GENERAL BUILDING

INTENTIONS
The following guidelines within this Section are meant to generally apply to all new construction (including entire new buildings as well as remodels or additions to existing buildings) on the University of California at Davis (UCD) Campus. However, any projects, due to specific project program limitations, may not be able to incorporate all of the general guidelines as listed below. Any questions as to applicability of these guidelines should be directed to the University’s Representative for clarification.

DISABLED ACCESS
Provide for disabled access to all buildings as per the requirements of CCR Title 24 and the Americans with Disabilities Act of 1990 (ADA) accessibility guidelines, using the most stringent where the two conflict.

ACOUSTICS
All plumbing penetrations (bathroom, hydronic, etc.) in walls must be caulked airtight using specified acoustical caulk.

Where recessed fixtures of any type are installed, (e.g., medicine cabinets, fire extinguishers, electric distribution panels, recessed water fountain, recessed bookcases, etc.) ensure that required acoustic wall construction extends behind these recessed elements.

Installation of noisemaking equipment (such as telephones, water fountains, etc.) is not allowed on walls of rooms requiring acoustic protection.

Use surface mounted rather than recessed lighting fixtures and fans, etc. at ceilings of rooms requiring acoustical protection in order to minimize sound transfer.

Space doors to rooms requiring acoustical protection so that neighboring rooms do not have directly adjoining doors, and so that doors on opposite sides of corridors do not directly face each other. Stagger all doors. Do not place any doors to rooms requiring acoustical protection opposite stairwell or bathroom doors.

Provide a maximum gap of 1/2 inch at all door bottoms (less when possible).

Do not place bathrooms (public or private) or student lounges over rooms requiring acoustical protection (especially rooms having non-carpeted floors).

Separate studs, with a structural, in-wall air gap, must isolate the jamb of all heavily used corridor doors from any adjacent rooms requiring acoustical isolation.
Mechanical equipment in spaces above or below rooms requiring acoustic isolation must be vibration isolated, including piping and conduits, from walls, floors and ceilings.

**HUMAN FACTORS**
Buildings on campus should be designed with awareness and sensitivity for human interaction with the built environment. Design Professionals are to consider scale, way-finding, and adequate clearances.

Stationary workstations in the office/laboratory setting should provide adequate surfaces for ergonomic arrangement of the computer keyboard/pointing device, monitor, and document/work holders. Follow good ergonomic principles providing height adjustable work surfaces, openings adequate for leg and knee clearances and sufficient overhead space to allow adjustments to vertical equipment placement. In particular care shall be given when designing fixed workstations for public contract work activities, such as cashiering, customer service counter, and pharmacy. These workstations shall be less than 30 inches wide and adjustable for either seated or standing work. The BSR/HFES100 Draft Standard for Trial Use, “Human Factors Engineering of Computer Workstations” or ANSI/HFS100-1988 “American National Standard for Human Factors Engineering of Visual Display Terminal Workstations” may be of value to the Design Professional.

**CUSTODIAL SPACES**
Custodial Equipment Rooms shall be strategically located on all floors throughout the building for the storage of custodial cleaning equipment. Locate to avoid moving equipment long distances. Minimum size: 55 sq. ft. provide one room per 20,000 gross sq. ft. Typical equipment and sizes are:

1. Mopping cart - 2 feet by 6 feet
2. Trash cart (6 bushel) - 2 feet by 3 feet
3. Vacuum; carpet (upright) - 3 feet by 1 foot
4. Floor machine (buffer) - 2 feet by 4 feet+

Custodial Wet Closets shall be strategically located on all floors throughout the building; they may be designed in conjunction with Custodial Equipment Rooms and should contain the following: (minimum size: 60 sq. ft.)

1. 32-inch by 32-inch or 30-inch by 24-inch floor basin with approximately 4-inch curb height.
2. Hot and cold water outlet with attached hose (and wall clip) for filling buckets, etc.
3. Three or more dry mop and dust mop hooks or clips on wall away from basin.
4. Three or more wet mop hooks or clips arranged to permit dripping of wet mops into basin.
5. Pad/brush holder.
6. Step ladder - 1 foot by 2 feet.
7. Vacuum, wet or dry - 2 feet by 3 feet.
8. Shelving - 1 foot deep by at least 15 lineal feet of adjustable shelving.
9. Electric receptacle, grounding type located approximately 2 feet above the floor and near the corridor door.
10. **Mop Rack.** Rack is fabricated of a one-piece channel of No. 20 gauge, type 304L, 18-8 Alloy stainless steel with horizontal edges returning 1/2 inch to the wall. Surface of rack is polished to a No. 4 satin finish. Mop holders are riveted to rack at 10-inch intervals. A pivoting serrate runner cam holds in fixed position. Mounting suggestion - 70 inches from top of finished floor to bottom of rack.

Custodial Storage Rooms shall be one room per building for bulk storage of custodial supplies, may require limited shelving, and shall be near the loading dock and an elevator. Minimum size: 100 sq. ft.

Additional requirements for custodial spaces are as follows:

1. Doors shall swing out and shall be large enough to permit free movement of boxes and equipment.
2. Custodial Wet Closets shall have exposed concrete or painted drywall ceiling, hardened smooth concrete floor, and washable hard smooth finish on concrete block walls. Provide glazed tile walls at basin.
3. Finishes in other custodial spaces shall be similar to those for Custodial Wet Closets.
4. Provide adequate ventilation.
5. Lighting shall meet Illuminating Engineering Society of North America (IES) guidelines with no exposed lamps. No rooms shall contain telephone switchgear, elevator panels, electrical panels, metering devices or similar equipment.

**GENERAL STRUCTURAL REQUIREMENTS**

Building floor and roof loads shall be designed to exceed code minimums. Verify with the University’s Representative for specific design criteria.

**GENERAL MECHANICAL REQUIREMENTS**

Heating, Ventilation, and Air Conditioning (HVAC) for offices and classrooms should be given careful consideration for providing for human comfort levels. The following design criteria for HVAC apply:

1. **General**
   a. The ventilation system shall provide a sufficient volume of outdoor air to maintain the occupant level of the room within 15 degrees F of outside air temperature under design cooling conditions.
   b. Unoccupied high bay areas may be at warmer temperatures.
2. **Lecture Halls**
   a. The HVAC system for large lecture halls, classrooms without windows, and large office spaces without windows, shall be equipped with both supply (make up air) and exhaust fans.
   b. The supply system shall distribute air throughout the room at velocities that will provide a cooling effect to all occupants. The supply system should provide air near the occupant level to avoid short cycling into the exhaust.
c. The exhaust system should draw air from a location near the highest point in the room.

d. When the same supply fan system is used for both heating and heat control ventilation, variable air volume controls shall be used to avoid the use of excessive air volumes while in the heating mode.

3. Control for HVAC Systems

   a. The control system should operate the HVAC system automatically based on room temperature.
   b. The control system shall be properly interfaced with the heating system to lockout operation of the HVAC system when in the heating mode.
   c. Outdoor air ventilation shall automatically be reduced to a minimum when in the heating mode.
   d. The control system shall prevent operation of the HVAC system during unoccupied periods.

4. HVAC Design Criteria

   a. For all projects, use ASHRAE Climatic Data for Region X to determine outside design conditions. Davis conditions are in parentheses.

      (1) For 100% outside air systems, use the 0.1 percent summer conditions (103 degrees dry bulb/72 degrees mcwb) and the 0.2 percent winter conditions (30 degrees).

      (2) For recirculating air systems use the 0.5 percent (99 degrees dry bulb/70 degrees mcwb) summer conditions and the 0.6 percent winter conditions (34 degrees).

      (3) For interior temperature conditions, use 75 degrees for cooling and 70 degrees for heating. More stringent animal care codes may override these criteria.

      (4) For cooling tower selection use the 0.1 percent design wet bulb conditions (74 degrees).

   b. Identify duct pressure classes on the ductwork plans, that is 1/2, 1, 2 etc. inside a triangle (see Sheet Metal & Air Conditioning Contractors' National Association, Inc. (SMACNA) HVAC Duct Construction Standards, Figure 1-1).

   c. Show round ducts on plans whenever possible.

   d. Provide ducted return air systems whenever possible.

   e. When constant volume, VAV reheat or coil module systems are used, provide reheat coils in all interior zones.

   f. See Design for Energy Efficiency Guidance in CS&DG for other required and recommended criteria.

5. Mechanical System Noise


   b. For large Lecture Halls, Auditoriums, Concert Halls, Recording Studios etc., (where more stringent controls are desirable), consult with the University's Representative to set standards suitable for the intended uses. Design all other areas within the NC standards recommended in the most recent American
Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) handbooks.

c. Inform the University’s Representative during the Design Development stage if necessary sound control measures will be adding a high cost value to the project.

6. Ventilation Criteria for Research Laboratories - Hazardous materials that are used or stored in Chemical, Biological, or Radiological Research and Teaching Laboratories require special ventilation.

   a. Room Ventilation

      1) New laboratory building ventilation systems must be designed to minimize exposure to airborne hazards from hazardous materials to be used or stored in the laboratory. The number of laboratory air changes per hour is dependent on the hazards, heat, and/or odors to be controlled. The campus recommended criteria is 6 to 12 air changes per hour. At no time during operation will the laboratory room air changes per hour be less than 6.

      2) The ventilation system for animal rooms shall be capable of providing 15 air changes minimum per hour with 100 percent exhaust to the outside. Room pressure is to be negative to all adjacent areas. The air distribution device shall be designed to create a “no draft” environment.

      3) No re-circulation of laboratory exhaust air to the building air supply.

      4) Both supply air and exhaust air must be ducted. No open-air plenums.

      5) Animal rooms within mixed-use buildings are to be on a separate, dedicated HVAC system.

   b. Room Air Pressure Differential

      1) Laboratories and storage areas must be maintained negative relative to non-laboratory or storage areas (hallways, offices, conference rooms, etc.), a room offset value of 10 percent of the maximum air value to the room is recommended.

      2) Animal facilities containing noninfectious animals/agents and that are located within mixed-use buildings, should maintain room air pressure differentials such that air is not discharged to the rest of the buildings.

      3) The containment of carcinogenic, radioactive, or infectious animals/agents within mixed-use buildings needs to be evaluated on a case by case basis.

      4) Special containment (ventilated storage cabinets, special local exhaust, etc.) may be required for extremely noxious operations (muffle furnaces, etc.) or extremely odoriferous materials (mercaptans, sulfur compounds, etc.). Toxic gases (arsine, phosphine, etc.) require ventilated cabinets with alarms.

   c. Chemical Fume hoods

      1) Chemical fume hoods must meet criteria of the campus fume hood design guide (Section 11600 Laboratory Equipment).

   d. Biosafety Cabinets and In-Place HEPA Filters
1) All biosafety cabinets must be tested per National Sanitation Foundation (NSF) Standard 49 or manufacturer’s specifications after installation. University’s Representative shall forward the testing results to UCD EH&S for review.

2) Class II Type B biosafety cabinets must be installed on a dedicated exhaust system.

3) Exhaust in-place HEPA filters must be of the bag-in/bag-out type.

e. Glove Boxes
1) Glove hood (box) may be required for special applications using highly toxic, extremely reactive or California Occupational Safety and Health Act (COSHA) regulated chemical carcinogens.


f. Other Specialty Hoods and Local Exhaust
1) Histology hoods, specimen hoods, and other local exhaust specialty hoods require a minimum operating face velocity of 100 fpm with a range of 100-120 fpm.

2) An audible/visual flow alarm may be required depending on use.

g. Exhaust Stack Height
1) A minimum fume hood exhaust stack height of 10 feet is required for new construction. The results of the wind tunnel evaluation may necessitate a higher stack height.

h. Air Cleaners
Special air cleaning devices may be required for some fume hood applications as required by the local Air Quality Management District.

i. Flammable and Corrosive Storage Cabinets
1) Flammable storage cabinets must be UL listed and/or NFPA approved.

2) Flammable storage cabinets, other than under fume hoods, are not required to be ventilated. If cabinet is to be vented it must be ducted into the fume hood exhaust system above the fume hood trim damper.

3) Corrosive chemical storage cabinets (acids and bases) do not require venting. If cabinets are to be vented they must be vented separate from that of the fume hood exhaust system.

7. Ventilation Criteria for Non-Laboratory Settings
New building ventilation systems for offices, auditoriums, conference spaces and bathrooms must be designed to provide a healthful indoor air quality environment.

a. Office Spaces
1) The campus recommended ventilation criteria is greater than or equal to 20 cfm/person of outside air. This number is based on less than or equal to 7-people/1000 ft² of floor area.

b. Auditoriums and Conference Spaces
1) The campus recommended ventilation criteria is greater than or equal to 15 cfm/person of outside air. This number is based on less than or equal to 150-people/1000 ft² of floor area.

c. Bathrooms
   1) The campus recommended ventilation criteria is greater than or equal to 50 cfm/fixture of outside air. Fixtures include urinals and toilets.

8. Wind Tunnel Studies
   a. A wind tunnel evaluation is required for all new construction that produces emissions of a hazardous, noxious, odoriferous, or otherwise nuisance character and that poses a health and safety risk. Common emission sources can include laboratory exhaust, cooling towers, generators, incinerators, kitchen exhaust, and vent stacks.
   b. A wind tunnel evaluation may be required for remodeling projects if new exhausts are being added that may impact sensitive receptors or when the total volume of exhaust is being substantially increased or when the project may be affected by nearby existing buildings. Sensitive receptors can include air intakes, courtyards, operable windows, or sensitive animal populations, that are either part of the facility being remodeled or that exist nearby.
   c. Required Dilution
      The required dilution is based on the chemical makeup of the exhaust and the type of receptors that are affected. Target dilution factors are 1/1,000 at minimum, as measured from the top of the exhaust fan to the receptor in question. For highly toxic emissions where a 1/1,000-dilution factor is inadequate, the appropriate dilution level should be calculated for the specific application.
   d. Chemical Parameters
      Chemical parameters to be evaluated include, but are not limited to: worst case spill releases and modeling with chemicals possessing highest toxicities, greatest volatility, and lowest threshold limit values (TLV).
   e. Wind Tunnel Study Parameters
      The wind tunnel study chosen shall use best available technology and current industry testing standards. The ASHRAE Handbook of Fundamentals, 1997, Chapter 15, or the Environmental Protection Agency (EPA) Guideline for Fluid Modeling of Atmospheric Diffusion, EPA-600/8-81-009 should be consulted. At minimum, the wind tunnel study shall take into account probable evaporation times based on ventilation rates, exhaust stack height & diameter, exit velocity, exhaust location, wind speed & direction, building features, and any nearby features that could influence emission dispersion.

GENERAL PLUMBING REQUIREMENTS
1. Water & Gas Meters
   a. Provide each new building, or portions of new buildings, with separate meters for water and gas.
b. Portions of existing buildings, and large additions or remodels of existing buildings may also require separate meters. Verify all requirements with the University’s Representative.

2. Hose Bibb
   a. Provide each new building with a hose bibb at 100 feet maximum spacing along exterior walls.

3. Plumbing Fixtures
   a. Provide low-flow showerheads, low-flush toilets, etc.

**GENERAL ELECTRICAL REQUIREMENTS**

1. Electrical Meter Requirements
   a. Provide each new building, or portion thereof with a separate electrical meter.
   b. Large additions to or remodels of existing buildings may also require separate meters. Verify all requirements with the University’s Representative.

2. Utility Service to Buildings
   a. All buildings are to be connected to existing utilities on campus. Verify all points of connection with the University’s Representative.
   b. All utility service, including electric, telephone, fire alarm, etc. are to be underground.
   c. All buildings are to be pre-wired for telephone, data, EMS, and fire alarm.
   d. High security areas are to be pre-wired for security alarms and electronic access systems. Refer to UCD Policy and Procedure 360-35 and UCD Police Department Security Alarm Ordinance.

3. Lighting Levels
   a. Lighting levels shall conform to Title 24 and IES standards see section “Design for Energy Efficiency” for lighting table.
   b. Low brightness lenses shall be utilized for offices, classrooms, and laboratories. Parabolic louvers are recommended for areas of high concentrations of CRT’s.

4. Harmonics: The following practices shall be reviewed with the University’s Representative for incorporation into the project in order to reduce harmonics and provide quality power.
   a. Provide full size separate neutrals for all branch circuits.
   b. Install full size ground wire in all electrical installations. Do not depend on the conduit for grounding.
   c. Derate transformers or install K-rated transformers.
   d. Size neutral conductor on all 3-phase 4-wire panel boards by 200 percent of phase conductors.
   e. Share neutrals of lighting circuits powered from 277 volts if neutral is rated for 200 percent.
   f. Provide 10 percent or less total harmonic distortion of electronic ballasts.
   g. Provide minimum conduit size of 3/4 inch from electrical panels to boxes and between boxes.
   h. Do not fill new conduit runs more than 30 percent of capacity.
NON STRUCTURAL BUILDING ELEMENTS

Falling hazards from non-structural building elements including equipment, fixtures, ceilings, furniture, and other contents should be abated, to the extent practical. This includes the following guidelines:

1. Free-standing bookshelves, cabinets, and equipment shall be anchored according to Uniform Building Code (as modified by applicable California State Codes), Chapter 16 Structural Design Requirements and 25 Gypsum Board and Plaster.

2. Shelves shall have doors, or restraints to keep items from falling. For bookshelves, the restraint should extend at least one-half inch above the shelf. For chemicals and in other laboratory areas, the restraint should extend at least two inches above the shelf. Where glass chemical containers will be stored, the restraint material should be of a nonmetallic or a rubber coated metallic material.

3. Sliding or swinging cabinet doors shall have mechanical latches.

4. Compressed gas cylinders shall be restrained using approved brackets with two metal straps or chains that have been firmly attached to walls. When using chains, one should be located approximately 8 inches from the floor and the second should be located approximately 34 inches from the floor.

5. Flexible utility connections shall be used for fume hoods and other equipment.
SITE

GENERAL CONDITIONS
The Design Professional is to refer to all specific program requirements, Soils Reports when furnished by the University, the Long Range Development Plant (LRDP), the LRDP Environmental Impact Report (EIR), project EIR, District Planning Guides, Architectural Design Guide, and any other applicable guidelines in designing buildings and site improvements on the UCD campus, as well as the following requirements.

SITE UTILITY
All significant Campus Core buildings shall be on campus central systems unless an exception is reviewed and approved by the University’s Representative.

1. Provide a detailed utility plan showing onsite and offsite facilities, and their connections to existing Campus utilities. Show any portions of the existing system to be abandoned.
2. It is common for a project to be dependant on the construction of the specific utility facilities by another project or phase of the same project. The project shall coordinate with other known project and Campus master plans, utility system designs will incorporate all phases and any off-site sewer that is required for the connection to an existing main.
3. Plans shall use the current UC Davis GIS utility maps as a base map for utility plans and shall use the same coordinate system for all plans, California State Plane Coordinates, Zone II, NAD83.
4. Additions and deletions shall be drawn on new and separate layers. The layers shall be named for each utility as “Utility System Additions” and “Utility System Deletions”.
5. All new manholes, cleanouts, lift stations, Wells and other infrastructures shall be annotated with an empty identification bubble. The new structures will have designators assigned by UC Davis – Facilities Engineering Services staff to be included in the final bid documents. The project shall coordinate with University and include the designation numbers in the project design documents.
6. Investigate and clearly identify the need in the design documents to specify the order of work to ensure new facilities are in place before existing facilities are taken out of service, either temporarily or permanently, to reduce or eliminate interruptions to any utilities. For interruptions that can’t be avoided provide a detailed Utility Shutdown Plan that identifies all utilities affected, how the utility is to be isolated, the estimated duration of the interruption, any by-pass or temporary services that the contractor will be required to provide and the proposed timing of the shutdown that will be least disruptive to the University.

STORM DRAINAGE
Provide underground drainage systems for all roof storm water. Prevent concentrated roof storm water from flowing across pedestrian paths or walkways. Provide grates or screens over underground system, and open clean-out areas at downspout/underground system junction.

The California Code of Regulations, Title 23, Section 22560 sets forth regulations for management of wastewater from confined animal facilities. The following are best management practices to prevent the discharge of pollutants into groundwater and surface waters.

1. Management of Wastewater
All wastewater generated from water wash down and other cleaning activities within confined animal facilities and that contact manured areas must be disposed of via a sanitary sewer connection. Under no circumstances should any wastewater (e.g., water produced during cleaning operations, generated by cooling systems or other processes) be allowed to drain into the stormwater collection system. Furthermore, all areas that drain to the sanitary sewer collection system must be designed to minimize the introduction of rainwater and stormwater runoff.

2. Management of Storm Water

All stormwater runoff that contacts animal waste must be managed to prevent the off-site flow of contaminants. For example, polluted runoff generated from storm events can be disposed of in an on-site retention pond. For ease of long-term maintenance, the pond may have a hook-up to sanitary sewer where feasible. Any discharge from the pond to the sanitary sewer must be made during non-storm event/“off peak times” and with prior approval of the Waste Water Treatment Plant superintendent.

a. Design and construction of an on-site retention pond requires review and approval from University of California Davis Environmental Health & Safety (UCDEH&S). UCDEH&S will also determine if the project requires approval or permit from the Central Valley Regional Water Quality Control Board (RWQCB).

b. For retention ponds that received polluted runoff from animal facilities, RWQCB guidance states that the on-site retention pond must be designed to retain drainage during a 25-year, 24-hour storm event. Retention ponds must be lined with soils that contain at least 10 percent clay and not more than 10 percent gravel or artificial materials of equivalent impermeability. The retention pond must be managed to minimize percolation to groundwater.

3. Management of Unpolluted Storm Water

Runoff is permitted to enter a storm drain from areas separated from confined animal facilities such as access drives, where only incidental water contact with manure areas may occur. This is allowed as long as the runoff waters are not adversely impacting the environment.

4. Physical Separation of Runoff Sources

Physical barriers such as concrete curbs, gutters, berms, etc. should be constructed around confined animal facilities to contain animal residues/runoff and to prevent it from running off-site or mixing with runoff from non-manure areas. To minimize effluent loading to the sanitary sewer or on-site holding pond from non-manure areas, the topography should be engineered so that its runoff does not pass through and mix with runoff from manure areas.

**LANDSCAPE**

The following are general requirements for landscape design. See Section 02900 Landscape Work for more detailed information.

1. General Design
   
a. Landscape areas should contribute to the identity of each building complex. New landscaping at existing buildings should conform to or complement the existing character of planting.
b. The design of each building complex should be sensitive to, and complementary of, any existing sensitive vegetation and mature specimen trees. All landscaping should endeavor to enhance the natural beauty of the site and to establish or preserve the identity of each building complex.
c. The landscape design shall provide for bicycle parking and circulation as well as for pedestrian circulation.

2. General Planting Selection
   a. Planting areas within building compounds should respond to the uses and functions of the buildings and spaces: providing shady and sunny seating areas, colorful entries, and screening or buffers when necessary.
   b. Plant sizes should be chosen to assure long-term adaptability to specific site locations.
   c. Coordinate proposed plant material with Grounds and Arboretum.
   d. For planting guidelines (specifications for Nursery Tree Acceptance, Tree Planting Detail, Planting Procedures and Tree Spacing), refer to “Treescapes at UC Davis - A Landscape Management Plan for the Tree-Lined Corridors”.
   e. In order to reduce the potential for criminal activity, plant sizes should not inhibit a clear line of vision for users.

3. Drainage
   a. Ponding of water on the site ground surfaces is not allowable; all surfaces must have a positive drainage.
   b. Drain all water away from the building foundations.

4. Maintenance
   a. Plant materials should be selected for ease of maintenance so as not to require substantial pruning, leaf and litter collection, or pest control.
   b. Avoid large deciduous trees in interior courtyards that require substantial leaf collection.
   c. Plants should be drought tolerant and low water use types.

5. Lawn Areas
   a. When lawn areas are provided, provide a few larger areas of lawn, as opposed to many small individual patches of lawn, in order to minimize maintenance costs.
   b. In layout of lawn areas and other specialized landscape areas, consider the ease of lawn mower or other maintenance equipment access to such areas.
   c. Do not use decomposed granite or gravel at paths within developed areas adjacent to buildings where such materials can contaminate or migrate onto lawn or building entry systems.

6. Design Considerations for Existing Trees
   a. All trees on campus are a prime natural asset and should be carefully protected. All new building should observe the following guidelines:
      (1) Whenever possible, avoid fill or excavations within the drip line of other species, to avoid suffocation and root cutting. Avoid placing utility lines through trees to be saved.
(2) Establish finish grades on paving, footings etc., above the root system. The grade at the base of all trees should not be raised or lowered.
(3) Limit root coverage to not more than 40 percent unless a loose permeable covering is used such as gravel, decomposed granite, etc.
(4) Re-establish drainage systems around trees where natural drainage system has been disturbed. Finish grades should drain away from the tree.

PARKING/ CIRCULATION
The following are general requirements for design of parking and circulation.

1. General Design
   a. All parking areas near buildings on campus are to include a portion of the total spaces for handicapped parking as per requirements of the OSA and CCR.
   b. Parking should be convenient, but not obtrusive. Screening or buffering of parking areas is encouraged.
   c. Pedestrian movement in and out of parking areas shall be incorporated into the landscape design.
   d. Parking should not create an obstacle for pedestrians traveling through the campus core.
   e. Parking and service areas shall be landscaped, retain existing trees where possible, conform to the topography, and be limited in size to decrease their visual impact.
   f. All parking areas or clusters of areas 1 acre or larger shall either be provided with sedimentation/infiltration basins designed to capture the majority of suspended or emulsified contaminants or they shall be provided with easily maintainable grease traps.
   g. Parking areas are to provide planting to generate 50 percent shade in 15 years time.

2. Minimum Parking Area Requirements
   a. Provide wheel stops (curb may be used as a wheel stop).
   b. Provide wide striping (with traffic paint) at all HC parking spaces.
   c. Provide minimum dimensions of 8 feet-6 inches wide by 18 feet-0 inches long per space.
   d. Motorcycle parking shall be provided as specified in Detailed Project Program (DPP).
   e. Provide bicycle parking convenient to building entries and on the project site. Verify amount of bicycle parking with DPP.
   f. Provide Lighting per Section 16550 Street & Path Lighting Standards.

3. Vehicle/Bicycle/Pedestrian Circulation
   a. Two lane roads are to be 24 ft. wide, minimum, with minimum 30 ft. radius at curves.
   b. Provide asphalt or concrete site paths of a width appropriate to its intended use. If asphalt is used, provide pressure treated pathway headers. Verify with the University's Representative.
c. Provide for bicycle circulation from bike paths to bike parking to pedestrian path to building entry. Bicycle and pedestrian paths shall be separate when possible.

**SITE LIGHTING & ELECTRICAL**

1. Goals
   a. The primary goals for campus lighting area safety, security and aesthetics.
      (1) Safety involves minimizing conflicts with pedestrians, bicycles, and vehicles through channeling traffic to the safest paths, and providing adequate sight lines and lighting levels.
      (2) Security minimizes personal harm or property loss by achieving good visibility and by removing shadows along paths.
      (3) Aesthetics in lighting refers to the appearance and place making qualities of the lighting design, both during the day and night.

2. Lighting Categories
   The campus lighting recommendations fall into five categories of lighting type and context; including vehicular streets, parking lots, bike and pedestrian corridors, special places, and accent lighting. Refer to Section 16550 – Street & Path Lighting.
ENERGY EFFICIENCY

OVERVIEW
This chapter of CS&DG is not a replacement for the requirements of Title 24, but a supplement. Although Title 24 is a model energy conservation code, it makes no attempt to optimize the life cycle costs of buildings.

It is the intent of UCD to ensure that as many life cycle cost-effective measures as possible be installed in all new construction and remodeling projects. Every attempt should be made to ensure that all energy conservation measures with a simple payback period of less than 10 years are installed.

The Executive Design Professional is encouraged to suggest alternative designs to reduce both energy use and demand. Alternative design suggestions could include, but are not limited to:

1. Revised building orientation
2. Revised construction materials
3. Increased insulation
4. Use of variable air volume (VAV) HVAC systems vs. constant volume systems
5. More effective use of outdoor air in HVAC systems
6. Revised piping configurations to reduce pumping costs
7. More efficient building and heat recovery equipment selections
8. More sophisticated equipment control strategies
9. High efficiency motors in long run time applications
10. More efficient lighting systems

Alternatives involving increased construction costs shall be economically evaluated to determine pay back period. In determining the pay back period, data concerning energy costs and energy cost escalation rates will be furnished by the University. Data furnished by the University and all assumptions used in the evaluation shall be clearly stated.

BUILDING CONFIGURATION
Minimize the ratio of surface area of walls and roof to gross building area in order to reduce surface heat loss within reasonable design/aesthetic constraints.

GLAZING
Use appropriate glazing systems to minimize heat loss and reflected glare to adjacent buildings or public areas.

The use of projections and roof overhangs is recommended over windows in sunny locations (especially south and west orientations). The length of the projection shall be calculated to provide solar gain in winter and shading in the summer. Horizontal shutters, fixed awnings, or other architectural devices, may also provide this function.
INFILTRATION
All exterior doors and operable windows shall be weather-stripped.
Door thresholds shall incorporate a weather-strip seal.

LIFE CYCLE COST ANALYSIS
See chapter, "Mechanical, Electrical and Structural Calculations" in Part I of this guidebook for life cycle cost analysis requirements. For some small remodeling projects, it may not be practical to perform life cycle costing procedures, although required and recommended measures do need to be evaluated for project applicability. If the Executive Design Professional feels that life cycle costing is inappropriate, an exemption may be requested by writing a letter of justification to the University's Representative. If approved, then formal life cycle costing procedures may be omitted.

In an effort to ensure that as many life cycle cost effective measures as possible are installed, UC Davis requires all new construction and major remodeling projects to be at least 10 percent more efficient than Title 24 requirements. In addition, energy conservation measures with a simple payback period of 10 years or less are to be evaluated for installation.

LOAD MANAGEMENT VS. ENERGY CONSERVATION
Although not specifically addressed in Title 24, load management plays an important factor in keeping UC Davis' utility bills low. UC Davis has a summer demand charge of approximately $16/kW, which is 2 times higher than other PG&E E-20T customers. UCD also has an extremely low nighttime energy rate of $0.031/kWh. These factors tend to make current load management strategies attractive to UC Davis' energy efficiency program.

TITLE 24 EXEMPT BUILDINGS
Buildings that are exempt from Title 24 requirements (e.g. labs, medical research, animal buildings and hospital spaces, etc.) are to be at least 20 percent more efficient than a standard design for that type of space.

The design of an exempt building must include a computer simulation analysis of a standard base case, exempt building with standard design, and an analysis for the upgraded building design which will include many of the measures described in the following paragraph, plus ideas from the Design Professional Consultants. The result of the analysis is that the upgraded building must use at least 20 percent less energy than the standard exempt building. However, systems and strategies used to achieve energy savings shall not compromise in any way the health and safety of building occupants.

Some typical measures that could be used for the upgraded design are: VAV supply and exhaust; VAV fume hoods; heat recovery and/or indirect evaporative cooling and other measures not required by Title 24.

REMODELING PROJECTS
Every remodeling project is to be evaluated with the University Representative to determine the limits of construction and extent of life cycle cost effective measures to be installed. Title 24 documentation should only be provided for systems that are replaced or upgraded.

**TITLE 24 DOCUMENTATION**
In addition to standard Title 24 documentation, the design analysis is to include a copy of the required and recommended measures checklist at the end of this chapter, identifying which measures have been included.

**INFRASTRUCTURE BENEFITS**
Many energy efficiency measures such as heat recovery and thermal ice storage reduce loading on the campus chilled water system, steam system and electrical distribution system. Contact University's Representative to determine the value of the infrastructure benefits that are to be used in life cycle cost analysis.

**ENERGY OFFICE**
UC Davis Energy Conservation Office - (530) 752-0401.

**PG&E ENERGY EFFICIENCY PROGRAMS**
The UCD Energy Office works closely with PG&E’s new construction energy efficiency design team - (916) 757-5261. Make every effort to include the requirements of PG&E’s rebate programs in the design of the building.

**REQUIRED ENERGY CONSERVATION MEASURES**
Identifies energy conservation measures that are required (e.g. F32T8 lamps and electronic ballasts, premium efficiency motors etc.). Exceptions: If the Design Professional determines that a required measure is not cost effective, then discuss measure with the University's Representative, providing detailed backup calculations in the design analysis.

**BUILDING ENVELOPE**
A1 Minimum roof insulation level of U-0.050.
A2 Minimum wall insulation levels of U-0.100.
A3 Windows with no exterior shading shall have a visible transmittance to shading coefficient ratio greater than 1.1 (VT/SC > 1.1).
A4 For all spaces where humidification and/or dehumidification are required and outside air requirements are low (e.g. main frame computer rooms), provide a vapor barrier around the entire controlled space. Include detailing of pipe and conduit penetrations of vapor barriers.

**PUMPS**
E1 Provide lead/lag pumping for VFD systems requiring (i.e. split 1- 100 percent pump into 2- 60 percent lead/lag pumps).

**HYDRONIC SYSTEMS**
F1  For pumping systems that are approximately 10 HP and larger, provide variable water volume (VWV) pumping systems for chilled water, hot water, heat recovery and possibly other types of water systems. Chilled water systems using chillers are to be separated into a primary-secondary system so that the chillers may operate at constant volume.

F2  For chilled water systems connected to the central plant, the chilled water delta T should be maximized as much as possible to minimize the flow of chilled water from the central loop and to improve performance for future thermal energy storage system. The minimum acceptable and desired coil leaving water temperatures (LWT) and chilled water coil delta T’s are shown below.

<table>
<thead>
<tr>
<th>CHW Coil Design</th>
<th>Coil LWT</th>
<th>Coil CHW Delta T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>62 degrees</td>
<td>16 degrees</td>
</tr>
<tr>
<td>Desired (Required &gt;= 10HP AHU)</td>
<td>66 degrees</td>
<td>18-20 degrees</td>
</tr>
</tbody>
</table>

F3  For heating hot water systems, use 180-degree hot water supply temperature for coil sizing. Hot water system delta T should be maximized to reduce pump and pipe sizing. Typically, a 40 to 60 degree delta T should be used for air handling coils and a 30 to 40 degree delta T should be used for reheat coils when 180-degree hot water system is used.

F4  For hydronic systems where variable water volume (VWV) is used, provide the following:
- Install modulating 2-way valves with tight shut-off rated to close against a differential pressure of 1-1/2 times pump head.
- Provide one 3-way valve (or end-of-line needle valves) on heating hot water systems.
- Locate differential pressure sensor at hydraulically most remote coil.
- If hydraulically most remote coil is variable, provide multiple differential pressure sensors and use a low signal selector to send proper signal to variable frequency drive.
- Limit total bypass gpm through 3-way valves to 1.5 gpm per pump horsepower by installing balance valve in the bypass of all 3-way valves.

F5  For constant or variable flow water systems, provide 2-way control valves for all reheat and recool coils except as noted above.

F6  In coil schedule, identify the control valve Cv value.

AIR HANDLERS

G1  Provide a variable frequency drive (VFD) for VAV systems with motors 15 HP and larger.

G2  Provide a variable frequency drive (VFD) for constant volume systems with motors 25 HP and larger and that utilize 65 percent efficient and greater filtering.

G3  Chilled water, hot water, direct expansion, heat recovery, terminal and other coils are to be sized at a life cycle cost effective face velocity and pressure drop. Maximum desired face velocities and air pressure drops are identified below:
<table>
<thead>
<tr>
<th>System Type</th>
<th>Operating Hours</th>
<th>Desired Max. Coil Face Velocity (fpm)</th>
<th>Max. Coil Wet Air Pressure Drop (H₂O)</th>
<th>CHW &amp; DX Run-</th>
<th>Hot Water 110°F</th>
<th>Hot Water 180°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>24h/d, 7d/w</td>
<td>350</td>
<td>0.45</td>
<td>0.40</td>
<td>0.30</td>
<td>0.10</td>
</tr>
<tr>
<td>Constant</td>
<td>10h/d, 5d/w</td>
<td>400</td>
<td>0.50</td>
<td>0.45</td>
<td>0.35</td>
<td>0.13</td>
</tr>
<tr>
<td>Variable</td>
<td>24h/d, 7d/w</td>
<td>400</td>
<td>0.50</td>
<td>0.45</td>
<td>0.35</td>
<td>0.13</td>
</tr>
<tr>
<td>Variable</td>
<td>10h/d, 5d/w</td>
<td>450</td>
<td>0.55</td>
<td>0.50</td>
<td>0.40</td>
<td>0.16</td>
</tr>
</tbody>
</table>

**AIR FILTERS**

H1 For air handlers approximately 7.5 HP and larger, provide low pressure drop, UL-approved air filters similar to the following:

<table>
<thead>
<tr>
<th>Filter Efficiency</th>
<th>Similar to</th>
<th>Desired Maximum Face Velocity (fpm)</th>
<th>Maximum Initial Pressure Drop (H₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 percent</td>
<td>LUWA FP75</td>
<td>400</td>
<td>0.17</td>
</tr>
<tr>
<td>65 percent</td>
<td>LUWA FP75</td>
<td>400</td>
<td>0.17</td>
</tr>
<tr>
<td>85 percent</td>
<td>LUWA FP85</td>
<td>400</td>
<td>0.19</td>
</tr>
<tr>
<td>95 percent</td>
<td>LUWA FP95</td>
<td>375</td>
<td>0.23</td>
</tr>
<tr>
<td>99.97 percent HEPA</td>
<td>FARR</td>
<td>250</td>
<td>0.65</td>
</tr>
<tr>
<td>99.99 percent HEPA</td>
<td>FARR</td>
<td>200</td>
<td>0.65</td>
</tr>
</tbody>
</table>

**VAV AND CV BOXES**

I1 For VAV systems, unless calculations indicate otherwise, set minimum air flow for cooling and for heating to 40 percent of the maximum air flow value, or 0.70 cfm per square foot, whichever is less.

I2 The maximum air pressure drop (PD) of a bare box shall be 0.07 inches. For 1 row coil add 0.10 inches max. PD and for 2 row coil add 0.15 inches to 0.20 inches PD.

**DUCTWORK**

J1 SMACNA smoke and bubble tests indicate that splitters, extractors, scoops and 90-degree branch taps have high pressure drops and should be avoided. Smoke tests also indicate that the fittings in the following table have low pressure drops and are the fittings of choice for SA, RA and EA branch ducts. Please show or require these fittings in specs.

**PREFERRED BRANCH TAKE-OFFS**

<table>
<thead>
<tr>
<th>Duct Branch</th>
<th>Preferred</th>
<th>SMACNA Figure *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular to Rectangular</td>
<td>Shoe</td>
<td>14-14.N or W</td>
</tr>
<tr>
<td>Rectangular to Round</td>
<td>Conical</td>
<td>14-14.M or V</td>
</tr>
<tr>
<td>Round to Round</td>
<td>Wye</td>
<td>14-14.B, C or J</td>
</tr>
</tbody>
</table>

J2 Require random (or complete) duct leakage testing in all ducts rated at (1 or) 2 inches of water and greater.

HEAT RECOVERY AND INDIRECT EVAPORATIVE COOLING
M1 Heat recovery and/or indirect evaporative cooling systems shall be provided for all 100 percent outside air systems and shall be evaluated for systems using high outside air flow rates.

COMPRESSED AIR AND VACUUM PUMP SYSTEMS
P1 Main/standby equipment is not allowed except for buildings that are considered critical by UC Davis. Lead/lag systems are desired for systems requiring 10 HP compressors/pumps and larger (i.e. split 1-10 HP compressor/pump into 2-5 HP or 2-7.5 HP lead/lag compressor/pumps).

P2 Provide intercooled and aftercooled, 2 stage compressors/pumps for all systems 5 HP and larger.

P3 Do not reject compressor heat into the chilled water system.

P4 Do not provide once through cooling water systems.

MECHANICAL
Q1 All motors 1 HP and over that are used at least 1,000 hours per year are to be premium efficiency per requirements of NEMA MG-1, Table 12-6D (see below).

<table>
<thead>
<tr>
<th>HP</th>
<th>eff</th>
<th>HP</th>
<th>eff</th>
<th>HP</th>
<th>eff</th>
<th>HP</th>
<th>eff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>85.5</td>
<td>5</td>
<td>89.5</td>
<td>20</td>
<td>92.4</td>
<td>50</td>
<td>94.1</td>
</tr>
<tr>
<td>1.5</td>
<td>86.5</td>
<td>7.5</td>
<td>91.0</td>
<td>25</td>
<td>93.6</td>
<td>60</td>
<td>94.5</td>
</tr>
<tr>
<td>2</td>
<td>86.5</td>
<td>10</td>
<td>91.0</td>
<td>30</td>
<td>93.6</td>
<td>75</td>
<td>95.0</td>
</tr>
<tr>
<td>3</td>
<td>89.5</td>
<td>15</td>
<td>92.4</td>
<td>40</td>
<td>94.1</td>
<td>100</td>
<td>95.4</td>
</tr>
</tbody>
</table>

Q2 Fractional horsepower motors 1/20 HP and larger are not to be shaded pole motors.

Q3 For variable frequency drives (VFD’s) provide adequate protection from current harmonic distortion, typically a 3 percent input line filter or isolation transformer.

Q4 For rooms that are provided with dedicated air handlers (e.g. lecture halls, gymnasiums etc.), provide occupancy sensor control of fluorescent lighting systems and air handlers. For small air handlers, cycle fan to maintain thermostat setpoint when no occupancy is sensed. For larger air handlers, set fan to low speed (approximately 20 Hz) when no motion is sensed.

Q5 For intermittently occupied spaces that are equipped with their own air handlers (e.g. lecture halls and gymnasiums), provide ASHRAE 62-1989 approved demand ventilation control of outside air dampers. If CO2 sensors are used, then modulate OSA dampers to maintain 600 to 700 ppm of CO2 during occupied periods. The minimum OSA rate is to be 0.15 cfm/person during occupied periods. The maximum OSA rate is to be 100 percent.
LIGHTING
Fluorescent fixtures equipped with energy saving lamps and ballast shall be standard. The University's Representative must approve in writing use of incandescent fixtures.

Zone lighting or task lighting shall be utilized whenever energy efficiency can be improved by these measures.

INTERIOR LIGHTING
R1 Lighting levels for campus spaces are based on IES standards. If not shown below, consult IES lighting handbook. Maintained lighting levels are to be designed as follows:

## Maintained Foot Candle Requirements

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Illumination Level in Foot-Candles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Auditorium</strong></td>
<td></td>
</tr>
<tr>
<td>Assembly Only</td>
<td>15</td>
</tr>
<tr>
<td>Study Hall</td>
<td>50</td>
</tr>
<tr>
<td><strong>Classroom Space</strong></td>
<td></td>
</tr>
<tr>
<td>Regular classroom work</td>
<td>50</td>
</tr>
<tr>
<td>Drafting rooms (manual)</td>
<td>100</td>
</tr>
<tr>
<td><strong>Corridors (see also- Emergency)</strong></td>
<td></td>
</tr>
<tr>
<td>Office, Classroom Buildings Intersections</td>
<td>10** 20</td>
</tr>
<tr>
<td>Student Housing</td>
<td>10**</td>
</tr>
<tr>
<td><strong>Dormitory Rooms</strong></td>
<td></td>
</tr>
<tr>
<td>Prolonged Study</td>
<td>50</td>
</tr>
<tr>
<td>Lounge/Lobbies</td>
<td>10</td>
</tr>
<tr>
<td>Kitchen (w/o task light)</td>
<td>50</td>
</tr>
<tr>
<td>Kitchen (with task light)</td>
<td>30</td>
</tr>
<tr>
<td><strong>Emergency Lighting</strong></td>
<td></td>
</tr>
<tr>
<td>Corridors</td>
<td>1 min, 3 ave, 10 max **</td>
</tr>
<tr>
<td>Stairwells</td>
<td>1 min, 3 ave, 10 max **</td>
</tr>
<tr>
<td><strong>Gymnasiums</strong></td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td>15</td>
</tr>
<tr>
<td>Recreation, Practice</td>
<td>30**</td>
</tr>
<tr>
<td>Exhibits, Matches</td>
<td>50**</td>
</tr>
<tr>
<td>Kitchen, Commercial</td>
<td>75</td>
</tr>
<tr>
<td><strong>Laboratories</strong></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>65</td>
</tr>
<tr>
<td>Close Work (task lighting)</td>
<td>100</td>
</tr>
</tbody>
</table>

Lecture Rooms
General............................................................... 35
Special, Demonstration, Exhibit (task lighting) ........ 100
Chalkboards, Markerboards (task lighting).......... 100

**Libraries**
Reading Rooms, Carrels........................................ 50
Stacks (active)...................................................... 20*
Book Repair and Bindings .................................... 50
Check in and out, catalogs, card files............... 50

**Lounges**
Study (with task light)......................................... 30
Study (w/o task light)........................................... 50
Non-Study........................................................... 20

**Offices**
Designing, detailed drafting (task lighting) .......... 100
Accounting, bookkeeping, business machines........ 50
General, reading, transcribing, filing, mail sorting ... 50
General (w/ task lighting and user coordination).... 30
Computer Rooms (VDT's) ..................................... 30 - 50 ***
Conference Rooms............................................... 30

**Recreation**
Basketball (regulation) ......................................... 50**
Basketball (recreation) ......................................... 30**
Restrooms............................................................ 15**
Service Areas (Mechanical, Electrical Rooms)...... 20**
Stairwells (see also- Emergency)........................... 10**
* vertical FC at a work plane height of 30".
** work plane height of 0".
*** see IES standard RP-24.

R2 All general lighting fixtures to include high efficacy F32T8 lamps and electronic ballasts where applicable. Suggested minimum ballast product quality requirements are:
- Ballast shall have a 3 year manufacturer’s warranty.
- Ballast shall be UL listed class P.
- Ballast shall be sound rated A.
- Ballast must be solid state, not hybrid.
- Ballast shall maintain light regulation of +/- 10 percent with +/- 10 percent input voltage variation.
- Current total harmonic distortion shall be less than 10 percent.
- Flicker shall be 15 percent or less with any lamp suitable for the ballast.
- Ballast shall be designed to withstand line transients per IEEE 587, category A.
- Ballast shall operate at 20 kHz or greater.
- Ballast shall have been on the commercial market for a minimum of two years.
• Ballast shall be instant start and parallel wired.

R3 Specify 3500 kelvin for F32T8 lamp color. If color rendering is important consider specifying a minimum CRI of 80.

R4 Emergency EXIT signs are to be the LED type. Maximum wattage per sign shall be less than 7 watts and the minimum warranty shall be 5 years. Signs are to be painted white and use green LED's.

R5 The use of standard incandescent lighting (e.g. A-lamps, R-40's, PAR-38's etc.) shall be minimized (including closets). If a high color rendering lamp or point source of light is necessary, consider the use of 130-volt halogen lamps. Wherever appropriate, the use of hard-wired compact fluorescent shall be maximized.

R6 In rooms where incandescent lighting and fluorescent lighting are provided for different uses, provide an interlock so that only one type of light source can be used at one time.

R7 Occupancy sensors are to be provided in all common bathrooms (2 water closets or more with connected load of 150 watts or more), lecture halls and classrooms. Specify ceiling mounted, ultrasonic type sensors. Locate sensors so that they will “see” inside bathroom stalls, but will not “see” outside the room. Provide standard wall switches in classrooms and in bathrooms that have windows so that the lights may be turned off manually. Light switches are not required in bathrooms with no windows. In bathrooms, provide 1- PL fixture near door that is not controlled by the occupancy sensor but is controlled only by the switch.

R8 For buildings that utilize DDC for HVAC control, integrate the Title 24 required light sweeping system into the DDC controls system, where feasible.

R9 In enclosed stairwells, provide adequate daylighting for emergency egress if possible and put any stairwell lighting on photocell control.

EXTERIOR LIGHTING

S1 In general, all exterior lighting is to be high-pressure sodium. Metal halide is acceptable if good color rendition is necessary. Fluorescent or compact fluorescent is acceptable for small areas.

S2 Provide two switched conductors to each exterior fixture. One switched conductor is to be on a timeclock, (dusk to 11 PM), the other switched conductor is to be on photocell (dusk to dawn) or astronomic clock. Conductors should be located such that any fixture can be changed from one conductor to the other with minimal effort.

REQUIRED AND RECOMMENDED ENERGY CONSERVATION MEASURES

The following energy conservation measures are provided in a checklist type format. When properly implemented, these measures are cost effective in many instances (required measures are identified in bold).

BUILDING ENVELOPE

_____ A1 Minimum roof insulation of U=0.050
_____ A2 Minimum wall insulation of U=0.100
### A3 High performance glazing (*without shading*)

### A4 Vapor barrier in humidified spaces

### A5 Optimize building orientation

### A6 Upgrade roof insulation from $U=0.050$ to $U=0.033$

### A7 Upgrade wall insulation from $U=0.100$ to $U=0.050$

### A8 Daylighting to minimize artificial light

### A9 Double glazed windows

### A10 Thermal breaks in windows

### A11 High performance glazing (low SC, high VT) (*with shading*)

#### CHILLERS

### B1 Thermal storage (TES) or natural gas fired cooling for remote buildings

### B2 Limit air-cooled chiller to 30 tons

### B3 Limit air-cooled chiller to 150 tons w/ TES

### B4 Limit evaporative cooled chiller to 150 tons

### B5 Provide energy efficiency options

#### COOLING TOWERS

### C1 FRP, coke bottle shaped, propeller tower

### C2 Close approach temperature (4-7 degrees)

### C3 Oversized w/ low fan power ($<0.03$ kW/ton)

### C4 2 speed motor for fans 1 HP and up

### C5 VFD for fans 15 HP and up

#### BOILERS

### D1 Modulating or high/low fire

### D2 Factory insulated to R-6 or better

### D3 Energy efficiency options

### D4 Pulse boiler

#### PUMPS

### E1 No standby pumps

### E2 Optimize selection to minimize HP

### E3 Suction diffuser on base mounted pumps

### E4 Lead/lag variable water volume for small systems

### E5 Optimize selection for maximum 60-foot head

#### HYDRONIC SYSTEMS

### F1 Variable Volume, 10 HP and larger

#### F2 Maximize chilled water delta T, 16-20 degrees

#### F3 Maximize hot water delta T, 40-60 degrees

#### F4 Water Coil:

1. Tube velocity of 3.5 to 4.0 fps under design conditions
(2) maximum water side differential pressure of 15 feet

- **F5** Variable volume valve types
- **F6** 2-way modulating valves for all reheat and recool coils
- **F7** Identify control valve Cv
- **F8** Reverse return piping or pipe looping
- **F9** Pot feeders in parallel with pumps
- **F10** Limit pressure drop to 2 feet H2O per 100 feet

**AIR HANDLERS**

- **G1** VFD for VAV systems, 10 HP and larger
- **G2** VFD for constant volume systems, 25 HP and larger
- **G3** Limit coil air pressure drop
- **G4** Optimize selection to minimize fan HP
- **G5** VFD for VAV systems 3 HP to 10 HP
- **G6** Casing insulation of R-8 or greater
- **G7** Low leakage dampers
- **G8** Low pressure drop sound attenuation
- **G9** Limit air handler size to 25,000 cfm

**AIR FILTERS**

- **H1** Provide low pressure drop air filters

**VAV and CV BOXES**

- **I1** Set minimum air flow to 40 percent
- **I2** Minimize pressure drops of boxes and coils

**DUCTWORK**

- **J1** Low pressure drop duct fittings
- **J2** Random duct leakage testing of high pressure ducts
- **J3** Use ducted transfer air from corridors as supply air for bathrooms and janitors closets
- **J4** To improve IAQ, use high SA, low RA
- **J5** To improve IAQ, use induction type diffusers
- **J6** Maximize the use of round duct
- **J7** Provide duct looping (or gridding)
- **J8** Limit pressure drop to 0.07 inches H2O per 100 feet
- **J9** Provide minimum R-6 insulation for supply ducts

**EXHAUST FANS**

- **K1** Optimize selection to minimize fan HP
- **K2** Provide 5 to 10 diameters straight duct into fan
- **K3** Use propeller fans for low delta P applications

**PACKAGE UNITS and SPLIT SYSTEMS**
L1 Select high SEER equipment
L2 Provide slightly oversized evaporator coil
L3 For multi-compressor systems, intertwine coils

HEAT RECOVERY (Indirect Evaporative, Runaround Coils, Heat Pipes)
M1 Required on 100 percent outside air systems
M2 Provide lead/lag pumping
M3 Additional pre-cooling using cooling tower
M4 Additional pre-cooling by spraying exhaust air coil

FUME HOODS
N1 Variable air volume hoods
N2 Gang hoods onto exhaust plenum w/ multiple fans
N3 Size ducts per Industrial Ventilation, 21st edition

DOMESTIC and INDUSTRIAL HOT WATER
O1 Size recirculating pumps for a 10-degree temperature drop
O2 Specify low flow showerheads w/o flow restrictors
O3 Minimum R-16 insulation for packaged water heaters
O4 Minimum R-16 insulation for storage tanks

COMPRESSED AIR and VACUUM PUMP SYSTEMS
P1 No standby equipment
P2 Intercooled, aftercooled, 2 stage compressors
P3 No heat rejection into chilled water system
P4 No once through cooling water systems
P5 Heat recovery into DHW or runaround systems

MECHANICAL/ELECTRICAL, General
Q1 Premium efficiency motors
Q2 No shaded pole motors
Q3 VFD harmonics protection
Q4 Demand ventilation, cycling
Q5 Demand ventilation, modulating
Q6 Provide power factor correction at MCC’s or motors
Q7 Provide proper K-rated transformers
Q8 Provide 80 C or 115 C rise transformers (interior, dry type, natural convection)
Q9 Provide Pipe all grease fittings to locations that can be easily maintained
Q10 Shaft grounding of motors

INTERIOR LIGHTING
R1 Maintained lighting levels
R2 Electronic ballasts and F32T8 lamps
R3  Lamp color of 3500 kelvin
R4  LED EXIT Signs
R5  No incandescent lighting
R6  Lighting interlocks
R7  Occupancy sensors- bathrooms and classrooms
R8  Lighting controls integrated into DDC system, if feasible
R9  Daylighting of stairwells
R10 Maximize use of 3 and 4 lamp ballasts
R11 Wall mounted occupancy sensors in private offices
R12 15 minute twist timer for bulletin board lighting
R13 4 hour twist timer for janitors closets

EXTERIOR LIGHTING
S1  High pressure sodium is preferred
S2  Dual circuits to each light pole

EMERGENCY POWER
T1  Design system for load shedding capabilities
T2  Autostart and transfer generator using EMCS system
T3  Emergency generator alarms shall be interfaced with the campus remote monitoring system
COMMUNICATIONS RESOURCES ENGINEERING AND CONSTRUCTION

GENERAL
The CR Telecommunications Standards contain policies and procedures for telecommunications projects for new and renovated buildings, and for upgrading and adding cabling infrastructures that support campus voice and data networks.

MEASUREMENT OF SQUARE FOOTAGE

GROSS AREA
(See Appendix C for examples and required format)
1. Definition
   Gross Area is defined as the sum of the floor areas of the building included within the outside faces of the exterior walls for all stories, or areas that have floor surfaces.
2. Basis for Measurement
   Gross area should be computed by measuring from the outside face of exterior walls, disregarding cornices, pilasters, buttresses, etc., which extend beyond the wall face. Measure in terms of gross square feet (GSF).
3. Description
   In addition to all the internal floor spaces obviously covered above, the gross area should include basements (except unexcavated portions), attics, garages, enclosed porches, penthouses, lobbies, mezzanines, balconies utilized for operational functions, mechanical equipment floors, and corridors, provided they are within the outside face lines of the building. Roofed loading or shipping platforms should be included, whether within or outside the building lines. Stairways, elevators shafts, mechanical service shafts, and ducts are to be counted as gross area on each floor through which the shaft passes.
4. Limitations
   Exclude any courts or light wells, or portions of upper floors eliminated by rooms, atriums, or lobbies that rise above single floor ceiling height.

ASSIGNABLE AREA
(See Appendix C for examples and required format)
1. Definition
   The sum of all areas on all floors of a building assigned to, or available for assignment to, an occupant (excepting those spaces defined as custodial, circulation, mechanical, or structural areas).
2. Basis for Measurement
   All assignable areas should be computed by measuring from the outside finishes of surfaces which form the boundaries of the designated areas.
3. Description
   Included should be space subdivisions for offices, classrooms, laboratories, seminar and conference rooms, libraries, file rooms, storage rooms, etc., including those for special purposes (e.g., auditoriums, cafeterias, TV rooms, locker and shower rooms, maintenance and repair shops, garages) which can be put to use in accomplishing the mission of the institution.
4. Limitations
   Deductions should not be made for necessary building columns and projections.
BUI LDING AND DI RECTIONAL SI GNAGE

OVERVI EW
The UCD Campus has a campus sign program. A copy of these guidelines may be obtained from the University's Representative. This policy does not apply to the UCD Medical Center, which has its own sign program.

I N T E N T I O N S
The intent of the guidelines is to:

- Provide graphic standards for a campus sign program;
- Provide category classification for all sign types in the program;
- Assist in identifying which sign type is appropriate to use;
- Help in developing sign packages for specific areas or facilities; and
- Assist in the application and placement of signs.

The sign program provides for consistency of message, appearance, and identity by the use of shape, size, color, typeface, symbols and wording. Careful implementation of these guidelines will insure a consistent and highly recognizable visual identity for the UCD Campus. This sign program strives to ensure a smooth flow of pedestrian and vehicular traffic in and around campus buildings.

LABORATORY ROOM SI GNAGE
Laboratory faucets served by industrial water shall be labeled “Industrial Water - Do Not Drink”. Signs to be of panel type construction with dimensions of 1 by 4-inch minimum. Panel color shall be dark with lettering of high contrast. Coordinate with campus sign program.

EMERGENCY EVACUATION SI GN
All campus buildings over one story high shall have building evacuation signs posted on every floor. The signs shall be posted at all stairway and elevator landings and immediately inside all public entrances to the building (California Code of Regulations, Title 19). The evacuation plan sign is noted in the Campus Sign Program as type Interior 4.G.

The insert for the holder shall conform to the following criteria to comply with state regulations:

1. Show floor plan for the level on which it is placed. Should be easy to see immediately by someone entering that floor of the building.
2. Place signs no more than 4 feet above finished floor.
3. Make sign's lettering at least 3/16 inch high in a sans-serif font. The words shall be in sharp contrast to the background and easy to read.
4. Include emergency procedure information for the physically disabled.
5. Indicate the locations of exits and fire alarm pull stations.
6. Describe what the fire alarm sounds and looks like (audible and visual warning devices).
7. List the fire department emergency telephone number.
8. If there are elevators on the floor, state they are not to be used during emergencies.
9. Other pertinent information may be added to the sign, such as location of fire extinguishers, hazardous material spill kits or emergency preparedness equipment.
NON-HAZARDOUS WASTE COLLECTION

WASTE COLLECTION SITING ISSUES
Most buildings on campus are generally near an outside solid waste or recycling storage bin location, accessible by the campus solid waste and recycling collection trucks for periodic (usually daily) collections. All new buildings or building additions should consider convenient access locations to trash and recycling bins by building residents and Custodial personnel, as well as by Solid Waste and R4 Recycling collection trucks.

The following are design considerations:
1. Balance convenience to users with desirable isolation of odors and visibility of trash bins when siting bins. For example, avoid placement near air intakes.
2. Screen bin locations, whether by planting, wood fencing concrete walls, etc., depending on particular program requirements. Include continuing accessibility (for instance, growth of maturing plants) in screening plans.
3. Outdoor dumpsters for trash and cardboard storage and collection locations are subject to Solid Waste Section Review.
4. Outdoor and indoor recycling storage and collection locations are subject to R4 Recycling Program Review.

RECYCLING ACTIVITIES
1. Wheeled cart dimensions are 27 inch by 27 inch by 42 inch tall. Allow space in the Recycling Collection Room for 2 carts for each large department or group of offices.
2. Copy room paper recycling bins are 16 inch diameter by 29 inches tall. Allow space for 2 bins in each copy room.
3. Break rooms or dining facilities beverage container recycling bins are 17 inches by 17 inches by 31 inches tall. Allow designated space for 2 beverage container bins and 1 paper recycling bin in each room.
4. Provide a hose bibb and drain in all areas storing recyclable beverage containers.
5. Provide adequate lighting and custodial cart access for outdoor storage areas.
6. Recyclables collection methods change with the building activities. Check with the R4 Recycling Program at 530-752-6970 during the planning and design process for most recent needs. Or for further information on bins and carts specifications, reference the web page at http://www-oes.ucdavis.edu/r4/bins/bins.html.

COLLECTION TRUCK ACCESS
1. To accommodate the weight of front axles while dumping bins, provide a concrete pad under truck access capable of supporting over 20,000 lbs. Reinforce a 10 foot by 10 foot area beginning 5 feet in front to the bin. The concrete pad must be the same grade as the parking lot or access road.
2. Allow 60 feet clear from front of bin enclosure to wall, parking or landscaping to accommodate collection truck backing and straightening operations.
3. Allow a minimum of 12 feet clear beyond the side of bin enclosure to accommodate a 3-point turn.
4. Allow a minimum driveway width of 18 feet-22 feet for vehicle to turn into a driveway from the street.
5. Allow 23 feet overhead clearance to accommodate emptying bins in collection vehicle.

**BIN PAD/ENCLOSURE**
1. Allow 12 feet overhead clearance to open bin lid for loading trash or cardboard.
2. Single: Trucks are 8 feet wide plus mirrors. Allow a minimum of 12 feet clear width and 10 feet of depth.
3. Multiple: Trucks are 8 feet wide plus mirrors. Allow a minimum clear width of 22 feet for two bins plus 10 feet for each additional bin. Allow minimum 10 feet depth.
4. Provide a hose bibb with backflow preventer and consider drainage at each bin location. Any bin receiving food waste must have a hose bibb and drainage. All drainage shall be to sewer, not storm drainage system.
5. Provide adequate lighting and custodial cart access for outdoor trash storage areas.
6. Avoid gates in residential areas where residents may be accessing the bins with their hands full. Bins must still be screened from view.
7. If gates must be included, plan to have as few gates as possible to open and close while servicing the area. Areas with gates shall have mechanical means to keep gates open while area is being serviced.
8. Allow a designated outdoor space 96 inches by 36 inches with signage for recycling cart collections.

**OUTDOOR RECYCLING/TRASH COLLECTION CONTAINERS**
1. Concrete walkways and building entrances.
   Provide outdoor trash and recycling bin set at all building entrances, resting areas, patio areas, eating areas, and walkways.
   Trash bin is Quick Crete Products, model number QS-PS2532W-N-UCDAVIS.
   Recycling bin is Quick Crete Products, model number QS-PS2532W-M-UCDAVIS.
   Vendor is Quick Crete Products Corporation, 909-737-6240.
2. Dirt/Gravel/Open/Grass Areas
   Provide outdoor trash and recycling bins for dirt, gravel, open, or grass areas.
   (1) Mixed Paper bin is CS 3035- barrel with Mixed Paper labeled lid with (1) C 3520 - rigid plastic liner with CS 3110 - side access door
   (1) Cans and Bottles bin is CS 3035- barrel with Cans and Bottles labeled lid with (1) C 3520 - rigid plastic liner with CS 3110 - side access door
   (1) Trash bin is CF 4510 - 45 gallon flat top barrel, no lid with (1) DA 1855 - steel dome top for 55 gallon barrel with (1) C 3555 - rigid plastic liner
   (1) CS 3600- Post with Signs and Brackets
Color: gray.
Signage on bins: “Mixed Paper”, “Cans and Bottles”, and “Trash”.
Signage on post: “Recycle”, “Recycle”, and “Trash”.
Vendor is Windsor Barrel Works, 800-527-7848.
For purchasing use CMAS 4-97-72-0006A.

Products to match campus standards. No known equal.

INDOOR RECYCLING/TRASH COLLECTION CONTAINERS

1. Copy/Mail Rooms or Offices
   a. Mixed paper recycling container is United Receptacles Inc, Blue Round Metal Recycling Wastebasket (16 inch Diameter by 29 inch H) and lid (Cat No. WB2029 and SEC-500).

2. Lobby or Public Areas
   Public Square Recycling Set is Witt by Safco Products
   a. Waste Container bin (Cat. No. 2983 BG) (38 inches by 15 1/4 inches by 15 1/4 inches: 37 gal.)
      Color is Burgundy, with square lid (Cat. No. 2989BL)
   b. Paper Recycling bin (Cat. No 2982BR) (32 inches by 15 1/4 inches by 15 1/4 inches: 31 gal.)
      Color is Brown, with slot lid (Cat. Nos. 2987BL)
   c. Cans/Plastic Recycling bin (Cat No. 2982BR) (32 inches by 15 1/4 inches by 15 1/4 inches: 31 gal.)
      Color is Brown, with circle lid (Cat. No. 2988BL)
   d. Glass Recycling bin (Cat No. 2981GN) (26 inches by 15 1/4 inches by 15 1/4 inches: 25 gal.)
      Color is Green, with circle lid (Cat. No. 2988BL)

Products to match campus standards. No known equal.
FIRE AND LIFE SAFETY

FIRE PROTECTION
It is the policy of UC Davis to install fire sprinkler systems in all new construction/facilities administered by UC Davis. If the building is classified as a pole barn, shed, carport, fence, tank or tower (other “U” occupancies may also fall under this exception) and is less than 4,000 square feet, then the provisions for sprinklers may not apply.

Special conditions may exist that will require sprinkler retrofit, but each facility will be evaluated on a case-by-case basis. Exceptions to this standard shall only be granted, in writing, by the Associate Vice Chancellor-Facilities.

FIRE DEPARTMENT REQUIREMENTS
Refer to the UCD Fire Department web site for information on Fire Department requirements, such as fire access, hydrants, inspection, plan review, etc.
http://fire.ucdavis.edu/ucdfire/UCDFDfirenetHome.htm
STUDENT HOUSING

GENERAL
Design and construction standards for Student Housing projects may differ from general campus standards. This chapter includes general statements of preferences for Student Housing projects. When an item or characteristic is not mentioned herein, it must be assumed that the larger CSDG applies.

Student Housing standards may differ from CSDG standards for the following reasons:

1. Student Housing, an auxiliary unit of the Campus, receives no funds from the Campus, State, or federal government. No grant funds are used in any projects. Any financing used by Housing is arranged through UCHS (University of California Housing System), part of UCOP. UCHS coordinates and manages housing funds from all ten UC campuses; short- and long-term financing, if used in a project, is derived from UCHS pool funds or discrete bond issues for university student housing only. All remaining funds for Housing work are directly funded from Student Housing fees.

2. Student Housing facilities are owned by the UC Regents but managed by the Student Housing Auxiliary. Some campus housing (The Colleges, Primero Grove and Russell Park) is privately owned and operated; these projects are built to local industry standards except for utility connections to Campus systems, and other features as negotiated individually as a part of the respective Ground Lease.

3. UC Davis Student Housing desires to build new housing for students that exceeds the quality of the average new housing in the Davis multi-family market. The target is to build housing that is durable and easy to maintain, and that has a predictable service life of at least 40 years. Most such housing is for first-year students; this housing must have durable finishes, fittings and hardware.

4. UC Davis Student Housing projects are governed by all federal and state laws that apply to other University projects. What can vary is the “Campus preferences” that are described in detail in the Campus Standards guide. Certain requirements for laboratories and classrooms do not apply to wood frame multi-family housing.

5. Student Housing contracts through UC Davis Architects and Engineers or Operations and Maintenance for all major design and construction projects. These projects are subject to the same Capital Project approval rules as others: Campus, State, and Regents’ reviews are required. Drawing and phase submittal requirements are generally the same, although some projects may be built via an alternative process such as “design-build”.
6. Privatized housing projects are not initiated by Student Housing. These projects are usually developer designed, built and operated, and sit on land owned by the University. A typical ground lease for such a project is for a term lasting between 30 and 60 years. Construction standards for these projects are often identical to private-sector housing, with the usual exception of telecommunications and utility / underground construction. The University does not maintain these properties but does monitor maintenance and service obligations in the respective ground lease.

Student Housing Preferences:

1. Doors and Door Hardware:
   a. Entry Doors: C-CURE card access system.
   b. Local prop open alarms placed on all exit doors.
   c. Student Room Doors: Onity card access lever sets, brushed chrome.
   d. Other Doors (storage rooms, etc): Best Lock Lever sets with University-standard Best cylinders.
   e. Trash Room Doors: Motorized rollup (if appropriate), key switch operated, Best Lock cylinder, fuse link to close door in case of fire.

2. Telecommunications (basics of ResNet):
   a. Housing is a client of UC Davis Communication Resources. Student Housing buildings are connected to the NOC (network Operations Center). All components and configurations need to be compatible with the campus network.
   b. The typical two person occupancy student room is equipped with two 100Mbps Category 5e outlets, one RJ-11 voice outlets, and a coaxial cable TV connection. TV signals for students are generated at the Housing Media Resource Center, sent digitally to the NOC, and distributed via fiber to residence halls and other Student Housing buildings. The signal is reconverted to analog and distributed within buildings via coaxial cable. This is the “ResNet” model.

3. Security Systems:
   a. Certain lobbies and other public spaces are equipped with video cameras. There is no monitoring of cameras, no cameras are present in private spaces and no cameras are concealed from view. Images are stored locally on-site and with images being downloaded when needed.
   b. All exterior entry doors are equipped with prop alarms that sound locally.

4. Electric Power:
   a. All new buildings are served by the Campus 12 kV distribution system. Looped feeders and redundancy are desirable in new installations. Pad-mounted transformers are standard if they can be located in a non-public area.
   b. Every Housing building is individually metered at the transformer.
   c. When and where appropriate, consideration may be given to the addition of photovoltaic generation systems in new projects.
d. Each student room should be served by the equivalent of two 20 amp circuits per room. Outlet locations are determined by expected furniture layout.

5. Interior Finishes:
   a. Walls: 5/8" minimum thickness drywall.
   b. Ceilings: 5/8" drywall preferred at non-access locations. T-bar locking clips at access ceilings.
   c. Student room floors should be durable and allow for ease of cleaning. Student Housing will give direction regarding the use of carpet versus linoleum (or other hard surface). When carpet is used, it is often preferred to use carpet tiles thus allowing for easy replacement.
   d. Bathrooms: floors, walls, partitions should all be durable and easy to clean, (i.e. FRP, solid plastic, tile, plastic lockers, etc.).
   e. Custodial closets: High-impact plastic wall finish over 5/8" drywall.

6. Lighting fixtures and lighting levels:
   a. Student Rooms: Two ceiling mounted fixtures, double-switched, 50 FC max level; Surface-mounted, low-profile, electronic ballasts, T-8 or T-5 lamps.

7. Windows:
   a. Student Rooms: aluminum frame with thermal break, double-glazed, operable required by Code for exiting; Slider, single-hung or casement; Low-E glazing 3 exposures; sunshades required 3 exposures.
   b. Other areas: Aluminum frame, double glazed, Low E glass; Shading optional.
   c. Security screens may be preferred on designated first floor windows.

8. HVAC Controls:
   a. Degree of automation and controllability: Preference for Siemens Campus Standard controls on all primary systems and any other interface with campus utilities.
   b. Two-pipe distribution system for manual switchover by Housing staff;
   c. Student rooms have individual or grouped fan coils, individual room controls.