Columbine Elementary

Green building Strategies for consideration

May 20th, 2009 – 1st draft

Categories follow LEED for Schools 2009 v3

Sustainable Sites

Construction Activity Pollution Prevention
Control soil erosion, waterway sedimentation and airborne dust generation

Environmental Site Assessment
Assess for environmental contamination - remediate as necessary.

Site Selection
Avoid the development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

Development Density & Community Connectivity
Channel development to urban areas with existing infrastructure, protect green-fields and preserve habitat and natural resources.

Alternative Transportation, Public Transportation
Reduce pollution and land development impacts from automobile use.

Alternative Transportation, Bicycle Use
Reduce pollution and land development impacts from automobile use.

Include ample, conveniently sited, well lit bike racks at multiple access points to facilitate bike use.

Design pathways and landscape to increase and enhance pedestrian and bike access to the school and through the site.

Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles
Include a plug-in hybrid station

Alternative Transportation, Parking Capacity
No new parking is added even though capacity of the school is greater than the current school. Planning anticipates increased neighborhood attendance with a resulting percentage increase in the number of students arriving by bike or walking.

Site Development, Protect or Restore Habitat

Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Existing trees will be protected and the southern edge of the property will be landscaped to promote a natural habitat for local wildlife.

Site Development, Maximize Open Space
Promote biodiversity by providing a high ratio of open space to development footprint.

Provide vegetated open space area adjacent to the building that is equal in area to the building footprint.

Stormwater Design, Quantity Control
Limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from storm-water runoff and eliminating contaminants.

Placement of the building to allow maximum opportunity for storm-water run-off to percolate through permeable surface.

Placement of building to improve or maintain existing 100 year floodway conditions.

Placement of landscape features (Learning landscape nature trail) to accept surface water from site and protect existing residential neighbors.

Storm-water Design, Quality Control
Implement a storm-water management plan that reduces impervious cover, promotes infiltration and captures and treats the storm-water runoff from 90% of the average annual rainfall1 using acceptable best management practices (BMPs).

Placement of the building to allow maximum opportunity for storm-water run-off to percolate through permeable surface.

Design of landscape features and selection of plants (Learning landscape nature trail) to accept and filter surface water from site (bio-filtration swales).

Heat Island Effect, Non-Roof
Provide shade from the existing tree canopy or within 5 years of landscape installation. Landscaping (trees) must be in place at the time of occupancy.

Heat Island Effect, Roof
Use roofing materials with a solar reflectance index2 (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Light Pollution Reduction

Comply with Dark Skies ordinance; use minimum safe, exterior light levels allowed by code; implement a Lights Off Program (after 11pm) for all exterior lights

Site Master Plan
Planning for future capacity and demographic changes

Joint Use of Facilities
Planning for neighborhood use of common facilities such as media center, gym, stage, walking paths, fields, playgrounds and parking for soccer events.

Soil conservation
Stockpile existing topsoil for re-use

Balance cut and fill on site

"Learning Landscape"
Create an interpretive Nature Walk along the southern edge of the site connecting Repplier and 22nd.

"Garden to Table"
Incorporate edible gardens into the landscape and curriculum to augment the school lunch program.

Water Efficiency

Water Efficient Landscaping
Reduce water use by 50% through use of Xeriscaping, Permaculture, drip irrigation and low-spray emitter heads.

Protect existing established trees – no additional irrigation to existing trees.

Use rooftop rainwater diversion into planting beds.

Water Use Reduction
30% Reduction target; use waterless urinals, low flow toilets, appliances, kitchen equipment and faucets.

Grey-water
Grey-water is now legal in Boulder. Sink & shower water is reclaimed and purified, then re-used to flush toilets. Currently there have only been residential applications locally. It is not yet allowed for landscaping use due to Colorado water law and Health Department issues.

Permeable surfaces
Maximize permeable landscape surfaces for water absorption.

Energy & Atmosphere

Passive Solar design
The overall layout of the school began with passive solar design. This includes:
Primary long axis is east-west, allowing for optimal passive solar control.
Most classrooms to receive northern or (indirect) southern day-light
External horizontal shading devices protect southern windows
High-performance (max. U-0.30), double paned, Low-E windows on all faces to be "tuned" for optimal Solar Heat Gain Coefficient
Overhangs and eaves sized for optimal winter gain and summer shading

High performance envelope
Walls: R-30 min.
Roof: R-60 min.
Slab: R- 10 min.

Insulation shall be a combination of spray foam, cellulose, sub-grade rigid insulation and on the roof tapered rigid insulation. Design shall include special attention to eliminate all thermal breaks.

Fundamental Commissioning of the Building Energy Systems
Verify that the project's energy-related systems are installed, calibrated and perform according to the owner's project requirements, basis of design and construction documents.

Designate an individual as the commissioning authority

Commission:
- Heating, ventilating, air conditioning and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls
- Lighting and day-lighting controls
- Domestic hot water systems
- Renewable energy systems

Energy Performance
Target for all systems:
Comply with all of the prescriptive measures identified in the Advanced Energy Design Guide for K-12 school buildings or the Advanced Buildings™ Core Performance™ Guide

OR 30% better than ASHRAE 90.1- 2004.

Fundamental Refrigerant Management
Zero use of chlorofluorocarbon (CFC)-based refrigerants in new base building heating, ventilating, air conditioning and refrigeration (HVAC&R) systems

Optimize Energy Performance
Utilize energy modeling – currently seeking modeling grant through Xcel

On-Site Renewable Energy
Solar electric (PV): Plan and pre-conduit for a 10kW roof-mounted Photovoltaic system; apply for grants to fund the system

Solar hot water: considered and rejected due to BVSD's prior experience with solar hot water resulting in substantial long-term maintenance issues

Wind: not cost effective at this time; Boulder has the lowest wind suitability rating due to wildly variable wind conditions (min. average suitable wind speed is 10mph – Boulder is 8.6; the extra high winds common here can also shut down or damage the turbines); tower would need to be a minimum of 60 ft. tall for optimal performance.

Geothermal: an excellent long-term heating and cooling source, however up-front costs are prohibitive without additional outside funding; system is estimated to cost $_____ above our recommended baseline system.

Enhanced Commissioning
Begin the commissioning process early in design process and execute additional activities after systems performance verification is completed.

Per LEED recommendations this may be cost-prohibitive, but some enhanced commissioning may be performed by design team mechanical/electrical engineers.

Enhanced Refrigerant Management
Per LEED requirement, select refrigerants and heating, ventilating, air conditioning and refrigeration (HVAC&R) that minimize or eliminate the emission of compounds that contribute to ozone depletion and global climate change

Measurement & Verification
Develop and implement a measurement and verification (M&V) plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2) or Energy Conservation Measure Isolation, as specified in the International Performance Measurement & Verification Protocol (IPMVP)

Other Green Power
Purchase wind generated electricity from Xcel

Exit signage
Utilize LED exit signs

Smart Grid metering
Utilize Smart Grid electrical meters

Energy management System
HVAC system controlled by Andover Energy Management system. System adjusts heating and cooling levels during unoccupied times to reduce overall energy consumption, uses outside air to cool buildings in the spring, winter and fall, and allows to night-time building flush.

Electrical Lighting Energy Saving Concepts

1. Daylight Harvesting:
    a. Classrooms – Option 1:
        Photosensors to control lights adjacent to window and possible in center of room – Consider integral photosensors in lights
        Dimming ballast in lights by window and in center of room
        Occupancy sensor in room to turn lights off when not occupied
        Manual controls at door for audio/visual presentations, etc.

    Provides most user comfort, saves most energy, but is most costly option.

    Classroom – Option 2:
        Photosensor to control lights adjacent to window – Consider integral photosensors in lights
        Standard ballasts in lights – will switch on / off
        Occupancy sensor in room to turn off when occupied
        Dual level switch, separate by rows or front/back

    Automatic daylight harvesting, Switching of lights on and off is distracting, but less expensive option that still saves energy.

    Classroom – Option 3:
        Photosensor to control lights adjacent to window– consider integral photosensors in lights
        Step-dimming ballasts in lights. Utilize either 7 step product Simply5, proprietary by Lithonia and Osram Sylvania, or utilize 5 step product, non-proprietary but “steps” of lights are more apparent.
        Simply5 is only for T5 or T5HO lamps
        5 step dimming ballast will limit number of lamps able to use

Occupancy sensor
Dual level switching,

Allows for automatic daylight harvesting, cost saving over dimmable ballasts, step dimming may still cause some distraction but should be less than switching, compatible lamps are limited, proprietary system. 2nd most expensive option

Note:
Photosensors can be provided in individual classroom or a single photosensor could control a zone of classrooms.

Classroom – Option 4 – Base:

Dual level switching with one switch at door, second switch for window row of lights will be located on or near window wall.
Occupancy sensor – 50% on, Auto off

Least energy saved with no automatic daylight harvesting. Meets District's Tech Guide.

2. Occupancy sensors:
    a. The District's standard requests occupancy sensors in corridor, gang toilets. We will also use dual level occupancy sensors in offices, and conference rooms.
    b. Utilize timer switches in storage areas.

3. Exterior lighting:
    a. Utilize CF lamping in building mount exterior luminaires.
    b. Pole mounted luminaires will utilize metal halide lamps.
    c. **Considered but discarded because of payback/cost issues:** Two levels of lighting with motion sensor controls allows light to stay at lower light levels and increase light levels when personnel enter the area. Requires two lamps or step dimming system for HID lamps. Expensive cost but saves energy and reduces light output.
    d. **Considered but discarded because of payback/cost/maintenance issues as well as untested technology:** LED exterior luminaires: There are exterior LED pole lights available. These luminaire are more costly than standard light but offer energy saving as well as reduced maintenance cost because of the 50,000+ lamp life.
    e. District utilizes a Lights Out program which turns off exterior lighting at 11:00 pm. Relay panel will provide time clock and photocell control for exterior lights and time clock control for interior lights.

4. Provide provisions for future connection of PV system
5. Provide 220V recharging station receptacles at parking lot for electric cars.
6. Include a system which will monitor and display electrical usage is being explored.

Mechanical Concepts

- Multiple HVAC options being considered
- Recommended: VAV w/ overhead distribution
- Energy saving system strategies:
  - High efficiency condensing hot water boilers
  - Indirect evaporative cooling
  - Heat recovery from building exhaust
  - Variable speed pumping, variable air volume control on the air systems
  - High efficiency domestic water heaters (condensing type)
  - High efficiency air-cooled water chiller
  - White TPO roof to minimize “heat island effect” cooling loads

Materials & Resources

Storage & Collection of Recyclables

Provide an easily-accessible dedicated area or for the collection and storage materials for recycling for the entire building. Materials must include at a minimum paper, corrugated cardboard, glass, plastics and metals.

Provide composting facilities.

Building Reuse

Reuse furnishing from existing school.

Deconstruction of existing school

Divert a minimum of 50% by weight from Landfill Disposal
Donate re-useable materials to The Reuse People

Construction Waste Management

Divert 50% from Disposal

Ecologically preferable materials

Select materials that:
include recycled material
are recyclable
are rapidly renewable
are durable
are local (extracted, harvested, processed and/or manufactured within a 500 mile radius)

Some specific products include but are not limited to:
Cradle-to-cradle carpeting
Min. 25% fly-ash in concrete
Homosote acoustic boards
Cork flooring
Engineered lumber
Salvaged lumber

Certified Wood
Use a minimum of 50% (based on cost) of wood-based materials and products that are certified in accordance with the Forest Stewardship Council's principles and criteria, for wood building components. These components include at a minimum, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes.

Optimum Value Engineered recycled steel structure
Structural layout to include Optimum Value Engineered design to minimize steel and other required structural elements.

Indoor Environmental Quality

Minimum IAQ Performance
Meet the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality (with errata but without addenda1).

Environmental Tobacco Smoke (ETS) Control
Prohibited within building or within 25 ft. of building openings.

Minimum Acoustical Performance
Achieve a maximum background noise level1 from heating, ventilating and air conditioning (HVAC) systems in classrooms and other core learning spaces of 45 dBA. Design classrooms and other core learning spaces to include sufficient sound-absorptive finishes for compliance with reverberation time requirements as specified in ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools.

Confirm that 100% of all ceiling areas (excluding lights, diffusers and grilles) in all classrooms and core learning spaces are finished with a material that has a Noise Reduction Coefficient (NRC) of 0.70 or higher.
Or
Confirm that the total area of acoustical wall panels, ceiling finishes, and other sound-absorbent finishes equals or exceeds the total ceiling area of the room (excluding lights, diffusers and grilles) Materials must have an NRC of 0.70 or higher to be included in the calculation.

Outdoor Air Delivery Monitoring
Install permanent monitoring systems to ensure that ventilation systems maintain design minimum requirements.

Increased Ventilation
Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2007 (with errata but without addenda1) as determined by IEQ

Provide operable windows in all spaces; coupled with sensors to de-activate mechanical HVAC when opened.

Use heat recovery ventilators to minimize the additional energy consumption associated with higher ventilation rates.

Construction IAQ Management Plan, During Construction
Develop and implement an (IAQ) management plan for the construction and preoccupancy phases of the building per LEED requirements.

If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction.

Construction IAQ Management Plan, Before Occupancy
Flush out period: After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot of floor area while maintaining an internal temperature of at least 60° F and relative humidity no higher than 60%.

Low-Emitting Materials
Reduce the quantity of indoor air contaminants that are odorous, irritating and/ or harmful to the comfort and well-being of installers and occupants.

Adhesives and Sealants:
All adhesives and sealants installed in the building interior (defined as insidethe weatherproofing system and applied on-site) must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

Paints and Coatings:
All paints and coatings installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions fromVarious Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

Flooring Systems:
All flooring elements installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

Composite Wood and Agrifiber Products:
All composite wood and agrifiber products installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

Furniture and Furnishings:
New Classroom furniture including all student and teacher desks, tables and seats that was manufactured, refurbished or refinished within 1 year prior to occupancy must be GREENGUARD Children and Schools certified. Salvaged and used furniture that is more than 1 year old at the time of occupancy is excluded.

Ceiling and Wall Systems:
All gypsum board, insulation, acoustical ceiling systems and wall coverings installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

Indoor Chemical & Pollutant Source Control
Select products that minimize Volatile Organic Compound (VOC) content throughout.

Minimize building occupant exposure to potentially hazardous particulates and chemical pollutants.

Employ permanent entryway systems at least 10 feet long

Sufficiently exhaust each space where hazardous gases or chemicals may be present or used

In mechanically ventilated buildings, install new air filtration media in regularly occupied areas prior to occupancy; these filters must provide a minimum efficiency reporting value (MERV) of 13 or higher.

Provide containment (i.e. a closed container for storage for off-site disposal in a regulatory compliant storage area, preferably outside the building) for appropriate disposal of hazardous liquid wastes in places where water and chemical concentrate mixing occurs (e.g., housekeeping, janitorial and science laboratories).

Controllability of Systems, Lighting

Provide lighting system controls for all learning spaces to enable adjustments that meet group needs and preferences.

In classrooms, provide a lighting system that operates in at least 2 modes: general illumination and A/V. (See energy section for Columbine's specific recommendations)

Controllability of Systems, Thermal Comfort
Provide individual comfort controls for 50% (minimum) of the building occupants in workspaces to enable adjustments to meet individual needs and preferences.

Conditions for thermal comfort are described in ASHRAE Standard 55-2004 (with errata but without addenda2) and include the primary factors of air temperature, radiant temperature, air speed and humidity.

Thermal Comfort, Design
Design heating, ventilating and air conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy (with errata but without addenda1).

Thermal Comfort, Verification
Agree to conduct a thermal comfort survey of building occupants

Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building.

Daylight & Views
Provide building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Target 100% of primary classrooms to have optimal natural day-lighting.

Incorporate light shelves or day-lighting louvered blinds to bounce light further into classroom spaces.

Utilize Suntubes, Sundolier, insulated Kalwall skylights or other rooftop daylight harvesting devices for interior spaces.

Refer to LEED requirements for day-lighting design where applicable.

Enhanced Acoustical Performance, 40 dBA / RC level of 32
Design the building shell, classroom partitions and other core learning space partitions to meet the Sound Transmission Class (STC) requirements of ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, except windows, which must meet an STC rating of at least 35

Reduce background noise level1 to 40 dBA or less from

Mold Prevention
Provide heating, ventilating and air conditioning (HVAC) systems and controls designed to limit space relative humidity to 60% or less during all load conditions, both occupied and unoccupied.

Utilize EPA's Design Tools for Schools - a comprehensive program for preventing mold during the design and construction phases of a school project

Innovation & Design Process

School as a Teaching Tool
Design a curriculum based on the high-performance features of the building, and commit to implementing the curriculum

Install monitoring equipment that allows teachers, staff and students to observe and analyze the system performance of the school.

Operations and maintenance

Cleaning products
Use non-toxic cleaning and maintenance products

Green Star
Continue participation in The Green Star waste reduction program