Green Healthcare Construction Guidance Statement

Green Building Committee of the American Society for Healthcare Engineering
Developed for use in conjunction with the ASHE Sustainable Design Awards Program.
NOTE: ASHE has withdrawn this document in deference to the subsequent development of the GGHC. It is included here for historical reference

Statement of Principles

The construction and use of buildings in all sectors consumes 3 billion tons of raw materials annually (40% of raw stone, gravel, sand, and steel, 25% of virgin wood, 40% of energy resources, 75% of PVC, 17% of freshwater flows) and generates significant waste (25-40% of municipal solid waste from construction and demolition alone), 50% of CFCs, about 30% of US CO2 production, and substantial toxic emissions.

Given this, the opportunities are significant to improve environmental quality through green planning, design, construction and operations and maintenance practices. Improving the environment through green construction practices is consistent with the American Hospital Association's recent voluntary agreement with the United States Environmental Protection Agency to reduce waste volume and toxicity.

Building design and construction practice can be shaped to protect health at three scales:

1) Protecting the immediate health of building occupants

The health of patients, staff, and visitors can be profoundly affected by the quality of the indoor air which in turn is dependent upon physical and mechanical design (such as ventilation and location of wastes and toxics), the choice of building materials, the management of construction emissions, and building operations and maintenance. Additionally, access to daylighting has been found to favorably affect staff productivity and patient outcomes.

2) Protecting the health of the surrounding community

Local air and water quality is also significantly affected by building design choices. Off-gassing building materials and finishes, construction equipment and HVAC systems directly emit VOCs, particulates and other materials that can result in the formation of ground level ozone (smog), and cause allergic attacks, respiratory problems and other illnesses. Land use and transportation planning, landscape and water management on the grounds and water conservation efforts within the building will influence the amount of toxic emissions released to the water and air throughout the life of the building.

3) Protecting the health of the larger global community and natural resources

The health impact of a building stretches far beyond its immediate community. The production of building materials can result in the release of persistent bioaccumulative toxic compounds, carcinogens, endocrine disruptors and other toxic substances. These compounds threaten communities where the materials are manufactured, and, because of the long life of some of these compounds, can risk the health of communities and ecosystems far from their release.

Climate change resulting from burning fossil fuels is expected to increase the spread of disease vectors far from their current regions and destabilize ecosystems, threatening worldwide nutrition. Loss of rainforests from unsustainable forestry can result in the loss of medicines and important genetic information that could help fight disease. Moreover, release of CFCs and HCFCs damages the stratospheric ozone layer, allowing increased levels of ultraviolet rays on Earth resulting in heightened potential for skin cancer.

The Importance of Prevention

Prevention is a fundamental principle of health care and public health. Indeed, to prevent disease is preferable to treating disease after it has occurred. In the face of uncertainty, precautionary action is appropriate to prevent harm. This public health approach makes sense both in the clinical setting and in responses to environmental and public health hazards. Similarly, a precautionary and preventive approach is an appropriate basis for decisions regarding material selection, design features, mechanical systems, infrastructure, and operations and maintenance practices.

Practices: Integrating Green Principles into the Design Process

1) Integrated Design

Vision statement

Achieving an effective sustainable design requires a collaborative process engaging the multiple design disciplines, as well as users, construction managers, contractors and facility managers. The merging of ideas, perspectives and areas of expertise facilitated by an open communications process reaps multiple benefits, as the project team moves from the optimization of single systems in isolation to the optimization of the entire building enterprise. Establishing vertical support throughout the organization helps ensure success.

Goals

- Enhance cost-effectiveness by recognizing interrelationships between systems
- Enhance building performance by integrating design elements
- Encourage cross-disciplinary problem-solving
- Build support among key constituencies for sustainable design

Suggested Strategies

- Develop an environmental health vision statement for the project
- Reinforce corporate/institutional commitments to environmental health and community responsibility.
- Use cross discipline design, decision making, and charettes
- Use goal setting workshops and build a team approach
- Engage owner, staff, contractors, user groups and community groups, educating them on the benefits of green design and bringing them in to the design process
- Use computer-modeling tools such as DOE-2, Energy 10, Radiance to optimize the interactions of different elements (e.g., orientation, insulation, HVAC sizing)

2) Site Design

Vision Statement

The introduction of a building to a site inevitably causes disruptions that affect the health of the local ecosystem. Good site design recognizes the ecological integrity of a site, whether it be a brownfield or a greenfield, and pursues strategies that minimize disruptions such as erosion and habitat displacement and, better, contribute to site restoration. Understanding the building as a series of flows enables the physical structure to achieve a good fit. Site location should reflect a consideration to lessen the ripple effect of the building on the surrounding community by enabling easy access by healthy transportation modes such as walking, bicycling and mass transit.

Goals

- Maintain and restore site biodiversity
- Minimize site development footprint
- Reduce storm water run-off
- Eliminate toxic chemical application for pest and vegetative control
- Optimize design for the local micro-climate and reduce dependence on mechanical systems for building operations
- Reduce reliance on single-occupancy vehicles
- Integrate design and orient building to take advantage of local micro-climate for heating, cooling, shading, ventilation and daylighting (*See also Energy)*
- Eliminate light trespass from the building site, improve night sky access, and reduce development impact on nocturnal environments

Suggested Strategies

- Evaluate brownfield sites to determine appropriate reuse for health care facilities
- Reuse and renovate existing buildings
- Site buildings in urban areas with existing infrastructure
- Avoid agricultural land, 100 year flood plains, threatened or endangered species habitat, wildlife corridors, wetlands
- Orient buildings to make best use of solar energy for heating or daylighting
- Orient buildings to encourage natural ventilation and passive cooling
- Design to reduce erosion and run off into sewer systems and/or air pollution
- Reduce building footprint, optimize layouts and reduce size of roads, parking and other site improvements to concentrate and limit total paving and other site disturbance
- Minimize impervious cover by using open-grid and pervious paving materials
- Maximize preservation and restoration of biodiverse open space/habitat
- Use native trees, shrubs and plants
- Develop and implement an integrated pest management plan
- Use vegetative and other shading techniques to assist passive cooling and ventilation of buildings and public and paved areas
- Site in proximity to transit options

- Establish a transportation plan. Support alternatives to fossil fueled single occupancy vehicles (preferred van/carpool parking, bike parking and changing facilities, electric car charging and other alternate vehicle fueling, nearby transit access). Reduce paved parking area appropriately.
- Design in accordance with Illuminating Engineering Society of North America (IESNA) footcandle requirements as stated in the Recommended Practice Manual: *Lighting for Exterior Environments*, and design interior and exterior lighting such that zero direct beam illumination leaves the building site.

(See Water and Energy for more site design issues)

3) Water

Vision Statement

Water efficient design strategies balance water quality and quantity demands within a building and are responsive to the watershed's capacity as source and sink. Public works projects, such as treatment plants and sewage systems, are unable to adequately remove or process the toxic materials that infiltrate these systems, potentially threatening public health. Take a systematic look to identify potential water sources, how water is used in the building and how it flows around the building site to reduce water usage and wastewater discharges.

Goals

- Minimize the use of potable water while conserving water quality and availability
- Minimize off site treatment of wastewater
- Minimize storm water release from the site
- Maximize use of on-site water resources, (e.g., rainwater, greywater)
- Match water quality with end use requirements
- Maximize aquifer recharge

Suggested Strategies

- Specify EPA Energy Star and high performance fixtures and equipment: e.g., low flow and pressure assist toilets and urinals; waterless urinals; low-flow showerheads and faucets; automatic use activation on sinks, toilets and urinals; Energy Star dishwashers and laundry equipment; ozone-injected laundry equipment
- Maximize water conservation in cooling towers by using non-potable site recycled water for cooling tower makeup, or use non-evaporative condenser heat rejection equipment (air cooled, or ground source)
- Specify native plants that are tolerant of local climate, soils and water
- Install drip irrigation and high efficiency irrigation control (moisture sensors, weather based controllers)
- Implement appropriate, safe strategies to recycle site waste water (e.g. gray water or condensate) and/or municipal secondary treated water for irrigation, sewage conveyance, and toilet flushing
- Collect storm water runoff from roofs and site and use for irrigation, sewage conveyance, toilet flushing and/or HVAC/process makeup water or recharge in to aquifer
- Minimize hardscapes and install permeable paving and other pervious surface materials
- Create wetlands or other systems to locally recharge underground water flows

(see Operations & Maintenance Section for additional Water issues)

4) Energy

Vision Statement

The burning of fossil fuels is the single largest contributor to global climate change, as well as a contributor to a host of toxic emissions that impair the environmental health of directly affected communities and the world. Rising energy prices impose a significant economic imperative that requires a careful examination of understanding how to best assure a comfortable healthy indoor environment supportive of patient recovery with a significantly reduced energy demand. Take a comprehensive, systematic look at the building and site's energy flows to reduce energy bills, evaluate opportunities for reliance on renewable energy sources, and improve environmental health outcomes.

Goals

- Reduce building energy demand
- Reduce emissions from energy use
- Reduce reliance on energy generated by fossil fuels
- Maximize use of energy generated by renewable sources

Suggested Strategies

- Use ASHRAE 90.1-1999 as basis of design to optimize thermal envelope performance and evaluate and document opportunities to exceed
- Use energy simulation tools, such as DOE2, Energy 10, Radiance, to optimize interactions between building elements and optimize design
- Optimize layout and orientation of building to optimize energy performance
- Design for appropriate daylighting strategies that reduce heat gain and control glare and contrast
- Specify efficient lighting fixtures
- Specify user controls and ambient condition lighting controls integrated with daylighting
- Specify efficient HVAC equipment (high efficiency, appropriately sized, low NOX)
- Specify EPA Energy Star electrical equipment and appliances

- Specify solar water heating and low-flow hot water fixtures and appliances
- Specify zoning and controls for mechanical equipment to optimize use
- Specify EPA Energy Star™ roofing materials and/or green roofs to reduce cooling loads and heat island effect
- Develop a commissioning plan and hire an independent Commissioning Agent (*See also Commissioning Section)*
- Specify HVAC, refrigeration & fire suppression equipment that do not utilize CFCs and halons. When reusing existing base building HVAC equipment, develop a comprehensive CFC phaseout conversion. Balance ozone depletion potential (ODP) of HCFC alternatives with global warming potential (GWP) *(Refer to Materials Section for further guidance concerning considerations on materials to avoid in energy related equipment and design, such as mercury and PVC).*
- Evaluate feasibility for and specify cogeneration, fuel cells, renewable energy systems (such as photovoltaics, wind, biomass and low impact hydroelectric) and other alternative energy sources
- Design for continued monitoring and verification of system performance
- Purchase green energy where available that meets the Center for Resource Solutions Green-e products certification requirements.

(See Site for transportation and climatic design issues)

5) Indoor Environmental Quality

Vision Statement

Growing awareness about the relationship between indoor environmental quality -- materials, lighting, thermal comfort -- and human health and productivity has catalyzed substantial research to support healthier buildings. Eliminating materials identified as allergens, mutagens, carcinogens and endocrine disruptors, while providing access to daylight and comfortable indoor climate, are fundamental green building elements. Engage in a design process that balances the objectives of a well daylit, comfortable, energy efficient and non-toxic indoor environment and results in improved productivity and patient outcomes.

Goals

- Provide an environment for occupants that is healthy and encourages rapid patient recovery and staff productivity
- Minimize production and distribution of pollutants
- Provide occupants with access to daylight and views
- Provide energy efficient thermal comfort
- Provide occupant environmental controls (light, view, thermal, ventilation)
- Provide appropriate air changes with sufficient percentage of fresh air

Suggested Strategies

- Ensure high quality indoor air by meeting or exceeding ASHRAE 62-1999 as a basis of design
- Ensure thermal comfort by meeting or exceeding ASHRAE 55-1992 as a basis of design
- Specify low VOC / low toxic finishes and materials, such as Green Seal-certified paints; composite wood and agrifiber products with no added urea-formaldehyde resins; carpet systems certified by Carpet & Rug Institute Green Label Program; adhesives meeting South Coast Air Quality Management District guidelines; flooring, ceiling wall covering, paints and other interior finishes and materials meeting Washington State indoor air quality guidelines.
- Minimize use of carpets and other materials that attract, absorb and re-release indoor pollutants
- Specify permeable wall covering and other materials to prevent trapping of water and microbial growth
- Establish green housekeeping protocols (*See Operations & Maintenance section*)
- Design to reduce pest infestation opportunities
- Install permanent entryway systems (e.g., grates) to trap dirt and particulates
- Position air intakes to prevent contamination from vehicle exhaust and other sources paying attention to prevailing winds
- Assure easy access to inspect and clean filters and ductwork in each straight run
- Ventilate enclosed parking areas and other source areas (smoking areas, housekeeping, copying rooms, hazardous waste)
- If building cannot be 100% non smoking, provide total environmental separation for non smokers and assure no feed in to ventilation system
- Provide building occupants access to daylight, views and operable windows where appropriate
- Provide user controls for airflow, temperature, light (integrated with daylighting - see also Energy section)
- Provide carbon dioxide monitoring system to provide feedback on space ventilation performance
- Specify materials, products, mechanical systems and design features to attenuate sound and vibration, and not to exceed Room Criteria (RC) ratings listed for Hospital and Clinics in Table 34 of Chapter 46, Sound and Vibration Control, 1999 ASHRAE Application Handbook

(See also Operations and Maintenance)

6) Materials & Products

Vision statement

Use of sustainable materials can significantly enhance a building's environmental health performance. The sustainable harvest of materials enhances the health of habitats and increases biodiversity. The Memorandum of Understanding between the US EPA and AHA establishes minimizing production of persistent and bioaccumulative toxics (PBTs) and reducing waste as priorities for the health care industry. Review material specifications to eliminate those that contribute to harmful health affects.

Goals

- Reduce resource depletion
- Reduce embodied energy
- Reduce toxics generated throughout the life cycle of materials
- Reduce waste
- Reduce impact of reuse or disposal of building

Suggested Strategies

- Reuse existing structures
- Specify materials free from ozone depleting substances and/or equipment using CFCs, HCFCs, and halons, balancing ozone depletion potential (ODP) with global warming potential (GWP)
- Specify materials free from toxic chemicals and that do not release toxic byproducts throughout their life cycle, particularly those toxins that are carcinogenic, persistent or bioaccumulative. Key materials to avoid include mercury (switching equipment), arsenic (pressure treated wood), urea formaldehyde (engineered wood), PVC (floors, wall coverings, furniture, roof membranes, plumbing pipe, electrical wire), and asbestos
- Specify materials and products that are:
- Recycled (preferably with high post consumer content), reused/salvaged, remanufactured or from rapidly renewing sustainable sources
- Sustainably harvested (e.g., specify FSC certified wood products)
- Obtained from local sources
- Low in embodied energy
- Durable
- Low in VOC and/or other chemical emissions in use (see IEQ section)
- Low maintenance and not requiring toxic materials to maintain and/or operate
- Easily reusable, recyclable, compostable, or otherwise biodegradable on disposal
- Design for efficient material use i.e., less material use and standard sizes to reduce waste
- Design for adaptability of building design as user needs change (e.g., reusable movable office divider walls and raised floor systems to enhance future flexibility)
- Design for disassembly and recycle or reuse at end of building life
- Prioritize sensitive areas (e.g., neonatal intensive care units, pediatrics, and maternity departments)
- Specify a careful product substitution review procedure to insure that environmental health performance is not degraded by contractor substitutions

7) Construction Practices

Vision Statement

The construction process affects every facet of design, from site, to materials, to mechanical systems, to indoor environmental quality, and to waste generation. Construction practices will have a significant direct impact on the health of the local environment during construction and will determine if the building achieves its long term health and sustainability goals. The construction team, including construction management, general contractor, and subcontractors are all integral to achieving these goals. The team in place during Construction Administration needs to be fully informed of and, preferably, have a role in developing, the project's sustainable design vision and goals.

Goals

- Establish a partnering relationship between all parties; engage subs and crews
- Maximize reduction, reuse or recycling of construction, demolition and land clearing debris
- Establish appropriate protocols for safe, appropriate management of toxins associated with renovation and demolition.
- Eliminate use of toxic substances, particularly those that are persistent and bioaccumulative
- Protect materials from contamination
- Ensure good indoor air quality
- Control erosion to reduce negative impacts on water and air quality

Suggested Strategies

- Implement a waste management plan for separation and recycling or reuse (including composting, chipping, mulching) of construction, demolition and land clearing debris (CD&L) and proper disposal of residual materials. Crush and reuse demolished concrete, asphalt and masonry for beneficial on-site or off-site use
- Survey for hazardous materials in demolition or renovations (mercury, asbestos and lead) and plan for safe remediation or removal and disposal
- Minimize packaging waste and reuse or return packaging waste to suppliers or manufacturers for reuse/recycling; recycle all packaging that cannot be reused or returned.

- Sequence work phases to minimize negative impacts on habitat and on ambient and indoor air quality
- Implement a site sedimentation and erosion control plan
- Follow the SMACNA (Sheet Metal & Air Conditioning Contractors National Association) IAQ Guidelines for Occupied Buildings Under Construction (e.g., dust control measures, protection of absorptive materials from moisture damage, sequencing installation of interior materials to avoid absorption of volatile organic compounds)
- Allocate time, prior to occupancy, for building flush-out appropriate to climate using new filtration media to assure removal of initial outgassing emissions
- Engage crews, including subcontractor crews, in education sessions to familiarize them with the reasons for and importance of green design and construction practices and to solicit their feedback

8) Commissioning

Vision Statement

The commissioning process ensures the building owner and occupants that all mechanical, electrical and plumbing equipment are operating consistent with the Design Intent Document, and exceeds conventional testing and balancing procedures. An independent third-party commissioning agent offers an objective review and should be part of the design team from the earliest stages.

Goals

- Assure that building elements are installed and calibrated properly to meet the project's environmental health goals in addition to mechanical, electrical and plumbing system performance parameters
- Assure that building occupants are appropriately trained and that thorough and explicit written materials are in easily identifiable and accessible places to ensure proper operating and maintaining of building systems to meet goals

Suggested Strategies

- Contract an independent commissioning agent
- Clearly document design intent
- Specify commissioning requirements, including a commissioning plan
- Review carefully at construction documents and occupancy phases
- Develop an O&M manual for systems operations and ongoing monitoring and calibration
- Verify installation, operation to specifications, training, documentation and access to documentation
- Evaluate post-occupancy commissioning at 6 month or 1 year intervals to ensure continued system effectiveness

9) Operations & Maintenance

Vision Statement

The planning and implementation of a building's operations and maintenance are essential to benefit from the building's healthy green design features. Buildings are designed to last many decades. Practices employed during the life of the building should reflect a commitment to the hallmarks of sustainable building: high performing mechanical systems, healthy indoor air quality, continual recognition of life cycle impacts of materials and methods employed.

Goals

- Reduce the "ecological footprint" associated with materials and methods used during a building's occupancy phase
- Commit to a process of continuous improvement to enhance the building's environmental health performance
- Educate the community

Suggested Strategies

- Program and design adequate dedicated storage and flow space to facilitate recycling and composting of waste.
- Program and design adequate dedicated storage and flow space and cleaning/sanitation facilities to facilitate reuse of items such as medical products, linens, and food service items to replace disposables and reduce waste.
- Program and design adequate dedicated storage and flow space for separation and management of hazardous wastes
- Provide educational opportunities (meetings, newsletters) for all building staff on the building's green design features – the direct and indirect benefits of green design and their role to optimize its performance
- Prepare building operating manuals, to include:
- Contacts of all involved in design and construction
- Design Intent documents and as built construction drawings
- Manuals for all mechanical and electrical systems including how to maximize their efficient operation and how they interact with other building elements

- System performance monitoring and inspection schedules and protocols, and other ongoing commissioning requirements
- Green cleaning and maintenance protocols for mechanical equipment, glazing, finish surfaces, lighting and plumbing fixtures and all other housekeeping responsibilities
- Manufacturers and service/repair contacts for all components
- Integrated Pest Management practices
- Provide community education (press releases, newsletters, meetings, tours, interpretive displays) on the building's green features

10) Innovation

Vision
Every building is a unique blend of site, program, people, budget, with a unique set of challenges and opportunities. Innovative, integrative design practices recognize that new solutions emerge from a process that engenders creative problem solving and "thinking out of the box". We encourage you to delve into an exploratory process to discover new benchmarks for 21st century health care facilities.

Sources:

- Leadership in Energy & Environmental Design (LEED), US Green Building Council www.usgbc.org
- Minnesota Sustainable Design Guide, University of Minnesota, http://www.sustainabledesignguide.umn.edu/
- NY High Performance Building Guidelines, New York City Department of Design and Construction, http://www.ci.nyc.ny.us/html/ddc/html/highperf.html
- BREEAM, ECD Energy and Environment Canada, www.breeamcanada.ca

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