

DESIGN REQUIREMENTS – GENERAL

GENERAL DESIGN GUIDELINES

The following guidelines 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. Some projects, due to specific project budgetary, regulatory, or program constraints may not be able to incorporate all of the guidelines listed below. Any questions as to applicability of these guidelines should be directed to the University's Representative for clarification.

For broad campus goals and Physical Design Framework please see:

<http://dcm.ucdavis.edu/PhysicalDesignFramework/index.htm> This guide was prepared in 2008/2009 and describes a vision for creating a physical environment that supports the University's mission, vision and values as well as addresses the principles of the University's Long Range Development Plan (LRDP). The University's LRDP and the LRDP Environmental Impact Report (EIR), at <http://www.ormp.ucdavis.edu/environreview/lrdp.html>, are also important for campus environmental mitigation measures that may apply to projects.

Refer to all specific program requirements, Soils Reports (when furnished by the University), the project EIR, District Planning Guides, and any other applicable guidelines in designing buildings and site improvements on the UCD campus, as well as the following requirements. In order to comply with the UC Policy on Sustainable Practices, new buildings shall be designed to achieve a LEED "Silver" equivalent rating or higher.

ACCESSIBILITY

Provide for disabled access to all sites and 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.

SUSTAINABLE MATERIALS, PRODUCTS, AND EQUIPMENT

Specify materials, products and equipment with the following attributes where they meet the performance goals needed for the project:

1. Materials, products and equipment that have an inherent ability to serve their function with minimal maintenance.
2. Materials, products or equipment that can be removed and re-used when they are no longer needed for the project.
3. Materials, products or equipment that create no or minimal health risks to the people who occupy, construct and maintain the project.
4. Materials, products or equipment that have significant post-industrial and post-consumer recycled content.
5. Local/regional materials and equipment manufactured or having final assembly at a facility within 500 miles of the Project.
6. Certified wood from manufacturers declaring conformance with Forest Stewardship Council Guidelines for certified wood building components.

DESIGN REQUIREMENTS – SITE

SITE UTILITIES

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

STORM DRAINAGE

Comply with the requirements found in the "State Water Resources Control Board Water Quality Order No. 2013-0001-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000004, Waste Discharge Requirements (WDRs) For Storm Water Discharges From Small Municipal Separate Storm Sewer Systems (MS4s) (General Permit)" section F.5.g. Post Construction Storm Water Management Program at www.waterboards.ca.gov/water_issues/programs/stormwater/docs/phsii2012_5th/order_final.pdf

For specific requirements, refer to LEED Sustainable Site guidelines.

Prevent concentrated roof storm water from flowing across pedestrian paths or walkways.
Provide open clean-out areas at downspout/underground system junction.

Design drainage for new construction and/or redevelopment loading dock projects to minimize run-on and runoff of storm water. Direct connections from depressed loading docks (truck wells) to storm drains are prohibited. Refer to Division 33 Utilities for details.

LANDSCAPE

The design of each building complex should be sensitive to, and complementary of, any existing sensitive vegetation and mature specimen trees. Use water-conservative landscaping, particularly on the west and south campuses where domestic water is used for irrigation. Landscape, where appropriate, with drought tolerant plants and use lawns only where needed for pedestrian traffic, activity areas, and recreation. Install efficient irrigation systems that are compatible with the Campus central control system and are water efficient. Apply heavy applications of mulch to landscaped areas to reduce evaporation.

The landscape design shall provide for bicycle parking and circulation as well as for pedestrian circulation.

Heat Island Mitigation

Provide shade (within 5 years of landscape installation) and/or use light-colored/high-albedo materials with a Solar Reflectance Index (SRI) of at least 29 for at least 50 percent of the site's non-roof impervious surfaces, including parking areas, walkways, plazas, fire lanes, etc.;

OR

Place a minimum of 50 percent of parking spaces underground or covered by structured parking. See Appendix for SRI calculation requirements.

Design Considerations for Existing Trees

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, to avoid suffocation and root cutting. Avoid placing utility lines near 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.
4. Re-establish drainage systems around trees where natural drainage system has been disturbed. Finish grades should drain away from the tree.

General Planting Selection

1. Providing shady and sunny seating areas, colorful entries, and screening or buffers when necessary.
2. Plant sizes should be chosen to ensure long-term adaptability to specific site locations.
3. Coordinate proposed plant material with Grounds and Arboretum.
4. For planting guidelines, refer to the University's Standard Specification Section 32 90 00 Planting and Standard Details.
5. In order to reduce the potential for criminal activity, plant sizes should not inhibit a clear line of vision for users.
6. Plant materials should be selected for ease of maintenance so as not to require substantial pruning, leaf and litter collection or pest control.
7. Avoid large deciduous trees in interior courtyards that require substantial leaf collection.
8. Plants should be drought tolerant and low water use types.

Lawn Areas

1. When lawn areas are required, provide a few larger areas of lawn, as opposed to many small individual patches of lawn, in order to minimize maintenance costs.
2. In layout of lawn areas and other specialized landscape areas, consider the ease of lawn mower or other maintenance equipment access to such areas.
3. 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.

PARKING/CIRCULATION

General Design

1. See Heat Island Mitigation section under the Landscaping section above for further requirements.
2. All parking areas near buildings on campus are to include a portion of the total spaces for handicapped parking as per the requirements of the DSA and CCR.
3. Parking should be convenient, but not obtrusive. Screening or buffering of parking areas is encouraged.
4. Pedestrian movement in and out of parking areas shall be incorporated into the landscape design.

5. Parking should not create an obstacle for pedestrians traveling through the campus core.
6. 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.
7. 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.
8. Provide conduit stub-outs and pull strings for future installation of emergency phone and for ticket/permit dispensers.
9. Layout for parking should provide 5.4 parking spaces for every 10 occupants (staff, faculty and student) of the building.
10. Designate spaces for Disabled, Vendor/Diamond E, and Meter parking. Adequate signage shall be provided to identify designated spaces and identify the parking lot.

Minimum Parking Area Requirements

1. Provide wheel stops (curb may be used as a wheel stop).
2. Provide parking stalls with minimum dimensions of 8 feet-6 inches wide by 18 feet-0 inches long per space. Aisle width shall be a minimum 25 feet wide for 90 degree parking on both sides.
3. Compact parking spaces are not normally provided.
4. Motorcycle parking shall be provided as specified in the Detailed Project Program (DPP). When provided, motorcycle parking shall be on a concrete pad.

Vehicle/Bicycle/Pedestrian Circulation

1. Two lane roads are to be 24 ft. wide minimum, with minimum 30 ft. radius at curves.
2. Provide asphalt or concrete side paths of a width appropriate to its intended use. If asphalt is used, provide pressure treated pathway headers. Verify with the University's Representative.
3. Provide bicycle parking (to serve a minimum of 5 percent of the regular building occupancy) convenient to building entries and on the project site. Verify amount of bicycle parking with DPP, if given. For new development and remodel of existing developments, site selection and site planning shall include an examination of the appropriate locations and quantities for bike racks. The proposed locations of bike racks should logically link the proposed development with the campus circulation system and provide a clear transition for bike users to access a site, park their bikes, and then proceed to a building entrance.
4. This progression should recognize that easy access to a building helps to improve the campus bike system by making bikes an efficient mode for quickly moving across campus. However, the site planning must also avoid placing bikes and pedestrians in conflicting situations near building entrances. For determining the quantity of bike racks, the site planning and building programming analyses should consider the size of the building, the proposed occupancy, and types of building uses as well as the existing bike parking near the site and the bike network connections near the site. Comparisons to existing nearby buildings or similar buildings elsewhere on campus are an appropriate starting point for the bike rack assessment. The campus Bicycle Coordinator shall be

consulted during site selection and site planning to provide feedback on the placement and quantities of the proposed bike racks.

Signalized Intersections and Bicycle Detection

1. Wherever vehicle detection is necessary to activate traffic signals at intersections, any device (loop or video detector) installed for that purpose must be designed for, and properly adjusted to detect the presence of bicycles.
2. The application of properly positioned pavement markings will better ensure detection of cyclists at bicycle-sensitive loop detectors. Federal and state requirements for such pavement markings accompanying bicycle-sensitive loop detectors may be found in Chapter 9 of the MUTCD and Part 9 of the California Supplement.
3. Push button signal activation for cyclists is not recommended as such installations typically require cyclists to put themselves in unsafe roadway positions to access the device.

SITE LIGHTING & ELECTRICAL

The primary goals for campus lighting area safety, security and aesthetics: Only light areas where exterior lighting is clearly required for safety and security. Lighting used solely for aesthetic effects shall be used only to achieve campus wide way-finding goals.

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.

WASTE COLLECTION

All buildings on campus shall include an outdoor enclosure area and pad for solid waste and recycling storage bins accessible by the campus solid waste and recycling collection trucks for periodic (usually daily) collections. All new buildings or building additions shall design 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.

In design, consider convenience to users, isolation of odors and minimized visibility of trash bins. For example, avoid placement air intakes near trash location.

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.

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.

Minimum clearances:

1. 18 feet driveway width for vehicle to turn into a driveway from the street.
2. 60 feet from front of bin enclosure to wall, parking or landscaping to accommodate collection truck backing and straightening operations.
3. 12 feet beyond the side of bin enclosure to accommodate a 3-point turn.
4. 23 feet overhead to accommodate emptying bins into collection vehicle.

Bins must be screened from view but accessible by custodial carts. Provide a designated outdoor space 96 inches by 36 inches with signage for recycling cart collections.

Gates: Avoid gates in residential areas where residents may be accessing the bins with their hands full. 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.

Minimum Clearances:

1. 14 feet overhead for truck access.
2. 10 feet depth.
3. Width: Trucks are 8 feet wide plus mirrors. 12 feet clear width for a single bin. 22 feet for two bins plus 10 feet for each additional bin.

Provide lighting and hose bibb with backflow preventive 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.

Division 12 – Furnishings for trash and recycling receptors.

DESIGN REQUIREMENTS – BUILDING

ACCESS TO NATURAL LIGHT AND VIEWS

Design the building to maximize interior day-lighting. Strategies to consider include building orientation, shallow floor plates, increased building perimeter, exterior and interior permanent shading devices, high performance glazing and photo-integrated light sensors.

Achieve a minimum Daylight Factor of 2 percent (excluding all direct sunlight penetrations) or achieve at least 25 foot candles using a computer simulation model in 75 percent of all regularly occupied areas. Provide daylight redirection and/or glare control devices to ensure daylight effectiveness. Exceptions for areas where tasks would be hindered by the use of daylight shall be identified in the project program.

In order to provide best use of day-lighting, incorporate the following best practices:

1. Use white or light color finishes for ceilings (minimum reflectance 90 percent), walls, countertops (white, off-white, putty or light grey), and floors (minimum reflectance 40 percent). Minimize surface gloss of ceilings, painted walls, work surfaces and floors.
2. Minimize visual contrast between work surfaces and adjacent finishes as much as possible.
3. Use translucent materials for screens, chase covers and drying racks and adjust the geometry of overhead shelves and vertical pipe chases to minimize shadowing from natural and artificial light sources.
4. Diffuse daylight and artificial light as evenly as possible throughout the space.
5. Enhance penetration of controlled daylight from windows with reflective ceilings and light shelves, high windows, high visible transmittance glazing, etc.
6. Mitigate direct sun and excessive daylight glare by employing a north orientation where possible, operable shades, fixed shades, optimizing window size and appropriate selection of glazing options.

Provide direct line of sight to vision glazing for building occupants in 90 percent of all regularly occupied areas (occupied by an individual for more than 4 hours daily). Exceptions shall be identified in the project program.

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 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. See General Mechanical section for additional acoustic requirements.

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. Walkway canopies, railings and similar work shall be designed to reflect their exposure to student use for consideration in restricting climbing, loading, etc.

INDOOR POLLUTANT REDUCTION AND CONTROL

Adhesives, sealants, sealant primers and aerosol adhesives used inside the exterior weatherproofing system must not exceed the requirements listed in Division 9, Finishes.

Paints and coatings used on the interior of the building and applied on-site must not exceed the VOC limits and must not include any of the chemical components limited or restricted by the standards listed in Division 9, Finishes.

Carpet shall be certified by the California Gold Sustainable Carpet Standard at the Gold or Platinum level. Carpets systems must also not exceed the target emissions factors of the Carpet and Rug Institute's:

Green Label (cushion and adhesive) and Green Label Plus (carpet) Program and Testing Procedures.

Composite wood and agrifiber products, including core materials, must contain no added urea-formaldehyde resins. Adhesives used in field- and shop-fabricated assemblies containing these products must contain no urea-formaldehyde.

Pollutant Control

Design to minimize and control pollutant or biological contaminant entry into buildings and later cross-contamination of regularly occupied areas:

1. Employ permanent entryway systems (recessed walk-off mats or grates, etc.) to capture dirt, particulates, etc. from entering the building at all high volume entryways.
2. Where hazardous gases or chemicals may be present or used (including garages, housekeeping/laundry areas, and copying/printing rooms), provide segregated areas with deck to deck partitions with separate outside exhaust at a rate of at least 0.50 cubic feet per minute per square foot, no air re-circulation, and operated at a negative pressure compared with the surrounding spaces of at least an average of 5 Pa (0.02 inches of water gauge) and with a minimum of 1 Pa (0.004 inches of water) when the doors to the rooms are closed.
3. Provide containment drains plumbed for appropriate disposal of hazardous liquid wastes in places where water and chemical concentrate mixing occurs for maintenance, or laboratory purposes.

4. Provide regularly occupied areas of the building with new air filtration media prior to occupancy that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better.
5. For fireplaces or wood-burning appliances, require low-emitting EPA certified wood-burning appliances, or residential natural-gas fireplaces.

PLANNING GUIDELINES FOR OFFICE SPACE

The following space guidelines shall be used for Campus planning and space allocations to deans, vice chancellors, and vice provosts.

Actual space assignments may vary due to available building space and floor plan configurations. Consult the University's Representative.

Title	ASF *	Notes
Dean/Vice Chancellor/Vice Provost	200	Office to accommodate small private meetings
Associate/Assistant Dean/Vice Chancellor	145	
Faculty	130	Includes tenured and non-tenured
Lecturer	130	Part-time lecturers share an office
Senior Professional	120	E.g., Director, Manager
Professional Staff **	100	E.g., MSO, Analyst, Planner, Programmer, Engineer
Administrative Staff**	80	
Clerical Staff**	64	
Student (paid, part-time)	30	Shared space with other paid students
Emeriti (faculty)	0	Space may be provided if available after paid personnel are accommodated
Non-paid students, readers, etc.	0	Shared space as needed

Common Rooms	ASF *
Conference	8 percent of total assigned office space
Office service (e.g., photocopy, supplies)	4 percent of total assigned office space

* ASF = assignable square feet

** For appointments 50 percent time or greater

LACTATION ROOMS

Lactation rooms are required in every major new campus building unless waived by UC Davis Worklife and Wellness for small buildings, special uses or occupancies, etc.

At a minimum all Lactation Rooms shall have:

1. A lavatory for hand and equipment washing with mirror.
2. Open counter space at lavatory.
3. Space for a chair or bench and small table to place pump on.

4. A U-bolt shall be installed in either the floor or wall near the pump table to attach a cable for securing the pump equipment.
5. A duplex electrical receptacle (preferably near chair and table).
6. Privacy (i.e. no windows to the public).
7. Adequate signage for easy location within a building.
8. Occupied / Unoccupied Signage on exterior of the door.
9. A lock for privacy – no keys, keypad preferred.
10. A tackboard or other wall-mounted system to provide informational flyers and sign in sheet.
11. Natural day lighting.
12. Coat rack.
13. Lockers or the ability to store and lock personal items, such as a lockable cabinet.

ACCESS

All equipment shall be installed per the manufacturer's written requirements and all recommended clearances for access and maintenance shall be maintained. The Design Professional shall clearly indicate and label all clearances on the plans for all of the proposed equipment.

Access panels: Equipment located within an access panel shall not be located more than 4-feet vertically and 1-foot horizontally from the face of the access panel.

Valve handles or any other such operating devices shall not have a conflict with or touch any other surface or equipment in any position, open or shut.

MAINTENANCE

Locate and specify windows, when possible, to enable convenient window cleaning by occupants and maintenance personnel. Pivoting windows or easily accessible windows for cleaning are desirable.

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+.
5. Hi speed buffer 2 feet x 4 feet.
6. Shelving - 1 foot deep by at least 15 lineal feet of adjustable shelving.

Custodial Wet Closets shall be strategically located on all floors throughout the building; they may be designed in conjunction with Custodial Equipment Rooms. Minimum size: 70 sq. ft. and designed as follows:

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. Pad/brush holder.
5. Space for equipment as follows: Step ladder - 1 foot by 2 feet, vacuum - 2 feet by 3 feet, and carpet extractor – 3 feet by 7 feet.
6. Shelving - 1 foot deep by at least 15 lineal feet of adjustable shelving.
7. Electric receptacle, grounding type located approximately 2 feet above the floor and near the corridor door.
8. 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. The Custodial Storage Room shall not be required if the Custodial Equipment Room and Custodial Wet Rooms are each greater than 90 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.

LABORATORIES

Per campus policy, laboratory buildings shall include a separate employee eating area.

DESIGN REQUIREMENTS - STRUCTURAL

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

SECURING NON STRUCTURAL 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 shall 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.

ENERGY EFFICIENCY

In order to reach the climate action goals of the UC Policy on Sustainable Practices, buildings shall be designed in conformance with the following criteria:

GENERAL REQUIREMENTS

All projects shall outperform the California, Title 24, Part 6 Energy Efficiency Measures, by minimum 25 percent. For small projects, the components or parts of the system that are replaced or modified shall meet the same requirements. The project shall exceed this requirement pending available funds and payback analysis.

TITLE 24 EXEMPT BUILDINGS

Buildings or systems that are exempt from Title 24, Part 6 requirements (e.g. process loads for labs and 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 or system.

The project shall develop computer simulated, performance approach energy model to prove compliance with the above requirement. The software must be acceptable and recognized by the State of California, Pacific Gas and Electric Company (PG&E) and United States Green Building Council (USGBC).

LIFE CYCLE COST ANALYSIS

Projects shall develop life cycle cost analysis to identify the most cost effective measures. The project shall implement the energy measures associated with building systems with 10 years payback (mechanical, electrical, etc.) and measures associated with building envelope with 15 years payback (exterior walls, windows, roof, etc.).

Many energy related items such as central system load management, carbon foot print and other University sustainability goals play a significant role in life cycle cost analysis. Life Cycle cost

analysis shall be performed to match the University's standard net-present life cycle cost spreadsheet. Contact the University's Representative for a copy.

Every project shall review and evaluate with the University's Representative to determine the limits of construction and extent of life cycle analysis required to identify the most effective measures to be installed.

ENERGY CONSERVATION MEASURES

The following list identifies energy conservation measures that the Design Professional should consider implementing in order to reach the campus energy conservation goal.

BUILDING ENVELOPE

- A1 Optimize building orientation.
- A2 Optimize building envelope performance including glazing, insulation, etc.

CHILLERS

- B2 Limit air-cooled chiller to 30 tons.
- B3 Limit evaporative cooled chiller to 150 tons.

COOLING TOWERS

- C1 Close approach temperature (4-7 degrees).
- C2 Oversized w/low fan power (<0.03 kW/ton).
- C3 Two speed motor for fans up to 10 HP.
- C4 VFD for fans 10 HP and up.

BOILERS

- D1 Modulating or high/low fire.

PUMPS

- E1 Provide variable water volume (VWV) pumping for hydronic systems that are approximately 5 HP and larger.

HYDRONIC SYSTEMS

- F1 For chilled water systems connected to the central plant, provide a chilled water delta T of 24 degrees or higher.
- F2 For heating hot water systems, provide a system delta T of 60 degrees or higher.

AIR HANDLERS

- G1 Provide a variable frequency drive (VFD) for constant volume systems with motors 10 HP or larger.
- G2 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. Consider face velocities and air pressure drops identified below:

Air Face Velocity	CHW & DX Coil Pressure Drop	Runaround Coil Pressure Drop	Heating Hot Water Coil Pressure Drop
400	0.45	0.40	0.10

- G3 Design to achieve sound control with no sound attenuation or low pressure drop sound attenuation.

AIR FILTERS

- H1 Provide high efficiency, extra-low pressure drop filter system

DUCTWORK

- I1 Provide duct looping (or gridding).

EXHAUST FANS

- J1 Provide 5 to 10 diameters straight duct into fan.

PACKAGE UNITS and SPLIT SYSTEMS

- K1 Select high SEER/EER equipment.
 K2 Oversized evaporator coil.
 K3 For multi-compressor systems, intertwine coils.

ENERGY RECOVERY and INDIRECT EVAPORATIVE COOLING

- L1 Provide energy recovery system (run around coil, heat pipe or enthalpy wheel) and pre-cooling for 100 percent outside air systems or systems using high outside air flow rates.
 L2 Provide lead/lag pumping.

DOMESTIC and INDUSTRIAL HOT WATER

- M1 20 percent more insulation than required by T24, Part 6 for packaged water heaters.
 M2 20 percent more insulation than required by T24, Part 6 for storage tank.

COMPRESSED AIR and VACUUM PUMP SYSTEMS

- N1 Provide inter-cooled and after cooled 2-stage compressors / pumps for systems smaller than 5 HP.
 N2 Reject compressor heat into the chilled water return.