirements must be clearly spelled out in the contract documents.

#### 5. Custodial Closets

Each floor of a multi-floor building shall have a minimum of 1 (one) janitor closet per 20,000 SF. First floor closet may be combined with a custodial equipment room for buildings 50,000 square feet or larger. Minimum size shall be 56 square feet (preferred 7' x 8') and maximum of 8' x 10' (80 square feet). Furnish with prefab floor sink with bibb faucet, with brace, wood shelving, stainless steel mop and broom holder. Janitorial closets shall serve that specific use only. Each building shall have a central housekeeping storage room located on the first floor accessible to the main corridor. Size of the room should be a minimum of 8' x 10'. Buildings 50,000 square feet and larger should consider an adjacent storage room to accommodate specific storage requirements. Housekeeping storage rooms shall serve that specific use only.

There is an extended discussion on custodial closets in the appendix.

#### 6. Mechanical Rooms and Pipe/Duct Shafts

Appropriately, there has always been a preoccupation with building efficiency – i.e., net assignable square footage for end users versus gross square footage.



Unfortunately, over zealous pursuit of this objective can have a devastating effect on the long term function of the facility. Science facilities inherently require more generous provisions for mechanical and electrical systems and equipment than most other occupancies, which conflicts with building efficiency considerations. Design philosophy must recognize this and adjust accordingly.

Adequate space for mechanical equipment shall be provided in the basement, adjacent to the utility tunnel connection, to provide for proper management of all central mechanical utilities and their distribution within the building. Distribution of utilities within the building shall be via readily accessible pipe and duct shafts. There should also be full access per manufacturers' recommendations and adequate clearance for filter and maintenance accessibility. These should be shown on plans.

Mechanical rooms should take into consideration possible re-entrainment of fumes of adjacent buildings and avoid pressurized duct within a building that is exhausting contaminants.

#### 7. Electrical Rooms and Closets

Adequate space for electrical equipment shall be provided in the basement, adjacent to the utility tunnel connection, to provide for proper management of all central electrical utilities and their distribution within the building. Distribution of utilities within the building shall be via readily accessible electrical rooms or closets. e.g., communications, telephone, custodial, etc. Adequate ventilation & cooling for heat producing and/or heat sensitive electrical equipment must be provided – gravity or transformer vaults and main switchgear areas; The University must not be exposed to the risks which can result from lack of proper design attention to this requirement.

#### 8. Communications Closets

Communications systems requirements are so diverse and extensive that communications closets independent from all others must be provided. Since communications requirements are one of the most rapidly changing areas in modern facilities, provisions for same must be designed for maximum flexibility.



Careful attention to the requirements included for communications must be given early on in order to make appropriate provisions. It is required that communication closets on each floor be stacked.

#### 9. Utility Corridors

This discussion is not intended to dictate the design solution but rather, suggest a technique that appears to serve a variety of needs very effectively. It is generally desirable to locate "desk bound" staff in the exterior areas where natural light and ventilation are available and windows provide some relief from the tedium. This also provides a buffer zone between the heat gain/heat loss surfaces of the facility and the laboratory spaces which often require more critical control of environmental conditions those standard office type areas.

Thus, if laboratory spaces are located in the interior areas of the building in a somewhat back-to-back configuration, then there is a marvelous opportunity to provide a service/utility corridor down the centerline of such an area. A well designed service/utility corridor of this type can be a real boon to the end users for purposes of materials and equipment movement and storage, and the informal interaction of staff.

Obviously, there can be many ways to achieve the same goals as described above and the Consultant should recommend the most effective design on a case by case basis.

Much more important to the professional building manager, however, is the facility this provides to distribute and manage the utilities for the laboratories. The corridor should be a utilitarian area devoid of cosmetic complications. All piping should be exposed and accessible for maintenance. Branch connection shutoff valves to the adjoining laboratories should be located in accessible communications cable tray should be located in this corridor. Hazardous materials handling and containment requirements can be included. Security and maintenance convenience requirements can be better managed by designing a high level for lab security and a low level for utility corridor security.

If the utility corridor can accommodate virtually all of the more industrial mechanic and electrical requirements, this will free up the ceiling spaces above the general



circulation corridors surrounding the laboratory spaces for ventilation apparatus requiring occasional but less frequent access.

If the apparatus requiring maintenance and adjustment can be kept out of the ceiling spaces above laboratories then laboratory security can be improved, end user disruption reduced maintenance convenience can be achieved and related costs reduced. All of this must be given full consideration from the very first day of design.

#### F. Mechanical Requirements

#### 1. Plans and Specifications

The University Planning and Construction Office will work with the Consultants to prepare a draft utilities distribution and connection drawing. The drawing is intended to be only diagrammatic.

The Consultant shall make all provisions required by codes, regulatory agencies, and industry practices for high quality installations. Pipe sizes shown on the drawing are intended to be the minimum acceptable to the University and should be increased as design calculations may dictate. When design calculations have been completed, Consultants shall verify that service requirements can be met at the University's proposed points of service connection. The Consultant should consider suggesting even larger capacity for distribution piping/ductwork for future expansion projects within the building.

Unplanned renovation projects, even very soon after new buildings have been constructed, are becoming more frequently and result in excessive expenses due to the lack of additional capacity on the system and the distribution systems.

The Consultant's documents shall be complete for this project. Reference to other drawings and specifications is not acceptable except for nationally and locally accepted industry standards and codes. Due to the inherent complexity of science facilities, it is preferred that piping and duct work not be shown on the same drawings when the scale is less than one-quarter inch to the foot.

Complicated areas requiring careful coordination of trades in order to install all systems and maintain maintenance access shall be detailed with cross-section drawings at on-quarter inch to the foot or larger scale, showing all systems. Cross 2006 Edition Page 18 of 25



sections shall be provided for all mechanical equipment rooms to show the vertical relationship of important components. Such drawings shall ensure accessibility to routine operation, maintenance and repair. Burying apparatus requiring operation, maintenance and repair above or behind fixed piping, conduit, duct work, etc., is unacceptable.

#### 2. Sanitary Sewer and Storm Drainage

Sanitary sewer and storm drainage systems are separated. Corrosive waste may require a dilution/neutralizing tank. Radioactive wastes are disposed of by a collection service. All active and/or inactive sanitary or storm piping within the footprint of the facility shall be removed and relocated as appropriate. Pumping storm drainage is not acceptable. (refer to Storm water management section above).

#### 3. Water Service

Water service to the facility shall be provided from the adjacent central water distribution mains in accordance with the utilities drawing provided for this project. Two services shall be provided, one for potable and not-potable uses, and one for fire protection.

#### 4. Natural Gas

Natural gas is available and shall be utilized where appropriate in mechanical spaces and where needed in laboratories. Generally, natural gas shall not be utilized where electricity can do the job as cost effectively for laboratory equipment.

#### 5. Compressed Air

Compressed air should be reduced to 30 psig before distribution with buildings. Occasionally there is a requirement for 60 psig air, which should be separately served.

#### 6. Plumbing



Cross contamination control in all facilities is a critical concern. Consequently, four water distribution systems shall be provided within each facility, i.e., potable, non-potable, fire, and irrigation. The non-potable system shall serve laboratory and similar end-user requirements. A separate Backflow Preventer (BFP) shall be inserted on any branch line leading to mechanical equipment. All distribution systems must be isolated from each other and the utility service to the building by backflow prevention devices. The University has a standard for BFP installations above ground level. Generous space provision must be allowed in such areas for proper testing and maintenance.

Provide central distribution systems with circulation for hot water heated in instantaneous heaters using low pressure steam. A separate instantaneous hot water heater must be provided in the non-potable system, isolated from the potable system by the backflow prevention device of the non-potable system.

#### 7. Heating

The University recommends variable air volume (VAV) units on all heating and cooling systems for energy conservation. Design temperature is minus 25 degrees  $(-25^{\circ}F)$ . Heat source is steam from the University's central heating plant. Isolated boilers or heat sources shall not be used on campus for heating purposes. A heat recovery loop (HRL) should be implemented for energy conservation purposes.

#### 8. Cooling

The existing buildings on campus have air conditioning (AC) supplied by a ground water cooling system. New buildings must include a project design standard that is consistent with the campus' overall GO thermal protection plan. The University recommends variable air volume (VAV) units on all heating and cooling systems for energy conservation.

#### 9. Ventilation

Mechanical ventilation shall be provided for all spaces. Even though the exterior rooms may be provided with code-complying ventilation capacity in the



fenestration, a minimum six air change per hour ventilation rate shall be mechanically maintained to alleviate the problems of the "air-tight" building and preclude opening windows during the heating season for ventilation purposes, which becomes an uncontrolled heat loss and causes undesirable drafts.

All interior ventilation shall meet occupancy driven building code ventilation requirements, maximum internal heat-gain cooling requirements, and fume exhaust make-up air requirements. Supply air ventilation systems shall be variable volume type to assure that minimum amounts of supply air are processed at all times to assure minimum operating costs throughout the entire systems. Heating and cooling energy costs are second only to custodial costs in regard to the annual cost of operating facilities. Every energy cost reduction resulting from improved design techniques is an investment in the life-long economic value of the building.

Supply air intakes and exhaust fan discharges are critical issues for the building being planned and for the buildings surrounding the site selected for the new building. Outdoor air intakes must be carefully located to avoid entraining contaminated air from exhaust air discharges from this or other building, vehicles in roadways or at loading docks, etc. Similarly, exhaust air discharges from this building must be carefully located to avoid re-entrainment into this building and to avoid contaminating the air intakes of adjoining buildings. Experience indicates mistakes are virtually irreversible or, at best, are exceedingly costly to correct. Air intake and discharge requirements must be resolved before almost all other design considerations due to the influence such decisions will have on all of the rest of the design. The University recommends a study in the vicinity of science buildings.

#### 10. Controls

The University has standardized its control systems into two specifications. These include a "Building Management System (BMS)" which consists of the controls, devices, and equipment which actually operate the building, and a "Building Automation System Integration (BASI)" which consists of the computer system that is the human interface to the system. This is often referred to as the "front end" or other such terms.



The purpose of this split is to allow standardization on one BASI for commonality among systems that the University's maintenance department must work with on a regular basis. This system is Tridium AX. It is the University's intent by doing this to allow a singular "look and feel" for a person who is operating any given system, regardless of the building controls behind it.

The BMS is then allowed to be virtually any controls system that can meet the specification, including integrating to the BASI.

In order to facilitate this integration, more detail is required in design than normally would be expected. The bid documents must include a points list and a graphics list, both which are described further in Section C.

The Consultant is required to participate in meetings (pre-engineering, engineering, and pre-installation) outlined in the specification in Section D.

#### 11. Fire Protection

All new University buildings shall be provided with wet-pipe sprinkler fire protection systems throughout, except where disallowed by code or dry-pipe type is required for freeze protection reasons. All systems shall be normal-hazard, or greater as may be required by code. Do not install in non-conditioned spaces.

#### 12. Irrigation

All landscaping closely associated with the building shall be provided with automatic irrigation. A separate BFP shall be inserted when taping into potable lines. Time-clock controls shall be located in the basement mechanical room and remotely located automatic valves shall be located in valve boxes. This is a non-potable water system and must be designed as such. Plastic piping is acceptable; not less than schedule 40. Zone the system so as to not mix dissimilar discharge components on the same zone.

Generally, the mechanical engineer should be responsible for the irrigation header in the mechanical room and piping within the building. The civil engineer or landscape architect shall be responsible for outside piping.



#### 13. Steam system

Steam on campus is distributed at 25-40 psi. Normal loop pressure is 30 psi. Distribution and use of steam is recommended where possible in lieu of electricity or natural gas. However, one should not use steam for direct humidification.

A pressure reducer valve (PRV) is recommended to maintain optimal building operational flow and pressure, especially during periods of varied steam distribution pressure.

#### G. Electrical Requirements

#### 1. Plans and Specifications

The Consultant will work with the University to develop a draft utilities distribution and connection drawing. The drawing is intended to be only diagrammatic. The Consultant shall make all provision required by codes, regulatory agencies, and industry practices for high quality installations. Conduit and cable sizes shown on the drawing are intended to be the minimum acceptable to The University and should be increased as design calculations may dictate. When design calculations have been completed, Consultants shall verify that service requirements can be met at the University's proposed points of service connection.

The Consultant's documents shall be complete for this project. Reference to other drawings and specifications is not acceptable except for nationally and locally accepted industry standards and codes. Due to the inherent complexity of science facilities, it is preferred that lighting, power and communications wiring not be shown on the same drawings when the scale is less than onequarter inch to the foot.

Complicated areas requiring careful coordination of trades in order to install all systems and maintain maintenance access shall be detailed with cross-section drawings at on-quarter inch to the foot or larger scale, showing all systems. Cross-sections shall be provided for all electrical equipment rooms to show the vertical relationship of important components. Such drawings shall ensure accessibility for routine operation, maintenance and repair. Burying apparatus



requiring operation, maintenance and repair above or behind fixed piping, conduit, ductwork, etc., is unacceptable.

#### 2. Primary Power

The University operates a three feeder 12780 KV primary electric power distribution system, distributed throughout the campus via undergrounds utility tunnels. New project must determine the available distribution capacity on the system as a result of this project.

#### 3. Power Distribution

Twenty years ago power was provided to laboratories on the basis of ten watts per square foot. Some of these laboratories area are being retrofit for forty watts per square foot. Granted, this is a local condition which was not anticipated. However, bringing the additional power is extremely expensive. The point is that there is no way to outguess what might become a large load special need. That, in turn, simply indicates that flexibility is imperative. Local distribution must continue to be done on some reasonable per-square-foot basis. However, more generous conduit sizing, sleeving, space allocating in principal electrical cabinets or closets, must make it reasonably convenient to bring in new feeders to supply unique high power requirements in the middle of an already amply supplied laboratory. Sleeving and conduit up-sizing is a modest-cost investment toward serving unknown future requirements, which can then be accommodated by the relatively inexpensive installation of additional size wiring and is recommended. Being frugal at this point is not in the best long term interests of the owner.

#### 4. Building Services

Prior paragraphs have proposed that some type of utility corridor be provided to serve a variety of purposes through laboratory areas. If such can be achieved, then it would be highly desirable to provide local electric panelboards, in the utility corridors, dedicated to individual or small groups of laboratories. The many panelboards would be best served via an exposed bus-duct system in the utility corridor with local disconnects to each panelboard. Such a bus-duct would then make it convenient to provide for spot loads which exceed the per-square foot average. The design should allow for the stacking of communication closets adjacent to the electrical closets.



#### 5. Lighting

Building occupants generally turn the lights on when they arrive and seldom turn them off. The design should take control of lighting controls. Greater use of motion sensors and photo-cells must be included but variability of switching levels will allow for flexibility in choosing optimum lighting levels. Over rides must be of some time-delay type that restores original control after a finite period of time.

Lighting control systems must also take into consideration their use by other than the normal building occupants; e.g., custodial staff, maintenance mechanics, etc, on/off control must be provided for service support staff otherwise sophisticated control systems may be aborted by frustrated staff who don't understand normal operation.

Four-foot fluorescent tubes are standard stock. Anything else is unacceptable as a design solution and shall be provided without specific approval of the University Engineer.

#### 6. Fire Alarm system

Major changes have been occurring with fire alarm systems due to (1) changing requirements of the City of Missoula Fire Department and (2) technological advancements in equipment and systems. Accordingly, direction will have to be provided on a project-by-project basis.

# The University of Montana

## Design & Construction Campus Policies & Procedures Consultant's Manual

### Section C Overall Campus Design Standards

Planning and Construction Facilities Services Bldg 32 · Missoula · Montana · 59812 2006



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#### I. Introduction

- A. This section contains specific University practices and standards that the Consultant needs to incorporate into the design of future University facilities.
- B. The criteria represents 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 to the users and taxpayers, while still supporting academic and research missions of the University.
- C. The general standard practices are grouped under major headings of ARCHITECTURAL, MECHANICAL, and ELECTRICAL.
- D. Any conflicts, real or perceived, between the requirements in listed reference documents shall be resolved by the Project Manager.

#### II. ARCHITECTURAL

#### A. Site Preparation

 Site preparation shall be specifically addressed in detailed specifications as part of the construction documents and include but not be limited by the following:

• CONSTRUCTION FENCING shall be a minimum of 6 ft high and made of galvanized chain link.

• TREE AND SHRUB PROTECTION shall be 4-ft high, plastic snow fencing with 6 ft long metal drive stakes or as stated in the approved Arborist's report. Tree and shrub protection shall remain in place until directed by the Arborist's report for removal. For the duration of construction, the Contractor shall provide minimum maintenance that shall include watering, fertilizing, and spraying for insects. The Contractor shall provide protection for roots and branches over 1  $\frac{1}{2}$  " diameter that are cut during construction operations by covering them with wet burlap and earth as soon as possible.

• CLEARING AND GRUBBING shall include the felling, cutting, and disposal of all trees, stumps, and vegetative debris produced by clearing operations. Excavation or grading within the branch spread



of trees to be saved shall be performed only under the direction of the Owner and the project's assigned Arborist.

• SELECTIVE CLEARING, THINNING AND PRUNING. In designated areas, prune trees 3 "in diameter to the full height of the affected trees. Pruning shall include the satisfactory removal and disposal of all debris material generated by the operation. Wooded areas shall be thinned out to provide space for healthy growth by the elimination of thinner, weaker trees.

• STRIPPING AND STOCKPILING OF TOPSOIL. Prior to starting general excavation, all topsoil shall be stripped from areas to be graded and shall be stockpiled in Owner approved locations for later use. Stockpiled topsoil shall be covered at all times until it is used.

• REMOVAL, SALVAGE, AND DISPOSAL. Items designated by the Owner, such as flagpoles, parking signs, dumpsters, trash bins, existing site lights, or others shall be carefully removed and salvaged. They shall be delivered to a stockpiling area identified by the Owner. All other materials, such as pavement, gutter / curb, and others shall be legally removed from the site.

See Appendix 7 for detained guidelines for tree and shrub preservation in construction areas.

#### **B.** Landscape and Planting

#### 1. Materials

- a. Topsoil
  - Topsoil shall be <u>6" minimum topsoil over loosened base</u> <u>material</u> friable, free from clay clumps, grass, brush, roots, stumps, toxic substances, litter, gravel, or other foreign material. Only screened topsoil to <u>1/2</u>" will be accepted. Topsoil shall not contain plant parts of Quackgrass, Knapweed, Leafy Spurge, Dalamation Toadflax, or other noxious weeds. Topsoil shall not be delivered in a muddy or frozen condition and shall meet the following analysis, to be verified by soil test and/or University representative. <u>Texture</u>: per USDA Soil Classification System

	<u>% by Volume</u>	
	Minimum	<u>Maximum</u>
Sand	9	30
Silt	30	75
Clay	10	27



Organic matter

1.5

<u>Soil pH</u> : 5.5 min. 7.0 max.

- b. Mulch for trees, shrubs and ground covers to be 3"-4" minimum depth.
  - i. Wood mulch shall be fir or pine bark, bark nuggets only (not shredded mulch).

#### 2. Plant Materials

- a. General All plant material shall conform to the species specified on the plant list. No size or type substitutions shall be permitted unless approved in writing or by the Landscape Supervisor, and only if the completion of the project would be materially delayed by unavailability of specified material. If plant material of a greater caliper or size is approved by the Landscape Architect, the diameter of the root ball and spread of foliage head shall be increased proportionately as required by "<u>Standard for Nursery</u> <u>Stock</u>," ANSI Z60.1, and meet all NAA standards for such stock. Whenever possible plant stock shall be obtained from a nursery that climatically approximates the growing conditions on campus.
- b. Deciduous trees shall be of the height and/or caliper indicated on the plant list with branching configuration required by ANSI Z60.1 for type and species required. Trees shall have straight trunks with single leader intact except where this is uncharacteristic for the particular species selected. Inverted bark ridges at branch crotches will not be accepted. Trees shall be balled and burlapped (B&B).

#### 3. Turf Materials

a. <u>The blend of seed used at the University for turf areas is an</u> <u>athletic turf mix. It is composed of:</u>

Kentucky Bluegrass	<u>40%</u>
Creeping Red Fescue	30%
Perennial Ryegrass [6.16.05]	<u>30%</u>

- b. Sod General
  - i. All sod shall be nursery grown, of high quality, and free of diseases, nematodes, and soil borne insects. Sod shall be free of noxious weeds, including but not limited to Knapweed, Leafy Spurge, Locoweed, Sulfur cinquefoil, Toadflox, Quack Grass, Annual Bluegrass, Poison Ivy, Yellow Nutsedge, Nimblewill, Canadian or Russian Thistle, Bindweed, Bentgrass, Wild Garlic, Ground Ivy, Perennial Sorel, Wild Violet, and



Nightshade. Sod shall be considered free of other weed types if less than 5 weeds are found per 100 square feet of area.

- ii. All sod shall be stripped at a uniform solid thickness of approximately 1 inch, plus or minus 1/4 inch. Measurement for thickness shall exclude top growth and thatch, and shall be determined at the time of field cutting. Sod thatch, uncompressed, shall not exceed 1/2 inch.
- iii. Root development shall be such that standard size pieces will support their own weight and retain their shape, when suspended vertically from a firm grasp on the uppermost 10% of area, or when rolled and unrolled 3 times.
- iv. Before stripping, the sod shall be mowed uniformly at a height of 2 to 2-1/2 inches.
- v. Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect survival of the sod.
- vi. Sod shall be harvested, delivered, and installed within a period of 24 hours. Sod not transplanted within this period shall be inspected and subject to rejection.
- c. Bluegrass sod shall contain a mixture of 100% by weight improved Kentucky Bluegrass (at least three certified varieties).
- Fescue sod shall be turf-type Tall Fescue sod or an approved mixture of improved turf-type Tall Fescue and improved Kentucky Bluegrass. Bluegrass content of the mixture shall not exceed 10% by weight.

#### 4. Miscellaneous Landscape Materials

- Black plastic edging shall be used. Edge King lawn edging by Oly-Ola with 1" bead. It shall be anchored by a 9" non-bending, steel staked, and carry a full 15 year replacement guarantee. For each 20 strip, a minimum of 6 stakes shall be used, and as many as required on curved installations. Only approved substitutes may be used.
- b. Timber Landscape Edging shall be 6 inches by 6 inches rough-cut, CCA treated, or pressure treated timbers with water-borne preservatives for ground contact as complying with AWPB LP-22. Edging shall be secured with a 12" spike for every 2 lined feet in a staggered fashion.
- c. Non-Selective Herbicide shall be Glyphosate as marketed under the trade name "Round-Up", or other approved herbicide.



- d. Antidessicant shall be an emulsion-type, film forming agent designed to permit transpiration, but retard excessive loss of moisture from the plants, such as "Wilt-Pruf", or approved equal.
- e. Weed Barrier Fabric shall be a water-permeable, black, polypropylene fabric, 4.0 to 5.0 ounces per square yard product.
- f. Tree Stakes and Guys Tree stakes shall be steel fence posts, 5 feet long, or duckbill anchors. Wire ties and guys shall be two-strand, twisted, pliable galvanized steel wire not lighter than 12 gauge. Tree straps shall be 1-1/2 inches wide, soft polymerwebbing with a brass grommet in each end for wire entry.
- g. Erosion Control Fabric shall be a mesh with uniform open plain weave of unbleached single jute yarn averaging 130 pounds per spindle of 14,400 yards. Weight of 48-inches-wide fabric shall average 1.22 pounds per linear yard. Staples for securing the fabric shall be 11-gauge, steel wire formed into a "U" shape 6 inches long.

#### 5. Quality of Materials

- a. Nursery Growing Conditions All plant material shall be grown in conditions as closely approximating the project site climatic conditions as possible. Balled and Burlapped (B&B) nursery stock shall be dug from field areas that are free from noxious weeds including Bindweed, Nutsedge, Nightshade, Rush Skeletonweed, Leafy Spurge, Knapweed, Toadflax, and Sulfur Cinquefoil.
- b. Nursery Stock Freshness All B & B plants shall be freshly dug nursery stock. Heeled-in stock or stock from cold storage shall only be accepted if it is impossible to produce stock that has been recently transplanted.
- c. Pruning Prior to Delivery Plant material shall not be pruned prior to delivery except as authorized by the Owners Representative.
- d. Condition of Nursery Stock All plants shall have a normal habit of growth for the species and shall be sound, healthy and vigorous, grown at a recognized nursery in accordance with accepted horticulture practice, and free of disease, insects, eggs, larvae and defects, including knots, sun scald, injuries, abrasions or disfigurement. All cuts over 1-1/4 inches shall be callused over.
- e. Specimen Quality Plants Bid prices shall permit using specimen stock which is "better than average nursery row material," particularly for large deciduous material and evergreen trees. The quality of the plant material, as it relates to plant health for a typical specimen of that particular species along with characteristic



branching habit, and, if applicable, symmetry will be the criteria for approval of said specimens along with size.

- f. Nursery Stock Measurements Plants shall conform to the measurements indicated on the plant list. The caliper of tree trunks shall be the diameter of the trunk measured 12 inches above the natural surface of the ground.
- g. Nursery Stock Inspection The Owner reserves the right to inspect plants at the source and/or on the site before planting for compliance with the requirements. All protective tree trunk covering shall be removed prior to inspection of plants on the site. <u>The Contractor shall furnish the Landscape Supervisor a list</u> <u>indicating the source of each of the plant types to be supplied.</u> This source list must be submitted within two weeks after receipt of the notice to proceed.
- h. Nursery Stock Delivery All shipments of plant stock shall comply with existing State and Federal laws and regulations governing plant disease, infection, and interstate, movement of nursery stock. Protective covering during delivery shall include the wrapping of all tree trunks with cardboard, or other approved material, and covering top to protect from wind burn. Nursery stock with loose or damage root balls will not be accepted.
- Nursery Stock Storage If planting is delayed for more than six hours after delivery, set plant material in a shaded area, protected weather and other acceptable means of retaining moisture. Contractor is responsible for watering the heeled-in nursery stock.

#### 6. Execution

- a. Preparation
  - i. Layout The location for all trees and outlines for all planting beds shall be staked on the ground by the Contractor and must be approved by the Landscape Supervisor before excavation of planting holes begins. Adjustments in planting locations shall be made by the Contractor as directed by the Assistant Director. The spacing between the center of shrubs and the edge of the bed shall be equal to the spacing between shrubs unless otherwise noted on the drawings.
  - ii. All existing turf and weed areas scheduled for planting bed development shall be sprayed with a non-selective herbicide such as Glyphosate, following manufacturer's recommended rate of application. Commencement of planting bed construction shall depend on herbicide manufacturer's recommended waiting period.



- iii. For all proposed turf areas and planting beds outside of the dripline of existing trees, subgrade soil (6 inches below finish grade) that has been compacted by vehicles, equipment, material storage, and other areas designated on the drawings, shall be plowed to a depth of 12 inches in two directions at 90 degrees to each other by a chisel tooth plow or other suitable machine to loosen the subsurface of the soil. After plowing, the area shall be regraded to a smooth and even grade. The top 6 inches of topsoil shall be free of scrap lumber, trash, rocks larger than 3 inches diameter, concentrations of crushed rock, scraps of waste concrete and asphalt, and other deleterious materials prior to topsoil placement.
- b. Planting of Trees and Shrubs
  - i. Excavated pits for individual trees and shrubs shall be circular with rough edges and vertical sides. Pits for all B & B trees and shrubs, and container grown shrubs shall be at least twice as large as the root ball diameter and equal to the ball depth. For pits excavated with an auger, scarify and loosen hard soil on sides of excavation prior to backfilling.
  - ii. <u>Plant trees with root ball shall be 2" above grade. Install bark</u> <u>mulch to fill 2" level difference</u>. Immediately prior to planting time, remove the container from nursery stock. Vertically cut around the root ball at approximately 4 to 6 inch intervals and "fluff" the roots by hand to encourage root growth into the surrounding soil. Do not girdle the plant. The growing medium shall be thoroughly watered prior to removal of the container.
  - iii. Plants shall be set in the center of the pit directly on undisturbed soil. Plants shall be plumb. The plants shall be set so that they are planted at the height originally grown at the nursery of origin. Trees and shrubs, depending on size, shall be planted 1/2" higher in heavy soil.
  - iv. After setting the plants, backfill the lower one-third of the planting pit with native topsoil and tamp lightly to secure the root ball in place. Frozen or muddy topsoil, or topsoil containing clods greater than 3 inches in diameter, shall not be used for backfilling plant pits. Fill all voids. Remove all burlap and lashing from the top onethird of the root balls. Excess burlap shall be cut off and removed from the plant pit. If wire baskets have been used to secure B & B stock, remove it entirely, taking care not to break apart the root ball.
  - v. Fill the remainder of the planting pit with water and allow to settle thoroughly. Backfill the planting pit with topsoil and construct a shallow saucer on the finished grade by forming a shoulder or ridge



of topsoil around the edge of each pit or planting group. Fill the saucer with water.

- vi. Contractor shall be responsible for 100% vegetation kill in tree and shrub areas prior to placing mulch. Glyphosate may be used to kill vegetation within the mulch area. Rate of application and use of Glyphosate shall strictly follow the manufacturer's recommendations.
- vii. Thoroughly till shrub beds to a depth of 6 inches prior to installing plants.
- viii. In areas designated on the drawings, install weed barrier fabric with "smooth side" facing toward the ground and a minimum edge overlap of 6 inches. Secure edges and seams with 6" by 1" by 6" wire staples at 5'-0" spacing.
  - ix. Mulch all shrub beds with a continuous 3-inch deep blanket of mulch. Around freestanding trees, construct a spaded trench 4 inches deep. Provide a gradual slope from the bottom of the trench to the top of the planting bed. The top of the mulch layer shall be 1 inch below the top of the adjacent surface.
  - x. Wrap tree trunks of 1-1/2 inches caliper and larger with doublelayered kraft paper. Wind wrapping from the base of the tree to the second tier of branches with an overlap of 1-1/2 inches. Secure the wrapping at the top with two complete windings of black electrical tape or approved equal. Warp within seven days after planting. Wrap all ornamental trees and shade trees except evergreens, River Birch, and Hawthorns.
  - xi. Power spray anti-desiccant to provide an adequate film over trunks, branches, stems, twigs, and foliage. The use of an anti-desiccant shall be required for all B & B coniferous evergreens with an application to be made at the nursery and another made two weeks after planting. If the project schedule requires that B & B deciduous stock be moved in full-leaf, an application of the antidesiccant shall be made at the nursery prior to transport and again two weeks after planting.
  - xii. All trees shall be staked immediately after planting as detailed on the drawings. Stakes shall be placed 4-6 inches outside the edge of the tree pit. All trees less than or equal to 3 inch trunk caliper shall require 3 stakes. The tree straps shall be placed above the first branch and secured to the metal stakes with galvanized wire with sufficient tension to support the tree. <u>Stakes shall be removed</u> <u>after 1 year of placement.</u>
- c. Planting of Ground Covers and Herbaceous Perennials



- Amend growing medium in planting beds to a depth of 8 inches with the following soil mix: 1/3 topsoil, 1/3 compost, 1/3 peat moss <u>at all shrub areas</u> (unless otherwise noted on the drawings). Growing medium shall be mixed thoroughly prior to setting plants.
- ii. The plants shall be set so that, after settlement, a normal and natural relationship of the crown of the plant with the surrounding finish surface grade shall be established. If root growth is concentrated against the sides of the container, "fluff" the roots by hand, or use split ball technique as required, to encourage root growth into the surrounding soil mix. The growing medium shall be thoroughly watered prior to removal of the container.
- iii. Apply approved fertilizer to the planting bed at manufacturer's recommended rate.
- iv. Mulch planting beds with a continuous 2-3 thick blanket of compost, topsoil, and peat/manure. Along curbs, turf areas, and pavement surfaces, construct a spaded trench 3 inches deep.
  Provide a gradual slope from the bottom of the trench to the bottom of the trench to the top of the planting bed. The top of the mulch layer shall be 1 inch below the top of the adjacent surface.
- v. Thoroughly soak the top 6 inches of the planting bed with water after planting.
- d. Planting of Turf Areas Sodding
  - i. Sod shall NOT be installed until the irrigation system is in place.
  - ii. All areas to be sodded are indicated on the drawings.
  - iii. The sodding operation shall not commence until site conditions are satisfactory. Sodding shall not be done when the ground is excessively wet, frozen, or untillable.
  - iv. All areas to be sold shall meet the specified finish grades before sodding and be free of deleterious materials, including weeds, existing grasses, tree branches, oil drippings, stones greater than V<sub>2</sub> inch diameter, concentrations of crushed rock, mortar and other loose building materials. Finish grade shall consist of a minimum 6 inch layer of topsoil except where greater thicknesses are noted on the drawings. Grades for the flow lines of swales and ditches, detailed on the drawings, shall be carefully established at level even with the thatch surface of the sod. Sod placement, rolling, and watering shall conform with the grades shown on the drawings.
  - v. Sod shall be installed in tightly abutted parallel rows with the lateral joints staggered at a minimum distance equal to the width of the sod slab. Voids between sod strips will not be accepted.



- vi. For sloping surfaces, sod shall be laid beginning at the base of the slope, with staggered joints and at right angles to the flow of water. Sod placed on 3:1 slopes or steeper, and in ditch flow lines, shall be staked with 6 stakes per square yard or roll of sod. Stakes shall be wood, 1/2 inch by 1 inch by 12 inches, and shall be driven in to the ground, leaving approximately 1/2 inch of the top above the sod line. Stakes should be set sufficiently in the ground to permit mowing.
- vii. The sod shall be watered immediately after installation. Prevent sod from drying during progress of work. After sodding is completed in any one section, the entire area shall be thoroughly irrigated to at least one inch depth below the new sod pad.
   Subsequent watering should maintain moisture to a depth of at least 4 inches.
- viii.Maintenance shall begin immediately after planting. The sod shall be protected and maintained by watering, mowing, fertilizing, and replanting for as long as it is necessary to establish a uniform strand of grass. Any sod not surviving prior to its first mowing shall be replaced with new sod from the same source. Mowing of the sod will be the responsibility of the owner.
- e. Relocation of Existing Trees and Shrubs
  - i. Trees and shrubs to be relocated shall be balled and burlapped (B & B) according to accepted nursery industry standards. Plants shall be dug with firm natural balls of earth in a diameter not less than specified by "<u>American Standard for Nursery Stock</u>," ANSI Z60.1 and shall be securely wrapped with burlap or canvas, and tightly bound with rope or wire.
  - ii. Trees and shrubs shall be immediately replanted or heeled-in after digging in accordance with the specifications of this section.
- f. Installation of Landscape Bed Edging (Plastic)
  - i. Place edging in areas indicated on the drawings.
  - ii. Installed edging shall be a smooth and consistent line. The top portion of the edging shall be installed with the bead above the finish grade of the adjacent turf root crown and 1/2 inch above the mulched bed.
  - iii. Place the stakes at 3 feet on center. Place the projecting "barb" of the edging on the turf side of the planting bed. Tamp soil tightly against "barb."
- g. Installation of Landscape Bed Edging (Wood Timbers)
  - i. Place edging in areas and with dimensions indicated on the drawings.



- ii. Installed edging shall be flush with the grade of the adjacent turf area and 1/2 inch above the mulched bed, unless otherwise indicated on the drawings.
- iii. Anchor edging with reinforcing rod placed not more than 3 feet on center and driven at least 24 inches into the subgrade. Stakes shall be placed in holes that are drilled on center with the timber edging. Four galvanized 12" spike shall be used per 2 lineal feet.
- h. Clean-up and Protection
  - i. During the course of landscape work, waste and excavated materials not to be reused shall be continuously and promptly removed. Pavements and associated landscape areas shall be kept clean and the work area shall be kept in an orderly condition.
  - ii. Protect landscape work and materials from all damage. Maintain landscape protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed by owner's representative.
- i. Plant Guarantee and Maintenance Requirements
  - i. All trees, shrubs, ground covers, and herbaceous perannials shall be guaranteed by the contractor to be in vigorous growing condition. All plant material shall have a growth guarantee of <u>one</u> <u>full year</u>. Replacements shall be made at the beginning of the first succeeding planting season at the owner;s request. Dead plants, and plants not in a vigorous growing condition, shall be promptly removed and replaced at the contractor's expense. The guarantee period will begin upon acceptance of the work.
  - ii. The maintenance of the seeded turf areas shall be the contractor's responsibility until the new grass is 4 inches high and thick enough to receive its first mowing by the owner. Until the first mowing, the contractor shall apply the herbicide bromoxynil, or approved equal, at the label rate, one month after seeding to kill any broadleaf weeds. Water as necessary and reseed bare spots which are larger than one square foot in size. Contractor shall protect seeded areas by watering, fertilizing, applying weed killer, and replanting as necessary, for a uniform stand of established grass, or until approved by the owner's representative. Scattered bare spots, no larger than one square foot, will be allowed up to a maximum of 5% of any planted area.
  - iii. The maintenance of sodded turf areas shall be the contractor's responsibility until the first mowing by the owner. The first mowing will not be attempted until the sod is securely in place, uniform in appearance, and the turf leaves have reached a height of 4 inches.



#### C. Irrigation

#### 1. General

- a. The Irrigation system shall have:
  - i. Adequate head-to-head overlap & coverage.
  - ii. Mains buried at 24" minimum and laterals at 18".
  - iii. Pipe that is Sch. 90 PVC (polypipe shall be considered only at valve engineering.)
  - iv. Rainbird or Hunter heads. No impact heads allowed (only pop-ups & rotors).
  - v. Quick couplers for blow-out purposes.
  - vi. An automated system, using Rainbird or Hunter stations.
  - vii. Locate station near an exterior wall of building in waterproof enclosure.
  - viii. Proposal or target of digital control of automatic clocks over Internet by central control for water conservation.
  - ix. No drip irrigation but use bubblers instead where warranted.
- b. Irrigation system shall be installed in all areas that are finished with grass, flowerbeds and shrubs. The system shall have a connection to a water supply and electrical system.
- Piping inside the building shall be Type L copper and after penetrating the basement wall galvanized Sch. 40 pipe shall be used for direct burial up to the Watts 909-700 backflow preventer (BFP). BFP shall have unions on each side. Use Sch. 40 PVC downstream of the BFP.
- d. Fittings for copper pipe shall be solder joints, copper or brass. Soft solder joints shall not be accepted for underground installation.
- e. Irrigation distribution piping starting 5 FT. outside of the building shall be PVC Sch. 40. Piping mains shall be installed 12 inches deep and shall have copper wire installed on top to allow for pipe tracing. Wire shall be accessible in 6 " Test Box to induce signal.
- f. Fittings shall be schedule 40 PVC.
- g. Valves shall be 150-lb. bronze with solder joint ends.
- h. Zone valves for automatic sprinkler systems shall be heavy-duty electric solenoid valves. Valves shall be for 24-volt operation.
- i. Laterals & risers for sprinkler heads shall be 100 psi poly.
- j. Valve boxes shall be 12" x 18" minimum; 2 valves per box maximum
- k. Wiring for electric valves shall be Type UF used for valve circuit wiring. All wire splices shall be soldered, properly insulated, and



waterproofed. Wiring shall be a min. of single conductor 14 gage irrigation wire, UF rated for direct burial with a max. run of 2400 linear feet. Two extra wires to far box for future use.

I. Provide a quick coupler at the backflow preventer for connections to air compressor for winterization.

#### 2. Scope of Section

a. Irrigation shall be designed by a designer with a minimum of five years experience in irrigation system design and/or certification from a nationally recognized organization.

#### 3. Water Source

a. Main Campus: Water service for irrigation systems shall be obtained from a location identified by the Office of Facilities Services.

#### 4. Materials

- a. Piping
  - i. Pipe shall be Sch. 40 PVC for main lines and 100psi poly for laterals.
- b. Valves
  - i. Electric valves shall be Rainbird PE series, or equal. Valves shall be tagged with permanent appropriate zone number on corrosion resistant tags.
- c. Zone Control Wiring
  - i. Control wires shall be a minimum of 14 gauge copper singleconductor wire with vinyl insulation. Wiring connectors shall be waterproof connectors, equal to Rainbird.
  - ii. Wire color code: Provide control or "hot" wires is red for each zone and black for spare. Provide white for common or "ground" wires.
- d. Valve Boxes
  - i. In areas that may be subject to vehicle traffic, valve boxes are to be traffic-rated. In other areas, valve boxes shall be green PVC with locking lid.
  - ii. Acceptable Manufacturer: Ametek 12 inch "Superflexion," or equal.
- e. Irrigation Head Fittings
  - i. Fittings at irrigation heads shall be pre-manufactured swing joints.
- f. Irrigation Riser Pipe
  - i. Irrigation riser pipe shall be 100 psi poly.



- g. Shrubs Adapters/Pop-up Spray Heads
  - i. Shrub adapters/pop-up spray heads shall be VANS (variable angle nozzle spray).
- h. Pop-up Rotors
  - i. Pop-up rotors shall be a minimum Rainbird or Hunter. No other substitutes equal.
- i. Automatic Controllers
  - i. Automatic controllers shall be Hunter ProC or Hunter ICC or compatible with Maxi-com central control system. Install in a lockable water-proof, rust-proof wall-mounted cabinet on the exterior of the building. Contractor shall install an as-built map (in a waterproof cover) showing all the zones color-coded and placed in the Controller box.
- j. Backflow Prevention Devices (BFPD)
  - i. Use Watts \_\_\_\_\_, no substitutes

#### 5. Execution

- a. Piping
  - i. Minimum depth of irrigation piping shall be 18" below grade. Piping installation shall include Piping shall be laid in 6" of bedding sand in trenches for mains. Poly pipe may be pulled in lieu of trenching.
  - ii. Sprinkler heads, valve boxes, etc., shall be installed so as not to interfere with mowing operations.
- b. Valve Wiring
  - i. Wires are to be bundled and taped together every 10 feet. Lay the wire beneath pipe.
- c. Wire Diagram
  - i. Provide a written description keying each wire color to the appropriate zone and post it on the inside of the cabinet door. Also, provide a separate diagram for owner's records.
- d. Wire Splicing
  - i. Where needed use water-proof splice kits as directed by irrigation manufacturer. Irrigation field splices need to be indicated on record drawings.
- e. Irrigation Record Documents
  - i. Provide a minimum of three copies to University. Diagram shall show location and type of all control valves, irrigation heads, irrigation piping, sleeving, controllers, power source, water meter source, and all field splicing locations.
- f. Backfill



- i. Provide approved earth fill or sand to a point 4" above the top of pipe.
- ii. Backfill shall be free from all foreign materials larger than 2" diameter.
- iii. Compaction of subgrade within 6" of surface shall be in 6" layers with 95% compaction.

#### D. Thermal Insulation

- 1. Fiber Glass Batt Insulation
  - a. Refer to IECC 2003 Standards and LEED guidelines for appropriate levels of insulation.
- 2. Exterior Insulation and Finish Systems (EIFS) are not allowed on campus.

#### E. Roofing

- **1.** University Roofing Options:
  - a. No asphalt singles
  - b. Sloped roofs will have a standing seam of 24 ga. minimum.
- **2.** Three types of materials
  - a. Metal tile/shingle profile
  - b. Concrete tiles
  - **c.** Copper shingles
- 3. Mounting mechanical equipment on the roof is not recommended. Mechanical equipment shall be in penthouses.

#### F. Doors & Windows

- 1. Doors in high-traffic areas, loading docks, operating rooms, and corridors should be metal doors.
- 2. Locations for the installation of card readers should be confirmed by a representative of the University and included in the design of the exterior doors. Electric magnetic door holders shall be included in the design of corridor doors. The holders shall be located at the top of the door. Coordinate with Fire Alarm system. See Appendix 5 Griz card.
- 3. Mineral core doors are strictly prohibited.

#### G. Security Reader (Griz Card)

1. The University's Student Affairs department is responsible for the card reader systems for academic, administrative and housing facilities (Griz Card). This includes termination, installation,



maintenance, and monitoring of the Griz Card equipment. This also includes providing all card reader equipment. The Consultant or Project Manager should consult with the Student Affairs department during the design and construction phases of any project that includes Griz Card readers.

2. Appendix 5 contains the 'Security Reader Installation and Setup Manual' from Blackboard Inc.

#### H. Painting

#### 1. Location: type of paint/instructions

- a. Stairwells, corridors/ Durable, washable finish; semi-gloss latex (100% acrylic)
- b. Offices/ Durable, washable finish; semi-gloss latex (100% acrylic)
- c. Classrooms/ Durable, washable finish; semi-gloss latex (100% acrylic)
- d. Laboratories/Washable epoxy finish where required by researcher/Washable latex semi-gloss in other labs.
- e. Custodial room/Semi-gloos, acrylic as a minimum. Epoxy preferred.
- f. Elect./Mech. Rooms/Semi-gloss acrylics
- g. Food-preparation/2 parts epoxy, washable, certified for food service kitchens
- h. Food Service/Dining areas/Semi-gloss, 100% acrylics, washable surfaces.
- i. O&M manual/Shall include a complete list of all types, colors, & textures of paint types used on the project with areas-room numbers of where the paint was used identified.
  - Use low-odor, low VOC paint for interior finishes.
  - When painting is in occupied spaces, use low odor, zero VOC paint
  - Under no circumstances shall on-site lacquer painting be permitted.

#### III. MECHANICAL

#### A. General Mechanical Standards

- 1. The following information is provided as a guide for designing Mechanical/HVAC, piping and utility systems.
- 2. Major equipment shall be provided with adequate pressure, temperature, and flow indicators at the time of installation to



establish unit performance.

- 3. Equipment shall be provided with bearings lubricated for life by the manufacturer or built in automatic lubrication system where possible. Where periodic lubrication is needed, the specification shall require the lubrication points to be readily accessible for lubrication.
- 4. Electric heating systems shall not be used.
- 5. Access doors shall be provided to coils, filters, motors, belts, etc.
- 6. Vibration and sound transmission from mechanical equipment shall not exceed ASHRAE sound criteria.
- 7. All motors shall be high efficiency.

#### B. Heating and Cooling Loads

- 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 <u>ASHRAE Handbooks</u>.
- 2. Indoor design temperature and humidity conditions for general comfort applications shall be in accordance with the comfort criteria established in the latest edition of ANSI/ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy of ASHRAE Fundamentals Handbook.
- 3. Ventilation systems shall be designed to provide air ventilation rates in accordance with the latest edition of ANSI/ASHRAE Standard 62.
- 4. 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 in accordance with <u>ASHRAE 90.1.</u>

#### C. Insulation

- 1. Provide insulation on equipment, pipes, and ducts where:
  - a. Heat transmitted will significantly affect ambient temperatures in controlled spaces.
  - b. Heating or cooling effects will be significantly affected due to heat flow into or out of pipes or ducts.
  - c. Condensation will occur as a result of surface temperature approaching dew point of the ambient air.
  - d. Significant energy loss would result from heat transfer.
  - e. Personal injury may result.



- 2. All plumbing systems shall be insulated.
  - a. <u>All</u> cold & hot water supply including hydronic lines
  - b. Roof drainage piping.
- 3. Insulation shall have a flame spread rating of 25 or less, a fuel contribution rating of 50 or less, and a smoke development rating of 50 or less.
- 4. Insulation containing asbestos is prohibited.
- 5. Insulation type and thickness shall be in accordance with ASHRAE Standard 90 or IECC latest edition.

#### D. Distribution Systems

- 1. Supply/Return air systems shall be designed in accordance with the latest addition of the ASHRAE Fundamentals Handbook.
- 2. Provide balancing dampers at all branch ducts locations and where required to facilitate balancing. Dampers shall be opposed blade type when minimum duct dimension is 12" or greater.
- 3. Variable air volume systems shall be installed whenever feasible.
- 4. Pilot tube test port stations shall be provided in all locations as required to determine fan system or zone air volumes.
- 5. The use of flexible duct shall be limited as follows:
  - a. Maintain (adequate) length of ductwork before and after fan and fittings (per SMACNA).
  - b. No greater than 5 feet in length.
  - c. Shall not be used as part of main or upstream of variableair-volume (VAV) boxes.
  - d. Exhaust systems shall be designed in accordance with the latest edition of the Industrial Ventilation Manual by the American Conference of Government Industrial Hygienist.
  - e. Piping systems shall be designed in accordance with the latest edition of the ASHRAE Fundamentals Handbook.
  - f. Provide shut-off valves at pipe branches to facilitate partial system isolation.

#### E. Metering

- 1. Provide at:
  - a. The domestic water line entering a building shall be metered <u>Totalizer only</u>.
  - b. The steam condensate line exiting a building shall be metered.
  - c. Ground water supply & injection shall be metered. Locate readout & remote readout & Totalizer.
- 2. Metering points shall be provided for utilities which shall include



adequate straight lengths of pipe, and isolation valves. Straight lengths of pipe shall be a minimum 10 pipe diameters in front and 5 pipe diameters down stream in length with 40" of clear space above.

a. Meters shall be located within 60" AFF & be easily readable.

#### F. Steam Piping

- 1. Steam piping expansion joints shall be grease pack type.
- 2. Steam piping slides/guides shall be "spider" type.

#### G. Equipment Location

- 1. All HVAC equipment shall be located to facilitate maintainability and replacement, 18" for personnel access & 36" around valves and electrical.
- 2. 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.
- 3. All mechanical equipment/systems shall be installed on concrete pads, and where required steel support framing as required to allow proper housekeeping, drainage, and access.
- 4. For rooftop equipment, 12" roof curbs shall be utilized as a minimum.

#### H. Heating, Ventilating, and Air-Conditioning (HVAC) Equipment

- 1. Equipment shall have a minimum efficiency at the specified rating condition, not less than the values shown in ASHRAE Standard 90.
- 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.
- 3. Chillers Options
  - a. Make use of existing chilled water distribution system and existing chiller.
  - b. Provide new chiller, but use the existing distribution system as much as possible.
  - c. Provide new chiller with new chilled water distribution system.
- 4. Chillers shall be furnished with chilled water temperature reset capability.
- 5. The design of cooling towers shall consider energy



conservation techniques when economically feasible, e.g., 2-speed fans, fan control, etc.

- 6. Provisions shall be made for complete tower drain down, and ladders and walkways shall be installed to allow access to tower fans, motors, gear boxes, etc.
- 7. Screens shall be provided around cooling towers.

#### I. Controls

1. The draft specifications provided in Section D are constantly changing documents. The copies provided in this document are most likely out of date since the control specification work usually commenced nearly at the end of the design. This is often long after this document has been provided to the consultant and the consultant shall request the most recent version.

2. Consultant shall utilize the draft specifications as the starting point for development of the controls specification for this project. Thorough evaluation of them for completeness, accuracy, and applicability to the specific project is expected. Changes as required to make them complete may be made only with the authorization of the owner. Such changes shall be proposed by the consultant and made collaboratively. The consultant is ultimately responsible for the specifications included in the contract documents.

3. The consultant shall develop a points list specific to this project. An example is included in Appendix 10, for reference on how this was achieved on other projects. Other examples are available from the owner, if desired. This points list is key in ensuring proper integration between the BMS and BASI. It specifies exactly what points must be incorporated in the BASI. This tells both the BMS and BASI contractors that they must be able to pass and share this information. Therefore, both BMS and BASI specifications shall include a reference to the points list.

4. The consultant shall also develop a graphics summary. An example is included in Appendix 10, for reference on how this was achieved on other projects. Other examples are available from the owner, if desired. This document outlines to the BASI contractor exactly what information shall be grouped together on graphical pages. It also outlines how that information shall be shown. The



intent of this document is to maintain the similarity between existing graphics and new ones. It is the consultants responsibility to ensure that this document accurately portrays the existing graphics, and incorporates any improvements requested by the owner.

5. The consultant must be aware that this controls specification forces a design slightly different than they may be accustomed to. Often times a lot of the detail design of control sequences, interlocks, safeties, etc are left to the controls contractor. The meetings outlined in Section D require participation by the consultant, and these are intended for full collaboration on ensuring that the system will operate as designed given the constraints that may not be apparent during the design phase. This collaborative effort has proven very successful in ensuring the building operates within the needs of all parties.

6. Because of the unique nature of these specifications, the consultant may want to seek out personnel with expertise in controls systems for assisting with these specifications.

#### J. Fire Protection

- 1. All new buildings shall be designed with automatic fire protection systems throughout the building. Wet pipe type system is preferred.
- 2. Fire protection systems shall be provided as required by BOCA.
- 3. Test valves, gauges, site glasses, etc., shall be located within mechanical rooms and with easy access.
  - a. Include pipe test connection on exterior of building.
  - b. Exterior fire fighting water connections shall be sized according to requirements of the local fire district.

#### K. Refrigerant Cooling Systems [less than 10 tons]

#### 1. General design guidelines

- All refrigerant systems shall comply with ASHRAE 90.1 and IECC latest edition – reference Appendix 2 – Energy Guidelines.
- b. New cooling units shall be ground water. Smaller package units, where required, shall have outdoor air economizer.



- c. All roof mounted condensing units shall be designed to 105°F outside air temperature.
- d. Consideration shall be given to accessibility for service when locating all equipment.

#### 2. Material

- a. All piping and fittings shall be copper except in an evaporative condenser, where <u>ACR</u> steel piping is acceptable. Long radius fittings are preferred for HVAC systems where space allows and are required for refrigerant systems.
- b. All valves shall be full port. Provide isolation valves on each side of driers. The designer shall evaluate the need for check valves on the discharge of compressors, especially when the condenser is higher than the compressor. The discharge from all relief valves shall be piped to the exterior of the building.
- All solder shall be 15% silver solder except on connections to expansion valves, sight glasses, and driers where "Stabrite" solder is acceptable.
- d. Insulate suction and hot gas bypass in all locations and discharge lines if exposed in occupied areas. For units above 5 tons, use 1" fiberglass insulation. For smaller units, use 1/2" closed cell foam insulation, minimum. All insulation shall comply with ASHRAE 90.1. All insulation on exterior piping shall be protected by an aluminum jacket.
- e. Label all lines at all access points and every 20' of exposed piping with the type of refrigerant contained in the lines.

#### 3. Equipment

- a. The designer shall evaluate the need for vibration eliminators, especially where the compressor is located inside the building.
- b. Compressors
  - i. All compressors shall be supplied with a 5 year warranty.
  - ii. Multiple units are preferred over larger single units. Each unit shall be able to be isolated by valves.
  - iii. All compressors shall be single speed.
  - iv. All 3 phase units shall have adjustable, voltage monitors for each phase, with manual reset.


- v. Provide recycle timers and crankcase heaters with all compressors.
- vi. Provide high and low pressure switches.
- c. All solenoid valves shall have a manual lift stem.
- d. Provide driers on all liquid lines with isolation valves on each side of the drier.
- e. Condensing units, if designed to operate at less than 55°F, shall be provided with hot gas bypass and with condenser fan cycle control operated from the head pressure.
- f. All coils shall have copper tubes and aluminum fins.

## L. Water Cooling Systems

#### 1. Ground Water Cooling System

- a. Well
- b. Piping to Building
- c. Frequency Drive
- d. Plate heat exchanger

#### 2. Interior Chilled Water Systems

- a. Piping
  - i. PVC shall not be used for chilled water systems above ground.
  - ii. Welded steel systems shall use black steel piping and fittings, ASTM A120, Schedule 40. The minimum pipe size shall be 3/4".
  - iii. Copper systems shall use a minimum of Type L copper. The solder shall be lead-free.
- b. Valves
  - i. Control valves shall be globe valves.
  - ii. Isolation valves, for pipe sizes 2" and smaller, shall be full port ball valves. For pipe sizes larger than 2", the isolation valves shall be butterfly valves.
  - iii. Autoflow or balancing valves shall be pressure port plug valves.
  - iv. 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. Insulation
  - i. All insulation shall comply with ASHRAE 90.1 and IECC.



- ii. All insulation shall be either fiberglass, flexible unicellular foam, or cellular glass. <u>No asbestos</u> insulation shall be used.
- iii. All interior piping, that is exposed in occupied areas, shall have an all service jacket (ASJ) PVC jacket installed. This jacket shall be painted to match the surrounding background.
- iv. All interior piping that is exposed in mechanical rooms, and is within 6' of the finished floor, shall have an aluminum jacket installed.
- v. All penetrations through firewalls, or floor or roof decks shall have firestopping material installed at the penetrations.
- d. Hanger design, application, and installation shall comply to <u>International Mechanical Code (IMC).</u>
- e. All chilled water systems shall have a <u>manual</u> fill and makeup connection installed. A <u>reduced pressure zone (RPZ)</u> backflow preventer shall be installed at each connection. It is preferred that the connection be sized to allow the filling of the system in approximately 4 hours. However, the size should be evaluated in relation to the cost of the backflow preventer. Adequate drainage shall be provided for the discharge of the RP (to sanitary sewer).
- f. All chilled water systems shall have an air separator installed.
- g. Equipment
  - i. The selection of all equipment shall comply IECC and ASHRAE 90. reference Appendix 2 Energy Conservation.
  - ii. All motors shall be premium efficiency.
  - iii. All equipment shall be mounted on isolation pads.

# 3. Ground Water Cooling

- a. Cooling Towers
  - i. The minimum standard of quality is a fiberglass structure with stainless steel fittings and PVC fill. The designer shall evaluate the cost/benefit of using stainless steel tower for each installation.
  - Consideration shall be given to the aesthetic qualities of any towers located in the view of the public. A screen or other method of removing the tower from



view may be appropriate in some situations. <u>Screen</u> should match exterior finish of building.

- iii. If year around operation is desired, a dry-basin type tower is preferred over sump heaters.
- iv. Gravity flow distribution systems are preferred.
- v. A five-year warranty shall be provided with each cooling tower.
- vi. All cooling towers must have CTI certified performance.
- vii. The designer shall evaluate the use of 2-speed or variable speed fans. All variable frequency drives shall be installed with a bypass switch.
- viii. All cooling towers shall have extended lubrication lines.
- ix. All cooling towers shall have vortex breakers installed on cold water sumps.
- x. The designer shall evaluate the cost/benefit of aluminum or fiberglass support systems over coated steel.
- xi. Cooling towers shall be located on grade.
- b. Chillers
  - i. The type of chiller to install shall be determined by the Energy Management Engineer for chillers larger than 100 tons.
  - ii. The designer shall consider efficiency losses over time when sizing the cooling tower for a chiller.
  - iii. Chiller controls shall be digital type controls. For systems larger than 100 tons, controls shall be integrated with the building EMCS. A hand-off-auto switch shall be provided to allow local control or EMCS control. All control panels shall be provided with interface capabilities for connection to the EMCS for demand control and chilled water reset.
  - Provide thermometers and pressure gauges for the entering and leaving condenser and chilled water and the bypass lines. The thermometers shall be 6" dial type. Mercury thermometers are not allowed in this application.
  - v. Provide hour meters on electric chillers.
  - vi. Provide flow meter/switch combinations on chilled water, condenser water, and steam lines.



- vii. Consideration shall be given to sound attenuation when designing the location and installation of a chiller.
- viii. Condensate coolers shall be used on absorption chillers.
- ix. All pipe connections to chillers shall be flanged.
- x. All cold sections and lines shall be insulated.
- xi. All chillers shall be installed on housekeeping pads that are a minimum of 4" in height.
- c. Pumps
  - i. 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.
- d. Expansion tanks
  - xii. All expansion tanks shall be located on the suction side of pumps and shall be diaphragm type.
  - xiii. All condensing water systems shall have stainless steel strainers installed.
- e. Controls
  - i. All equipment shall have a hand/off/auto switch installed to allow manual override of the normal controls.
  - ii. Chiller controls shall be digital and shall include the capability to interface with the Energy Management Control System for chilled water reset, demand limiting, and remote start/stop.
- f. Water Treatment
  - i. The designer shall coordinate the design of the water treatment system with **University** Maintenance.

#### STEAM AND HOT WATER HVAC SYSTEMS – detail to be added. 1.Distribution (Steam) a.Manholes b. Medium and Low Pressure Steam (Above grade) c.Hot Water

#### M. Air Handling Systems

#### 1. General requirements

a. Design of air handling systems shall comply with <u>ASHRAE</u> <u>90.1 and IECC reference Appendix 2 – Energy Guidelines.</u>



- b. Equipment shall be limited to the fewest number of components practical.
- c. Variable Air Volume (VAV) systems are preferred.
  - i. Economizer cycles are preferred but should be evaluated on a cost/benefit basis. If an economizer cycle is used, a return air fan is suggested to prevent over pressurization of the conditioned space.
- d. All systems that use 100% outside air should be evaluated for the use of heat recovery systems.
- e. All designers shall consider noise and ease of maintenance when locating equipment.
- f. A drawing shall be mounted near the air handling unit showing the as-built locations of all fire dampers, balancing dampers, VAV boxes, coils, and other equipment in the ductwork served by that unit. The drawing shall be protected by glass or other suitable material.
- g. The location of outside air intakes shall be carefully considered to prevent intake of exhaust from other systems or equipment.

# 2. Comfort systems

- a. Air handling units
  - For new construction, and existing buildings where possible, locate all air handling units inside the building or in a penthouse. Rooftop and above ceiling locations are not preferred. Variable air volume (VAV) boxes should be located in corridors or other common areas whenever possible.
  - All units shall provide thorough mixing of outside and return air. Blow-through units are preferred over draw-through units. The designer shall evaluate the need for engineered mixing boxes, blenders, or other methods to prevent stratification of the air.
  - iii. Hinged access doors shall be provided on all units to provide access to filters, coils, fans, dampers, etc.
     Door handles shall be used on these doors. Bolted panels are not acceptable except on very small units.
  - iv. All drain pans shall be 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. For example, if a unit requires a 6" trap, a 4" housekeeping pad would not be sufficient.

- v. All units shall have a magnahelic type filter pressure differential indicator installed with a manifold and valves to isolate the lines to each side of the filter.
- vi. Thermometers shall be installed to show the temperatures of the mixed, discharge, outside, and return air. Thermometers shall be bi-metal type with a minimum dial face of 4".
- vii. All oil and grease lines shall be extended to the exterior of the case.
- viii. Filters shall comply with ASHRAE Systems. <u>Filters</u> shall be polyester provided in metal hinged frames.
- ix. Dampers
  - (a). All dampers that will be used in a fully closed position shall be low-leakage type. A standard of quality is Ruskin CD60.
  - (b). All balancing dampers shall lock in position.
  - [c]. The position of all dampers shall be marked on the shaft of the damper by the use of a groove or saw kerf.
- x. Ductwork
  - (a). All main and branch ductwork shall be constructed of galvanized sheet metal. Other materials may not be used. Construction shall include the use of duct sealant.
  - (b). Maximum leakage for all duct systems is 5%.
  - [c]. All branch duct takeoffs shall use the 45 degree design and shall have a balancing damper installed in each branch as close to the main duct as practical. No splitter dampers or air extractors shall be used.
  - (d). Insulation shall comply with ASHRAE 90.1. Only external insulation shall be used. In mechanical rooms or other places where ductwork is exposed, rigid fiberglass insulation shall be used. The rigid fiberglass insulation shall be a minimum of 2" thick and shall be glued and pinned.



- (e). Flexible ductwork shall have a maximum length of 6' and shall be properly supported. Flexible ductwork shall only be used for connecting the branch duct to the diffuser. In no case shall flexible ductwork be used upstream of VAV boxes.
- xi. Diffusers
  - (a). Diffusers with integral dampers shall not be used.
  - (b). Perforated diffusers shall not be used.
  - [c]. In a suspended ceiling installation, it is preferred that diffusers use a 24" x 24" mounting plate. A small diffuser mounted in a large ceiling tile is not preferred.
  - (d). Diffusers for VAV systems shall be specified with consideration given to air dumping at low velocities.
  - (e). All turning vanes shall be airfoil type.
  - (f). Variable air volume controllers should be specified with high quality and long term usage in mind.

#### N. Fume hoods and laboratory systems

#### 1. General requirements

- a. All fume hood systems shall be designed using "high hazard" requirements.
- b. All systems shall be designed using variable air volume(VAV) concepts. Exceptions to this need life-cycle cost/benefit evaluations. If the complete exhaust-supply system cannot be installed at the time of fume hood installation, at a minimum VAV controllers for the new equipment shall be installed.
- c. All fume hood systems shall be designed according to ANSI Z9.5 with the following exception: The design face velocity at half-sash may be 100 fpm.
- d. Where feasible it is preferred that systems be grouped to use fewer pieces of equipment.
- e. Perchloric systems shall be completely separate from other exhaust systems.



## 2. Fume hoods

- a. The standard of quality for fume hoods is Kewaunee Air Flow Supreme.
- b. All fume hoods shall be equipped with a face velocity monitor and markings on the front of the hood indicating the maximum sash opening height and sash height for maximum air flow.
  - i. All fume hoods must be certified by UMC Environmental Health and Safety before use.
  - ii. Fume hoods and supply air diffusers shall not be located so that a supply diffuser is in front of a fume hood.
- c. Ductwork
  - i. All fume hood and laboratory exhaust system ductwork shall be constructed with 304 stainless steel and shall be of welded construction.
  - ii. All fume hoods & laboratory exhaust system ductwork shall be constructed with PVC used where applicable.
- d. Animal quarters
  - i. Design parameters for animal quarters shall include 100% outside air, 100% exhaust, heat recovery on the exhaust air, and a 50% safety factor on the total heat load.
  - ii. Verify the required space temperatures with the ultimate user of the space.
  - iii. Where available, use steam for all preheat coils. Use a freeze-proof design on all coils.
- e. Auditoriums
  - i. Design of air handling systems for auditoriums should consider the use of CO2 monitors and occupancy monitors to control the amount of outside air required.
  - ii. Generally it is preferred that auditorium systems be separate from other building systems.
  - iii. Special consideration shall be given to noise problems in auditorium applications. Submit acoustic calculations for the mechanical equipment. Particular attention shall be given to low frequency vibrations.
- f. See Appendices 1 & 9.



#### **IV. PLUMBING SYSTEMS**

#### A. General Mechanical Plumbing Standards

- 1. The designer is notified that the campus water distribution system operates at 60-65 psi. [Hydrants are @ 60psi]
- 2. All piping systems shall be labeled with the type of service and the direction of flow. Insulated piping shall "asbestos-<u>free</u>."

#### B. Building Plumbing Systems

#### 1. General Standards

- a. Access doors
  - Access doors shall be supplied for all concealed valves or other equipment that may require operation or adjustment.
- b. Thermometers and gauges
  - (1). All thermometers and gauges shall be installed to allow reading from floor level.
  - (2). All thermometers shall be of the dry well type.
  - (3). All thermometers and gauges shall be selected with the expected operating conditions near the middle of the range of the device.
  - (4). Thermometers and pressure gauges shall be accurate to 1% of full scale.
  - (5). All gauges shall be installed with gauge cocks.
- c. Metering
  - (1). All meters shall be installed with a three valve bypass design. The bypass valve shall be full flow and capable of being locked. Meters shall include readout of both local and remote totalized flow.
- A water sampling tap shall be installed on all water mains upon end building. The tap shall consist of a 1/2" tap with a ball valve installed 12 o'clock position. Two 90 degree elbows shall be installed to direct the flow toward the floor, similar to a faucet.
- e. All piping systems, except natural gas, shall be tested at <u>one and one-half</u> times the expected working pressure, or a minimum of psig and a maximum [60-<u>65psi</u>] of the design pressure of the pipe and fittings systems for a minimum of four hours. For natural



gas, test at twice working pressure or a minimum of 3 psig.

- f. All piping systems shall be installed with section valves at all branch connections.
- g. All equipment, fixtures, or other appliances attached to any piping shall have a shut off valve located at the connection to the piping.
- All piping shall be labeled at intervals no greater than 20 feet on straight runs including risers and drops, adjacent to each valve fitting, and each side of penetrations of the structure or enclosure. All labeling shall be with ANSI A13.1.
- i. All valves shall be tagged with an engraved brass tag that describes the type of service and area controlled by the valve.

# 2. Domestic Water Systems

- a. Materials
  - (1). No PVC piping shall be used for domestic systems.
  - (2). All pipe and fittings, 4" and smaller, shall be copper, Type L, hard or soft. All solder shall be lead free.
  - (3). Unions 2-1/2" and larger shall have flange joints.
  - (4). Valves
    - (a). <u>Butterfly</u> valves, 4" to 12", shall be flanged, cast iron, 125 lb., solid wedge, bolted bonnet, OS&Y. <u>No Gate valves</u> <u>shall be used inside buildings.</u>
    - (b). Check valves 2" and smaller shall be soldered, bronze, 125 lb., horizontal swing. Check valves 2-1/2" to 8" shall be flanged, cast iron, 125 lb., bolted bonnet, horizontal swing.
    - (c). Ball valves, 3" and smaller, shall be soldered, bronze 125 lb., full port.
    - (d). Butterfly valves, 6" and larger, shall be gear operated.
    - (e). Strainers, 2" and smaller, shall be soldered bronze, 250 lb., 20 mesh. Strainers 2-1/2" to 12" shall be flanged,



cast iron, 125 lb., .045" perforated stainless steel screen.

- b. Hot water systems
  - (1). Instantaneous, <u>steam</u> tankless water heating systems are preferred whenever feasible.
  - (2). All hot water systems shall have recirculating pumps except in those systems that have the heating in close proximity to the use. <u>Steam heating systems are preferred whenever possible.</u>
  - (3). Recirculating pumps in hot water systems shall be constructed of ferrous material.
  - (4). The desired temperature for hot water is a maximum of 110 degrees F at the point of usage for normal faucet applications. Other types of uses require other temperatures (dishwashers, cage washers, etc.) are to be evaluated individually. Where temperatures higher than 110 degrees F, required at certain outlets for a particular intended use, separate, or booster heaters shall be installed for those outlets. Use steam for booster heaters whenever practical.
- c. Electric water coolers
  - (1). All electric water coolers shall be of the refrigerated type.
  - (2). ADAAG guidelines shall be used in the selection and installation of any electric water coolers.
  - (3). Locations of electric water coolers shall be noted on electrical plans as well as plumbing and architectural plans.
  - (4). <u>Fixtures shall be NSF Certified</u>.
- d. Hose bibbs and wall hydrants
  - (1). A hose connection shall be installed in each mechanical room.
  - (2). 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. The preferred spacing for hose connections is one every 100'. Where feasible, hose connections should be installed within 15' of the main entrance to the building.



- (3). All exterior hose connections shall be of the recessed socket type, <u>freeze-proof with locking</u> cover.
- e. Backflow preventers
  - All backflow preventers shall be located and configured to allow ready accessibility for maintenance and testing. Minimum clearance is 24" in all directions.
  - (2). Pit installations of backflow preventers will not be allowed.
  - (3). Minimum of double-check on domestic and fire; RP's required on buildings with other water systems, such as, ground water or hydronic.
  - (4). Use campus standard details for relief of RP's.

## f. Insulation

- (1). All domestic water systems shall be insulated with fiberglass insulation.
- (2). Insulation on piping in plenum areas shall be plenum rated.
- (3). All insulation shall comply with <u>ASHRAE 90.1 or</u> <u>latest IECC edition.</u>

#### 3. Sanitary Waste and Vent

#### a. Materials

- (1). Pipe and fittings may be cast iron, DWV copper, or DWV Schedule 40 PVC. The copper and PVC may be used above grade only. The cast iron shall be no-hub only.
- b. Every piece of equipment that requires indirect waste (backflow preventing 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 the pieces of equipment are close to each other and the 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 can the drainage be accomplished by installing piping across the floor to the floor drain.
- c. Floor drains



- (1). All floor drains shall have a minimum pipe size of 6 1/2 ", and have a removable strainer. Drains and floor sinks shall have trap primers per code.
- (2). Upon completion of the installation of the floor drain and the flooring of it, each area shall be tested to ensure that water on the floor in which served by the drain is able to reach the drain by the force of gravity alone.
- (3). All bathrooms & mechanical rooms shall have a minimum of one floor drain.
- d. All drain piping for accessible sinks that could be touched by the public shall be insulated. This shall comply with the requirements of ADAAG.

# 4. Storm Sewer Systems

- a. Pipe and fittings may be cast iron or DWV schedule 40 PVC.
- All surface water shall NOT be directed to a storm sewer system. Storm sewer shall be directed to area drywells. In no case shall storm water be placed in a sanitary sewer system.
- c. Surface discharge of storm water shall not be allowed.
- d. All interior piping of storm water shall be insulated.
- e. Roof drainage may be used for irrigation to secure LEEDs points if required
- f. Roof drains & overflows shall meet code & be labeled within building to identify.

# 5. Lab Plumbing & Fixtures

- a. Emergency showers and eye washes
  - Floor drains shall not be installed in close proximity to emergency showers and eye washes.
  - (2). All piping to emergency showers and eyewashes shall comply with ANSI Z358.1.
  - (3). In all new construction, any situation requiring either an emergency shower or eyewash should have both installed. It is preferred that they be co-located. Operating heights of showers and eyewashes shall meet ADAAG.



- (4). All emergency showers shall have a local alarm to notify persons in the area that the shower is in use.
- b. Acid waste
  - Pipe and fittings shall be polypropylene (Eufield). All materials must be rated and approved for acid waste use.
- c. Distilled and deionized (DI) water
  - Pipe and fittings shall be Schedule <u>40 PVC</u> or other plastic piping systems designed specifically for this type of service. Fixtures & fittings shall be appropriate for DI water service.
  - (2). Faucets shall have flow controls for maximum 1-1/2 gpm.
  - (3). Spears true-union ball valves shall be used on DI piping.
  - (4). Utilize existing campus DI system for new science/lab buildings, rather than local DI generators.
- d. 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.
  - (3). Valves larger than 1" shall be plug valves.
- e. Compressed air and vacuum
  - (1). Pipe and fittings shall be Type L copper. Accept soldered fittings only.

# 6. Fixtures

- a. All fixtures and related equipment shall be of commercial grade or better and shall be NSF certified.
- b. Custodian closets
  - Each custodian closet shall be supplied with a <u>precast stone</u> floor sink. The preferred size is 24" by 36" and the minimum size is 24" by 24". The sink shall be supplied with a stainless steel edge cap.
  - (2). Stainless steel splash plates shall be installed on the wall around the floor sink.
  - (3). The faucet shall be equipped with a hose



connection and vacuum breaker. Faucets shall be capable of hanging a bucket from. Brace faucet to wall.

- c. Rest rooms
  - (1). ADA**AG** guidelines shall be used in the design of rest rooms.
  - (2). All fixtures (sinks, urinals, water closets, etc.) shall be white in color.
  - (3). All fixture hardware (faucets, flush valves, etc.) shall be chrome color.
  - (4). For typical campus applications, no pop-up drain stoppers shall be installed in sinks.
  - (5). In new construction, all fixtures shall be wallhung. In existing construction, wall-hung fixtures are preferred if feasible. <u>Bathroom</u> <u>lavoratories may be counter-top mounted.</u>
  - (6). Spring return valves on faucets are not acceptable.
  - (7). Motion sensors are preferred in bathrooms.

#### 7. Recommended Manufacturers/Styles/Types

- a. Faucets
  - Chicago or equal. Bradley or Chicago where motion sensor fixtures are specified. Motion activated faucets are preferred in public bathrooms.
- b. Urinals
- (1). Kohler or equal. Wall mounted with carriers c. Flushomatics
  - (1). Handle-type auto-flush, batter operated on urinals. Some preferred on W.C.s
- d. <u>W.C.'s</u>
  - (1). Wall-hung, Kohler or equal, elongated, openfront seat. C.Beamis or equal, with wall cabinets.
- e. Kitchen Sinks
  - (1). Stainless steel, Elkay, or equal.
- f. Drinking Fountains
  - (1). Elkay or equal, refrigerated. NSF lead-free.
- g. Laboratory Sinks
  - (1). Epoxy resin or stainless steel depending on type of function.



h. Roof Drains

(1). Zurn, A.O. Smith or equal.

i. Floor Drains/Sinks

(1). A.O. Smith, Zurn or equal.

k. Lavoratories

(1). Bradley, Kohler, American Standard, oval bowls.

# C. Underground Piping Systems - exterior

## 1. General Requirements

- In locations where piping passes beneath roadways or driveways, the engineer shall evaluate the expected load and specify appropriate materials to carry the load.
- All underground piping systems shall have a <u>#14</u>
  AWG wire attached to the pipe for a tracing wire <u>at</u> <u>24" above S.S and water.</u> The wire shall be labeled and terminated in an accessible location.
- c. All underground piping systems shall have a warning tape; with appropriate wording, buried 24" above the pipe.
- Using a standard proctor at optimum moisture content (+2% or -2%), all backfill shall be mechanically 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.

#### 2. Sanitary Sewer

- a. Cast iron systems
  - Pipe and fittings, all sizes, shall be cast iron, service weight, bell and plain end spigot, ASTM A 74. No-hub type piping may be used.
- b. PVC Systems
  - (1). All piping shall be a minimum of Schedule 40.
  - (2). All fittings shall be DWV.
  - (3). PVC systems shall be protected by bedding material 6" above and on each side and 3" below the pipe. The bedding materials may be sand, rolled stone, or other appropriate



material that has no rocks larger than 3/4".

- (4). PVC shall not be used beneath buildings.
- c. Clean outs
  - (1). All clean outs shall be located in non-traffic areas.
    - (2). Clean outs shall be installed in a concrete surround that is a minimum of 12" by 12" and 4" thick.
  - (3). All clean out plugs shall be cast bronze with a hex head.
- d. Testing
  - (1). All sanitary sewer systems shall be tested with 10' of head pressure for not less than four hours <u>for 100' or less of sewer main. Where</u> <u>greater than 100' of sewer mains are laid, the</u> <u>line shall be video'd.</u>

## 3. Storm Sewer Systems

- a. PVC piping may be used on storm sewer systems.
   For pipe sizes 8" and less, Schedule 40 shall be the minimum pipe used. For pipe sizes greater than 8", SDR 35 piping may be used. All fittings shall be DWV.
- b. Cast iron pipe may be used.
- c. Concrete pipe may be used.
- d. Clean outs
  - (1). All clean outs shall be located in non-traffic areas.
  - (2). Clean outs shall be installed in a concrete surround that is a minimum of 12" by 12" and 4" thick.
  - (3). All clean out plugs shall be cast bronze with a hex head.

#### 4. Water Distribution Systems

- a. All piping systems shall comply with AWWA standards.
- b. All water piping shall have a minimum of 72" of cover.
- c. All water meters shall be located inside buildings.
- d. The cover to the valve box shall be marked "Water."
- e. The preferred material for water distribution systems is ductile iron.
- f. <u>Ductile iron</u>



- (1). All fittings shall be ductile iron encased in polypropylene.
- (2). All fittings shall be installed with UL listed and approved retainers.
- (3). Valves shall be ductile iron, with resilient seats and bronze gates that conform to AWWA C509. No split (2 piece) gates shall be allowed. Butterfly valves with gear box are permitted.

## g. Copper systems

- Copper shall only be used on pipe sizes 2" and smaller, and shall be used for building service only.
- (2). All copper pipe shall be Type K, ASTM B88, installed per AWWA C800.
- (3). Fittings shall be ANSI B16.22 wrought copper. Silver solder to be used.
- (4). Valves, 2-1/2" and larger, shall be ductile iron, flanged, with key head. Valves, 2" and smaller, shall be key operated stop.
- All water systems shall be hydrostatically tested at least at 1-1/2 times the expected working pressure, or 100 psig, whichever is greater, for a minimum of 4 hours.
- i. The water piping systems shall be cleaned according to AWWA M23.

# D. Fire Protection Systems

# 1. Sprinkler Systems

- All test valves shall be located in mechanical rooms in central locations. A minimum number of locations shall be used for test valves. In new construction it is preferred that all test valves be at one location.
- A pressure gauge shall be installed on the main supply of each sprinkler system, upstream from the main test valve.
- c. 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. This is particularly important at the location for testing the main drain of a system.



- d. All valves shall be located with sufficient room for maintenance or replacement.
- e. All sprinkler systems shall have a fire alarm panel installed that is capable of monitoring and reporting flow in all zones and tampering with valves of the system. The panel shall be equipped for sounding a local alarm and shall be capable of interface with the campus security system. If the campus security system is in place in the building, the fire alarm panel shall be connected to that system.
- f. Materials
  - (1). All materials shall comply with NFPA.
  - (2). If mechanical joint systems are used, the fittings shall be equal to Victaulic 005 Firelock Rigid. No cut grooves shall be allowed.
  - (3). All underground piping shall be ductile iron fittings. The fittings shall be coated and wrapped with polyethylene per AWWA C105.
- g. Testing
  - (1). All sprinkler systems shall be tested no less than 200 psig for no less than four hours.

# **IV. ELECTRICAL SYSTEMS**

#### A. Distribution Systems

- 1. Duct Bank Systems (Concrete Encased)
  - a. It is preferred that all duct banks have a minimum of 3' of earth cover. Instances that do not allow this amount of cover must be approved by the owner.
  - b. Duct shall be type DB PVC. In runs over 100', the designer shall evaluate the need for galvanized rigid steel elbows to prevent damage during cable installation.
  - c. All duct shall be installed in such a manner to prevent accumulation of water that may be subject to freezing.
  - d. A warning tape that is a minimum of 6" wide shall be installed 18" above all duct banks.



- e. Upon completion of the installation of the duct and prior to pulling any cable in the duct, a mandrel 1/2" smaller than the nominal size of duct shall be pulled through the duct.
- f. 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 the 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.
- g. 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.
- h. Concrete
  - i. The concrete shall cover the duct a minimum of 3" in all directions, and a maximum of 6".
  - The 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.
  - iii. The maximum aggregate size shall be 3/4".
  - iv. The concrete shall be placed with the aid of a mechanical vibrator.
  - v. If trench erosion occurs, the use of forms may be required to prevent overly large masses of concrete.
  - vi. Minimum reinforcing of the concrete shall be as follows:
    - (a). The minimum size is #4.



- (b). The 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 1-1/2".
- [c]. Reinforcing shall be installed latitudinally, as needed to hold the above in place during placement of the concrete.

## 2. Direct Burial Systems – No direct burial is permitted.

#### 3. Medium Voltage (600 volts - 35,000 volts)

- a. Equipment
  - (1). Transformers
    - (a). The designer shall evaluate the anticipated building harmonics to determine the K rating for each transformer installation. The K factor shall be determined as follows:

Transformer K-Factor (Harmonic rating): The transformers shall be designed to operate at full kava rating while carrying harmonic current contents as defined by the indicated K-Factor. Harmonic current content shall be defined as odd harmonics (3rd thou 15th order) which are all equal in their percentage of the fundamental (60 hertz) frequency. Transformer nameplates shall be clearly marked with the transformer K-Factor rating.

- (b). Transformers shall be pad-mounted, exterior to building. Provide screens around transformers too.
- [c]. In all transformer installations, especially retrofit or replacement, the secondary system fault current shall be analyzed.
- (d). Transformer nameplates shall contain the information listed on the transformer nameplate data sheet.
- (2). Switch gear
  - (a). All pad-mounted switch gear shall be type Trayer or Square D.
- b. Execution
  - (1). All cable installations where the calculated pulling tension exceeds 67% of the manufacturer's recommended maximum



tension shall be installed using tension measuring equipment. The owner's representative must be present to observe these installations. These cable runs shall be clearly marked on the plans.

- (2). All cable pulled through wet or damp conduit shall be sealed on the end to prevent any moisture from entering the insulation.
- c. Testing
  - (1). Medium Voltage Cable Direct-current Voltage Test (D. C. HiPot): After installation and prior to being placed in service, all medium voltage cables shall be tested by use of a D. C. HiPot test. Test voltages and procedures shall be in accordance with ICEA standard S-68-516/NEMA standard WC-8 (latest edition).
  - (2). Transformers: The following test shall be performed on each transformer prior to the unit being placed in service.
    - (a). Insulation resistance tests (5000 volt MEGGER) shall be performed on high voltage and low voltage windings prior to placing the transformer in service. This test must be approved by the transformer manufacturer prior to testing.
    - (b). All primary and secondary voltages shall be recorded and forwarded to the owner.(3). All testing shall be witnessed by the Owner's Representative or Commissioning Agent.

# B. Secondary Circuits

#### 1. General Requirements

- a. All neutral conductors shall be a minimum of full size. The designer shall evaluate the need for oversized neutral conductors.
  - (1). The preferred method for grounding is through the use of a buried loop, or in new construction, use of the concrete reinforcing steel. Use of the building steel for grounding shall not be allowed unless the steel was designed for this use or the grounding capability of the steel was tested and found adequate.



- (2). The designer shall evaluate anticipated building loads for potential harmonic design requirements.
- (3). No aluminum conductors or busses shall be allowed. All conductors shall be copper.
- (4). When installing or changing equipment, the designer shall evaluate available fault currents and size the ampere interruption capacity accordingly.
- (5). Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

208/120Volts Phase 480/277Volts

Black	А	Brown
Red	В	Orange
Blue	С	Yellow
White	Neutral	White or Gray
Green	Ground	Green

#### 2. Service Entrance

In new installations, it is preferred that only one disconnect be installed per service entrance.
 However, if multiple disconnects are installed, no more than 4 disconnects shall be installed, with space allowed for a total of 6 disconnects.

#### 3. Feeders

- a. All feeders shall have a separate 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 panel boards shall have separate grounding and neutral busses. All grounding and neutral wiring shall be terminated on the proper buss.
- d. Snap-in breakers are permitted.
- e. All panel boards shall be sized to allow a minimum of <u>40%</u> of space for additional breakers, by count of breakers.



f. No piggyback breakers shall be allowed.

# 4. Branch Circuits

- a. All wiring systems shall be installed using conduit. Flexible wiring systems shall not be used.
- b. The minimum conduit size shall be 3/4", except conduit enclosed in a wall, conduit used for switch legs, and conduit used for control wiring. These exceptions shall have a minimum of 1/2" conduit.
- c. A separate grounding conductor shall be installed. Use if the conduit or raceway is not an acceptable grounding method.
- d. All general purpose power circuits shall be a minimum of 20 amps.
- e. General purpose power circuits in office areas shall not have shared neutrals.
- f. Conduit shall be supported from the building structure. Attachment to other pipes, conduits, ductwork, etc. shall not be allowed.
- g. 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.
- h. All exposed conduit installed in a finished space shall be painted to match the background.
- i. All lighting switching layouts shall be shown on the drawings. The drawings shall show the circuit numbers for each receptacle, and shall show the wire counts for all circuitry. Label receptacles accordingly.
- j. Panel boards shall be supplied with lighting sufficient for working at the panel board. In some cases this may require the installation of additional lighting.
- k. Conductors carrying more than 150v to ground shall not be installed in conduits with conductors carrying less than 150v to ground.
- i. <u>Hubbell 3 0 Base Track is permitted. Non-metallic.</u>

# C. Devices and Motors

#### 1. Devices

a. All receptacles and switches shall meet the requirements of ADA. The preferred mounting



heights, above finished floor, are 48" for switches and 18" for receptacles.

- b. 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 and for receptacle is Hubbell #5362-1.
- c. The preferred color for receptacles is **to match**. Other colors may be used to match existing devises or for special uses.
- d. Each rest room must have at least one receptacle and it must be a GFI receptacle.

## 2. Fuses

- a. Renewable fuses shall not be used.
- b. As much as possible, equipment should be specified with fuse holders that will accept fuses that are 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. The designer shall evaluate the need for a box for storage of the 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.

# 3. Safety Switches (Disconnects)

- a. All safety switches shall be heavy duty grade.
- b. All safety switches shall have a durable label permanently attached to the inside of the cover that describes the fuse size, type, current limiting ability and devices controlled.
- c. 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.
- d. The covers on safety switches shall be provided with a method of opening the cover without opening the switch.
- e. Safety switches in mechanical rooms shall have NEMA 3R enclosures unless the environment or usage requires a different enclosure.
- f. All safety switches shall have a grounding bar.



## 4. Motors

- a. All motors shall meet ASHRAE 90.1 and shall have a minimum service factor of 1.15.
  - (1). Three approved manufacturers are:
    - (a).
    - (b).

[C].

- b. The designer shall evaluate the possibility of using 480v whenever practical.
- c. No motors shall be designed to operate in the service factor.
- d. The designer shall evaluate the use of soft starting whenever appropriate & variable speed drives.

# D. Alarm Systems

#### 1. Fire Alarm Systems

- a. All new buildings and major renovations shall include a central, zoned fire alarm system.
- b. All fire alarm systems shall comply with ADAAG.
- c. Drawings for fire alarm systems shall include zoning and locations for each device on the plan view and a riser diagram.
- d. Acceptable brands for fire alarms systems are Notifier and Simplex. Notifier is preferred, other brands are not acceptable.
- e. The vendor for fire alarms systems must show the ability to respond to requests for service within 24 hours and the ability to supply replacement parts for the system within 48 hours.
- f. All new fire alarm panels must be expandable. The future ability to provide fire alarm service for the entire building is desired.
- g. All fire alarm panels shall be equipped with a "walk test" feature. This allows each activating device to be tested without the need to reset the panel after each device is activated.
- h. All fire alarm panels shall be equipped with a "building evacuate" switch.
- i. All fire alarm panels shall be located at the main entrance of the building or shall have a remote annunciator located at the main entrance. A diagram



of the building showing the various zones shall also be located at the main entrance.

- j. Pull stations shall be located at all building and floor entrances.
- k. If a security system is available in the building where a new fire alarm panel is being installed, the fire alarm panel shall be connected to the security system to allow reporting of a fire alarm to the Campus Police through the security system.
- I. All fire alarm panels shall be capable of reporting through the security system or other external system.
- m. If an Energy Management Controls System (EMCS) is available in the building where a new fire alarm panel is being installed, the fire alarm panel shall be connected to the EMCS.
- n. If door hold-opens are used, they shall be wallmounted, magnetic type with proper mounting blocking in the wall. Combination door closer/holdopens shall not be used.
- o. All pull stations shall be key operated, keyed the same as the building fire alarm panel. All keying shall be coordinated with the UMC Fire Inspector.
- p. Ionization type smoke detectors shall not be installed in mechanical rooms.
- q. All smoke detectors or other activating devices shall be installed in locations that are readily accessible for maintenance. Beam detectors shall be used in atriums or other high ceiling areas.
- r. When fire alarm systems are installed in buildings with elevators, provisions shall be included for alternate floor controls.
- s. All wiring for fire alarm systems shall be Type FPLM, plenum rated cable.

# The University of Montana

Design & Construction Campus Policies & Procedures Consultant's Manual

Section D Specification Standards DIVISION 0 - DIVISION 27 This section contains the 'Work in progress' table of contents of the Facilities Services' specification listing by CSI division. Individual specifications are on file in Planning and Construction Office.

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Section E Appendices

 $\begin{array}{l} \mbox{Planning and Construction Facilities Services}\\ \mbox{Bldg 32} \cdot \mbox{Missoula} \cdot \mbox{Montana} \cdot \mbox{59812} \end{array}$ 

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## I. Introduction

## A. Basis of Design

General use instructional rooms are essential components in the University of Montana's (University) instructional mission. Instructional rooms have increasing complex design and technical requirements. This section is intended to inform the University's professional design consultants of the University's expectations and requirements for instructional spaces.

## B. Programming

The following Design Goals have been established for the University instructional rooms:

- 1. To provide the most effective learning environments based on desired pedagogy;
- 2. To provide an environment designed to enhance a student's ability to understand, observe and participate in active learning;
- 3. To provide an environment that is comfortable for students and instructors as well as durable, reliable, and easy to maintain; and,
- 4. To provide a room that is easy for faculty and student equipment operators to use through standardization of controls, layouts, and equipment.

## II. Design Criteria - Classrooms

## A. General Guidelines

- 1. Unless the program dictates, locate classrooms and auditoria on ground and lower floors, convenient to building entrances/exits that provide direct pathways to other instructional and student buildings.
- 2. Classrooms should be buffered from internal building noise (e.g., student lounges/vending machine areas) and exterior building noise (e.g., loading docks.)
- 3. Adequate restrooms shall be located convenient to classrooms but not directly adjacent to classrooms.
- 4. Classroom corridor doors shall have noise reduced closure mechanisms. Entrance/exit door(s) to the room shall be located to minimize disruptive noise from late-comers. Doors shall have adequate light seals to prevent light from outside the room striking the projection screen.
- 5. Size room entrance doors to handle double the room capacity to allow simultaneous entrance/exiting during class break periods.
- 6. Hallway floors and room entrances shall be barrier-free to comply with ADA requirements and allow free movement of equipment carts.

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- 7. Corridors and auditoria lobby shall be sized to accommodate waiting students and encourage post-lecture discussion/impromptu gatherings. Whiteboards shall be considered for these areas.
- 8. Built-in corridor/lobby seating, adjacent to classrooms, shall be included per program to encourage small group discussions and pre- and post-class group interaction.
- 9. Recommendations for room length and width dimension for the different configurations can vary significantly, and shall be determined interactively with the design team and classroom committee. A general guideline is to size classrooms in a 2:3 or 3:4 width to length ratio.
- 10. Seminar/Breakout rooms are generally recognized to be either rectangular or almost square with little distinction of a "front" side of the room.
- 11. Classrooms (used extensively by instructors using audio-visual/multimedia presentations) shall be designed with the length dimension of the room approximately 1.5 times the width dimension. (Rooms wider than they are long provide unacceptable viewing angles for projected media.) An open "front" area of the room shall be clearly defined.
- 12. No seat shall be more than 45 degrees off the center axis of a classroom to ensure adequate viewing to the white board(s) and projection screen(s).
- 13. Case Study rooms (used primarily for discussion/case study instruction) can be more square than rectangular in shape. A "front" area for the Instructor should be clearly defined. However, unlike multi-purpose classrooms, if the room is rectangular, the instructor's area should be along the wider wall of the room and extended into the center "U".
- 14. Auditoria and classrooms with over 100 seats shall be fan-shaped to provide clear viewing angles and acoustics. A "front" area for the Instructor shall be clearly defined.
- 15. Avoid center aisles to provide the maximum seating area with the best viewing angle.
- 16. In classrooms with fixed seating, stagger the seats to provide clear viewing angles. Maximum incline of sloped floors should comply with ADA regulations.
- 17. The depth and slope of rooms have a direct and critical impact on the required floor to ceiling height of rooms. The farther away the last row of seats is from the front wall of the room, the higher the ceiling must be to accommodate the appropriately sized projection screen for the room.
  - a. There is a table in section B.15, below that shows the size of the screen installed in each room based on the depth and seating capacity of the room. The table includes the mounting height in a separate column.
- 18. An area of the room shall be kept clear of student seating to provide adequate space for a teaching area for the instructor. Approximately 10 feet of open space from the front wall of the room to the front edge of the first row of student seats shall be provided.
- Provide an area to accommodate the University's standard podium, a sturdy 24"x60" table, a chair and audio visual equipment as specified by classroom committee. The front area must be large enough to give a minimum of 42"

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for instructors to stand behind the podium and/or desk and still allow free movement of students between the front of the podium/desk and the seats.

- 20. Provide adequate area for the instructor to have free movement around the front of the room with access to the white boards, audio-visual equipment, lectern/podium, equipment control system (i.e., AMX), lighting controls, etc.
- 21. The students shall have a clear view of the instructor at all times. Conversely, the instructor should be able to make eye contact with any student in the room during presentations (including multi-media presentations), discussions and lectures.

## B. Additional Guidelines by area

With special notes for lecture halls with seating capacity greater than 175 students. Guidelines communicate technology requirements to administrators, architects, and contractors, but each classroom requires individual interpretation. Emphasize easy to use hardware, user-friendly controls and clear signage.

### **1. SEATING CAPACITY**

- While interpretation of standards varies, the maximum number of loose tabletarm chairs that can be accommodated in a college classroom can be approximated by taking the total square footage of the room, subtract 100 sq. ft. for teaching area then divide by 20 sq. ft. per student while conference rooms should use 15 sq. ft. per chair. Shops and labs should use 50 sq. ft. per student.
- In computer classrooms a 36" wide work surface is minimum for one person, 42"- 48" is preferred. The height of the work surface should allow the keyboard to be at a comfortable level (29"- 31").
- Classrooms with only one entrance/exit door are limited to a maximum of 49 occupants.

#### 2. PRESENTATION SPACE & FLOORS

# a. Space required in the front of a classroom to ensure that transparencies on an overhead projector (with a standard 14" lens) will be legible in the back of the room:

- A small classroom, less than 27' deep, with less than 30 students needs 9' of space in the front of the room
- A small classroom, 27' to 32' deep, with 30-50 students needs 10' of space in the front of the room
- A large classroom, 32' to 37' deep, with 50-100 students needs 11' of space in the front of the room
- A large classroom, 37' to 42' deep, with 100-150 students needs 13' of space in the front of the room
- A lecture hall, 42' to 48' deep, with 150-210 students needs 15' of space in the front of the room
- A lecture hall, 48' to 54' deep, with 210-300 students needs 16' of space in the front of the room

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• A lecture hall, 54' to 60' deep, with 300-400 students needs 18' of space in the front of the room

Special note for LARGE LECTURE HALLS: Large halls need tiered floors and staggered seating to improve sight lines and sound transmission.

Lecture halls with capacity exceeding 200 students are equipped with 10', 12' or 14' motorized screens.

Lecture halls need two or more screens for projection of more than one image at a time.

## 3. WHITEBOARDS

- Every inch of available space on the front wall of the room should have a whiteboard.
- Mount writing surfaces 36" above floor and include a tack strip above it.

## 4. CLOCK

A large easy to read clock shall be in each classroom and lecture hall mounted at the back of the classroom.

## 5. LIGHTING ISSUES

It is critical to prevent ambient room light from washing out the images on the screen. During projection, room light should be bright enough (30-40 foot candles) for student interaction, not just dim for note taking. Sufficient light is needed at the computer lectern and on the board, but it must be controlled to minimize ambient light that washes out the image on the screen. When room lights in the student zone of the classroom are turned on, no more than 3-5 foot candles of ambient room light should fall on the screen. This requirement tends to preclude indirect lighting.

- Provide light zones so that lights just in the front, just in the center, or just in the rear of the room, or any combination can be switched on/off, switch the banks of lights parallel to the front of the room.
- Design lighting to minimize glare on computer screens in classrooms with computers at each student work station.
- Locate front row of lights near the whiteboard. Light on the whiteboard improves readability.
- Light switch controls should be simple to use, clearly labeled, and conveniently located at room entrance and at the front of the room, near the technology cabinet, so the teacher can adjust lighting.
- Engrave labels on light switch cover plates so that users know which switch controls what lights.
- Light from outside the room needs to be controlled. Vision panels in doors should be narrow to reduce spillage of light from the hallway.
- In any dimming system the lights must dim down to 5% of output with no light flicker.



• 100 seat plus classrooms should have lighting controllers (Lutron) that interfaces with switches in podium. For classrooms that have less than 100 seats the architect should have switches that are interactive too.

Special notes for LARGE LECTURE HALLS There should be separate pairs of front podium "spotlights" to focus on a speaker at stage left or stage right, to provide some light on the presenter while showing slides or images from video/data projector. Control lights from the booth and from the front of the room so they can be switched from either location.

## 6. ENTRY DOORS

Vision panels should be installed in or near doors to allow students to check whether the classroom is in use. Panels should be narrow to reduce spillage of light from the hallway. Install paper holders on the wall just outside the door near the entrance of each classroom.

Faculty can use them like bulletin boards to post grades, notes etc. without tape or thumbtacks.

Some faculty prefer entry doors at the rear of the room so late comers don't disturb the class, while others prefer entry doors at the front to encourage students to sit up front.

### Special notes for LARGE LECTURE HALLS

Often lecture hall doors are designed for students to enter from the rear and exit at the front. All entry and exit doors in the room should be designed so that no light from outside the room falls on the screen when doors are opened. It is distracting when students who enter late, open the door and wash out an image on the screen.

## 7. WALLS & CEILINGS

To prevent seats from gouging walls, 8" chair rails should surround the perimeter of classrooms.

Top of chair rail should be 33" AFF to accommodate backs of chairs. Bottom should be 25" AFF to accommodate tablet arm edges.

Sound Panels should be used in rooms with 50 or more students to control sound reverberation.

All classrooms should have at least a 9 foot high ceiling.

Special note for LARGE LECTURE HALLS: Ceilings should be at least 15' high at the front of the room and, even with tiered seating, at least 9' high at the rear. See table in section 17 below.

## 8. WINDOWS & WINDOW COVERINGS

If there are windows, they should be capable of being opened in the spring and fall. Sunlight shining into the room can wash out projection images so window coverings are imperative. Venetian blinds, room darkening shades and/or drapes need to cover all windows to block light and assure that glare from windows does not appear on

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computer screens, TV screen or projection screen(s). Dimming and blackout capabilities are identified as continuing concerns in college classrooms.

Each window should have two window coverings to provide a range of light control and the assurance that if one device malfunctions, the teacher still has an alternative. Blinds inside the window well prevent most direct sunlight and glare. Shades outside the window well, extending several inches past window edge, minimize light seepage around the edges.

Special note for LARGE LECTURE HALLS

Windows should be avoided in large lecture halls.

## 9. VENTILATION

Classroom thermostats should keep temperatures at 65°- 68° in winter and 72°- 74° in summer. Humidity levels should be maintained close to 50%.

## **10. CONNECTIVITY**

Include telephone lines convenience phone 243 numbers @ .....station (category 3), TV distribution (coax) and data connections (category 5e/6).

Classrooms must have Ethernet service that has a transfer rate of 100 Mbps or higher over twisted pair wiring or fiberoptic cable.

In addition, there is growing demand for classrooms that originate distance education. All classrooms will have "ring down phone" service so that faculty members can call for assistance.

At each Data/Video Projector location a data jack shall be present for connecting the projector to the campus LAN.

Wi-Fi: Provide on a case-by-case basis – Bldg-wide is encouraged but it doesn't replace need for hard-wired outlets. Must have compatibility that allows instructor to 'switch off' the Wi-Fi hot-spots for students response system (vs. little remote clickers).

## **11. ELECTRICAL POWER**

Each room needs a double grounded three-prong electrical outlet in the front center of the room, 18" above the floor, for an overhead projector and other instructional equipment.

In the rear of the room, a double grounded three-prong electrical outlet should be located 18" AFF to provide flexible positioning of portable projection equipment. Two sets of double grounded three-prong electrical outlets should be located in the base of the lectern to provide power for laptop computers and peripherals.

Eight grounded three-prong electrical outlets should be located inside the media cabinet to provide power for the VCR and the television receiver.

All electrical outlets must be surge protected.

Special notes for LARGE LECTURE HALLS Ample electrical power is needed at the presentation area of the lecture hall.

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## 12. CONDUIT FOR SLIDE REMOTES, TV, VIDEO/DATA PROJECTION & LECTERN

Conduit needs: 3/4 " conduit for co-ax, power, phone & cat 5 data; 2" for multi-coax. The campus closed-circuit cable TV system needs 3/4 " conduit for co-ax (RG-6) into the room.

In classrooms with a ceiling mounted video/data projector, a single 2" conduit for control cable and multi-coax should run from the panel in the front corner of the room to the ceiling.

Appropriate conduit must be provided between media equipment connection points, projector location (s), speakers, equipment rack (s), camera location (s), and instructor station connectivity.

## **13. ACOUSTICAL TREATMENT**

Acoustical treatment should address the twin concerns of hearing the presenter more easily and containing the room sound so it does not bother nearby classrooms and offices.

Appropriate "voice-friendly" acoustical treatment permits faculty to teach without sound reinforcement, except in the largest classrooms.

Carpeting, acoustical ceiling treatment, sound absorption panels on the back wall and sound absorbing fabric below chair rails help minimize unwanted noise in the classroom. Mount speakers for computer, CD and television sound at the front of the room on both sides of the screen to allow for perceptualization of audio imaging when required by presentation material.

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

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

Regarding background noise levels, the following limits should be adhered to:

< L35 dBa new classrooms, NC 30.

35-42 dBa renovated classrooms, NC 30-35.

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#### Special notes for LARGE LECTURE HALLS

Side walls should not be parallel, nor should they be a continuous hard surface. Front wall should use hard surface materials. Sound-dampening should be applied to rear & side walls.

The back wall may need to be completely covered with acoustical absorption materials. Ceiling speakers around the room and an amplifier are necessary for voice. Assistive listening transmitters are required in rooms with seating capacity greater than 50.

## 14. FURNITURE: STUDENT SEATING - TEACHER'S TABLE & CHAIR

In college classrooms, chairs should have the dorsal-back hinged chair style, stackable (no tablets), movable tables as required. 10% of tablet-arm chairs should be for left-handed students.

When possible, in larger classrooms, continuous writing surfaces, common in professional schools, should be used to provide students with room to spread out materials.

A chair and a  $60'' \times 30''$  teacher's table are desirable in the front of each classroom. If the table gets too large, it becomes a barrier between the teacher and the students.

Depth of t	he room &	seating capacity determine	ne the size of the screen installed i	n each ro	om.
Room Depth	Seating Capacity	Measurement from Center of Screen to Rear Corner Seat:	Standard Screen (4x3) Required Wider Screen (16x9) Required for HDTV: D	Approx. Diagonal	Mounting HeightAFF
less than 25'	15 - 25	Less than 30'	6 foot screen (72" wide x 54" high) 7 foot screen (84" wide x 54" high)	7.5 ft.	8.5 ft.
25' to 30'	25 - 50	Between 30' and 35'	7 foot screen (84" wide x 63" high) 8 foot screen (96" wide x 63" high)	8.75 ft.	9.25 ft.
30' to 35'	50 -100	Between 35' and 40'	8 foot screen (96" wide x 72" high) 9 foot screen (108" wide x 72" high)	10 ft.	10 ft.
35' to 40'	100 -150	Between 40' and 45'	9 foot screen (108" wide x 81" high) 11 foot screen (132" wide x 81" high)	11 ft.	10.75 ft.
40' to 45'	150 -210	Between 45' and 50'	10 foot screen (120" wide x 90" high) 12 foot screen (144" wide x 90" high)	12.5 ft.	11.5 ft.
45' to 50'	210 -275	Between 50' and 55'	11 foot screen (132" wide x 99" high) 13 foot screen (168" wide x 99" high)	14 ft.	12.5 ft.
50' to 55'	275 -400	Between 55' and 60'	12 foot screen (144" wide x 108" high) 14 foot screen (192" wide x 108" high)	15 ft.	13 ft.
55' to 60'	400 -500	Between 60' and 65'	14 foot screen (168" wide x 126" high) 16 foot screen (228" wide x 126" high)	17.5 ft.	14.5 ft.

#### **15. DETERMINING SCREEN SIZE & MOUNTING HEIGHT**

For additional flexibility, add one or two screens on either side of the one center screen as sized above. Sometimes a classroom will lend itself to an additional corner screen mounted at an angle.

#### **16. TEACHING STATION**

Instructor's teaching station shall be an Antho "Adjusta Cart" providing an adjustable work surface and projector and internet connectivity for a laptop computer.

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# 17. TECHNOLOGY CABINET with RECESSED CONTROL PANEL in rooms with a ceiling mounted video/data projector [This section continues to be defined at the U]

A ceiling-mounted video/data projector requires a control panel recessed into the front corner of the room. The panel contains a standard 19" sliding equipment rack. Controls for the ceiling mounted projector and audio amplifier are located in the panel. This media panel also incorporates a recessed VCR, the wireless transmitter for the assistive listening device and external audio & video jacks. ADA requires controls no higher than 54" above the floor. A locked door below provides storage for additional media hardware.

A 2' x 2' polycarbonate sheet covers the panel. A supplier follows a custom template with cutouts for the VHS tape recorder and the projector remote.

Each cabinet has eight AC outlets inside to power the VCR, the audio amplifier, the transmitter for the assistive listening device and other electronic equipment. Simple clear signage completes the panel. A sign specifies the basic information necessary to utilize the hardware, and a phone to call for assistance or more information.

## 18. AMERICANS WITH DISABILITIES ACT (ADA)

The ADA, enacted in 1990, prohibits discrimination against persons with physical and mental disabilities. – Refer to Appendix 7 for ADA guidelines. The goal for classroom designers is to keep in mind persons with mobility, hearing, vision, and mental disabilities.

## **19. MOBILITY IMPAIRMENTS**

Set aside 2% of classroom seating for wheelchairs. Provide the ADAAG required knee clearance for fixed tables at wheelchair accessible stations.

Locate and design the teaching station, including the boards, audiovisual controls and projection screens to be barrier free. A 60" diameter is necessary for wheelchair turnaround.

Controls for technology devices in classrooms cannot be higher than 54" nor lower than 9" above the floor and must accommodate a parallel approach by a person in a wheelchair.

Ramps must not exceed one foot rise in twelve feet of run (1:12 ratio).

## 20.HEARING IMPAIRMENTS

For new construction, if classrooms accommodate at least 50 persons, or, if they have audio-amplification (voice reinforcement) systems, and they have fixed seating, they must have a permanently installed assistive listening system. These systems at the University will use an FM signal which is picked up by listeners wearing special receivers and headsets or earphones.

In existing locations, assisted listening systems may be portable or permanently installed.



## 21. VIDEO PROJECTION & VIDEO/DATA PROJECTION

Video projectors are permanently mounted in the ceiling, with controls located at the front of the room or on the instructor's teaching station. Calculate 2 times the width of the screen to approximate the distance between the screen and the lens of the video/data projector. Brightness is measured in ANSI lumens. 2000 ANSI lumens is considered minimal for a 70" image. Light output must increase proportionately as the image size increases.

Some factors to consider in the selection of a video/data projector: Ability to automatically display any video or any computer source; Ability to automatically return to a pre-set normal position; Ability to automatically turn the projector off after 10 min. of sync loss; and a quiet fan.

### 22. FLAT TV / PLASMA SCREENS - Flat Panel display for TV and Computers

A new alternative to a television monitor is a flat panel plasma-gas screen to display both video and computer images. This screen should be considered for specialized applications only.

## 23. COMPUTER CAPABILITY FOR THE PRESENTER (PLUG-&-SHOW Classrooms & Laptops)

In a typical PLUG & SHOW computer presentation classroom, faculty bring in a laptop computer, already loaded with the necessary configurations, applications, files, and appropriate cards or adapters to access still and moving images via the classrooms' Ethernet. A ceiling-mounted video/data projector with a user-friendly interface makes it possible to show computer displays from laptops or workstations as well as campus cable TV, and VHS videotapes. A single, commonly available cable connects the user-supplied computer to a small lectern, with AC power, computer display connection, network jack and audio input, in the front corner of the room. The control panel, recessed into a corner wall, at eye-level, contains controls & VCR [discussions are on-going at the U for VCRs].

## a. Plug and Show Presentation Classroom are being considered and discussed at the U.

- b. Some unique features of Plug and Show Presentation classrooms are:
  - Presentations require little set-up in the classroom
  - Laptop computers are powerful, user-friendly, non-intimidating hardware with choice of platform
  - The PLUG & SHOW CLASSROOM is self-service so staffing costs are minimized
  - Connecting a computer in the PLUG & SHOW CLASSROOM is simple
  - One cable connects the laptop at the lectern to the ceiling-mounted projector in the classroom
  - Ethernet connectivity provides access to information outside the classroom

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#### c. Some comments on Classrooms Wired for Students Laptop Computers at each station

- Technology classrooms may be moving away from installed computers in the classrooms.
- Students and faculty will carry laptop computers with them and simply connect at classroom scholar stations. These wired classrooms will have power outlets and data connections for computing and communicating on and off campus, providing fingertip access to information.
- d. Computers at each student workstation in the classroom
- The U, working through specific departments continue to evaluate the need and practicality of personal computers (PCs) at each workstation. There are several computer labs throughout the campus currently.
- The law school leads all departments in this area.

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## I. SUMMARY

- A. This section outlines the University's energy philosophy as it relates to building design. Specific design or system data is contained in the appropriate section of the general design guideline and the campus standards, e.g., insulation, lighting, etc. Reference those sections as necessary.
  - 1. Even the best HVAC equipment and systems cannot compensate for a building design with inherently high cooling and heating needs. The greatest opportunities to conserve non-renewable energy are through architectural design that controls solar gain, while taking advantage of passive heating, daylighting, natural ventilation and cooling opportunities. The critical factors in mechanical systems' energy consumption and capital cost are reducing the cooling and heating loads they must handle.
  - 2. The University designs most major structures for a 60 to 75 year life. However, many structures are in excess of 100 years old.
  - 3. The University, as the owner and operator of those structures, bears the full operating costs, which, in present value terms, is many times the cost of the building.
  - 4. In general, the policy is to make sound capital investments during the design and construction of a structure so as to reduce the operating cost. The present value of the reduction in operating cost should exceed the amount of the construction cost increase, minimizing the life-cycle operating cost.
  - 5. Because of the uncertainty of energy prices, and the lifetime of typical components, life cycle costing for energy purposes should be done over a 30-year period, not 60 years. Contact the Office of Facilities Planning and Construction for the current discount rates and the acceptable Rate of Interest (ROI).
  - 6. The Architect and Engineer are expected to optimize the design for the lowest life-cycle cost before the design reaches completion of the construction document phase.

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- 7. The Engineer and Architect must work together to minimize life cycle costs due to energy use, and this effort shall be demonstrated in final reports at the end of each design phase. This includes the optimization of the building orientation, building envelope and fenestration systems to minimize losses/gains, use of natural light and window overhangs, passive solar design features to control and utilize solar gain, attention to materials selection, construction inspection, and commissioning.
- The University will decide on a project basis whether to pursue a Leadership in Energy and Environmental Design (LEED) certification. All designs are to be scored at each design phase for the Owner's information. However, the goal for each project should be to design on a LEED certifiable basis.
- B. All buildings shall be designed to meet the following energy codes: (In areas where the codes contradict, use the more energy conserving code.)
  - 1. State of Montana adopted International Energy Conservation Code (IECC).
  - 2. Energy Conservation in New Building Design, ASHRAE 90.1 or current version.
  - 3. Ventilation for Acceptable Indoor Air Quality, ASHRAE 62 or current version.

The University requires that an annual energy consumption model (of the building) be created and updated at each phase from schematic through construction documents. The output of this model shall be provided to and approved by the Office of Facilities Planning and Construction (P&C) prior to submittal to the building department. The final model shall be delivered to the Owner during the construction phase using as-built information.

## **II. DESIGN DEVELOPMENT PHASE**

A. The engineer shall model all HVAC designs for life-cycle costs as follows:

1. All life cycles shall be presented as Net Present Values. The values shall be negative, showing a net cost to own and operate lighting, electrical (plug loads and support systems), and HVAC systems.

2. The economic conditions shall be defined in consultation with the

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University engineering staff. The data should include economic lifetimes, discount rates, utility rates, and energy escalations.

3. Capital costs, energy costs, and maintenance costs shall be included.

4. Annual energy modeling shall be done by the University approved computer simulation. The Engineer shall review with the University all assumptions used to develop the simulation. During the review, the University may elect to reduce the size or complexity of the model, as best meets the programming needs.

- a. The model shall determine peak load (i.e. BTU/hr, kW) for steam, water, sewer and electricity, and establish the time of year these peaks occur.
- b. The model shall determine annual total consumption for steam, water, sewer, and electricity. Breakout the cost of each main category of energy consumption such as lighting, cooling, heating, and connected equipment.
- 5. The engineer shall, as a minimum, model the following system concepts as appropriate to the project:
  - a. Unoccupied schedules.
  - b. Heat recovery, either air-to-air or glycol runaround.
  - c. Economize cooling.
  - d. Individual Room Temperature control, allowing night setbacks.
  - e. Lighting Systems (daylight harvesting, lamp technology selection, controllers, design for effectiveness, and occupancy sensors). Natural daylight sensing controllers and scheduling controllers for lighting with interface to the building controls system.
  - f. Variable volume heating and cooling water systems.
  - g. Digitally controlled VAV hoods.
  - h. Glycol runaround heat recovery.
  - i. Two (2) speed hoods.
  - j. Fan powered series VAV terminal boxes. Noise shall be included in this evaluation.
  - k. Energy efficient building skin components (higher than code insulation and glazing, etc.).
  - I. Demand controlled ventilation for large air handling systems (greater than 20,000 CFM) based on carbon dioxide or other

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sensor technology.

- 6. The model outputs and the life cycle cost spreadsheet shall be included in the design development report with a written interpretation of the results and a recommendation.
- 7. Form F.1, "Utility Data Sheet" detailing expected annual peak and average utility use, should be completed at the end of the design development phase.

## **III. CONSTRUCTION DOCUMENT PHASE**

- A. The engineer shall prepare a report for submission to the local code compliance officers showing the design meets the Montana Model Energy Code for building permit.
  - 1. The University requires annual consumption data even though code compliance may not require this information.
  - 2. Care must be exercised to adequately address the infrastructure capacity for utilities as a result of the construction of the building.

## IV. CONSTRUCTION, COMMISSIONING, AND WARRANTY PHASES

## A. Construction

- 1. Energy conservation features should not be "value engineered" out of a project in order to reduce first cost and meet budget constraints.
- 2. The Owner's representative, the design team, and the contractor should work together to pursue any advances in energy efficiency that occur due to advances in technology during the sometimes long period of time from final design to submittal review.



## B. Commissioning

- 1. The University has adopted a formal commissioning process and expects the design documents to include this critical quality control methodology. Each project will require a somewhat customized approach, but all the University project energy systems will be appropriately commissioned to verify full conformance with the design intent.
- 2. A commissioning report shall be prepared by the commissioning agent at the end of this phase to document the process (es) used and related results.

## C. Warranty

1. In order to verify the performance of the building systems, the Architect/Engineer shall analyze the annual energy use of the building at the end of one year. The analysis shall include all forms of energy use and compare the building's actual performance to that expected during design. Any deviations from the expected performance should be documented, and should the building be using more energy than expected, the Architect/Engineer shall evaluate options and make recommendations of actions that should be made to correct the problems.

## V. SYSTEMS DESIGN

Systems should be designed in accordance with the following guidelines:

## A. Mechanical Systems

- 1. In all cases, an occupied/unoccupied mode selection (or similarly functional system) shall be provided. This feature shall also be remotely controllable from the central EMCS through an override command. Occupancy sensors shall be used wherever possible to further automate the occupancy mode.
- 2. All thermostats shall provide for night setback/unoccupied mode with a user override pushbutton for an adjustable time period.

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- 3. Variable air volume systems shall always be the minimum design without special approval.
- 4. No electric heat shall be designed in new buildings.
- 5. All building well water pumps, central station air handlers, and return fans shall be equipped with variable frequency A.C. drives.
- 7. All building hydronic heating/cooling pumps over 3 hp shall be equipped with variable frequency A.C. drives.
- 8. Three-way control valves shall not be used on either heating or cooling loops.
- 9. All air-handling systems shall include economizer outside air cooling cycles. 100% outside air systems and return air systems over 10,000 CFM shall include air flow monitoring (supply, return, and outside air) and outside air flow control logic.
- 10. Laboratory space occupancy and hood proximity sensors shall be used to put laboratory spaces and hoods into unoccupied modes. All sensors shall be spaced as appropriate to provide adequate coverage. Failure modes and alarm of sensor failure shall be provided for in the design.
- 11. All building cooling shall be provided via groundwater cooling. Tying into an existing campus cooling system is preferred where water exists. If a loop exists and can be expanded into the system additional capacity shall be installed and integrated into the existing loop. If the loop does not exists, additional wells shall be drilled.
- 19. Groundwater cooling systems shall utilize plate and frame heat exchangers and a propylene-glycol loop to the cooling coils.

## B. Electrical Systems

- 1. Transformers shall be sized so as not to require fan cooling under normal load.
- 2. Transformer rooms shall always be cooled with convection flow of

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outside air. Cooling using chilled water is not permissible.

- 3. Lighting design shall include all electronic ballasts and T5 &T8 lamps, multi-level switching, or dimmable ballast, occupancy sensors in public and general spaces to go to an unoccupied safety level, or off.
- 4. Lighting designers shall evaluate and work to include the use of diffuse day lighting controlled by manual or motorized shades, or light harvesting skylight and light tubes. Where possible, this should be augmented with light level controllers on electrical lighting systems.
- 5. Residence hall lighting systems should be designed to minimize the need for student supplied (typically incandescent) fixtures to augment the installed fixtures. In all cases, halogen lighting is prohibited from residence halls, and a goal for the designers is to provide adequate low energy use lighting in the rooms so students will not need to bring in extra lighting.

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UTILITY DATA SHEET	FORM F-1
Building Design Phase Engineer	Date:
Gross Heated Areas (Building or Addition)	
1. Steam	
Peak Design Load Anticipated Annual Consumption	LB/HR 10 <sup>6</sup> LB/YR
2. Ground Water Cooling	
Peak Design Load Anticipated Annual Consumption	Tons GPM AF/YR
3. Electricity	
Peak Demand Anticipated Annual Consumption	KW KWH
4. <b>Potable Water</b> Peak Consumption	GPM
Peak Consumption (domestic hot water)	GPM
Required Pressure (@ Bldg. Entrance)	psi
Annual Consumption	GAL/YR
Annual Consumption (domestic hot water)	GAL/YR
5. Fire Service	
Required Flow	GPM
Required Pressure (@ Bldg. Entrance)	psi
6. Sewer	
Peak Flow	gpm
Annual Flow	ccf
Sewer System	lift/metered

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Facilities Services Appendix 3 Custodial Requirements

## Introduction

Included with the Standards Drawings, is a diagram of a typical custodial closet. It shows the relative sizes and positions of typical equipment that a custodian will use to maintain a building. It should be noted that one cannot store custodial supplies in a Mechanical Room per instructions from the Fire Marshall.

Besides the depicted items, additional supplies and equipment must fit into the blank spots and adjustable shelving. These include: cases of toilet tissue, towels, 20+ gallons of chemicals in 5 gallon containers & buckets, pails, brooms, floor pads and scrubbing brushes, safety signs/traffic cones, vacuum accessories, extension cords, chalk, small/medium/large liners, extra dust mops, spare waste receptacles, pick-up barrel, and miscellaneous cleaning items. Safety concerns dictate that heavier or bulky items occupy lower spaces and shelving not exceed a certain height. 24" lowest shelf – permanently from the floor. Three types of custodial space are required

- 1. **Bulk Space:** 200 square feet per major building, preferably located in the basement and near a loading dock. This space is for custodial equipment storage, filters, and fluorescent lamps.
- Primary Custodial Closets: 80 (10' x 8') square feet serves the needs of the assigned area for each custodian (approximately 25,000 to 30,000 square feet). Locate primary closets on alternate floors and should house custodial supplies and fluorescent lamps.
- 3. Secondary Custodial Closets: 50 to 60 square feet per floor that does not include a Primary Working Closet. Locate on alternate floors. This area should house custodial supplies and fluorescent lamps. This closet will provide convenient access to water and serve as an additional working area. In major buildings, these should be alternated with the primary spaces, depending on the number of floors and keeping the 25,000 to 30,000 square feet figure per custodian in mind and proximity to elevator location.

## UTILITY SERVICES THROUGH-OUT THE FACILITY

Duplex receptacles for commercial grade custodial cleaning and polishing equipment shall be generously located through-out the facility rated 20 amp, 110 volt. Circuits shall be served by 20 amp breakers which are independent from

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circuits serving offices, laboratories, or other building uses located as follows:

- 1. Corridors: 40 feet on center. GFCI (for using water with scrubbers, etc.)
- 2. Entrances/exits: On both sides of the door opening where equipment can be plugged in and not become a direct tripping hazard and where receptacles will not be blocked by furnishings
- 3. Stairways: at all floor landings
- 4. Large public circulation areas: 40 feet on center on walls and on columns, located so as not to be blocked by furnishings.

## BULK STORAGE AREA

Provide a 200 square feet room near loading dock configuration to allow storage of case paper products and drum chemicals.

- 1. Door width: 60 inches out swinging
- 2. Lighting: Fluorescent
- 3. Electrical: 110 volt duplex receptacle near door
- 4. Plumbing: Floor drain in center
- 5. Ventilation: Mechanical exhaust 12 air changes/hour
- 6. Shelving: 16 inch deep, adjustable.

## PRIMARY CUSTODIAL CLOSET

- 1. Dimensions: 8 feet by 10 feet
- 2. Door width: 36" self-closing doors that open directly onto the corridor out swinging
- 3. Lighting: Fluorescent
- 4. Electrical: 110 volt duplex receptacle near door. Provide GFCI protected receptacle.
- 5. Plumbing: Provide a floor drain in center of floor (lowest spot) near mop sink. Provide one floor mounted mop/custodial sink, with splash shield on wall made of fiberglass reinforced plastic panels (FRP). Locate mop sink to allow easy access and also to provide space for moving custodial carts in and out of custodial room efficiently.
- 6. Ventilation: Mechanical exhaust: 12 air changes/hour
- 7. Combination mop hanger/drying rack: 3 above sink and 3 on adjacent wall near sink.
- 8. Shelving: 16 inch deep, adjustable.

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- 9. No utility panels or pipe chase accesses in closet
- 10. Closets should not be located inside restrooms
- 11. Typical supplies and equipment to be stored would consist of: carton (18" x 24") paper supplies for 3 to 4 weeks, wet/dry vacuum, standard buffing machine, canister vacuum, high-speed polisher, custodial cart, upright vacuum, (2) mop buckets, up to 20 gallons of chemicals in plastic 1 gallon containers, brooms, wet mops, two dust mops, pails, cleaning supplies, plus 3 one-gallon containers.
- 12. Do not place any utility panels including but not limited to electrical circuit panels, lighting control, fire equipment panes or the like in any custodial closet.
- 13. Do not place any telecommunications panels in any custodial closet.
- 14. Do not place any mechanical equipment including but not limited to water heaters, pumps, motors, valves or the like in any custodial closet.

## SECONDARY CUSTODIAL CLOSET

- 1. Dimensions: 8 feet x 7 feet
- 2. Door Width: 36 inches out swinging
- 3. Lighting: Fluorescent
- 4. Electrical: 110 volt duplex receptacle near door
- 5. Plumbing: Floor drain in center floor-mounted custodial sink with splash shield on wall, located near doorway
- 6. Ventilation: Mechanical exhaust: 12 air changes/hour
- 7. Combination mop hanger/drying rack: 3 above sink and 3 on adjacent wall near sink.
- 8. No utility panels or pipe chase accesses in closet
- 9. Do not place any telecommunications panels in any custodial closet.
- 10. Closets should not be located inside restrooms.
- 11. 16" wide shelving.

During each design phase, verify the custodial requirements with the Maintenance and Operation's Staff. The equipment and supplies for each building will depend on the interior finishes, program requirements, and the size of the building.

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### EQUIPMENT AND SUPPLIES

The following is a list of the type, approximate size and quantity (determined by finishes and square footage) of equipment and supplies that will be stored in the buildings:

- Auto scrubber, minimum of three feet x five feet floor space, one per floor.
- Carpet extractor, minimum of three feet x three feet floor space, one per floor.
- 36 inch diameter trash barrel, one per custodial room.
- Vacuum cleaner, minimum of three feet x three feet floor space, one per closet.
- 2-24 inch diameter floor buffers and five gallon pails of floor wax (one for high speed buffing and one for low-speed).
- two per floor cartons of toilet tissue, minimum of two feet x three feet floor space
- two per closet cases of paper towels, minimum of two feet x three feet floor space.

## WASTE DISPOSAL: GENERAL REQUIREMENTS

During each design phase, verify with Facility Services Custodial, Grounds, Labor Assistant Director, the requirements for the waste collection areas and the method of disposal, compaction, and hauling. These requirements will vary depending on the program needs and the size of the building.

Screened exterior. One 3 cubic yard dumpster located near a screened exterior location per 30,000 gross square foot (GSF).

If the volume of trash warrants, a stationary compactor shall be located at the service entrance. This will reduce collection costs and keep the dock area clean and clear of trash.

Provide one or more rooms, located adjacent to the service entrance, for receiving, storing, and disposing of wastes, including recycling.

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Facilities Services Appendix 3 Custodial Requirements

## **HAZARDOUS WASTES:**

Verify with Facility Services Management and Department of Environmental Health and Safety the space requirements for the collection and control of hazardous wastes including but not limited to fluorescent light tubes, batteries, waste motor oil and lubricates, and solvents and paint. Hazardous wastes may be generated by either program or maintenance and operations procedures.

## RECYCLING

Designate space throughout the building for "quads" (secondary recycling and trash containers). Quads are a group of four separate waste containers (recycle aluminum cans and plastic bottles, recycle newspaper, recycle office paper) Each quad requires 36 inches x 12 feet of floor space.

It is Facilities Management's experience that buildings designed prior to the use of the quad system, that occupants move recycling and trash containers into hallways, stairwells, or other unsafe or inaccessible areas. The migration of the quads is decreased when space for them is included in the design. Therefore, provide space for one set of quads per floor in major buildings. This quad shall be located in a centrally accessible area.

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Facilities Services Appendix 4 Sustainable Design Guidelines

## [for Missoula Campus Only]

## I. Introduction

A. The University of Montana (University) has been informally embracing the concept of 'sustainability' through the Facility Services Department (FSD) in its construction of new buildings as well as retrofit projects for many years. The areas of energy conservation, building siting arrangements, chemical minimization, and envelope possibilities continue to be the focus during program development stage of each major project.

In addition, the FSD has been operating a recycling program for many years as well as targeting lighting and water conservation measures and operating procedures (see program comments at end of document).

The FSD strives to improve its efforts to link the interconnected components of economic, environmental, and social issues on the University campus. By working with the sustainable committee and others, through interdisciplinary thought, collective discussions, decisions, commitment, and actions the University will continue to improve campus life for students, faculty, and staff and by extension to all inhabitants of the greater Missoula area.

## II. General Sustainable Principles

- A. The University, through the FSD, is committed to the following sustainability principles in all its design and construction processes and implementation:
  - 1. Reduce *environmental impact* through careful *site selection*.
    - The impact of new construction on green space versus parking lots versus adaptive re-use of existing buildings must be carefully considered.
    - Smaller footprints are a desirable goal.
    - Site new structures mindful of orientation, shading, and the effect on adjacent buildings and spaces.
    - Maximize building flexibility to satisfy the varied demands of current and future users and residents.
  - 2. Ensure *energy efficiency* by energy costs reduction strategies through building design, maximizing the use of

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natural day light, the use of energy efficient artificial lighting, passive heating/cooling and other cost effective energy conservation designs.

- Sustainable energy generation (solar & wind) should be considered on a case-by-case basis for each new project (see Appendix 2 – Energy Conservation).
- Adopt monitoring, measuring, and feedback systems to establish baselines of energy usage and building performance, against which the University can evaluate improvements and set goals for future projects.
- 3. Pursue *resource conservation* when considering the use of land and materials, and build in the most efficient & effective manner through the use of pre-used construction materials, use of construction materials made from recycled content, minimize construction waste, and use materials that can be recycled.
- 4. Promote better *health and well-being environment* for building occupants through the use of daylighting, efficient HVAC systems that provide fresh outdoor air in adequate amounts, temperature control, acoustical attenuation within spaces and eliminate indoor air pollution.
- 5. Pursue high levels of *water efficiency* in landscaping and water usage within a building.
  - Use landscape design to create healthy and ecologically appropriate spaces, provide pleasant outdoor environments, reduce exterior lighting demand and minimize storm water runoff.

## III. Sustainable Design Requirements

- A. Sustainable design shall be a high priority for the design of all New Construction & Major Remodeling of Existing *Facilities* 10,000 GSF or greater.
- B. The University directs the A/E Consultant to include sustainable design features that would allow the facility to qualify for a U.S. Green Building Council's Leadership in Energy & Environmental Design *(LEED) 'Certified' Level*. Anything above this level (Silver, Gold, Platinum) shall be up to the Building Committee chair and donor. It is important that this decision is made early on in the design stage for the A/E Consultant.
- C. The A/E Consultant will work with the University's LEEDs

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Certified agent to prepare the necessary *documentation* and submittals to the USGBC.

- D. Maximize, to the extent possible, construction practices that reduce the environmental impact of the current project. These practices would include: demolition, recycling waste, the handling of toxics, energy and water use, storm water pollution, protecting soils and vegetation, and protecting building occupants from health risks.
- E. The A/E Consultant must report to the Owner the effectiveness & success of the project design in adhering to the sustainability principles.

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## IV. Additional University Programs

A. The following is a brief update on two growing areas where the University is pursuing sustainability practices, in addition to the above design and construction activities. They are the Recycling Program and the UM Farm to College Program.

## 1. Recycling Program

The goal of the Recycling Program is to reduce the solid waste stream by 25%. Efforts to date have resulted in a reduction of approximately 18%. Recycling stations, scattered across campus, and the addition of a Recycling Intern to coordinate the Waste-Wise Education Program have resulted in increasing collections of recyclables.

The Campus Recycling Oversight Committee, which makes program and budget recommendations to the Facilities Services Director, has also placed a strong emphasis on the value of reusing equipment and furniture. They have also recently worked together with the Dining Services on a pilot project to install two composting "Earth Tubs" located behind the Lommasson Center.

Funds to operate the recycling program on campus are generated from the sale of recycled material, donations from University Staff, a \$2.00/semester student fee (negative check off) and vending machine revenue. The annual amount has averaged approximately \$57,000 over the last five years.

From the period 2/1/91 through 6/30/05 a total of 2,400,300 pounds were recycled from approximately 20<sup>1</sup> types of waste. In addition, the Recycling Department has expanded recyclables to include the following: furniture/appliances/PC's/office partitions/filing cabinets/shelving/office equipment/classroom fixtures e.g., bulletin boards, chalkboards, projection screens, cabinets and counter tops.

## 2. UM Farm to College Program

<sup>&</sup>lt;sup>1</sup> Types of waste recycled – newsprint, aluminum, 2 types of ledger, cardboard, glass, plastics, several types of paper, tin, magazines, yellow brass, stainless steel, and copper.

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University Dining Services and four UM graduate students teamed-up in the spring of 2003 to create the UM Farm to College Program, dedicated to buying more food locally and regionally to feed the campus community. Through this program, the University plays a greater role in supporting Montana's family farming & rural economy, strengthening the local community and helping to preserve Montana's natural and cultural heritage.

The program will have targeted \$1,000,000 in local and regional purchases by the end of Spring 2006 semester. Besides the obvious immediate benefits of reducing pollution and energy consumption with local purchases, this program allow money to flow into the local economy and educates the local producers and vendors about setting up positive, long-term, relations with the University.

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## I. Introduction

On July 26 1990, President Bush signed into law the Americans with Disabilities Act (ADA). The ADA prohibits discrimination on the basis of disability in employment, State and local government services and transportation, public accommodations and telecommunications. The ADA is divided into four main Titles:

Title I: Employment: requires employers to ensure equal opportunity for disabled applicants applying for jobs and for current employees seeking transfers & promotions. The regulatory body for Title 1 is EEOC. Key definitions are "reasonable accommodations" & "undue burden" in providing changes to the work environment to enable people with disabilities to enjoy equal opportunities in the work place.

Title II: Public Services & Transportation: requires non-discrimination on basis of disability to access public services & transportation. The regulatory body is Dept. of Transportation. Title II strengthened legal protections of Section 504 of the Rehabilitation Act of 1973 to include all state & local governments, agencies & departments regardless of size to refrain from discriminating based on disability.

Title III: Public Accommodations: intended to prevent discrimination of disabled people in places of public accommodation. It also prohibits privately owned & operated businesses from denying goods, programs & services to people with disabilities. Access to services & goods must be equal for all patrons, regardless of their disabilities (e.g. must have same entry door for all patrons). The regulatory body is Dept. of Justice. The Title seeks businesses to remove architectural & communication barriers. Key questions for each facility are what is "readily achievable", does not cause "undue burden" and is "safe".

Title IV: Telecommunications: requires federally regulated telecommunication providers (telephone & public service TV) to provide continuous voice transmission, TDD relays, close captioning etc for the hearing & speech impaired people. This also applies to theaters showing films to the general public. Regulatory body is the Federal Communications Commission.

The University of Montana (University) is committed to compliance with the ADA to the maximum extent possible. In December 1993, UM President Dennison created a University policy called **"Universal Access in Facility Design"** to insure programs at The University of Montana campus are accessible to all

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students, employees and general public. *"Program access allows some part of a facility to be inaccessible so long as no person with a disability is denied or limited participation in, or benefits of, the program solely on the basis of disability"*. There must be a clear reason why new construction cannot be barrier-free (e.g. prohibitive cost). Renovation projects are required to improve the current accessibility of the building, not hinder it further. The purpose of design according to the universal access standard is:

- To require designers of University facilities to create designs which include minimal barriers, and
- To publicly discuss why barriers to universal access will be included in facility design. This discussion occurs with the ADA Committee.

The University has an ADA Committee, whose mission is ..."To monitor University facilities, programs, policies, plans, and activities to assure the identification, prevention, and elimination of physical and /or programmatic barriers that interfere with faculty, staff, and student access to and benefit from University programs, facilities, and resources ".

Designers of New Construction and Renovations are to include universal access as a goal of their design & be prepared to justify why accessibility barriers are included in their submissions to the ADA Committee. Designers must present their plans to the ADA Committee (in conjunction with Planning & Construction) at the Schematic Design stage & receive the Committee's recommendations before proceeding to Design Development. The Designer shall again present to the Committee at 65% Design Development stage for their comments before proceeding to Construction Documents. At 95% Construction Document stage, the Designer shall once more present to the Committee for their final comments & approval before proceeding with Bids.

The President of the University has the final decision concerning disability access and ADA related design issues. Facilities Services Planning and Construction Office are charged with the enactment of the Universal Design Policy & presentation of design barriers to the ADA Committee.

## II. Universal Design

The purpose of universal design is to design projects that accommodate all people to the greatest extent possible without the need for individual adaptation. When designing projects at the University, the architect shall strive to design facilities that serve the same means of use for all users, identical whenever possible, equivalent when not. Avoid segregating or stigmatizing any users. Make provisions for privacy, security and safety equally available to all users. Make the

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design appealing to all users. The architect shall use AADAG Standards as a reference during the project design phase. Building codes refer to ICC/ANSI A117.1 for accessibility. The Architect shall use the stricter of ADAAG and/or ANSI A117.1 when the two codes differ on any given issue.

## III. Design

As outlined in the president's "Universal Access" policy, all proposed facility designs must include a list of barriers which do not meet the standard of universal access prior to the acceptance of the design. For example, any pathway, entry, restroom, class room, office, seating area, lobby, or any other facility feature which is not universally accessible, must be identified by the designers of the facility, and by either University Facility Services or an accessibility consultant. Identified barriers must be submitted to the ADA Committee for review.

## IV. Guidelines

The following Accessibility Guidelines are to be considered as a minimum for University public buildings and shall be incorporated in the early design phase and project budget for any construction/renovation project:

## A. General

- 1. Fixed seating plans in classrooms and auditoria should accommodate disabled persons and shall not be segregated. Designated spaces shall be set aside for wheelchairs in both the front and back of the rooms. Ramps shall be incorporated into the design such that people with & without disabilities can use the same path of travel. Any emergency escape routes required by code shall also be made accessible to wheelchair users. Where stages are provided, the designer must provide a spot on stage with appropriate controlled lighting for a sign language interpreter.
- 2. Laboratories shall have accessible counter space. The appropriate sinks, showers, fume hoods etc., must be wheelchair accessible. The minimum amount of accessible counter space, fume hoods & other equipment required shall be agreed upon with the ADA Committee on a project by project basis.
- 3. Stages, platforms and other raised areas, in classrooms or auditoria, shall have accessibility for wheelchair users.
- 4. Sound systems in classrooms and auditoria should be designed for hearing impaired persons. Coordinate sound systems with Presentation Technology

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Services (PTS) on campus that provides hearing devices in rooms equipped with transmitters.

- 5. Public-use telephones need to be mounted at the proper height for mobility-impaired persons.
- 6. Workstations in computer laboratories need to accommodate mobilityimpaired persons have the required floor clearances & counter heights.
- 7. All sidewalk curb cuts and walkways should have tactile markings for visually impaired persons. Curb ramps are required to connect to parking spaces, transport & sidewalk systems on Campus.
- 8. Classrooms, study rooms, offices, dormitory rooms, libraries etc need to provide some furniture for disabled persons. Furniture whose height can adjust easily for able/disabled users works best.
- 9. Reception desks/counters must accommodate wheelchair users.
- 10. Lever door handles shall be used instead of round doorknobs in all publicuse areas.
- 11. Parking: handicap stalls must be provided as close to the main entrance of new buildings as possible. At least one of the required handicap parking stalls shall be van-accessible. Refer to the overall campus parking map for locating accessible parking. Refer to Public Safety Director & the ADA Committee for parking locations & number of stalls required.

## B. Entrances

- 1. At least one entrance door shall be electrically operated, with wheelchairaccess signage. Large push devices shall be used in lieu of the smaller button type. The operating buttons shall be a minimum of 5 inches square or round in diameter.
- 2. Installation of power-operated doors shall be coordinated with security hardware requirements, including Griz card readers. Design the installation to allow for future modification of controls. Minimum requirements include conduit to the doorjamb and a weatherproof, blank junction box near the operating button for installing card/keyed controls.
- 3. Push buttons may be wall or bollard mounted, depending on site conditions. Locate ADA buttons clearly ahead of door swings, allowing wheelchair user's sufficient clearance between the push button & door to swing open. Avoid locating push-buttons immediately beside doors to be activated by the button.
- 4. In a vestibule where the depth between two sets of doors is 7 feet, both sets of doors shall open and close at the same time to ensure efficient movement of people in wheelchairs. Where the distance between doors is larger than 7 feet, doors shall open on time-delay to save energy (loss

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Facilities Services Appendix 5 Access for Disabled Persons

of building conditioned air).

- 5. Timing for power doors shall be five seconds to open, 10 seconds to remain open, and five seconds to close.
- 6. Exterior and interior doors shall meet code for opening force.
- 7. In construction of New Buildings, the designer shall attempt to provide a roof/canopy over any access ramp to the main entry door.

# C. Elevators

- 1. Elevators should be centrally located within the building. Elevator call buttons shall be installed so that mobility-impaired persons can have a clear approach from all sides.
- 2. Areas of Rescue Assistance shall be incorporated into the design even if not required by the Building Code. This shall apply for new construction as well as renovations where ADA elevators are part of the scope of work.
- 3. The minimum size for ADA elevators is 51" x 68" internal with side opening door. However, campus policy is to provide larger elevators to accommodate moving of furniture, heavy equipment etc to reduce Workmen's Comp expenses. As such, the minimum size of elevators in renovation projects of classroom/office function is 51" x 81" (clear inside) and 2,500 lb capacity. For all new construction and renovations of science/lab buildings, the minimum elevator size shall be 56" x 81" (clear inside) and 3,000 lb capacity. The preferred elevator size for science/lab buildings is 68" x 94" (clear inside) and 4,500 lb capacity. These dimensions assume that a passenger elevator will double as a freight elevator for a building. However, if a separate freight elevator is planned, then an ADA passenger elevator of 51" x 81" shall be the minimum size planned.

# D. Lifts

1. Wheelchair platform lifts for accessible routes to primary areas in new construction are prohibited. In renovation projects, the use of platform lifts must be discussed & approved by the ADA Committee during schematic design stage.

# E. Noise Criteria

1. Quiet space is a necessary condition for a person to comfortably rest, study or do research. Unwanted periodic noise or loud noise and

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reverberation interfere with these activities. Poor acoustics are a barrier to those with mild to moderate hearing loss, speech impairments and learning disabilities. Poor acoustics also interfere with communication for individuals who use English as a second language. HVAC systems, water circulation pumps and other mechanical systems can be the source of intolerable acoustical stimuli. The designer shall determine appropriate noise criteria for a project, and design systems and select equipment that achieve the criteria.

- The following background noise criteria are suggested: concert halls NC 20; sleeping rooms NC 30; classrooms and lecture halls NC 30; libraries NC 30; open-plan office areas NC 40; laboratories with fume hoods NC 45.
- 3. The following reverberation times for unoccupied rooms are suggested: Classrooms and lecture halls 0.6 to 0.7 seconds maximum.
- 4. Outside of buildings, noise must be less than 50dBA at night when measured at the Campus boundary with residential areas and must meet City Ordinances for Noise Pollution Control.

# F. Construction Site

- The designer shall address the needs of people with disabilities both in the building design and within the construction limits. Indicate on the drawings, circulation patterns and disability parking that may be affected by the construction and make provisions for disabled users to access places of work/study and parking/sidewalk systems without undue inconvenience or hardship.
- 2. The designer shall request a copy of the Accessibility Guide and Map from Disability Services on Campus prior to completion of Design Development for implications relative to access during construction. Site planning shall include consideration for accessibility for people with disabilities. Areas adjacent to the construction project shall remain accessible to people with disabilities. Conduct construction activities in such a way that potential hazards to disabled people are minimized.

# G. Links

1. The Consultant should visit the University of Montana's website at <a href="http://www.umt.edu/dss/access/default.htm">http://www.umt.edu/dss/access/default.htm</a> for specific policy and related ADA documents.

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# Appendix 6

Security Reader and Installation and Setup Manual (Griz card)



# Protection of trees during construction

# A. Introduction

The objective of these guidelines is to reduce the negative impacts of construction on trees. The tree protection standards and specifications are intended to insure that appropriate practices will be implemented in the field to eliminate or mitigate undesirable consequences that may result from construction activities.

Typical negative impacts that occur during construction may include:

- Mechanical injury to roots, trunk or branches;
- Compaction of soil, which degrades the functioning roots, inhibits the development of new ones and restricts drainage;
- Changes in existing grade which can cut or suffocate roots;
- Alteration of the water table either raising or lowering;
- Sterile soil conditions associated with stripping off topsoil.

# **B. Definitions**

For the purpose of these Guidelines and interpretation of the standards and specifications, the following definitions shall apply:

- 1. <u>Arborist Periodically Inspection Report.</u> As stipulated in contract, this report will be prepared as determined by Arborist, Facilities Services, and Construction Manager.
- 2. <u>Construction Limits</u> the total construction area including the slope site, access area, and equipment and staging area.
- <u>Construction Project</u> any construction activity including demolition, grading, drainage improvements, new construction of building or accessory structures, added square footage to existing buildings or accessory structures, site preparation and landscaping.
- 4. <u>Dead Tree</u> a tree that is dead or that has been damaged beyond repair or is in an advanced state of decline as determined by a certified arborist and the arboretum committee. If a particular situation is determined to be an emergency immediate action may be necessary.
- 5. <u>Diameter at Breast Height (DBH)</u> the diameter of the tree trunk at 4 feet above natural grade level. The diameter may be calculated by using the following formula:

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 $DBH = circumference at 4 feet \div 3.142$ 

- 6. <u>Disturbance</u> refers to construction activities that may damage trees.
- 7. <u>Dripline</u> A tree's dripline is a ring around the trees canopy on the ground level that receives most of the rainwater shed from the tree canopy. This can be calculated as one foot radius for each inch of tree diameter at breast height. For specimen trees larger than 30 inch diameter, the ratio is 1.5 foot per inch diameter. Each dripline shall be determined by the judgment of the construction arborist assigned to the project.
- 8. <u>Excessive Pruning</u> removing in excess of 25 percent of the functioning leaf, branch. Pruning in excess of 25 percent is injurious to the tree and is prohibited.
- Injury bruising, scarring, tearing or breaking of roots, bark, trunk, branches or foliage, herbicide or poisoning, or any other action which is likely to cause the death or permanent damage to a tree.
- **10.** <u>Master Plan</u> a plan prepared by the University Arboretum Committee for a consistent understanding and accurate record of all trees on campus and the differing design areas (zones) by the public, interested parties and all associated with large construction projects.
- 11. <u>Mechanical Injury</u> a noninfectious injury which often leads to poor growth, a damaged appearance or death to the tree. Common causes of mechanical injury are landscape maintenance equipment, staking damage, vehicles, vandalism, weather, insects and animals.
- **12.** <u>**Owner Representative**</u> the Associate Director (AD) of Planning and Construction or the AD's designee.
- Project Arborist a certified arborist selected by Facilities Services for the purpose of preparing an Evaluation Report regarding existing trees for a proposed construction project.
- Protective Tree Fencing a temporary enclosure erected around a tree to be protected at the boundary of the <u>Tree Protection Zone</u>. This will be chain link and posts will be buried into ground.
- 15. <u>Site Plan</u> a set of drawings (e.g. preliminary drawings, grading, demolition, building, utilities, landscape, irrigation, tree survey, etc.) that show existing site conditions and proposed landscape improvements, including trees to be removed, relocated or to be retained. Site plans shall include the following minimum information that may impact trees:

a. Surveyed location, species, size, dripline area of trees (including trees located on neighboring property that overhang the project site) and Street Trees within 30-feet of the project site

b. Paving, concrete, trenching or grade change located within the <u>Tree Protection Zone</u> (<u>TPZ</u>)

- c. Existing and proposed utility pathways
- d. Surface and subsurface drainage and aeration systems to be used

e. Walls, tree wells, retaining walls and grade change barriers, both temporary and permanent

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f. Landscaping, irrigation and lighting within dripline of trees

g. All of the final approved site plan sheets shall reference tree protection instructions

- <u>Soil Compaction</u> the compression of soil particles that may result from the movement or parking of heavy machinery and trucks, storage of construction materials, structures, paving, etc. within the <u>Tree Protection Zone. (TPZ)</u>.
- 17. <u>Soil Fracturing</u> the loosening of hard or compacted soil around a tree.
- **18.** <u>Street Tree</u> any tree growing within the street right-of-way, outside of the University property.
- 19. <u>Temporary Access road</u> If there is heavy vehicle travel, 4-6" of wood chips or layers of <sup>3</sup>/<sub>4</sub>" plywood is required.
- Temporary Root Buffer a temporary layer of material to protect the soil texture and roots. The buffer shall consist of a base course of tree chips spread over the root area, keeping one foot clear of the trunk clear, to a 4"- 6" depth.
- 21. <u>Tree Protection Zone, (TPZ)</u> , unless otherwise specified by a Project Arborist, the area of temporary fenced tree enclosure covering the tree's drip line..
- Trenching & Excavating any project-related excavation to provide irrigation, install foundations, utility lines, services, pipe, drainage or other property improvements below grade.
- 23. <u>Verification of Tree Protection</u> the Project Arborist shall verify, in writing, that all pre-construction requirements have been met before mobilization for the project occurs.
- 24. <u>Vertical Mulching</u> auguring, hydraulic or air excavation of vertical holes within a tree's root zone to loosen and aerate the soil, typically to mitigate soil compaction.

# C. Planning and Implementation of Tree Preservation during Construction Process

#### Step 1: Notification.

The University of Montana (University) Facilities Services Planning and Construction (P&C) department will notify the University's Arboretum committee (UAC) of the general location of new buildings and major construction projects. This notification shall take place after the Campus Committee for Facilities (CCF) has approved a site for a new building or major project. The Arboretum Committee shall prepare an Initial Evaluation Report listing possible impacts to the existing trees as well as provide a list of recommended tree species for planting on that site in keeping with the Arboretum Master Plan.

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# Step 2 - Site Evaluation

Upon substantial completion of the Schematic Design Stage, the design Architect shall present the Site plan to the Arboretum Committee for evaluation. The plan shall show the proposed building foot-print and any site improvements; impact to existing trees & proposed new tree planting locations & species; construction access pathway, staging area & existing utilities & infrastructure.

The Committee shall then engage a certified arborist with experience and training in construction and tree preservation to investigate and evaluate the proposed site.

- The arborist shall be provided with the site plan & Arboretum Master Plan for his investigation.
- The arborist will prepare an <u>Evaluation Report</u> presented to the Arboretum Committee and P&C.

The Evaluation Report will include the following:

1. An evaluation of each tree that would be impacted by the construction including trees in or near access roads and staging zones.

2. The health, age, diameter, value, uniqueness, rarity, drip line and/or the root protection zone will be included in the report.

3. Trees worth moving will be identified along with those not worth saving and those that cannot be economically moved.

4. Important trees worth protecting in place will be identified.

5. All trees at risk will be noted, with recommendations for the proper techniques to mitigate construction damage.

6. The arborist will advise on overall ways to minimize tree damage; including input on building construction limits, staging area, and access road placement.

7. The Arborist shall meet with the Architect and Project Manager to discuss the Evaluation Report & provide advice on alternatives to minimize impact on existing trees.

# Step 3 - Arboretum Committee Action.

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The Committee members will receive and review the arborist's <u>Evaluation Report</u> prior to its next scheduled meeting. At that meeting the report will be an agenda item to be critically discussed and voted on by members. P&C shall be present to participate in the discussions & provide any clarifications of the project as required.

<u>The Evaluation Report & Committee's comments</u> will be forwarded to the design Architect by P&C to be included in further design progress. The Committee shall include the <u>Report & their comments</u> in the 65% Design Development manual for the project. The Committee shall also be a signatory in the 65% DD manual. If there is any conflict between the direction given by the Committee and the Architect, P&C shall attempt to resolve. If there is no resolution, the matter shall be taken to The VP for Administration for executive action.

# Step 4 – Construction Drawings & Implementation Stage.

The design Architect shall incorporate the Committee's suggestions into his revised Site Plan & develop it through Construction Document (CD) stage. At 95% CD review stage, the Architect shall present the latest Site Plan to the Committee showing the exact Building footprint, site improvements, parking, infrastructure & utilities, staging area, contractor parking, site access route, new & existing trees (location, species, trunk diameter & drip-line), shrubs & irrigation system. The plan shall be critically discussed & voted on by Committee members. P&C shall be present to participate in the discussions & provide any clarifications of the project as required. The Committee's comments shall be included in the 95% CD manual. The Committee shall also be a signatory in the 95% CD manual. P&C shall be responsible to ensure that the Committee's comments are fully incorporated into the final Bid Documents.

Prior to the successful Contractor starting any site activity, there shall be a Pre-Construction site meeting between the Architect, General Contractor, major Sub-Contractors (including excavator), Project Manager, P&C and Committee's representative to review the information contained in the Site Plan of the Bid Documents and is fully understood by the contractors. It shall be the Project Manager's responsibility to observe & ensure that information detail on the Site Plan is implemented by the General Contractor.

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# D. Additional Guidelines – this section generally expands on key areas that have been addressed in the previous sections.

- 1. Pre-construction Pruning
  - a. Construction can damage trees in several ways. Lowering grade and installation of utilities severs roots. Raising grade, stockpiling fill or construction material, and operating heavy equipment reduces oxygen levels in the root zone and causes root loss. Large equipment used in construction damages trees by physically hitting the branches and trunk. Trees within the construction zone that are to be preserved may be pruned wherever construction equipment is expected to contact overhanging branches. All dead branches should be removed to make the area safer for construction personnel. This should be done one week before actual construction work takes place.
  - b. Pre-Construction pruning can only be done be trained University crews or UAC-approved contractors.
  - 2. Construction Personnel Training:
    - a. The International Society of Arboriculture (ISA) has provided two video tapes that specifically address how construction can adversely affect trees. The two tapes run approximately 30 minutes. Viewing the tapes is a prerequisite for all Project Managers, or their approved designees, and the general contractor
  - 3. Onsite-monitoring during construction:
    - a. Most construction companies lack professional arborists on their staff. In general, supervisory personnel do not have the training in arboriculture to make decisions on behalf of trees on site. Therefore, it is essential to have the UAC designee or consulting arborist available to make on-the-spot decisions on behalf of the trees within the construction zone. The person monitoring does not have to be present

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every minute of the construction operation, but should inspect the area on a bi-weekly schedule.

- 4. Pre-construction root Pruning:
  - a. In general, most tree roots are located in the upper thirty inches of soil. Few roots grow beneath paved streets. Roots are more likely to follow utility corridors, and grow beneath sidewalks and to some extent beneath hard paved surfaces. If standard equipment with a blade or shovel (e.g. backhoe) is used for grade lowering, roots caught by blade or shovel are actually ripped apart, often to the tree base. This results in extensive damage to the tree. To prevent the tearing of the roots, they should be cut with appropriate root pruning equipment to a minimum of 24 inches deep before construction begins. The cuts should be made 6-12 inches closer to the tree than the construction limit. This allows for root regeneration (within the 6-12 inch area) during the construction period. If the cut is made at the construction limit, the cut surfaces of the roots remain exposed to air which causes dieback from that point.
- 5. Tree Protection Zone (TPZ):
  - a. A highly visible physical barrier (6 foot chain link fencing) will be constructed around each tree designated for protection. Single-strand or plastic flagging is not considered acceptable. Entry within the "nonviolation" zone will be permitted ONLY under the supervision of the on site designee. Otherwise, the "non-violation" zone is not to be transgressed without penalty by a preset fine.
- 6. Utility auguring:
  - a. Since most tree roots are located near the surface, trenching for the installation of utilities can cause significant root loss, often resulting in the death of the tree four to six years later. Trees designated for

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protection are worth saving and worth the cost for auguring beneath the root system.

- 7. Tree Watering:
  - a. Trees designated for protection should be watered during any 30-day period, watering costs and responsibility shall be borne by construction contractor. The amount of water per tree should be based upon 50 gallons per inch diameter. Application should be made so that the water slowly soaks into the ground and does not runoff.
- 8. Sidewalk removal measures:
  - a. Major injury to trees con occurs when sidewalks are removed. Removal equipment compacts parkway soil, damages trunks and branches, and rips-up roots. Trees designated for protection should be root pruned before sidewalk removal. Broken sidewalk pieces can be pulled from the street surface with construction equipment. In difficult areas, sidewalk damage during construction (e.g. Grade-All) should be used whenever possible.
- 9. Topsoil backfilling and grading:
  - a. Most construction projects use existing excavated material for fill. Often this material is subsoil with a high percentage of clay and aggregate material. Subsoil is generally unsuitable for root growth. Areas where trees are growing or will be planted should have a minimum of 12 inches of "good" topsoil at the surface.
- 10. Mulch restoration:
  - a. Tree roots do not grow well in competition with (sod). Optimum root growth is obtained in organic mulch (4 inches maximum). All trees to be protected will be mulched to the tree protection zone prior to construction.

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- 11. Post-construction treatments:
  - a. Some trees may be inadvertently damaged during construction. The post-construction pruning is to remove any damaged branches. Also, trees which lose more than 25% of their root system may be selectively pruned to remove a portion of the top (not to exceed 15%) to compensate for the root loss. The on-site UAC designee will designate trees for post-construction pruning.

#### The following sections are currently a work-in-process.

- E. Recommended Tree Species List in process
- F. Parking Lot Trees in process
- G. Shrubs List in process
- H. Construction Projects do's/don'ts in process
- I. Injury mitigation in process
- J. Damage to trees in process
- K. List of Recommended Arborists in process

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# A. Introduction

1. There are several good reference reports, located in the Planning and Construction Offices, that the Consultant should review as part of the background research prior to beginning design work.

2. They would include:

- The 2003 NIH Design Policy and Guidelines
- ASHRAE Laboratory Design Guide<sup>1</sup>
- American National Standard, Laboratory Ventilation, American Industrial Hygiene Association (AIHI)

#### B. General Outline

- 1. The following outline is from the above referenced ASHRAE Guide:
  - Types of Laboratories
    - 1. General Chemistry
    - 2. Radio-Chemistry
    - 3. Teaching
    - 4. Research
    - 5. Hospital or Clinical
    - 6. Biological Containment
    - 7. Animal
    - 8. Isolation/Cleanrooms
    - 9. Material Testing
    - 10. Electronics/Instrumentation
    - 11. Support Spaces

Laboratory Equipment

- 1. Fume Hoods
- 2. Biological Safety Cabinets
- 3. Flammable and Solvent Storage Cabinets

Critical information and guidance needed during the planning phases of a laboratory building project:

- 1. Risk assessment
- 2. Environmental requirements
  - a. Identification and understanding hazards
    - i. Chemicals
      - 1. Flammables

<sup>&</sup>lt;sup>1</sup> ASHRAE Research Project 969, 2001, McIntosh, Dorgan, Dorgan.

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- 2. Toxins
- 3. Carcinogens
- 4. Compressed Gases
- ii. Biological
- iii. Radiological
- iv. Physical
- b. Hazard analysis methods
  - i. Hazard and operability (HAZOP) studies
  - ii. Failure mode, effects, and critical analysis (FMECA)
  - iii. Fault tree analysis
  - iv. Event tree analysis
  - v. Cause-consequences analysis
  - vi. Human-error analysis
- 3. Appliances and occupancy
  - a. Appliance loads
  - b. Lighting
  - c. Occupants
- 4. Pressure relationships
  - a. Negative pressure room
  - b. Neutral pressure room
  - c. Anteroom
  - d. Transfer air
- 5. Ventilation and indoor air quality considerations
  - a. Minimum supply air changes
  - b. Minimum exhaust air changes
  - c. Minimum outdoor air changes
  - d. Minimum total air changes
  - e. Recirculation considerations
  - f. Occupied vs. unoccupied mode
  - g. Cooling load vs air-change requirements
  - h. Potential pollutants and sources
  - i. Supply air/exhaust air treatment requirements
- 6. Laboratory codes and standards
  - a. National Fire Protection Association (NFPA)
  - b. Occupational Safety and Health Administration (OSHA)
  - c. National Institutes of Health (NIH)
  - d. Building Officials and Code Administrators International, Inc. (BOCA)
  - e. Scientific Equipment and Furniture Association (SEFA)
  - f. American National Standards Institute (ANSI)

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Facilities Services Appendix 8 Laboratory – General Guidelines

- g. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- 7. Integration of Architecture and Engineering Systems
  - a. Building Concept
  - b. Utility Distribution
  - c. Laboratory Layout Approaches
  - d. Budgeting
- 8. Development of Planning Documents
  - a. Owners Design Intent Documents
    - i. General Project Description
    - ii. Objectives
    - iii. Functional uses
    - iv. General quality of materials and construction
    - v. Occupancy requirements
    - vi. Indoor environmental quality (IEQ) requirements
    - vii. Performance requirements
    - viii. Budget consideration and limitations

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Facilities Services Appendix 9 Hazardous Material Handling Guidelines in Construction Areas

- A. General New Construction
  - 1. For the construction of all new buildings on the campus of the University of Montana the use of asbestos, asbestos-based materials is prohibited.
  - 2. For the construction of all new buildings on the campus of the University of Montana the use of lead or lead-based paints is prohibited.
- B. General New additions or remodeling construction projects
  - However, there may be construction projects (additions, remodeling of existing facilities) that require or result in disturbing or uncovering areas where hazardous materials (like asbestos or lead-based paints) are present and create a need for abatement.
  - 2. The Consultant shall work with the Owner to ascertain which existing materials contain hazardous materials. The Consultant or Owner shall engage an environmental consultant experienced and qualified in hazardous materials abatement to do a complete survey of the existing building being renovated to identify what hazardous materials are involved and where they are located. The environmental consultant shall prepare a set of plans and specifications for the safe removal of identified hazardous materials before any general construction can proceed.
  - 3. In all cases, work will stop immediately once it is suspected that a hazardous material is present and a specifically-tailored abatement plan will be designed and implemented as soon as possible by the Owner.

The Consultant should review the University's Environmental Health and Risk Management website regarding all hazardous materials, including asbestos and lead-based paint (reference <u>http://www.umt.edu/research/eh/hazmat.htm</u>) <u>http://www.facs.umt.edu/BuildingMaint/Asbestos/Documents/Asbestos\_Operations\_&\_Maintenan</u> <u>ce\_Plan\_08102004.pdf</u>

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Facilities Services Appendix 10 Building Controls



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