INTEGRAL GROUP

NATURAL CAPITALISM SOLUTIONS

Colorado Mountain College: Sustainable Design Standards

Objective: Design and build to the highest energy and water standards in order to meet the College's Carbon Neutrality Objective in the most cost-effective manner available.

To meet energy performance goals, energy use targets are to be established for new construction in coordination with Colorado Mountain College (CMC). From concept design through each design-to-build phase, the project must demonstrate that it meets energy targets. This includes using whole building energy modeling and documenting the comparison and selection of proposed systems based on a lifecycle cost analysis. It is recommended that CMC bring in a cost estimator during the Schematic Design and Design Development phases to provide early cost feedback.

Introduction: Colorado Mountain College is committed to reach carbon neutrality by 2050 in recognition of the need to conserve limited natural resources in the face of rising utility costs and tighter budgets. The goal of these standards is to help building design and construction teams to design and build buildings in a sustainable manner that supports CMC in achieving its carbon neutrality goals. This is a living document that will be reviewed and updated every 3 years as public awareness, technologies, and energy costs change.

FOR DESIGNERS AND BUILDERS

These design standards are *mandatory* for new CMC buildings, major repairs and alterations, and modernizations. Both performance based standards and prescriptive requirements described here are to be used in the programming, design, and construction of Colorado Mountain College buildings. Levels of performance are specified which allow a design team to identify and implement the best strategies to meet those goals. The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) and Leadership in Energy and Environmental Design (LEED) standards provide guidance for design and construction best practices.

Performance Criteria (unless specifically exempted from the project scope by Colorado Mountain College)

Design

- Develop an energy model for new buildings to make design decisions.
- Include cost estimate for ASHRAE 90.1 baseline design and 10% better than ASHRAE 90.1.
- Design is subject to peer review.

Energy (New Construction)

- At least 10% more efficient than the design required by ASHRAE 90.1– 2013: Energy Standard for Buildings (or current version) if life cycle cost effective (before any on-site renewable energy credit).

Energy (Retrofits)

- As many of the new construction objectives, performance criteria, and strategies should be implemented as practical. A target of at least 20% energy reduction from the previous calendar year at time of design (or another agreed upon baseline year) energy use of the building should be set. When replacing and improving HVAC systems, systems that provide the highest level of energy performance should be used. The entire HVAC system must be recommissioned after improvements are implemented.

Envelope

- Envelope insulation must meet prescriptive requirements outlined in ASHRAE 90.1-2013 (or current version) and at a minimum Roof R-35, Wall R-25, Slab R-15, whichever is more stringent.
- Envelope infiltration must meet minimum performance of no more than 0.1 cfm/sf. Confirm performance with an air barrier test in envelope commissioning.
- Actively reduce thermal bridging by providing a continuous thermal barrier.
- Glazing must meet prescriptive requirements outlined in ASHRAE 90.1-2013 (or current version) and at a minimum U=0.4, SHGC=0.5, VLT to SHGC ratio of 1.5, whichever is more stringent. (U = overall heat transfer coefficient, SHGC = solar heat gain coefficient, VLT = visible light transmittance)
- Orient glazing and overhangs to prevent any direct solar gain at noon of the summer solstice.

Lighting

- Demonstrate through annual computer simulations that spatial daylight autonomy ($sDA_{300/50\%}$) of at least 55% is achieved consistent with LEED v4 Indoor Environmental Quality Credit: Daylight. In other words, at least 55% of floor area has a minimum light level of 300 lux that can be met by daylight for 50% of work hours.
- Provide continuous dimming capability for classrooms, offices, and theaters, multipurpose areas, and any space with daylighting controls.

Commissioning, Measurement, and Verification

- Commissioning is required for HVAC, lighting, daylighting controls, plumbing, energy monitoring systems, and renewable systems, consistent with LEED v4 (or current version) EA Prerequisite Fundamental Commissioning and Verification Prerequisite and EA Credit Enhanced Commissioning (pursue both options 1 and 2).
- Perform envelope commissioning consistent with LEED v4 (or current version) Energy & Atmosphere Credit: Enhanced Commissioning, Option 2.
- Separate and submeter HVAC equipment, lighting, and plug load equipment in new buildings (at the panel level) and connect to the College energy monitoring dashboard system. Further submeter all HVAC equipment larger than 10 hp.
- Develop and implement a Measurement and Verification plan and report to compare building energy performance with the simulated energy model consistent with LEED v3 Energy & Atmosphere Credit 5: Measurement and Verification. The engineer must work with the College through the first year of post-construction occupancy to ensure the building is performing optimally.

Water

- Reduce indoor aggregate water consumption by at least 20% using LEED v4 Water Efficiency Indoor Water Use Reduction Prerequisite and Credit calculation methodology.
- Reduce irrigation by at least 50% consistent with LEED v4 Water Efficiency Credit: Outdoor Water Use Reduction.

Design Strategies

Design Process

- Follow an integrated design process to look holistically at the interaction between site, energy, and water systems. Prepare Owner's Project Requirements (OPR) and Basis of Design (BOD) documents to clarify the goals for the project and the strategies implemented to meet them. See LEED v4 Integrative Process Prerequisite and Credit methodology for more information.

Heating, Ventilation, and Air Conditioning Energy Reduction Strategies

- The primary focus should be on reducing heating and cooling loads through passive means (e.g. optimal shading, orientation, envelope, and internal load reduction) to allow for a smaller HVAC system.
- After reduction of loads, focus should be on efficient equipment, then on-site renewable energy generation.
- Implement heat recovery wherever possible.
- Implement air side or water side economization wherever possible.
- Target compressor-free cooling where possible.
- When using chilled water for cooling, design for medium temperature systems (chilled water supply temperature of 55F or higher).
- Design for low temperature heating hot water (heating hot water temperature of 120F or lower).
- Use geothermal heat pumps for low temperature heating and medium temperature cooling.
- If chillers are used, consider water-cooled chillers instead of air-cooled chillers for greater electric efficiencies.
- Minimize reheat for space conditioning.
- Consider part load operation performance when sizing and selecting mechanical equipment.
- Separate ventilation from space conditioning.
- Minimize friction in air and water systems.
- Design for air handler low coil face velocity (less than 300 fpm).
- Target efficient fan systems (less than 0.6 W/cfm).
- Target efficient pumping systems (less than 19 W/gpm).
- Equipment efficiencies must meet prescriptive requirements outlined in ASHRAE 90.1-2013 (or current version) and at a minimum, whichever is more stringent:
  - Condensing boiler Annual Fuel Utilization Efficiency: at least 95%
  - Water-cooled chiller efficiency: 0.4 kW/ton or lower IPLV at AHRI conditions
  - Air-cooled chiller efficiency: 0.8 kW/ton or lower IPLV at AHRI conditions
  - Heat pump Coefficient of Performance: at least 3.5.

Thermal Comfort Strategies

- Provide adequate thermal comfort consistent with ASHRAE Standard 55 – 2013: Thermal Environmental Conditions for Human Occupancy (or current version).

  Consider increased air movement provided by ceiling fans which can expand the comfort range outlined in ASHRAE Standard 55 – 2013.

Indoor Environmental Quality Strategies

- Provide adequate ventilation consistent with local codes and ASHRAE Standard 62.1 – 2013: Ventilation for Acceptable Indoor Air Quality (or current version), whichever is more stringent.

  Consider at least 30% higher ventilation rates consistent with LEED v4 (or current version) Indoor Environmental Quality *Credit: Enhanced Indoor Air Quality Strategies. This can help with increasing* *the availability of economizing for cooling and higher ventilation can improve control of indoor carbon dioxide levels (which can impair cognitive ability at high concentrations).*

- Protect indoor air quality during construction and preoccupancy phases consistent with LEED v4 (or current version) Indoor Environmental Quality Credit: Construction Indoor Air Quality Management Plan.
    - Development and implement an indoor air quality management plan.
    - Keep contaminants out of the HVAC system and out of the building.
    - Prevent circulation of contaminated air.
    - Maintain a clean job site.
    - Sequence construction activities to reduce air quality problems.
    - Install absorptive-finish materials after wet-applied materials have fully cured whenever possible.
    - Remove all temporary filtration media and replace with new filters before occupancy.
    - Protect absorptive materials from moisture damage.

- Specify materials (adhesives and sealants, paints and coatings, flooring systems, composite wood) that are low-emitting and meet the thresholds consistent with LEED v4 (or current version) Indoor Environmental Quality Credit: Low-Emitting Materials methodology.
    - Adhesives and sealants (at least 90% by volume for emissions, 100% for VOC content)
    - Paints and coatings (at least 90% by volume for emissions, 100% for VOC content)
    - Flooring systems (100%)
    - Composite wood (100% not covered by other categories)

- Keep pollutants from the exterior out of buildings by using walk-off mats at entries and indoor ventilation practices that prevent hazardous fumes from being distributed within the buildings.

Envelope Strategies

- Consider meeting Passive House standard for envelope because of the synergy from acoustical requirements.
- Specify high albedo roof coating.

Lighting Strategies

- Possible daylight penetration methods include light shelves and transparent or translucent interior space dividers. Daylighting controls paired with excellent building daylighting design and fixture selection, can achieve 50% or greater annual lighting energy savings along with additional cooling energy savings when properly designed.
- Focus on light quality rather than installed light density or illumination.
- Consider lighting on the vertical plane in addition to the horizontal plane
- Consider the contrast between surfaces
- Balance direct and indirect lighting
- Balance day lighting and artificial lighting
- Incorporate LED task lighting in offices, where possible, to reduce ambient installed lighting.
- Use LED technology everywhere, as practicable.
- Follow best design practices described in the Illuminating Engineering Society (IES) Lighting Handbook

Electrical Strategies

- Reduce plug loads through appliance selection, scheduling, and monitoring.

On-Site Renewable Energy Strategies

- Renewable Energy Ready (building structure, orientation, and electrical infrastructure are able to accommodate future on-site renewable energy generation).

  Renewable energy technologies include solar photovoltaics (PV) on roofs, parking lots and grounds; solar thermal for domestic hot water; PV-Thermal for combination electricity/hot water generation; and wind turbines.

  If installing crystalline silicon PV, specify a minimum 16% efficient panel. Consider using higher efficiency panels, great than 20%, if lifecycle cost-effective. Consider using module-level power electronics like (direct current) DC optimizers and micro-inverters to improve solar PV performance.

- Develop lifecycle costs and feasibility for on-site renewable energy generation potential and the feasibility of on-site net zero energy. Net zero energy is defined as: "One hundred percent of the project's (electric and natural gas) energy needs must be supplied by on-site renewable energy on a net annual basis."

Water Reduction Strategies

- Meter total potable water use for each building.
- Sub-meter irrigation and domestic hot water use.
- Target the following fixture water specification maximums:
  - Lavatories: 0.35 gpm (at most 0.5 gpm per LEED v4 baseline)
  - Water Closets: Dual-flush 0.9/1.28-gpf (at most 1.6 gpf per LEED v4 baseline)
  - Urinals: 0.125-gpf (at most 1.0 gpf per LEED v4 baseline)
  - Showers: 1.5 gpm (at most 2.5 gpm per LEED v4 baseline)
  - Sinks: 1.0 gpm (at most 2.2 gpm per LEED v4 baseline)

Sustainable Sites Strategies

- Manage site runoff using low-impact development and green infrastructure consistent with LEED v4 (or current version) Sustainable Sites Credit: Rainwater Management.
- Control light pollution consistent with LEED v4 (or current version) Sustainable Sites Credit: Light Pollution Reduction.

Materials and Resources Strategies

- Divert at least 50% of construction waste consistent with LEED v4 Materials & Resources Credit: Construction and Demolition Waste Management Option 1 Path 1. Document waste diversion consistent with LEED v4 (or current version) Materials & Resources Prerequisite: Construction and Demolition Waste Management Planning.

  Consider following Path 2 with a diversion rate of 75% and four material streams.

- Materials selected for the buildings should be high quality and durable, extending the life expectancy of the buildings and optimizing the lifecycle cost of materials.

  Use locally sourced materials with a high-recycled content, as feasible.

- Do not use chlorofluorocarbon (CFC) refrigerants in new refrigeration equipment and phase out CFC refrigerants in existing equipment.