Environmental Quality

Required

EQ Prerequisite 1

Minimum IAQ Performance

Intent

Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and wellbeing of the occupants.

Health Issues

The EPA estimates that indoor air pollution is one of the top five environmental risks to public health. Indoor air can be as much as 10 times more polluted than outside air and contain many unique contaminants. Indoor air pollutants can cause problems ranging from immediate acute effects such as eye, nose, and throat irritation; sinusitis, asthma attacks, headaches; loss of coordination; and nausea; to long range chronic damage to the lungs, liver, kidney, and central nervous system and cancer. Building materials and the products used to install, clean and maintain them can be significant sources of a wide range of VOCs and other indoor air pollutants. Coupling properly designed, operated and maintained mechanical equipment with low-emitting materials can ensure healthy indoor air.

Credit Goals

- Meet the minimum requirements of the relevant local licensing requirement for ventilation or Section 4 through 7 of voluntary consensus standard ASHRAE 62-2004, Ventilation for Acceptable Indoor Air Quality, whichever is more stringent. Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure or the applicable local code, whichever is more stringent.
- Naturally ventilated buildings shall comply with ASHRAE 62.1-2004, paragraph 5.1 or the relevant local licensing requirement, whichever is more stringent.

Suggested Documentation

❑ Prepare calculations demonstrating that the project is fully compliant with relevant local licensing requirements or ASHRAE 62-2004 and describing the procedure employed in the IAQ analysis (Ventilation Rate Procedure).

Reference Standards

ASHRAE 62-2004 Ventilation for Acceptable Indoor Air Quality http://www.ashrae.org and Standard 62 Addenda page at http://www.ashrae.org/template/AssetDetail/assetid/30205.

Potential Technologies & Strategies

Establishing strategies for good indoor air quality at the outset of project development is more effective and achievable than addressing air quality as an issue during construction or building operation. These strategies can be categorized by type and prioritized as follows:

- **Ventilation** (refer to GGHC EQ Credit 2). Develop ventilation strategies that support operable windows, where appropriate. Design for mechanical ventilation air change rates required by health code standards, zoning areas where contaminants are generated.

EQ Prerequisite 1 continued

Minimum IAQ Performance

- **Construction Methods** (refer to GGHC EQ Credit 3). Control indoor air quality during construction and mitigate impacts on occupied building air quality. Flush newly constructed or renovated buildings with 100% outside air prior to occupancy.
- **Building Materials** (refer to GGHC EQ Credits 4 & 8). Many materials and products used in the building emit volatile organic compounds (VOCs), including formaldehyde. Examples of possible sources of indoor air pollution include adhesives, paints, carpeting, upholstery, manufactured wood products and other components of furniture, including medical furniture & equipment.
- **Chemical & Pollutant Source Control** (refer to GGHC EQ Credit 5 and Operations). Sources can include outdoor pollutants, indoor chemical use (including glutaraldehyde and other sterilizing agents and methylene chloride, used in adhesive removers, paint stripper, and aerosol spray paints), cleaning products, fragrances and pest control activities.
- **Building Maintenance and Operation** (refer to GGHC EQ Credit 5 and GGHC *Operations* section).
- **Control Systems** (refer to GGHC EQ Credits 6 & 7). Install sensors for relative humidity, temperature, and carbon dioxide. Consider occupant control systems to improve individual comfort.

Resources

Guidelines for Environmental Infection Control in Health-Care Facilities: Recommendations of CDC and the Health Care Infection Control Practices Advisory Committee (HICPAC), U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report, Recommendations and Reports June 6, 2003 / Vol. 52 / No. RR-10, http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm.

High Performance Building Guidelines, New York City DDC, 1999, http://www.ci.nyc.ny.us/html/ddc/html/ddcgreen/highperf.html

I-Beam: The Future of IAQ in Buildings, United States Environmental Protection Agency; EPA 402-C-01-001, December 2002, IAQ Building Education and Assessment Model (I-Beam), http://www.epa.gov/iaq/largebldgs.

GGHC Construction Credit Synergies

- SS Credit 1: Site Selection
- SS Credit 2: Development Density & Community Connectivity
- SS Credit 4: Alternative Transportation
- WE Credit 1: Water Efficient Landscaping
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Prerequisite 1: Storage & Collection of Recyclables
- MR Credit 1: Building Reuse
- EQ Prerequisite 2: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation
- EQ Credit 3: Construction EQ Management Plan
- EQ Credit 4: Low-Emitting Materials

EQ Prerequisite 1 continued

Minimum IAQ Performance

- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 7: Thermal Comfort

GGHC Operations Credit Synergies

- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 2: IAQ Management
- IO Prerequisite 3: Environmental Tobacco Smoke Control
- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- CM Credit 1: Community Contaminant Prevention
- CM Credit 2: Indoor Pollutant Source Control
- CM Credit 3: Chemical Discharge
- ES Credit 2: Indoor Integrated Pest Management
- ES Credit 4: Sustainable Cleaning Products & Materials
- ES Credit 5: Environmentally Preferable Janitorial Equipment
- EP Credit 6: IAQ Compliant Products

Required

EQ Prerequisite 2

Environmental Tobacco Smoke (ETS) Control

Intent

Prevent exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS).

Health Issues

There are well-known health risks associated with Environmental Tobacco Smoke (or "secondhand smoke"). A 1993 report published by the United States EPA, *Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders,* concluded that secondhand smoke causes lung cancer in adult nonsmokers and impairs the respiratory health of children, corroborating earlier studies undertaken by the National Academy of Sciences and the U.S. Surgeon General. The EPA report classified secondhand smoke as a Group A carcinogen, indicating sufficient evidence of the substance causing cancer in humans. Only 15 other substances including asbestos, benzene and radon are included in the U.S. EPA's list of known carcinogens.

Credit Goals

- Prohibit smoking in the building (except as noted below).
- Locate any exterior designated smoking areas at least 50 feet (15.24 meters) away from entries, operable windows, air intakes, bus stops, disabled parking, and other locations where occupants could inadvertently come in contact with ETS when occupying, entering or leaving the building.
- Only for residential facilities where the functional program requires accommodation for smokers may there be an exception to establish negative pressure smoking rooms:
  - Provide one or more designated smoking rooms designed to effectively contain, capture and remove ETS from the building. At a minimum, the smoking room must be directly exhausted to the outdoors with no re-circulation of ETS-containing air to the non-smoking area of the building, and enclosed with impermeable deck-to-deck partitions. With the doors to the smoking room closed, operate exhaust sufficient to create a negative pressure with respect to the adjacent spaces of at least an average of 5 Pa (0.02 inches of water gauge) and with a minimum of 1 Pa (0.004 inches of water) when the door(s) to the smoking room are closed.
  - Verify performance of the smoking room differential air pressures by conducting 15 minutes of measurement, with a minimum of one measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed. Conduct the testing with each space configured for worst case conditions of transport of air from the smoking rooms to adjacent spaces with the smoking rooms' doors closed to the adjacent spaces.

Suggested Documentation

- ❑ Establish and maintain a no-smoking policy on the property.
- ❑ Provide a site map showing exterior designated smoking areas in compliance with the Credit Goals.

EQ Prerequisite 2 continued

Environmental Tobacco Smoke (ETS) Control

- ❑ Residential facilities that accommodate smoking:
  - ❑ Prepare a copy of the building site plan indicating designated smoking areas and their distances from entries, operable windows, air intakes, and other locations where occupants could inadvertently come in contact with ETS.
  - ❑ Compile documentation demonstrating that designated smoking rooms comply with Credit Goals.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Prohibit smoking in the building and other locations where occupants could inadvertently come in contact with ETS.
- Take into account prevailing winds and micro-climate effects in siting exterior smoking areas.

Resources

U.S. EPA, Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders, http://cfpub1.epa.gov/ncea/cfm/recordisplay.cfm?deid=2835.

Construction Credit Synergies

- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 2: Natural Ventilation
- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 6: Controllability of Systems

Operations Credit Synergies

- IO Credit 2: IAQ Management
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 3: Energy Efficient Equipment
- EE Credit 5: Performance Measurement
- CM Credit 1: Community Contaminant Prevention
- ES Credit 1: Outdoor Grounds & Building Exterior Management

Required

EQ Prerequisite 3

Hazardous Material Removal or Encapsulation

Intent

Reduce the building occupant's potential exposure to asbestos, mercury, lead, and mold; and, prevent associated harmful effects of these hazardous materials in existing buildings. (New construction projects are exempt from compliance with this Prerequisite.)

Health Issues

Asbestos exposure is linked to documented health impacts, most notably mesothelioma (a specific kind of cancer of the lung, chest and/or abdominal lining) and asbestosis, a chronic form of lung disease. To minimize exposure of building occupants, regulatory authorities require remediation of asbestos containing building materials, either through a process of encapsulation or removal. Asbestos abatement undertaken during renovation while building is partially occupied should take especial precautions to ensure 100% containment of asbestos fibers.

PBTs are toxic chemicals of particular health concern because they do not break down quickly in the environment, they become widely distributed geographically and they bio-magnify or concentrate in the tissue of living organisms as they move up the food chain. With a few exceptions, the major source of human exposures to PBTs occurs from the consumption of contaminated food in the ordinary diet. PBTs cause a range of adverse wildlife and human health effects, including cancer, and developmental impacts in the nervous, reproductive, and immune systems. Immature, developing organisms are the most sensitive to exposures to PBTs.

Because of their toxicity, persistence, and bioaccumulative characteristics, even very small, difficult to detect releases can lead to harmful exposures. This has led to an emphasis on strategies that eliminate of the production and use of PBT substances, or those that are known to lead to their formation, rather than attempts to control emissions.

Lead is a potent neurotoxin, particularly in the developing brain of fetuses and children, and can also cause kidney and reproductive system damage. Mercury is a potent neurotoxin. Significant amounts of mercury released into the environment are transformed into methylmercury, which bioconcentrates in the foodchain. Prenatal exposure to methylmercury can result in deficits in language, memory and attention.

Exposure to molds can cause symptoms such as nasal stuffiness, eye irritation, wheezing, skin irritation, fever and shortness of breath. Conditions not generally associated with an allergic response—including nervous-system effects, suppression of the immune response, hemorrhage in the intestinal and respiratory tracts, rheumatoid disease, and loss of appetite—have also been reported in people who work or live in buildings exhibiting toxic microbial growth. Appropriate design of envelope waterproofing and breathable interior finishes has been found to greatly reduce the risk of mold growth in wall spaces.

Credit Goals

- Establish a program for the discovery, testing and mitigation of asbestos, mercury, lead and mold.
- Identify applicable regulatory requirements.
- Obtain survey records that identify known contamination in the building and on the site. Survey locations where hazardous materials may be present in previously uninvestigated areas of the building and site.

EQ Prerequisite 3 continued

Hazardous Material Removal or Encapsulation

- Include a plan for capture of historical mercury sources during demolition, including but not limited to piping infrastructure. Designate collected mercury devices for recycling that precludes overseas donation/disposal.
- Remove and properly dispose of disconnected wiring that contains lead stabilizers.
- Provide contract requirements for reporting and investigating suspect mold encountered in demolition. Remediate contaminated surfaces: remove and dispose of contaminated materials in accord with recognized procedures that protect workers, building occupants and the public.

Suggested Documentation

❑ Obtain a letter from the facility manager, an accredited HAZMAT (Hazardous Materials) program manager or inspector stating that hazardous materials are not present in the building, on the building exterior or on the site.

OR

❑ Describe the current HAZMAT management program that identifies the applicable local, state, and federal regulatory requirements and explains how the program is addressing HAZMAT remaining in the building on an ongoing basis.

❑ Review the previously completed HAZMAT abatement work and incorporate this data in a comprehensive HAZMAT survey for the building and the site that describes: (1) where asbestos, lead, mercury, and mold has been removed; (2) where these materials remain; and, (3) how the remaining contamination is being addressed.

❑ Update the HAZMAT survey for the building and the site with current information by: (1) sampling additional likely locations in the building and on the site for HAZMAT; and, (2) testing samples to confirm if HAZMAT is present.

❑ If the survey identifies any previously unknown contamination, describe how the HAZMAT management program is addressing all remaining asbestos, lead, mercury, and mold remaining in the building.

❑ Obtain a letter from the licensed abatement contractor stating that all materials within the affected demolition or renovation areas have been removed or encapsulated.

Reference Standards

New York City Department of Health and Mental Hygiene Guidelines on Assessment and Remediation of Fungi in Indoor Environments, http://www.nyc.gov/html/doh/html/epi/moldrpt1.shtml

U.S. Code of Federal Regulations (CFR)

29 CFR 1910.1000 - Air Contaminants; current edition.

40 CFR 273 - Standards For Universal Waste Management; current edition.

40 CFR 761 - Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions; current edition.

40 CFR Part 61, Subpart M - National Emission Standard for Asbestos; current edition.

EQ Prerequisite 3 continued

Hazardous Material Removal or Encapsulation

U.S. EPA

Identification of Dangerous Levels for Lead; Final Rule, http://www.epa.gov/fedrgstr/EPA-TOX/2001/January/Day-05/t84.pdf

Lead in dust, soil and paint, http://www.epa.gov/opptintr/lead/pubs/regulation.htm

Mold, http://www.epa.gov/mold/mold_remediation.html

National Emission Standards for Hazardous Air Pollutants (NESHAP) 40 CFR 61, http://www.epa.gov/enviro/html/rad/rad_cfr_part61.html.

U.S. Toxic Substances Control Act (TSCA); 15 USC s/s 2601 et seq. (1976), http://www.eh.doe.gov/oepa/laws/tsca.html

Potential Technologies & Strategies

- Engage an environmental testing agency and licensed abatement professional to audit building systems and materials and determine protocols and procedures to encapsulate or remove materials as appropriate.
- Mercury Elimination Plan
  - Successful implementation of the *Green Guide* mercury elimination credits requires an understanding of potential sources of mercury within the building. Developing a spreadsheet of potential sources and an action plan for their removal are the first steps in mercury elimination. The following plan paraphrases the Health Care Without Harm "Mercury Alternatives" website, http://www.noharm.org/mercury/alternatives.
    1. Identify mercury-containing items using resources from organizations such as Health Care Without Harm, National Institutes of Health, U.S. EPA, and Hospitals for a Healthy Environment.
    2. Implement a mercury-free purchasing policy that targets construction materials, equipment, and medical supplies. Most purchasing policies phase in substitutions as equipment ages rather than rushing premature equipment replacement. The policy must also develop a plan for proper disposal or recycling of mercury-containing materials as they are replaced.
    3. Set mercury reduction goals for mercury-containing devices in use at the facility. Policies that phase in substitutions in conjunction with a facility-wide education campaign will raise the level of awareness among the staff regarding the importance of eliminating mercury use.
    4. Measure success through a program such as the Hospitals for a Healthy Environment "Making Medicine Mercury Free" award.
- Define a process for surveying and assessing hazardous materials in the existing building, including mold, mercury, lead and asbestos. Mercury is a material that may require special remediation attention in the renovation or demolition of an existing health care facility as significant quantities of mercury can accumulate in places such as traps, light fixtures and ceiling and inter-floor spaces from medical equipment breakage over the years, providing an unanticipated significant hazard to construction and demolition crews.

EQ Prerequisite 3 continued

Hazardous Material Removal or Encapsulation

- Lead Radiation Protection construction components. Pay particular attention to lead in C&D debris, often used as components of Radiation Protection Systems. Separate sheet lead radiation protection and lead lined gypsum board products, lead-lined doors and frames for reuse, salvage or reprocessing. Salvage for reuse or reprocessing all lead-lined glazing products.

Resources

American Hospital Association (AHA) and the United States Environmental Protection Agency (U.S. EPA) signed a Memorandum of Understanding identifying goals to reduce the impact of health care facilities on the environment. A primary goal included the virtual elimination of mercury waste from the health care waste stream. http://www.h2e-online.org/about/mou.htm.

Institute of Medicine – National Academies Press, http://www.nap.edu/books/0309091934/html/

Mercury sources – San Francisco Medical Society, http://www.sfms.org/AM/Template.cfm?Section=Home&template=/CM/HTMLDisplay.cfm&ContentID=1767

U.S. Army Center for Health and Health Promotion, http://usachppm.apgea.army.mil/mold/

GGHC Construction Credit Synergies

- ID Prerequisite 2: Health Mission Statement & Program
- SS Credit 1: Site Selection
- SS Credit 3: Brownfield Redevelopment
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- MR Credit 1: Building Reuse
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation
- EQ Credit 3: Construction EQ Management Plan
- EQ Credit 4: Low-Emitting Materials

GGHC Operations Credit Synergies

- IO Credit 2: IAQ Management
- EE Prerequisite 1: Existing Building Commissioning
- CM Credit 1: Community Contaminant Prevention
- CM Credit 2: Indoor Pollutant Source Control

1 point

EQ Credit 1

Outdoor Air Delivery Monitoring

Intent

Provide capacity for ventilation system monitoring to help sustain occupant comfort and wellbeing.

Health Issues

Elevated CO2 levels can indicate diminished indoor air quality due to inadequate amounts of outdoor air being introduced into the building. By maintaining low CO2 levels, building occupants are likely to experience improved indoor air quality to the extent that outdoor ambient air quality is good, resulting in improved health and productivity. This is particularly important in hospitals, where inadequate dilution of recirculated air with outdoor air can result in exposure of patients to higher levels of indoor generated pollutants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from compromised indoor air quality.

Credit Goals

- Install permanent monitoring systems that provide feedback on ventilation system performance to ensure that ventilation systems maintain design minimum ventilation requirements. Configure all monitoring equipment to generate an alarm when the conditions vary by 10% or more from setpoint, via either a building automation system alarm to the building operator or via a visual or audible alert to the building occupants.

FOR MECHANICALLY VENTILATED SPACES

- Monitor carbon dioxide concentrations within all densely occupied spaces (those with a design occupant density greater than or equal to 25 people per 1,000 sq. ft.). CO_2 monitoring locations shall be between 3 feet and 6 feet above the floor.
- For each mechanical ventilation system serving non-densely occupied spaces, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 5% of the design minimum outdoor air rate.

FOR NATURALLY VENTILATED SPACES

- Monitor CO2 concentrations within all naturally ventilated interior spaces. CO2 monitoring shall be located within the room between 3 feet and 6 feet above the floor. One CO2 sensor may be used to represent multiple spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants.

Suggested Documentation

- ❑ Confirm the type of ventilation system and installed controls.
- ❑ Compile a narrative summary describing the project's ventilation design and CO2 monitoring system. Include specific information regarding location and quantity of installed monitors, operational parameters and set points.

EQ Credit 1 continued

Outdoor Air Delivery Monitoring

- ❑ Compile copies of the applicable project drawings to document the location and type of installed sensors. Drawings should also show natural ventilation components (operable windows, air intakes, etc.) as applicable.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Install carbon dioxide and airflow measurement equipment and feed the information to the HVAC system and/or Building Automation System (BAS) to trigger corrective action, if applicable. If such automatic controls are not feasible with the building systems, use the measurement equipment to trigger alarms that inform building operators or occupants of a possible deficiency in outdoor air delivery.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 2: Natural Ventilation
- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 6: Controllability of Systems
- EQ Credit 7: Thermal Comfort

GGHC Operations Credit Synergies

- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 2: IAQ Management
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 3: Energy Efficient Equipment
- EE Credit 5: Performance Measurement
- CM Credit 1: Community Contaminant Prevention
- CM Credit 2: Indoor Pollutant Source Control
- CM Credit 3: Chemical Discharge

1 point

EQ Credit 2

Natural Ventilation

Intent

Provide natural ventilation for improved occupant comfort, well-being, and productivity.

Health Issues

Improved ventilation can be linked to enhanced worker productivity, comfort and reduced absenteeism. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from compromised indoor environmental quality.

Research shows that natural ventilation can improve patient outcomes by providing control over thermal comfort and ventilation. In addition, natural ventilation can reduce energy consumption, thereby lowering chemical and particulate emissions resulting from fossil fuel extraction, processing and combustion that contribute to smog and global warming.

Credit Goals

- Design natural ventilation systems for occupied spaces in the building where allowed by relevant building code requirements AND where air distribution design is not mandated and/or restricted by process requirements (such as operating rooms, negative pressure isolation rooms, burn rooms, and certain other critical care rooms) to meet the recommendations set forth in the Carbon Trust "Good Practice Guide 237" [1998]. Determine that natural ventilation is an effective strategy for the project by following the flow diagram process shown in Figure 1.18 of the Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10:2005, Natural Ventilation in Non-Domestic Buildings.

AND

- Use diagrams and calculations to show that the design of the natural ventilation systems meets the recommendations set forth in the CIBSE Applications Manual 10:2005, Natural Ventilation in Non-Domestic Buildings.

OR

- Use a macroscopic, multi-zone, analytic model to predict that room-by-room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by ASHRAE 62.1-2004 Chapter 6 or relevant building code requirements, for at least 90% of applicable occupied spaces.

Suggested Documentation

❑ Use diagrams and calculations to show that the design of the natural ventilation systems meets the recommendations set forth in the CIBSE Applications Manual 10: 2005, Natural Ventilation in Non-Domestic Buildings.

OR

EQ Credit 2 continued

Natural Ventilation

❑ Use a macroscopic, multi-zone, analytic model that predicts that room-by-room outdoor airflow rates meets credit goals for at least 90% of applicable occupied spaces.

Reference Standards

ANSI/ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality, Chapter 6.

The Carbon Trust Good Practices Guide 237 – Natural ventilation in non-domestic buildings – a guide for designers, developers and owners, http://www.thecarbontrust.org.uk/energy.

Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10:2005, Natural Ventilation in Non-Domestic Buildings, http://www.cibse.org.

Potential Technologies & Strategies

- Test the air change effectiveness of the building after construction.
- Follow the eight design steps described in the Carbon Trust Good Practice Guide 237
  1. Develop design requirements.
  2. Plan airflow paths.
  3. Identify building uses and features that might require special attention.
  4. Determine ventilation requirements.
  5. Estimate external driving pressures.
  6. Select types of ventilation devices.
  7. Size ventilation devices.
  8. Analyze the design. Use public domain software such as NIST's CONTAM, Multizone Modeling Software, along with LoopDA, Natural Ventilation Sizing Tool, to analytically predict room-by-room airflows.

GGHC Construction Credit Synergies

- ID Prerequisite 2: Health Mission Statement & Program
- SS Credit 1: Site Selection
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 5: Chemical & Pollutant Source Control
- EQ Credit 7: Thermal Comfort

EQ Credit 2 continued

Natural Ventilation

GGHC Operations Credit Synergies

- IO Prerequisite 4: Outside Air Introduction & Exhaust Systems
- IO Credit 2: IAQ Management
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 3: Energy Efficient Equipment
- EE Credit 5: Performance Measurement
- CM Credit 1: Community Contaminant Prevention
- CM Credit 2: Indoor Pollutant Source Control
- CM Credit 3: Chemical Discharge
- ES Credit 2: Indoor Integrated Pest Management
- ES Credit 4: Sustainable Cleaning Products & Materials
- ES Credit 5: Environmentally Preferable Janitorial Equipment
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 3.1

Construction EQ Management Plan: **During Construction**

Intent

Reduce indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and wellbeing of construction workers and building occupants.

Health Issues

Enhanced indoor air quality is an imperative for health care facilities. Air that is free from harmful levels of contaminants aids patients with a variety of underlying chronic diseases or conditions and the capacity of staff to make critical decisions and perform critical tasks. IAQ complaints commonly include headaches, eye irritation, sinus congestion, cough, and wheeze. Health impacts associated with construction practices in health care settings are regulated through Infection Control Risk Assessment (ICRA) policies and procedures in the *AIA Guidelines for Construction of Health Care Facilities*, adopted by many U.S. states. The Infection Control Risk Assessment and AIA *Guidelines* themselves, mandate construction procedures and practices to minimize health impacts on building occupants in adjacent occupied areas. This credit includes sustainable construction practices that reinforce and exceed the current ICRA and AIA *Guideline* provisions.

Credit Goals

Develop and implement an Environmental Quality (EQ) Management Plan for the construction and pre-occupancy phases of the building as follows:

- Establish an integrated Infection Control Team comprised of the Owner, Designer, and Contractor to evaluate infection control risk and document the required precautions in a project-specific plan. Utilize the Infection Control Risk Assessment (ICRA) standard as defined by the Joint Commission on Accreditation of Health Care Organizations (JCAHO) Environment of Care Standard (EC.3.2.1) as a guideline for construction activities.
- Mold & mildew: Prepare a written program to guide actions to prevent mold and mildew growth. Protect stored on-site or installed absorptive materials from moisture damage. Immediately remove from site and properly dispose of any materials with stains, mold, mildew or other evidence of water damage and replace with new, undamaged materials.
- If permanently installed air handlers are used during construction, install filtration media with a Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2-1999, at each return air grill. Protect outdoor air intakes with filtration media. Replace all filtration media immediately prior to occupancy.
- VOC Absorption – Schedule construction procedures to minimize exposure of absorbent materials to VOC emissions. Complete “wet” construction procedures such as painting and sealing before storing or installing “dry” absorbent materials such as carpet or ceiling tiles. These materials accumulate pollutants and release them over time. Store fuels, solvents and other sources of VOCs separately from absorbent materials.

EQ Credit 3.1 continued

Construction EQ Management Plan: **During Construction**

Suggested Documentation

- ❑ Compile, implement and maintain a written Construction EQ Management Plan highlighting the ICRA requirements.
- ❑ Compile, implement and maintain a written mold and mildew growth prevention program in accordance with credit goals.
- ❑ Document the use of air filtration media during construction. Photograph representative applications of filter media on return air grilles during construction when required by the Construction EQ Management Plan. Document the installation of temporary filter media in permanent air-handling units operated during construction and the installation of new filter media in those units immediately prior to occupancy. Include the MERV value, manufacturer name and model number of filter media used in the project.
- ❑ Prepare and document the implementation of specifications requiring proper sequencing of construction procedures materials storage to minimize exposure of absorbent materials to VOC emissions.

Reference Standards

ANSI/ASHRAE Standard 52.2-1999, Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.

Joint Commission on Accreditation of Health Care Organizations (JCAHO) Environment of Care Standard (EC.3.2.1), http://www.jcrinc.com.

Potential Technologies & Strategies

- Adopt an EQ Management Plan utilizing an Infection Control Risk Assessment (ICRA) standard to protect the HVAC system during construction, control pollutant sources and interrupt contamination pathways. Sequence the installation of materials to avoid contamination of absorptive materials such as insulation, carpeting, ceiling tile and gypsum wallboard. Coordinate with GGHC EQ Credits 3.2 and 5 to determine the appropriate specifications and schedules for filtration media.
- If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction. Consult the LEED for New Construction Version 2.2 Reference Guide for more detailed information on how to ensure the well-being of construction workers and building occupants if permanently installed air handlers must be used during construction.
- Utilize negative air machines vented to the outside atmosphere to extract floating dust or particulate matter even if negative air is not required. This reduces the amount of exposure to the construction crews by constantly “vacuuming” or cleaning the air, which will effectively purge the air of materials that have adverse health impacts. Maintain indoor air quality meeting the National Institute for Occupational Safety and Health (NIOSH) standards for worker exposures.

EQ Credit 3.1 continued

Construction EQ Management Plan: **During Construction**

- Prepare temporary ventilation and exhaust systems to maintain a negative pressure relationship in the construction area relative to the adjacent space. Maintain containment areas (negative air pressure) with the use of negative air machines ducted to outside of the building that is under construction. Use air pressure monitors (e.g. magnahelic gages) connected to an audible or visual alarm that notifies the construction area when negative pressure as relates to the protection areas has not been maintained. Reduce the amount of supply air to the construction area (if construction is adjacent to an occupied area or building) to help facilitate this negative pressure area. Seal off windows and building envelope locations separating patients adjacent to the construction area that may be susceptible to the suction created by negative air machines in the construction zone to prevent possible particulate exposure.
- Provide effective dust control. When existing ventilation systems serving occupied areas are to be modified, the designer should evaluate the changes and provide guidance to the contractor to avoid disturbing pressure relationships in the occupied areas of the building during the modifications. Survey existing ventilation systems to determine the extent of dust accumulation and include requirements for proper duct cleaning when the survey indicates need.
- Consider outdoor vectors that increase infection risk and degrade ambient air quality and implement effective mitigation measures.
- Install full height (floor to deck) partitions to contain dust, fumes and odors generated during construction (e.g. demolition, cutting/sawing, grinding, painting, epoxy flooring, adhesive and coating applications) and an Ante Room for secondary air containment and a wipe down and changing area if recommended by the ICRA process.
- Wear “booties” within the construction area if access is through an occupied building and utilize floor “tacky” mats just outside construction areas to trap particles from shoes after booty removal and wheeled items like covered and taped debris carts leaving the construction zone.
- Frequently wet mop floors outside of construction area that are being used for access to the construction area to prevent particle disturbance.
- Vacuum and disinfect the bottom metal stud tracks with Biocide (or similar) prior to second-side drywall installation to remove construction dust and debris.
- When construction requires working above existing ceilings in occupied areas or corridors, confirm that a ceiling access permit has been issued if required by the facility. The facility may require the installation of a pre-fabricated plastic partition, “zip wall” or similar for this work taking place outside the construction area.

EQ Credit 3.1 continued

Construction EQ Management Plan: **During Construction**

Resources

NIOSH Publication No. 99-113: Control of Drywall Sanding Dust Exposures, http://www.cdc.gov/niosh/.

GGHC Construction Credit Synergies

- MR Credit 2: Construction Waste Management
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 4: Low-Emitting Materials

GGHC Operations Credit Synergies

- IO Credit 2: IAQ Management
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 3.2

Construction EQ Management Plan: **Before Occupancy**

Intent

Reduce indoor air quality problems resulting from the construction/renovation process in order to help sustain the comfort and well-being of construction workers and building occupants.

Health Issues

The indoor air quality impacts of recently installed construction materials are well documented. Many wet applied products, such as paints, adhesives, varnishes, and sealants, and some dry interior finish materials such as carpets, flooring and wall coverings, off-gas considerable levels of volatile organic compounds (VOCs) for months after application, but particularly in the 7 – 14 day period following their initial installation. These may result in a variety of health effects in patients and health care workers, including headaches and respiratory symptoms. Many of the products of particular concern are finish materials, which are applied or installed on the site late in the construction process, shortly before intended occupancy dates.

Credit Goals

Develop and implement an Indoor Air Quality (IAQ) Management Plan for the pre-occupancy phase of the building as follows:

OPTION 1: Flush Out

- After construction ends, prior to occupancy, and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees Fahrenheit and, where mechanical cooling is available, relative humidity no higher than 60%.

  OR

- If occupancy is desired prior to completion of the flush out, the space may be occupied following delivery of a minimum of 3,500 cu.ft. of outdoor air per sq.ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm/sq.ft. of outside air or the design minimum outside air rate determined in GGHC EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space.

OR

OPTION 2: Air Testing

- Conduct baseline indoor air quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air and as detailed below.

EQ Credit 3.2 continued

Construction EQ Management Plan: **Before Occupancy**

Note: Additional contaminant maximum concentrations limitations are listed below beyond those required in U.S. EPA and LEED for New Construction guidelines. Demonstrate that the contaminant maximum concentrations listed below are not exceeded.

- Demonstrate that the contaminant maximum concentrations listed below are not exceeded.

Contaminant	**Maximum Concentration**
Formaldehyde	33 micrograms per cubic meter (27 ppb)
Particulates (PM10)	50 micrograms per cubic meter
Total Volatile Organic Compounds (TVOC)	500 micrograms per cubic meter
Individual Organic Compounds	Chronic Reference Exposure Levels (CREL) established by California Office of Environmental Health Hazard Assessment (OEHHA) plus additional compounds, supplemented by CA DHS Standard Practice For the Testing of Volatile Organic Emissions of July 15, 2004
* 4-Phenylcyclohexene (4-PCH)	2.5 micrograms per cubic meter
Carbon Monoxide (CO)	9 parts per million and no greater than 2 parts per million above outdoor levels

Source: PM10, TVOC and CO levels are the same as LEED for New Construction Version 2.2. All other levels are based upon the CA DHS Standard Practice For the Testing of Volatile Organic Emissions of July 15, 2004.

* This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing material are installed as part of the base building systems.

- For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test.
- The air sample testing shall be conducted as follows:
  1. All measurements shall be conducted prior to occupancy, but during normal occupied hours, and with the building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
  2. The building shall have all interior finishes installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.

EQ Credit 3.2 continued

Construction EQ Management Plan: **Before Occupancy**

3. The number of sampling locations will vary depending upon the size of the building and number of ventilation systems. For each portion of the building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq.ft., or for each contiguous floor area, whichever is larger, and include areas with the least ventilation and greatest presumed source strength.
4. Air samples shall be collected between 3 feet and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum 4-hour period.

Suggested Documentation

❑ Document the building flush-out procedures in accordance with credit goals, including actual dates for building flush out.

OR

❑ Document that the referenced standard's IAQ testing protocol has been followed. Include a copy of the testing results.

Reference Standards

CA DHS Standard Practice for the Testing of Volatile Organic Emissions, CA/DHS/EHLB/R-174, July 15, 2004 including addendum 2004-01, Table 8.1, http://www.dhs.ca.gov/IAQ/VOCS/Section01350_7_15_2004_FINAL_PLUS_ADDENDUM-2004-01.pdf

Chronic Reference Exposure Levels (CREL), California Office of Environmental Health Hazard Assessment (OEHHA), http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html

Duct Cleanliness for New Construction Guidelines, 2000.

Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 1995.

Potential Technologies & Strategies

- Specification of low-emitting materials as per GGHC EQ Credit 4 will improve potential for early passage of baseline testing. Coordinate with GGHC EQ Credits 3.1 and 5.1 and replace the filtration media if it is not dirty.
- For IAQ testing use a recognized measurement protocol such as the U.S. EPA "Compendium of Methods for the Determination of Air Pollutants in Indoor Air."
- Copies of the IAQ testing results should describe:
  - The contaminant sampling and analytical methods
  - The locations and duration of contaminant samples
  - The field sampling log sheets and laboratory analytical data

EQ Credit 3.2 continued

Construction EQ Management Plan: **Before Occupancy**

- The methods and results utilized to determine that the ventilation system was started at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode through the duration of the air testing

GGHC Construction Credit Synergies

- MR Credit 2: Construction Waste Management
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 4: Low-Emitting Materials

GGHC Operations Credit Synergies

- IO Credit 2: IAQ Management
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 4.1

Low-Emitting Materials: **Interior Adhesives & Sealants**

Intent

Minimize indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and wellbeing of installers and occupants.

Health Issues

Volatile organic compound emissions (VOCs) from building materials compromise air quality and negatively affect human health. VOCs and other carcinogens and reproductive toxicants that can be emitted by building materials can represent a serious health risk to both the installers and the building occupants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from indoor pollutants.

Credit Goals

- Use only adhesives and sealants with volatile organic compound (VOC) content that does not exceed the VOC content limits of South Coast Air Quality Management District (SCAQMD) Rule #1168 limits scheduled for 2007 as indicated in the table below. Aerosol adhesives not covered by Rule 1168 must meet Green Seal Standard GS-36 requirements.

Adhesives (SCAQMD 1168)	**VOC limit**	**Adhesives (SCAQMD 1168)**	**VOC limit**
Ceramic tile	65	Welding: ABS (avoid)	325
Contact	80	Welding: CPVC (avoid)	490
Fiberglass	80	Welding: plastic cement	250
Metal to metal	30	Welding: PVC (avoid)	510
Multipurpose construction	70	Plastic primer (avoid)	650
Rubber floor	60	Special Purpose Contact	250
Wood: Structural member	140	Sealants (SCAQMD 1168)	
Wood: flooring	100	Architectural Porous Primers (avoid)	775
Wood: all other	30	Sealants & Non Porous Primers	250
All other adhesives	50	Other Primers (avoid)	750
Aerosol Adhesives (GS-36)	**VOC limit**	**Aerosol Adhesives (GS-36)**	**VOC limit**
General purpose mist spray	65%	Special purpose aerosol adhesives	70%
General purpose web spray	55%		
VOC weight limit based on grams/liter of VOC minus water. Percentage is by total weight			

- Use only adhesives and sealants with no carcinogen or reproductive toxicant components present at more than 1% of total mass of the product as defined in the following lists:
  - California OEHHA, Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
  - California Air Resources Board (ARB), list of Toxic Air Contaminants (California Air Toxics).

EQ Credit 4.1 continued

Low-Emitting Materials: **Interior Adhesives & Sealants**

Suggested Documentation

❑ Compile a list of adhesives and sealants used in the building and manufacturer verification documenting compliance with the applicable standards.

Reference Standards

California Air Resources Board (ARB), list of Toxic Air Contaminants (California Air Toxics), http://www.arb.ca.gov/toxics/summary/summary.htm.

California OEHHA (State of California Office of Environmental Health Hazard Assessment), Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html.

Green Seal Commercial Adhesives (GS-36), http://www.greenseal.org/standards/commercialadhesives.htm.

South Coast Air Quality Management District (SCAQMD) Rule #1168, (Adhesive and Sealant Applications), http://www.aqmd.gov/rules/reg/reg11/r1168.pdf.

Potential Technologies & Strategies

- Specify low-VOC and non-carcinogenic, non toxic materials in construction documents, including furniture and equipment specifications.
- Ensure that VOC and carcinogen/toxicant component limits are clearly stated in each section where adhesives and sealants are addressed.
- Avoid use of all products with VOC content of ≥300 g/l or greater.
- VOC content has serious limitations as a predictor of emissions. Emissions testing protocols are beginning to evolve to evaluate building materials and products. Ask distributors for products with actual emission testing from protocols such as CA 01350 or GREENGUARD. This *Green Guide* credit will evolve in that direction as more tested products enter the marketplace.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- MR Credit 4: PBT Elimination
- MR Credit 5: Furniture & Medical Furnishings
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 3: Construction EQ Management Plan

EQ Credit 4.1 continued

Low-Emitting Materials: **Interior Adhesives & Sealants**

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- EP Credit 4: Toxic Reduction
- EP Credit 5: Furniture & Medical Furnishings
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 4.2

Low-Emitting Materials: **Wall & Ceiling Finishes**

Intent

Minimize indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and wellbeing of installers and occupants.

Health Issues

Volatile organic compound emissions (VOCs) from building materials compromise air quality and negatively affect human health. VOCs and other carcinogens and reproductive toxicants emitted by building materials can represent a serious health risk to both installers and the building occupants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from indoor pollutants.

Several persistent bioaccumulative toxicants (PBTs) used in building products are being found at levels of concern in blood samples in the general population, raising serious health concerns. Animal studies indicate growing evidence that many of the halogenated flame retardants (HFRs) used to counteract the high flammability of plastics have toxic properties akin to those of chlorinated PBTs, such as dioxin and PCBs. These effects include immune system suppression, endocrine disruption, nervous system disorders, and cancer. Of particular concern are the widely used polybrominated diphenyl ethers (PBDEs).

DEHP and several other phthalates have received attention in the medical community because of their potential to disrupt normal reproductive tract development in male fetuses, infants, and children. DEHP is used as a plasticizer in many PVC medical products. Other phthalates of concern are also used in some building materials. Phthalates in flexible PVC building materials have also been linked to bronchial irritation and asthma in building occupants.

Credit Goals

- Use only paints and coatings on the interior of the building that do not exceed the VOC limits of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect for 7/1/2008, as indicated below.

Coating (SCAQMD 1113)	**Limit (g/l)**	**Coating** (SCAQMD 1113)	**Limit (g/l)**
Paints (flat and non flat, except anti rust)	50	Rust preventative paints & coatings	100
Clear wood finishes: (varnish, lacquer or sanding sealers)	275	Sealers: Waterproofing & all other	100
		Shellacs: Clear (avoid)	730
Primers and undercoaters	100	Shellacs: Pigmented (avoid)	550
Swimming pool coatings (avoid)	340	Stains	100

EQ Credit 4.2 continued

Low-Emitting Materials: **Wall & Ceiling Finishes**

- Specify ceiling tiles (including suspended acoustical tiles) and wall coverings that meet or exceed the indoor air quality requirements of California's Special Environmental Requirements, Specifications Section 01350, as specified in California Department of Health Services Standard Practice CA/DHS/EHLB/R-174. Testing should be conducted by an independent laboratory, and modeling should use the standard office building protocol parameters. The following programs currently utilize 01350 requirements for compliance:
  - Certification by Scientific Certification Systems (SCS) under their Indoor Advantage Gold Environmental Certification Program.
  - Certification by GREENGUARD under their Product Emission Standard For Children & Schools.

AND

- Do not contain either of the following ingredients:
  - Polybrominated diphenyl ethers (PBDE)
  - Phthalates

Suggested Documentation

❑ Compile a list of paints and coatings used in the building with manufacturers' documentation declaring that they comply with the current VOC and chemical component limits of the credit goals. Compile documentation indicating that wall covering and ceiling tile products have been tested for compliance with the VOC credit goals and do not contain any of the restricted ingredients. Listing in the CHPS Low-Emitting Materials Compliant Materials Table will suffice for documentation of the VOC goal. Ingredient goals, however, are not covered by this listing.

Reference Standards

California Department of Health Services (DHS) Standard Practice CA/DHS/EHLB/R-174, http://www.dhs.ca.gov/iaq/VOCS/Practice.htm.

CHPS Low-Emitting Materials Compliant Materials Table, http://www.chps.net/manual/lem_table.htm.

Collaborative for High Performance Schools (CHPS), Section 01350 Special Environmental Requirements, http://www.chps.net/manual/documents/Sec_01350.doc.

GREENGUARD Product Emission Standard for Children & Schools, http://www.greenguard.org.

Green Seal Certified Products List, http://www.greenseal.org/certproducts.htm#paints.

Scientific Certification Systems Indoor Advantage Gold Environmental Certification Program SCS-EC10-2004, http://www.scscertified.com/iaq.

South Coast Air Quality Management District (SCAQMD) Rule 1113, (Architectural Coatings), http://www.aqmd.gov/rules/reg/reg11/r1113.pdf.

EQ Credit 4.2 continued

Low-Emitting Materials: **Wall & Ceiling Finishes**

Potential Technologies & Strategies

- Specify low- and no-VOC paints, coatings, and interior finishes in construction documents, including furniture and equipment specifications. Ensure that the relevant chemical limits are clearly stated in each section where these finishes are addressed.
- Green Seal Class A paints are both lowest in toxic content and do not contain VOCs. Use Class A paints wherever possible.
- Avoid use of all products with VOC content of 300 g/l or greater.
- VOC content has serious limitations as a predictor of emissions. Emissions testing protocols are beginning to evolve to evaluate building materials and products. Ask distributors for products with actual emission testing from protocols such as CHPS/CA01350 or GREENGUARD. This standard will evolve in that direction as more tested products enter the marketplace. Note also that no current emission standard addresses the release of SVOCs (semi-volatile organic compounds) such as phthalates and materials such as heavy metal stabilizers and halogenated flame retardants.
- Avoid paints with added antimicrobials.
- Avoid field-applied painting entirely by using pre-finished metals.
- Avoid all halogenated organic flame retardants (HFRs), including not only PBDEs (polybrominated diphenyl ether) but also Tetrabromobisphenol-A (TBBPA), Hexabromocyclododecane (HBCD), Deca-BDE (Decabromodiphenyl ether), Tris(2-chloroisopropyl) phosphate (TCPP), Tris(2-chloroethyl) phosphate (TCEP), and Dechlorane Plus.
- Several new chemicals of concern, listed below, are emerging that should be avoided where possible. While substitutes are not yet widely available to support a credit, substitution is encouraged where suitable alternatives exist for products containing the following:
    - Polycarbonate: The bisphenol-A (BPA) used in its production is a suspected endocrine disruptor.
    - Teflon, Stainmaster and Zonyl: The PFOA (Perfluorooctanoic acid or C8) used in its production persists in the environment and is found on a widespread basis in human blood samples. Studies have linked PFOA to cancer, birth defects and other serious health problems in animals. Because of concerns regarding the health impact of PFOA Scotchguard and some other stain resistant treatments are now made from a different perfluorochemical, PFBS (perfluorobutane sulfonate, or C4). All perfluorochemical related products should be avoided when possible.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- MR Credit 4: PBT Elimination
- MR Credit 5: Furniture & Medical Furnishings
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 3: Construction EQ Management Plan

EQ Credit 4.2 continued

Low-Emitting Materials: **Wall & Ceiling Finishes**

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- EP Credit 4: Toxic Reduction
- EP Credit 5: Furniture & Medical Furnishings
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 4.3

Low-Emitting Materials: **Flooring Systems**

Intent

Minimize indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and wellbeing of installers and occupants.

Health Issues

Volatile organic compound emissions (VOCs) from building materials contribute to lower air quality and negatively affect human health. VOCs and other contaminants emitted by building materials can include carcinogens, reproductive toxicants, and respiratory irritants and represent a serious health risk to both the installers and the building occupants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from indoor pollutants.

Several persistent bioaccumulative toxicants (PBTs) used in building products are being found at levels of concern in blood samples in the general population, raising serious health concerns. Animal studies indicate growing evidence that many of the halogenated flame retardants (HFRs) used to counteract the high flammability of plastics have toxic properties akin to those of chlorinated PBTs such as dioxin and PCBs. These effects include immune system suppression, endocrine disruption, nervous system disorders, and cancer. Of particular concern are the widely used polybrominated diphenyl ethers (PBDEs).

DEHP and other phthalates have received most attention in the medical community for their potential developmental toxicity for young children. Phthalates have also been linked to bronchial irritation and asthma associated with their use in flexible PVC building materials.

Credit Goals

- Specify carpet and resilient flooring systems that meet or exceed:
  - The indoor air quality requirements of California's Special Environmental Requirements, Specifications Section 01350, as specified in California Department of Health Services (DHS) Standard Practice CA/DHS/EHLB/R-174. Testing should be conducted by an independent laboratory, and modeling should use the standard office building protocol parameters. The following programs currently utilize 01350 requirements for compliance:
    - Certification by the Carpet and Rug Institute (CRI) under their Green Label Plus program,
    - Certification by GREENGUARD under their Product Emission Standard For Children & Schools,
    - Certification by the Resilient Floor Covering Institute under their Floor Score program.
    - Listing on the Collaborative for High Performance Schools Low-Emitting Materials Table

AND

- Specify carpet and resilient flooring systems that do not contain any of the following ingredients:
  - Polybrominated diphenyl ethers (PBDE)
  - Phthalates
  - Natural rubber latex

EQ Credit 4.3 continued

Low-Emitting Materials: **Flooring Systems**

- Testing should be done on whole assemblies of flooring with the adhesive, if any, which will be utilized in the installation.
- Use only adhesives and sealants with no carcinogen or reproductive toxicant components present at more than 1% of total mass of the product as defined in the following lists:
- California Office of Environmental Health Hazard Assessment (OEHHA), Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
- California Air Resources Board (ARB), list of Toxic Air Contaminants (California Air Toxics).
- For wood, concrete or any other floors requiring coatings, sealants or other finishes, use only products meeting the VOC requirements of GGHC EQ Credit 4.2.

Suggested Documentation

❑ Obtain documentation that all the carpet and resilient flooring systems have been tested by an independent indoor air quality testing laboratory and modeled to comply with the credit criteria. Confirm that tests have been performed within the last twelve months. Listing on the CHPS Low-Emitting Materials Table or the Carpet and Rug Institute (CRI) “Green Label Plus” listing may be accepted in replacement for actual test data.

❑ Obtain documentation that all adhesives and sealants do not exceed the content limits for carcinogenic or reproductive toxicant substances.

❑ Obtain documentation that all carpets do not include natural rubber latex in the backing.

Reference Standards

California Air Resources Board (ARB), list of Toxic Air Contaminants (California Air Toxics), http://www.arb.ca.gov/toxics/id/taclist.htm

California Department of Health Services Standard Practice CA/DHS/EHLB/R-174, http://www.dhs.ca.gov/iaq/VOCS/Practice.htm.

California Office of Environmental Health Hazard Assessment (OEHHA) Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html

CHPS Low-Emitting Materials Compliant Materials Table, http://www.chps.net/manual/lem_table.htm.

Collaborative for High Performance Schools, Section 01350 Special Environmental Requirements, http://www.chps.net/manual/documents/Sec_01350.doc.

GREENGUARD Product Emission Standard for Children & Schools, http://www.greenguard.org

“Green Label Plus" Carpet Testing Program, http://www.carpet-rug.com.

Potential Technologies & Strategies

- Specify low-VOC carpet and resilient flooring products and systems in Construction Documents. Ensure that all carcinogenic or reproductive toxicant and other VOC limits are clearly stated where carpet and resilient flooring systems are addressed.

EQ Credit 4.3 continued

Low-Emitting Materials: **Flooring Systems**

- Give preference to materials tested by an independent lab in accordance with “Green Label Plus” or using California DHS Standard Practice CA/DHS/EHLB/R-174 for office buildings. The Carpet and Rug Institute (CRI) “Green Label Plus" program uses most aspects of the DHS protocol, with the exception of the stipulation to report out actual chemical concentrations - it is purely a pass-fail based upon a standard office building specification. If using the “Green Label Plus” certified materials, consider requiring submission of the actual test data from the manufacturer to inform material comparisons.
- Avoid use of all products with VOC content of 300 g/l or greater.
- Avoid all halogenated organic flame retardants (HFRs), including not only PBDEs (polybrominated diphenyl ether) but also Tetrabromobisphenol-A (TBBPA), Hexabromocyclododecane (HBCD), Deca-BDE (Decabromodiphenyl ether), Tris(2-chloroisopropyl) phosphate (TCPP), Tris(2-chloroethyl) phosphate (TCEP), and Dechlorane Plus.
- Several new chemicals of concern, listed below, are emerging that should be avoided where possible. While substitutes are not yet widely available to support a credit, substitution is encouraged where suitable alternatives exist for products containing the following:
    - Polycarbonate: The bisphenol-A (BPA) used in its production is a suspected endocrine disruptor
    - Teflon, Stainmaster and Zonyl: The PFOA (Perfluorooctanoic acid or C8) used in its production persists in the environment and is found on a widespread basis in human blood samples. Studies have linked PFOA to cancer, birth defects and other serious health problems in animals. Because of concerns regarding the health impact of PFOA Scotchguard and some other stain resistant treatments are now made from a different perfluorochemical, PFBS (perfluorobutane sulfonate, or C4). All perfluorochemical related products should be avoided when possible.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- MR Credit 4: PBT Elimination
- MR Credit 5: Furniture & Medical Furnishings
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 3: Construction EQ Management Plan

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- EP Credit 4: Toxic Reduction
- EP Credit 5: Furniture & Medical Furnishings
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 4.4

Low-Emitting Materials: **Composite Wood & Insulation**

Intent

Minimize indoor air contaminants that are odorous, potentially irritating and/or harmful to the comfort and wellbeing of installers and occupants.

Health Issues

Volatile organic compound emissions (VOCs) from building materials compromise air quality and negatively affect human health. VOCs and other carcinogens and reproductive toxicants emitted by building materials represent a serious health risk to both installers and building occupants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from indoor pollutants.

Formaldehyde (HCHO) is listed by the U.S. EPA as a probable human carcinogen and by the National Institute for Occupational Safety as a workplace carcinogen. Formaldehyde exposure can increase the risk of a range of health effects in installers and building occupants. These effects include: irritation of mucous membranes, including the eyes and respiratory tract; sensitization resulting in asthma symptoms (e.g., wheezing and chest congestion) and skin reactions; and cancer.

Credit Goals

- Specify composite wood and agrifiber products and fiberglass materials (including acoustical and other suspended ceiling tiles) used on the interior of the building (defined as inside of the weatherproofing system) with no added urea-formaldehyde resins.
- Specify laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies that contain no added urea-formaldehyde resins. Composite wood and agrifiber products are defined as: particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores.

Suggested Documentation

❑ Obtain documentation, confirming that all the casework, fiberglass insulation (both acoustic and thermal), furniture and other agrifiber or composite wood products used in the building contain no added urea-formaldehyde resins.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Review the MSDS and other printed literature accompanying building materials and products, especially for composite wood products, casework, fiberglass products, insulation (both acoustic and thermal) agriboard products, and furniture finishes to ensure that no added urea-formaldehyde was used in the products' manufacture.

EQ Credit 4.4 continued

Low-Emitting Materials: **Composite Wood & Insulation**

- Specify and use urea-formaldehyde-free substitutes that achieve equal or superior performance.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- MR Credit 4: PBT Elimination
- MR Credit 5: Furniture & Medical Furnishings
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 3: Construction EQ Management Plan

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- EP Credit 4: Toxic Reduction
- EP Credit 5: Furniture & Medical Furnishings
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 4.5

Low-Emitting Materials: **Furniture & Medical Furnishings**

Intent

Minimize the use of furniture including medical furnishings that may release indoor air contaminants that are odorous or potentially irritating and may be deleterious to installer and occupant health, comfort and wellbeing.

Health Issues

Volatile organic compounds (VOCs) from building materials compromise air quality and negatively affect human health. VOCs and other carcinogens and reproductive toxicants emitted by building materials represent a serious health risk to both installers and building occupants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from indoor pollutants.

Several persistent bioaccumulative toxicants (PBTs) used in building products are being found at levels of concern in blood samples in the general population, raising serious health concerns. Animal studies indicate growing evidence that many of the halogenated flame retardants (HFRs) used to counteract the high flammability of plastics have toxic properties akin to those of chlorinated PBTs such as dioxin and PCBs. These effects include immune system suppression, endocrine disruption, nervous system disorders, and cancer. Of particular concern are the polybrominated diphenyl ethers (PBDEs) widely used in plastic foam and other parts of furnishings.

Likewise the perfluorochemicals (PFCs) used directly in the manufacture of many stain protection and non stick treatments, most notably perfluorooctanoic acid (PFOA), or resulting as a breakdown product, are showing up in human blood samples in increasing frequency and are demonstrating a similar broad range of toxicological effects in animal studies.

DEHP and other phthalates have received most attention in the medical community for their potential developmental toxicity for young children. Phthalates have also been linked to bronchial irritation and asthma associated with their use in flexible PVC building materials.

Credit Goals

- Select a minimum of 40% (by cost) of all furniture and medical furnishings (including mattresses, foams, panel fabrics and other textiles) that contain no more than one of the four listed materials:
  - Polybrominated diphenyl ethers (PBDE, a flame retardant)
  - Teflon®, Stainmaster® or other stain protection treatment that utilizes perfluorooctanoic acid (PFOA or C8) in its production
  - Urea formaldehyde
  - Phthalate plasticizers

OR

- That contain no more than two of the four above-listed materials AND meet or exceed the indoor air quality requirements of California's Special Environmental Requirements, Specifications Section 01350, updated with California DHS Standard Practice CA/DHS/EHLB/R-174 as determined by independent laboratory testing and using the standard office building protocol parameters. The following programs currently utilize 01350 requirements for compliance:

EQ Credit 4.5 continued

Low-Emitting Materials: **Furniture & Medical Furnishings**

- Certification by Scientific Certification Systems (SCS) under their Indoor Advantage Gold Environmental Certification Program
- Certification by GREENGUARD under their Product Emission Standard For Children & Schools

Suggested Documentation

❑ Obtain documentation listing each product description (all components) and complete matrix indicating the number of criteria met for each furnishing group.

❑ If applicable, obtain test results of the furniture assemblies that have been tested in accordance with the noted VOC protocol indicating compliance with the emissions limits. Test results must be current within twelve (12) months of the project specification, and must be dated and signed by an officer of the independent laboratory where the testing was conducted.

Reference Standards

California Department of Health Services Standard Practice CA/DHS/EHLB/R-174, www.dhs.ca.gov/ps/deodc/ehlb/iaq/VOCS/Practice.htm.

California Office of Environmental Health Hazard Assessment (OEHHA) Chronic Reference Exposure Limits (REL), http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html.

GREENGUARD Product Emission Standard For Children & Schools, http://www.greenguard.org.

Scientific Certification Systems Indoor Advantage Environmental Certification Program SCS-EC10-2004, http://www.scscertified.com/iaq

Testing Requirements For Volatile Organic Compound Emissions, DGS Environmental Specifications for Office Furniture Systems, http://www.ciwmb.ca.gov/greenbuilding/Specs/Furniture/.

Potential Technologies & Strategies

- Prepare specification language identifying the VOC and chemicals of concern goals for the aforementioned material categories and indicating that review of material content will be a criterion in all substitution reviews.
- Avoid all halogenated organic flame retardants (HFRs), including not only PBDEs (polybrominated diphenyl ether) but also Tetrabromobisphenol-A (TBBPA), Hexabromocyclododecane (HBCD), Deca-BDE (Decabromodiphenyl ether), Tris(2-chloroisopropyl) phosphate (TCPP), Tris(2-chloroethyl) phosphate (TCEP), and Dechlorane Plus.
- One strategy to meet the PBDE-free goal is to specify seating with mesh and no foam.
- HFRs are rarely listed on product data sheets; PFCs are most commonly used as a process chemical or are a break down product, so they show up as a contaminant rather than a final ingredient. Determining association of these chemicals with furniture may require direct discussion with manufacturers. PFCs are used most commonly in such stain and non-stick treatments as Scotchguard®, Teflon®, Stainmaster®, Scotchban®, and Zonyl®.

EQ Credit 4.5 continued

Low-Emitting Materials: **Furniture & Medical Furnishings**

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- MR Credit 4: PBT Elimination
- MR Credit 5: Furniture & Medical Furnishings
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 3: Construction EQ Management Plan

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- EP Credit 4: Toxic Reduction
- EP Credit 5: Furniture & Medical Furnishings
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 4.6

Low Emitting Materials: **Exterior Applied Products**

Intent

Protect installers and building occupants and safeguard air quality resulting from exposure to hazardous and/or odorous substances used during construction.

Health Issues

Volatile organic compound emissions (VOCs) from building materials compromise air quality and negatively affect human health. VOCs and other carcinogens and reproductive toxicants emitted by building materials represent a serious health risk to both installers and building occupants. Children, pregnant women, the elderly, and those with allergies, asthma or chemical sensitivities are especially at risk of suffering adverse health effects from indoor pollutants.

Health care construction rarely occurs on undeveloped sites remote from ongoing existing operations. In most instances, construction operations are proximate to existing operational health care facilities, where construction practices have health impacts on adjacent building occupants and building system performance.

Fumes from application of hot applied materials, such as coal tar, asphalt and bitumens, particularly for roofing, pavement sealing and waterproofing increase risks of cancer and respiratory disease.

Credit Goals

- Specify coatings, roofing and waterproofing materials with volatile organic content (VOC) content limits of South Coast Air Quality Management District (SCAQMD) Rules 1113 and 1168 scheduled for 2007 as indicated in the table below and in the table in GGHC EQ Credit 4.2.
- Specify no roofing installations using hot asphalt.
- Specify no use of coal tar sealants for parking lots and other paved surfaces.
- For any waterproofing, asphalt roofing needing repair, parking lot sealing or other high VOC emissions outdoor construction process, create a plan to manage fumes and avoid infiltration to occupied spaces. Comply with procedures established by NIOSH Publication No. 2003-112: Asphalt Fume Exposures During the Application of Hot Asphalt to Roofs.

EQ Credit 4.6 continued

Low-Emitting Materials: **Exterior Applied Products**

Adhesives (SCAQMD 1113)	**limit (g/l)**	**Sealants & Sealant Primers** (SCAQMD 1168)	**limit (g/l)**
Outdoor carpet	150	Architectural	250
Structural glazing	100	Architectural Porous	775
Single ply roof membrane	250	Marine Deck	760
Coatings (SCAQMD 1113)	**limit (g/l)**	Modified bitumen (Avoid)	500
Fire proofing exterior coatings	350	Non membrane roof	300
Roof coatings – aluminum	100	Roadway	250
Roof coatings – all other	50	Single ply roof membrane	450
Roof primers, bituminous	350		
Swimming pool coatings	340		
Traffic coatings	150		
Wood preservatives	350		

Suggested Documentation

- ❑ Prepare a written containment plan for isolating potentially hazardous or odorous substances occurring during construction to insure that they do not migrate into occupied areas. Provide verification of implementation.
- ❑ Obtain a cut sheet or Material Safety Data Sheet (MSDS) for each material used on the building highlighting VOC limits.

Reference Standards

NIOSH Publication No. 2003-112: Asphalt Fume Exposures During the Application of Hot Asphalt to Roofs.

South Coast Air Quality Management District (SCAQMD) Rule 1113 (Architectural Coatings), http://www.aqmd.gov/rules/reg/reg11/r1113.pdf.

South Coast Air Quality Management District (SCAQMD) Rule 1168 (Adhesive and Sealant Applications), http://www.aqmd.gov/rules/reg/reg11/r1168.pdf.

Potential Technologies & Strategies

- During active outdoor construction periods, establish a schedule for regular monitoring of outdoor air quality at intakes to insure that outdoor air contaminants are not entering the building systems.
- Avoid use of all products with VOC content greater than 300 g/l.

EQ Credit 4.6 continued

Low-Emitting Materials: **Exterior Applied Products**

- Avoid use of pavement sealer entirely if possible in favor of unsealed concrete, pavers or concrete topper on asphalt. If sealing is required, use asphalt instead of coal tar due to its lower PAH content.
- Establish containment barriers to isolate the work area from occupied areas. Use pressurization as needed to protect occupied areas.
- Seal all openings between occupied areas and adjacent construction areas, including but not limited to:
  - Windows
  - Doorways
  - Elevator openings
  - Drains
  - Grates and skylights
  - with exceptions of the means of entry and exit.

Resources

City of Austin Ordinance 200051117-070 Relating to Coal Tar Pavement Products, http://www.ci.austin.tx.us/watershed/coaltar_main.htm

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- MR Credit 4: PBT Elimination
- MR Credit 5: Furniture & Medical Furnishings
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Materials Removal or Encapsulation
- EQ Credit 3: Construction EQ Management Plan

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- IO Credit 2: IAQ Management
- CM Prerequisite 1: Polychlorinated Biphenyl (PCB) Removal
- EP Credit 4: Toxic Reduction
- EP Credit 5: Furniture & Medical Furnishings
- EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 5.1

Chemical & Pollutant Source Control: **Outdoor**

Intent

Prevent the entry of contaminants into buildings from the exterior, including ensuring adequate supply of air that meets the National Ambient Air Quality Standard to the building at all times.

Health Issues

Indoor air pollution often begins with unintended outdoor pollutants penetrating the building envelope. Health care buildings are highly trafficked, with large numbers of staff and visitors entering the building. Vehicular traffic patterns often include idling vehicles near major entryways, and emissions sources (vehicles, helicopters, emergency generators, etc.) can generate various pollutants that can be harmful or offensive to hospital staff and patients.

Credit Goals

Design to minimize pollutant contamination of regularly occupied areas due to exterior factors.

- Employ permanent entryway systems at least six feet long in the primary direction of travel to capture dirt and particulates from entering the building at all entryways that are directly connected to the outdoors. Acceptable entryway systems include permanently installed grates, grilles, or slotted systems that allow for cleaning underneath. Roll-out mats are only acceptable when maintained on a weekly basis by a contracted service organization. Qualifying entryways are those that serve as regular entry points for building users.
- Minimize the entry of contaminants into the building from vehicles, pesticides, herbicides, helipads, diesel generators, designated smoking areas, sources of exhaust air, and other sources of potential contaminants. Achieve this by:
    - Providing pressurized entryway vestibules at building entrances; and,
    - Designing facilities to maximize the availability of air meeting the National Ambient Air Quality Standard at the outdoor air intakes.
        - Ensure, through the results of mathematical (e.g. CFD) and/or physical (e.g. wind tunnel) modeling that outdoor air intakes will capture less pollutant concentrations than the thresholds established for the project. These thresholds can be achieved through a combination of (1) selecting outdoor air intake locations, (2) moving emissions/pollutant sources, and (3) cleaning emissions at the source. Consideration should be given to emissions from vehicles idling at loading docks and entry points. Policies prohibiting or limiting these sources of pollutants may be included in the design strategy to comply with this credit goal.
        - The primary “emissions of concern” shall be CO, Nox, Sox, and particulate matter. Other pollutants specific to the conditions of the project shall be included in the “emissions of concern” (and considering such sources as helicopters, fume hoods, EtO sterilizer exhausts, loading docks, garage exhausts, smoking areas, etc.).

EQ Credit 5.1 continued

Chemical & Pollutant Source Control: **Outdoor**

- Air intake concentrations shall be no higher than 20% of the acceptable indoor concentrations, and 1% of the Threshold Limit Value (TLV). Acceptable indoor concentrations shall be based on the Short Term Exposure Limits (STEL) from the *2006 Guide to Occupational Exposure Values* published by the American Conference of Governmental Industrial Hygenists (ACGIH). TLV values shall be taken from the *2006 Threshold Limit Values for Chemical Substances and Physical Agents*, published by the ACGIH.

- In mechanically ventilated buildings, provide regularly occupied areas of the building with new air filtration media prior to occupancy that provide a Minimum Efficiency Reporting Value (MERV) of 13 or better. Filtration should be applied to process both return and outside air that is to be delivered as supply air.

Suggested Documentation

- ❑ Compile a building plan showing all entryways that are directly connected to the outdoors and all permanently installed entryway systems (grilles, grates, etc). Show acceptable entryway systems.
- ❑ Provide the results of mathematical (e.g. CFD) and/or physical (e.g. wind tunnel) modeling to show that outdoor air intakes will capture less than the desired thresholds of pollutants as outlined in the credit goals.
- ❑ Document replacement of air filtration media prior to occupancy that provide a Minimum Efficiency Reporting Value of 13 or better.

Reference Standards

2006 Guide to Occupational Exposure Values, Short Term Exposure Limits (STEL). American Conference of Governmental Industrial Hygienists (ACGIH), http://www.acgih.org.

2006 Threshold Limit Values (TLV) for Chemical Substances and Physical Agents. American Conference of Governmental Industrial Hygienists (ACGIH), http://www.acgih.org.

National Ambient Air Quality Standard, US Environmental Protection Agency, http://www.epa.gov/air/criteria.html.

Potential Technologies & Strategies

- Minimize introduction of dirt with appropriately sized, recessed metal grating or similar entryway system within vestibules.
- Install additional “walk-off mats” in entryways to prevent dirt from entering the building.

EQ Credit 5.1 continued

Chemical & Pollutant Source Control: **Outdoor**

GGHC Construction Credit Synergies

- ID Prerequisite 2: Health Mission Statement & Program
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Prerequisite 1: Storage & Collection of Recyclables
- MR Credit 1: Building Reuse
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation

GGHC Operations Credit Synergies

- IO Prerequisite 3: Environmental Tobacco Smoke Control
- IO Credit 2: IAQ Management
- CM Credit 2: Indoor Pollutant Source Control
- ES Credit 2: Indoor Integrated Pest Management
- ES Credit 3: Environmentally Preferable Cleaning Policy
- ES Credit 4: Sustainable Cleaning Products & Materials
- ES Credit 5: Environmentally Preferable Janitorial Equipment
- EP Credit 4: Toxic Reduction, EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 5.2

Chemical & Pollutant Source Control: **Indoor**

Intent

Minimize exposure of building occupants to potentially hazardous indoor pollutants and chemicals that adversely impact air quality and human health.

Health Issues

The Joint Commission on the Accreditation of Health Care Organizations (JCAHO) has expressed increasing concern over growing respiratory issues among health care workers. JCAHO has identified indoor chemical pollutants as a contributing factor to indoor air quality issues, including photocopiers, glutaraldehyde and ethylene oxide sterilants, xylene, aerosolized medication distribution systems, anesthetic gases, chemotherapeutic agents, latex, cleaners and floor finishes.

Credit Goals

Design to minimize cross-contamination of regularly occupied spaces:

- Where hazardous gases or chemicals may be present or used (including garages, soiled utility areas, sterilization and disinfection areas, housekeeping/laundry areas and copying/printing rooms), exhaust each space sufficiently to create negative pressure with respect to adjacent spaces with the doors to the room closed. For each of these spaces, provide self-closing doors and deck-to-deck partitions or a hard lid ceiling. The exhaust rate shall be at least 6 air changes/hour (for rooms containing disinfectant and sterilant applications, provide minimum 12 air changes/hour), with no air re-circulation. The pressure differential with the surrounding spaces shall be at least 5 Pa (0.02 inches of water gauge) on average and 1 Pa (0.004 inches of water) at a minimum when the door(s) to the room(s) are closed.
- Develop an action plan to eliminate, minimize, substitute, recycle, and dispose of harmful chemicals safely. The plan should improve distribution, and limit quantities, storage and waste.

Suggested Documentation

- ❑ Compile a building plan showing all rooms where chemical mixing, sterilization or high level disinfection of instruments occurs, and demonstrating that all chemical use areas and copy rooms have been designed to comply with the credit goals.
- ❑ Include review of equipment locations as part of the initial building commissioning plan.
- ❑ Compile an action plan for proper handling and disposal of harmful chemicals, in compliance with credit goals.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Isolate potential pollution sources through separate zoning of areas where contaminants are generated.

EQ Credit 5.2 continued

Chemical & Pollutant Source Control: **Indoor**

- Consider centralized high-level disinfection and/or sterilization practices to reduce the number of satellite locations, increase quality control and best management practices.
- Consider automatic washers and less toxic methods of sterilization and high-level disinfection of instruments. (See Resources section for guidance documents.) Create a committee to standardize best management practices for high-level disinfection to increase safety and reduce worker exposure.
- Locate copiers, fax machines and other office equipment in spaces with direct exhaust ventilation.
- Include infection control and environmental services in material selection to address cleaning protocol and to reduce toxicity of cleaning agents, including waxers and strippers, required to clean and disinfect interior finishes, furniture, and furnishings.
- In diagnostic and treatment areas, include utility rooms with negative pressure and direct exhaust to accommodate sterilization systems and other medical equipment that require chemical use.
- Develop material handling and processing guidelines as a part of initial building design, and monitor implementation of guidelines as a part of final building commissioning. Guidelines should reduce consumption of hazardous materials, and to prevent potential contamination of the surrounding environment.
- Provide dedicated centralized areas for receiving of, return of, or safe disposal of, hazardous materials. Also consider providing dedicated space in each lab for receiving of, return of, or safe disposal of hazardous materials. Include an area for reporting of all hazardous material "transactions" to a central inventory system.
- Develop decanting procedures that eliminate waste or allow for recycling of waste streams. Minimize proliferation of hazardous materials in laboratories by developing a "just in time" inventory system.
- Provide a coordinated materials transport strategy that allows efficient "just in time" delivery of hazardous materials.
- Use alternative equipment or laboratory methods designed to reduce consumption of hazardous materials.
- Minimize use of hazardous materials in relationship to testing/experimental volume.
- Use automated laboratory equipment that maximizes sample throughput while minimizing sample size, reagent quantity, and waste streams.
- Work with EH&S (Environmental, Health, and Safety) personnel and local code officials in developing an action plan.

Resources

California Department of Health Services EtO fact sheet, http://www.dhs.ca.gov/ohb/HESIS/eto.htm.

Center for Disease Control and Prevention – Guideline for Handwashing and Hospital Environmental Control, 1985 (Includes guidance on cleaning, disinfecting and sterilizing equipment), http://wonder.cdc.gov/wonder/prevguid/p0000412/p0000412.asp

Disinfection Best Management Practices – Minnesota Technical Assistance Program, http://mntap.umn.edu/health/73-DisinfectionBMP.htm

Disinfection and Sterilization – Sustainable Hospitals Project, http://www.sustainablehospitals.org/cgi-bin/DB_Report.cgi?px=W&rpt=Cat&id=28

EQ Credit 5.2 continued

Chemical & Pollutant Source Control: **Indoor**

EtO fact sheet, http://www.osha.gov/OshDoc/data_General_Facts/ethylene-oxide-factsheet.pdf

Glutaraldehyde control, http://www.sustainablehospitals.org/HTMLSrc/IP_Glutcontrol.html

Glutaraldehyde fact sheet, http://www.osha.gov/SLTC/etools/hospital/hazards/glutaraldehyde/glut.html

Health Facilities Management Article – August 2004 "Instituting a Green Floor Care Program", http://h2e-online.org/docs/hfm80104.pdf

Hospital for a Healthy Environment's Ten Step Guide to Implementing a Green Cleaning Program, http://www.h2e-online.org

Hospitals for a Healthy Environment's Ten Step Guide to Implementing an Integrated Pest Management Program, http://www.h2e-online.org

Labs for the 21s Century, Materials & Resources Credit 8: Chemical Resource Management, http://labs21.lbl.gov

OSHA's Best Practices for Safe Use of Glutaraldehyde in Health Care, http://www.osha.gov/Publications/glutaraldehyde.pdf

Overview of Proper use of Cidex OPA for High Level Disinfection of Reusable Medical Equipment, http://h2e-online.org/docs/h2e10stepcidexopa.pdf

Reduce Hazardous Chemicals and Waste—Meeting JCAHO Standards with Pollution Prevention, http://www.mntap.umn.edu/health/jcaho-chem.htm

GGHC Construction Credit Synergies

- ID Prerequisite 2: Health Mission Statement & Program
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Prerequisite 1: Storage & Collection of Recyclables
- MR Credit 1: Building Reuse
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation

GGHC Operations Credit Synergies

- IO Prerequisite 3: Environmental Tobacco Smoke Control
- IO Credit 2: IAQ Management
- CM Credit 2: Indoor Pollutant Source Control
- ES Credit 2: Indoor Integrated Pest Management
- ES Credit 3: Environmentally Preferable Cleaning Policy
- ES Credit 4: Sustainable Cleaning Products & Materials
- ES Credit 5: Environmentally Preferable Janitorial Equipment
- EP Credit 4: Toxic Reduction, EP Credit 6: IAQ Compliant Products

1 point

EQ Credit 6.1

Controllability of Systems: **Lighting**

Intent

Provide a high level of lighting system control by individual occupants, or by specific groups in multi-occupant spaces (i.e., holding and recovery areas, treatment spaces, patient rooms), to promote the productivity, comfort, wellbeing, and satisfaction of building occupants.

Health Issues

Building occupants' health is directly impacted by the degree of control that individuals can exercise over their immediate environment. Given the wide range and variety of individuals receiving care, patient or resident control cannot be extended to all elements of the physical environment. Because the sense of loss of control can be disturbing and stressful to patients or residents and their family members, every effort should be made to allow individual control over as many elements of the environment as possible and reasonable, including but not limited to temperature, lighting, and privacy. Control over lighting, window treatments, and temperature directly impacts the quality of the experience of the interior environment. Occupant control of ventilation or airflow may conflict with regulatory requirements for ventilation rates and pressurization in health care environments.

Credit Goals

- Provide individual lighting controls for a minimum of 90% of the building occupants, including staff, to enable adjustments to suit individual needs and preferences.
- Install lighting controls in patient rooms that are readily accessible from the patient bed.
- Provide individual lighting controls for each bed in multi-occupant spaces, such as recovery rooms, emergency departments, infusion areas, and similar open areas.
- Provide occupant controls over window shades, blinds, and/or curtains that are readily accessible from the patient bed.

Suggested Documentation

❑ Provide lighting control plans indicating compliance with the goals of this credit.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Design the building with occupant controls for lighting and window treatments. Strategies to consider include lighting controls and task lighting. Integrate lighting systems' controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.

EQ Credit 6.1 continued

Controllability of Systems: **Lighting**

- Provide dimming or other multi-level switching capable of reasonably uniform illuminance reduction for conference rooms, dining areas, lounges, and all other spaces larger than 100 square feet in which the connected lighting load exceeds 0.8 watts per square foot.
- Provide occupant controls for shading devices in staff and multi-occupant spaces.
- Provide photocell daylighting controls for daylit spaces, including corridors.

GGHC Construction Credit Synergies

- SS Credit 9: Connection to the Natural World
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Prerequisite 3: Hazardous Material Removal or Encapsulation
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation
- EQ Credit 7: Thermal Comfort
- EQ Credit 8: Daylight & Views

GGHC Operations Credit Synergies

- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 3: Energy Efficient Equipment
- EE Credit 5: Performance Measurement

1 point in addition to EQ Credit 6.1

EQ Credit 6.2

Controllability of Systems: **Thermal Comfort**

Intent

Provide a high level of thermal comfort system control by individual occupants, or by specific groups in multi-occupant spaces (i.e., holding and recovery areas, treatment spaces, patient rooms), to promote the productivity, comfort, and wellbeing of building occupants.

Health Issues

The health of building occupants is directly impacted by the degree of control that individuals can exercise over their immediate environment. Control over temperature directly impacts the quality of the experience of the interior environment. Studies have shown that occupant control over the immediate thermal environment positively impacts patient and staff satisfaction, while decreasing overall energy consumption.

Occupant control of ventilation or airflow may conflict with regulatory requirements for ventilation rates and pressurization in health care facilities.

Credit Goals

- Provide individual thermal comfort controls for 50% (minimum) of the building occupants, exempting patient rooms, to enable adjustments to suit individual task needs and preferences.
- Provide individual thermal comfort controls that are readily accessible from the patient bed in all patient rooms.
- Operable windows can be used in lieu of individual controls for areas that are 20 feet inside of and 10 feet to either side of the operable part of the window. The areas of operable window must meet the requirements of ASHRAE 62.1-2004, paragraph 5.1, Natural Ventilation.

AND

- Provide comfort system controls for all shared multi-occupant spaces to enable adjustments to suit group needs and preferences.

Note: Conditions for thermal comfort are described in ASHRAE Standard 55-2004 to include the primary factors of air temperature, radiant temperature, air speed and humidity. Comfort system control for the purposes of this credit is defined as the provision of control over at least one of these primary factors in the occupant's local environment.

Suggested Documentation

❑ Compile schematic drawings demonstrating the required individual thermal comfort controls are provided.

Reference Standards

ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy

ASHRAE Standard 62.1-2004, Natural Ventilation, Paragraph 5.1

EQ Credit 6.2 continued

Controllability of Systems: **Thermal Comfort**

Potential Technologies & Strategies

- Design the building and systems with comfort controls to allow adjustments to suit individual needs or those of groups in shared spaces. ASHRAE Standard 55-2004 identifies the factors of thermal comfort and a process for developing comfort criteria for building spaces that suit the needs of the occupants involved in their daily activities.
- Develop control strategies that expand on the comfort criteria outlined in the Credit Goals to allow adjustments to suit individual needs and preferences. These may involve system designs incorporating operable windows, hybrid systems integrating operable windows and mechanical systems, or mechanical systems alone.
- Individual adjustments may involve individual thermostat controls, local diffusers at floor, desk or overhead levels, or control of individual radiant panels, or other means integrated into the overall building, thermal comfort systems, and energy systems design.
- In addition, designers should evaluate the closely tied interactions between thermal comfort (as required by ASHRAE Standard 55-2004) and acceptable indoor air quality (as required by ASHRAE Standard 62.1-2004, whether natural or mechanical ventilation).
- Additional strategies to consider include:
  - Underfloor HVAC systems with individual diffusers
  - Displacement ventilation systems
  - Operable windows
- See GGHC EQ Credit 6.1 for Credit Synergies.

1 point

EQ Credit 7

Thermal Comfort

Intent

Provide for the assessment of building thermal comfort over time.

Health Issues

Occupant comfort is an essential component of healthy and productive indoor environments. By optimizing thermal control, including humidity control, there are documented improvements in occupant health, including improved respiratory function, and reduced mold and mildew growth. This is particularly important in hospitals, where patients are likely to have suppressed immune systems or other illnesses that make them more vulnerable to poor indoor environmental conditions.

Credit Goals

- Agree to implement a thermal comfort survey of building occupants (patients and staff) within a period of six to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of the respondents in each group are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004.

Suggested Documentation

- ❑ Develop a thermal comfort survey and a plan for corrective action in compliance with the credit goals.
- ❑ Document the facility's commitment to implement the thermal comfort survey within six to 18 months after occupancy and to respond to its results in a timely manner.

Reference Standards

ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy

Potential Technologies & Strategies

- ASHRAE Standard 55-2004 provides guidance for establishing thermal comfort criteria and the documentation and validation of building performance to the criteria. While the standard is not intended for purposes of continuous monitoring and maintenance of the thermal environment, the principles expressed in the standard provide a basis for design of monitoring and corrective action systems.

EQ Credit 7 continued

Thermal Comfort

GGHC Construction Credit Synergies

- SS Credit 7: Heat Island Effect
- WE Credit 1: Water Efficient Landscaping
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Prerequisite 1: Minimum IAQ Performance
- EQ Credit 1: Outdoor Air Delivery Monitoring
- EQ Credit 2: Natural Ventilation
- EQ Credit 6: Controllability of Systems

GGHC Operations Credit Synergies

- IO Prerequisite 1: Integrated Operations & Maintenance Process
- IO Credit 2: IAQ Management, WC Credit 4: Enhanced Metering
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 3: Energy Efficient Equipment
- EE Credit 5: Performance Measurement

5 points

EQ Credit 8.1

Daylight & Views: **Daylight for Occupied Spaces**

Intent

Provide building occupants with a connection between indoor spaces and the outdoors by introducing daylight and views into the building's regularly occupied areas.

Health Issues

Americans are estimated to spend about 90% of their time indoors. Increasingly, studies are identifying links between a range of health issues and exposure to lightness and darkness during the daily 24-hour cycle. The distinction between daylit and electrically lit spaces is significant: daylight intensity levels are in the range of 10,000 to 40,000 lux, while a brightly lit interior averages between 300 and 500 lux. Daylight changes and modulates not only in intensity but also in spectrum and creates cues for the passage of time with continuously changing shadow patterns.

Benefits of natural light in hospitals and health care facilities include improved physiological and psychological states for both patients and staff. Studies show that daylighting can reduce the stress experienced by caregivers, patients and families.

Studies also indicate that daylight can reduce a patient's post surgical recovery time. Moreover, in certain illnesses, the human biological clock or the circadian system plays an important role in maintaining the well-being of the individual by alleviating depression, improving night sleep quality, alertness and performance quality. In Alzheimer's patients, for example, exposure to bright lights during the day consolidates nighttime sleep, which in turn reduces the stress on caregivers. Studies show that "ICU psychosis", a state of delirium experienced in critical care environments, is dramatically reduced when spaces are daylit.

Daylighting in long term care facilities is beneficial in maintaining calcium levels, sleep patterns among elderly, and higher ambient lighting levels required for the aging eye (glare should be prevented). Recent studies have linked the quality of light to the quality of life for frail elderly.

Credit Goals

Note: a project may earn either one or both sets of daylighting credits, which calculate daylight for Diagnostic and Treatment area separately from Inpatient areas.

- **Diagnostic and Treatment (D&T) Areas: (8.1a, 8.1b, and 8.1c: 1 to 3 points)**

  Provide access to daylight in D&T areas as follows:

  1. Determine the gross floor area of the D&T portion of the building floorplate.
  2. Calculate the percentage of area within 15 feet of the perimeter of a hypothetical square floorplate of equal area to the building floorplate to determine the 'square-root base' daylit area.

EQ Credit 8.1 continued

Daylight & Views: **Daylight for Occupied Spaces**

3. Configure the building floorplate to provide an increased percentage of daylit area above the 'square-root base' percentage daylit area to achieve 1, 2 or 3 credits using the following table:

Criteria percent of total floor area within 15' of perimeter window by building floorplate area	
Point Total	**Daylit floor area required**
8.1a - 1 point total	6% above 'square-root base' daylit area
8.1b - 2 points total	12% above 'square-root base' daylit area
8.1c - 3 points total	18% above 'square-root base' daylit area
Sample calculation of 'square-root base' daylit area for 30,000 SF building floorplate: √30,000 square feet = 173.2 feet 173.2 feet – 30 feet = 143.2 feet 143.2 feet x 143.2 = 20,507.7 square feet (non-daylit area) 30,000 square feet – 20, 507.7 square feet = 9,492.3 square feet (daylit area) 9, 492.3 square feet / 30,000 square feet = 31.6% (percent daylit area)	

- Floorplates < 14,000 SF are to achieve daylighting percentages equal to those required for a floorplate of 14,000 SF.
- Floorplates > 50,000 SF are to achieve daylighting percentages equal to those required for a floorplate of 50,000 SF.

Note:

- *Courtyards with a minimum nominal width the lesser of 15' per floor or 60' total qualify as perimeter.*
- *Atria with one glazed end with a minimum nominal width the lesser of 10' per storey or 40' total also qualify as perimeter.*
- *Floor areas directly under skylights equal to the horizontally projected area of the skylight glazing qualify as daylit floor area.*
- *This calculation is based upon a percentage of total floor area (building GSF), and is independent of function, layout, or the final distribution of glazing. All floor area within 15' of an outside facing, qualifying courtyard or atria facing perimeter wall where it would be possible to provide fenestration qualifies.*

- Where D&T floors vary in area or perimeter, use the average floor area to determine the percentage of daylit floor area required and use the total area of all floors and the total area within 15' of the perimeter to determine the percentage of daylit floor area provided.

EQ Credit 8.1 continued

Daylight & Views: **Daylight for Occupied Spaces**

- Use only the D&T area of floors with both D&T and IPUs to determine daylit floor area.
- Areas or rooms on floors below grade with a normal use occupancy level lower than 1 per 1,000 square feet may be excluded in calculations for this credit.
- For building additions, subtract all daylit area within the existing building that loses daylight (length of windowed wall blocked-in x 15 feet) from the daylit area within the addition.

- **Inpatient Units (8.1d, 8.1e: 1-2 points):**
  - Provide access to daylight on inpatient units as follows:
    - **8.1d – (1 point):** In multi-bed inpatient rooms, provide a window configuration to ensure that both patients have visual connection to the outdoors, even when cubicle curtains are closed, AND provide a window direct to the outdoors from **75%** of regularly occupied staff work spaces and non-inpatient-room spaces.
    - **8.1e – (1 point):** Achieve 8.1d AND provide a window direct to the outdoors from **90%** of regularly occupied staff work spaces and non-inpatient-room spaces.
  - Inpatient unit spaces with a direct view of courtyards or atria that meet the requirements of credits 8.1a-c qualify as daylit for credits 8.1d and 8.1e.

Suggested Documentation

- ❑ Compile area calculations that define the percentage of daylit gross floor area achieved for the Diagnostic & Treatment area credits.
- ❑ Develop Inpatient Unit plans confirming that all patient bed locations have direct access to daylight in multi-bed rooms when curtains are drawn.
- ❑ Identify all regularly occupied staff spaces on Inpatient Units, indicating the percentage that have direct access to a window.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Design the building to maximize interior daylighting. Insure compliance with the goal early in the design process, acknowledging site constraints at the programming stage, when block planning is tested and initial design parameters are established.
- Strategies to consider include:
  - Building orientation
  - Shallow floor plates
  - Increased building perimeter
  - Courtyards

EQ Credit 8.1 continued

Daylight & Views: **Daylight for Occupied Spaces**

- Atria
- Exterior and interior permanent direct daylight shading and diffusion devices
- High performance glazing
- High performance window treatments
- Photo-integrated light sensors

Resources

Daylight in Buildings: A Source Book on Daylighting Systems and Components, International Energy Agency Solar Heating and Cooling Programme, July, 2000, http://www.iea-shc.org.

Edwards, L. and Torcellini, P. A Literature Review of the Effects of Natural Light on Building Occupants, National Renewable Energy Laboratory, Golden, CO, July, 2002. NREL/TP-550-30769. Chapter 8, Daylighting in Health Care.

Heschong Mahone Group, Daylighting in Schools: An Investigation into the Relationship between Daylight and Human Performance, A Report to Pacific Gas and Electric Company, August, 1999, http://www.h-m-g.com.

Verderber, S (February, 1983) "Human Response to Daylighting in the Therapeutic Environment." 1983 International Daylighting Conference. Phoenix, AZ: General Proceedings, pg. 415.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- SS Credit 1: Site Selection
- SS Credit 2: Development Density & Community Connectivity
- SS Credit 5: Site Development
- SS Credit 9: Connection to the Natural World
- WE Credit 1: Water Efficient Landscaping
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Credit 6: Controllability of Systems

GGHC Operations Credit Synergies

- WC Credit 1: Water Efficient Landscaping
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 3: Energy Efficient Equipment
- ES Credit 1: Outdoor Grounds & Building Exterior Management

1 point

EQ Credit 8.2

Daylight & Views:
Connection to the Natural World: Indoor Places of Respite

Intent

Connect patients, visitors, and staff to the natural environment through views of nature from indoor places of respite.

Health Issues

Research shows that physical and visual connections to the natural environment (access to outdoor space, views of nature, natural daylighting) provide social, psychological, and physical benefits. Such connections also assist in patient recovery and healing, reduce stress, and improve the overall health care environment. Similar benefits accrue to the staff, thus leading to improved delivery of services to the patients they serve.

Credit Goals

- Provide patient, visitor, and staff accessible indoor places of respite with 90% of the aggregate net program area of those spaces having direct views of nature. To qualify, these spaces must have direct connection to the natural environment and must be spaces where no medical intervention or direct medical care is delivered and where no facility administration or maintenance is being conducted.
  - Exterior views of nature or outdoor places of respite (as defined in GGHC SS Credit 9) may be used to meet this credit requirement.
  - Audio-visual technology that simulates nature may be used to fulfill up to 20% of the credit goal in spaces that are not accessible to nature,
  - Indoor Places of Respite may include, but are not limited to:
    - Family consultation or gathering spaces
    - Lounges without negative distractions, such as televisions
    - Café or cafeteria seating areas
    - Grieving rooms
    - Meditation spaces or chapels
    - Resource areas and libraries
    - Designated staff break areas with positive sensory distractions
    - Spa or exercise spaces for staff and/or visitors
    - Seating areas within Atrium spaces that are sky lit and have live plant material

Suggested Documentation

❑ Compile floor plans highlighting places of respite with views of nature.

❑ Compile a building program and calculation showing that 90% of these spaces meet the credit goal of having direct views or connection to nature.

EQ Credit 8.2 continued

Daylight & Views:
Connection to the Natural World: Indoor Places of Respite

- ❑ Compile annotated and descriptive plans graphically demonstrating site planning principles to maximize the experience of significant natural features for therapeutic value.
- ❑ Compile a list of all places of respite in the building program. Identify their intended activities and areas, with calculations showing that 90% of the aggregate area of those spaces meets the credit goal of having direct views or connection to nature.
- ❑ Compile floor plans highlighting all places of respite, indicating those with views of nature.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Direct connection to the natural environment from indoor places of respite includes views of distant and nearby nature (such as inaccessible rooftop spaces with "green" (vegetated) roofs and mature street trees), including, but not limited to:
  - Views of outdoor places of respite as defined in GGHC SS Credit 9.
  - Close views of trees or a vine covered wall
  - Views of a natural rock face or ledge
  - Framed views of a distant landmark
  - Views of a pedestrian activity in an outdoor setting, such as an urban street view with street trees
- Provide sitting areas or vestibules within widened corridors that offer views of nature and places to pause.
- For spaces like cafeterias deeper than 15' from the perimeter wall with the natural view, only the area of the space within a distance from the perimeter wall less than or equal to 1.5 x the length of the perimeter wall qualifies as an indoor place of respite.
- Provide choice and variety in the design of spaces (for example, spaces that engage all the senses but also areas with limited sensory stimulation). Consider a variety of smaller spaces conveniently located throughout the facility rather than one large space.
- In development of room data sheets or project space programs, include criteria for orientation relative to major exterior views and other natural features (daylight, seasonal variations, sound of water).

EQ Credit 8.2 continued

Daylight & Views:
Connection to the Natural World: Indoor Places of Respite

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- SS Credit 1: Site Selection
- SS Credit 2: Development Density & Community Connectivity
- SS Credit 5: Site Development
- SS Credit 9: Connection to the Natural World
- WE Credit 1: Water Efficient Landscaping
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Credit 6: Controllability of Systems

GGHC Operations Credit Synergies

- WC Credit 1: Water Efficient Landscaping
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 3: Energy Efficient Equipment
- ES Credit 1: Outdoor Grounds & Building Exterior Management

1 point

EQ Credit 8.3

Daylight & Views: **Lighting & Circadian Rhythm**

Intent

Reinforce natural circadian rhythms (sleep/wake patterns) in patients and daytime staff, and promote alertness in both day-shift and night-shift staff.

Health Issues

Lighting, both natural and electric, has an effect on the system regulating human circadian rhythm. Light received at the retina suppresses the amount of melatonin released into the blood stream from the pineal gland. Melatonin regulates the sleep-wake cycle, and long-term imbalanced melatonin levels have been linked to effects on the immune system and risk of cancer and Alzheimer's Disease, among others. The use of natural and electric light in the healthcare environment should support circadian rhythms to the extent possible. However, the timing of an individual's circadian functions will typically vary dependent upon their population group (i.e. the young, the aged, those undergoing chemotherapy, day-shift versus evening- or night-shift staff.) Therefore, any lighting system that helps to support a healthy circadian rhythm must be capable of being tuned to the individual patient or to the staff. Care must be taken to educate the staff on the use of such a system because when the lighting works against the establishment of a healthy circadian rhythm, adverse impacts may occur. Even over the short term, low alertness, deteriorated work performance, sleep disturbance, carbohydrate craving, confusion, or loss of coordination may ensue.

Credit Goals

Establish electric lighting and daylighting systems and controls for patient areas and staff work areas based upon principles of circadian rhythm (a self-sustained biological rhythm that in an organism's natural environment normally has the period of approximately 24 hours). See GGHC EQ Credit 6.1: Controllability of Systems: Lighting for possible Credit Synergies.

PATIENT AREAS

In patient sleeping areas, establish lighting and lighting control design solutions that allow for variation in day and night lighting characteristics.

- Provide a separately controlled nighttime navigational lighting system in the amber to red area of the color spectrum.
- Shield patient rooms from the bright light of work areas and circulation spaces.
- Shield staff self-luminous monitors and chart lighting located within patient rooms from patient bed view.
- Provide night-time shielding of patient rooms from exterior light sources.

STAFF AREAS

In staff areas, establish lighting to support work performance and alertness through both daytime and nighttime lighting cycles. Insure that the area has multiple levels of lighting available.

EQ Credit 8.3 continued

Daylight & Views: **Lighting & Circadian Rhythm**

- Provide sleeping areas for staff and residents capable of near complete darkness. If more than one person uses the sleeping room, provide a night-time-navigational lighting system in the amber to red area of the color spectrum.
- Provide at least one location for night shift staff that provides a separately controlled vertical lighting element of 4000K or greater color temperature with a target vertical illuminance level of 250 footcandles when measured two (2) feet away at eye height. Provide a control that turns the lighting element off when the space is unoccupied. Provide space for stretching and/or mild physical activity to support alertness. Ensure that staff are not required to walk through this area in order to access the sleeping area.
- Provide access to daylight for all staff on their regularly traversed workpath without the need to enter a patient room or other private space.

Suggested Documentation

❑ Compile drawings and specification information in compliance with credit goals.

Reference Standards

There is no reference standard for this credit.

Potential Technologies & Strategies

- Research shows that light toward the blue portion of the color spectrum is more effective in stimulating a "daytime" response while light in the amber to red portion of the color spectrum has little impact. Carefully use blue or blue-white sources in areas and at times where alertness is desired and avoid in areas and at times when encouraging sleep. Keep in mind that high-quality white light, containing adequate portions of the blue, yellow and red portions of the spectrum, is necessary for proper patient diagnosis.
- Brightness on vertical surfaces is a critical lighting design element. Supplement indirect ceiling lighting with light on the walls.
- Provide automatic multi-level or dimming lighting controls with manual override in patient and common areas to support the change of lighting conditions throughout the day. Connect the lighting controls to a time-of-day controller. Insure that all lighting in staff areas is automatically controlled with temporary overrides available to the staff.
- Provide blackout shades on windows in sleeping areas with occupant controls that are readily accessible from the patient bed. See GGHC Environmental Quality Credit 6.1: Controllability of Systems: Lighting for more information.
- Staff access to natural light should be achieved without going into private spaces. Staff should not have to enter a patient/resident room to have access to natural light. Examples include windows at the ends of corridors, skylights into deep areas of the building in highly trafficked areas, transoms, and door sidelights. Provide solar day rooms or common areas for staff.
- Provide automatic control of electric light variation that can be individually set for each patient, dependent upon his/her situation. Provide a default setting that reinforces the typical daytime cycle (e.g., a time-of-day controller). Provide an educational manual for the hospital staff that describes

EQ Credit 8.3 continued

Daylight & Views: **Lighting & Circadian Rhythm**

how the control system works and how it can be reset per individual. For example, cancer patients undergoing chemotherapy may benefit from a circadian cycle that is shifted from typical daytime cycles. The manual should also cover other aspects of contribution to the circadian cycle such as the effects of daylight and yellow goggles/daylight filters, the effects of nightlights, etc.

- Design for circadian rhythm is particularly important in nurseries and NICUs because research has shown that newborns are sensitive to variations in lighting.

Resources

Brainard, G.C., Glickman, G. (2003). The Biological Potency of Light in Humans: Significance to Health and Behavior. CIE, 25th Session, Vol.1, I-22-33, 2003.

The Bright side of Blue Light. Lighting Design and Application, May 2005, http://www.lrc.rpi.edu/programs/lightHealth/pdf/blueLight.pdf

Co, E. L., Rosekind, M. R., Johnson, J. M., Weldon, K. J., Smith, R. M., Gregory, K. G., Miller, D. L., Gander, P. H., Lebacqz, J. V. (1994). Fatigue Countermeasures: Alertness Management in Flight Operations. Southern California Safety Institute Proceedings, Long Beach, 1994, 190-197

eMedicine, "Shiftwork in the Practice of Emergency Medicine", July 6, 2005, available at www.emedicine.com/emerg/topic835.htm.

Institute for Safe Medication Practices, Medication Safety Alert, "An Exhausted Workforce Increases the Risk of Errors:, June 2, 2005, available at www.ismp.org/newletters/acutecare/articles/20050602.asp

Lighting Research Center at the Rensselaer Polytechnic Institute: Listing of articles regarding "Light and Health": http://www.lrc.rpi.edu/programs/lightHealth/overview.asp

Making Health Care Safer: A Critical Analysis of Patient Safety Practices. Evidence Report/Technology Assessment: Number 43. AHRQ Publication No. 01-E058, July 2001. Agency for Healthcare Research and Quality, Rockville, MD. http://www.ahrq.gov/clinic/ptsafety/

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- SS Credit 1: Site Selection
- SS Credit 2: Development Density & Community Connectivity
- SS Credit 5: Reduced Site Disturbance
- SS Credit 9: Connection to the Natural World: Outdoor Places of Respite
- WE Credit 1: Water Efficient Landscaping
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Prerequisite 2: Minimum Energy Performance
- EA Credit 1: Optimize Energy Performance
- EA Credit 2: On-Site Renewable Energy
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- EQ Credit 6: Controllability of Systems

EQ Credit 8.3 continued

Daylight & Views: **Lighting & Circadian Rhythm**

GGHC Operations Credit Synergies

- WC Credit 1: Water Efficient Landscaping
- EE Prerequisite 1: Existing Building Commissioning
- EE Prerequisite 2: Minimum Energy Performance
- EE Credit 1: Optimize Energy Performance
- EE Credit 2: On-Site & Off-Site Renewable Energy
- EE Credit 3: Energy Efficient Equipment
- ES Credit 1: Outdoor Grounds & Building Exterior Management

1 point

EQ Credit 9.1

Acoustic Environment: **Exterior Noise, Acoustical Finishes, & Room Noise Levels**

Intent

Provide building occupants with a healing environment free of disruptive levels of sound.

Health Issues

Noise is a well-documented source of stress in health care settings. Noise from personnel, equipment, and visitors impacts patient privacy and sleep patterns. In turn, noise increases stress levels for patients and caregivers. Research finds that in hospitals that reduced noise levels, the patients' satisfaction with care giving increased, their sleep improved, and their blood pressure lowered; similarly, staff in low-noise environments were more positive about their jobs and indicated improved sleep.

The World Health Organization recommends that continuous background noise in hospital rooms should not exceed 35 decibels (dB), and nighttime peaks in patient care areas should not exceed 40 dB. Studies have found that background noise levels typically are in the range of 45 to 68 dB and many peaks commonly exceed 90 dB.

As hospitals operate continuously, the noise from heliports, generators, outdoor mechanical equipment, and service vehicles impacts the local community as well as the building occupants.

Credit Goals

Design the facility's acoustic environment in accordance with the following three sections of the 2006 AIA/AHA Draft Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities:

- **Minimize the Impact of Site Exterior Noise on the Building Occupants and on the Surrounding Community**: For all categories of exterior noise exposure, taking into account the effect of site heliports, emergency power generators, outdoor mechanical equipment, and building services, comply with Section 1.4 Classification of Facility Produced Noise Exposure.

  Measure and collect data to determine the Exterior Site Noise Exposure Category (A, B, C, or D).

  - Design the building envelope composite STC rating to meet the design goals in Table 1.4-1 for the Exterior Site Exposure Category that applies.
  - Alternatively, test and measure the exterior building envelope sound isolation performance using methods generally conforming to the current edition of ASTM E966 Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements. If the NIC rating is no more than 5 dB less than the required composite STC rating, then that section of the building façade meets the criteria for this point. Test no less than 5% of each façade type and condition (i.e. 5% of occupied rooms on exterior walls of each type).
- **Acoustical Finishes and Detail:** Design the facility by selecting and specifying materials, products, mechanical systems and design features to attenuate sound and vibration, and to meet or exceed room average sound absorption coefficients shown in Table 2.3-1.
  - In the design process, select room finishes using room sound absorption coefficients as listed in Table 2-1 and Table 2-2 (or other similar laboratory data for the materials considered) as guidance towards meeting the requirements of Table 2.3-1.

EQ Credit 9.1 continued

Acoustic Environment:

Exterior Noise, Acoustical Finishes, & Room Noise Levels

  - Alternatively, test and measure the average sound absorption coefficient through the measurement of the reverberation time (T_R) generally in accordance with the current edition of ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. Test 5% of occupied rooms of each type (see Table 2.3-1) in the building.

- **Room Noise Levels:** Consider background sound levels generated by building mechanical systems and other hospital noise sources (MRI, elevators, etc.)
  - Design the facility to meet the requirements of Table 3.3-1, Recommended Criteria for Noise in Interior Spaces.
  - Alternatively, test sound level in 25% of rooms of each type using a sound level meter outfitted with a windscreen. Instrumentation must conform to ANSI S1.4 for type 1 precision sound measurement instrumentation.

Reference Standard

AIA/AHA Draft Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities November 1, 2006, http://www.healthcareacoustics.org.

Suggested Documentation

❑ Compile documentation demonstrating that the acoustic design complies with Credit Goals.

OR

❑ Compile test and measurement data demonstrating that the acoustic design complies with Credit Goals.

Potential Technologies & Strategies

- In inpatient floor planning, avoid locating patient rooms adjacent to elevators, stairwells, and visitor/ public spaces.
- Acoustically isolate patient rooms from each other. Where increased sound isolation between the patient rooms and corridors does not interfere with clinical operation, install gasketed doors. Glass doors and/or vision panels provide both visual supervision and sound isolation.
- Locate televisions in public and staff areas only where there is adequate space for patients and staff to be out of hearing range if they so choose. Provide headsets and/or pillow speakers for televisions and radios located in semi-private rooms or other locations where sound can carry to other patients.
- Specify and install ceiling tiles with Ceiling Attenuation Class (CAC) ratings of 35 or greater for spaces with noisy plenum equipment or walls that stop short of the deck.
- Specify and install sound-absorptive wall treatment with an NRC of 0.7 or higher.

EQ Credit 9.1 continued

Acoustic Environment:

Exterior Noise, Acoustical Finishes, & Room Noise Levels

- Specify and install flooring products to reduce footfall and cart rolling noise.
- Use sound absorbing finish materials in waiting areas and other public spaces.
- Elevate the level of continuous background sound where applicable to achieve a greater perceived level of quiet.
- In open bay treatment areas, such as Emergency Departments or Recovery rooms, select ceiling products for high sound absorption.
- At nurse stations and open staff areas, carefully integrate sound absorbing elements (ceilings, furniture systems, etc.) to reduce noise.
- Enclose nursing and chart stations in IPU areas.
- Isolate vibration-generating equipment from the building structure in accordance with the Sound and Vibration Chapter of the current ASHRAE Applications Handbook.
- Locate noise generating mechanical and electrical equipment away from patient and staff areas, and from neighboring residential communities.
- Implement noise control protocols. This is particularly important in Neonatal Intensive Care Units. Install noise level sensor systems, which provide visual feedback when acoustic thresholds are exceeded.

Resources

Sound and Vibration Control chapter, current ASHRAE Application Handbook, http://www.ashrae.org.

GGHC Construction Credit Synergies

- ID Prerequisite 1: Integrated Design Process
- ID Prerequisite 2: Health Mission Statement & Program
- SS Credit 1: Site Selection
- SS Credit 2: Development Density & Community Connectivity
- EA Prerequisite 1: Fundamental Building Systems Commissioning
- EA Credit 3: Enhanced Commissioning
- EA Credit 5: Measurement & Verification
- MR Credit 1: Building Reuse
- MR Credit 3: Sustainably Sourced Materials
- EQ Credit 3: Construction EQ Management Plan

GGHC Operations Credit Synergies

- IO Credit 1: Building Operations & Maintenance
- EE Prerequisite 1: Existing Building Commissioning
- EE Credit 5: Performance Measurement
- EP Credit 6: IAQ Compliant Products

1 point in addition to EQ credit 9.1

EQ Credit 9.2

Acoustic Environment:
Sound Isolation, Paging & Call Systems, & Building Vibration

Intent

Provide building occupants with a healing environment free of disruptive levels of sound.

Health Issues

Noise is a well-documented source of stress in health care settings. Noise from personnel, equipment, and visitors impacts patient privacy and sleep patterns. In turn, noise increases stress levels for patients and caregivers. Research finds that in hospitals that reduced noise levels, the patients' satisfaction with care giving increased, their sleep improved, and their blood pressure lowered; similarly, staff in low-noise environments were more positive about their jobs and indicated improved sleep.

The World Health Organization recommends that continuous background noise in hospital rooms should not exceed 35 decibels (dB), and nighttime peaks in patient care areas should not exceed 40 dB. Studies have found that background noise levels typically are in the range of 45 to 68 dB and many peaks commonly exceed 90 dB.

As hospitals operate continuously, the noise from heliports, generators, outdoor mechanical equipment, and service vehicles impacts the local community as well as the building occupants.

Credit Goals

- Achieve GGHC EQ Credit 9.1: Acoustic Environment: Exterior Noise, Acoustical Finishes, & Room Noise Levels.

AND

- Design the facility's acoustic environment in accordance with two out of the three following sections of the 2006 AIA/AHA Draft Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities:
  - **Sound Isolation Performance of Construction – Speech Privacy Goal:** Adequate sound isolation will result in speech privacy, acoustic comfort, and a reduction in noise-produced annoyance. Sound isolation between hospital occupants and noise sources is the sound level difference between source and receiver spaces, and adjusted for the background sound at the receiver's location.
    - Design the facility to meet the criteria of Table 4-3 Speech Privacy goals for Enclosed Rooms and Table 4-4 Speech Privacy Goals for Open Plan Spaces. Design sound isolation between spaces in accordance with Table 4.3-1, Recommended Sound Isolation Performance Between Enclosed Rooms
    - Alternatively, Test 5% of the privacy adjacencies in a building.
  - **Paging & Call Systems, Clinical Alarms, Masking Systems & Sound Reinforcement**

    a. Paging and Call Systems

    - Voice paging and call systems shall be designed to achieve a minimum speech transmission index (STI) of 0.50 or a common intelligibility scale (CIS) rating of 0.70 at representative points within the area of coverage to provide acceptable intelligibility from

EQ Credit 9.2 continued

Acoustic Environment:
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the system. The conversion between CIS and other scales of intelligibility is available from Annexes A and B of IEC 60489-Sound Systems for Emergency Purposes (NFPA 72-2002).

- Performance of the system shall be designed to achieve:
  i. 70 dBA minimum sound level; or
  ii. 10 dBA above background noise levels (whichever is higher); and,
  iii. Coverage within +/- 4 dB at the 2000 Hz octave band throughout corridors, open treatment areas and public spaces.

- Alternatively, test and measure performance in 5% of building spaces.

b. Clinical alarms

- Clinical alarms shall be designed to be audible according to ISO 7731 "Danger signals for work places – Auditory danger signals"
- Alternatively, test and measure performance in 25% of building spaces.

c. Audibility of tonal alarms

- Design the facility according to the 2002 edition of NFPA 72, the National Fire Alarm Code, which provides a method for measuring the audibility of narrow band tonal alarms using the techniques in ISO 7731. These techniques use the favorable audibility of tonal sounds versus broadband sounds in the midst of competing noise, based on staff training.
- Test and measure performance in 50% of building spaces.

d. **Masking Systems:** Sound masking systems are useful tools for reducing patient distractions and enhancing speech privacy in all types of medical facilities.

- Systems shall be designed for levels that do not exceed 48 dBA. Loudspeaker coverage shall provide for uniformity of +/- 2 dBA
- Alternatively, test and measure performance in 100% of building spaces where masking sound has been installed.

e. **Sound Reinforcement:** All large conference rooms and auditoria seating more than 25 persons shall consider sound reinforcement and AV playback capabilities.

- Sound reinforcement system shall be designed to achieve a minimum Speech Transmission Index (STI) of 0.60 or a Common Intelligibility Scale (CIS) rating of 0.77 at representative points within the area of coverage to provide acceptable intelligibility from the system.

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- Performance of the system shall be designed to achieve:
  i. 70 dBA minimum sound level; or
  ii. 10 dBA above background noise levels (whichever is higher); and
  iii. Coverage within +/- 3 dB at the 2000 Hz octave band throughout the space.
- Alternatively, test in a 100% of spaces where sound systems have been installed.

- **Building Vibration:** Building vibration produced by building mechanical equipment, footfall, road and rail traffic, and medical equipment shall be considered in the design of a hospital building. Seismic restraint shall be compatible with vibration isolation methods covered in this section.
  - Design the building to meet the requirements of Table 6.3.2-1 Recommended Limits on Footfall Vibration in Hospitals. In addition, meet any more restrictive vibration criteria that may be required by manufacturers of medical and laboratory equipment.
  - Alternatively, test floor vibration velocities for a period of 5 minutes at not less than 5% of rooms of each type. Test vibration level as per manufacturers' requirements in all spaces having equipment having specific ambient vibration limits.

Reference Standard

AIA/AHA Draft Interim Sound and Vibration Design Guidelines for Hospital and Healthcare Facilities November 1, 2006, http://www.healthcareacoustics.org.

Suggested Documentation

❑ Compile documentation demonstrating that the acoustic design complies with Credit Goals.

OR

❑ Compile test and measurement data demonstrating that the acoustic design complies with Credit Goals.

Potential Technologies & Strategies

See GGHC EQ Credit 9.1 for Potential Technologies & Strategies and Credit Synergies.

Resources

See GGHC EQ Credit 9.1 for Resources.