

# WBDG

WHOLE BUILDING DESIGN GUIDE

## WBDG: A Web-based Resource for High-Performance Retrofits of Existing Buildings

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Federal Buildings Program Manager  
Sustainable Buildings Industry Council  
[www.SBICouncil.org](http://www.SBICouncil.org)



Federal Environmental Symposium - East



Sustainable Buildings Industry Council



## The Sustainable Buildings Industry Council

**Our mission:** We unite and inspire the building industry toward higher performance-through education, outreach, advocacy and the mutual exchange of ideas.

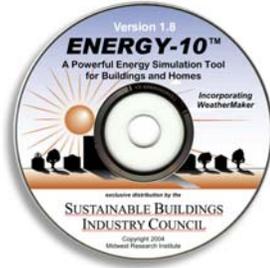
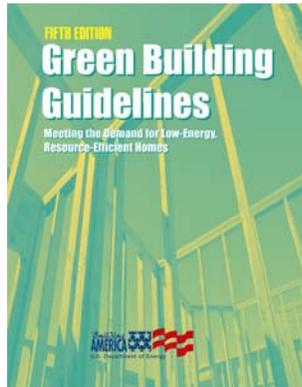
**Our vision:** To dramatically improve the long-term performance and value of buildings by advancing a whole building approach to design, construction and operation.

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## Residential & Small Commercial Buildings



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## K-12 School Buildings



**High-Performance School Buildings**  
Resource and Strategy Guide

THIRD EDITION



Published by  
**Sustainable Buildings Industry Council**  
Principal Author:  
Oliver Farris, FASIA

Beyond Green™

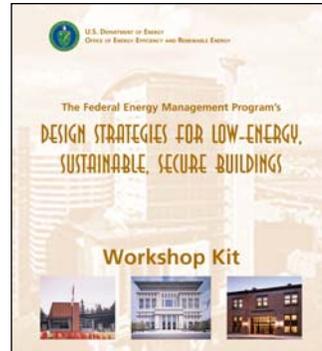


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## Federal Buildings



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Congratulations to the winners of the  
2008 *Beyond Green*™ High-Performance Building Awards  
from the Sustainable Buildings Industry Council



Nationals Park  
Submitted by: HOK / Devroux and Purnell Architects  
Category A, First Place Winner  
Photo Courtesy of Jim Maguire

Special thanks to our Platinum Partners:  
BASF Corporation  
Southern California Edison

**Time to start planning to submit for the 2009 SBIC Awards!**

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# Beyond Green™

A High Performance Approach to  
Building Design,  
Construction and Operations

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## What Is a High Performance Building?

### Energy Policy Act, Section 914. Building Standards

- A building that integrates & optimizes all major high-performance building attributes, including energy efficiency, durability, life-cycle performance, and occupant productivity.

### Energy Independence & Security Act of 2007, Title IV, Energy Savings in Buildings and Industry, Section 401, Definitions

- A building that integrates and optimizes on a life cycle basis all major high performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

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## High-Performance Buildings

- Achieve long-term value and performance
- Are enduring assets in their communities
- Support and enhance human performance
- Reduce operating costs
- Are safe, secure, accessible
- Protect the environment
- Are the result of using a whole building approach

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## High-Performance Bldg Design Strategies

- Design and build a better building envelope (or upgrade existing)
- Reduce water runoff and water pollution
- Build tight – Ventilate right
- Right-size the HVAC system (do the real calcs, not rules of thumb)
- Reduce paths of air and water penetration
- Provide daylighting and views to occupants
- Specify high efficiency HVAC equipment
- Specify plumbing fixtures that use less or no water
- Specify high efficiency lighting fixtures and controls with occupancy sensors and daylighting controls
- Specify materials that pollute less
- Investigate design alternatives with energy modeling
- Use Total Building Commissioning of all building systems
- Use proven technologies - no gadgets or high costs

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## What are we getting now?

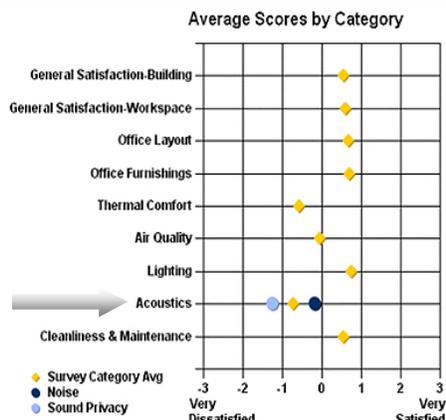
- Building codes are minimum
- One attribute is prominent while others are overlooked or trivialized
- Low Occupant satisfaction
- Lawsuits
- Premature failures of materials & systems
- Value of investment decreases while costs of operations & maintenance increase

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## Acoustical Satisfaction Low

- CBE's analysis of 15 buildings by 4096 respondents
- over 60% of occupants in cubicles think acoustics interfere with their ability to get their job done



The Center for the Built Environment (CBE) at UC Berkeley

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## Green buildings: What's working, what's not – HOK Post Occ. Report

Occupants of green buildings generally show a higher level of satisfaction with their built environment than do occupants of standard buildings, but their buildings fall short in some key areas.

Common complaints had to do with:

- acoustics (too noisy, not enough privacy),
- thermal comfort (limited temperature control), and
- daylighting (too much glare and light spill).

[HOK Post Occupancy Evaluation Report of 7 HOK-designed green buildings as reported in BD&C June 9, 2006]

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## Assessing Green Building Performance

*A Post  
Occupancy  
Evaluation of  
12 GSA Buildings*

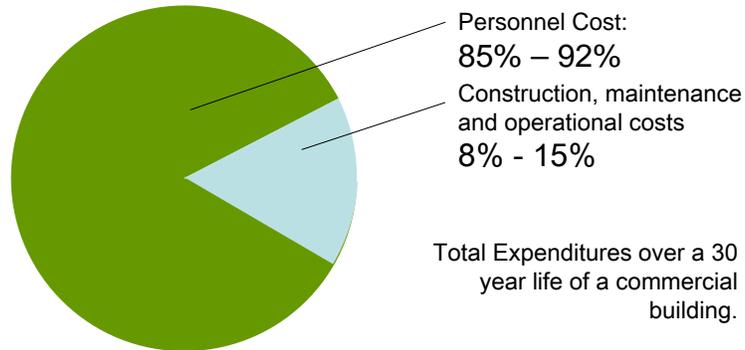
Kim M. Fowler  
Emily M. Rauch

Pacific Northwest  
National Laboratory  
Operated by Battelle for the  
U.S. Department of Energy



## Business Rationale for Better Buildings

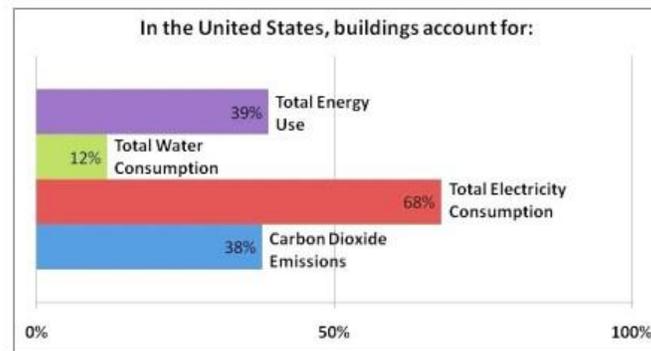
Personnel costs represent the most significant portion of total life cycle cost



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## Environmental Impact of Buildings



Source: EPA, 2004

Reusing an existing building can lessen the environmental impact

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## Goal: Reduce Environmental Impact

- Optimize Site Potential
- Optimize Energy Use
- Protect and Conserve Water
- Use Preferable Products
- Enhance IEQ
- Optimize Operational/Maintenance Practices

### WBDG Sustainable Design Objectives

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## Rating Systems

How do you measure the performance of your building?

Who can you trust with confidence to certify critical aspects of your building?

- Green Buildings (Existing)
  - LEED-EBOM
  - Green Globes CIEB
  - Energy Star
- Building Security
  - PLUS/BSC
- Others



Also Professional Accreditations: AIA, PE, CEM, LEED AP, BSCP, Bd Cert NCE, etc.

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## To Do a Job Well It Takes the Right Tools



If You are planning, designing, constructing, renovating, operating or maintaining a building you also need the right tool ...

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# WBDG

## WHOLE BUILDING DESIGN GUIDE



Federal Bldg.  
Oakland, CA



Walter Reed Army Institute  
of Research, Forest Glen, MD



Bldg. 33,  
Washington Navy Yard

## The Whole Building Design Guide

[www.wbdg.org](http://www.wbdg.org)

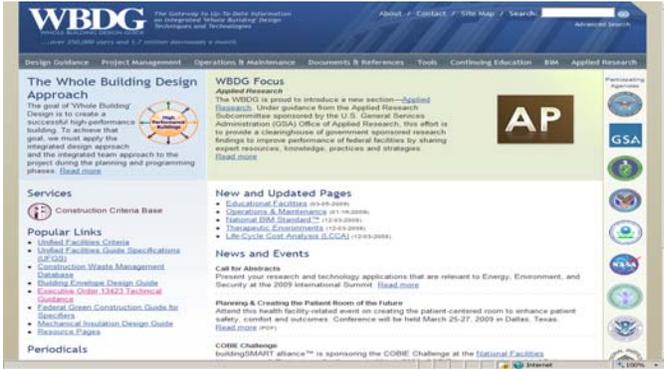
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# The Whole Building Design Guide (WBDG) as a Tool

Your Complete Internet Resource to Integrated, 'Whole Building', Design Information and Tools.

The WBDG condenses the vast amount of Web-based data on building design, products, & systems Into usable, up-to-date information.



Single Point Access!

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# What is Whole Building Design?

- It is an **Integrated Design Approach** and a
- **Integrated Team Process** to achieve high-performance buildings



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## 'Whole Building' Approach



NREL Solar Laboratory  
Golden, CO

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- Materials, systems, and assemblies reviewed from many different perspectives
- Building components, sub-systems and materials are interdependent, can impact the total performance of the whole, and can perform 'double duty'



## Integrated Project Team



Mark O. Hatfield U.S. Courthouse  
Portland, OR

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- Comprehensive Stakeholder involvement throughout the building's life cycle
- Evaluation for cost, quality-of-life, future flexibility, energy efficiency, overall environmental impact, productivity, creativity, and how the occupants will be enlivened



## Applying the Integrated Team Process



Who needs to be at the table at the outset of your project to ensure an integrated team process?

- Architect
- Landscape Architect
- Owner, Client, Tenants
- Engineers
- Programmers
- Interior Designer
- Contractor
- Specialists (Security, Telecom, Acoustics)
- Community Members or Other Stakeholders
- Operations and Maintenance Personnel
- Others???? (Real Estate Buyer)

An Integrate Team can find a single design strategy that meets multiple design objectives

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## Building Siting Issues

- Solar Access\*
- Security (Standoff Distance, CPTED)
- Stormwater Management
- Public Transportation
- Occupant Amenities
- Compatible Functions
- Disaster Avoidance



\*Building orientation for passive solar heating, daylighting, natural ventilation, views, potential impacts of future development.

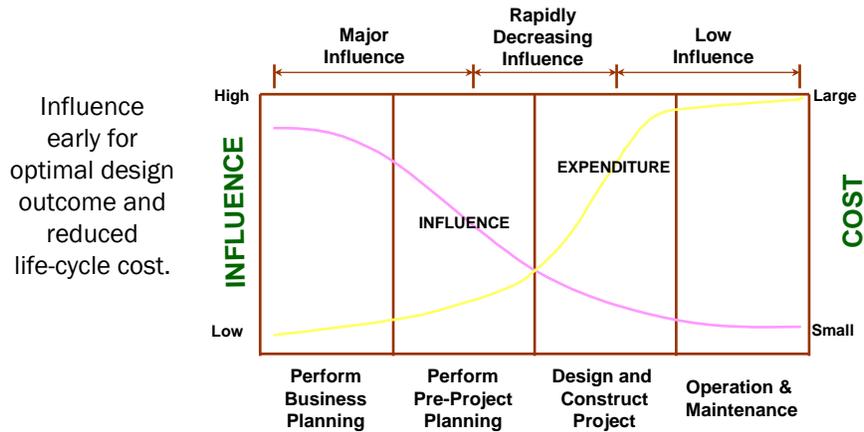
*[Real Estate Buyer **must** be informed!!!]*

**Note: Applies to Selecting an Existing Building, as well!**

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# Cost / Influence Over the Quality of a Project



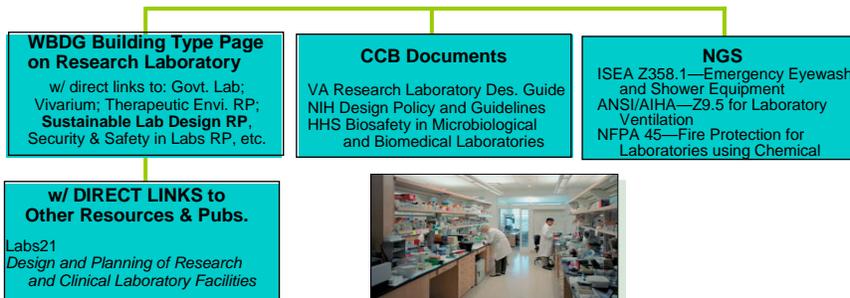
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## WBDG Goal



*... to provide centralized access and use of facility information in a knowledge based management environment, from a 'whole building' perspective.*



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**WBDG** WHOLE BUILDING DESIGN GUIDE The Gateway to Up-To-Date Information on Integrated 'Whole Building' Design Techniques and Technologies

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Design Guidance | Project Management | Operations & Maintenance | Documents & References | Tools | Continuing Education | BIM | Applied Research

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**The Whole Building Design Approach**

The goal of 'Whole Building' Design is to create a successful high-performance building. To achieve that goal, we must apply the integrated design approach and the integrated team approach to the project during the planning and program phases. [Read more](#)

**Services**

- Construction Criteria Base
- Unified Facilities Criteria
- Unified Facilities Guide Specifications (UFGS)
- Construction Waste Management Database
- Building Envelope Design Guide
- Executive Order 13423 Technical Guidance
- Federal Green Construction Guide for Specifiers
- Mechanical Insulation Design Guide
- Resource Pages

**Popular Links**

- Unified Facilities Criteria
- Unified Facilities Guide Specification (UFGS)
- Construction Waste Management Database
- Building Envelope Design Guide
- Executive Order 13423 Technical Guidance
- Federal Green Construction Guide for Specifiers
- Mechanical Insulation Design Guide
- Resource Pages

**Periodicals**

**JBM** Journal of Building Information Modeling  
 Fall 2008: *The BIM Balancing Act: Tilt the Scales in Your Favor*  
[Download and/or subscribe](#)

**JBED** Journal of Building Envelope Design  
 Summer/Fall 2008: *The Best of the BEST! Conference: Experts Meet in Minneapolis to Discuss Building for Energy Efficiency and Durability at the Crossroads*  
[Download and/or subscribe](#)

**New and Updated Pages**

- Educational Facilities (03-05-2009)
- Operations & Maintenance (01-16-2009)
- National BIM Standard™ (12-02-2008)
- Therapeutic Environments (10-01-2009)
- Life-Cycle Cost Analysis (LCCA) (12-03-2008)

**News and Events**

**Call for Abstracts**  
 Present your research and technology applications that are relevant to Energy, Environment, and Security at the 2009 International Summit. [Read more](#)

**Planning & Creating the Patient Room of the Future**  
 Attend this health facility-related event on creating the patient-centered room to enhance patient safety, comfort and outcomes. Conference will be held March 25-27, 2009 in Dallas, Texas. [Read more \(PDF\)](#)

**COBIE Challenge**  
 buildingSMART alliance™ is sponsoring the COBIE Challenge at the National Facilities Management & Technology Conference in March 2009. COBIE is currently the topic of [Bib Wisniewski's NMF Blog](#). [Read more](#)

**FEDCon® '08 Presentations**  
 The National Institute of Building Sciences presented FEDCon® '08 on December 9, 2008 at the Washington Convention Center in Washington, DC. FEDCon was co-located with AEC-STB Fall and Ecobuild® Fall conference and exhibition. [Presentations](#)

**More News and Events**

[RSS](#) [Add WBDG/COBIE RSS Feed](#)

Participating Agencies

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**THE WBDG**

- Whole Building Design
- About the WBDG
- News and Events
- Site Map**
- Contact

**Site Map**

The graphic below illustrates the layout and structure of information within the Whole Building Design Guide. Click on any section title to jump to the list of pages contained within that section.

DESIGN GUIDANCE	BUILDING TYPES	GENERAL BUILDING TYPES PAGES	SPECIFIC BUILDING TYPES PAGES
	SPACE TYPES	SPACE TYPES PAGES	
	DESIGN DISCIPLINES	DESIGN DISCIPLINES PAGES	
	DESIGN OBJECTIVES	GENERAL DESIGN OBJECTIVES PAGES	SPECIFIC DESIGN OBJECTIVES PAGES
	PRODUCTS & SYSTEMS	PRODUCTS PAGES	SYSTEMS PAGES
PROJECT MANAGEMENT	PROJECT DELIVERY TEAMS		
	PROJECT PLANNING & DEVELOPMENT		
	BUILDING COMMISSIONING		
OPERATIONS & MAINTENANCE	PROJECT DELIVERY & CONTROLS		
	REAL PROPERTY INVENTORY (RPI)		
DOCUMENTS & REFERENCES	COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEMS (CMMS)		
	FEDERAL MANDATES		
	CONSTRUCTION CRITERIA BASE		
	PERIODICALS		
	CASE STUDIES		
	PARTICIPATING AGENCIES		
	INDUSTRY ORGANIZATIONS		

Click on Topic to go directly to that section

# Design Objectives

WBDG The Gateway to Up-To-Date Information on Integrated Whole-Building Design Techniques and Technologies

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Design Guidance | Project Manager | Design Objectives | Whole Building Design Guide - Microsoft Internet Explorer

DESIGN GUIDANCE

- Building Types
- Space Types
- Design Disciplines
- Accessible
- Aesthetics
- Cost-Effective
- Functional / Operational
- Historic Preservation
- Productive
- Secure / Safe
- Sustainable
- Products & Systems

COST-EFFECTIVE

- Accommodate Life, Safety, and Security Needs
- Comply with Accessibility Requirements

PRODUCTIVE

Pertains to occupants well-being—physical and psychological comfort—including building elements such as air distribution, lighting, workspaces, systems, and technology.

Related topics:

- Integrate Technological Tools
- Assure Reliable Systems and Spaces
- Design for the Changing Workforce
- Promote Health and Well-Being
- Provide Comfortable Environments

SECURE / SAFE

Pertains to the physical protection of occupants and assets from man-made and natural hazards.

Related topics:

- Plan for Fire Protection
- Ensure Occupant Safety and Health
- Resist Natural Hazards
- Provide Security for Building Occupants and Assets

SUSTAINABLE

Pertains to environmental performance of building elements and strategies.

Related topics:

- Optimize Site Potential
- Optimize Energy Use
- Protect and Conserve Water
- Use Environmentally Preferable Products
- Advance Indoor Environmental Quality (IEQ)

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# Tools and Resources in WBDG

GSA LEED® Cost Study Final Report

GSA Public Buildings Service

LEED®-DoD Antiterrorism Standards Tool

Green Construction Guide for Federal Specifiers

Construction Waste Management Database

Department of Defense (DOD) Unified Facilities Criteria Program

# Impact of WBDG as a Tool

In 2008, WBDG had 2,400,000 visitors

[average of 250,000 visitors a month]

And 20,800,000 downloads

[1.7 million pdf downloads a month]



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**DESIGN GUIDANCE**

Building Types

Space Types

Design Disciplines

Design Objectives

- Accessible
- Aesthetics
- Cost-Effective
- Functional / Operational
- Historic Preservation
- Productive
- Secure / Safe
- Sustainable
- Optimize Site Potential
- Optimize Energy Use
- Protect and Conserve Water
- Use Environmentally Preferable Products
- Enhance Indoor Environmental Quality (IEQ)

**Sustainable**  
by the WBDG Sustainable Committee  
Last updated: 10-12-2008

**Overview**

Building construction and operation have an enormous direct and indirect impact on the environment. As illustrated in the figure below, buildings not only use resources such as energy and raw materials, they also generate waste and potentially harmful atmospheric emissions. As economy and population continue to expand, designers and builders face a unique challenge to meet demands for new and renovated facilities that are accessible, secure, healthy, and productive while minimizing their impact on the environment.

**In the United States, buildings account for:**

Category	Percentage
Total Energy Use	39%
Total Water Consumption	12%
Carbon Dioxide Emissions	38%
Total Electricity Consumption	68%

**LEVEL 3 - SUSTAINABLE**

...s to this challenge call for an integrated, synergistic approach that raises the facility life cycle. This "sustainable" approach supports an

COMMENT ON THIS PAGE

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RELATED RESOURCE PAGES

- Aesthetic Challenges
- Aesthetic Opportunities
- Balancing Security/Safety and Sustainability Objectives
- Construction Waste Management
- Facility Performance Evaluation (FPE)

VIEW ALL RELATED (14)

VIEW RESOURCE PAGE INDEX

WBDG SERVICES

- Construction Criteria Base

## Resource Pages

- Concise summaries
- Written by industry experts
- Format:
  - Introduction
  - Description
  - Application
  - Relevant Codes & Standards
  - Emerging Issues
  - Additional Resources



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## Sustainability- and Security/Safety-Related Pages in WBDG

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Achieving Sustainable Site Design through Low Impact Development</li> <li>• Air Barrier Systems in Buildings</li> <li>• Air Decontamination</li> <li>• Balancing Security/Safety &amp; Sustainability Objectives</li> <li>• Building Integrated Photovoltaics</li> <li>• Cost Impact of the ISC Security Criteria</li> <li>• Daylighting</li> <li>• Designing Buildings to Resist Explosive Threats</li> <li>• Distributed Energy Resources</li> <li>• Electric Lighting Controls</li> <li>• Energy Efficient Lighting</li> <li>• Evaluating and Selecting Green Products</li> </ul> | <ul style="list-style-type: none"> <li>• Glazing Hazard Mitigation</li> <li>• High-Performance HVAC</li> <li>• Life Cycle Cost Analysis (LCCA)</li> <li>• Low Impact Development Technologies</li> <li>• Mold and Moisture Dynamics</li> <li>• Security and Safety in Laboratories</li> <li>• Sun Control and Shading Devices</li> <li>• Sustainable Laboratory Design</li> <li>• Sustainable O&amp;M Practices</li> <li>• Threat/Vulnerability Assessments and Risk Analysis</li> <li>• Water Conservation</li> <li>• Windows and Glazing</li> </ul> |
|---|---|

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# Sustainable Design Objectives

- Optimize Site/Existing Structure Potential
- Optimize Energy Use
- Protect & Conserve Water
- Use Environmentally Preferable Products
- Enhance Indoor Environmental Quality (IEQ)
- Optimize Operational & Maintenance Practices



[EPA's New England Regional Laboratory \(NERL\)](#) achieved a LEED Version 1.0 Gold rating. From conception the project was charged to "make use of the best commercially-available materials and technologies to minimize consumption of energy and resources and maximize use of natural, recycled and non-toxic materials." Chelmsford, MA

**LEVEL 3 - SUSTAINABLE**



RELEVANT CODES AND STANDARDS

- [ASTM E2432—Standard Guide for the General Principles of Sustainability Relative to Building](#)
- [Energy Policy Act of 2005](#) (PDF 1.9 MB, 860 pgs)
- [Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management"](#)

Major Resources

WBDG

BUILDING / SPACE TYPES  
Applicable to most [building types](#) and [space types](#).

DESIGN OBJECTIVES  
Information in these Sustainable pages must be considered together with other [design objectives](#) and within a total project context in order to achieve quality, high—performance buildings.

PRODUCTS AND SYSTEMS  
[Building Envelope Design Guide—Sustainability of the Building Envelope](#)  
Federal Green Construction Guide for Specifiers:

- [01 10 00 \(01100\) Summary](#)
- [01 30 00 \(01300\) Administrative Requirements](#)
- [01 74 19 \(01351\) Construction Waste Management](#)
- [01 40 00 \(01400\) Quality Requirements](#)
- [01 41 00 \(01411\) Regulatory Requirements](#)
- [01 42 00 \(01421\) References](#)
- [01 50 00 \(01500\) Temporary Facilities & Controls](#)
- [01 78 53 \(01780\) Sustainable Design Close-Out Documentation](#)
- [01 91 00 \(01810\) Commissioning](#)
- [01 91 11 \(01821\) Environmental Demonstration and Training](#)
- [01 91 23 \(01830\) Operation & Maintenance Data](#)

MANAGEMENT  
Commissioning

**LEVEL 3 - SUSTAINABLE**

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## Optimize Energy Use

by the WBDG Sustainable Committee  
Last updated: 10-13-2008

### Overview

On an annual basis, buildings in the United States consume 39% of America's energy and 68% of its electricity. Furthermore, buildings generate 38% of the carbon dioxide (the primary greenhouse gas associated with climate change), 49% of the sulfur dioxide, and 25% of the nitrogen oxides found in the air. Currently, the vast majority of this energy is produced from nonrenewable, fossil fuel resources. With America's supply of fossil fuel dwindling, concerns for energy supply security increasing (both for general supply and specific needs of facilities), and the impact of greenhouse gases on world climate rising, it is essential to find ways to reduce load, increase efficiency, and utilize renewable fuel resources in federal facilities.



2004 ASLA Award Recipient  
(Photo: Nancy Rottle)

facility design and development building projects must have a comprehensive, [integrated perspective](#) that

Reduce heating, cooling, and lighting loads through climate-responsive design and conservation practices; employ renewable energy sources such as [daylighting](#), [passive solar](#)

**SUSTAINABLE LEVEL 4 – OPTIMIZE ENERGY USE**

COMMENT ON THIS PAGE  
EMAIL THIS PAGE

RELATED RESOURCE PAGES

- Air Barrier Systems in Buildings
- Air Decontamination
- Balancing Security/Safety and Sustainability Objectives
- Building Integrated Photovoltaics (BIPV)
- Cool Metal Roofing**
- VIEW ALL RELATED (29)
- VIEW RESOURCE PAGE INDEX

WBDG SERVICES

- Construction Criteria Base

Protect and Conserve Water

- Use Environmentally Preferable Products
- Enhance Indoor Environmental Quality (IEQ)
- Optimize Operational and Maintenance Practices

Products & Systems

During the facility design and development process, building projects must have a comprehensive, [integrated perspective](#) that seeks to:

- Reduce heating, cooling, and lighting loads through climate-responsive design and conservation practices;
- Employ renewable energy sources such as [daylighting](#), [passive solar heating](#), [photovoltaics](#), and geothermal;
- Specify [efficient HVAC](#) and [lighting systems](#) that consider part-load conditions and utility interface requirements;
- Optimize building performance by employing energy modeling programs and optimize system control strategies by using [occupancy sensors](#) and air quality alarms; and
- Monitor project performance through a policy of [commissioning](#), metering, and annual reporting.

**Recommendations**

**Reduce Heating, Cooling, and Lighting Loads through Climate-Responsive Design and Conservation Practices**

- Use [passive solar design](#); orient, size, and [specify windows](#); and locate landscape elements with solar geometry and building load requirements in mind.
- Use high-performance building envelopes; select walls, roofs, and other assemblies based on long-term, insulation, and durability requirements.

**Employ Renewable or High-Efficiency Energy Sources**

- Evaluate the use of common, on-site renewable energy technologies such as [lighting](#), [solar water heating](#), and [geothermal heat pumps](#).
- Investigate the use of emerging, on-site renewable energy technologies such as [photovoltaics](#) and wind turbines.
- Evaluate purchasing electricity generated from renewable sources or low polluting sources such as natural gas.

**Efficient HVAC and Lighting Systems**

Energy Analysis Tools

- Energy Codes and Standards
- Energy Efficient Lighting
- Energy Master Planning for HVAC Systems in New and Existing Buildings
- Extensive Green Roofs
- Facility Performance Evaluation (FPE)
- Fuel Cell Technology
- High-Performance HVAC
- Life-Cycle Cost Analysis (LCCA)
- Microturbines
- Mold and Moisture Dynamics
- Natural Ventilation
- Passive Solar Heating
- Reliability-Centered Maintenance (RCM)
- Solar Water Heating
- Sun Control and Shading Devices
- Sustainable Laboratory Design
- Sustainable O&M Practices
- Water Conservation**
- Windows and Glazing**

SHORTEN THE LIST

**RELATED RESOURCE PAGES**

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Home > Windows and Glazing

**RESOURCE PAGES**  
A-C D-H I-R S-W

Security and Safety in Laboratories  
Seismic Design Principles  
Seismic Safety of the Building Envelope  
Solar Water Heating  
Style  
Sun Control and Shading Devices  
Sustainability of the Building Envelope  
Sustainable Historic Preservation  
Sustainable Laboratory Design  
Sustainable O&M Practices  
Therapeutic Environments  
Threat/Vulnerability Assessments and Risk Analysis  
Trends in Lab Design  
UFC/ISC Security Design

## Windows and Glazing

by Gregg D. Ander, FAIA  
Southern California Edison  
Last updated: 05-26-2008

**Introduction**

Windows have long been used in buildings for natural light and ventilation. Many studies have shown that windows can improve comfort, and productivity are improved in office environments and access to natural light. Windows also represent a major source of energy used to offset unwanted heat gain, and condensation problems. In the United States \$20 billion (one-fourth of total energy consumption) is spent on space heating and cooling).

In recent years, windows have undergone a revolution. High-performance, energy-efficient glazing systems are now available that reduce energy consumption and pollution, reduce heat loss, less air leakage, and warm interiors. They improve comfort and minimize condensation. Modern performance windows feature double or triple panes, specialized transparent coatings, insulating gas between panes, and improved frames that reduce air leakage, thereby cutting energy consumption.

page covers basic concepts of energy-efficient windows.

**COMMENT ON THIS PAGE**  
**EMAIL THIS PAGE**

**RELATED RESOURCE PAGES**  
Acoustic Comfort  
Aesthetic Challenges

- Assure Reliable Systems and Spaces
- Design for the Changing Nature of Work
- Promote Health and Well-Being
- Provide Comfortable Environments

### OVERVIEW

Given the choice, nearly everyone would prefer to work in an office with a view of the exterior space. But what is that window view "worth?" Does a more satisfied "productive" worker in the form of regular attendance, reduced stress, job satisfaction, and more effective work?

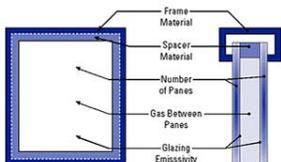


Do windows in work spaces contribute to higher productivity?  
(Courtesy of Perkins & Will)

**RESOURCE PAGE**

**DESCRIPTION**

Window systems are comprised of glass panes, structural frames, spacers, and sealants. In recent years, the variety of glass types, coatings, and frames available for use in window systems has increased dramatically, as has the opportunity to fine-tune and optimize window selection on a project-by-project basis.



Factors affecting window performance  
(Courtesy of Energy User News)

Careful specification of window and glazing systems is essential to the energy efficiency and comfort of all buildings. In residential, skin-load dominated structures (such as housing) optimum window design and glazing specification can reduce energy consumption from 10%-50% below accepted practice in most climates. In internal-load dominated commercial, industrial, and institutional buildings, properly specified fenestration systems have the potential to reduce lighting and HVAC costs 10%-40%.

Window and glazing choices should be considered holistically. Once the design team and owner agree on the design problem, window and glazing options can be evaluated. Issues to consider include:

- Heat gains and losses
- Visual requirements (privacy, glare, view)
- Shading and sun control
- Thermal comfort
- Condensation control
- Ultraviolet control
- Acoustic control

**RESOURCE PAGE**

**A. Specifying Windows and Glazings**

To fully specify a window system, it is necessary to specify the following characteristics:

- Window U-value
- Window Solar Heat Gain Coefficient (SHGC), or shading coefficient (SC)
- Glass Visible Transmittance ( $T_{vis-glass}$ )

For specific aesthetic and performance objectives the specifier may also wish to specify:

- Tints (colors) and Coatings

**U-Value**

U-value indicates the rate of heat flow due to conduction, convection, and radiation through a window as a result of a temperature difference between the inside and outside. The higher the U-factor the more heat is transferred (lost) through the window in winter.

- The units of U-value are: Btus per hour per square foot per °F ( $Btu/hr \cdot ft^2 \cdot ^\circ F$ )
- U-factors usually range from a high of 1.3 (for a typical aluminum frame single glazed window) to a low of around 0.2 (for a multi-paned, high-performance window with low-emissivity coatings and insulated frames).
- A window with a U-factor of 0.6 will lose twice as much heat under the same conditions as one with a U-factor of 0.3.
- Total (or net) window U-factors can be considerably higher than the center-of-glass U-factors.

**Solar Heat Gain Coefficient (SHGC)**

SHGC indicates how much of the sun's energy striking the window is transmitted through the window as heat. As the SHGC increases, the solar gain potential through a given window increases.

- The SHGC is a ratio between 0 and 1. SHGC = 0 means none of the incident solar gain is transmitted through the window as heat and SHGC = 1 means all of the incident solar energy is transmitted through the window as heat.
- A window with a SHGC of 0.6 will admit twice as much solar heat gain as one with a SHGC of 0.3.

Windows with low SHGC values are desirable in buildings with [high air-conditioning loads](#) and windows with high SHGC values are desirable in buildings where [passive solar heating](#) is used.

"SHGC" is relatively new and is intended to replace the term "shading coefficient (SC)." When the terms are related, the shading coefficient of glass is defined as the ratio of the solar heat

**RESOURCE PAGE**

**B. Representative Glass Specifications**

Glass Type (Product)	Glass Thickness (Inches)	Visible Transmittance (% Daylight)	U-factor (Winter)	Solar Heat Gain Coefficient (SHGC)
Single Pane glass (standard clear)	0.25	89	1.09	0.81
Single White Laminated w/Heat Rejecting Coating (Southwall California Series <sup>5</sup> )	0.25	73	1.06	0.46
Double Pane Insulated Glass (standard clear)	0.25	79	0.48	0.70
Double Bronze Reflective Glass (LOF Eclipse <sup>5</sup> )	0.25	21	0.48	0.35
Triple Pane Insulated Glass (standard clear)	0.125	74	0.36	0.67
Pyrolytic Low-e Double Glass (LOF Clear Low-e <sup>6</sup> )	0.125	76	0.33	0.71
Soft-coat Low-e Double Glass w/Argon gas fill (PPG Sungate <sup>7</sup> 100 Clear)	0.25	73	0.26	0.57
High Efficiency Low-e (SolarScreen 2000 VEI-2M <sup>TM</sup> )	0.25	70	0.29	0.37
Suspended Coated Film (Heat Mirror <sup>TM</sup> 66 Clear)	0.125	55	0.25	0.35
Suspended Coated Film w/ Argon gas fill (Azurite <sup>8</sup> Heat Mirror SCT5)	0.125	53	0.19	0.27
Double Suspended Coated Films w/ Krypton (Heat Mirror <sup>TM</sup> 77 Superglass)	0.125	55	0.10	0.34

Performance information was calculated using [Lawrence Berkeley National Laboratory WINDOW 5.2 computer analysis program](#)

Azurite<sup>8</sup> and Sungate<sup>7</sup> are registered trademarks of [PPG Industries](#)  
 foma Series<sup>5</sup> are trademarks of [Southwall Technologies](#)  
 66 is a registered trademark of [Pilkington/Libby-Owens-Ford Co.](#)  
 2M<sup>TM</sup> is a registered trademark of [Virogon](#)

**RESOURCE PAGE**

LOF Eclipse™ is a registered trademark of Pilkington/Libby-Owens-Ford Co.  
SolarScreen 2000 VEI-2M™ is a registered trademark of Viracore

### C. Other Attributes

Other important attributes of window and glazing systems include:

- **Gas Fills**—Inert gases such as argon and krypton are often injected between panes of glass to reduce conductive and convective heat transfer. These low-cost, gas fills reduce U-values without affecting shading coefficients or visible transmittance.
- **Fritting**—Baked on ceramic coatings, or frits, can be applied to the surface of glass in many different **patterns, colors, and densities**.
- **Safety and Security Glass**—Visit the [North American Laminated Glass Information Center](#). It provides information on the applications and benefits of laminated architectural glass.
- **Retrofit Films**—For information on the pros and cons of retrofit films, visit [Florida Solar Energy Center](#) and [Austin Energy](#).

**RESOURCE PAGE**

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Home » Glazing Hazard Mitigation

### Glazing Hazard Mitigation

by Joseph L. Smith, PSP and Nancy A. Renfro, PSP  
Applied Research Associates, Inc.  
Last updated: 07-24-2008

#### Introduction

While windows and glazing are important architectural and functional components of a building (e.g. for [daylighting](#)) glass fragments caused by accidents, [natural disasters](#), or intentional events such as terrorist attacks can lead to serious injuries to building occupants. In order to mitigate glass fragment hazards, designers must consider a multitude of factors, including a building's occupancy, [functional requirements](#), and anticipated threats and risks to people and mission. As a result



Fig. 1. Las Vegas Federal Courthouse used one-inch thick insulating glass panels.

COMMENT ON THIS PAGE

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RELATED RESOURCES

- Acoustic Control
- Aesthetic Challenges
- Aesthetic Options
- Balancing Security/Safety/Sustainability
- Blast Safety of Building Envelope

VIEW ALL RELATED RESOURCES

VIEW RESOURCE INDEX

WBDG SERVICES

### APPLICATION

#### Case Study

The State of Iowa Facilities Improvement Corporation (SIFIC) and the Mental Health Institute in Independence, Iowa joined forces to identify and implement energy management improvements. Among several strategies, the team installed more than \$300,000 worth of energy-efficient windows. To date, the Institute has saved more than \$100,000 annually in energy costs. [More...](#)

Argonne National Laboratory, Argonne, Illinois, is one of DOE's first buildings to pursue [LEED certification](#) by the U.S. Green Building Council. The design includes more than 15 building materials chosen for their recycled, renewable, or lower-emitting content. In addition, several energy conservation features, such as high-performance windows selective to west and north orientations, will reduce electric consumption by 20% and natural gas by 30%, lowering the building's greenhouse gas impact by 55 tons/year. [More...](#)



Argonne National Laboratory—Argonne, IL

### RELEVANT CODES AND STANDARDS

[Energy Star® Windows](#)  
[National Fenestration Rating Council \(NFRC\) Certified Products Directory](#)—Contains performance characteristics for window assemblies from most manufacturers.

**RESOURCE PAGE**

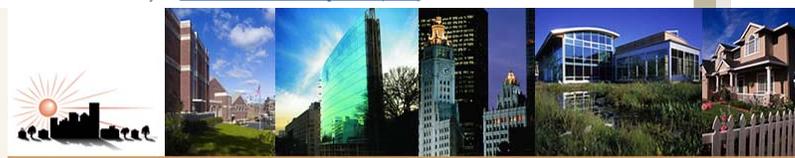
**RESOURCES**

[Active, Aesthetics, Section 07900: Joint Sealers](#)

**Design and Analysis Tools**

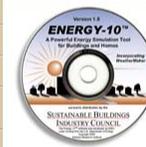
**WINDOW PROPERTIES**

- [Energy Star® Windows](#)
- Usually, the physical properties of glazing systems are easily obtained from product literature and certified by the [National Fenestration Rating Council \(NFRC\)](#).



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**ENERGY-10™ A Powerful Energy Simulation Tool for Buildings and Homes**

Project Partners: NREL Center for Building and Thermal Systems, SBIC, Lawrence Berkeley National Laboratory, and the Berkeley Solar Group  
Licensed to: Sustainable Buildings Industry Council, Innovative Design  
Version: 1.8

*ENERGY-10™* software analyzes and illustrates the energy and cost savings that can be achieved by applying up to a dozen sustainable design strategies. Hourly energy simulations quantify, assess, and clearly depict the benefits of:

- Daylighting
- Passive Solar heating and cooling
- Natural Ventilation
- Well-insulated building envelopes
- High-performance windows
- High-performance lighting systems
- High-performance mechanical equipment
- And more

**RESOU  
PAGE**

## Retrofitting Existing Buildings

- Retrofitting an existing building can be more cost effective than building a new facility. Designing major renovations & retrofits for existing buildings to include sustainability initiatives reduces operation costs & environmental impacts, & can increase building resiliency.
- Understand building adaptability & resiliency.
- Increase energy security: minimize energy consumption, use distributed generation, incorporate on-site renewable energy sources, & conserve water.
- Glazing: retrofit for energy efficiency, blast & noise.



## Existing Building Characteristics

- **Building Resiliency:** the capacity of a building to continue to function and operate under extreme conditions, such as (but not limited to) extreme temperatures, sea level rise, natural disasters, etc. As the built environment faces the impending effects of global climate change, building owners, designers, and builders can design facilities to optimize building resiliency.
- **Building Adaptability:** the capacity of a building to be used for multiple uses and in multiple ways over the life of the building. E.g., designing a building with movable walls/partitions allow for different users to change the space. Additionally, using sustainable design allows for a building to adapt to different environments & conditions.

From WBDG Sustainable Design Objective

Sustainable Buildings Industry Council



## Strategies for Energy Retrofits for Existing Buildings

- Recommission\* all energy & water systems to determine they are operating at optimum performance
- Determine occupancy patterns, then apply daylight\* & HVAC\* & lighting sensors in appropriate locations
- Determine if natural ventilation\* & fresh air intake are feasible alternatives to reduce heating and cooling loads
- Evaluate the potential for installing renewable energy systems\* to offset part of building load
- Consider solar shading devices\* for windows and doors, including those that generate electricity by PV.
- Replace existing windows w/ high-performance windows\* appropriate for climate & exposure. If building requires security upgrade, evaluate blast resistant windows & films\*

\* = WBDG Resource Page Topic

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## Strategies for Energy Retrofits for Existing Buildings

- Take the opportunity afforded by the building renovation to incorporate sustainable operations & maintenance\* practices & switch to green cleaning product & methods\*
- For historic buildings, update systems appropriately\* to maintain a balance between the need for energy & water savings with the character of the original building fabric
- Develop a plan to optimize the recycling and reuse of demolition debris & construction waste\* to minimize waste to landfill
- Determine if a cool roof\* or green roof\* are cost effective ways to reduce heat island effect & stormwater runoff
- To ensure your newly renovated building continues to perform as designed, measure the performance\* of the building regularly
- Balance the project's sustainable goals with its security goals\* including site renovation

\* = WBDG Resource Page Topic

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## Additional Resources

- Journal of Building Enclosure Design (JBED)
- WBDG Case Studies
- FEMP High Performance Federal Buildings Database
- DOE-EERE Commercial Buildings: Design, Construct & Renovate
- LEED for Existing Buildings: Operations & Maintenance (LEED-EBOM)
- The Green Globes Continual Improvement Tool for Existing Buildings (CIEB)

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# Modernization

For GSA, its [First Impressions Program](#) addresses the quality of the entrance and lobby areas of its older facility portfolio. Key areas to upgrade:

- Exterior envelope
- Mechanical systems
- Security
- Interior finishes, and
- Telecommunications infrastructure



Federal Office Building, San Francisco, CA

Other considerations: workplace quality, maintenance, historic preservation

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WHOLE BUILDING DESIGN GUIDE

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**Windows and Glazing**  
by Gregg D. Ander, FAIA  
Southern California Edison

**LEED® Version 2.1 Credit / WBDG Resource Page**  
Tools Index > - [LEED Version 2.1 Credit / WBDG Resource Page Matrix](#)

The LEED® (Leadership in Energy and Environmental Design) rating system, developed by the [U.S. Green Building Council](#), provides a framework for assessing building performance and achieving [sustainability](#) goals. Increasingly, designing to meet LEED® criteria is a requirement for federal, other public, and private-sector projects.

[Windows and Glazing](#)  
by Gregg Ander  
Southern California Edison

This page provides information on technologies and/or strategies that could be the following LEED® credits. Select the LEED® designation to view more WBDG that credit.

- [EA-1](#) Optimize Energy Performance
- [EA-P2](#) Minimum Energy Performance
- [EQ-2](#) Ventilation Effectiveness
- [EQ-6.1](#) Controllability of Systems - Perimeter Spaces
- [EQ-6.2](#) Controllability of Spaces - Non-Perimeter
- [EQ-7.1](#) Thermal Comfort - Comply with ASHRAE Standard 55-1992
- [EQ-8.1](#) Daylight and Views - Daylight 75% of Spaces
- [EQ-8.2](#) Daylight and Views - Views for 90% of Spaces

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Home > Tools

## TOOLS

Welcome to the Tools section of the Whole Building Design Guide. These pages offer information on a variety of desktop or Web-based tools used in the building industry.

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Home > Tools > Listing by Category

## Tools (Listing by Energy Analysis Category)

The following tools are listed in alphabetical order. Click on the tool name for more information.

**ATHENA IMPACT ESTIMATOR FOR BUILDINGS**  
 Architects, engineers and researchers can get life cycle assessment (LCA) answers about conceptual designs of new buildings or renovations to existing...

**BUILDING FOR ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY (BEES)**  
 The BEES software brings to your fingertips a powerful technique for balancing the environmental and economic performance of building products. The to...

**BUILDING LIFE-CYCLE COST (BLCC)**  
 BLCCS is programmed in Java with an XML file format. The user's guide is part of the BLCCS Help system. The program maintains the same basic approach...

TOOLS  
 Browse Alphabetically  
 Browse by Category  
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 Design & Analysis  
**Energy Analysis**  
 Life-Cycle Costing / Assessment  
 Life-Cycle Management / Maintenance  
 Professional & Construction Services  
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Home > Design Guidance > Building Types

## Building Types

A building's function strongly influences its design and construction. Consequently, the WBDG provides a branch of information and guidance organized by building use types. For each general Building Type there is a discussion of the attributes and requirements of the type as well as links to information on more specific uses. Each of the specific building types is then linked to a series of Resource Pages explaining standards, technologies and applications relevant to that specific use type.

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Home > Design Guidance > Building Types > Fire Station

## Fire Station

by Eric G. Milon  
 Lewis & Zimmerman Associates, Inc.  
 Last updated: 05-24-2007

### Overview

A fire station supports the needs of the fire department and the community in which it is located. It must accommodate extremely diverse functions, including housing, recreation, administration, training, community education, equipment and vehicle storage, equipment and vehicle maintenance, and hazardous materials storage. While it is usually only occupied by trained personnel, the facility may also need to accommodate the general public for community education or outreach programs.

Fire stations will vary somewhat in design depending on specific mission, i.e., the types of emergencies that will be responded to or the types of fires that will be fought. Usually, the facility differences relate to the size of the firefighting apparatus and facility location. The location of the facility is largely driven by the need to minimize response time. For example, aircraft rescue firefighting (ARFF) stations provide fire protection to flight lines and aircraft and are located adjacent to the runways at airport property. Similarly, stations with hazardous waste response teams are located near likely spill sites, etc.

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 Archives & Record Storage Building  
 Armories  
 Aviation  
**Community Services**  
 - Family Service Centers  
 - Fire Station  
 - Youth Centers  
 Educational Facilities  
 Federal Courthouse  
 Health Care Facilities

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RELATED RESOURCE PAGES  
 Daylighting  
 High-Performance HVAC  
 Water Conservation  
 Windows and Glazing

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**Community Services**  
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 Educational Facilities  
 Federal Courthouse  
 Health Care Facilities

The two primary drivers for facility layout and functional space adjacencies in a fire station are the following:

1. Ensure that internal response times can be met (time for a firefighter to reach the apparatus and be ready to depart).
2. Separate the diverse and sometimes conflicting functions such as industrial maintenance spaces and residential spaces.

Sample adjacency diagram for a fire station.  
Developed by DMJM Design, Arlington, VA

**APPARATUS BAYS**

By placing the apparatus bay between the maintenance and support functions and the residential and administrative functions, both primary layout goals can be accomplished. Some of the adjacencies shown above may be accommodated through a hallway rather than a direct entrance/exit from one space to another. This is particularly true with the apparatus bay and the day room as many facility spaces require an adjacency with these two spaces.

This approach to the layout can also accommodate expansion of the apparatus bay on the other side of the support and maintenance areas, although care must be taken to ensure that internal response times can be met after any expansion.

Sizing the apparatus bay is critical, and it should be designed to accommodate variable

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# Use Bldg Types When No Agency Criteria Exists

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**Building Attributes**

A. Types of Spaces

**Application**

**Representative Example**

[Shanghai-Jahwa Research Laboratory](#), Shanghai, China  
Architect: Perkins & Will Size: 97,000 gsf

The Jahwa Research Facility, in Shanghai, China, demonstrates the Chinese government's new desire to provide researchers with safe, world-class labs to enhance China's position in the international R&D market.

The new Shanghai-Jahwa research facility is part of a master plan at the firm's manufacturing campus in Shanghai. This facility contains pharmaceutical, cosmetic, fine chemistry, and basic research laboratories, combined with an administrative and creative development and exhibition component. The building is intended to provide closure and definition to the campus front lawn, creating a sense of place by reinforcing the southern edge of the site. The architectural

Shanghai-Jahwa Research Laboratory—Shanghai, China

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**DESIGN GUIDANCE**  
Space Types

Building Types  
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Auditorium  
Automated Data Processing Mainframe  
Automated Data Processing System  
**Child Care**  
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Conference / Classroom  
Courthouse: Courtroom  
Courthouse: Enhanced Office  
Courthouse: Judicial Chamber  
Firing Range  
Food Service  
General Storage  
Hearing Room  
Joint Use Retail  
Laboratory: Dry  
Laboratory: Wet  
Library  
Light Industrial

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Conference / Classroom  
Courthouse: Courtroom  
Courthouse: Enhanced Office  
Courthouse: Judicial Chamber  
Firing Range  
Food Service  
General Storage  
Hearing Room  
Joint Use Retail

**Child Care**  
by WBDG Staff  
Last updated: 02-08-2009

**Overview**

The Child Care space types, described herein, are the facilities required for child care services permitted within federal facilities. Child Care space types include all space sub-types, including [toilets](#), [food preparation and service](#), [office space](#), and meeting space, as well as [security features](#) required in compliance with codes and regulations.

**Space Attributes**

Child Care spaces should be [secure](#) environments that provide a variety of learning experiences and meet the physical [needs](#) of the children. See WBDG [Child Development Centers](#) for more information on the unique attributes of spaces designed for child development and care. Typical features of Child Care space types include the list of applicable design objectives elements as outlined below. For a complete list and definitions of the design objectives within the context of whole building design, click on the titles below.

**Functional / Operational**

- Classroom equipment and durable goods including cots and cribs, chairs and other seating devices, furniture, play equipment, academic equipment, presentation equipment, audiovisual equipment, computer equipment, food service, and hygiene

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RELATED RESOURCE PAGES  
Daylighting  
Electric Lighting Controls  
Energy Efficient Lighting  
Evaluating and Selecting Green Products  
Facility Performance Evaluation (FPE)  
VIEW ALL RELATED (9)  
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**PROJECT MANAGEMENT**  
Delivery Teams  
Planning & Development  
Building Commissioning  
Delivery & Controls

**Project Planning, Management and Delivery**  
Last updated: 10-02-2008

**Introduction**

Successful project management requires team leadership and coordination, diligent project planning, and effective oversight of the delivery process. Recognizing the importance of these qualities in satisfying clients' expectations, the Project Management section offers guidance for the entire delivery team to successfully and effectively carry out a high performance building project.

While this section is still under development, click on one of the following areas to begin your exploration:

- [Project Delivery Teams](#)—Contains guidance on assembling and effectively managing the project team.
- [Project Planning and Development](#)—Contains guidance on how to plan and deliver a project, from inception to turnover.
- [Building Commissioning](#)—Provides an overview of commissioning drivers, benefits, goals, and principles.
- [Project Delivery and Controls](#)—Contains descriptions of procedures and practices used to manage project scope, budget, and schedule.

Note: Terminology and processes described within this section of the WBDG typically refer to federal projects, but may be applicable to other public sector institutions with adaptation for local standards of professional practice.

**Major Resources**

**Federal Agency Links**

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**PROJECT MANAGEMENT**

- Delivery Teams
- Planning & Development
- Building Commissioning**
- Determine Project Performance Requirements
- Document Compliance & Acceptance
- Plan the Commissioning Process
- Delivery & Controls

**Building Commissioning**  
by the WBDG Project Management Committee  
Last updated: 10-02-2008

**Introduction**

Building Commissioning is a rapidly emerging A-E-C project management practice that is being embraced by public and private organizations because of its benefits in improved project delivery results.

This section of WBDG organizes commissioning information, guidance, and resources under three broad principles, including *Determine Project Performance Requirements*, *Plan the Commissioning Process*, and *Document Compliance and Acceptance*. It is important to note that all three principles are applied over the life-span of a capital design and construction project, and that it takes a multi-disciplined effort involving owners, design professionals, constructors, and commissioning providers to achieve optimal results from the commissioning process.

This WBDG page provides an overview of commissioning drivers, benefits, goals, and principles and general commissioning guides, standards, and resources.

**Definition**

ASHRAE Guideline 0, *The Commissioning Process*, defines commissioning as "a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria". Commissioning is therefore an "umbrella" process for all the planning, delivery, verification, and managing risks to critical functions performed in, or by, facilities. Commissioning uncovers deficiencies in design or installation using peer review and field verification. Commissioning also encompasses higher energy efficiency, environmental health, and occupant safety and

**WITHIN THIS PAGE**

- [Introduction](#)
- [Application](#)
- [Relevant Codes and Standards](#)
- [Additional Resources](#)

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**RELATED RESOURCE PAGES**

- Balancing Security/Safety and Sustainability Objectives
- Construction Operations Building Information Exchange (COBIE)
- Construction Phase Cost Management
- Facility Performance Evaluation (FPE)
- Indoor Air Quality and Mold Prevention of the Building Envelope

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**Federal Mandates**

The Whole Building Design Guide has identified key federal mandates that apply to the areas of building design, construction and management. Select from one of the categories below to view those documents or links.

**EXECUTIVE ORDERS**

**CODE OF FEDERAL REGULATIONS (CFR)**

**FEDERAL ACQUISITION REGULATIONS**

**OMB CIRCULARS**

**U.S. CODES**

Done

Sustainable Buildings Inc

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Home > Documents & References > Case Studies and High Performance Building Database

## Case Studies and High Performance Building Database

Below you will find case studies that demonstrate the 'whole building' process in facility design, construction and maintenance.

**Center for Neighborhood Technology**  
 Project Size: 13,800 ft<sup>2</sup>  
 Building Type: Institutional  
 Project Type: New Construction

**EPA New England Regional Laboratory**  
 Project Size: 72,000 ft<sup>2</sup>  
 Building Type: Single story laboratory and administrative office office and support space, with hazardous materials storage building and boat storage  
 Project Type: New construction

**EPA Region 8 Headquarters**  
 Project Size: 248,849 RSF  
 Building Type: Leased Office Building  
 Project Type: New Construction

**Home Depot Smart Home NEW!**  
 Project Size: 6,000 square feet  
 Building Type: Residence Hall  
 Project Type: New Construction

**WBDG SERVICES**  
 Construction Criteria Base

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Home > Documents & References > CCB

## Construction Criteria Base (CCB)

a service of the Whole Building Design Guide

Construction Criteria Base (CCB) is an extensive electronic library of construction guide specifications, manuals, standards and many other essential criteria documents. Published and updated continuously, CCB contains the complete unabridged, approved, current electronic equivalents of over 10,000 documents direct from participating federal agencies. CCB is the most effective tool available for finding and using current, approved U.S. construction criteria. Documents are available as Adobe® PDF files and some documents are also furnished by agencies in word-processing formats or in the SPECSINTACT specification processing program used by the Army, NAVFAC and NASA. Documents are organized first into Libraries, then by Source and Category.

For document inquiries or additional information, please contact us either by phone at 877-CCB-5667 or by email at [cbsupport@nibs.org](mailto:cbsupport@nibs.org).

### Construction Criteria Base Index

**SPECIFICATIONS LIBRARY**

- UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)
- NAVFAC SPECIFICATIONS
- NAVFAC STANDARD SPECIFICATIONS
- NAVFAC GUIDE PERFORMANCE WORK STATEMENTS
- VA MASTER SPECIFICATIONS
- DOE GENERAL DESIGN CRITERIA
- NIBS SPECIFICATIONS

**REGULATIONS LIBRARY**

- FEDERAL MANDATES
- OSHA REGULATIONS
- MILSH REGULATIONS

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**Industry Organizations**

Browse more of WBDG's industry organization information by selecting the first letter in the organization's name.

A B C D E F G H I K L M N O P R S T U V W

**ADHESIVE AND SEALANT COUNCIL, INC. (ASC)**

7979 Old Georgetown Road  
Suite 500  
Bethesda, MD 20814-2429  
Phone: 301-986-9700  
Fax: 301-986-9795  
[Web site](#) | [Email](#)

**ADVISORY COUNCIL ON HISTORIC PRESERVATION (ACHP)**

1100 Pennsylvania Avenue NW  
Suite 803  
Washington, DC 20004  
Phone: 202-606-8503  
[Web site](#) | [Email](#)

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National Aeronautics and Space Administration (NASA)  
Administrative Office of the United States Courts (AOUSC)  
Department of Homeland Security (DHS)  
National Institutes of Health (NIH)  
National Park Service (NPS)  
Smithsonian Institution

**Department of Defense (DOD)**

**Unified Facilities Criteria Program**

- [Unified Facilities Guide Specifications \(UFGS\)](#)
- [Unified Facilities Criteria \(UFC\) Technical Publications](#)
- [Criteria Change Request \(CCR\)](#)
- [Unified Facilities Spreadsheets](#)

 **US Army Corps of Engineers®**

 **NAVFAC**



The Department of Defense (DoD) and the military services have initiated a program to unify all technical criteria and standards pertaining to planning, design, construction, and operation and maintenance of real property facilities. The objective of the Unified Facilities Criteria (UFC) program is to streamline the military criteria system by eliminating duplication of information, increasing reliance on private-sector standards, and creating a more efficient criteria development and publishing process. Both technical publications and guide specifications are part of the UFC program. Previously, each service had its own publishing system resulting in criteria being disseminated in different formats. [UFC documents](#) have a uniform format and are identified by a number such as UFC 1-300-1.

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National Institutes of Health (NIH)  
National Park Service (NPS)  
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Specifications (UFGS)

- Unified Facilities Criteria (UFC) Technical Publications
- Criteria Change Request (CCR)
- Unified Facilities Spreadsheets

The Department of Defense (DoD) and the military services have initiated a program to unify all technical criteria and standards pertaining to planning, design, construction, and operation and maintenance of real property facilities. The objective of the Unified Facilities Criteria (UFC) program is to streamline the military criteria system by eliminating duplication of information, increasing reliance on private-sector standards, and creating a more efficient criteria development and publishing process. Both technical publications and guide specifications are part of the UFC program. Previously, each service had its own publishing system resulting in criteria being disseminated in different formats. [UFC documents](#) have a uniform format and are identified by a number such as UFC 1-300.

Though unification of all DOD criteria is the ultimate goal, not every particular document may not apply to all services. Documents have been fully revised to reflect all service requirements. In some instances, the UFC or UFGS (in MasterFormat™ 1995) document number will be followed by an alpha-designator, such as UFC 1-300-09N or UFGS 01320A. Alpha-designators are as follows:

A USACE  
F Air Force  
N Navy  
S NASA

Starting April 2006, UFGS in MasterFormat™ 2004, have a numeric designator at the end of the document number, for example UFGS 41 22 23 19 40. The fifth numeric pair in this numbering system identifies it as an agency-unique section. If there is no fifth pair in the UFGS number, it is a unified section, for use by all participating agencies. Numeric

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NAVFAc

NAVFAc HQ Sustainable Development Program e-Solicitation

NAVFAc Publications  
Interim Technical Guidance  
Eng. Criteria and Programs Office  
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Specifications Library  
NAVFAc Design-Build Master (NDBM)  
Reports and White Papers  
Non-Government Standards-IHS  
British Standards-IHS  
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National Aeronautics and Space Administration (NASA)  
Administrative Office of the United States Courts (AOUSC)  
Department of Homeland Security (DHS)  
National Institutes of Health (NIH)  
National Park Service (NPS)  
Smithsonian Institution

NAVFAc Sustainable Development Program

The purpose of this Web site is to provide access to sustainable resources and report outcomes of the NAVFAc Sustainable Development Program to advance the program goals and objectives. For more information, [contact NAVFAc](#).

- Policy and Mandates
- Criteria
- Specifications
- Contract Documents
- NAVFAc Sustainable Team Meetings
- NAVFAc's Corporate USGBC Membership
- Presentations
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- Training

NAVFAc

U.S. Green Building Council  
Corporate Member

NAVFAc Building 33  
Washington, D.C.

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**NAVFAC**  
Naval Facilities Engineering Command

## Sustainable Development Online Training

NAVFAC | CONTACT

**USER LOG IN**

Username:

Password:

Login

[Register Now](#)

[Forgot your password?](#)

[Technical Support](#)

Site Requirements:  
Internet Explorer 5+  
Windows Media Player 9+  
(for video content)

### Welcome to NAVFAC's Sustainable Development Online Training!

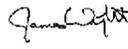
This online training has been designed especially for NAVFAC's Project Acquisition Team to help integrate principles of sustainable development into the acquisition process. Courses are tailored for each of the 13 project team members who comprise the facility development team.

**The NAVFAC Business Lines - Project Team Members**

- Environmental Specialist
- Real Estate Specialist
- Base Development
  - Facility Planner
  - Project Developer
- Capital Improvements
  - Project Manager
  - Cost Engineer
  - In-house Designer
  - Construction Manager/Resident Officer in Charge of Construction (ROICC)
- Public Works Specialist/Facility Manager
- Acquisition/Contract Specialist



*"This online training course carries out the Navy's commitment to incorporating sustainable development into its facility design and renovation processes to reduce costs and to deliver facilities that incorporate the latest industry standards for planning, design and construction."*



Former NAVFAC Chief Engineer

[Windows Media Player](#)  
[View introductory remarks](#)  
about this training by Dr.

Welcome back Sam Zero

**NAVFAC**  
Naval Facilities Engineering Command

## Sustainable Development Online Training Environmental Specialist

ENV SPECIAL HOME | SIGN OUT | CONTACT

**FUNDAMENTALS OF SUSTAINABLE DEVELOPMENT:**  
(Required courses are highlighted)

1. Basic Concepts/Navv Approach

2. Principles of Sustainability

**PROCESS COURSES:**

1. Comprehensive Planning

2. Project Development

3. Site Acquisition/Selection

4. Planning and Programming

5. Contractor Procurement

6. FACD/Design Charrette

7. Design Development

8. Design Reviews

9. Construction

10. Occupancy

11. Reuse/Disposal/Decommissioning

**User Account Management**  
[Update User Information](#)  
[View Progress Report](#)

[Technical Support](#)

### Welcome Environmental Specialist!

This is your homepage for accessing the NAVFAC Sustainable Development Online Training!

**OVERVIEW OF TRAINING:**

The purpose of this course is to:

- Inform you about the importance of sustainable development to NAVFAC facility and infrastructure projects; and
- Identify your role in ensuring the successful integration of sustainable development concepts during the project phases in which you are involved.

As an Environmental Specialist for a given facility project, you work to balance the installation's natural and cultural resources with the Client's/Occupant's facility requirements. While your main focus is on environmental compliance, your expertise in stormwater management, solid waste and recycling, clean air and water issues, hazardous materials, and/or historic preservation makes you a natural (no pun intended!) champion for the overall sustainability of the project.

Throughout this training, you will learn about your key responsibilities in the facility life-cycle process related to sustainable development. These include:

- Provide technical consultation on site selection and facility disposal
- Advocate environmental and sustainability goals during project planning and programming

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Home > Design Guidance > Building Envelope Design Guide

## Building Envelope Design Guide

The National Institute of Building Sciences (NIBS) under guidance from the [Federal Envelope Advisory Committee](#) has developed this comprehensive guide for exterior envelope design and construction for institutional / office buildings. The Envelope Design Guide (EDG) is continually being improved and updated through the Building Enclosure Councils (BECs). Any edits, revisions, updates or interest in adding new information should be directed to the [BEDG Review Committee](#) through the 'Comment' link on this page.

**BEDG**  
BUILDING ENVELOPE DESIGN GUIDE

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**DESIGN GUIDANCE**

- Building Envelope Design Guide
- Introduction
- Below Grade Systems
- Wall Systems
- Fenestration Systems
- Roofing Systems
- Atna Systems

This section supported by:  
 Building Enclosure Council

**Introduction**

**Below Grade Systems**

- Foundation Walls
- Floor Slabs
- Plazas, Tunnels, Vaults

**Wall Systems**

- Cast-In-Place Concrete
- Exterior Insulation and Finish System (EIFS)
- Masonry
- Panelized Metal
- Precast Concrete
- Thin Stone

**Fenestration Systems**

- Glazing

Done, but with errors on page. Internet 100%

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## Design Disciplines

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Home > Design Guidance > Design Disciplines > Fire Protection Engineering

## Fire Protection Engineering

by Morgan Hurley, P.E., SFPE  
Last updated: 07-08-2008

**Introduction**

Fire protection engineers use science and technology to protect people and property from fire. When designing new buildings or renovations to existing buildings, fire protection engineers develop the [plan for fire protection](#).

Fire protection engineering has evolved significantly over the past several centuries. Early applications of fire protection engineering were intended to prevent conflagrations, which could destroy entire cities. Until the early 1900s, the primary objective of fire protection engineering was to limit a fire to its building of origin. As fire protection engineering advanced, this objective was refined to limit a fire to its object or room of origin.

However, it wasn't until the later part of the 20th century that fire protection engineering had matured to the point that it included the fundamental tenets of a distinct, professional discipline (Lucht, 1989).

**Description**

A. Professional Definition

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**Design Objectives**

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**DESIGN GUIDANCE**

Federal Green Construction Guide for Specifiers

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01: General Requirements

02: Site Construction

03: Concrete

04: Masonry

05: Metals

06: Wood, Plastics, and Composites

07: Thermal and Moisture Protection

08: Openings

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Frequently Asked Questions

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**DESIGN GUIDANCE**

Federal Green Construction Guide for Specifiers

Last updated: 06-26-2007

01 57 19.11 (01352) Indoor Air Quality (IAQ) Management

This is a guidance document with sample specification language intended to be inserted into project specifications on this subject as appropriate to the agency's environmental goals. Certain provisions, where indicated, are required for U.S. federal agency projects. Sample specification language is numbered to clearly distinguish it from advisory or discussion material. Each sample is preceded by identification of the typical location in a specification section where it would appear using the SectionFormat™ of the Construction Specifications Institute; the six digit section number cited is per CSI MasterFormat™ 2004 and the five digit section number cited parenthetically is per CSI MasterFormat™ 1995.

**SPECIFIER NOTE:**  
This section includes requirements for IAQ management during construction. Coordinate with requirements of other sections; verify that products and installation methods.

Home » Documents & References » Federal Mandates » Executive Orders » Executive Order 13423 Technical Guidance

**EXECUTIVE ORDER 13423 TECHNICAL GUIDANCE**

Frequently Asked Questions

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**Executive Order 13423 Technical Guidance for Implementing the Five Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings**

**Introduction**

As directed in [EO 13423](#), the Interagency Sustainability Working Group has developed this technical guidance to assist agencies in meeting EO goals and statutory requirements. This technical guidance includes clarification of requirements; related mandates; additional recommendations and considerations; and resources for implementation, including model contract and specification language per the [Federal Green Construction Guide for Specifiers](#).

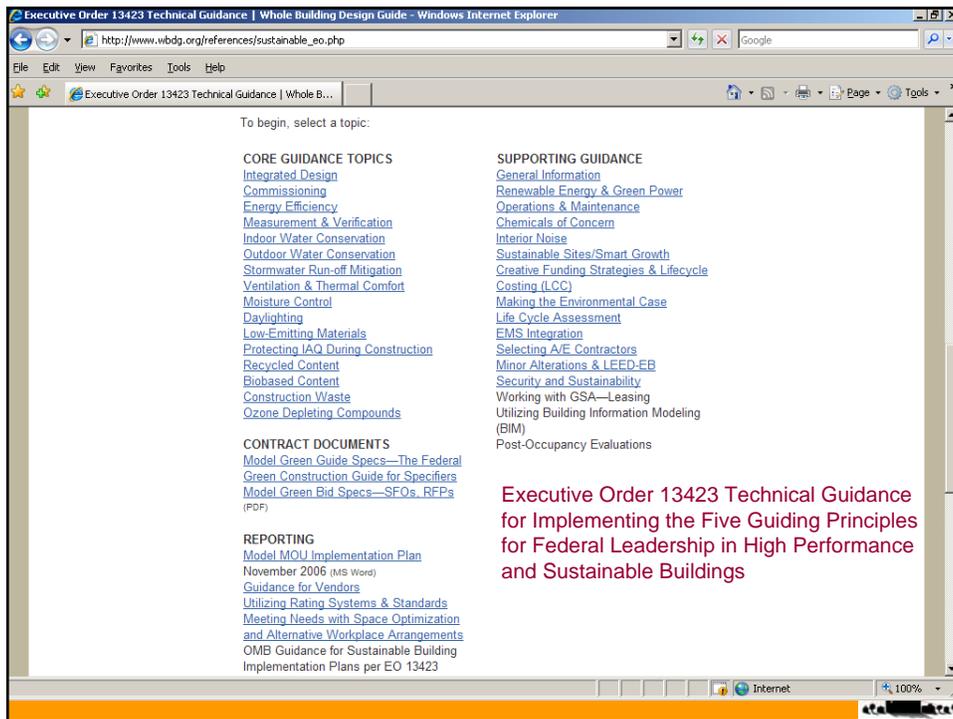
The ISWG shall review the *Guiding Principles* and Technical Guidance periodically for updates and to consider adopting additional principles or goals addressing issues such as conservation plantings, integrated pest management, deconstruction, and siting.

**Notice - High Performance and Sustainable Buildings Guidance**

New guidance on High Performance Federal Buildings was issued December 5, 2008. It includes revised Guiding Principles for new construction, new Guiding Principles for existing buildings, clarification of reporting guidelines for entering information on the sustainability data element (#25) in the Federal Real Property Profile, and an explanation of how to calculate the percentage of buildings and square footage that are compliant with the Guiding Principles for agencies' scorecard input. The WBDG will be updated in the coming months to reflect these changes.

A set of answers to frequently asked questions (FAQs) on this guidance, is also provided below. These FAQs are based on comments received during the development of this guidance, and will be updated as necessary.

- [High Performance and Sustainable Buildings Guidance](#) (PDF 192 KB)
- [High Performance and Sustainable Buildings Guidance - Comment Resolution Summary](#) (PDF 98 KB)



## E.O. 13423 Technical Guidance Five Guiding Principles

The five Guiding Principles address:

- **Employing integrated design;**
- **Optimizing energy performance;**
- **Protecting and conserving water;**
- **Enhancing indoor environmental quality; and**
- **Reducing the environmental impact of materials.**

To build from this and other accomplishments and to pave the way for future success, the President signed **Executive Order 13423 "Strengthening Federal Environmental, Energy and Transportation Management"** on January 24, 2007. This Executive Order (EO) consolidates and strengthens a number of prior EOs by establishing new and updated goals, practices, and reporting requirements for environmental, energy, and transportation performance and accountability.

In the area of sustainable design and high performance buildings, **the new EO makes mandatory the five Guiding Principles of the MOU for all new construction and major renovations** and sets an aggressive goal for applying these practices to existing capital assets over the next decade.



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**DESIGN GUIDANCE**

**Mechanical Insulation Design Guide**  
by the National Mechanical Insulation Committee (NMIC)  
Last updated: 12-27-2007

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The National Institute of Building Sciences (NIBS) through the [National Mechanical Insulation Committee \(NMIC\)](#) has developed the [Mechanical Insulation Design Guide \(MIDG\)](#) to provide a comprehensive source of information on the performance, use, testing and standardization of mechanical insulation in buildings and industrial facilities.

The MIDG is continually being improved and updated. Any edits, revisions, updates or interest in adding new information should be directed through the 'Comment' link on this page. [Disclaimer](#)

**MIDG**  
MECHANICAL INSULATION DESIGN GUIDE

**Introduction**

- **Introduction**
- **Background**  
National Mechanical Insulation Committee  
National Mechanical Insulation Committee (NMIC) Objective  
Mechanical Insulation Market Definitions
- **Scope of the Design Guide**  
Using the Mechanical Insulation Design Guide  
Why?, What?, Where?, How?, How To?, How Much?
- **Example Design Problems**  
Example 1  
Example 2

[Design Objectives](#)

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**OPERATIONS & MAINTENANCE**

**Facilities Operations & Maintenance**  
by Don Sapp, Plexus Scientific  
Updated by the Facilities O&M Committee  
Last updated: 01-19-2009

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**Real Property Inventory (RPI)**

**Computerized Maintenance Management Systems (CMMS)**

**Introduction**

Facilities operations and maintenance encompasses all that broad spectrum of services required to assure the built environment will perform the functions for which a facility was designed and constructed. Operations and maintenance typically includes the day-to-day activities necessary for the building and its systems and equipment to perform their intended function. Operations and maintenance are combined into the common term O&M because a facility cannot operate at peak efficiency without being maintained; therefore the two are discussed as one.

The Facilities O&M section offers guidance in the following areas:

- **Real Property Inventory (RPI)**—Provides an overview on the type of system needed to maintain an inventory of an organization's assets and manage those assets.
- **Computerized Maintenance Management Systems (CMMS)**—Contains descriptions of procedures and practices used to track the maintenance of an organization's assets and associated costs.
- **Computer Aided Facilities Management**—is an approach in Facilities Management that includes creation and utilization of Information Technology (IT)-based systems in FM practice.

Future updates to the Facilities O&M section will provide additional guidance in the following areas:

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**OPERATIONS & MAINTENANCE**

Real Property Inventory (RPI)

Computer Aided Facilities Management (CAFM)

Computerized Maintenance Management Systems (CMMS)

**Real Property... Inventory (RPI) and Asset Management (RPAM)**

by James R.Watson, MACTEC E&C  
Last updated: 01-29-2009

**Introduction to Real Property Inventory and Asset Management**

*What do we own, where is it, what is it worth, how fast are we using it up, and what should we do?*

Real Property Inventory (RPI) is a record of an organization's assets/real property. Real Property Asset Management (RPAM) is a program for collecting and maintaining a real property inventory. RPAM provides data to manage those assets and meet asset record and reporting requirements. RPAM provides the information necessary to formulate facility budgets, make decisions on facility replacement, identify repair costs, identify penalty costs, and improve the management of investments in Real Property assets, throughout the organization. Federal Real Property Asset Management places specific requirements on owners of Federal Real Property to identify and categorize all real property owned, leased, or other-wise managed by the agency. [Executive Order 13327](#), signed in 2004 underscores the importance of RPAM to the overall success of any organization with a portfolio of Real Property. In the past, real property records were maintained for ready reference within folders in file cabinets and consisted of a list of assets, their value and limited other information. Since requirements to manage the Total Cost of Ownership (TCO) within an organization have become more critical with rising costs and shrinking budgets, the demand for factual data about real property has increased. RPAM managers must support ever increasing requests for information about the Real Property in their portfolio, especially since information requests are not limited to building data as in the past. Information demands include Infrastructure, Building Systems, Utilities, Energy Consumption, Space

**WITHIN THIS PAGE**

- [Introduction to RPI and RPAM](#)
- [Introduction to RPI Databases](#)
- [Application](#)
- [Emerging Issues](#)
- [Relevant Codes and Standards](#)
- [Major Resources](#)

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- Construction Operations Building Information Exchange (COBIE)
- Deferred Maintenance - The Use of Parametrics for Estimating Maintenance Costs
- Facility Performance Evaluation (FPE)
- Life-Cycle Cost Analysis (LCCA)
- Predictive Testing & Inspection (PT&I) Can Prevent Operational Interruptions

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- WBDG02 Whole Building Approach to Laboratories
- WBDG03 Planning for Secure Buildings
- WBDG04 Optimizing Operations and Maintenance (O&M)
- WBDG05 Daylighting Principles and Strategies for Sustainable Design
- WBDG06 Sustainable Roofing Design Considerations and Applications
- WBDG07 Defining, Evaluating, and Selecting Green Products
- WBDG08 Principles and Goals of Accessible Design

**Continuing Education**

Welcome to the WBDG continuing education system. The WBDG contains a wealth of information and is your gateway to up-to-date information on integrated 'Whole Building' Design Techniques and Technologies. The courses featured offer an introduction to whole building design concepts as well as more specific applications for design objectives, building types and operations and maintenance.

The content in the WBDG has been developed by top experts in the fields of architecture, engineering, planning, and facility management, among others. So you can be assured that the information is up to date and relevant and will inspire you to engage in the process of whole building design contributing to the stock of America's building.

Distance education is a great and very convenient way for architecture, engineering, and building design professionals to gain valuable knowledge about whole building design while earning continuing education credits. As a registered CES provider, the WBDG CES system is a source of AIA Continuing Education System learning units for registered architects. AIA members will receive their learning units and certificate of completion upon passing the course tests and completing an evaluation form and filling out an affidavit. Other building design professionals will receive a certificate of completion for approval and processing with their professional membership organization upon passing the course test and completing an evaluation form and filling out an affidavit.

[Enroll now](#) or [Log In](#) to begin taking a class with the WBDG Continuing Education System.

**COURSES**

**WBDG01 THE INTEGRATED DESIGN PROCESS**

This course will introduce you to the concepts of whole building design and the elements of an integrated design process.

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**Continuing Professional Education**

AIA Home :: NEW! Sustainable Design

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**NEW! Sustainable Design**  
 Becomes a Mandatory Continuing Education Requirement for AIA Membership

The AIA Board of Directors modified the AIA — member continuing education requirement to include **4 hours of education in sustainable design as part of the existing 18 — hour annual requirement**. This sustainable design requirement goes into effect in calendar year 2009 and extends through 2012.

**About the Requirement**

Sustainability has been a focus of architectural practice for over thirty years, and the AIA has provided resources and tools to assist its members in better serving their clients and communities through environmentally responsible projects. The AIA Board of Directors recognized the need to again help prepare their colleagues and fellow practitioners respond to the latest challenge and opportunity facing the profession. The issue of climate change and the impact of buildings on carbon emissions created a new expectation among clients and the public to look to the expertise of architects for solutions that can help them leave a greener footprint. The AIA is responding to this growing demand for our members to assume greater leadership in addressing the challenges facing our planet.

**Resources For AIA Members**

This sustainable design mandatory continuing education requirement is for AIA membership renewal. However, some states may develop their own special continuing education requirements in addition to HSW. For verification of a specific state's mandatory continuing education (MCE) requirement, please contact the state licensing board directly.

- AIA/CES Member FAQs
- Find your state licensing board
- Coming January 1, 2009, a list of registered AIA CES Providers who offer sustainable design courses.

**Resources For AIA/CES Providers**

- AIA/CES Provider FAQs
- Guidelines for Approving AIA/CES Sustainable Design (SD) Courses
- Register a NEW AIA/CES program
- Coming soon, resources for developing SD qualifying programs

**Green Resources**

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**BUILDING INFORMATION MODELING (BIM)**

NIBS BIM Initiatives  
 Industry BIM Initiatives  
 BIM Libraries

**Building Information Modeling (BIM)**  
 by Dana K. (Deke) Smith, FAIA - Executive Director, buildingSMART alliance, and Alan Edgar, Chair - National BIM Standard Project Committee

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**BUILDING INFORMATION MODELING (BIM)**

NIBS BIM Initiatives  
 National BIM Standard

Industry BIM Initiatives  
 BIM Libraries

**National BIM Standard™**  
 Last updated: 12-03-2008

The NBIMS Executive Committee has released *National BIM Standard Version 1 - Part 1: Overview, Principles, and Methodologies* for public use. This document, which includes contributions by more than thirty subject matter experts in the capital facilities industry, incorporates industry comments and now contains new and expanded information about the NBIMS production and use process.

With the release of this document there remain many Building Information Modeling (BIM) issues to discuss, coordinate, and resolve, not only throughout the United States, but also with our international counterparts. It is hoped that this effort will facilitate discussion and lay the groundwork for ongoing organizational and operational activities.

The Executive Committee expresses sincere appreciation to all those who have contributed and continue to contribute to the creation of the National BIM Standard. As always, we invite participants to join the Committee to help shape and share in the transformation of our industry. There is no cost to download *Version 1 - Part 1*.

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Done, but with errors on page.

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**APPLIED RESEARCH**

- Workplace
- Building Envelope
- Sustainable and High Performance Building Strategies
- Energy Efficiency
- Building Technology
- Behavioral
- Post Occupancy
- Practice

## Applied Research

### Introduction

The Applied Research module serves as repository for research projects, reports, papers, and proceedings sponsored by federal agencies.

The purpose of this effort is to provide a clearinghouse of government sponsored applied research findings to improve performance of federal facilities by sharing expert resources, knowledge, practices and strategies. The National Institute of Building Sciences (NIBS) under guidance from the Applied Research Subcommittee sponsored by the U.S. General Services Administration (GSA) Office of Applied Research developed the following organizational research areas:

- [Workplace](#)
- [Building Envelope](#)
- [Sustainable and High Performance Building Strategies](#)
- [Energy Efficiency](#)
- [Building Technology](#)
- [Behavioral](#)
- [Post Occupancy](#)
- [Practice](#)

The Applied Research module will be continually updated. Any edits, revisions, updates or interest in adding new information should be directed to [dfernandez@nibs.org](mailto:dfernandez@nibs.org) or through the 'Comment' link on this page.

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**APPLIED RESEARCH**

- Workplace
- Building Envelope
- Sustainable and High Performance Building Strategies
- Energy Efficiency
- Building Technology
- Behavioral
- Post Occupancy
- Practice

## Sustainable and High Performance Building Strategies Research

### Abstracts

**Assessing Green Building Performance: A Post Occupancy Evaluation of 12 GSA Buildings - Case Study**  
Sponsored by: U.S. General Service Administration (2008)

This study compares measured whole building performance for 14 GSA buildings located in half of its national regions to industry standard performance of energy, water, maintenance and operations, waste, recycling, transportation, and occupant satisfaction metrics. Eight of the buildings are U.S. Green Building Council LEED certified, two are LEED registered, one used Green Building Challenge and h... [More](#)

**Assessing Green Building Performance: A Post Occupancy Evaluation of 12 GSA Buildings - White Paper**  
Sponsored by: U.S. General Services Administration Public Buildings Service, Office of Applied Science Applied Research (2008)

To answer the question, 'does sustainable design deliver?' GSAA evaluated 12 sustainably designed buildings in its national portfolio. The evaluation of these buildings was comprehensive—measuring environmental performance, financial metrics, and occupant satisfaction. No previous analysis has taken such a holistic view. The buildings studied all incorporated sustainable design criteria to ... [More](#)

[Online Applied Research Submission Form](#)

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## Charrettes/Project Team Meetings

- A high-performance building cannot be achieved unless the integrated design approach is employed.
- Conduct charrettes & project team meetings from concept through planning, design & construction (include O&M folks)
- Use the Whole Building Design Guide as a tool to achieve high-performance buildings



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Home > Planning and Conducting Integrated Design (ID) Charettes

**RESOURCE PAGES**  
A-C D-H I-R S-W

Indoor Air Quality and Mold Prevention of the Building Envelope

Life-Cycle Cost Analysis (LCCA)

Low Impact Development Technologies

Materials

Measuring Performance of Sustainable Buildings

Microturbines

Mold and Moisture Dynamics

Natural Ventilation

Optimizing HVAC Life-Cycle Performance

Passive Solar Heating

**Planning and Conducting Integrated Design (ID) Charettes**

Playground Design and Equipment

Predictive Testing & Inspection (PT&I) Can Prevent Operational Interruptions

Psychosocial Value of Space Reliability-Centered

**Planning and Conducting Integrated Design (ID) Charettes**  
by Joel Ann Todd, Environmental Consultant, and Gail Lindsey, FAIA, Principal, Design Harmony  
Last updated: 05-22-2008

**Introduction**

Process is critical to successful, balanced designs; and a key step in the design process is an integrated design charrette. In this Resource Page, a charrette is defined as an intensive workshop in which various stakeholders and experts are brought together to address a particular design issue, from a single building to an entire campus, installation, or park. The term can also be applied to shorter, focused project team meetings, project planning meetings, brainstorming sessions, and extensive community visioning events.



Left: Participants in the charrette work groups discuss the project's environmental priorities using the LEED® Green Building Rating System. Charrette for Southface New Office Building. (Photo by Paul Torcellini)  
And Right: Charrette work groups work at round tables in a large meeting room—note the flip chart pages taped to the walls. San Francisco Maritime National Historic Park: Greening Charrette. (Photo by Joel Todd)

A charrette can be the mechanism that starts the communication process among the

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**RELATED RESOURCE PAGES**

- Achieving Sustainable Site Design through Low Impact Development Practices
- Aesthetic Challenges
- Aesthetic Opportunities
- Balancing Security/Safety and Sustainability Objectives
- Cost Impact of the ISC Security Criteria

[VIEW ALL RELATED \(27\)](#)

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Construction Criteria Base

## Emerging Issues

- Focus on Existing Buildings
- Carbon footprint / greenhouse gas reduction
- Building Information Modeling (BIM)
- Design for deconstruction
- Smart building technology
- Passive Survivability
- Net Zero Energy Buildings





**Thank you for your time!**

**QUESTIONS??**

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