COLORADO COLLEGE

FACILITY DESIGN GUIDELINES MANUAL

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Colorado College Facilities Services
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PREFACE

The purpose of the Facility Design Guidelines Manual is to provide design teams with clear and concise guidance related to ***specified and designed material, design processes and procedures, and system performance requirements*** for Colorado College facilities. The guidelines are to be used for both new and renovation construction types. It is anticipated that the Manual will serve as the initial technical design concept development resource in the course of preparing and delivering project construction documents. The Manual also provides a comprehensive description of the college's ***intended design and submittal process, design intent documentation, criteria and procedures for the design of High Performance Sustainable Facilities*****, and specific design and built environment requirements for various system elements of facilities and infrastructure at Colorado College.**

A Design Intent and Criteria Manual is to be prepared and maintained by the Architect to communicate how the building is intended to operate, describe operational performance goals, describe Basis of Design of all systems to achieve performance goals, description of Sequence of Operations and interaction of systems, description of systems anticipated efficiency and capacities, and the verification of systems meeting performance criteria during the acceptance testing or commissioning process. The Design Intent and Criteria Manual is to be included in the Operations and Maintenance Manual for the project, to be used for facilities staff training purposes and for system retro-commissioning reference purposes throughout the life-cycle of the building.

The **specific design and built environment requirements** are organized according to The Construction Specifications Institute's ***UniFormat***™ system of construction assemblies. This represents a unique, innovative, and repeatable approach to communicate **System Design and Construction Requirements** for college facilities. The design guidelines are subdivided into major system elements including ***Substructure (foundations), Shell (structural frame and enclosure), Interiors (construction and finishes), Facility Services (building environmental control systems), and Site Construction (infrastructure and landscaping)***. Other major system elements are under consideration for future development within the ***UniFormat***™ structure, including Equipment, Furnishings, and Special Construction. Each Section within these system element categories addresses detailed requirements which ***prescribe general methods of construction*** desired by the College. Included also are built ***system performance requirements including basic function, amenity and comfort, health and safety, structural requirements, durability and life-cycle requirements, and operations and maintenance considerations***.

These Facility Design Guidelines, when completely implemented with a ***strong sense of commitment by all participants in the design and construction process, are anticipated to result in superior building and outdoor environments at Colorado College***. Using the guidelines as an initial step, we believe design teams are encouraged, supported, and empowered to develop exciting, innovative, and creative 21st century educational, social, and pedagogically rich environments for the students and faculty of Colorado College.

Note: To facilitate ease-of-use of the Facility Design Guidelines Manual, each category listed in the Table of Contents acts as a hyper-link, which can be used to jump directly to that section.

COLORADO COLLEGE FACILITY DESIGN GUIDELINES MANUAL
TABLE OF CONTENTS

END OF TABLE OF CONTENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Design requirements for the construction of:
   1. New facilities.
   2. Major building additions.
   3. Major renovations of existing facilities.
   4. Other facilities as determined by College Facilities Services Department.

1.02 DEFINITIONS

A. Building Committee: Consisting of representatives of the Project's educational department, primary user group, and other Project stakeholders including but not necessarily limited to College Facilities Services Department, Information Technology, and others to be determined who will best serve the needs and intended outcomes of the Project.

B. Code: The code referred to herein consists of all applicable local, state, and federal regulations, and the following:
   1. Building Codes: The following documents are incorporated into the definition of "the code" for the purposes of these design and construction guidelines, except for administrative provisions contained therein; where referenced, the code enforcement official is the Pikes Peak Regional Building Department of Colorado Springs. **The College was subject to a Department of Justice ADA compliance audit and agreed to a continuous self-managed ADA compliance plan governed by the DOJ standards listed below for all new construction projects subsequent to the 2007 agreement.** Editions currently enforced by the Pikes Peak Regional Building Department of Colorado Springs are applicable:
      a. ICC International Fire Code.
      b. ICC International Building Code.
      c. ICC International Plumbing Code.
      d. ICC International Mechanical Code.
      e. ICC International Fuel Gas Code.
      f. ICC International Energy Conservation Code.
      g. NFPA 70 - National Electrical Code.
      h. **2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.**
      i. FED-STD-795 - Uniform Federal Accessibility Standards; 1988 (Residential Facilities only).
      j. 29 CFR 1910 - Occupational Safety and Health Standards; current edition; as a work place.

C. College Facilities Services: Represents Colorado College for all facility design and construction activities on the campus; term used interchangeably with "Owner", "User", and similar terms referring to representatives of Colorado College.

D. Communications: Services that provide voice and data transmission, sound reinforcement, and television reception and distribution.

E. Conveying Equipment: Mechanized means of conveying people and goods, comprising people-moving equipment, material handling equipment, and maintenance conveying equipment.

F. Demolition: Removal of unneeded and undesirable existing elements.

G. Design Phases: Detailed requirements are included in DESIGN PROCESS AND SUBMITTAL REQUIREMENTS.

H. Electrical: Provision and distribution of electrical power to operate all electrically-operated devices, including those included under other services and those provided separately by the College Facilities

Services; artificial lighting to illuminate spaces and tasks, both interior and exterior, without reliance on natural light; grounding systems, including lightning protection, and cathodic protection.

I. Electronic Safety and Security: Services that provide fire detection and alarm, access control, intrusion detection, and remote surveillance.

J. Equipment: Fixed or portable equipment elements usually having services connections.

K. Exterior Enclosure: All non-structural vertical exterior elements, including openings and elements closing or covering openings, comprising the exterior skin, the structure supporting the skin unless part of the superstructure, weather barriers, balcony walls and railings, parapets, joint sealers, insulation, exterior ceilings and soffits, and wall mounted appurtenances, but not including the interior finish unless an integral part of the enclosure.

L. Fire Suppression: Automatic fire sprinklers, standpipes, and extinguishing systems.

M. Fixed Seating: All types of fixed seating, including audience seating, conference seating, lounge seating, pews, and benches.

N. Fixtures: Fixed elements used by occupants in the functioning of the project but not having services connections.

O. Food Service Equipment: Fixed equipment relating to commercial and institutional food service whether or not requiring services connections and movable equipment requiring services connections, including refrigeration, storage, food preparation, serving, cleaning, and exhaust hoods and fans. Not including residential appliances.

P. Furnishings: Movable elements used by occupants in the functioning of the project, not requiring services connections; not site furnishings.

Q. General Equipment: Equipment that could occur in buildings of any occupancy, such as fire protection specialties, loading dock equipment, solid waste handling equipment and chutes, anchorage systems for working on the roof, and built-in vacuum system.

R. Hazardous Waste Abatement/Remediation: As prescribed by College Facilities Services Department Environmental Health and Safety Coordinator.

S. HVAC: Artificial means of maintaining interior space comfort and air quality, including heating, cooling, ventilation, and energy supply.

T. Information Fixtures: Fixed elements relating to communications but not part of communications services, such as signs and other identifying devices (including those mounted on the roof, exterior walls, or in the site), visual display surfaces, including projection screens, and fixed mountings and enclosures for communications equipment.

U. Integrated Automation: Integrated systems for centralized and/or remote monitoring and/or operation of services and non-services elements.

V. Interior Finishes: All applied finishes on the interior of the building, including on the interior side of exterior wall elements; wall finishes, including wall bases, trim, corner guards and other protection; floor finishes, including recessed mats and grilles; suspended ceilings and soffits, applied ceiling finishes; stair finishes and other finishes.

W. Interiors: All elements necessary to subdivide and finish the enclosed space, including partitions, doors, interior windows and other openings, stairs, finishes, and fixtures, except fixtures associated with services and specialized equipment.

X. Landscaping: Plants and turf throughout the site and indoors, and elements that contribute to their maintenance, such as irrigation.

Y. Maintenance Conveying Equipment: Vertical and horizontal conveying equipment for moving people and goods for facility maintenance, such as swingstages and lifts for window washing.

Z. Plumbing: Means of delivery of water to points of utilization; automatic heating and conditioning of domestic water; and unattended removal of water, rainwater, and liquid waste.

AA. Process Elements: Equipment and services serving a specialized process that is the primary objective of the facility other than support of occupants.

AB. Roofing: All elements forming weather barriers at the sloped or essentially flat weather-proof enclosure over the entire "top side" of the building, including all elements from the top of the deck up, roof coverings, gutters and downspouts, wearing surfaces, roof openings and elements that close openings, such as skylights, vents, and hatches, and roof mounted appurtenances.

AC. Services: Mechanized, artificial, automatic, and unattended means of supply, distribution, transport, removal, disposal, protection, control, and communication.

AD. Shell: The superstructure, exterior enclosure, and roofing.

AE. Site Fixtures and Equipment: All kinds of elements installed outdoors, primarily fixed or permanently mounted, such as fences and other barriers, athletic fixtures and equipment, miscellaneous minor structures, site furnishings, and flagpoles (including those mounted on roof or exterior wall).

AF. Site Improvements: Pavements and surfacing, site fixtures and equipment, landscaping, and tunnels that are not part of substructure or a utility structure applicable to a single utility.

AG. Site Elements and Work: Modifications to the site, site improvements, and site portions of services (i.e. utilities).

AH. Storage Fixtures: Fixed storage elements, usually modular, and to some extent relocatable, including built-in cabinetry, wardrobe units, lockers, anchored utility shelving, mailboxes and other postal specialties except in post offices.

AI. Substructure: Elements below grade and in contact with the ground.

AJ. Superstructure: All elements of floor and roof construction above grade and within basements, and elements required for support, including structural frame and load-bearing walls, and including fireproofing and firestopping, and vapor retarders and air barriers when an integral part of the structure.

AK. Window Treatment: Fixed elements that control view and natural light, for both exterior and interior openings, such as blinds, shades, shutters, and curtain tracks (but not the curtains).

1.03 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASHRAE Std. 62.1 - Ventilation For Acceptable Indoor Air Quality.

E. ASHRAE Std. 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

F. ICC (IFC) - International Fire Code.

G. ICC (IBC) - International Building Code.

H. ICC (IPC) - International Plumbing Code.

I. ICC (IMC) - International Mechanical Code.

J. ICC (IFGC) - International Fuel Gas Code.

K. ICC (IECC) - International Energy Conservation Code.

L. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1).

M. NFPA 70 - National Electrical Code.

N. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

1.04 SAFETY CONSIDERATIONS

A. Design all College buildings with full consideration for the safety of the occupants and maintainers.
   1. Occupied Buildings: Safety and minimizing the disruption to the Faculty, Staff, and Students is of primary concern and may involve tightly phased and scheduled planning for both the Consultants and Contractor.
   2. Renovation Projects: The College will provide Contractor with a hazardous materials assessment report based on the identified project scope.
      a. College Facilities Services Environmental Health and Safety Coordinator will contract and organize the work to be performed by an abatement contractor so as to not adversely impact the construction schedule.
   3. Contractor is responsible for maintaining the site and completing work in a safe manner and in accordance with the applicable Occupational Health & Safety Administration (OSHA) regulations.

B. Approvals:
   1. It is Architect's responsibility to secure approval of Construction Documents from all appropriate code authorities. Furnish copies of approval letters and drawings to College Facilities Services Department. College Facilities Services Department will review and approve the final Construction Documents based on considerations identified during the design process and included in the Colorado College Design Guidelines.

C. Corridors:
   1. Corridors, means of access and egress, of an appropriate width and configuration to provide safe exiting from the building. Recess doors swinging into corridors when possible to avoid interference with the flow of pedestrian traffic. Place and secure movable furniture and equipment so as not to obstruct the required width or travel path. Provide appropriate spaces or recesses for community recycle collection stations

D. Stairs:
   1. Enclosed Stairways: Engineered smoke evacuation or mechanical pressurization for smoke control as required by the code.
   2. All Stairs: Non-slip tread nosings and constructed of materials appropriate for the location and installation.

E. Floors:
   1. Floor Construction: Design to a vibration criteria appropriate to the use. In critical installations, vibration analysis may be appropriate. When mechanical equipment is located in a Penthouse, give special consideration to transmission of vibrations into the building; providing a proper vibration isolation and structural system.
   2. Flooring in Laboratories and Chemical Storage Rooms: Constructed with chemical resistant liquid-tight flooring materials, including raised sill not less than 4 inches in height at all points, including in front and behind cabinets, but excluding doorways.
   3. Flooring in Commercial Kitchens: Constructed of a slip resistant, easily maintained material acceptable to the El Paso County Health Department.
   4. Floors in Toilet Rooms, Showers, Greenhouses and Other Special Use Spaces: Flooring appropriate for the use and as approved by the College Facilities Services Department.

F. Roofs:
   1. Provide safety railings and barriers at hazardous locations on roofs including but not necessarily limited to rooftop equipment in close proximity to parapets and roof edges. Comply with the Code as a minimum requirement, and with other requirements identified or established by the College Facilities Services Department.

G. Doors:
   1. Where utilized, connect electro-magnetic holders for rated doors to the building smoke detection and alarm system.

2. Doors to all laboratory spaces must swing toward the corridor and have a vision panel when allowed by the Code.

3. Many exterior doors are monitored and/or controlled through the campus-wide communication/data card access network system.
    a. System: CBORD card access system.

H. Fire Extinguishers:
1. Locate fire extinguishers as required by National Fire Protection Association and the code. Provide and install a recessed cabinet or semi-recessed cabinet and the College will provide the fire extinguisher unit. All aspects of fire extinguisher location and installation conform to the currently applicable International Fire Code (IFC), title 29 of the Code of Federal Regulations (29 CFR) section 1910.157, other sections in this document and applicable codes.
2. Fire Extinguishers: 5 lb type ABC dry chemical, unless otherwise determined by the code.
3. Locations: A minimum of one fire extinguisher in the following locations, with additional units as required:
    a. Laboratory: 1 Unit/650 gsf
    b. Chemical Storage: Unit/500 gsf
    c. Shops: 1 Unit/650 gsf
    d. Stage Platforms: 1 each side.
4. The Architect is responsible for locating the fire extinguisher cabinets on the drawings.

I. Fire Protection:
1. A fire alarm system is required in each new or remodeled building.
2. While the NFPA is a specification guide, it does not necessarily address all requirements of the local Fire Department. The Architect is required to contact the Chief of the Colorado Springs Fire Department and/or City of Colorado Springs Fire Inspector to coordinate design aspects to ensure an expedient fire response is designed and specified. Building fire alarm systems must be connected to the Campus central monitoring network.

J. Building exterior and interior designs must identify locations and clear access to the following:
1. Fire and emergency vehicles.
2. Hydrant and water supply.
3. PIV and Fire Department standpipe.
4. Fire alarm annunciator panel(s).
5. Special fire suppressant agent storage.
6. Knox box key and fire plan storage.
7. Sprinkler control valve room.
8. Emergency exit signage.

K. Fire Protection Sprinkler and Suppression Systems:
1. An automatic fire suppression system will be required where design and code dictate and when included in the Owner's Project Requirements. Discuss with College Facilities Services Department during the design process and review the system.
2. Provide all commercial kitchen hoods with an approved fire suppression system. In chemical storage rooms, a chemical fire suppression system, such as "Barricade" or "AFFF" is preferred. In central computer rooms, the College "when required" desires gaseous fire extinguishing systems. Consider "Inergen" as the extinguishing material and review with College Facilities Services Department and Information Technology Services (ITS).

L. Fire Hazard Safeguards:
1. Flammable or Combustible Material Storage: Exceeding 10 gallons, stored in a small fire-resistive room or in an approved flammable liquid safety cabinet.
2. Chemical Storage Cabinets: When included in the contract, selected as follows:
    a. When the chemical storage cabinets are purchased by the Owner, the Architect is required to coordinate and design to accommodate them.
    b. All Laboratories: At least one (1) and no more than (3) flammable liquids storage cabinets, as specified in the most recently published version of the International Fire Code (IFC).
    c. The number of flammable liquids storage cabinets determined by program design. Review with the College Facilities Services Department and incorporate into the design as approved.

M. Coiling Doors/Fire Curtains:
   1. The use of this type door is strongly discouraged, and only used by permission of the College Facilities Services Department.

N. Eyewash and Safety Showers:
   1. All Laboratories: At least one plumbed eyewash unit with a floor drain below, that meets or exceeds the requirements for plumbed eyewash units in the most recent printing of the ANSI Standard Z387.1 “American National Standard for Emergency Eyewash and Shower Equipment.”
      a. Units properly tested.
      b. Install safety showers installed in laboratory buildings as required by the code.

O. Asbestos Removal:
   1. Most College buildings and utility tunnels constructed before 1970 contain asbestos materials in some form or another. The most typical use is mechanical insulation and other building materials.
   2. Generally, it is the policy of the College to remove and dispose of these materials, whenever a construction project is undertaken, to remodel a building or part of the project.
   3. Based on the Scope of Work established in the Architect’s documents, the College will provide the design team and Contractor a written report from a State Certified Inspector identifying the areas of concerns. The actual removal and disposal will be accomplished through the Facilities Services Environmental Health and Safety Coordinator using an outside contractor prior to the start of the remodeling project or when appropriate to the construction sequence of the Project. If the removal project is large enough to require a bidding process, the Owner may contract with a consultant for preparation of contract documents. These services will be separate and distinct from the Architect/Engineer's services. If during the course of remodel construction, additional suspicious material is discovered, notify the College Facilities Services Environmental Health and Safety Coordinator immediately. The College will assess the situation and remove the material appropriately.

P. Use of Asbestos or Products with Asbestos:
   1. The use of asbestos or any product containing asbestos banned by the Environmental Protection Agency and Department of Labor's Occupational Safety and Health Administration is absolutely prohibited from use in College facilities. Any contractor installing any product with asbestos will bear full responsibility and liability for any penalties, damages, suits or loss and will be required to pay for any and all costs of removal and replacement and also all legal costs if they are involved. Any product specified that unknowingly contains asbestos must be brought to the attention of the Architect/Engineer in writing prior to its purchase, and must not be installed.

1.05 GENERAL DESIGN CONSIDERATIONS

A. A sound, functional plan is the single most important factor in obtaining an acceptable solution to the **Facility Program**. This can best be achieved through a careful study of the space relationships and a thorough understanding of the needs of the users as expressed in the **Building Program** and in subsequent meetings and discussions held between the Architect and the Building Committee and/or Facilities Services Director.

B. It must also be recognized that changing curricula and modifications of space are frequent occurrences in College operation. Flexibility should be a consideration in any plan to accommodate anticipated as well as unanticipated changes and future growth.

C. Exterior design of the building is expected to be compatible with neighboring buildings and with the campus as a whole. Exterior materials as well as the building form will be examined very carefully at every step of the process to ensure compliance with the requirements of the project and College design standards. Landscape architects will coordinate with the College to design ADA accessibility with considerations based intended usage, safety, security, planting features, access paths, water features such as ponds, topography and grades, lighting, signage, structures, etc. This design will be reviewed by the Campus Design Review Board (DRB) to ensure consistency with the Campus Master Plan.

D. It is neither the policy nor the intent of the College to limit the creative individuality of the Architect/Engineer in design or selection of materials. The recommendations presented in the Colorado College Facility Design Guidelines are based upon College experience with materials and construction methods and details that have resulted in the fewest problems in operation and maintenance, and in the

best service and life of materials and equipment. Uniformity in the use of materials and equipment throughout the campus limits the range of cleaning and maintenance products and reduces the variety of parts and materials which must be stocked for repairs and replacements as well as providing a continuity of aesthetic and functional user-experiences.

E. New materials and products and new methods of construction, when proven sound, may justify deviation from these guidelines. Give special consideration to technology and careful analysis to accommodate future advancement. Consider and discuss design with building sustainability concepts, and integrate into the Project. Planning for technological flexibility within budgetary constraints is a primary task. Review proposals to use such new applications and secure approval by the College Facilities Services Department prior to presenting them to the entire Building Committee and incorporating them into the Documents. General durability of construction, selection of appropriate materials, parts availability, adequate parts inventory, and long term maintenance must be a primary concern during the design, and must be specifically identified in the Construction Documents.

F. The College's East Campus properties on North Weber, east of the alley easement, between Uintah and Cache la Poudre Streets are in the North Weber/Wahsatch Historic District. Historical Design Guidelines have been developed for this area.
   1. Be aware of these historical design guidelines and review the design with the Owner's Representative and, if warranted, History Colorado or the Colorado State Historical Fund, as applicable.

G. The College also has buildings in the Old North End Historic District and many campus buildings on the National Register of Historic Places which require special design considerations for historic buildings. In some cases College historic buildings carry 20 to 50 year covenants requiring that exterior or site changes or modifications comply with the Department of Interior Standards and require review and approval by the Colorado State Historical Fund (SHF) due to the prior use of SHF grant funds for restoration work

H. **Energy efficiency and opportunities for high performance energy efficiency design goals and strategies** must be given special consideration in the design of new or remodeled College buildings in order for the College to achieve its long-term sustainability goals. Additional high performance design goals and strategies information is provided in the "**Facility High Performance Design Criteria Checklist**" in this Colorado College Facility Design Guidelines Manual. Colorado College requires a life-cycle cost analysis, where appropriate, on major components of new facilities and renovation projects. Review building operating cost analysis with the Owner's Representative at the Design Development and/or General Contractor construction submittal Phases.

I. The College and their Utility Consultants have an understanding of the functioning and future expansion of the Central Plant design, distribution and operations. In the beginning of all Projects, the Architect and their Engineers are required to review the scope of the Project to understand the need and constraints of the Central Distribution System.

J. **Colorado College supports and promotes sustainable and environmentally conscious building design**, a systematic consideration of a project's true cost to the environment and energy resources. Sustainable design opportunities should be identified, and innovative strategies and concepts should be applied within the budgetary and programmatic constraints of the specific projects. Additional sustainable design information is provided in the "**Facility Life-Cycle Design Guidelines for Sustainability**" in this Colorado College Facility Design Guidelines manual. A primary motivating premise for sustainability is to make wise resource decisions that will minimize our impact on future generations. The Colorado College campus becomes a prominent forum for educating the public, promoting greater community consciousness and leading by example. The building and associated landscape have substantial influence on teaching and learning. The benefits of improved indoor air quality, energy efficiency and enhanced visual surroundings promote a healthy and productive environment for inhabitants.

K. During the design process, develop and discuss a reasonable and feasible analysis of potential sustainable design opportunities and strategies to understand the financial, programmatic schedule, and greenhouse gas impacts of the strategies on the entire Project. The level of analysis should be proportional to the project and determined at the beginning of the project. The Consultants are required

to facilitate an integrated multi-disciplinary design process that evolves through the entire design and construction process. The Architect is responsible to prepare and maintain a **Design Intent and Criteria Manual**, containing design intent and performance criteria that will be of use during construction, occupancy, and operation of the project. Conduct discussion and review of potential sustainable design opportunities and strategies with the Building Committee and/or Facilities Services Director at each Design Phase. Produce a commissioning plan and develop an implementation process for projects with substantial mechanical or electrical work. Consideration of mechanical and lighting system efficiency, daylighting schemes, reduction/elimination of environmentally harmful substances, regional material availability and indigenous or xeric plant usage are general strategies that should be evaluated.

1.06 FACILITY PROGRAM

A. For larger Projects over $1 million, the Architect will provide a written **Facility Program**, including a comprehensive design narrative for all Project design functions. For smaller Projects under $1 million, the College will develop a **Facility Program** to include both design and construction specific details and goals. The typical Facility Program may include the following:
   1. Introduction:
      a. A statement of the nature and function of the end user of the facility, background information regarding development of the project to date, and identification of the site.
   2. Design Considerations:
      a. A statement of general design and construction specific details and goals pertinent to the project, including functional area narratives covering site design details, civil engineering design details, electrical design details, mechanical design details, sustainability design details, interior design details, life-safety design details, ADA accessibility design details to include All Gender restrooms, and information technology/audio-visual design details.
   3. Project Cost Considerations:
      a. An estimated Project Cost is included in the **Building Program**. The Architect should be especially concerned with the amount identified as Construction Cost. The heading "Construction Cost" normally includes all built-in or fixed equipment for the Project. It is the responsibility of the Architect to design within that estimated figure or immediately advise the College Facilities Services Department that this cannot be accomplished. The Owner may budget and provide certain aspects of the Project (furnishings, special equipment, etc.) The Architect shall thoroughly review these costs with the Building Committee and College Facilities Services Department assisting in developing the overall Project Budget.
   4. Project Time Considerations:
      a. The **Building Program** usually incorporates a tentative time schedule indicating when various phases of the work are expected to be completed. This schedule is based on a critical occupancy date(s) which in turn relate to other planned programs and the College academic calendar. A revised time schedule may be developed after discussions between the Architect, General Contractor, and the College Facilities Services Department.
   5. Space Requirements Summary:
      a. A tabulation of net areas required for assignable spaces. Net areas given in the Program shall be maintained in the Architect's design as closely as possible. Any significant deviation from the areas given or functional relationships shown in the program could result in rejection of the schematic design unless previously approved by the College Facilities Services Department.

1.07 NON-PROGRAMMED SPACE REQUIREMENTS

A. Corridors:
   1. Attention should be given to adequate corridor widths for the loads generated by the particular occupancy of each part of the Project. Obviously corridors serving classrooms must be wider than those to offices. When possible, doors opening in the direction of the exitway should be recessed in an alcove to prevent intrusion into the pedestrian flow. Provide drinking fountains and other public facilities such as benches to serve the building occupants. The area under drinking fountains and recycling bins shall have an impervious floor material. Drinking fountains should include filtered water bottle filling dispensers. Provide appropriate spaces or recesses for community recycle collection stations.

2. Make similar analysis for determination of number and size of elevators and number and size of public toilets.
3. Corridor walls are required to be designed and constructed of durable materials. Generally, corridors will be of framed gypsum board construction. Use vandal resistant or plywood backing on the passage face of the partition.

B. Public Toilets:
1. Provide adequate and code-compliant facilities to accommodate building occupants including physically handicapped. Particularly in remodel projects, review toilet count with the code official to provide a reasonable accommodation in an existing condition.
2. In large public toilets, provide pipe space behind water closets minimum 36 inches clear and readily accessible. Include lighting and a separate 120-volt duplex receptacle in each pipe space.
3. The code will determine the required fixture count. It is particularly important in building renovation and/or addition projects to discuss and resolve this issue early in the design process.

C. Mail:
1. Discuss with the College Facilities Services Department the nature of mail facilities for each individual building.

D. Custodian Closet:
1. A custodian closet is preferred on each floor of the building for storage of cleaning equipment and supplies. The minimum size space required is 80 square feet. If possible, provide a larger custodian room on the main floor near the service entrance and near an elevator, (minimum size 120 square feet); space requirements on other floors may be reduced to 50 square feet.
2. Equip each custodian closet with curb-type utility floor sink, hose bibb, hot and cold water, and shelves. Provide adequate ventilation where battery chargers or other similar devices are used. Each custodian space must have adequate electrical outlets. Coordinate with College Facilities Services and the College custodial contractor for specific requirements in closets.
3. Custodian closets should not be shared with other functions (i.e., telecommunications boards, pipe chases, etc.).

E. Waste Disposal:
1. Trash, compost, and recycle material disposal is an almost continuous operation. Trash, compost, and recycle material pick-up is on a daily or more frequent basis to each building, using packer type trucks into which containers are emptied. Building custodians take trash, compost, and recycle materials from individual spaces to the nearest exterior collection containers. Verify and accommodate for the interior container sizes as identified by the Owner's Representative. Accommodation for specially required interior trash recycling and composting containers is to be considered during the design process.
2. Biological wastes, chemical wastes and radioactive materials require special consideration and their requirements will be analyzed and programmed in specific buildings where it occurs.
3. The College has extensive single-stream recycle waste materials and other materials recycling programs. Review both internal and exterior waste collection requirements with the College and provide adequate space in the design to accomplish this efficiently.

F. Maintenance Personnel:
1. When identified by the Owner's Representative, provide a secure work area for building maintenance personnel with a service sink, workbench and/or space for tools. For HVAC mechanics, this may be in a mechanical room if sound levels permit.

G. Maintenance Materials Storage:
1. Provide a storage space of 100 square feet for storage of spare maintenance parts and materials items for the building such as spare floor tiles, etc. For public spaces, additional storage may be required for events furniture.

H. Utility Closets:
1. Locate telecommunications equipment and electrical branch circuit panel boards in the same utility closet dedicated to this purpose when possible. Some utility closets require provision of adequate ventilation equipment. Provide proper clearance around equipment.

I. Elevators:
   1. To provide code-compliant access in buildings over two stories, provide ADA qualified elevator(s). In remodel projects, particularly in historic buildings, it may be difficult to find a reasonable shaft location. In such cases, a custom size elevator in accordance with ADAAG requirements or larger may be provided.

1.08 CLASSROOM DESIGN

A. Due to the nature of the Block Plan, classroom design will require flexibility and adaptability. There needs to be a variety of lighting levels and controls designed for various classroom uses with adequate and durable daylighting controls to accommodate special AV media uses. Each Faculty instructor and/or program will have unique teaching methods and classroom configurations, which may be modified for the new instructor of the next Block. The structured class will generally last the entire morning with one break at mid-morning. Discuss these unique needs with the College Facilities Services Department.

B. Classrooms need to be a friendly, desirable facility that promotes good relationships. A classroom design promoting interaction includes principle features as comfort, appearance and use of visual displays.

C. A general circulation plan of entryways and corridors must accommodate student interaction and relaxation during break periods.

D. Materials should be primarily chosen with durability, cleanability, and acoustical properties in mind. Acoustical treatment is important to control sound within the room as well as reduce noise between rooms.

E. Review specific technology needs, both current and future, with the building users. Generally, the College will hire Contractors directly for installation of Data/Com Systems and equipment. The Architect and their Consultants are responsible for assisting and coordinating these needs and accurate indicating what is needed to support the completed system.

F. General Guidelines:
   1. Normally, install chalkboard/markerboards/tackboards on the front and rear walls and sidewalls in some cases; review the specific placement with the Users. White markerboards are used in classrooms with computer installations. Above all chalkboards and markerboards, provide a cork tackstrip with spring clips and hooks. Usually a projector screen will be located centered in the front of the room.
   2. Generally, classrooms should have effective, easily operated and durable closures over the windows allowing the room to be completely darkened for projection. Blackout blinds are preferred.
   3. Audience entrances/exits should be at the back of the room.
   4. Provide adequate wheelchair locations in fixed seating rooms.
   5. Normally the instructor's table/lectern and student's desks/tables will be moveable furniture unless utilities are required.
   6. Provide College telecommunications voice-data jack near outlet on center front wall below chalkboard/whiteboard with exact location in consultation with Owner Representative and the College's Information Technology Services (ITS) media services.
   7. Provide quiet and adequate mechanical systems.
   8. Left-handed fixed seating writing tablets should be provided for about 10 percent of the seats. Exact location in consultation with Owner’s Representative.
   9. Generally, classrooms with a seating capacity in excess of 50 and scheduled for fixed seating should be designed for the use of sloped floor and/or risers toward rear of room.
   10. Classrooms must be designated and include a minimum of a console at the front of the room with a network computer cabling and adequate space for a variety of Audio/Visual sources (VCR, DVD, CD, etc.). These needs should be specifically discussed with the College's Information Technology Services (ITS) media services.
   11. Lecture Hall Seats: Not be less than 20 inches in width with preference of 22 inches.
   12. Folding Tablet Arms: Rattle-free mechanisms.
   13. Review lighting general requirements with the specific user. The following recommendations are suggested:
       a. Student Seating: 50 foot-candles.

b. Instructor-Presenter Area: 100 foot-candles.
c. Chalkboard/Markerboard: 70-90 foot-candles.
d. Aisle Lights in Lecture Halls: As required by Code.
e. Note taking light level should be 5 foot-candles-minimum without light spillage to projection screen.
f. Light Switches: Clearly labeled functions.
g. Generally, classrooms should have two lighting levels, one for general use and a lower level for projector use. Dual level switched fluorescent lights are preferred. The row adjacent to the screen should be shut off with the lower level lighting.
h. Dimmable fluorescent lighting systems are generally NOT acceptable, without prior approval by the Owner's Representative. Enhanced dimmable fluorescent lighting circuit systems that address "flickering" will be considered.
i. To avoid interference with a ceiling mounted projector, ceiling light fixtures should not extend below 9 feet above the floor.
j. Note: Consideration for maintainability and efficiency should be incorporated into the lighting design. An excessive number of fixtures and/or types of fixtures and lamps is not acceptable.
k. Occupancy sensor controls should be used to turn off lighting in unoccupied classrooms.

14. Electrical requirements to be reviewed with the specific user.
    a. Provide three duplex boxes and one duplex outlet on the left or right side of the front wall for the media equipment rack approximately 24 inches x 24 inches x 42 inches high. Provide one box with one 1-inch conduit terminating above the ceiling for the data service. Provide one duplex outlet and one box with one 1-1/2 inch empty conduit from a duplex box terminating in the ceiling approximately 14 feet from the front of the room for the data projector. Provide one box with two 1/2-inch empty conduits terminating outlet boxes approximately 8 feet above the floor and 9 to 12 feet apart on the front wall for speakers. Coordinate the layout of the audio visual system with the Building Committee and the College's information technology media services.
    b. When required by the program, provide empty 1½" conduit between front and rear walls with blank faceplates for slide projectors.
    c. For portable media devices and utility, provide one duplex outlet in the front center and on the side and rear walls.
    d. All electrical circuits should be fed from "clean" legs from the contact panel.
    e. Provide electrical operating projection screen in all classrooms with capacity of 30 or larger. Size, location and quantity will be determined during the planning process.
    f. When requested by the User, provide one duplex outlet with adequate empty conduits terminating an outlet boxes at 6 foot high on a sidewall near the front of the room for a wall-mounted TV/VCR/DVD.
15. Audio-Visual recommended requirements to be reviewed with the specific user and the College's Information Technology Services (ITS) media services.
    a. Specific requirements for conduit sizes, cable trays, etc. will be developed for individual projects with the Owner's Representative and the College's information technology media services.
    b. In auditorium and classrooms, controls for operation of equipment and for lights should be provided at and interconnected between the speaker's station at the front and the projector location at the rear of room. Separate projection rooms may be required.
    c. Projection screens over eight feet wide used in large rooms are normally electrically operated. Screens seven feet or smaller may be manually operated.
16. Media Utilization Design Guidelines and Criteria:
    a. All group instructional facilities need to be designed to accommodate the following visual and audio educational practices:
        1) Proper viewing angles (sight lines for all students) and size of projection surfaces.
        2) Effective lighting control and levels.
        3) Quality audio listening levels and acoustics. The design of the room should be conducive to intelligible un-assisted listening.
        4) Proper storage and installation of media equipment and general storage for special events. Security control of the media equipment for special events shall be considered in the design.

5) Control of installed media equipment from the front and rear of facilities.
6) Provision of standard, high quality and serviceable models of media equipment.

G. Specific Recommendations:
1. Classroom (16-49 seats):
a. When a permanent installation is not requested by the Building Committee and/or Facilities Services Director, provide space for a media rack. In addition, provide one outlet duplex box with an empty ½ inch empty conduit from the rack location to the center of the front wall for a microphone.
b. Minimum workspace at front of room should allow 8 feet of distance between screen surface and transparency projector position.
c. Largest dimension should be from front to rear of the classroom. Depth of room is critical to proper viewing angle for projection. Seating outside of a 30 degree angle on each side of the room's center line is poor viewing for front screen viewing of overhead or other projection equipment.
d. To allow for unobstructed viewing, when feasible, classroom screens should be 72 inches high vertically with the bottom at 42 inches above the floor.
e. All interior and exterior windows shall have black-out shades.
f. Markerboard or tackboard must be used adjacent to the media rack installation.
2. Lecture/Presentation Room (50 seats and larger):
a. When a permanent installation is not requested by the Building Committee and/or Facilities Services Director, provide space for a media rack. In addition, provide one outlet duplex box with an empty ½ inch empty conduit from the rack location to the center of the front wall for a microphone and one from the rack location to a ceiling box for speakers, then to a public address system location.
b. Front projection screens larger than 8 feet wide should utilize electrical models and controls
c. Minimum workspace at front of room should allow 8 feet of distance between screen surface and transparency projector position.
d. Largest dimension should be from front to rear of the classroom. Depth of room is critical to proper viewing angle for projection. Seating outside of a 30 degree angle on each side of the room's center line is poor viewing for front screen viewing of overhead or other projection equipment.
e. Halls may need to utilize a riser at room front or sloped seating to allow proper viewing for halls larger than 80 seating capacity.
f. To allow for unobstructed viewing, the screens should be a minimum of 72 inches high vertically with the bottom at 42 inches above the floor. When feasible, size the screen using the formula H (height) = MDV (distance to the most distant viewer) / 6.
g. Provide one duplex ceiling outlet for a video/data projector located 14 to 20 feet from the front of the room. Coordinate required monitor bracket support. If the projector is placed in a Control Booth, provide a duplex outlet within 3 feet.
3. Auditoriums:
a. Space (5 feet x 10 feet minimum) for an enclosed, secure projection booth should be provided at rear of auditorium. Provide space (10 inch x 20 inch min) to accommodate audio lighting and video controls. In primary performance spaces, the design criteria will vary and shall be reviewed in detail to determine the size and equipment needs.
b. Booth should contain:
1) Fixed glass projection window.
2) All controls similar to those in front of auditorium.
3) Power outlets above counter surface.
4) Two 1-1/2 inch conduits to front control panel.
5) Two entrances (one to auditorium, one to foyer).
6) Network data jack.
7) Intercom system connecting the booth with two locations backstage, two locations in front of house and additional location as required.
c. Minimum work space at front of auditorium should allow 10 feet of distance between screen surface and overhead projection position. Should utilize a second corner mounted 84 inch minimum screen for overhead projection.
d. Centered front projection screen should utilize electrical recessed ceiling models.

e. Largest dimension should be from front to rear of the classroom. Depth of room is critical to proper viewing angle for projection. Seating outside of a 30 degree angle on each side of the room's center line is poor viewing for front screen viewing of overhead or other projection equipment.
f. Auditoriums may need to utilize a riser at room front or loped seating to allow proper viewing.
g. Auditorium ceiling height should allow viewing of a vertical 96 inch image without obstruction from all seating positions.
h. Provide for a ceiling mounted video projector mount to be:
    1) Approximate 15 feet from front, centered screen.
    2) Minimum of a 2 inch conduit from projector position to front control panel location.
    3) 110V AC power outlet at ceiling mount location.
i. Provide a control panel/storage cabinet at front/side of room. Panel should contain:
    1) All lighting, electrical, projection, voice/data, and audio controls and jacks.
    2) Lockable storage compartment for video player, PA/sound system amplifier, and remote control unit for video projector.
    3) Storage space for microphones.
    4) Equipment controls should be duplicated in the control booth to enhance flexibility of the space.
j. Potential use of auditorium for remote video conference reception and origination should be reviewed with potential users, and the College's information technology media services. If usage is probable, the planning should include:
    1) Conduit for remote camera locations.
    2) Extra space and a switching console in projection booth.
    3) Interconnects (conduit and cable runs) to building broad band and fiber band and fiber optics panel.
    4) Extra conduit (2-3/4 inch) from projection booth to front control panel.

4. General Environment:

	Classrooms (16-49 Seats)	**Lecture/Presentation** (50-120 Seats)	**Auditorium** (120-400 Seats)
Lectern-Mobile	When Requested	X	X
Projection Cabinet/Storage-Cabinet/ Storage-Rear of Room	When Requested	X	X
Projection Booth-Fully Enclosed/Secure	When Requested	X	X
Projection Screen for Slides/Film/Video (Front Surface, Matte White)	X	X	X
Overhead Projection Screen	When Requested	X	X
Video Projection Capabilities	X	X	X
Control Switches at Control Booth	When Requested	X	X
In-Wall Panel at Front of Room	X	X	X
Control Switches Near Exit Door(s)	When Requested	X	X

5. Audio Requirements:

	Classrooms (16-49 Seats)	**Lecture/Presentation** (50-120 Seats)	**Auditorium** (120-400 Seats)
PA System	When Requested	X	X
Voice/Data Communications	X	X	X
Audio Inputs to Sound System (various levels)	X	X	X

6. Visual Requirements:

	Classrooms (16-49 Seats)	**Lecture/Presentation** (50-120 Seats)	**Auditorium** (120-400 Seats)
Slide Projection	When Requested	X	X
Overhead Projection	X	X	X
Video Recording with Video Camera	When Requested	X	X
Video Projection	X	X	X
Live Demo with Video Camera	When Requested	When Requested	X

7. Media Equipment:

	Classrooms (16-49 Seats)	**Lecture/Presentation** (50-120 Seats)	**Auditorium** (120-400 Seats)
Overhead projector/Cart and Screen	S When Requested	S When Requested	S/B
Film Strip Projector	When Requested	When Requested	When Requested
16mm Film Projector	When Requested	When Requested	When Requested
Video Projector	S/B	S/B	B
Slide Projector(s) and Audio Playback	When Requested	When Requested	When Requested
DVD/Videotape System (VCR)	S/B	S/B	B
Video Conferencing System	When Requested	When Requested	When Requested
Interactive Video (Video and Computer)	S/B When Requested	S/B When Requested	B
Front Surface Projection Screen	B (60-70 Inch Wide)	B (70-84 Inch Wide)	B (10-14 Feet Wide) (1)
Sound System	S/B	B	B

LEGEND:
S - Space and power provided in facility only.
B - Item stored or built into facility.
(1) - Electrically operated; size depends on distance from most distant viewer, ceiling height, etc.

1.09 FIXED AND MOVABLE EQUIPMENT

A. Two classifications of equipment are identified on all projects; fixed and movable.
   1. Fixed Equipment:
      a. This includes all built-in items such as laboratory casework, fume hoods, benches, wall cabinets and shelves, counters, chalkboards, tack boards, permanently installed projection screens, coat racks, etc. All such items shall be included in the specifications and shown on the working drawings. Their costs are included in the total construction cost for the project. "Owner supplied" fixed equipment/furnishings such as carpet, drapes, window blinds, etc. will be noted in the Project Budget during the Building Program or Schematic Design Phase.
      b. Prepare the drawings and specifications to ensure that all required utilities for fixed equipment items are called for and properly located. Provide specifications that leave no question as to which of the several trades and suppliers has responsibility for making all necessary connections and installation of equipment and responsibility for unloading, uncrating and disposal of rubbish.
   2. Movable Equipment:
      a. This includes such items as office furniture, file and storage cabinets, free-standing bookcases, scientific equipment, copying machines, etc. and are generally "Owner supplied". Any movable equipment included in the contract will be specified and shown on the drawings for the project.
      b. Show all movable equipment items on the Design Development drawings to demonstrate there is adequate space and appropriate utility services for their proper placement in each room. The Architect is not responsible for design or selection of such items.

1.10 PROVISIONS FOR ACCESSIBILITY

A. General: Attention is directed to the necessity of providing entrances and other architectural features of College buildings for the functional use by physically handicapped persons. The following are College requirements in addition to those required by the 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010 code.
   1. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010 Code: The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.
   2. Entrance Doors: Electric door openers for use by the physically handicapped must be provided at primary entrances to all major buildings. Locate entrances to provide direct access from an accessible route and/or handicapped parking. Review with College Facilities Services Department.
   3. Elevators: All major buildings must have an accessible elevator. In existing buildings, it may be difficult to reasonably locate a new shaft using dimensions of a new, full-sized elevator. In such cases, a cab size as allowed by ADAAG for inside dimension of elevators is acceptable.
   4. Restrooms: All major buildings must have accessible restroom facilities. In existing buildings, it may be difficult to reasonably re-arrange spaces as required in new construction. In such cases, creative, reasonable solutions must be explored, including the use of gender-neutral facilities.

1.11 TELECOMMUNICATIONS REQUIREMENTS

A. The following Standards apply to all facilities:
   1. EIA/TIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
   2. EIA/TIA 568A - Commercial Building Telecommunications Cabling Standard.

B. Review additional telecommunication requirements with the College Facilities Services Department and Information Technology Services (ITS).

1.12 SITE CONSIDERATIONS

A. General:
   1. The site for a proposed new building is determined by the College to be consistent with the Campus Master Plan. The facility design must address not only its relationship to nearby buildings, but its function in connection with the open spaces and landscaping around it. Give careful attention to entrances and their effect on pedestrian travel patterns, and to service drives, parking, ADA accessibility, weather considerations, and loading dock locations.

2. In the Schematic Design Phase, be aware of the location of utility lines and utility tunnels/vaults serving the building and adjacent spaces. Locate the mechanical equipment room and transformer room in relation to those lines.

B. Site Design Criteria:
   1. The portion of walkway adjoining building entries may have an appropriate “doormat” of specially designed materials consistent with the Campus Master Plan.
   2. Design sidewalks, terraces and patios to support snow removal equipment or Fire department access in accordance with the College's recommendations, and of a material consistent with the Campus Master Plan.
   3. Locate walks away from walls, which may cause snow drifting. Where walls must adjoin walks or paved areas the walls should be designed with openings to allow for snow removal.
   4. Avoid surface drainage of storm water across walks.
   5. Primary entrances to buildings must be accessible. Discuss with the Owner Representative and identify on the drawings, including the accessible path to the building from the parking access and the primary accessible route(s) connecting to the Campus.
   6. Fixed objects to be part of the landscaping of the building should be designed for ease of maintenance and snow removal.
   7. Use of window wells and below grade open structures should be avoided possible.
   8. The proposed design of such features requires approval of the College Facilities Services Department prior to incorporation into the design.
   9. Maximum slope for banks is 3:1 (Horizontal: Vertical). Use 4:1 or less where possible.
   10. Provide for protection of existing plant material during construction.
   11. Service drives should have a minimum inside radius of 35 feet. Verify all requirements for Fire Department access including paving materials and fire lane location and configuration.
   12. The College waste removal is provided by commercial companies. Investigate and verify container sizes and frequency of disposal with assistance from the College. Space for containers should be in service areas, and/or adjoining grade flush with front of dock in an appropriate trash enclosure construction. Provide for compost and recycling containers. Trash enclosure design and location is a requirement of the Campus Master Plan.
   13. Bicycles are a major method of transportation on the campus. Bicycle parking area should be considered in the development of the site plan for the building. Appropriate campus standard bicycle racks and site accessories are required to be located during the design process.
   14. Submit Schematic Design/Design Development/Construction Document site plan showing layout of new site utilities to the College Facilities Services Department for use by Facilities Services. The Owner will advise the Architect concerning the central utilities extension proximity to the project site and any required extensions that will be included in the project budget.
   15. The entire Campus is considered a parking district by City Planning. Additional parking requirements are usually minimal, but must be determined during the Schematic Design Phase.

C. Land Survey:
   1. For most projects, the College Facilities Services Department will provide the Architect/Engineer a site survey created by a registered land surveyor as described in the Agreement Between Owner and Architect. These drawings will be created by referencing College maps and by actual utility locates. Invert elevations will be determined on existing utilities so that both plan and profile drawings can be created for new utility installations.
   2. Discuss exact location of the proposed building with the Building Committee and the College Facilities Services Department who will review it with Facilities Services Staff and other College personnel for final approval.

D. Subsurface Investigation:
   1. As soon as the Architect/Engineer has developed the design to the point where approximate foundation design loads can be determined, make request through the College Facilities Services Department that test borings be made to determine subsurface conditions. This generally will occur during the Schematic Design phase. The College Facilities Services Department will arrange to have the necessary borings made and will provide a geotechnical investigation report and recommendations.

E. General Landscape and Irrigation:
   1. The landscaping is a major contributing element to the overall campus presence, with some of the planting dating to the earliest planning. The historic elements and trees should be respected and modification should be specifically discussed with the College during the design process. Landscape designs should be consistent with the Campus Master Plan. Paving materials vary throughout the Campus depending on the hierarchy of walkways. Major Projects may have an entry “doormat” extending from the building to transition to the walkway paving material consistent with the Campus Master Plan. The map of the Campus walkway system is available through College Facilities Services. The use of hardscape paving at building entrances for design expression and durability is generally acceptable, but should be limited. The Architect/Engineer, Owner’s Representative, Building Committee, and Campus Design Review Board will review and approve these issues during the design process.
   2. Colorado College, both in education and in practice, maintains an emphasis on environmental issues. The Architect and consultants should consider xeriscape, native planting materials, energy/water conservation planting/grading techniques and other environmentally conscious concepts in developing the design consistent with the Campus Master Plan.
   3. The main campus has a central non-potable irrigation system. Consult with the College Facilities Services Department for system development and design criteria. Refer to the Colorado Springs Utilities Water Resources Department “Standard Specification for Installation and Operation of the Non-potable Water Distribution System” for the primary system technical requirements. Some of the smaller buildings, primarily residential dormitory buildings located in the eastern and northern portion of the campus, have residential grade exterior potable water systems operated from individual house taps; this should be reviewed with the Owner’s Representative.
   4. The City of Colorado Springs owns the trees, planting, curbs/gutters and sidewalks in the street right-of-ways and medians. Any removal or redesign must be approved by the Parks and Recreation/Forester and Public Works Departments. All City owned trees located in the construction limits must be adequately protected during construction to avoid damage assessments by the City. The College is generally responsible for the removal and replacement of damaged curbs/gutters and sidewalks. All associated costs must be included in the project budget.
   5. The College’s East Campus properties on North Weber, east of the alley easement, between Uintah and Cache la Poudre Streets are in the North Weber/Wahsatch Historic District. Historic Design guidelines have been developed for landscaping, including fences, grading, planting and signage, for this area. The design must conform to the guidelines and be reviewed with the Owner’s Representative and, if warranted, History Colorado or the Colorado State Historical Fund, as applicable.

1.13 CLIMATE AND WEATHER CONDITIONS

A. Temperature and humidity, rainfall, solar intensity and elevation should all be considered in building design. The following data shall be used for design purposes.

B. Colorado Springs, Colorado is located at latitude 38 degrees 49’ N and 104 degrees 43’ west longitude at an elevation of 6145 feet.
   1. Highest recorded temperature was 100 degrees on June/July 1954.
   2. Lowest recorded temperature was minus 27 degrees on February 1951.
   3. Sunshine Frequency: 48 percent of possible days in December to 75 percent in July.

C. Outdoor design conditions as specified by Pikes Peak Regional Planning Code are:
   1. Winter Design Dry-bulb: 2 degrees F.
   2. Summer Design Dry-bulb: 88 degrees F.
   3. Summer Design Wet-bulb: 57 degrees F.
   4. Degree-days Heating: 6415.

D. Appropriate safety factors should be used for critical spaces to ensure that required indoor air conditions are properly maintained.

E. Research completed by the Rocky Mountain Chapter of ASHRAE indicates that ASHRAE’s Solar Heat Gain Factors (SHGF) need to be adjusted by a multiplier of 1.173 to account for the higher elevation and lower moisture content and thus greater transmissivity of the air.

F. All psychometric, heat transfer and air movement calculations are to be adjusted for elevation above sea level.

G. Indoor Conditions:
   1. Indoor conditions shall be maintained as follows unless otherwise required by specific design requirements:
      a. Winter: 72 degrees F.
      b. Summer: 78 degrees F.
   2. If humidification is provided in the winter, design for no more than 30 percent RH. Design de-humidification in the summer for not lower than 60 percent RH unless equipment operation is less energy consuming at a lower level.

1.14 ROOM NUMBERING SYSTEM

A. Use room names indicated in the Facility Program on the project Drawings, Floor Plans and Schedules.

B. At the time Construction Document drawings are started, prepare a final numbering system for rooms and all other spaces with the assistance of the College Facilities Services Department's Locksmith Shop using the campus standard building room numbering convention. These numbers and the room or space names must be incorporated on the final floor plans and schedules. Use only room and door numbers approved by the College Facilities Services Department on the Design Development documents. Specify that the Contractor and their supplier use the established numbering systems.

C. For all Contract Documents and “As-Built” Documents, the room finish schedule is required to include the original building room numbers as well as any changes to the final room numbers for coordination purposes.

D. Room Numbering Procedures:
   1. Number rooms with three digit numbers whenever possible, with the first digit always referring to the floor.
   2. Example:
      a. Basement: 1 - 99.
      b. First Floor: 100 - 199.
      c. Second Floor: 200 - 299.
      d. Third Floor: 300 - 399, etc.
   3. The numbering sequence should be clockwise.
   4. A “room” is defined as a space enclosed on all sides or, in other words, a space with one or more open sides is not considered to be a room.
   5. Typically, begin the numbering sequence at the main entrance of the building. Maintain even numbers on one side of a corridor and odd numbers on the opposite side.
   6. In addition to rooms, number all interior spaces that can be directly accessed, such as corridors, vestibules, stairwells, and other accessible spaces shall have a room number and appear on the room finish schedules.
   7. A primary room is accessed directly from a corridor, to the exterior or a general circulation path. When rooms are accessed from a primary room and not directly from a corridor (a “suite” of rooms), use the primary room number followed by a letter suffix (example: Office 105 A or Office 105 F).
   8. Number internal courtyards as rooms, but do not number roof areas unless approved by the College Facilities Services Department. Number stairs extending to the roof as a floor.
   9. Where large rooms that may be subdivided occur, allow for new number assignments within the normal sequence.
   10. Design the numbering sequence to be easily extended when future additions are constructed.
   11. Complete final room numbering and secure approval by the Owner during the Design Development Phase. Any changes in the final numbering in the Construction Documents, as may be generated by a change order during construction, must be approved by the College Facilities Services Department.
   12. The numbering system will be used for the permanent building signage.
   13. The HVAC building automation system graphics software must also use the same room numbers as the Contract Documents and As-Built Documents.

E. Door Numbers Procedures:
   1. The door numbering scheme is similar to that of the room numbering. Generally, the number the door is the same as the number of the room and is the primary entry into the space. Where secondary doors occur within a room, add a letter suffix to the primary door number (example: Door 219A). Include existing doors requiring work of any kind, including hardware changes or refinishing, on the door schedule.
   2. Normally, the door number is identified with (and on the lock cylinder side of) the room or area the access is to (assume stairwell-to-corridor doors have a cylinder on the stairwell side). If there is no cylinder on a door between rooms, the door will usually be identified with the innermost room, or with the room the door swings into. If a door has a locking cylinder on each side, the door will have a different door number on each side.
   3. The numbering of roof access doors or hatches are identified with the room or area the access is from followed by letter suffix. Note that door numbers and cylinders of roof doors or hatches are located on the interior side of the door or hatch. Include in the specifications, that the contractor and the door/hardware supplier shall utilize the numbering identified on the drawings.

1.15 BUILDING AREA CALCULATIONS

A. From the first concept of a building need to the final occupancy of the space, there is a continuing reference to the net and gross areas involved. These areas must be considered in the original program planning and are used in reference to unit costs in preliminary estimates, in establishing budgets and in final accounting.

B. To avoid any possible misunderstandings of the meaning of the terms used, the following definitions and methods of calculations are provided.

C. Gross Area:
   1. Definition: The sum of the floor areas within the outside faces of the exterior walls for all stories that have usable floor surfaces.
   2. Basis for Measurement: Gross area shall be computed by measuring from the outside face of exterior walls, disregarding cornices, pilasters, buttresses, etc., which extend beyond the wall face.
   3. Description: In addition to ground to top-story internal floored spaces, gross area shall include basements (except unexcavated portions), attics, garages, enclosed porches, penthouses and mechanical equipment floors, lobbies, mezzanines, all balconies - inside or outside - utilized for operational functions, and corridors, provided they are within the exterior face lines of the building. Roofed loading or shipping platforms should be included whether within or outside the exterior face lines of the building.
   4. Limitations: Open courts and light wells, or portions of upper floors eliminated by rooms or lobbies which rise above single-floor ceiling height, should not be included in the gross area, nor should unenclosed, roofed-over area or floored surfaces with less than 6 feet-6 inches clear head-room be included without discussion and agreement with the College Facilities Services Department.

D. Net (Assignable) Area:
   1. Definition: The sum of all areas on all floors of a building assigned to, or available for assignment to, an occupant, including every type of space functionally usable by an occupant; except Custodial Area, Circulation Area, and the Mechanical Area.

1.16 FIELD CONDITIONS

A. Trees and Vegetation:
   1. College Facilities Services requires preservation of trees to the greatest extent possible.
   2. Existing vegetation that must be preserved includes trees, shrubs, ground cover plants, and sod.
   3. Extent of preservation and salvage of vegetation is specified in the project program.

B. Other site features that may affect the design or construction include irrigation systems, site lighting, site emergency phones, fencing, and other designated items.

C. Work by College Facilities Services: College Facilities Services will perform the following work, with its own forces or using other consultants and contractors:
   1. Pre-Construction Survey: To be prepared by College Facilities Services; control and reference points will be indicated.

2. Hazardous waste remediation, including cleanup of contaminated soils.
3. Installation of items identified as NIC; prepare spaces and provide applicable utility connections.
4. Design and documentation of any impacted specialized high temperature hot water (HTHW) connections or system modifications to existing infrastructure systems.

D. Existing Built Elements:
1. Extent of preservation, restoration, re-use, or adaptation is specified in the project program.
2. Preservation: The following existing elements must be preserved:
   a. Existing structures and fixed elements are of historical value to the College Facilities Services and must be preserved and restored in their entirety.
   b. As much of the existing structure(s) as possible.
   c. Existing historic facades.
3. Relocation: Relocate other existing construction and utilities as required for the design.

PART 2 PRODUCTS

2.01 DO NOT USE:

A. CFC-based refrigerants.

B. HCFC's or Halon.

C. Plastic piping or conduit, unless approved by the College Facilities Services Department.

D. Aluminum electrical conductors, unless approved by the College Facilities Services Department.

E. Other materials or products restricted by College Facilities Services Department.

PART 3 DESIGN REQUIREMENTS

3.01 BASIC FUNCTION

A. Code: Make all portions of the project comply with the code.

B. Provide design for built elements and site modifications as required to fulfill needs described in the project program and as specified.

C. Provide design for permanently enclosed spaces for all functional areas shown in the project program, unless otherwise indicated.

D. Provide design for a physical enclosure that keeps out weather, unwelcome people, animals, and insects without requiring specific action by occupants, while providing convenient movement of occupants between inside and outside, desirable natural light, and views from inside to outside.

E. Provide interior design services for efficient and functional space utilization, including appropriately subdivided interiors with level floor areas, comfortable ceiling heights, vertical walls, and finishes and fixtures suitable for the occupancy and functional needs.

F. Provide design for the following services:
1. Plumbing.
2. HVAC.
3. Environmental Controls. Verify BMS system compatibility with College Facilities Services.
4. Electrical.
5. Fire suppression. Verify system with College Facilities Services.
6. Fire detection and alarm. Verify system with College Facilities Services.
7. Access control. Verify system with College Facilities Services.
8. Voice and data communication. Verify system with College Facilities Services.
9. Acoustic treatment as required.
10. Other services as determined by project program.

G. Provide design for the following fixtures as shown in the project program and as specified:
1. Information fixtures.
2. Window treatment.

3. Fixed seating.
4. Toilet, bath, and laundry accessories.
5. Other fixtures as determined by project program.

H. Provide design for the following equipment as shown in the project program and as specified:
1. General equipment.
2. Food service equipment.
3. Other equipment as determined by project program.

I. Provide design for the following furnishings as shown in the project program and as specified:
1. General furnishings.
2. Food service furnishings.
3. Other furnishings as determined by project program.

J. Provide design for the following site elements and work:
1. Site preparation, earthwork, erosion control.
2. Hazardous waste remediation, if required.
3. Pavements and surfacing.
4. Site fixtures and equipment.
5. Landscaping.
6. Site services between buildings on same campus, if required.
7. Other site construction as determined by project program.

3.02 SUSTAINABLE DESIGN AND HIGH PERFORMANCE GOALS

A. Sustainable Environmental, Economic, and Social Responsibilities:
1. In addition to other requirements, the Architect/Engineer is responsible for designing facilities that enhance the quality of the indoor and outdoor environment, and minimize consumption of energy, water, construction materials, and other resources. Refer to the **Colorado College Facility Life-cycle Design Guidelines for Sustainability** in this Facility Design Guidelines manual.
2. The College's April 2009 signing of the American College and University President's Climate Commitment required initiation of tangible actions to reduce greenhouse gases. The College agreed to "establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent". **The college's goal is to use customized high performance building design standards criteria which exceed the LEED Silver minimum standards in order to meet its long range sustainability strategies for achieving carbon neutrality.** Applying the college's criteria to achieve building high performance design goals for new construction and renovation projects is the responsibility of Architect/Engineer, in consultation with Colorado College Facilities Services, unless otherwise indicated. Additional high performance design goals and strategies information is provided in the "**Facility High Performance Design Criteria Checklist**" in this Colorado College Facility Design Guidelines manual.
3. The College Facilities Services Department will collaborate with the Architect/Engineer to identify high performance design opportunities that are feasible, based on each project's available funding, building energy use targets, building condition, etc. Based on whole building life-cycle cost savings analysis by the Architect/Engineer, Facilities Services will authorize the design and implementation of those high performance measures which will be most beneficial in helping the college achieve its long term sustainability goals.
4. Sustainable Design Emphasis: Design of facilities is strongly encouraged to emphasize the following categories within the LEED-NC credit structure:
    a. Water use reduction and water efficiency.
    b. Energy performance and energy efficiency; this includes design of the exterior envelope as a high-performance and integral component of the facility's energy management system.
    c. Fundamental and enhanced refrigerant management.
    d. Indoor environmental quality; with emphasis on the use of low-emitting materials, finishes, and furniture systems.
    e. Implementation of construction phase Indoor Air Quality (IAQ) procedures.
    f. Review and consideration of all LEED-NC prerequisites is required.

5. The College Facilities Services Department should be consulted for consideration of the applicability of the following LEED prerequisites and credit categories to the Facilities O&M Program related to specific design projects:
    a. Site selection, development density, and community connectivity.
    b. Brownfield redevelopment (if applicable).
    c. Alternative transportation strategies. (if applicable)
    d. Fundamental and enhanced commissioning (where applicable).
    e. Renewable power.
    f. Other prerequisites and credits as determined by College Facilities Services Department.

B. Facility Life-Cycle Design Guidelines for Sustainability:
1. In addition to other requirements, incorporate the Design Guidelines for Sustainability processes, and design facilities to address the life-cycle of the facility in general conformance to the Facility Life-Cycle Design Guidelines for Sustainability in this Facility Design Guidelines manual.

C. College Reference for Historical Design Guidelines:
1. In addition to other requirements, design applicable facilities to address specific historic preservation guidelines in conformance with most current edition of The Secretary of the Interior's Standards for Rehabilitation & Guidelines for Rehabilitating Historic Buildings (& Illustrated Guidelines on SUSTAINABILITY for Rehabilitating Historic Buildings).
    a. These guidelines are accessed website online at http://www.nps.gov/tps/standards/rehabilitation/rehab/index.htm.

3.03 AMENITY AND COMFORT

A. Thermal Performance: Comply with requirements specified in this Facility Design Guidelines manual, Section D30, and the code.
1. Shell: Provide construction that will have thermal resistance as necessary to maintain interior comfort levels specified and in accordance with applicable sustainable design requirements and the code.
    a. Condensation: None on interior surfaces under normal interior temperature and relative humidity conditions, during 98 percent of the days in the coldest 3 months of the year.
        1) Components That Have Surfaces Facing Both Interior and Exterior Environment: Condensation Resistance Factor (CRF) as required to meet requirement above, when tested in accordance with AAMA 1503.

B. Air Infiltration: Maximum of 0.06 cfm per square foot of exterior surface area, measured in accordance with ASTM E283 at differential pressure of 6.24 psf.
1. Use supplementary air barrier if necessary to maintain performance over entire shell.
2. Use method of sealing joints between elements that will be effective given available construction practices.

C. Water Penetration Resistance: Design and select materials to prevent water penetration into the interior of the building, under conditions of rain driven by 50 mph wind.

D. Natural Light: Provide fenestration in shell as required to meet requirements for natural light in accordance with code and the following:
1. See Environmental Responsibility, above.
2. Exterior Glazing: Minimum 10 percent of total floor area for each habitable room; not required for bathrooms, toilet compartments, closets, halls, or storage and utility spaces.
3. Compliance with LEED requirements for daylight and views credit criteria to the greatest extent possible or practical according to proper functioning of affected spaces.

E. Ventilation:
1. Indoor Air Quality: Comply with the code and the following:
    a. Acceptable air quality as defined by ASHRAE 62.1.
2. Ventilation of Attics, Crawl Spaces, and Similar Semi-Enclosed Spaces: Outside air movement through enclosed shell volumes in accordance with code.
3. Equipment Producing By-Product Heat: Design and specify requirements to ventilate housings and cabinets as required by equipment manufacturer and rooms and spaces as required to maintain specified environmental conditions.

F. Condensation Resistance: Provide design to prevent condensation from forming on interior elements under normal thermal and humidity conditions inside building.
    1. Exception: Insulated drain pans and piping to remove condensation from cooling coils.

G. Sound Transmission and Vibration Resistance:
    1. Shell: Design shell to limit sound transmission as follows:
        a. Ambient Sound Level: Maintain ambient sound levels in perimeter spaces within Noise Criteria (NC) ranges specified in Section DC C during normal hours of occupancy.
        b. Exterior Noise Level: Maintain maximum average daytime and nighttime noise level from interior sound sources in accordance with local regulations, measured at the project property line.
        c. Vibration Control: Use shell elements that will not resonate at frequencies that are characteristic of ambient exterior sound sources at the project site.
    2. Services:
        a. Design to maintain sound transmission characteristics of assemblies through which services must pass.
        b. Prohibited Plumbing Noises: All sounds of flushing and of liquid running through pipes ("bathroom sounds") are prohibited outside of the rooms housing toilets, bathtubs, and showers, with the exception of when doors to those rooms are open.
        c. Equipment Noises: Noise level below that which will be objectionable, based on occupancy of spaces.
        d. When services are located within assemblies that perform sound isolation functions, consider the noise produced by the service itself as one of the external sound sources.
    3. Structure-Borne Sound and Vibration: Design to prevent transmission of perceptible sound and vibration from equipment that rotates, vibrates, or generates sound, by isolating such equipment from superstructure or by isolating equipment support foundations from building foundations.

H. Cleanliness:
    1. Exterior Surfaces: Design and select materials to:
        a. Prevent attraction and adherence of dust and air-borne dirt and soot, and minimize appearance of settled dust and dirt.
        b. Be washed reasonably clean by normal precipitation.
        c. Prevent precipitation from washing settled dust and dirt over surfaces exposed to view.
    2. Services, such as air handlers, chillers, pumps, switchgear, and panelboards by one or more of the following methods.
        a. Provide 4 inch thick, concrete housekeeping pads.
        b. Provide corrosion-resistant equipment stands.

I. Appearance:
    1. Exterior Appearance: Design and select materials to provide exterior appearance with characteristics as follows:
        a. Compatible with adjacent buildings on same campus, as ultimately approved by College Facilities Services.
        b. Matching College Facilities Services' concept design and rendering.
        c. Concealing mechanical equipment, plumbing equipment, electrical equipment, piping, conduit, and ducts, and similar items from view from the street.
        d. Concealing rooftop mechanical equipment, plumbing equipment, electrical equipment, piping, conduit, and ducts, and similar items from view from the street, windows in the project that overlook the roof, and windows in adjacent buildings that overlook the roof.
    2. Services Elements:
        a. Conceal services elements from view to greatest extent possible, with exposed portions of simple, neutral design and color.
            1) Exception: Standard designs of manufacturers, without consideration for appearance, may be used for fire suppression sprinkler heads.
            2) Where exposed portions are acceptable, do not obstruct or diminish clear dimensions of doorways, windows, other operable openings, access panels and cabinet doors, or passageways, stairs, and other exitways.

3) Where exposed piping is acceptable, install it close to walls and overhead structure, parallel and square to finished construction, plumb and nominally horizontal (except where required to slope for drainage).

b. Specify requirements to conceal spaces around pipes, ducts, and conduits, where they pass through walls, ceilings, and floors with escutcheons or cover plates.

3.04 HEALTH AND SAFETY

A. Fire Resistance: Design and select materials to provide fire resistance in accordance with code.
1. Provide type construction as specified in the code, subject to the approval of College Facilities Services.
2. For all elements required to have a fire resistive rating and which are not made of materials and systems specified as acceptable by the code, use proven-by-mock-up construction.
3. Acceptable Testing Agencies: Agencies include Underwriters Laboratories Inc., Underwriters' Laboratories of Canada, Inchcape Testing Services (Warnock-Hersey), and Factory Mutual.
4. Provide design to maintain fire resistance of walls, floors, ceilings, and other fire-rated assemblies that services must pass through, in accordance with requirements of the section in which the fire-rated assembly is specified.
5. Provide design for fire-rated separations between equipment rooms and other spaces where required, and as specified by the code.
6. Select and specify products which are fire rated for the specific locations where they are installed.

B. Prevention of Accidental Injury: As required by code and as follows:
1. Safety Glazing: As defined by 16 CFR 1201; provide in locations required by code, glazed areas subject to human impact, glazed areas at grade, and doors.
2. Design to prevent ice and snow from falling off building elements onto pedestrians, building occupants, and vehicles.

C. Lightning Hazard: Design to prevent damage to occupants, structure, services, and contents due to lightning strikes.
1. Provide protection equivalent to that specified in NFPA 780; supplementary strike termination devices, ground conductors, and grounding electrodes are required only where the integral portions of the structure cannot perform those functions.

D. Health Hazards:
1. Design to prevent growth of fungus, mold, and bacteria on surfaces and in concealed spaces on a long-term basis.

E. Electric Shock Hazard: Select equipment which is designed to protect personnel from electrical shock.
1. Electrically-Operated Equipment and Appliances: UL listed for application or purpose to which they are put; suitable for wet locations listing for exterior use.

F. Explosion Hazard:
1. Shell: Design shell to provide relief from explosion hazards so as to minimize effect on occupants and structural members.

G. Excess Pressure Hazard: Design pressurized components to withstand operational pressures without failure and to relieve or reduce excessive pressure to prevent failure.

H. Materials Selection: Choose materials that are environmentally friendly, worker friendly, and user friendly.

3.05 STRUCTURAL

A. Structural Performance: Design and select materials to support all loads without damage due to loads, in accordance with code.
1. Existing Elements To Remain: Design elements to prevent movement or settlement of existing elements that are to remain.
2. Earthquake Loads: Accommodate loads as prescribed by code.
3. Special Loads: In addition to loads defined by code, design for loads from moving machinery, elevators, cranes, vehicles, and similar items.
4. If design method is not specifically prescribed by code, design in accordance with ASCE 7.

5. Design shell elements to resist loosening or detachment in winds equivalent to the code design wind speed.
6. Shell elements engineered by their manufacturer or fabricator, rather than by the engineer-of-record, shall be specified to comply with the following additional requirements:
    a. Manufacturer/fabricator employs licensed structural engineer to accomplish design of structural elements.
    b. Manufacturer/fabricator has minimum of 5 years' experience in the design and manufacture of similar structures.

B. Services Components and Their Supports: In accordance with code.
1. Safety Factor for Component Structural Elements: Two; based on weight of component.
2. Supports for Piping, Conduit, Ducts, and Other Services Components: Design for attachment to, and support by, the superstructure, not to or by non-structural construction or sheet metal elements, so that they do not move or sag, using the following:
    a. Supports that allow movement of the rigid linear elements (pipe, etc.) without undue stress on the piping, tubes, fittings, components, or the superstructure.
    b. Intermediate supports mounted between structural members to limit distance between supports.
    c. Supports capable of handling seismic forces in accordance with the code.
    d. Mounting frames, bases, or pads, designed for ease of anchorage or mounting.
    e. Rigid sway bracing at changes in direction of more than one-half of a right-angle, for all pipes.

C. Concealed or Buried Components: Design cover or concealment so that components are not subjected to damaging stresses due to applied loads.

D. Construction Loads and Erection Stresses: Accommodate temporary construction loads and erection stresses during construction.

3.06 DURABILITY

A. Expected Service Life Span: Expected functional service life of campus facilities is 50 years.
1. Ducts, Piping, and Wiring in All Services: Same as the service life of the building.
2. All Components Permanently Installed Underground or Encased in Concrete: Not less than service life of building.
3. Software and Firmware Integral to Operation of Services Equipment: Minimum 20 year's functional life without reprogramming required.
4. Service life spans of individual elements that differ from the overall project life span are defined in other sections.
5. Additional requirements for elements not required to have life span equal to that of the project as a whole are specified below under "Operation and Maintenance."
6. Manufacturer warranties are not considered adequate substantiation of expected service life span.

B. Water Penetration Resistance:
1. Shell: Design and select materials to prevent water penetration into the interior of shell assemblies, under conditions of rain driven by 35 mph wind.
    a. Exception: Controlled water penetration is allowed if materials will not be damaged by presence of water or freezing and thawing, if continuous drainage paths to the exterior are provided, and water passage to the building interior is prevented.

C. Moisture Vapor Transmission Resistance: Design to prevent deterioration of materials due to condensation of moisture vapor inside assemblies.
1. Use supplementary vapor retarder if necessary to meet requirements.
2. Use method of sealing joints between elements that will be effective given available construction practices.

D. Corrosion Resistance: Design shell elements to prevent corrosion by specifying corrosion-resistant materials, designing and specifying assemblies that will prevent galvanic action, by designing and specifying requirements that prevent contact between metals and concrete and masonry, and by designing assemblies that will prevent condensation on metals.
   1. Separation of Dissimilar Metals:
      a. Where different metals subject to galvanic action are exposed to weather or moisture, prevent direct contact between them.
      b. Piping Connections for Piping of Dissimilar Metals: Dielectric adapters.
   2. Aluminum: Prevent direct contact of aluminum with concrete or cementitious materials.
   3. Steel: Where permitted to be coated with other than zinc, zinc-alloy, or aluminum-zinc alloy, follow the recommendations of Society for Protective Coatings (SSPC) in regard to preparation for coating and coating type.
   4. Outdoor Metal Elements Except in Contact with Soil: The following are considered corrosion-resistant metals:
      a. Aluminum.
      b. Stainless steel, Type 304 or 316.
      c. Brass and bronze, but not copper.
      d. Cast iron, ductile iron, and malleable iron.
      e. Hot-dipped galvanized steel, with minimum zinc coating of 0.90 oz/sq ft total, both sides, or equivalent aluminum-zinc alloy coating.
      f. Cadmium-plated steel, with minimum coating of 12 micrometers.
   5. Indoor Metal Elements Potentially Exposed to Moisture: The following are considered corrosion-resistant metals:
      a. All metals listed above for exterior exposure.
      b. Steel coated with high-build epoxy, with minimum coating thickness of 15 mils.
      c. Chrome-plated steel.
   6. Underground Metal Elements: without maintenance, unless otherwise required by product manufacturer.
      a. Underground metal elements include, but are not limited to, pipes, tanks, conduits, ducts, structural members.
      b. 3 inches of concrete cover is considered to be permanent protection.
      c. Coatings or wrappings are not considered sufficient protection for the following types of elements:
         1) Underground elements subject to movement due to structural loads or thermal expansion or contraction.
         2) Metal elements buried in a soil environment known to cause corrosion on similar nearby structures.
         3) Metal elements buried in a soil environment in which stray DC electrical currents are present.
         4) Metal piping carrying petroleum products or other hazardous or toxic materials buried or otherwise installed without means of visual observation of entire exterior surface of piping.
         5) Metal tanks holding petroleum products or other hazardous or toxic materials buried or otherwise installed without means of visual observation of entire exterior surface of tank.
      d. Cathodic protection alone is not considered sufficient protection for some underground metal elements.

E. Weather Resistance: Design and select materials to minimize deterioration due to precipitation, sunlight, ozone, normal temperature changes, salt air, and atmospheric pollutants.
   1. Weather resistance requirements apply to all components exposed to the outdoor environment, including services, unless specifically excepted; equipment enclosures are considered the equivalent of the exterior enclosure.
   2. Deterioration includes corrosion, shrinking, cracking, spalling, delamination, abnormal oxidation, decay and rot.
   3. Surfaces Exposed to View: Deterioration adversely affecting aesthetic life span includes color fading, crazing, and delamination of applied coatings.
      a. Coated Finishes: Minimize use of materials with separate coated finishes.
      b. Coating Performance: AAMA 2605 (10-year), minimum.

c. Coating Salt Spray Resistance: No deterioration when tested in accordance with ASTM B117 for 1000 hour exposure with 5 percent salt fog at 95 degrees F.
d. Use one of the following:
1) Fluoropolymer coating (70 percent Kynar 500 (tm) or Hylar 5000(tm)), minimum two coats.
2) Siliconized polyester coating.
e. Do not use:
1) Baked enamel.
2) Paint.
3) Field finishes of any type.

4. Joint Components and Penetration Seals: Specify materials and systems capable of resisting expected thermal expansion and contraction; use overlapping joints that shed water wherever possible.
5. Transparent Elements (Glazing): No haze, loss of light transmission, or color change, during entire expected service life.
6. Service Temperature: Low temperature equal to historically-recorded low; high temperature equal to that expected due to any combination of air temperature and heat gain from solar and other sources.
7. Freeze-Thaw Resistance: Adequate for climate of project.
8. Ozone Resistance: Do not use materials that are adversely affected by ozone.
9. Buried Water Piping: Minimum of 12 inches below lowest recorded level at which the ground freezes.

F. Temperature and Humidity Endurance: Design equipment to endure temperature and humidity that will be encountered and to resist damage due to thermal expansion and contraction.

G. Impact Resistance: Design and select materials to resist damage due to impact in accordance with code and the following:
1. Minimize damage from windborne debris propelled at up to 35 mph.
2. Design and select materials to resist damage from hail of size up to 1/2 inch.
3. Minimize damage due to potential vandalism.
4. Natural Hazards: Design to resist damage from perching, nesting, and feeding birds.

H. Wear Resistance: Design and select materials to provide resistance to normal wear-and-tear in accordance with code and the following:
1. Elements Within Reach of Pedestrians: Minimize degradation from rubbing and scratching caused by pedestrians.

3.07 OPERATION AND MAINTENANCE

A. Space Efficiency: Design facilities to minimize floor area required while providing specified spaces and space relationships, plus circulation and services areas required for functions.

B. **High Performance Energy Efficiency Goals**: Comply with requirements specified, in accordance with the code and the following:

1. The highest feasible facility energy use reduction goals will be attained based on each project's available funding, each building's optimum performance design potential, and each building infrastructure system's conditions, etc. Colorado College Facilities Services will provide the project design team with **project specific high performance building design criteria to be used to develop the project design intent documentation**. The College has achieved Net-Zero Energy/Net-Zero Carbon buildings and strives to maintain that level of building design performance whenever appropriate. The following table highlights the **minimum** construction performance targets for Colorado College:

Performance Goal	Goal Quantification
Total Energy Use	20 KBTU/SF/YR or less
Water Use – Building	2.4 Gal/Building SF/YR or less
Water Use – Irrigation	14 Gal/Turf SF/YR or less
Total Building Power Factor	Not less than 0.95 lagging at the utility meter
Indoor Air Quality	700 PPM CO^2 or less during occupied hours
Artificial Lighting	0.30 W/SF or less
Lighting Levels	35 FC in classrooms

Note that the energy usage goal represents total building load including plug loads, not just HVAC and lighting. Predicted energy use shall be tracked during design using modeling and will be confirmed using utility billing data. Likewise the water usage goal represents both building use and irrigation.

C. Water Consumption: Design facilities to minimize water consumption.

D. Ease of Operation and Use:
   1. Provide design of facilities, equipment, and systems that are easily operated by intended personnel.
      a. Space Around Components: Working clearances and access routes as required by code and as recommended by component manufacturer.
      b. Access: All mechanical and electrical equipment located to allow easy access. Provide access doors for equipment accessed through walls, partitions, or fixed ceilings.
      c. Valves and Other Control Devices: Accessible handles, switches, control buttons; valve handles on top/upper side; chain or other remote operators where located out of normal reach above floor level in SU1 and SU2 spaces.
   2. Design facilities to minimize the need for specialized training in operation of specific equipment or systems; identify all equipment and systems for which the manufacturer recommends or provides training programs.
   3. Preparation for Use: Specify requirements to prepare services for use by testing appropriately for proper operation before start-up, eliminating operational anomalies, adjusting control systems for optimum operation, and demonstrating proper functioning.
      a. Specify requirements to perform demonstration, training, and commissioning as recommended by recognized professional societies for all services systems, building envelope, doors, and non-services equipment included in contract.

E. Ease of Maintenance:
   1. Design facilities to minimize the amount of maintenance required.
   2. Do not design the location of any equipment requiring maintenance on the roof, in attics, in crawl spaces, where access must be through attics or crawl spaces, or where access is not possible using removable panels or doors.
   3. Light Levels: Design for adequate lighting for locating and maintaining equipment; emergency lighting for critical components.
   4. Cleaning: Where not otherwise specified, design equipment mountings to allow easy cleaning around, and under, equipment, if applicable, without crevices, cracks, and concealed spaces where dirt and grease can accumulate and with raised, closed bases for equipment mounted on the floor.
   5. Equipment Enclosures: Design and specify removable access panels to allow cleaning.
   6. Site Utilities: Specify requirements to record or mark locations of existing, abandoned, and new utility lines in such a manner that they can be easily located during and after completion of construction.
   7. Piping Systems:
      a. Piping Other Than Gravity Drains: Design systems to provide means of isolating convenient portions of piping system, so that small portions may be shut down leaving the remainder in operation and so that drainage of the entire system is not required to enable repair of a portion of it.
      b. Piping: Design entire systems to be drainable without disassembly of piping.
      c. Above Ground Piping: Specify labeled to identify contents and direction of flow, each shut-off valve, each piece of equipment, each branch take off, and at 20 ft maximum spacing on exposed straight pipe runs.

d. Equipment in Piping Systems: Specify each unit to be provided with a union or flanged connector at each pipe connection to allow easy removal.

8. Replaceability of Parts:
   a. Parts Having Service Life Less Than That Specified for Element: Specify easily replaceable parts, without de-installation or de-mounting of the entire element, component, or equipment item.
   b. Valves: Specify easily replaceable internal parts, eliminating necessity of removal of entire valve for repair.
   c. Parts Availability: Specify readily available parts from stocking distributors within 50 miles of project location.
9. Exceptions: Elements that do not meet the specified requirements for ease of maintenance are provided, and College Facilities Services' acceptance is granted.

F. Ease of Replacement:
1. Elements Not Required to have Expected Service Life Span Equal to that Specified for the Facility as a Whole: Specify provisions for replacement without undue disruption of building operation.
2. Large Equipment: doors and corridors large enough for removal of major pieces of equipment, such as, chillers and boilers.

END OF SECTION

DESIGN PROCESS AND SUBMITTAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Working relationships between Colorado College, the design team members, and the construction team members.

B. Procedures for design of new facilities and major renovations, based on applicable design and construction requirements.

C. Description of design phases, and requirements for work products and deliverables for each phase.

1.02 WORKING RELATIONSHIPS

A. General:
   1. Agreement: The Agreement Between Owner and Architect establishes the basic terms and conditions for delivery of professional services between the College and the Architect.
   2. Owner, Owner's Representative, Building Committee and Design Review Board:
      a. Owner: Colorado College (or College); Administrative Office located in Armstrong Hall, 14 E. Cache la Poudre Street, Colorado Springs, CO 80903-3294.
         1) The Vice President for Finance & Administration's signature is required on all financial and contractual documents.
      b. Owner's Representative: Each project will have an appointed Owner's Representative, generally the Director of Facilities Services or an appointed designee. The Owner's Representative will review the Documents for conformance to the Design and Construction Guidelines.
         1) Facilities Services Department: Located at 1125 Glen Avenue, Colorado Springs, CO, 80905. When the Owner's Representative is a member of the Facilities Services Staff, correspondence should be addressed accordingly.
         2) Direct all communication from the Architect to the College to the Owner's Representative unless otherwise arranged.
         3) Owner's Representative will be identified by the College.
         4) Owner's Representative will be responsible for construction issues.
      c. Building Committee: Major projects may have a Building Committee appointed by the College. The Building Committee will consist of a Chair, the Director of Facilities Services, and members of the academic, administrative, support staff, and students.
         1) During the design phases the Building Committee chair will recommend approval or other action to the College.
         2) The Building Committee chair and/or Director of Facilities Services will present the project conceptual design documents to the DRB for review and recommendations.
         3) The Building Committee and/or Director of Facilities Services will be responsible for design issues.
      d. Design Review Board (DRB): The campus Design Review Board is responsible for reviewing development of Campus facilities and associated landscaping to ensure consistency with the Campus master plan.
   3. Architect:
      a. Throughout these Design and Construction Guidelines, wherever the term Architect is used in referring to a professional engaged by the College for a particular project, the term is equally applicable to an engineer or other specialized consultant similarly retained by the College.
      b. Defined as an Architect or Engineer and their consultants licensed to practice in the State of Colorado.
         1) Architect is required to designate one Principal and one Project Manager who will represent their office throughout all phases of the project. The Architect's Project Manager is responsible for all communications with the Owner and the Contractor.
         2) Architect is responsible to communicate all relevant information from these Design and Construction Guidelines to the Contractor.

3) Change in the Architect's Project Manager during the life of the Agreement Between Owner and Architect may be made only after written request by the Architect and written concurrence of the Owner's Representative.

4. Contractor:
   a. Includes the term Construction Manager / General Contractor (CM/GC), General Contractor (GC), Design-Build Contractor (D-BC), or other types of construction Contracts; this will be identified in the Architect's agreements.
   b. College will select a contractual relationship with the Contractor that is appropriate for the project.
5. Project Title:
   a. The official title of the project will be stated in the Agreement Between Owner and Architect. It is required that all correspondence, drawings, and other project documents be identified with the official project title.
6. Architect's Invoices:
   a. Submit to Owner's Representative or Designee: Applications for payment and statements for compensation earned under the terms of the Agreement.
      1) Make each application on the Architect's invoice, clearly indicating the agreed upon payment schedule based on the scope of services phase.
      Include the total amount requested to date, less amount already paid, and amount requested on current invoice. Indicate the amount requested on the current invoice as a percentage of the total contract amount.
      2) Describe any adjustment to the scope of services on an approved Consultant Agreement Amendment, and indicate the approved amendment on the invoice or payment request.
7. Minutes of Meetings:
   a. Architect is responsible for conducting and documenting all meetings between its office personnel and College personnel, including telephone conversations for all phases of services covered under the Agreement Between Owner and Architect.
      1) Prepare and transmit written minutes of meetings or phone conversations to the Owner's Representative and all affected participants no later than the third working day following the telephone conversation or two working days before the next scheduled meeting.
      2) Owner's Representative will distribute copies to other appropriate parties as needed or required.

1.03 CONSULTANTS

A. The Agreement Between Owner and Architect usually requires the Architect to include design consultants, including structural, electrical, plumbing, and mechanical engineering services for the project. Specialized consultants may also be required, including but not limited to acoustics, vibration, radiation, cost estimating, and others.
   1. All Consultants must be approved by the Owner's Representative.
   2. The Owner reserves the right to contract with special consultants on the project.
   3. When the Architect contracts with consultants which are not direct employees of the Architect for these services, Owner's approval is required of those consultants.
   4. Consultants may be approved by inclusion in the Agreement Between Owner and Architect or by the Owner's Representative after execution of the Agreement Between Owner and Architect. The latter must be requested in writing by the Architect and approved prior to the any consultant performing work on the project.

B. Any change of consultant during the term of the Agreement Between Owner and Architect must be approved by the Owner's Representative.

C. The employment of consultants does not relieve the Architect from design responsibility for the entire project, for full coordination and management of services required under the Agreement Between Owner and Architect, whether the work is performed by the Architect or by the Architect's consultants.
   1. Agreements between the Architect and its consultants may be reviewed by the Owner's Representative before they are finally executed.
   2. The Architect's consultants are required to be active on the project through all phases, and to attend all meetings where their work is discussed.

D. An Architect’s or Professional Engineer's seal must be affixed on the Construction Documents for their portion of the design work whether this design work is performed by the Architect's directly employed staff or by an independent consultant.

E. The College may directly contract with other architectural or engineering consultants, most commonly landscape architects and utility engineers, or suppliers/installers of carpeting, furniture, scientific casework, window shades/blinds, and other furnishing items.
   1. The Architect and its consultants are responsible for providing information and reasonable coordination of these other consultants' design work during the design and construction phases of the project.

1.04 PROJECT DELIVERY THROUGH A CONSTRUCTION MANAGER / GENERAL CONTRACTOR

A. Construction Manager / General Contractor (CM/GC):
   1. For some projects, the Owner may elect to retain a Construction Manager / General Contractor (CM/GC). The CM/GC may be expected to provide various services including value engineering, cost estimating and project scheduling during both design and construction.
   2. The Architect will be required to cooperate and work closely with the CM/GC for the benefit of the total project. This requirement has only a minor effect on the procedures outlined in these Design and Construction Guidelines.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DESIGN PHASES - GENERAL

A. College Facilities Services will appoint representatives of the following departments to provide details of functional needs, review proposed solutions, and participate in design phase meetings as needed:
   1. User groups.
   2. Operations staff.
   3. Maintenance staff.
   4. College Facilities Services' commissioning agent (CxA).
   5. Others as may be determined for specific project or facility.

B. Design phases are generally defined as follows:
   1. Schematic Design: Confirmation of facility programming, **definition of mission-critical design intent and criteria (New Process Step)**, and conceptual design to define basic scope and character of the project.
   2. Design Development: Detailed design of the project based on the facility program, **design intent and criteria (New Process Step)**, and development of the scope and character of the project to a level of detail sufficient for preliminary pricing and review for conformance with design criteria and intent.
   3. Construction Documents: Preparation of detailed documentation, including construction drawings, construction specifications, and other documentation required to fully communicate the design of the project to the construction team for purposes of securing necessary building permits and of constructing the project.
   4. Bidding or Negotiation: Participation in the process of bidding or negotiating the Contract Sum for the project.
   5. Construction: Performing construction contract administration services, including project closeout, as stipulated in the Agreement Between Owner and Architect, the General Conditions of the Contract for Construction, and any other applicable supplementary conditions or provisions of the construction Contract.
   6. Post Construction: Preparation of project record documentation, and participation in post-occupancy inspections.

3.02 PROGRESS DOCUMENTATION

A. Progress Schedule:
   1. Submit updated schedule for the design phases of the Project whenever adjustments that change the Project Schedule are approved.

B. **Design Intent and Criteria Manual (New Requirement):** Architect is responsible to prepare and maintain a Design Intent and Criteria Manual, containing design intent and performance criteria that will be of use during construction, occupancy, and operation of the project.
   1. Prepare initial draft of Manual and submit with other submittals at the conclusion of the Schematic Design phase.
   2. Submit refined and developed versions of Manual with other required submittals at the conclusion of the Design Development and Construction Documents phases.
   3. Manual will be used to review and evaluate compliance of the design with established design intent and performance criteria for the project.
   4. Organize Manual's content according to the following table of contents:
      a. Project Intent Statement.
      b. Project Description (scope summary).
      c. **Facility Program** (copy of program provided by Architect in collaboration with the College, including any additions or clarifications developed during the Schematic Design phase).
      d. Design Criteria:
         1) **Sustainable Design and High Performance Goals** (See General Facility Design Guidelines Requirements).
            (a) Summary of High Performance Goals and/or LEED Scorecard if required.
            (b) Summary of strategies addressing **Facility Life-Cycle Design Guidelines for Sustainability** in this Design and Construction Standards manual.
            (c) Energy model/performance calculations and conclusions if required.
         2) **Compliance Statement** (stating that design substantially complies with applicable Design and Construction Guidelines).
            (a) **Guidelines Deviations** (list substantial deviations from applicable Design and Construction Guidelines, if any).
         3) **Facility Maintenance Considerations** (list of design strategies employed and products selected which support effective and efficient facility maintenance by the College).
         4) Supplemental Information (include if required).

C. Construction Documents:
   1. Construction Drawings: Prepared using PC-based CAD software, using College Facilities Services' specified drawing and layering conventions.
   2. Specifications: Prepared in substantial conformance to current editions of industry standards established and maintained by The Construction Specifications Institute (CSI), including *MasterFormat*, *SectionFormat*, and *PageFormat*.
   3. **Design Intent and Criteria Documentation (New Requirement) Included in Construction Documents:** Organized logically (from the point of view of operations staff) and placed in a prominent location in O&M Manuals, or in drawing sets or specifications if applicable.
      a. **This information is not to be characterized as Contract requirements to be fulfilled by the Contractor, but is to be provided only for reference by the Owner and others during the design, construction, occupancy, and operation phases of the facility's life-cycle.**

D. Documentation during the Construction phase may consist of annotated modifications to and amplification of the Construction Documents, including changes that may affect Contract Times or Contract Sum.
   1. College Facilities Services will retain the project documents, modified by the design consultants and the Contractor to reflect changes made during refinement of the design and during construction.

E. Documentation for College Facilities Services's Project Record:
   1. During Construction: Digital photographic record of concealed items including but not limited to valves, adjustable components, and similar items, taken from consistent locations, distances, and angles; mark locations on ceilings and other covering surfaces in a recognizable but inconspicuous manner as directed by the College.

2. During Closeout: Detailed digital photographic record of each interior room and space, each exterior elevation, the roof, and all site areas as directed by the College.
3. Operation and Maintenance Manuals: Two (2) hard-copy manuals (multiple binders if necessary) and one (1) electronic copy in portable document format (.pdf) with table of contents hyper-linked to individual and grouped files.
4. Photographs and Videos: Include the date taken, a short title of the view, and the compass orientation in each view; data must be in the actual photograph or frame, rather than added after printing (hand-printed lettering on an erasable marker board is acceptable).

3.03 SCHEMATIC DESIGN PHASE

A. General: The Architect is responsible to prepare the following, at a minimum:
1. Schematic Design Studies: Illustrating the scale and relationship of project components for approval by the Owner's Representative.
   a. Number of studies may vary with the complexity of the project. In remodel and renovation Project, adequate field investigation beyond information provided by the Owner, must be performed by Architect to ensure the practicality of proposed design solutions.
   b. Continue generating studies until the requirements of Project are met and a Schematic Design is approved by the Building Committee and/or Facilities Services Director.
   c. Proceed to the Design Development Phase only when written approval has been received.
2. **Sustainable Design Opportunities and Strategies:** Develop and review with the Owner's Representative and the Building Committee and/or Facilities Services Director to establish realistic expectations within budgetary constraints. Explore options and creative solutions as early in the design process as possible.
3. Occupancy and Construction Type: Establish building occupancy, mixed occupancy considerations, and general exiting systems.
4. Addition and Renovation Projects: Where portions of existing buildings are to be renovated, include adequate drawings to establish general scope of the demotion work.

B. Submittal Requirements: The Architect is responsible to provide the following, at a minimum:
1. **Design Intent and Criteria Manual (New Requirement):** First draft, as specified under DESIGN PHASES - GENERAL in this Section.
2. Drawings:
   a. Dated and scaled, with consistent view orientations and title block information.
   b. Include site plan, floor plans, roof plan, and exterior elevations of all sides.
      1) Floor Plans: Include room names as identified in the Building Program, gross area of each floor, and total gross area of the building.
3. Technical Information:
   a. Building and occupancy classification.
   b. Type of construction.
   c. Location on property/site.
   d. Allowable floor area for code analysis.
   e. Height and number of stories.
   f. Exiting and accessibility.
   g. Structural analysis: sketches and descriptions of proposed structural systems
   h. Building systems, including sketches and descriptions of plumbing, mechanical and electrical systems.
   i. Building materials, including outline description of proposed construction materials, including sustainable materials.
   j. Tabulation of areas; indicate the Net Assignable Square Feet (NASF) of all spaces.
   k. Cost Estimate:
      1) When required by the Agreement Between Owner and Architect, prepare an opinion of probable construction cost for each Schematic Design study. Include appropriate amounts for contingency and inflation to reflect anticipated condition at the time of bidding.
      2) When the Owner employs an independent Cost Consultant or CM/GC Contractor, review estimates/reports and notify the Owner in writing if the Architect takes exception to any item or items in reports.

l. Architectural Models and Perspective Drawings:
   1) Provide perspective rendering and/or a presentation quality model of the project. The actual requirements for each project will be specified in the Agreement Between Owner and Architect.
   2) When architectural models are required, show as much detail as possible at the scale to which they are built; large enough to include adjacent streets, approach drives, walks, associated parking and service facilities, and a clear plastic cover.
   3) When a perspective rendering is required, show the proposed building on its actual site with representative surrounding or adjacent buildings. Pedestrian view is preferred.
   4) Perspective renderings and architectural models become the property of the Owner.
   5) Study models (not architectural models) are encouraged, but not specifically required, to help in developing the design and communicating it to the Building Committee and/or Facilities Services Director. Study models are considered a part of the Architect's basic services.

C. Reviews:
   1. First Formal Review: Made after a single Schematic Design has been selected by the Building Committee and/or Facilities Services Director.
   2. Detailed Review: Made by the Building Committee, Campus Design Review Board (DRB), other Representatives (not on the Building Committee), College Facilities Services Department, and other Administrative and Academic Personnel. Written comments will be assembled by the Owner and will be transmitted to the Architect for inclusion in the design or for further study or discussion. Each comment requires a written response from the Architect and/or Consultant.
   3. Code Review: Architect is responsible to review the accepted schematic design with the code officials and furnish the Owner's Representative with copies of resulting comments and suggestions.
   4. Approval to Proceed: After the schematic design submittal has been approved by the Building Committee and/or Facilities Services Director, the Architect will be notified in writing to proceed with preparation of the Design Development Documents.

3.04 DESIGN DEVELOPMENT PHASE

A. General: The Architect is responsible to prepare the following, at a minimum:
   1. Design Development Documents: Drawings and other documents, including specifications, to fix and describe the size and character of the entire project as to kinds of materials, type of structure, mechanical and electrical systems, and other work that may be required for construction of the project.
   2. Meet with the Building Committee and Facilities Services to determine specific and detailed requirements of all spaces in the proposed building and surrounding site requirements. Determine and describe mechanical and electrical systems to serve the building.
   3. Study and analysis in such detail that all data is sufficient to begin construction drawings without additional consultation with the using departments.
   4. **Sustainable Design Strategies and Options:** Determined, identified in the documents, and integrated into the Cost/Budget Estimate for this phase.
   5. Resolve all substantial design decisions and budget issues for the College to approve the Design Development Phase submittal.

B. Submittal Requirements: The Architect is responsible to prepare the following, at a minimum:
   1. **Design Intent and Criteria Manual (New Requirement):** Second draft, as specified under DESIGN PHASES - GENERAL in this Section.
   2. Drawings:
      a. Code Compliance: Information identifying Occupancy Type and Construction Type, allowable and actual calculations in sufficient detail to support the specific design. Include additional code excerpts as applicable. Code compliance must be reviewed and accepted by the Building Official prior to completion of the Design Development submittal. Include the Owner in these reviews with the Building Department.
      b. Site plan showing new site construction information, and including legal and physical improvements existing on the site.

c. Floor plan(s), including structural frame and envelope dimensioning; room, door, and other opening identification numbering; construction assembly identifications; and other functional improvements included in the design.
    1) Coordination Plan: Provide consultant coordination plan(s) identifying general workstation layout with the associated electrical, tele/data and other specialized utility connection locations.
    2) Demolition Plan(s): On remodel/addition projects when substantial demolition occurs, provide a demolition plan clearly identifying the Scope of Work.
d. Roof plan(s), showing drainage patterns and points of discharge, openings and equipment locations, and similar information.
e. Exterior elevations, identifying all materials and intended detailing.
    1) Remodel and Renovation Projects: Graphically differentiate between existing and new.
f. Building sections.
g. Reflected ceiling plan(s).
h. Enlarged floor plan(s) and section(s) (as applicable).
    1) Toilet Room Plans: Show plumbing fixtures, accessories, stall layout and handicap accessibility. Verify plumbing fixture count with local code official and Owner's Representative, particularly on renovation and addition projects.
    2) Kitchens: Provide a commercial kitchen equipment plan and schedule when applicable.
    3) Stair and Elevator Section(s): Show vertical/horizontal dimensions and hand/guardrail design.
i. Schedules:
    1) Doors, windows, and associated frames, including preliminary opening schedules.
    2) Preliminary room finish schedule.
j. Wall/Partition Types and Rated Assemblies:
    1) Provide a legend identifying the materials used and fire/smoke and acoustic ratings as applicable; cross referenced to the plans and sections.
k. Structural General Notes:
    1) Live Loads: Floor, stairs, corridors, roof, snow, earthquake and wind.
    2) Dead Loads: Material weight, mechanical and electrical weight, wet-pipe or dry-pipe fire sprinkler system, and soil bearing pressure.
    3) Materials Strength: Concrete, masonry, steel and wood. Foundation design based on College accepted recommendations contained in Soils Report.
    4) Foundation design based on College accepted recommendations contained in Soils Report.
    5) Outline to NOT include:
        (a) Incorporation of the geotechnical report by reference as a Contract Document.
        (b) Detailed administrative, product/material, and execution specifications that duplicate same specifications contained in the Project Manual.
l. Structural Plans:
    1) Foundation and framing plan(s) that indicate floor, roof, and load-bearing wall construction.
    2) Particularly in buildings containing sensitive equipment, incorporate vibration analysis and mitigation appropriate to the projects requirements.
m. Mechanical Drawings:
    1) Scaled plans of each floor, showing double-line duct layouts, equipment locations, and typical heating and cooling devices (e.g., scaled VAV boxes and branches with supply and return diffusers).
    2) Mechanical-room drawings, showing locations and sizes of AHU(s), fans, pumps, compressors, heat exchangers, and similar design components. Show elevation cross sections where necessary.
    3) System schematics showing all system components and control devices and sequence of operation, including sustainable design measurement and verification features, if applicable.
    4) Particularly in buildings containing sensitive equipment, incorporate vibration analysis and mitigation appropriate to the projects requirements.

n. Plumbing Drawings:
    1) Plans of each floor, noting fixture locations and types. Indicate routing of main distribution lines with sizes.
    2) Preliminary fixture schedule(s).
    3) Utility connections to piping distribution systems if required by the design.
o. Electrical Drawings:
    1) Plans of each floor, noting device locations and types.
    2) Proposed electrical room/closet areas.
    3) Main electrical feed type of service and location.
    4) Identify and locate proposed electrical sub-panel locations; type and size at each floor.
    5) Preliminary lighting fixture layout and schedule(s).

3. Draft specifications; include table of contents of all Sections anticipated to be included in the construction documents, identifying those Sections not yet included; include drafts of Sections that can be adequately prepared and reviewed for content at design development level.
4. Tabulation of areas; updated, indicating the Net Assignable Square Feet (NASF) of all spaces.
5. Cost Estimate:
    a. When required by the Agreement Between Owner and Architect, prepare updated opinion of probable construction cost. Include appropriate amounts for contingency and inflation to reflect anticipated condition at the time of bidding.
    b. When the Owner employs an independent Cost Consultant or CM/GC Contractor, review updated estimates/reports and notify the Owner in writing if the Architect takes exception to any item or items in reports.
6. **Energy report or model describing energy considerations and recommendations including building operations first-cost and life-cycle cost projections.**

C. Reviews:
1. Formal Review: Made after the Design Development Phase submittal has been presented to and approved by the Building Committee and/or Facilities Services Director.
2. Detailed Review: The Building Committee, other Representatives of the using departments, College Facilities Services Department, and other Administrative and Academic personnel will critically examine this submission to ensure that all requirements of the Building Program have been satisfied. Written and/or “redlined” drawing comments will be assembled by the Building Committee and transmitted to the Architect for inclusion in the design or for further study or discussion. Each comment requires a response and resolution by the Architect or their Consultant. Substantial issues must be resolved to the Owner’s satisfaction; a revised Design Development Phase submittal may be required as determined by the Building Committee.
3. Cost Estimate: Reviewed by the Building Committee and/or Facilities Services Director to determine that the estimated construction cost is within the limits of the available funds. If estimated costs exceed the budgeted funds, the Architect will be required to make changes to reduce the cost.
4. Code Review: Architect is responsible to review the Design Development Phase documents with all required City of Colorado Springs and State agencies including Regional Building, Utility, Fire and Health Departments. Provide copies of agency review comments and the Architect’s responses to Colorado College. Resolve substantial design and budget issues for the College to approve the Design Development Phase submittal.
5. City of Colorado Springs Planning Department: Requires submittal and approval of a Development Plan. Refer to the City of Colorado Springs Zoning Ordinance for requirements and achieve compliance with those requirements.
6. Approval to Proceed: Once submittal has been approved by the Building Committee and/or Facilities Services Director, the Architect will be notified in writing to begin preparation of the Construction Documents.

3.05 CONSTRUCTION DOCUMENTS PHASE

A. General: The Architect is responsible to prepare the following, at a minimum:
1. Construction documents which are complete in all respects to permit fully informed bidding and construction. All elements must be accurately shown, appropriately detailed, and properly specified.

2. Construction Documents: Consisting generally and usually of component parts listed below. This is not a complete list of all the Contract Documents that may be used during the Bidding/Negotiation and Construction Phases of a Project.
    a. Advertisement for Bids (provided by CM/GC or required for open bids only) and Instructions to Bidders (required for open bids only).
    b. The Form of Bid (required for open bids only) and General Conditions.
    c. Supplementary Conditions and Special Conditions.
    d. Construction drawings and technical specifications, including Division 01 General Requirements specifications.
3. Construction Drawings and Technical Specifications: Prepared in conformance with these Design and Construction Guidelines; other documents listed above will be developed by the Owner's Representative utilizing Colorado College forms.
4. Materials, Components, Systems and Equipment: Perform a diligent investigation to ensure the College that these items are not specified, approved, or used which will be discontinued or significantly redesigned by the manufacturer or suppliers in the near future, (preferably within 5 years).
5. Remodel and Renovation Projects: Perform adequate field investigations, beyond the information provided by the Owner, to ensure that work indicated on the construction documents represents an accurate description of the scope of work and feasibility of proposed construction.

B. Submittal Requirements: The Architect is responsible to prepare the following, at a minimum:
1. **Design Intent and Criteria Manual (New Requirement):** Final document, as specified under DESIGN PHASES - GENERAL in this Section.
2. Drawings and Specifications - General:
    a. Quality Control Review: Carefully reviewed by the Architect to achieve coordination between all consultants, civil, structural, mechanical, electrical specialized consultant and fixed equipment.
    b. Proprietary Names: Do not use propriety product names on the drawings, except when instructed by the Owner’s Representative, and properly coordinated with the specifications.
    c. Professional Seals: Affixed to construction documents as required by code officials, with corresponding signatures and registration numbers.
        1) Deliver one (1) stamped set, with the jurisdiction authority's Building Permit approval notice, to the College as a permanent record set.
3. Drawings Content and Organization - Minimum:
    a. CAD Standards: Comply with general guidelines of the Uniform Drawing System components of the United States National CAD Standard, current edition, a product of the National Institute of Building Sciences buildingSMART alliance (NIBS bSa) for drawing set organization, sheet numbering, terms and abbreviations, notations, and layering conventions; www.nationalcadstandard.org.
    b. Title sheet.
        1) Based on information provided by the College, identify types, amounts and locations of all hazardous materials intended to be stored or used. List actual quantities and compare to exempt amounts. Projects with extensive quantities of hazardous materials will be required to submit a “Hazardous Materials Management Plan” as prepared by the Facility Services Environmental Health and Safety Office.
    c. Site plan(s).
    d. Demolition plan(s) (Conditional).
    e. Architectural floor plan(s).
    f. Architectural roof plan(s).
    g. Architectural exterior elevations.
    h. Architectural building sections.
    i. Architectural reflected ceiling plan(s).
    j. Architectural enlarged floor plan(s).
    k. Architectural interior elevations.
    l. Architectural schedules.
    m. Architectural building and wall sections.
    n. Architectural details and enlarged sections.
    o. Structural drawings.

p. HVAC drawings.
q. Plumbing drawings.
r. Electrical drawings.
s. Other drawings as applicable to the project.

4. Technical Specifications - General:
   a. Format Requirements: Comply with general guidelines of MasterFormat, SectionFormat, and PageFormat, current editions with supplements, as published by CSI (The Construction Specifications Institute) for specifications Division organization, section numbering, and section/page formatting; www.csinet.org.
   b. Complete specification sections for all products, materials, components, systems, and finishes.
   c. Carefully prepare specifications to include all items pertaining to the project and to omit items not intended to be incorporated into the project. Use terminology, references, and abbreviations consistently on drawings and in specifications.
   d. Submittals: Include a complete summary list of all specified shop drawings, samples, product data, and other submittals.
   e. Warranties: Include a complete list of standard warranty and extended warranty requirements, and list of items for which operations and maintenance data are required.
   f. Maintenance Materials: Include a summary list of specified Owner's maintenance materials and additional quantities specified beyond that required to complete the construction.
   g. Reference Standards: Ensure that specified industry reference standards are reviewed to verify current and correct identification of standards and date of issue.
   h. Terminology Conventions: For consistency in format the following rules should be observed:
      1) The term "Architect" refers to the Architect and/or their Consultants and Engineers who prepare the Documents. The terms should be capitalized and no other term should be used to refer to other consultants or engineers.
      2) The term "Owner" should be capitalized, and no other term should be used in reference to the College and/or the Owner's Representative.
      3) References to the "Drawings" should be capitalized and refers to the entire set of construction drawings, not to less inclusive term such as "plans." The term "Drawings" refers to that portion of the Construction Documents.
      4) "Specifications" should be capitalized when reference is made to the work results sections generally. The term "Specifications" refers to that portion of the Construction Documents.
      5) "General Conditions," "Supplementary Conditions," and "Special Conditions" are conditions of the Contract and are not parts of the Specifications.
      6) "Contractor" should be capitalized, and no other term should be used reference to any subcontractor, supplier, or other entity under contract to the "Contractor." The term "Contractor" refers to the prime General Contractor or any subcontractor or suppliers contracted directly by the Contractor.
      7) When reference is made to the "Contract" between a Contractor and the Owner it should be capitalized.
      8) The term Contract Documents refers to all the documents identified in the Contract Between Owner and Contractor and in the General Conditions.
      9) The terms "Project," "Architect,, "Owner," and "Owner's Representative" should be capitalized; no other pronouns should be capitalized.
   i. Project Manual - General:
      1) The General Conditions, Supplementary Conditions, Special Conditions (if any), and other bidding requirements should be bound together with the "Work Results (Product) Specifications" to form the Project Manual. Obtain special permission from the Owner's Representative before placing other documents such as schedules and detail drawings in the Project Manual. Number all pages, using document or section number and page number, separated by a dash ("-").
      2) Table of Contents: An index or table of contents for the entire Project Manual is required. The use of different colored paper for the major divisions is required as follows:

3) The Project Manual should include official Project title, Architect's name and date on the cover. A project directory including consultant's names and contact information should be included immediately behind the cover. This date shall be the same as that on the Drawings and, in the case were earlier editions exist, shall be titled Contract Edition. Architect's and Engineer's seals shall be placed on the title page.A project directory including consultant's names and contact information should be included immediately behind the cover.
4) Colorado College's standard forms will be used for all projects. Final copies tailored to each project will be provided by the Owner's Representative for insertion into the Project Manual.

j. Tabulation of areas; updated, indicating the Net Assignable Square Feet (NASF) of all spaces.
k. Cost Estimate:
1) When required by the Agreement Between Owner and Architect, prepare updated opinion of probable construction cost. Include appropriate amounts for contingency and inflation to reflect anticipated condition at the time of bidding.
2) When the Owner employs an independent Cost Consultant or CM/GC Contractor, review updated estimates/reports and notify the Owner in writing if the Architect takes exception to any item or items in reports.

C. Reviews:
1. Building Permit: Reproduce the Drawings and Specifications in the number of sets required by the jurisdictional authority and submit the authority. The Architect is required to secure all required jurisdiction approvals and permits, including City of Colorado Springs and State of Colorado. Provide copies of jurisdictional authority review comments and resolutions to Colorado College with one (1) sealed and approved set of Construction Documents.
2. Mass Reproduction of Documents: Because changes will probably be required, the reproduction in multiple sets of documents for bidding should not be made until after jurisdictional reviews and approvals are completed. If significant changes are required due to the jurisdictional authority review, addenda, and/or Owner's review, the Owner's Representative may request the Architect to consolidate these modifications into the final Construction Documents. If required, it is the Architect's responsibility to complete this at no additional cost to the Owner.
3. Alternates: The Architect is responsible to include provisions for alternate proposals in the bidding documents to permit a reduction in the scope of the project should this become necessary to award contracts within the budgeted funds. Alternates to be incorporated in the bidding documents must be approved by the Owner's Representative before they are documented and included on the bid proposal form.
4. Detailed Review: The Construction Documents will be critically examined by the Building Committee, Owner's Representative, Owner's Commissioning Authority (CxA), Facilities Services Staff, Environmental Health/Safety, Information Technology, and other College Administrative staff to ensure that the requirements of the Building Program are satisfied. The primary emphasis is to assure that the approved Design Development has been described in adequate technical terms to complete the project on time and within budget. Some of the primary concerns include construction durability, life/safety related to applicable codes, sustainability goals, building environmental controls, energy efficiency and general completeness/coordination of the documents. Colorado College is not the building code official, and compliance to all applicable codes is the responsibility of the Architect and its consultants.
5. Scope of the Work: Must be sufficiently defined in the documents to prevent unreasonable cost escalation during construction. The Owner's written and "redlined" comments will be transmitted to the Architect. The Architect and its consultants are required to respond to the Owner's Comments in writing and incorporate all necessary modifications into the final Construction Documents.
6. Approval to Proceed: After the Construction Documents have been approved by the Owner, the Architect will be notified in writing to issue the final Construction Documents for Bidding or Negotiation.

3.06 BIDDING OR NEGOTIATION PHASE

A. General:
1. Date for Receipt of Bids: Will be established by the Construction Manager or Owner's Representative.

2. Open Bids Only: The advertisement will be placed in the official papers by the Owner's Representative, or the CM/GC acting in the College's behalf. Release of Contract Documents to bidders should be simultaneous with the date of appearance of the advertisement.
3. Bidding Documents: Will not be released to bidders until such release has been approved by the Owner's Representative.
    a. Documents will be released by the Architect or CM/GC from his office and must be returned to same office after bid date. Copies for bidders' inspection will be made available at the Colorado College and at various construction reporting agencies and builders' exchanges, the number and locations to be determined by the size and nature of the Project.
4. In a CM/GC Contract, a select list of qualified bidders will be developed by the CM/GC and Owner.
    a. Deposits may be required on the documents. On some projects the Owner may choose to charge a non-refundable amount equivalent to the actual cost of reproducing and handling the documents. In a CM/GC Contract, the original Construction Documents will be given to the CM/GC's office for reproduction and distribution.
5. During the bidding period, the Architect will prepare and issue bidding Addenda) to all documents holders. In a CM/GC Contract, the Contractor will be responsible for distribution of Addenda. If the requested Addendum clarification becomes too numerous, the Architect may be requested to consolidate these changes into a Final Construction Documents. If required, it is the Architect's responsibility to complete this at no additional cost to the Owner.
6. The Owner's Representative or Construction Manager will prepare Bid Tabulation sheets for the Bid Opening.
7. Recommendations for award of contract(s) will be made to the Colorado College if the bids received are within the available funds for the Project.
8. A notice of award letter will be sent to the successful bidder by the Owner's Representative or Construction Manager.

3.07 CONSTRUCTION PHASE

A. General:
1. The Architect and its Consultants are expected to make periodic visits to the site during the construction period to observe the progress of the Project. The frequency of these visits will vary with the contractual obligations of the different stages of the Project with the minimum being once every two weeks. A written report shall be issued containing observations and issues.
2. The Architect is required to review specified submittals, including shop drawings, product data, samples, and other submittals, and take appropriate action on approvals in conformance with the specifications. During construction, the Architect is required to provide necessary interpretations of the construction documents and provide supplemental details and instructions which may be required to explain the intent of the documents.
3. The appropriate G-series American Institute of Architect's (AIA) standard forms will be utilized.
4. Architect is required to review decisions on finish materials and color selections with Owner's Representative, and secure Owner's approval, before instructions are given to the Contractors for implementation.
5. Monthly Payment Procedures:
    a. Three (3) originals submitted by Contractor to Architect, om the date prescribed in the Agreement.
    b. Architect reviews and coordinates approval with Owner's Representative.
    c. Architect provides one (1) certified original to Owner.
6. The Architect's responsibilities include issuing and responding to the following in a timely manner at no additional cost to the Owner. If identified as having a cost or schedule impact, the Architect will advise the Owner's Representative on the validity of the claim.
    a. Request for Information (RFI).
    b. Architect's Supplemental Instructions (ASI).
    c. Construction Change Directives (CCD).
    d. Proposal Request (PR).
7. The Contractor is required to maintain record documents, which will be the basis for the Architect's preparation of the project Record Documents.

8. Meetings are scheduled generally weekly with Architect, Contractor and College personnel. The Architect and its consultants, when directly concerned, are expected to be present at these meetings. The Contractor will:
    a. Take minutes, prepare a report of each meeting, and distribute to the primary attendees within 48 hours of the meeting.
    b. Provide current construction progress schedule, RFI Log, PR/CO Log, and Submittal Log, which will be reviewed during the meeting and incorporated in the meeting minutes.
        1) One copy sent to the Owner's Representative for reproduction and distribution to appropriate College offices.
9. The Architect is required to be present, with their Consultants, to conduct the Final Inspection of the building, together with the Owner's Representative or their authorized Facilities Services representatives. At Substantial Completion and Final Acceptance, the Architect is required to certify to the Owner's Representative that the Project was completed in substantial compliance with the Contract.
10. Substantial Completion: Defined in the General Conditions and AIA G704, Certificate of Substantial Completion, and includes the following, at a minimum, subject to Architect and Owner's determination of Substantial Completion:
    a. In the case of Owner’s requested portion of the Project, extension of the exiting systems and life/safety systems; completion of those systems through unfinished portions of the Project.
    b. Final Inspection Certificates: Receipt of Temporary Certificate of Occupancy or Certificate of Occupancy from Building Officials, Fire Department, Health Department and all applicable jurisdictional authorities; original certificates delivered to the Owner.
    c. Permanent utilities, plumbing, mechanical and electrical systems fully operational and commissioned.
    d. Exiting systems, life/safety systems, and circulation systems complete, including installation of door and opening hardware.
    e. Exterior development and building access sufficiently complete for egress and building maintenance including vehicular access.
    f. Initial Balancing Report complete and submitted to the Architect, Engineers, and Owner. Commissioning of the building systems sufficiently complete to assure that the building is functioning properly for human habitation, comfort, safety, and in conformance with the Owners Project Requirements.
    g. Punchlist: List of corrective and defective work to be completed by the Contractor issued by Contractor and supplemented by Architect, including the Owner’s identified items. Punchlist completed by Contractor, and re-inspection completed by Architect. Outstanding items, particularly those which are dependent on shipping or manufacturing, identified in writing including the anticipated completion date.
11. Final Acceptance of the Contractor’s includes the following, at a minimum:
    a. Operation and Maintenance Manuals, including all specified warranties, reviewed and accepted by the Architect and Owner.
    b. Building Commissioning and Owner’s training, including the final balancing report, completed.
        1) LEED Projects (if applicable): Initial credit submissions to GBCI complete and accepted by Owner. Fulfillment of some LEED Credits may extend beyond the Final Acceptance date; if so, the Owner and the responsible party will establish a reasonable cost and time frame for completion.
    c. Punchlist items completed by the Contractor and accepted by the Architect and Owner.
    d. Specified Contractor-furnished Owner’s maintenance materials received and accepted by the Owner.
    e. Record documents by Contractor submitted and accepted by the Architect and Owner.
        1) **Design Intent and Criteria Manual (New Requirement): Verification and comments for the Architect and Owner regarding design intent and criteria achievement or non-achievement as indicated through the commissioning process.**
    f. Required lien waivers received by the Owner.
    g. The General Contractor is required to complete and file the City of Colorado Springs Tax Rebate Form ST 16.

B. Warranties:
   1. Specified to commence on the Date of Substantial Completion. If an item or system is identified on the Punchlist as defective or incomplete, such item's or system's warranty will not commence until completion of the remedial work and acceptance by the Architect and Owner.
   2. Commissioning Authority and Owner Warranty Review: Conducted to review all building systems at 6 months and 10 months after the beginning of the established warranty period. All work identified as not meeting the Owner's Project Requirements must be corrected within the specified warranty period.

3.08 POST CONSTRUCTION PHASE

A. Record Documents:
   1. Architect's Responsibility: Prepare Record Documents and submit to Owner, based on information provided by the Contractor in their record documents, and on document modifications made during construction, the Record Documents consisting of updated As-Built Drawings and Specifications. Record Documents consist of the following:
      a. **Drawings in full blue-line sets organized and bound by section, and matching digitized (CD) or USB Memory Stick copies of sections in PDF and DWG (AutoCad) file formats.**
      b. Two notebooks containing all RFI's, ASI, CCP, PR and other information documenting modifications to the documents.
      c. Operations and Maintenance Manual: Reviewed and approved to be in conformance with the construction documents, **including the Design Intent and Criteria Manual**, then be delivered to the Owner for review and final acceptance. Upon Owner's approval of the O&M Manuals, the Contractor is required to provide two (2) hard copy (binder notebooks) sets and two (2) digitized (CD) or USB Memory Stick copies to Owner.
         1) Digitized File Format: PDF; each mechanical equipment tag and/or device type represented by separate files.
   2. Provide two (2) copies of the Quality Assurance Manual to the Owner as stated in the Commissioning Plan, if applicable.
   3. The Contractor's record drawings are required to be completed and delivered to the Architect prior to final acceptance of the construction.
   4. Final payment to Architect will not be authorized until the Owner's Representative has received and accepted the Record Documents from the Architect.

B. Post-Occupancy Inspection:
   1. The Architect and all professional consultants retained by the Architect are required to accompany the Owner's Representative or their authorized representative on a post-occupancy and warranty review prior to the expiration of the warranty period. This should take place after the Owner has had an adequate opportunity to detect any defective conditions.
   2. Commissioning Authority and Owner Warranty Review: Conducted to review all building systems at 6 months and 10 months after the beginning of the established warranty period. All work identified as not meeting the Owner's Project Requirements must be corrected within the specified warranty period.

END OF SECTION

Facility High Performance Sustainability Design Procedures Manual

Overview

In support of the college's sustainability goals, the following **High Performance Sustainability Design Procedures** ensures sustainable building and landscape design for all construction and renovation efforts at Colorado College. This document is aimed at maximizing opportunities for applying sustainability concepts and principles to the design of facilities through integrated design procedures. The summarized goals of the sustainable design procedures are listed below.

- The design team will be expected to make creative and innovative **High Performance Sustainable Design** recommendations that align with the college's commitments to sustainability, integrative design, and suggest innovative opportunities which result in long term sustainable solutions supportive of the college mission and core values.
- New buildings and renovations should minimize building life-cycle costs (direct and indirect) related to energy use, maintenance, waste disposal and occupant health and productivity.
- New projects should be progressive whenever possible, meaning they attain the highest energy performance possible, given each project's available funding, each building's optimum performance design potential, and each building infrastructure system's conditions, etc.
- Landscaping projects should be water efficient, should minimize stormwater runoff, and should include native and/or climate appropriate plantings to the arid Rocky Mountain West whenever appropriate for use and/or foot traffic.
- Purchasing of goods and services from manufacturers and vendors should comply with the Colorado College Sustainable Purchasing Guidelines.
  [Sustainable Purchasing Guidelines]
- Building and landscape design should consider long term maintainability requirements per the Colorado College Sustainable Operations & Maintenance Guidelines.
  [Sustainable Operations & Maintenance Guidelines]

The Sustainable Building and Landscape design procedures are a targeted approach to steadily reduce the college's reliance on fossil fuels. Design and construction efforts that incorporate high performance design procedures will contribute to a significant reduction in campus carbon emissions. These design procedures are intended to encourage the highest performance and lowest life-cycle cost over the expected lifetime of built facilities.

This document supports the current goals outlined in the Colorado College facility design guidelines while providing a defined procedure to facilitate integration of those guidelines into the design process. [Colorado College Facility Design Guidelines Manual]

These procedures have been formulated to encourage implementation of the college's core value to nurture the ethic and practice of environmental sustainability. In addition, the President's signing of the American College and University President's Climate Commitment Pledge in April 2009 included the aggressive goal of achieving Carbon neutrality by 2020. The Sustainable Building & Landscape Design Procedures will establish an appropriate mechanism designed to provide an orderly and effective process toward

attainment of this ambitious goal. [ACUPCC President's Climate Commitment]

1.0 Hiring the Design Team, *Consultant Experience and Expertise in High Performance Sustainable Design*

To ensure implementation of its sustainable design philosophy, Colorado College intends to select design and related professional services on the basis of knowledge and demonstrated capability in applying sustainability concepts and principles to the design of facilities through an integrated design approach.

Demonstration of this knowledge will be specified in invitations for bids (IFBs) and requests for proposals (RFPs). Specifically, prospective design teams will be asked to demonstrate:

- Expertise with environmentally responsible and/or **High Performance Sustainable Building Design.**
- Specific expertise in applying "Integrated Design" methodologies.
- Experience with projects that use less heating and cooling energy than conventional standards.
- Experience demonstrating actual, verifiable building performance.
- Experience with projects that use less electrical energy and less energy for lighting than industry standards.
- Verifiable experience with projects with LEED™ or other green building ratings.
- Experience with projects that have specifically addressed ensuring good indoor air quality through use of less toxic materials, integrated pest management, etc.
- Experience with projects demonstrating site planning that sustains and enhances the natural environment by: maximizing solar energy potential and use of natural light; maximizing the potential for natural ventilation; and minimizing off-site storm water runoff.
- Experience writing specifications requiring waste management and recycling plans for construction and demolition.
- Experience with life-cycle analysis techniques to select building materials that minimize environmental impacts.
- Client references for previous sustainable design work.

Preference will be given to design teams with actual experience in the items listed above. However, in the absence of experience, evidence that the design team has the capability to adequately incorporate **High Performance Sustainability Design** features into the project will be considered. If the **High Performance Sustainable Design** expertise resides with a sub consultant rather than prime consultant, priority will be given to teams that have had success working together on prior sustainable design projects. Priority will be given to submittals containing at least one example of a sustainable project previously designed by the firm or the team, including an explanation of:

- Increased energy conservation and efficiency.
- Increased use of renewable energy resources.
- Application of daylighting strategies.
- Reduction or elimination of toxic and harmful substances.
- Efficiency in resource and materials utilization.
- Selection of materials based on life-cycle environmental impacts.
- Recycling of construction waste and building materials after demolition.

- Metered performance and post occupancy evaluation data.

2.0 Sustainable Design Charrettes

A "Sustainable Design Charrette" is a process advocated by the American Institute of Architects (AIA) in which a multi-disciplinary team works together to envision creative and varied design solutions for a building program with an emphasis upon long-term economic, social and environmental sustainability.

Typically, a Sustainable Design Charrette is a workshop held in a two day period. At the discretion of the **High-Performance Building Design Team**, the design team will consider holding one to two charrettes during the design phases of a new facility (during conceptual and/or schematic design). The charrette participants would operate as an "expanded design team", providing expertise and input to the core design team in an integrated fashion.

The Sustainable Design charrette participants is envisioned to include the **High Performance Building Design Team** from the Campus Sustainability Committee, facilities staff and faculty, contracted design and professional service firms, as well as outside expertise and other project stakeholders, such as the Colorado Springs Utilities.

Ideally, the initial charrette workshop would occur early in the facility planning process, helping to build interest, ideas, and understanding. When each member of an interactive design charrette is engaged and participating, the synergy typically assures that the whole becomes greater than the sum of its individual parts. A good sustainable facility is ultimately the result of community ideals and values expressed in a cultural and physical form; and a sustainable charrette provides an effective vehicle for this important community input.

3.0 Building HIGH PERFORMANCE Goals

Colorado College feels strongly that the likelihood of achieving a high performing and sustainable campus ethos is greatly increased with projects that are designed to meet quantitative performance targets. Without them, the concepts of sustainability are open to interpretation that may vary widely. There is plenty of evidence that simply telling the design team you want an energy efficient building doesn't guarantee the College will get one. To that end, Colorado College has spent considerable time researching benchmarks and discussing appropriate targets for its campus facilities. **The highest feasible facility energy use reduction goals will be attained based on each project's available funding, each building's optimum performance design potential, and each building infrastructure system's conditions, etc. Colorado College Facilities Services will provide the project design team with project specific high performance building design criteria to be used to develop the project design intent documentation**.

The College has achieved Net-Zero Energy/Net-Zero Carbon buildings and strives to maintain that level of building design performance whenever appropriate. The following table highlights the **minimum** construction performance targets for Colorado College:

Performance Goal	Goal Quantification
Total Energy Use	20 KBTU/SF/YR or less
Water Use – Building	2.4 Gal/Building SF/YR or less
Water Use – Irrigation	14 Gal/Turf SF/YR or less
Total Building Power	Not less than 0.95 lagging at the utility
Indoor Air Quality	700 PPM CO^2 or less during occupied hours
Artificial Lighting	0.30 W/SF or less
Lighting Levels	35 FC in classrooms

Note that the energy usage goal represents total building load including plug loads, not just HVAC and lighting. Predicted energy use shall be tracked during design using modeling and will be confirmed using utility billing data. Likewise the water usage goal represents both building use and irrigation. The appendix of these Sustainable Design Procedures contains information such as system parameters and occupancy schedule that would be needed to evaluate these goals.

4.0 THE SUSTAINABLE DESIGN PRODUCT: KEY FEATURES OF HIGH PERFORMANCE FACILITIES

This section addresses the question of what differentiates the **High Performance Design** *product* from a standard design product. That is, what features will characterize **HIGH PERFORMANCE FACILITIES**. The following features collectively represent a comprehensive, High Performance Facility:

1) Sustainable site planning and landscape design.
2) Use of renewable energy sources.
3) High quality and energy efficient lighting.
4) Flexible teaching spaces for accommodation of changing usage.
5) Ease of integration of technology changes and additions over time.
6) Energy efficient building shell.
7) Energy efficient HVAC systems.
8) Environmentally preferable, healthy building materials.
9) Water conservation.
10) Convenient Recycling and waste management accommodations.
11) Construction waste reduction and recycling requirements.
12) Commissioning to ensure high performance goals are achieved.
13) Eco-education as a laboratory demonstrating and teaching sustainability principles to students and faculty.
14) Design for Maintainability.
15) Design for low life-cycle operating costs.

As noted earlier, these guidelines do not necessarily reflect requirements for new facilities. Rather they illustrate possible features requiring development in further design detail during the design phases of the project.

4.1 Site Planning and Landscape Design

Site planning is critical to the success of a sustainable building. Careful planning, building orientation, and landscaping can, among other benefits, cut energy

consumption levels and monthly utility expenses considerably. Analysis of the site should consider all existing features both natural and human made, to determine the inherent qualities that give a site its personality. A topographical analysis of existing features is advised. Emphasis should be placed on the site's relationship to the larger environment and its special values. This analysis includes natural, cultural, and aesthetic factors that affect it.

The site should also be viewed as a valuable resource for education, not just a building site. At least eight features characterize a sustainable site:

1) Preserves existing bio-diversity and reduces site disturbances.
2) Low input after establishment (e.g., water, mowing, labor, fertilizers, etc.).
3) Relates to and is connected to the area's natural systems.
4) Uses green materials where possible.
5) Looks like it belongs in the bio-climatic region (automatically met if features 1-4 are attained).
6) Visible from the indoors.
7) Modulates heating and cooling of the building (e.g., wind buffers, shading).
8) Reinforces the health and welfare of the local community and economy and engages the community in its construction and use.

In site planning for the built environment, the designer must be aware that any structure will inevitably, by virtue of its physical presence and functioning, affect not only the site's ecosystem but others elsewhere. The structure's possible influence on surrounding ecosystems must be included as part of the set of design considerations. The well designed building site lets natural energy sources work for it, such as solar heating and natural cooling breezes.

When evaluating the site's natural features, outdoor views for building occupants should also be taken into consideration. While southern exposure is optimal for solar heat gain, diffuse light from other orientations contributes to the daylighting design and may offer scenic views for the building occupants to connect with the area's natural systems.

HIGH PERFORMANCE DESIGN APPENDIX

This Appendix includes tables that depict energy performance modeling parameters and results. The first table represents both the parameters that are specified by the College and those to be determined by the design team. The second table shows a table for the minimum information that is requested to report modeling results.

HIGH PERFORMANCE Design Guideline

Energy Performance Modeling Parameters

Characteristic	College Supplied Information	Design Team Information
Conditioned area (S.F.)		
Occupancy schedule for lighting and HVAC		
Occupied set points		
Unoccupied set points		
Occupancy		
Occupant sensible load		
Occupant latent load		
Plug load density		
Plug load schedule		
Weather Data		
Timing for electric system peak (MST)		
Envelope U-values		
Window/wall area ratio		
Glazing U-value		
Glazing shading coefficient		
Glazing visible		
Description of lighting strategies (daylighting and electric lighting)		
Description of HVAC strategies and		

Energy Performance Modeling Results

Minimum information for energy modeling and reporting modeling results. Provide data to complete table. Supplemental information may be provided.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Electric Energy (kWh)													
Peak Electric (kW)													
Natural Gas (Therms)													
Energy Cost ($)													

Colorado College Facility Life-Cycle Design Guidelines for Sustainability

A. Design Goals for Sustainability

The design team should follow the Colorado College Campus Master Plan guidelines and processes. The strategic program states that the college serves as a "model of environmental stewardship and innovation by advancing both the study and the practice of sustainability." The college strives to reflect innovation in the application and evolution of sustainability practices related both to the built environment and the management of College resources.

1. The President's signing of the American College and University President's Climate Commitment pledge in April 2009 included the goal of achieving carbon neutrality by 2020. Achieving carbon neutrality by 2020 requires a three strategy approach.
    a. The first strategy is to reduce building energy use by **20%** through conservation measures to include improved building systems scheduling, sustainability education and energy usage awareness, and encouraging behavioral changes throughout the college community.
    b. The second strategy is to reduce energy usage by **30%** through maintenance and renovation of building structures, electrical systems, mechanical systems to improve energy efficiency; and investment in technological improvements to reduce energy usage.
    c. The third strategy is to purchase or produce all electric energy through renewable energy sources and provide supplement heating through renewable energy technologies. The college plans to reduce its carbon footprint by **50%** through producing enough energy through renewable resources to offset the carbon footprint in other sectors such as the use of natural gas for heating and college related travel.

    Opportunities for achieving energy and water use reductions should be identified by design and engineering professionals in every construction or renovation project and considered for implementation based on life-cycle cost savings, impact on reaching carbon neutrality, and the importance of demonstrating social responsibility by supporting the college core values and taking a leadership role in nurturing the ethic of environmental sustainability.
2. The College's April 2009 signing of the President's Climate Commitment required initiation of tangible actions to reduce greenhouse gases. The College agreed to **"**establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent". **The College has established a High Performance Building Design Criteria program which exceeds the LEED Silver minimum prescribed requirements in order to meet its long range sustainability strategies for achieving carbon neutrality.**
3. New buildings, additions to existing buildings, or existing building renovations should minimize building life-cycle costs, direct and indirect, relating to energy use, maintenance, waste disposal and occupant health & productivity. Life-cycle costs should be based on a "whole-building perspective", rather than from the perspective of individual building systems or components.
4. Minimize environmental impacts throughout the building life-cycle, including product manufacturing, construction activity, use/occupancy, and demolition or renovation/reuse.
5. Purchasing of goods and services from manufacturers and vendors shall comply with the Colorado College Sustainable Purchasing Guidelines.
6. Optimize indoor environmental air quality.

B. Design Process

1. The Project Design Team is to evaluate sustainable design opportunities and strategies appropriate for project program, site and budget.

2. **Building performance design standards**: All new construction and renovation projects are to follow the Colorado College Facility Design Guidelines Manual, Colorado College Facility Design Guidelines , which contains expected **High Performance Building Design** requirements for new construction and renovations. The College's **High Performance Building Design Criteria** exceeding LEED prescriptive requirements, customized to meet Colorado College's sustainability goals, is to be used on all new building construction and existing building renovation projects over $1 million in cost**. The highest feasible facility energy use reduction goals will be attained based on each project's available funding, each building's optimum performance design potential, and each building infrastructure system's conditions, etc. Colorado College Facilities Services will provide the project design team with project specific high performance building design criteria to be used to develop the project design intent documentation**. The College has achieved Net-Zero Energy/Net-Zero Carbon buildings and strives to maintain that level of building design performance whenever appropriate. The following table highlights the **minimum** construction performance targets for Colorado College:

Performance Goal	Goal Quantification
Total Energy Use	20 KBTU/SF/YR or less
Water Use – Building	2.4 Gal/Building SF/YR or less
Water Use – Irrigation	14 Gal/Turf SF/YR or less
Total Building Power Factor	Not less than 0.95 lagging at the utility meter
Indoor Air Quality	700 PPM CO^2 or less during occupied hours
Artificial Lighting	0.30 W/SF or less
Lighting Levels	35 FC in classrooms

Note that the energy usage goal represents total building load including plug loads, not just HVAC and lighting. Predicted energy use shall be tracked during design using modeling and will be confirmed using utility billing data. Likewise the water usage goal represents both building use and irrigation.

3. Do not make project funding decisions based on first costs only. Evaluate life-cycle costs of design alternatives to reduce long term operating and maintenance costs of major building systems. **Life-cycle costs** should be based on a "**whole-building perspective**", rather than from the perspective of individual building systems or components.
4. Evaluate use of **renewable energy sources** for electric use or supplementing heating requirements to help reduce the carbon footprint and achieve the goal of carbon neutrality by 2020.
5. Use energy simulation/modeling software on projects greater than $1 million cost where feasible and within available funding resources.
6. Life-cycle cost saving strategies used should have **maximum payback period of 5-15 years**, or contribute significantly to the 30% reduction of energy use or carbon footprint goal by 2020.
7. Architectural/Engineering consultants are to include the above services in the Professional Services Agreement.
8. Architects and Engineers selected for the project should demonstrate proficiency and experience in sustainable design. Consultants with these qualifications should be included in the **earliest programming and conceptual design phases** to help identify and evaluate **high performance design** opportunities beyond the minimum LEED Silver certification feasibility, or feasibility of higher energy design standards attainability.

C. Design Guidelines

1. Energy Use
   a) Integrate Buildings with the Site: Consider local climate & site influences on building energy use. Utilize "free" energy sources where feasible, such as solar energy, daylight, exterior temperature variations and winds.

b) Optimize Energy Performance: Select building envelope, mechanical and electrical systems for improved energy efficiency. Where applicable, research products in order to meet Colorado Springs Utilities efficiency requirements for utility rebate savings. Typical strategies & technologies:
    1) Building Envelope
        - Control & utilization of solar heat gain
        - Daylighting of interior spaces
        - High performance windows/glazing
        - Energy efficient window coverings
        - Optimized insulation values
        - Reduced air infiltration
    2) Mechanical Systems
        - High efficiency equipment
        - Direct Digital Control System (DDC) for HVAC
        - Occupancy sensors/CO2 monitoring
        - Occupancy sensors
        - Heat recovery systems
        - Economizer cycle cooling
        - Zoning of HVAC system based on building orientations & loads
        - Variable speed drives on motors and fans
        - Low flow plumbing fixtures
        - Time of day scheduling
        - Separate controls for individual spaces, where feasible
    3) Electrical Systems
        - High efficiency lighting fixtures (no incandescent)
        - Occupancy sensors
        - Daylight sensors
        - Separate ambient and task lighting
        - Lighting dimmers
    4) Energy and Water Metering
        - Every building or energy and water using facility should have sub meters monitoring energy and water use. Where possible high energy or water consuming operations within buildings or facilities should be sub-metered locally to identify, monitor, and control energy and water use.

c) CFC/HCFC/Halon Reduction: Avoid use of these products in HVAC refrigerants and fire suppression systems.

d) Building Systems Commissioning
    1) All projects shall implement a Commissioning plan, with the scope to be determined by the project team.
    2) Key mechanical & electrical systems are to go through a Commissioning process, which includes the following:
        - Inspection & testing for functional performance in accordance with project objectives & the Colorado College Facility Design & Construction Guidelines.
        - Documentation of criteria, inspections/testing & acceptance.
        - Training of Colorado College operations & maintenance staff.

3. Water Use
    a) New low flow water devices are required for new construction by current building codes. Opportunities for achieving water-use reductions should be identified in the course of routine maintenance improvements and renovation projects. Older water faucets typically having flows of approximately 2.5 gpm and should be replaced with 1.5 gpm or .5 gpm flow devices depending on the applications. Older toilets have flush volumes of approximately 3.5 to 4.5 gpf and should be replaced with dual-flush toilets, or 1.6 gpf toilets, which tend to be equivalent to the dual-flush toilet flows on average.
4. Building Materials
    a) Recycled Content Materials: Use materials with post-consumer or post-industrial recycled content where feasible. Common products with recycled content include structural steel,

aluminum windows, gypsum board, acoustical ceiling tiles, rubber floor tiles, carpeting, and toilet partitions.

b) Durable & Flexible Materials: Utilize components and systems which are durable and easy to maintain. Where feasible, use materials which provide flexibility for future changes and modifications to occur.
c) Renewable Materials: Consider use of products that are comprised of raw materials that are in abundant supply or come from renewable sources. When feasible, obtain wood products from suppliers certified as utilizing sustainable harvesting methods.
d) Local Materials: Use products produced regionally where possible.
e) Construction Waste Management: Contractors are to develop a plan for sorting, storing & recycling of waste materials on projects. A waste minimization specification is to be used as guidance for this work. All projects shall implement a Construction Waste Minimization Plan, with the scope to be determined by the project team. A minimum of 50% of construction waste is to be salvaged, recycled or otherwise diverted from landfill or incineration.
f) Recycling Facilities: Plan for convenient areas to be designed in new buildings and building renovations for sorting & storage of recyclable items by the building occupants.

3. Indoor Environmental Quality
   a) Design for Human Health: Consider environmental needs of people in terms of daylight, ventilation, exterior views and thermal/acoustic/visual comfort for interior spaces. A direct line of sight to exterior vision glazing from 90% of all regularly occupied spaces is a long term goal.
   b) Ventilation Requirements: Optimize the amount of fresh air provided to building spaces. Connect occupancy sensors & carbon dioxide monitors to HVAC systems, where feasible.
   c) Low Emitting Materials: Utilize materials which have low levels of volatile organic compound off-gassing. Minimum requirements for 45% of materials (by cost):
      - Adhesives & sealants: VOC content less than established limits.
      - Paints & coatings: VOC emissions that do not exceed Green Seal's Standard GS-11.
      - Carpet: Comply with CRI Green Label Plus Testing program.
      - Carpet cushion: Comply with CRI Green Label Testing program.
      - Composite panels: No added urea formaldehyde resins.
   d) Construction Air Quality Management: Protect ductwork and equipment from contamination during construction. At a minimum:
      - During construction, comply with SMACNA IAQ Guideline for Occupied Buildings Under Construction, 1995, Chapter 3.
      - Protect stored on-site or installed absorptive materials from moisture damage.
      - If air handlers are used during construction, filtration media with a MERV value of 8 are to be used at each return grille, per ASHRAE 52.2-1999.
      - Replace all filtration media immediately prior to occupancy.
      - Conduct a 2 week building flush-out with new filtration media with 100% outside air after construction ends & prior to occupancy. After flush out, replace filtration media.

      or

      - Conduct a baseline indoor air quality testing procedure to demonstrate that concentration of air contaminants are below specified levels. Meet the testing requirements listed in LEED IEQ Credit 3.

4. Site Work
   a) Building Siting and Landscaping: Use the Colorado College Campus Master Plan design guidelines as a guide for design decisions.
   b) Minimize Site Disturbance: Consider the impact of project on the surrounding ecosystem. Investigate methods to minimize impacts on natural habitats and watersheds.
   c) Stormwater Management: Limit off site storm water runoff and employ methods to increase on-site infiltration.
   d) Alternative Transportation: Provide site facilities to encourage pedestrian, bicycle and bus transport, where feasible.
   e) Light Pollution Reduction: Minimize site lighting levels & off-site light spillover/ glare, while providing for adequate levels for security and way finding.

f) Water Efficient Landscaping: Utilize drought resistant plant materials and low flow irrigation techniques, where feasible. Consider use of native plant species.
g) Erosion & Sedimentation Control: Employ techniques such as silt fencing, sediment traps/filters, topsoil stockpiling and slope stabilization to minimize erosion of soil during construction. At a minimum, comply with EPA Document No. 832/R-92-005 (1992) Stormwater Management for Construction Activities, Chapter 3: Sedimentation & Erosion Control.

D. References

General

- US Green Building Council- LEED Green Building Rating System, www.usgbc.org.
- Colorado College Campus Master Plan
- Colorado College Facility Design Guidelines
- Colorado College Sustainable Purchasing Guidelines
- American College and University President's Climate Commitment
- CC Goal to Achieve Carbon Neutrality by 2020

Energy Use

- ASHRAE Standard 90.1-1999 Energy Standard for Buildings except Low Rise Residential Buildings US DOE/EPA Energy Star Guidelines.

Building Materials

- EPA Comprehensive Guide for Procurement of Products Containing Recovered Materials; Recovered Materials Advisory Notice III; Final rule (1/19/00) 40 CFR Part 247.
- Forest Stewardship Council Guidelines.
- Triangle J Council of Governments, "Waste Spec"- Model Specification for Construction Waste Reduction.
- Green Seal Paints and Coatings Requirements- Paints (GS-11), First Edition, 5/20/1993.
- Carpet and Rug Institute Green Label Indoor Air Quality Test Program.

Indoor Environmental Quality

- ASHRAE 62-1999: Ventilation for Acceptable Air Quality.
- ASHRAE Standard 55-1992, Addenda 1995- Thermal Environment Conditions for Human Occupancy, Including ANSI/ASHRAE Addendum 55a-1995.
- Sheet Metal & Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 1995.

Site Work

- EPA Storm water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
- IESNA Recommended Practice Manual: Lighting for Exterior Environments (RP-33-99).

Facility High Performance Design Criteria Checklist

I. Introduction

Energy efficiency, opportunities for high performance energy efficiency design goals and strategies must be given special consideration in the design of new or renovated college buildings **in order for the college to achieve its long term sustainability goals**.

The purpose of this **Facility High Performance Design Criteria Checklist** is to provide design consultants and the college design team with a guideline to assist in establishing and defining **mission-critical design criteria and design intent for new construction and renovation projects**. The College's **High Performance Building Design Criteria** exceeding LEED prescriptive requirements, customized to meet Colorado College's sustainability goals, is to be used on all new building construction and existing building renovation projects over $1 million in cost**. The highest feasible facility energy use reduction goals will be attained based on each project's available funding, each building's optimum performance design potential, and each building infrastructure system's conditions, etc. Colorado College Facilities Services will provide the project design team with project specific high performance building design criteria to be used to develop the project design intent documentation**. The College has achieved Net-Zero Energy/Net-Zero Carbon buildings and strives to maintain that level of building design performance whenever appropriate. The following table highlights the **minimum** construction performance targets for Colorado College:

Performance Goal	**Goal Quantification**
Total Energy Use	20 KBTU/SF/YR or less
Water Use – Building	2.4 Gal/Building SF/YR or less
Water Use – Irrigation	14 Gal/Turf SF/YR or less
Total Building Power Factor	Not less than 0.95 lagging at the utility meter
Indoor Air Quality	700 PPM CO^2 or less during occupied hours
Artificial Lighting	0.30 W/SF or less
Lighting Levels	35 FC in classrooms

Note that the energy usage goal represents total building load including plug loads, not just HVAC and lighting. Predicted energy use shall be tracked during design using modeling and will be confirmed using utility billing data. Likewise the water usage goal represents both building use and irrigation.

This **Facility High Performance Criteria Checklist** includes applicable sections and information from the **Advanced Buildings Core Performance Guide**, which is a prescriptive program to achieve significant, predictable energy savings in new commercial construction. The program is based on the results of extensive energy modeling protocol used to identify consistent strategies that lead to anticipated energy savings. This **Facility High Performance Criteria Checklist** includes guidelines from the **Advanced Buildings Core Performance Guide** for implementing improved design processes to foster design integration, thereby improving overall building performance opportunities. These strategies set the stage for additional whole building performance improvements beyond LEED certification requirements. **The United States Green Building Council (USGBC) LEED V4 Minimum Energy and Atmosphere requirement, Energy Performance Prerequisite, identifies three acceptable**

options for compliance, one which is the use of the Advanced Buildings Core Performance Guide for prescriptive compliance.

The college's high performance design goals **exceed the USGBC LEED V4 goal**, which requires achieving reductions of building energy use by **5% for new construction, 3% for renovations, and 2% for core & shell projects** compared to the ANSI/ASHRAE/IESNA Standard 90.1 baseline. While not actually seeking LEED certification, the college's aspiration of pursuing high performance design goals strives to steer the College in the direction of **making fundamentally sound business and environmental sustainable stewardship decisions for our projects.**

This Facility High Performance Design Criteria Checklist addresses those opportunities and strategies for high performance energy efficiencies which clearly contribute to reducing facilities energy use in excess of the ANSI/ASHRAE/IESNA Standard 90.1 baseline building performance rating and in excess of the local Pikes Peak Regional Building Department (PPRBD) Code and the International Energy Conservation (IECC) Code.

The design consultants and college design team are expected to use these general checklist criteria as a guideline to assist in identifying sustainable design opportunities and innovative strategies and concepts which achieve the greatest possible facility energy use reduction possible within a project's available funding for new construction and renovations, and within an existing building system's conditions capabilities for renovation projects. **However, this general criteria list does not preclude the design consultants and college design team from identifying other opportunities and innovative strategies and concepts for reducing facility energy use unique to each specific project.**

II. The Benefits of High Performance Buildings

High-performance buildings use less energy while providing a variety of environmental, economic, human resource, design and construction benefits, including:

☐**Reduced "Environmental Footprint."** High-performance facilities not only reduce energy use, fossil fuel dependence, environmental pollution, they also showcase a more environmentally benign use of materials and contribute positively to preserving the environment.

☐**Lower Operating Costs.** Energy efficiency, use of renewable energy, water conservation, design for ease of cleaning and maintenance and reduced waste streams all contribute to lower operating costs as well as improving the reliability of the building systems and reducing the long-term life-cycle costs of facility ownership.

☐**Improved Productivity and Learning Environment.** Studies have demonstrated a link between an educational facility's physical condition and student, faculty and staff morale and performance. Optimized lighting that combines controlled day-lighting and artificial lighting together with superior indoor air quality, contribute to student performance and higher faculty and staff satisfaction.

III. Criteria Category: Design Process Strategies

The criteria in this section from the **Advanced Buildings Core Performance Guide** describe desired steps for the design team to effectively implement the **Facility High Performance Design Criteria** program.

1. Identify Design Intent

Conduct a team meeting to identify key energy performance goals for the project, identify design strategies to achieve these goals, and to coordinate subsequent efforts among team members. Document the meeting summary/goals statement for use in subsequent steps to guide the design team in setting specific performance goals for the project.

2. Communicating Design Intent

Develop key information about project performance requirements to insure that design goals are translated forward through the design process. Project goals are converted into documentation incorporated into each phase to guide design, sequence of operation, specifications, bid submittals, construction, acceptance testing and building operation. All of the documentation must be developed in the design phase, updated as needed in each subsequent phase, and included in the final documentation package turned over to the college. A copy of the following documentation should be included in the operations and maintenance manual for the project:

A. Design Intent Meeting Summary Document

Complete this document before the end of the schematic design phase. Develop a written summary of the outcomes of the Design Intent meeting. This summary should be used to guide subsequent decisions on design features and performance Criteria throughout the course of the design process.

B. Operational Performance Requirements Document

This document identifies how the building is intended to operate. It should be developed as a narrative statement, before completion of the design development phase. The document should describe the following:

1) The operational performance goals, providing detailed explanation of the ideas, concepts and Criteria that the college defines as important.
2) A description of the Basis of Design of the systems including all information necessary to prepare a design to accomplish operational performance.
3) A description of how the design team has minimized energy consumption and demand by first reducing loads to a minimum then designing an appropriate mechanical system to meet those loads through a range of operating conditions.
4) A description of the Sequence of Operation of the systems and their interaction with other systems.
5) A description of the systems, including the capacities and anticipated efficiency of the equipment or systems.

6) A set of guidelines requiring that substitutions proposed in the construction process identify how the proposed substitution affects the operational parameters described above.

C. Acceptance Testing (or Commissioning Plan) Requirements Document

An acceptance testing (or commissioning plan scope) plan shall be prepared that specifies the process for meeting the college's project requirements. This document shall explain the process to be implemented to meet the requirements of the performance Criteria. The plan should be developed in the construction documents phase and included in the bid documentation as a project requirement. The document shall describe:

1) A process to verify proper coordination among systems and assemblies and between all contractors, subcontractors, vendors and manufacturers of furnished equipment and assemblies.
2) A list of key equipment to be tested and the construction phase in which testing is to occur.
3) A description of the testing requirements and the passing Criteria to be used to ensure proper equipment operation and control.
4) A list of test (or commissioning plan checklists) outcome documentation and forms necessary for review prior to final systems acceptance.

D. Construction Documents

1) The construction documents shall contain sufficient information to describe the envelope, including: air barrier; heating, ventilation, and air conditioning (HVAC); service hot water; lighting; electric power distribution systems; and system operational features and controls. All HVAC, lighting and electric power distribution system plans shall contain sufficient information to identify the system and equipment arrangements, system and equipment sizing, systems specifications, efficiency requirements and systems sequence(s) of operation.
2) The construction documents shall demonstrate that tabulation of the “building loads” used assumptions are consistent with the operational performance requirements and the statement of project goals and principles or document why different assumptions were used.
3) Specifications shall include narrative descriptions in each subsection that includes systems and equipment related to building energy performance. The narrative shall identify performance requirements for the equipment and systems and shall include a list of performance parameters that must be submitted with any proposed substitution request in the construction process.
4) The construction documents shall require the submittal of operation manuals and maintenance manuals as a condition of final acceptance, including a description of their format and content. **The operation manual shall provide all relevant information needed for day-to-day operation and management of each system. The maintenance manual shall describe equipment inventory and support the maintenance program.** The submittal of record drawings and control documents are a condition of final acceptance.

E. Requirements for Bid Submittals

1) **The construction documents shall include specific requirements for Bid Submittals and Change Requests generated by the contractor. These requirements shall ensure that Bid Submittals contain comparative energy performance information so they can be reviewed to assure conformance with the Construction Documents.** Changes shall be reviewed to assure they are consistent with the specific operational performance requirements and the statement of project goals and principles. "Or Equal" substitutions shall be shown to assure equal or better energy and indoor environmental performance when compared to the same element in the original construction document**. Proposed changes that do not demonstrate equivalent energy performance shall not be considered "Or Equal" substitutions.**

3. Building Configuration

Consider the implications of alternate building configurations (or modifications to existing building shell/envelope) to maximize opportunities for building energy performance, functionality and daylighting. Identify the pros and cons of several alternate building configurations using existing analysis tools, design consultants, reference material or other resources.

4. Mechanical System Design

Use project-specific load calculations based on ***High Performance Design*** requirements and part-load conditions to properly size mechanical equipment, rather than relying solely on generic rule-of-thumb sizing Criteria. **Ensure that the mechanical system is designed to minimize energy consumption and maximize occupant comfort throughout the range of operating conditions.** The design engineer shall document the following actions in the design process:

A. When sizing the heating and cooling equipment, perform load calculations using building shell and interior load assumptions that are consistent with the specific operational performance requirements and the statement of project goals and principles. Include accurate characterization of lighting, solar loads, glazing performance, occupancy and ventilation loads based on specific design characteristics of this project.
B. When sizing the fan and air distribution systems, document fan-sizing calculations with zone-by-zone load calculations. Perform calculations to determine critical path supply duct pressure loss. Compare fitting selections for the critical branch to minimize fan horsepower requirements. Utilize round or oval duct wherever feasible to lower leakage and reduce pressure loss, and avoid high-pressure duct systems where possible. Separate all fittings in medium and high-pressure duct work by several duct diameters to reduce system effects wherever feasible. Use relief fans in lieu of return fans where possible, and provide automatic dampers on exhaust in lieu of barometric dampers to reduce fan power and increase barometric relief.
C. Perform a second set of calculations using part-load conditions (maximum likely load and/or standard operating conditions). This includes using benchmark data, average daytime temperatures and non-peak solar gain, and other assumptions to define part-load conditions for the heating and cooling system. Include diversity factors for interior loads and other factors that will allow proper assessment of part-load operation.
D. Describe the system operation at these conditions and describe features of the design that will facilitate efficient operation at these part-load conditions. Document

in design intent manual how the system will deliver ventilation air, maintain comfort in accordance with ASHRAE Standard 55 and operate in an energy- efficient manner.

The design practices described above will lead to installed system capacities that more closely match actual building loads. This reduces installed excess system capacity, reducing equipment first costs. *By* sizing the system more closely to the actual building loads, the system operating characteristics more closely match the efficiency curves and performance characteristics anticipated in manufacturer data. This increases operating efficiency, reduces operating costs, and extends equipment service life. Additional savings can be achieved *by* adopting the adaptive comfort standards described in ASHRAE Standard 55.

5. Operator Training & Documentation

Ensure that the building operations team understands how the building is intended to operate and has the resources to monitor and understand building operational characteristics. Collect a full set of construction documents and specifications, systems manuals, maintenance and calibration requirements, control protocols, etc. for use by the building operations and maintenance team. **Conduct an operator training session to make sure the building operators understand the systems and operation of the building. Information should be collected in a set of manuals designed to facilitate building operation and future communication of this information to new operating staff.** Consult with the college Facilities Services Department to identify the best way to collect, store and distribute this information.

A. Complete an Operator Training program and provide full documentation of building characteristics, equipment, operation, control, maintenance and monitoring protocols. Verify that the following steps were taken before occupancy:

    1) Operator training was performed by the building construction and design team.
    2) Systems manuals and a full set of design and installation documents were delivered and accepted by the building operations team.
    3) Appropriate maintenance schedules and calibration requirements were included in the operations manual.
    4) Information is developed and provided describing building user interface with lighting, ventilation and temperature controls.
    5) Control and data collection protocols were set up and understood by the building operations team.

B. Building specific information should be gathered and turned over to the building operations team. This information should not be limited to manufacturer information about installed equipment but should also include descriptions of system operation and maintenance procedures and a full set of design documents. A narrative describing design intent and building operation protocols should be included, with information about control system operation. Maintenance schedules and part reordering information should also be included. All of this information should be well organized and tabbed, so that building operators can use the manuals as a reference. Consider video recording the training for future reference.

CORE PERFORMANCE
2012 IECC SUPPLEMENT

Advanced Buildings
CORE PERFORMANCE

Core Performance 2012 IECC Supplement

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Table of Contents

2012 Supplement Requirements

Introduction to the 2012 Supplement

During development of the 2012 version of the International Energy Conservation Code (IECC), a partnership of the AIA, DOE and NBI submitted a comprehensive proposal to update the IECC based largely on the provisions of NBI's *Core Performance Guide*. That proposal went through a public review and revision process that updated the original Core Performance provisions to create the proposal that was ultimately accepted for the 2012 IECC. This process was used in turn to revise the *Core Performance Guide* (Version 1.1) and bring it up to a level of efficiency on par with what was ultimately adopted in the 2012 IECC.

The *Core Performance 2012 Supplement* is a drop-in replacement for Section 2 of the *Core Performance Guide* that fully aligns the *Core Performance Guide* with the requirements of the 2012 IECC. Although Version 1.1 of the *Core Performance Guide* reaches the same basic level of stringency as IECC 2012, it is not exactly the same level, nor are the requirements in the same format. This allows the *Guide* to be used as guidance for projects seeking compliance with IECC 2012, either as a base code, stretch code or utility program. While the *2012 Supplement* contains many of the code requirements of the IECC, it does not contain all of the 2012 IECC code requirements and is not a replacement for the language in code books. It complements the code language with narrative that gives guidance on how to meet the requirements of the 2012 IECC.

HOW TO USE THE 2012 SUPPLEMENT

The *Core Performance Guide* is comprised of three sections. Section 1 provides guidance for the design process. Section 2 provides the "Core" building requirements of Core Performance. Section 3 provides Enhanced Measures for even higher performance. The *2012 Supplement* is intended for use with version 1.1 of the *Core Performance Guide* as a drop-in replacement for Section 2. This new section provides guidance for meeting the principal requirements of 2012 IECC and is used as a complete replacement for Section 2. Projects still use the existing measures of Section 1 to help guide the design process and can use the Enhanced Measures in Section 3 for higher levels of performance.

Each measure in the *2012 Supplement* includes new elements that describe the relationships between the Supplement, the 2012 IECC code and the rest of the *Core Performance Guide*. Each measure begins with "signposts" that identify which IECC code section the measure addresses, which building types in which climate zones must comply, and related enhanced measures or enhanced approaches from either Core Performance or the 2012 IECC. When a measure contains special conditions, requirements or exceptions, these are identified and described in the adjacent inset boxes.

SECTION THREE AND THE REDUCED SET OF ENHANCED MEASURES

A handful of Enhanced Measures from Core Performance are included in whole or in part in the 2012 IECC. The table below lists the Enhanced Measures that *cannot* be used when the *2012 Supplement* is being used, or can only be used in a limited way.

SECTION	DESCRIPTION
3.1 COOL ROOFS	Cannot be used with the 2012 Supplement
3.2 DAYLIGHTING AND CONTROLS	Can only be used in spaces and conditions not required in the 2012 Supplement
3.3 ADDITIONAL LIGHTING POWER REDUCTIONS	Cannot be used with the 2012 Supplement
3.7 HEAT RECOVERY	Cannot be used with the 2012 Supplement
3.9 PREMIUM ECONOMIZER PERFORMANCE	Provides additional guidance beyond 2012 Supplement
3.12 ON-SITE SUPPLY OF RENEWABLE ENERGY	Can only be used for projects that do not pursue the Renewable Energy option in S.15 of the 2012 Supplement
3.14 FAULT DETECTION AND DIAGNOSTICS	Provides additional guidance beyond 2012 Supplement

S.1 Energy Code Compliance

2012 IECC CORRESPONDENCE: SCOPE - SECTION C401
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: NOT APPLICABLE

PURPOSE

Define minimum level of acceptable performance for measures not specified in *Core Performance – 2012 IECC Supplement.*

CRITERIA

All buildings shall meet or exceed applicable state and local energy codes. Where state and local codes are not as stringent as 2009 International Energy Conservation Code (IECC) or ASHRAE 90.1-2007 requirements, features of building elements not described in *Core Performance – 2012 IECC Supplement* shall meet or exceed the 2009 IECC.

For additional references and information about this measure, visit **www.advancedbuildings.net/refmaterials.htm**.

Photo courtesy of DOE\NREL.

LEED Relationship

SS	
WE	
EA	prereq 2
MR	
EQ	

S.2 Air Barrier Performance

2012 IECC CORRESPONDENCE: SECTION C402.4
2012 IECC REQUIREMENT: CLIMATE ZONES 4 -8

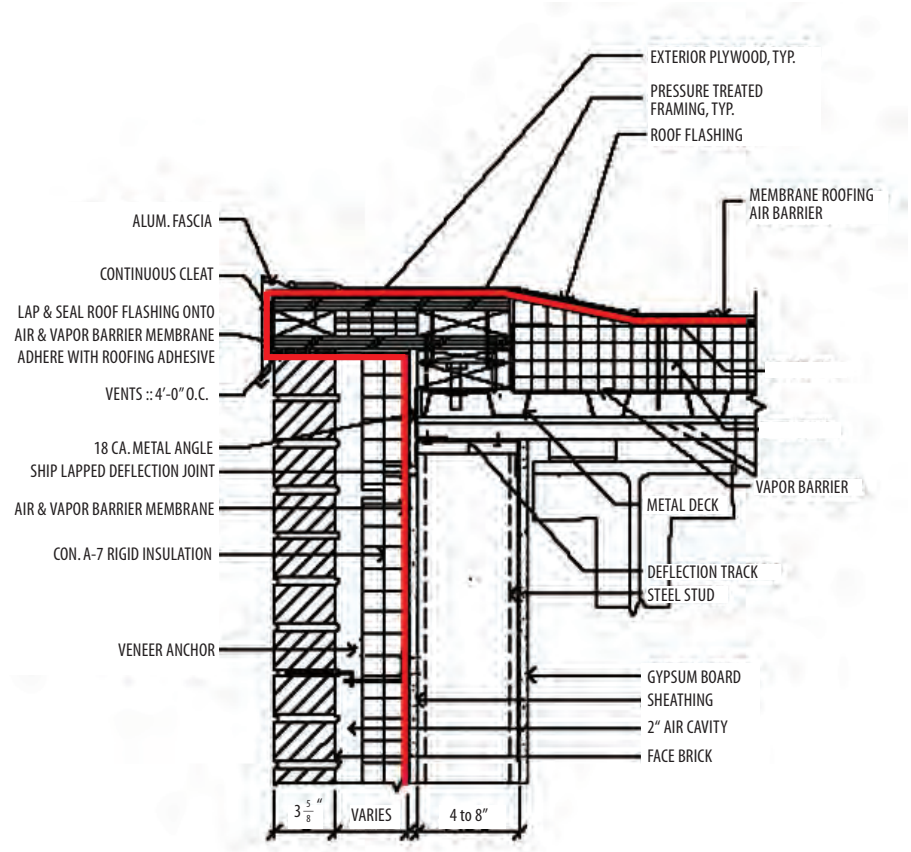
ENHANCED STRATEGY: COMPLETE SECTION C402.4.1.2.3 - BUILDING TEST

PURPOSE

Reduce uncontrolled air movement through the building envelope.

CRITERIA

The building envelope shall be designed and constructed with a continuous air barrier system to control air leakage into or out of the conditioned space. An air barrier shall also be provided for interior separations between conditioned spaces designed to maintain ambient temperatures or humidities that differ by more than 50%. The air barrier system shall have the following characteristics:



DETAIL AT ROOF EDGE

REFERENCE DETAIL: REGISTERED PROFESSIONAL TO REVIEW PRIOR TO USE

Attention to detail is critical at all joints and penetrations to assure a complete air barrier.
Detail: Courtesy of the state of Massachusetts and Wagdy Anis, FAIA.

- It must be continuous, with all joints made airtight.
- Materials used for the air barrier system shall have an air permeability not to exceed 0.004 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/s.m^2 @ 75 Pa) when tested in accordance with ASTM E 2178. The following materials can be assumed to meet this standard when installed according to the manufacturer's instructions:
  1. Plywood - minimum ⅜ in (10 mm)
  2. Oriented strand board - minimum ⅜ in (10 mm)
  3. Extruded polystyrene insulation board - minimum ½ in (12 mm) in thickness
  4. Foil-back urethane insulation board - minimum ½ in (12 mm) in thickness
  5. Exterior or interior gypsum board - minimum ½ in (12 mm) in thickness
  6. Cement board - minimum ½ in (12 mm)
  7. Built-up roofing membrane
  8. Modified bituminous roof membrane
  9. Fully adhered single-ply roof membrane
  10. A Portland cement/sand parge, or gypsum plaster minimum ⅝ in (16 mm) thick
  11. Cast-in-place and precast concrete
  12. Fully grouted concrete block masonry
  13. Sheet steel or aluminum
  14. Closed-cell spray foam a minimum density of 1.5 pcf (2.4 kg/m^3) no less than 1-½ inches (36 mm) in thickness.
  15. Open-cell spray foam with a density between 0.4 and 1.5 pcf (0.6 and 2.4 kg/m^3) no less than 4-½ inches (140 76 mm) in thick

ENHANCED STRATEGY

In lieu of the materials qualification list, the completed building may be tested for an air leakage rate of the building envelope not to exceed 2.0 L/s•m^2 @ 75 Pa (0.40 cfm/ft^2 at a pressure differential of 0.3" w.g. [1.57 psf]) in accordance with ASTM E779.

The air barrier shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement and shall transfer the load to the structure. It shall not displace adjacent materials under full load.

- It shall be durable or maintainable. Air barrier joints and seams shall be sealed, including sealing transitions in places and changes in materials. Penetrations of the air barrier and paths of air leakage shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction materials and location. Joints and seals shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials shall be appropriate to the construction materials being sealed. Joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
- Verify that the sequence of construction allows for installation of a continuous air barrier and thorough sealing of all joints and penetrations.

- All ducts in unconditioned spaces should be sealed at joints with mastic. (See code Section C407.2.7.)
- Connections between the following components shall be made with caulk, mastic, gaskets or other appropriate sealants:
  - Foundation and walls
  - Walls and windows or doors
  - Different wall systems
  - Wall and roof
  - Wall and roof over unconditioned space
  - Walls, floor and roof across construction, control and expansion joints
  - Walls, floors and roof to utility, pipe and duct penetrations

Also see fenestration infiltration requirements in Section S.6; Fenestration Area and Performance.

S.3 Minimum IAQ Performance

2012 IECC CORRESPONDENCE: NONE
2012 IECC REQUIREMENT: NONE

PURPOSE

Provide building occupants with acceptable indoor air quality.

CRITERIA

Design and operate the building to meet or exceed ASHRAE Standard 62-2004. This includes:

- Design and implement an ASHRAE Standard 62-compliant outdoor air control technique.
- Develop and implement an IAQ Construction Management Plan to control contaminants and dust during construction.
- Flush the building with 100% of the scheduled quantity of outdoor air prior to occupancy and after the punch list is complete.
- Develop and implement an IAQ Operations Management Plan for building operation.

Maintaining outside air volumes is more straightforward in constant volume systems than in VAV systems Additional information about OA control options for VAV systems can be found at www.advancedbuildings.net.

Clackamas High School, Oregon. **Photo by Michael Mathers**

S.4 Cool Roofs

2012 IECC CORRESPONDENCE: SECTION C402.2.2.1.1
2012 IECC REQUIREMENT: CLIMATE ZONES 1-3

ENHANCED STRATEGY: NOT APPLICABLE

PURPOSE

Promote the installation of roof surfaces that reduce the urban "heat island" effect, reduce energy use and provide other environmental benefits. Cool roofs not only have a positive effect by reducing building loads, they also reduce the heat island impact of the building on its surroundings.

CRITERIA

On low-slope roofs (2:12 or less) above cooled conditioned spaces, install a Cool Roof that meets one of four specification options below. The options may be applied on an area-weighted basis.

1. Three-year aged solar reflectance of 0.55 and a three-year thermal emittance of 0.75
2. An initial solar reflectance of 0.70 and initial thermal emittance of 0.75.
3. A three-year solar reflectance index of 64.
4. An initial solar reflectance index of 82.

For additional references and information about this measure, visit **www.advancedbuildings.net/refmaterials.htm**.

Cool roofs not only have a positive effect by reducing building loads, they also reduce the "heat island" impact of the building on its surroundings.

EXCEPTIONS AND SPECIAL CONDITIONS

ROOF AREAS EXEMPTED FROM COOL ROOF REQUIREMENTS

1. Areas that have roof gardens or landscaped roofs.
2. Areas covered by solar electric or solar thermal systems.
3. Areas covered by walkways, skylights, equipment or other building components.
4. Portions of roofs that are ballasted.
5. Portions of roofs shaded from the direct sun on the summer solstice by permanent features of the building or an adjacent building.

LEED Relationship

SS credit 7.2
WE
EA
MR
EQ

S.5 Opaque Envelope Performance

2012 IECC CORRESPONDENCE: SECTION C402.2
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: NOT APPLICABLE

PURPOSE

Reduce environmental impacts and increased operational costs associated with thermal conductance through the building envelope.

Decoupling the slab-on-grade or below-grade masonry from the ground reduces the potential for condensation on those surfaces.

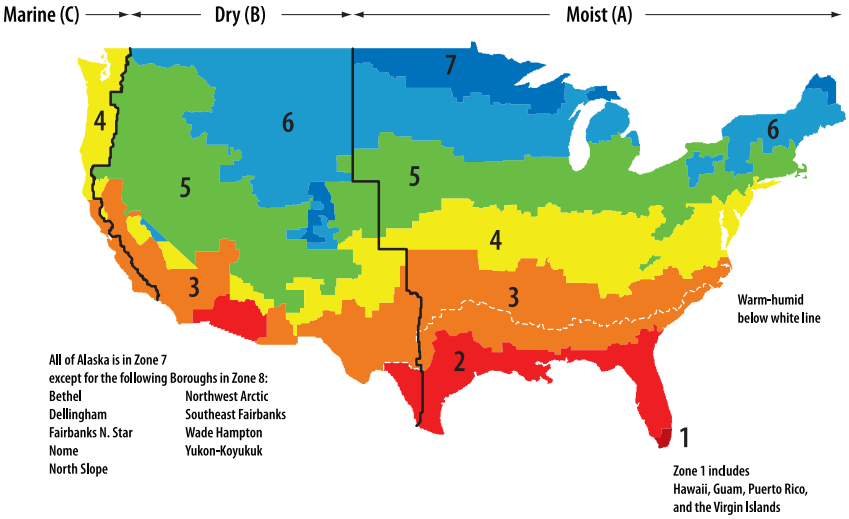
CRITERIA

Walls, roof assemblies, floors and slabs-on-grade which are part of the building envelope for buildings where the window and glazed door area is not greater than 30% of the gross area of above-grade walls shall meet the Criteria shown in Table C402.2.

The U-factors within fenestration product categories (e.g. vertical windows) can be calculated by an area-weighted average to achieve compliance with the values in Table C402.2. COMcheck and other software tools can be used for this averaging.

Buildings with window and glazed area greater than 30% of gross wall area and not meeting the daylighting zone exception (described in Section S.6) must demonstrate achievement of equivalent energy performance with energy modeling. Energy modeling requirements are described in Section Four.

The climate map below indicates which zone designation should be used in determining envelope and fenestration performance requirements. A more detailed version of this map is located in Appendix B.



Slab-on-grade floors and below-grade floors and walls shall be isolated from ground temperatures with a minimum layer of insulation according to Table C402.2. Where a heated slab is below grade, the below-grade walls shall comply with the exterior insulation requirements for the heated slab.

- Motorized dampers are required in stairway and shaft vents. They must be capable of automatically opening in response to a power loss or a fire alarm signal. With some exceptions in Section C402.4.5.2, motorized dampers must also be provided for outdoor intakes and exhausts.
- Vestibules are required for most public entrances to building spaces greater than 3,000 square feet, except for buildings in Climate Zones 1 and 2.
- Recessed luminaires with air leakage to unconditioned spaces require sealing with a gasket and caulk and require a labeled air leakage rate of not more than 2.0 cfm.
- Loading dock doors and cargo doors must be weather sealed to restrict infiltration when vehicles are parked at the doorway.

TABLE C402.2 – OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

CLIMATE ZONE	1	2	3	4 (EXCEPT MARINE)	5 (AND MARINE 4)	6	7	8
ROOFS								
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-30ci	R-35ci	R-35ci
Metal Buildings (with R-5 thermal blocks)[a, b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and Other	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49
WALLS, ABOVE GRADE								
Mass	R-5.7ci	R-5.7ci	R-7.6ci	R-9.5ci	R-11.4ci	R-13.3ci	R-15.2ci	R-25ci
Metal Building	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci
Metal Framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood Framed and Other	R-13 + R-3.8 ci or R-20	R-13 + R-3.8 ci or R-20	R-13 + R-3.8 ci or R-20	R-13 + R-3.8 ci or R-20	R-13 + R-3.8 ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci
WALLS, BELOW GRADE								
Below-grade wall[d]	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-10ci
FLOORS								
Mass	NR	R-6.3ci	R-10ci	R-10ci	R-10ci	R-12.5ci	R-15ci	R-15ci
Joist/Framing	NR	R-30	R-30	R-30	R-30	R-30	R-30[e]	R-30[e]
SLAB-ON-GRADE FLOORS								
Unheated Slabs	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below
Heated Slabs[d]	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-20 for 24" below	R-20 for 48" below
OPAQUE DOORS								
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or Sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. | ci = Continuous insulation. | NR = No requirement. | LS = Linear System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.

a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.
c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-f^2 °F.
d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
e. Steel floor joist systems shall be insulated to R-38.

S.6 Fenestration Area and Performance

2012 IECC CORRESPONDENCE: SECTION C402.3
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: NOT APPLICABLE

CRITERIA

FENESTRATION INFILTRATION REQUIREMENTS - All fenestration assemblies must meet the air leakage requirements of Section C402.4.3 unless the building is pressure tested to meet the overall air leakage requirements in Section C401.4.1.2. Table C402.4.3 provides the infiltration rates and test procedures that must be met for each category of fenestrations.

Field-fabricated fenestration assemblies only need to meet the construction methods and sealing requirements listed for the air barrier construction in Section 402.4.1.1. "Field-fabricated" is defined by the IECC as constructed from standard dimensional lumber and other materials not formed with the intention to be used as fenestration product. "Site-built" fenestration (e.g. storefront windows, curtain walls, etc.) do not qualify as field-fabricated. Site built assemblies must meet whole-unit (frame+glass) performance values.

VERTICAL FENESTRATION - Vertical glazed systems which are part of the envelope for buildings where the window and glazed door area is not greater than 30% of the area of above-grade walls shall meet the criteria in Table C402.3. Each vertical fenestration system must meet the U-Factor and SHGC for the corresponding climate zone.

INCREASED VERTICAL FENESTRATION SHGC - Based on the calculated Projection Factors (the Projection Factor is determined by an equation in Section C402.3.3) and the orientation of the fenestration, the SHGC may be increased by the multipliers in Table C402.3.3.1. In addition, the SHGC of clerestory glazing (defined as glazing entirely located 6 feet or higher above the floor) may be increased to 0.40 in Climate Zones 1, 2 and 3.

SKYLIGHTS - Skylights which are part of the envelope for buildings where the skylight area is not greater than 3% of the roof area shall meet the criteria in Table C402.3. Each skylight system must meet both the U-Factor and SHGC for the corresponding climate zone.

INCREASED SKYLIGHT FENESTRATION SHGC - If a skylight is placed over a daylight zone equipped with automatic controls, the SHGC is permitted an increase in SHGC to 0.60.

U-FACTOR AVERAGING – The U-Factors within each fenestration category in Table C402.3 may be averaged based on the area-weighted average of all fenestration units within that category. SHGC may not be averaged. If averaging is used, the average must meet the applicable fenestration U-factors in Table C 402.3.

PRESCRIPTIVE PATHWAY TO INCREASE GLAZING AREA ALLOWANCES - The maximum amount of vertical fenestration may be increased in some climate zones to a 40% Window-to-Wall Ratio (WWR) if a minimum number of automatically controlled daylight zones are be provided in the building. In order to qualify for up to a 40% WWR in Climate Zones 1-6 only, at least 50% of the conditioned floor area of the building must be in daylight zones.

TABLE C402.4.3 - MAXIMUM AIR INFILTRATION RATE FOR FENESTRATION ASSEMBLIES

FENESTRATION ASSEMBLY	MAXIMUM RATE (CFM/FT²)	TEST PROCEDURE
WINDOWS	0.20[a]	AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400
SLIDING DOORS	0.20[a]	
SWINGING DOORS	0.20[a]	
SKYLIGHTS - WITH CONDENSATION WEEPAGE OPENINGS	0.30	
SKYLIGHTS - ALL OTHER	0.20[a]	
CURTAIN WALLS	0.06	NFRC 400 or ASTM E 283 at 1.57 psf (75 Pa)
STOREFRONT GLAZING	0.06	
COMMERCIAL GLAZED SWINGING ENTRANCE DOORS	1.00	
REVOLVING DOORS	1.00	
GARAGE DOORS	0.40	ANSI/DASMA 105, NFRC 400, or ASTM E 283 at 1.57 psf (75 Pa)
ROLLING DOORS	1.00	

For SI: 1 cubic food per minute = 0.47L/s, 1 square foot = 0.093 m².

a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 at 6.24 psf (300 Pa).

TABLE C402.3 – BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 (EXCEPT MARINE)	5 (AND MARINE 4)	6	7	8
VERTICAL FENESTRATION								
***U*-FACTOR**								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SKYLIGHTS								
***U*-FACTOR**	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

TABLE C402.3.3.1 - SHGC ADJUSTMENT MULTIPLIERS

PROJECTION FACTOR	ORIENTED WITHIN 45 DEGREES OF TRUE NORTH	ALL OTHER ORIENTATION
$0.2 \leq PF < 0.5$	1.1	1.2
$PF \leq 0.5$	1.2	1.6

All these daylight zones must be provided with separately installed automatic daylighting controls. In addition, the visible transmittance of the glazing for these daylight zones must be at least 1.1 times the SHGC.

One requirement must be met to increase the skylight-to-roof ratio (SRR) from 3% to 5%: automatic daylight controls must be installed in the daylight zones under all skylights.

Buildings where windows and glazed doors exceed the base 30% WWR, or 40% WWR if the daylighting exception is met, must conduct energy modeling to demonstrate equivalent performance. Buildings where skylights exceed the base 3% SRR, or the 5% SRR exception, must also follow the modeling compliance path.

EXCEPTIONS AND SPECIAL CONDITIONS

CALCULATING THE AREA OF A DAYLIGHT ZONE: A daylight zone adjacent to vertical fenestration is defined in the IECC to be 15 feet deep and 2 feet on each side of a vertical window. A daylight zone under a skylight is defined as the ceiling-to-floor height added in each dimension to the skylight dimension. Daylight zones may not overlap (be "double-counted") and must stop when a ceiling height opaque partition is reached.

S.7 Lighting Controls

2012 IECC CORRESPONDENCE: SECTION C405.2
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: NOT APPLICABLE

PURPOSE

To reduce lighting energy use through the installation of automatic lighting controls and adjustable lighting level strategies.

CRITERIA

1. **BI-LEVEL SWITCHING –** All areas of the building with manual lighting controls, except those exempted, must have bi-level controls. Bi-level switching should be achieved by one or more of the following:
   1. Step control of all lamps and luminaires
   2. Dual switching of alternate rows of luninaires, alternate luminaires or alternate lamps
   3. Switching the middle lamp luminaires independently of the outer lamps
   4. Switching each lamp or each luminaire

EXCEPTIONS AND SPECIAL CONDITIONS

THE FOLLOWING AREAS ARE EXEMPTED FROM BI-LEVEL SWITCHING:

1. Areas with only one luminaire
2. Areas with rated power less than 100 watts
3. Areas controlled by an occupant-sensing device
4. Corridors, storerooms, restrooms, or public lobbies, electrical or mechanical rooms
5. Sleeping unit (see Section 505.2.3)
6. Spaces that use less than 0.6 watts per square foot (6.5 W/m^2)
7. Daylight zones equipped with Automatic Daylighting Controls

2. **SPECIFIC APPLICATION CONTROLS**
   The 2012 IECC identifies several specific applications that must meet special control requirements.

   - Display lights, case lights, and accent lights must have a control that is independent of all other dedicated general room controls.
   - Sleeping units in hotels and motels must have a master device at the room entry that controls all installed lights and switched receptacles.
   - Supplemental task lighting and cabinet-mounted lighting must have either a switch integral to the fixture or a readily accessible wall switch.
   - Additional control requirements apply to lighting for plant growth, food warming, fixtures for sale and lamps for sale.

3. ADDITIONAL (AUTOMATIC) LIGHTING CONTROLS

Automatic lighting controls must be installed throughout the building to reduce lighting energy use. Each class of automatic controls (time switch devices, occupancy sensors, automatic daylight zone controls) may be required or be optional as specified below. Complete lists of requirements and exceptions are found in 2012 IECC, Section C405.2.

EXCEPTIONS AND SPECIAL CONDITIONS

THE FOLLOWING AREAS ARE EXEMPTED FROM THE REQUIREMENTS FOR ADDITIONAL LIGHTING CONTROLS.

1. Sleeping Units
2. Lighting in spaces where patient care is directly provided
3. Spaces where an automatic shutoff would endanger occupant safety or security

A - AUTOMATIC TIME SWITCH CONTROLS

Automatic Time Switch controls shall be installed to control lighting in all areas of the building that are not exempted.

EXCEPTIONS AND SPECIAL CONDITIONS

THE FOLLOWING AREAS ARE EXEMPTED FROM AUTOMATIC TIME SWITCH CONTROLS

1. Emergency egress lighting. (The limit on emergency egress lighting is 15% of total connected lighting load.)
2. Lighting in spaces controlled by occupancy sensor

Automatic time switch control devices shall include an **override switching device** located in a readily accessible location. The lights controlled by the override switch must be visible from the switch and be manually controlled by the override switch. Operation of the switch shall permit the controlled lights to remain on for no longer than 2 hours. Any individual override switch shall not control more than 5,000 square feet of floor space.

In malls, arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the time limit on the override switch shall be permitted to exceed 2 hours provided the override switch is a captive key device; and the area controlled by the override switch shall be permitted to control up to 20,000 square feet (1,860 m^2) of floor space.

B – OCCUPANCY SENSORS

Occupancy Sensors shall be installed to control lighting in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 square feet or less enclosed by ceiling-height partitions.

These automatic control devices shall be installed to automatically turn off lights within 30 minutes of the last occupant leaving the space. The control device should switch on the lights to no more than 50% power, or be manually switched on. Automatic-on to full power is permitted in corridors and other high-use areas or where safety or security are of concern.

Occupancy sensors may be appropriate in additional space types and should be evaluated on a case-by-case basis. For instance, open office areas can be served by ceiling-mounted occupancy sensors in many cases.

C - AUTOMATIC DAYLIGHT CONTROLS

There are three portions of the 2012 IECC that require the installation of automatic daylight controls.

1. In large "high-bay" areas (this "special condition" is described in the box below)
2. When the window-to-wall ratio falls between 30% and 40% or the and skylight-roof ratio falls between 3% and 5%
3. When the optional reduced LPD packages are chosen for offices, retail and warehouses in Section C406.3

When automatic daylight controls are required by the 2012 IECC, they must meet the specifications listed below. Automatic daylight controls are not required in other daylight zone applications but are highly recommended when appropriate.

EXCEPTIONS AND SPECIAL CONDITIONS

REQUIREMENTS FOR MINIMUM DAYLIT AREAS AND AUTOMATIC CONTROLS IN 'HIGH-BAY' AREAS

In Climate Zones 1-5, most spaces greater than 10,000 square feet, with a ceiling height of 15 feet or greater, and directly under a roof require that skylights be installed such that 50% or more of the floor area is within a daylight zone and controlled by multi-level lighting controls. The multi-level control must respond to daylight and meet general lighting requirements by reducing the lights to no more than 35% of its rated power.

Where automatic daylight controls are installed, they shall meet the following specifications:

- Control the lights in the daylit areas separately from the non-daylit areas.
- Automatically reduce electrical lighting power in response to available daylight in a daylit area by either:
  - Continuous dimming using a combination of dimming ballasts and daylight-sensing automatic controls capable of automatically reducing the power of general lighting in the daylit zone continuously to less than 35% of rated power at maximum light output.

- ☐ Stepped dimming using a combination of multi-level switching and daylight-sensing controls capable of reducing the lighting power automatically. The system should provide at least two control channels per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 50-70% of rated power and another control step shall reduce lighting power by 65-100%. This control shall be capable of automatically reducing the general lighting in the daylit area in multiple steps in response to available daylight while maintaining a reasonably uniform and appropriate level of illuminance.

S.8 Lighting Power Density – Interior and Exterior

2012 IECC CORRESPONDENCE: SECTION C405.5 AND C405.6
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: NOT APPLICABLE

PURPOSE

Reduce environmental impacts and increased operational costs associated with the energy consumption of lighting systems.

CRITERIA

Installed lighting power density (LPD) shall not exceed the lighting equipment power density (LPD) allowances as shown in Table C405.5.2(1) and Table C405.5.2(2) . Using the Building Area Method, the LPD of each area of the building must be less than or equal to the LPD listed in the Building Area Method Table C405.5.2(1). An "area" for this purpose is defined as all contiguous areas of a building associated with the types listed in the tables below.

Alternately, using the Space-by-Space Method, the total connected LPD for the whole building may not exceed the sum of the area of each space times the maximum LPD listed for that space in the Space-by-Space Method Table C405.5.2(2). A "space" for this purpose is defined as all contiguous areas of a building associated with the types listed in the tables below. If the Space-by-Space Method is used for compliance, trade-offs are permitted between spaces.

CALCULATING THE INSTALLED LIGHTING POWER DENSITY – The rules for calculating LPD are found in Sections C 405.5.1.1 through C405.5.1.4. Screw lamp holders are calculated at the **maximum labeled wattage.** Wattage for low-voltage lighting is calculated as the **rated wattage** of the supplying transformer.

EXCEPTIONS AND SPECIAL CONDITIONS

EXEMPTIONS FROM THE LIGHTING POWER CALCULATIONS:

Types of lighting equipment exempted from the LPD calculation:

- Lights in hotel/motel sleeping units
- Task lighting for medical/dental purposes
- Furniture-mounted task lighting controlled by an automatic shutoff
- Displays for museums and galleries
- Many other exceptions are found in **Section C405.5.1.**

TABLE C405.5.2(1) - INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (W/SF^2)
Automotive Facility	0.9
Convention Center	1.2
Courthouse	1.2
Dining: bar lounge/leisure	1.3
Dining: cafeteria/fast food	1.4
Dining: family	1.6
Dormitory	1.0
Exercise center	1.0
Fire Station	0.8
Gymnasium	1.1
Health Care Clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion picture theater	1.2
Multifamily	0.7
Museum	1.1
Office	0.9
Parking garage	0.3
Penetentiary	1.0
Performance Arts Theater	1.6
Police Station	1.0
Post office	1.1
Religious building	1.3
Retail	1.4
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.6
Workshop	1.4

TABLE C405.5.2(2) - INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE-BY-SPACE TYPES	LPD (W/FT^2)
Atrium - First 40 feet in height	0.03 per ft. ht.
Atrium - Above 40 feet in height	0.02 per ft. ht.
Audience/seating area - permanent	
For auditorium	0.90
For performing arts theater	2.60
For motion picture theater	1.20
Classroom/lecture/training	1.30
Conference/meeting/multipurpose	1.20
Corridor/transition	0.70
Dining area	
Bar/lounge/leisure dining	1.40
Family dining area	1.40
Dressing/fitting room performing arts theater	1.10
Electrical/mechanical	1.10
Food preparation	1.20
Laboratory for classrooms	1.30
Laboratory for medical/industrial/research	1.80
Lobby	1.10
Lobby for performing arts theater	3.30
Lobby for motion picture theater	1.00
Locker room	0.80
Lounge recreation	0.80
Office - enclosed	1.10
Office - open plan	1.00
Restroom	1.00
Sales area	1.60[a]
Stairway	0.70
Storage	0.80
Workshop	1.60
Courthouse/police station/penetentiary	
Courtroom	1.90
Confinement cells	1.10
Judge chambers	1.30
Penitentiary audience seating	0.50
Penitentiary classroom	1.30
Penitentiary dining	1.10

TABLE C405.5.2(2) - INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD (CONTINUED)

COMMON SPACE-BY-SPACE TYPES	LPD (W/FT²)
BUILDING SPECIFIC SPACE-BY-SPACE TYPES	
Automotive - service/repair	0.70
Bank/office - banking activity area	1.50
Dormitory living quarters	1.10
Gymnasium/fitness center	
Fitness area	0.90
Gymnasium audience/seating	0.40
Playing area	1.40
Healthcare clinic/hospital	
Corridors/transition	1.00
Exam/treatment	1.70
Emergency	2.70
Public and staff lounge	0.80
Medical supplies	1.40
Nursery	0.90
Nurse station	1.00
Physical therapy	0.90
Patient room	0.70
Pharmacy	1.20
Radiology/imaging	1.30
Operating room	2.20
Recovery	1.20
Lounge/recreation	0.80
Laundry - washing	0.60
Hotel	
Dining area	1.30
Guest rooms	1.10
Hotel Lobby	2.10
Highway lodging dining	1.20
Highway lodging gues rooms	1.10
Library	
Stacks	1.70
Card file and cataloging	1.10
Reading area	1.20
Manufacturing	
Corridors/transition	0.40
Detailed manufacturing	1.30

TABLE C405.5.2(2) - INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD (CONTINUED)

COMMON SPACE-BY-SPACE TYPES	LPD (W/FT²)
Equipment room	1.00
Extra high bay (>50-foot floor-ceiling height)	1.10
High bay (25- – 50-foot floor-ceiling height)	1.20
Low bay (<25-foot floor-ceiling height)	1.20
Museum	
General exhibition	1.00
Restoration	1.70
Parking garage - garage areas	0.20
Convention center	
Exhibit space	1.50
Audience/seating area	0.90
Fire stations	
Engine room	0.80
Sleeping quarters	0.30
Post office	
Sorting area	0.90
Religious building	
Fellowship hall	0.60
Audience seating	2.40
Worship pulpit/choir	2.40
Retail	
Dressing/fitting area	0.90
Mall concourse	1.60
Sales area	1.60[a]
Sports arena	
Audience seating	0.40
Court sports area - Class 4	0.70
Court sports area - Class 3	1.20
Court sports area - Class 2	1.90
Court sports area - Class 1	3.00
Ring sports area	2.70
Transportation	
Air/train/bus baggage area	1.00
Airport concourse	0.60
Terminal – ticket counter	1.50

TABLE C405.5.2(2) - INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD (CONTINUED)

COMMON SPACE-BY-SPACE TYPES	LPD (W/FT²)
Warehouse	
Fine material storage	1.40
Medium/bulky material	0.60

FOR SI: 1 foot = 304.8 mm, 1 watt per square foot = 11 W/m².

a. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.
Calculate the additional lighting power as follows:
Additional Interior Lighting Power Allowance = 500 watts + (Retail Area 1 x 0.6 W/ft²) + (Retail Area 2 x 0.6 W/ft²) + (Retail Area 3 x 1.4 W/ft²) + (Retail Area 4 x 2.5 W/ft²),
where:
Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.
Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.
Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.
Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.
Exception: Other merchandise categories are permitted to be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is *approved* by the authority having jurisdiciton.

EXTERIOR BUILDING POWER ALLOWANCES

The lighting power density of all exterior lighting supplied through the building's energy service must not exceed the allowances in Table C405.6.2(2). All exterior lighting is included in the LPD calculation except that specifically excluded or exempted in the box below. The overall lighting power allowance is the sum of the base site allowance plus the area allowances for each type of area illuminated. Trade-offs are permitted as specified in the table.

In addition, all non-excepted exterior luminaires on the building grounds that are supplied by the building's energy service and operate at greater than 100 watts must be controlled by a motion sensor or contain lamps with an efficacy of at least 60 lumens per watt.

EXCEPTIONS AND SPECIAL CONDITIONS

EXTERIOR LIGHTING EXCLUDED FROM LIGHTING POWER REQUIREMENTS

1. Low-voltage landscape lighting
2. Historical, safety, signage or emergency lighting that has been approved by a code official

EXTERIOR LIGHTING EXEMPTED FROM LIGHTING POWER REQUIREMENTS WHEN SEPARATELY SWITCHED

When the following exterior applications are separately controlled from the non-exempt applications, the lighting device is not covered by the LPD calculations nor by the grounds lighting efficacy requirements (a complete list of exceptions is at C405.6.2):

1. Advertising or directional signage
2. Lighting to provide directions or signal for transportation
3. Lighting for industrial production , material handling, transportation sites and associated storage areas

TABLE C405.6.2(2) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		ZONE 1	ZONE 2	ZONE 3	ZONE 4
BASE SITE ALLOWANCE (Base allowance is usable in tradable or nontradable surfaces.)		500 W	600 W	750 W	1300 W
TRADABLE SURFACES (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	**UNCOVERED PARKING AREAS**				
	Parking areas and drives	0.04 W/ft^2	0.06 W/ft^2	0.10 W/ft^2	0.13 W/ft^2
	BUILDING GROUNDS				
	Walkways less than 10 feet wide	0.70 W/linear foot	0.70 W/linear foot	0.80 W/linear foot	1.00 W/linear foot
	Walkways 10 feet wide or greater, plaza areas, special feature areas	0.14 W/ft^2	0.14 W/ft^2	0.16 W/ft^2	0.20 W/ft^2
	Stairways	0.75 W/ft^2	1.00 W/ft^2	1.00 W/ft^2	1.00 W/ft^2
	Pedestrian tunnels	0.15 W/ft^2	0.15 W/ft^2	0.20 W/ft^2	0.30 W/ft^2
	BUILDING ENTRANCES AND EXITS				
	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
	Entry canopies	0.25 W/ft^2	0.25 W/ft^2	0.40 W/ft^2	0.40 W/ft^2
	SALES CANOPIES				
	Free-standing and attached	0.60 W/ft^2	0.60 W/ft^2	0.80 W/ft^2	1.00 W/ft^2
	OUTDOOR SALES				
	Open areas (including vehicle sales lots)	0.25 W/ft^2	0.25 W/ft^2	0.50 W/ft^2	0.70 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot
NONTRADABLE SURFACES (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	Building facades	No allowance	0.10 W/ft^2 for each illuminated wall or surface or 2.50 W/linear foot for each illuminated wall or surface length	0.15 W/ft^2 for each illuminated wall or surface or 3.75 W/linear foot for each illuminated wall or surface length	0.20 W/ft^2 for each illuminated wall or surface or 5.00 W/linear foot for each illuminated wall or surface length
	Automated teller machines and night depositories	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area	0.75 W/ft^2 of covered and uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.50 W/ft^2 of covered and uncovered area	0.50 W/ft^2 of covered and uncovered area	0.50 W/ft^2 of covered and uncovered area	0.50 W/ft^2 of covered and uncovered area
	Drive-up windows/doors	400 W per drive-through	400 W per drive-through	400 W per drive-through	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry	800 W per main entry	800 W per main entry	800 W per main entry

FOR SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m^2.

S.9 Mechanical Equipment Efficiency Requirements

2012 IECC CORRESPONDENCE: SECTION C403.2.3
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: NOT APPLICABLE

PURPOSE

Reduce environmental impacts and operational costs associated with energy consumption of heating, ventilating and air conditioning equipment.

CRITERIA

Unless simulation is used, the minimum efficiency of HVAC equipment being installed must meet one of the tables in this section - Table C403.2.2(1) through Table C403.2.2(9).

Mechanical equipment shall comply with the following:

- Unitary and applied equipment shall meet the minimum efficiency requirements in Tables C403.2.3(1) and C403.2.3(2).
- Oil and gas furnaces and oil and gas warm-air-unit heaters shall meet the minimum efficiency requirements in Table C403.2.3(4).
- Package terminal air conditioners and heat pumps, and room air conditioners and air conditioner heat pumps shall meet the minimum efficiency requirements in Table C403.2.3(3).
- Boilers shall meet the minimum efficiency requirements in Table C403.2.3(5).
- Electric and absorption chillers shall meet the energy efficiency requirements in Table C403.2.3(7).
- Heat rejection equipment shall meet the minimum efficiency requirements in Table C403.2.3(8).

The most important efficiency aspect of HVAC performance is the overall efficiency of the whole system for delivery of space conditioning, not just the efficiencies for components given in the tables below.

Using the design principles discussed in Criteria 1.4 Mechanical System Design and Criteria S 2.12 Mechanical System Design Calculations will help assure that the balance of system components (pipes, ducts, pumps, fans, etc.) enhances total system efficiency and that the system is sized for more efficient performance.

TABLE C403.2.3(1) - MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
				BEFORE 6/1/2011	AS OF 6/1/2011	
AIR CONDITIONERS, AIR COOLED	< 65,000 Btu/h[b]	All	Split System	13.0 SEER	13.0 SEER	AHRI 210/240
			Single Package	13.0 SEER	13.0 SEER	
THROUGH-THE-WALL (AIR COOLED)	≤ 30,000 Btu/h[b]	All	Split System	12.0 SEER	12.0 SEER	
			Single package	12.0 SEER	12.0 SEER	
SMALL-DUCT HIGH-VELOCITY (AIR COOLED)	< 65,000 Btu/h[b]	All	Split System	10.0 SEER	10.0 SEER	
AIR CONDITIONERS, AIR COOLED	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.2 EER 11.4 IEER	11.2 EER 11.4 IEER	AHRI 340/360
		All Other	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 11.2 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	11.0 EER 11.2 IEER	
		All Other	Split System and Single Package	10.8 EER 11.0 IEER	10.8 EER 11.0 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.0 EER 10.1 IEER	10.0 EER 10.1 IEER	
		All Other	Split System and Single Package	9.8 EER 9.9 IEER	9.8 EER 9.9 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.7 EER 9.8 IEER	9.7 EER 9.8 IEER	
		All Other	Split System and Single Package	9.5 EER 9.6 IEER	9.5 EER 9.6 IEER	
AIR CONDITIONERS, WATER COOLED	< 65,000 Btu/h[b]	All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 210-240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.5 EER 11.7 IEER	12.1 EER 12.3 IEER	AHRI 340/360
		All	Split System and Single Package	11.3 EER 11.5 IEER	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	12.5 EER 12.7 IEER	
		All	Split System and Single Package	10.8 EER 11.0 IEER	12.3 EER 12.5 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.1 IEER	12.4 EER 12.6 IEER	
		All	Split System and Single Package	10.8 EER 10.9 IEER	12.2 EER 12.4 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.1 IEER	12.0 EER 12.4 IEER	
		All	Split System and Single Package	10.8 EER 10.9 IEER	12.0 EER 12.2 IEER	

TABLE C403.2.3(1) - MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS (CONTINUED)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
				BEFORE 6/1/2011	AS OF 6/1/2011	
AIR CONDITIONERS, EVAPORATIVELY COOLED	< 65,000 Btu/h[b]	All	Split System and Single Package	12.1 EER 12.3 IEER	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.5 EER 11.7 IEER	12.1 EER 12.3 IEER	AHRI 340/360
		All	Split System and Single Package	11.3 EER 11.5 IEER	11.9 EER 12.1 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	12.0 EER 12.2 IEER	
		All	Split System and Single Package	10.8 EER 11.0 IEER	11.8 EER 12.0 IEER	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.1 IEER	11.9 EER 12.1 IEER	
		All	Split System and Single Package	10.8 EER 10.9 IEER	12.2 EER 11.9 IEER	
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.0 EER 11.1 IEER	11.7 EER 11.9 IEER	
		All	Split System and Single Package	10.8 EER 10.9 IEER	11.5 EER 11.7 IEER	
CONDENSING UNITS, AIR COOLED	≥ 135,000 Btu/h			10.1 EER 11.4 IEER	10.5 EER 14.0 IEER	AHRI 365
CONDENSING UNITS, WATER COOLED	≥ 135,000 Btu/h			13.1 EER 13.6 IEER	13.5 EER 14.0 IEER	
CONDENSING UNITS, EVAPORATIVELY COOLED	≥ 135,000 Btu/h			13.1 EER 13.6 IEER	13.5 EER 14.0 IEER	

FOR SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.
b. Single-phase, air-cooled air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

TABLE C403.2.3(2) - MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
AIR COOLED (COOLING MODE)	< 65,000 Btu/h[b]	All	Split System	13.0 SEER	AHRI 210/240
			Single Package	13.0 SEER	
THROUGH-THE-WALL, AIR COOLED	≤ 30,000 Btu/h[b]	All	Split System	13.0 SEER	
			Single package	13.0 SEER	
SINGLE-DUCT HIGH-VELOCITY AIR COOLED	< 65,000 Btu/h[b]	All	Split System	10.0 SEER	
AIR COOLED (COOLING MODE)	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER 11.2 IEER	AHRI 340/360
		All Other	Split System and Single Package	10.8 EER 11.0 IEER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	10.6 EER 10.7 IEER	
		All Other	Split System and Single Package	10.4 EER 10.5 IEER	
	≥ 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	9.5 EER 9.6 IEER	
		All Other	Split System and Single Package	9.3 EER 9.4 IEER	
WATER SOURCE (COOLING MODE)	< 17,000 Btu/h	All	86°F entering water	11.2 EER	ISO 13256-1
	≥ 17,000 Btu/h and < 65,000 Btu/h	All	86°F entering water	12.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	All	86°F entering water	12.0 EER	
GROUND WATER SOURCE (COOLING MODE)	< 135,000 Btu/h	All	59°F entering water	16.2 EER	
		All	77°F entering water	13.4 EER	
WATER-SOURCE WATER TO WATER (COOLING MODE)	< 135,000 Btu/h	All	86°F entering water	10.6 EER	ISO 13256-2
			59°F entering water	16.3 EER	
GROUND WATER SOURCE BRINE TO WATER (COOLING MODE)	< 135,000 Btu/h	All	77°F entering water	12.1 EER	
AIR COOLED (HEATING MODE)	< 65,000 Btu/h[b]	—	Split System	7.7 HSPF	AHRI 210/240
		—	Single Package	7.7 HSPF	
THROUGH-THE-WALL (AIR COOLED, HEATING MODE)	≤ 30,000 Btu/h[b] (cooling capacity)	—	Split System	7.4 HSPF	
		—	Single Package	7.4 HSPF	
SMALL-DUCT HIGH VELOCITY (AIR COOLED, HEATING MODE)	< 65,000 Btu/h[b]	—	Split System	6.8 HSPF	

TABLE C403.2.3(2) - MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS (CONTINUED)

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
AIR COOLED (HEATING MODE)	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb Outdoor Air	3.3 COP	AHRI 340/360
			17°F db/15°F wb Outdoor Air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb Outdoor Air	3.2 COP	
			17°F db/15°F wb Outdoor Air	2.05 COP	
WATER SOURCE (HEATING MODE)	< 135,000 Btu/h (cooling capacity)	—	68°F entering water	4.2 COP	ISO 13256-1
GROUND WATER SOURCE (HEATING MODE)	< 135,000 Btu/h (cooling capacity)	—	50°F entering water	3.6 COP	
GROUND SOURCE (HEATING MODE)	< 135,000 Btu/h (cooling capacity)	—	32°F entering water	3.1 COP	
WATER SOURCE WATER TO WATER (HEATING MODE)	< 135,000 Btu/h (cooling capacity)	—	68°F entering water	3.7 COP	ISO 13256-2
		—	50°F entering water	3.1 COP	
GROUND SOURCE BRINE TO WATER (HEATING MODE)	< 135,000 Btu/h (cooling capacity)	—	32°F entering fluid	2.5 COP	

FOR SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8.

a. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.
b. Single-phase, air-cooled air conditioners less than 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

TABLE C403.2.3(3) - MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
			BEFORE 10/08/2012	AS OF 10/08/2012	
PTAC (COOLING MODE) NEW CONSTRUCTION	All Capacities	95°F db outdoor air	12.5 - (0.213 x Cap/1000) EER	13.8 - (0.300 x Cap/1000) EER	AHRI 310/380
PTAC (COOLING MODE) REPLACEMENTS[b]	All Capacities	95°F db outdoor air	10.9 - (0.213 x Cap/1000) EER	10.9 - (0.213 x Cap/1000) EER	
PTHP (COOLING MODE) NEW CONSTRUCTION	All Capacities	95°F db outdoor air	12.3 - (0.213 x Cap/1000) EER	14.0 - (0.300 x Cap/1000) EER	
PTHP (COOLING MODE) REPLACEMENTS[b]	All Capacities	95°F db outdoor air	10.8 - (0.213 x Cap/1000) EER	10.8 - (0.213 x Cap/1000) EER	
PTHP (HEATING MODE) NEW CONSTRUCTION	All Capacities	—	3.2 - (0.26 x Cap/1000) COP	3.2 - (0.26 x Cap/1000) COP	
PTHP (HEATING MODE) REPLACEMENTS[b]	All Capacities	—	2.9 - (0.26 x Cap/1000) COP	2.9 - (0.26 x Cap/1000) COP	

TABLE C403.2.3(3) - MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS, SINGLE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS (CONTINUED)

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY		TEST PROCEDURE[a]
			BEFORE 10/08/2012	AS OF 10/08/2012	
SPVAC (COOLING MODE)	< 65,000 Btu/h	95°F db/75°F wb outdoor air	9.0 EER	9.0 EER	AHRI 390
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/75°F wb outdoor air	8.9 EER	8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/75°F wb outdoor air	8.6 EER	8.6 EER	
SPVHP (COOLING MODE)	< 65,000 Btu/h	95°F db/75°F wb outdoor air	9.0 EER	9.0 EER	
	≥ 65,000 Btu/h and < 135,000 Btu/h	95°F db/75°F wb outdoor air	8.9 EER	8.9 EER	
	≥ 135,000 Btu/h and < 240,000 Btu/h	95°F db/75°F wb outdoor air	8.6 EER	8.6 EER	
SPVHP (HEATING MODE)	< 65,000 Btu/h	47°F db/43°F wb outdoor air	3.0 COP	3.0 COP	
	≥ 65,000 Btu/h and < 135,000 Btu/h	47°F db/43°F wb outdoor air	3.0 COP	3.0 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h	47°F db/75°F wb outdoor air	2.9 COP	2.9 COP	
ROOM AIR CONDITIONERS, WITH LOUVERED SLIDES	< 6,000 Btu/h	—	9.7 SEER	9.7 SEER	ANSI/AHA-MRAC-1
	≥ 6,000 Btu/h and < 8,000 Btu/h	—	9.7 SEER	9.7 SEER	
	≥ 8,000 Btu/h and < 14,000 Btu/h	—	9.8 SEER	9.8 SEER	
	≥ 14,000 Btu/h and < 20,000 Btu/h	—	9.7 SEER	9.7 SEER	
	≥ 20,000 Btu/h	—	8.5 EER	8.5 EER	
ROOM AIR CONDITIONERS, WITH LOUVERED SLIDES	< 8,000 Btu/h	—	9.0 EER	9.0 EER	
	≥ 8,000 Btu/h and < 20,000 Btu/h	—	8.5 EER	8.5 EER	
	≥ 20,000 Btu/h	—	8.5 EER	8.5 EER	
ROOM AIR-CONDITIONER HEAT PUMPS WITH LOUVERED SIDES	< 20,000 Btu/h	—	9.0 EER	9.0 EER	
	≥ 20,000 Btu/h	—	8.5 EER	8.5 EER	
ROOM AIR-CONDITIONER HEAT PUMPS WITHOUT LOUVERED SIDES	< 14,000 Btu/h	—	8.5 EER	8.5 EER	
	≥ 14,000 Btu/h	—	8.0 EER	8.0 EER	
ROOM AIR CONDITIONER CASEMENT ONLY	All capacities	—	8.7 EER	8.7 EER	
ROOM AIR CONDITIONER CASEMENT-SLIDER	All capacities	—	9.5 EER	9.5 EER	

FOR SI: 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8.

"Cap" = The rated cooling capacity of the project in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculations.

a. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.

b. Replacement unit shall be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) in height and less than 42 inches (1067 mm) in width.

TABLE C403.2.3(4) - WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS, WARM AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY[d, e]	TEST PROCEDURE[a]
WARM AIR FURNACES, GAS FIRED	< 225,000 Btu/h	—	78% AFUE or 80%E_t[c]	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity[c]	80%E_t[f]	ANSI Z21.47
WARM AIR FURNACES, OIL FIRED	< 225,000 Btu/h	—	78% AFUE or 80%E_t[c]	DOE 10 CFR Part 430 or UL 727
	≥ 225,000 Btu/h	Maximum capacity[b]	81%E_t[g]	UL 727
WARM AIR DUCT FURNACES, GAS FIRED	All capacities	Maximum capacity[b]	80%E_c	ANSI Z83.8
WARM AIR UNIT HEATERS, GAS FIRED	All capacities	Maximum capacity[b]	80%E_c	ANSI Z83.8
WARM AIR UNIT HEATERS, OIL FIRED	All capacities	Maximum capacity[b]	80%E_c	UL 731

FOR SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.
b. Minimum and maximum ratings as provided for and allowed by the unit's controls.
c. Combination units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.
d. E_t = Thermal efficiency. See test procedure for detailed dicussion.
e. E_c = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.
f. E_c = Combustion efficiency. Units must also include an IID, have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
g. E_t = Thermal efficiency. Units must also include an IID, have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

TABLE C403.2.3(5) - MINIMUM EFFICIENCY REQUIREMENTS: GAS- AND OIL-FIRED BOILERS

EQUIPMENT TYPE[a]	SUBCATEGORY OR RATING CONDITION	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY	TEST PROCEDURE
BOILERS, HOT WATER	Gas-fired	< 300,000 Btu/h	80% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	80% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	82% E_c	
	Oil-fired[c]	< 300,000 Btu/h	80% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	82% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	84% E_c	
BOILERS, STEAM	Gas-fired	< 300,000 Btu/h	75% AFUE	10 CFR Part 430
	Gas-fired- all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	79% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	79% E_t	
	Gas-fired-natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	77% E_t	
		> 2,500,000 Btu/h[a]	77% E_t	
	Oil-fired[c]	< 300,000 Btu/h	80% AFUE	10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[b]	81% E_t	10 CFR Part 431
		> 2,500,000 Btu/h[a]	81% E_t	

FOR SI: 1 British thermal unit per hour = 0.2931 W.

E_c = Combustion efficiency (100% less flue losses). E_t = Thermal efficiency. See referenced standard document for detailed information.

a. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.
b. Maximum capacity - minimum and maximum ratings as provided for and allowed by the unit's controls.
c. Includes oil-fired (residual).

TABLE C403.2.3(6) - MINIMUM EFFICIENCY REQUIREMENTS: CONDENSING UNITS, ELECTRICALLY OPERATED

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY[b]	TEST PROCEDURE[a]
CONDENSING UNITS, AIR COOLED	≥ 135,000 Btu/h	10.1 EER 11.2 IPLV	AHRI 365
CONDENSING UNITS, WATER OR EVAPORATIVELY COOLED	≥ 135,000 Btu/h	13.1 EER 13.1 IPLV	

FOR SI: 1 British thermal unit per hour = 0.2931 W.

a. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.
b. IPLVs are only applicable to equipment with capacity modulation.

TABLE C403.2.3(7) MINIMUM EFFICIENCY REQUIREMENTS: WATER CHILLING PACKAGES[a]

EQUIPMENT TYPE	SIZE CATEGORY	UNITS	BEFORE 1/1/2010		AS OF 1/1/2010[b]				TEST PROCEDURE[c]
					PATH A		PATH B		
			FULL LOAD	IPLV	FULL LOAD	IPLV	FULL LOAD	IPLV	
AIR-COOLED CHILLERS	< 150 tons	EER	≥ 9.562	≥ 10.416	≥ 9.562	≥ 12.500	NA	NA	AHRI 550/590
	≥ 150 tons	EER			≥ 9.562	≥ 12.750	NA	NA	
AIR-COOLED WITHOUT CONDENSER, ELECTRICALLY OPERATED	All capacities	EER	≥ 10.586	≥ 11.782	Air-cooled chillers without condensers shall be rated with matching condensers and comply with the air-cooled chiller efficiency requirements				
WATER COOLED, ELECTRICALLY OPERATED, RECIPROCATING	All capacities	kW/ton	≤ 0.837	≤ 0.696	Reciprocating units shall comply with water cooled positive displacement efficiency requirements				
WATER COOLED, ELECTRICALLY OPERATED, POSITIVE DISPLACEMENT	< 75 tons	kW/ton	≤ 0.790	≤ 0.676	≤ 0.780	≤ 0.630	≤ 0.800	≤ 0.600	
	≥ 75 tons and < 150 tons	kW/ton			≤ 0.775	≤ 0.615	≤ 0.790	≤ 0.586	
	≥ 150 tons and < 300 tons	kW/ton	≤ 0.717	≤ 0.627	≤ 0.680	≤ 0.580	≤ 0.718	≤ 0.540	
	≥ 300 tons	kW/ton	≤ 0.639	≤ 0.571	≤ 0.620	≤ 0.540	≤ 0.639	≤ 0.490	
WATER COOLED, ELECTRICALLY OPERATED, CENTRIFUGAL	< 150 tons	kW/ton	≤ 0.703	≤ 0.669	≤ 0.634	≤ 0.596	≤ 0.639	≤ 0.450	
	≥ 150 tons and < 300 tons	kW/ton	≤ 0.634	≤ 0.596					
	≥ 300 tons and < 600 tons	kW/ton	≤ 0.576	≤ 0.549	≤ 0.576	≤ 0.549	≤ 0.600	≤ 0.400	
	≥ 600 tons	kW/ton	≤ 0.576	≤ 0.549	≤ 0.570	≤ 0.539	≤ 0.590	≤ 0.400	
AIR COOLED, ABSORPTION SINGLE EFFECT	All capacities	COP	≥ 0.600	NR	≥ 0.600	NR	NA	NA	AHRI 560
WATER COOLED, ABSORPTION SINGLE EFFECT	All capacities	COP	≥ 0.700	NR	≥ 0.700	NR	NA	NA	
ABSORPTION DOUBLE EFFECT, INDIRECT FIRED	All capacities	COP	≥ 1.000	≥ 1.050	≥ 1.000	≥ 1.050	NA	NA	
ABSORPTION DOUBLE EFFECT, DIRECT FIRED	All capacities	COP	≥ 1.000	≥ 1.000	≥ 1.000	≥ 1.000	NA	NA	

FOR SI: 1 ton = 3517 W, 1 British thermal unit per hour = 0.2931 W, °C = [(°F) - 32]/1.8.
NA = Not applicable, not to be used for compliance; NR = No requirement.

a. The centrifugal chiller equipment requirements, after adjustment in accordance with Section C403.2.3.1 or Section C403.2.3.2, do not apply to chillers used in low-temperature applications where the design leaving fluid temperatures is less than 36°F. The requirements do not apply to positive displacement chillers with leaving fluid temperatures less than or equal to 32°F. The requirements do not apply to absorption chillers with design leaving fluid temperatures less than 40°F.
b. Compliance with this standard can be obtained by meeting the minimum requirements of Path A or B. However, both the full load and IPLV shall be met to fulfill the requirements of Path A or B.
c. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.

TABLE C403.2.3(8) - MINIMUM EFFICIENCY REQUIREMENTS: HEAT REJECTION EQUIPMENT

EQUIPMENT TYPE[a]	TOTAL SYSTEM HEAT REJECTION CAPACITY AT RATED CONDITIONS	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[b, c, d]	TEST PROCEDURE[e, f]
PROPELLER OR AXIAL FAN OPEN CIRCUIT COOLING TOWERS	All	95°F Entering Water 85°F Leaving Water 75°F Entering wb	≥ 38.2 gpm/hp	CTI ATC-105 and CTI STD-201
CENTRIFUGAL FAN OPEN CIRCUIT COOLING TOWERS	All	95°F Entering Water 85°F Leaving Water 75°F Entering wb	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
PROPELLER OR AXIAL FAN CLOSED CIRCUIT COOLING TOWERS	All	102°F Entering Water 90°F Leaving Water 75°F Entering wb	≥ 14.0 gpm/hp	CTI ATC-105S and CTI STD-201
CENTRIFUGAL CLOSED CIRCUIT COOLING TOWERS	All	102°F Entering Water 90°F Leaving Water 75°F Entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI STD-201
AIR-COOLED CONDENSERS	All	125°F Condensing Temperature R-22 Test Fluid 190°F Entering Gas Temperature 15°F Subcooling 95°F Entering db	≥ 176,000 Btu/h•hp	ARI 460

FOR SI: °C = [(°F) - 32]/1.8, L/s • kW = (gpm/hp)(11.83), COP = (Btu/h • hp)/(2550.7).
db = dry bulb temperature, °F, wb = wet bulb temperature, °F.

a. The efficiencies and test procedured for both open and closed circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of wet and dry heat exchange Sections.
b. For purposes of this table, open circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 403.2.3(8) divided by the fan nameplate rated motor power.
c. For purposes of this table, closed circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 403.2.3(8) divided by the sum of the fan nameplate rated motor power and the spray pump nameplate rated motor power.
d. For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan nameplate rated motor power.
e. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.
f. If a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, then the product shall be listed in the certification program, or, if a certification program exists for a covered product, and it includes provisions for verification and challenge of equipment efficiency ratings, but the product is not listed in the existing certification program, the ratings shall be verified by an independent laboratory test report.

TABLE C403.2.3(9) - HEAT TRANSFER EQUIPMENT

EQUIPMENT TYPE	SUBCATEGORY	MINIMUM EFFICIENCY	TEST PROCEDURE[a]
LIQUID-TO-LIQUID HEAT EXCHANGERS	Plate type	NR	AHRI 400

NR = No Requirement

a. Chapter 6 of the referenced standard contains a complete specification of the referenced test procedure, including the reference year version of the test procedure.

S.10 Economizer Performance

2012 IECC CORRESPONDENCE: SECTION C403.3
2012 IECC REQUIREMENT: CLIMATE ZONES 2-8

ENHANCED STRATEGY: CORE PERFORMANCE 3.9

PURPOSE

Ensures that buildings served by unitary or packaged HVAC equipment optimize their energy savings from the proper performance of outside-air (OA) economizers.

CRITERIA

Economizers are required on all cooling systems ≥33,000 Btu/h in all climate zones except 1 A&B. All installed economizers should include the following features. Performance of these features should be verified at project completion.

- **FACTORY-INSTALLED ECONOMIZER.** These are generally more reliable than field installed economizers.
- **FULLY-MODULATING DAMPER MOTOR.** A fully-modulating damper motor is necessary for ensuring that the return air dampers can provide up to 100 percent of the design supply air quantity as outdoor air for cooling. Economizer dampers should be capable of being sequenced with the mechanical cooling equipment as required in Section C403.3.1.1.2.
- **DAMPER DRIVE MECHANISM.** Robust economizer operation requires a direct modulating actuator with gear-driven interconnections and a permanently lubricated bushing or bearing on the outside and return dampers.
- **PRIMARY CONTROL SENSOR PLACEMENT.** For direct-expansion (DX) cooling coils, place primary control sensor in the discharge air position, after the cooling coil. When chilled water coils are used, place primary control sensor before the cooling coil in the mixed-air position.
- **COORDINATED CONTROL.** Ensure the economizer is only active when there is a call for cooling.
- **ECONOMIZER CONTROL.** Economizer control type will be differential dry-bulb, fixed dry-bulb, combined dew point/dry-bulb temperature or differential enthalpy control. Economizer systems shall be integrated with the mechanical cooling system as required in Section C403.4.1.3.
- **CHANGEOVER CONTROL.** Economizer controller will utilize a deadband between economizer enable/disable operation. Refer to Table C403.2.3(2) for high-limit shutoff controls settings for air economizers. Allowing the following additional high-limit shutoff controls is recommended:

DEVICE TYPE	ACCEPTABLE IN CLIMATE ZONE AT LISTED SET POINT	HIGH LIMIT LOGIC (ECONOMIZER OFF WHEN)	NOT RECOMMENDED IN CLIMATE ZONE
FIXED ENTHALPY + FIXED DRYBULB	All	Outdoor air enthalpy exceeds 28 Btu/lb of dry air or Outdoor air dry bulb exceeds 75°F	All
DIFFERENTIAL ENTHALPY + FIXED (OR DIFFERENTIAL) DRYBULB	All	Outdoor air enthalpy exceeds return air enthalpy or Outdoor air dry bulb exceeds 75°F (or return air temperature)	All

- **RELIEF AIR AND MODULATING RETURN AIR DAMPER.** Systems shall be capable of relieving excess outdoor air during air economizer operation by providing relief air with either a barometric damper in the return air duct upstream of the return air damper, a motorized exhaust air damper or an exhaust fan with backdraft dampers. Return air relief and outside air intake hoods shall be installed so that relief dampers operate freely.
- **MINIMUM OUTSIDE VENTILATION AIR MEASUREMENT BY TEMPERATURE.** Verify the minimum OA set point by measuring the temperature of the mixed air, return air and outside air to calculate the percentage of outside air. This measurement is conducted during acceptance testing and should be considered an ongoing operational set point.
- **COMMISSIONING OF ECONOMIZER.** It is critical to the efficient performance of economizer-equipped HVAC units that the economizer be installed, calibrated, and operated as intended. Commissioning requirements apply to all economizers and are described in S. 14 of this document and Section C. 408.2.3.3 of the 2012 IECC.

EXCEPTIONS

Cooling equipment performance improvement trade-off as specified in Table C403.3.1(2).

S.11 Energy Recovery Ventilation

2012 IECC CORRESPONDENCE: SECTION C403.2.6

2012 IECC REQUIREMENT: CLIMATE ZONES 1-8 BASED ON OUTSIDE AIR FLOW RATE

ENHANCED STRATEGY: CORE PERFORMANCE 3.7

PURPOSE

Reduce energy use associated with ventilation requirements by recapturing waste heat and cooling in exhaust air flow.

CRITERIA

Install an energy recovery ventilation (ERV) system to recover waste heat into the incoming fresh air stream. ERV systems are required by the 2012 IECC based on a system's design supply fan airflow rate as shown in Table C403.2.6. The threshold airflow rate is determined by a combination of the system's climate zone location and percent outdoor air at full design airflow rate.

Energy recovery systems shall have the capability to provide a change in the enthalpy of the outdoor air supply of not less than 50%. Where an air economizer is required, the energy recovery system shall include a bypass or controls which permit operation of the economizer as required by Section C403.4.

EXCEPTIONS AND SPECIAL CONDITIONS

EXCEPTIONS TO ENERGY RECOVERY VENTILATION REQUIREMENTS

Energy recovery ventilation is not required when prohibited by the International Mechanical Code (or other applicable code such as the Uniform Mechanical Code) or if more than 60% of the heating energy for outdoor air is site-recovered energy or is from solar energy, In addition, ERV is not required:

1. For laboratory fume hoods that meet specific lower recovery requirements in Section C403.2.6(2)
2. For systems serving non-cooled spaces heated to less than 60 degrees.
3. On heating systems in Climate Zones 1 and 2, and on cooling systems in Climate Zones 3c, 4c, 5b, 5c, 6b, 7 and 8.
4. On systems expected to operate less than 20 hours per week at the outdoor air percentage listed in Table C403.2.6.

S.12 Demand Control Ventilation

2012 IECC CORRESPONDENCE: SECTION C403.2.5.1

2012 IECC REQUIREMENT: HIGH DENSITY OCCUPANCIES WITHOUT ENERGY RECOVERY

ENHANCED STRATEGY: CORE PERFORMANCE 2.11

PURPOSE

Reduce the energy use associated with heating and cooling outside air in excess of ventilation flow rates required by building occupancy, while maintaining high indoor air quality for the building occupants.

CRITERIA

On many systems where an Energy Recovery Ventilation (ERV) System has not been installed, Demand Control Ventilation (DCV) is required. DCV shall be provided for spaces larger than 500 square feet when the average occupant load is 25 people per 1,000 square feet or greater. Demand Control Ventilation is required on systems meeting one or more of the following conditions:

1. Contains an air-side economizer
2. Automatically modulates control of the damper
3. A design outdoor airflow rate greater than 3000 cfm

EXCEPTIONS AND SPECIAL CONDITIONS

EXEMPTIONS TO DEMAND CONTROL VENTILATION REQUIREMENTS

Demand Control Ventilation is not required for these spaces and systems:

1. Systems with ERV
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel
3. Systems with a design outdoor airflow less than 1200 cfm
4. Systems where the supply airflow rate minus any makeup air requirements is less than 1200 cfm
5. Ventilation provided exclusively for process loads

CAUTION: Additional ventilation may be required to dilute off-gassing of products in specific spaces

S.13 Mechanical System Design Calculations

2012 IECC CORRESPONDENCE: SECTION C403.2.1 AND SECTION C403.2.2
2012 IECC REQUIREMENT: ALL CLIMATE ZONES

ENHANCED STRATEGY: CORE PERFORMANCE 1.4

PURPOSE

Ensure that the mechanical system is designed to minimize energy consumption and maximize occupant comfort throughout the range of operating conditions.

CRITERIA

The requirements of the 2012 IECC are a roughly correlated set of calculations also found in Core Performance Criteria 1.4:

1. When sizing the heating and cooling equipment, perform load calculations using building shell and interior load assumptions that are consistent with the project designed to the standards in this Supplement and are in accordance with procedures described in *ANSI/ASNRA/ACCA Standard 183*.
2. Include accurate characterizations of lighting, solar loads, glazing performance, occupancy and ventilation loads based on specific design characteristics of this project. Account for load reductions due to energy recovery ventilation in accordance with the *ASHRAE HVAC Systems and Equipment Handbook*.
3. The output capacity of the equipment shall not exceed the capacity calculated as above. If one piece of equipment serves both heating and cooling functions, the performance mode that is not driving the sizing calculation should be specified with the smallest capacity that meets the load within the available equipment options.

S.14 Systems Commissioning

2012 IECC CORRESPONDENCE: SECTION C408

2012 IECC REQUIREMENT: ALL CLIMATE ZONES FOR BUILDINGS WITH COOLING CAPACITY GREATER THAN 480,000 BTU/H OR HEATING CAPACITY GREATER THAN 600,000 BTU/H

ENHANCED STRATEGY: CORE PERFORMANCE 3.13

PURPOSE

Ensure the design is constructed and operates as intended by the construction documents by testing and verifying system performance.

CRITERIA

The construction process shall be conducted to deliver a building that meets or exceeds the requirements of the owner, as identified in the Operational Performance Requirements and the acceptance testing plan developed under Criteria 1.2, and in the construction documents.

IECC DEFINITION OF BUILDING COMMISSIONING

A process that verifies and documents that selected building systems have been designed, installed and function according to the owner's project requirements and construction documents, and to minimum code requirements.

The 2012 IECC requires the commissioning of mechanical systems and lighting control systems, including the following equipment:

- Outdoor Air Systems
- Air Distribution Systems
- Hydronic Systems
- VAV Systems
- Package Rooftop Units
- Economizers
- Chilled-Water Systems
- Demand Control Ventilation Systems
- Automatic Daylighting Controls
- Automatic Time-of-Day Controls
- Occupancy Sensors

The Commissioning process shall include:

1. Construction documents should clearly indicate the requirements for the commissioning requirements and steps required for project completion.
2. A commissioning plan shall be prepared indicating the activities during each phase of the commissioning and identifying the personnel responsible for it. The plan shall list the specific equipment or systems and the tests that will be

applied to each. A description of the functions to be tested, the conditions under which testing shall be conducted and the respective performance criteria shall be included in the plan.

3. A preliminary commission report shall be prepared documenting the results of the commissioning test procedures. The report should document deficiencies that have not been corrected, deferred tests that could not yet be performed and the conditions necessary for completing the tests.
4. The completed Preliminary Commissioning Report shall be delivered to the building owner, and a letter of transmittal received by the building official, as a condition of passing the Final Mechanical Inspection.
5. The construction documents shall indicate that the drawings and manuals for the equipment subject to commissioning be provided to the building owner within 90 days of receipt of the Certificate of Occupancy.
6. The construction documents shall also indicate that within the 90-day period the owner will also receive a system balancing report and Final Commissioning Report. The Final Commissioning Report shall include the results of the functional performance tests, what actions were taken or proposed for the identified deficiencies found during commissioning, and a description of the testing procedures.

More details for the requirements of each of the functional tests and for the content of the reports are found in Section C408.

GENERAL

The commissioning documents demonstrate that the installing contractor, engineer of record or owner's agent:

- Reviews the installation
- Performs acceptance tests and documents results
- Documents the operating and maintenance information and test results.

The building owner may decide to use a third-party commissioning agent to conduct this work, as described in the Enhanced Strategy in Criteria 3.13.

For additional references and information about this measure, visit **www.advancedbuildings.net/refmaterials.htm**.

S.15 Meeting the Requirements for an "Additional Efficiency Package Option"

2012 IECC CORRESPONDENCE: SECTION C403.6
2012 IECC REQUIREMENT: ONE PACKAGE OPTION, ALL CLIMATE ZONES

ENHANCED STRATEGY: COMPLY WITH MORE THAN ONE PACKAGE OPTION

PURPOSE

The three "Additional Efficiency Package Options" in Section C406 provide a set of choices to achieve an approximately 3% reduction in the building's fossil fuel energy use.

CRITERIA

Minimum compliance with the IECC requires compliance with one of the three package options in this section: more efficient HVAC equipment, a reduction in lighting power density, or installation of on-site renewable energy systems. Though minimum compliance with the IECC requires the selection of only one of the three, additional savings goals or program requirements might point users to more than one of the additional packages.

If a building has not installed On-Site Renewable Energy system capacity to adequately meet the building's expected "built-out" requirements, individual tenant spaces must meet either the Efficient HVAC or the Efficient Lighting System requirement as they undergo tenant improvements.

EFFICIENT HVAC PERFORMANCE

The Efficient HVAC Performance option can only be chosen if the type of equipment being installed is covered by one of the tables in this section - Table C406.2(1) through Table C406.2(7). If the equipment is not found on any of those tables, then the project must comply with either the Efficient Lighting System or the On-Site Renewable Energy sections in S.15.

Equipment must meet the efficiency requirements in Tables C406.4(1) through C406.2(7), when applicable, and still meet the other requirements in the Mechanical Section C403. All other equipment must meet Section C403 in its entirety.

Mechanical equipment shall comply with the following:

- Package unitary equipment shall meet the minimum efficiency requirements in Tables C406.2(1) and C406.2(2)
- Oil and gas furnaces, and oil and gas warm-air-unit heaters shall meet the minimum efficiency requirements in Table C406.2(4)
- Package terminal air conditioners and heat pumps, and room air conditioners and air conditioner heat pumps shall meet the minimum efficiency requirements in Table C406.2.(3)
- Boilers shall meet the minimum efficiency requirements in Table C406.2(5)
- Electric and absorption chillers shall meet the energy efficiency requirements in Table C406.2(6)

EFFICIENT LIGHTING SYSTEM

The efficient lighting system package option allows the use of only the Building Area Method. There are no provisions in the efficient lighting package to use the Space-by-Space Method.

Installed lighting power density (LPD) shall not exceed the lighting equipment power density allowances as shown in Table C406.3. With the Building Area Method, the LPD of each area of the building must be less than or equal to the LPD listed. An "area" for this purpose is defined as all contiguous areas of a building associated with the types listed in the table.

Three building types have special specifications in their applicable efficient lighting package that involve the use of daylighting:

1. In warehouse building area types, since Section C402.3.2 already requires a minimum 50% of the floor space to be in daylight zones, the efficient lighting package requires that a minimum 70% of the floor space be dalylit instead of offering a reduced LPD option, which may not provide adequate lighting quality.
2. In office area types, there are two options. One requires reducing the LPD to 0.85 watts per square foot. The other option does not reduce the LPD, but rather requires that 30% of the conditioned floor space be in daylight zones with installed automatic daylighting controls.
3. In retail area types, there are two options. One option requires reducing the LPD to 1.30 watts per square foot. The other option does not reduce the LPD but rather requires that 30% of the conditioned floor space be in daylight zones with installed automatic daylighting controls.

BUILDING AREA METHOD ALLOWANCES – ADDITIONAL PACKAGE LPD OPTION

ON-SITE RENEWABLE ENERGY

The On-Site Renewable Energy package option requires that a renewable energy system with a certain minimum capacity be installed on the project site. Qualifying systems must derive energy from solar radiation, wind , waves, biomass, or the internal heat of the earth. (Ground-source heat pumps are not qualified as renewable energy systems.)

The minimum ratings of the installed renewable energy systems must exceed one of three thresholds:

1. For solar hot water systems, 1.75 Btu per square foot of conditioned floor area in the building.
2. For photovoltaic systems, 0.50 watts per square foot of conditioned floor area in the building.
3. A calculation showing that the capacity of all of the on-site installed renewable systems will provide at least 3% of the energy used by the lighting, mechanical and service hot water systems. This approach will mostly be used when a computer simulation is available.

TABLE C406.3 - REDUCED INTERIOR LIGHTING POWER

BUILDING AREA TYPE[a]	LPD (w/ft²)
Automotive Facility	0.82
Convention Center	1.08
Courthouse	1.05
Dining: bar lounge/leisure	0.99
Dining: cafeteria/fast food	0.90
Dining: family	0.89
Dormitory	0.61
Exercise center	0.88
Fire Station	0.71
Gymnasium	1.00
Health Care Clinic	0.87
Hospital	1.10
Library	1.18
Manufacturing Facility	1.11
Hotel/motel	0.88
Motion picture theater	0.83
Multifamily	0.60
Museum	1.06
Office	0.90/0.85[b]
Performance Arts Theater	1.39

BUILDING AREA TYPE[a]	LPD (w/ft²)
Police Station	0.96
Post office	0.87
Religious building	1.05
Retail	1.4/1.3[b]
School/university	0.99
Sports arena	0.78
Town hall	0.92
Transportation	0.77
Warehouse[c]	0.60
Workshop	1.20

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.
b. First LPD value applies if no less than 30 percent of conditioned floor area is in daylight zones. Automatic daylighting controls shall be installed in daylight zones and shall meet the requirements of Section C405.2.2.3. In all other cases, second LPD value applies.
c. No less than 70 percent of the floor area shall be in daylight zone. Automatic daylighting controls shall be installed in daylight zones and shall meet the requirements of Section C405.2.2.3.

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V. Criteria Category: Enhanced Performance Design Strategies

The Criteria in this section are not part of the basic requirements of the **Advanced Buildings *Core Performance 2012 IECC Supplemental Requirements*** program. The strategies identified here represent opportunities for significant additional energy savings beyond basic program requirements. Individual Criteria in this **Advanced Buildings Core Performance** section should be considered in the context of project characteristics and potential benefits.

TABLE OF CONTENTS

Enhanced Performance Strategies

3.4 Plug Loads/Appliance Efficiency

PURPOSE

Reduce energy use associated with equipment installed or located in the building.

CRITERIA

Identify equipment selection and control strategies to reduce the energy use of equipment installed or used in the building. Purchase and install only equipment rated by the ENERGY STAR program where applicable. Institute office equipment control strategies to reduce equipment run-time.

For all equipment types rated by ENERGY STAR, utilize only ENERGY STAR-qualified equipment. (Specific equipment types identified below must comply with requirements listed.) For equipment types not rated by ENERGY STAR, compare energy use characteristics of alternative selections and target the acquisition of lower-consumption equipment.

Install networked computer monitor control, or insure that at least 90% of computer monitors are flat-screen LCD-type monitors with low-energy-use characteristics. Enable power management settings on all computer workstations, and consider third-party centralized power management strategies to reduce equipment energy use.

EPA's ENERGY STAR program has developed performance Criteria for a wide range of equipment and appliances, from office equipment to residential appliances to commercial kitchen equipment. All equipment purchased for use in an Advanced Building should meet the performance Criteria established by ENERGY STAR.

The tables below provide specific equipment performance requirements for commercial refrigeration and ice-making equipment that goes beyond basic ENERGY STAR performance requirements and should be targeted for this type of equipment.

TABLE 3.4.1 - CRITERIA SPECIFICATIONS FOR TIER 2 REFRIGERATION EQUIPMENT PERFORMANCE

EQUIPMENT	TIER	CORRESPONDING BASE SPECIFICATION	MAXIMUM DAILY ENERGY USE/DAY (KWH/DAY)
SOLID DOOR REACH-IN REFRIGERATOR	2	ENERGY STAR + 40%	.06V + 1.22
SOLID DOOR REACH-IN FREEZER	2	ENERGY STAR + 30%	0.28V + 0.97

V = INTERNAL VOLUME, CUBIC FEET | ASHRAE STANDARD 117-2002 / 38 DEG. F

TABLE 3.4.2 - CRITERIA SPECIFICATIONS FOR TIER 2 ICEMAKING EQUIPMENT PERFORMANCE

EQUIPMENT TYPE	HARVEST RATE (100LBS ICE/24 HRS)	TIER	CORRESPONDING BASE SPECIFICATION	MAXIMUM DAILY ENERGY CONSUMPTION (KWH PER 100 LBS. ICE)	MAXIMUM DAILY WATER USE (GALLONS PER 100 LBS. ICE)
ICE-MAKING HEAD	<500 lbs day	2	20% below FEMP	6.24 - .0044H	200 - .022H
WATER COOLED	≥ 500 lbs day	2	20% below FEMP	4.46 - .0009H	200 - .022H
ICE-MAKING HEAD	<450 lbs day	2	20% below FEMP	8.21 - .0069H	Not Applicable
AIR COOLED	≥ 450 lbs day	2	20% below FEMP	5.51 - .0009H	Not Applicable
REMOTE-CONDENSING	<1000 lbs day	2	20% below FEMP	7.08 - .0030H	Not Applicable
AIR COOLED	≥ 1000 lbs day	2	20% below FEMP	4.08	Not Applicable
SELF CONTAINED	<200 lbs day	2	20% below FEMP	9.12 - .0152H	191 - .0315H
WATER COOLED	≥ 200 lbs day	2	20% below FEMP	6.08	191 - .0315H
SELF CONTAINED	<175 lbs day	2	20% below FEMP	14.4 – 0.375H	Not Applicable
AIR COOLED	≥ 175 lbs day	N/A	Not Applicable	Not Applicable	Not Applicable

H = ICE HARVEST RATE (LBS/24 HRS), ASHRAE STANDARD 29-1988 (R99)

Federal Energy Management Program (FEMP); **www.eren.doe.gov/femp/procurement/ice_makers.html**

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

LEED Relationship

SS
WE
EA **credit 1**
MR
EQ

3.5 Supply Air Temperature Reset (VAV)

PURPOSE

To reduce the energy use associated with cooling systems in VAV configurations when zones may require reheating of central supply air for temperature maintenance.

CRITERIA

Employ a control strategy that resets cooling supply air temperature in shoulder and cool weather seasons. During reset mode, employ a demand-based control that uses the warmest central supply air temperature setting that will satisfy all zones in cooling, to reduce the need for reheat.

GENERAL

The standard cooling supply air temperature setpoint (e.g. 55°F) is often only needed at design cooling conditions, i.e., summer months. In cooler seasons, the low cooling supply air temperature setpoint can lead to increased energy use by requiring both additional cooling and zone reheat in VAV systems, especially at the building perimeter. By resetting the supply air temperature setpoint higher during these conditions, the need for cooling and reheating energy use can be reduced.

A typical strategy is to reset the temperature of the cooling supply air to the warmest setting that still meets the cooling load of the warmest zone at any given time. This temperature setpoint may float through the range of 55 to 65°F in cooler seasons while still meeting cooling demand in the building. This strategy, supply air temperature reset or SATR, will also maximize the potential for economizer free cooling by expanding its range, especially helpful for displacement ventilation systems with their higher cooling supply air temperatures.

Moist outdoor conditions will affect the feasibility of supply air temperature setbacks. In moist climates, humidity monitoring should be used in conjunction with feedback from terminal boxes to determine whether reset is possible.

In the warmest months, the advantages of supply air temperature reset are lost, and a single setpoint is most effective.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

LEED Relationship

SS
WE
EA **credit 1**
MR
EQ

3.6 Indirect Evaporative Cooling

PURPOSE

Offset conventional cooling load by implementing energy efficient indirect evaporative cooling.

CRITERIA

Incorporate indirect evaporative cooling equipment to pre-cool outside air supplied to the building upstream of the conventional cooling equipment. Several configurations are available depending on equipment size and climate conditions; all provide energy savings over conventional cooling strategies.

GENERAL

Evaporative cooling technologies can deliver all or part of building comfort cooling needs by converting sensible heat (hot, dry air) to latent heat (cooler, moist air) through the process of evaporating water at ambient temperatures. The conventional direct evaporative cooler adds moisture to the conditioned air, which may not be appropriate in all climate types. Indirect evaporative coolers do not add moisture to building supply air and are therefore appropriate in a much broader range of climates and conditions.

Indirect evaporative cooling technology uses evaporation to cool a warm dry air stream below ambient temperatures. (Depending on equipment configuration, this air stream may be warm building exhaust, or outside air.) The cool, moist air stream passes through a heat exchanger to absorb heat (transfer cool) to the warm incoming outside air used to supply building cooling or ventilation systems. The moist air stream is exhausted before it is introduced to the building, but the incoming supply air is now pre-cooled before it reaches the conventional cooling coil, reducing the load on that equipment. Under many shoulder conditions, indirect evaporative cooling may meet all of the building cooling loads, completely offsetting conventional cooling needs and extending economizer function. Under other peak cooling conditions, the indirect evaporative module provides pre-cooling to reduce the load on the conventional cooling coil. Evaporative cooling in any form loses efficiency as outdoor humidity increases, so the effectiveness of the system is climate specific.

Evaporative cooling reduces cooling energy use and is particularly effective in reducing peak demand in hot, dry climates. Peak demand is reduced because power demand for evaporative systems remains constant as outside temperatures rise and because the efficiency and capacity of these systems tends to increase at higher outside temperatures while standard compressor-based systems become less effective at high outside temperature.

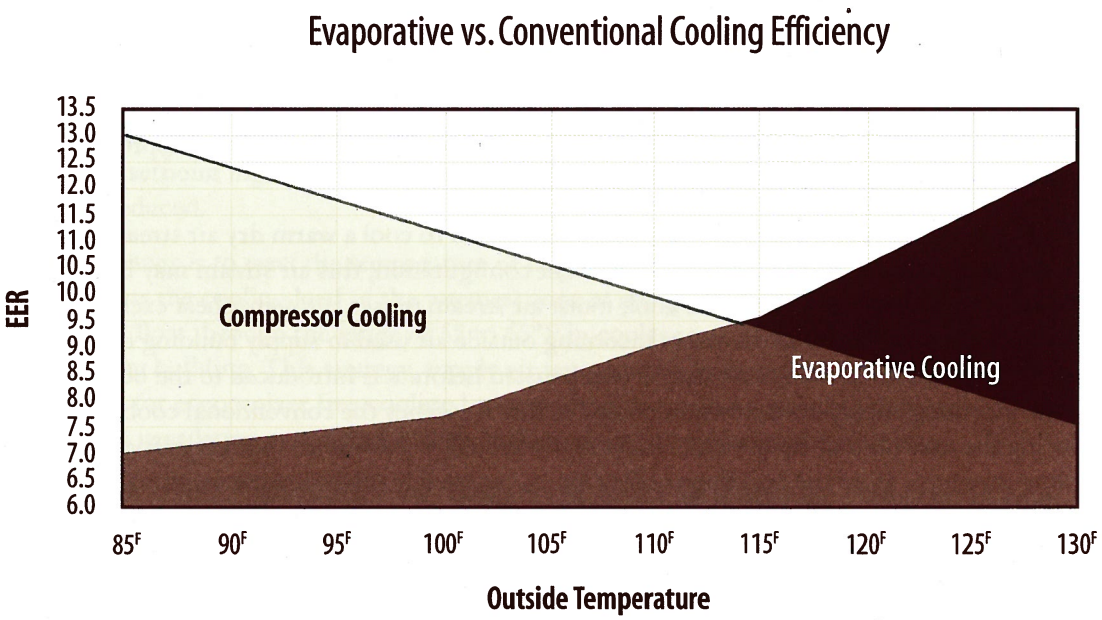
PRODUCT CONFIGURATIONS

INDIRECT-ONLY COOLERS

Indirect evaporative products currently on the market are of two basic types:

- **Traditional type** uses a standard plate-type heat exchanger and can reduce the dry-bulb temperature with a wet-bulb effectiveness of about 75%. While commercial scale indirect units can be used on their own, they are often found in larger specially engineered package systems.
- **Second type** of indirect cooler uses a more complex heat exchanger, involving multiple indirect heat exchange steps. Currently available products using this technology fall in the residential to light commercial range. They use a staged, cross-flow channeling system to cool air incrementally.

FIGURE 3.6.1



One of the huge advantages of evaporative cooling is that its efficiency increases with increased outdoor temperatures, while conventional compressor cooling becomes less efficient with increasing temperature. The chart has been simplified to save space. The compressor cooling is to scale but the evaporative cooling equivalent EER values are more than double what is shown here.

HYBRID SYSTEMS

The hybrid category includes systems that combine indirect evaporative cooling with at least one other cooling technology.

- **Indirect/Direct evaporative.** This two-stage evaporative cooling uses an indirect cooler to pre-cool the incoming air, which then passes to a direct evaporative cooling stage. The direct stage adds water to the air, but the system can still fully achieve the comfort conditions in areas of low humidity. Most recent product development has been directed at the residential sector, which may also be applicable to some small commercial buildings
- **Multi-stage built-up systems.** Many large-scale and engineered systems use a hybrid approach involving multiple components, often including both indirect and direct evaporative cooling as well as a conventional cooling module. The use of the three techniques together - exhaust air heat recovery, indirect evaporative cooling and direct evaporative cooling - may meet the full cooling load and provide 100% outside air, even without any of those individual components being exceptionally efficient. The smallest available scale for such systems is currently about 7.5 tons.
- **Indirect/DX.** A new, different hybrid approach, which is currently in the proof-of-concept stage, uses an indirect evaporative cooler packaged with an efficient economizer plus a compressor cycle that can be used when necessary to get the last 10°F or so of cooling in the supply air. This unit holds the promise of a 30- to 50% reduction in electrical demand.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

LEED Relationship

3.8 Night Venting

PURPOSE

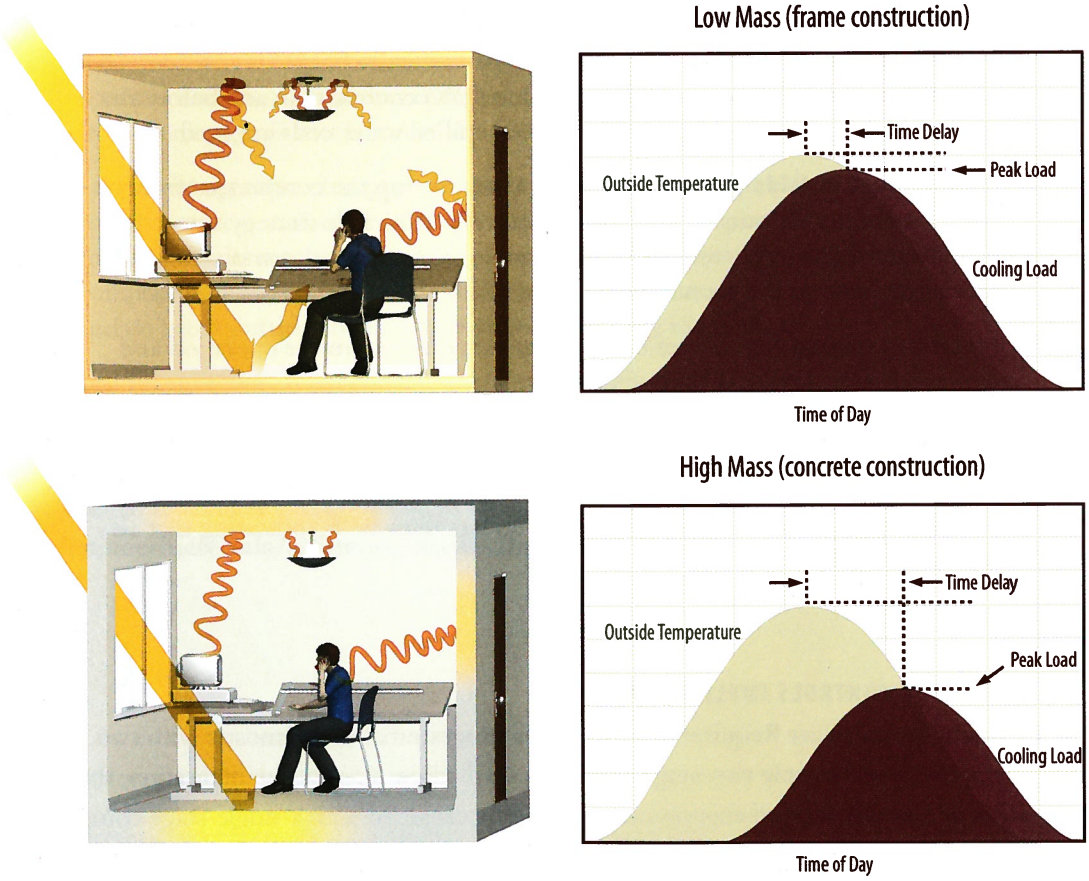
Use building's intrinsic thermal mass to reduce peak cooling loads by circulating cool nighttime air to pre-cool the building prior to daily occupancy in the cooling season.

CRITERIA

Install a building control system capable of operating ventilation fans in economizer mode on a scheduled basis in the cooling season. Set the controls to operate the ventilation fans to bring in outside air at partial flows for several hours prior to building occupancy each morning to pre-cool building mass and reduce peak cooling loads.

This strategy requires the incorporation of internal mass elements in the building (i.e. exposed concrete or masonry interior elements). Night ventilation should be controlled to prevent an increase in morning warm-up energy needs in winter and shoulder seasons. Excessive or prolonged fan operation will offset cooling energy savings, so consider implementation of low-flow or shorter duration night ventilation strategies. Night humidity conditions may preclude the use of this strategy.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.



Building mass can be used in conjunction with a night ventilation strategy to reduce peak cooling loads in the building spaces.

LEED Relationship

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3.9 Premium Economizer Performance

PURPOSE

Increase the savings associated with economizer systems by adding control and verification features to the economizer system.

CRITERIA

In addition to the Fundamental Economizer Requirements in Criteria 2.13, include the following in the design and implementation of the economizers:

- **Dedicated thermostat stage for economizer.** To obtain the greatest energy savings benefit, the economizer needs to provide cooling first, before the cooling compressor is engaged.
- **Differential changeover with both a return and outside air sensor.** Most economizer controllers have differential logic built in; the addition of a dry-bulb return air sensor (while maintaining an outside air sensor) increases savings.
- **Dry-bulb changeover in drier western climates and the use of enthalpy sensors in more humid eastern regions.** In western climates, high humidity rarely occurs near changeover temperatures, and dry-bulb sensors provide higher expected reliability at lower cost. In the more humid eastern US, enthalpy sensors are appropriate.
- **Primary control sensor placement** should be in the discharge air position, after the cooling coil, for a direct-expansion (DX) cooling coil, and before the cooling coil in the mixed-air position, when chilled water coils are used.
- **Low ambient outside air compressor lockout,** to stop the compressor from operating when the outside air is below setpoint. With this strategy, an economizer failure may result in a high temperature comfort complaint and service request, so the economizer is more likely to get needed service.
- **Installer training** that covers basic and advanced economizer operation and controls for the brand of economizer installed.
- **Advanced documented checkout.**
- **Minimum air flow.** The change in temperature across the cooling coil in full cooling, must be no more than 25°F and no less than 10°F, indicating that air flow is adequate.

GENERAL

THERMOSTAT AND CONTROLS IMPLICATIONS

The Premium Economizer Requirements require a programmable thermostat with two cooling stages. Even a simple two-stage thermostat will allow alternating integration, the best integration of compressor and economizer that can be obtained with a single-stage compressor.

More sophisticated programmable thermostats include microprocessor control and support full economizer integration with rooftop units employing multi-stage compressors or VFDs, meaning the economizer can be used to satisfy partial cooling loads, even when the compressor is running. Some microprocessor-based thermostats are "smart" enough to provide proportional integrated control and to include some anticipatory logic built into the control algorithms.

LEVELS OF ECONOMIZER CONTROL INTEGRATION

"Integration" refers to an economizer's ability to provide "partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load" (ASHRAE 2004, 38). Five discrete levels of integration exist, including a "non-integrated" case. The first two levels use a single-stage cooling thermostat, while the final three require a dedicated thermostat stage for the economizer.

- **Non-integrated or exclusive operation.** Below the changeover setting, only the economizer operates. Above the changeover setting, only mechanical cooling operates.
- **Time-delay integration.** On a call for cooling, the economizer operates for a set time (typically 5 minutes); then, if there is still a need for cooling, the cooling coil operates. The dampers return to minimum ventilation at the end of the call for cooling.
- **Alternating integration.** This is the best integration that can be achieved with a single-stage direct-expansion cooling unit. The first cooling stage activates the economizer. When the second stage is activated, the cooling compressor operates and the economizer dampers reduce OSA to avoid comfort problems from discharge air that is too cold.
- **Partial integration.** Integration is improved with a multiple-stage or variable-speed compressor direct-expansion cooling unit, able to provide partial cooling. Partial mechanical cooling provides less temperature drop when the compressor is on, and the economizer can use a lower outside air temperature and do more outside air cooling than in alternating integration.
- **Full integration.** A hydronic chilled-water cooling coil can be modulated to any cooling output, allowing the economizer to be fully open when additional cooling is required.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

3.10 Variable Speed Control

PURPOSE

Promote energy efficiency through variable control of air and fluid flow.

CRITERIA

Individual pumps serving variable flow systems and VAV fans having a motor horsepower of 5 hp or larger shall have controls and/or devices (such as variable speed control) that will result in pump or fan motor demand of no more than 30% of design wattage at 50% of design flow.

GENERAL

Variable-speed drives vary the frequency of air conditioning electricity in response to an electrical signal. When coupled to a fan or pump motor, the change in frequency will result in a corresponding change in motor speed. Since the power required to drive centrifugal fans or pumps is proportional to the cube of the fan or pump speed, large reductions in electricity are achieved when fans or pumps operate at reduced speeds.

Variable-speed drives are most commonly applied to supply and return fans for variable air volume systems, circulating pumps in hydronic systems and domestic water booster pumps in high-rise buildings. In many cases, the motors are controlled to maintain a constant pressure within air ducts or water pipes. A pressure sensor in the pipe or duct sends a signal to the building automation system that in turn sends an electronic signal to the drive. Thus, as valves and dampers close, the pressure rises, which in turn causes the flow to be reduced. The sensor should be located near the end of the distribution loop.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

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3.11 Demand-Responsive Buildings (Peak Power Reduction)

PURPOSE

Create buildings that help manage utility grid demand by responding to critical peak periods (either building peak or system peak) with equipment and design strategies able to reduce electrical demand or with equipment able to replace electricity supply.

CRITERIA

The building shall have the ability to automatically reduce total electrical demand by at least 10% during critical peak power periods. The building shall include an interface to the utility capable of responding to real-time signals which identify critical peak power periods. The building shall respond to this signal by utilizing one or more of the following strategies:

- Reduce mechanical equipment power demand.
- Reduce lighting equipment power demand without compromising necessary illumination in critical areas. Critical areas include spaces within the building that host tasks requiring a moderate to high degree of visual acuity (i.e. IESNA illuminance categories E or higher).
- Thermal energy storage.

On-site power generation using nonrenewable resources does not meet these requirements.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

3.12 On-site Supply of Renewable Energy

PURPOSE

Promote use of renewable energy in buildings.

CRITERIA

Incorporate an on-site renewable energy system to supply 5% or more of total building electrical loads.

Note: *Daylighting and passive solar systems are not considered part of this Criteria.*

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

A 60 kW grid-connected photovoltaic array on the roof of Oberlin College's Adam Joseph Lewis Center for Environmental Studies generates a substantial portion of the annual electricity use of the facility.

LEED Relationship

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3.13 Additional Commissioning Strategies

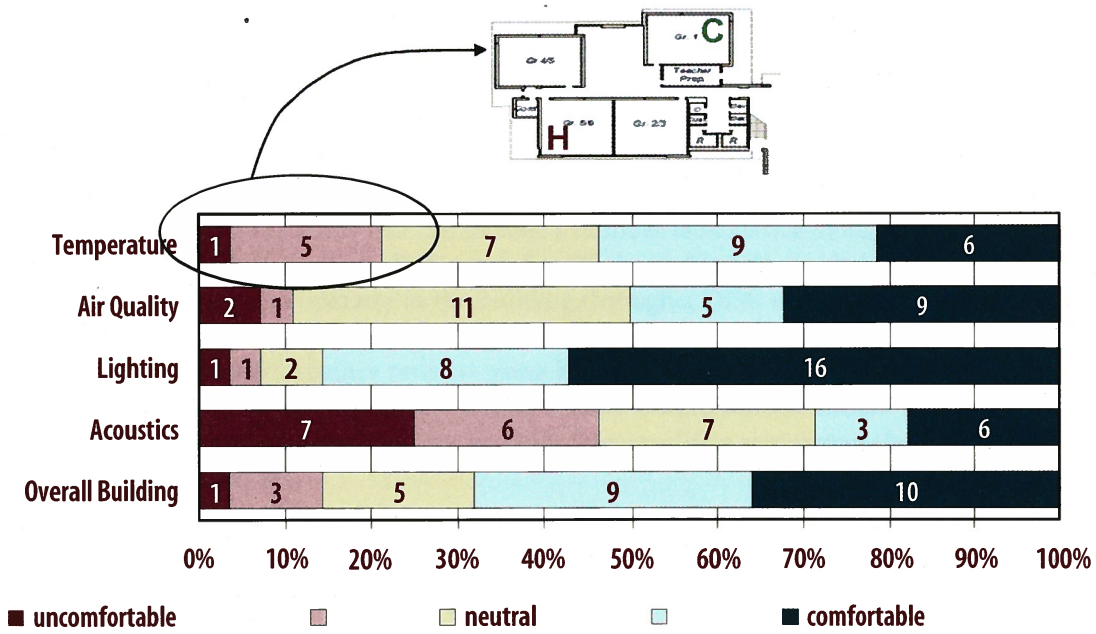
PURPOSE

Support the owner, design team, construction team and operations team in assuring the project's design intent is properly implemented from design through operation.

CRITERIA

- A third-party commissioning agent (CxA), independent of the design and construction management team, provides commissioning services to the building owner. The CxA must maintain certification credentials from either the Building Commissioning Association or an equivalent organization.
- A CxA conducts a peer review of the design development, construction documents, specifications and bid submittals. The CxA reviews the documentation developed to describe design intent in Criteria 1.2 and certifies that the final design package meets the intent of these documents. The CxA develops a commissioning plan for implementation as described in Criteria 2.14. The CxA also participates in the operator training undertaken in Criteria 1.5.

The CxA shall attend regular meetings with the owner's agent to review construction progress, pre-functional test requirements and witness acceptance test results. They shall verify test results and complete all documentation required by Criteria 2.14. The CxA is responsible for reviewing the final commissioning report with owner's agent and verifying that Criteria 2.14 is completed.



Occupant comfort survey data can help identify building operating problems. Additional information about building occupant surveys can be found at the Advanced Buildings website.

GENERAL

Additional commissioning utilizes Criteria 1.2, 2.14 and 1.5 as a framework to deliver building commissioning services through an independent, certified third party. Contracting for commissioning process services through a separate, independent professional or utilizing owner's employees enables the Commissioning Agent (CxA) to focus on the commissioning process and to avoid potential conflicts of interest.

In certain cases, the CxA may be an employee, associate or partner of the architect, engineer or construction management firm, but should not be part of the design team or construction management team. Whenever this choice is selected by the owner, the CxA should be separated from the design element or construction management unit in order to provide the owner with the independence required for the Commissioning Process to be successful and to avoid any conflicts of interest.

For additional references and information about this measure, visit **www.advancedbuildings.net/reference-materials/reference-materials-access-form**.

LEED Relationship

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3.14 Fault Detection and Diagnostics

PURPOSE

Provide tools to verify and maintain on-going operational performance of direct expansion rooftop unit (RTU) HVAC equipment by monitoring key operating condition and performance parameters, and providing reporting through a communications gateway either to a device in the building or to a remote site. Other commercial building HVAC equipment including chillers, ground source heat pumps and variable capacity (variable refrigerant flow) equipment may also have fault detection and diagnostic (FDD) monitoring and reporting capabilities. This section is focused on the most widely used HVAC system in smaller commercial building applications, the direct expansion (Dx) RTU with or without a gas heating component.

CRITERIA

Incorporate (FDD) capabilities in all RTU equipment selected for Advanced Buildings Core Performance projects to monitor equipment performance in the following areas:

- Airflow
- Economizer Operation
- Refrigerant Charge
- Sensors

HVAC manufacturer RTU product lines differentiate by price, efficiency, other features and control strategies. The majority of RTUs made and sold are the lowest priced units, with the lowest allowable EER/IEER ratings and are electromechanically controlled providing only a minimum component failure alarm notification at the thermostat in the building. Typically these alarms are only for catastrophic failures such as belt breakage or compressor failure along with a pre-programmed 'change filter' signal. These base units are not configured to be hooked into a Direct Digital Controller (DDC) or building energy management system through a communications gateway in order to provide operating condition data remotely to a building owner, facilities manager or service contractor. Increasing numbers of RTU models are microprocessor-controlled. These units cost more due to generally higher efficiency levels and greater set of features that can include a number fault alarms along with remote communications gateways, often a BACnet or LonWorks enabled device that can provide more detailed information to an operator in the building through a DDC system or to a remote site via a direct Ethernet connection to the Internet. It is assumed due to energy efficiency considerations, Core Performance projects using RTUs would have the higher end equipment specified that are microprocessor controlled, with more comprehensive feature sets and embedded fault alarms. However, alarms or FDD features differ across manufacturer product lines, even at the high end.

GENERAL

Studies conducted by NBI and many others have indicated multiple operating problems in RTUs, even those that are one to four years old.[1] At present, nothing has changed in this regard

[1] *http://www.newbuildings.org/sites/default/files/NWPCC_SmallHVAC_Report_R3.pdf*

based on continuing field experience through research and utility programs around the country. Oversizing of systems is typically ½ to 1 ton. There is little attention paid to quality installation practice. Service ("if it blows hot and cold, don't worry about it.") is the most common approach and is typically linked to the lowest priced HVAC contractor that can be found.

In fact, most of the problems are related to inadequate technician training, poor sizing, poor installation/commissioning, and poor maintenance (primarily driven by customer lack of understanding). The single largest sources of energy waste however, are related to equipment control by users topped by 1) 24 hour x 7 day fan operation when there is no special ventilation requirement, and 2) improper scheduling and related temperature set points, especially with equipment heating or cooling when there is no zone or building occupancy during a given day, night and weekend.

In all RTU systems, potential operating faults may occur at any time. There is no 'grace' period during which one expects flawless operation with optimal efficiency and performance. Severe faults are usually quickly detected by the occupants before any warning light or alarm is noticed. However, most faults cause degradation in operating performance and efficiency over the years, allowing the system to run, but wasting energy, potentially shortening equipment life (primarily the compressor), and potentially compromising occupant comfort and air quality.

The purpose of this Enhanced Criteria is to acknowledge the benefits of specifying embedded, automated fault detection of common degradation faults in the operation of HVAC equipment. The distinction made here between fault detection (alarms) and diagnosis has to do with the fact that while some fault conditions have single causes, others may have multiple potential causes and multiple faults can occur simultaneously and be hard to easily diagnose. FDD is fundamentally an adjunct function to the overall RTU control system and its capabilities. In larger rooftop unit sizes (>20 tons), most manufacturers offer optional communications modules to interconnect unit level conditioning monitoring and reporting to a DDC building energy management system or other building energy information system.

NON-ENERGY BENEFITS OF FDD

- **Lower operational and maintenance costs.** By maintaining optimal performance of the system, energy cost savings will occur over the life of the system. In addition, the fault detection features can actually decrease maintenance costs for a building owner by eliminating unnecessary maintenance costs.
- **Equipment life.** By maintaining operational peak efficiency, the life of the system, and in particular the compressor, the single most expensive component, will be extended.
- **Indoor air quality and occupant comfort.** The ability to maintain proper outside airflow to meet air quality and thermal comfort requirements is directly tied to the operating condition of the system and fault conditions that may arise.
- **Property management.** Organizations that manage multiple properties would perceive a significant benefit by having this component of building maintenance automated.

SAMPLE FDD CRITERIA

The following FDD framework should be reviewed and compared with the FDD or alarm functions that HVAC manufacturers already embed in their units or offer as an additional feature. This is not an exclusive list of diagnostic functions. This is the recommended minimum fault alarm set that should be specified in the HVAC equipment bid specification, as available. Unfortunately, at this time, there are no models in production that meet 100% of the FDD functions recommended. However, HVAC equipment that meets the requirements of Criteria 2.5, Mechanical Equipment Efficiency (CEE Tiers 1 & 2) will include 60-75%+ of the functionality recommended. Manufacturer's technical manuals provide detailed descriptions of available embedded and optional fault alarms. At present, there are no national standards or guidelines that provide consumers with methods of test to substantiate the various alarms or for the conditions that determine alarm thresholds. Work on the test methods and establishing fault thresholds is underway in California to meet proposed Title 24 RTU FDD requirements and just getting underway at ASHRAE.

The unit controller should detect and send a fault signal for the following conditions:

SEVERE FAULTS

- Failed compressor
- Failed evaporator fan motor
- Failed evaporator fan belt
- Failed condenser fan motor
- Sensor failure (all OEM products that are microprocessor-controlled have a sensor alarm(s)

DEGRADATION FAULTS

The FDD system should detect and report as many of the following subsystem and component faults as possible:

Controls

- Excess cycling (less than 5 minutes/10 times or more in 24 hours)
- Failed relief damper
- Simultaneous heating and cooling
- When conditions are favorable for economizer operation and economizer is not active
- When conditions are not favorable for economizer operation and economizer is active

DOE/CBEA RTU CHALLENGE FDD SPEC
SENSOR FAILURE/FAULT (INCL. DRIFT)
HIGH REFRIGERANT CHARGE
LOW REFRIGERANT CHARGE
COMPRESSOR SHORT CYCLING
LOW EVAPORATOR AIR FLOW
DIRTY FILTER
CAPACITY DEGRADATION
EFFICIENCY DEGRADATION
NOT ECONOMIZING WHEN IT SHOULD
DAMPER NOT MODULATING
EXCESS OUTDOOR AIR
LOW VENTILATION

Refrigerant System

- Superheat and subcooling should be within a range indicating charge is correct, assuming other faults/conditions have been addressed.
- Low refrigerant charge
- High refrigerant charge
- Air (non-condensable) in refrigeration loop
- Liquid line restriction in refrigeration loop

Air Handling System/Airflow

These fault conditions affect indoor air quality and reduce refrigeration cycle efficiency:

- Dirty air filter (all OEM equipment includes this alarm at the thermostat, but it is most often a timer-based alarm, not a condition-based alarm)
- Dirty evaporator coil
- Dirty condenser coil
- Reduced airflow
- Excessive airflow

RTU FDD FUTURE

The introduction of the High Performance Rooftop Challenge by US DOE and the Commercial Building Energy Alliances (CBEA), provides an important look at where some major national retailers want RTU equipment to go including higher efficiency (40%+ over current federal minimum standards) and comprehensive FDD features currently not offered by any OEM manufacturer.[2] The FDD features of interest to the CBEA are below. If this full set were available, this would represent the minimum FDD requirement for Core Performance projects specifying conventional RTUs.

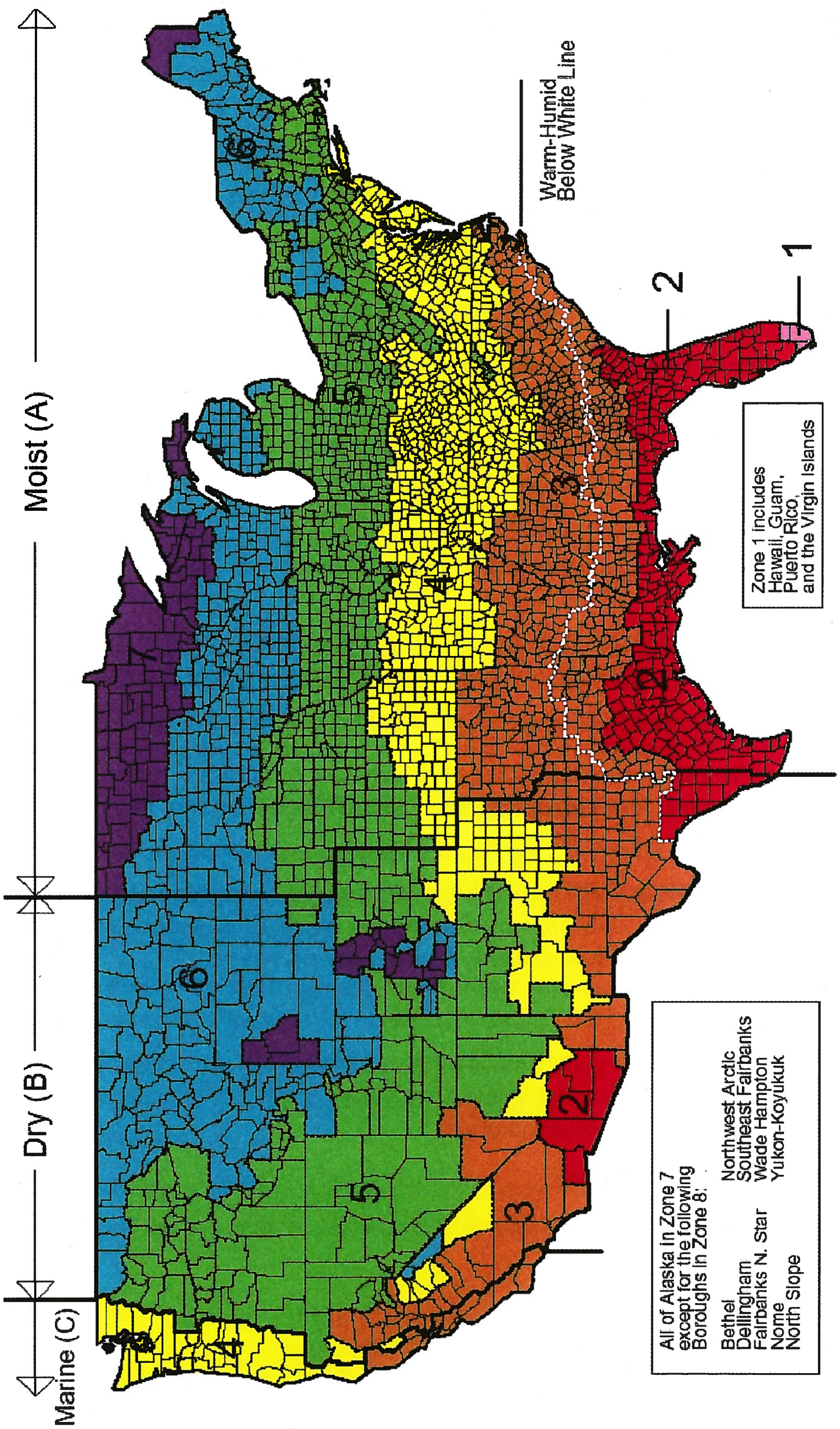
[2] *http://www1.eere.energy.gov/buildings/alliances/rooftop_specification.html*

VI. Appendices

Advanced Buildings Core Performance Guide

Appendix B:

Climate Zone Map



Climate Zones are defined primarily by heating or cooling loads, then by type (marine, Dry, Moist), creating a set of climate bands spanning the country.

Courtesy US Department of Energy, Office of Building Technologies, State and Federal Programs

Appendix C:
Acronyms and Definitions

The following definitions apply throughout the Guidelines:

1.1 ACRONYMS

ASHRAE – American Society of Heating, Refrigerating and Air-conditioning Engineers

HVAC – Heating, Ventilating and Air Conditioning

IECC – International Energy Conservation Code

IESNA – Illuminating Engineering Society of North America

LEED – Leadership in Energy and Environmental Design

USGBC – US Green Buildings Council

VAV – Variable Air Volume

VSD – Variable Speed Drive

1.2 DEFINITIONS

ballast: a device used in conjunction with an electric-discharge lamp to cause the lamp to start and operate under the proper circuit conditions of voltage, current, wave form, electrode heat, etc.

boiler: a self-contained low-pressure appliance for supplying steam or hot water.

building envelope: The elements of a building which enclose conditioned spaces through which thermal energy is capable of being transferred to or from the exterior or to or from unconditioned spaces.

Building Information Modeling (BIM): a building modeling and information tool developed for the construction industry to allow information sharing across all providers and facets of a project using a common database. It is available from several providers.

cfm: cubic feet per minute.

coefficient of performance (COP) – cooling: the ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigeration system or some specific portion of that system under designated operating conditions.

conductance: see thermal conductance.

construction documents: drawings and specifications used to construct a building, building systems, or portions thereof.

continuous insulation (cont. ins. or ci): insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior, exterior, or is integral to any opaque surface of the building envelope.

control device: a specialized device used to regulate the operation of equipment.

critical demand period: the period of peak electricity or natural gas demand, as defined by a utility tariff, that establishes annual system peak load. The critical demand period is different from typical demand periods as traditionally defined by utility tariffs.

daylit area: building floor area in proximity to glazing that is affected by natural daylight. Daylit area relative to glazing is generally defined as follows:

(a) vertical glazing: the daylit area extends perpendicularly from the wall 1.5 times the head height of the glazing, or to the nearest 60-inch or higher opaque partition, whichever is less; and a width of the window plus either 2 feet on each side.

(b) horizontal glazing: the daylit area is the footprint of the skylight well at the ceiling plus, in each of the lateral and longitudinal dimensions of the skylight, a distance of 0.75 times the ceiling height from the edge of the skylight well.

daylight glazing: exterior glazing over 6 feet above the finished floor.

demand: the highest amount of power (average kW over an interval) recorded for a building or facility in a selected time frame.

Demand Control Ventilation (DCV): A system of control based on real-time monitoring of carbon dioxide (CO2) to either insure indoor air quality and/or reduce energy consumption in unoccupied spaces.

design conditions: specified environmental conditions, such as temperature and light intensity, required to be produced and maintained by a system and under which the system must operate.

distribution system: conveying means, such as ducts, pipes, and wires, to bring energy from a source to the point of use. The distribution system includes such auxiliary equipment as fans, pumps, and transformers.

door: all operable opening areas (which are not fenestration) in the building envelope, including swinging and roll-up doors, fire doors, and access hatches. Doors that are more than one-half glass are considered fenestration. (See fenestration.) For the purposes of determining building envelope requirements, the classifications are defined as follows:

(a) non-swinging: roll-up, sliding, and all other doors that are not swinging doors.

(b) swinging: all operable opaque panels with hinges on one side and opaque revolving doors.

door area: total area of the door measured using the rough opening and including the door slab and the frame. (See fenestration area.)

DX – Direct Expansion: Refers to cooling systems that pass the air to be cooled directly over refrigerant cooling coils rather than using an intermediary fluid, such as water.

economizer, air: a duct and damper arrangement and automatic control system that together allow the use of outside air directly to reduce or eliminate the need for mechanical cooling during mild or cold weather.

ERV – Energy Recovery Ventilator: A device that uses heat and moisture exchangers to transfer both sensible and latent heat between the supply air and return air to minimize energy use and improve comfort. See also HRV.

efficiency: actual performance compared to ideal performance at specified rating conditions.

emittance: the ratio of the radiant energy emitted by a specimen to that emitted by an ideal blackbody at the same temperature and under the same conditions.

energy: the capacity for doing work. It takes a number of forms that may be transformed from one into another such as thermal (heat), mechanical (work), electrical, and chemical. Customary measurement units are British thermal units (Btu) and watt hours (Wh) where 1 Wh = 3.413 Btu.

energy efficiency ratio (EER): the ratio of net cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. (See coefficient of performance (COP)—cooling.)

energy performance rating: the energy use of a proposed building under simulated operating conditions normalized for a specific variable. Projected energy use targets can be used for buildings in the design or construction process. Examples include kBtu/sf/yr, $/sf/yr, $/gross sales, Energy Performance Rating Score (US EPA), or like expressions of energy performance.

EPAct 05: federal energy policy act adopted in 2005. EPAct05 provides a number of important incentives to reduce energy costs for institutional and commercial buildings.

FDD – Fault Detection and Diagnostics: software, typically embedded in building operations software, that identifies and, if possible, diagnoses faults in building equipment and/or operations. Some packages also take remedial action automatically.

fenestration: all areas (including the frames) in the building envelope that let in light, including windows, plastic panels, clerestories, skylights, glass doors that are more than one-half glass, and glass block walls. (See building envelope and door.) A skylight is a fenestration surface having a slope of less than 60 degrees from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

fenestration area: total area of the fenestration measured using the rough opening and including the glazing, sash, and frame. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area.

fixture: the component of a luminaire that houses the lamp or lamps (and ballast if present), positions the lamp, shields it from view, and distributes the light. The fixture also provides for connection to the power supply.

flue damper: a device in the flue outlet or in the inlet of or upstream of the draft control device of an individual, automatically operated, fossil fuel-fired appliance that is designed to automatically open the flue outlet during appliance operation and to automatically close the flue outlet when the appliance is in a standby condition.

F-value: value of the heat loss through the edge and body of a slab-on-grade floor expressed in terms of Btu/hrF per linear foot of perimeter. It represents the integral of all the various pathways heat travels out of the slab.

heating seasonal performance factor (HSPF): the total heating output of a heat pump during its normal annual usage period for heating (in Btu) divided by the total electric energy input (in kWh) during the same period.

HRV – Heat Recovery Ventilator: A device that uses a heat exchanger to transfer sensible heat between the supply air and return air flows to minimize energy use and improve comfort. See also ERV.

HVAC system: Heating, Ventilation, and Air Conditioning; the equipment, distribution systems, and terminals that provide, either collectively or individually, the processes of heating, ventilating, or air conditioning to a building or portion of a building.

infiltration: the uncontrolled inward air leakage into a building caused by pressure differences across these elements due to factors such as wind, inside and outside temperature differences (stack effect), and/or imbalance between supply and exhaust air systems.

integrated part-load value (IPLV): a single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.

kilowatt (kW): the basic unit of electric power, equal to 1000 W and 3413 Btu/h.

labeled: equipment or materials to which a symbol or other identifying mark has been attached by the manufacturer indicating compliance with specified standards or performance in a specified manner.

lamp: a generic term for a man-made light source often called a bulb or tube.

(a) **compact fluorescent lamp:** a fluorescent lamp of a small compact shape, with a single base that provides the entire mechanical support function.

(b) **fluorescent lamp:** a low-pressure electric discharge lamp in which a phosphor coating transforms some of the ultraviolet energy generated by the discharge into light.

(c) **general service lamp:** a class of incandescent lamps that provide light in virtually all directions. General service lamps are typically characterized by bulb shapes such as A, standard; S, straight side; F, flame; G, globe; and PS, pear straight.

(d) **high-intensity discharge (HID) lamp:** an electric discharge lamp in that light is produced when an electric arc is discharged through a vaporized metal such as mercury or sodium. Some HID lamps may also have a phosphor coating that contributes to the light produced or enhances the light color.

(e) **incandescent lamp:** a lamp in which light is produced by a filament heated to incandescence by an electric current.

(f) **reflector lamp:** a class of incandescent lamps that have an internal reflector to direct the light. Reflector lamps are typically characterized by reflector shapes such as R, reflector; ER, ellipsoidal reflector; PAR, parabolic aluminized reflector; MR, multi-faceted reflector; and others.

lighting system: a group of luminaires circuited or controlled to perform a specific function.

lighting power density (LPD): the connected lighting load power (in Watts) per unit area. Calculation of LPD includes combined energy use of lamp and ballast systems. It is typically characterized by building classification or space function and is used as an energy code limit value for a given building type or space use.

mechanical cooling: reducing the temperature of a gas or liquid by using vapor compression, absorption, desiccant dehumidification combined with evaporative cooling, or another energy-driven thermodynamic cycle. Indirect or direct evaporative cooling alone is not considered mechanical cooling.

occupant sensor: a device that detects the presence of people within an area.

opaque envelope: all areas in the building envelope, except fenestration and building service openings such as vents and grilles. (See building envelope and fenestration.)

operational performance requirements: A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance Criteria, budgets, schedules, success Criteria and supporting information.

orientation: the direction an envelope element faces relative to know referent, such as True North, i.e., the relative direction of a vector perpendicular to and pointing away from the surface outside of the element.

OA or OSA - outdoor (outside) air: air that is outside the building envelope or is taken from outside the building that has not been previously circulated through the building.

projection factor (PF): the ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection, in consistent units.

proposed design: a computer representation of the actual proposed building design or portion thereof used as the basis for calculating the design energy cost.

PTAC – Packaged Terminal Air Conditioning units: also known as "window-shakers, a factory-selected combination of heating and cooling components, assemblies or sections intended to serve a single room or zone.

R-value of insulation: the thermal resistance of the insulation alone as specified by the manufacturer in units of h·ft2·°F/Btu at a mean temperature of 75°F. Rated R-value refers to the thermal resistance of the added insulation in framing cavities or insulated sheathing only and does not include the thermal resistance of other building materials or air films. (See thermal resistance.)

record drawings: drawings that record the conditions of the project as constructed. These include any refinements of the construction or bid documents (often referred to as "as-builts".

reflectance: the percentage of the light reflected by a surface relative to the light incident upon it.

roof: the upper portion of the building envelope, including opaque areas and fenestration, that is horizontal or tilted at an angle of less than 60° from horizontal.

seasonal energy efficiency ratio (SEER): the total cooling output of an air conditioner during its normal annual usage period for cooling (in Btu) divided by the total electric energy input during the same period (in Wh).

utility service: the equipment for delivering energy from the supply or distribution system to the premises served.

single-zone system: an HVAC system serving a single HVAC zone.

skylight: see fenestration.

solar heat gain coefficient (SHGC): the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space. (See fenestration area.)

space: an enclosed space within a building. Spaces are defined as follows for the purpose of determining building envelope requirements.

(a) conditioned space: a heated or cooled space, or both, within a building and, where required, provided with humidification or dehumidification means so as to be capable of maintaining a space condition falling within the comfort envelope set forth in ASHRAE 55.

(b) unconditioned space: a space other than a conditioned space.

system: a combination of equipment and auxiliary devices (e.g., controls, accessories, interconnecting means, and terminal elements) by which energy is transformed so it performs a specific function such as HVAC, service water heating, or lighting.

TAB – Test and Balance: the process of verifying and calibrating the air flow through a building air conditioning system under varying operating conditions.

thermal resistance (R-value): the reciprocal of the time rate of heat flow through a unit area induced by a unit temperature difference between two defined surfaces of material or construction under steady-state conditions. Units of R are h·ft2·°F/Btu.

thermostatic control: an automatic control device or system used to maintain temperature at a fixed or adjustable set point.

tinted: (as applied to fenestration) coloring that is integral to the glazing material. Tinting does not include surface applied films such as reflective coatings, applied either in the field or during the manufacturing process.

Ton: a unit of cooling equal to 12,000 Btu. Derived from the amount of heat absorbed by a ton of ice while melting.

U-factor (thermal transmittance): heat transmission in unit time through unit area of a material or construction and the boundary air films, induced by unit temperature difference between the environments on each side. Units of U are Btu/h·ft2·°F.

unitary equipment: one or more factory-made assemblies that normally include an evaporator or cooling coil and a compressor and condenser combination. Units that perform a heating function are also included.

VAV – Variable Air Volume: a system designed to supply only the volume of conditioned air to a space that is needed to satisfy the thermal or ventilation load, saving fan energy.

ventilation: the process of supplying fresh air by natural or mechanical means to or from any space.

Visible Light Transmittance (VLT): a measure of the percentage (0-100%) of visible light transmitted by the glazing.

VSD (variable speed drive) or VFD (variable frequency drive) or ASD (adjustable speed drive): an electronic controller that allows an electric motor to operate over a range of speeds. Typically used on fans and pumps in variable flow systems.

wall area, gross: the area of the wall measured on the exterior face from the top of the floor to the bottom of the roof.

warm-up: increase in space temperature to occupied set point after a period of shutdown or setback.

A10

SUBSTRUCTURE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Substructure comprises foundations, basements, floors on grade, and other substructure elements.

B. Foundations: Structures responsible for transferring dead loads, live loads, and environmental loads of completed building to the earth in such a way that the building is supported evenly and without movement.
   1. Standard Foundations: Spread footings below columns, linear spread footings below loadbearing walls, foundation walls not part of basements, caisson (pier) caps, and pile caps.
   2. Other Foundations: All types of special foundation systems, including permanent shoring and underpinning, raft foundations, piles, drilled piers (caissons), cofferdams, and permanent dewatering systems.

C. Basements: Space-enclosing elements below grade, including necessary excavation, structural walls and floor, and other elements of enclosure such as waterproofing and thermal insulation.
   1. Basement Excavation: Excavation, excavation supports that become a permanent part of substructure, backfill, and compaction of backfill for basement construction.
   2. Basement Walls: All elements of wall construction that occur below or partially below grade, including thermal insulation, waterproofing and dampproofing, and subdrainage.

D. Floors on Grade: Structural slabs, individual pavers, and framed flooring systems that are installed over fill or at excavated and compacted grade, including all depressions in the floor, such as trenches, pits, and sumps; also equipment bases, under floor and perimeter drainage, thermal insulation at floor edge, and moisture barriers installed integrally with floor system.

E. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. ACI 201.2R - Guide to Durable Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (errata 2007).

D. ASTM E1155 - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers; 1996 (Reapproved 2008); or ASTM E1155M.

E. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

F. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

G. EPA/625/R-92/016 - Radon Prevention in the Design and Construction of Schools and Other Large Buildings.

PART 2 PRODUCTS AND METHODS

2.01 METHODS OF CONSTRUCTION

A. Use any of the following methods and techniques:
   1. Excavation, backfill, and compaction by machine or hand.
   2. Pile driving.
   3. Caisson or pier drilling.

4. Other systems as may be recommended by Owner's geotechnical engineer, accepted by Owner, and directed by Owner to Architect and structural engineering consultant.

B. Do not use any of the following methods and techniques:
1. Systems not recommended by Owner's geotechnical engineer.

2.02 FOUNDATIONS

A. Use one or more of the following:
1. Concrete slab on grade.
2. Reinforced concrete spread footings.
3. Cast-in-place reinforced concrete caissons.
4. Driven piles.
5. Reinforced concrete structural elements.
6. Other systems acceptable to College Facilities Services Department.

B. Do not use any of the following:
1. Reinforced masonry.
2. Structural steel.
3. Treated wood.
4. Untreated wood.
5. Displacement piles.
6. Timber piles.
7. Unfilled tubular steel piles.
8. Systems not specifically approved by College Facilities Services Department.

2.03 BASEMENT WALLS

A. Use one of the following:
1. Reinforced concrete.
2. Insulated concrete form foundation walls.
3. Other systems acceptable to College Facilities Services Department.

B. Do not use any of the following:
1. Precast, prestressed concrete.
2. Non-reinforced masonry.
3. Reinforced masonry.
4. Systems not specifically approved by College Facilities Services Department.

2.04 FLOORS ON GRADE

A. Use the following:
1. Concrete floor slabs; except where structurally supported floors with crawl space are recommended by geotechnical engineer and accepted by Owner.

B. Do not use any of the following:
1. Systems not specifically approved by College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide substructure as required to support the completed and occupied building safely and without uncontrolled subsidence or other movement.

B. Provide floors on grade as required to enclose habitable spaces and support interior functions without subsidence, structural cracking, or other uncontrolled movement.

C. Provide basement walls as required to enclose habitable space below grade.

D. Where space for excavations with sides sloped at minimum of 1:2 vertical to horizontal is not available, design retaining walls to resist soil and water pressure as well as live loads until permanent basement elements are constructed.

E. When excavation extends below bearing stratum for adjacent structures provide permanent underpinning to extend foundations of structures on adjacent property lines.

F. Prevent deterioration of loadbearing stratum due to accumulation of water in excavation.

G. Where substructure is integral with elements defined within another element group, meet requirements of both element groups.

H. In addition to the requirements of this Section, comply with all applicable requirements of General Facility Design Requirements.

3.02 AMENITY AND COMFORT CRITERIA

A. Thermal Performance: Provide thermal resistance as necessary to maintain interior comfort levels specified and in accordance with code and the following:
   1. Average Thermal Transmittance: U-value of 0.15 IP, maximum, for portions of substructure in contact with earth and enclosing conditioned space.
   2. Thermal Resistance:
      a. Minimum R-value of 10.0 IP, minimum, for portions above grade or within 36 in below grade and enclosing conditioned space.
   3. Condensation: None on interior surfaces under normal interior temperature and relative humidity conditions, during 97-1/2 percent of the days in the coldest 3 months of the year.
   4. Vapor Retardation: Limit vapor transmission through floor construction to maximum rate of 0.1 perms at locations where impermeable applied interior finishes such as resilient flooring, wood flooring, or acrylic terrazzo are used.
      a. Use supplementary vapor retarder if necessary to meet requirements.
      b. Use method of sealing joints between vapor retarder elements that will be effective given available construction practices.

B. Water Penetration Resistance: Prevent ground water penetration into the interior of the building, under any circumstances.
   1. Waterproofing: Provide permanent waterproofing at portions of foundation that extend below finished grade and enclose habitable space, using any of the following methods:
      a. Permanent, waterproof barrier on exterior of basement construction, protected against damage from backfill.
   2. Vapor Resistance at Floors on Grade: Provide permanent vapor retarder membrane for floors on grade as required by the coder. Acceptable methods are any of the following:
      a. Permanent vapor retarder complying with ASTM E1754, Class A beneath floor construction, protected against damage from floor installation; installed according to ASTM E1643.
   3. Drainage: Provide method of collecting and draining water away from exterior surfaces and from underside of elements that enclose habitable space, if recommended by geotechnical engineer, or if required by College Facilities Services Department.

C. Water Accumulation: Prevent accumulation of water in crawl spaces or open areas adjacent to substructure.

D. Natural Light: For spaces located at basement level and required to have natural light, provide daylighting levels not less than those provided for comparable spaces located completely above grade.
   1. Fenestration: Provide fenestration that comprises not less than 35 percent of basement wall area for such spaces.

E. Acoustical Performance: Limit sound transmission through substructure as follows:
   1. Ambient Sound Level: during normal hours of occupancy.
   2. Vibration Resistance: Use substructure elements that will not resonate at frequencies that are characteristic of ambient underground sound and vibration sources at the project site.
      a. Avoid sympathetic vibration at frequencies within the audible range of 500-4000 Hz.
      b. Mass: Not less than 75 lb/cu ft.

F. Floor Flatness (FF): Provide floors on grade engineered and constructed to achieve minimum degree of flatness as follows, when measured in accordance with ASTM E1155:
   1. Specified Overall Value (SOV) at locations required by College Facilities Services Department: 35.
   2. Minimum Localized Value (MLV): 24.

3.03 HEALTH AND SAFETY CRITERIA

A. Fire Resistance: Design and select materials to provide fire resistance in accordance with code.
   1. For all elements required to have a fire resistive rating and which are not made of materials and systems specified as acceptable by the code, use proven-by-mock-up construction.

B. Substance Exclusion: Design to prevent accumulation of harmful chemicals and gases in spaces below substructure and subsequent penetration into occupied spaces.
   1. Radon: Prevent accumulation and penetration of radon by any of the following means:
      a. Airtight construction.
      b. Impermeable seals at all service penetrations of enclosure elements.
      c. Active soil depressurization system in accordance with recommendations of EPA/625/R-92/016.
      d. Building pressurization in accordance with recommendations of EPA/625/R-92/016.

C. Vermin Resistance: Design for protection against infestation of construction by ground dwelling termites and other vermin, using any of the following methods:
   1. Treatment of soil adjacent to substructure with EPA-approved chemicals prior to construction.
   2. Elimination of gaps or cracks in substructure construction.
   3. Impermeable seals at all service penetrations of enclosure elements.
   4. Physical barriers to the movement of termites.
   5. No use of untreated wood within 12 in of soil.
   6. No use of continuous planes of exterior foam insulation extending from below grade to areas above grade.

3.04 STRUCTURAL CRITERIA

A. Capacity: Design to provide loadbearing substructure members as required by code and designed to distribute dead loads, live loads, and environmental loads so that bearing capacity of soil is not exceeded.
   1. Extend bearing portions of substructure to levels below frostline at project location; not less than 3 ft below grade.
   2. Minimum Wall Thickness: 8 in.
   3. Minimum Wall Reinforcement: Steel with minimum yield strength not less than 60,000 psi.
   4. Spread Footings: Designed not to exceed the allowable soil bearing capacity.
   5. Caissons and Drilled Piers: Designed with adequate friction to withstand loading or bearing on rock.
   6. Piles: Designed with adequate friction to withstand loading.

B. Dead Loads: Accommodate loads from weights of building materials, construction itself, and all fixed service equipment.

C. Live Loads: Accommodate loads from use and occupancy of the building, either uniformly distributed loads as prescribed by code or concentrated loads, whichever are more demanding structurally.
   1. Uniformly Distributed Loads: As required by code for building occupancy.
   2. Concentrated Loads: As required by project program and building design.

D. Environmental Loads: Accommodate loads from all environmental forces in accordance with code and the following:
   1. Lateral Soil Loads: Lateral pressure of soil adjacent to vertical substructure elements, including potential surcharge from fixed or moving loads and potential hydrostatic pressure.
   2. Vertical Soil Loads: Full hydrostatic pressure applied over entire substructure area.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span: Same as building service life without any deterioration.

B. Concrete Durability:
   1. Monolithic Concrete Floor Slabs on Grade: Composition and finishing as recommended by ACI 302.1R based on type of anticipated traffic and intended use.
   2. Concrete Slabs on Grade Partly or Completely Exposed to Freezing Conditions:
      a. Water-Cement Ratio: As recommended by ACI 302.1R.
      b. Air Content: In accordance with recommendations of ACI 201.2R.

END OF SECTION

B10

SUPERSTRUCTURE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The superstructure comprises roofs and elevated floors and their supports.

B. Roofs: Roof construction, including canopies, and elements required for their support, insulation, fireproofing, and firestopping.

C. Elevated Floors: Floor construction above grade and within basements, including balcony, mezzanine, and ramp floors, floors elevated for access, stair construction if part of the structure, and roof decks intended for occupant live load; and the elements required for their support, insulation, fireproofing, and firestopping, as well as finishing, if an integral part of the floor construction.

D. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. AAMA 1503 - Voluntary Test Method for Thermal Transmission and Condensation Resistance of Windows, Doors, and Glazed Wall Sections.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM C755 - Standard Practice for Selection of Vapor Retarders for Thermal Insulation.

E. ASTM E84 - Standard Test Methods for Surface Burning Characteristics of Building Materials.

F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

G. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

I. ASTM E1677 - Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.

PART 2 PRODUCTS

2.01 SUPERSTRUCTURE

A. Use one of the following:
1. Structural steel frame, concrete-filled steel deck for floors, and unfilled steel deck for roofs.
2. Cast-in-place reinforced concrete frame and slabs.
3. Precast concrete frame and floor and roof units.
4. Load-bearing masonry walls, open-web steel joists, steel deck, and minor structural steel.
5. Other systems acceptable to College Facilities Services Department.

B. Do not use:
1. Pre-engineered metal building.
2. Air-supported structure.
3. Wood structural members.
4. Non-reinforced load-bearing masonry.
5. Do not use liquid-membrane curing compound on concrete floors unless it will not interfere with adhesion of floor finishes.
6. Systems not specifically approved by College Facilities Services Department.

2.02 ROOF SUPERSTRUCTURE

A. Structure Supporting Roofs:
   1. Use one or more of the following:
      a. Structural steel beams, columns, girders, joists, and wind-bracing.
      b. Cast-in-place reinforced concrete beams, columns, walls, girders, and joists.
      c. Precast concrete beams, columns, tees, and hollow slabs.
      d. Open-web steel joists or joist girders.
      e. Load-bearing concrete masonry wall.
      f. Load-bearing brick masonry walls.
      g. Load-bearing heavy timber wood posts and beams.
      h. Glued-laminated wood columns, beams, and arches.
      i. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Dead-flat roofs.
      b. Systems not specifically approved by College Facilities Services Department.

B. Roof Decks:
   1. Use one or more of the following:
      a. Steel deck without concrete fill.
      b. Concrete-filled steel deck.
      c. Concrete-filled composite steel deck, minimum 2-1/2 inches concrete thickness from top of steel deck.
      d. Cast-in-place reinforced concrete slabs, minimum 4 inches thick.
      e. Precast concrete tees or hollow core slabs without additional concrete covering.
      f. Precast concrete tees or hollow core slabs covered with minimum 1-1/2 inches concrete.
      g. Tongue-and-groove wood decking, minimum 1-1/2 inches thick.
      h. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Any construction with unprotected openings to floor below.
      b. Systems not specifically approved by College Facilities Services Department.

C. Canopy Decks: Same as for roof decks.

2.03 ELEVATED FLOOR SUPERSTRUCTURE

A. Structure Supporting Floors:
   1. Use one or more of the following:
      a. Structural steel beams, columns, girders, joists, and wind-bracing.
      b. Cast-in-place reinforced concrete beams, columns, walls, girders, and joists.
      c. Precast concrete beams, columns, tees, and hollow slabs.
      d. Open-web steel joists or joist girders.
      e. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Wood structural members.
      b. Unfireproofed structural steel.
      c. Systems not specifically approved by College Facilities Services Department.

B. Plaza Decks: Same construction as structure supported floors.

2.04 COMPONENTS OF SUPERSTRUCTURE ELEMENTS

A. Fireproofing:
   1. If applied fireproofing is required, use one of the following:
      a. Concealed:
         1) Sprayed-on cementitious.
      b. Interior, Exposed But Out of Reach:
         1) Sprayed-on cementitious.
         2) Intumescent.

c. Exterior, Exposed But Out of Reach:
   1) Sprayed-on cementitious.
   2) Intumescent.
d. Exposed within Reach:
   1) Sprayed-on high-density cementitious.
   2) Intumescent.

2. Do not use:
   a. Sprayed-on mineral fiber.
   b. Systems not specifically approved by College Facilities Services Department.

B. Firestopping: As required by the code.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide structural elements, above grade and within basements, capable of supporting all anticipated loads without failure or damage.

B. Do not use any electrically-operated or fuel-powered construction for support of floor or roof members.

C. Where superstructure elements also must function as elements defined within another element group, meet requirements of both element groups.

D. In addition to the requirements of this section, comply with all applicable requirements of General Colorado College Facility Design Guidelines.

3.02 AMENITY AND COMFORT CRITERIA

A. Thermal Performance of Plaza Decks: Same as that required for roofs.

B. Thermal Performance of Roofs, Including Elements on Top of Roof Deck:
1. Average Thermal Transmittance: U-value of 0.05 IP.
2. Maximum Thermal Transmittance of Any Portion: U-value of 0.05 IP.
3. Condensation Resistance Factor (CRF): Minimum 50, when measured in accordance with AAMA 1503.

C. Water Penetration Resistance: Where roof coverings as specified are not used over roofs provide supplementary waterproof construction providing equivalent protection.

D. Air Barrier Under Roof Deck: Provide continuous separate membrane that allows moisture vapor transmission while preventing air infiltration.
1. Air Leakage Rate: Comply with ASTM E1677.
2. Vapor Permeance: At least 1 perm, when tested in accordance with ASTM E96/E96M.

E. Vibration Resistance: Isolate structure from sources of vibration.

3.03 HEALTH AND SAFETY CRITERIA

A. Fire: Provide members with combustibility, flame spread, and smoke generation characteristics not greater than allowed by code.

B. Fire Resistance: Design and select materials to provide fire resistance in accordance with code.
1. Fire Resistance Ratings: Determined by testing in accordance with ASTM E119.
2. Flame Spread Index of Materials: Determined by testing in accordance with ASTM E84.
3. Smoke Developed Index of Materials: Determined by testing in accordance with ASTM E84.
4. Firestopping:
   a. Where fire resistance integrity of superstructure assemblies is impaired by subsequent installation of other construction elements, restore fire resistance using identical materials or other materials tested under ASTM E814.
   b. Provide firestopping that is rated at not less than the required fire resistance of the penetrated element.

C. Slip Resistance:
   1. Roofs: Where roof structure is the finished roof weather surface, also comply with requirements for roofing.
   2. Exposed Structural Floors: Same as specified for floor finishes.
   3. Access Floor Panels: Same as specified for floor finishes.

3.04 STRUCTURAL CRITERIA

A. Structural Design: In addition to the requirements of the code, design to comply with ASCE 7.

B. Capacity: Design and provide load-bearing structural members of capacities required by code.

C. Dead Loads: Design to resist loads from weights of materials, construction, and fixed service equipment.

D. Live Loads:
   1. Floors: Resist uniformly distributed, concentrated, and impact loads with code permitted live load reductions.
   2. Roofs: Resist uniformly distributed, concentrated, and impact loads.

E. Environmental Loads:
   1. Wind: Basic wind speed in accordance with code, Importance Factor in accordance with code, Exposure A, Wind design pressure in accordance with code.
   2. Snow: Ground snow load in accordance with code, snow exposure factor in accordance with code, snow load importance factor in accordance with code.
   3. Rain: Resist loads from ponding rainwater when the primary drainage system is blocked.
   4. Earthquake: In compliance with provisions of code.

F. Structural Serviceability: Comply with requirements and recommended design procedures of ASCE 7.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span: Same as for facility as a whole, except as follows:
   1. Load-Bearing Structural Members: Minimum of 100 years with no anticipated deterioration.
   2. Protective Elements: Minimum 25 years.

B. Moisture Resistance of Load-Bearing Members: Use materials that are not damaged by contact with water or moisture vapor.

C. Vapor Retarder Under Deck: Continuous separate membrane located on the warm side of the winter dew point.
   1. Vapor Permeance: 1 perm, maximum when tested in accordance with ASTM E96/E96M.
   2. Design and select materials in accordance with ASTM E1677, including appendices, and ASTM C755.

D. Impact Resistance of Load-Bearing Members: Use materials that are not easily damaged by common hand tools.

E. Portions of Superstructure Exposed on Exterior: Comply with requirements for Exterior Closure for water penetration, weather resistance, impact resistance, and wear resistance.
   1. Exposed Roof Deck Surfaces: Comply with requirements for roofing weather barrier.
   2. Exposed Exterior Structural Floor Surfaces: Comply with requirements for pavement finishes.
   3. Plaza Deck Surfaces: Comply with requirements for roofing.

F. Exposed Interior Structural Floor Surfaces: Comply with requirements for floor finishes.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Ease of Maintenance and Alteration:
   1. Provide floors elevated for access, with removable panels, at:
      a. Mainframe computer rooms.
      b. Control rooms.
      c. Other locations required by Colorado College Facility Services Department.

END OF SECTION

B20

EXTERIOR ENCLOSURE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior enclosure comprises the essentially vertical separation between exterior and interior conditioned space, including exterior walls, exterior windows, exterior doors, other openings, exterior wall fixtures, and other exterior enclosure elements.

B. Exterior Walls: The supporting structure; the exterior skin, vapor retarders, air barriers, and insulation; glazed walls; the interior skin if an integral part of the wall; exterior screens and railings; balcony walls and parapets; exterior soffits unless they do not form a weather barrier; firestopping and draftstopping within wall and between wall and floors; and other exterior wall elements.

C. Exterior Windows and Other Openings: Windows, fixed glazing other than glazed walls, ventilation openings, protection devices for openings, and elements that form or complete the openings, unless an integral part of another element.

D. Exterior Wall Appurtenances: All elements attached to the outside of the exterior walls, unless consisting of equipment or services fixtures. Exterior wall appurtenances required are those defined in the project program, made necessary by the design, and the following:
   1. Any pre-existing or new exterior wall appurtenances approved by or required by College Facilities Services Department.

E. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. AAMA 1503 - Voluntary Test Method for Thermal Transmission and Condensation Resistance of Windows, Doors, and Glazed Wall Sections.

C. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM C755 - Standard Practice for Selection of Vapor Retarders for Thermal Insulation.

E. ASTM C1199 - Standard Test Method for Measuring the Steady State Thermal Transmittance of Fenestration Systems Using Hot Box Methods.

F. ASTM C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

K. ASTM E413 - Classification for Rating Sound Insulation.

L. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.

M. ASTM E1677 - Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.

N. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies.

O. ASTM F1233 - Standard Test Method for Security Glazing Materials and Systems.

1.03 FIELD CONDITIONS

A. The following existing exterior enclosure elements must be preserved:
   1. Historic exterior enclosure elements on existing facilities, as determined by College Facilities Services Department.

PART 2 PRODUCTS

2.01 EXTERIOR WALL ELEMENTS

A. Exterior Skin of Exterior Walls:
   1. Match existing exterior skin on building additions and major renovation projects, as directed by College Facilities Services Department.
   2. Use one of the following, as determined by facility program and other design requirements:
      a. Precast concrete.
      b. Face brick.
      c. Stone (natural).
      d. Aluminum panels, prefinished.
      e. Glass.
      f. Portland cement plaster or stucco (three-coat systems only).
      g. Tile.
      h. Other materials complying with other specified performance requirements and as specifically approved by College Facilities Services Department.
   3. Do not use:
      a. Exterior insulation and finish systems.
      b. Wood or fiber cement siding panels.
      c. Other materials which cannot comply with other specified performance requirements, and which are specifically not approved by College Facilities Services Department.
   4. Joint Sealers in Exterior Skin:
      a. Use one of the following:
         1) Silicone sealant is preferred at all locations, subject to compatibility with adjacent surfaces being sealed.
         2) Polyurethane sealant is acceptable only at locations where silicone sealant is specifically not recommended by sealant manufacturer for surfaces being sealed.
         3) Other sealant materials specifically approved by College Facilities Services Department.
      b. Do not use:
         1) Sealant materials and systems that cannot comply with other specified performance requirements, and which are specifically not approved by College Facilities Services Department.
         2) Sealants of other formulations that are not specifically intended by sealant manufacturer for exterior applications in climatic conditions prevalent at Colorado College.
   5. Air Barriers:
      a. Use one of the following:
         1) Air barrier coating systems are preferred at all locations behind exterior cladding systems.
         2) Air barrier sheet systems are acceptable, subject to compliance with other specified performance requirements.
         3) Other air barrier systems specifically approved by College Facilities Services Department.
      b. Do not use:
         1) Air Barrier systems that cannot comply with other specified performance requirements, and which are specifically not approved by College Facilities Services Department.

6. Vapor Retarders:
    a. Use one of the following:
        1) Vapor retarder materials and systems as required to achieve other specified performance requirements; compatible with other products and system components within assemblies requiring vapor retarders.
    b. Do not use:
        1) Vapor retarder materials and systems that cannot comply with other specified performance requirements, and which are specifically not approved by College Facilities Services Department.
7. Insulation:
    a. Use one of the following:
        1) Board insulation at roofing systems, masonry cavity wall assemblies, and below grade foundation/basement wall locations.
        2) Batt insulation at locations specifically required to comply with other specified performance requirements.
        3) Insulation systems required to achieve compliance with other performance requirements, and which are specifically approved by College Facilities Services Department.
    b. Do not use:
        1) Loose fill insulation.
        2) Blown insulation.
        3) Sprayed insulation.
        4) Insulation systems that cannot comply with other specified performance requirements, and which are specifically not approved by College Facilities Services Department.

B. Supporting Structure of Exterior Walls:
1. Use one of the following:
    a. Cast-in-place concrete.
    b. Insulated concrete form walls.
    c. Precast concrete.
    d. Load-bearing unit masonry assemblies.
    e. Non-load-bearing unit masonry assemblies.
    f. Surface bonded masonry construction.
    g. Secondary structural steel members.
    h. Shop fabricated wall panels for field assembly.
    i. Cold formed metal framing.
    j. Glazed aluminum curtain wall systems.
    k. Structural glass curtain wall systems.
    l. Translucent wall panel assembly.
    m. Other systems required to comply with other specified performance requirements, and which are specifically approved by College Facilities Services Department.
2. Do not use any of the following for the supporting structure of walls:
    a. Tilt-up wall construction.
    b. Wood stud framing.
    c. Other systems specifically not approved by College Facilities Services Department.

C. Exterior Ceilings and Soffits:
1. Use one of the following:
    a. Construction similar to exterior walls.
    b. Portland cement plaster or stucco.
    c. Other materials specifically approved by College Facilities Services Department.
2. Do not use:
    a. Exterior insulation and finish system (EIFS).
    b. Gypsum exterior soffit board.
    c. Other materials specifically not approved by College Facilities Services Department.

2.02 WINDOWS

A. Windows (Operable and Fixed):
   1. Match the existing operable windows as closely as possible on historic buildings, building additions and major renovations.
   2. Glazing: Double pane insulated units with low-e glazing and appropriate solar control.
   3. Use one of the following:
      a. Metal windows.
      b. Aluminum windows.
      c. Metal-clad wood windows.
      d. Other windows specifically approved by College Facilities Services Department.
   4. Do not use:
      a. Plastic-clad wood windows.
      b. Tubular plastic windows.
      c. Composite windows.
      d. Other windows specifically not approved by College Facilities Services Department.

B. Existing Windows:
   1. Where necessary to enhance performance properties, use one of the following: reflective plastic film, heat absorbing acrylic coating, or other application specifically approved by College Facilities Services Department.

2.03 OTHER EXTERIOR OPENINGS

A. Ventilation Openings: Cover all natural and mechanical ventilation openings.
   1. Match the existing ventilation openings as closely as possible on building additions and major renovations.
   2. Material: Aluminum, steel, stainless steel, or other material specifically approved by College Facilities Services Department.
   3. Use one of the following:
      a. Stationary blade vents or louvers.
      b. Operable vents or louvers.
      c. Grilles.
   4. Do not use:
      a. Any material specifically not approved by College Facilities Services Department.

2.04 OTHER EXTERIOR ENCLOSURE ELEMENTS

A. Concealed Flashings:
   1. Use one of the following:
      a. Galvanized steel flashing.
      b. Stainless steel flashing.
      c. Copper flashing.
   2. Do not use:
      a. Aluminum flashing.
      b. Plastic flashing.
      c. Paper flashing.
      d. Uncoated steel flashing.

PART 3 DESIGN REQUIREMENTS

3.01 BASIC FUNCTION

A. Provide an essentially vertical separation between exterior and interior conditioned space, that keeps out weather, uninvited people, and animals and insects, without unusual action by occupants, while providing convenient movement of occupants between inside and outside, desirable natural light, and views from inside to outside.

B. Fill, cover, close, or otherwise protect all openings in the exterior walls (other than doors) so that the entire exterior enclosure functions as specified, using windows and other opening elements as specified, without using components that must be installed at changes of season.

C. Balcony Walls: Same requirements as exterior walls, except thermal performance is not required.

D. Parapets: Same requirements as associated walls, except thermal performance is not required.

E. Where exterior enclosure elements also must function as elements defined within another element group, meet requirements of both element groups.

F. In addition to the requirements of this Section, comply with all applicable requirements of General Facility Design Requirements.

3.02 SUSTAINABLE DESIGN

A. See General Facility Design Requirements, for sustainable design requirements applicable to exterior enclosure.

3.03 AMENITY AND COMFORT

A. Thermal Performance:
   1. Thermal performance requirements are not applicable to parapets or balcony walls.
   2. Provide continuous insulation over entire enclosure.
   3. Entire Exterior Enclosure Average Thermal Transmittance: U-value of 0.059 IP, maximum, over entire Exterior Enclosure.
   4. Vertical Walls Average Thermal Transmittance: U-value of 0.042 IP, maximum.
   5. Any Portion of Vertical Walls Average Thermal Transmittance: U-value of 0.042 IP, maximum.
   6. Any Individual Component Maximum Thermal Transmittance: U-value of 0.50 Btu/sq ft/hr/deg F when tested in accordance with ASTM C1363 or ASTM C1199.
   7. Glazing and Frames: Minimum Condensation Resistance Factor of 35 when measured in accordance with AAMA 1503.
   8. Exterior Soffits and Ceilings: Same requirements as exterior walls.
      a. Exception: If the space between soffit and floor/roof above is not required to be conditioned space, thermal performance requirements do not apply.

B. Water Penetration Resistance:

C. Air Infiltration Resistance: Provide continuous separate membrane over entire exterior enclosure that allows moisture vapor transmission while preventing air infiltration.
   1. Air Leakage Rate: Maximum of 0.40 cfm/sq ft when tested in accordance with ASTM E1677.
   2. Vapor Permeance: At least 1 perm, when tested in accordance with ASTM E96/E96M.
   3. Operable Openings Intended to be Normally Closed: Maximum of 0.3 cfm/sq ft, measured in accordance with ASTM E283 at differential pressure of 1.57 psf.
   4. Mechanical Ventilation Openings: Automatically closed when ventilation is not required. Unless ducted, maximum of 0.3 cfm/sq ft of crack when closed, measured in accordance with ASTM E283 at differential pressure of 1.57 psf.

D. Airborne Sound Transmission Resistance: Achieve the following minimum outdoor-indoor level reductions (OILR values) for perimeter spaces, when tested in accordance with ASTM E966 and classified in accordance with ASTM E413:
   1. Quiet space (NC values of 20-30) and low exterior noise source (dBA values of 40 or lower): OILR 30.
   2. Moderately noisy space (NC values of 30-40) and moderate exterior noise source (dBA values of 40-60): OILR 30.
   3. Noisy space (NC values of 40-50) and loud exterior noise source (dBA values of 60-70): OILR 30.
   4. Very noisy space (NC values of 50-60) and very loud exterior noise source (dBA values of 70-80): OILR 30.

E. Acoustical Isolation:
   1. Provide composite STC values not less than OILR values required for the exterior enclosure, when individual components are tested in accordance with ASTM E90 and classified in accordance with ASTM E413.

F. Acoustical Performance:
   1. Window Sound Transmission Class: Minimum 39 STC at locations required by program, as measured in accordance with ASTM E90 and classified in accordance with ASTM E413.
   2. Louvers: No objectionable air movement noise.

G. Appearance:
   1. Glazing:
      a. Tint: Use as little tint as possible while complying with other requirements.
      b. Reflectivity: Do not use glass that has been treated to increase its natural reflectivity.
   2. Windows and Other Openings:
      a. Sight Lines of Glazed Areas: Provide maximum glazing area with minimum interruption by framing members.
      b. Exposed Blade Louvers: Concealed vertical mullions.

3.04 HEALTH AND SAFETY

A. Fire Resistance:
   1. All Materials of Exterior Enclosure: Non-combustible, with exceptions permitted by code.
   2. Openings: Rating as required to maintain fire resistance rating of exterior wall in which they occur.

B. Emergency Escape: Provide minimum opening size as required by code for bedroom windows below the fourth floor in residential buildings.

C. Physical Security: Design and construct to provide protection as follows:
   1. Opaque Elements at Ground Level: Use materials that give the impression of strength, for discouragement of opportunistic attempts at intrusion.
   2. Glazing at Ground Level: Forced entry resistance of Class II in accordance with ASTM F1233, minimum, and Grade 20, minimum, in accordance with ASTM F476 adapted to suit element.
   3. Glazed Elements at Ground Level: Minimize size and locate where under surveillance by staff at their normal workstations.

D. Vermin Resistance: Provide openable openings and ventilation openings with means of keeping insects, birds, and animals out.

3.05 STRUCTURAL

A. Design Loads: Comply with the code.

B. Wind Design: No damage when tested in accordance with ASTM E330/E330M at 1.5 times positive and negative design wind loads using 10 second duration of maximum load.
   1. Members Not Supporting Glass: Maximum deflection of 1/180 of span, unless otherwise indicated.
   2. Unit Masonry: Maximum deflection of 1/180 of span.
   3. Unit Masonry Veneer: Maximum deflection of 1/720 of span.
   4. Members Supporting Glass: Maximum deflection of flexure limit of glass; with full recovery of glazing materials.

C. Lintels: Constructed to span openings and support loads imposed by exterior wall; maximum deflection of 1/360 of span, vertically and horizontally.

D. Railing Assemblies: Resistant to required forces in accordance with ASCE 7.

E. Anchorage of Wall Fixtures: Design wall fixtures to be supported from building structural frame rather than from exterior wall.

3.06 DURABILITY

A. Expected Service Life Span: Same as for facility as a whole.

B. Temperature Endurance: Allow for daily expansion and contraction within and between elements caused by temperature range from most extreme low temperature to 70 degrees F greater than the most extreme high temperature, in any year, without causing detrimental effect to components and anchorage.

C. Water Penetration Resistance:
   1. Drain water, moisture, and condensation entering assemblies to the exterior.
      a. Top of Openings: If wall construction does not provide its own methods of drainage, use separate flashing to prevent water from entering opening components or the interior of the building.
      b. Bottom of Openings: Integral or separate sill or flashing to prevent water running over or draining out of opening components from entering the wall construction below or the interior of the building.
   2. Air Intake and Exhaust Openings: Minimize rainwater penetration and protect adjacent interior spaces from damage from water.
      a. Maximum Water Leakage: 0.01 oz/sf under most extreme conditions.
      b. Test Air Velocity: For exhaust openings: 0; for intake openings: normal operational velocity.

D. Moisture Vapor Transmission Resistance: Provide continuous separate membrane over entire exterior enclosure, located on the warm side of the winter dew point.
   1. Vapor Permeance: 1 perm, maximum when tested in accordance with ASTM E96/E96M.
   2. Design and select materials in accordance with ASTM E1677, including appendixes, and ASTM C755.

E. Weathering Resistance:
   1. Surface Finish of Exterior Wall Fixtures: Minimum service life of 10 years without color deterioration.

F. Impact Resistance:
   1. Elements Adjacent to Traffic Lanes: Resist damage from accidental passenger vehicular impact at 5 mph maximum velocity.

G. Glass Breakage Resistance:
   1. Type and thickness in accordance with ASTM E1300 combined with other applicable factors; minimum thickness 6 mm for each lite.

H. Integral Interior Surfaces: Comply with requirements for interior finish.

3.07 OPERATION AND MAINTENANCE

A. Expected Service Life Span:
   1. Operating Components: Remaining operable for 20 years under normal exposure conditions for the project site.

B. Ease of Use:
   1. Operators for Moving Parts: Electric motor- or pneumatically-operated.

C. Prevention of Misuse: Provide mechanical ventilation openings without moving parts on exterior of building or where accessible to occupants.

D. Ease of Cleaning: Design glazed openings to permit the exterior surface to be cleaned from inside or outside without removing window sash.

END OF SECTION

B30

ROOFING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roofing comprises all elements forming weather and thermal barriers at the sloped or essentially flat weather-proof enclosure over the entire "top-side" of building and over exposed floor superstructure, including plaza decks, balconies, and other exposed floors; including roof coverings, closures for roof openings, roof fixtures, and other roof elements, not including the structural supporting elements of the roof.

B. Roof Coverings: All weather-resistive components, including the primary weather barrier, vapor retarders, insulation, wearing surfaces, water collectors and conductors, trim and accessories.

C. Roof Openings: Skylights, ventilation openings, access openings, and other elements necessary to close roof openings, and elements associated with those openings.

D. Roof Appurtenances: All elements attached to the roof, unless equipment or services or specified elsewhere, and mounting brackets or frames for roof mounted services and equipment; roof fixtures required are those required by the program, those made necessary by the design, and the following:
   1. Screens for concealment of services and equipment.
   2. Other roof appurtenances specifically approved by College Facilities Services Department.

E. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements.

C. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.

D. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

E. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies.

F. ASTM F1233 - Standard Test Method for Security Glazing Materials And Systems.

G. NFPA 204 - Guide for Smoke and Heat Venting.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual.

1.03 FIELD CONDITIONS

A. The following existing roofing elements must be preserved:
   1. Historic roof elements on existing facilities, as determined by College Facilities Services Department.

PART 2 PRODUCTS

2.01 COLLEGE-FURNISHED PRODUCTS

A. The following items are to be provided by College Facilities Services:
   1. Includes and pre-existing or additional non-building related products placed on the roof, or mounted on the roof, such as roof pavers, safety barriers, protective walking mats, solar PV materials, scientific equipment, cell tower rental equipment, telecommunications antennas, sound and video equipment, and similar items.

B. College-Furnished Items: Performance requirements that specify characteristics of equipment items do not apply; requirements for accommodating items to the project do apply.

2.02 ROOF COVERINGS

A. Roof Coverings - General:
1. Use one of the following:
   a. Product whose installation method is specified in the code, provided the material complies with specified requirements.
   b. Other product complying with requirements, based on specified substantiation.
   c. Low-Slope Roofs: Four-ply built-up bituminous roofing system with light-colored mineral surfaced cap sheet is preferred for all applications, and required where solar panels are to be installed on roof.
      1) Vapor Retarder: Include in roofing assembly if required for specific environmental or climatic circumstances as determined by exterior enclosure analysis required in Section B20 - Exterior Enclosure.
      2) Re-Roofing: Evaluate existing structural capacity for consideration of systems proposed for re-roofing.
      3) Other systems as specifically approved by College Facilities Services Department.
   d. High-Sloped Roofs: System and finish material approved by College Facilities Services to be compatible with existing historic roof systems on campus.
      1) Metal Roof Panel System: Required where solar panels are to be installed on roof; metal panel roof profile and color subject to review and approval by College Facilities Services.
      2) College may have stock or identify preferred sources of certain roofing materials; confirm during Preliminary Design phase.
      3) Other systems as specifically approved by College Facilities Services Department.
2. Do not use any of the following:
   a. Asphalt roll roofing.
   b. Asphalt shingles, except as specifically approved by College Facilities Services.
   c. Mineral-fiber-cement shingles or tiles.
   d. Wood shingles or shakes, except as specifically approved by College Facilities Services for historic buildings.
   e. Built-up coal tar roofing.
   f. Elastomeric or thermoplastic membrane roofing, ballasted or unballasted, unless specifically approved by College Facilities Services for particular applications.
   g. Modified bitumen membrane roofing.
   h. Cold-applied bituminous roofing.
   i. Rubberized asphalt roofing.
   j. Fluid-applied roofing membrane.
   k. Sprayed coated foam roofing.
   l. Other roof systems specifically identified in project program as unacceptable.

B. Concealed Deck Roofing/Waterproofing:
1. Use one of the following:
   a. Fluid-applied elastomeric roofing/waterproofing membrane .
      1) Made of polyurethane or CSPR (Hypalon).
      2) Installed over insulation, if required.
   b. Rubberized asphalt roofing/waterproofing membrane .
      1) Application: Fluid-applied.
      2) Installed over insulation, if required.
   c. Other systems as specifically approved by College Facilities Services Department.
2. Do not use:
   a. Built-up bituminous roofing/waterproofing membrane.
   b. Cold-applied bituminous roofing/waterproofing membrane.
   c. Elastomeric roofing/waterproofing membrane.
   d. EPDM roofing/waterproofing membrane.
   e. PVC roofing/waterproofing membrane.
   f. CSPE roofing/waterproofing membrane.
   g. Thermoplastic roofing/waterproofing membrane (heat-welded).
   h. Thermoplastic roofing/waterproofing membrane (adhesive seamed).

i. Modified bituminous roofing/waterproofing membrane.
j. Loose-laid roofing/waterproofing membrane.
k. Adhered roofing/waterproofing membrane.
l. Mechanically attached roofing/waterproofing membrane.
m. Inverted roofing/waterproofing membrane assembly (insulation over membrane).

C. Insulation Over Roof Superstructure:
1. Use one of the following:
a. Closed cell polyisocyanurate, minimum density 25 psi; thickness and other properties as required to achieve compliance with the code and other specified design criteria.
b. Other types specifically approved by College Facilities Department.
2. Do not use:
a. Polystyrene.
b. Wood fiber board.
c. Semi-rigid glass fiber or mineral wool.
d. Other types specifically prohibited by the code or College Facilities Services Department.

D. Water Collectors and Conductors:
1. Use one of the following:
a. Metal piping.
b. Copper sheet metal.
c. Stainless steel sheet metal.
d. Factory-finished galvanized steel sheet metal.
e. Other materials as specifically approved by College Facilities Services Department.
2. Do not use:
a. Sheet metal; unfinished or field painted.
b. Galvanized steel sheet metal.
c. Molded or extruded polyvinyl chloride plastic.
d. Other materials specifically prohibited by the code or College Facilities Services Department.

E. Flashing, Trim, and Accessories:
1. Use one of the following:
a. Copper sheet metal.
b. Stainless steel sheet metal.
c. Factory-finished galvanized sheet metal.
d. Other materials as specifically approved by College Facilities Services Department.
2. Do not use:
a. Sheet metal; unfinished or field painted.
b. Galvanized steel sheet metal.
c. Lead sheet metal.
d. Flexible flashing.
e. Other materials specifically prohibited by the code or College Facilities Services Department.

2.03 ROOF OPENINGS

A. Roof Openings - General:
1. Minimize the need for roof openings of any kind to the greatest extent possible, except for necessary equipment and services; minimize potential for roof leaks.
2. Use the following:
a. Product specified in the code, provided material complies with other specified requirements.
b. Other product complying with specified requirements, based on accepted substantiation.
c. Other products as specifically approved by College Facilities Services Department.
3. Do not use:
a. Plastic unit skylights.
b. Metal-framed skylights.
c. Roof hatches, except as required by the code or College Facilities Services Department.
d. "Drop-out" type heat/smoke vents.
e. Hinged heat/smoke vents.
f. Gravity ventilators.
g. Other products specifically prohibited by the code or College Facilities Services Department.

2.04 ROOF APPURTENANCES

A. Screens:
   1. Use one of the following:
      a. Any material allowed for exterior walls.
      b. Other materials as specifically approved by College Facilities Services Department.
   2. Do not use:
      a. Materials specifically prohibited by the code or College Facilities Services Department.

PART 3 DESIGN REQUIREMENTS

3.01 BASIC FUNCTION

A. Provide a weather-proof enclosure over the entire "top-side" of building that also excludes unwelcome people, animals, and insects without requiring specific action by occupants, while shedding water and preventing uncontrolled water infiltration, withstanding anticipated loading conditions, providing required access, and permitting the entry of desirable natural light.

B. Where roofing elements also must function as elements defined within another element group, meet requirements of both element groups.

C. In addition to the requirements of this Section, comply with all applicable requirements of General Facility Design Requirements.

3.02 SUSTAINABLE DESIGN

A. See General Facility Design Requirements, for sustainable design requirements applicable to roofing.

3.03 AMENITY AND COMFORT

A. Thermal Performance: As specified in General Facility Design Requirements and the following:
   1. Attics: Provide mechanical exhaust of heated air during cooling season, with minimum free area of 1.0 sq ft for each 150 sq ft of attic floor area.

B. Air Infiltration Resistance: If a jointless or completely sealed-seam or welded-seam membrane-type water barrier is not used for roof covering, provide auxiliary method of complying with air infiltration criteria.

C. Water Penetration Resistance :
   1. No uncontrolled water penetration at static pressure of 6.24 psf and 5.0 gal/sf/hr, when tested in accordance with ASTM E331.

D. Run-Off: Direct water run-off to storm drains without splashing or dripping.

E. Noise Reduction:
   1. Noise of Precipitation: Design and select materials that dampen the sound of precipitation on the roof to maintain interior ambient sound levels as specified.

F. Convenience:
   1. Design a fixed ladder, stair, ship's ladder, or alternating tread stair leading to each hatch used for access to roof equipment or required by code.
   2. Access Hatches: Openable from outside, provided user unlocked from inside before exiting.

G. Appearance:
   1. Concealment of Services and Equipment: Substantial construction other than screens.
   2. Color: Compatible with energy efficiency design and architectural character of facility, using finish materials that are used on other locations of the exterior envelope of the facility.
   3. Cleanliness: In addition to requirements of General Facility Design Requirements for cleanliness of exterior surfaces, if roofing surfaces are exposed to view, select and specify surface materials that will conceal dirt.
   4. Ponding: Design drainage of roof so no ponding will occur, regardless of whether roofing material will withstand ponding of water or not.

3.04 HEALTH AND SAFETY

A. Fire Resistance: In addition to fire resistance specified in General Facility Design Requirements, select and specify materials that will prevent:
   1. Roof surface catching fire due to external fire sources.
   2. Roof coverings catching fire due to internal fire sources.
   3. External fire sources from breaking through roof openings.
   4. Fire Retardance of Roof Covering: ASTM E108 Class A roof covering, without the use of fire retardant treatment unless treatment is permanent.
   5. Fire Resistance of Elements Closing Openings: As required by code.

B. Smoke Ventilation: As required by code and the following:
   1. Upward Opening Units: Operating properly under specified structural snow load.

C. Heat and Smoke Vents in Roof: Comply with the code.
   1. Vent Design: NFPA 204, including curtain boards and ancillary elements.
   2. Releasing Device: Any type allowed by code.
   3. Releasing Device Rating: 150 degrees F above normal highest ambient temperature of space, or as specifically required by the code.
   4. Operation: Open despite external design snow load and wind load; prevent inadvertent opening under design wind uplift.
   5. Curtain Boards: Material and construction that resists passage of smoke ; non-combustible.

D. Prevention of Accidental Injury:
   1. Ladder Safety: Comply with ANSI A14.3.
   2. Roof Worker Safety: Design to provide safe design and safety measures as required by code and the following:
      a. Provide permanent access to all areas of the roof in the form of stairs or fixed ladders.
      b. Provide permanently installed supports for equipment used for cleaning windows and other glazed areas of the shell.

E. Physical Security: Consider the roof area and all roof openings unsupervised.
   1. Fixed Homogeneous Elements: Forced entry resistance of Class I in accordance with ASTM F1233, minimum.
   2. Operable Openings: No unlocking devices accessible from outside.
   3. Roof Openings and Assemblies: Forced entry resistance of Class I in accordance with ASTM F1233, minimum, and Grade 20 in accordance with ASTM F476 adapted to suit assembly.

3.05 STRUCTURAL

A. Self-Supporting Elements: Same requirements as for superstructure.

B. Rainwater Load: As required by code.

C. Roof Component Wind Resistance:
   1. Uplift: Same pressure as specified in code for structural members.
   2. Wind Uplift: Where roof covering has a lower air transmission rate than the roof superstructure, provide means of preventing blow-off or ballooning due to low negative pressure over roof.

D. Snow Load:
   1. Roof Opening Elements: Exceed code requirements by 15 percent.

E. Roof Covering Substrate: Sufficiently rigid or dense to support water barrier in a manner that prevents puncture due to traffic on roof.

F. Roof Fixtures:
   1. Mounting Brackets and Frames for Equipment and Services: Complying with design requirements for superstructure.
   2. Screens: Complying with design requirements for exterior walls.
   3. Anchorage: Design roof fixtures to be supported from building structural frame or structural deck, but not sheet metal deck.

3.06 DURABILITY

A. Expected Service Life Span: Same as for facility as a whole, except as follows:
   1. Roof Covering Weather-Barriers: Minimum 20 years, fully functional.
   2. Surfaces Exposed to View: Minimum 20 years aesthetic service life; in addition, deterioration includes color fading, crazing, and delamination of applied coatings.
   3. Aesthetic Life Span: Significant degradation of appearance during the functional life span is not acceptable.
   4. Manufacturer Approval of Design: Specify appropriate requirements where roof covering manufacturer recommends or requires certain design features for satisfactory performance or for warranty.
   5. Manufacturer Warranty:
      a. Materials: 10 years, minimum.
      b. Installation and Workmanship: 10 years, minimum.

B. Water Penetration Resistance: None, under conditions of rain driven at 50 mph , unless water paths are completely accessible.
   1. Water Barrier Type Roof Coverings: lapped for positive run-off, a monolithic jointless membrane, or a membrane with sealed joints.
      a. Minimum Slope:
         1) Field of Roof: 1/4 inch per foot.
         2) Water Conductors: 1/8 inch per foot.
      b. Fasteners Penetrating Water Barrier: Prohibited, unless fasteners are located under overlapping material.
   2. Shingles, Tiles, and Other Traditional Lap-Type Roof Coverings: If proven-in-use overlap dimensions are used, mock-up testing is not required.
   3. Roof Fixtures: Design fixtures to maintain integrity of roofing water penetration resistance at points of fixture and mounting attachment to supporting structure.

C. Moisture in Unconditioned Attics and Similar Spaces: mechanical exhaust with free area of 1.0 sq ft for each 150 sq ft of attic floor area, or as specifically required by the code.

D. Weathering Resistance: Design and specify weather-exposed roof coverings and other components that comply with weather resistance specified in General Facility Design Requirements and the following:
   1. Minimization of Deterioration Due to Weather: For weather-barrier materials, minimization means no deterioration that adversely affects water penetration resistance at any time during the specified service life span.
   2. Roof Fixtures:
      a. Surface Finish: Minimum service life of 10 years without color deterioration.
      b. Mounting Brackets and Frames for Services and Equipment: Complying with durability requirements specified for exterior walls.

E. Chemical Resistance: Wherever there is a possibility of the introduction of grease, oils, or chemicals onto the roof, select and specify materials that are not damaged by such leakage.

F. Ice: Design to avoid damage due to ice formation and buildup on roofing and in water conductors.

G. Wear Resistance:
   1. Surfaces in Areas Occupied in Manner Similar to Interior Spaces: Same requirements as for the floor finishes for the equivalent interior space.
   2. Surfaces Subject Only to Maintenance Foot Traffic: Not punctured by ordinary materials or tools when stepped on.
   3. Surfaces Subject to Other Traffic Levels: Durability appropriate to level of traffic anticipated.

3.07 OPERATION AND MAINTENANCE

A. Water Conductor Capacity: As required by code or SMACNA Architectural Sheet Metal Manual (ASMM), whichever is greater, based on 100 year 1 hour intensity.

B. Ease of Maintenance:
   1. All components of roofing (not just roof covering) easily accessible by maintenance persons on foot without the use of portable ladders or other portable devices.
   2. Rooftop fixtures serviceable by simple replacement of parts, minimizing time required on roof, and eliminating need for repair work in the weather.
   3. Water Barrier Subject to Foot Traffic: Easily accessible for repair; if covered, covering must be removable by one person without the use of tools other than shovel and broom, with original covering materials replaceable to the same degree of coverage using the same tools.

C. Ease of Replacement: As specified in General Facility Design Requirements for elements not required to have expected service life span equal to that specified for the facility as a whole.
   1. Easily replaceable roof coverings include:
      a. Any membrane adhered to mechanically attached insulation.
      b. Shingles.
      c. Tiles.

END OF SECTION

C10

INTERIOR REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interiors comprise all elements necessary to subdivide and finish space enclosed within the shell, including applied interior surfaces of the exterior enclosure; interior doors, windows, and other openings and coverings; interior fixtures attached to interior construction to add functionality to enclosed spaces, except for elements classified as equipment or services fixtures.

B. Partitions: All types of space dividers, including demountable and operable partitions.
   1. Fixed Partitions: Solid, stationary space dividers that are opaque, transparent, and translucent and extend full height.
   2. Partial Height Partitions: Fixed, solid, opaque and translucent visual barriers, including toilet compartments, dressing cubicles, and screens.
   3. Demountable Partitions: Fixed, solid, modular space dividers designed to be relocatable without significant damage to partitions or substrates.
   4. Operable Partitions: Movable barriers that form solid, visual and acoustical subdivisions of a space.
   5. Fixed, Open Protection and Control Devices: Barriers include interior railings, perforated screens, and mesh partitions.

C. Interior Openings: Doors, windows, louvers, vents, expansion joint covers.
   1. Interior Doors: All interior doors, including hardware and frames, except for elevator doors.
   2. Interior Windows: All interior fixed and operable windows, including frames and casings.
      a. Fixed windows , but excluding glazed partitions.
      b. Window openings without glazing, including finished sills, head, and jambs.
   3. Other Interior Openings: Interior utility openings such as hatches and access panels, louvers and vents, expansion joint covers, and elements forming or completing interior openings, including sills, jambs, heads, and operating hardware.

D. Stairs and Ramps: Those interior and exterior stair and ramp elements not a part of superstructure or exterior enclosure, comprising the following elements:
   1. Structure supporting stairs, unless an integral part of superstructure.
   2. Tread and riser construction, unless an integral part of superstructure.
   3. Railings for interior stairs.
   4. Integral stair finishes.

E. Interior Finishes: All functional and decorative applied interior finishes, including secondary support structures, for ceilings, walls, floors, doors, and other field finished elements.

F. Interior Fixtures: Functional items that are permanently attached to interior walls, ceilings, and floors, except for elements classified as equipment or services fixtures, comprising the following elements:
   1. Toilet, Bath, and Laundry Accessories.
   2. Information Fixtures: Identifying devices, visual display surfaces, and communications enclosures.
   3. Storage Fixtures: Non-furniture items intended primarily for storing or securing objects, materials, and supplies, such as cabinets, casework, wardrobes, closet specialties, lockers, shelving, and postal boxes.
   4. Window Treatment: Non-furnishing accessories for control of light, solar heat gain, privacy, and view at interior and exterior windows, including blinds, shades, and shutters.
   5. Fixed Seating: Single and multiple seating that is attached to the building.

G. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCED STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.

D. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.

E. ASTM E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

H. ASTM E413 - Classification for Rating Sound Insulation.

I. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies.

J. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches ; 2011 (ANSI/BHMA A156.2).

K. BHMA A156.3 - American National Standard for Exit Devices ; 2008 (ANSI/BHMA A156.3).

L. BHMA A156.5 - Cylinders and Input Devices for Locks ; 2010 (ANSI/BHMA A156.5).

M. BHMA A156.12 - American National Standard for Interconnected Locks ; 2005 (ANSI/BHMA A156.12).

N. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000 ; 2012 (ANSI/BHMA A156.13).

O. IESNA RP-5 - Recommended Practice of Daylighting.

1.03 FIELD CONDITIONS

A. Encapsulation of existing asbestos and asbestos-containing materials and finishes is not permitted; abatement is required as specified in general Facility Design Guidelines.

B. Renovation and Remodel Projects: The following existing interior elements must be preserved:
   1. Fire-rated partitions around stairwells and shafts, unless project scope includes such removal.

C. Renovation and Remodel Projects: The following existing interior elements may require partial or complete removal to accomplish new construction:
   1. Existing partitions, ceilings, doors, finishes, and fixtures (entire interior will be gutted).
   2. Abandoned services elements, including pipes, ducts, conduit, equipment, and fixtures.
   3. Existing asbestos and asbestos-containing ceiling finishes.
   4. Existing asbestos or presumed asbestos-containing floor finishes.
   5. Existing lead-based paint and coatings.
   6. Other items required by facility program and project requirements.

PART 2 PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS AND SERVICES

A. The following items are to be provided by College Facilities Services:
   1. Hazardous materials abatement, including but not limited to asbestos-containing materials and finishes, and lead-based paint and coatings.

B. Owner-Furnished Items: Performance requirements that specify characteristics of equipment items do not apply; requirements for accommodating items to the project do apply.

2.02 PARTITIONS

A. Do not use:
   1. Exposed wood.
   2. Particleboard of any type.
   3. Exposed plastic surfaces.
   4. Gypsum plaster.
   5. Wood framing.
   6. Systems not accepted by College Facilities Services Department.

B. Fixed Partitions:
   1. Design and construct partitions using the following:
      a. Gypsum board on metal framing and furring generally at all locations.
      b. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Gypsum plaster on gypsum lath over wood framing and furring.
      b. Solid gypsum plaster on steel framing.
      c. Portland cement plaster on metal lath over metal framing.
      d. Gypsum board on wood framing and furring.
      e. Wood paneling on wood framing and furring.
      f. Systems not accepted by College Facilities Services Department.

C. Demountable Partitions:
   1. Use the following:
      a. Laminated metal-honeycomb panel systems generally at all locations where required by facility program.
      b. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Panelized gypsum board systems.
      b. All metal panel systems.
      c. Systems not accepted by College Facilities Services Department.

D. Operable Partitions:
   1. Use the following:
      a. Paired panel systems, continuously hinged, manually operated, generally at all locations required by facility program.
      b. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Individual panel systems.
      b. Electrically operated panel systems.
      c. Accordion folding systems.
      d. Systems not accepted by College Facilities Services Department.

E. Interior Railings:
   1. Use the following:
      a. Pipe and tube railings of aluminum, steel, or stainless steel at locations according to facility design.
      b. Ornamental metal and glass-supported railings at locations according to facility design.
      c. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Ornamental metal railings of wrought iron.
      b. Systems not accepted by College Facilities Services Department.

F. Interior Doors: Minimum 1-3/4 inch thick.
   1. Use one of the following as require by facility design:
      a. Hollow steel doors and frames.
      b. Flush wood doors.
      c. Stile-and-rail (panel) wood doors at appropriate locations; minimum 5 inch wide stiles.
      d. Glazed aluminum doors.
      e. Other door types acceptable to College Facilities Services Department.

2. Do not use:
    a. Plastic laminate faced doors.
    b. Glazed bronze doors.
    c. Glazed stainless steel doors.
    d. Door types not accepted by College Facilities Services Department.

G. Fire Separation Doors Not Used for Egress:
1. Use one of the following:
    a. Same type as for other doors.
    b. Coiling overhead doors.
    c. Other door types acceptable to College Facilities Services Department.
2. Do not use:
    a. Folding accordion doors.
    b. Door types not accepted by College Facilities Services Department.

H. Door Frames:
1. Use one of the following:
    a. Steel frames.
    b. Aluminum frames.
    c. Wood frames at appropriate locations.
2. Do not use:
    a. Frames not approved by College Facilities Services Department.

I. Glazing in Doors: Glass .
1. Use one of the following:
    a. Fully tempered glass.
    b. Laminated glass.
2. Do not use:
    a. Plain float or sheet glass.
    b. Heat-strengthened glass.
    c. Acrylic sheet.
    d. Polycarbonate sheet.
    e. Wired glass.
    f. Obscure glass.

J. Door Louvers:
1. Louvers in Metal Doors: Same material as doors.
2. Use fire rated louvers on fire rated doors.
3. Louver in Wood Doors: Use one of the following:
    a. Steel louvers at all locations.

K. Hardware for Swinging Doors :
1. Use satin stainless steel finish at all locations (US 26D/626).
2. Use fire rated hardware on fire rated doors.
3. Lock Cylinders:
    a. Small Projects: Supplied by College Facilities Services lock shop.
    b. Large Projects: Specify for hardware supplier to coordinate with College Facilities Services lock shop to ensure proper keying.
4. Lock Sets:
    a. Acceptable Manufacturer: Sargent; no substitutions or exceptions. Adams-Rite paddles are acceptable in storefront applications only.
        1) Offices, Labs, and Meeting Rooms: Sargent 11G05 LL 26D bored lockset or Sargent 8205 mortise lockset.
        2) Custodial Closets and Mechanical Rooms: Sargent 11G04 LL 26D lockset or Sargent 8204 mortise lockset.
        3) Passage Functions: Sargent 11U15 LL 26D or Sargent 8215 mortise passage set.
        4) Privacy Functions: Sargent 11U65 LL 26D or Sargent 8265 mortise lockset.
        5) Other Functions: As determined by College Facilities Services lock shop for specific project requirements.
        6) Not Permitted: IC core cylinders.

5. Other Door Hardware: Comply with the following, unless otherwise approved by College Facilities Services lock shop:
    a. Exit Devices: Sargent rim devices, with mullions where necessary; keyed removable mullions may be required in some locations.
        1) Vertical rod exit devices are not permitted.
    b. Door Closers: LCN; no substitutions or exceptions.
        1) Closets and Student Rooms: LCN 1460.
        2) All Other Locations: LCN 4040.
    c. Handicap Operators: Horton; no substitutions or exceptions; specify to be supplied and installed by Automatic Access of Colorado Springs.
    d. Hinges: Ball-bearing butt hinges as appropriate to door function.
        1) Heavy-duty, minimum 4.5 x 4.5 inch unless larger hinges are required for specific door size or indicated function.
    e. Door Stops: Unless specifically indicated as one type, wall-mounted type or overhead door/frame mounted type.
        1) Do not use floor-mounted type or other types not permitted by College Facilities Services Department.
    f. Door Hold-Opens: Unless specifically indicated as one type, magnetic hold-open type.
        1) Do not use floor-mounted type, overhead-mounted type, hold-open feature in closer alone without a separate stop, or other types not permitted by College Facilities Services Department.

L. Do not use:
1. Different metals subject to galvanic action in direct contact with each other.
2. Aluminum in direct contact with concrete or cementitious materials.

2.03 INTERIOR OPENINGS OTHER THAN DOORS AND BORROW LITES

A. Access Doors:
1. Use one of the following:
    a. Manufactured metal doors at locations required to access concealed plumbing and HVAC valves, equipment, and similar items .
    b. Other doors acceptable to College Facilities Services Department.
2. Do not use:
    a. Custom fabricated metal doors.
    b. Custom fabricated wooden doors.
    c. Doors not accepted by College Facilities Services Department.

B. Expansion Joint Covers:
1. Use one of the following:
    a. Manufactured all-metal covers at locations required by superstructure design for thermal and seismic movement control.
    b. Manufactured metal covers with resilient filler at locations required by superstructure design for thermal and seismic movement control.
    c. Other systems acceptable to College Facilities Services Department.
2. Do not use:
    a. Systems not accepted by College Facilities Services Department.

2.04 STAIRS AND RAMPS

A. Use one of the following as required by facility design:
1. Poured-in-place concrete stairs.
2. Custom fabricated metal stairs.
3. Preassembled metal stairs with poured-in-place concrete treads.
4. Pipe railings.
5. Tempered glass railing assemblies.
6. Ornamental metal stairs.
7. Other systems acceptable to College Facilities Services Department.

B. Do not use:
   1. Precast concrete treads.
   2. Metal spiral stairs.
   3. Wood stairs.
   4. Ornamental wood stairs and railings.
   5. Systems not accepted by College Facilities Services Department.

2.05 TOILET, BATH, AND LAUNDRY ACCESSORIES

A. Reflective Surfaces of Mirrors:
   1. Use one of the following:
      a. Glass.
      b. Mirror-polished stainless steel.
      c. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Polycarbonate plastic.
      b. Acrylic plastic.
      c. Systems not accepted by College Facilities Services Department.

B. Toilet, Bath, and Laundry Accessories:
   1. Use one of the following:
      a. Stainless steel accessories.
      b. Enameled steel accessories.
      c. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Brass accessories.
      b. Chrome-plated cast zinc accessories.
      c. Aluminum accessories.
      d. Systems not accepted by College Facilities Services Department.

C. Shower Closures:
   1. Use one of the following:
      a. Plastic shower curtains.
      b. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Fabric shower curtains.
      b. Glazed shower doors.
      c. Systems not accepted by College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Interiors: Provide appropriately finished interiors for all spaces indicated in the program, equipped with interior fixtures as required to function properly for specific occupancies.

B. Interior Partitions: Provide physical separation between spaces, constructed to achieve fire ratings required by code, appropriate security between adjacent spaces, and visual, acoustical, olfactory, and atmospheric isolation as necessary to maintain desirable conditions in each space.

C. Interior Doors: Provide doors between adjacent spaces where required by the program or where proper functioning of adjacent spaces requires movement of people or objects between them.

D. Interior Windows: Provide interior windows between adjacent spaces where required by the program or where proper functioning of adjacent spaces requires limited visual or physical connection between them.

E. Other Interior Openings:
   1. Ventilation Openings: Provide interior openings between adjacent spaces when required for air movement, equipped with automatic fire dampers where separations are fire-rated.
   2. Access Openings: Provide interior openings where required for maintenance access to mechanical services and other concealed systems , designed to be as unobtrusive as possible.

3. Joint Covers: Provide covers for interior expansion joints that protect joints from debris, provide safe and durable support for anticipated traffic, and minimize visual discontinuity with adjacent surfaces.

F. Stairs: Provide interior stairs and ramps as necessary for access to and egress from all occupied spaces required by the program, in compliance with code and as follows:
   1. Provide not less than one alternating tread stair to all unoccupied roofs, mechanical spaces, and equipment mezzanines.
   2. Wider Stairs: Provide stairs that are 50 percent wider than required by code to facilitate student movements during passing periods, unless otherwise permitted by College Facilities Services.

G. Interior Finishes: Provide finishes for interior surfaces that are appropriate for the functions of each space.
   1. See Section C30 for criteria.

H. Where interiors elements also must function as elements defined within another element group, meet requirements of both element groups.

I. In addition to the requirements of this Section, comply with all applicable requirements of General Facility Design Criteria.

3.02 AMENTIY AND COMFORT CRITERIA

A. Access: Provide access to all primary interior spaces from circulation spaces (no access to any primary interior space exclusively through another primary interior space).

B. Accessibility: Provide interior fixtures that are easily usable by disabled persons without outside assistance.
   1. Provide interior fixtures that comply with ADAAG.

C. Thermal Performance: Where adjacent spaces have differential required temperatures in excess of 10 degrees F, provide separation having minimum U-factor of 0.61 Btu/sq ft/hr/deg F.

D. Provision of Natural Light:
   1. Natural lighting is required for the following spaces:
      a. Occupant Work, unless otherwise permitted by College Facilities Services.
      b. Classroom and Instruction, unless otherwise permitted by College Facilities Services.
      c. Residential , except for bathrooms.
   2. Natural lighting is not required in the following types of secondary spaces:
      a. Storage.
      b. Circulation.
      c. Building Services.
      d. Utility Equipment.
   3. Light Levels: Maximize natural lighting in interior spaces while maintaining performance of other criteria, unless otherwise permitted by College Facilities Services.
   4. Visual Comfort: Provide ambient natural light in primary spaces that is free of excessive direct or reflected glare, as defined in IESNA RP-5, Recommended Practice of Daylighting.
   5. Daylight Control: Provide local devices to enable occupants to control brightness and glare from direct daylighting.
      a. Window treatments are acceptable methods of complying with this requirement.
      b. Do not use window treatments that have only "fully open" and "fully closed" modes or fabric window treatments.

E. Visual Privacy:
   1. Provide fixed, full-height partitions at toilet rooms, dressing rooms, changing rooms, and similar locations that afford visual privacy between adjacent stalls.

F. Glare: Provide interior fixtures that are not a source of direct or reflected glare.
   1. Written and Graphic Information on Interior Fixtures: Clearly legible from typical viewing distances by occupants with normal eyesight.
   2. Surfaces Containing Written or Graphic Information: Matte finished to reduce the incidence of veiling reflections.

3. Trans-Illuminated Surfaces: Luminance that is not more than 10 times brighter than surrounding surfaces under ambient lighting conditions for the space.

G. Ambient Noise: Provide interiors that maintain ambient sound levels within primary spaces at levels recommended in ASHRAE HVAC Applications Handbook, when adjacent spaces are occupied and are being used normally.

H. Impact Noise: Provide floor-ceiling construction, including floor structure, floor finish, and ceiling finish, to insulate primary spaces from undesirable impact noise when adjacent spaces are occupied and are being used normally.
   1. Roof spaces occupied in similar manner to interior spaces are considered interior spaces for purposes of impact noise reduction.

I. Acoustical Reverberation: Provide reverberation times in primary spaces for frequencies of 500-1000 Hz as follows:
   1. Classrooms: 0.6-0.8 seconds.
   2. Lecture Rooms and Conference Rooms: 0.9-1.1 seconds.
   3. Auditorium and Multipurpose Space: 1.5-1.8 seconds.

J. Odor Control: Prevent unpleasant, dangerous, or noxious odors generated within a space from affecting occupants of adjacent spaces, by providing physical isolation of the spaces, separate ventilation, or a combination of isolation and ventilation.
   1. Control odors from spaces of the following types:
      a. Commercial kitchen.
      b. Laboratory.
      c. Laundry or dry cleaning.
      d. Swimming pool.
      e. Toilet rooms.
      f. Locker or changing rooms.
      g. Animal housing.
      h. Parking garage.
      i. Trash collection.
      j. Trash removal or incineration.
      k. Other spaces required by facility program.

K. Appearance: Provide interiors that are pleasing in appearance and do not detract from the primary functions performed in each space.
   1. Provide partitions that are smooth in texture at all circulation routes.
   2. Interior Openings Other Than Doors and Borrow Lites:
      a. Compatibility: Provide access panels, hatches, and louvers that are compatible in appearance with the finished surfaces in which they are installed, employing similar colors and textures.
      b. Contrast: Provide expansion joint covers that contrast in material, color, and texture with the finished surfaces in which they are installed.
      c. Frames: Design frames to give a nearly flush appearance.
   3. Interior Fixtures: Provide interior fixtures that are coordinated in design with other elements of interior construction, using compatible materials, colors, textures, and design features.

L. Texture: Provide interior elements and surfaces that are textured appropriately for primary functions to be accommodated within each space.
   1. Surfaces Within Reach: Provide durable, low maintenance exposed surfaces where within reach of occupants engaged in activities normal for the particular space in which they are installed.
      a. Flat, Exposed Metal Surfaces: Finishes that are satin, that is, non-reflective rather than smooth polished surfaces.
      b. Flat Metal Surfaces: Coatings not permitted.
      c. Hardware and Other Rounded Metal Surfaces: Finishes that are satin , or high performance organic coatings.
      d. Plastic Surfaces: Matte, rather than glossy or polished finishes.
      e. Concrete and Stone Surfaces: Honed or other textured, non-polished finishes.
   2. Surfaces Not Within Reach: For surfaces that are not within normal reach of occupants, provide textures that are comparable to those within normal reach.

M. Doors - Accessibility and Convenience:
   1. Dimensions: Provide interior doors that are sized appropriately for people, vehicles, and goods likely to move between adjacent spaces.
   2. Height: Not less than 80 inches (6'-8") .
   3. Width: Not less than 36 inches in width , except for doors to shallow closets.
   4. Closing Devices: Not required unless specifically indicated or required by code; smooth closing motion , with slower latching speed than closing speed (no slamming).

N. Doors - Appearance:
   1. Provide interior doors that match existing doors at locations in renovation and remodel projects, unless otherwise permitted by College Facilities Services Department.

3.03 HEALTH AND SAFETY CRITERIA

A. Flammability: Provide interior fixtures made of materials with flame spread index of 25 or less and smoke developed index of 450 or less when tested in accordance with ASTM E84 at all locations throughout the project.
   1. Projection Surfaces: Free-hanging and tensioned fabric screens flame retardant in accordance with code.

B. Fire Resistance: Design and select materials to provide fire resistance in accordance with code.
   1. For all elements required to have a fire resistive rating and which are not made of materials and systems specified as acceptable by the code, use proven-by-mock-up construction.
   2. For proven-by-mock-up construction, acceptable testing agencies are Underwriters Laboratories Inc., Underwriters' Laboratories of Canada, Inchcape Testing Services (Warnock-Hersey), and Factory Mutual.

C. Safety: Design and provide interior construction to protect building occupants in accordance with code and the following:
   1. Egress: Provide egress from all interior spaces in accordance with code.
   2. Heights: Protect building occupants from falling from elevated interior observation decks, balconies, and walkways.
   3. Emergency Escape Windows: Provide minimum opening size as required for secondary means of egress in applicable facilities.
   4. Tripping: Protect building occupants from tripping hazards due to uneven floor surfaces or abrupt changes in floor elevation of more than 1/8 inch.
      a. Provide floor expansion joint covers and floor hatches that are flush with finished floor surface or lapped not more than 1/4 inch above finished surface with tapered edges to present minimal tripping hazard.
   5. See other Sections for minimum performance values for other interior elements.
   6. Broken Glass Hazard: Provide only fully tempered float glass for glass in fixtures.
   7. Fixtures Expected to Support or Assist in the Support of Persons: Touchable surfaces having slip resistance of 0.80 minimum, measured in accordance with ASTM D2047, using wet conditions.

D. Safety of Stairs:
   1. Slip Resistance: Design and construct exterior stairs so that treads have a minimum static coefficient of friction of 0.80 minimum, measured in accordance with ASTM D2047.
   2. Risers: Design and construct stairs with closed risers.
   3. Treads: Design and construct stairs with treads that have a maximum bevel or radius on leading edge of 1/4 inch.
   4. Guards or Guardrails: Design and construct stairs so that there are no openings in guards or guardrails required by code that are large enough for a sphere with a diameter of 4 inches to pass through.
   5. Winders: Design and construct stairs without winders , even if permitted by code.
   6. Spiral Stairs: Do not employ spiral stairs , even if permitted by code.
   7. Circular Stairs: Do not employ circular stairs , even if permitted by code.

E. Sanitation: At spaces used for food preparation and facility maintenance, provide smooth, impervious, and water-resistant partition surfaces and integral coved base that will allow chemical cleaning and sterilization without damage.

F. Doors - Fire Safety: Protect door openings in fire-rated walls and partitions in accordance with the code and the following:
   1. Hold-Open Function: At required locations; wall-mounted electromagnetic device that allows the door to swing freely and that automatically closes door upon detection of local fire or smoke.
   2. Closers: Sufficient closing force to close and latch door despite drafts and wind, but not more than that specified by code.
   3. Floor Clearance: Not to exceed 3/4 inch, or as otherwise restricted by fire/smoke label on each door assembly.

G. Doors - Emergency Egress: Where doors must be latched or locked, comply with the code and the following:
   1. Exceptions in the code waiving requirements for panic hardware or egress without the use of a key, under conditions that a sign stating that "This door must remain unlocked during business hours" is posted, are not allowed.
   2. Locking Devices Requiring a Key for Egress: Not allowed.
   3. Exit Doors Having Occupant Load of 50 or More (Regardless of Occupancy): Use exit hardware that releases the locking/latching mechanism upon the application of a force in the direction of egress travel.

H. Doors - Physical Security:
   1. Locks: Secure each room door using a keyed lockset that allows exit from inside using only one motion.
      a. Exceptions:
         1) The following must be secured from the "inside" rather than from the outside and do not require free exit:
            (a) Doors into exit stairwells (secure from stair side).
         2) The following may have privacy lock function (without key):
            (a) Doors to bathrooms, water closet compartments, shower compartments, single person restrooms, or similar spaces.
      b. Keys: Minimize unauthorized entry.
         1) Keying: Key all locks to the existing Campus keying system .
         2) Keymaking Restrictions: Key blanks and keymaking restricted to College Facilities Services Department; all lock cylinders to have restricted keyways.
      c. Locking Functions: Appropriate to the space location and function as indicated in program.
   2. Glazing in Doors: Comply with specified requirements for safety glazing, security, and forced entry as applicable.

3.04 STRUCTURAL CRITERIA

A. Structural Performance: Provide interior construction and fixtures to support without damage all loads required by code.
   1. Live Loads: Provide suspended interior fixtures or portions of fixtures designed for storage or support of persons or objects that have been engineered and installed to withstand 1.5 times the anticipated live loads without excessive deflection or permanent distortion.
      a. Grab Bars: Strength, design, anchorage, and support as required to withstand 250 pounds-force applied vertically at the center between supports and 250 pounds-force tension applied at any support; supports of sufficient rigidity to prevent rotation of bars under load.
   2. Special Loads: In addition to loads defined by code, provide for adequate support of wall-mounted or ceiling-mounted furnishings and equipment in spaces where such equipment is required by program or is likely to be installed after construction because of intended function.
      a. Adequate support is defined as the ability to sustain 150 percent of design loads without damage to building or equipment.

B. Seismic Loads:
   1. Interior Partitions at Stairs and Elevators: Provide partitions that have been engineered and installed to withstand seismic forces that are minimum 10 percent greater than those required by code.
   2. Fire Rated Ceiling Assemblies: Provide ceilings that have been engineered and installed to withstand seismic forces that are minimum 10 percent greater than those required by code.

3. Interior Fixtures: Provide interior fixtures or portions of fixtures designed for storage or support of persons or objects that have been engineered and installed to withstand seismic forces that are minimum 10 percent greater than those required by code.
    a. Application: For design purposes, apply the component seismic force at the center of gravity of the component nonconcurrently in any horizontal direction.
    b. Exception: For design purposes, the contents to be included need not be more than 50 percent of the rated capacity of the interior fixture if the supports and framing of the fixtures are designed and connected to act as braced or moment-resisting frames.

C. Vertical Loads: Provide partitions with sufficient strength to withstand anticipated vertical loads for wall-mounted handrails, equipment, and furnishings without excessive deflection or structural damage.
1. Partial Height Partitions: Withstand point load of 200 lbf applied every 2 feet to top of partition.
2. Demountable Partitions: Capable of supporting hanging components weighing up to 7 lbf/in when tested in accordance with ANSI/BIFMA X5.6.

D. Horizontal Loads: Provide partitions with sufficient strength and rigidity to withstand anticipated horizontal loading conditions without excessive deflection or structural damage.
1. Fixed Partitions: Withstand loading of 10 psf with maximum deflection of L/120, per ASTM E72.
2. Elevator Shaft Wall Partitions: Withstand intermittent air pressure loads of 10 psf with maximum deflection of L/120, per ASTM E72.
3. Air Shaft Partitions: Withstand sustained air pressure loads of 10 psf with maximum deflection of L/120 per ASTM E72.
4. Partial Height Partitions: Withstand concentrated load of 200 lbf applied over not more than 10 sq in anywhere on partition surface.
5. Demountable Partitions: Withstand loading of 5 psf with maximum deflection of L/120, per ASTM E72.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span: Same as building service life , except as follows:
1. Interior Doors and Other Operable Elements: Minimum 20 years functional and aesthetic service life.
2. Interior Windows: Minimum 15 years functional and aesthetic service life with normal operation without requiring replacement of any parts.
3. Interior Ceiling Finishes: Minimum 15 years functional and aesthetic service life; including suspended ceilings.
4. Interior Wall and Floor Finishes: Minimum 15 years functional and aesthetic service life.
5. Operating Components : Minimum of 10 years under normal use conditions.
6. Other Interior Construction: Minimum 15 years functional and aesthetic service life.

B. General Durability: Provide interior construction and fixtures that are suitable in durability for the degree and type of traffic to be anticipated in each space and ordinary cleaning and maintenance operations.
1. At swimming pool enclosures, steam rooms, laundry rooms, trash collection rooms, and janitorial closets, provide interior construction that will allow harsh chemical cleaning without damage.

C. Moisture Resistance:
1. Shower Curtains: Do not use plastic shower curtains unless treated with a permanent mildewcide.
2. Mirrors: Silvered surfaces protected from degradation due to presence of moisture.
3. At swimming pool enclosures, steam rooms, laundry rooms, shower rooms, trash collection rooms, janitorial closets, and similar spaces, provide interior construction and fixtures that will not be damaged by water or high humidity.

D. Humidity Endurance: At interior spaces exposed to high humidity, such as swimming pool enclosures, provide interior construction that will withstand continuous or intermittent exposure without significant changes in dimension.

E. Corrosion Resistance: At swimming pool enclosures, steam rooms, laundry rooms, shower rooms, and similar spaces, provide interior construction materials and fixtures that are inherently resistant to corrosion and rot.

F. Ultraviolet Resistance: In interior spaces exposed to direct sunlight, provide interior construction and fixtures that are inherently resistant to fading and discoloration.

G. Vandal Resistance: In spaces accessible to the public and not subject to continuous surveillance, provide interior construction and fixtures that are inherently vandal resistant or designed to be difficult to access or damage.

H. Theft Resistance: Provide interior fixtures at all locations that are attached to substrates with concealed, tamper-resistant, or tamperproof fasteners to minimize theft and vandalism.
   1. Toilet Accessories:
      a. In All Locations: Secure to substrates using tamperproof or concealed fasteners.

I. Doors - Expected Life Span of Operating Components: Remaining operable for 10 years under normal exposure conditions for the project site.
   1. Wear Resistance:
      a. Door Surfaces: Scuff-resistant in areas where foot impact is likely; highly scratch-resistant in areas where hand contact is likely ; applied protective surfaces for vulnerable areas are acceptable.
      b. Door Handles and Knobs: Highly scratch-resistant and of finish that will minimize appearance changes due to wear; satin or brushed finish only.
   2. Flexible Seal Materials: Minimize deterioration due to operation of doors and aging.
   3. Swinging Doors: Control door swing to prevent damage due to impact, to either door or element impacted.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Frequency of Servicing: College Facilities Services expects that refilling/emptying will occur at the following intervals; provide capacity appropriate to servicing interval and expected use, based on project occupancy:
   1. Paper Towel Dispensers: Weekly.
   2. Toilet Paper Dispensers: Weekly , with sufficient redundancy to prevent running out.
   3. Toilet Seat Cover Dispensers: Weekly.
   4. Facial Tissue Dispensers: Weekly.
   5. Hand Soap Dispensers: Weekly.
   6. Waste Receptacles: Daily.
   7. Personal Supplies Vendors: Weekly.

B. Ease of Use:
   1. Interior Fixtures with Movable Components: Easy to use without special instruction and designed to prevent misuse.
   2. Hinges and Latches: Heavy duty hardware , easily adjustable, providing minimum anticipated service life of 20 years.
   3. Mechanical Controls: Movable cranks, rotors, pulleys, and levers designed for trouble-free operation over a minimum anticipated service life of 20 years.

C. Ease of Cleaning:
   1. Waste Receptacles: Removable, water- and steam-cleanable liners.

D. Ease of Repair:
   1. Mirrors: Breakable glazing replaceable without disassembly of frame.

E. Ease of Maintenance: Provide interior fixtures at all locations that are designed to permit repair or replacement of individual components without removal of fixture.

F. Ease of Relocation:
   1. Ease of Replacement or Relocation: Provide interior fixtures at all locations that are modular in form, detachable from substrate without damage to fixtures, and relocatable.

END OF SECTION

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C30

INTERIOR FINISHES REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior finishes comprise the following elements:
   1. Wall finishes, including those applied to the interior face of exterior walls and to the vertical faces of superstructure elements.
   2. Floor finishes, except for access floors.
   3. Suspended ceilings and soffits.
   4. Applied ceiling finishes.
   5. Stair finishes, except for integral stair surfaces.
   6. Finishes applied to other interior surfaces.

B. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCED STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. AATCC Test Method 134 - Electrostatic Propensity of Carpets.

D. AATCC Test Method 174 - Antimicrobial Activity Assessment of Carpets.

E. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

F. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

H. ASTM E413 - Classification for Rating Sound Insulation.

I. ASTM E1111 - Standard Test Method for Measuring the Interzone Attenuation of Open Office Components.

J. ASTM E1414 - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.

K. ASTM E1477 - Standard Test Method for Luminance Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.

L. NFPA 99 - Health Care Facilities Code.

1.03 FIELD CONDITIONS

A. The following existing elements must be preserved:
   1. Existing interior finishes required by facility program or designated by College Facilities Services Department.

B. Do not use any method involving sanding of existing resilient flooring, unless determined definitely not to contain asbestos.

C. Coordinate with College Facilities Services for testing for any hazardous materials like asbestos or lead paint prior to any demolition, sanding, scraping, or other finish application activities.

D. Contractor is required to limit any odors or dust in work areas from contaminating other areas of the building through HVAC systems or other means in occupied buildings. The fire alarm system must be protected and if necessary turned off to prevent accidental alarm activation in coordination with College Facilities Services.

PART 2 PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

A. The following items are to be provided by College Facilities Services:
   1. Coordinate with College Facilities Services Department on items to be furnished on specific projects on a case-by-case basis.

B. Owner-Furnished Items: Performance requirements that specify characteristics of equipment items do not apply; requirements for accommodating items to the project do apply.

2.02 CEILINGS AND CEILING FINISHES

A. Use one or more of the following as determined by facility program:
   1. Painted gypsum board ceilings.
   2. Acoustical panel ceilings.
   3. Linear wood ceilings at special locations determined by design.
   4. Other systems acceptable to College Facilities Services Department.

B. Do not use:
   1. Systems not accepted by College Facilities Services Department.

2.03 WALL FINISHES

A. General: Consult with the College Facilities Services Department on preferred brands of paint. In some cases the College Facilities Services Department may suggest preferred color pallets where applicable in order to minimize the variety of paint brands and colors required for spare product storage.

B. Use one or more of the following as determined by facility program:
   1. Ceramic tile.
   2. Stone facing at locations determined by design.
   3. Acoustical wall treatment at locations determined by acoustical requirements.
   4. Interior paints and coatings.
   5. Interior transparent stains.
   6. High performance coatings.
   7. Low VOC paints and coatings are preferred as long as they meet the durability requirements as determined by College Facilities Services Department.
   8. Other systems acceptable to College Facilities Services Department.

C. Do not use:
   1. Portland cement terrazzo.
   2. Wallpaper.
   3. Flexible wood veneer wall covering.
   4. Systems not accepted by College Facilities Services Department.

2.04 FLOOR FINISHES

A. Use one or more of the following as determined by facility program:
   1. Ceramic tile.
   2. Quarry tile.
   3. Paver tile.
   4. Portland cement terrazzo.
   5. Thinset epoxy terrazzo.
   6. Athletic flooring systems of types and at locations determined by design.

7. Brick flooring at locations determined by design.
8. Stone flooring at locations determined by design.
9. Cushioned wood flooring at locations determined by design.
10. Resilient sheet flooring.
11. Resilient tile flooring.
12. Fluid-applied flooring such as acrylic or epoxy coatings at locations as determined by design.
13. Sheet carpet, glued-down or stretched over pad at locations as determined by design.
14. Carpet tile.
15. Other systems acceptable to College Facilities Services Department.

B. Do not use:
1. Systems not accepted by College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide appropriately finished interiors for all spaces required by the program.

B. Where interior finishes are integral with elements defined within another element group, meet requirements of both element groups.

C. In addition to the requirements of this Section, comply with all applicable requirements of General Colorado College Facility Design Guidelines and Section C10.

3.02 AMENITY AND COMFORT CRITERIA

A. Moisture Vapor Transmission Resistance:
1. Interior Wall Finishes at Exterior Walls: Provide vapor permeance of 1 perm maximum when tested in accordance with ASTM E96/E96M.
2. Interior Ceiling Finishes at Roof Level: Provide vapor permeance of 1 perm maximum when tested in accordance with ASTM E96/E96M.

B. Reflectivity:
1. Glare: Provide interior finishes that will not result in discomfort glare due to excessive contrast with light sources.
   a. Ceiling Surfaces: Not less than 80 percent reflectivity, when measured in accordance with ASTM E1477.
   b. Wall Surfaces: Not less than 50 percent reflectivity.
   c. Floor Surfaces: Not less than 30 percent reflectivity.
   d. Exceptions: Non-public and service spaces designated by College Facilities Services Department spaces.
2. Specular Reflections: Provide interior finishes that will minimize specular reflections.

C. Acoustical Performance:
1. Sound Absorption: Provide acoustical absorption within interior spaces to achieve reverberation times within the limits specified in Section C10.
2. Articulation Class: For open office areas, provide ceiling and wall finishes that have been tested in accordance with ASTM E1111 to provide Articulation Class (AC) values not less than 150.
3. Sound Isolation: In areas where interior partitions stop at the ceiling and a plenum space extends above, provide ceilings tested in accordance with ASTM E1414 and classified in accordance with ASTM E413 to provide minimum Ceiling Attenuation Class (CAC) values as follows:
   a. Similar Functions and NC Levels on Both Sides of Partition: CAC 35.
   b. Quiet Space (NC 20-30) Separated From Moderately Noisy Space (NC 30-40): CAC 45.
   c. Quiet Space (NC 20-30) Separated From Noisy Space (NC 40-50): CAC 50.
   d. Quiet Space (NC 20-30) Separated From Very Noisy Space (NC 50-60): CAC 55.
   e. Moderately Noisy Space (NC 30-40) Separated From Noisy Space (NC 40-50): CAC 45.
   f. Moderately Noisy Space (NC 30-40) Separated From Very Noisy Space (NC 50-60): CAC 50.
   g. Noisy Space (NC 40-50) and Very Noisy Space (NC 50-60): CAC 45.

3.03 HEALTH AND SAFETY CRITERIA

A. Flammability: Provide ceiling, wall, and floor finishes with flame and smoke development ratings not greater than required by the Code.

B. Slip Resistance: For spaces subject to floor wetting, including entry lobbies, provide floor finishes with inherent slip resistance under wet conditions.
   1. At building entries, provide means for reducing or minimizing moisture and debris on shoe soles.
   2. At spaces such as kitchens, wet areas in retail spaces, treatment rooms, laboratories, steam rooms, and toilets, provide floor surfaces with minimum static coefficient of friction of 0.50 when wet, measured in accordance with ASTM C1028 or ASTM D2047.
   3. At stairs and corridors, provide floor finishes with minimum static coefficient of friction of 0.60, measured in accordance with ASTM D2047.
   4. At ramps, showers, steam rooms, and sloped floor surfaces, provide floor finishes with minimum static coefficient of friction of 0.80, measured in accordance with ASTM D2047.

C. Static Resistance: At laboratories, provide floor finishes with conductivity between 25 kiloohms and 1.0 megaohms, in compliance with NFPA 99.

D. Static Generation: At computer installations, laboratories with electronic equipment, and similar spaces, provide floor finishes that generate less than 2.0 kV at 20 percent relative humidity, when tested in accordance with AATCC 134 using step and scuff tests with Neolite and leather soles.

E. Cleanliness:
   1. For kitchens, provide wall, ceiling, and floor surfaces that are USDA approved.
   2. For spaces such as treatment rooms, laboratories, toilet rooms, bathrooms, maintenance rooms, and similar spaces, provide wall, ceiling, and floor surfaces that are inherently resistant to moisture and that can be cleaned by caustic agents without damage.

F. Antimicrobial Properties: At laboratories, provide wall, floor, and ceiling surfaces that will not support mold, mildew, or bacterial growth.
   1. Provide floor materials that are heat-welded to provide seamless surfaces.
   2. For carpeted areas, not less than 2 mm halo of inhibition for staphylococcus aureus, when tested in accordance with AATCC 174.
   3. For carpeted areas, not less than 1 mm halo of inhibition for klebsiella pneumoniae, when tested in accordance with AATCC 174.
   4. For carpeted areas, no fungal growth, when tested in accordance with AATCC 174.

3.04 STRUCTURAL CRITERIA

A. Floor Loading: Provide floor finishes that are capable of withstanding static loading of 125 psi without permanent deformation.

3.05 DURABILITY CRITERIA

A. Expected Service and Aesthetic Life Span:
   1. Ceilings: Provide ceilings and ceiling finishes that are appropriate for anticipated usage and traffic in each area, based on a 30 year replacement cycle.
   2. Walls: Provide wall finishes that are appropriate for anticipated usage and traffic in each area, based on a minimum of 10 year replacement cycle.
   3. Flooring: Provide floor finishes that are appropriate for anticipated usage and traffic in each area, based on a minimum of 10 year replacement cycle.

B. Wall Protection: In corridors, mail rooms, freight receiving rooms, and similar spaces, provide impact resistant wall bumpers and corner guards or wall surfaces that are inherently resistant to impact damage due to rolling carts, hand trucks, and similar equipment.

C. Opening Protection: At partition openings intended to accommodate pedestrian or vehicular traffic, provide protection of opening edges in the form of door frames (cased openings) or corner guards.

END OF SECTION

D10

CONVEYING EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. People-moving equipment are conveying systems and devices that are primarily intended to move people between levels and which may secondarily convey materials, comprising the following elements:
   1. Elevators: All components for passenger and service elevators, including items such as shaft rails, pit ladders, exhaust louvers, and car and hoistway doors.
      a. Passenger Elevators: Rated for passenger service and generally wider than deep.
      b. Service Elevators: Rated for passenger service but suitable for carrying maintenance and delivery carts and large furniture and equipment; dedicated service elevators are not considered passenger elevators for the purpose of calculating total passenger elevator capacity.
      c. Electric Elevators: Hoisting machine, hoist ropes, car frame and enclosure, counterweight, guide rails and roller guides, power and operational controls, signal fixtures, hoistway entrances, door operator equipment and safety devices.
      d. Hydraulic Elevators: Power unit and control valves, hydraulic cylinder and plunger, controller, car platform and frame, car enclosure, guide rails, signal fixtures, hoistway entrances, door operator equipment and safety devices.
   2. People Lifts: All devices for moving passengers vertically or diagonally between adjacent levels, that operate independent of a fully enclosed shaft and do not qualify as elevators, escalators, or moving walks.
      a. Vertical Wheelchair Lifts: Driving mechanism, guide rails, car frame and platform, operating devices and control equipment, access doors, and safety devices.
      b. Inclined Wheelchair Lifts: Driving mechanism, inclined guide rails, car frame and platform, operating devices and control equipment, access doors, and safety devices.

B. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. ASME A17.1 - Safety Code for Elevators and Escalators.

PART 2 PRODUCTS

2.01 PEOPLE-MOVING EQUIPMENT TYPES

A. Use the following:
   1. Passenger elevators at multi-story buildings.
   2. Service elevators at locations required by facility program.
   3. Wheelchair lifts at locations required by facility program or by accessibility requirements.
   4. Other systems acceptable to College Facilities Services Department.

B. Do not use any of the following:
   1. Escalators.
   2. Moving walks.
   3. Stairway chairlifts.
   4. Systems not accepted by College Facilities Services Department.

2.02 ELEVATORS AND LIFTS

A. Passenger and Service Elevators:
   1. Use one of the following:
      a. Hydraulic elevators at facilities generally less than 55 feet in vertical travel distance from lowest stop to highest stop.
      b. Electric elevators at facilities generally 55 feet and greater in vertical travel distance from lowest stop to highest stop, or installed as retrofits in existing buildings.

B. People Lifts:
   1. Use one of the following:
      a. Vertical wheelchair lifts at locations required by facility program or by the code.
   2. Do not use any of the following:
      a. Inclined wheelchair lifts.
      b. Inclined stairway chairlifts.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Building Population for Capacity Computations: In accordance with code for occupancy, unless otherwise recommended by qualified conveying system consultant.

B. Passenger Elevators: If the project has more than one level, provide passenger elevators to provide access to every habitable floor.
   1. Provide at least one accessible and stretcher-capable passenger elevator complying with code that serves every habitable level as required by code.
   2. Provide elevator capacity as required by code to provide degree of convenience specified below.
   3. Exceptions:
      a. Intermediate levels less than one full story height from the level above or below are not required to be served by elevators if ramps are provided to connect such levels to at least one level with passenger elevator access.
      b. Where wheelchair lifts to provide accessibility to intermediate levels are permitted by the code.

C. Service Elevators: Provide service elevators as required by code in the following situations:
   1. If the building or portion of building is more than 2 stories tall, and the need for occasional movement of large objects, materials, or equipment between floors is likely.
   2. Exceptions:
      a. Intermediate levels less than one full story height from the level above or below are not required to be served by service elevators if ramps are provided to connect such levels to at least one level with passenger elevator access.

D. Where people-moving equipment is integral with elements defined within another element group, meet requirements of both element groups.

E. In addition to the requirements of this Section, comply with all applicable requirements of General Colorado College Facility Design Guidelines.

3.02 AMENITY AND COMFORT CRITERIA

A. Accessibility:
   1. Elevators: Provide passenger elevators that comply with the Americans with Disabilities Act Accessibility Guidelines ADA Standards for Accessible Design.
      a. Include tactile control identification and oral/aural response signals for the blind, and visual control response signals for the deaf.
      b. Height of Controls: Top button not higher than 45 in from finished floor.

B. Convenience: Location of vertical people-moving system (when required by other requirements):
   1. Not more than 100 feet from primary building entrance.

3.03 HEALTH AND SAFETY CRITERIA

A. Fire Resistance: Where vertical people-moving equipment must pass through fire resistant floor construction, provide fire resistance in conformance with code and the following:
   1. Shaft Enclosure: Not less than 2 hour fire resistance rating.
   2. Doors: Not less than 1-1/2 hour labeled fire protection rating; set in open position under normal operating conditions; self-closing in fire-alarm mode as required by the code.

3.04 STRUCTURAL CRITERIA

A. Comply with structural requirements of code and the following:
   1. Elevator Car Frames: All welded construction.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span: Provide people-moving equipment with functional service life the same as specified for the building, assuming that they will have continuing professional maintenance and periodic replacement of wearing parts.
   1. Controls: Solid state only.

B. Weather Resistance of Outdoor Installations: Provide features as required to permit operation in unconditioned spaces.
   1. Components Exposed to Open Air Even if Under Cover: Made of corrosion-resistant materials only; stainless steel, aluminum, bronze, brass, or cast iron.
   2. Provide storm drains in pits that are adequate to remove precipitation under extreme conditions.
   3. Provide heating elements to eliminate accumulation of snow and freezing of precipitation on walking surfaces as determined by College Facilities Services.

C. Wear and Abuse Resistance: Comply with requirements for exposed surface finishes specified in Section C30, unless otherwise indicated.
   1. Provide durable materials that will reliably resist scratches and other damage that can be reasonably expected due to anticipated traffic and use.
   2. Passenger and Service Elevators:
      a. Doors: Brushed stainless steel; shaft access keyhole required on every floor, sleeved completely through door.
      b. Hoistway Door Frames: Brushed stainless steel.
      c. Car Interior Walls: High-pressure plastic laminate, or other wall finish material approved by College Facilities Services.
      d. Railings: Provide protective railings at sides and rear that are made of brushed stainless steel.
   3. Control and Annunciator Panels: Brushed stainless steel; vandal-proof control and communications items that are normally accessible to the user.
   4. Provide pins for attaching protection pads during construction and as needed during ongoing operations.
   5. Provide durable, easily replaceable carpet tile flooring.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Elevators: Comply with provisions of ASME A17.1, unless otherwise indicated.

B. Traction Elevators: Provide "Helwig" red buffer caps on all brushes on direct current motors and generators.

C. Hydraulic Elevators:
   1. Hydraulic Oil: PCB-free.
   2. Jack Casings: Electrolysis protection.
   3. Scavenge Pumps: Pumps manufactured by Wagner preferred; pumps manufactured by Nylube not acceptable.
      a. Pump Requirements: External controls, clear top cover (for vCCal inspection, flood control, and minimum 100 ft head pressure.
   4. Temperature compensated hydraulic control valves preferred.
   5. Flexible hydraulic hoses not permitted; provide solid piping with appropriate mufflers.
   6. Hydraulic pumps mounted inside reservoir permitted.

7. Sump Pit: Provide as required by the code; verify and comply with all applicable requirements.
8. College Preference: Twin-post hydraulic systems for ease of maintenance and avoidance of underground jackshaft problems.

D. Passenger Elevator Duty, Including Service Elevators: Preferred operating characteristics as follows:
   1. Minimum Load Capacity: 3500 lb.
   2. Minimum Ultimate Elevator Speed:
      a. Up to 5 floors: 200 fpm.
      b. 5-10 floors: 400 fpm.
   3. Service Elevators:
      a. Minimum Loading Area: 29 sq ft.
      b. Minimum Height: 100 inches.

E. Passenger Elevator Operating System: As follows:
   1. Single Elevators: Selective collective operation.
   2. Controller must accept dry contact input from smoke detectors in elevator lobbies and have output contacts to control hoistway vent dampers.

F. Operating Features for All Elevators:
   1. Key switch in each elevator car for independent operating service.
   2. Key-controlled out of service feature.
   3. Automatic load weighing bypass.
   4. False car call canceling.
   5. Emergency power operation of elevators required by College Facilities Services Department, or in accordance with code.
   6. Provide card access or key operation as required by College Facilities Services.

G. Ease of Use: Provide equipment that operates automatically or in response to passenger input, without intervention by trained operators.

H. Minimization of Misuse: Provide features and mechanisms in excess of those required by code that will prevent or minimize unsafe conditions or inconvenience attributable to vandalism, pranks, or deliberate sabotage as required by College Facilities Services.

I. System Maintenance: Provide equipment designed to require minimum maintenance.

END OF SECTION

D20

PLUMBING SYSTEM REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water Supply: Water sources and storage.
   1. Water source for fire suppression systems is Colorado Springs Utilities potable water mainlines.

B. Domestic Water: All elements required to distribute water to fixtures, including piping and equipment for water cooling, heating and storage.
   1. Water Distribution: Piping within the building, serving fixtures. specialties, and equipment.
   2. Plumbing Equipment: Pumps, tanks, filters, and treatment equipment.

C. Sanitary Waste: All elements required for removal of sanitary waste, including piping, venting, discharge and disposal, and equipment.

D. Rain Water Drainage: All elements required for drainage of rain water from building areas in which it may accumulate and drainage of clear wastes from building services; not including gutters and downspouts or subdrainage.

E. Plumbing Fixtures: All fixtures necessary for sanitation, occupancy, and use, which are connected to water supply or drainage; not including water heating or conditioning equipment or kitchen appliances.

F. Other Plumbing Elements: Services elements required for:
   1. Swimming Pools: Water supply, treatment, and drainage.

G. Utility Sources and Outlets:
   1. Water Source and Sewage Disposal: Existing public utility.
      a. Water Utility: Colorado Springs Utilities.
      b. Water Utility Address: Leon Young Service Center, 1521 South Hancock Expressway, Colorado Springs, Colorado.
      c. Water Utility Telephone Number: 719-448-4800.
   2. Rain Water Drainage Outlet: Existing public utility storm drainage system independent of sanitary sewer.
      a. Storm Water Utility: Colorado Springs - City Engineering.
      b. Storm Water Utility Address: Stormwater Management, 30 S. Nevada Avenue, Colorado Springs, Colorado.
      c. Storm Water Utility Telephone Number: 719-385-5918.

H. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. ASME A13.1 - Scheme for the Identification of Piping Systems.

D. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.

1.03 FIELD CONDITIONS

A. The following existing plumbing work site elements must be preserved:
   1. Historic decorative metal fencing and stone retaining walls.
   2. Significant trees should be protected by fencing outside drip lines during construction.
   3. Campus standard building, ADA, or wayfinding signage should be carefully removed without damage, stored, and replaced after construction is completed.
   4. Campus standard seating, light pole fixtures, and emergency phone pole equipment should be carefully removed without any damage, stored, and replaced after construction is completed.

B. The following existing plumbing work site elements must be removed to accomplish new construction:
   1. Underground petroleum storage tank(s).
   2. Underground tunnels or utilities.
   3. Statuary art work.
   4. Campus standard building, ADA, or wayfinding signage.
   5. Campus standard seating, light pole fixtures, and emergency phone equipment.

PART 2 PRODUCTS

2.01 PIPING - GENERAL

A. Do not use:
   1. Plastic piping of any type.
   2. Plastic piping inside the building.
   3. Steel piping, for any purpose.
   4. Systems not accepted by College Facilities Services Department.

2.02 DOMESTIC WATER PIPING AND EQUIPMENT

A. Water Piping - Buried:
   1. Use one of the following according to Colorado Springs Utilities code:
      a. Copper pipe (ASTM B42), with brazed or soldered cast copper or wrought copper or bronze fittings, or flared cast bronze fittings.
      b. Ductile iron water pipe, cement lined, with ductile iron or gray iron fittings and gasketed joints.
      c. Other systems acceptable to College Facilities Services Department .
   2. Do not use:
      a. Plastic pipe of any type except as specifically approved.
      b. Acrylonitrile butadiene styrene (ABS) plastic pipe.
      c. Brass pipe.
      d. Chlorinated polyvinyl chloride (CPVC) plastic pipe.
      e. Galvanized steel pipe.
      f. Polybutylene (PB) plastic pipe or tubing.
      g. Polyvinyl chloride (PVC) plastic pipe.
      h. Polyethylene pipe and fittings, with mechanical clamped joints.
      i. Polyethylene/aluminum composite pipe, with brass compression joints.
      j. Concrete, clay, or asbestos cement pipe.
      k. Lead pipe or fittings (bends, traps, caps and plugs).
      l. Piping not accepted by College Facilities Services Department.

B. Water Piping - Not Buried:
   1. Use one of the following:
      a. Copper tube, cast copper, wrought copper, or bronze fittings, and soldered joints.
      b. Aqua-Therm piping and associated fittings and joints.
      c. Other piping acceptable to College Facilities Services Department.
   2. Do not use:
      a. Acrylonitrile butadiene styrene (ABS) plastic pipe.
      b. Brass pipe.
      c. Galvanized steel pipe.
      d. Chlorinated polyvinyl chloride (CPVC) plastic pipe or tubing.
      e. Polyvinyl chloride (PVC) plastic pipe or tubing.
      f. Polybutylene (PB) plastic pipe or tubing.

g. Cross-linked polyethylene (PEX) plastic pipe or tubing; Exception: Use may be permitted in certain circumstances as approved by College Facilities Services.
h. Cross-linked polyethylene/aluminum/cross-linked polyethylene (PEX/AL/PEX) pipe or tubing.
i. Polyethylene/aluminum/polyethylene (PE/AL/PE) pipe or tubing.
j. Concrete, clay, or asbestos cement pipe.
k. Lead pipe or fittings (bends, traps, caps and plugs).
l. Lead pipe or fittings (bends, traps, caps and plugs).
m. Piping not accepted by College Facilities Services Department.

C. Insulating Materials:
1. Use one of the following:
a. Mineral fiber.
b. Cellular glass.
c. Calcium silicate.
d. Fiberglass.
e. Flexible cellular elastomeric.
f. Other insulation acceptable to College Facilities Services Department.
2. Do not use:
a. Any plastic foam, fiber, or cellular insulation no specifically approved.
b. Insulation not accepted by College Facilities Services Department.

D. Valves For Shut-Off or Isolation of Equipment, Fixtures, and Parts of Systems:
1. Use one of the following:
a. Ball valves; 4 inch or smaller.
b. Butterfly valves; larger than 4 inch.
2. Do not use:
a. Gate valves.
b. Globe valves.
c. Valves not accepted by College Facilities Services Department.

E. Valves For Flow Control, Throttling, or Bypass:
1. Use one of the following:
a. Ball valves.
b. Butterfly valves.
c. Other valves acceptable to College Facilities Services Department.
2. Do not use:
a. Gate valves.
b. Globe valves.
c. Plug valves.
d. Valves not accepted by College Facilities Services Department.

F. Water Heating Method for Domestic Hot Water:
1. Use one of the following:
a. Electric water heaters.
b. Gas-fired water heaters.
c. Hot water storage tanks.
d. Solar source heating.
e. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

2.03 SANITARY WASTE AND VENT PIPING AND EQUIPMENT

A. Sanitary Waste and Vent Piping - Buried:
1. Use the following:
a. Polyvinyl chloride (PVC) DWV pipe and fittings, with solvent welded or gasketed joints.
b. Other piping acceptable to College Facilities Services Department.

2. Do not use:
    a. Plastic pipe of any type.
    b. Acrylonitrile butadiene styrene (ABS) plastic pipe.
    c. Asbestos-cement sewer pipe.
    d. Cast iron pipe.
    e. Reinforced concrete pipe.
    f. Non-reinforced concrete pipe.
    g. Copper pipe or tube.
    h. Fiberglass pipe.
    i. Vitrified clay pipe.
    j. Lead pipe.
    k. Piping not accepted by College Facilities Services Department.

B. Sanitary Waste and Vent Piping - Not Buried:
1. Use one or more of the following:
    a. Brass pipe and fittings, chrome-plated, with mechanical compression joints.
    b. Cast iron pipe and fittings, hub-and-spigot, with neoprene or lead/oakum joint seals.
    c. Cast iron pipe and fittings, hubless, with neoprene gaskets and stainless steel clamps.
    d. Polyvinyl chloride (PVC) DWV pipe and fittings, with solvent welded joints.
    e. Copper tubing (DWV), with cast bronze or wrought copper fittings and soldered joints.
    f. Other piping acceptable to College Facilities Services Department .
2. Do not use:
    a. Plastic pipe of any type.
    b. Acrylonitrile butadiene styrene (ABS) plastic piping and fittings.
    c. Galvanized steel pipe.
    d. Aluminum (DWV) pipe.
    e. Fiberglass pipe and fittings.
    f. Lead pipe.
    g. Glass pipe.
    h. Piping not accepted by College Facilities Services Department.

C. Chemical Resistant Sanitary Waste and Vent Piping:
1. Use one or more of the following:
    a. Polyvinyl chloride (PVC) DWV pipe and fittings, with solvent welded joints.
    b. Glass pipe and fittings, with gasketed compression couplings.
    c. Polypropylene pipe and fittings, with fusion welded joints.
    d. Other piping acceptable to College Facilities Services Department.
2. Do not use:
    a. Acrylonitrile butadiene styrene (ABS) plastic pipe.
    b. Cast iron pipe.
    c. Copper pipe, copper tubing, galvanized steel pipe, or lead pipe.
    d. Vitrified clay pipe.
    e. Piping not accepted by College Facilities Services Department.

D. Cleanout Plugs:
1. Use one or more of the following:
    a. Brass.
    b. Plastic.
    c. Stainless steel.
    d. Other material acceptable to College Facilities Services Department.
2. Do not use:
    a. Material not accepted by College Facilities Services Department.

E. Cleanout Caps:
1. Use one or more of the following:
    a. Brass.
    b. Plastic.
    c. Reinforced neoprene.
    d. Cast iron.
    e. Other material acceptable to College Facilities Services Department.

2. Do not use:
    a. Material not accepted by College Facilities Services Department.

F. Floor Drains:
1. Use one of the following:
    a. Plastic.
    b. Other material acceptable to College Facilities Services Department.
2. Do not use:
    a. Cast iron.
    b. Copper.
    c. Lead.
    d. Material not accepted by College Facilities Services Department.

2.04 RAIN WATER PIPING AND DRAINS

A. Rain Water Piping - Not Buried:
1. Use one or more of the following:
    a. Any pipe/fitting/joint combination specified for sanitary sewer piping, not buried.
    b. Brass pipe and fittings, chrome-plated, with mechanical compression joints.
    c. Cast iron pipe, hub and spigot, with neoprene or lead/oakum joint seals.
    d. Cast iron pipe, hubless, with neoprene gaskets and stainless steel clamps.
    e. Polyvinyl chloride (PVC) DWV pipe and fittings, with solvent welded joints.
    f. Other piping acceptable to College Facilities Services Department.
2. Do not use:
    a. Plastic pipe of any type.
    b. Acrylonitrile butadiene styrene (ABS) plastic pipe.
    c. Copper pipe.
    d. Copper tube.
    e. Galvanized steel pipe.
    f. Aluminum pipe.
    g. Fiberglass pipe.
    h. Lead pipe.
    i. Piping not accepted by College Facilities Services Department.

B. Rain Water Piping - Buried:
1. Use one or more of the following:
    a. Any pipe/fitting/joint combination specified for buried sanitary sewer piping.
    b. Polyvinyl chloride (PVC) pipe and fittings, with solvent welded or gasketed joints.
    c. Other piping acceptable to College Facilities Services Department.
2. Do not use:
    a. Plastic pipe of any type.
    b. Acrylonitrile butadiene styrene (ABS) plastic pipe.
    c. Cast iron pipe.
    d. Concrete pipe.
    e. Copper pipe.
    f. Copper tube.
    g. Fiberglass pipe.
    h. Vitrified clay pipe.
    i. Piping not accepted by College Facilities Services Department.

C. Roof Drains, Area Drains, and Floor Drains:
1. Use one or more of the following:
    a. Bronze.
    b. Galvanized cast iron.
    c. Plastic.
    d. Other drains acceptable to College Facilities Services Department.
2. Do not use:
    a. Stainless steel.
    b. Drains not accepted by College Facilities Services Department.

2.05 PLUMBING FIXTURES

A. Water Closets :
   1. Use the following, unless otherwise approved:
      a. Water Closet - Residential Use: TOTO; Drake 2; floor mounted, with flush valve (no motion sensor).
      b. Water Closet - Commercial Use: Floor mounted, with Sloan flush valve (no motion sensor).
      c. Other types acceptable to College Facilities Services Department.
   2. Do not use:
      a. Types not accepted by College Facilities Services Department.

B. Urinals:
   1. Use the following, unless otherwise approved:
      a. Urinal: Porcelain white; with Sloan flush valve (no motion sensor).
      b. Other types acceptable to College Facilities Services Department.
   2. Do not use:
      a. Types not accepted by College Facilities Services Department.

C. Lavatories:
   1. Use the following, unless otherwise approved:
      a. Lavatories: Vitreous china; Moen faucet, Model 8800.
      b. Other types acceptable to College Facilities Services Department.
   2. Do not use:
      a. Types not accepted by College Facilities Services Department.

D. Sinks:
   1. Use the following, unless otherwise approved:
      a. Mop Sink: Zurn; 24 x 24 inch high-density composite sink; faucet manufactured by Chicago or T&S, brass, with vacuum breaker, 3/4 inch MIP hose end, and wall anchor.
      b. Kitchen Sink: Stainless steel; Moen faucet, Model 7437.
      c. Other types acceptable to College Facilities Services Department.
   2. Do not use:
      a. Types not accepted by College Facilities Services Department.

E. Bathtubs:
   1. Use one or more of the following as appropriate to location and function:
      a. Enameled cast iron.
      b. Enameled steel.
      c. Other types acceptable to College Facilities Services Department.
   2. Do not use:
      a. Fiberglass reinforced acrylic plastic.
      b. Solid plastic resin.
      c. Types not accepted by College Facilities Services Department.

F. Showers:
   1. Use one or more of the following as appropriate to location and function:
      a. Precast terrazzo receptors.
      b. Fiberglass reinforced acrylic resin receptors.
      c. Fiberglass reinforced acrylic resin walls.
      d. Solid plastic resin walls.
      e. Other types acceptable to College Facilities Services Department.
   2. Do not use:
      a. Solid plastic resin receptors.
      b. Types not accepted by College Facilities Services Department.

G. Faucets and Trim:
   1. Use one or more of the following as appropriate to location and function:
      a. Polished chrome-plated finish; see fixture types above for specific requirements.
      b. Other types acceptable to College Facilities Services Department.

2. Do not use:
    a. Polished brass finish.
    b. Colored coated finishes.
    c. Types not accepted by College Facilities Services Department.

H. Drinking Fountains:
1. Use one or more of the following as appropriate to location and function:
    a. Non-refrigerated drinking water fountains.
    b. Electric water coolers.
    c. Stainless steel finished units.
    d. Enameled steel units.
    e. Other types acceptable to College Facilities Services Department.
2. Do not use:
    a. Types not accepted by College Facilities Services Department.

I. Other Plumbing System Accessory Components:
1. Use the following, unless otherwise approved:
    a. Trap Primers: Non-mechanical type; RECTORSEAL, Sure Seal trap sealer; approved by ASSE 1072 and PPRBD.
    b. Water Hammer Arrestors: Sioux Chief, or other type approved by College Facilities Services.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide water supply necessary for building occupancy and use.

B. Provide delivery of domestic water to points of utilization.
1. Provide hot and cold domestic water to plumbing fixtures as required.

C. Provide water supply for fire sprinkler system and standpipes.

D. Provide drainage for disposal of waste as required by the code and for the following:
1. Fixtures and equipment which have a waste connection or a domestic water connection.
    a. Waste connections are not required on icemakers, refrigerators with icemakers, exterior hose bibbs, and coffee makers.
2. Emergency Drainage: Floor drains located in:
    a. Basements.
    b. Laundry rooms.
    c. Rooms where waterproof membrane is specified or installed under floor finish.
    d. Other areas required by code.
3. Cleaning Drainage: Floor drains located in:
    a. Kitchens.
    b. Restaurant and bar service areas.
    c. Food storage rooms.
    d. Walk-in freezers and coolers.
    e. Hose-down areas.
    f. Similar locations as required by College Facilities Services Department.
4. Indirect Drainage: Floor drains to receive piping, with trap primers as required by code, from:
    a. Equipment drain pans.
    b. Condensate drains.
    c. Other equipment that produces clear wastes.
    d. Other equipment specified to have indirect drain.
    e. Other areas required by code.

E. Provide drainage for disposal of rain water and clear wastes, as required by the code.
1. Drainage of roof areas that do not drain naturally without ponding, including built-in gutters.
2. Clear wastes include condensate drainage and HVAC cooling water.
3. Drainage for outdoor areas that are completely surrounded by construction that prevents natural drainage (e.g. areaways) or that are so sloped as to result in accumulation of water or ponding.

4. Drainage of interior areas where ground water may accumulate naturally, including sump pits and elevator pits.

F. Provide plumbing fixtures necessary for occupancy, use, and sanitation.

G. Provide services for other plumbing elements indicated.
   1. Swimming Pools: Comply with requirements of SBCCI Standard Swimming Pool Code.

H. Where plumbing elements must also function as elements defined within another element group, meet the requirements of both element groups.
   1. Services elements within food service spaces shall also comply with requirements of applicable food service equipment.
   2. Where services elements are located outside the building in the site area, meet applicable requirements of Section G30.

I. In addition to the requirements of this section, comply with all applicable requirements of Colorado College Facility Design Guidelines.

3.02 AMENITY AND COMFORT CRITERIA

A. Hot Water Supply:
   1. Provide pressure balanced shower valves which limit the water temperature to 110 degrees F.
   2. Provide a master thermostatic mixing valves where required which limit the hot water supply temperature to 110 degrees F.

B. Swimming Pool Water Temperature: Provide a means to heat swimming pool water to:
   1. Winter: 83 degrees F.
   2. Summer: 78 degrees F.

C. Noise:
   1. Design to prevent noise due to air trapped in piping systems.
   2. Provide water hammer arrestors as required to eliminate noise produced by the domestic water fixtures.
   3. Locate risers in dedicated and sound attenuated chases.
   4. Minimize noise produced by fixtures.

D. Convenience:
   1. Water Heaters:
      a. Locate water heaters in utility room.
      b. Do not locate water heaters above ceilings or where the public has access to them.
      c. Point-of-Use Applications: Locations only as approved by College Facilities Services.
   2. Fixture Heights: As specified in code.
   3. Fixture Configurations: As specified in code.
   4. Maneuvering Space: Provide space between and around fixtures as required by code.
   5. Faucets: Single action operation in the following locations:
      a. Lobby restrooms.
      b. Restrooms.
      c. Executive restrooms.
      d. Other locations as approved by College Facilities Services Department.
   6. Install floor drains flush with the surface on which they are installed, out of pedestrian traffic patterns wherever possible.
   7. Do not locate floor drains and floor cleanouts in doorways or directly in traffic paths.
   8. Slope floor to drains wherever possible.

E. Condensation:
   1. Insulate horizontal and vertical rain water piping, including the underbody of roof drains, using material of sufficient insulating value to prevent condensation.

F. Odors:
   1. Locate odor producing elements in areas separate from human occupancy in dedicated equipment rooms.
   2. Do not locate sanitary waste vent openings where odors are noticeable by occupants or by occupants of adjacent properties or where odor-bearing air may enter building spaces.
      a. Do not terminate vents within 10 feet horizontally of doors, windows, air intake or exhaust openings, or other openings in the exterior enclosure, unless vent termination is at least 3 feet above the top of the opening.
      b. Do not locate vent openings under overhangs.
      c. Do not locate vent openings closer than 10 feet to lot line.
      d. Extend vent pipes at least 6 inches above the surface of roofs.
         1) Exception: Where roof areas are to be occupied for normal building functions, extend vent pipes at least 7 feet above the roof surface.
      e. Extend vent pipes at least 12 inches above overflow level of the highest fixture served by the vent.
      f. Provide an automatic means of priming traps which may evaporate enough water to break the trap seal allowing sewer gases to enter the building.
   3. Connect fixtures to prevent entry of sewer gases into occupied spaces.
   4. Provide traps for all indoor drains connected to rain water drainage system.

G. Appearance:
   1. Do not locate rain water leaders or downspouts where they are visible from the outside of the building.
   2. Vents: Conceal vents from view.
   3. Fixtures:
      a. Smooth, corrosion-resistant, non-absorbent, with no crevices to collect dirt.
      b. Aesthetically pleasing and easy and comfortable to use; high style appearance is very important.
      c. Color: White, except where metal fixtures are required.

3.03 HEALTH AND SAFETY CRITERIA

A. Health: Provide potable water .
   1. Public utility water can be considered to be potable.
   2. Maintain the safety of the potable water source at all times.
   3. Do not connect the potable water source to any non-potable water source.
   4. Do not connect private potable water source to public potable water source.
   5. Keep animals and vermin out of open pipes, tanks, and other system components.
   6. Keep other contaminants out of the distribution systems, equipment, and water source.
   7. Provide water treatment as required to produce potable water complying with applicable government health agency requirements.
   8. Provide potable water supply with backflow preventers in accordance with code and filtration to remove pollutants. Provide backflow prevention devices at washing machines, utility sinks, mop sinks, chemical dispensers, and similar fixtures as required by code.
   9. No non-integral overflow outlets in lavatories, sinks, or tubs; these must be built-in.
   10. All openings and edges around the sides and bottom of each fixture permanently sealed with waterproof material.
   11. Provide filtration device on water supply to drinking fountains.
   12. Do not locate indirect drains in toilet rooms, unventilated or inaccessible rooms, or in air distribution or return plenums.
   13. Provide a backflow prevention device in the sewer discharge to prevent back-up into plumbing fixtures and floor drains.

B. Waste Disposal: Connect each fixture to sanitary drainage system for proper disposal of waste and harmful materials.

C. Pressure Control: Control pressures to protect the building, fixtures, equipment, and occupants from harm.
   1. Maximum Water Distribution Working Pressure: 55 psi.
   2. Pressure Reduction: Use pressure reducing valves or regulators.
   3. Air Removal: Remove air trapped in water distribution system.

D. Excess Pressure Hazard: Include devices to reduce accidental excess pressure to acceptable level, with maximum overpressure of 10 percent over specified system operating pressure, for the following items:
   1. Water heaters.
   2. Hot water storage tanks.
   3. Booster pumps.
   4. Hot water recirculating pumps.

E. Prevention of Sewer Gas Leaks:
   1. Provide waste system vents as required by code to avoid trap siphonage or compression.
   2. Prevent entry of sewer gases from the sanitary sewer into building's sewer system.

F. Protection of Potable Water Supply: As required by code.

G. Toxic Materials:
   1. Lead: Do not use lead or lead-containing materials in potable water systems.

H. Waste Drainage: Provide food handling equipment, food storage equipment, commercial dishwashing, drinking fountains, and water coolers with indirect waste pipe for drainage.

I. Burn Hazards:
   1. Maximum Fixture Discharge Temperature: 110 degrees F.
   2. Maximum Exposed Surface Temperature: 95 degrees F.
   3. Protect wheelchair occupants from hot water pipes and drains.

J. Fire Hazards:
   1. Do not use combustible piping materials inside the building.
   2. Terminate combustible piping entering the building within 5 feet outside of penetration.

K. Vermin Resistance: Provide grated coverings for rain water drains to prevent entry of rodents, insects and birds.

L. Hazard Labeling: Clearly label domestic hot water, domestic cold water, rain water drainage, and sanitary waste and vent systems indicating the nature of contents and direction of flow.
   1. Conform to requirements of ASME 13.1.

M. Hazardous Material Drainage: Prevent damage to public utility drainage systems by removing or neutralizing hazardous materials before discharging.

N. Flammable or Toxic Wastes: Provide means of safely disposing of:
   1. Gasoline.
   2. Diesel fuel.
   3. Oil.
   4. Anti-freeze (glycol solution).
   5. Acetone.
   6. Pesticides.

O. Supplementary Drinking Water:
   1. Provide sanitary and sealed water for human consumption.
   2. Provide lead-free water from treated municipal source, which utilizes multi-barrier processing methods, such as reverse osmosis, micron filtration, and distillation.

P. Swimming Pools:
   1. Provide filter and filter media to trap suspended particles from being recycled back into the pool.
      a. Filter Type: Cartridge filter.
   2. College Facilities Services personnel will be required to perform periodic chemical analysis of water.
   3. Provide automatic dispensing of treatment chemicals at adjustable intervals.
   4. Provide heated enclosure to house pool pump and filter.

3.04 STRUCTURAL CRITERIA

A. Rain Water Drains:
   1. Locate drains to avoid ponding loads in excess of structural capacity.
   2. Prevent inadvertent ponding by protecting drain openings from clogging, using raised strainers with minimum height of 4 inches wherever possible and flat gratings in all other locations.

B. Hub-and-Spigot Pipe Joint Support: Support joints so they do not separate under weight of pipe or live loads.

C. Insulated Pipes: Prevent compression of insulation by using pipe shields or saddles or dense insulation inserts.

D. Fixtures:
   1. Anchored to support weight of fixtures and a minimum of 400 pounds without failure or stress on the connecting pipes.
   2. Wall Mounted Fixtures: Carriers concealed inside fixture and in wall or floor.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span: Same as service life of building unless otherwise indicated.
   1. Shut-Off Valves and Similar Components: Same as service life of building.
   2. Electrically- and Fuel-Operated Equipment: Minimum 20 years.
   3. Other Moving Components: Minimum 20 years.
   4. Plumbing Fixtures: Same as building service life.
   5. Faucet Valves: 20 years.
   6. Flushing Mechanisms: 20 years.

B. Water Penetration: Reinforce weather barrier around roof and deck drains using extremely durable, permanently watertight material.

C. Moisture: Do not locate water heaters where leakage would cause damage to surrounding building materials , unless drip pans piped to floor drains are provided.

D. Condensation:
   1. Provide insulation on cold water pipes, fittings, valves, and equipment to limit condensation.
   2. Prevent condensation from forming on or dripping from sanitary drain piping, floor drain bodies, drinking fountain or water cooler waste piping, condensate piping, and p-traps.

E. Temperature Changes: Provide method of allowing thermal expansion of domestic water in the hot water system.
   1. Provide expansion tanks with bladders.
   2. Provide designed expansion loops on long runs.

F. Wear Resistance:
   1. Shutoff Valves: Resistant to corrosion, breakage, and scratching due to continual contact with water, human usage, and cleaning with abrasive materials.
   2. Fixtures, Trim and Accessories: Resistant to corrosion, breakage, scratching, burning, fading and chipping due to continual contact with water, human usage, and cleaning with abrasive materials.
      a. Acid resistant finish at lavatories, sinks, tubs, and water closets.

G. Shock Resistance: Do not use cast iron components where thermal or mechanical shock is expected.

H. Freeze Protection: Protect piping from freezing with heat tracing.

I. Joint Durability: Provide watertight joints.

J. Electrical Component Protection:
   1. Do not route piping through electrical rooms, switchgear rooms, transformer vaults, and elevator equipment rooms unless it is absolutely necessary.
      a. Where piping must be routed near electrical equipment, shield the electrical equipment with drip pans which drain to the nearest floor drain.

K. Equipment Protection:
   1. Domestic Water Distribution System: Provide a filtration device upstream of equipment which may be damaged by debris in the distribution system.

L. Maximum Discharge Temperature into Sewer: 140 degrees F.

M. Abuse: Protect rain water drainage conductors and leaders by placing in dedicated locations.

N. Resistance to Corrosive Wastes:
   1. Where corrosive wastes can be neutralized or diluted below harmful levels, removal is not required; otherwise, provide appropriate interceptors to remove corrosive wastes, including solids.
   2. Neutralizing Devices: Automatically operating, using water or neutralizing medium to render basic materials, acidic materials, and other chemical wastes harmless.
      a. Construct the drainage system upstream of the neutralizing devices using materials which are resistant to the specific corrosive elements entering the system.
      b. Corrosive agents entering the sanitary drainage system which must be neutralized or removed:
         1) Hydrochloric acid.
         2) Sulfuric acid.
         3) Caustic solutions.
   3. Oil Interceptors: Located as required by code.
   4. Sediment Interceptors: Located at each floor drain where significant amount of sand is likely to be tracked in by occupants or blown in by wind.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Fixture Functions:
   1. Lavatories: Standard spout, with integral overflow.
   2. Urinals: Siphon jet flushing action.
   3. Bidets: With flushing rim.
   4. Whirlpool Baths: multi-directional adjustable jets, air volume controls, and safety shut-off.
   5. Showers: With single-action hot-cold mixing valve.
   6. Kitchen Sinks: Swivel spout, water spray nozzle.
   7. Drinking Fountains: With hand operation, foot operation; chilled water service.
   8. Utility (Mop or Janitor's) Sinks: Filling of standard rolling mop bucket required ; spout designed to support full bucket of water.

B. Water Consumption: Provide low-flow fixtures to meet college sustainability program goals.

C. Capacity of Water Service: Provide adequate water flow and pressure to supply peak demand requirements. Comply with requirements specified in the code and the following.
   1. Size the water supply to exceed code by 10 percent.
   2. Water Delivery: If the water source has insufficient flow or pressure, provide means of increasing to required level.
      a. Use booster pumps or elevated storage tanks.
      b. Substantiation:
         1) Design Development: Identification of pressure and flow requirements (design conditions) for the building; verification of source availability at design conditions.
         2) Construction Documents: Equipment to be used to deliver water at design conditions; submit pump curves.
         3) Construction: Test of system flow and pressure; submit report verifying performance.
   3. Water Flow:
      a. Maximum Velocity: 8 fps at the design flow rate.

4. Water Supply Pressures:
    a. Water Pressure/Flow At Fixtures: 8 psi, minimum, except as otherwise required by code.
        1) Showers: 20 psi, minimum.
        2) Blowout Water Closets: 25 psi, minimum.
        3) Flush Valves at Water Closets and Urinals: 15 psi, minimum.
    b. Service Main Working Pressure: 100 psi at 75 degrees F.
    c. Water Distribution Working Pressure: 55 psi at 75 degrees F.
    d. Pressure Classification: Provide pipe, pipe components, and equipment with a pressure classification of 125 psi.

D. Waste Pipe Sizing:
1. Size piping as required by code.
2. Building Drain: 4 inches diameter, minimum.
3. Buried Piping Below Slabs: 3 inches diameter, minimum.
4. Pipes 3 inches in Diameter and Smaller: Sloped at 1/4 inch per foot, minimum, downward in the direction of flow.
5. Pipes 4 inches in Diameter and Larger: Sloped at 1/4 inch per foot, minimum, downward in the direction of flow.

E. Rain Water Drainage Capacity: As specified in the code and as follows:
1. Design Rainfall Rate: Short storm intensity of 1 inch in any 5 minute period.
2. Secondary Drainage: Required for roofs and exterior structural decks that do not drain naturally. Provide secondary roof drains connected to a secondary drainage system.
3. Rain Water Drainage Capacity:
    a. Roof Areas of 10,000 sq ft and Less: Minimum of two roof drains.
    b. Roof Areas of 10,000 sq ft or More: Minimum of four roof drains.
    c. Areaways and Courtyards: Drainage is not required for areas with less than 100 square feet open to the sky.
4. Drainage Outlets: As specified above and as follows:
    a. Secondary Drainage: Drain to completely redundant drain piping system.
    b. Scuppers: Drain to grade adjacent to building, rain water drainage system, street gutter, or dry well located in landscaped area.
    c. Parking and Service Garages: Drain floor drains into rain water drains, not into sanitary sewer.
    d. Areaways and Courtyards: Drain to rain water drainage system, sump pit with pump, dry well located in landscaped area, or water retention pond.

F. Maintenance of Drainage:
1. Sanitary Drainage:
    a. Where sewer discharge is higher than item to be drained, provide a means of lifting the waste for drainage.
        1) Method of Lifting Waste: Provide a grinder pump ejector or sewage pump and vented sump to lift waste to the sanitary sewer for drainage.
    b. Fittings, Joints, and Offsets: As required to ensure optimal flow through horizontal and vertical piping and at changes of direction.
    c. Transitions Between Horizontal Piping and Vertical Risers:
        1) Sanitary Waste: Sanitary tees, wyes, or wyes and eighth bends.
        2) Vents: Wyes, wyes and eighth bends, and short radius fittings.
    d. Provide video inspections and flow testing records for any new or renovation installation of sewerage waste lines 2 inch diameter and larger; include existing systems being tied into new or renovated installation.
        1) Video and Flow Tests: From last building fixture to Colorado Springs Utility main line; identify back-grading, verify reamed pipe ends, verify square pipe cuts, and identify pipe obstructions that would impede normal flow. Document locations and distances (dimensions) on video record.
2. Rain Water Drainage:
    a. Pipes sloped at 1/8 inch per foot, minimum, downward in direction of flow.

G. Energy Efficiency:
   1. Circulation Heat Loss: Provide insulation to limit heat loss of domestic hot water to a maximum of 2 degrees F in any 100 feet of pipe, when water is running, and maximum of 2 degrees F per hour, when water is standing, or as required to comply with energy code, whichever is more stringent.
      a. Provide recirculating pumps to limit the domestic hot water temperature drop to 2 degrees F within 100 feet of fixtures requiring domestic hot water, or as required to comply with energy code, whichever is more stringent.
   2. Equipment Heat Loss: Provide insulation on the following equipment to limit domestic hot water heat loss to maximum of 2 degrees F per hour, without energy input, or as required to comply with energy code, whichever is more stringent:
      a. Water softeners.
      b. Storage tanks.
      c. Water heaters.
      d. Hot water expansion tanks.

H. Minimization of Cleaning:
   1. Grease Interceptors: Located at drains specifically intended for disposal of grease, as indicated in program.
   2. Sediment Interceptors: Located at each floor drain where significant amount of sand is likely to be tracked in by occupants or blown in by wind.

I. Ease of Cleaning:
   1. Provide adequate access for cleaning each fixture and the areas around it.
   2. Floor Drains: At low points in floor and flush with finish floor surface.
   3. Cleanouts: Wall-mounted only; positioned minimum 6 inches higher than flood rim level of water closets or lowest flood level fixture in area serviced by cleanout.
   4. Drain equipment which produces or collects clear waste, such as condensation from cooling coils. Provide piping for the clear waste to the nearest floor drain.
   5. Indirect Waste Pipes Over 1 inch Diameter: Provide a means to catch and remove solid materials 1/2 inch and larger, such as a strainer.

J. Ease of Maintenance and Repair:
   1. Do not locate underground piping beneath electrical service, equipment, or footings.
   2. Provide City of Colorado Springs primary shut-off valve, and College secondary shutoff valve at the utility service main and the service entry point.
   3. Provide devices at each branch take-off which allow insertion of measurement devices to monitor flow and pressure levels in the water distribution system.
   4. Isolation of Piping Segments and Equipment: Provide a means of isolating the following:
      a. Each building from main water service. Provide a shut-off valve located inside a valve box whose removable access cover is at grade level.
      b. Water meter from building piping.
      c. Each building floor from water main service that floor in multi-story buildings.
      d. Each toilet room core or group from water main serving that core or group where toilet room exceeds two fixtures; provide separate shut-off valves for each gender toilet room so that both are not shut off for maintenance at the same time.
      e. Each water intensive area such as kitchen, mechanical equipment room, science lab, and similar spaces from building service, excluding locations where there is only one fixture with its own isolation valves.
      f. Each water branch from main service.
      g. Each vertical riser from piping below.
      h. Each water branch to fixtures or equipment from main vertical riser.
      i. Piping lower than the supply, to prevent unnecessary draining in the case of disconnection.
      j. Each plumbing fixture, storage tank, and item of equipment, so that removal of one will not necessitate shutdown of others.
      k. Individual fixtures and equipment. Provide an isolation device within 3 feet of pipe connection to item.

5. Provision for Drainage of Water Distribution Piping:
    a. Slope Piping Toward Drain: 1/4 inch per 10 feet.
    b. Provide a system drain at the lowest point in the system.
    c. Provide an adequately sized drain for the volume of water inside the distribution system.
    d. Drain valve (or fixture shut-off valve) located at each low point.
6. Provision for Cleaning of Drainage Piping: Provide a cleanout as required by code and as follows:
    a. At the upstream end of each horizontal sanitary drainage pipe, for cleaning in direction of flow.
    b. At the dead end of each dead-end pipe.
    c. Pipe 3 inches and Smaller: At intervals of 50 foot, maximum.
    d. Pipe 4 inches to 6 inches: At intervals of 80 foot, maximum.
    e. Pipe 8 inches and Larger: At intervals of 100 foot, maximum.
    f. Clearance: As required by code to allow for cleaning and rodding of pipe.
7. Interceptors That Must be Manually Cleaned:
    a. Designed for minimum of 2 months operation between cleanings.
    b. Located close to or in the same area as drains that receive the harmful wastes, for supervision and maintenance by occupants creating the waste.
    c. Removable waste container, with spare.
8. Plumbing Fixtures:
    a. Faucet valves easily removable and replaceable as a single unit.
    b. Each pipe connection to each fixture provided with a stop valve, for easy disconnection from water service.
    c. Provide access to all concealed connections, such as floor and wall cleanouts and slip-joint connections.
    d. Electrically-Powered Fixtures: Battery-power operation not allowed.

END OF SECTION

D30

HVAC SYSTEM REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. HVAC: Artificial and natural means of maintaining interior space comfort and air quality, including heating, cooling, ventilation, and energy supply.

B. The HVAC system consists of the following elements used to maintain occupant comfort:
   1. Energy Supply: Elements which provide energy.
   2. Heat Generation: Elements required to heat building.
      a. Heat generation elements comprise high temperature hot water (HTHW), heat exchangers and heat pumps.
      b. With prior approval of College Facilities Services, boiler and furnace heat generation systems may be considered as an acceptable design solution.
   3. Refrigeration: Elements necessary to generate the cooling required.
      a. Refrigeration elements comprise water chillers, cooling towers, condensing units, packaged terminal air-conditioners, packaged terminal heat pumps, auxiliary equipment, and evaporative coolers (swamp coolers).
   4. Air Distribution: Elements required to supply, return, and exhaust air associated with heating or cooling the building.
   5. Hydronic Distribution: Elements required to distribute water and other liquids for heating or cooling.
      a. System(s) required include low temperature water system, medium pressure water system, high temperature water system, chilled water system, and low temperature brine or water system.
   6. Freeze Protection: Entire central plant chilled and hot water systems are 100 percent water; no antifreeze or glycol.
   7. Steam Distribution: Elements required to distribute steam for heating and humidification and collect and return steam condensate.
   8. Refrigerant Distribution: Elements required to distribute refrigerant for heating or cooling.
   9. HVAC Controls: Elements required to monitor and control HVAC equipment and systems.
   10. Smoke Control Systems: Elements required to control smoke in the event of a fire and to remove smoke after the fire is extinguished.
   11. Humidification and Dehumidification Equipment; it is the Campus standard to NOT humidify or dehumidify spaces as part of achieving required thermal comfort conditions, with conditional exception of science labs and greenhouses, library rare book spaces, computer service rooms, music instrument storage or performance spaces, art materials storage or display spaces, or as required by College Facilities Services.
   12. Energy Recovery Equipment.

C. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 DEFINITIONS

A. AHU - Air handling unit.

B. DDC - Direct-digital control.

C. ERV - Energy recovery ventilator.

D. HTHW - High-temperature hot water.

E. HX - Heat exchanger.

F. LTHW - Low-temperature hot water.

G. DOAS - Dedicated outdoor air system.

H. VAV - Variable air volume.

I. VRF - Variable refrigerant flow system using year-round chilled water supply and return distribution system as a heat sink for building heating and cooling, similar to geothermal heat pump applications.

1.03 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. AABC MN-1 - AABC National Standards for Total System Balance; 2002.

C. AHRI 880 - Air Terminals.

D. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications.

E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013 (ANSI/ASHRAE Std 15).

F. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

G. ASHRAE Std 55 - Thermal Environmental Conditions for Human Occupancy.

H. ASHRAE Std 62.1 - Ventilation For Acceptable Indoor Air Quality.

I. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2010.

J. ASME A13.1 - Scheme for the Identification of Piping Systems; 2007 (ANSI/ASME A13.1).

K. ASME B16.5 - Pipe Flanges and Flanged Fittings.

L. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

M. ASME B16.11 - Forged Fittings, Socket-welding and Threaded.

N. ASME B31.1 - Power Piping.

O. ASME B31.3 - Process Piping.

P. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

Q. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.

R. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

S. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

T. SMACNA (DCS) - HVAC Duct Construction Standards.

1.04 FIELD CONDITIONS

A. The following existing HVAC elements must be preserved:
   1. Campus High Temperature Heating Hot Water (HTHW) system serving building space heating and domestic hot water (no glycol).
   2. Campus Chilled Water System (CWS) (no glycol) operates 12 months of the year; system design should discourage chilled water during winter operation and utilize airside economizers in conjunction with part-time central plant waterside economizer operation whenever outside air temperatures are appropriate.

B. The following existing HVAC elements must be removed to accomplish new construction:
   1. Steam heating systems, when found appropriate, should be replaced with hydronic heating systems, tied to the campus HTHW heating distribution system, or other stand-alone building heating systems as required by College Facilities Services.

2. Removal of air cooled DX refrigeration systems, when found appropriate, should be replaced with air conditioning systems connected to the campus chilled water distribution system, or other stand-alone building air conditioning systems as required by College Facilities Services.
3. Removal of exposed rooftop air handling units (AHUs) with water coils.
4. Pneumatic controls.
5. Complete removal of all abandoned existing systems related to ancillary and subsidiary components including associated controls, wiring, support systems (hangers, straps, etc.), ductwork, piping and piping accessories, and similar items.

PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

A. The following items are to be provided by College Facilities Services:
   1. Energy thermal meters.
   2. Water treatment:
      a. Contractor is required to clean, flush, purge, and refill hydronic distribution system.
      b. College's water treatment consultant will inspect system.
      c. Contractor is required to re-clean hydronic distribution system.
      d. College's HVAC mechanic will add water treatment chemicals and inhibitors.

2.02 HVAC SYSTEM TYPES

A. Use one or more of the following:
   1. Central HVAC Systems:
      a. Central chilled water system with fan coil units and air handlers.
      b. Low temperature hot water (LTHW) hydronic heating system (160-180 degrees F).
      c. Ultra-LTHW hydronic heating system (130 degrees F).
      d. Direct drive variable volume air handlers with:
         1) Exterior zone parallel fan VAV air terminal units with ECM motors.
         2) Interior zone pinch-down VAV air terminal units.
      e. Active chilled beams with energy recovery ventilation or a dedicated outdoor air system (DOAS).
      f. Variable refrigetant flow (VRF) using chilled water supply and return distribution system as a building heating and cooling system heat pump source.

B. Do not use, without prior approval:
   1. Stand-Alone HVAC Systems:
      a. Forced-draft, natural gas furnace with split-system cooling.
      b. Forced-draft, natural gas furnace with split-system heat pump.
      c. Packaged terminal air-conditioning units or heat pumps.
      d. Air-cooled, self-contained air handlers.
      e. Rooftop unit.
      f. Variable air volume, self-contained, air-conditioning unit.
   2. Central HVAC Systems:
      a. Central condenser water loop with water-cooled, variable air volume, self-contained, air conditioning units or water source heat pumps.
      b. Steam heating system.
   3. HVAC elements required to maintain occupant comfort:
      a. Exterior Zones: VAV system with single duct with hot water reheat and 1st stage perimeter radiant heat. HW reheat shall be limited to 30 percent of peak airflow according to ASHRAE Std 90.1; review all proposed exceptions with College Facilities Services.
      b. Exterior Zones (Alternate): VAV system with single duct hot water reheat and parallel fan powered boxes. Limit HW reheat to 30 percent of peak airflow.
      c. Interior Zones: VAV system with single duct with hot water reheat. Limit HW reheat to 30 percent of peak airflow.
      d. Active chilled beams with energy recovery ventilation or a dedicated outdoor air system (DOAS).

e. 4-pipe fan coil units with chilled and hot water coils with energy recovery or a dedicated outdoor air system (DOAS).
f. Water source heat pumps with a dedicated outdoor air system (DOAS).
g. Low temperature hot water (LTHW) terminal units including fin-tube radiation, fan coils, unit heaters, and similar.
h. Other HVAC elements proposed by Architect/Engineer for approval by College Facilities Services.

2.03 HEAT GENERATION

A. Boilers:
1. Use one or more of the following:
a. College's HTHW generators, water tube, 400 degrees F, 400 psi pressure.
b. Water source heat pumps exceeding ASHRAE Std 90.1 minimum COP and supplemental loop heating system generated by College's central plant or high-efficiency condensing boiler.
c. High-efficiency condensing boilers, with prior approval only.
2. Do not use any of the following:
a. Systems not approved by College Facilities Services Department.

B. Energy Recovery Units:
1. Use one or more of the following as required by ASHRAE Std 90.1, IECC, or simple payback calculated to be less than 10 years:
a. Enthalpy wheels.
b. Heat pipes.
c. Air-to-air units.
d. Run-around coil loop heat recovery.
2. Do not use:
a. Systems not approved by College Facilities Services Department.

2.04 REFRIGERATION

A. Do not use:
1. CFC-based refrigerants.
2. HCFC-based refrigerants.
3. Ammonia refrigerants.

B. Refrigeration Units:
1. Use one or more of the following, only with prior approval:
a. Water chillers.
b. Cooling towers.
c. Condensing units.
d. Packaged terminal air-conditioners - heat pumps.
e. Evaporative coolers.
2. Do not use:
a. Systems not approved by College Facilities Services Department.

C. Water Chillers:
1. Use one or more of the following, only with prior approval:
a. Air-cooled chillers.
b. Reciprocating chillers.
c. Rotary screw chillers.
d. Centrifugal chillers.
2. Do not use:
a. Systems not approved by College Facilities Services Department.

D. Cooling Towers:
1. Use one or more of the following, only with prior approval:
a. Forced draft, counterflow cooling towers.
b. Induced draft, counterflow cooling towers.
c. Induced draft, crossflow cooling towers.

2. Do not use:
    a. Systems not approved by College Facilities Services Department.

E. Auxiliary Equipment:
1. Use one or more of the following, only with prior approval by College Facilities Services Department:
    a. Pot feeders.
    b. Chemical pumps.
    c. Automatic water analyzer.
    d. Mineral concentration conductivity blowdown controller.
    e. Centrifugal filter.
    f. Cyclone separator.
2. Do not use:
    a. Systems not approved by College Facilities Services Department.

2.05 AIR DISTRIBUTION

A. Humidifiers:
1. Use one or more of the following, only with prior approval for data centers, MDF rooms, art studios, and science labs:
    a. HTHW (shell and tube).
    b. Pan humidifiers.
    c. Jacketed steam humidifiers.
2. Do not use:
    a. Gas-fired humidifiers.
    b. Ultrasonic fog generation humidifiers.
    c. Electric humidifiers.
    d. Systems not approved by College Facilities Services Department.

B. Ductwork:
1. Use one or more of the following:
    a. G90 galvanized sheet metal duct.
    b. Stainless steel sheet metal duct.
    c. Aluminum sheet metal duct.
    d. Flexible duct; limited to 60 inches in length.
2. Do not use:
    a. Fibrous glass duct.
    b. Ductwork materials not approved by College Facilities Services Department.

C. Diffusers, Registers, and Grilles:
1. Use one or more of the following:
    a. Steel diffusers.
    b. Aluminum diffusers.
    c. Stainless steel diffusers.
2. Do not use:
    a. Devices not approved by College Facilities Services Department.

D. AHU Fans:
1. Use one or more of the following:
    a. Plenum (plug-type) fans.
    b. Plenum fans in array arrangement.
2. Do not use:
    a. Steel fan housing with an aluminum propeller.
    b. Steel fan housing with a stamped steel propeller.
    c. Aluminum fan housing with an aluminum propeller.
    d. Aluminum fan housing with an aluminum centrifugal wheel.
    e. Steel fan housing with an aluminum centrifugal wheel.
    f. Steel fan housing with a steel centrifugal wheel.
    g. Plastic fan propellers.
    h. Plastic fan wheels.

i. Fans not approved by College Facilities Services Department.

E. Air Filters:
1. Use one or more of the following:
a. Two inch deep MERV 8 disposable pleated filters.
b. For LEED Certified projects or Facility High Performance Criteria projects, use one or more of the following to achieve required MERV rating:
1) Panel filters.
2) Pleated panel filters.
3) Extended surface filters.
4) Cartridge filters.
5) Bag-type filters.
2. Do not use:
a. Automatic roll filters.
b. Cleanable media filters.
c. Filters not approved by College Facilities Services Department.

2.06 HYDRONIC DISTRIBUTION

A. HTHW Distribution Piping:
1. Use one or more of the following:
a. Pipes 2 Inches (NPS 2) in Diameter and Smaller:
1) ASTM A53/A53M or ASTM A106/A106M, Type S (seamless), Grade B, Schedule 80, black steel, plain ends
2) Joints and Fittings:
(a) Socket welded joints using forged steel fittings.
(b) Forged Steel Threaded Fittings: ASME B16.11, 3000 psig class.
b. Pipes Larger than 2 Inches (NPS 2-1/2 through NPS 12) in Diameter:
1) ASTM A53/A53M or ASTM A106/A106M, Type S (seamless), Grade B, Schedule 40, black steel, plain ends
2) Joints and Fittings:
(a) Butt-welded welded joints using forged steel fittings.
(b) Wrought-Steel Fittings: ASME B16.9; ASTM A234/A234M, Grade B.
(c) Forged-Steel Flanges and Flanged Fittings: ASME B16.5, ASTM A105/A105M; class 300, weld-neck type, including bolts, nuts, and gaskets of the 1.1 material group.
2. Do not use:
a. Materials:
1) Standard weight, seam welded steel pipe.
2) Other materials not approved by College Facilities Services Department.
b. Joints and Fittings:
1) Grooved piping.
2) Threaded Class 125 cast iron fittings.
c. Hydronic Specialties
1) P/T ports (Pete's plugs).
3. Basis of Design:
a. Triple Offset Rotary Valves, 3 inch and larger manufactured by Vanessa.
b. Manual Air Vents: Air collection chamber, 1/2 inch vent piping including two (2) 1/2 inch steel globe valves.

B. Heating Water Distribution Piping:
1. Use one or more of the following:
a. Pipes 2 Inches (NPS 2) in Diameter and Smaller:
1) Standard weight, continuous welded steel pipe with threaded Class 125 cast iron fittings.
2) Hard copper, Type L with brazed or silver soldered wrought copper fittings.
b. Pipes Larger than 2 Inches (NPS 2) in Diameter:
1) Standard weight, electric resistance welded pipe.
2) Joints and Fittings:
(a) Welded Class Standard wrought steel fittings.

(b) Flanged Class 150 wrought steel fittings.
(c) Flanged Class 125 cast iron fittings.
(d) Flanged Class 250 cast iron fittings.

2. Do not use:
   a. Pipes 2 Inches (NPS 2) in Diameter and Smaller:
      1) Grooved piping.
      2) Copper press systems require design review and approval of College Facilities Services
   b. Pipes Larger than 2 Inches (NPS 2) in Diameter:
      1) Grooved piping.
      2) Joints and Fittings:
         (a) Grooved ductile iron fittings.
   c. Configuration - Heating Water: Reverse return.

C. Chilled Water Distribution Piping:
1. Use one or more of the following:
   a. Pipes 2 Inches in Diameter and Smaller:
      1) Standard weight, continuous welded steel pipe with threaded Class 125 cast iron fittings.
      2) Hard copper, Type L with brazed or silver soldered wrought copper fittings.
   b. Pipes Larger than 2 Inches in Diameter:
      1) Standard weight, electric resistance welded pipe.
      2) Joints and Fittings:
         (a) Welded Standard Class wrought steel fittings.
         (b) Flanged Class 150 wrought steel fittings.
         (c) Flanged Class 125 cast iron fittings.
         (d) Flanged Class 250 cast iron fittings.
2. Do not use:
   a. Pipes 2 Inches in Diameter and Smaller:
      1) Joints and Fittings:
         (a) Grooved ductile iron fittings.
   b. Pipes Larger than 2 Inches in Diameter:
      1) Grooved ductile iron.
      2) Joints and Fittings:
         (a) Grooved ductile iron fittings.
3. Configuration - Chilled Water: Reverse return.

2.07 STEAM DISTRIBUTION

A. Steam Piping (for pre-approved systems):
1. Use one or more of the following:
   a. Pipes 2 Inches (50 mm) in Diameter and Smaller:
      1) Standard weight, continuous welded steel pipe with threaded Class 125 cast iron or Class 150 malleable iron fittings.
      2) Standard weight, electric resistance welded pipe with threaded Class 150 malleable iron fittings.
      3) Extra strong, electric resistance welded pipe with threaded Class 250 cast iron or Class 300 malleable iron fittings.
   b. Pipes Larger than 2 Inches (50 mm) in Diameter:
      1) Standard weight, electric resistance welded pipe with welded Standard Class or flanged Class 150 wrought steel fittings.
      2) Extra strong, electric resistance welded pipe with welded Class XS or flanged Class 300 flanged or welded wrought steel fittings.

B. Condensate Piping:
1. Use one or more of the following:
   a. Pipes 2 Inches (50 mm) in Diameter and Smaller:
      1) Schedule 80, continuous welded steel pipe with threaded Class 125 cast iron or Class 150 malleable iron fittings.
      2) Schedule 80, electric resistance welded pipe with threaded Class 150 malleable iron fittings.

b. Pipes Larger than 2 Inches (50 mm) in Diameter:
    1) Schedule 80, electric resistance welded pipe with welded Standard Class or flanged Class 150 wrought steel fittings.

2.08 HUMIDITY CONTROL EQUIPMENT

A. Humidifiers:
1. Use one or more of the following, only with prior approval:
    a. Evaporative pan humidifiers.
    b. Steam humidifiers.
2. Do not use:
    a. Wetted media evaporative humidifiers.
    b. Equipment not approved by College Facilities Services Department.

2.09 HVAC CONTROLS

A. Communications Protocols:
1. Use one of the following:
    a. LonTalk.
    b. BACnet, only when LonTalk is not available.
2. Do not use:
    a. Modbus2 (Exception: Only option to control remote device equipment).
    b. Manufacturer-specific proprietary protocol.
    c. More than one protocol.
    d. Controls not approved by College Facilities Services Department.

B. Control System Types:
1. Use one or more of the following:
    a. Direct digital control (DDC) system.
    b. LONWORKS based controls.
    c. Combination DDC/pneumatic system (HTHW control valves only); include air compressor requirements:
        1) Duplex type or second compressor for redundancy.
        2) Adjustable low air pressure alarm.
        3) Emergency power.
        4) Tank size calculated for 50 percent run time.
2. Do not use:
    a. Electric control system.
    b. Pneumatic system.
    c. Control systems not approved by College Facilities Services Department.

C. Operators and Sensors:
1. Use one or more of the following:
    a. Electric valve actuators.
    b. Electric damper actuators.
    c. Thermocouples.
    d. Thermistors.
    e. DDC sensor stats.
2. Do not use:
    a. Pneumatic valve actuators.
    b. Pneumatic damper actuators.
    c. Pneumatic thermostats.
    d. Electric thermostats.
    e. Pneumatic valve actuators; exception: HTHW Fisher valve actuators serving HX's.
    f. Devices not approved by College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide design for natural and artificial means of controlling temperature, relative humidity, velocity and direction of air motion in the interior spaces enclosed by the shell, and reduction of airborne odors, particulates, and contaminant gases.
   1. Elevation: 6200 feet.
   2. Heating Dry Bulb:
      a. Classroom/Administration Facilities: Minus 2 degrees F.
      b. Residential/Dormitory Facilities: Minus 10 degrees F.
   3. Cooling Dry Bulb (0.4 percent): 90.7 degrees F.
   4. Mean Coincident Dry Bulb (0.4 percent): 58.8 degrees F.
   5. Evaporation Dew Point Temperature (0.4 percent): 59.3 degrees F.
   6. Extreme Annual Wind Speed (1.0 percent): 27.7 mph.
   7. Heating Degree-Days (HDD-65): 6279.
   8. Cooling Degree-Days (CDD-65): 440.

B. Altitude correction for Colorado College projects during design is essential as air pressure and density is lower than at sea level, consequently, larger air moving equipment will be required.

C. Design HVAC systems to provide partially redundant systems with fan array system where practical.
   1. Entering Chilled Water Temperature: 45 degrees F.
   2. Leaving Chilled Water Temperature: 12 to 14 degrees F.
   3. Entering Heating Water Temperature: 180 degrees F.
      a. Heating Water Reset: Reset temperature based on outside air (OA) temperature or "worst case" HW valve position.
   4. Leaving Heating Water Temperature: 160 degrees F.
   5. Cooling Leaving Air Temperature: 52 degrees F.
   6. Heating Leaving Air Temperature: 90 degrees F.
   7. VAV, DOAS, and ERV Pre-Heat Leaving Air Temperature: 55 degrees F maximum; reset based on OA temperature.
   8. Cooling Entering Air Temperature: 80 degrees F dry-bulb; 60 degrees F wet-bulb.
   9. Refer to Article 3.02 below for indoor space temperature requirements.

D. Limit air velocities of wet coils to values that prevent water carryover into the ductwork (for thermal comfort applications, recommended to select wet coils in the range of 400-500 fpm air face velocity).

E. Design ductwork in accordance with ASHRAE: Handbook of Fundamentals, Duct Design Chapter; constructed in accordance with the ASHRAE: HVAC Systems and Equipment Handbook, Duct Construction Chapter, and the SMACNA Design Manuals. Design air distribution to maintain required space conditions:
   1. Maximum Air Velocity (Noise Level Controlling Factor):
      a. For 6 Inches W.G. (1500 Pa) Duct Pressure Class: 2000 feet per minute.
      b. For 4 Inches W.G. (2000 Pa) Duct Pressure Class: 2000 feet per minute.
      c. For 3 Inches W.G. (750 Pa) Duct Pressure Class: 1800 feet per minute.
      d. For 2 Inches W.G. (500 Pa) Duct Pressure Class: 1500 feet per minute.
      e. For 1 Inch W.G. (250 Pa) Duct Pressure Class: 1500 feet per minute.
      f. For 0.5 Inches W.G. (125 Pa) Duct Pressure Class: 1000 feet per minute.
   2. Supply and return ductwork is recommended to be sized using the equal friction method for ductwork downstream of VAV boxes:
      a. For low pressure supply duct, recommend maximum 0.08 inches per 100 feet.
      b. For return air duct, recommend maximum 0.05 inches per 100 feet.
      c. For exhaust duct, recommend maximum 0.05 inches per 100 feet.
   3. Supply ductwork upstream of VAV boxes:
      a. Recommended initial criteria of 0.25 inches per 100 feet unless maximum air velocity exceeded.
      b. Maintain constant equal friction based throughout duct run determined by maximum air velocity.
      c. Airflow diversity shall only be applied to main branches.

F. Distribute heating water and cooling water to maintain the required space conditions.
   1. Site Chilled Water:
      a. System Pressure: Assume available head pressure of 8 psig from central plant to building.
      b. Distribution Temperature: 45 deg F.
   2. Site High-Temperature Heating Water:
      a. System Pressure: 400 psig.
      b. Distribution Temperature: 400 deg F.
   3. Building Systems:
      a. Water Velocity: 5 feet per second, maximum.

G. Provide the elements necessary to control the building's indoor environment.
   1. Provide a building control system which controls the indoor environment, manages energy consumption, schedules preventative maintenance, controls interior lighting, controls exterior lighting, integrates fire alarm and security functions, monitors fuel consumption, monitors water usage, and monitors packaged equipment controls.
   2. Provide following minimum thermostatic zoning and space temperature control:
      a. Dedicated terminal unit and thermostat for each separated space.
      b. Dedicated terminal unit and thermostat for each corner space.
      c. Single thermostat and terminal unit for spaces with similar function, exposure, and location.
         1) Zone interior spaces together, separate from exterior spaces.
         2) Zone exterior spaces together, separate from interior spaces.
         3) Maximum of two occupied offices with similar exposure and/or internal loads.
         4) Each corner office with exterior exposure.
      d. Maximum Interior Zone Size - Cooling Mode: 200 square feet.
      e. Maximum Exterior Zone Size - Cooling Mode: 200 square feet.
      f. Zone each classroom and laboratory separately.
      g. Zone each conference room, separately. Dedicate at least one terminal unit and thermostat to each conference room zone.
      h. Provide each computer room with a dedicated zone. Provide temperature control.
      i. Elevator machine room; consider dedicated DX equipment for non-electronic elevator controls.
      j. Electrical equipment room.

H. Provide building pressurization at 0.05 inch water column plus or minus 0.01 inch water column relative to outdoor pressure.

I. Provide the following control points, minimum:
   1. VAV Air Terminals:
      a. Discharge air temperature (degrees F)
      b. Airflow (cfm)
      c. Active Setpoint (degrees F)
      d. BAS Active Setpoint (degrees F)
      e. Space Temperature (degrees F)
      f. Occupancy (Occupied or Unoccupied)
      g. Heat Output (percent)
      h. Fan speed (FPVAV terminal units only)
      i. Operable window switch
   2. Air Handlers:
      a. Start-stop, status
      b. Supply air temperature
      c. Return air temperature
      d. Mixed air temperature
      e. Outside air temperature (facility-wide reference acceptable)
      f. Outside air damper position
      g. Outside air damper position
      h. Outside airflow (cfm)
      i. HW Valve position (% open)
      j. CHW Valve position (% open)
      k. SF (Supply fan) speed
      l. SF kW, kWh, alarm via Lon card equipped VFD

m. Duct static pressure
n. Building (zone) static pressure
o. Filter static pressure (analog)
p. RF/EF (return or exhaust fan, if equipped) start-stop
q. RF/EF status
r. RF/EF speed
s. RF/EF kW, kWh, alarm via Lon card equipped VFD
t. Freeze-stat
u. SF high pressure
v. RF low-pressure
w. Exhaust air damper

3. Chillers:
   a. Start-stop status
   b. Entering chilled water temperature
   c. Leaving chilled water temperature
   d. Entering condenser water temperature
   e. Leaving condenser water temperature
   f. Percent of full load
   g. Chilled water flow
   h. Condenser water flow
   i. Chilled water temperature setpoint
   j. Safety alarms via Lon card
4. Pumps:
   a. Start-stop status.
   b. Entering chilled water temperature.
   c. Leaving chilled water temperature.
   d. Entering condenser water temperature.

J. Control all mechanical equipment with Building Automation System.

K. Incorporate following standard Sequences of Operation:
1. OSS (Optimized Start/Stop): Mandatory requirement of ASHRAE/IES Std 90.1 (Section 6.4.3.3.3).
2. DCV (Demand Controlled Ventilation): Required control strategy to adjust the quantity of outdoor ventilation air supplied to a zone by a central air handling unit based on the ventilation rate required to provide adequate indoor air quality for densely occupied spaces.
3. Static Pressure Reset: Reset VAV duct pressure based on airflow deviation from setpoint. From ASHRAE Std 90.1 (Section 6.5.3.2.3, “For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure setpoint shall be reset based on the zone requiring the most pressure; i.e., the setpoint is reset lower until one zone damper is nearly wide open”).
4. Supply Air Temperature Reset: Reset SAT based on room temperature deviation from setpoint; reference ASHRAE Std 90.1 (Section 6.5.3.4).
5. Return Fan Control: Modulate return fan to maintain return air duct pressure of 0.2 inches water column, and modulate exhaust air damper to maintain building pressure at 0.05 inches water column.
6. Single Zone VAV: Control on single-zone systems for chilled water air handlers with fans of 5 hp or greater.
7. Lighting Occupancy Sensor Integration: Utilize unoccupied room signal from lighting control to shut off VAV primary air and cycle terminal unit damper to maintain occupied temperature setpoint.

L. Where services elements are located outside the building in the site area, meet applicable requirements for Section G30 Site Services Design Requirements.

M. In addition to the requirements of this Section, comply with all applicable requirements of General Facility Design Requirements.

3.02 AMENITY AND COMFORT CRITERIA

A. Critical Space Temperature Setpoint:
   1. Computer Rooms: 72 deg F, plus or minus 0.5 deg F.
   2. Uninterruptible Power Supply Rooms: 70 deg F, plus or minus 2 deg F.

B. Space Temperature Control: Coordination of air distribution system's design and installation with zoning and space temperature requirements.
   1. Maintain winter effective temperature as defined by ASHRAE Std 55 between 68 degrees F and 74 degrees F.
   2. Maintain summer effective temperature as defined by ASHRAE Std 55 between 73 degrees F and 79 degrees F.
   3. Vertical Air Temperature Difference: Comply with requirements of ASHRAE Std 55.
   4. Provide 5 degrees F deadband for auto changeover temperature controls.

C. Unoccupied Space Temperature Control Setpoints:
   1. Heating: 60 degrees (adjustable).
   2. Cooling: 85 degrees (adjustable).

D. Air Movement:
   1. Provide an air distribution system that limits the air velocity to 50 fpm, maximum.
   2. Adjustments: Provide an air distribution system which allows relocating supply diffusers, adjusting direction of airflow from supply diffusers, adjusting dampers, and changing the thermostat setpoint.

E. Acoustical Performance:
   1. Air Distribution Background Noise: Provide systems which comply with the acoustical requirements for Section C10 Interiors Requirements and the following RC Levels as defined in ASHRAE HVAC Applications Handbook. Do not exceed the sound pressure level for any octave band at the specified RC.
      a. Meeting Rooms: 25-35, neutral.
      b. Halls, Corridors, and Lobbies: 35-45, neutral.
      c. Executive and Private Offices: 25-35,neutral.
      d. Conference Rooms: 25-35, neutral.
      e. Teleconference Rooms: 25, maximum, neutral.
      f. Open Plan Offices: 30-40, neutral.
      g. Classrooms: 40, maximum, neutral.
      h. Libraries: 30-40, neutral.
      i. Theater: 35, maximum, neutral.
   2. Equipment: Provide equipment with sound ratings which comply with testing and rating requirements of AHRI 880.
   3. Sound Boots: Provide at all return plenum air grilles and wall transfer grilles for conference rooms, offices, classrooms, and all background noise sensitive spaces.
   4. Avoid opposed blade dampers for occupied areas including classrooms, dormitory rooms, offices, and particularly acoustically sensitive spaces.

F. Indoor Air Quality: Provide sufficient ventilation to obtain acceptable indoor quality, determined using the Ventilation Rate Procedure of ASHRAE Std 62.1.

G. Humidity Control (Where required by Owner):
   1. Maintain relative humidity between 30 and 60 percent in habitable spaces.
   2. Provide monitoring and control of humidification equipment.
   3. Provide dehumidification equipment in areas of high humidity.
   4. Provide humidification equipment in computer rooms, in museum artifact storage and display areas, and in library rare book storage and display areas.
      a. Maintain relative humidity between 20 and 60 percent in these spaces.
   5. Capacity:
      a. Humidifiers: 100 pounds (45 kg) of steam per hour).
      b. Dehumidifiers: 15 pints (7 L) of moisture per day; rated in accordance with AHAM DH-1.

H. Convenience: Provide a central location to monitor and control each zone setpoint.

I. Cleanliness:
   1. Provide filtration of the air distributed to the occupied spaces.
   2. Filter Efficiency: MERV 13, minimum, in accordance with ASHRAE 52.2.

J. Appearance:
   1. Diffuser Shape: Provide square diffusers.
   2. Diffuser Face: Provide perforated face diffusers.
   3. Linear Diffusers: Provide single slot linear diffusers.
   4. Diffuser Color: Provide diffusers with ceiling matching color.

3.03 HEALTH AND SAFETY CRITERIA

A. Life Safety: Provide interconnection and coordination of HVAC controls with other life safety systems.

B. Fire Sources:
   1. Provide products which are rated for the specific locations where they are installed.
   2. Provide distribution elements constructed from incombustible materials.

C. Fire Spread: Provide interlocks to prevent operation or start-up of air distribution elements when fire or smoke detection systems are in alarm condition.

D. Systems Safety:
   1. Natural and LP Gas: Comply with ICC International Fuel Gas Code.
      a. Natural Gas System Working Pressure: 5 psig, maximum.
      b. Natural Gas Entrance into Facility: Locate the service meter at least 3 feet from ignition sources.
      c. Liquefied Petroleum System Working Pressure: 10 psig, maximum.
   2. Condensing Units: Construct condensing units to ASHRAE Std 15, Safety Standard for Refrigeration Systems.
   3. Chillers: Construct chiller pressure vessels to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, including both coolers and condensers.
   4. Hydronic and Steam Systems: Provide pressure relief valves to prevent overpressurizing the systems.
   5. Air Coils: Provide air coils with pressure ratings of 450 psig and which exceed the pressure rating of the system in which they are installed.

E. Burn Hazards: Provide boilers and furnaces which safeguard people, property and equipment from the following potential hazards:
   1. Exposure to open flames.
   2. Exposure to hot surfaces.
   3. Exposure to excessively hot water.

F. Bacterial Growth: Provide humidifiers which do not promote the growth of microorganisms.

G. Accident Prevention:
   1. Provide safe access to all parts that must be serviced, including railings at edges of platforms and cages on ladders.
   2. Where maintenance personnel could be exposed to chemicals during routine maintenance and repair, furnish all personal safety equipment and clothing necessary for adequate protection.

H. Emergency Power: Provide emergency power in accordance with code plus the following equipment:
   1. Smoke control system fans.
   2. AC equipment serving critical systems (data equipment, science lab freezers, etc.).
   3. Mechanical rooms.
   4. Emergency lighting systems.

I. Electrical Shock Prevention:
   1. Electrically Operated Equipment: Tested and listed by UL.
   2. Provide a means of disconnecting power at each piece of equipment.
   3. Provide a disconnect switch at each powered induction unit and electric reheat coil.

J. Smoke Detection: provide duct smoke detectors are a code-mandated device where required by NFPA 72, NFPA 101, and the International Mechanical Code (IMC). NFPA 90A requires the first duct smoke detector to be installed on the supply side of air handler units of more than 2,000 cubic feet per minute (cfm) and requires one on the return side of units of more than 15,000 cfm and serving more than one story.

K. Smoke Control: Coordinate control of ventilation fans, supply fans, return fans, exhaust fans, and dampers with smoke control systems where provided or required.

L. Refrigerants:
1. Comply with the requirements of ASHRAE Std 15.
2. Prevent release of refrigerant to atmosphere.
3. Prevent exposure of occupants to hazardous refrigerants.

M. Accidental Explosion: Provide ventilation to prevent build-up of explosive gases as follows:
1. Uninterruptible Power Supply Room: 2 cfm per sq. ft..

3.04 STRUCTURAL CRITERIA

A. Seismic Protection: Comply with applicable requirements of the code, and with applicable requirements of SMACNA Seismic Restraint Manual for Mechanical Systems.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span:
1. HVAC:
    a. Shut-Off Valves: Minimum 10 years.
    b. Dampers, Louvers, Registers, Grilles: Same as service life of building.
    c. Main Heat Generation and Cooling Equipment: Minimum 20 years.
    d. Secondary Equipment: Minimum 10 years.
    e. Control Components, Except Wiring: Minimum 10 years.
2. Energy Supply System: Provide a system which will last a minimum of 15 years in service without major repairs or operating expense.
3. Air Distribution System: Provide a system which will last a minimum of 25 years in service without major repairs or operating expense.
4. Hydronic and Steam Distribution Systems: Provide a heating water and chilled water system which will last a minimum of 25 years in service without major repairs or operating expense.
5. HVAC Control System: Provide a system which will last a minimum of 10 years in service without major repairs or operating expense.

B. Aesthetic Life Span: Provide units exposed within the occupied space which will not fade, chip, or peel for a minimum of 10 years.

C. Temperature Endurance:
1. Equipment: Provide equipment designed for ambient temperatures ranging from 50 degrees F to 122 degrees F (10 degrees C to 50 degrees C).
2. Chimneys and Flues: Provide flues designed for flue gas temperature of 400 degrees F.

D. Erosion Control: Provide a means of removing air from cooling water and heating water distribution systems to prevent erosion. Design systems in a manner to prevent cavitation.

E. Corrosion Control: Drain condensate from cooling coils to prevent corrosion of associated equipment.

F. Underground Piping Corrosion Control: See General Facility Design Requirements.

G. Pipe Stress and Strain Control: Provide pipe loops, bends, expansion joints, and flexible pipie connectors to reduce stress and strain due to expansion and contraction.
1. For HTHW piping systems, provide pipe stress analysis in accordance with ASME B31.1 and ASME B31.3.

H. Vandalism:
1. Energy Supply: Protect the service meters from unauthorized access.
2. Control System: Protect the system field panels from unauthorized access.

I. Accidental Damage:
   1. Protect service meters from accidental damage by installing bollards to stop vehicles.
   2. Protect ductwork from accidental damage.
   3. Exposed Units within Occupied Spaces: Heavy gage, galvanized sheet steel, painted casing.
   4. Protect thermostats and sensors from accidental damage.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. HVAC Reliability:
   1. Chillers (If approved): Provide multiple chillers to deliver design load capacity.
      a. For 2 Chillers: Size each at 60 percent of design load capacity.
      b. For 3 Chillers: Size each at 50 percent of design load capacity.
      c. For 4 Chillers: Size each at 40 percent of design load capacity.
   2. Boilers (If approved): Provide multiple boilers to deliver design load capacity.
      a. For 2 Boilers: Size each at 60 percent of design load capacity.
      b. For 3 Boilers: Size each at 50 percent of design load capacity.
      c. For 4 Boilers: Size each at 40 percent of design load capacity.
   3. Cooling Towers (If approved): Provide multiple cooling towers to deliver design load capacity.
      a. For 2 Cooling Towers: Size each at 60 percent of design load capacity.
      b. For 3 Cooling Towers: Size each at 50 percent of design load capacity.
      c. For 4 Cooling Towers: Size each at 40 percent of design load capacity.
   4. Pumps: Provide multiple pumps to deliver design flow requirements.
      a. For 2 Pumps: Size each at 100 percent of design flow.
      b. For 3 Pumps: Size each at 50 percent of design flow.
      c. For 4 Pumps: Size each at 33.3 percent of design flow.
      d. Provide a stand-by pump for each chiller, boiler, and condenser water pump.
   5. Provide natural gas for facilities not supplied by the central plant for use by HVAC, plumbing, and process equipment as follows:
      a. System Capacity: Provide a fuel supply line (pipe) with capacity to serve the facility plus 50 percent reserve capacity.

B. Energy Efficiency: Specify equipment efficiency requirements for all HVAC equipment including unitary air conditioners, chilled water systems and boilers to meet or exceed current requirements published by the International Energy Conservation Code and ASHRAE Std 90.1.

C. Pump Efficiency: Match pump pressure and flow characteristics with the pressure and flow characteristics of the distribution system.

D. Fan Efficiency:
   1. Fans: Match fan pressure characteristics to the air distribution system pressure characteristics including the system effect factors; pressure characteristics based on AMCA Standard 210 fan ratings and system characteristics based on engineering calculations.

E. Air Distribution Efficiency: Provide duct construction in accordance with SMACNA HVAC Duct Construction Standards, based on the following:
   1. All Ducts Pressure Class: 2 inches w.g..
   2. Duct Seal Class A for Duct Pressure Classes 4 inches w.g. and above.
   3. Duct Seal Class B for Duct Pressure Classes 3 inches w.g., and 2 inches w.g..
   4. Duct Seal Class C for Duct Pressure Class 1 inch w.g., and 0.5 inches w.g..
   5. Renovation Projects:
      a. Test existing ductwork to be reused or repurposed to another duct pressure class to same requirements as new duct construction.
      b. Clean existing ductwork to be reused or repurposed to standards established by NADCA (National Air Duct Cleaning Association) commercial-industrial standard ACR (Assessment, Cleaning and Restoration of HVAC Systems); 2006.
      c. Replace existing duct work with insulation liner with new insulation liner.

F. Electric Power Conservation: Provide random start function to prevent simultaneous start-up of multiple units that would increase peak demand.

G. Ease of Use:
   1. Design access to and working clearances around heating equipment as recommended by the manufacturer.
   2. Air Distribution: Provide terminal units with individual controls adjustable by occupant of space.
   3. Locate fuel piping system mains in dedicated piping chases.
   4. Control System:
      a. Locate field panels in electrical closets.
      b. Locate the central controller in the maintenance office.
      c. Provide a system which is user programmable.
      d. Provide field panels which are independent and do not need the central controller to continue functioning.

H. Ease of Service:
   1. Provide shut-off valves as required by code.
   2. Air Distribution: Provide units which are modular in design.
   3. Hydronic and Steam Distribution: Provide manholes and valves at branch take-offs for each building, and at 500 foot intervals to stop flow in case of breakage.
   4. Control System: Provide a system of modular design.
   5. Provide blow-down piping from all strainers on hydronic distribution systems more than 5 feet from floor drains for routine servicing.
   6. Provide permanent access cage or ship ladders and maintenance platforms to ensure safe servicing of elevated equipment, beyond minimum code requirements.
   7. Elevate piping systems on roof with B-Line Dura Block DB-5 roof supports or equivalent.
   8. Provide complete Contractor direction for systems identification:
      a. Label all equipment with equipment tag identified on contract documents and as to area served.
      b. Label all control devices with device name and equipment controlled with 1.2 inch tall clear labels with black letters.
      c. Label ceiling grid below equipment with 1/2 inch tall clear adhesive labels with black letters.
      d. Label piping, ductwork, and access panels with adhesive labels with 1-1/2 inch tall letters and with flow arrows, attached to piping every 20 feet. Labels and lettering color shall conform to ANSI/ASME A13.1.
      e. Label fire rated walls with stencils every 20 feet above ceiling, or as required by applicable building code.

I. Ease of Cleaning:
   1. Equipment: Provide units with removable access panels to allow cleaning.

J. Allowance for Change and Expansion: Provide a building control system which is expandable to meet future needs.
   1. Interchangeability of Parts: Allow for new devices made by a different manufacturer than the original installation.
   2. Spare Capacity: Provide sensors and points required to perform as specified and add 50 percent more points.
   3. Spare Capacity: Provide sensors and points required to perform as specified and add 30 points more than required.
   4. Spare Capacity: Provide a central controller with field panel slots to perform as specified and add 50 percent more slots in the central controller.
   5. Spare Capacity: Provide a central controller with field panel slots to perform as specified and add 5 open slots in the central controller.

K. College Facilities Services Personnel Training:
   1. Provide training for all systems utilizing approved Operation and Maintenance manuals and training agendas with name of qualified trainer for all systems. Contractor is required to submit training attendance sheet for all training sessions.
   2. Operational: Minimum of 8 hours, for 1 person, for each separate system.
   3. Maintenance: Minimum of 8 hours, for 1 person, for each separate system.

END OF SECTION

D40

FIRE PROTECTION SYSTEM REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire Detection and Alarm: Elements required to detect fires and communicate fire location to occupants, facility management, and public fire fighting agencies.

B. Fire Sprinkler and Extinguishing Systems: Elements which automatically extinguish fires; automatic fire suppression is required in accordance with the code.

C. Standpipe and Hose Systems: Elements that deliver adequate supplies of water to locations in the building for manual fire-fighting.

D. Other Fire Protection Elements: Elements that are not covered in other fire protection Sections.

E. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. NFPA 11 - Standard for Low-, Medium, and High-Expansion Foam Systems.

D. NFPA 13 - Standard for the Installation of Sprinkler Systems.

E. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

F. NFPA 16 - Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.

G. NFPA 17 - Standard for Dry Chemical Extinguishing Systems.

H. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

I. NFPA 72 - National Fire Alarm and Signaling Code.

J. NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems.

1.03 FIELD CONDITIONS

A. The following existing elements must be preserved:
   1. Protect trees using fencing at drip line throughout construction period.
   2. Protect designated historical site structures from all damage whatsoever.

B. The following existing elements must be removed to accomplish new construction:
   1. Relocate underground utilities impacted by project scope.
   2. Carefully remove campus standard signage, light poles, and site accessories without damage, stored, and reinstalled after construction.

PART 2 PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

A. Owner-Furnished Items: Performance requirements that specify characteristics of equipment items do not apply; requirements for accommodating items to the project do apply.

2.02 FIRE DETECTION AND ALARM SYSTEMS - GENERAL

A. Life Safety of students and facility occupants is of the highest priority at Colorado College and the design of the Life Safety Fire Alarm system is not to be compromised. Comply with all applicable codes and standards for all Residential and Academics Facilities:
   1. International Fire Code.
   2. NFPA 72.
   3. ADA Standards.

B. Colorado College maintains a close working relationship with the Colorado Springs Fire Department, and the Fire Department is closely involved in the design, installation, and operation of the Life Safety Fire Alarm systems installed on the Campus. All work on any Fire Alarm system requires an installation permit by the Colorado Springs Fire Department.

C. All Fire Alarm systems on the Campus are interconnected through a fiber optic network, and all system events from any Facility are displayed on graphic display computer screens in the Colorado College Safety Office as well as on Network Display Units in the Power Plant for backup monitoring. Alarms from any campus facility are also transmitted to the SimplexGrinnell U.L Listed Monitoring Central Station for automatic Fire Department notification and dispatch.

D. Since all components are an integral part of the overall Campus Network, the College has standardized on Simplex as the sole-source manufacturer for this equipment.

E. All additions and modifications to the Colorado College Campus Fire Alarm system require the reprogramming of the Graphic Command Center in the Campus Safety Office.

F. Concealed all wiring and cabling, and take care to insure proper support of conductors and to insure that the integrity of the wiring will not be compromised by normal building operations, including maintenance operations.

G. Local SimplexGrinnell district office in Colorado Springs provides support for the Fire Alarm and Access Control systems installed in Colorado College. The contact information is as follows:
   SimplexGrinnell
   915 Valley Street
   Colorado Springs, CO 80915
   (719) 277-0559
   (719) 574-1253

2.03 FIRE DETECTION AND ALARM SYSTEMS - COMPONENTS

A. Provide each facility, as requested by Colorado College Facilities Services Department, with a Simplex Addressable Fire Alarm Control Panel and interconnected onto the Fiber Optic Network through a dedicated fiber loop configured per NFPA style 7.
   1. Substitutions: Not permitted; these systems are to be specified and provided on a sole-source basis.

B. The design of the Life Safety System within each building includes the following components:
   1. Main Fire Alarm Control Panel: Simplex 4100u or Simplex 4010 (small system); installed in the building main electrical room or non public mechanical / utility room.
   2. Remote Alarm Annunciator: Simplex 4603 or Simplex 4606 (compatible w/4010).
   3. Manual Pull Stations: Simplex 4099-9003 installed at each building exit and at the entrances to the stairwells on all floors not at grade level.
   4. Smoke Detectors: Simplex 4098-9714 installed in each room with Fire Alarm Control equipment, within all commons areas and corridors, within electrical and telephone equipment rooms, attic areas, and mechanical areas. Provide sleeping rooms with detectors that include sounder bases, programmed such that sleeping room smoke detectors initiate supervisory signals at the panel and

the Safety Office (not alarm) while at the same time activating the sounder base at the detector. Program sounders to activate upon any other alarm activation within the building to insure adequate alarm signal (sound pressure level) within the sleeping area and at the pillow level. Smoke detectors are required to process smoke intrusion using the UL Listed / NFPA recognized Alarm Verification process except when directly activating control events per NFPA.

5. Heat Detector: Simplex 4098-9733 installed in mechanical spaces that are not heated and mechanical rooms that are too dusty or dirty to be detected with smoke detectors.
6. Duct Smoke Detectors: Simplex 4098-9756 installed within all fan units serving in excess of 2,000 cubic feet per minute (CFM) of air. Exhaust fans need not be equipped with duct smoke detectors. All fans are required to be shut down upon detection of smoke within the associated duct smoke detector, or upon closure of smoke dampers within the building to prevent damage to ductwork.
7. Sprinkler Monitor Modules: Simplex 4090-9001 installed adjacent to, and for the purpose of monitoring all sprinkler waterflow switches and all sprinkler control valve (tamper) switch positions. Install exterior horn/strobe above the fire department connection to indicate sprinkler waterflow; controlled by the Fire Alarm System.
8. Horn/Strobes: Simplex 4903 series horn/strobes and 4904 series strobe lights with white trim installed per NFPA 72. All facilities are required to comply with ADA, and select residential rooms within dormitories are required to be equipped with strobe lights for the hearing impaired. Provide all sleeping areas with notification devices capable of producing 75 db alarm signal at the pillow level. Provide this level of signal with a sounder base on the apartment detector and/or mini-horn within the sleeping room itself.
9. Elevator Recall: Provide for all elevators. Install smoke detectors in all elevator lobbies and machine rooms. Shafts are not to be sprinklered in Colorado Springs, so no smoke detectors will be required in the shaft, nor will there be a requirement for shunt trip heat detectors. Elevator recall is required to include primary and alternate levels of recall, and a 3rd point to indicate an unsafe elevator condition (flashing hat within the elevator car). Control modules are Simplex 4090-9002.
10. Smoke Damper Control: Control smoke dampers by system connected smoke detectors and control modules according to International Building Code requirements.
11. Access Control System Interface: Where doors are secured in the closed and locked position by the Simplex Access Control System, provide interface modules at each door location to release the door upon a building Fire Alarm condition. Interface modules are Simplex 4090-9002.

2.04 FIRE SUPPRESSION SYSTEM TYPES

A. Do not use:
   1. CFC, HCFC, or Halon-based extinguishing agents.
   2. Systems not accepted by College Facilities Services Department.

B. Use one or more of the following:
   1. Wet pipe sprinkler system.
   2. Dry pipe sprinkler system.
   3. Preaction sprinkler system.
   4. Deluge sprinkler system.
   5. Non-water extinguishing systems.
   6. Standpipe system.
   7. Other systems acceptable to College Facilities Services Department.

C. Do not use:
   1. Standpipe and hose system.
   2. Systems not accepted by College Facilities Services Department.

2.05 FIRE SPRINKLER AND EXTINGUISHING SYSTEM COMPONENTS

A. Pipe:
   1. Use one or more of the following:
      a. Materials permitted by code.
      b. Steel pipe with welded joints.
      c. CPVC pipe with solvent welded joints.
      d. PB pipe with solvent welded joints.
      e. Other systems acceptable to College Facilities Services Department.

2. Do not use:
    a. Copper pipe, unless specifically approved by College Facilities Services.
    b. Systems not accepted by College Facilities Services Department.

B. Fittings:
1. Use one or more of the following:
    a. Materials permitted by code.
    b. Steel.
    c. Cast iron.
    d. CPVC.
    e. PB.
    f. Other systems acceptable to College Facilities Services Department.
2. Do not use:
    a. Copper, unless specifically approved by College Facilities Services Department.
    b. Systems not accepted by College Facilities Services Department.

C. Fire Pumps: Generally not permitted or required, unless specifically approved by College Facilities Services Department.

2.06 STANDPIPE AND HOSE SYSTEM COMPONENTS

A. Pipe:
1. Use one or more of the following:
    a. Materials permitted by code.
    b. Steel pipe.
        1) Joints: Welded or grooved with seals and couplings.
    c. Hoses: Provided by local Fire Department only.
    d. Other systems acceptable to College Facilities Services Department.
2. Do not use:
    a. Owner-furnished hoses; not permitted by local Fire Department.
    b. Systems not accepted by College Facilities Services Department.

B. Fittings:
1. Use one or more of the following:
    a. Materials permitted by code.
    b. Steel.
    c. Cast iron.
    d. Other systems acceptable to College Facilities Services Department.
2. Do not use:
    a. Copper.
    b. Other systems acceptable to College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide code-required fire suppression and detection regardless of type or coverage specified, unless otherwise specifically exempted.

B. Fire Detection and Alarm: Provide automatic fire detection and automatic alarm systems as specified.
1. Connect the protected premises system(s) to public fire department via transmission to remote central station supervising station and as otherwise specified.
2. Functions:
    a. Detection, Alarm, Notification Methods: In accordance with NFPA 72.
    b. Evacuation Plan: Multiple smoke zones and alarm notification of any zone or combination of zones in addition to general evacuation of entire premises.

c. Detection:
    1) Air Handling Units Over 2,000 cfm: Minimum of one detector in both supply and return.
    2) Upon detection of fire or smoke condition, automatic notification of occupants, building operations staff, owner's central emergency staff, private monitoring service, and applicable public emergency authorities as specified.
d. Alarms:
    1) Means for occupants to communicate same types of alarm as automatic system does.
    2) Manual stations at minimum of 150 feet intervals along means of egress paths.
    3) Audible Alarms: Minimum of 15 dB over ambient noise, audible throughout common areas and means of egress.
    4) Visual alarms, in locations required by code and public toilets and corridors.
    5) Separate audible and visual signals for alarms and trouble notification in corridors.
e. Fire Protection Controls:
    1) Provide connections between alarm and detection system and fire suppression system activation sensors.
    2) Upon Alarm: Shut down or deactivate the following:
        (a) HVAC air distribution.
        (b) Elevators (fire emergency service).
        (c) Fire-rated door hold-opens.
        (d) Locks restricting exit through doors constituting means of egress.
f. Audible and visual trouble notification of operations staff, for alarm zone failures, annunciator zone failures, ground faults, backup power failure, water supply equipment failures.
g. Error and Failure Prevention: Hard wired system; "tamper" sensors at sensitive points; products of only one manufacturer or certified by manufacturer as compatible.

C. Fire Sprinklers: Types as indicated for specific spaces and areas.
1. Design and construction in accordance with code and NFPA 13.
2. Provide wet pipe sprinkler systems unless otherwise indicated or required by code.
3. General Use (Not Indicated As Another Type): Wet pipe.
    a. Occupancy: Light Hazard.
    b. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
4. Print Shop:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
5. Lobby:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
6. Training Room:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
7. General Offices:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
8. Computer Room:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
9. Machine Shop:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.

10. Storage:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.15 gpm per sq ft over 1,500 sq ft.
11. Kitchen:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.15 gpm per sq ft over 1,500 sq ft.
12. Flammable Gas Storage:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.40 gpm per sq ft over 2500 sq ft.
13. Emergency Generator Room:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.15 gpm per sq ft over 1,500 sq ft.
14. Boiler Room:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.15 gpm per sq ft over 1,500 sq ft.
15. Mechanical Room:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.15 gpm per sq ft over 1,500 sq ft.
16. Warehouse:
    a. System Type: Wet pipe.
    b. Occupancy: Light Hazard.
    c. Density/Area: 0.10 gpm per sq ft over 1,500 sq ft.
17. Other Spaces: System type, hazard classification, and density/area; as required by code.

D. Fire Extinguishing Systems: Types as indicated for specific spaces and areas.
    1. Kitchen Exhaust Hoods: Dry chemical extinguishing system.
    2. Data Centers, Libraries, and Art Galleries: Clean-agent extinguishing systems; Inergen or Sapphire.
    3. Dry-Chemical Extinguishing Systems: Design and construction in accordance with code and NFPA 17.
    4. Foam Extinguishing Systems: Design and construction in accordance with code and NFPA 11.
    5. Foam Water Extinguishing Systems: Design and construction in accordance with code and NFPA 16.

E. Standpipe System: Provide a Class I, automatic-dry standpipe system.
    1. Design and construction in accordance with code and NFPA 14.

F. Water Source: Provide water supply as required by NFPA 14.
    1. Determine minimum water supply requirements for each sprinkler system using the hydraulic calculation method defined by NFPA 13.
    2. Provide a permanent water supply for standpipes as required by code.
    3. Provide water from a public service main.

G. Where fire protection elements also must function as elements defined within another element group, meet the requirements of both element groups.

H. Where services elements are located outside the building in the site area, meet applicable requirements of Section G30.

I. In addition to the requirements of this section, comply with all applicable requirements of General Colorado College Facility Design Guidelines.

3.02 AMENITY AND COMFORT CRITERIA

A. Leakage: Provide systems that are leak-free.

B. Accessibility: Provide clearances around system components for service and use.
   1. Provide fire department connections as required by code.
   2. Provide a hose cabinets as required by code; local Fire Department will provide hoses.

C. Convenience: Provide fire department connections for each standpipe as required by code.

D. Appearance:
   1. All spaces unless indicated otherwise on the Drawings: Concealed or semi-recessed sprinklers, unless otherwise approved by College Facilities Services:
   2. All spaces: Concealed or semi-recessed sprinklers, except as follows:
      a. Lobby: Concealed sprinklers.
      b. Corridor: Concealed sprinklers.
      c. Board Room: Concealed sprinklers.
      d. Retail Space: Concealed sprinklers.
      e. Clinic: Concealed sprinklers.
      f. Executive Office: Concealed sprinklers.
      g. Other High-Profile Areas Designated by College Facilities Services Department: Concealed sprinklers.
   3. Provide hose cabinets with off-white finish and space for a manual, dry-chemical fire extinguisher.
   4. Provide valves with bright-chrome finish.
   5. Provide fire department connections with bright-chrome finish.

3.03 HEALTH AND SAFETY CRITERIA

A. Path of Egress: Provide systems which safeguard path of egress.

B. Fire Source: Provide system materials which do not contribute to the spread of the fire.

C. Fire Spread: Provide systems to limit spread of fire from storage area to office area.

D. Chemical Exposure or Use: Provide systems designed and installed according to NFPA 2001, which will limit exposure of occupants to harmful extinguishing agents.

E. Dry-Chemical Nozzle Performance: As required by code and NFPA 17.

F. Sprinkler Head Performance: As required by code and NFPA 13.
   1. Flammable Storage Room: ESFR sprinklers.
   2. Laboratory: ESFR sprinklers.

3.04 STRUCTURAL CRITERIA

A. Seismic Design:
   1. Provide a sprinkler system which allows movement where differential movement is anticipated.
   2. Provide sprinkler system supports capable of supporting twice its installed wet weight.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span:
   1. Provide a detection and sprinkler systems which will last a minimum of 20 years in service without major repairs or operating expense when maintained as specified in NFPA 25.
   2. Sprinkler Heads, Valves, and Other Inlet and Outlet Components: Same as building service life.
   3. Pumps and Other Operating Components: Minimum 20 years.
   4. Provide standpipes which will last a minimum of 20 years in service without major repairs or operating expense.

B. Corrosion Resistance: Use corrosion resistant materials; ferrous metal is not considered corrosion resistant unless it is hot dipped galvanized, chrome plated, or coated with rust inhibitive paint.

C. Vandalism: Provide systems which are tamper-resistant.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Capacity: As required by code.

B. Ease of Use: Provide easy access to and working clearances around system components.

C. Ease of Use: Provide standpipes which comply with the acceptance requirements of NFPA 14.

D. Ease of Service:
   1. Spare Sprinkler Heads: Provide additional sprinkler heads as required by code to service the system.

E. Unauthorized Use: Provide systems which minimize activation and use by unauthorized persons.

F. Maintenance:
   1. Provide sprinkler system maintenance in accordance with NFPA 25.
   2. Provide standpipe maintenance in accordance with NFPA 25.
   3. Provide clean-agent system maintenance in accordance with NFPA 2001.
   4. Provide dry-chemical system maintenance in accordance with NFPA 17.

END OF SECTION

D50

ELECTRICAL SYSTEM REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical: Provision and distribution of electrical power to operate all electrically-operated devices, including those included under other services and those provided separately by the College Facilities Services; artificial lighting to illuminate spaces and tasks, both interior and exterior, independent of reliance on natural light; and grounding systems; comprising the following elements.

B. Electrical Energy Supply and Generation: Utility power sources, engine-generator systems, battery power systems, uninterruptible power supply systems and unit power conditioners.
   1. Electrical Power Source: Existing public utility.
   2. Electric Utility: Colorado Springs Utilities.
   3. Electric Utility Address: Leon Young Service Center, 1521 South Hancock Expressway, Colorado Springs, Colorado.
   4. Electric Utility Telephone Number: 719-448-4800.

C. Service and Distribution: Service entrance equipment, distribution equipment, transformers, motor control equipment, service and feeder wiring (conductors and raceways), monitoring, safety and control equipment, and other elements required for a complete functional system.
   1. Main Electrical Service: The utility will provide a primary service transformer to convert its distribution voltage to the building's utilization voltage.
   2. Distribution Circuit Configuration: Secondary transformers are generally located in buildings feeding distributed panelboards.
   3. Switchgear Location: Locate in building main electrical room.
   4. Panelboard Locations: Locate panelboards in electrical rooms on each floor. Locate panelboards in public corridors, hallways, or stairwells only when there is no better alternative, and with approval of College Facilities Services.
      a. Provide separate panelboards for lighting, receptacles, and mechanical equipment where applicable.

D. Branch Circuits: Branch circuit wiring and receptacles and other branch circuit wiring systems, comprising the following elements:
   1. Branch circuit breakers.
   2. Conductors and cable from panelboards to fixtures, wiring devices, and mechanical equipment.
   3. Raceways and boxes.
   4. Wiring devices, including, but not limited to, receptacles, floor boxes and plates, wall switches, wall dimmers, remote control switching devices, and wall plates.

E. Interior Lighting: Comprising the following elements:
   1. Luminaires for general illumination.
   2. Accent lighting.
   3. Built-in task lighting at appropriate locations.
   4. Emergency lighting.
   5. Illuminated exit signs.

F. Exterior Area Lighting: General lighting of exterior spaces including roadways, driveways, walkways, parking areas, and recreation areas; comprising exterior luminaires, poles, standards, or other means of mounting the luminaires, power supply, and controls.

G. Athletic Lighting: Lighting for interior and exterior athletic activities; comprising luminaires, standards and other means of mounting the luminaires, power supply, and lighting controls.

H. Special Grounding Systems: Elements for lightning protection, and raised access floor grounding.
   1. Lightning Protection. See General College Facility Design Guidelines for lightning protection design for facilities.

I. Cathodic Protection: Supplementary corrosion prevention using cathodic protection as required by product manufacturer; see General College Facility Design Guidelines for elements for which cathodic protection is a permitted or required measure.

J. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. ASHRAE Std 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.

D. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1).

E. IEEE 142 - IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

F. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings.

G. IEEE 493 - IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems.

H. IEEE 739 - IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities.

I. IEEE 1100 - IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

J. IEEE C57.12.00 - IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

K. IESNA (LH) - Lighting Handbook.

L. IESNA RP-6 - Recommended Practice for Sports and Recreational Area Lighting.

M. NACE SP0169 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

N. NACE RP0285 - Corrosion Control of Underground Storage Tank Systems by Cathodic Protection.

O. NACE SP0572 - Design, Installation, Operation, and Maintenance of Impressed Current Deep Groundbeds.

P. NACE TM0497 - Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems.

Q. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

R. NFPA 70 - National Electrical Code.

S. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

1.03 FIELD CONDITIONS

A. The following existing electrical elements must be preserved:
1. Historic decorative metal fencing and stone retaining walls.
2. Significant trees should be protected by fencing outside drip lines during construction.
3. Campus standard building, ADA, or wayfinding signage should be carefully removed without damage, stored, and replaced after construction is completed.
4. Campus standard seating, light pole fixtures, and emergency phone pole equipment should be carefully removed without any damage, stored, and replaced after construction is completed.

B. The following existing electrical elements must be removed to accomplish new construction:
   1. Underground petroleum storage tank(s).
   2. Underground tunnels or utilities.
   3. Statuary art work.
   4. Campus standard building, ADA, or wayfinding signage.
   5. Campus standard seating, light pole fixtures, and emergency phone equipment.

PART 2 PRODUCTS

2.01 UTILITY SERVICE ENTRANCE

A. Configuration:
   1. Overhead service entrance.
   2. Underground service entrance.

2.02 ELECTRICAL ENERGY GENERATION

A. Generator Sets:
   1. Engine Type:
      a. Use the following:
         1) Four-stroke, natural gas fuel.
      b. Do not use:
         1) Two-stroke.
   2. Engine Cooling:
      a. Use the following:
         1) Liquid-cooled engine mounted radiator.
      b. Do not use:
         1) Liquid-cooled remote mounted radiator.
         2) Liquid-cooled engine mounted heat exchanger.
         3) Liquid-cooled remote mounted heat exchanger.
         4) Air-cooled.

2.03 SERVICE AND DISTRIBUTION

A. Transformer Applications:
   1. Distribution Transformers For Ordinary Loads: Use general purpose transformers.
   2. Distribution Transformers For Loads Sensitive to Noise and Harmonics: Shielded isolation transformers serving applicable areas.

B. Transformers:
   1. Use one of the following:
      a. Dry type.
   2. Do not use:
      a. Air type.
      b. Cast-coil.
      c. Oil type.
      d. Less-flammable liquid type.
      e. Liquid filled.
      f. Gas type.

C. Secondary Service and Distribution Feeders:
   1. Conduits:
      a. Use one of the following:
         1) Below Grade: GRS conduit or PVC conduit.
         2) Exterior, Exposed: GRS conduit or PVC conduit.
         3) Interior, Exposed: GRS conduit or EMT.
         4) Interior, Concealed: GRS conduit or EMT.
      b. Do not use:
         1) Below Grade: IMC conduit.
         2) Exterior, Exposed: IMC conduit.

3) Interior, Exposed: IMC conduit.
4) Interior, Concealed: IMC conduit.

2. Conductors:
   a. Use one of the following:
      1) Aluminum; feeders only.
      2) Copper.
   b. Do not use:
      1) Aluminum for any conductors other than feeders.

D. Main Service Equipment:
1. Types of Equipment:
   a. Use the following:
      1) Low voltage switchgear.
      2) Switchboards.
      3) Distribution panels.
      4) Motor control centers.
      5) Other equipment acceptable to College Facilities Services Department.
   b. Do not use:
      1) Equipment not accepted by College Facilities Services Department.
2. Main Devices:
   a. Use one of the following:
      1) Power circuit breakers.
      2) Molded case circuit breakers.
      3) Bolted pressure switch.
   b. Do not use:
      1) Fused switches.
      2) Equipment not accepted by College Facilities Services Department.
3. Branch Devices:
   a. Use the following:
      1) Circuit breakers.
   b. Do not use:
      1) Fused switches.
      2) Equipment not accepted by College Facilities Services Department.
4. Busbars:
   a. Use the following:
      1) Copper.
   b. Do not use:
      1) Plated aluminum.
      2) Equipment not accepted by College Facilities Services Department.

E. Branch Circuit Panelboards:
1. Busbars:
   a. Use the following:
      1) Copper.
   b. Do not use:
      1) Plated aluminum.
      2) Equipment not accepted by College Facilities Services Department.
2. Circuit Breakers:
   a. Use the following:
      1) Molded case circuit breakers.
   b. Do not use:
      1) Fused switches.
      2) Equipment not accepted by College Facilities Services Department.

F. Motor Control Centers:
1. Busbars:
   a. Use the following:
      1) Copper.

b. Do not use:
    1) Plated aluminum.
    2) Equipment not accepted by College Facilities Services Department.
2. Overcurrent Protectors:
    a. Use one of the following:
        1) Circuit breakers.
        2) Motor circuit protector (MCP).
    b. Do not use:
        1) Fused switches.
        2) Equipment not accepted by College Facilities Services Department.

2.04 BRANCH CIRCUITS

A. Branch Circuit Wiring:
1. Use the following:
    a. Conduit, MC, or Romex.
2. Do not use the following:
    a. Surface mounted raceway.
    b. Multiple outlet assemblies.
    c. Wiring not accepted by College Facilities Services Department.

B. Receptacle Cover Plates:
1. Use the following as appropriate to location:
    a. Material and Finish: Plastic, off-white.
    b. Material and Finish: Plastic, beige.
    c. Material and Finish: Metal, chrome plated.
    d. Material and Finish: Wood, natural grain.
    e. Material and Finish: Stainless steel, brushed.
2. Do not use the following:
    a. Cover plates not accepted by College Facilities Services Department.

2.05 LIGHTING

A. Interior Lighting:
1. Use the following as appropriate to location and function:
    a. Direct lighting units.
    b. Semi-direct lighting units.
    c. General diffuse lighting units.
    d. Direct-indirect lighting units.
    e. Semi-indirect lighting units.
    f. Indirect lighting units.
    g. Compact fluorescent lamps.
    h. Reflector halogen lamps.
    i. U-tube fluorescent lamps.
    j. Full size fluorescent lamps.
2. Do not use the following:
    a. Incandescent lamps.
    b. Lighting systems not accepted by College Facilities Services Department.

B. Emergency Lighting:
1. Use one of the following types:
    a. Centralized battery bank.
    b. Electrical generators.
2. Do not use the following:
    a. Self-contained battery-powered lighting units.
    b. Equipment not accepted by College Facilities Services Department.

C. Exterior Area Lighting Luminaires:
   1. Use the following types as appropriate to location and function:
      a. Direct lighting units.
      b. Semi-direct lighting units.
      c. General diffuse lighting units.
      d. Direct-indirect lighting units.
      e. Semi-indirect lighting units.
      f. Indirect lighting units.
   2. Do not use the following:
      a. Lighting systems not accepted by College Facilities Services Department.

D. Exterior Area Lighting Lamps:
   1. Use the following types as appropriate to location and function:
      a. Tungsten-halogen lamps.
      b. Compact fluorescent lamps.
      c. U-tube fluorescent lamps.
      d. Full size fluorescent lamps.
      e. Mercury lamps.
      f. Metal halide lamps.
      g. High pressure sodium lamps.
      h. Low pressure sodium lamps.
      i. Cold cathode lamps.
   2. Do not use the following:
      a. Incandescent lamps.
      b. Lighting systems not accepted by College Facilities Services Department.

E. Exterior Area Lighting Poles (See Campus Standards):
   1. Use the following:
      a. Black cast iron.
   2. Do not use:
      a. Galvanized steel.
      b. Spun aluminum.
      c. Treated wood.
      d. Precast concrete.
      e. Fiberglass.
      f. Lighting poles not accepted by College Facilities Services Department.

F. Athletic Lighting Luminaires:
   1. Use the following types as appropriate to location and function:
      a. Enclosed heavy duty floodlights.
      b. Enclosed general purpose floodlights.
      c. Sharp cutoff type floodlights.
      d. Direct-indirect lighting units.
      e. Semi-indirect lighting units.
   2. Do not use the following:
      a. Lighting systems not accepted by College Facilities Services Department.

G. Athletic Lighting Lamps:
   1. Use the following types as appropriate to location and function:
      a. Rapid-start fluorescent lamps.
      b. Metal halide lamps.
      c. LED lamps.
      d. Induction lamps.
   2. Do not use the following:
      a. Incandescent lamps.
      b. Tungsten-halogen lamps.
      c. Mercury lamps.
      d. High pressure sodium lamps.
      e. Lighting lamps not accepted by College Facilities Services Department.

H. Athletic Lighting Standards or Poles:
   1. Use one or more of the following:
      a. Powder coated steel.
      b. Spun aluminum.
   2. Do not use:
      a. Galvanized steel.
      b. Treated wood.
      c. Precast concrete.
      d. Fiberglass.
      e. Poles and standards not accepted by College Facilities Services Department.

2.06 CATHODIC PROTECTION:

A. Use the following:
   1. Galvanic anodes of zinc.
   2. Impressed current system, using anodes and DC current source.

B. Do not use any of the following:
   1. Systems not accepted by College Facilities Services Department.

2.07 SPECIAL GROUNDING SYSTEMS

A. Lightning Protection Conductors:
   1. Use of the following:
      a. Stranded copper cable; existing building retrofits only.
   2. Do not use any of the following:
      a. A mixture of materials.
      b. Copper conductors on aluminum surfaces.
      c. Aluminum conductors on copper surfaces or where subject to runoff from copper surfaces.
      d. Exposed copper where contact with corrosive gases is possible.
      e. Metal services piping.
      f. Sheet metal roofing or walls.
      g. Structural steel superstructure.
      h. Concrete reinforcing steel.
      i. Aluminum for any component in contact with earth.
      j. Stranded aluminum cable.
      k. Solid aluminum strip.
      l. Solid copper strip.
      m. Grounding systems not accepted by College Facilities Services Department.

B. Lightning Protection Grounding Terminals:
   1. Use the following:
      a. Solid copper ground rods; existing building retrofits only.
   2. Do not use any of the following:
      a. Grounding plates, unless no other method is effective.
      b. Concrete encased electrodes located in or near footings.
      c. Ground ring electrode in direct contact with earth.
      d. Ground ring electrode encased in footings.
      e. Grounding systems not accepted by College Facilities Services Department.

C. Lightning Protection Strike (Air) Terminals:
   1. Use one or more of the following:
      a. Solid copper.
      b. Hollow tubular copper.
      c. Any metal part of building of 3/16 inch metal thickness or greater.
   2. Do not use any of the following:
      a. Any metal part of building of less than 3/16 inch metal thickness.
      b. Hollow tubular aluminum.
      c. Solid aluminum.
      d. Grounding systems not accepted by College Facilities Services Department.

D. Raised Access Floor Grounding:
   1. Use one or more of the following:
      a. Braided copper conductors.
      b. Copper straps.
      c. Grounding to electrical system ground.
      d. Grounding to structural steel.
   2. Do not use any of the following:
      a. Lattice or grid arrangement located under raised floor.
      b. Grounding systems not accepted by College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide electrical power with the appropriate characteristics to operate all electrically operated devices, including those in other services.
   1. Capacity: Calculated in accordance with NFPA 70.
   2. General Receptacle System Voltage: 120 volts/3-phase/60 Hz.
      a. Provide 208 volt/3-phase/60 Hz receptacles in the following locations:
         1) Copier room.
         2) Training center.
         3) Maintenance area.
         4) Penthouse.
         5) Laundry.
         6) Welding shop.
         7) Other locations required by College Facilities Services Department.
      b. Equipment Voltage: 480 volts/3-phase/60 Hz.
   3. Primary Electrical Energy Generation:
      a. Provide capacity at least 25 percent more than the connected load.
      b. Provide 5 watts per square foot for the entire building.
      c. As required by code and the following:
         1) General Office: 10 watts per square foot.
         2) Computer Room: 20 watts per square foot.
         3) Print Shop: 10 watts per square foot.
      d. Generator Set Start Up: Minimum time-delay to start of 15 minutes, to prevent transfer in case of short-time outage.
   4. Service Transformers (Provided by Colorado Springs Utilities): As required to serve connected load plus 10 percent spare capacity.
      a. Kilovoltampere (kVA) Rating: Provide transformers with preferred ratings according to IEEE C57.12.00.
      b. Primary Voltage: As required..
      c. Secondary Voltage: As required to serve building switchgear and electrical loads. See Section D5 for system voltages.
      d. Connection Method: Delta connection.
   5. Main Switchboards: In accordance with code plus 10 percent spare capacity.
   6. Interior Distribution Transformers: As required to serve building circuits and equipment plus 10 percent spare capacity.
   7. Branch Circuit Panelboards: In accordance with code plus 10 percent spare capacity.
   8. Utility Revenue Meters: Meter incoming electrical service on the low-voltage side of the service transformer (secondary metering).
   9. College Submeters for Energy Data Collection: Provide campus standard building wattnode meters connected to campus Building Energy Management System.

B. Emergency Power: Provide emergency power as required by code including the following:
   1. Emergency Lighting: Duration as required by code.
   2. Warning Lights: Duration as required by code.
   3. Stair Pressurization System: Duration as required by code.
   4. Smoke Control System: Duration as required by code.
   5. Fire Detection and Alarm System: Duration as required by code.

6. Central Control Station and Lighting: Duration as required by code.
7. Mechanical Equipment serving Smokeproof Enclosures: Duration as required by code.
8. Public Address System: Duration as required by code.

C. Standby Power: Provide standby power as required by code including the following:
   1. Transfer time of 0.0167 seconds (1 cycle).
   2. Security Lights: Duration as required by code.
   3. Electrical Room Lights: Duration as required by code.
   4. Elevators: See Section DC D11 for requirements.
   5. Stair Pressurization System: Duration as required by code.
   6. Smoke Control System: Duration as required by code.
   7. Fire Detection and Alarm System: Duration as required by code.
   8. Central Control Station and Lighting: Duration as required by code.
   9. Mechanical Equipment Serving Smokeproof Enclosures: Duration as required by code.
   10. Public Address System: Duration as required by code.
   11. Communications System: Duration as required by code.
   12. Standby Generator:
      a. Electrical Characteristics: 480/208 volts/3 phase/60 Hz.
      b. Generator Fuel Supply: Natural gas.
      c. Generator Reliability: 100 percent.
      d. Power Quality: Compatible voltage, wave shape, and frequency with the primary power source.

D. Uninterruptible Power Supply: Provide uninterruptible power supply (UPS) system as follows:
   1. Telephone System: Transfer time of 0.0167 seconds (1 cycle).
      a. Duration of 15 minutes.
   2. Main Server Rooms, Computer Systems, and Auxiliary Equipment: Transfer time of 0 seconds.
      a. Duration of 15 minutes.
   3. Fire Alarm and Detection Systems: Transfer time of 0 seconds.
      a. Duration as required by code.
   4. Configuration: Parallel redundant with automatic transfer from UPS power to normal power.

E. Distribution: Distribute electric power for equipment circuits, lighting circuits, receptacle circuits, and electrical utilization devices.
   1. Branch Circuits: Provide adequate electrical power and safe and efficient distribution from panelboards to lighting, wiring devices, equipment, appliances, and the locations where it is needed.
   2. Pole Mounted Athletic Lighting: Provide power distribution to lighting as follows:
      a. Loads Below 50 Amperes per Phase per Pole: Low voltage circuits to each pole.

F. Lighting: Provide artificial means of lighting interior and exterior spaces.
   1. Interior Lighting: Provide artificial lighting for all interior spaces that is adequate in quality and distribution for the performance of tasks typical for the type of space and the characteristics of the intended population, regardless of the availability of natural light.
      a. Provide lighting controls to reduce artificial light level when natural light is present, while maintaining specified light levels.
      b. Accent Lighting: In addition to general and task illumination, provide lighting on architectural features, displays, and artwork in focal areas to produce luminances that are within the range of 5:1 with respect to ambient background.
      c. Portable lamps (not permanently attached to the building or other building furnishings) may not be used to accomplish required artificial lighting.
   2. Exterior Lighting: Provide artificial lighting for exterior spaces that is adequate in quantity, quality, and distribution for the performance of tasks typical for the type of outdoor space and the characteristics of the intended user population.
   3. Athletic Lighting: Provide artificial lighting for athletic activities, as required by the project program, that is adequate in quantity, quality, and distribution for the intended activities and the characteristics of the intended user population.

G. Grounding: Provide grounding systems that:
   1. Provide protection from lightning strikes; scope and design of protection as defined in General Colorado College Facility Design Guidelines.
   2. Provide protection from shock due to overhead power transmission lines accidentally contacting metal fences.
   3. Reduce static electricity and transient and induced current in raised access flooring and electronic equipment cabinets, racks, and supports.
   4. Comply with applicable recommendations of IEEE 142 and IEEE 1100.

H. Where electrical elements also must function as elements defined within another element group, meet the requirements of both element groups.
   1. Electrical elements within food service spaces shall also comply with requirements for applicable food service equipment.
   2. Where electrical elements are located outside the building in the site area, meet applicable requirements of Section G30.

I. In addition to the requirements of this Section, comply with all applicable requirements of Colorado College Facility Design Guidelines.

3.02 AMENITY AND COMFORT CRITERIA

A. Accessibility: Comply with ADA Standards for Accessible Design.
   1. Receptacles: Provide ADA accessible receptacles in all spaces as required by code.
      a. Location: Where ADA accessible receptacles are required, mount devices no higher than 48 inches and not less than 15 inches above the finished floor.
   2. Lighting Controls: Provide accessible lighting controls for all spaces, regardless of location.
      a. Location: Where accessible lighting controls are required, provide devices that are mounted so they can be reached from a wheelchair and are not more than 48 inches and not less than 15 inches from the floor.
      b. Operating Force: Where accessible lighting controls are required, provide controls that can be operated without tight grasping or pinching and by a force of not more than 5 lbf.

B. Artificial Light Levels: Provide maintained ambient illuminance values for various activities based on the primary visual tasks to be accommodated and that are within the ranges specified in the IESNA Lighting Handbook, except for the following:
   1. Emergency Lighting: In addition to exit signs and means of egress lighting, provide emergency illumination of not less than 1 fc for a minimum of 1 hour in spaces as follows:
      a. Computer room.
      b. Lobby.
      c. Control room.
      d. Emergency generator room.
      e. Retail space.
      f. Telephone room.
      g. Supply room.
      h. Restrooms.
      i. Other spaces required by College Facilities Services Department.
   2. Interior Lighting: Not less than the following, when measured at task height:
      a. Category A (Public spaces where reading and visual inspection are performed only occasionally): General lighting throughout space of 3 fc.
      b. Category B (Lobbies and other spaces characterized by short stays and the need for simple orientation): General lighting throughout space of 5 fc.
      c. Category C (Working spaces where simple visual tasks are performed): General lighting throughout space of 10 fc.
      d. Category D (Spaces requiring performance of visual tasks of large size and high contrast): Task illumination of 30 fc.
      e. Category E (Spaces requiring performance of visual tasks of high contrast and small size, or low contrast and large size): Task illumination of 50 fc.
      f. Category F (Spaces requiring performance of visual tasks of low contrast and small size): Task illumination of 100 fc.

g. Category G (Spaces requiring performance of visual tasks that are near the threshold of visibility): Task illumination of 500 fc, achieved by a combination of general and local lighting.

3. Interior Lighting: Not less than the following, when measured at task height:
   a. Customer Contact Spaces:
      1) Reception Desk: 50 fc.
      2) Customer Service, Point of Sale: 50 fc.
      3) Showrooms: 50 fc.
      4) Display Area: 200 fc,
      5) Exhibit Hall: 20 fc.
      6) Museum Gallery: 20 fc.
      7) Greenhouse: 20 fc.
   b. Occupant Work Spaces:
      1) Private Office: 20 fc.
      2) Open Office Cubicle: 50 fc.
   c. Equipment Utilization Spaces:
      1) Work Room: 50 fc.
      2) Copier Room: 50 fc.
      3) Computer Room: 100 fc.
      4) Mailroom: 50 fc.
      5) Commercial Kitchen: 50 fc.
      6) Treatment Room: 50 fc.
      7) Steam Room: 10 fc.
      8) Hot Tub or Spa: 10 fc.
      9) Exercise Room: 20 fc.
      10) Barber or Beauty Shop: 50 fc.
      11) Laboratory: 50 fc.
      12) Recording Studio: 50 fc.
      13) Service Retail: 50 fc.
   d. Audience Spaces:
      1) Seating Area: 10 fc.
      2) Proscenium Stage Area: 10 fc.
      3) Platform Stage Area: 10 fc.
      4) Projection Booth: 15 fc.
   e. Assembly Spaces:
      1) Assembly Hall: 10 fc.
      2) Restaurant Dining: 10 fc.
      3) Bar: 5 fc.
      4) Library Reading Room: 50 fc.
      5) Playroom: 20 fc.
   f. Meeting and Instruction:
      1) Conference Room: 20 fc.
      2) Classroom: 50 fc.
      3) Music Practice Room: 50 fc.
      4) Learning Laboratory: 50 fc.
   g. Special Facilities:
      1) Gymnasium: 20 fc.
      2) Swimming Pool: 20 fc.
      3) Bowling Alley: 10 fc.
   h. Resident or Occupant Service Spaces:
      1) Toilet Room or Bathroom: 10 fc.
      2) Locker Room: 10 fc.
      3) Kitchen: 20 fc.Dining room:
      4) Break Room: 20 fc.
      5) Living Room or Lounge: 10 fc.
      6) Bedroom: 10 fc.
   i. Storage Spaces:
      1) Closet: 10 fc.
      2) Storeroom: 10 fc.

j. Automotive Interior Spaces:
    1) Parking Garage: 2 fc.
    2) Passenger Loading Zone: 5 fc.
    3) Drive-up Window: 10 fc.
    4) Truck Loading Dock: 10 fc.
k. Circulation Spaces:
    1) Corridor: 10 fc.
    2) Lobby: 10 fc.
    3) Waiting Room: 10 fc.
    4) Stair: 10 fc.
    5) Escalator: 20 fc.
    6) Elevator: 10 fc.
l. Maintenance Facilities:
    1) Janitors Closet: 10 fc.
    2) Trash Collection: 10 fc.
    3) Trash Removal or Incineration: 2 fc.
    4) Maintenance Shop: 20 fc.
m. Utility Equipment Spaces:
    1) Mechanical Equipment Room: 10 fc.
    2) Electrical Equipment Room: 10 fc.
    3) Communications Equipment Room: 10 fc.
    4) Elevator Equipment Room: 10 fc.

4. Local Interior Lighting: In spaces where local task lighting is used to achieve maintained luminance levels, maintain balance with ambient illumination such that general lighting for space provides not less than 20 percent of local lighting level.
5. Exterior Area Lighting: Not less than the following, when measured at grade:
    a. Parking Lots, High Activity: 1.5 fc, maximum uniformity ratio (average to minimum) of 4:1.
    b. Parking Lots, Medium Activity: 1.0 fc, maximum uniformity ratio (average to minimum) of 4:1.
    c. Parking Lots, Low Activity: 0.6 fc, maximum uniformity ratio (average to minimum) of 4:1.
    d. Building Entrance Areas: 4 fc, maximum uniformity ratio (average to minimum) of 4:1.
    e. Bikeways: 0.75 fc, maximum uniformity ratio (average to minimum) of 10:1.
    f. Pedestrian Areas:
        1) Sidewalks in Commercial Areas: 1.5 fc, maximum uniformity ratio (average to minimum) of 4:1.
        2) Sidewalks in Intermediate Areas: 0.75 fc, maximum uniformity ratio (average to minimum) of 4:1.
        3) Sidewalks in Residential Areas: 0.4 fc, maximum uniformity ratio (average to minimum) of 10:1.
        4) Walkways in Landscaped Areas: 0.75 fc, maximum uniformity ratio (average to minimum) of 10:1.
        5) Pedestrian Tunnels: 2.5 fc, maximum uniformity ratio (average to minimum) of 4:1.
        6) Stairways: 0.75 fc, maximum uniformity ratio (average to minimum) of 10:1.
6. Athletic Lighting: Based on the primary visual tasks to be accommodated, the class of play, and the needs of spectators.
    a. Light Levels: Provide maintained illuminance values as recommended in IESNA RP-6.
    b. Horizontal Illuminance: Provide maintained illuminance values that are not less than the following, when measured at the playing surface:
    c. Class I Facilities:
        1) Lacrosse: 150 fc; uniformity (maximum to minimum) of 1.5.
        2) Soccer: 100 fc; uniformity (maximum to minimum) of 1.5.
        3) Tennis: Average level of 125 fc, minimum level of 100 fc; uniformity (maximum to minimum) of 1.2 within lines and 1.5 within principal playing area.
        4) Basketball: 125 fc; uniformity (maximum to minimum) of 1.5.
        5) Swimming: Level at water surface of 70 fc, level at deck of 50 fc.
    d. Class II Facilities:
        1) Lacrosse: 100 fc; uniformity (maximum to minimum) of 1.5.
        2) Soccer: 75 fc; uniformity (maximum to minimum) of 1.5.

3) Tennis: Average level of 60 fc, minimum level of 40 fc; uniformity (maximum to minimum) of 1.5 within lines and 1.7 within principal playing area.
4) Basketball: 75 fc; uniformity (maximum to minimum) of 2.1.
5) Swimming: Level at water surface of 50 fc, level at deck of 20 fc.

e. Class III Facilities:
1) Lacrosse: 80 fc; uniformity (maximum to minimum) of 1.5.
2) Soccer: 50 fc; uniformity (maximum to minimum) of 1.5.
3) Tennis: Average level of 40 fc, minimum level of 30 fc; uniformity (maximum to minimum) of 1.7 within lines and 2.0 within principal playing area.
4) Basketball: 50 fc; uniformity (maximum to minimum) of 3.0.
5) Swimming: Level at water surface of 30 fc, level at deck of 10 fc.

f. Class IV Facilities:
1) Lacrosse: 65 fc; uniformity (maximum to minimum) of 1.5.
2) Soccer: 40 fc; uniformity (maximum to minimum) of 1.5.
3) Tennis: Average level of 30 fc, minimum level of 20 fc; uniformity (maximum to minimum) of 2.0 within lines and 2.5 within principal playing area.
4) Basketball: 30 fc; uniformity (maximum to minimum) of 3.0.
5) Swimming: Level at water surface of 30 fc, level at deck of 10 fc.

C. Artificial Light Quality: Provide luminous environment in each space that is designed to complement the functions and the character of the space.
1. Interior Lighting:
a. Distribution: In keeping with geometry of space and location of visual tasks.
b. Visual Comfort: Provide lighting systems with the following characteristics:
1) VCP: Visual Comfort Probability (VCP) of not less than 70.
2) Luminance Ratio: Maximum luminance of luminaire does not exceed average luminance by ratio of more than 5:1 at 45, 55, 65, 75, and 85 degrees from nadir for crosswise and lengthwise viewing.
3) Maximum luminances of luminaires crosswise and lengthwise do not exceed the following values:
(a) 45 degrees above nadir: 7710 cd/sq m.
(b) 55 degrees above nadir: 5500 cd/sq m.
(c) 65 degrees above nadir: 3860 cd/sq m.
(d) 75 degrees above nadir: 2570 cd/sq m.
(e) 85 degrees above nadir: 1695 cd/sq m.

c. Spatial Luminance: Provide luminous environments throughout project in which brightness ratios are maintained within the following ranges:
1) Task Area and Adjacent Darker Surroundings: 3:1.
2) Task Area and Adjacent Lighter Surroundings: 1:3.
3) Task Area and More Remote Darker Surfaces: 10:1.
4) Task Area and More Remote Lighter Surfaces: 1:10.
5) Light Sources and Adjacent Surfaces: 10:1.
6) Any Surfaces Within Normal Field of View: 30:1.

d. Color of Light: Appropriate for functions accommodated in space and characteristics of interior finishes.
1) Color: Provide light sources throughout project with Color Rendering Index of not less than 70.
(a) Exception: Automotive Interior.
(b) Exception: Maintenance Facilities.
(c) Exception: Utility Equipment.

2. Exterior Area Lighting:
a. Glare Minimization: Provide exterior area lighting that minimizes the incidence of discomfort glare and avoids disability glare under all normal conditions of use, in accordance with IESNA recommendations.
b. Color: Provide light sources throughout project that render automobile colors with reasonable accuracy.

3. Athletic Lighting:
    a. Glare Minimization: Provide special purpose lighting that minimizes the incidence of discomfort glare and avoids disability glare under all normal conditions of use, in accordance with recommendations of IESNA.
        1) Luminaire Mounting Height: Not less than 30 feet above playing surface.
        2) Location of Luminaires: Away from critical or most frequently viewed position of players.
        3) Background Luminance: Low luminance for tennis, baseball, and other sports with light colored game objects.
        4) Background Luminance: High luminance for basketball, football, and other sports with dark-colored game objects.
    b. Flicker: Provide a flicker index of less than 0.1 for all special purpose lighting at tennis courts and baseball fields.
    c. Color: Provide light sources throughout project that render colors of players' uniforms with reasonable accuracy.

D. Lighting Cutoff:
1. Configure exterior area lighting to avoid spill light on adjacent property and streets.
2. Configure exterior area lighting to minimize illumination of building facade and building windows, in particular.
3. Configure lighting to minimize illumination of spectator areas.

E. Sound and Noise:
1. Provide generator exhaust silencer ratings of the industrial (12-18dB(A)) type.
2. Provide generator enclosures of the sound attenuated type.
3. Provide uninterruptible power supply system's noise generation of no more than 69 dBA measured at 5 feet.
4. Provide unit power conditioner audible noise generation of no more than 58 dBA measured at 5 feet.
5. Do not locate transformers near sound sensitive areas. See Section C for interior space sound level requirements.
6. Provide transformers with noise generation 3 dBA less than the sound levels listed in IEEE Standard 241.

F. Convenience:
1. Provide convenience receptacles as needed along the base of all wall areas.
2. Locate metering and monitoring facilities in a single location as required by College Facilities Services Department.
3. Provide means of connecting power meters and demand meters to the building energy management system.
4. Provide an interface between the electrical monitoring and the building automation system including the following:
    a. Switchboard Monitoring:
        1) Power Analysis Values:
            (a) Output voltage of each phase; line-to-line and line-to-neutral.
            (b) Output current; each phase and ground.
            (c) Real power; per phase.
            (d) Reactive power; per phase.
            (e) Apparent power; per phase.
            (f) Power factor; per phase.
            (g) Frequency.
    b. Energy Readings of:
        1) Real accumulated energy.
        2) Reactive accumulated energy.
        3) Apparent accumulated energy.
        4) Bi-directional readings.
    c. Real-Time Readings of:
        1) Crest factor; per phase.
        2) Demand, per phase; instantaneous over interval of 15 minutes.
        3) Displacement Power factor, per phase.

4) Fundamental voltages; per phase.
5) Fundamental real power; per phase.

d. Demand Readings:
1) Demand current; per phase and peak.
2) Average power factor; 3-phase total.
3) Demand real power; 3-phase total.
4) Demand apparent power; 3-phase total.
5) Demand reactive power; 3-phase total.

G. Appearance:
1. Location of Service Transformer: Outside the building as indicated on the drawings.
2. Do not locate switchboards, transformers, and panelboards in corridors, lobbies, or stairwells.
3. Conceal electrical conduit in walls and behind ceilings in the occupied spaces. See Section D for additional requirements.
4. Conceal grounding conductors and ground terminals wherever possible.
5. Character of Lighting Fixtures: Coordinated with architecture and other building systems and appropriate to finish level.
6. Provide emergency lights which appear to be normal space luminaires.
a. Exception: Mechanical and electrical rooms may have self-contained emergency lights.
7. Provide exterior area lighting that is compatible with overall appearance and coordinated with site layout and building organization.
a. Luminaire Mounting:
1) Installation on poles, wall mounting brackets, architectural fixtures, or suspended cables:
2) Coordinate maximum height with College Facilities Services.
3) Style compatible with campus standard design, unless otherwise approved by College Facilities Services.
4) Material and finish compatible with exterior building elements.
b. Luminaire Design:
1) Light distribution by direct or indirect methods.
2) Optical control by reflectors or refractors.
3) Material and finish of housing compatible with mounting.
8. Appearance: Conceal all portions of cathodic protection systems.

3.03 HEALTH AND SAFETY CRITERIA

A. Fire Hazard:
1. Locate electrical energy generation equipment away from storage areas and flammable materials.
a. Generators and Fuel Supplies: Located out-of-doors.
2. Provide branch circuit elements in compliance with code and that are UL listed or labeled..
a. Provide elements that have their flame spread and smoke developed ratings printed on them.
3. Fire-Resistant Construction: Provide lighting elements throughout the project that are made of incombustible materials in compliance with code and that are UL listed or labeled, with flame spread and smoke developed ratings printed on product.

B. Lightning Hazard: See Section D50, Design Criteria for portions of the project that must be protected and coordinate protection elements with other built elements.
1. Provide protection equivalent to that specified in NFPA 780; supplementary strike termination devices, ground conductors, and grounding electrodes are required only where the integral portions of the structure cannot perform those functions.
2. Maximum Ground Resistance: 10 ohms, between any individual down conductor and ground.
3. Ground Resistance Measurement Methods: As described in NFPA 780, Appendix I, or IEEE 81.

C. Electrical Hazards: Design in accordance with all NFPA standards that apply to the occupancy, application, and design.
1. Control access to spaces housing electrical components and allow access only by qualified personnel.
2. Provide electrical distribution equipment with locking cabinets, doors, and panels when it is located in public areas.
3. Comply with NFPA 70 requirements for hazardous locations applications.

D. Hazardous Locations: Comply with requirements of NFPA 70 chapter on Hazardous (Classified) Locations, in the following areas:
   1. Flammable gas storage.
   2. Flammable liquid storage.
   3. Service stations.
   4. Paint booth.
   5. Chemical storage.
   6. Bottled gas storage.
   7. Vehicle repair.
   8. Other locations determined by College Facilities Services Department.

E. Accidental Explosion: Ventilate electrical energy generation equipment to prevent the build-up of explosive gases.

F. Intrusion: Protect electrical energy generation and service and distribution equipment from unauthorized access and vandalism.

G. Protection from Breakage:
   1. Locate electrical energy generation equipment away from high traffic areas, building occupants, public, and vehicular traffic.
   2. Locate service and distribution equipment in closets and electrical rooms.

3.04 STRUCTURAL CRITERIA

A. Seismic Design:
   1. Provide electrical energy generation elements with flexible joints where differential movement is anticipated.
   2. Provide electrical energy generation equipment supports capable of supporting twice equipment's normal weight.
   3. Provide service and distribution elements with the ability to move where differential movement is anticipated.

B. Wind Resistance: Provide mounting systems for exterior lighting that are capable of withstanding 3-second wind gusts in excess of 90 mph.

3.05 DURABILITY CRITERIA

A. Expected Service Life Span:
   1. Electrical:
      a. Power Distribution Equipment: Same as building service life.
      b. Power Generation Equipment: Minimum 40 years.
      c. All Components of Life Safety-Related Systems: Minimum 40 years.
      d. Control Components, Except Wiring: Minimum 20 years.
   2. Lighting Fixtures: Minimum 25 years.
   3. Lightning Protection and Special Grounding Systems: Same as building service life.
   4. Expected Service Life Span: Provide UPS systems which will last a minimum of 15 years in service without major repairs or operating expense.
   5. All Grounding Systems: Life of the building without requiring any more maintenance than annual inspection and minor repairs not more frequently than annually.
      a. Lightning Protection Elements: Minimum quality demonstrated by listing or labeling by UL.
      b. Lightning Protection Strike (Air) Terminals: Sheet metal elements less than 3/16 inch thick are likely to be damaged (punctured) by direct lightning strikes and may not be used as strike (air) terminals.
   6. Exterior Area Lighting: Provide a system which will last a minimum of 25 years in service without major repairs.
   7. Athletic Lighting: Provide a system which will last in service a minimum of 25 years without major repairs.

B. Minimum Outdoor Operating Temperature: Provide lighting systems that operate at temperatures as low as -20 degrees F.

C. Transformer Insulation Class: As follows:
   1. Service Transformers: Insulation Class 105 degrees C.
   2. General-Purpose Transformers: Insulation Class 105 degrees C.

D. Electronic Equipment Protection: Provide a signal reference grid or plane for the entire raised floor area as high-frequency ground for electronic equipment.
   1. Comply with recommendations of IEEE 1100.
   2. Conductor Maximum Impedance: 23 ohms per 12 inches of ground conductor at frequency of 1 kHz.
   3. Ground: Multi-point bonding to all metallic objects crossing grid, including structural elements within 6 feet of grid.

E. Moisture Resistance:
   1. Water-resistant equipment includes transformers, raceways, enclosures, panelboards, and switchgear.
   2. Provide electrical energy generation equipment which is resistant to moisture.
   3. Regardless of whether exposure to moisture is likely or not, design lighting equipment to be resistant to moisture.
   4. Enclosures: As required to protect equipment from environment in which it is installed, complying with NEMA 250 and:
      a. Areas to be Hosed-Down, or Equivalent, Exterior or Interior: Type 4.
      b. Exterior, Exposed to Weather and Wind: Type 3S.
      c. Exterior, Other Locations: Type 3R.
      d. Interior, Subject to Settling Dust, Falling Dirt, or Dripping Liquids: Type 5.
      e. Interior, Subject to Circulating Dust: NEMA Type 12.
      f. Interior, Other Locations: Type 1.

F. Corrosion Resistance: Provide electrical energy generation equipment which is resistant to corrosion.

G. Corrosion Prevention by Cathodic Protection: Designed and constructed in accordance with NACE RP0169 and NACE RP0285; either galvanic anode or impressed current system.
   1. Design of Protected Elements: In addition to requirements specified elsewhere, as specified in NACE RP0169 and NACE RP0285, including coatings.
   2. Anode Systems Located More than 15 feet Below Grade: NACE RP0572.
   3. Measurement Techniques: As specified in NACE TM0497.

H. Impact Resistance:
   1. Provide electrical energy generation equipment with a protective housing.
   2. Provide service and distribution equipment with industrial grade enclosures.
   3. Provide poles for parking lot area lighting that are located to avoid damage by automobiles or mounted to bases that are structurally capable of withstanding moderate impact.

I. Vandal Resistance - Exterior Area Lighting:
   1. Parts not easily removed without the use of special tools.
   2. Luminaires mounted at minimum height of 12 ft above grade.
   3. Lenses of tempered glass, high impact acrylic, polyacrylate, or polycarbonate.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Power Quality:
   1. Power Conditioning: Modify incoming power characteristics to comply with utilization equipment requirements.
      a. Provide power conditioning for all equipment in computer rooms.
      b. Function:
         1) Static Voltage Regulation: For any load condition:
            (a) At Nominal Input Voltage: Plus or minus 3 percent.
            (b) For Input Voltage Variation within 40 Percent Plus and Minus: Plus 5 to minus 5 percent.
         2) Unbalanced Load Voltage Regulation: Within plus 5 and minus 2 percent, at nominal input voltage at 100 percent load imbalance.

3) Overload Voltage Regulation: Output voltage of no less than minus 6 percent of nominal, at nominal input voltage for an increasing load from 100 percent to 200 percent of full load.
4) Electrical Noise Suppression:
(a) Common Mode: 120 dB minimum.
(b) Normal Mode: 120 dB minimum.
5) Single-Phasing Response: Upon loss of one input phase, output phase voltages shall remain within plus 5.8 to minus 4 percent of nominal from no load to 60 percent load.
6) Harmonic Distortion: Less than 4 percent from no load to full load.

c. Input Power Factor: 0.96 lagging or better, independent of the load power factor.
d. Input Current Distortion: Less than 8 percent THD, independent of the output current distortion.
e. Paralleling capable.
f. Control and Monitoring:
1) Manual or auto restart, emergency power off, main output circuit breaker.
2) Overtemp and EPO monitor.
3) Power monitor.
4) Transient suppression.
5) Input surge arrestor.
6) Bypass switch.
7) Bypass transformer.

2. Uninterruptible Power Supply Systems:
a. Current Distortion: Less than 10 percent total harmonic distortion with included filter.
b. Overload Rating, Percent of Full Load For Any Combination of Linear and Non-Linear Loads:
1) 125 percent continuously.
2) 125 percent for 10 minutes.
3) 150 percent for 30 seconds.
c. Harmonic Content of Output Waveform:
1) Maximum 4 percent RMS for nonlinear load.
2) Maximum 2 percent RMS for any linear load.
3) Maximum 5 percent RMS for nonlinear load.

B. Load Characteristics:
1. Maximum Harmonic Current Distortion: Plus or minus 2 percent of design current.
2. Transient Suppression: Limit voltage transients below damage curve of the electrical system and connected equipment.

C. Protection Against Disturbances:
1. Provide circuits which serve sensitive electronic equipment with electrical characteristics within the ranges defined in IEEE Standard 1100 and as follows.
a. Transient Limit: 200 volts.
b. Swells and Sags: Voltage fluctuation limit of plus or minus 5 percent.
c. Overvoltage and Undervoltage: Voltage fluctuation limit of plus or minus 5 percent.
d. Conducted RFI/EMI Limit: 0.3 volts.
e. Radiated RFI/EMI Limit:
1) Less than 200 kHz: 10 kV per m.
2) Greater than 200 kHz: 0.5 kV per m.
f. Voltage Distortion Limit: 3 percent.
g. Phase Imbalance Limit: 1 percent.
2. Noise Protection: Limit frequency excursions between 90 to 110 percent of design frequency.
a. Protect the circuits as indicated on the drawings.
1) Receptacles serving personal computer terminals.
2) Receptacles serving network servers.
3) Power supply to fire alarm panel.
4) Power supply to telephone system.
3. Surge Protection: Voltage excursion limit of 2 times design voltage.
a. Provide protection of the circuits as indicated on the drawings.
1) Receptacles serving personal computer terminals.

2) Receptacles serving network servers.
3) Power supply to fire alarm panel.
4) Power supply to telephone system.
5) Power supply in the laboratory.
6) Entire building service.
7) Motors over 5 horsepower.

D. Energy Efficiency:
1. Comply with requirements of IEEE Standard 739.
2. Comply with requirements of ASHRAE 90.1. Additional high performance design goals and strategies information is provided in the "**Facility High Performance Design Criteria Checklist**" in this Colorado College Facility Design Guidelines manual.
3. Metering: Provide meters to measure power consumption of lights, receptacles, HVAC systems, water heaters, elevators, and loads greater than 20 kW.
4. Minimize operating expenses by providing peak-shaving capability, if cost effective.
   a. Evaluation of Cost Effectiveness: Simple payback is less than 5 years.
      1) Provide a calculation of simple payback based upon utility rate structure, demand charges, capital expense, and energy management.
5. Interior Lighting Controls: Provide level of control of lighting appropriate to type of space and College Facilities Services requirements for energy conservation.
   a. Daylighting Controls: Provide separate lighting circuits for spaces or zones adjacent to fenestration.
      1) Controls: Daylight sensing controls, multiple-step dimming throughout project.
   b. Occupancy Controls: Provide lighting circuits for private offices that are controlled by devices that do not require action by occupants.
      1) Controls: Occupancy sensor and programmable timing control throughout project.
6. Exterior Area Lighting Controls: Provide level of control of lighting appropriate to type of are and College Facilities Services requirements for energy conservation.
7. Exterior Area Lighting Controls: Provide daylight sensing controls, on-off switches, and programmable timing.
8. Athletic Lighting Controls: Provide level of control of lighting appropriate to type of are and College Facilities Services requirements for energy conservation.
9. Athletic Lighting Controls: Provide daylight sensing controls, on-off switches, and programmable timing.
10. Light Sources: Provide lamps with average lamp efficacy rating not less than the following:
    a. Compact Fluorescent Lamps: 55 lumens/watt.
    b. Full Size Fluorescent Lamps: 75 lumens/watt.
    c. LED Lamps: 50 or greater lumens/watt.
11. Ballasts: Provide electronic or energy efficient ballasts with fluorescent lamps.

E. Ease of Use:
1. Configuration: Design wiring and protective devices so that outages caused by local overloads do not affect unrelated areas or systems.
2. Provide main busway centrally located to minimize branch wiring runs.
3. Main Switchboard: Provide only one, located in basement.
4. Branch-Circuit Panelboards:
   a. Provide a dedicated panelboard for sensitive electronic equipment and lighting which is separate from building specific panelboards serving equipment.
5. Motor Control: Provide motor control centers for each group of 5 motors. Provide motors with the appropriate protective, control, and indicating devices.
6. Locate monitoring read-out at one central location.
7. Monitoring: Provide local and remote monitoring of any of the following metrics as required by College Facilities Services:
   a. Switchboard Monitoring:
      1) Power Analysis Values:
         (a) Output voltage of each phase; phase-to-phase and phase-to-neutral.
         (b) Output current; each phase and ground.
         (c) Real power; per phase.

(d) Reactive power; per phase.
(e) Apparent power; per phase.
(f) Power factor; per phase.
(g) Frequency.

2) Energy Readings of:
(a) Real accumulated energy.
(b) Reactive accumulated energy.
(c) Apparent accumulated energy.
(d) Bi-directional readings.

3) Real-Time Readings of:
(a) Crest factor; per phase.
(b) Demand, per phase; instantaneous.
(c) Displacement Power factor, per phase.
(d) Fundamental voltages; per phase.
(e) Fundamental real power; per phase.
(f) Harmonic power.
(g) Unbalance; current and voltage.
(h) Phase rotation.

4) Demand Readings:
(a) Demand current; per phase and peak.
(b) Average power factor; 3-phase total.
(c) Demand real power; 3-phase total.
(d) Demand apparent power; 3-phase total.
(e) Demand reactive power; 3-phase total.
(f) Coincident reading.
(g) Predicted Demands.

b. Locate monitoring read-out at one central location.

c. Panelboard Monitoring:

1) Power Analysis Values:
(a) Output voltage of each phase; line-to-line and line-to-neutral.
(b) Output current; each phase and ground.
(c) Real power; per phase.
(d) Reactive power; per phase.
(e) Apparent power; per phase.
(f) Power factor; per phase.
(g) Frequency.
(h) Total harmonic distortion (THD); current and voltage.
(i) K-factor; per phase.

2) Energy Readings of:
(a) Real accumulated energy.
(b) Reactive accumulated energy.
(c) Apparent accumulated energy.
(d) Bi-directional readings.

3) Real-Time Readings of:
(a) Crest factor; per phase.
(b) Demand, per phase; instantaneous, and integrated over interval of 15 minutes.
(c) Displacement power factor, per phase.
(d) Fundamental voltages; per phase.
(e) Fundamental real power; per phase.
(f) Harmonic power.
(g) Unbalance; current and voltage.
(h) Phase rotation.

4) Demand Readings:
(a) Demand current; per phase and peak.
(b) Average power factor; 3-phase total.
(c) Demand real power; 3-phase total.
(d) Demand apparent power; 3-phase total.
(e) Demand reactive power; 3-phase total.

(f) Coincident reading.
(g) Predicted Demands.

d. Motor Control Center Monitoring:
1) Power Analysis Values:
(a) Output voltage of each phase; line-to-line and line-to-neutral.
(b) Output current; each phase and ground.
(c) Real power; per phase.
(d) Reactive power; per phase.
(e) Apparent power; per phase.
(f) Power factor; per phase.
(g) Frequency.

8. Voltage Regulation: Within 3 percent of design voltage at all branch receptacles.

F. Availability: Provide an electrical system which is available to deliver power at least 99 percent of the time.

G. Reliability Indexes:
1. System Interruption Frequency: Calculated in accordance with IEEE 493.
2. System Expected Interruption Duration: Calculated in accordance with IEEE 493.
3. Service Interruption Definition: Voltage of zero for 1 minute or longer.
4. Failure Modes and Effects Analysis: Determine the components or combination of components whose failure causes a service interruption.

H. Allowance for Change and Expansion:
1. Spare Capacity - Building System:
a. Load: 25 percent, minimum.
b. Rated Capacity: 25 percent, minimum.
c. Number of Additional Circuits: 25 percent, minimum.
2. Future Capacity - System Wide: 40 percent, minimum.
a. Load: 40 percent, minimum.
b. Rated Capacity: 40 percent, minimum.
c. Number of Additional Circuits: 40 percent, minimum.
3. Spare Capacity:
a. Generator Systems: 50 percent over total load.
b. Battery Systems: 50 percent over total load.
c. Power Conditioners: 25 percent over total load.
4. Provide space for the addition of transformers in the future.
5. Branch Circuits: Provide branch circuit wiring with sufficient capacity to accommodate future growth and renovation without major rewiring.
a. All Circuits: Limit design loads to 50 percent of capacity permitted by code.

I. Ease of Cleaning:
1. Interior Lighting: Provide luminaires that do not collect dirt rapidly and are readily cleanable.
a. Luminaire Categories: Provide luminaires of IESNA Category I, II, or V, for minimum dirt accumulation and LDD factors.
2. Exterior Area Lighting: Provide luminaires of IESNA Category I, for minimum dirt accumulation and LDD factors.
3. Athletic Lighting: Provide luminaires that do not collect dirt rapidly and are readily cleanable.

J. Ease of Maintenance:
1. Relamping: Provide luminaires designed for easy relamping with special tools.
2. Uninterruptible Power Supply Systems: Provide the following functions:
a. Maintenance Bypass: Provide a maintenance switch to transfer UPS loads to the standby generators.
b. Internal maintenance bypass.
c. Emergency power off.
d. Input isolation transformer.
e. Maintenance bypass cabinet
f. Maintenance bypass transformer.
g. SNMP communications capability.

h. Remote monitor panel.
i. Alarm status contacts.

3. Service and Distribution Equipment:
   a. Select equipment which is segmented into modules to ease replacement of component failures.
   b. Wherever equipment is located in cabinets or enclosures, provide doors or removable panels sized to allow easy removal and replacement.
4. Cathodic Protection:
   a. Anodes: Located for ease of replacement; locations recorded in project record documents.
   b. Test Stations: Permanent testing stations and test equipment for periodic measuring of cathodic potential, as specified in NACE RP0169 and NACE RP0285 and at minimum of 2 locations.
   c. Impressed Current Type: Monitoring panel for electrical equipment located in a utility room, with separate readouts for each current source, display of last inspection date, and storage for maintenance records.

END OF SECTION

G20

SITE IMPROVEMENT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pavements and Surfacing: Finished surfaces for vehicular, bicycle, pedestrian walkways and plazas, and sports and recreational activities, other than turf, comprising the following elements:
   1. Exterior paved or surfaced areas such as roadways, driveways, parking lots, walkways, sports surfaces, and bicycle parking pads.
      a. Comply with Campus Master Plan and Walkway Master Plan-2008 for primary, secondary, and tertiary walkway materials and design. Other designs are permitted if approved by College Facilities Services.
   2. Exterior steps and ramps not connected to buildings, including handrails and stair nosings.
   3. Appurtenances for roadways and driveways, including curbs, gutters, pavement markings, and parking bumpers.
   4. Signs, including traffic signals, "stop," "yield, and directional signs, and parking space marking and identification.
      a. Comply with Campus signage standards.

B. Site Fixtures and Equipment: Fixtures, equipment, and miscellaneous structures located out-of-doors, except those located on the roof or mounted on walls of buildings. Site fixtures and equipment that are required include:
   1. Flagpoles:
      a. Pedestal-Mounted Flagpole(s): Earle Flag Pole; for US flag. Minimum flag size: 4 by 6 feet.
   2. Fences and Barriers:
      a. Athletic Fields Along Monument Creek Trail: Provide fences and barriers conforming to NCAA competition requirements on north, west, and south sides, for security.
      b. Facilities Services: Provide security fences around transportation and maintenance yards.
      c. Utility Areas: Provide visual and security screening around utility areas including transformers, emergency generators, trash, and recycling collection areas.
      d. Fence and Barrier Types: Ornamental wrought iron is preferred in high-profile campus areas, and vinyl-coated chain like fencing is preferred over galvanized chain link fencing in areas of lower profile.
   3. Athletic fixtures and fixed equipment, including:
      a. Tennis court enclosure fence, windbreaker, nets, practice backstop.
      b. Football goalposts (for Summer camps).
      c. Soccer goals.
      d. Basketball goals and backstops.
      e. Volleyball nets.
      f. Lacrosse goals.
      g. Scoreboards at Washburn Field and Stewart Field.
      h. Playground equipment at Children's Center.
      i. Bleachers at Washburn Field.
   4. Site furnishings conforming to Campus standards, including:
      a. Outdoor seating, benches, tables, and chairs.
      b. Waste and recycling receptacles.
      c. Bicycle racks.
      d. Walkway light poles.
      e. Emergency phone poles.
   5. Outdoor signs other than roadway and parking lot signs conforming to Campus standards, including:
      a. Main building identification signs, located near main building entrances.
      b. Wayfinding signage and campus map signs.

6. Minor site structures, including:
    a. Earle Flagpole tiger sculpture base and donor recognition monument.
    b. Ritt Kellog Memorial Pergola shelter and table west of McGregor Hall.
    c. Victory bell monument at Washburn Field.
    d. Tiger Trail stone sign monument west of McGregor Hall.
    e. Waste and recycling collection enclosures near major buildings.

C. Landscaping: Outdoor plants and elements supporting plants. Additional landscaping information is provided in the Campus Master Plan landscape design guidelines. Landscape planting features that are required are:
1. Turf areas for specific activities as follows:
    a. Sports and athletic surfaces at Stewart Field and Autry Field.
    b. Campus quadrangles for student recreational activities.
2. Turf for ornamental or erosion-control purposes.
3. Visual screening of the following:
    a. Utility areas, including trash and recycling collection facilities.
4. Shade for outdoor activities.
5. Improvement of appearance of natural and functional features including the following:
    a. Storm water overflow channels.
    b. Sediment retention basins.
    c. Long slopes and hillsides.
    d. Retaining walls; coordinate with College Facilities Services regarding campus standard materials.
    e. Decorative stone and concrete seat walls.
6. Ornamental plantings at following locations:
    a. Cascade Avenue median raised planter beds.
    b. Various movable planter container locations.
    c. Around building perimeters.
    d. Parking lot planting beds.
    e. Various raised planting beds along campus walkways, and at main intersections of driveways and walkways.
7. Water garden at Max Kade House garden area.
8. Consult College Facilities Services Grounds Shop to coordinate the following plantings; Architect/Engineer is required to design planting areas based on discussions regarding irrigation and soils requirements:
    a. Vegetable gardens.
    b. Annual and Perennial flower and shrub bed plantings.
    c. Water garden plantings.
    d. Indoor garden room plantings. Barnes Science Center Greenhouses are managed by Academic Departments, and building indoor ornamental plantings are furnished and managed by contract services.
    e. Tree and shrub plantings.
    f. Xeriscape Plantings: Xeriscape planting areas should be of smaller sizes which are manageable for ease of maintenance and more likely to be successful. Xeriscape plants located in garden areas should be compatible in scale of size for ease of maintenance, and plantings in areas with similar watering requirements are more likely to be successful.

D. Other Site Improvements:
1. Underground service tunnels.
    a. For underground tunnels accommodating high-temperature hot water (HTHW) pipe lines, some chilled water lines, some domestic water lines, and telecommunications, comply with requirements for basements specified in other Sections except that finishes of interior surfaces are not required.
2. Underground storage tanks.
    a. Central Plant: One (1) underground fuel tank for the Central Plant heating fuel.
    b. Facility Services Transportation Shop: Two (2) underground fuel tanks, and one (1) waste oil tank.

E. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. 2010 ADA Standards for Accessible Design, Department of Justice, September 15, 2010. The 2010 Standards for public accommodations and commercial facilities, which consist of the Title III regulations at 28 CFR part 36, subpart D, and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. Regulations can be found on DOJ website at www.ADA.gov.

C. 40 CFR 280 - Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks.

D. AASHTO GDPS - Guide for Design of Pavement Structures, Volume 1.

E. AASHTO GDHS - A Policy on Geometric Design of Highways and Streets.

F. ASTM A536 - Standard Specification for Ductile Iron Castings.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

H. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

I. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

J. ASTM D2027 - Standard Specification for Cutback Asphalt (Medium-Curing Type).

K. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

L. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

M. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

N. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material.

O. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

P. ASTM F1292 - Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.

Q. ASTM F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use.

R. CSRWD Standards - City of Colorado Springs Reclaimed Water Design Standards.

S. CPSC Pub. No. 325 - Public Playground Safety Handbook; Consumer Products Safety Commission.

T. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles.

1.03 FIELD CONDITIONS

A. The following existing elements must be preserved:
   1. Historic decorative metal fencing and stone retaining walls.
   2. Significant trees should be protected by fencing outside drip lines during construction.
   3. Campus standard building, ADA, or wayfinding signage should be carefully removed without damage, stored, and replaced after construction is completed.
   4. Campus standard seating, light pole fixtures, and emergency phone pole equipment should be carefully removed without any damage, stored, and replaced after construction is completed.

B. The following existing elements must be removed or relocated to accomplish new construction:
   1. Underground tunnels or utilities.
   2. Statuary art work.
   3. Campus standard building, ADA, or wayfinding signage.
   4. Campus standard seating, light pole fixtures, and emergency phone equipment.

PART 2 PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

A. Site fixtures and equipment that will be provided by College Facilities Services are as follows; Architect/Engineer is to provide mountings and install:
   1. Campus standard seating benches.
   2. Campus standard bike racks.
   3. Campus standard lighting poles.
   4. Campus standard building signage, ADA signage, and wayfinding signage.

B. Owner-Furnished Items: Criteria for characteristics of items do not apply; requirements for accommodating items to the project do apply.

2.02 PAVEMENTS AND SURFACING

A. Pavements and Surfacing:
   1. Use one of the following:
      a. Rigid paving at walkways to facilitate snow removal and ADA requirements, and in drainage swales through flexible asphalt paving areas.
      b. Flexible asphalt paving at driveways and parking lots.
      c. Modular pavers at plazas and bicycle parking areas.
      d. Turf reinforcing systems at fire truck access lanes to buildings, and in storm water drainage swales through turf areas.
      e. Resilient sports surfacing at running tracks and tennis courts.
      f. Granular surfacing at dry areas next to buildings, around free standing campus signage as protection from mowing machines, and as approved by College Facilities Services Grounds Shop.
   2. Do not use:
      a. Granular surfacing for walkways unless approved by College Facilities Services due to ADA and snow removal requirements.

B. Vehicular Paving:
   1. Use any of the following; subject to approval of College Facilities Services:
      a. Asphalt paving at driveways and parking lots.
      b. Concrete pavement at selective parking spaces.
      c. Brick pavers at selective parking spaces.
      d. Concrete pavers at selective parking spaces.
      e. Stone pavers at selective parking spaces.
      f. Turf reinforcement paving system at fire truck access lanes to buildings.
      g. Other paving acceptable to College Facilities Services Department.
   2. Do not use the following:
      a. Decorative concrete topping.
      b. Asphalt pavers.
      c. River-washed gravel over compacted subbase.
      d. Crushed stone over compacted subbase.
      e. Paving not accepted by College Facilities Services Department.

C. Pedestrian Areas:
   1. Use any of the following; subject to approval of College Facilities Services:
      a. Concrete pavement at sidewalks and plazas conforming to Walkway Master Plan.
      b. Brick pavers at plazas and other selective areas.
      c. Concrete pavers at sidewalks and plazas conforming to Walkway Master Plan.

d. Stone pavers at plazas and other selective areas.
e. Other paving acceptable to College Facilities Services Department.

2. Do not use the following:
a. Asphalt paving.
b. Decorative concrete topping.
c. Asphalt pavers.
d. River-washed gravel over compacted subbase.
e. Paving not accepted by College Facilities Services Department.

D. Exterior Sports Surfacing:
1. Use any of the following; subject to approval of College Facilities Services:
a. Asphalt paving at tennis courts.
b. Concrete pavement at tennis courts.
c. Acrylic topping over concrete at tennis courts.
d. Acrylic topping over asphalt at tennis courts.
e. Seamless rubber and polyurethane surfacing system at running tracks.
f. Synthetic turf system at athletic fields.
g. Other surfacing acceptable to College Facilities Services Department.

2. Do not use the following:
a. Rubber tile system.
b. Surfacing not accepted by College Facilities Services Department.

2.03 SITE FIXTURES AND EQUIPMENT

A. Visual Barriers:
1. Use the following:
a. Fences, walls, or hedges at area perimeters for security and visual screening.

B. Fences and Visual Barriers:
1. Use one of the following:
a. Vinyl-coated chain link fencing at locations approved by College Facilities Services Department.
b. Powder-coated ornamental steel fencing at locations approved by College Facilities Services Department.
c. Wood board fencing at waste and recycling collection enclosures and residential yards.
d. Wood split rail fencing at locations approved by College Facilities Services Department.
e. Walls constructed of any materials specified as acceptable for building at waste and recycling collection enclosures and equipment screening.
f. Other fencing and visual barriers accepted by College Facilities Services Department.

2. Do not use:
a. Galvanized chain link fencing, unless approved by College Facilities Services Department.
b. Chain link fencing with privacy slats.
c. Aluminized chain link fencing.
d. Extruded aluminum fencing.
e. Wood panel fencing.
f. Hedges, or other plantings.
g. Fencing and visual barriers not accepted by College Facilities Services Department.

C. Sound Barriers:
1. Use the following:
a. Masonry at locations approved by College Facilities Services Department.
b. Other barriers accepted by College Facilities Services Department.

2. Do not use:
a. Precast concrete, unless approved by College Facilities Services Department.
b. Solid wood timbers.
c. Barriers not accepted by College Facilities Services Department.

D. Permanent Site Fixtures:
   1. Use products made of one of the following:
      a. Cast-in-place concrete.
      b. Precast concrete.
      c. Bronze.
      d. Cast iron.
      e. Steel.
      f. Other materials accepted by College Facilities Services Department.
   2. Do not use products made of:
      a. Terracotta.
      b. Aluminum, unless approved by College Facilities Services Department.
      c. Stainless steel.
      d. Materials not accepted by College Facilities Services Department.

E. Site Furnishings:
   1. Use products made of one of the following:
      a. Cast-in-place concrete.
      b. Precast concrete.
      c. Bronze.
      d. Cast iron.
      e. Steel.
      f. Other materials accepted by College Facilities Services Department.
   2. Do not use products made of:
      a. Terracotta.
      b. Aluminum, unless approved by College Facilities Services Department.
      c. Stainless steel.
      d. Reinforced plastic.
      e. Materials not accepted by College Facilities Services Department.

F. Signs:
   1. Use Campus standard building signs and wayfinding signs unless otherwise approved by College Facilities Services Department.
   2. Do not use:
      a. Signs painted on the face of the exterior wall.
      b. Signs constructed of the same material as the exterior skin of the exterior wall, unless approved by College Facilities Services Department.
      c. Dimensional letter signs, unless approved by College Facilities Services Department..
      d. Box signs.
      e. Neon light signs.
      f. Electronic message boards, unless approved by College Facilities Services Department.

2.04 LANDSCAPING

A. Landscape Trees, Plants, and Shrubs:
   1. Use evergreen and deciduous types permitted by Campus Master Plan and as approved by College Facilities Services Grounds Shop.
   2. Do not use:
      a. Tree, plant, and shrub types not permitted by Campus Master Plan or approved by College Facilities Services Grounds Shop.

B. Turf:
   1. Use one of the following:
      a. Bluegrass.
      b. Buffalo grass.
      c. Perennial ryegrass.
      d. Tall fescue.
      e. Other species permitted by Campus Master Plan and accepted by College Facilities Grounds Shop.

2. Do not use:
    a. Bermuda grass.
    b. Centipede grass.
    c. Fine fescue.
    d. St. Augustine grass.
    e. Zoysia grass.
    f. Other species not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.
3. Use one of the following methods of installation:
    a. Sodding.
    b. Seeding.
4. Do not use:
    a. Sprigging.
    b. Plugging.
    c. Hydroseeding.

C. Evergreen Ground Covers:
1. Use one of the following:
    a. Euonymus fortunei (wintercreeper).
    b. Vinca minor (periwinkle).
    c. Other species permitted by Campus Master Plan and accepted by College Facilities Grounds Shop.
2. Do not use:
    a. English ivy.
    b. Juniper.
    c. Pachysandra.
    d. Other species not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.

D. Deciduous Ground Covers:
1. Use one of the following:
    a. Daylily.
    b. Other species permitted by Campus Master Plan and accepted by College Facilities Grounds Shop.
2. Do not use:
    a. Liriope (lilyturf).
    b. Hypericum (St. John's wort).
    c. Other species not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.

E. Vines:
1. Use one of the following:
    a. Clematis.
    b. Honeysuckle.
    c. Trumpet vine.
    d. Wisteria.
    e. Other species permitted by Campus Master Plan and accepted by College Facilities Grounds Shop.
2. Do not use:
    a. Jasmine.
    b. Lantana.
    c. Other species not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.

F. Street Trees:
1. Use the following:
    a. Linden.
    b. Other species permitted by Campus Master Plan and accepted by College Facilities Grounds Shop.

2. Do not use:
    a. Bradford pear.
    b. Gingko.
    c. Zelkova.
    d. Other species not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.

G. Irrigation Systems:
1. Control System Components:
    a. Satellite Controller Assembly:
        1) Acceptable Manufacturer and Model: Toro E-Series Satellite controller with Osmac Digital Wireless Paging. Satellite controller must contain a radio frequency receiver and decoder capable of receiving and decoding standard digital paging signals compatible with the College's existing Site Pro Central Control System.
    b. Satellite Controller Assembly Pedestal:
        1) Toro Osmac E-series locking, weatherproof, cabinet-type enclosure; painted stainless steel. Mount on concrete pad with mounting bracket, sleeving, and conduits for electrical power, cables, wires, grounding, and surge protection.
        2) Provide combination switch/GFCI outlet in accordance with local codes inside satellite controller pedestal enclosure.
        3) Electrical Conduit: PVC, Schedule 40 conduit conforming to ASTM D1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for buried installations.
        4) Lightning Protection: Provide one 12 inch x 36 inch x 0.0625 inch ground plate, one 5/8 inch x10 foot copper clad UL listed grounding rod, 30 feet of #6 AWG barecopper grounding wire, two 6-inch round valve boxes, and one CADWELD connector at each satellite controller group.
        5) Wire Markers: Pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.
    c. Low Voltage Control Wire:
        1) American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use AWG No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
        2) Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Provide spare control wires of color different from active control wire. Wire color continuous over entire lengths.
        3) Warning Tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils; 3 inch wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."
    d. Communication Cable and Sensor Cable:
        1) Cable and Conductors: Shielded and jacketed, twisted pair, multi conductor PE-39 (3 pair), 19 AWG wire designed for direct burial.
        2) Splices: Use 3M #SLiC with 3M "Insulation Displacement Connectors" (316IR or UR-2), Ranger Serviseal Connectors, or accepted substitution.
        3) Warning Tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."
2. Underground Irrigation Piping:
    a. Mainline pipe velocities must not exceed 5 FPS. Lateral pipe velocities must not exceed 7.5 FPS.
    b. Maximum allowable variation between the highest and lowest sprinkler operating pressures on an individual lateral must not exceed 10 percent.
    c. Minimum Mainline Pipe Size: 2 inch outside diameter.
    d. Minimum Sprinkler Lateral Pipe Size: 1 inch outside diameter.
    e. Minimum Drip Lateral Pipe Size: 3/4 inch outside diameter.

3. Sleeving:
    a. Provide separate sleeves beneath hardscapes for wiring bundle.
    b. Sleeve all mainline and sub-mainline piping when it is to be installed above existing potable waterlines. Sleeve for 10-feet each side of potable waterline.
    c. Provide SDR 11, HDPE pipe or SDR-21 CL200 PVC for wire sleeving.
    d. Sleeve Sizing: Two times diameter of pipe or wiring bundle.
4. Pipe and Fittings:
    a. Non-Potable Mainline Pipe and Fittings:
        1) Sizes: 4-inch and larger.
        2) Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
        3) Use C900 Class 200 (DR-14), rated at 200 PSI, conforming to the dimensions and tolerances established by AWWA C900 and DR-14 requirements.
        4) Use Pantone 522 purple colored pipe, embossed or integrally stamped/marked “CAUTION RECLAIMED WATER DO NOT DRINK”. Pipe may also be installed with a purple identification tape, or a Pantone 512 purple polyethylene vinyl wrap.
        5) Use rubber-gasketed pipe equipped with factory installed reinforced gaskets. Gasketed pipe joints must conform to the “Laboratory Qualifying Tests” section of ASTM D3139. Gasket material must conform to ASTM F477. Use rubber-gasketed mechanical joint ductile iron fittings conforming to ASTM A536 and ASTM F477. Use lubricant approved by the pipe manufacturer.
        6) Tracer Wire: Copper wire with connectors per City of Colorado Springs Standard details.
    b. HDPE Mainline Pipe and Fittings:
        1) Sizes: 4 inch and larger.
        2) Use high density, extra high molecular weight polyethylene pipe (HDPE), extruded from material meeting the specifications of cell classification on PE 345434C, ASTM D3350, SDR 9, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM F714 for mainline pipe.
        3) Use Pantone 522 purple colored pipe or pipe with marking stripe, embossed or integrally stamped/marked “CAUTION RECLAIMED WATER DO NOT DRINK”. Pipe may also be installed with a Pantone 512 purple identification tape, or a purple polyethylene vinyl wrap.
        4) Join pipe lengths using butt-fusion technique as recommended by pipe manufacturer. Join HDPE to dissimilar pipe materials using HDPE (butt-fusion) x flange adapter with ductile iron back-up ring.
        5) Tracer Wire: Use copper wire with connectors per City of Colorado Springs Standard details.
    c. Sub-Mainline Pipe and Fittings:
        1) Sizes: 2 inch.
        2) Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
        3) Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters that are not manufactured in Class 200.
        4) Use Pantone 522 purple colored pipe or pipe with marking stripe, embossed or integrally stamped/marked “CAUTION RECLAIMED WATER DO NOT DRINK”. Pipe may also be installed with a Pantone 512 purple identification tape, or a purple polyethylene vinyl wrap.
        5) Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use Harco rubber-gasketed deep bell ductile iron fittings conforming to ASTM A536 and ASTM F477. Use lubricant approved by the pipe manufacturer.

6) Tracer Wire: Use copper wire with connectors per City of Colorado Springs Standard details.

d. Lateral Pipe and Fittings:
   1) Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM D1784, with an integral belled end suitable for solvent welding.
   2) Use Class 160, SDR-26, rated at 160 PSI, conforming to the dimensions and tolerances established by ASTM D2241. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM D2466 and ASTM D1784 for PVC pipe. Use primer approved by the pipe manufacturer. Use solvent cement of type approved by the pipe manufacturer.
   3) Use Pantone 522 purple colored pipe or pipe with marking stripe, embossed or integrally stamped/marked “CAUTION RECLAIMED WATER DO NOT DRINK”. Pipe may also be installed with a Pantone 512 purple identification tape, or a purple polyethylene vinyl wrap.

e. Specialized Pipe and Fittings:
   1) Copper Pipe: Use Type "K" rigid conforming to ASTM B88. Use wrought copper or cast bronze fittings, soldered or threaded per the installation details. Use 95 percent tin and 5 percent antimony solder.
   2) Use a dielectric union wherever a copper-based metal (copper, brass, and bronze) is joined to an iron-based metal (iron, galvanized steel, and stainless steel).
   3) Low Density Polyethylene Hose:
      (a) Use pipe specifically intended for use as a flexible swing joint.
         (1) Inside Diameter: 0.490 inch +/- 0.010 inch.
         (2) Wall thickness: 0.100 inch +/- 0.010 inch.
         (3) Color: Black.
      (b) Use spiral barb fittings supplied by the same manufacturer as the hose.
   4) Threaded Pipe Assemblies: Use PVC Schedule 80 nipples and PVC Schedule 40 threaded fittings.
   5) Joint Sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

f. Thrust Blocks:
   1) Use thrust blocks on all gasketed mainline pipe and fittings and at dead ends, ells, tees, or changes of direction.
   2) Use 3,000 psi concrete.
   3) Use 2 mil thick plastic.
   4) Use No. 4 reinforcing bar wrapped or painted with asphalt tar based mastic coating.

g. Joint Restraint Harness:
   1) Use joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
   2) Use joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
   3) Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel.
   4) Use on pipe greater than or equal to 4-inch diameter or any diameter rubber gasketed pipe.

5. Mainline Components:
   a. Isolation Gate Valve Assembly: Acceptable manufacturers are American, Clow, Kennedy, or Mueller.
   b. Air-Vacuum Relief Valve Assembly: Provide a continuous acting combination air vacuum relief valve with an operating pressure rating of 150 PSI. Acceptable manufacturers are Bermad, Crispin, Fresno, or Waterman.
   c. Flow Sensor Assembly: Acceptable manufacturer is Data Industrial.

6. Sprinkler Irrigation Components:
    a. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over 3 inch depth of 3/4 inch gravel for each assembly. Acceptable manufacturer and model for remote control valve is Weathermatic. Acceptable manufacturer for valve box is Armor.
    b. Sprinkler Assembly: Acceptable manufacturer and model for pop-up spray sprinklers in turf is Rain Bird 1804-PRS-SAM. Acceptable manufacturer and model for pop-up spray sprinklers in shrubs is Rain Bird 1812. Acceptable manufacturer and models for pop-up rotary sprinklers are Hunter I-20 and I-25.
7. Drip Irrigation Components:
    a. Remote Control Valve (RCV) Assembly for Drip Laterals: As required by irrigation system design.
    b. Zone Control Valve Assembly: As required by irrigation system design.
    c. Drip Emitter Assembly:
        1) Use emitter devices as required by irrigation system design.
        2) Use flexible plastic distribution tubing to direct water from emitter outlet to emission point. Use distribution tubing compatible with emitters. Do not exceed five feet length between emitter and distribution tubing outlet. Use tubing stakes to anchor distribution tubing.
        3) Provide access sleeve for each multiple-outlet emitter located in shrub area.
    d. Flush Cap Assembly: As required by irrigation system design.
    e. Inline Drip Tubing:
        1) Tubing: Use UV resistant polyethylene drip tubing with integral pressure compensating drip emitters. Use emitters that are pressure compensating from 7 to 70 PSI. Use tubing with outside diameter of 0.67 inch, and inside diameter of 0.57 inch. Use fittings compatible with inline drip tubing.
        2) Blank Drip Tubing: Use UV resistant polyethylene blank drip tubing for exhaust manifold tubing. Use tubing with outside diameter of 0.67 inch, and inside diameter of 0.57 inch. Use fittings compatible with inline drip tubing. Use blank tubing from same manufacturer as Inline drip tubing.
        3) Air and Vacuum Relief Valve: Provide air and vacuum relief valve assembly on inline drip lateral per drawings and installation details. Use air and vacuum relief valve compatible with inline drip tubing.

H. Mulch:
1. Use one of the following:
    a. Ground or shredded bark.
    b. Chipped bark or wood.
2. Do not use:
    a. Pine needles.
    b. Peanut, pecan, or cocoa-bean shells.
    c. Peat moss.
    d. Rounded riverbed gravel.
    e. Crushed or chipped marble or granite.
    f. Nonwoven polypropylene or polyester fabric.
    g. Processed wood fiber.
    h. Other materials not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.

I. Edgings for Beds:
1. Use one of the following:
    a. Polyethylene plastic.
2. Do not use:
    a. Galvanized steel, painted.
    b. Other species not permitted by Campus Master Plan or accepted by College Facilities Grounds Shop.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide all elements required for finished and durable site surfaces, and outdoor improvements.

B. Provide exterior pavements and surfacing, as required by code, that are adequate in extent and sufficiently durable to accommodate without damage the types of traffic that can be reasonably anticipated for the facility type and intended user population.
   1. Roadways and Driveways: Provide paved surfaces as required for vehicular access to various functional areas requiring vehicular access, including parking areas, freight docks, loading and unloading zones, and main entrances to campus.
      a. Comply with recommendations of AASHTO "A Policy on Geometric Design of Highways and Streets".
      b. Minimum Widths: Traffic lanes not less than 11 ft wide.
      c. Maximum Slopes: 1:10.
      d. Curbs: Minimum 4 inch mountable curbs at all roadways and driveways.
      e. Gutters: Minimum 12 in width, designed in accordance with AASHTO recommendations, located on one side of all roadways and driveways.
      f. Traffic Lanes and Directional Markings: Permanent and highly visible, minimum width of 4 in.
   2. Parking Areas: Provide paved surfaces as required for vehicular parking.
      a. Minimum Width of Parking Spaces: 96 inches (8 feet) for compact vehicles; 108 inches (9 feet) for other vehicles.
      b. Bumpers or Wheelstops: Located and sized to prevent damage to fixed objects or excessive encroachment on pedestrian walkways.
      c. Space Markings: Permanent and highly visible, minimum width of 4 in.
      d. Parking Signage: As required by code.
   3. Walkways, Pedestrian Ramps, and Exterior Stairs: Provide paved surfaces as required for pedestrian movement on the site without damage to landscaping.
      a. Minimum Widths: Sized to allow comfortable two-way traffic.
         1) Main Entrance: 72 inches (6 feet).
         2) Secondary Entrances and Emergency Exits: 48 inches (4 feet).
         3) Major Routes: 60 inches (5 feet).
         4) Secondary Routes: 48 inches (4 feet).
      b. Handrails, Railings, or Protective Walls: Required when pedestrian walkway surfaces are more than 12 in above adjacent grade.
   4. Sports Surfacing: Provide smooth, seamless, and resilient surfacing for outdoor athletic activities not normally conducted on grass, including tennis and track and field events.
   5. Playground Surfacing: Provide smooth and resilient surfacing complying with CPSC Pub. No. 325 under playground equipment, including swings, climbing equipment, slides, and merry-go-rounds.

C. Provide all fixtures, equipment (other than that associated with services), and miscellaneous structures located out-of-doors that are required as a result of these and other requirements.

D. Provide landscaping over all areas of the site not finished with paving, surfacing, or buildings.
   1. Provide a permanently installed irrigation system.
   2. Provide a concealed irrigation system for all plantings that are not required to survive normal weather extremes without supplementary irrigation.
   3. Where a permanently installed irrigation system is not required; provide conveniently located and appropriately sized irrigation water connections for hose-and-sprinkler equipment provided by College Facilities Services Grounds Shop.

E. Irrigation Systems: Comply with CSRWD Standards (City of Colorado Springs Reclaimed Water Design Standards) for the design of all irrigation systems on the Colorado College Campus.
   1. Submit hydraulic calculations showing friction loss calculations from the point of connection to the most remote water emission device for the worst case spray sprinkler and rotary sprinkler laterals. List the highest and lowest sprinkler operating pressures on the lateral.
   2. Submit uniformity evaluation charts for each sprinkler/nozzle/spacing combination showing the scheduling coefficient for the critical 1, 5, 10 percent window size.

3. Submit control wire diagrams including sizing and calculations verifying that the control wire size is in accordance with valve manufacturer's printed recommendations.
4. Submit Peak Season Irrigation Schedule as required by the City of Colorado Springs. Precipitation rates must be calculated for each remote control valve. Typical product catalog precipitation rates for nozzles will not be accepted. Submit calculations to College Facilities Services Department if requested.

F. Sprinkler Layout Guidelines:
1. Use pop-up spray sprinklers on turf areas and annual planting beds. Use pop-up spray sprinklers in areas less than 30 feet in width or in areas, which are oddly shaped.
2. Use pop-up rotary sprinkles in turf areas. Use pop-up rotary sprinklers in areas greater than 30 feet in width.
3. Use a sprinkler nozzle and spacing combination such that the scheduling coefficient for every sprinkler lateral is between 1.1 and 1.2. If a maximum scheduling coefficient of 1.2 cannot be achieved, use a sprinkler nozzle and spacing combination to achieve the minimum scheduling coefficient possible.
4. Trim out all hardscape areas. Layout sprinklers to minimize overspray onto sidewalks, buildings, and attractions.
5. Spray sprinklers on an individual zone must have matched precipitation rate nozzles.
6. Nozzles for rotary sprinklers on an individual zone must approximate a uniform precipitation rate.
7. All sprinklers must show the intended sprinkler nozzle.

G. Drip Irrigation Layout Guidelines:
1. Use inline drip tubing products, installed beneath the landscape fabric on intensively planted shrub and perennial beds.
2. Use point source drip emitters on shrubs and trees that are planted in a nonlinear or random pattern or are not adequately dense for the use of inline drip tubing.

H. Provide other site construction elements required for a complete facility.

I. Where site improvements are integral with elements defined within another element group, meet requirements of both element groups.

J. In addition to the requirements of this Section, comply with all applicable requirements of General Colorado College Facility Design Guidelines.

3.02 AMENITY AND COMFORT CRITERIA

A. Accessibility:
1. Comply with ADA Standards for Accessible Design.
2. Parking: Provide no fewer accessible parking spaces than the number required under the ADA Standards for Accessible Design in each parking lot as approved by College Facilities Services.
3. Van Accessibility: Provide no fewer van accessible parking spaces than the number required under ADA Standards for Accessible Design in each parking area.
4. Pedestrian Ramps: Limit slope to maximum of 1:12, with minimum 5 x 5 foot landing at no more than 30 foot run.

B. Stair Comfort:
1. Steepness: Provide exterior stairs with risers of not more than 6.5 inches and treads sized so that twice the riser height plus the tread depth totals 24 to 25 inches.
2. Landings: Provide exterior stairs with maximum rise of not more than 8 ft between landings.

C. Noise Control:
1. Paving: Provide paving at parking lots, roadways, and driveways that minimizes noise from automobile tires due to rough surface texture and paving joints.

D. Ramp Comfort:
1. Pedestrian Ramps: Limit slope to maximum of 1:16 and rise to maximum of 24 in in any run.
2. Landings: Provide ramps with landings of not less than 8 ft in length.

E. Convenience:
   1. Irrigation Connections For College Facilities Services-Furnished Equipment: At intervals as required so that sprinklers can reach all areas to be watered, using hoses of not more than 100 feet in length.
   2. Irrigation Frequency: Maximum of once a day, per zone.
   3. Irrigation Control: Automatically controlled by local controller.
      a. Separate frequency, time, and duration settings for each zone.
      b. Different plant hydrozones on separate irrigation zones.
      c. Manual over-ride.
      d. Seasonal programs, minimum of 2.
      e. Easily programmable, for daily adjustment of zone settings.
      f. Rain sensor over-ride.
      g. Evapotranspiration gauge control, as required by College Facilities Services.
      h. Location of Controllers: As determined by College Facilities Services.
   4. Irrigation Remote Control Valves:
      a. Individual turf zones have a capacity for a maximum flow of 100 gpm.
      b. Individual drip zones have a capacity for a maximum flow of 20 gpm.
      c. 1 inch remote control valves must have a flow capacity between 0 to 25 gpm.
      d. 1-1/2 inch remote control valves must have a flow capacity between 26 to 50 gpm.
      e. 2 inch remote control valves must have a flow capacity between 51 to 100 gpm.
      f. Spray sprinklers and rotary sprinklers should be installed on separate remote control valves.
      g. Areas with different exposures, plant material, water use requirements, and active or passive uses must be on separate remote control valves. For example, turf in a parking island should be on a separate lateral from turf in a pedestrian area.
   5. Controller Stationing/Sequencing:
      a. Assign only one remote control valve per controller station.
      b. Assign station numbers in a logical manner to allow maintenance personnel to easily inspect the operation of the system on a regular basis.
   6. Irrigation Timing: Preset to hours between 11 pm and 8 am; adjustable.
   7. Water Use Monitoring: Provide a meter separate from building water supply meter.

F. Appearance:
   1. Pavements and Surfacing: Provide rigid surfaces that are smooth, consistent in color and finish, sloped and drained to avoid ponding, and neatly finished at edges.
      a. Vehicular Areas: Marked neatly to denote traffic lanes and parking spaces.
      b. Pedestrian Areas: Designed to contrast visually with vehicular areas.
      c. Athletic Areas: Color and texture in keeping with governing sports authority, with permanent game markings.
      d. Vehicular Paving at Parking Lots and Driveways: Design and construct paving to achieve plain, utilitarian appearance.
      e. Pedestrian Stairs at Grade Changes on Non-ADA Designated Walkways: Provide pedestrian walking surfaces that contrast with vehicular paving and achieve detailed, decorative appearance.
      f. Exterior Sports Surfacing at Tennis Courts and Running Tracks: Provide surfaces that are smooth and colorful and contrast with adjacent materials.
      g. Curbs and Gutters at Parking Lots and Driveways: Provide smooth, rounded shapes that contrast with roadway and walkway surfaces for maximum visibility.
      h. Railings, Handrails, Guardrails, and Protective Walls at Stairs and Elevated Plazas: Provide materials and finishes that are consistent with building exterior in appearance.
   2. Flagpoles: Flag(s) to be visible during daylight and nighttime hours by pedestrians and motorists.
   3. Plants: Selected, arranged, and planted for pleasant appearance throughout the year.
      a. Outdoor: Provide an attractively landscaped site that looks tidy during non-growing seasons.
      b. Provide a naturalized landscape using native trees, shrubs, and ground covers, with as little lawn as possible.
      c. Provide a neat and tidy urban landscape with ornamental feature plants.
      d. Pleasant appearing evergreens, perennial flowers, annual flower beds, ground covers, and shrub beds will be acceptable as approved by College Facilities Services.

e. Design the landscape to look complete within a year after planting and to remain of basically the same appearance indefinitely without significant pruning.
f. Native water plants should be planted in storm water retention pond areas for erosion control.

4. Plants in Beds: Bordered with permanent mulch, edging, or paving for tidy appearance.
5. Mulch: Use only types of pleasant appearance as approved by College Facilities Services.

G. Resilience: Provide exterior sports surfacing with inherent flexibility and resilience appropriate for the intended uses.
1. At Playground Equipment: Critical height of not less than 4 ft, when measured in accordance with ASTM F1292 in the Use Zones defined by ASTM F1487.

3.03 HEALTH AND SAFETY CRITERIA

A. Potable Water Contamination:
1. Prevent contamination of potable water supply by irrigation water with proper installation to avoid cross-connections, and proper maintenance for backflow preventers.

B. Safety:
1. Accidental Injury:
a. Do not locate irrigation equipment within the field of turf intended for foot traffic.
b. Plants Used to Inhibit Foot Traffic: Spiny leaves, such as on holly, may be used, but spines, like on spiny honey locust, may not.
2. Playground Equipment: Comply with ASTM F1487.
3. Pedestrian Surfaces:
a. Slip Resistance: Provide walking surfaces of exterior stairs, ramps, and walkways with a minimum static coefficient of friction of 0.80, measured in accordance with ASTM D2047.
b. Stairs:
1) Risers: Closed.
2) Treads: Maximum bevel or radius on leading edge of 1/2 inch in.
c. Guards, Guardrails, or Protective Walls:
1) Openings: No openings large enough for a sphere with a diameter of 4 in to pass through.
2) Minimum Height: In accordance with code, but not less than 42 in above leading edge of treads or walking surface.
4. Vehicular Areas:
a. Traffic Signs and Signals: Provide highly visible signs and signals as required to regulate traffic for safety and convenience.
1) Comply with requirements of the State Department of Transportation for placement and design.

C. Pollution Control: Comply with 40 CFR 280.70 and applicable state and local regulations for underground storage tank removal, including all responsibilities of the College Facilities Services, including emptying, closure, and removal of tank, and removal of all contaminated soil found.
1. Surplus tank contents, including petroleum products and toxic liquids, may not be disposed of on site.
2. College Facilities Services will accept surplus tank contents if delivered in containers to location in same city to be determined.

3.04 STRUCTURAL CRITERIA

A. Exterior Stairs, Ramps, and Elevated Walkways: Capable of supporting loads in excess of those required by code, as follows:
1. Live Load: Minimum 150 psf.
2. Concentrated Load: Minimum 400 pounds at any point.

B. Exterior Handrails, Guards, and Guardrails: Capable of resisting forces in excess of those required by code, as follows:
1. Uniform Load: Minimum 50 lb/ft applied in any direction at the top.
2. Concentrated Load: Minimum 200 pounds applied in any direction at any point along the top.
3. Normal Load to Intermediate Rails or Guard: Minimum 50 pounds horizontally applied to area of not more than 1 foot square.

C. Bicycle Racks: Constructed of materials strong enough to resist forces generated by attempted forcible removal of bicycle.
   1. Use only Campus standard bicycle racks.

D. Supports For Vines and Other Climbing Plants: Designed to structural requirements of building elements, unless designed for immediate breakaway under weight of a small child.

E. Flagpoles: Design in accordance with NAAMM FP 1001 to resist the combined wind loads on pole and flag(s) at code design wind load, assuming that flag(s) will be removed during winds of over 50 mph.

F. Underground Structures: Comply with the requirements of the code.
   1. Campus Utility Tunnels: Design vehicular tunnel crossings to support fire trucks, concrete trucks, and loaded dump trucks without having to place steel crossing plates for additional support.

3.05 DURABILITY CRITERIA

A. Service Life Span:
   1. Paved Surfaces: 20 years, under normally anticipatable usage.
   2. Minor Site Structures: Same as for equivalent building elements.
   3. Other Fixed Site Improvements: 15 years under normal use and weather.
   4. Athletic Nets: 5 years under continuous weather exposure.

B. Traffic Resistance: Provide surfacings that are designed and engineered to withstand the types and intensity of traffic anticipated for the facility size and type.
   1. Pavements and Surfacing: To accommodate traffic as follows, based on procedures in AASHTO GDPS and GDPS3-V2, Guide for Design of Pavement Structures:
      a. Category A: Parking areas and access lanes for autos, pickups, and panel trucks only.
      b. Category A1: Truck access lanes for average daily truck traffic of 1 vehicle with 6 wheels or more.
      c. Category B: Parking entrance areas and major service lanes, with average daily traffic of 25 vehicles with 6 wheels or more.
      d. Category B1: Parking areas and interior traffic lanes for buses or trucks, with average daily traffic of up to 25 vehicles.
      e. Category C: Parking entrances and exterior traffic lanes for buses or light trucks, with average daily traffic of up to 25 vehicles.
      f. Category D: Parking entrances and exterior traffic lanes for heavy trucks, with average daily traffic of up to 25 vehicles.
   2. Turf: Do not use turf for regularly used vehicular or pedestrian traffic surfaces, except where turf is specifically required for foot traffic use (such as playfields).
   3. Turf for Functional Traffic Surfaces: Grass type selected for best resistance to wear; College Facilities Services understands turf specifically required for traffic purposes may be subject to unavoidable damage that may result in the need to replace sod.
      a. Contractors are asked to mark and avoid sprinkler heads; and use proper turf tires, ground cover mats, or plywood to protect turf during occasional work activities to prevent or minimize turf damage.

C. Weather Resistance:
   1. Site Fixtures and Equipment: Same as specified for components of exterior shell in Exterior Closure Requirements Section B20, Colorado College Facility Design Guidelines.
   2. Underground Irrigation Piping and Equipment: Comply with requirements of Plumbing System Requirements Section D20, and General Colorado College Facility Design Guidelines for water and drainage systems.
      a. Prevent freezing of water-containing components.
   3. Mulch: Where soil would otherwise be exposed around individual plants, cover soil with mulch that allows penetration of precipitation but minimizes evaporation; type of mulch coordinated with erosion resistance requirements as approved by College Facilities Services.

4. Plants: It is understood that ultimate survival of plants will depend on weather conditions as well as maintenance; however, the Architect/Engineer is responsible for specifying plants that will survive under the specified conditions when maintained according to the procedures specified by the Architect/Engineer.
    a. Trees and Woody Shrubs: Sustainable without supplemental irrigation.
    b. Soil: Suitable for growing the plants provided, with adequate nutrients for the first year of growth, based on recommendations of established authorities.
    c. The Architect/Engineer shall provide maintenance recommendations for all plants, including irrigation, during the initial establishment period.
    d. The landscape contractor shall provide maintenance oversight for all plants, including irrigation, during the first year after completion.
    e. At the end of one year after completion, if any plants are dead, dying, or wilting, the landscape contractor shall replace them with other plants of better weather resistance, care for the replacement plants during their establishment period, and furnish maintenance data to the College Facilities Services Grounds Shop.

D. Insect and Disease Resistance: Avoid the use of plants and turf that are known to be subject to insect damage or disease.

E. Wear Resistance:
1. Flagpoles: Protect flagpole finish from damage caused by windblown halyards and flagsnaps.

F. Accidental Damage:
1. Plants in Beds: Where planting beds adjoin turf areas, edge of turf shaped for ease of mowing with motorized equipment without damage to plants in beds.
2. Street Trees in Pavement Wells: Root area protected from mechanical damage.
3. Irrigation Equipment: Designed and located to prevent damage by normal user traffic and plant maintenance equipment.
4. Irrigation Equipment: Concealed in ground or out of way of landscape maintenance equipment.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Irrigation Water Source: Potable water source is same as the building supply, where possible, or as otherwise directed by College Facilities Services. Non-potable water source is the Colorado Springs Utilities main line on the west side of the Mesa Road Bridge.

B. Irrigation Capacity: Sufficient to maintain landscape plantings with maximum contribution by precipitation equal to the Precipitation Allowance (PA).
1. Precipitation Allowance (PA): 25 percent of normal rainfall, maximum, in any month.
2. Application Rate: Enough water to soak soil to depth of 6-8 inches at each application; intermittent applications if necessary to avoid saturation to runoff; adjustable for less water on damp soil.
3. Irrigation Efficiency (IE): 55 percent, minimum, of applied water actually reaching plants, under normal wind conditions.
4. Locations of Irrigation Equipment: To provide complete coverage of landscaped area requiring irrigation, without overspray or runoff onto pavements, buildings, or unirrigated planted areas.
5. Variation in Application Rate at Individual Locations: Not more than 50 percent.
6. Sloped Areas: Prevent drainage out of lower outlets.
7. Operating Pressure: As low as possible as is compatible with results.

C. Irrigation Installation:
1. Minimum cover (distance from top of pipe or control wire to finish grade):
    a. 36 inch minimum over mainline pipe.
    b. 18 inch over lateral pipe.
    c. 18 inch over control wire.
    d. 12 inch over lateral pipe to pop-up spray sprinklers.
    e. 12 inch over lateral pipe to rotary sprinklers.
2. Maintain at least 15 feet clearance from the centerline of any tree.
3. PVC lateral pipes may be pulled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling. Minimum burial depths equals' minimum cover listed above.
4. Backfill only after lines have been reviewed and tested.

5. Enclose pipe and wiring beneath roadways, walks, curbs, and other hardscapes in sleeves. Use of water for compaction around sleeves ("puddling") will not be permitted.
6. Where utilities conflict with irrigation trenching and pipe work, contact College Facilities Services Grounds Shop for trench depth adjustments.

D. Water Conservation: See General Colorado College Facility Design Guidelines for basic water conservation requirements.
1. Despite the fact that a permanent irrigation system is not required for some low water plant species and native plants, design to minimize the potential water usage by selection of appropriate plants.
2. Coordinate irrigation design with plant selection requirements.
3. Provide irrigation for native plants until established, and as determined by College Facilities Services Grounds Shop.
4. Maximum Turf Area: A percentage of land area of site not occupied by buildings or pavements as determined by Campus Master Plan and College Facilities Services.
5. Hydrozones: Locate plants of different water needs in groups for ease of water application.
6. Rain Sensors: To prevent operation in the rain.
7. Evapotranspiration Gage(s): To automatically adjust duration of application in accordance with recent weather conditions.
8. Maximum Water Allowance: As required by code.
9. Maximum Irrigation Water Usage: Not more than Potential Evapotranspiration (PET) times Maximum Plant Factor (MPF) of 0.5 times Irrigation Efficiency (IE), less Precipitation Allowance (PA); in inches per year; excluding areas exempt from water conservation requirements.
10. Potential Water Usage (PWU): Estimated Evapotranspiration (EET) times Irrigation Efficiency (IE), in inches per year; areas of planting exempt from water conservation requirements calculated separately.
11. Estimated Evapotranspiration (EET): Equal to Potential Evapotranspiration (PET) times Average Plant Factor (APF), in inches per year.
12. Potential Evapotranspiration (PET): Inches per month for each month of year, for reference crop of 4-inch high well-watered grass, as determined by government or educational agricultural or irrigation information agency for actual project location.
13. Average Plant Factor (APF): Average of plant factor of each different hydrozone based on relative areas of each, using plant factors as follows (or otherwise documented by research as relative to evapotranspiration of reference crop of 4-inch high well-watered grass):
    a. Native Plants: Defined as plants that grow in the wild in natural local climate, or other plants and turf of equivalent climatic endurance requiring minimal or no supplementary irrigation; plant factor of 0 (zero) as determined by College Facilities Services Grounds Shop.
    b. Low Water-Using Plants: Plants proven to be able to survive significant periods without water in the local climate without degradation of appearance; 0.3.
    c. Warm-Season Grasses: 0.6.
    d. Cool-Season Grasses: 0.8.
    e. Moderate Water-Using Plants: Plants proven to be able to survive periods without water in the local climate but with significant degradation of appearance; 0.8.
    f. Flowering Plants, When in Flower: 1.20.
    g. Area Within Drip Line of Trees: 1.0; regardless of other type of planting.
    h. All Other Plants: 1.0.
14. Irrigation Efficiency (IE): As calculated or designed for actual system provided.
15. Irrigation Efficiency (IE): For purposes of calculation, assume the use of overhead sprinklers and hoses at efficiency of 0.50 (50 percent).
16. Precipitation Allowance (PA): See Irrigation Capacity, above.

E. Ease of Maintenance:
1. Turf: Do not use areas of turf that cannot be mowed with motorized equipment.
2. Plants: Arranged for ease of access for weeding, mulching, and watering.
3. Shrubs and Woody Plants: Do not use plants that require routine annual or seasonal pruning without approval of College Facilities Services Grounds Shop.
4. Non-Woody Plants: Do not use plants that are not perennial.
5. Plants in Planters: Permanent irrigation where possible, and drainage system.

6. Irrigation System Tools and Spare Parts: Provide the following:
    a. Two operating keys for each type of manually operated valve.
    b. Two of each servicing wrench or tool needed for complete access, adjustment and repair of all rotary sprinklers.
    c. Two quick coupling keys, each with attached hose swivel ell for operation of the quick coupling valves.

END OF SECTION

G30

SITE UTILITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide the following site services:
   1. Water Supply: Means of supplying, collecting, storing, and distributing water for all purposes required in buildings and on site. See Section D20 for additional requirements.
   2. Sanitary Sewer: Means of removing, treating, storing, and recycling liquid waste generated in buildings on site. See Section D20 for additional requirements.
   3. Storm Sewer: Means of removing, controlling, and storing rainwater runoff from buildings and site areas. See Section D20 for additional requirements.
   4. Electrical Power: Adequate supply of power for project functions. See Section D50 for additional requirements.
   5. HTHW Supply: Means of supplying and distributing heating hot water at temperatures up to 380 degrees F. and up to 200 psi pressure for building heat, domestic hot water and steam supply. See Section D30 for additional requirements.
   6. Chilled Water Supply: Means of supplying and distributing chilled water for building cooling water. See Section D30 for additional requirements.

B. Products: Where specific products are required or allowed, use products complying with the additional requirements specified elsewhere.

1.02 REFERENCE STANDARDS

A. Specify conformance to reference standard date of issue current on date of Construction Documents, except where a specific date is established by applicable code.

B. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

D. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

E. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

1.03 FIELD CONDITIONS

A. The following existing elements must be preserved:
   1. Historic decorative metal fencing and stone retaining walls.
   2. Significant trees should be protected by fencing outside drip lines during construction.
   3. Campus standard building, ADA, or wayfinding signage should be carefully removed without damage, stored, and replaced after construction is completed.
   4. Campus standard seating, light pole fixtures, and emergency phone pole equipment should be carefully removed without any damage, stored, and replaced after construction is completed.

B. The following existing elements must be removed to accomplish new construction:
   1. Underground petroleum storage tank(s).
   2. Underground tunnels or utilities.
   3. Statuary art work.
   4. Campus standard building, ADA, or wayfinding signage.
   5. Campus standard seating, light pole fixtures, and emergency phone equipment.

PART 2 PRODUCTS

2.01 WATER SUPPLY

A. Fire and Domestic Water Service Lines:
   1. Use one or more of the following:
      a. Copper for domestic water 2 inch & under diameter pipe.
      b. Ductile Iron for domestic water over 2 inch diameter pipe.
      c. Ductile Iron for all Fire lines.
   2. Do not use:
      a. High density polyethylene pipe and compression fittings.
      b. PVC pipe and fittings.

B. Non-Potable Water Main Lines:
   1. Use one or more of the following:
      a. High density polyethylene pipe (HDPE).
      b. PVC pipe and fittings.
   2. Do not use:
      a. ABS pipe and fittings.

2.02 SANITARY SEWER

A. Pipe:
   1. Use one or more of the following:
      a. Cast iron soil pipe and fittings, hub and spigot.
      b. Cast iron soil pipe and fittings, hubless.
      c. ABS pipe and fittings.
      d. PVC pipe and fittings.
      e. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Concrete pipe.
      b. Clay pipe.
      c. Copper tube or pipe.
      d. Systems not accepted by College Facilities Services Department.

B. Manholes:
   1. Use one or more of the following:
      a. Prefabricated concrete.
      b. Poured-in-place concrete.
      c. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Systems not accepted by College Facilities Services Department.

C. Sump Pumps:
   1. Use one or more of the following:
      a. Submersible pumps.
      b. Sewage pumps.
      c. Grinder pumps.
      d. Pedestal pumps.
      e. Other systems acceptable to College Facilities Services Department.
   2. Do not use:
      a. Systems not accepted by College Facilities Services Department.

2.03 STORM SEWER

A. Pipe:
   1. Use one or more of the following:
      a. Cast iron soil pipe and fittings, hub and spigot.
      b. Cast iron soil pipe and fittings, hubless.
      c. Concrete pipe.

d. ABS pipe and fittings.
e. PVC pipe and fittings.
f. Other systems acceptable to College Facilities Services Department.

2. Do not use:
a. Clay pipe.
b. Copper tube or pipe.
c. Systems not accepted by College Facilities Services Department.

B. Culverts:
1. Use one or more of the following:
a. Concrete pipes.
b. Galvanized corrugated steel pipe.
c. Aluminum coated steel pipe.
d. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

C. Storm Drains:
1. Use one or more of the following:
a. Cast iron.
b. Wrought iron.
c. Plastic.
d. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Stainless steel.
b. Bronze.
c. Systems not accepted by College Facilities Services Department.

D. Lift Stations:
1. Use one or more of the following:
a. Prefabricated.
b. Cast-in-place concrete.
c. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

E. Manholes:
1. Use one or more of the following:
a. Prefabricated concrete.
b. Cast-in-place concrete.
c. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

F. Sump Pumps:
1. Use one or more of the following:
a. Submersible pumps.
b. Sewage pumps.
c. Grinder pumps.
d. Pedestal pumps.
e. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

2.04 ELECTRICAL POWER

A. Transformers:
1. Use one or more of the following:
a. Dry-type transformers (College-owned).
b. Oil-insulated transformers (City-owned).

c. Pad mounted transformers (depends on location).
d. Underground transformer vaults (depends on location).

2. Do not use:
a. Autotransformers.
b. Liquid-filled transformers.
c. Pole mounted transformers.
d. Systems not accepted by College Facilities Services Department.

B. Utility Poles: Not permitted; all power lines are required to be underground.

C. Conductors:
1. Use one or more of the following:
a. Solid copper.
b. Copper-clad aluminum.
c. Aluminum.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

D. Conduits:
1. Use one or more of the following:
a. Nonmetallic conduit with wires for direct burial.
b. Nonmetallic conduit with wires to be encased in concrete.
c. Intermediate metal conduit.
d. Rigid metal conduit.
e. Rigid nonmetallic conduit.
f. Electrical metallic tubing.
g. Other systems acceptable to College Facilities Services Department.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

2.05 HIGH TEMPERATURE HOT WATER PIPING (HTHW)

A. HTHW Above Grade Hydronic Piping In Tunnel Systems:
1. Use all of the following:
a. Steel Pipe, 2 inch and Smaller: ASTM A53/A53M or A106/A106M, seamless, Grade B, Schedule 80, black steel.
b. Steel Pipe, 2-1/2 inch and Larger Through 12 inch: ASTM A53/A53M or A106/A106M, seamless, Grade B, Schedule 40, black steel.
c. Joints: Butt-welded for pipe 2-1/2 inch and larger; socket welded for pipes 2 inch and smaller.
d. Wrought-Steel Fittings: ASME B16.9 and ASTM A234/A234M, Grade B; wall thickness to match adjoining pipe; all elbows long radius.
e. Socket welded fittings.
f. Forged Steel Threaded Fittings: 3000 psig class.
g. Forged-Steel Flanges and Flanged Fittings: Class 300, weld-neck type.
h. Valves: Gate, check, and triple offset rotary type.
i. Insulated piping and fittings with high density mineral wool.
2. Do not use:
a. Systems not accepted by College Facilities Services Department.

B. HTHW Pre-fabricated Conduit Piping System (Direct Buried ‘Class A’):
1. Use all of the following:
a. Inner Steel Pipe: ASTM A53/A53M or A106/A106M, seamless, Grade B, Schedule 80, black steel.
b. Pipe Fittings: Welded fittings to match adjoining pipe, unless otherwise approved by College Facilities Services Department.
c. Manufactured, pre-insulated, pre-fabricated conduit piping system by Perma-Pipe, Thermacor or Rovanco.
d. Piping System: Carrier pipe, inner conduit metal casing, and non-metallic outer jacket.
e. Factory Applied Pipe Insulation: Mineral-fiber, ASM C547, Type I, molded, glass fiber with jacket.

2. Do not use:
    a. Systems not accepted by College Facilities Services Department.

2.06 CHILLED WATER AND LOW TEMPERATURE HOT WATER PIPING

A. Chilled Water and Low Temperature Hot Water “Direct Buried “Distribution Piping Systems:
    1. Use all of the following:
        a. High density polyethylene for Chilled Water Supply and Return Piping (Direct Buried System).
        b. Steel Pipe, 2 inch and Smaller: Schedule 80 black steel, ASTM A53/A53M, Grade B, Type E electric resistance welded or S (seamless); or ASTM A106/A106M Grade B.
        c. Steel Pipe 2-1/2 inch and Larger: Schedule 40 black steel, ASTM A53/A53M, Grade B, Type E electric resistance welded or S (seamless).
        d. Fittings and Valves: Welded joints only.
        e. Acceptable Pre-fabricated Insulated Piping Manufacturers: Thermacor Process Inc., Perma-Pipe, or Rovanco.
        f. Pre-insulated Piping System: Carrier pipe, prefabricated fittings, foam insulation, jacket, joint closures, bolstering material and anchors.
    2. Do not use:
        a. Systems not accepted by College Facilities Services Department.

B. Chilled Water Above Grade Hydronic Piping In Tunnel Systems:
    1. Use all of the following:
        a. Steel Pipe, 2 inch and Smaller: ASTM A53/A53M or A106/A106M, seamless, Grade B, Schedule 40, black steel.
        b. Steel Pipe, 2-1/2 inch and Larger Through 12 inch: ASTM A53/A53M or A106/A106M, seamless, Grade B, Schedule 40, black steel.
        c. Joints: Butt-welded for pipe 2-1/2 inch and larger; socket welded for pipes 2 inch and smaller.
        d. Wrought-Steel Fittings: ASME B16.9; ASTM A234/A234M, Grade B; wall thickness to match adjoining pipe; all elbows long radius.
        e. Welded butt fittings.
        f. Steel Threaded Fittings: 2 inch and smaller.
        g. Steel Flanges and Flanged Fittings: Class 300, weld-neck type.
        h. Valves: Gate, check, and triple offset rotary type.
        i. Insulated piping and fittings with high density mineral wool with canvas cover.
    2. Do not use:
        a. Systems not accepted by College Facilities Services Department.

PART 3 DESIGN CRITERIA

3.01 BASIC FUNCTION

A. Provide a stand-alone storm sewer to meet project storm drainage requirements.
    1. Type of Drainage: Gravity drain connected to the public utility system.
    2. Minimum Pipe Size: 4 inches in diameter.
    3. Pipe Slope: 1/8 inch per foot.
    4. Maximum Manhole Spacing: 300 feet.

B. Provide electrical power supply and distribution elements.

C. Where site services elements must also function as elements defined within another element group, meet requirements of both element groups.

D. In addition to the requirements of this Section, comply with all applicable requirements of General Colorado College Facility Design Guidelines, and Section G20 - Site Improvements.

3.02 AMENITY AND COMFORT CRITERIA

A. Leakage: Provide distribution systems which are leak-free.

B. Accessibility: Provide clearances around components that are adequate for service and use.

C. Odor: Connections between storm water and sanitary sewer not permitted.

D. Appearance:
   1. Storm Sewer: Provide decorative storm grates with painted black finish.
      a. Provide decorative grates in the following areas:
         1) Courtyards and plazas.
         2) Gardens.
         3) Front entrances.
         4) Perimeter of planters.
         5) Edge of flower beds.
         6) Around trees in finished areas.
   2. Electrical:
      a. Provide only underground electrical power distribution with pad mounted transformers.

3.03 HEALTH AND SAFETY CRITERIA

A. Safety Hazards: Avoid safety hazards wherever possible; where services must involve flammable materials or hazardous operations, comply with code and the following:
   1. Slipping: Provide storm grates with a non-slip surfaces and perforations sized to safely handle pedestrian traffic with smaller shoe heels.
   2. Fire Source: Provide site electrical elements which are incombustible.

B. Unauthorized Access: Provide locking devices to stop unauthorized access.

C. Excess Pressure: Design pressurized components to withstand operational pressures without failure and to relieve or reduce excessive pressure to prevent failure.

D. Electrical Shock: Isolate electrical conductors from personnel.
   1. Provide a means of disconnecting power at each piece of equipment.
   2. Provide a means of disconnecting power at each lift station.
   3. Provide a means of disconnecting power at each sump pump.

E. Accidental Explosion: Provide equipment designed to withstand electromotive forces without catastrophic failure.

F. Misuse: Minimize misuse that could result in damage to property, injury, or loss of life.

G. Hazardous Materials: Piping carrying flammable liquids and toxic materials clearly labeled.

H. Vermin Resistance: Use components that are resistant to the entry of rodents and insects.

3.04 STRUCTURAL CRITERIA

A. Concealed or Buried Piping and Components: Design cover or concealment so that they are not subjected to damaging stresses due to applied loads.

B. Supports for Piping and Components: Support piping and components using the following:
   1. Supports that allow movement of the pipe without undue stress on the piping, tubes, fittings, components, or foundations.

C. Structural Design of Components and Their Supports: In accordance with code.
   1. Safety Factor for Component Structural Elements: Two; based on weight of component.
   2. Anchors: Securely and positively attach piping to supports.
   3. Provide storm grates with the strength to withstand repetitive loading without damage or undue wear.
   4. Provide storm grates with the strength to withstand concentrated loads up to 2000 psig.

D. Seismic Protection:
   1. Provide seismic supports in compliance with local code requirements.

3.05 DURABILITY CRITERIA

A. Service Life Span: Same as the service life of the building, except as follows:
   1. Life Span: Provide a sanitary sewer which will last a minimum of 50 years in service without major repairs or operating expense.

2. Life Span: Provide a storm sewer which will last a minimum of 50 years in service without major repairs or operating expense.
3. Life Span: Provide an electrical power system which will last a minimum of 50 years in service without major repairs or operating expense.
4. Piping: Same as service life of building specified in Colorado College Facility Design Guidelines.
5. Piping and Components Permanently Installed Underground or Encased in Concrete: Same as service life of building specified in Colorado College Facility Design Guidelines.
6. Shut-Off Valves and Similar Components: Same as building service life specified in Colorado College Facility Design Guidelines.
7. Hydrants: Same as building service life specified in Colorado College Facility Design Guidelines.
8. Electrical Equipment: Minimum of 35 years without failure.

B. Corrosion Resistance: Prevent corrosion by using corrosion-resistant materials, by preventing galvanic action, by preventing contact between metals and concrete and masonry, and by preventing condensation on metals.
1. Sanitary Sewers: Provide internal coatings on concrete structures to protect against microbiologically influenced corrosion.
2. Electrical Conduits: Provide buried conduits which are resistant to corrosion.
3. Metals Considered Corrosion-Resistant: Aluminum, stainless steel, brass, bronze, cast iron, ductile iron, malleable iron, hot-dipped galvanized steel, chrome-plated steel, cadmium-plated steel, and steel coated with high-build epoxy or coal tar-based paint.
4. Underground Elements: Provide supplementary protection for underground metal pipes and tanks, sufficient to prevent corrosion completely, for the service life of the element without maintenance.
    a. 3 inches of concrete cover is considered to be permanent protection.
    b. Bituminous or other waterproof coating or wrapping is considered permanent protection unless cathodic protection is required and unless underground element is subject to movement due to structural loads or thermal expansion or contraction.
    c. Provide cathodic protection if any of the following is true; coatings or wrappings will not be considered sufficient protection for elements falling under these criteria:
        1) Metal elements are submerged or buried in a soil environment known to cause corrosion on similar nearby structures.
        2) Metal elements are submerged and buried in a soil environment in which stray DC electrical currents are present.
        3) Metal piping carrying petroleum products or other hazardous or toxic materials is buried or otherwise installed without means of visual observation of entire exterior surface of piping.
        4) Metal tank holding petroleum products or other hazardous or toxic materials is buried or otherwise installed without means of visual observation of entire exterior surface of tank.

C. Resistance to Accidental Damage and Abuse:
1. Provide barriers or protected locations for services, to prevent damage due to vehicular traffic.
2. Buried Components: Minimum of 18 inches below surface of ground.
3. Underground Piping: Watertight and root proof.

D. Provide storm grates which resist corrosion in all areas.

E. Vandalism: Provide tamper-resistant anchors on trench drain gratings.

F. Flood: Provide a storm sewer which diverts storm water safely away from the building. Provide structures which channel drainage from roads.

3.06 OPERATION AND MAINTENANCE CRITERIA

A. Capacity:
1. Water Supply, Sanitary Sewer, and Storm Sewer: As required by code and as specified in Section D20.
2. Heating, Cooling, and Ventilating: Provide site services sufficient to maintain interior environment within ranges specified in Colorado College Facility Design Guidelines.
3. Fire Suppression: As required by code and as specified in Section D40.

4. Electrical Power: As required by code.
    a. Transformer Ratings:
        1) Primary Voltage/Phase/Frequency: 12,470 volt/3 phase/60 Hz.
        2) Secondary Voltage/Phase/Frequency: 480 volt/3 phase/60 Hz.
        3) Efficiency: 99 percent.

B. Ease of Use: Provide easy access to and working clearances around system components.

C. Minimization of Misuse: Provide locking devices to stop unauthorized access.

D. Ease of Cleaning: Provide electrical distribution elements with removable access panels to allow cleaning.

E. Ease of Maintenance:
1. Non-metallic, Buried Piping: Include 18 gage copper tracer wire buried with pipe to allow locating and detecting piping location.
2. Piping: Provide means of isolating portions of piping system, so that small portions may be shut down leaving the remainder in operation, by using isolation valves located so that drainage of the entire system is not required for repair.
3. Sanitary Sewers:
    a. Maximum Manhole Spacing: 400 feet.
    b. Maximum Cleanout Spacing: 100 feet.
    c. Replacement Field Capacity: 100 percent of original system capacity.
4. Storm Sewers:
    a. Maximum Cleanout Spacing: 100 feet.
    b. Ease of Repair: Provide trench drains with replaceable covers or grates.
5. Electrical Distribution: Provide electrical distribution elements which are modular in design.

F. Ease of Service: Provide a shutoff valve at the utility service main and the service entry point.

G. Ease of Repair: Provide easy access and working clearances to and around system components.

H. Provision for Change and Future Capacity:
1. Provide electrical equipment which can be modified to increase service capacity in the future.

I. Maintenance Service: Maintain services as specified in Design Process and Submittal Requirements, including periodic inspections, routine maintenance recommended by manufacturers, and repair and replacement of defective elements; maintenance is required only for systems so specified.

END OF SECTION