SUSTAINABILITY

GENERAL DESIGN GUIDELINES

General Sustainability Design Guidelines

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July 2009

General Sustainable Development Design Guidelines

At Centerra, sustainable development and design is an important part of the community values and principles. Based upon the roots established by the United Nations World Commission on the Environment and Development and the Rio de Janero Earth Summit, the intentions of the founders of the community and Loveland's unique position in the country, Centerra has adopted the goal of being a sustainable community. This includes sustainable building practices as an important aspect of all future development. At the community level, the goal of sustainable development and design is to meet the needs of the present, without compromising the ability of future generations to meet their own needs. At individual project development and building design levels, it means environmentally sound planning and "better" building solutions, with special attention to construction materials and methods, energy-efficiency, daylighting/solar applications, recycling opportunities, etc. This entails looking at a Value-Added approach to development, not simply first cost.

It is important to understand, that sustainable development and design encompass a comprehensive approach and a commitment to ongoing environmental responsibility. There's no such thing as "adding" sustainable design features or incorporating a suitable number of "green" products as a means of fulfilling this responsibility to future generations. Projects must be designed as integrated solutions that consider all aspects of sustainability from the very beginning.

Sustainability concerns the way land is used and sites designed; where buildings are located, how buildings are designed; materials and equipment selections; job site practices; and the education and practices of people, the users of places and buildings, and the ultimate benefactors of sustainable design and development.

Centerra is committed to sustainable development at both community and individual building levels, and expects individual developers and builders to approach their projects with environmentally-sound planning and design solutions.

Applicants for individual projects within Centerra will be expected to develop strategies and specific design and development proposals that are consistent with the goals of sustainable communities and sustainable buildings. Sustainable design and development includes a significant concern for and recognition of Centerra as a particular place. An understanding of, and response to the unique conditions and characteristics of site within a local and regional context. Just because a prototypical design has worked in other locations doesn't mean it is appropriate for Centerra.

Sustainability is influenced by a number of factors, including:

User Requirements

The needs of the users/occupants of the building or community, including spatial, auditory, visual, comfort, safety, and the energy and environmental loads dictated by these requirements. Users' needs should be organized and balanced in such a manner as to encourage sustainable design solutions.

Climate

Wind, sun, temperature, and other meteorological factors influences site climate, building placement, pedestrian and vehicle movement, daylighting, and use of renewable energy.

Vegetation

The kind and location of vegetation in and around the site as it influences site climate, building exposures, water consumption, wildlife habitat, and site integration.

Topography

The undulation of the ground plane and how it relates to drainage, wind patterns, airflow, and building integration.

Materials

Indigenous materials available on or around the site or from the region that can be used in the construction of the facility without significant adverse environmental impacts, and the use of products made from recycled materials or re-use of materials and products

Water

Judicious use of water resources for site vegetation needs and building and community needs.

Socio-Cultural

The manner in which past, present, and future generations influence and view the site and region and have shaped their values and beliefs.

Architectural Traditions

The way past and present generations interpreted the site and regional influences in architectural forms and materials used. The way that architecture has evolved near the site and the region.

Economics

A place of vitality and commerce. Where people can conduct their daily lives in an economically sustainable way. Sustainable development and design should not be a burden, but create added value.

Certifications

As part of Centerra's ongoing commitment to Sustainable Design and Development, all applicants will be required to demonstrate their level of compliance with the appropriate third party program as part of their DRC Applications for each application from Schematic Design through completion. For non-residential and high-rise residential projects, the U.S. Green Building Council's "Leadership in Energy and Environmental Design" (LEED) Green building rating system shall be used. It is a goal of Centerra to have applicable projects meet or exceed the current minimum standards for LEED Certification, (26 points) whether actually certified or not. For residential projects, Centerra's goal is to achieve a "Built Green" designation by the Home Builders Association of Denver, utilizing its "Built Green Checklist". This checklist will be used whether the builder chooses to enroll in the program or not. While full participation in these or other programs is highly encouraged, and will be acknowledged by the DRC, it will not be a requirement for final DRC approval of the project.

In addition to a number of local consultants who are well versed in assisting applicants in achieving these goals, the staff at Centerra's own High Plains Environmental Center (HPEC) is a close-in resource available to all applicants in Centerra.

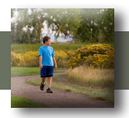
In addition to owning and managing much of Centerra's natural areas, the HPEC provides information and education to residents and users within Centerra regarding such things as environmentally sensitive lifestyle practices, wildlife cohabitation, local resources for building materials, local recycling programs, and landscape materials. The HPEC has a LEED accredited professional staff to assist applicants in their projects.

Resources

In addition to the following standards and guidelines, there are several good resources available to assist and guide the applicant in the design and development of their project. These resources were used in the development of these guidelines. Some resources and concepts are better suited for residential construction, while others are oriented to non-residential uses and construction. While not a comprehensive list of potential resources, they were consulted in the preparation of these guidelines and/or are a local resource to Centerra.

- **Architectural Energy Corporation**
  2540 Frontier Avenue, Suite 201
  Boulder, Colorado 80301
  (303) 444-4149
  Contact: Michael Holtz, FAIA
  www.archenergy.com

  A Boulder based energy and sustainable design consultant specializing in assisting owners in creating environmentally sensitive projects.



- **Eco-Products, Inc.**
  3640 Walnut St.
  Boulder, Colorado 80301
  (303) 449-1876
  www.ecoproducts.com

  Provides a wide variety of environmentally friendly, non-toxic and sustainable products.

- **RMI/ENSAR Built Environment**
  2305 Broadway
  Boulder, Colorado 80306
  (303) 449-5226
  Contact: Greg Franta FAIA
  www.ensargroup.com

  A Boulder based sustainable design consultant specializing in assisting owners in creating environmentally sensitive projects.

- **Environmental Protection Agency**
  "Energy Star" Program
  Climate Protection Partnership Division
  Energy Star Programs Hotline &
  Distribution (MS-6202J)
  1200 Pennsylvania Avenue NW
  Washington, DC 20460
  (888) STAR-YESS
  www.energystar.gov

- **High Plains Environmental Center**
  1854 Piney River Drive
  Loveland, Colorado 80538
  (970) 622-9697
  www.suburbitat.org

  The owner and manager of the natural areas at Centerra. Also serves as an educational resource for users in Centerra and includes a LEED accredited professional on staff.

- **Home Builders Association of Metro Denver**
  "Built Green Colorado" Program
  1400 S. Emerson
  Denver, Colorado 80210
  (303) 778-1400
  www.builtgreen.org

  Recommendations on Green Building for residential construction, including the "Built-Green Checklist."

- **Institute for the Built Environment**
  Guggenheim Hall
  Fort Collins, Colorado 80526-1584
  (970) 491-5041
  Contact: Brian Dunbar
  www.ibe.colorado.edu

  Part of Colorado State University Department of Construction Management, the Institute for the Built Environment leads and promotes educational programs on sustainability and green building design.

- **Ka$h or Kilowatts Electric Efficiency Program**
  Plate River Power Authority
  Paul Warila, Customer Services Engineer
  970-229-5604
  2000 East Horsetooth Road
  Fort Collins, Colorado 80525-5721
  www.prpa.org

  This program can help select the best technology for lighting, cooling and manufacturing. Savings of 15-50% on lighting, 10-30% on cooling, and 10-50% on manufacturing. In addition, they provide funding through their lighting project plan.

- **Leadership in Energy and Environmental Design (LEED)**
  Green Building Rating System.
  U.S. Green Building Council
  1015 18th Street, NW, Suite 508
  Washington, DC 20036
  (202) 828-7422
  www.usgbc.org

  The leading sustainable design evaluation system in the U.S. for non-residential and high-rise residential buildings.

- **National Association of Home Builders (NAHB)**
  Model Green Home Building Guidelines.
  National Association of Home Builders
  1201 15th street, NW, Washington D.C. 20005
  (800) 368 5242 x 8290
  Contact: Diane Webb (dwebb@nahb.com)
  www.nahb.org/gbg

  The boiler plate green home building guidelines published by the primary national trade organization for the housing industry.

- **Platte River Power Authority (PRPA)**
  2000 E. Horsetooth Road
  Fort Collins, Colorado 80525
  (970) 226 4000
  ww.prpa.org

  Wind Energy is aviable via the Loveland Water and Power Wind Program. PRPA is the source of this power.

- **Resource 2000**
  2700 63rd Street
  Boulder, Colorado 80303
  (303) 419-5418
  www.resource2k.org.

  Salvages used building material and re-sells them.

- **RMV Landscape and Maintenance**
  Rod Bryner
  970-278-9150
  2138 East Jeffers Frontage Road
  Loveland, Colorado 80538

  The company provides full irrigation and landscape installation and maintenance. Currently they manage Centerra's central control system for irrigation.

- **The Sustainable Design Resource Guide**
  AIA Denver
  1526 15th Street
  Denver, Colorado 80203
  (303) 446-2266
  www.aiacolorado.org/SDRG

  Published by AIA Denver, and the American Institute of Architects Committee on the Environment. A convenient resource that provides both general principles and guidance as well as specific, regional contacts and sources for services, materials, and equipment.

- **Waste-Not Recycling**
  1065 Poplar Street
  Loveland, Colorado 80537
  www.waste-not.com

  The program can help set up recycling of construction waste, providing containers and collecting wood, metal and other material. There are also ongoing recycling programs available for the commercial business in Centerra.

The following guidelines are aimed at improving building and site occupant well-being, protection of water sources, reduction in energy use and atmospheric impacts, improvement of indoor environmental qualities (air quality, thermal comfort, access to daylight, views, etc.), and reduction of the creation of waste/increase the use of recyclable/renewable material. Every choice that is made during the design and development process has an environmental consequence. These guidelines will assist an applicant in making choices that will be consistent with Centerra's guiding principles related to sustainability. The guidelines are organized in four overall categories: General Criteria, Land Use and Site Design, Building Design, and Job Site Practices. The general criteria introduce broad concepts while the remaining sections provide more specific recommendations for ease of use by the development, design and engineering team.

These standards and guidelines for sustainable development and design, in conjunction with nationally recognized resources (such as the LEED Rating System) define

the sustainable design criteria that shall be considered, which, if followed in an integrated manner, will result in a sustainable solution.

1.0 General Criteria

Principles

1. Establish a team that has a consciousness about all aspects of sustainable design and development.

2. Adhere to sustainable design and development principles and practices in all decision making.

Criteria

1.1 Assemble a design team based upon sustainability credentials in addition to other criteria.

1.2 Approach each task with environmental responsibility and sensitivity.

1.3 Wherever possible incorporate systems and procedures to reduce emissions that harm the environment.

1.4 Reduce and/or eliminate wastes at every opportunity.

1.5 Utilize energy-conserving systems, products, and practices.

1.6 Integrate environmental considerations in design and operational decisions.

1.7 Enhance natural ecosystems and preserve and promote urban wildlife opportunities.

1.8 Restore the environment at every opportunity.

1.9 Deal with the public in an open manner regarding environmental concerns, issues, and problems.

1.10 Develop owner/developer/management commitment to goals regarding environmental responsibility.

1.11 If the nature of a business requires the generation or storing of hazardous wastes, provide annual environmental audits and "progress reports", to be available for public review.

2.0 Land Use and Site Design

Principles

1. Control erosion to reduce negative impacts on water and air quality.

2. Reduce the environmental impact of the location of a building on a site.

3. Reduce pollution and land development impacts from vehicle use.

4. Protect existing natural areas and restore damaged areas for wildlife habitat.

5. Manage storm water run-off to limit disruption and pollution of natural water flows.

6. Reduce heat island effects of buildings and pavement to minimize impact on the micro climate.

7. Reduce water consumption through the use of water efficient landscapes.

8. Eliminate light trespass from the building and site to improve night sky and reduce development impact on nocturnal environments and xeriscape techniques.

2.1 Mix of Uses

2.1.1 Mix compatible land uses to promote pedestrian connections and reduce vehicular trips.

2.1.2 Provide shared parking opportunities for mixed-use projects to reduce total parking coverage.

2.1.3 Encourage development that allows people to live, work, shop, learn, gather, and play as part of their experience in the community.

2.2 Efficient Land Use

2.2.1 Increase density in compact, walkable centers.

2.2.2 Design facilities to use land efficiently and preserve natural open space and wildlife habitat.

2.2.3 Concentrate or cluster buildings to minimize impact on the land.

2.2.4 Leave the most pristine areas "untouched", developing primarily those areas which have already been impacted.

2.2.5 Utilize parking garages/structures to reduce the size of open parking fields and heat island effect.

2.3 Transportation

2.3.1 Locate buildings adjacent to existing roadways and trail systems and provide good connectivity.

2.3.2 Connect to and expand pedestrian and bike trail systems and provide connectivity for pedestrians and bikes internal to the site between buildings.

2.3.3 Locate near existing or proposed mass transit opportunities.

2.3.4 Provide secure bicycle storage and shower/changing facilities for building occupants to encourage bicycle and pedestrian commuting.

2.3.5 Organize carpools and shuttle systems to reduce reliance on single occupancy vehicles. Provide preferred parking for carpools and other incentives.

2.3.6 Provide and or encourage alternative fuel vehicles and provide preferred parking for these vehicles.

2.4 Building Siting and Orientation

2.4.1 Reduce energy use by orienting buildings to make optimal use of passive solar heating, daylighting, and natural cooling.

2.4.2 Situate buildings to benefit from existing vegetation, where possible. Trees on east or west sides can dramatically reduce cooling loads.

2.4.3 Organize buildings, roads and parking on their sites to minimize the amount of cut and fill which is energy intensive and minimizes import/export of material.

2.4.4 Limit site disturbance, including earthwork and clearing of vegetation to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways and utility trenches, and 25 feet beyond constructed areas with permeable surfaces (such as detention areas and landscape areas).

2.4.5 Provide shade (within 5 years) and/or use light colored/high albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's non-roof impervious surfaces, including parking lots, walkways, plazas, etc. to reduce heat island effects.

2.4.6 If possible, exceed the open space requirement for the site by 25% by reducing the building footprint and area for parking and drives.

2.4.7 If possible, place a minimum of 50% of parking spaces underground or covered by structured parking.

2.5 Storm Water Management
(see also the General Landscape Design Guidelines)

2.5.1 Develop grading and drainage designs that minimize run-off, impervious surfaces, and utilize storm drainage systems to meet basic engineering requirements.

2.5.2 Direct water from parking lots, roof drains and other areas into landscape areas that could benefit from additional water and/or improve the quality of the storm water.

2.5.3 Utilize porous pavement systems to minimize concentrated run-off and allow water to percolate through the pavement. Examples include modular pavers, porous asphalt, and porous concrete.

2.5.4 Utilize flexible paving systems, which adapt more naturally to site variations and can function as a porous pavement system.

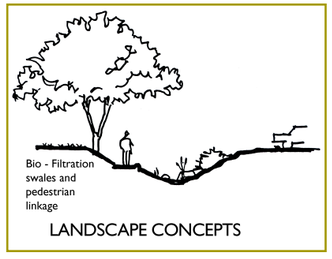
2.5.5 Convey drainage along dedicated streets, private drives and swales along property lines, or in open space corridors. Sheet flow and surface drain where possible.

2.5.6 Meet or exceed City of Loveland and Urban Drainage Best Management practices and standards for storm water management and erosion control.

2.5.7 Post development 1.5 year, 24 hour peak, run-off rates shall not exceed pre-developed 1.5 year, 24 hour, run-off rates.

2.5.8 Provide on-site storm water treatment systems designed to remove 80% of the annual post-development total suspended solids and 40% of the average annual post-development total phosphorous for all storms less than or equal to 2-year/24-hour storm by implementing either EPA or local Best Management Practices documents, whichever is more stringent.

2.6 Wetlands and Open Water



LANDSCAPE CONCEPTS

2.6.1 Wetlands provide multiple benefits to an ecosystem, including enhancing wildlife diversity functions as a part of the storm drainage system, and assist in water quality and flood control. Strict Federal regulations apply to both existing, natural wetlands and to those created. Any modifications to existing wetlands are likely to require permitting and involve the Army Corps of Engineers. The following should be considered when creating or modifying wetlands:

a. Proposed wildlife use
b. Proposed recreation use
c. Filtration zones
d. Hydraulics
e. Wildlife linkages
f. Management practices
g. Water quality
h. Aesthetics

2.6.2 Approach open water areas with piers and docks to avoid degrading water edges.

2.6.3 Provide biofiltration for all surface drainage entering open waters, allowing lateral zones to dominate wetland edges.

2.6.4 Within the western portion of Centerra, do not incorporate islands in wetland areas, as they invite large avian species which may interfere with the adjacent Fort Collins/Loveland airport.

2.6.5 Provide appropriately designed drop structures pond aeration, and fountains for aerating water bodies, subject to DRC approval.

2.6.6 Provide vegetation, native to Colorado and appropriate to the location, that enhance the habitat and its food sources for wetland species.

2.6.7 Avoid impacting existing wetlands. When impacts are necessary, mitigation shall be provided in appropriate manners. Plans involving any potential impacts or mitigation – or creating new wetlands – must be approved by the DRC and possibly the Army Corps of Engineers.

2.6.8 When dealing with wetlands and considering wetland modifications, retain qualified specialists to assess the existing conditions and develop mitigation plans.

2.7 Landscape Design and Management Practices

2.7.1 Effective landscape design and management yields many benefits, including such environmental benefits as water conservation, erosion control, wildlife habitat enhancement, and increasing the public's general appreciation for the surroundings. At Centerra, beneficial landscape design and management practices are intended to be used to the maximum extent possible.

2.7.2 See the General and District Specific Landscape sections for additional details and guidelines.

2.7.3 Use high efficiency irrigation technology in compliance with the specific Irrigation sections of the Design Guidelines.

2.7.4 Utilize water-efficient, low maintenance landscaping in compliance with the Landscape sections of the Design Guidelines with a goal of reducing potable water consumption for irrigation by 50% over conventional means.

2.8 Wildlife Cohabitation

2.8.1 Preserving and enhancing desirable wildlife habitat within Centerra are encouraged. This should be accomplished through thoughtful planning and design and consultation with the High Plains Environmental Center.

2.8.2 Identify each site's opportunities to sustain ecosystems, both macro and micro, in perpetuity. Do not introduce exotic species or unnatural solutions for maintaining or introducing species.

2.8.3 Use existing and proposed land forms to complement planting and water designs.

2.8.4 Consider long-term impacts and user loads relative to the site and habitats. It's unrealistic, for example, to expect appreciable levels of wildlife involvement in areas exposed to high human traffic. In such areas of high pedestrian and human involvement, appropriately scaled infrastructure must also be incorporated to minimize environmental damage. Docks and bridges or hard-surfaced nodes and pathways, for example, should be used for relating human traffic to pods and water, rather than via fragile natural areas.

2.8.5 When selecting target species to be introduced to an area, consider in the landscape/site design food sources; reproductive habitat requirements; and security. Many avian species are excellent choices, however targeting large, flocking birds should be limited to areas in the eastern portion of Centerra, and is discouraged in the western portion because of airport fly zones.

2.8.6 Incorporate linkages between open space and recreational corridors as part of individual site designs. Such linkages are critical for improving the wildlife system, and an important enhancement element for urban design. Primary target species for the area are small birds, and proposed uses for recreation areas are generally compatible with creating avian habitat. Increase and/or allow maximize edges between various structures' boundaries (e.g. water and shore, meadow and trees, etc.)

2.8.7 Separate compatible uses relative to wildlife habitats (e.g. a circulation path conflicting with an animal's reproductive habitat).

2.8.8 Incorporate specific habitat requirements for target species in the landscape/site design. In avian species, this means plant materials that provide winter cover and food. Birdhouses and shelter structures should also be incorporated. Interpretive signs should be considered for explaining objectives and identifying wildlife.

2.8.9 For control purposes, incorporate specific habitat-limiting elements (e.g. prairie dogs enjoy long,

unobstructed views – eliminating such views with plantings or structures is a limiting element for the prairie dog; ducks and geese enjoy larger ponds with islands and significant open water – limiting such features helps control the large flocks of birds, which are considered a nuisance to aviation at the nearby airport).

2.8.10 Provide clear corridors for wildlife movement. Many types of wildlife (especially small mammals) will resist crossing paved surfaces.

3.0 Building Design

A significant challenge to Sustainable Design and Development is finding suitable and available sources for material, products, and systems that are consistent with the goals of sustainability. The following guidelines are organized following Construction Specification Institute (CSI) Division Sections for ease of use by the specifiers of materials and systems by identifying the important concepts and options that should be considered in the project. More detailed information, particularly for local and regional sources, are available from the resources identified earlier, especially the AIA Committee on the Environment's Sustainable Design Resource Guide. The following are some of the questions that should be asked when selecting materials, products, and systems. They become The Foundations for the Principles associated with building development.

- Is the raw material renewable/recyclable?
- Does the harvesting/extraction/manufacturing process cause environmental degradation?
- What happens to waste/pollution during the process?
- Is it an energy intensive process?
- What is the payback period for energy/water saving systems and products – the time in which initial costs are recouped through lower long-term operating and maintenance costs?
- What is the recycled percentage for resource conserving materials?
- Is it more durable than competitors/alternatives?
- Does it off-gas toxins, and if so, for how long?
- Has the minimum amount of packaging been used and is it recyclable?
- How is the product disposed?
- Is it easily recycled and into what?
- What are its maintenance requirements?

Principles

1. Create energy and environmentally responsive buildings.
2. Enhance the quality and performance of the workplace environment, thus contributing to improved employee productivity, satisfaction, comfort, health, and morale.
3. Enhance the quality and performance of the retail environment, thus contributing to improved customer comfort and purchasing.
4. Enhance the quality and performance of the residential environment, thus contributing to improved residential comfort, satisfaction, and health.

3.1 General

3.1.1 Design buildings with optimum use of interior space in mind to keep overall building sizes – and operating demands on natural resources – to a minimum.

3.1.2 Orient buildings to make optimal use of passive solar heating, daylighting, and natural cooling opportunities.

3.1.3 Maximize daylighting opportunities, but when additional lighting is required use zoned and task lighting. To reduce energy consumption and cooling loads.

3.1.4 Utilize open interior planning to promote access to light, views, and ventilation.

3.1.5 Utilize energy-efficient building envelope techniques, specifying high levels of insulation, high-performance windows, tight construction, etc.

3.1.6 Design structures "to last", in terms of adaptability to other uses, as well as materials and methods. Choose materials and components that can be reused or recycled when changes are required.

3.1.7 Design buildings to use renewable energy. Consider incorporating photovoltaics in the structure, or incorporate opportunities for future installation.

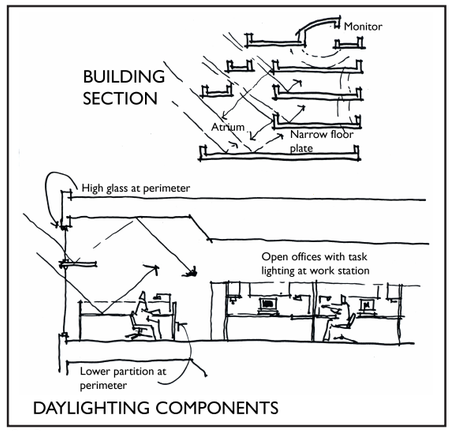


fig 3a

3.1.8 Optimize material use. Minimize waste by designing for standard sizes.

3.1.9 Avoid potential health and indoor air quality hazards, including radon, EMF, off-gassing, and pesticides by careful selection of materials and details.

3.1.10 Avoid ozone depleting chemicals in mechanical equipment and insulation.

3.1.11 Use durable products and materials. A product that lasts longer or requires less maintenance usually saves energy. Durable products also contribute less to solid waste issues.

3.1.12 Choose building materials with low embodied energy, the energy required to produce the material.

3.1.13 Buy locally (within 500 miles) produced building materials to reduce transportation impacts (energy use and pollution).

3.1.14 Use building products made from recycled materials, including:

a. Concrete
b. Asphalt
c. Metals
d. Wood
e. Glass
f. Certain plastics
g. Cellulose insulation

3.1.15 Use salvaged building materials when possible.

3.1.16 Minimize use of old-growth timber or tropical hardwoods, unless the seller can document that the wood comes from well-managed forests.

3.1.17 Minimize use of pressure treated lumber because of the toxins present in the product and used in its production.

3.1.18 Purchase items that minimize packaging waste, and recycle the packaging materials.

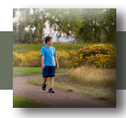
3.1.19 Install high-efficiency heating and cooling equipment to reduce energy consumption.

3.1.20 Install high-efficiency lights and appliances to reduce energy consumption.

3.1.21 Install water-efficient equipment.

3.1.22 Install mechanical ventilation equipment.

3.1.23 Fully commission all buildings. Major portions of the commissioning process include specifications, Operations and Maintenance manuals, operator training, and functional testing of all building systems to ensure that they are operating according to the design intent.



3.1.24 Choose materials, components, and systems based upon the following:

a. Indoor air quality
b. Operating energy
c. Resource depletion
d. Building durability and maintenance
e. Embodied energy
f. Embodied CO2

3.1.25 Plan for future expansion without demolition of built facilities.

3.2 Site Work

(Now Divisions 31-35 in current CSI Format - See also other sections of the guidelines including the Specific and General Landscape Guidelines for additional site work and landscape details and guidelines)

3.2.1 Cut and fill should be balanced to minimize reliance on imported or exported material and maintain sustainable earthwork practices.

3.2.2 Use of flexible paving systems should be maximized since they adapt themselves more naturally to site variations than rigid paving systems. The use of porous paving systems should be maximized since they allow water to percolate through the pavement, thus minimizing concentrated run-off. Flexible and porous paving systems include gravel surfaces, modular systems, grass paving systems, porous asphalt, and porous concrete paving.

3.2.3 Reuse construction pallets or grind up to produce landscaping mulch material.

3.2.4 Use native Colorado materials whenever possible to minimize transportation costs, conserve energy, and reduce pollution.

3.2.5 Where feasible, fly ash should be used in place of Portland cement in the concrete mixes.

3.2.6 Use plantings to provide wind and solar protection for both the building and occupants.

3.2.7 Radon control and mitigation should be considered in building design and construction. The site should be tested for radon prior to construction so that radon mitigation systems can be designed for the building to prevent indoor air quality problems.

3.2.8 Choose vegetation that is native to the area and minimizes water use.

3.2.9 Utilize natural mulchers to control weeds and moisture.

3.2.10 Protect existing trees to the maximum extent possible.

3.3 Concrete

3.3.1 Concrete should be specified with as high a pozzolan (fly ash) content as possible (15-30%) while still maintaining the appropriate strength and structural characteristics. Fly ash is a useful by-product of coal-fired power plants and can be a substitute for Portland cement.

3.3.2 Locally mined and produced aggregates and concrete products shall be specified from local manufacturers.

3.3.3 Concrete specifications should prohibit the use of toxic concrete additives and shall include a clause prohibiting the use of unapproved additives.

3.3.4 Use of precast concrete should be maximized due to the increased efficiency associated with the forming, batching, and casting at a central location.

3.3.5 When cast-in-place concrete is required, repetitive shapes should be used so that form work can be reused; avoid one-off configurations; and when plywood forming is essential, plan flat surfaces in modules of plywood dimensions to reduce waste.

3.3.6 Where practical, concrete using recycled materials should be used.

3.3.7 Utilize stay-in-place insulating form work when possible.

3.3.8 Residential foundations should include insulation levels that meet an R-10 rating.

3.4 Masonry

3.4.1 When brick is used, specify locally made bricks using indigenous materials.

3.4.2 When concrete masonry units are required:

a. Specify locally manufactured units;
b. Specify units manufactured using a maximum amount of fly ash (when possible).

3.4.3 Use masonry appropriate for the application, exploiting at least two of masonry's positive qualities (ease of design and construction, durability, load bearing capacity, potential for thermal performance).

3.4.4 When stonework is required, the following guidelines should be used in specifying stone with the lowest embodied energy.

a. Use loose stones found on or near the surface.
b. Use stone from a local source (within 75 miles.)
c. Allow for dimensional variation in size/ thickness of stone.
d. Specify a rougher surface finish whenever possible, since it requires less energy to produce.

3.4.5 Carefully select chemical treatments for mortar to minimize their environmental effects. Specify non-toxic additives, and include a clause in the specifications prohibiting the use of unapproved additives.

3.4.6 Consider masonry made with recycled and waste materials.

3.4.7 Specify masonry using locally mined and produced materials.

3.4.8 Utilize straw bale construction technology when allowed by building codes.

3.5 Metals

3.5.1 Specify metals with a high recycled content.

a. Structural steel should have a recycled content in excess of 66%.
b. Steel joists and girders should have recycled content in excess of 80%.
c. Cold-formed metal framing should utilize the highest recycled content possible. Products shall be specified with recycled contents in excess of 50% (100% recycled content if possible).

3.5.2 Recycle all construction waste.

a. Provide job site separation for the different types of metals being used on the project.

3.5.3 Whenever possible, specify materials from local manufacturers.

3.6 Wood, Plastics, and Composites

3.6.1 Engineered lumber products should be used to minimize use of old growth timber. Engineered lumber uses low density, fast-growing varieties of trees in combination with plastic resins. Engineered lumber includes truss-joists, I-joists, laminated veneer lumber (LVL), parallel strand lumber (PSL), glue-laminated beams, oriented strand board (OSB), waferboards, and particleboards.

3.6.2 Waste lumber on the site shall be recycled for blocking, engineered lumber, mulch, etc.

3.6.3 Formaldehyde emissions should be minimized by specifying low-emitting UF-bonded panel products or phenol-bonded products.

3.6.4 Materials from local manufacturers should be specified whenever possible.

3.6.5 Waste plastic on the job site should be recycled.

3.6.6 Use woods originating from known sustainable or well-managed sources.

3.6.7 When rare woods are required, use veneers instead of solid wood.

3.6.8 When wood preservatives are required:

a. Use preservatives sparingly and develop standard details, which do not rely on preservatives. Less toxic preservatives should be used whenever possible. These include copper napthenate, copper-8-quinolinate, and borax salt for indoor use.

b. Have treated wood sealed whenever possible.

3.6.9 Recycled plastic products should be specified whenever possible.

3.6.10 Avoid plastic foams which use CFC's or HCFC's as blowing agents.

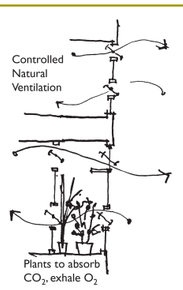
3.6.11 Minimize the use of materials which use PVC's in their makeup.

3.6.12 Use easily recycled plastics (avoid composites, which are difficult to recycle).

3.6.13 Avoid using plastics for coating, bonding, and sealing.

3.6.14 Avoid petroleum based plastics.

3.6.15 Utilize salvaged lumber for flooring, trim, heavy timbers, and framing when possible.



AIR QUALITY CONCEPTS

fig. 3b

3.7 Thermal and Moisture Protection

3.7.1 Sealants shall be of a "neutral curing" with no solvent release format.

3.7.2 When waterproofing, damp-proofing, and/or water repellents have to be used, products shall be specified which minimize the use of volatile organic compounds (VOC's). The following minimum requirements shall be met.

a. General primers, sealers, and undercoaters must not have VOC concentrations exceeding 2.9 lbs./gal.

b. Waterproofing mastic coatings must not have VOC concentrations exceeding 2.5 lbs./gal.

c. Waterproof sealers must not have VOC concentrations exceeding 3.3 lbs./gal.

3.7.3 Avoid using isocyanurate, urethane, and phenolic rigid foam insulation manufactured using CFC's or HCFC's. If rigid boardstock is required, choose rigid fiberglass or expanded polystyrene (often called EPS or beadboard) which is formed using pentane.

3.7.4 Whenever possible, only products and materials with high recycled content should be used.

3.7.5 When loose-fill mineral fiber insulation is used, carefully seal the insulation from inhabited spaces to minimize carcinogenic potential.

3.7.6 Where possible, maximize use of cellulose for insulation.

3.7.7 Lead-coated roofing and flashing should be avoided.

3.7.8 When coal and petrochemical roofing systems are required, care should be taken to use products with a high percentage of recycled material.

3.7.9 Utilize manufactured roofing and siding systems that include; fiber cement, recycled metals, recycled plastics, and wood-waste by-products.

3.7.10 Explore the use of Green Roof technology www.greenroofs.org.

3.8 Openings

3.8.1 Solar heat gain from glazings shall be minimized for non-residential projects through use of shading devices.

3.8.2 Passive solar heating strategies should be utilized for residential applications through appropriate building/window orientations.

3.8.3 Exterior glazing materials adjacent to occupants shall be selected which maximize occupant comfort, usually incorporating high performance films or coatings.

3.8.4 Use of recycled materials shall be maximized where appropriate.

3.8.5 Use high performance glazing (low 'e' and/or suspended plastic film heat mirror) appropriate to the exposure.

3.8.6 U-values should be appropriate for the wall section. Doors and windows should not be expensively over-insulated.

3.8.7 To ease future recycling of building components, avoid using complicated material combinations.

3.9 Finishes

3.9.1 Low toxic content finishing materials should be used to ensure better indoor air quality.

3.9.2 Latex paints should be used instead of alkyd-based paints to minimize toxic fumes.

3.9.3 Do not select finishes only on the basis of low first cost. More durable materials with less outgassing may have a higher initial cost, but can be more economically viable over the life of a building.

3.9.4 Install carpets with natural fibers (jute, cotton, wool) and which do not contain formaldehyde, or select carpets, which utilize recycled content.

3.9.5 Wherever possible, use drywall systems that contain recycled material. These new systems behave like a combination of standard drywall systems and old-style lathe and plaster and are not difficult to apply.

3.9.6 Avoid materials with volatile organic compounds (VOC's) and urea-formaldehyde to improve indoor air quality.

3.9.7 Flooring materials containing PVC, which is a VOC, should be avoided. Sheet vinyl and vinyl tile are often composed mainly of PVC material, whereas linoleum, which is biodegradable and emits no toxic gases, does not. Rubber sheet goods and certain tiles are also good candidates for flooring; many of these products contain recycled materials.

3.9.8 When using wood wall or floor finishes, wood should be selected from sustainably managed, preferably regional, forests.

3.9.9 When using wall coverings, utilize biodegradable papers with recycled content of paper or fiber. Avoid vinyl wall coverings that are manufactured from PVC.

3.9.10 Explore wall coverings made of alternative materials, such as pressed sunflower seeds as an alternative to wood or other materials.

3.9.11 Utilize ceiling tiles that do not promote indoor air quality problems, such as those made from perlite.

3.9.12 Utilize non-solvent adhesives such as yellow and white glues.

3.9.13 Avoid butyl sealants as they emit VOC's and other toxic compounds.

3.10 Specialties

3.10.1 Whenever possible, use specialty products that use recycled material. Examples include: recycled plastic toilet partitions, vanity tops, locker room benches, tack boards, shelving, display panels, and partitions.

3.10.2 Avoid use of wood burning stoves/fireplaces unless they comply with State and EPA clean burning standards

3.11 Equipment

3.11.1 Energy Star rated office equipment should be

used to minimize thermal loads on the building.

3.11.2 Consider Energy Star rated refurbished products. Examples include: refrigerators, stoves, copiers, fax machines, printers, and computers.

3.11.3 Refer to EPA's ENERGY STAR logo indicating a power-down feature during periods of inactivity.

3.11.4 Consider the indoor air quality issues associated with office equipment. Of particular concern are copiers, fax machines, computer monitors, and printers.

3.11.5 Provide convenient recycling equipment and facilities for all users and occupants.

3.11.6 Provide Carbon Monoxide (CO) sensors with alarms.

3.12 Furnishings

3.12.1 Furnishings should be selected which use natural and recycled materials and which minimize the use of materials containing toxic substances. (Note: Life safety issues sometimes require the use of substances such as fire retardants which contain some toxic elements).

3.12.2 Whenever possible, foam products made without CFC's shall be used.

3.12.3 Whenever possible, mats and rugs made with recycled materials, such as recycled tires, should be used. Note: mats and rugs made from natural materials (wool, cotton, or jute) are not as durable as synthetic products but should still be considered.

3.12.4 All wood furnishings should be of indigenous materials, not exotic species.

3.12.5 Manufactured casework should be selected that include non-toxic finishes and adhesives.

3.12.6 To reduce heat gain, provide shades and blinds made of natural or recycled materials to the extent possible. Avoid plastic blinds.

3.12.7 Utilize refurbished and reconditioned furnishings to the extent possible.

3.13 Special Construction

3.13.1 Provide alternative energy systems (including photovotaics or geo-thermal energy) for water heating, space heaters, exterior lighting, pumping systems, etc.

3.13.2 Utilize light shelves at windows to enhance daylighting applications.

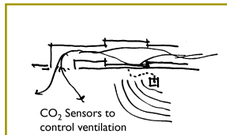
3.14 Conveying Equipment

3.14.1 Utilize the minimum amount of elevators, escalators, and people movers possible to encourage walking and climbing of stairs as a means to promote a healthy lifestyle.

3.15 Plumbing and HVAC (Now Divisions 22 & 23 In CSI Format)

3.15.1 The mechanical systems shall be designed using energy efficient equipment for heating, cooling, and ventilation.

3.15.2 The mechanical systems shall be sized to account for the use of daylighting or passive solar heating within the building.



AIR QUALITY CONCEPTS
fig. 3c

3.15.3 Indoor air quality issues shall be addressed when designing the ventilation system.

3.15.4 All cooling systems shall be CFC-free.

3.15.5 Select equipment that will not have high maintenance problems and beware of commonly overlooked interactions between conservation measures that undermine overall efficiency of building operation.

3.15.6 Use salvaged materials when possible, buy locally produced products, and avoid ozone-depleting chemicals in mechanical equipment.

3.15.7 Take maximum advantage of ventilation as a cooling strategy (air economizer) to minimize mechanical cooling requirements. Water economizers, which require a cooling tower, may be used instead of an air economizer. The relative economic benefits of air vs. water economizers should be explored for a given application.

3.15.8 The HVAC system should be commissioned prior to building occupancy and periodically diagnosed for proper operation. An independent commissioning agent should be retained to monitor the work of contractors and to oversee the operation of a building over the long term.

3.15.9 During the heating season, mechanical heating needs can be offset by the use of heat recovery devices in the ventilation system for non-residential uses.

3.15.10 Passive solar heating strategies should be used to reduce mechanical heating needs in residential uses.

3.15.11 Consider evaporative cooling as a highly cost-effective strategy in the dry Colorado climate to augment mechanical cooling.

3.15.12 Given the cost of electricity, gas cooling may be a viable alternative.

3.15.13 Thermal storage systems should be considered to improve the performance of electric and gas cooling equipment.

3.15.14 Energy management systems (EMS) are a highly effective means to ensure the efficient operation of an HVAC system. Major strategies to consider are: nighttime temperature setback, optimizing supply air temperature based on individual zone requirements, shutting off fans at night, and so forth.

3.15.15 Heat recovery from hot water use should be considered.

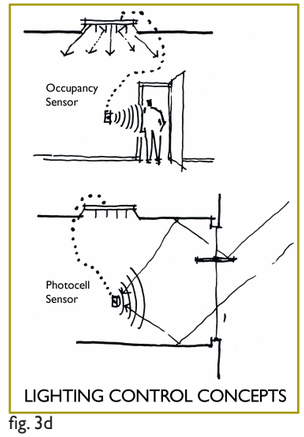
3.15.16 Install water conservation devices: low flow toilets, showerheads, and faucets with infrared sensors to sense user presence, greywater use devices, etc.

3.16 Electrical and Lighting (Now Divisions 26 & 27 in Current CSI Format)

3.16.1 Efficient lighting fixtures using compact fluorescent lamps, T8 fluorescent lamps, and electronic ballasts should be used to meet the required illumination levels, and to reduce electrical energy use and demand.

3.16.2 Occupancy sensors and EMS should be used to turn off lights when they are not needed.

3.16.3 For office spaces, the luminous environment shall be designed for a visual display terminal (VDT) intensive environment, including consideration of indirect lighting.



LIGHTING CONTROL CONCEPTS
fig. 3d

3.16.4 Occupant override of automatic lighting controls should be provided.

3.16.5 All lighting controls and equipment should be selected and optimized to take full advantage of the daylighting systems designed into the building.

3.16.6 All lighting control equipment should be commissioned prior to building occupancy.

3.16.7 Cogeneration, which generates electricity (usually by a gas-fired system) and utilizes a heat-recovery system, should be considered for the building.

3.16.8 Electromagnetic fields (EMF's) generated by electrical conductors and equipment should be diagnosed and treated by appropriate shielding to protect human health.

3.16.9 Use renewable energy when available, including power from "wind farms", such as that available from Platte River Power Authority.

4.0 Job Site Practices

The practices of the Contractor during construction is a key influence on sustainable building. Up to 25% of an average landfill is construction and demolition waste. Minimizing site disturbance and grubbing practices can make a big difference in site bio-diversity and protection of habitat. All construction at Centerra will incorporate a wide variety of sustainable building techniques.

4.1 Protect trees from damage during construction by fencing off the "drip line" around them and avoiding major changes to surface grade.

4.2 Avoid use of pesticides, herbicides, and other chemicals that may leach into groundwater.

4.3 Do not bury any construction debris.

4.4 Centralize cutting operations to reduce waste and simplify sorting.

4.5 Set up clearly marked bins for different kinds of usable or recyclable waste (wood scraps, metals, cardboard, etc.). Educate all workers on recycling procedures.

4.6 Arrange carpools to job sites. Schedule site related errands to minimize unnecessary driving.

4.7 Set up break/lunch areas to discourage workers from leaving the job site at lunch.

4.8 Minimize the use of disposable cups, etc. on the job site. Recycle all materials possible.

4.9 Utilize recycled office paper and supplies and recycle after use.