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Part 1
Introduction to the LEED Process

Presented by:

Thomas A .Fisher, AIA, LEED AP
Senior Project Manager
Sustainable Design Consulting, LLC
December 10, 2008 8:30 -9:30

Sustainable & Smart
ecobuild fall
Sustainable, Green and High Performance Solutions for the Built Environment

Part 1 - Introduction

Sustainable Design Consulting

- Offices in Washington, DC and Richmond, VA
- Small woman-owned business
- Focus on greener solutions for the built environment
- Consulted on over 80 green building projects, over 200 LEED-related projects
- Commercial, institutional, multi-family, greater-DC-area and Central Virginia
- Project consulting mostly to Developers/Owners and Architects

What we do

- Green Building Project Management
- Drawing & Spec Review
- LEED advisory
- Lectures, Workshops & Trainings
- Design Guidance and Research

www.sustaindesign.net

Eastern Village Cohousing

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Outline

- Part I – Introduction
  - Impact of Buildings
  - Benefits of Green/Integrated Design
  - Overview and History of LEED
  - LEED Standards
  - Cost of LEED
  - Project Certification & Accreditation
  - Resources & Website
  - Questions, Discussion
- Part 2 – Sustainable Sites
- Part 3 – Energy & Atmosphere
- Part 4 – Materials & Resources
- Part 5 – Indoor Environmental Quality
- Part 6 – Water Efficiency, Innovation in Design, Exam Review, LEED 2009

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Why Green Building ?

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Why Green Building?

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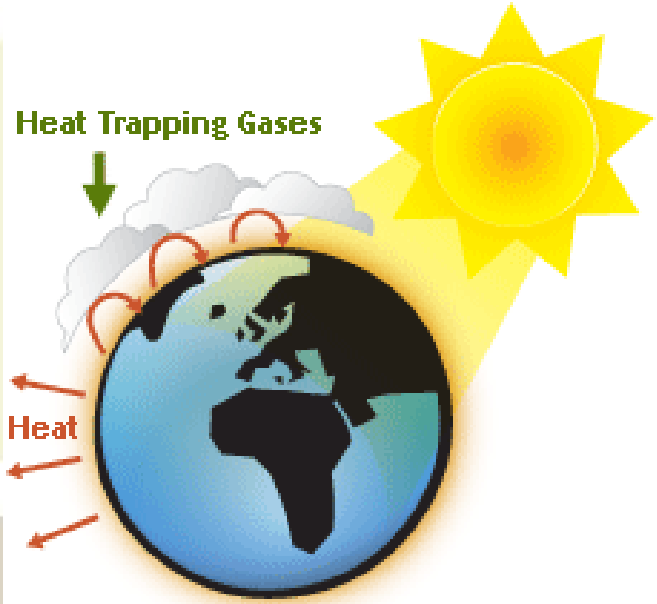
Why Green Building



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Why Green Building?

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Why Green Building?

Source: NRDC & NASA

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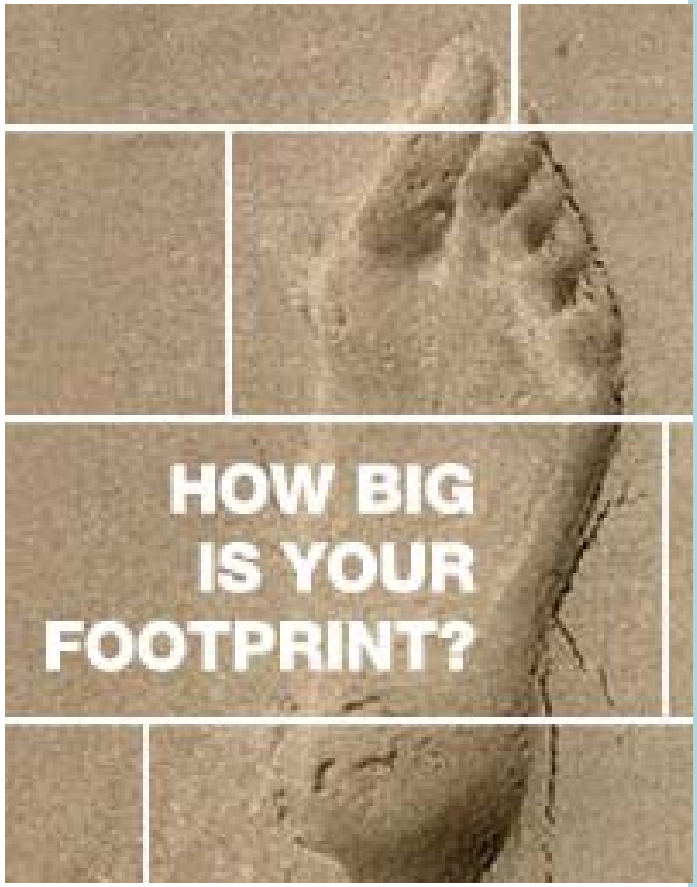
Why Green Building?



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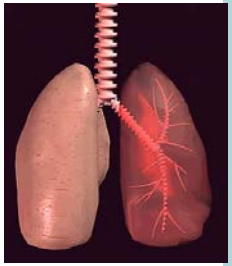
Why Green Building?



Other Environmental Issues:

- Ozone Layer deterioration
- Ecosystem deterioration
- Water resource loss
- Indoor Environmental Quality
- Waste build up

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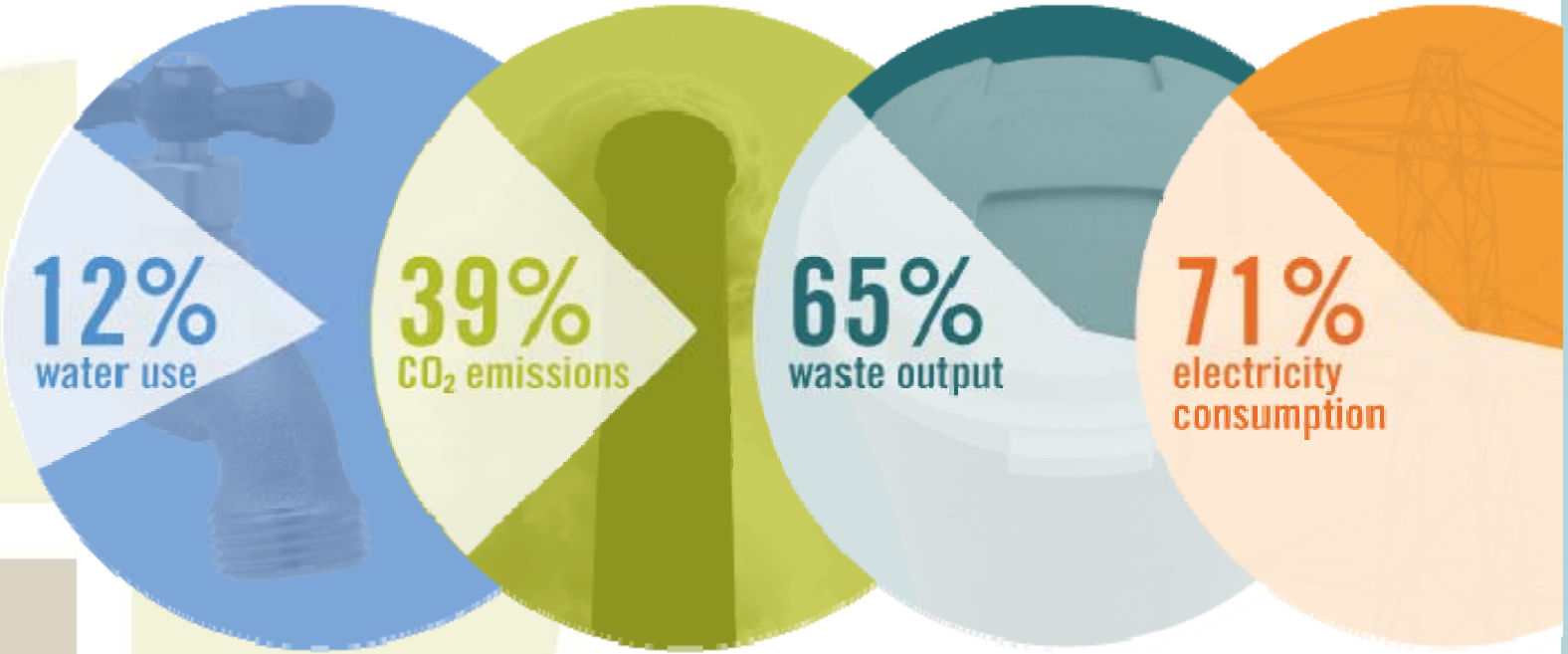
Current Impacts of Buildings

On the Environment

U.S. Building Impacts:



•Source: USGBC

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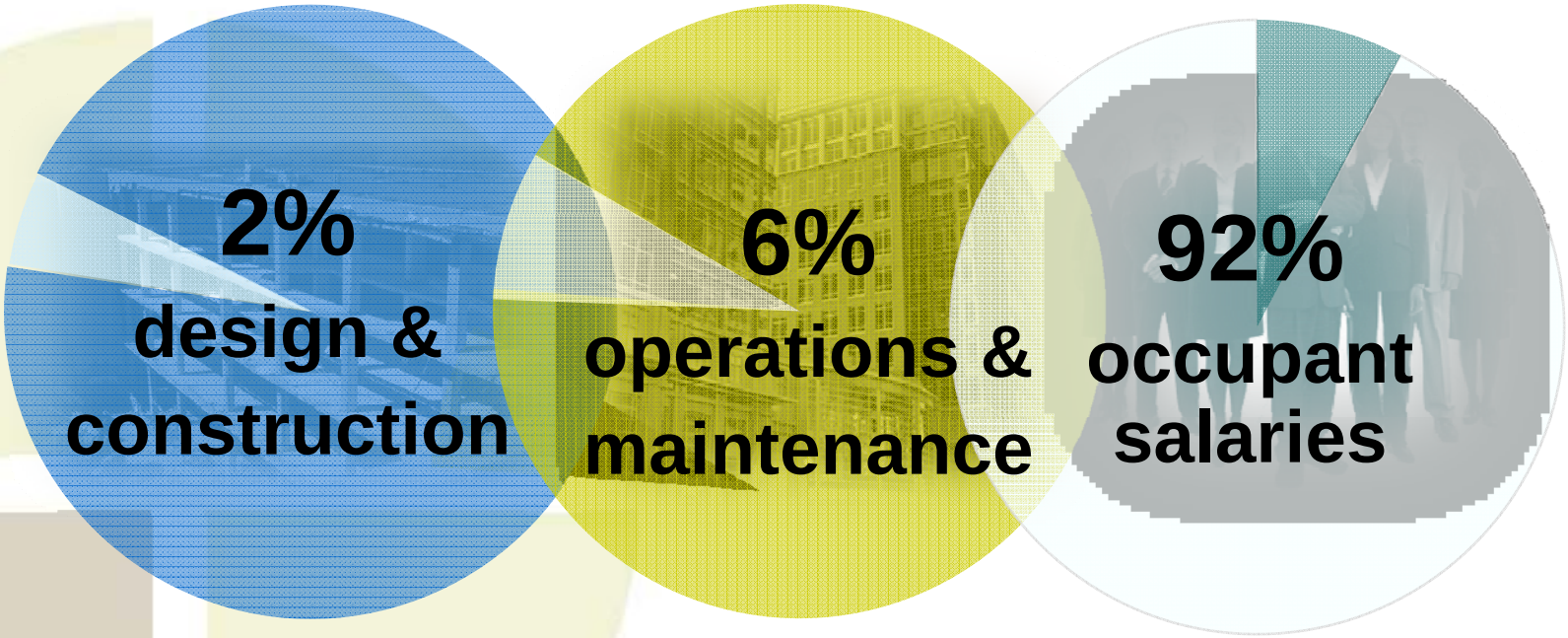
Current Impacts of Buildings

- **On the Economy**
- A Building's Life Cycle Costs:



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Current Impacts of Buildings

On People

- Americans spend 90% of their time indoors.
- 30% of new and renovated buildings have poor IAQ
- Indoor levels of pollutants 2 - 5 times higher than outdoor levels.
- More than 20 million people, including over 6 million children, have asthma.
  - 10 million outpatient clinic visits
  - 14 million missed school days
  - 4,500 deaths

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What is ‘Green’ Building?

Planning, design, construction, and operations and maintenance practices that significantly reduce or eliminate the negative impact of buildings and developments on the environment and occupants while creating vibrant, healthy, comfortable, durable, cost-effective places to live, work, and play

- **“green”**
- **“high performance”**
- **“environmentally-friendly”**
- **“sustainable design”**

•Building 850, Port Hueneme, CA

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Talking the Talk…

Sustainability: Meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Balances environmental, economic and social needs.

Green: A popular term for environmentally sensitive or beneficial.

High Performance Buildings: Buildings that incorporate a variety of sustainability features such as energy and water efficiency, natural stormwater management, and indoor environmental quality.

Life Cycle Analysis: Examines total environmental and health impacts through each stage of a product's existence.

Embodied Energy: quantifies the total energy required to acquire raw materials, produce a product, and transport to point-of-use

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Talking the Talk…

Indoor Air Quality: The condition of air inhaled by building occupants relative to the presence of vapors, particles and toxins

Sick Building Syndrome: A pattern of maladies or illnesses thought to be caused by indoor conditions such as air quality.

Building Related Illness: Maladies with known causes, such as Legionnaire's disease

Bioaccumulant: Substances that increase in concentration in living organisms

Volatile Organic Compound: VOCs are compounds that have a high vapor pressure and low water solubility. Many VOCs are human-made chemicals that are used and produced in the manufacture of paints, sealants, and refrigerants.

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Costs and Benefits of Green Building

	Costs (Investment)	Benefits (Returns)
Owner	Up-front professional fees Hard-costs for systems & materials with high-return on investment	Reduced liability. Better building performance. Realization of corporate/institutional goals.
Design Team	Green building learning curve and stepping outside of conventional comfort zones. Increased coordination efforts.	More holistic understanding of green buildings and sites. Development of marketable in-house expertise.
General Contractor	Green building learning curve and stepping outside of conventional comfort zones. Increased management efforts.	More holistic understanding of green buildings and sites. Development of marketable in-house expertise.
Facility Manager	Added training and control requirements.	Reduced maintenance and replacement. Development of marketable in-house expertise.
Occupant	Elevated standards for building requirements. Sometimes increased rents.	Better total environmental quality. Increased environmental awareness. Lower resource use (operating costs).

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Costs and Benefits of Green Building

Financial Benefits of Green Buildings
Summary of Findings (per ft^2)

Category	20-year Net Present Value
Energy Savings	$5.80
Emissions Savings	$1.20
Water Savings	$0.50
Operations and Maintenance Savings	$8.50
Productivity and Health Value	$36.90 to $55.30
Subtotal	**$52.90 to $71.30**
Average Extra Cost of Building Green	(-$3.00 to -$5.00)
Total 20-year Net Benefit	**$49.90 to $66.30**

Source: Capital E Analysis

www.cap-e.com

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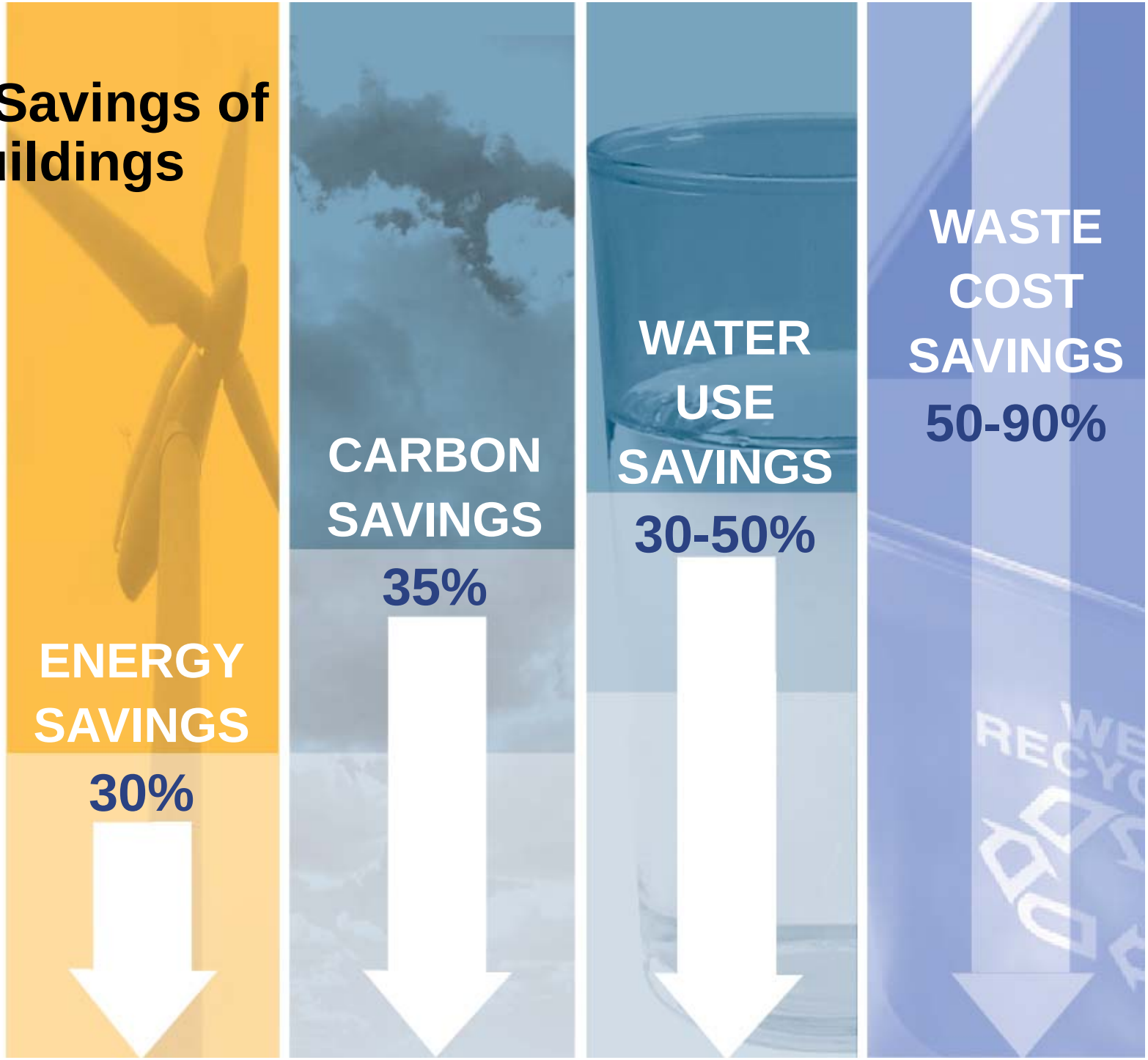
Average Savings of Green Buildings



Benefits of Building Green

Measurable Benefits

- Energy and Water Savings
- Waste Reduction
- Minimize strain on local infrastructure

More Difficult to Measure

- Enhance occupant comfort and health
- Improved Productivity
- Marketability

Energy Resource Center.

Photo: Construction Technologies Group Inc.

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Challenge of Green Building

Many governments are doing it in some form:

- Washington, DC
- Federal Government
- Virginia
- Arlington County, VA
- Montgomery County, MD
- Prince Williams County, VA
- Fairfax County, VA
- City of Alexandria, VA
- City of Falls Church, VA
- City of Richmond, VA
- City of Gaithersburg, MD

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Why bother with Sustainable Design?

LA Courthouse
Perkins and Will

Schneider house
Inscape Studios

Scottish Gas Headquarters Norman Foster & Partners

High Performance and Good Design

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Integrated Design Approach

In buildings, to achieve a truly successful project, **<u>all design objectives must be considered in concert with each other</u>** :

Source: www.wbdg.org

Design Objectives:

- ***Accessible***
- ***Aesthetic***
- ***Cost-Effective***
- ***Functional***
- ***Historic Preservation***
- ***Productive***
- ***Secure/Safe***
- ***Sustainable***

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Whole Systems Approach

Example: Choosing a Paint – looking at a whole systems approach…

- Can the paint choice help reflect daylighting into the interior spaces and decrease lighting energy use?
- Can the paint choice support better worker conditions?
- Can the paint choice enhance indoor environmental health for the user?

Energy Resource Center.
Photo: Milroy & McAleer

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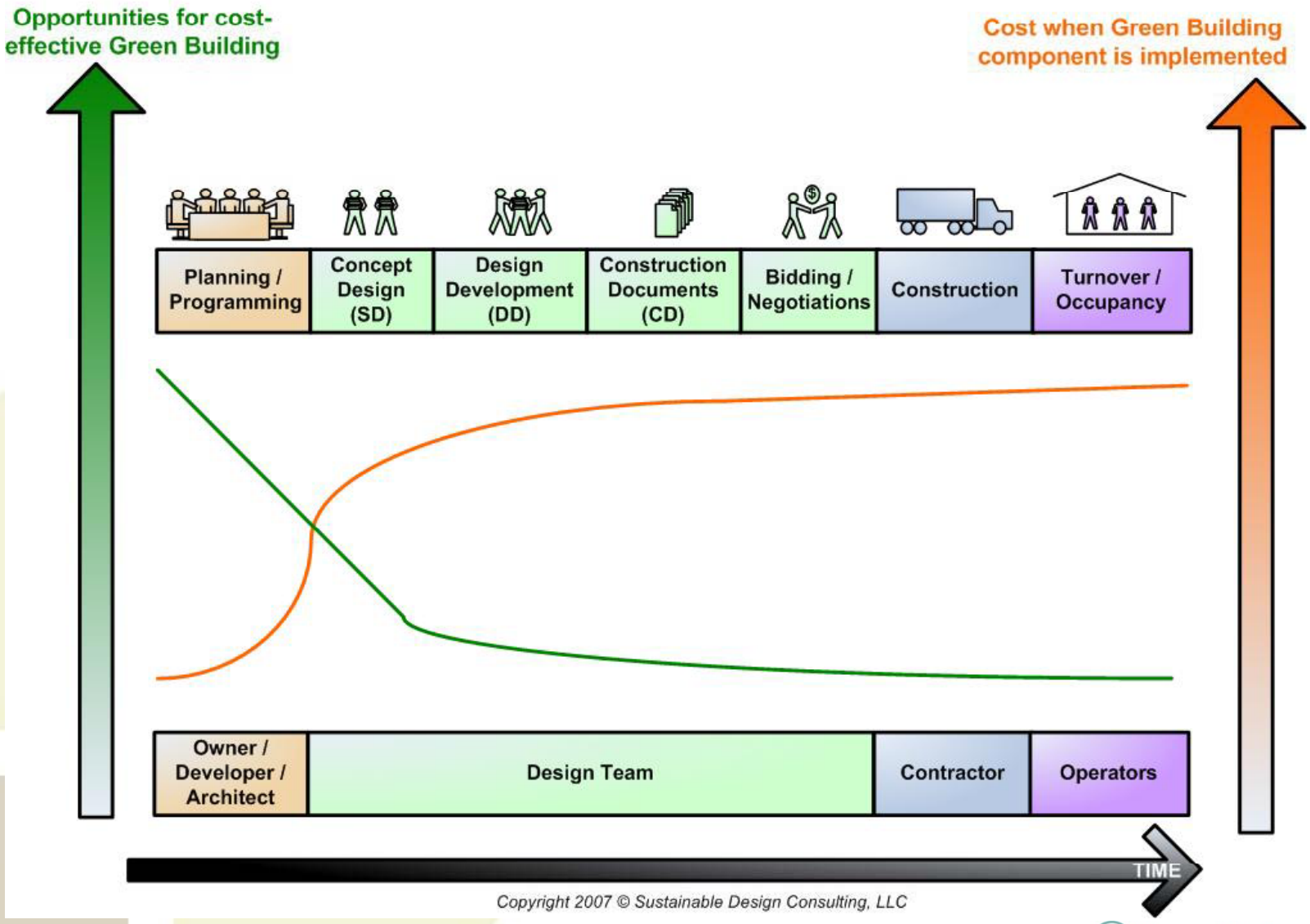
Integrated Design Process: Early Green Decisions = Lower Implementation Costs



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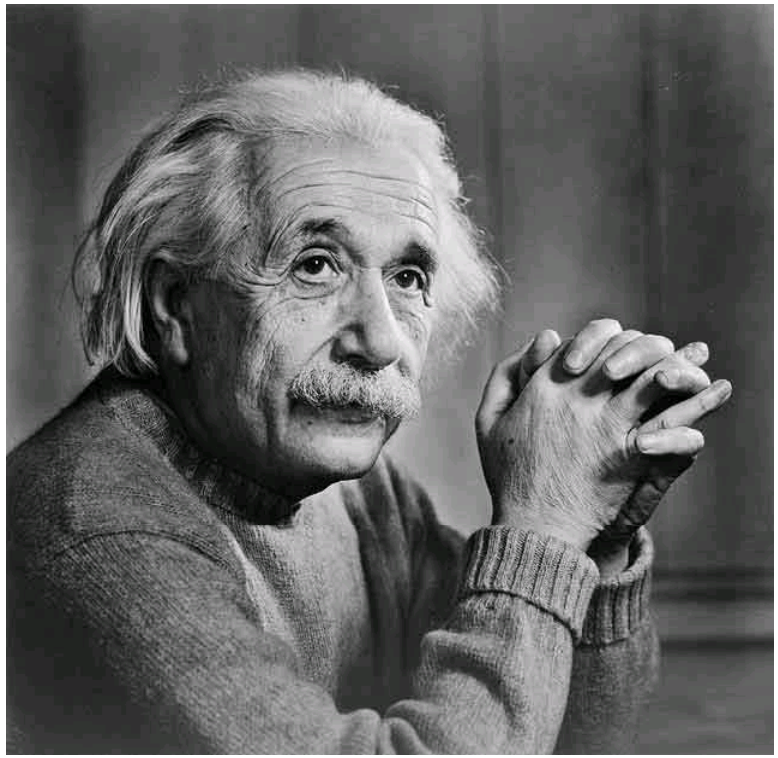

"We can't solve problems by using the same kind of thinking we used when we created them."

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Brief History of USGBC

The U.S. Green Building Council is the nation's foremost coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work.

- Organized in 1993
- LEED 1.0 (1998)
- LEED 2.0 (2000)
- LEED 2.1 (2002)
- LEED-NC 2.2 (2005)
- LEED-CI (2005)
- LEED-CS (2006)
- LEED-S (2007)
- LEED-Homes (2008)
- LEED 2009 & v3

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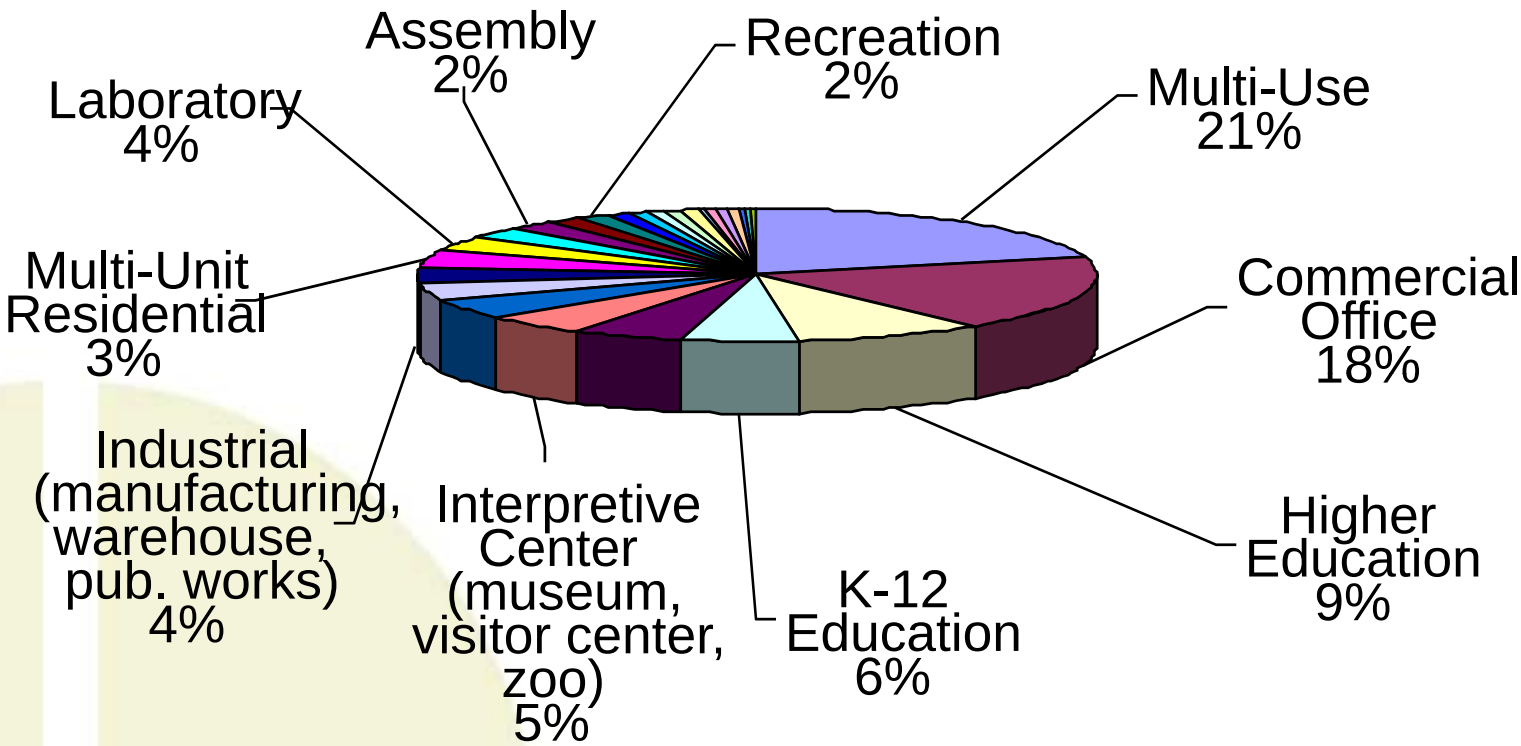
The Purpose of LEED®



- Limit 'greenwashing'
- Stimulate green competition
- Define 'green' by providing a standard of measurement
- Promote whole building integrated design process
- 3rd party verification

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Put LEED into Perspective

LEED Is . . .

- A means to an end.
- A measure of the achievement.
- A widely accepted benchmarking tool.
- Voluntarily performance standard
- A tool

LEED Isn't . . .

- The end in itself.
- The achievement itself.
- Perfectly applicable to all project scenarios.

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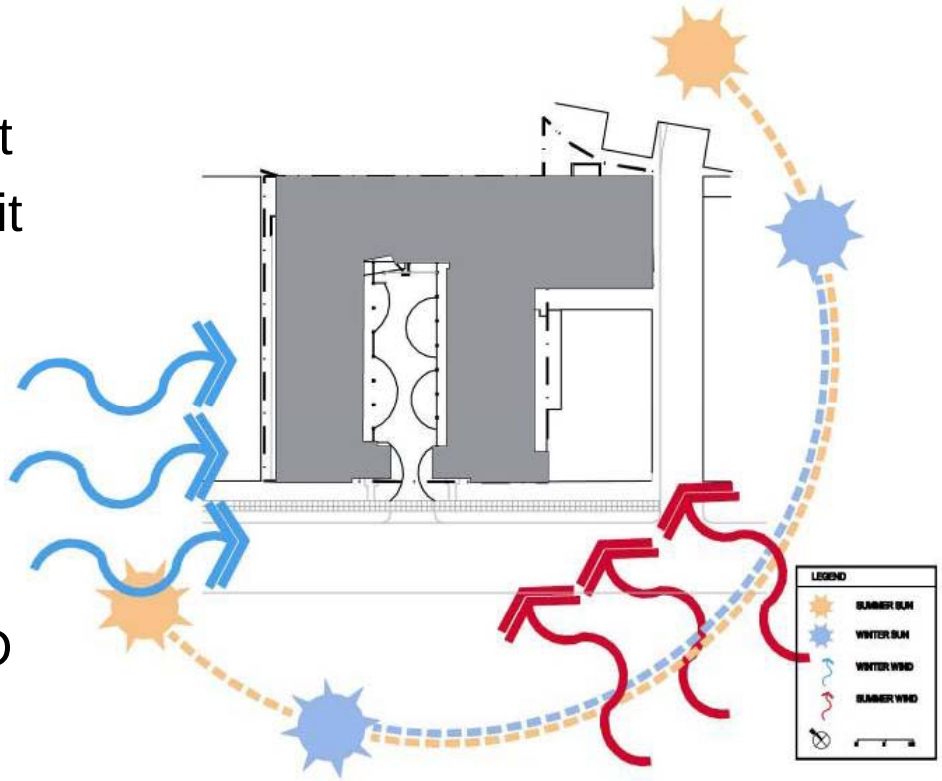
LEED Imperfections

- Weighs all strategies equally…
  - Cost to capture credit
  - Environmental benefit
- Regionally appropriate strategies
- Naturally ventilated buildings
- Life cycle analysis
- Building types and LEED



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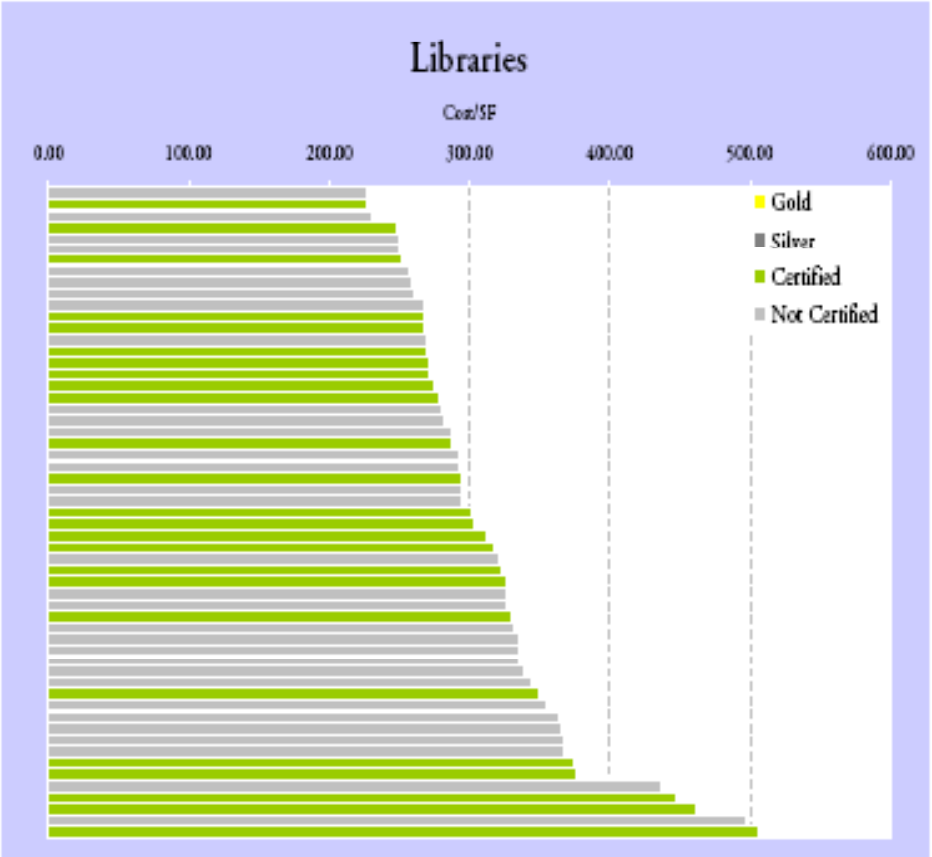
What do LEED-Certified Buildings Cost?

Cost of Green Revisited – Davis Langdon; 2007

- "…there is no significant difference in average cost for green buildings as compared to non-green buildings."
- Construction costs have risen dramatically, but projects are still achieving LEED
- The idea that green is an added feature continues to be a problem



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Where LEED Should and Shouldn't Cost More

LEED should cost more:

- Time spent up front in goal setting and team coordination.
- Time spent in the Learning Curve, if applicable.
- Hard first costs for systems and materials with high return on investment.

LEED shouldn't cost more:

- Time spent at the end "adding" green design to the project, redoing work because of poor communication or reinventing the documentation.
- Hard first costs for systems and materials with low return on investment.
- Operating expenses should be *less.*

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Meet the LEED Family

Current:

- **LEED-NC**: LEED for New Construction & Major Renovation (version 2.2)
- **LEED-CI**: LEED for Commercial Interiors (version 2.0)
- **LEED-CS**: LEED for Core & Shell Development (version 2.0)
- **LEED-EB**: LEED for Existing Buildings (version 2.0)
- **LEED-S**: LEED for K-12 Schools
- **LEED-H:** LEED for Homes

Pilots & Drafts:

- **LEED-ND:** LEED for Neighborhood Development
- **LEED-Retail:** LEED for Retail
- **LEED 2009**

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LEED-NC

New Construction and Major Renovations

- Basis for initial LEED system
- Structure, envelope and building-level systems
- Owner controls interior fit-out

One & Two Potomac Yard,
Davis Carter Scott Architects

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LEED-CS

Core and Shell Development

- Structure, envelope and building-level systems
- Owner does not control fit-out
- Similar to NC, less to evaluate
- Tenant Guidelines
- Pre-Certification

318 National Business Park SmithGroup

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LEED-CI

Commercial Interiors

- Tenant improvement (office, retail, institutional)
- Interior renovations
- Complement to LEED-CS

Different from NC

- Less emphasis on site credits
- Tenant lease
- Furniture and Equipment are included
- Energy analysis

USGBC Headquarters

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LEED-EB

Operation and upgrades of existing buildings

- Certify the operation and maintenance of the building
- Must include 100% of floor area
- Performance Period
- New Prerequisites
  - Asbestos & PCB abatement
- New Credits
  - Green Cleaning
  - Building Operation & Maintenance
- ENERGY STAR
- Re-certification required every 5 years

Pentagon Wedge 3

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LEED-S

New Construction and Major Renovations of K-12 School Facilities

- Structure, envelope and building-level systems
- Owner controls interior fit-out
- Different from NC
  - classroom acoustics
  - master planning
  - mold prevention
  - environmental site assessment

Laurel Beltsville Elementary School

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LEED-H

Single and Multi-family Homes

- Market-rate and Affordable Housing
- LEED for Homes Provider program
- Integrated Project
- ENERGY STAR
- Adjusts point requirements based on project size

Pleasant Hill Home Taggart Construction

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LEED-ND

Neighborhood Development Projects

- Smart growth and new urbanist best practices
- Promotes location and design of neighborhoods that reduce vehicle miles traveled
- Focus on site design instead of building design
  - Site Density
  - Mix of uses and housing types
  - Street and sidewalk design

Source: Natural Resources Defense Council

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LEED "Applications/ Adaptations"

LEED Market Sector Rating Systems:

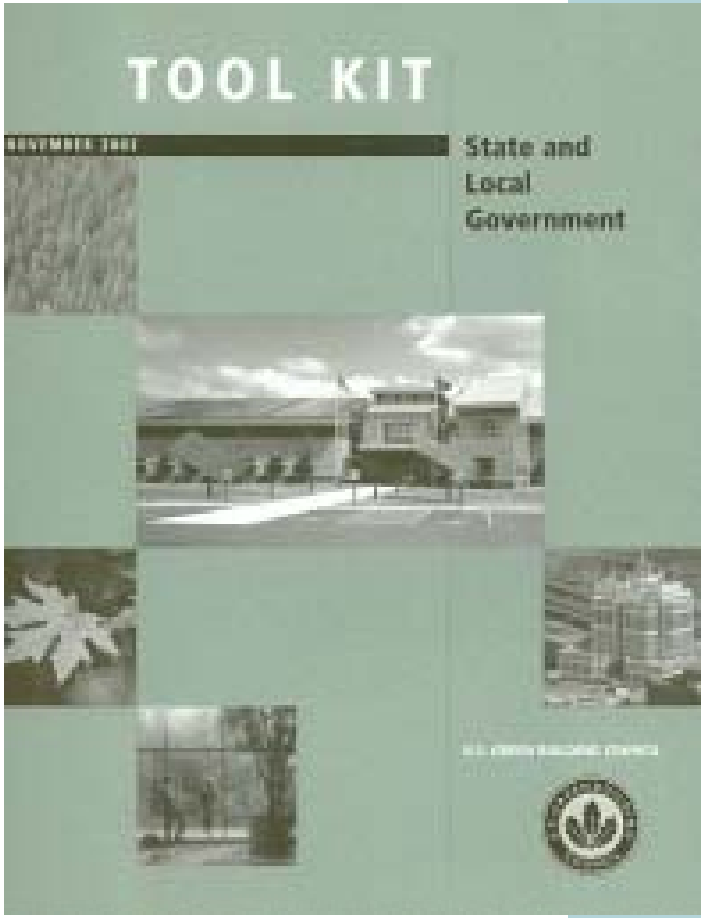
- LEED for Retail
- LEED Application Guide for Lodging
- LEED Multiple Buildings
- LEED for Healthcare

Guides in Progress/ Upcoming:

- LEED for Laboratories

State/ Local LEED Adaptations:

- Portland-LEED
- LEED-BC
- LEED-DC?



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Project Certification and Accreditation

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Why Certify your Building

LEED recognizes Quality Buildings and Environmental Stewardship

- Qualify for growing array of state and local government incentives
- Contribute to growing knowledge base
- LEED certification plaque
- Official certificate
- Marketing exposure through USGBC Web site, case studies, media announcements
- Bragging rights
- Process discipline

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4 Levels of Certification

	LEED-NC	LEED-CS	LEED-CI	LEED-EB
Prerequisites*	7	7	6	14
Certified	26	22	21	32
Silver	33	29	27	40
Gold	39	34	32	48
Platinum	52	45	42	64
TOTAL Possible	69	61	57	83

** All LEED projects registering after June 26, 2007 are required to achieve at least two (2) Optimize Energy Performance points*

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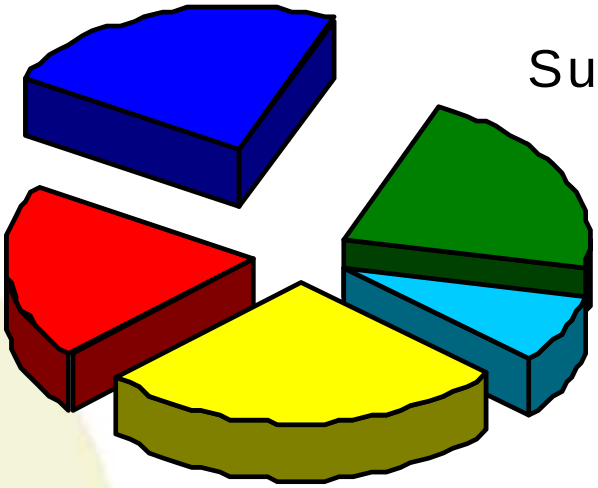
LEED-NC Categories

Indoor Environmental Quality
15 pts; 23%



Sustainable Sites
14 pts; 22%

Materials & Resources
13 pts; 20%

Water Efficiency
5 pts; 8%

Energy & Atmosphere
17 pts; 27%

+ Innovation & Design Process
5 Pts

(Incl. 7 Prerequisites)

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LEED Certification Process

A three step process :

- Step 1: Project Registration

ACCOUNT/LOGIN INFORMATION

* Indicates a Required Field

I already have a USGBC Web site account.

NOTE: If you already have an account, only enter your email address and password (twice). Do not complete the remainder of this section.

Create a new USGBC Web site account.

* Email Address

* Password Forgot your password? Click here

* Password (Verify)

* First Name | * Last Name | * Title | * Company Name

* Street Address 1 | Street Address 2 | * Corporate Access ID (If Applicable)

* City | * State/Province *(US/Canada)* | * Zip Code | * Country | * Job Title

* Phone | * Phone | * Industry Sector | * Referral

PROJECT TYPE

* Indicates a Required Field

RATING SYSTEM TYPE	MEMBER PRICE	NON-MEMBER PRICE
LEED FOR NEW CONSTRUCTION v2.2	$450	$600
LEED FOR EXISTING BUILDINGS v2.0	$450	$600
LEED FOR COMMERCIAL INTERIORS v2.0	$450	$600
LEED FOR CORE AND SHELL v2.0	$450	$600
LEED FOR SCHOOLS v2.0	$450	$600

Please select a project type and indicate whether you are a USGBC National Member to determine your registration fee.

* Select a Rating System Type

* Are you a member of USGBC?

$0.00

Amount Due

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LEED Certification Process

A three step process:

Step 2: Design

- Join the LEED Online Project Team

From: leed@usgbc.org Sent: Fri 6/23/2006 2:30 PM
To: kara@sustaindesign.net
Cc:
Subject: You Have Been Invited To Join A LEED Registered Project

Kara Strong, project team administrator for the LEED NC 2.2 project Howard Hughes Medical Institute - Headqu, has invited you to be a project team member. To join the project, please follow these steps:

1. Go to the USGBC web site at www.usgbc.org and go to "Your Account".
2. Login to the web site with your email address and password or follow the instructions on the page to register a new account.
3. Once logged in, click on "Access & Memberships" and then "Project Access" on the side menu.
4. On the "Project Access" page enter the following project Access ID code in the "Access Code" box and then click "Add Project": [redacted]

Please alert your project team administrator once you have joined. They will then assign you a team role in LEED Online located at leedonline.usgbc.org.

If you have any questions on the above steps, please contact LEED Staff at leedinfo@usgbc.org.

LEED Certification Process

A three step process:

Step 2: Design

- Reference Guide & Credit Rulings

CREDIT INTERPRETATION DETAILS

SUSTAINABLE SITES: Site Selection (SSc10)

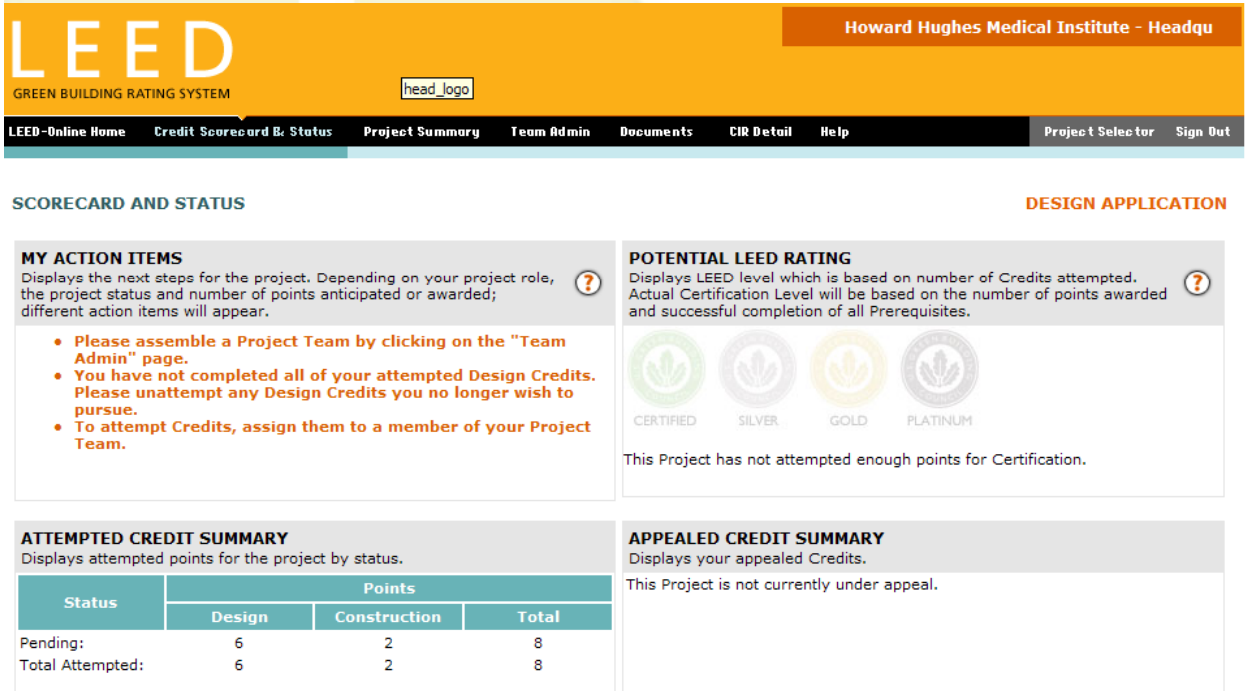
9/1/2005 -	**Credit Interpretation Request** TOPIC: 100' WETLAND CRITERION Regarding the wetland criterion for this credit, the LEED-NC 2.1 Reference Guide states that no "buildings, roads or parking areas" are permitted to be developed within the wetland zone. However, the recently published LEED-NC 2.1 Audited Credit Requirements and the CIR ruling from 7-21-03 both refer to "buildings" only with no mention of roads or parking. Our project is a corporate campus consisting of three buildings on a large site. The site is bisected by five drainage ways and associated wetland systems. The buildings and parking areas have been kept clear of the 100' wetland zone (including the master planning of possible future buildings and parking.) However, road infringement on this zone was unavoidable for access to the site. Furthermore, the entry location to the site was mandated by the Virginia Department of Transportation. Meanwhile, the project implemented a number of strategies to provide and protect wetland areas. Although we understand that created wetlands are not adequate substitutes for disturbed areas, we believe that the project strategies meet the intent of this credit. These strategies include re-vegetating over 2.5 acres of existing emergent wetlands and creating over 5.6 acres of forested wetlands onsite. The project also restored a minimum 50' riparian buffer along over 1,500 linear feet of stream channels disturbed by timbering activities under previous ownership. Finally, the project dedicated approx. 9.7 acres of wetlands onsite to a Conservation Easement to be protected from development for perpetuity. Considering the careful wetland strategies, will our project be disqualified for the road location?
9/19/2005 -	**Ruling** Locating a road within 100' of a wetland area disqualifies your project from achieving this credit. The credit's requirement language is clear that this standard be applied to "buildings, roads, or parking areas." The CIR ruling that you cite, dated 7/21/03, does not address roads because roads were not included in the question asked. This should not be interpreted to mean that roads or parking areas are exempt from credit requirements. The recently published LEED-NC 2.1 Audited Credit Requirements does not state that roads are exempt. This credit ruling is also supported by CIR rulings dated 4/17/03, 5/3/05 and 7/21/2003. The restoration strategies your team has taken are commendable and you should consider their applicability to credit 5.

LEED Certification Process

A three step process:

Step 3: Building Certification in LEED Online

- Design & Construction Reviews
  - All Prerequisites
  - All Points Captured
  - Project Description
  - Drawings and Photos



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LEED-Online Credit Documentation

LEED-NC
LEED FOR NEW CONSTRUCTION

LEED-NC 2.2 Submittal Template
SS Credit 4.2: Alternative Transportation:
Bicycle Storage & Changing Rooms

design

(Responsible Individual) (Company Name)

I, _____, from _____

verify that the information provided below is accurate, to the best of my knowledge.

SELECT OPTION

Please select the appropriate compliance path (this will activate the remainder of the submittal form)

- ○ **Option 1 - Non-Residential Projects:** Provide secure bicycle racks or storage for 5% of building users AND provide shower and changing facilities for 0.5% of Full Time Equivalent (FTE) Occupants.
- ○ **Option 2 - Residential Projects:** Provide covered bicycle storage facilities for 15% or more of building occupants.
- ○ **Option 3 - Mixed Residential & Nonresidential Projects:** Provide covered bicycle storage facilities for 15% or more of residential occupants, and provide secure bicycle racks or storage for 5% of non-residential building users. Provide shower and changing facilities for 0.5% of non-residential Full Time Equivalent (FTE) Occupants.

CREDIT COMPLIANCE

The project site plan(s) and floor plan(s) have been uploaded. The drawing(s) show the location of bicycle racks and/or storage areas and shower/changing facilities (as applicable).

Sheet Description Log

Please include sheet name, sheet number and file name for each uploaded, referenced drawing (e.g. A-101, Site Plan, siteplan.p

☐ I have provided the appropriate supporting documentation in the document upload section of LEED Onlin
Please refer to the above sheets.

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LEED-Online Credit Review

Respond to USGBC comments

CREDIT TEMPLATE

Displays information on credit template status and documents uploaded. Only the team member associated with credit can upload information.

Template Status:	Last Updated on 3/18/2008
Manage Template:	DOWNLOAD TEMPLATE Get Adobe Reader Note: LEED-Online requires Acrobat Reader or Professional 7.0.9 or newer. To allow any Template Download, pop-up blockers must be turned off for the LEED-Online web site. Click here for instructions on how to turn off pop-up blockers.
Required Documents:	Document Name: Other Documentation Uploaded Documents: Document Name Browse... Upload Cancel Note: LEED-Online accepts the following file types: PDF, JPG, JPEG, GIF, TIF, BMP, PNG, DWF, DFW, XLS, DOC, TXT, ZIP
Documentation Status:	Not Yet Complete
	Mark As Complete

REVIEW COMMENTS

Construction Application Review:	The Submittal Template and water use calculation declare that, based on tenant occupancy requirements, the project has reduced potable water use by 36.56% from the calculated baseline design fixture performance requirements established by the Energy Policy Act of 1992 for two points. However, females are not included in the calculation for the flush fixtures. Unless special conditions exist, projects should assume a 50 / 50 male / female ratio.
	TECHNICAL ADVICE: Please provide a revised LEED Submittal Template and water use calculation that includes the water closet for females.

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LEED Process

- Team submits Design Phase documentation
  - USGBC provides *Preliminary Review*. Each credit is assigned *Anticipated*, *Clarified*, or *Denied*
  - Team provides supplemental information
  - USGBC provides *Final Review*
- Team submits Construction Phase documentation
  - Same review process as in design: review, respond, award
- Team may appeal after either phase

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The LEED Process Takes a Team

Owner: Raise and enforce expectations of team and its product.

Design Team: Design green and keep LEED criteria on the front burner.

LEED Coordinator: Integrate with and support team's efforts while tracking compliance with LEED and other green criteria.

General Contractor: Rise to the occasion of building green and educate subcontractors.

Commissioning Authority: Help ensure Owner's requirements are met.

Facility Manager: Help ensure that the building *stays* green.

Realtor/Leasing Agent/Lender: Understand and communicate the value of green buildings to potential tenants or future Owners.

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Tools for Capturing Credits

- Green Workshop
  - Define goals with the project team
- Assign Green Champion
  - LEED AP or another with experience
- Develop and Maintain a LEED tracking tool
  - Monitor progress throughout Design & Construction
  - Assign Responsibilities to the Project Team
- Develop Division 1 specifications
  - Includes LEED credit goals
  - Specifies LEED documentation requirements

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USGBC Resources

- LEED Reference Guide
- USGBC Web site http://www.usgbc.org
- LEED Certification Process: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=64&
- Project registration application: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=65&
- LEED Credit Templates: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221&
- LEED Online: http://leedonline.usgbc.org
- Credit Interpretation Requests Process: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=168&

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Online Green Resources

- Environmental Building News: *http://www.buildinggreen.com*
- The Costs and Financial Benefits of Green Buildings: *http://www.usgbc.org/Docs/News/News477.pdf*
- Oikos (green building resource and articles): *http://www.oikos.com*
- Denver AIA (green product resource): *http://www.aiacolorado.org/SDRG/home.htm*
- Department of Energy (energy efficiency): *http://www.eere.energy.gov/EE/buildings.html*
- BEES (tool for selecting green building products): *http://www.bfrl.nist.gov/oae/software/bees.html*
- Whole Building Design Guide (green design information): *http://www.wbdg.org*
- Healthy Building Network (information, Pharos Project LCA) *http://www.healthybuilding.net*

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LEED Accredited Professional

Must Pass the LEED Professional Accreditation exam:

- LEED-NC v2.2
- LEED-EB v2.0
- LEED-CI v2.0

Responsibilities:

- Provides guidance to team on achieving LEED credits
- Raise team's awareness of integrated design and LEED process
- Does NOT sign off on submittal templates
- Does NOT certify project
- Is NOT required for LEED certification

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Exam Details

- Computer based exam
- 80 multiple choice questions with 1-3 answers
  - Questions are tricky, tough, realistic
  - No partial credit allowed
  - All questions are equally weighted
- Score 170/200 to pass
  - Suggests 48/80 correct answers are required
- 2 hours allowed
- Exam costs: $300 members / $400 non-members
- Schedule exam at: www.gbci.org

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LEED AP Exam: 4 Sections

1. Knowledge of LEED Credit Intents and Req'ts.
   - Tests understanding of the credit

2. Coordinate Project and Team
   - Gather all project information and requirements to support the LEED process
   - Interdependence of team members' work

3. Implement LEED Process
   - Manage LEED documentation/certification process

4. Verify, Participate In, and Perform Technical Analyses Required for LEED Credits
   - Determine if the credit requirements have been met

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What to Study

- LEED-NC 2.2 Reference Guide
- LEED-NC 2.2 Letter Template Renders
- LEED Website
- Credit-NC 2.2 Rulings
  - Understand the credit intent

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Lessons Learned

The exam focuses upon what you need to know to design, construct and document a LEED certified building

- Read the Reference Guide; especially the strategies section
- Know the documentation and calculation requirements
- Know which green strategies lead to what LEED credits
- Know in which phase to incorporate credit requirements into the project
- Be familiar with ASHRAE and other referenced standards
- The Credit Rulings might help clarify intent
- Read all questions thoroughly and slowly, sometimes the obvious answer is incorrect

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Exam Review

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Exam Question 1:

A proposed 40,000 sf building with five equal floors is located within a university campus with no zoning requirements. In order to achieve SS Credit 5.2, Site Development: Maximize Open Space the vegetated open space area adjacent to the building must be _____ sf.

A. 2,500
B. 5,000
C. 7,500
D. 8,000
E. 20,000

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Exam Question 2

A value engineering exercise has proposed that exterior horizontal louvers above south-facing windows will be deleted from the project. The change requires that various project team members review strategies and reconfirm calculations for several credits. Which three credits would be affected by this decision? (Choose three)

A. EA Credit 6, Green Power

B. SS Credit 7.1, Heat Island Effect: Non-Roof

C. EA Credit 1, Optimize Energy Performance

D. EQ Credit 1, Outdoor Air Delivery Monitoring

E. EQ Credit 8.1, Daylight and Views: Daylight 75% of Spaces

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Exam Question 3

Which LEED-referenced standard includes a volatile organic compound (VOC) limit for waterproofing sealers? (Choose one)

A. Green Seal Standard GS-11, Paints

B. Green Seal Standard GS-03, Anti-Corrosive Paints

C. Bay Area Air Quality Management District Regulation 8, Rule 51

D. South Coast Air Quality Management District Rule 1168, Architectural Coatings

E. Ozone Transport Commission, 2006 Control Measures

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Exam Question 4

A project involves the renovation of an existing commercial office building, which includes 4 of 10 stories and the entire core and shell. Project scope includes window replacement, HVAC equipment replacement, plumbing replacement and tenant fit-out of the 4 stories. Which rating system product(s) should be used for this project? (Choose one)

A. LEED for New Construction

B. LEED for Existing Buildings and LEED for Commercial Interiors

C. LEED for Commercial Interiors and LEED for Core and Shell

D. LEED for Core and Shell and LEED for Existing Buildings

E. LEED for Commercial Interiors

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Exam Question 5

Which three are true statements about the LEED certification process? (Choose three.)

A. No credits are awarded during a Design Phase Review

B. Appeals may only be filed following a Construction Phase Review

C. LEED certification may be awarded following a Design Phase Review

D. Additional information must be submitted during the Construction Phase Review for any Design Phase attempted credits that have changed

E. New Design credits can be submitted for the Construction Phase Review

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Exam Question 6

A LEED-registered project has a complex issue, which makes the project non-compliant with an aspect of a particular credit's requirements as written. Furthermore, that credit's submittal template does not address the issue within its own format. What should the responsible party do? (Choose one)

A. Contact USGBC review team directly to resolve the issue with appropriate documentation

B. Provide a separate narrative explaining the complex issue and how the credit intent is met

C. Complete the submittal template as though all aspects of the credit's requirements are met as written and submit for review

D. Use the alternative compliance path option on the LEED submittal template and provide a narrative and appropriate documentation demonstrating compliance

E. Copy the approach of another project's Credit Interpretation Ruling on an unrelated complex issue

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Exam Question 7

For a 200-occupant, all-residential condominium, the architect's plan indicates the use of bicycle racks that hold 10 bicycles inside the parking structure. What must the architect do to comply with SS Credit 4.2, Alternative Transportation: Bicycle Storage & Changing Rooms? (Choose one)

A. Replace the bicycle racks with bicycle lockers

B. Increase the number of bicycle racks to hold 30 bicycles

C. Provide two shower/changing rooms in the parking structure, one for each gender

D. Confirm that the bicycle storage location is within 200 yards of the building entrance

E. Provide one shower/changing room available to all occupants in the building

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Exam Question 8

A building is undergoing a major renovation and expansion. The addition is 1.5 times the square footage of the existing building. To achieve MR Credit 1, Building Reuse, what existing surface area information must be available to document compliance with this credit? (Choose three)

A. Window assemblies

B. Exterior skin and framing

C. Landscaped area to be retained

D. Structural floor and roof decking

E. Mechanical, electrical, and plumbing equipment

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Exam Question 9

The civil engineer determines that 68% of the site is pervious and that it has a pre-development discharge rate of 100 cfs and has a pre-development site run-off quantity of 10,000 gallons. What post-development discharge rate and run-off quantity would meet the requirements of Sustainable Sites Credit 6.1: Stormwater Quantity? (Choose one)

A. 25 cfs, 2,500 gallons

B. 125 cfs, 12,500 gallons

C. 75 cfs, 7500 gallons

D. 100 cfs, 10,000 gallons

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Exam Question 10

A men's bathroom has ultra low flow lavatories, low-flow toilets, and waterless urinals. Assuming regular occupant usage for a men's bathroom, how many times will each occupant use the bathroom fixtures per day? (Choose one)

A. 1 use of the low-flow toilet, 3 uses of the waterless urinal, 4 uses of the lavatory

B. 1 use of the low-flow toilet, 2 uses of the waterless urinal, 3 uses of the lavatory

C. 2 low-flow toilet, 1 use of the waterless urinal, 3 uses of the lavatory

D. 1 use of the low-flow toilet, 4 uses of the waterless urinal, 2 uses of the lavatory

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Q&A

?

?

?

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Part 1
Introduction to the LEED Process

Thank you!

Thomas A .Fisher, AIA, LEED AP
tom@sustaindesign.net

Sustainable & Smart
ecobuild® fall
Sustainable, Green and High Performance Solutions for the Built Environment

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Part 2
Sustainable Sites and the LEED Process

Presented by:

Thomas A .Fisher, AIA, LEED AP
December 10, 2008 10:00 - 11:00

Sustainable & Smart
ecobuild fall
Sustainable, Green and High Performance Solutions for the Built Environment

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Part 1 - Introduction

Sustainable Design Consulting

- Offices in Washington, DC and Richmond, VA
- Small woman-owned business
- Focus on green solutions for the built environment
- Consulted on over 200 LEED projects,
- Commercial, institutional, multi-family, greater-DC-area and Central Virginia
- Project consulting mostly to Developers/Owners and Architects

What we do

- Green Building Project Management
- Drawing & Spec Review
- LEED advisory
- Lectures, Workshops & Trainings
- Design Guidance and Research

www.sustaindesign.net

Eastern Village Cohousing

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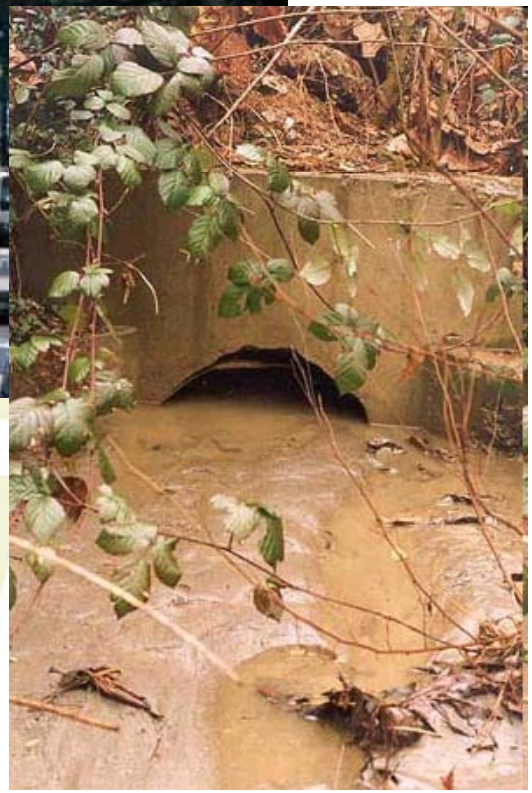
Why Green Building ?



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Why Green Building ?

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Outline

- Part I – Introduction
  - Impact of Buildings
  - Benefits of Green/Integrated Design
  - Overview and History of LEED
  - LEED Standards
  - Cost of LEED
  - Project Certification & Accreditation
  - Resources & Website
  - Questions, Discussion
- Part 2 – Sustainable Sites
- Part 3 – Energy & Atmosphere
- Part 4 – Materials & Resources
- Part 5 – Indoor Environmental Quality
- Part 6 – Water Efficiency, Innovation in Design, Exam Review, LEED 2009

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Part 2
Sustainable Sites

LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

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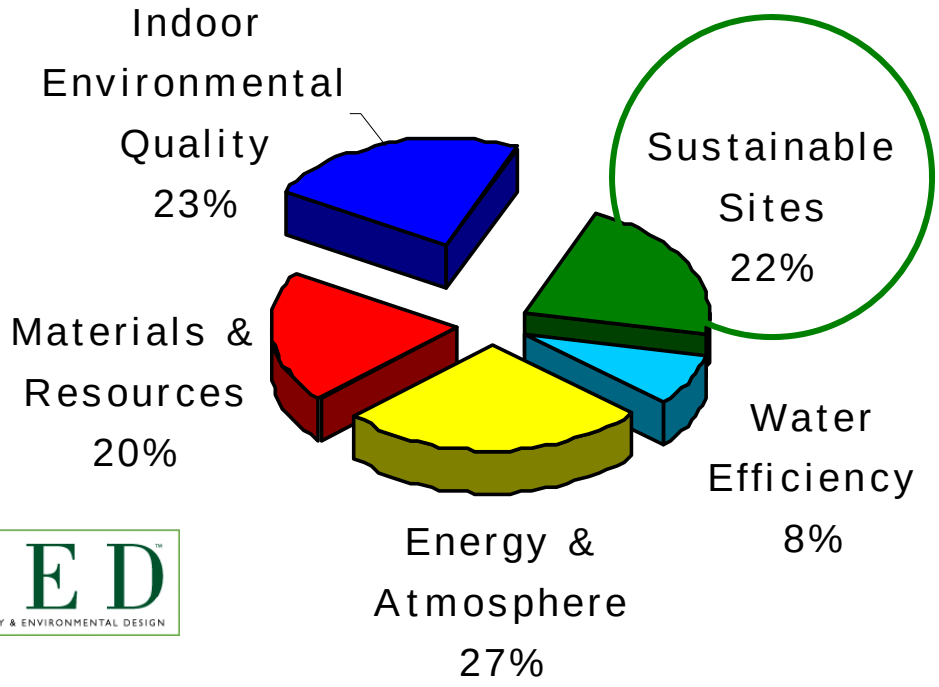
Part 2
Sustainable Sites

Sustainable Sites
- Overview of section
- Review credit
- Discuss trickier credits



+ Innovation & Design Process

LEED Categories: Sustainable Sites (SS) Overview

Intent: Select sites that reduce the need for cars, sprawl, re-uses existing infrastructure, and minimize project impact on surrounding areas after construction

- Prerequisite - Construction Activity Pollution Prevention
- Credit 1 - Site Selection (1 point)
- Credit 2 - Development Density & Community Connectivity (1 point)
- Credit 3 - Brownfield Redevelopment (1 point)
- Credit 4 - Alternative Transportation (4 points)
- Credit 5 - Site Development (2 points)
- Credit 6 - Stormwater Management (2 points)
- Credit 7 - Heat Island Effect (2 points)
- Credit 8 - Light Pollution Reduction (1 point)

TOTAL AVAILABLE: 14 points

Green Grid™ by Weston Solutions

Synergy: Green roofs contribute to Credits 5, 6 & 7

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SSp1: Construction Activity Pollution Prevention

Intent: Reduce pollution during construction by controlling soil erosion, waterway sedimentation & airborne dust generation.

Required: Create & implement an Erosion & Sedimentation Control (ESC) plan.

Submittals: Construction Submittal

- Signed LEED Submittal Template
- Drawings to document ESC measures implemented
- Confirmation of compliance path (National Pollution Discharge and Elimination System [NPDES] or Local)
- Describe ESC measures implemented

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SSp1: Construction Activity Pollution Prevention

Strategies:

- Control Technologies include Stabilization &/or Structural Control
- Stabilization: Planting fast-growing grass or permanent trees/shrubs or placing mulch or gravel to cover and hold soil
- Structural Control: Constructing Earth Dikes, Silt Fences or Ponds OR excavating ponds to create an Earthen embankment to allow for settling of sediment

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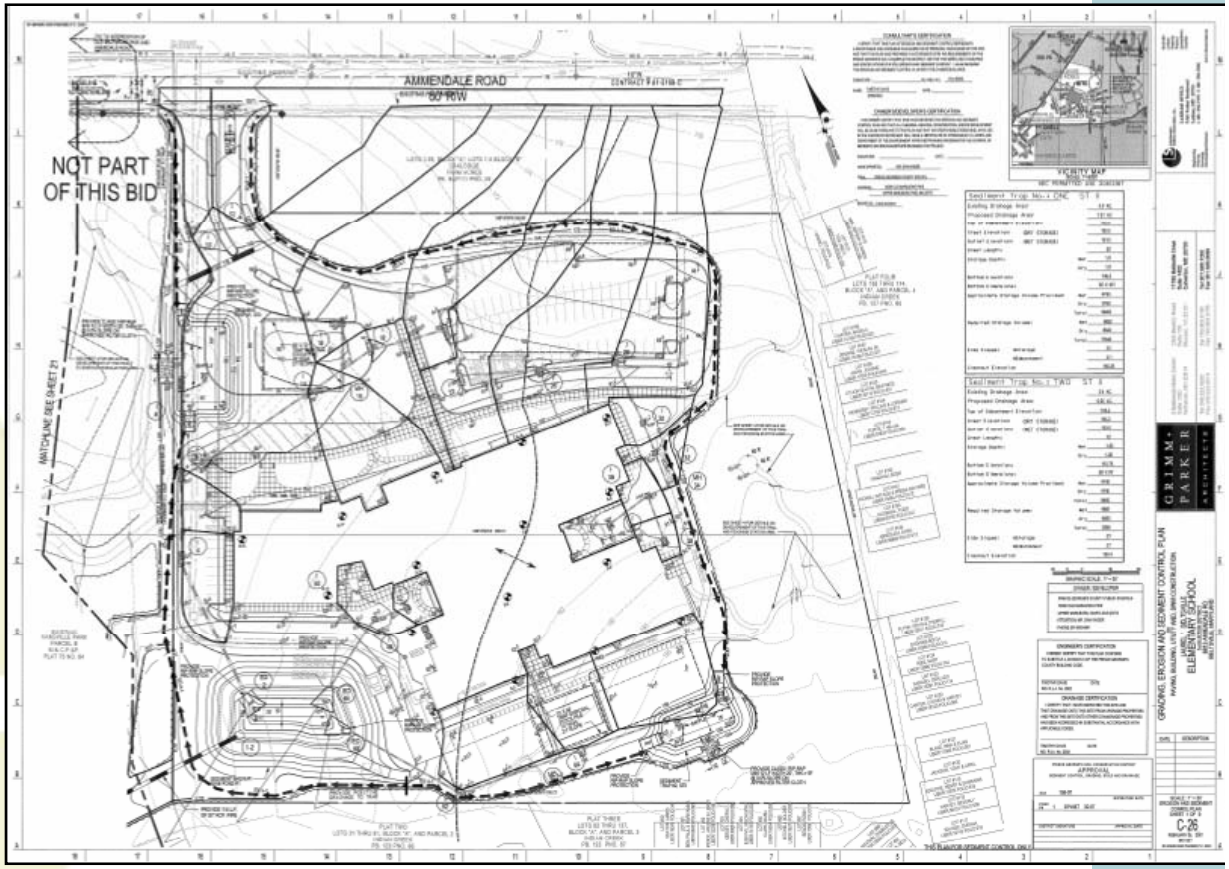
SSp1: Construction Activity Pollution Prevention

What do you look for in the Civil drawings to review for credit compliance?

- Erosion and sedimentation controls
- NPDES or Local storm water pollution prevention regulations



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SSc1: Site Selection

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

Required: Do not locate buildings…

- On prime farmland (defined by USDA)
- On undeveloped land < 5’ above 100-year flood (by FEMA)
- On habitat for endangered/threatened species
- Within 100’ of wetland (40 CFR Part 230-233)
- On undeveloped land within 50’ of a water body (by Clean Water Act)
- On Public Parkland, unless land is accepted for trade

Submittal: Design Submittal

Signed LEED Submittal Template

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SSc1: Site Selection

Do not build on or near:

On undeveloped land < 5’ above 100-year flood

Within 100’ of wetland

On habitat for endangered/threatened species

On prime farmland

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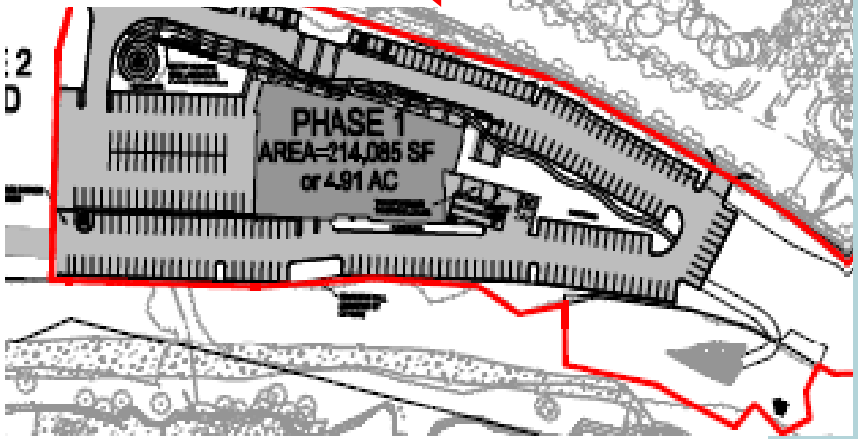
SSc1: Site Selection

Please confirm compliance with <u>all five</u> criteria <u>*or*</u> that your project meets the credit intent under special circumstances

- ☒ Prime farmland as defined by the United States Department of Agriculture in the United States Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (citation 7CFR657.5),
- ☒ Land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by the Federal Emergency Management Agency (FEMA),
- ☒ Land which is specifically identified as habitat for any species on Federal or State threatened or endangered lists,
- ☒ Within 100 feet of any water including wetlands as defined by United States Code of Federal Regulations 40 CFR, Parts 230-233 and Part 22, and isolated wetlands or areas of special concern identified by state or local rule, OR greater tha distances given in state or local regulations as defined by state or local rule or law, whichever is more stringent,

Don't check the box

If you're showing a Wetland



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SSc2: Development Density & Community Connectivity

Intent: Channel development to urban areas.

Required:

- Option 1: Develop within an existing development density of 60,000 SF/ acre (2 story), OR
- Option 2: Develop within ½ mi. of a neighborhood with a density of 10 units per acre & within ½ mi. of 10 Basic Services with pedestrian access
  - Count buildings under construction
  - Density Radius = 3 x SQRT(project site in acres x 43,560 SF/acre)
  - Development Density = gross building SF / property acres
- For both options, construct or renovate on a previously developed site

Submittals: Design Submittal

- Signed LEED Submittal Template
- Indicate the project site and building area (sf)
- Site vicinity plan showing project site, and density or community radius

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SSc2: Development Density & Community Connectivity

Exemplary Performance:

- Project density is 2x density of surrounding site area OR
- Development Density in area 2x as large ≥ 120,000 sf/acre

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SSc3: Brownfield Redevelopment

Intent: Rehabilitate damaged sites, preserving undeveloped land.

Required: Develop on a site documented as contaminated by a Phase II Environmental Site Assessment OR local Voluntary Cleanup Program, OR defined as a Brownfield by a local, state or federal agency. Must remediate the contamination

Submittals: Design Submittal

- Signed LEED Submittal Template
- Document the site contamination/classification
- Describe the type of contamination and the remediation efforts (ex situ, in situ)

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SSc3: Brownfield Redevelopment

Develop on a site documented as contaminated by a Phase II Environmental Site Assessment OR local Voluntary Cleanup Program, OR defined as a Brownfield by a local, state or federal agency. Must remediate the contamination

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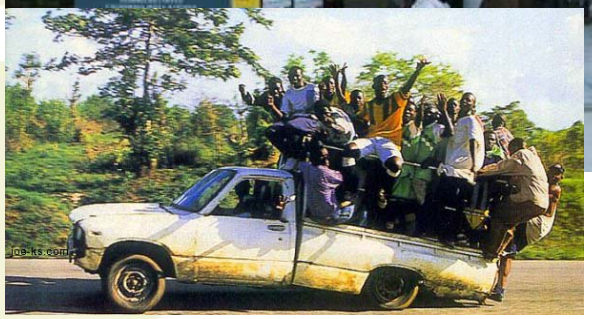
SSc4.1: Alternative Transportation Public Transportation Access

Intent: Reduce pollution from automobile use.

Four possible points from measures aimed at alternative use of automobile.



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SSc4.1: Alternative Transportation Public Transportation Access

Intent: Reduce pollution from automobile use.

Required: Locate project within

- 1/2 mile of existing (or planned & funded) commuter rail, light rail, subway station
- *OR:* 1/4 mile of 2 or more bus lines/stops

Submittals: Design Submittal

- Signed LEED Submittal Template
- Site vicinity drawing
- Highlight building location
- Indicate rail and bus lines and distances between them and the site

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SSc4.1: Alternative Transportation Public Transportation Access

Exemplary Performance :

- Project within ½ mile of at least 2 existing commuter rail, light rail or subway lines
- *OR:* within ¼ mile of at least 2 stops for 4 more public or campus bus lines
- *AND*
- ≥ 200 transit rides/day

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SSc4.1: Alternative Transportation Public Transportation Access

http://www.wmata.com/serviceNearby/default.cfm

Washington Metropolitan Area Transit Authority

Search

ALERTS: There are no service alerts at this time. All Advisories Elevator Status

- Home
- Maps & stations
  - Bus & rail maps
  - Find a stop/station
  - Trip Planner
  - Parking
  - Find service near location
- Schedules & fares
- Alerts & advisories
- Accessibility
- How to travel
- About Metro
- Board of Directors
- General Manager
- Outreach
- Metro calendar

Maps & stations | Find service near location

Find service near a location

The following stops were found near 1600 Pennsylvania Ave NW:

NW H ST & NW Madison PL [0.17 miles away]

How Do I Get Here?

- 11Y Metrobus towards Mount Vernon
- 42 Metrobus towards Metro Center
- G8 Metrobus towards Avondale
- P17 Metrobus towards Fort Washington Park & Ride
- P19 Metrobus towards Fort Washington
- W13 Metrobus towards FT Washington Forest
- X2 Metrobus towards Minn Ave Station
- OmniRide Bus towards Dale City

NW H ST & NW Madison PL [0.17 miles away]

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SSc4.2: Alternative Transportation Bicycle Storage & Changing Rooms

Intent: Reduce pollution from automobile use.

Required:

- For non-Residential: secure bicycle storage for 5% of all building occupants & changing facilities for 0.5% of FTE occupants within 200 yds. of building
- For Residential: covered, secure bicycle storage for 15% of occupants

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SSc4.2: Alternative Transportation Bicycle Storage & Changing Rooms

Submittals: Design Submittal

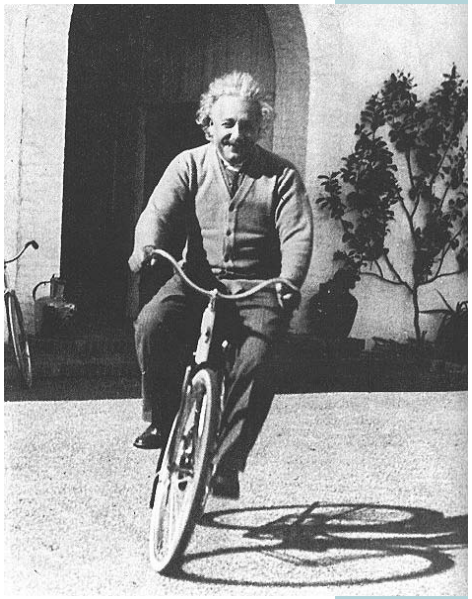
- Signed LEED Submittal Template
- FTE occupancy & Transient occupancy for the project
- Project drawings highlighting locations of bicycle storage & changing facilities

Calculations:

FTE (full-time equivalent) occupants =
Occupant hours / 8

ie. 4 people working 4 hours/day = 2 FTEs

Building users (peak) =
FTEs + transient occupants



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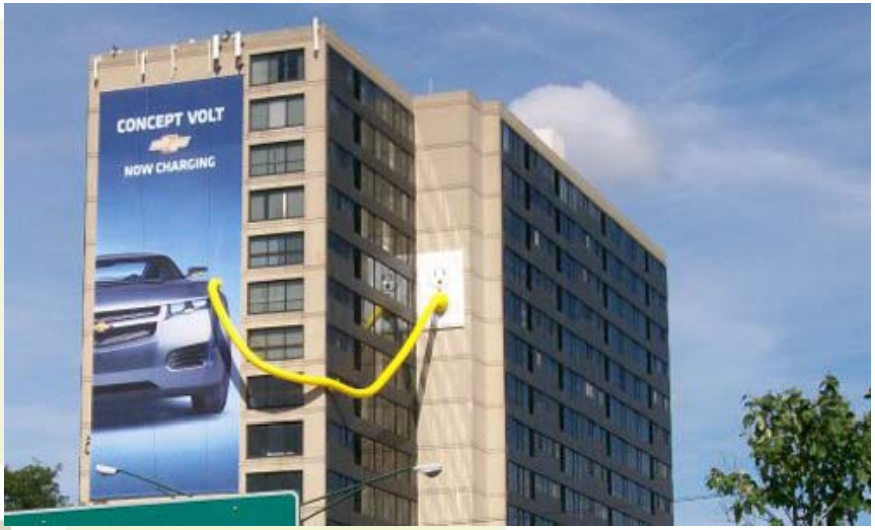
SSc4.3: Alternative Transportation Low Emitting & Fuel Efficient Vehicles

Intent: Reduce pollution from automobile use.



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SSc4.3: Alternative Transportation Low Emitting & Fuel Efficient Vehicles

Required:

- Option 1: Provide fuel-efficient vehicles for 3% of FTE occupants AND preferred parking spaces,
- Option 2: Provide preferred parking spaces for fuel-efficient vehicles for 5% of total parking capacity
- Option 3: Install alternative fuel refueling stations for 3% of total parking capacity

Submittals: Design Submittal

- Signed LEED Submittal Template
- FTE occupancy & total parking capacity
- Drawings highlighting preferred parking or refueling stations quantity, make, model, MFR, & ACEEE score for AFV's (Options 1 & 2)
- *OR:* fuel type, number of stations & fueling capacity (Option 3)

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SSc4.4: Alternative Transportation Parking Capacity

Intent: Reduce pollution and land development impacts from single occupancy vehicle use

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SSc4.4: Alternative Transportation Parking Capacity

Submittals: Design Submittal

- All: Signed LEED Submittal Template
- All: FTE occupancy & total parking capacity
- All: Local parking requirements
- For non-Residential: Number of preferred parking spaces
- For Residential: Description of infrastructure/ programs in place to support ridesharing

Exemplary Performance:

- Implement Transportation Management Plan that demonstrates multiple options to reduce personal auto use

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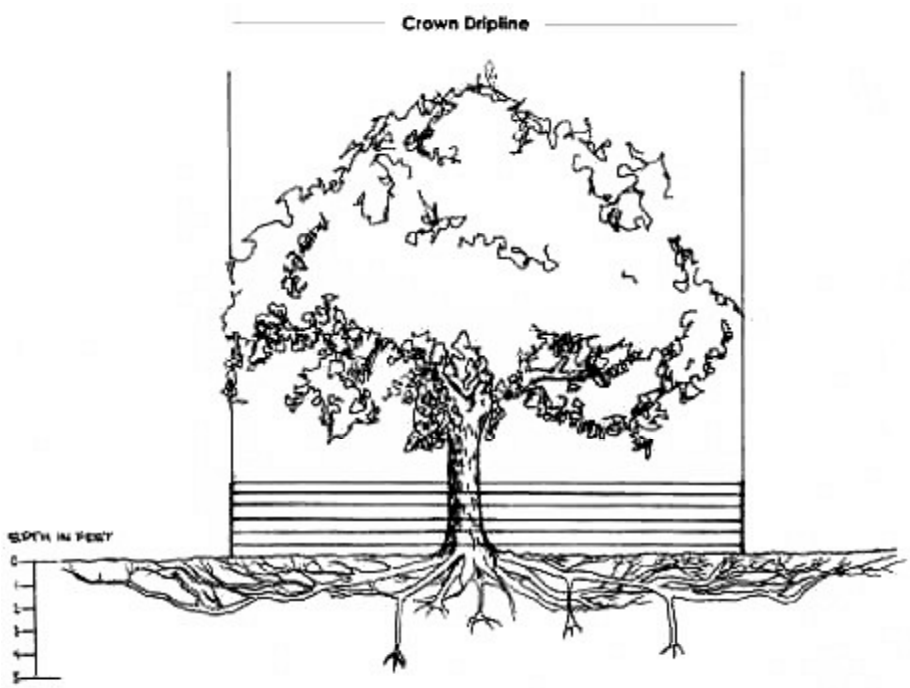
SSc5.1: Site Development Protect or Restore Habitat

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



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SSc5.1: Site Development Protect or Restore Habitat

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

Required:

- For greenfields: Limit site disturbance within
  - 40' of the building,
  - 10' of walkways, patios, parking & facilities,
  - 15' of roadways,
  - 25' of site features
- *OR*: For previously developed sites: Restore 50% of non-building site area with native/adapted vegetation (playfields don't count)
- *OR*: For urban projects earning SSc2 and on previously developed site, vegetated roof area can contribute. Restore 20% of site area with native/adapted vegetation

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SSc5.1: Site Development Protect or Restore Habitat

Submittal: Construction Submittal

- Signed LEED Submittal Template
- Site/grading plans highlighting site disturbance boundaries
- *OR:* the area of the site which has been restored & site/landscape plans showing restored area & planting materials

Exemplary Performance:

- 75% site area restoration/ protection

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SSc5.2: Site Development Maximize Open Space

Intent: Provide open space to promote biodiversity

Required:

- Exceed local zoning for open space by 25%
- *OR:* if no local zoning, designate open space equal to building footprint
- *OR:* if zoning ordinance exists without open space requirements, designate open space equal to 20% of the project site
- For urban projects earning SSc2, vegetated roof area or pedestrian oriented hardscape can contribute
- Wetlands may contribute if slope is < 1:4 & vegetated

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SSc5.2: Site Development Maximize Open Space

Submittals: Design Submittal

- Signed LEED Submittal Template
- Project site and building footprint areas
- Site/landscape drawings highlighting open space
- Area of open spaces required and provided (sf)

Exemplary Performance:

- Provide 2x required open space

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SSc6.1: Stormwater Design Quantity Control

Intent: Limit disruption to natural hydrology by reducing impervious cover, increasing on-site infiltration, & managing storm water runoff.

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SSc6.1: Stormwater Design Quantity Control

Required:

- Sites with existing imperviousness ≤ 50%: Do not Exceed the pre-development storm water runoff (discharge rate and quantity) after construction for 1- and 2-year, 24-hour design storms
- *OR:* Implement a Storm Water Management (SWM) plan to protect receiving stream channels
- Sites with existing imperviousness > 50%: Decrease pre-existing storm water runoff by 25% in volume after construction for 1- and 2-year, 24-hour design storms

Submittals: Design Submittal

- Signed LEED Submittal Template
- Provide pre- and post- runoff rate & quantity

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SSc6.1: Stormwater Design
Quantity Control

Strategies:

Decrease impervious area

- Smaller building footprint
- Pervious paving materials
- Green roofs
- Clustered development to reduce hardscaping

Arlington County Government Center

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SSc6.2: Stormwater Design
Quality Control

Intent: Reduce or eliminate water pollution by reducing impervious cover, increasing infiltration, eliminating sources of contaminants, and removing pollutants from stormwater runoff.

Required:

- Capture & treat stormwater runoff from 90% of average annual rainfall
- *AND*: Implement Best Management Practices (BMP's) to remove 80% of annual total suspended solids from captured stormwater

Submittals: Design Submittal

- Signed LEED Submittal Template
- List BMP's and/or structural controls utilized

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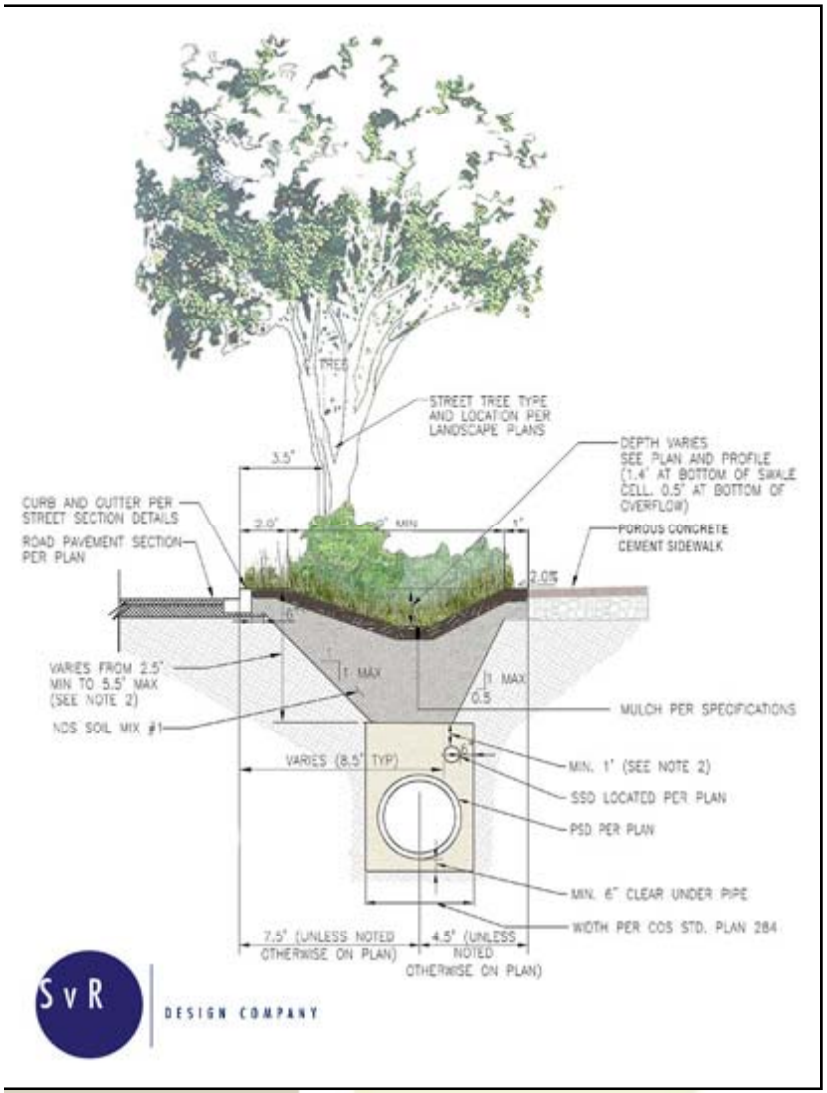
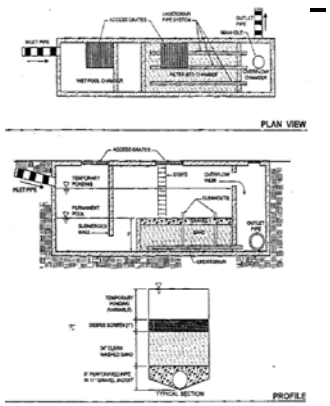
SSc6.2: Stormwater Design Quality Control



Bioswale design by SvR Design Company

- *Strategies:*
  - Non-structural:
    - Bioswales/Vegetated swales
    - Rain gardens
  - Structural:
    - Rainwater cisterns
    - Sand filters
    - Retention ponds



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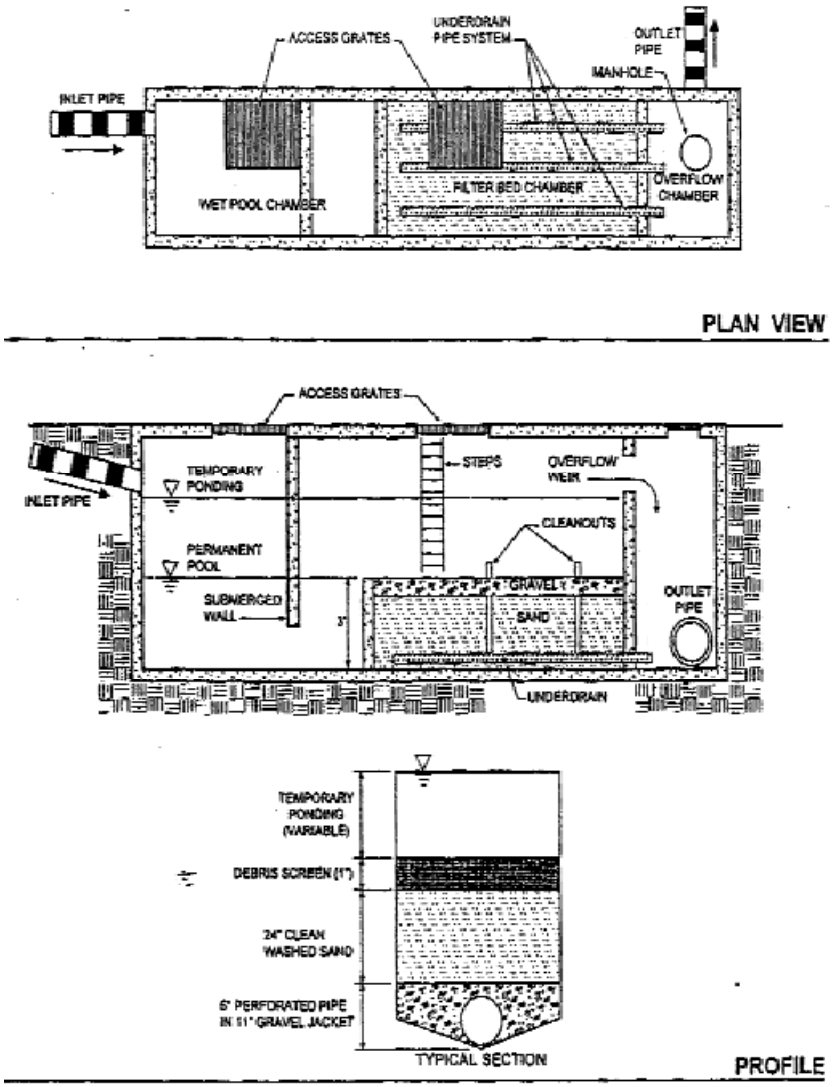
SSc6.2: Stormwater Design Quality Control



- *Strategies:*
  - Non-structural:
    - Bioswales/Vegetated swales
    - Rain gardens
  - Structural:
    - Rainwater cisterns
    - Sand filters
    - Retention ponds

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The Trickier LEED Credits: SSc6.2 – SWM Quality Control

Basic requirement: Use BMPs to remove 80% TSS

Interpretations:

- To capture & treat 90% of the average annual rainfall = the treatment of runoff from:
  - Humid Watersheds: 1” rainfall
  - Semi-arid Watersheds: 0.75” rainfall
  - Arid Watersheds: 0.5” rainfall
- Can prorate over entire site – not meeting requirement in one part of site may be OK if sufficiently exceeding remainder of site.

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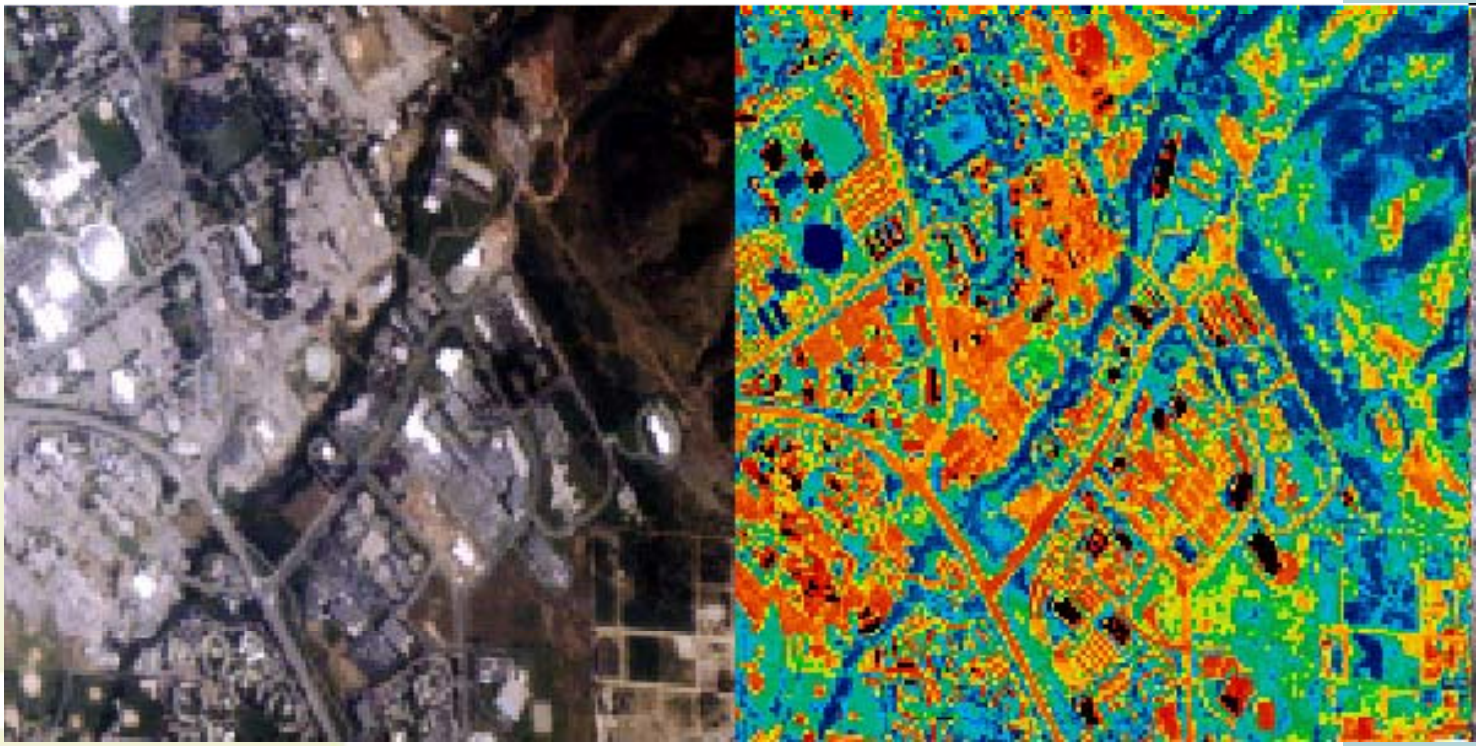
SSc7.1: Heat Island Effect
Non-Roof



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SSc7.1: Heat Island Effect
Non-Roof

Intent: Reduce heat islands to minimize impact on microclimate and human and wildlife habitat.

Required:

- Provide shading, use light-colored paving (SRI ≥ 29) and/or use open-grid pavement for 50% of non-roof surfaces
- *OR:* Place 50% of parking underground or covered with SRI ≥ 29

Submittals: Construction Submittal

- Signed LEED Submittal Template
- Site drawings highlighting location of landscape shading, paving, and underground or covered parking
- SRI for each paving material, and/or open grid pavement OR total # PK spaces & # covered PK spaces

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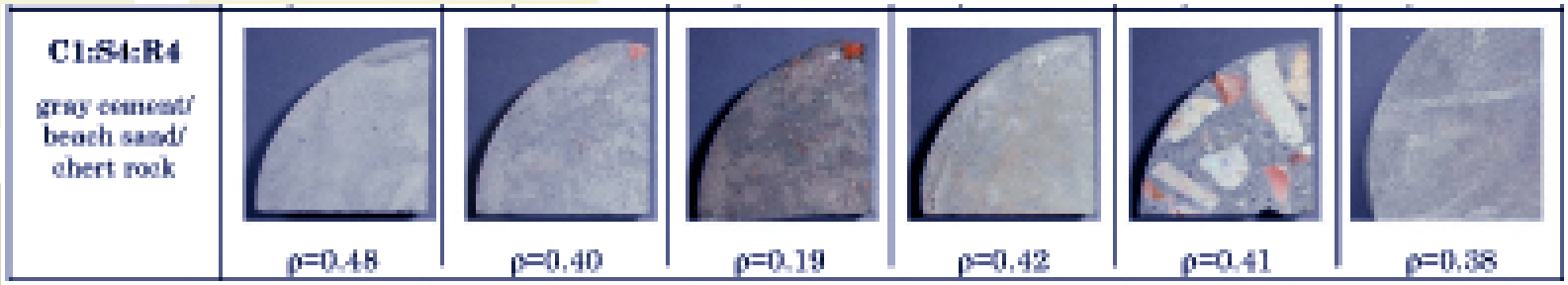
The Trickier LEED Credits: SSc7.1 – Heat Island Effect, Non-Roof

Several ways to achieve:

- 50% shaded / high-SRI/ open-grid-pavement
- 50% of parking structured or covered
- Open grid pavement means ≥ 50% voids containing vegetation (porous asphalt or concrete does not qualify)
- Solar Reflectance Index (SRI) is calculated using the LEED Submittal Template
  - A list of SRI values for typical paving materials is located in the LEED-NC 2.2 Reference Guide



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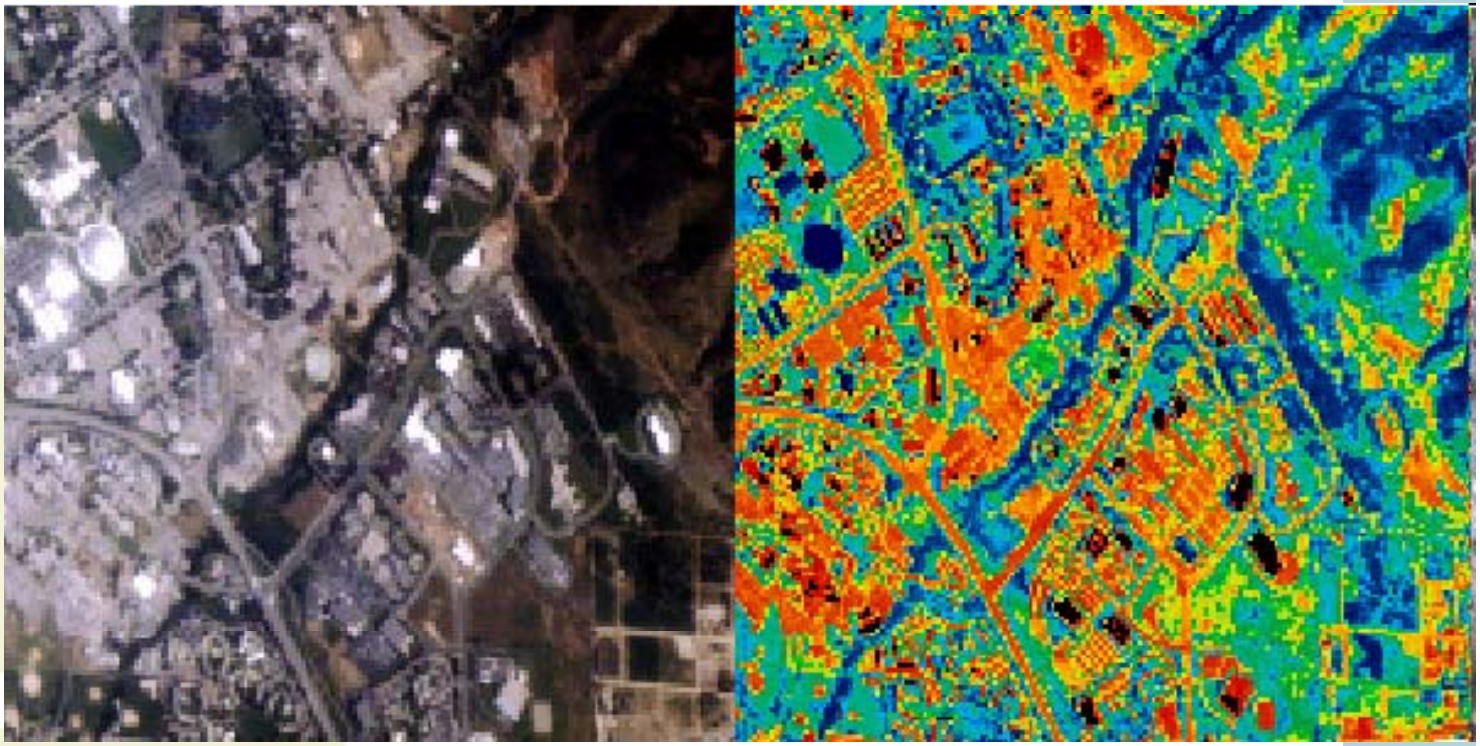
SSc7.2: Heat Island Effect Roof

Sustainable Design Consulting

SSc7.2: Heat Island Effect Roof



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SSc7.2: Heat Island Effect Roof

Intent: Reduce heat islands to minimize impact on microclimate and human and wildlife habitat.

Required:

- Use roof materials with an SRI ≥ 78 (low-sloped roof) or 29 (steep-sloped) for 75% of roof surface.
- *OR*: Install a vegetative roof covering 50% of roof area
- *OR*: Install high SRI & vegetative roof surfaces that meet the criteria: (SRI Roof Area/0.75)+(Vegetated Roof Area/0.5) > Total Roof Area

Submittals: Construction Submittal

- Signed LEED Submittal Template
- Roof drawings highlighting location of high albedo and/or vegetated roof areas

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SSc7.2: Heat Island Effect Roof

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SSc8: Light Pollution Reduction

Intent: Minimize light trespass from the building & site and reduce development impact on nocturnal environments; i.e. see the stars

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SSc8: Light Pollution Reduction

Intent: Minimize light trespass from the building & site and reduce development impact on nocturnal environments; i.e. see the stars

Required:

- Interior: Make sure that the angle of maximum candela from interior lights only intersects opaque building surfaces and does not exit through windows
- *OR:* All non-emergency interior lighting automatically turn off during non-business hours
- Exterior: Only light areas as required for safety and comfort. Do not exceed 80% of the lighting power densities for exterior areas & 50% for building facades defined by ASHRAE/IESNA 90.1-2004
- Lighting requirements are based on zone

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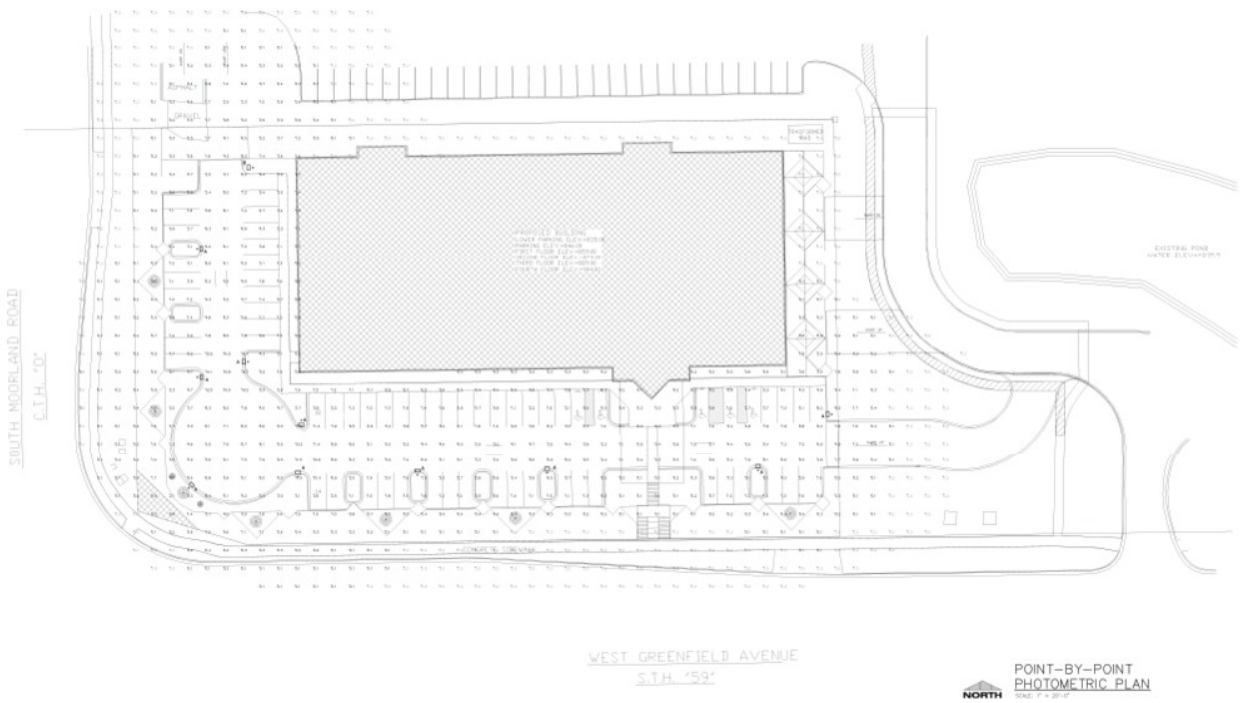
SSc8: Light Pollution Reduction

Submittals: Design Submittal

- Signed LEED Submittal Template
- Project lighting drawings (interior & site)



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Quiz time!

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Quiz Question 1:

The following strategies may capture the Urban Heat Island, Non-roof credit ***except***: (Choose two)

A. Open-grid pavement
B. Underground parking
C. Native shrubs
D. High SRI paving materials
E. Recycled-content black asphalt paving materials

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Quiz Question 2:

Which of the following sites may <u>not</u> capture the LEED Development Density credit? (Choose two)

A. An existing 10,000 SF building within ½ mile walking distance of 12 basic services and a neighborhood of 10 units per acre
B. A 120,000 SF building on a 1-acre site
C. A 120,000 SF building on a previously developed site within a development density of 65,000 SF/acre
D. A 120,000 SF building on previously developed site within a four-story downtown development
E. An undeveloped site within a development density of 130,000 SF/acre

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Quiz Question 3:

The following strategies are typical methods of controlling erosion during construction ***except*** for use of: (Choose one)

A. Silt fencing
B. Grass pavers
C. Temporary seeding
D. Sediment traps
E. Mulching

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Quiz Question 4:

How might a residential project comply with SS Credit 4.4, Alternative Transportation, Parking Capacity? (Choose two)

A. Install alternative-fuel refueling stations for 3% of the total vehicle parking capacity of the site

B. Provide infrastructure and support programs to facilitate shared vehicle usage such as shuttle services to mass transit

C. Provide preferred parking for carpools for 5% of the total provided parking spaces

D. Provide no new parking

E. Provide covered parking with preferred parking for low-emitting, fuel-efficient vehicles for 5% of the total provided parking spaces

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Quiz Question 5:

Which of the following projects might meet the requirements of SS Credit 1, Site Selection? (Choose three)

A. Proposed site meets the definition of Prime Farmland, but was previously used as a cow pasture

B. Building is located on public parkland and owned by the Park Authority

C. The site is 40’ from a healthy stream that supports fish

D. A previously developed site in a historic downtown area that is 2’ below the elevation of the 100 year flood plain

E. Buildings within 150’ of wetlands

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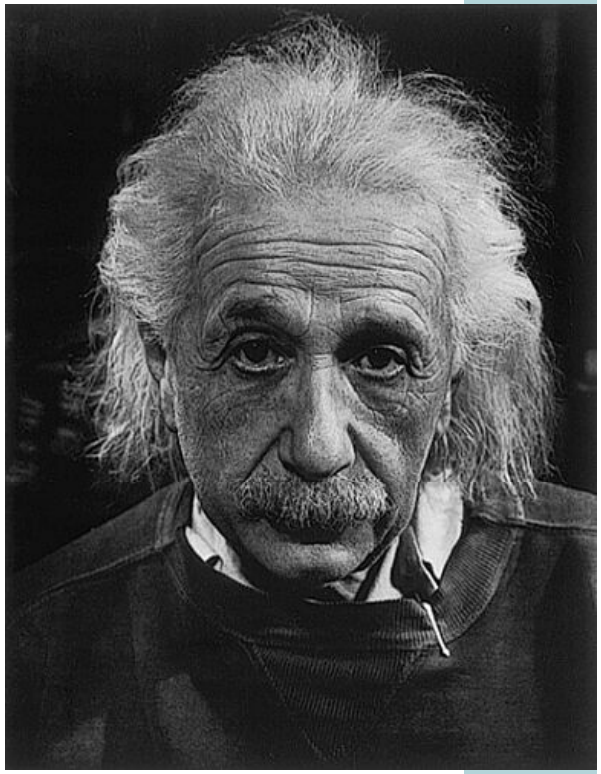

"We can't solve problems by using the same kind of thinking we used when we created them."

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Part 2
Sustainable Sites and the Process

LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Sustainable & Smart
ecobuild fall
Sustainable, Green and High Performance Solutions for the Built Environment

Thank you!

Thomas A . Fisher, AIA, LEED AP

tom@sustaindesign.net
www.sustaindesign.net

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Introduction to Part 3

Energy and Atmosphere

Presented by:

Thomas A .Fisher, AIA, LEED AP
Michael Babcock CEM®, LEED®-AP

December 10, 2008 4:00-5:00 PM

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Part 1 - Introduction

Sustainable Design Consulting

- Offices in Washington, DC and Richmond, VA
- Small woman-owned business
- Focus on greener solutions for the built environment
- Consulted on over 80 green building projects, over 200 LEED-related projects
- Commercial, institutional, multi-family, greater-DC-area and Central Virginia
- Project consulting mostly to Developers/Owners and Architects

What we do

- Green Building Project Management
- Drawing & Spec Review
- LEED advisory
- Lectures, Workshops & Trainings
- Design Guidance and Research

www.sustaindesign.net

Eastern Village Cohousing

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Part 1 - Introductions

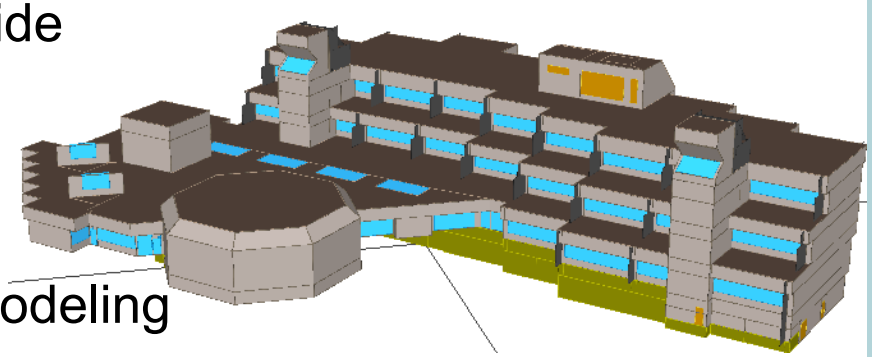
EMO Energy Solutions, LLC

- Located in Falls Church, VA
- SBA Certified Small Business
- Comprehensive unbiased energy solutions
- Energy consulting for over 300 LEED® projects and over 30 commissioning projects
- Commercial, institutional, residential, government, industrial, nationwide

www.emoenergy.com

What we do

- Energy audits
- Commissioning
- Hourly whole building energy modeling
- Measurement & Verification plans
- Daylight design and simulations
- Site light pollution evaluation
- Lifecycle cost analysis
- Renewable energy research



Outline

- Part I – Introduction
  - Impact of Buildings
  - Benefits of Green/Integrated Design
  - Overview and History of LEED
  - LEED Standards
  - Cost of LEED
  - Project Certification & Accreditation
  - Resources & Websites
- Part 2 – Sustainable Sites
- Part 3 – Energy & Atmosphere
- Part 4 – Materials & Resources
- Part 5 – Indoor Environmental Quality
- Part 6 – Water Efficiency, Innovation in Design, Exam Overview, LEED 2009

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Why Green Building ?

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Why Green Building?

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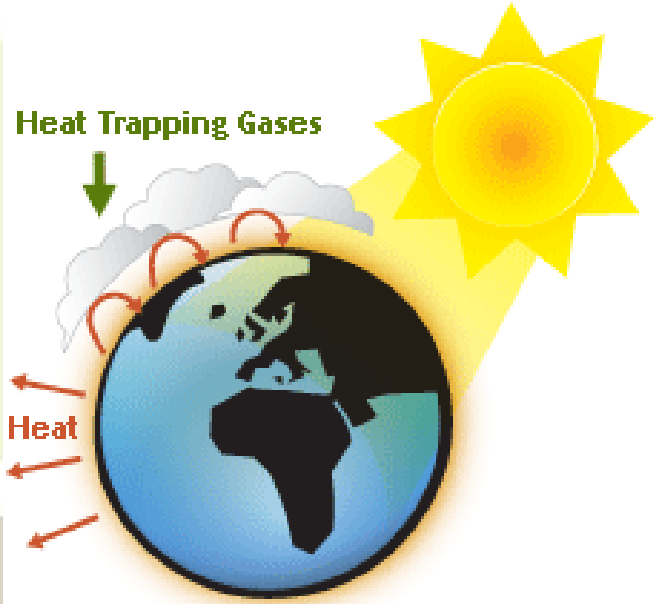
Why Green Building



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Why Green Building?

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Why Green Building?

Source: NRDC & NASA

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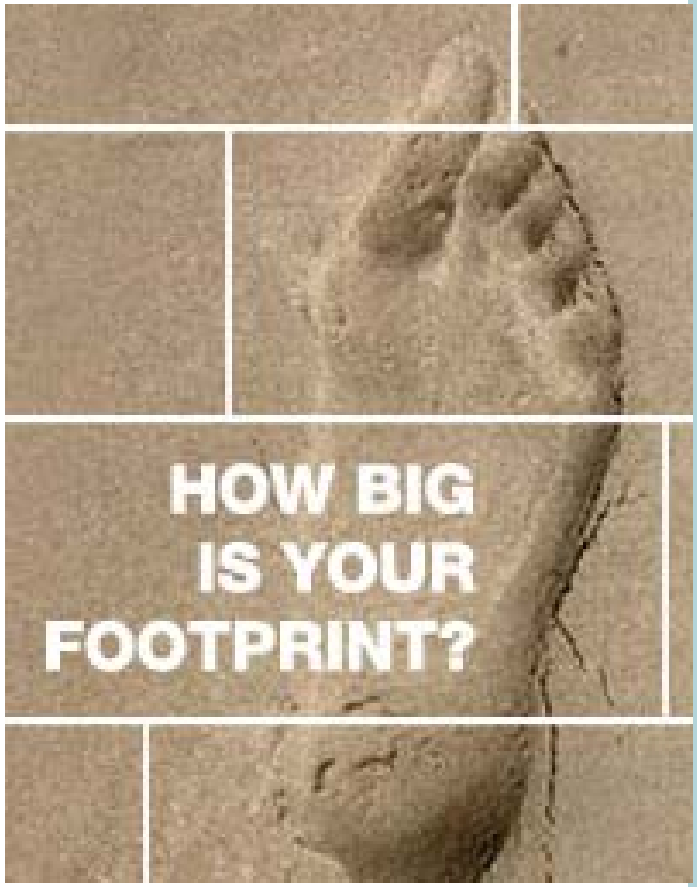
Why Green Building?



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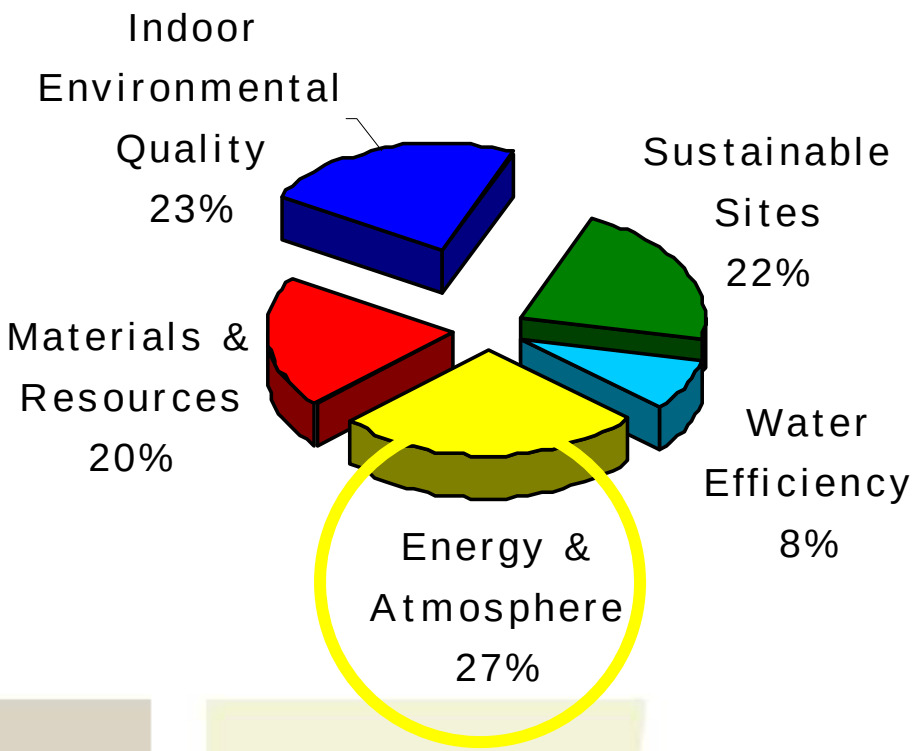
Part 3 – The LEED Credits



+ Innovation & Design Process

Energy & Atmosphere

- Overview of section
- Review credit
- Discuss trickier credits

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LEED Categories: Energy & Atmosphere (EA) Overview

***Intent**:* Reduce energy consumption while increasing building efficiency

Prerequisite 1 – Fundamental CxA of the Building Energy Systems
Prerequisite 2 – Minimum Energy Performance
Prerequisite 3 – Fundamental Refrigerant Management
Credit 1 – Optimize Energy Performance (up to 10 points)
Credit 2 – On-Site Renewable Energy (up to 3 points)
Credit 3 – Enhanced Commissioning (1 point)
Credit 4 – Enhanced Refrigerant Management (1 point)
Credit 5 – Measurement & Verification (1 points)
Credit 6 – Green Power (1 point)

TOTAL AVAILABLE: 17 points
Synergy: Solar Thermal and Electric contribute to Credits 1 & 2.

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EAp1: Fundamental Commissioning of the Building Energy Systems

Intent: Verify that the building's energy related systems are installed, calibrated and perform as intended.

Required: The commissioning team shall:

1. Designate a Commissioning Authority (CxA) independent of the project's design and construction management.
2. The Owner shall document the Owner's Project Requirements (OPR) & the design team shall develop the Basis of Design (BOD). The CxA shall review these documents.
3. Incorporate Cx requirements in the construction documents
4. Develop and implement a Cx plan
5. Verify installation, functional performance of the systems
6. Complete a commissioning report

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EAp1: Fundamental Commissioning of the Building Energy Systems

Submittals: Construction Submittal

- LEED Submittal Template
- Provide the name and company information for the CxA.
- Confirm that the 6 required tasks have been completed.
- Narrative description of the systems commissioned and the results of the Cx process.

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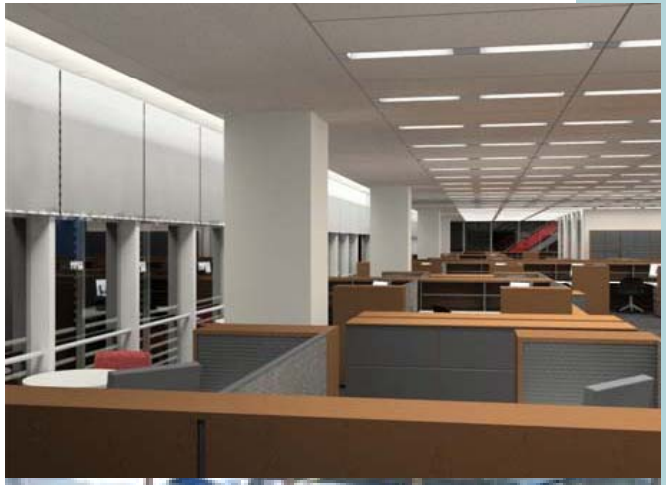
EAp1: Fundamental Commissioning of the Building Energy Systems

Commissioning Authority (CxA):

- Independent of the project's design and construction management, but may be employees of the firms providing those services
- *OR,* Qualified employee or consultant of the Owner
- OR, For projects < 50,000 sf projects, qualified person on design/construction team



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EAp1: Fundamental Commissioning of the Building Energy Systems

Systems **required** to be commissioned:

Energy-related systems:

- HVAC & R and associated controls
- Lighting and daylighting controls
- Domestic hot water systems
- Renewable energy systems

Systems encouraged to be commissioned:

- Water-using systems
- **Building envelope (Innovation Credit)**

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EAc3: Enhanced Commissioning

***Intent*:** Begin commissioning early during the design process and execute additional activities after systems performance verification is completed.

***Required*:** In addition to the Fundamental Building Commissioning prerequisite, implement :

1. CxA shall be independent of the design team
2. CxA shall complete a design development review
3. CxA shall verify training for O&M is complete
4. CxA shall verify transfer of system manuals to owner
5. CxA shall commence 10 month verification of systems
6. CxA shall provide a re-commissiong plan

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EAc3: Enhanced Commissioning

Submittals: Construction Submittal

- LEED Submittal Template
- Provide the name of firm, relation to design team and experience info for the CxA.
- Confirm that the 6 required tasks have been completed.
- Provide an Executive Summary of the CxA report that confirms all CxA tasks have been completed
- Upload any necessary supplemental documentation (i.e. plan, specifications, BoD, OPR, etc.)

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Commissioning Tasks	Primary Responsibilities	
	If you are only meeting EA Prerequisite 1	If you are meeting both EAp1 and EA credit 3
Commissioning Authority (CxA)	-- 3rd Party OR -- Independent of Team OR -- Design Team Member (<50,000sf)	3rd Party
Document Owner's Project Requirements (OPR)	Owner	Owner
Develop Basis of Design (BOD)	Design Team	Design Team
Incorporate commissioning requirements into the construction documents	Project Team or CxA	Project Team or CxA
Conduct commissioning design review prior to mid-construction documents	NA	CxA
Develop and implement a commissioning plan	Project Team or CxA	Project Team or CxA
Review contractor submittals applicable to systems being commissioned	NA	CxA
Verify the installation and performance of commissioned systems	CxA	CxA
Develop a systems manual for the commissioned systems	NA	Project Team and CxA
Verify that the requirements fort training are completed	NA	Project Team and CxA
Complete a summary commissioning report	CxA	CxA
Review building operation within 10 months after substantial completion	NA	CxA

The Trickier LEED Credits: EAp1 & EAc3: Commissioning

- Decide early whether to pursue Enhanced Commissioning
  - (has to be started before any submittals or final design activities)

- Although both Prerequisite 1 and Credit 3 address Commissioning and an agent independent of the design team, only Credit 3 requires:
  - The agent be from a third party firm
  - Review of design documents
  - Review of submittals for commissioned systems

- Additional services may include:
  - Energy modeling or review of model by others
  - Measurement & Verification design, plan and/or review
  - Daylight Simulation Analysis
  - Verify Water Usage

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EAp2: Minimum Energy Performance

Intent: Verify the minimum level of energy efficiency for the proposed building has been accomplished.

Required: Design the building to comply with both:

Mandatory provisions of **ASHRAE/IESNA Standard 90.1-2004**

AND

"The prescriptive requirements"

- (Sections 5.5, 6.5, 7.5 & 9.5)

OR

"The performance requirements"

- (Section 11 – Energy Cost Budget Method)

OR

"Computer simulation"

- (Appendix G – Performance Rating Method)

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BETA

LEED-CS 2.0 Certification Submittal Template
EA Prerequisite 2: Minimum Energy Performance

design

(Responsible Individual) (Company Name)

I, Michael Babcock, from EMO Energy Solutions, LLC

verify that the information provided below is accurate, to the best of my knowledge.

CREDIT COMPLIANCE

The project meets the minimum energy efficiency requirements.

☒ The project meets all the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments).

-- AND --

Select the appropriate compliance path:

☐ The prescriptive requirements (Sections 5.5, 6.5, 7.5, and 9.5) of ASHRAE 90.1-2004 (without amendments)

-- OR --

☐ The performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 (without amendments)

-- OR --

☒ The project has used a computer simulation model to document improved building energy performance under EA Credit 1

EAc1: Optimize Energy Performance

***Intent*:** Improve the whole building energy **cost** performance beyond the energy code minimum.

Required: Demonstrate level of energy **cost** performance improvement above the baseline (ASHRAE 90.1-2004)

Option 1: Whole Building Hourly Energy Simulation (0 – 10 pts)

New Buildings	Existing Buildings	Points
14.0%	7.0%	2*
17.5%	10.5%	3
21.0%	14.0%	4
28.0%	21.0%	6
35.0%	28.0%	8
42.0%	35.0%	10
45.5%	38.5%	11**

* 2 pts Mandatory ** +1 Exemplary Performance

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EAc1: Optimize Energy Performance

OR

Option 2: Prescriptive Method (4 pts)

Reference: **ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004**.

- Buildings must be office occupancy, < 20,000 sf
- Must fully comply with all applicable criteria established in Guide for climate zone where building is located

- Criteria include roofs, walls, floors, slabs, doors, vertical glazing, skylights, interior lighting, ventilation, ducts, energy recovery, and service water heating.

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EAc1: Optimize Energy Performance

OR

Option 3*: Prescriptive Method (2-5 pts)

Reference: **Advanced Buildings™ Core Performance™ Guide** developed by the New Buildings Institute.

- Buildings must be under 100,000 square feet.
- Buildings may NOT be health care, warehouse or laboratory projects.
- Must fully comply with *Sections One, Design Process Strategies, and Two, Core Performance Requirements*.

* NOTE: New option since June 2007 with mandatory 2 pts for EAc1

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EAc1: Optimize Energy Performance

Path	Compliance Method	Points Available	Standard
Option 1	Perfomance	1-10	ASHRAE 90.1-2004 Appendix G
Option 2	Prescriptive	4	ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004
Option 3	Prescriptive	2-5	Advanced Buildings Core Performance Guidelines
*Option 4	Prescriptive	1	Advanced Buildings Benchmark v1.1

* NOTE: Not available for projects registered after June 2007

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EAc1: Optimize Energy Performance

Submittals: Design Submittal

- LEED Submittal Template

- Performance Rating Method Compliance Report
  - Demonstrating energy conservation measures
  - Modeling assumptions (diversity, and density), and approach
  - Utility information and schedules
  - Input files, selected output files
  - Exceptional Calculation Measures
    - Energy Star Appliances, Garage CO/NOx control, Tenant lighting requirement, etc.

Exemplary Performance (Option 1 Compliance Path)*:*

- New Buildings: 45.5%
- Existing Buildings: 38.5%

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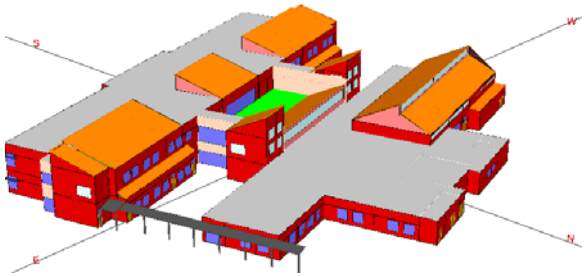
The Trickier LEED Credits: EAc1: Optimize Energy Performance



Proposed Building

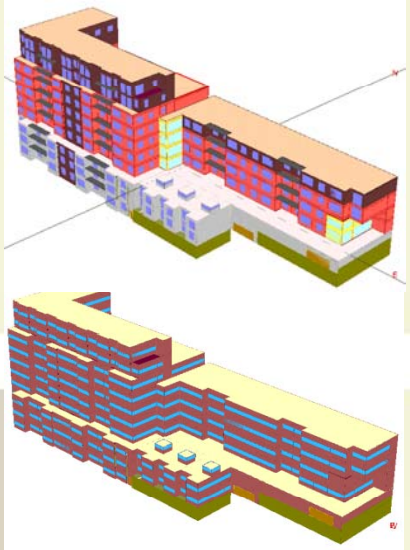
VS.

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

ASHRAE Baseline

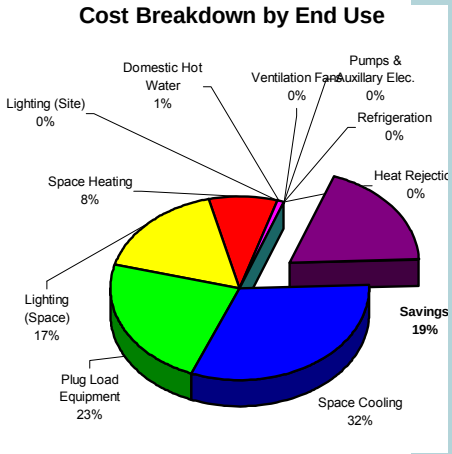


<u>Predicts</u> energy consumption of building <u>every hour of the year</u> based on set parameters & inputs

- New advances in daylighting algorithms
- Advanced calculation algorithms
- Thermal variance

Uses basic engineering/heat/light/flow/power equations

- Conduction through walls/roof
- Solar gain through windows
- Calculation of all internal heat gains
- Thermal mass/time lag
- Ventilation requirements
- Control Algorithms
- Energy content of distribution systems



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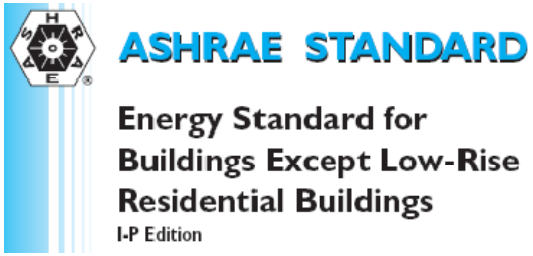
The Trickier LEED Credits: EAc1: Optimize Energy Performance



LEED Energy Modeling Expertise Is Very Helpful:

- Read **ASHRAE Standard 90.1-2004** thoroughly (the base case/ design case protocols are specific!)
- Make sure software is acceptable to USGBC (hourly simulation is critical!)
- Follow the LEED Reference Guide
- Keep up with LEED Credit Rulings
- Expect the model to be scrutinized by the USGBC reviewers!

Acceptable Software

- DOE-2.2
- DOE-2.1e
- Blast
- Energy Plus
- Trace 700
- Carrier HAP
- Others

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The Trickier LEED Credits: EAc1: Optimize Energy Performance

***Submittals**:* Option 1: Whole Bldg. Energy Simulation / Bldg Performance Rating Method:

– Complete LEED-Online Submittal Template:

1. Section 1.1 - General Information
2. Section 1.2 - Space Summary
3. Section 1.3 - Advisory Messages
4. Section 1.4 - Comparison of Proposed Design Versus Baseline Design Energy Model Inputs
5. Section 1.5 - Energy Type Summary
6. Section 1.6 - On-Site Renewable Energy *(if applicable)*
7. Section 1.7 - Exceptional Calc. Measure Summary *(if app.)*
8. Section 1.8 - Performance Rating Method Compliance Report

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The Trickier LEED Credits: EAc1: Optimize Energy Performance

TABLE 1.4 - Comparison of Proposed Design Versus Baseline Design

Model Input Parameter	Proposed Design Input	Baseline Design Input	
Exterior Wall Construction	1. Typical Exterior Wall: From outside to inside, the modeled wall construction consists of exterior air film; 4? nominal face brick, a vertical	ASHRAE 90.1-2004 Baseline Building Envelope: All above grade walls - Steel framed (Table G3.1 - Table 5.5-4)	CLEAR
Roof Construction	1. Sloped Roof: From outside to inside, the modeled roof construction consists of ?? simulated slate shingles, 1-1/2?	ASHRAE 90.1-2004 Baseline Building Envelope: All roofs - Insulation entirely above deck (Table G3.1 - Table 5.5-4)	CLEAR
Floor/Slab Construction	1. Slab-on-grade: F-factor 0.730	ASHRAE 90.1-2004 Baseline Building Envelope: Slab-on-grade floors - unheated (Table G3.1 - Table 5.5-4)	CLEAR
Window-to-gross wall ratio	16.12%	ASHRAE 90.1-2004 Table G3.1 (5.c): Vertical fenestration areas for new buildings and additions shall equal that in the proposed desig	CLEAR
Fenestration type	Marvin Windows Insulating Low-E II glazing	N / A	CLEAR
Fenestration U-factor	Center of Glass U-value: 0.310Btu/h-ft2-degF Assembly U-value: 0.356 Btu/h-ft2-degF (average)	ASHRAE 90.1-2004 Table 5.5-4: Vertical Glazing, % of Wall 0-10%.	CLEAR
Fenestration SHGC - North	SHGC: 0.30	ASHRAE 90.1-2004 Table 5.5-4: Vertical Glazing, % of Wall 0-10%.	CLEAR
Fenestration SHGC - Non-North	SHGC: 0.30	ASHRAE 90.1-2004 Table 5.5-4: Vertical Glazing, % of Wall 0-10%.	CLEAR

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VDOT Safety Rest Areas

 **Fredericksburg**	 **New Kent**	 **Winchester**
Expected Gold	Gold Certified	Expected Silver
6 EA C1 Points	10 EA C1 Points	8 EA C1 Points
ASHP w/ Heat Recovery	Ground Source Heat Pumps w/ Heat Recovery	Ground Source Heat Pumps w/ Heat Recovery
M&V indicates	Energy Savings not matching model	M&V indicates
	Condensing water loop not flushed	

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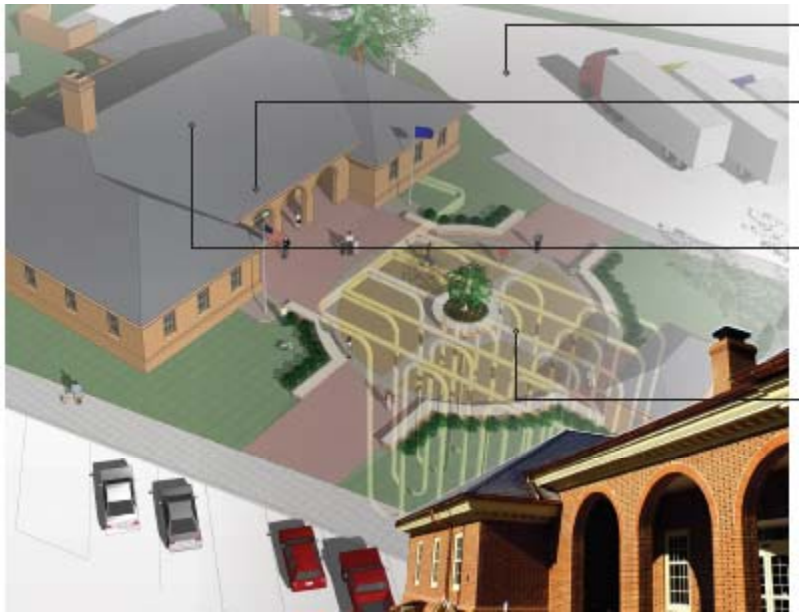
EAc1: Optimize Energy Performance
Case Study: VDOT – New Kent

- 32 Ground Source Heat Pumps
  - Wells in Courtyard Area
- High Efficiency Light Fixtures and low LPD
- Web based EMS
- High performance surface assemblies and windows
- Highly efficient centrifugal pumps
- Strategic site light. Reduced need for excessive illumination.



VDOT Virginia Department of Transportation

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EAp3: Fundamental Refrigerant Management

Intent: Reduce ozone depletion.

Required*:* Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion.

Submittals*:* Design Submittal

- LEED Submittal Template
- Confirm that the project does not use CFC refrigerants
- OR, when re-using base building HVAC equipment, narrative description of the phase-out plan

EPA's list of substitutes for ozone-depleting refrigerants: www.epa.gov/ozone/snap

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LEED-NC
LEED FOR NEW CONSTRUCTION

LEED-NC 2.2 Submittal Template
EA Prerequisite 3: Fundamental Refrigerant Management

design

(Responsible Individual) (Company Name)

I, Michael Babcock, from EMO Energy Solutions

verify that the information provided below is accurate, to the best of my knowledge.

CREDIT COMPLIANCE

Please select the appropriate compliance path:

☒ **Option 1: Zero use of CFC-Based Refrigerants**

The base building HVAC&R systems do not use CFC-based refrigerants..

☐ **Option 2: Phase out Plan for any Existing CFC-based Equipment**

The project is using existing base building HVAC&R systems that use CFC-based refrigerants. A comprehensive CFC phase-out plan has been developed and implemented for this project.

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EAc4: Enhanced Refrigerant Management

Intent: Reduce ozone depletion and support early compliance with the Montreal Protocol.

Required:

- Do not use refrigerants, OR
- Select refrigerants and HVAC&R that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming.

Submittals: Design Submittal

- LEED Submittal Template
- List HVAC&R equipment types, including number, size (tons), refrigerant, and refrigerant charge.

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The Trickier LEED Credits: EAc4: Enhanced Refrigerant Management

$$LCGWP + LCODP \times 100{,}000 \leq 100$$

Where: $LCODP = [ODPr \times (Lr \times Life + Mr) \times Rc]/Life$
$LCGWP = [GWPr \times (Lr \times Life + Mr) \times Rc]/Life$

- LCODP: Lifecycle Ozone Depletion Potential
- LCGWP: Lifecycle Direct Global Warming Potential
- GWPr: Global Warming Potential of Refrigerant
- ODPr: Ozone Depletion Potential of Refrigerant
- Lr: Refrigerant Leakage Rate (% of charge per year)
- Rc: Refrigerant Charge (lbs refrigerant / Ton of cooling capacity)
- Mr: End-of-life Loss (% of charge)
- Life: Equipment Life (Years)

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The Trickier LEED Credits: EAc4: Enhanced Refrigerant Management

Calculations: LCGWP + LCODP x 100,000 ≤ 100

- Refrigerant Type
- Equipment Type
- Equipment Cooling Capacity
- Refrigerant Charge

<u>R-123 Versus R-134a</u>

- HCFC VS. HFC
- ODP: R-134a has no Chlorine and no ODP
- GWP: Higher in R-134a, but minimal effects when emission rate factored in.

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EAc4: Enhanced Refrigerant Management

HVAC&R Equipment Type	N	Q (tons)	Refrig-erant	GWPr	ODPr	Rc (lb/ton)	Life (yrs)	Lr (%)	Mr (%)	LCGWP	LCODP x10^5	Refrigerant Impact per ton	Refrigerant Impact Total	
ERU-1	1	32.7	R-410a	1,890	0.0	2.11	20	2	10	99.7	0	99.7	3,260	Clear
ERU-2	1	36.8	R-410a	1,890	0.0	2.11	20	2	10	99.7	0	99.7	3,669	Clear
ERU-3	1	9.5	R-410a	1,890	0.0	2.11	20	2	10	99.7	0	99.7	947	Clear
ERU-4	1	42.6	R-410a	1,890	0.0	2.11	20	2	10	99.7	0	99.7	4,247	Clear
ERU-5	1	6.5	R-410a	1,890	0.0	2.11	20	2	10	99.7	0	99.7	648	Clear
HP-D	34	2.5	R-22	1,780	0.04	0.64	15	2	10	30.4	68.3	98.6	8,385	Clear
HP-E	17	2.6	R-22	1,780	0.04	0.64	15	2	10	30.4	68.3	98.6	4,444	Clear
HP-F	2	5.6	R-22	1,780	0.04	0.64	15	2	10	30.4	68.3	98.6	1,105	Clear
								2	10	0	0	0	0	Clear
								2	10	0	0	0	0	Clear
								2	10	0	0	0	0	Clear
								2	10	0	0	0	0	Clear
								2	10	0	0	0	0	Clear
								2	10	0	0	0	0	Clear
Total Tons:	418										Total:	99.3	41,519	

EAc5: Measurement & Verification

Intent: Provide for the ongoing accountability of building energy consumption over time.

Required*:* Develop and implement a Measurement & Verification (M&V) Plan as specified in the **International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003**.

The M&V period shall cover at least one year of post-construction occupancy.

Submittals*:* Design Submittal

- LEED Submittal Template
- Confirm the IPMVP Option (B or D)
- Upload a copy of the M&V plan.

EAc5: Measurement & Verification

IPMVP OPTION	HOW BASELINE IS DETERMINED	HOW SAVINGS ARE CALCULATED
OPTION B: Energy Conservation Measure Isolation Based on ***periodic or continuous measurements*** taken throughout the term of the M&V period at the device or system level	Calculating the hypothetical energy performance of the baseline system under measured post construction operating conditions	Engineering calculations using measured data.
OPTION D: Calibrated Simulation (Savings Estimation Method 2) Based on ***computer simulation*** of building or process; simulation is calibrated with measured data	Energy simulation of the baseline under the operating conditions of the M&V period	Comparing different models.

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EAc5: Measurement & Verification

When should a M&V plan be developed?

- M&V considerations can affect certain design decisions such as instrumentation, building systems organization
- M&V plan should progress with building design; can be finalized when design reaches a point where all M&V issues can be addressed

When should a M&V plan be implemented?

- Execution of the M&V plan should begin at minimum1 year post full operation (16 to 18 months recommended)

Who develops and implements a M&V plan?

- Energy engineer responsible for developing the building energy model used for EAp2 & EAc1 or CxA or 3rd-party firm

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EAc5: Measurement & Verification

- ***Example:*** Measurement & Verification (M&V) Option D:
  - Provide a detailed hourly building energy simulation
  - M&V Time Period
    - Initial & ongoing annual
  - Data Collection & Monitoring
    - Metering points & EMS
    - Inconsistent data
  - Energy Model Calibration
    - Parameter verification
    - Weatherized data
    - Baseline Energy Vs Metered Data
    - Quality assurance and error
  - Reporting
    - Savings = (Post-Construction metered data) – (Calibrated "Baseline Year" Model)

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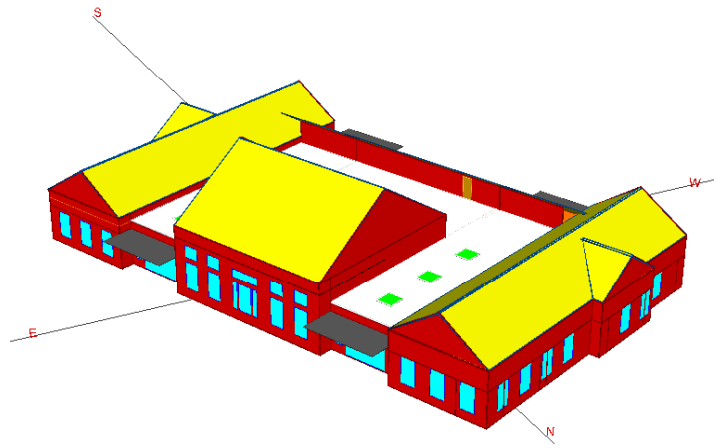
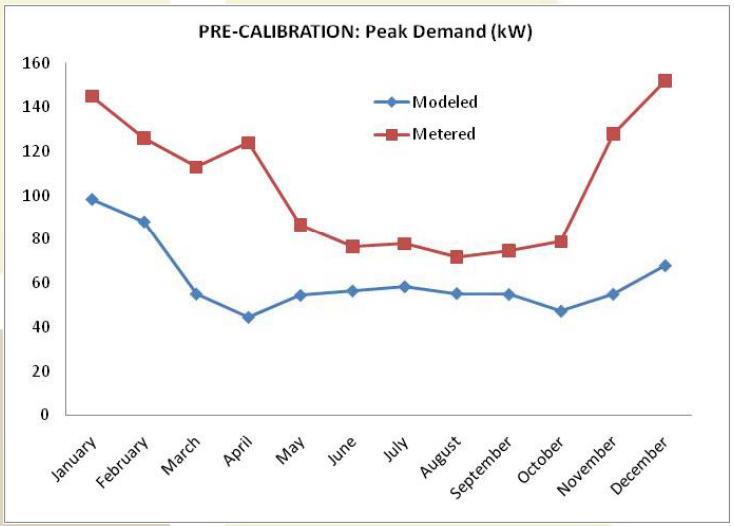
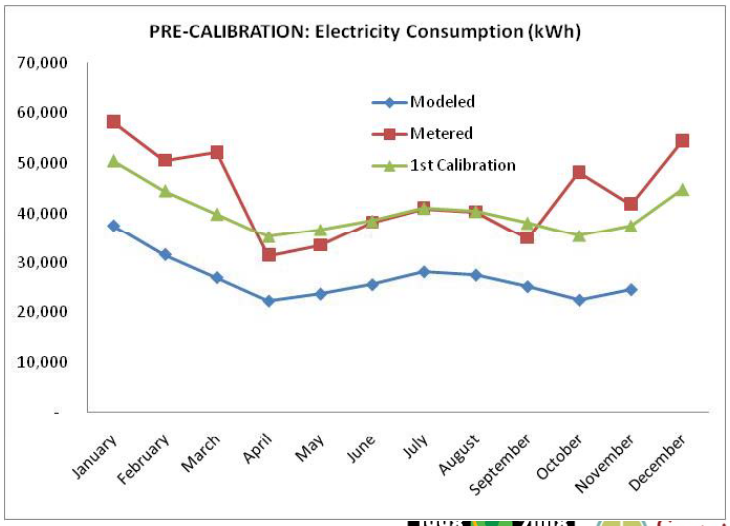
EAc5: Measurement & Verification

Case Study: VDOT – Fredericksburg







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EAc2: On-Site Renewable Energy

Intent: Use renewable technologies to reduce environmental impacts associated with fossil fuel energy use.

Required: Supply a net fraction of the building's total energy use through the use of on-site renewable energy systems.

% Renewables	Points
2.5%	1
7.5%	2
12.5%	3
17.5%	4*

* +1 Exemplary Performance

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EAc2: On-Site Renewable Energy

Submittals: Design Submittal

- LEED Submittal Template
- Provide the On-site Renewable Energy Source(s) used, the annual energy generated from each source, and the backup fuel for each source.
- Describe the source of the annual energy cost information.
- Calculations demonstrating that at least 2.5% (7.5%, or 12.5%) of total energy costs are supplied by the renewable energy system(s)

Calculation:

% Renewables = Renewable Energy ($) / Building Total Annual Energy Cost ($)

Example:

% Renewables = $12,500 / $ 500,000

% Renewables = 2.5% (1 point)

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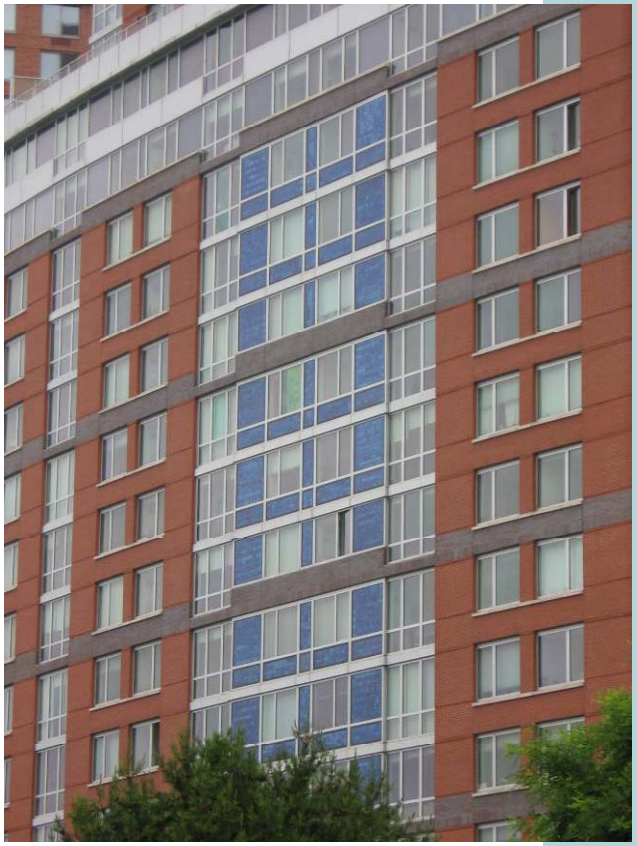
EAc2: On-Site Renewable Energy

Eligible Renewable Energy Systems (see Reference Guide):

- Photovoltaics
- Active solar thermal systems that employ collection panels
- Biofuel (biomass, bio-gas) based electrical systems
- Deep-earth water or steam geothermal heating systems (not ground source heat pumps) and geothermal electric systems
- Low-impact hydro electric power systems
- Wave and tidal power systems
- Wind power systems



Building Integrated Photovoltaics (BIPV) at The Solaire, NYC, NY

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EAc6: Green Power

Intent: Encourage the development and use of grid-source energy technologies on a net zero pollution basis.

Requirement: Provide at least 35% of the building's electricity from renewable sources, as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements. Engage in at least a two-year renewable energy contract.

Green-e®
100% Certified Renewable Energy

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EAc6: Green Power

***Submittals**:* Construction Submittal

- LEED Submittal Template
- Provide the name of the green power provider and contract term OR of the renewable energy certificate vendor.
- Enter total annual electricity consumption (kWh) and total annual green power purchase (kWh) OR the value of the green tags purchased (kWh).

***Exemplary Performance**:*

- 2x amount of electricity OR 2x contract length

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EAc6: Green Power

Calculations:

- Determine Baseline Annual Electricity Consumption (kWh):
  - Use annual electricity consumption calculated for Design Case model in EAc1 (which excluded on-site renewable and recovered energy), OR
  - Use DOE Commercial Buildings Energy Consumption Survey (CBECS) database (which lists fuel consumption by building type)
- Determine amount of Green Power needed
- Green Power Purchase = Annual Energy Consumption x 35% x 2 years

Example:

500,000 kWh x 35% x 2 years = 350, 000kWh

350,000 kWh x $<u>0.01</u>/kWh = $3,500

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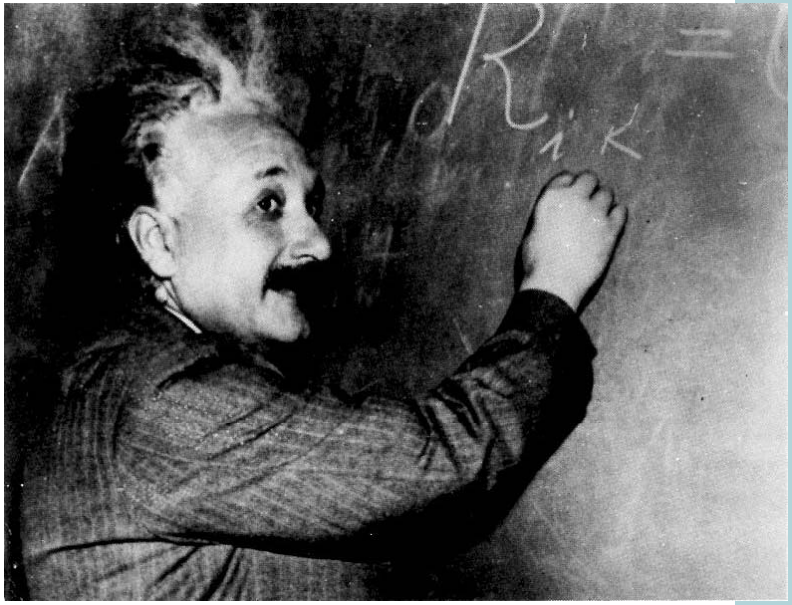
Quiz Time!

?

?

?



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Quiz Question 1:

Which strategy will contribute to earning points for both EA Credit 1, Optimize Energy Performance and EA Credit 2, On-Site Renewable Energy? (Choose one)

A. Install ground source heat pumps for heating and cooling

B. Implement architectural passive solar and daylighting strategies

C. Install active solar thermal energy systems that employ collection panels

D. Purchase tradable renewable energy certificates

E. Utilize natural ventilation strategies

Quiz Question 2:

Which commissioning tasks must be performed during the design phase? (Choose two)

A. Engage commissioning authority
B. Document owner's project requirements
C. Witness functional testing
D. Provide building operator training
E. Develop systems manuals for the commissioned systems

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Quiz Question 3:

In renovated buildings, teams may improve the energy performance of the envelope by: (Choose two)

A. Increasing the aesthetic quality of the façade

B. Replacing exterior windows

C. Removing hazardous materials

D. Installing daylight dimming sensors

E. Adding insulation

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Quiz Question 4:

Which of the following standards includes the criteria for LEED compliant Measurement & Verification? (Choose one)

A. ASHRAE/IESNA Standard 90.1-1999

B. The Montreal Protocol

C. ASHRAE 129-1997

D. IPMVP Volume III

E. ENERGY STAR

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Quiz Question 5:

What aspect of a building is not improved/ enhanced by a green roof? (Choose two)

A. Erosion prevention during construction

B. On-site renewable energy generation

C. Stormwater management

D. Life of roofing membrane

E. Reduction the heat island effect

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Introduction to Part 3

Energy and Atmosphere

Thank You!:

Thomas A .Fisher, AIA, LEED AP
Michael Babcock CEM®, LEED®-AP

December 10, 2008 4:00-5:00 PM

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Thank You!:

Thomas A .Fisher, AIA, LEED AP
www. sustaindesign.net
Tom@sustaindesign.net

Michael Babcock CEM®, LEED AP
www.emoenergy.com
mab@emoenergy.com

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Part 4
Materials & Recources and the Process

LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Sustainable & Smart
ecobuild fall
Sustainable, Green and High Performance Solutions for the Built Environment

Presented by:

Thomas A .Fisher, AIA, LEED AP
December 11, 2008 10:00 - 11:00

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Part 1 - Introduction

Sustainable Design Consulting

- Offices in Washington, DC and Richmond, VA
- Small woman-owned business
- Focus on greener solutions for the built environment
- Consulted on over 80 green building projects, over 200 LEED-related projects
- Commercial, institutional, multi-family, greater-DC-area and Central Virginia
- Project consulting mostly to Developers/Owners and Architects

What we do

- Green Building Project Management
- Drawing & Spec Review
- LEED advisory
- Lectures, Workshops & Trainings
- Design Guidance and Research

www.sustaindesign.net

Eastern Village Cohousing

Sustainable Design
Consulting

Outline

- Part I – Introduction
  - Impact of Buildings
  - Benefits of Green/Integrated Design
  - Overview and History of LEED
  - LEED Standards
  - Cost of LEED
  - Project Certification & Accreditation
  - Resources & Website
  - Questions, Discussion
- Part 2 – Sustainable Sites
- Part 3 – Energy & Atmosphere
- *Part 4 – Materials & Resources*
- Part 5 – Indoor Environmental Quality
- Part 6 – Water Efficiency, Innovation in Design, Exam Review, LEED 2009

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Why Green Building ?

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Part 2
Sustainable Sites

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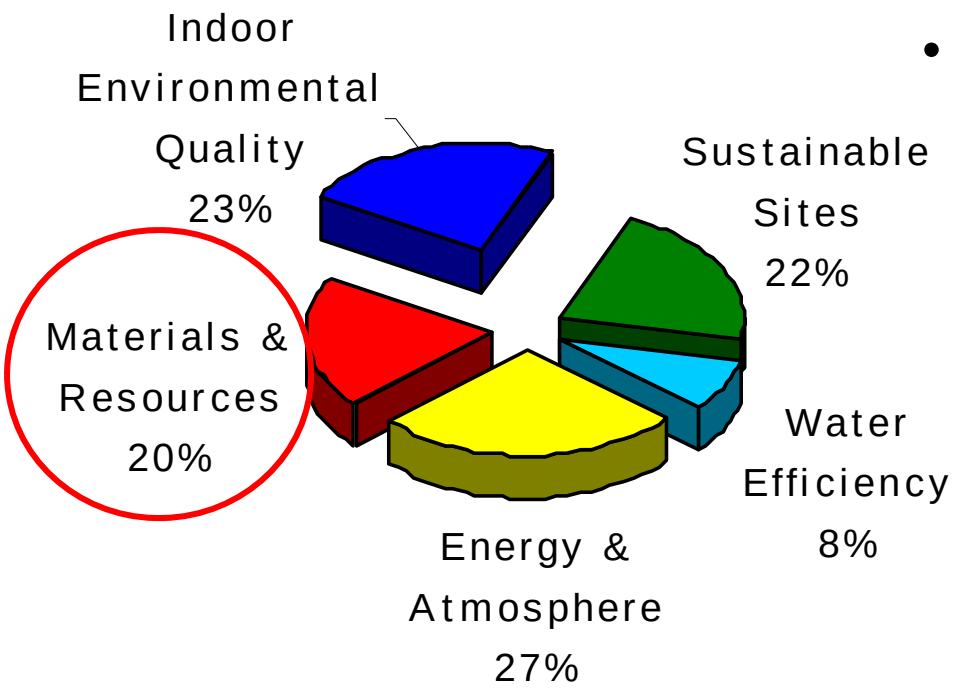
Part 4 – The LEED Credits



- Materials & Resources
  - Overview of section
  - Review credit
  - Discuss trickier credits

+ Innovation & Design Process

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LEED Categories: Materials & Resources (MR) Overview

Intent: Reduce waste, promote recycling; encourage building re-use; create a market demand for local and environmentally responsible products

- Prerequisite - Storage & Collection of Recyclables
- Credit 1 - Building Reuse (3 points)
- Credit 2 - Construction Waste Management (2 points)
- Credit 3 - Materials Reuse (2 points)
- Credit 4 - Recycled Content (2 points)
- Credit 5 - Regional Materials (2 points)
- Credit 6 - Rapidly Renewable Materials (1 point)
- Credit 7 - Certified Wood (1 point)

TOTAL AVAILABLE: 13 points

Synergy: *Straw fiberboard can contribute to Credit 6, can make Mrc7 easier to achieve, and can help earn EQc4.4*

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MRp1: Storage & Collection of Recyclables

Intent: Facilitate the reduction of waste disposed in landfills

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MRp1: Storage & Collection of Recyclables

Intent: Facilitate the reduction of waste disposed in landfills

Required: Provide an accessible recycling area that services the entire building

Paper, corrugated cardboard, glass, plastics, and metals

Submittals: Design Submittal

LEED Submittal Template - Confirm that recycling collection areas have been provided that meet the needs of the project

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MRc1.1 & 1.2: Building Reuse Maintain Existing Walls, Floors and Roof

Intent: Extend the life cycle of existing building stock and reduce the environmental impact of new construction

Required: Maintain existing building structure and exterior skin (not windows or non-structural roof material) This credit NOT applicable if addition is 2x area of existing building.

- 1.1: 75% minimum
- 1.2: 95% minimum

Submittals: Construction Submittal

- LEED Submittal Template
- Confirm whether the project is strictly a renovation or a renovation with an addition. For projects with additions, confirm the square footage of the new addition(s)
- Provide a tabulation of the existing and reused areas (sf) of each structural/envelope element

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MRc1.3: Building Reuse Maintain 50% of Interior Non-Structural Elements

Intent: Extend the life cycle of existing building stock and reduce the environmental impact of new construction

Required: Use existing interior non-structural elements (interior walls, doors, floor coverings and ceiling systems) in at least 50% (by area) of the completed building (including additions). This credit NOT applicable if addition is 2x area of existing building

Submittals: Construction Submittal

- LEED Submittal Template
- Confirm whether the project is strictly a renovation or a renovation with an addition. For projects with additions, confirm the square footage of the new addition(s)
- Provide a tabulation of the total and reused areas (sf) of each non-structural interior element

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MRc1: Building Reuse

Calculations:

- MRc1.1 & 1.2: Calculate area similar to contractor preparing construction bid
  - Exterior walls, floors, roof decking: One side area
  - Interior structural walls: Both sides area
- MRc1.3: Calculate area:
  - Finished ceilings and flooring: One side area
  - Interior doors: One side area
  - Interior casework: One side area (visible side)
  - Interior walls: Both sides area
  - Final calculation is based on TOTAL surface areas

Achievement of MRc1.1 & 1.2 is NOT required to achieve MRc1.3

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Eastern Village Cohousing
Silver Spring, MD

Photograph by Dan Cunningham

- Certified LEED-NC v2.1 SILVER in September 2005, with 34 points
- 4 stories, 56 condominium units plus shared common spaces
- Adaptive reuse of existing office building, completed 2005
- Received Maryland Green Building State Credit

Awards:

- NAHB 2005 National Green Building Award for Green Project of the Year: Luxury Multifamily
- 2005 *Environmental Design & Construction Magazine* Excellence in Design Award for Multi-Use Residential
- 2006 Green Roof Award of Excellence by Green Roofs for Healthy Cities

www.easternvillage.org

NAHB National Association of Home Builders

Green Roofs For Healthy Cities

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MRc1: Building Reuse
Case Study: Eastern Village Cohousing

- Reuse of Existing Building Structure, Exterior Walls and Stairwells

BEFORE . . .

. . . AFTER!

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MRc2: Construction Waste Management

Intent: Divert construction and demolition debris from landfill disposal.

Required: Develop and implement construction waste management plan that recycles and /or salvagse construction and demolition waste

- 2.1: 50% minimum by volume or weight (not both)
- 2.2: 75% minimum by volume or weight (not both)

Submittal: Construction Submittal

- LEED Submittal Template
- Narrative including Construction Waste Management Plan

Exemplary Performance:

- 95% diversion of waste from landfills

MRc2: Construction Waste Management

Construction and demolition waste:

- Typical: Cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard
- Include existing concrete and asphalt that are crushed and re-used on-site
- Include reused building materials for projects that reuse buildings but do not achieve MRc1
- Does NOT include excavated soil or land-clearing debris
- Does NOT include hazardous materials
- Include material donated

On-site segregated waste.

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MRc2: Construction Waste Management

Construction Waste Management Plan:

- Developed by Contractor (per Division 1 requirements)
- Content:
  - Diversion goal
  - Estimated job-site waste to be generated and materials to be recycled
  - Identification of party responsible for CWM implementation
  - Description of means and methods to achieve diversion goal
  - Identification of recycling contractors
  - Requirements for tracking waste generated and waste recycled/salvaged
  - Description of subcontractor and staff training

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One and Two Potomac Yard
Arlington, VA

- Architect: Davis Carter Scott
- Two towers, each 12 stories tall
- 9 floors of office, 650,000 sf total
- 6 levels of garage
  (3 above grade, 3 below)
- EPA is lead tenant with
  more than 405,000 sf
- Construction completed
  March 2006

MRc2: Construction Waste Management
Case Study: One and Two Potomac Yard

- Close to 75% construction waste diversion
- Were in the 85% range at the beginning of construction, but slipped during interior finishes stage

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MRc3: Materials Reuse

Intent: Reuse building materials and products in order to reduce demand for virgin materials and to reduce waste.

Required: Use salvaged, refurbished or reused materials

- 3.1: Minimum 5% of building materials by $ value
- 3.2: Minimum 10% of building materials by $ value

Submittals: Construction Submittal

- LEED Submittal Template
- Total project materials cost (Master Format 1995 Divisions 2-10) OR provide the total project cost (Divisions 2-10)
- A tabulation of each salvaged/reused material used on the project
- Narrative describing the material reuse strategy

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MRc3: Materials Reuse

Calculations:

- Total materials cost =
  - Total project materials cost (MasterFormat 1995 Div. 2-10)

  - OR -
  - 45% * (Total project cost for Div. 2-10)

- May include furniture if included consistently in MR credits 3-7
- This $ value applies to calculations for MR credits 3-6

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MRc3: Materials Reuse

Calculations:

- Cost of salvaged, refurbished, reused materials is based on:
  - Actual cost paid or the cost of an equivalent new item (aka replacement cost), whichever is higher

Exemplary Performance:

- 15% salvaged or reused

Brick collected for re-use

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MRc3: Resource Reuse

http://www.communityforklift.com

Examples include:

- Flooring
- Bathroom partitions
- Doors and Frames
- Furniture
- Cabinetry
- Brick

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MRc4: Recycled Content

Intent: Increase demand for building products containing recycled content

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MRc4: Recycled Content

Intent: Increase demand for building products containing recycled content

Required: Use materials with recycled content

- 4.1: 10% (post-consumer + 1/2 pre-consumer) based on $
- 4.2: 20% (post-consumer + 1/2 pre-consumer) based on $

Submittals: Construction Submittal

- LEED Submittal Template
- Total project materials cost (Divisions 2-10) OR provide the total project cost for (Divisions 2-10)
- A tabulation of each material used on the project that is being tracked for recycled content.

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MRc4: Recycled Content

Post-consumer material: Waste material generated by end-users of the product

- Steel: If no info. available, assume 25% post-consumer recycled content for

Pre-consumer material: Material diverted from waste stream during manufacturing process

- Fly ash and slag (cement replacements)

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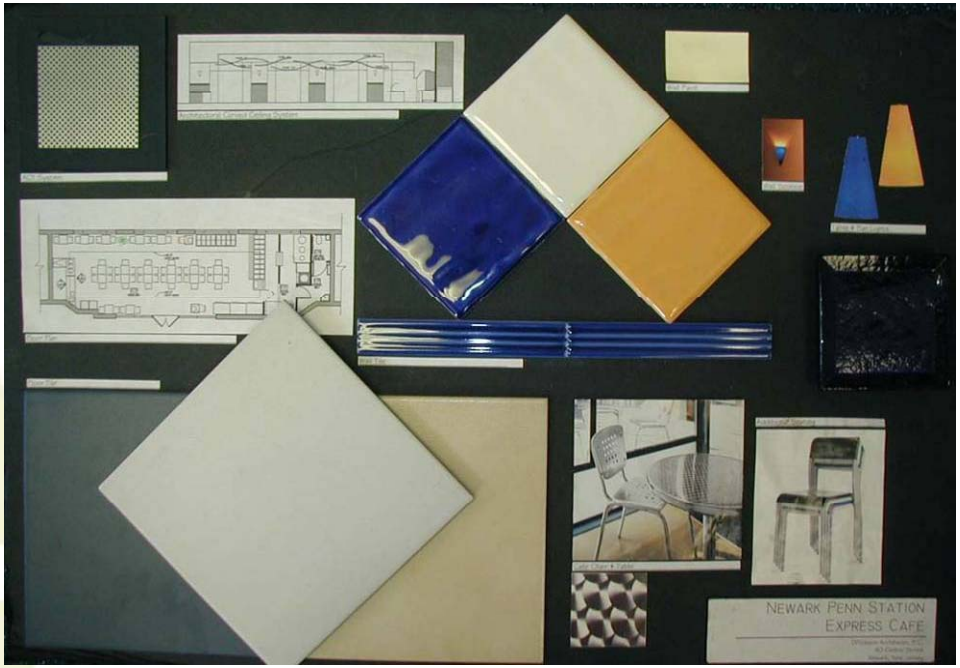
MRc4: Recycled Content

Materials with Recycled-Content (typical):

- Metals
- Concrete
- Acoustic tile
- Carpet
- Ceramic tile
- Insulation
- Drywall



http://designs4life.net

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Material Name	Manufacturer	Material Cost* ($)	Post-Consumer Recycled Content (%)	Pre-Consumer Recycled Content (%)	Recycled Content Information Source
Marmoleum Dual Tile	Forbo	$5,620.00	0.00	45.00	Material Cutsheet
Vibe Carpet	Invision	$2,706.00	0.00	16.70	Material Cutsheet
UltraBlend Particleboard	Roseburg Forest Products Co.	$27,946.00	0.00	100.00	Material Cutsheet
Plastic Laminate	Formica	$27,944.00	0.00	20.00	Material Cutsheet
USG SHEETROCK Brand Gypsum Panels	United States Gypsum Company	$22,810.00	3.80	96.00	Material Cutsheet
Optima #3251 Ceiling Tile	Armstrong	$30,550.00	10.00	30.00	Material Cutsheet
Steel Siding	MBCI	$35,400.00	25.00	0.00	Default Amount

The Trickier LEED Credits: MRc4: Recycled Content Materials

Calculations:

- Contractor typically does calculations
- Require initial estimate and monthly updates
- Identify material cost (requires getting info from subcontractors)
- Exclude mechanical & electrical equipment
- Confirm post-consumer vs. pre-consumer content
- For assemblies, calculate percentage by weight of recycled content

Exemplary Performance:

- 30% Recycled Content

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MRc5: Regional Materials

Intent: Increase demand for building materials and products that are extracted and manufactured within the region

Required: Use building materials and products that are extracted or recovered AND manufactured within a 500 mile radius

- 5.1: minimum 10% of building material by value
- 5.2: minimum 20% of building material by value

Submittal: Construction Submittal

- LEED Submittal Template
- Total project materials cost (MasterFormat 1995 Divisions 2-10) OR provide the total project cost (Divisions 2-10)
- A tabulation of each material used on the project that is being tracked for regional material.

Exemplary Performance:

- Minimum of 40% regional material

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The Trickier LEED Credits: MRc5: Regional Materials

- Provide the map w/ radius to the Contractor up front

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Product Name	Manufacturer	Total Product Cost* ($)	Percent Compliant (%)	Compliant Product Value	Harvest Distance (mi)	Manufacture Distance (mi)	Harvest / Manufacture Location Info Source
Stone	Vulcan Materials	$15,146.58	100.00%	$15,146.58	11.00	20.00	Data from Vulcan
Masonry Sand	Luck Stone	$7,573.32	100.00%	$7,573.32	30.00	30.00	Letter from Luck Stone
Gravel for Concrete Base	Luck Stone	$44,523.12	100.00%	$44,523.12	20.00	20.00	Letter from Luck Stone
CMU Block	Hagerstown Block	$129,466.00	100.00%	$129,466.00	152.00	120.00	Letter from Hagerstown
Brick	Old Va Brick	$44,232.25	90.00 %	$39,809.03	250.00	250.00	Letter from Old Va Brick
Aggregate C33used in Cast Stone	Lafarge	$68,293.00	100.00%	$68,293.00	118.00	24.00	Letter from Lafarge
Aggregate #7 Stone used in Cast Stone	Vulcan Materials	$1,492.00	100.00%	$1,492.00	91.00	24.00	Data from Vulcan
Concrete	Rowe Concrete	$33,496.52	100.00%	$33,496.52	114.00	20.00	Letter from Rowe Concrete
Site Concrete	Rowe Concrete	$62,500.75	100.00%	$62,500.75	114.00	20.00	Letter from Rowe Concrete
			%	$0.00			
			%	$0.00			
			%	$0.00			

MRc6: Rapidly Renewable Materials

Intent: Reduce the use of finite raw materials & long-cycle renewable materials by replacing them with rapidly renewable materials

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MRc6: Rapidly Renewable Materials

Required: Use rapidly renewable building products (10-year cycle or shorter) for 2.5% of the total value of all building materials

Submittals: Construction Submittal

- Signed LEED Letter Template
- Total project materials cost (MasterFormat 1995 Divisions 2-10) OR provide the total project cost (Divisions 2-10)
- A tabulation of each material used on the project that is being tracked as rapidly renewable material.

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MRc6: Rapidly Renewable Materials

- Rapidly renewable materials (typical):
  - Bamboo (flooring, cabinetry, wall paneling)
  - Strawboard, sunflower, wheatgrass (cabinetry, wall paneling)
  - Wool, cotton (wall covering, insulation)
  - Linoleum (flooring, wall covering)
  - Soy (cabinetry, wall covering, insulation)
  - Cork (flooring, tackboards)

Exemplary Performance:

  - 5% rapidly renewable materials

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MRc7: Certified Wood

Intent: Encourage environmentally responsible forest management

Required: Use a minimum of 50% of wood-based materials that are certified by the Forest Stewardship Council (FSC)

Submittals: Construction Submittal

- LEED Submittal Template
- Include a list of items (and/or components of products) claimed as FSC certified, including product type, manufacturer, and the appropriate entity's Chain of Custody (COC) certification number.
- New wood material value

Exemplary Performance:

- 95% FSC Certified Wood

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MRc7: Certified Wood

- FSC Certification:
  - Seal of approval awarded to:
    - Forest managers who adopt environmentally and socially responsible forest management practices:
      - Sustainable timber harvesting
      - Preserving habitat and biodiversity
      - Maintaining soil and water quality
      - Minimizing use of harmful chemicals
      - Conserving high value forests
      - Respecting indigenous rights
      - Benefiting community members
    - Companies that manufacture and sell products made from certified wood (Chain-of-Custody Certification)

www.fsc.org

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MRc7: Certified Wood

Calculations:

Wood-based materials =

Permanently Installed structural lumber + dimensional lumber + flooring + sub-flooring + wood doors + cabinetry + trim + finishes + others

Note: If reusable wood forms are included in the calculations, then all temporary wood materials must be included as well.

FSC

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MRc7: Certified Wood
Case Study: One and Two Potomac Yard

FSC Certified Wood

- 82.79% FSC
- All Millwork
- Wood Doors
- Concrete Formwork*
- Misc. Safety Carpentry
- All Blocking
- Wood Flooring

Not possible

- Lagging for Sheeting & Shoring

*NC2.1 projects included formwork in calculations

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CERTIFIED WOOD MATERIALS CALCULATION

Enter the values for all new wood-based components below to calculate the certified wood percentage for the project.

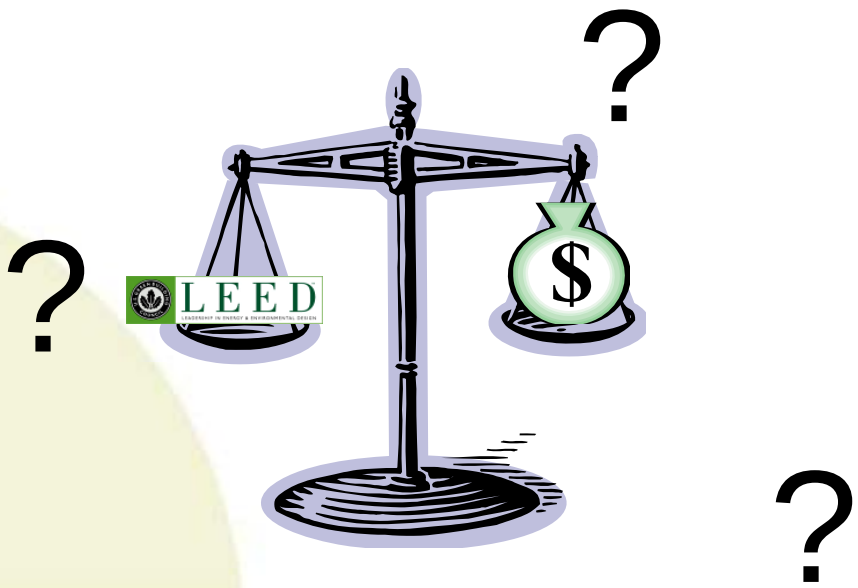
* For cost values, do not use commas and instead enter numbers only (i.e., enter 100000 for $100,000)

** For products that combine wood and other materials (i.e., assemblies), enter the percentage wood component by weight, volume or cost.

*** Products that are listed as "FSC Pure" or "FSC Mixed Credit" shall enter 100%; products that are listed as "FSC Mixed [NN]%" shall enter the actual percentage FSC content.

Product Name	Vendor	Product Cost ($)*	Wood Component Percentage (%)**	FSC Certified Wood Percentage (%) of Product Shown on Vendor Invoice***	FSC Chain-of-Custody Certificate Number from Vendor Invoice	
Plywood	Columbia Forest	$82.00	100.00 %	0.00 %	N/A	CLEAR
Doors	Marshfield	$50,000.00	100.00 %	70.00 %	SCS-COC-008523	CLEAR
Medite II	Roseburg	$100.00	100.00 %	100.00 %	SCS-COC-562387	CLEAR
Solid Maple Door Frames	Seiling and Jones	$1,920.00	100.00 %	100.00 %	SCS-COC-593722	CLEAR
Quartered Maple Veneer Panels	Seiling and Jones	$11,535.00	100.00 %	5.00 %	SCS-COC-821461	CLEAR
			%	%		CLEAR
			%	%		CLEAR

Quiz Time!



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Quiz Question 1:

When developing the Division 1 specifications, what should the architect require the contractor to document in order to comply with the requirements for MR Credit 2, Construction Waste Management? (Choose three.)

A. Quantity of waste leaving site

B. Description of waste material

C. Initial estimate of waste materials with recycled-content

D. Identity of haulers and recyclers

E. Description of the site logistics plan

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Quiz Question 2:

Using fly ash may help capture which of the following credits? (Choose one.)

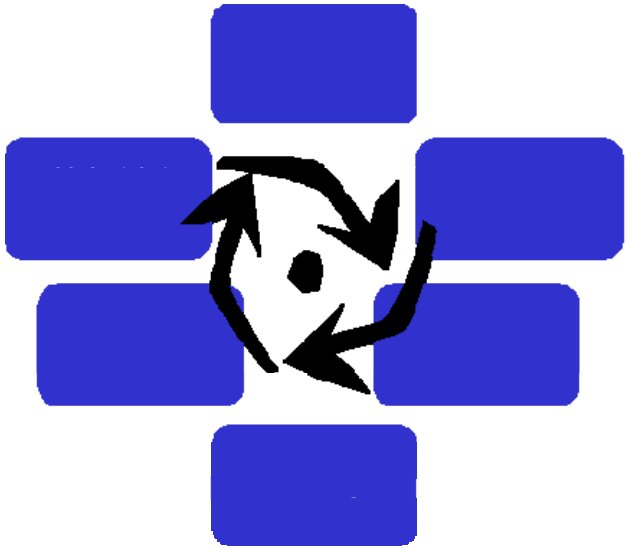
A. MR Credit 1 Building Reuse

B. MR Credit 3 Materials Reuse

C. MR Credit 4 Recycled Content

D. MR Credit 6 Rapidly Renewable Materials

E. MR Credit 7 Certified Wood



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Quiz Question 3:

A client in Arizona wants to add to an existing facility with the least amount of environmental impact. All of the following will help achieve that goal *except*: (Choose one.)

A. Energy audit of the Existing Facility

B. Specification of European stone

C. Specification of recycled-content materials

D. Incorporation of a wind turbine

E. Installation of high SRI roofing material

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Quiz Question 4:

How can the Total Materials Cost be determined in accordance with LEED? (Choose two.)

A. Multiply the total construction cost for Div 2-10 materials by 0.45

B. Tally the actual materials cost for Div 2-10 materials

C. Multiply the bid price by 0.45

D. Divide the total construction cost for Div 2-10 materials by 0.45

E. Tally the actual materials cost for Div 1-16 materials

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Quiz Question 5:

The design team has elected to pursue design strategies to meet the requirements of MR Credit 7, Certified Wood. What information should the Contractor's project manager verify? (Choose two.)

A. Total cost of all materials on the project

B. FSC chain-of-custody certificate number

C. Amount of added urea-formaldehyde in the wood-based products

D. Cost of all wood-based products in the project

E. VOC levels of adhesives used to install the wood-based products

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Part 4
Materials & Recources and the Process

LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Sustainable & Smart
ecobuild fall
Sustainable, Green and High Performance Solutions for the Built Environment

Thank you!

Thomas A .Fisher, AIA, LEED AP
tom@sustaindesign.net

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

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Part 5

Indoor Environmental Quality and the LEED Process

Trainer:

Thomas A . Fisher, AIA, LEED AP

December 11, 2008 11:00 AM

Sustainable & Smart ecobuild® fall

Sustainable, Green and High Performance Solutions for the Built Environment

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Part 1 - Introduction

Sustainable Design Consulting

- Offices in Washington, DC and Richmond, VA
- Small woman-owned business
- Focus on greener solutions for the built environment
- Consulted on over 80 green building projects, over 200 LEED-related projects
- Commercial, institutional, multi-family, greater-DC-area and Central Virginia
- Project consulting mostly to Developers/Owners and Architects

What we do

- Green Building Project Management
- Drawing & Spec Review
- LEED advisory
- Lectures, Workshops & Trainings
- Design Guidance and Research

www.sustaindesign.net

Eastern Village Cohousing

Sustainable Design
Consulting

Outline

- Part I – Introduction
  - Impact of Buildings
  - Benefits of Green/Integrated Design
  - Overview and History of LEED
  - LEED Standards
  - Cost of LEED
  - Project Certification & Accreditation
  - Resources & Website
  - Questions, Discussion
- Part 2 – Sustainable Sites
- Part 3 – Energy & Atmosphere
- Part 4 – Materials & Resources
- *Part 5 – Indoor Environmental Quality*
- Part 6 – Water Efficiency, Innovation in Design, Exam Review, LEED 2009

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Why Green Building ?

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Why Improving Indoor Environmental Air Quality is Important

83.30%	$130	Salaries
13.35%	$21	Gross Office Rent
2.10%	$3.20	Repair and Maintenance
1.20%	$1.80	Total Energy Costs
100%	$156	Typ. Office Bldg Operating Costs/SF/Yr

"…a 'productivity' increase of 1% will completely offset the building's entire energy bill."

-Whole Building Design Guide

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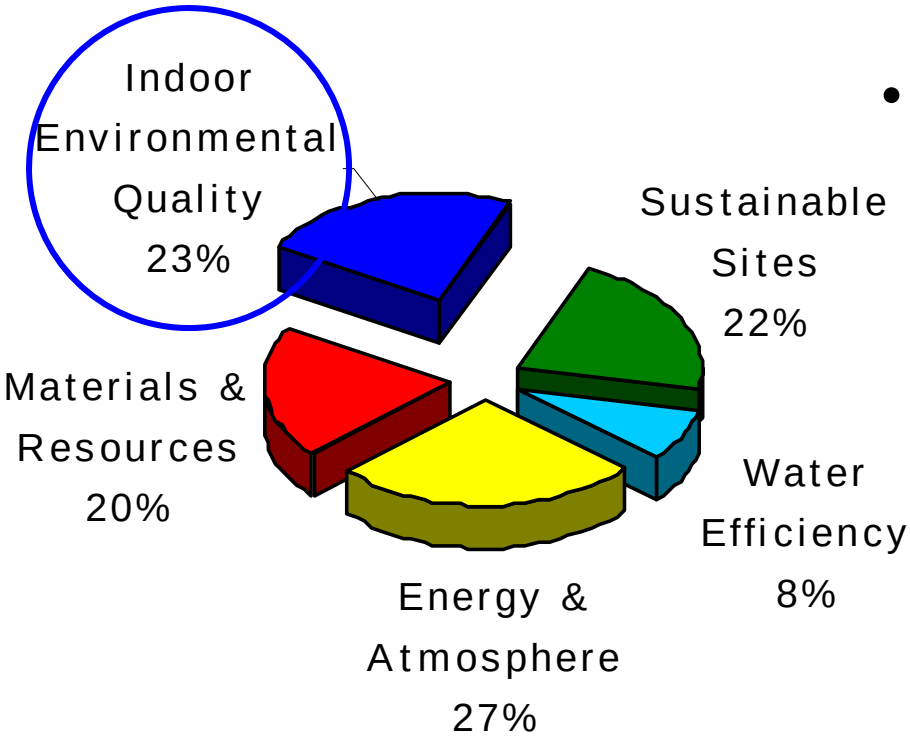
Part 5 – The LEED Credits



+ Innovation & Design Process

- Indoor Environmental Quality
  - Benefits
  - Overview of section
  - Review credit
  - Discuss trickier credits

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LEED Categories: Indoor Environmental Quality (EQ) Overview

Intent: Optimize interior spaces for building occupants

- Prerequisite 1 – Minimum IAQ Performance
- Prerequisite 2 – Environmental Tobacco Smoke (ETS) Control
- Credit 1 – Outdoor Air Delivery Monitoring (1 point)
- Credit 2 – Increased Ventilation (1 point)
- Credit 3 – Construction IAQ Management Plan (up to 2 points)
- Credit 4 – Low Emitting Materials (up to 4 points)
- Credit 5 – Indoor Chemical & Pollutant Source Control (1 point)
- Credit 6 – Controllability of Systems (up to 2 points)
- Credit 7 – Thermal Comfort (up to 2 points)
- Credit 8 – Daylight & Views (up to 2 points)

TOTAL AVAILABLE: 15 points

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EQp1: Minimum IAQ Performance

Intent: Establish minimum indoor air quality (IAQ) ventilation design

Required: Meet the minimum requirements of sections 4 – 7 of **ASHRAE 62.1-2004, Ventilation for Acceptable Indoor Air Quality**. Use the Ventilation Rate Procedure or the applicable code, whichever is more stringent.

Note: Naturally ventilated buildings shall comply with **ASHRAE 62.1-2004**, paragraph 5.1.

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EQp1: Minimum IAQ Performance

Submittals: Design Submittal

- LEED Submittal Template
- Narrative describing the project's ventilation design (fresh air intake volumes, special conditions, etc,).
- Mechanically Ventilated: confirm the project meets the minimum requirements of **ASHRAE Standard 62.1-2004**, Ventilation for Acceptable Indoor Air Quality, using the Ventilation Rate Procedure.
- Naturally Ventilated: confirm the project complies with the location and size of window openings per **ASHRAE Standard 62.1-2004**, Section 5.1 and provide project drawings.

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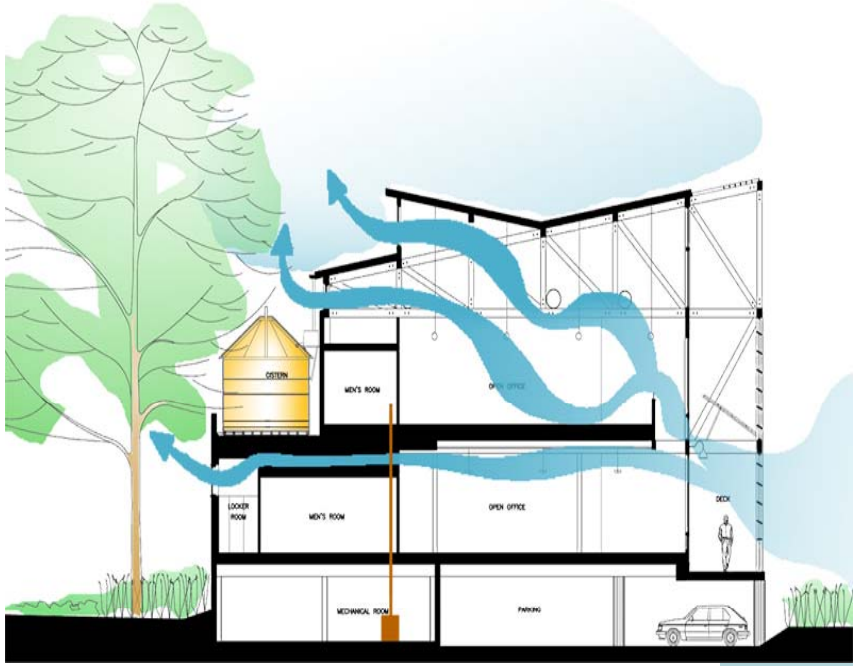
EQp1: Minimum IAQ Performance

Submittals: Design Submittal continued..

- Naturally Ventilated: confirm the project complies with the location and size of window openings per **ASHRAE Standard 62.1-2004**, Section 5.1 and provide project drawings.



Merrill Environmental Center
Architects: Smith Group

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EQc2: Increased Ventilation

Intent: Provide additional outdoor air ventilation to improve indoor air quality for improved occupant comfort, well-being and productivity.

Heat recovery ventilation: www.homemoisture.org/

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EQc2: Increased Ventilation

Required:

MECHANICALLY VENTILATED BUILDINGS:

Increase breathing zone outdoor air ventilation rates ≥ *30% above the minimum rates* required by **ASHRAE Standard 62.1-2004**.

NATURALLY VENTILATED SPACES:

Design natural ventilation systems for occupied spaces to meet the "**Carbon Trust Good Practice Guide 237**" [1998]. Follow the flow diagram process shown in Figure 1.18 of the **Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005**, Natural ventilation in non-domestic buildings.

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EQc2: Increased Ventilation

Submittals: Design Submittal

– LEED Submittal Template

MECHANICALLY VENTILATED:

- Confirm breathing zone ventilation rates in all occupied spaces exceed **ASHRAE 62.1-2004** or the applicable local code, whichever is more stringent, by a minimum of 30%.
- Provide a design narrative describing the project's ventilation system design.

NATURALLY VENTILATED :

- Confirm that the natural ventilation system has been designed to meet the **Carbon Trust Good Practice Guide 237** [1988].
- Provide a Design narrative describing the design method **(CIBSE Method/Analytic Model)** utilized in determining the natural ventilation design for the project.

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The Trickier LEED Credits: EQc2 & EAc1

- How to increase ventilation and achieve energy efficiency?
  - Heat recovery
  - Temperature air-side economizer
    - Outdoor air provides "free cooling" when the outdoor air temperature < return air temperature
    - Economizer operation dependent on outdoor temperature and humidity
    - Ineffective in hot humid climates
  - Ventilation with high Zone Air Distribution Effectiveness (e.g., underfloor air distribution)
    - Maintain acceptable air quality in breathing zone (3-6 ft above floor)
  - Occupancy sensing and demand control ventilation (DCV)

TABLE 6-2
Zone Air Distribution Effectiveness

Air Distribution Configuration	E_z
Ceiling supply of cool air	1.0
Ceiling supply of warm air and floor return	1.0
Ceiling supply of warm air 15°F (8°C) or more above space temperature and ceiling return.	0.8
Ceiling supply of warm air less than 15°F (8°C) above space temperature and ceiling return provided that the 150 fpm (0.8 m/s) supply air jet reaches to within 4.5 ft (1.4 m) of floor level. **Note**: For lower velocity supply air, $E_z = 0.8$.	1.0
Floor supply of cool air and ceiling return provided that the 150 fpm (0.8 m/s) supply jet reaches 4.5 ft (1.4 m) or more above the floor. **Note**: Most underfloor air distribution systems comply with this proviso.	1.0
Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification	1.2
Floor supply of warm air and floor return	1.0
Floor supply of warm air and ceiling return	0.7
Makeup supply drawn in on the opposite side of the room from the exhaust and/or return	0.8
Makeup supply drawn in near to the exhaust and/or return location	0.5

1. "Cool air" is air cooler than space temperature.
2. "Warm air" is air warmer than space temperature.
3. "Ceiling" includes any point above the *breathing zone*.
4. "Floor" includes any point below the *breathing zone*.
5. As an alternative to using the above values, E_z may be regarded as equal to air change effectiveness determined in accordance with ASHRAE Standard 129[16] for all air distribution configurations except unidirectional flow.

The Trickier LEED Credits: EQc2 & EAc1

- How to increase ventilation and achieve energy efficiency?
  - *Heat recovery*
  - Temperature air-side economizer
    - Outdoor air provi when the outdoo < return air temp
    - Economizer oper on outdoor temp humidity
    - Ineffective in hot
  - Ventilation with high Distribution Effective underfloor air distrib
    - Maintain accepta breathing zone (3-6 ft above floor)
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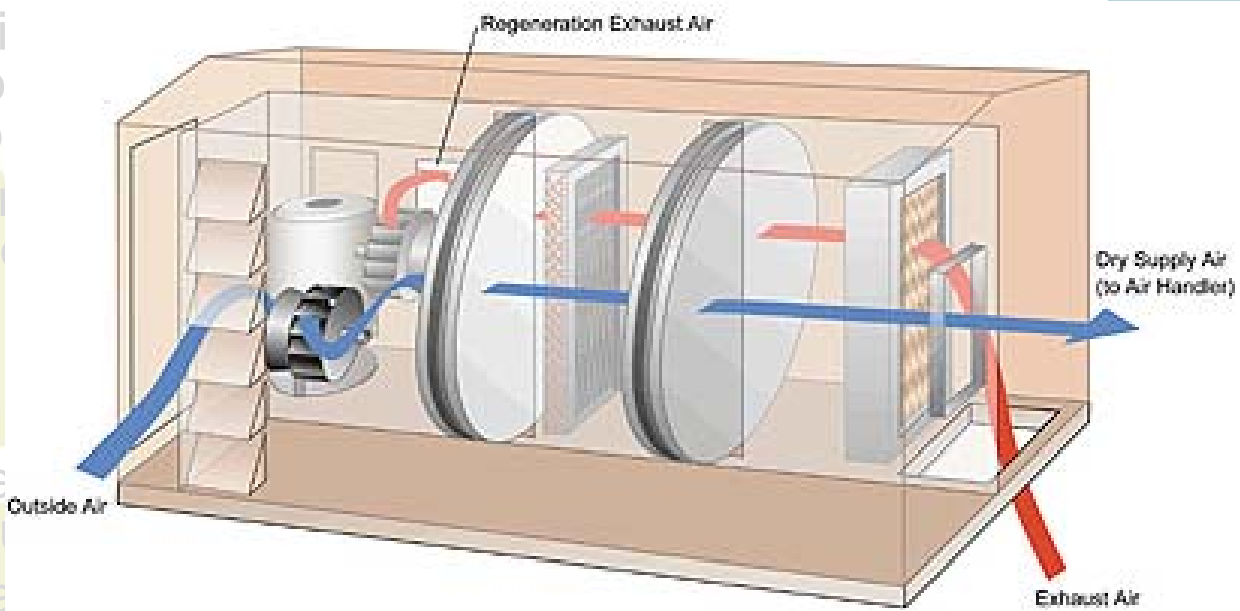

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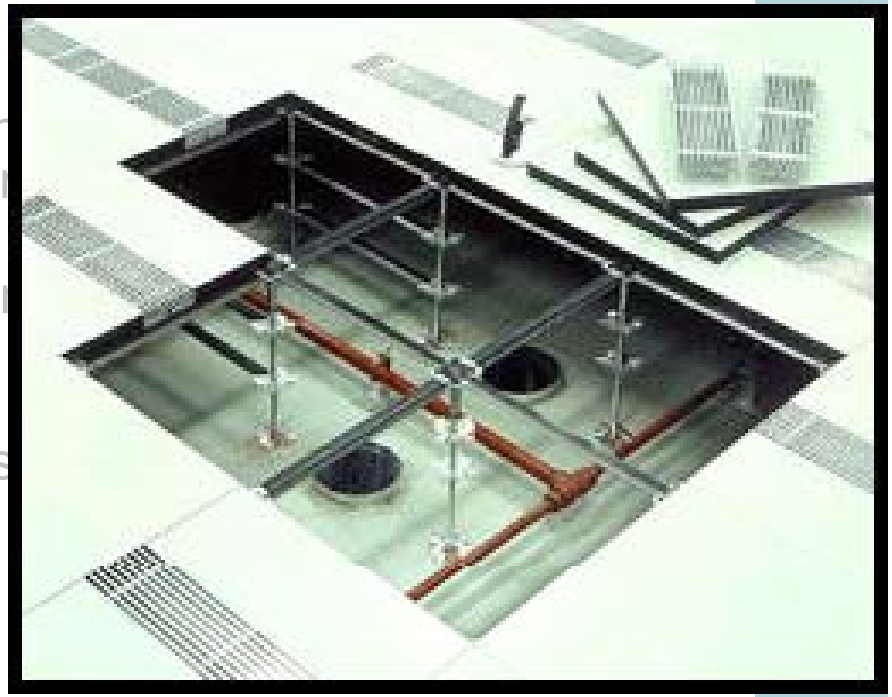
The Trickier LEED Credits: EQc2 & EAc1

- How to increase ventilation and achieve energy efficiency?
  - Heat recovery
  - Temperature air-side economizer
    - Outdoor air provides "free coolin when the outdoor air temperatu < return air temperature
    - Economizer operation depende on outdoor temperature and humidity
    - Ineffective in hot humid climates
  - Ventilation with high Zone Air Distribution Effectiveness (e.g., under floor air distribution)
    - Maintain acceptable air quality in breathing zone (3-6 ft above floor)
  - Occupancy sensing and demand control ventilation (DCV)



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EQp2: Environmental Tobacco Smoke (ETS) Control

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

Required:

- Option 1:
  - Prohibit smoking in the building
  - Locate any exterior designated smoking areas ≥ 25 feet away from entries, outdoor air intakes and operable windows

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EQp2: Environmental Tobacco Smoke (ETS) Control

OR Option 2:

- Establish negative pressure in the rooms with smoking.
- Prohibit smoking in the building except in designated smoking areas.
- Locate any exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows.

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EQp2: Environmental Tobacco Smoke (ETS) Control

OR Option 2 (cont):

- Locate designated smoking rooms to effectively contain, capture and remove ETS from the building.
- Verify performance of the smoking room differential air pressures by conducting 15 min. of measurement (1 every 10 sec.) of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed.

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EQp2: Environmental Tobacco Smoke (ETS) Control

Option 2 (cont):

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EQp2: Environmental Tobacco Smoke (ETS) Control

OR Option 3: (For residential buildings only)

- Prohibit smoking in all common areas of the building.
- Locate exterior designated smoking areas ≥ 25 feet away from entries, outdoor air intakes and operable windows opening to common areas.
- Minimize uncontrolled pathways for ETS transfer between individual residential units by sealing penetrations in walls, ceilings and floors in the residential units, and by sealing vertical chases adjacent to the units.
- All doors in the residential units leading to common hallways shall be weather-stripped.
- If the common hallways are pressurized, weatherstripping is not required
- Provide Blower Door testing

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EQp2: Environmental Tobacco Smoke (ETS) Control

Submittals: Design Submittal

- LEED Submittal Template
- Confirmation that the project has met the requirements for the selected option
- For buildings with interior smoking rooms or for residential projects, provide appropriate copies of construction drawings to document the location of the smoking rooms, designed area separations, and dedicated ventilation systems.

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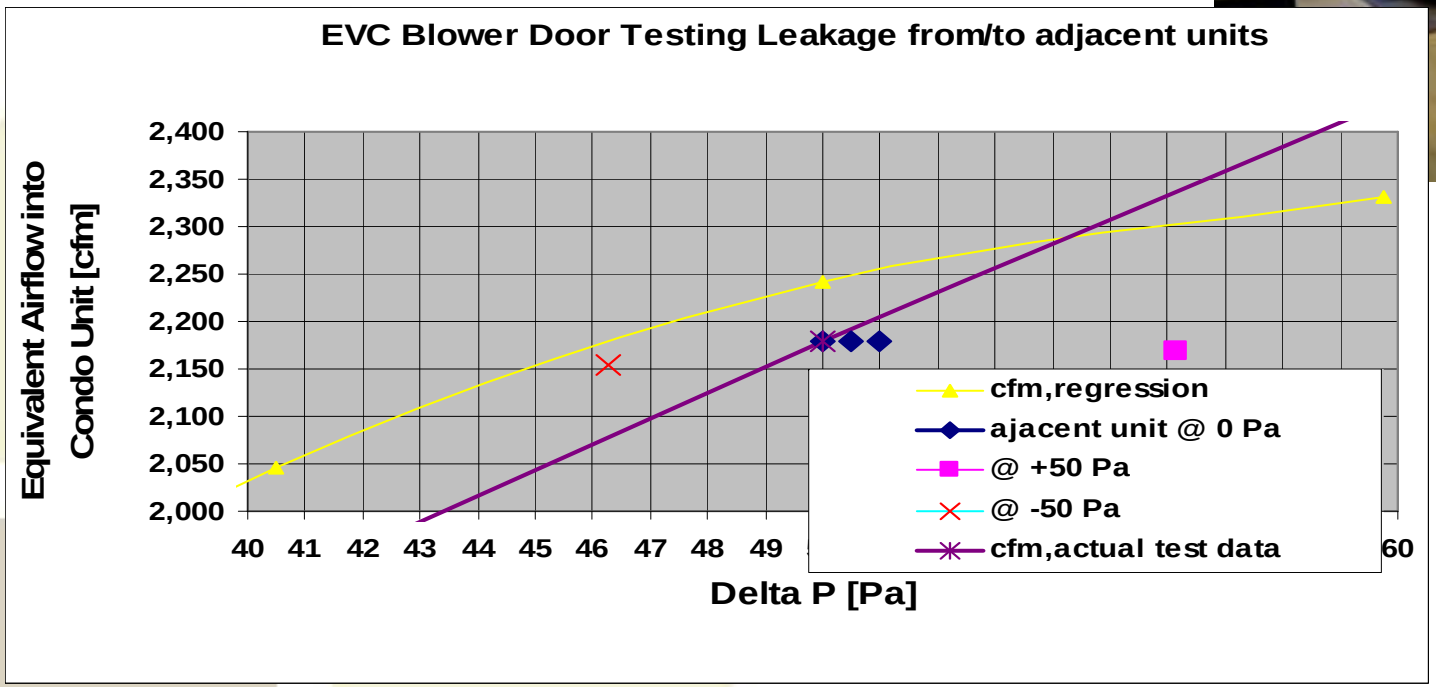
EQp2: ETS Control
Case Study: Eastern Village Cohousing

- Every condo considered smoking room (EQp2)
  - Seal between units



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EQc1: Outdoor Air Delivery Monitoring

Intent: Provide capacity for ventilation system monitoring to help sustain occupant comfort and well-being.

Required: Install permanent monitoring systems to ensure that ventilation systems maintain minimum ventilation requirements.

Submittals: Design Submittal

- LEED Submittal Template
- Confirmation of the type of ventilation system and installed controls.
- Design narrative describing the project's ventilation design and CO2 monitoring system.
- Project drawings to document the location and type of installed sensors and natural ventilation components (operable windows, air intakes, etc.) as applicable.

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EQc1: Outdoor Air Delivery Monitoring

Densely Occupied Spaces: greater than 25 people per 1000 sq. ft.

- Monitor carbon dioxide concentrations
- Locate monitors 3'-6' above floor
- Alarm when indoor CO2 concentrations exceed 1000ppm

Non-Densely Occupied Spaces: less than 25 people per 10000 sq. ft.

- Direct measurement of outdoor airflow rate
- Accuracy plus/minus 15% of ASHRARE 62.1-2004
- Provide visual or audit alert to systems operator

Natural Ventilated Spaces:

- Monitor carbon dioxide concentrations in all spaces
- Locate monitors 3'-6' above floor

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EQc1: Outdoor Air Delivery Monitoring

Densely Occupied Spaces: greater than 25 people per 1000 sq. ft.

- Monitor carbon dioxide concentrations
- Locate monitors 3'-6' above floor
- Alarm when indoor CO2 concentrations exceed 1000ppm

Non-Densely Occupied Spaces: less than 25 people pe

- Direct measurement of outdoor airflow rate
- Accuracy plus/minus 15% of ASHRARE 62.1-2
- Provide visual or audit alert to systems operato

Natural Ventilated Spaces:

- Monitor carbon dioxide concentrations in all spaces
- Locate monitors 3'-6' above floor

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EQc3: Construction IAQ Management Plan

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

EQc3.1 – During Construction (1 point)

EQc3.2 – Before Occupancy (1 point)

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EQc3.1: Construction IAQ Management Plan During Construction

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

- During construction, meet or exceed **SMACNA IAQ Guideline for Occupied Buildings Under Construction,** 1995, Chapter 3.
- Protect stored on-site or installed absorptive materials from moisture damage.
- If permanently installed air handlers are used during construction, use MERV 8 filtration media at each return air grille, per **ASHRAE 52.2-1999**. Replace all filtration media immediately prior to occupancy.

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EQc3.1: Construction IAQ Management Plan During Construction

Submittals: Construction Submittal

- LEED Submittal Template
- Provide a copy of the IAQ Management Plan.
- Confirm if air handling equipment was used during construction.
- Provide ***photos*** to highlight the implemented construction IAQ practices.
- List all filtration media

MERV 8

MERV 13

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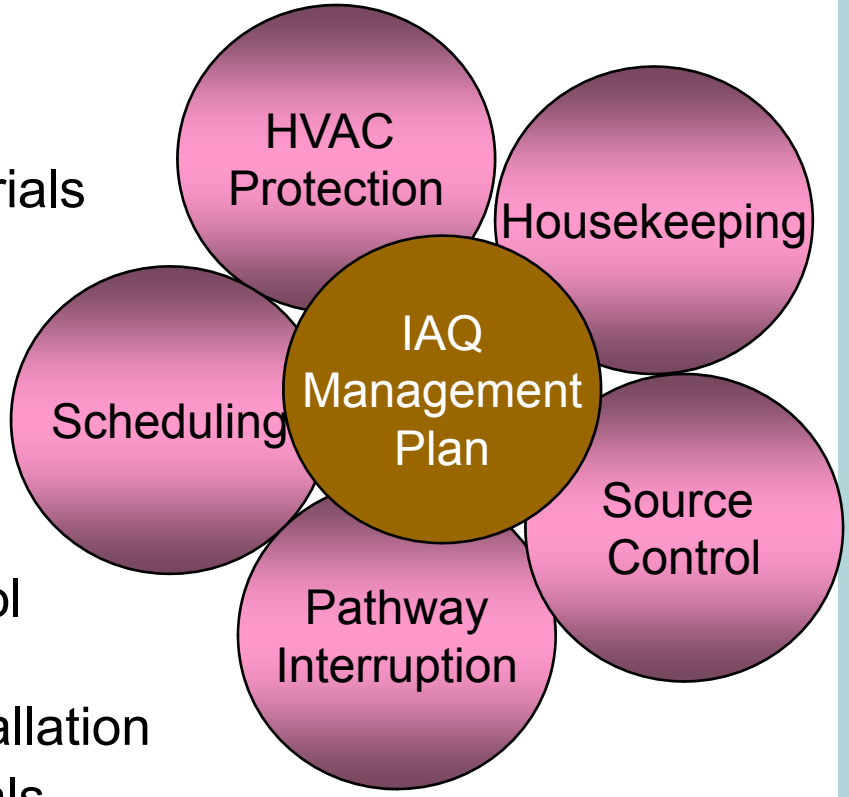
EQc3.1: Construction IAQ Management Plan During Construction

- IAQ Management Plan
  - HVAC protection
  - Source control
    - Control measures for materials containing VOCs
    - Low VOC materials
  - Pathway interruption
    - Isolation of work areas
  - Housekeeping
    - Cleaning activities to control contaminants
  - Scheduling / Sequence of Installation
    - Install high emitting materials before installing absorptive materials



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The Trickier LEED Credits: EQc3.1: Construction IAQ Management During Construction

- IAQ management measures:
  - Make sure Contractor submits detailed plan
  - Remember protect absorptive finishes, not just ductwork!
  - MERV-8 requirement throughout construction

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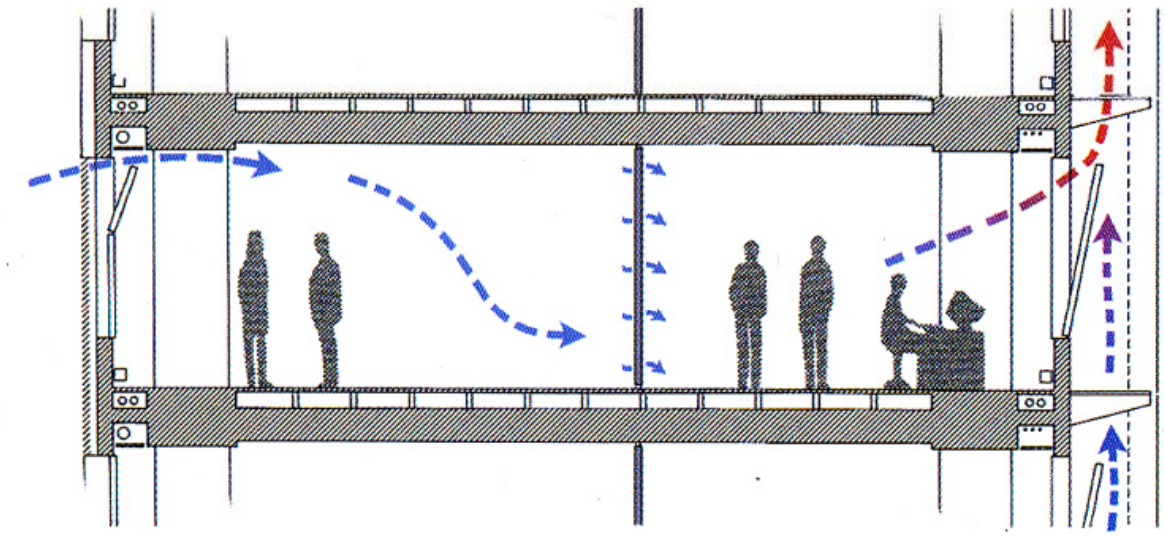
EQc3.2: Construction IAQ Management Plan Before Occupancy

Required: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the pre-occupancy phase

OPTION 1 — Flush-Out



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EQc3.2: Construction IAQ Management Plan Before Occupancy

Required: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the pre-occupancy phase

OPTION 1 — Flush-Out

- After construction, prior to occupancy, perform a building flush-out by supplying a total of 14,000 cu.ft./sq.ft. of outside air per sq.ft . Maintain a minimum temperature of 60ºF and 60% maximum relative humidity.
- OR occupancy prior to completion of the flush-out, Deliver a minimum of 3,500 cu.ft. of outdoor air per sq.ft. of floor area to the space. After occupancy, ventilate at a rate of 0.30 cfm/sq.ft. of outside air or the EQp1 design minimum. During the flush-out period, ventilation shall began 3 hours prior to occupancy and continue during occupancy. Continue until a total of 14,000 cu.ft./sq.ft. of outside air has been delivered to the space

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EQc3.2:
Construction IAQ Management Plan Before Occupancy

OPTION 2 — Air Testing

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EQc3.2: Construction IAQ Management Plan Before Occupancy

OPTION 2 — Air Testing

- Conduct baseline IAQ testing, after construction ends and prior to occupancy, using testing protocols consistent with the **EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air.**
- Demonstrate that the contaminant maximum concentrations listed below are not exceeded.

Chemical Contaminant	Maximum Concentration
Formaldehyde (HCHO)	50 parts per billion
Particulates	50 micrograms per cubic meter
TVOC (Total Volatile Organic Compounds)	500 micrograms per cubic meter
* 4-PCH (4-phenyl-cyclohexene)	6.5 micrograms per cubic meter
Carbon Monoxide (CO)	9 ppm and ≤ 2 ppm above outdoor levels
* This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing material are installed as part of the base building systems.	

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EQc3.2: Construction IAQ Management Plan Before Occupancy

Submittals: Construction Submittal

- LEED Submittal Template
- Confirmation regarding the approach taken by the project
- A narrative describing the project's specific flush-out procedures and/or IAQ testing process and results.
- A copy of the project's Indoor Air Quality testing report (if applicable).

IAQ testing at Washington-Lee

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The Trickier LEED Credits: EQc3.2: Construction IAQ Management Before Occupancy

- Option 1 - Typically requires a 2-week Flush-out @ 100% outside air:
  - Often difficult to schedule
  - Commissioning can take place but NO punch-out, cleaning, HVAC testing and balancing
  - Ability to provide high volume of outside air while maintaining 60% RH and 60degF depends on type of equipment and time of year

EPA Research Triangle Park Facility

Sustainable Design Consulting

EQc3: Construction IAQ Management Plan

Case Study: One and Two Potomac Yard

- Pursued IAQ Testing per LEED & EPA
- Failed at Installations of Recycled Rubber Flooring
- Had to Flush-Out and Re-Test
- Prolonged Testing Period, Delayed USGBC Submission

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EQc4: Low-Emitting Materials

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

- EQc4.1 – Adhesives and Sealants
- EQc4.2 – Paints and Coatings
- EQc4.3 – Carpet Systems
- EQc4.4 – Composite Wood & Agrifiber Products

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EQc4.1: Low-Emitting Materials Adhesives & Sealants

Required: All adhesives, sealants, and sealant primers used on the interior of the building shall comply with the VOC limits listed in the **South Coast Air Quality Management District (SCAQMD) Rule #1168**

All aerosol adhesives shall comply with the **Green Seal Standard for Commercial Adhesives GS-36** requirements

Submittals: Construction Submittal

- LEED Submittal Template
- List the adhesives, sealants, sealant primers & aerosol adhesives used in the building

AQMD

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CREDIT COMPLIANCE

Please provide the required data for each indoor Adhesive, Sealant, Sealant Primer and Aersol Adhesive Product(s) use on this project.

List of all Indoor Adhesives, Sealant and Sealant Primer Products

Product Manufacturer	Product Name / Model	Product VOC Content (g/L)	SCAQMD Allowable VOC Content (g/L)	Source of VOC Data
Design Polymerics	Duct Sealant	19.00	250.00	Submittal
USG	Acoustical Sealant	65.00	250.00	Submittal
USG	Joint Compound	2.00	50.00	Submittal
Wilsonart International	H20 Adhesive	20.00	50.00	
Gorilla Glue	Polyurethane Adhesive	0.00	70.00	
Chapco Adhesive Company	Safe-set 4 Cove Base Adhesive	0.00	50.00	
Key Resin Company	Epoxy Binder #510	0.00	50.00	

EQc4.2: Low-Emitting Materials Paints & Coatings

Required: Paints and coatings must not exceed the VOC limits of **Green Seal's Standard GS-11** requirements (Flats: 50 g/L; Non-Flats: 150 g/L). Primers must meet VOC limit for non-flat paints.

Anti-corrosive & anti-rust paints must not exceed the VOC limits of **Green Seal's Standard GS-03** (250 g/L).

Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements must not exceed the VOC limits **in South Coast Air Quality Management District (SCAQMD) Rule 1113**, Architectural Coatings

Submittals: Construction Submittal

- LEED Submittal Template
- Provide a listing of each indoor paint and coating used on the project.

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EQc4.3: Low-Emitting Materials Carpet Systems

Required: All carpet installed in the building interior shall meet the testing and product requirements of the **Carpet and Rug Institute's Green Label Plus** program

All carpet cushion installed in the building interior shall meet the requirements of the **Carpet and Rug Institute Green Label program**

All carpet adhesive shall meet the requirements of EQ Credit 4.1: 50 g/L VOC

Submittals: Construction Submittal

- LEED Submittal Template
- Provide a listing of each carpet product & each carpet cushion product installed in the building interior. Confirm that product complies with **CRI Green Label Plus** testing program.

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EQc4.4: Low-Emitting Materials Composite Wood & Agrifiber Products

Required: Permanently installed composite wood and agrifiber products must contain no added *urea*-formaldehyde resins.

Laminate adhesives shop-applied and field-applied must contain no added urea-formaldehyde resins

Submittals: Construction Submittal

- LEED Submittal Template
- List all the composite wood products used in the building

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EQc4.4: Low-Emitting Materials Composite Wood & Agrifiber Products

- Composite wood and agrifiber products:
  - Particleboard
  - Medium density fiberboard (MDF)
  - Plywood
  - Wheatboard / Strawboard
  - Include all products used inside building's weatherproofing / waterproofing system
  - Include composite components used in assemblies (e.g., panel substrates, door cores)
  - NOT furniture and equipment (because not part of base building systems)

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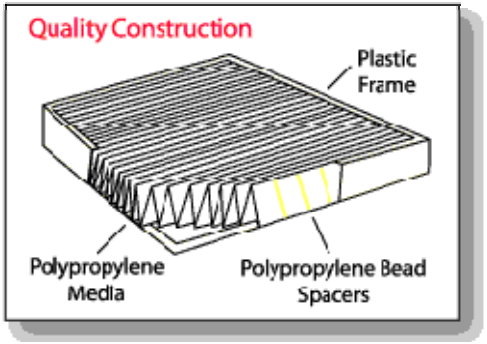
EQc5: Indoor Chemical & Pollutant Source Control

Intent: Minimize exposure of building occupants to potentially hazardous particulates & chemical pollutants.

Required: Design to minimize and control pollutant entry into buildings

- Install permanent entryway systems ≥ 6 ft long (e.g., grilles, grates, walk-off mats [w/ weekly maintenance]) at all regular entry points for building users.
- Where hazardous gases or chemicals may be present (copy rooms, janitor closets): Exhaust to create negative pressure, provide self-closing doors, and provide deck-to-deck partitions or a hard lid ceiling
- Mechanically ventilated buildings: Prior to occupancy, provide MERV 13 air filtration media (or better) for both return and outside air that is to be delivered as supply air



MERV13

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EQc5: Indoor Chemical & Pollutant Source Control

Submittals: Design Submittal

- LEED Submittal Template
- Confirm that required entryway systems have been specified/installed.
- List each entryway product specified/ installed in the building.
- Confirm that chemical use areas have been designed as separate rooms with dedicated exhaust systems and appropriate negative pressurization.
- Provide construction drawings to highlight the location of the installed entryway systems & mechanical drawings to highlight the location of chemical use areas, room separations, and the associated exhaust systems.
- If mechanically ventilated, confirm that the installed filters have a MERV rating of 13 or better.
- List the installed filters and their associated MERV ratings.

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EQc6: Controllability of Systems

Intent: Provide a high level of thermal, ventilation and lighting system control by individual occupants or specific groups in multi-occupant spaces (i.e. classrooms or conference areas).

EQc6.1 – Lighting (1 point)

EQc6.2 – Thermal Comfort (1 point)

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EQc6.1: Controllability of Systems Lighting

Required: Provide individual lighting controls for 90% (minimum) of the building occupants AND provide lighting system controllability for *all* shared multi-occupant spaces.

Submittals: Design Submittal

- LEED Submittal Template
- (Individual workstation controls) List the total number of individual workstations and lighting controls.
- (Shared multi-occupant space control) List the project's group multi-occupant spaces and a description of the installed lighting controls.
- Narrative describing the project's lighting control strategy.

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CREDIT COMPLIANCE

Please complete the following information to document credit compliance.

Individual Workstation Lighting Control*

** To qualify for the credit provide individual comfort controls for 90% (minimum) of the building occupants.*

Quantity of Individual Workstations (Includes Private Offices and Cubicles)	Quantity of Individual Workstation Lighting Controls Provided	Percentage of Workstations Provided with Controls (%)*
5	5	100.0

Shared Multi-Occupant Space Lighting Control

Multi-Occupant Space ID / Name	Brief Description of Installed Lighting Controls
101 - Classroom	Wall switch controls lighting in this space.
102 - Classroom	Wall occupancy switches control overhead and undercabinet lighting in this space.
103 - Classroom	Wall occupancy switches control overhead and undercabinet lighting in this space.
104 - Conference Room	Wall switches control lighting in this space.

EQc6.2: Controllability of Systems Thermal Comfort

Required: Provide individual comfort controls for ≥ 50% of building occupants (operable windows count for areas 20 ft inside of and 10 ft to either side of operable part of window)

AND Provide comfort system controls for all shared multi-occupant spaces. Conditions for thermal comfort are described in **ASHRAE Standard 55-2004**

Submittals: Design Submittal

- LEED Submittal Template
- List the total number of individual workstations and thermal controls
- List the project's group multi-occupant spaces and a description of the installed thermal controls
- Narrative describing the project's comfort control strategy

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EQc7.1: Thermal Comfort Design

Intent: Provide a thermally comfortable environment that supports the productive and healthy performance of the building occupants.

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EQc7.1: Thermal Comfort Design

Required: Design HVAC systems & the building envelope to meet the requirements of **ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy**, in accordance with the section 6.1.1 Documentation.

Submittals: Design Submittal

- LEED Submittal Template
- Provide data regarding seasonal temperature and humidity design criteria.
- Provide a narrative describing the method used to establish the thermal comfort conditions and how the systems design addresses the design criteria.

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EQc7.1: Thermal Comfort Design

- What factors influence thermal comfort?
  - Air temperature
  - Radiant temperature: heat that radiates from a warm object
  - Air speed
  - Relative humidity
  - Personal factors:
    - Activity / Metabolic Rate
    - Clothing

The Solaire, NYC, NY

Sustainable Design Consulting

EQc7.2: Thermal Comfort Verification

Intent: Provide for the assessment of the building thermal comfort over time.

Required: Agree to implement an anonymous thermal comfort survey of building occupants within a period of 6-18 months after occupancy and develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied.

Submittals: Design Submittal

- LEED Submittal Template
- Provide a narrative describing the survey planned for the validation of the thermal comfort conditions for the project. Include a specific description of the provisions for creating a plan for corrective action.

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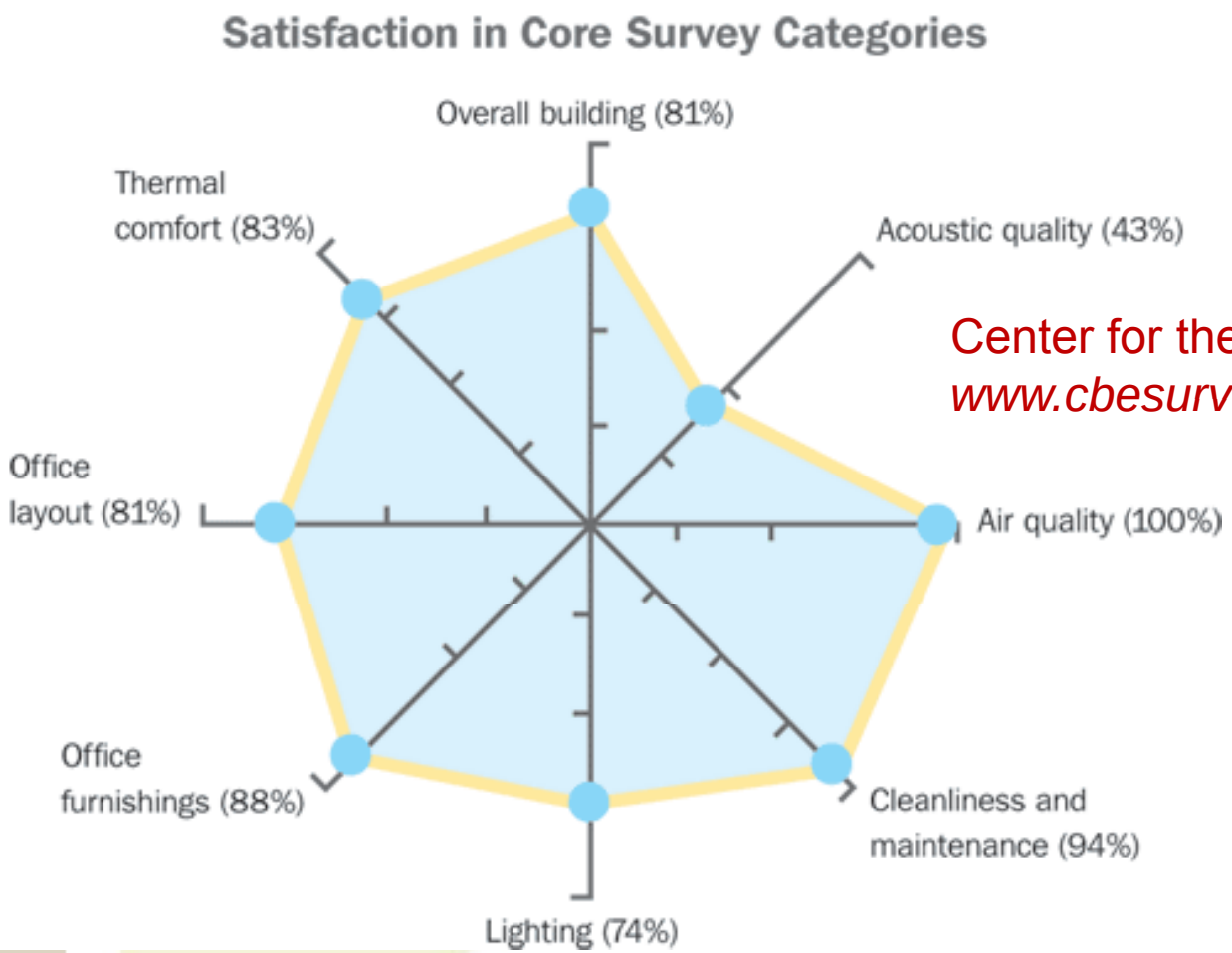
EQc7.2: Thermal Comfort Verification

Post-Occupancy Evaluation at The Global Ecology Center



Center for the Built Environment
www.cbesurvey.org

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EQc8: Daylight & Views

Intent: Provide for the building occupants a connection between indoor spaces and the outdoors

EQc8.1 – Daylight 75% of Spaces (1 point)

EQc8.2 – Views for 90% of Spaces (1 point)

Light shelf designed for BC Gas Operations Centre in Surrey BC.

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EQc8.1: Daylight & Views
Daylight 75% of Spaces

Required: Achieve a minimum level of daylight in 75% of all spaces occupied for critical visual tasks.

OPTION 1 — Calculation

Achieve a minimum Glazing (Daylight) Factor of 2% (excluding all direct sunlight penetration).

Exemplary Performance:

- 95% of spaces day lit

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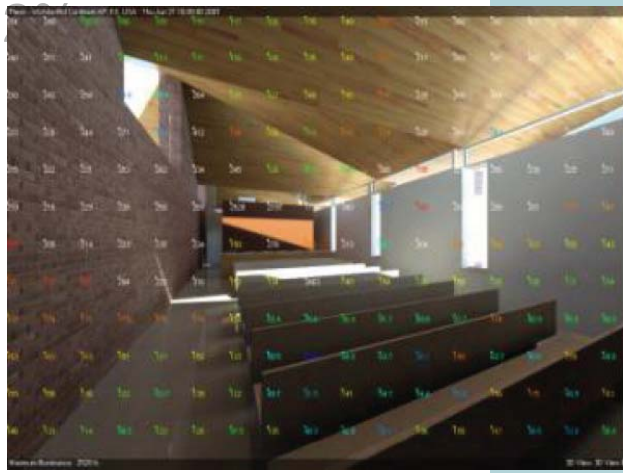
EQc8.1: Daylight & Views
Daylight 75% of Spaces

Required: Achieve a minimum level of daylight in 75% of all spaces occupied for critical visual tasks.

OPTION 1 — Calculation

Achieve a minimum Glazing (Daylight) Factor of 2 (excluding all direct sunlight penetration).



OPTION 2 — Simulation

Using computer simulation, achieve a minimum daylight illumination level of 25 foot candles.

OPTION 3 — Measurement

Using indoor light measurement, achieve a minimum daylight illumination level of 25 foot candles.

Exemplary Performance:

- 95% of spaces daylit

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EQc8.1: Daylight & Views
Daylight 75% of Spaces

Required (Cont.): In all cases, provide daylight redirection and/or glare control devices to avoid high-contrast situations that could impede visual tasks. Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits.

Submittals: Design Submittal

- LEED Submittal Template: fill in total regularly occupied space area (sq.ft.) AND

OPTION 1 — the overall Glazing Factor, area of each type of glazing (sidelighting and toplighting); and visible light transmittance (T-vis) for each glazing type.

OPTION 2 — the area that achieves a *simulated* minimum of 25 footcandles, and provide project drawings showing the illumination simulation results.

OPTION 3 — the area that achieves a *measured* minimum of 25 footcandles, and provide project drawings showing the illumination simulation results.

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EQc8.1: Daylight & Views
Daylight 75% of Spaces

- *Calculations*: OPTION 1 — Glazing Factor Calculation
  2% Glazing Factor

  – Glazing Factor = Ratio of exterior illumination to interior illumination
  – Visible Light Transmittance (Tvis) = ratio of amount of visible light passing through glazing to amount of light striking glazing surface

$$\text{Glazing Factor} = \frac{\text{Window Area [SF]}}{\text{Floor Area [SF]}} \times \text{Window Geometry Factor}^{*} \times \frac{\text{Actual Tvis}}{\text{Minimum Tvis}^{*}} \times \text{Window Height Factor}^{*}$$

* Value provided in LEED-NC Reference Guide

Variables:

- Floor area
- Window area
- Window Geometry
- Window Height

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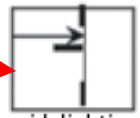
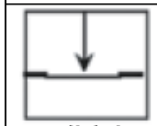
- Daylight glazing: Window areas 7’-6” above the floor

- Vision glazing: Window areas from 2’-6” – 7’-6” above the floor

Window Geometry Factor

Table 1: Daylighting Design Criteria

Window Type	Geometry Factor	Minimum T_{vis}	Height Factor	Best Practice Glare Control
 sidelighting daylight glazing	0.1	0.7	1.4	Adjustable blinds Interior light shelves Fixed transluscent exterior shading devices
 sidelighting vision glazing	0.1	0.4	0.8	Adjustable blinds Exterior shading devices
 toplighting vertical monitor	0.2	0.4	1.0	Fixed interior Adjustable exterior blinds
 toplighting sawtooth monitor	0.33	0.4	1.0	Fixed interior Exterior louvers
 toplighting horizontal skylights	0.5	0.4	1.0	Interior fins Exterior fins Louvers

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The Trickier LEED Credits: EQc8.1 & EAc1

- *Issue:* Coatings on glazing for energy efficiency decreases Tvis

- How to maximize daylighting and achieve energy efficiency?
  - Proper building orientation
  - Shallow floor plates
  - Daylight glazing (above 7'-6")
  - Light fixtures with daylight sensors and dimming controls
  - Shading devices
  - Light shelves
  - North facing skylights
  - Light colored walls and ceilings

WSSI HQ, Gainesville, VA

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EQc8.2: Daylight & Views
Views for 90% of Spaces

Required: Achieve direct line of sight to the outdoors via vision glazing (2'-6" – 7'-6") for building occupants in 90% of all regularly occupied spaces.

Submittals: Design Submittal

- LEED Submittal Template - Calculations demonstrating access to views from occupied spaces
- Project drawings showing the line of sight from interior spaces through exterior windows in both plan and section views.

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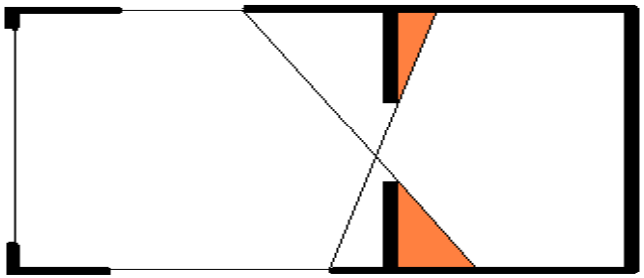
EQc8.2: Daylight & Views Views for 90% of Spaces

Calculations:

– Area with direct line of sight = All regularly occupied areas that meet:

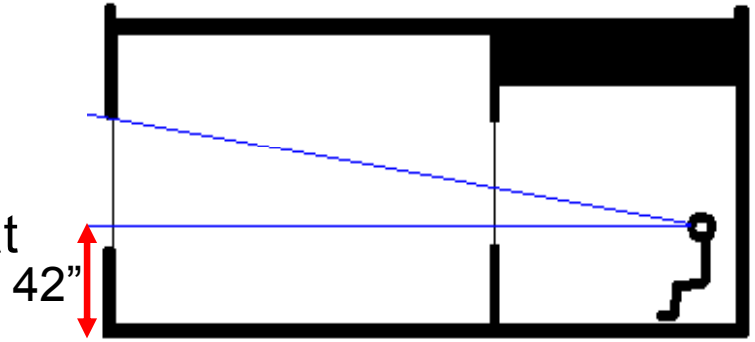
- In plan view: Area is within sight lines drawn from perimeter vision glazing



= Area NOT within sight lines

- AND -

- In section view: Direct sight line can be drawn from area to perimeter vision glazing (at 42” above floor)



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EQc8.2: Daylight & Views Views for 90% of Spaces

Calculations (cont'd):

- For private offices: Count entire area of office if ≥ 75% of area has direct line of sight
- For multi-occupant spaces: Count actual area of space with direct line of sight
- Line of sight can be drawn through interior glazing
- Adjust line of sight for full height partitions and other fixed obstructions

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LEED Calculator for Glazing Factor and Access to Views Calculation (EQc8.1 & EQc8.2)

LEED Calculator for EQc8:

- Available on LEED-Online
- Easy to use but produces simplistic results, not accounting for:
  - Window orientation
  - Light shelves
  - Shading devices
  - Light tube performance
  - Interior finishes

…computer simulation is more accurate

LEED-NC
LEED FOR NEW CONSTRUCTION

LEED-NC 2.2 Submittal Template
EQ Credit 8: Supporting Calculator

EQ CREDIT 8.1-8.2 - GLAZING FACTOR AND ACCESS TO VIEWS CALCULATION

Complete the Table below for EQc8.1-8.2 using the instructions below:

List all regularly occupied spaces. For each space, enter the glazing properties for all glazing above 2.5 feet to calculate the Glazing Factor. Also enter the Space Area with Access to View within that space if pursuing EQ Credit 8.2.

All fileds marked in RED are required for EQc8.1 and EQc8.2
All fields marked in BLUE are required for EQc8.1 Glazing Factor Calculation
All fields maked in GREEN are required for EQc8.2 Access to Views Calculation

*After completing the Supporting Calculator sheet use the results from the **Glazing Factor Calculation** and/or **Access to Views Calculation** to complete the appropriate sections in EQc8.1 and EQc8.2 Submittal Templates to demonstrate compliance.*

Save and upload the completed Supporting Calculation PDF to the project workspace in addition to the EQc8.1/EQc8.2 Submittal Templates.

Enter Total Number of Building Spaces
(This will modify the number of rows in the table): 12

Space ID	Regularly Occupied Space Name	Space Area (SF)	Glazing Area (SF)	Type of Glazing	Tvis (Actual)	Glazing Factor (%) Each	Glazing Factor (%) Room	Space Area with Access to Views (SF)
1	Room 1	2000	100	Daylight Glazing-Sidelight	.64			1100

CLEAR FIELDS

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EQc8: Daylight & Views
Case Study: One and Two Potomac Yard

- Pursued Both Credits, Achieved EQc8.2 Only, Despite Relatively Open Plan
- EPA Employee Advocate Championing Worker Environment – Difficult to Explain Non-Compliance to Layperson
- EQc8.1 Issues
  - Ratio of Window Area to Floor Area
  - Glazing above 7'-6" has 175% More Weight than Glazing Below

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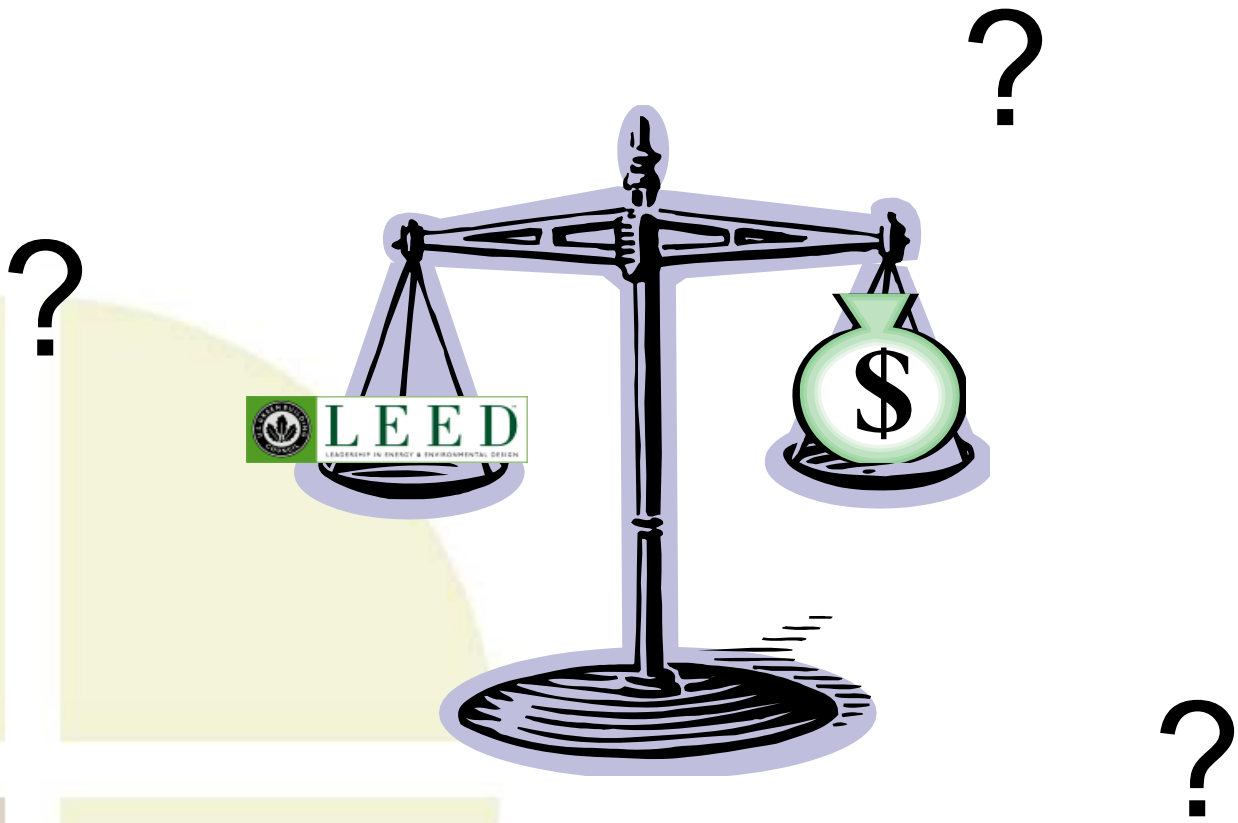
Quiz time!



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Quiz Question 1:

Increasing outdoor air ventilation rates by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2004 will likely_____ (choose one)

A. Improve thermal comfort

B. Improve indoor air quality

C. Assist with compliance with EAp2, Minimum Energy Performance

D. Assist with compliance with EAp1, Fundamental Commissioning of the Building Energy Systems

E. Increase indoor VOC levels

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Quiz Question 2:

What information must the contractor include in the Construction IAQ Management Plan? (Choose two)

A. How absorptive materials stored onsite will be protected

B. The IAQ Testing Schedule

C. Where carbon monoxide monitors must be installed

D. How cleaning activities will be carried out during occupancy

E. How the construction and occupied zones will be separated

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Quiz Question 3:

A factory-installed ductwork-liner uses an adhesive with a high VOC. Which of the following credits are impacted? (Choose one)

A. EQ Credit 2, Increased Ventilation

B. EQ Credit 3, Construction IAQ Management Plan

C. EQ Credit 4.1, Low Emitting Materials, Adhesives and Sealants

D. EQ Prerequisite 2, Minimum Acoustical Performance

E. None of the above

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Quiz Question 4:

What is the best method to ensure low emitting materials are installed in the project? (Choose one)

A. Require them in the project manual and specifications

B. Contact green suppliers and tell them about the project

C. Educate the project stakeholders

D. Tell the contractor to use them

E. Assign a LEED AP to the team

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Quiz Question 5:

The daylighting calculation methodology as defined in the LEED Reference Guide for EQ Credit 8.1, Daylight and Views, accounts for which three? (Choose three.)

A. Window area

B. Room floor area

C. Wall reflectance

D. Solar orientation

E. Visible light transmittance of glazing

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Part 5

Indoor Environmental Quality and the LEED Process

Thank you!

Thomas A . Fisher, AIA, LEED AP

tom@sustaindesign.net
www.sustaindesign.net

Sustainable & Smart ecobuild® fall
Sustainable, Green and High Performance Solutions for the Built Environment

Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

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Part 6

Water Efficiency, Innovation & Design and the LEED Process

Trainer:

Thomas A . Fisher, AIA, LEED AP
December 11, 2008 3:00 PM

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Sustainable Design Consulting, LLC
Richmond, VA Washington, DC

Part 1 - Introduction

Sustainable Design Consulting

- Offices in Washington, DC and Richmond, VA
- Small woman-owned business
- Focus on greener solutions for the built environment
- Consulted on over 80 green building projects, over 200 LEED-related projects
- Commercial, institutional, multi-family, greater-DC-area and Central Virginia
- Project consulting mostly to Developers/Owners and Architects

What we do

- Green Building Project Management
- Drawing & Spec Review
- LEED advisory
- Lectures, Workshops & Trainings
- Design Guidance and Research

www.sustaindesign.net

Eastern Village Cohousing

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Outline

- Part I – Introduction
  - Impact of Buildings
  - Benefits of Green/Integrated Design
  - Overview and History of LEED
  - LEED Standards
  - Cost of LEED
  - Project Certification & Accreditation
  - Resources & Website
  - Questions, Discussion
- Part 2 – Sustainable Sites
- Part 3 – Energy & Atmosphere
- Part 4 – Materials & Resources
- *Part 5 – Indoor Environmental Quality*
- Part 6 – Water Efficiency, Innovation in Design, Exam Review, LEED 2009

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Why Green Building ?
Water Issues

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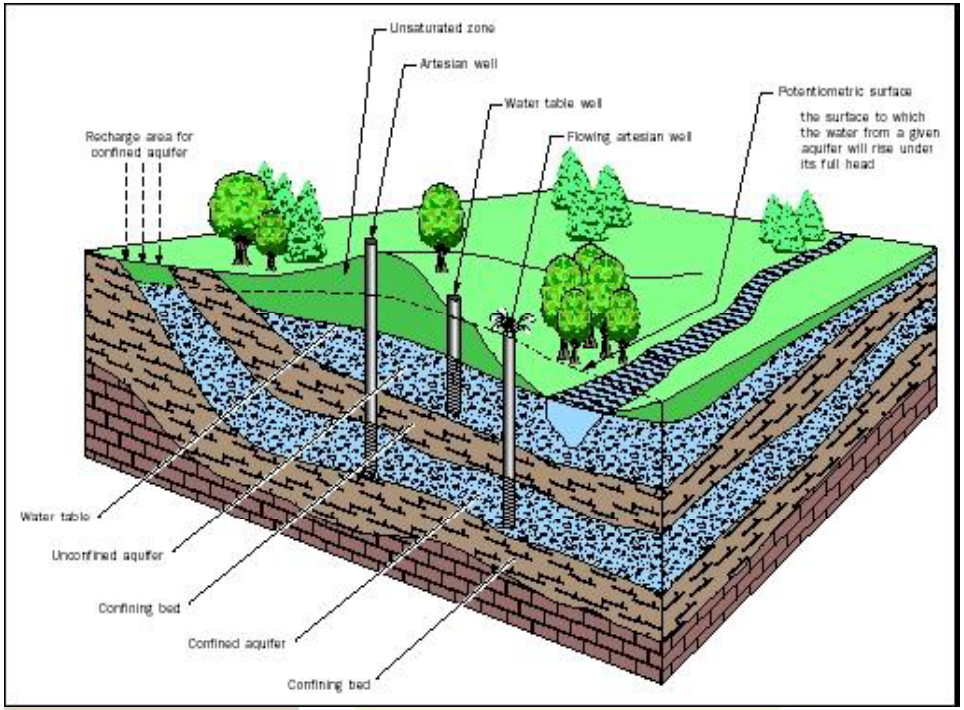
Why Green Building ?
Water Issues



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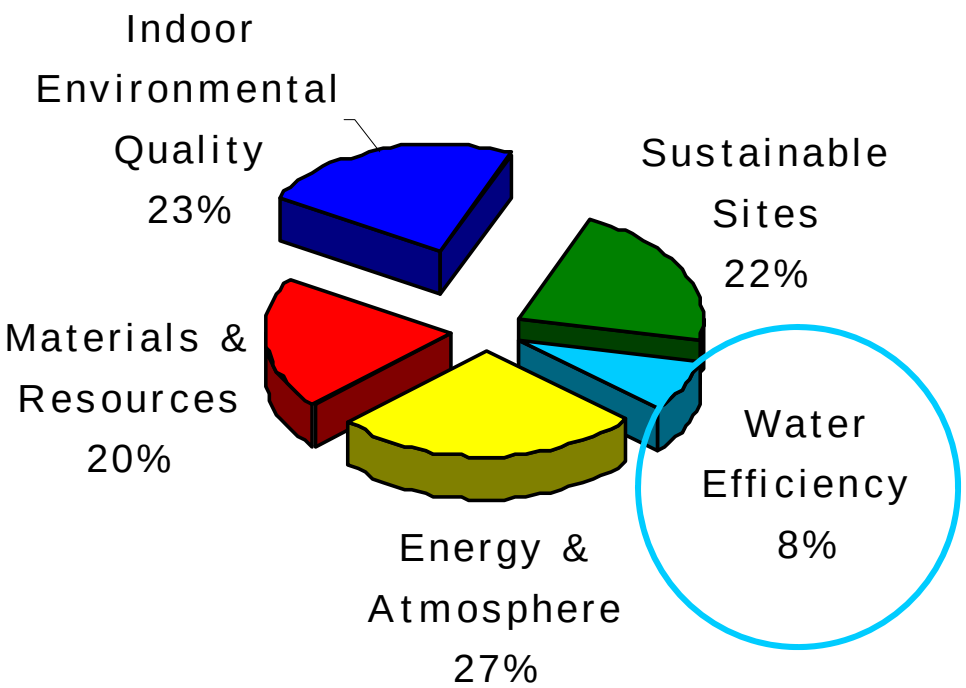
Part 6 – The LEED Credits



+ Innovation & Design Process

Water Efficiency
- Overview of section
- Review credit
- Discuss trickier credits

Innovation & Design
- Overview of section
- Review credit
- Discuss trickier credits

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LEED Categories: Water Efficiency (WE) - Overview

Intent: Reduce/Eliminate the need for potable and waste water infrastructure as well as recharging the local aquifer

- Credit 1 - Water Efficient Landscaping (up to 2 points)
- Credit 2 – Innovative Wastewater Technologies (1 point)
- Credit 3 – Water Use Reduction(up to 2 points)

TOTAL AVAILABLE: 5 Points

Synergy: *Rainwater collection cisterns may contribute to all 3 WE credits*

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WEc1: Water Efficient Landscaping

Intent: Limit or eliminate the use of potable water for landscape irrigation.

Required:

- 1.1 – Reduce potable water consumption for irrigation by 50% from a calculated mid-summer baseline case.
- 1.2 – Use only captured rain or recycled site water (100% total reduction) for site irrigation needs, OR, do not install permanent landscape irrigation systems.

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WEc1: Water Efficient Landscaping

Submittals: Design Submittal

- LEED Submittal Template
- Calculations: base case Total Water Applied (TWA) & design case TWA (if applicable)
- Total non-potable water supply(#)
- Narrative of the equipment used and/or the use of drought-tolerant or native plants.

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The Trickier LEED Credits: WEc1: Water Efficient Landscaping

If providing permanent irrigation:

- Use high-efficiency technologies
- Explore capturing mechanical condensate
- Explore cisterns to capture rainwater
- Explore graywater reuse
- Note that landscaped area for calculations must remain constant between Base and Design case

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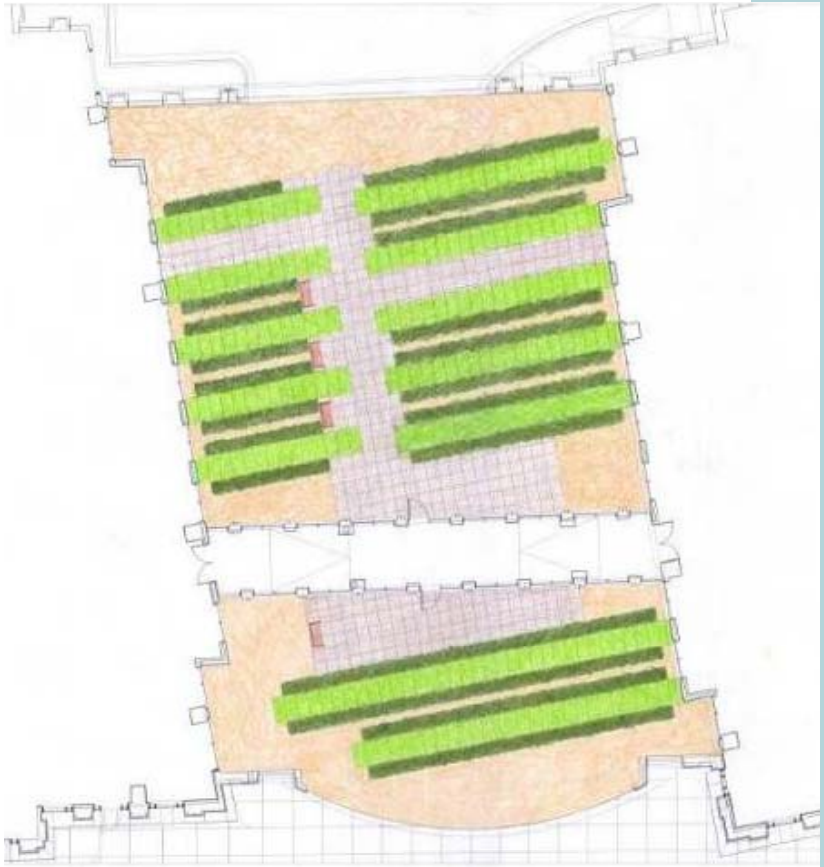
WEc1: Water Efficient Landscaping

Case Study: One and Two Potomac Yard

Drought-resistant plants eliminated need for permanent irrigation systems

Submission to the USGBC included:

- Narrative
- Plant List
- Information on the temporary irrigation installed



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WEc2: Innovative Wastewater Technologies

Intent: Reduce the generation of wastewater and potable water demand, while increasing the local aquifer recharge.

Required: Reduce potable water use for building sewage conveyance by 50% through the use of water conserving fixtures (water closets, urinals) or non-potable water (captured rainwater, recycled grey water, and on-site or municipally treated wastewater);

OR, Treat 50% of wastewater on site to tertiary standards. Treated water must be infiltrated or used on-site.

Exemplary Performance:

- 100% water reduction OR 100% treated and re-used/infiltrated

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WEc2: Innovative Wastewater Technologies

Submittals: Design Submittal

- LEED Submittal Template
- Plumbing drawings highlighting any onsite wastewater treatment facilities
- Calculations: occupants, baseline & design case water usage
- Installed fixture information (MFR, model, gpf)
- If treating wastewater onsite, provide non-potable water supply available for sewage conveyance
- Narrative of potable water reduction strategies

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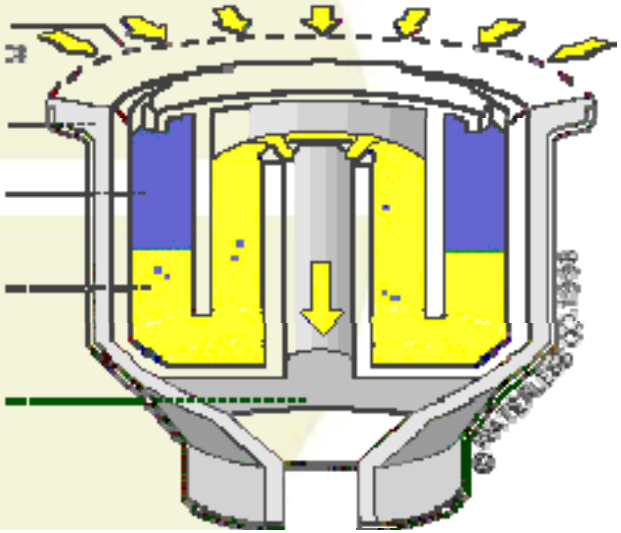
The Trickier LEED Credits: WEc2 – Innovative Wastewater Technologies

Generally easier to meet 50% potable water reduction criteria with what's already being used for WEc3:

- Waterless urinals
- Dual- or ultra-low-flush toilets
- Captured rainwater
- Reclaimed grey water



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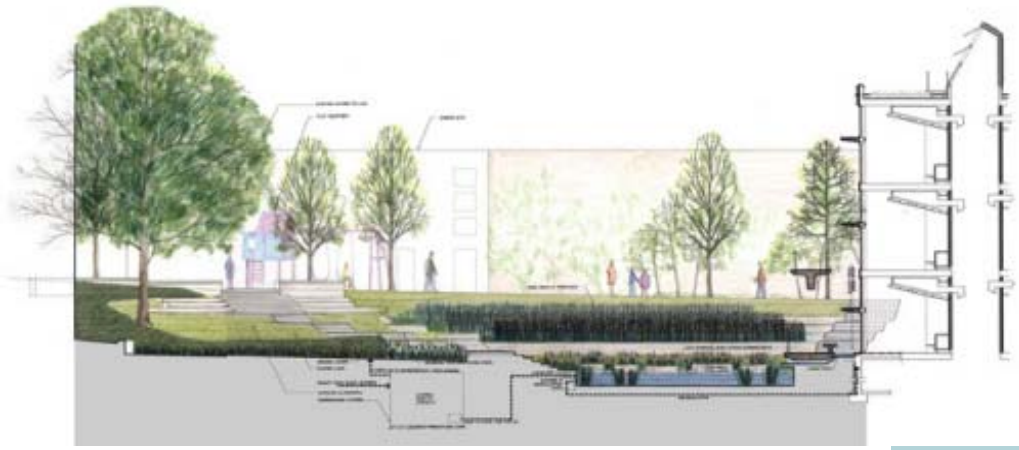
The Trickier LEED Credits: WEc2 – Innovative Wastewater Technologies

Constructed wetlands one way to meet treatment criteria

Generally easier to meet 50% potable water reduction criteria with what's already being used for WEc3:

- Waterless urinals
- Dual- or ultra-low-flush toilets
- Captured rainwater
- Reclaimed grey water

Merrill Center
Smith Group

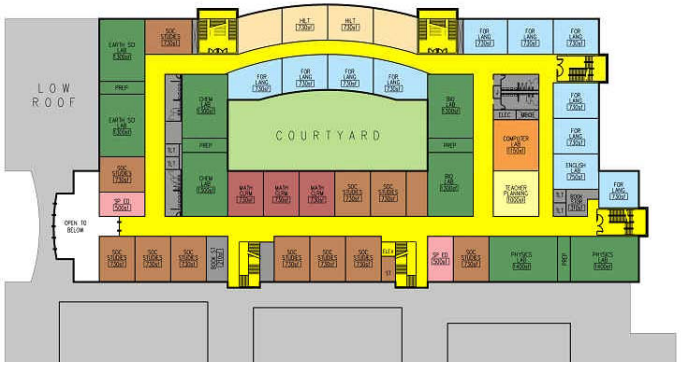


Sidwell Friends School Constructed Wetlands
Andropogon

Sustainable Design Consulting

Washington-Lee High School
Arlington, VA

- Architect: Grimm + Parker
- Approx. 358,102 sf
- 1600 students, 200 staff
- New construction in coordination with phased demolition
- Completion Dates: Phase 1: July, 2007; Phase 2: June 2009; Phase 3 (Ballfield): Fall 2009



Grimm + Parker Architects

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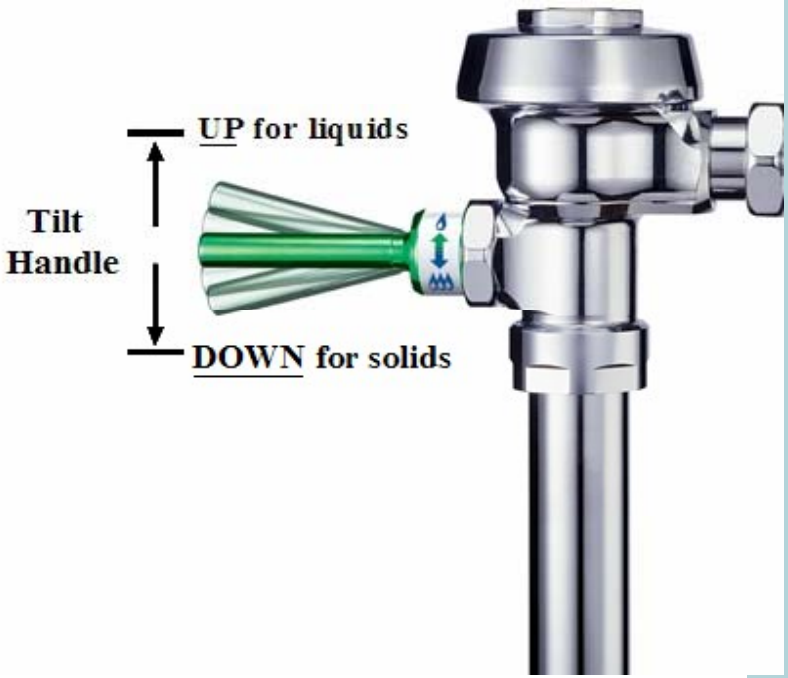
WEc2: Innovative Wastewater Technologies

Case Study: Washington Lee High School

- Waterless urinals in boys rooms
- Dual-flush (1.1/1.6) flush valves in girls rooms and staff toilets (lengthy process to make this selection!)
- Still not enough to earn credit!
- Projects usually must harvest rainwater or greywater for flushing.



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WEc3: Water Use Reduction

Intent: Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Required:

- 3.1 – Use 20% less potable water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements.
- 3.2 – Use 30% less potable water

Exemplary Performance:

- Use 40% less potable water or 10% less potable water in process/non-regulated fixtures

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WEc3: Water Use Reduction

Submittals: Design Submittal

- LEED Submittal Template
- Spreadsheet Calculations demonstrating that water-consuming fixtures reduce occupancy-based potable water consumption by 20% *(or 30%)* compared to baseline conditions
- Narrative describing the potable water reduction strategies employed by the project, including any reclaimed water usage.

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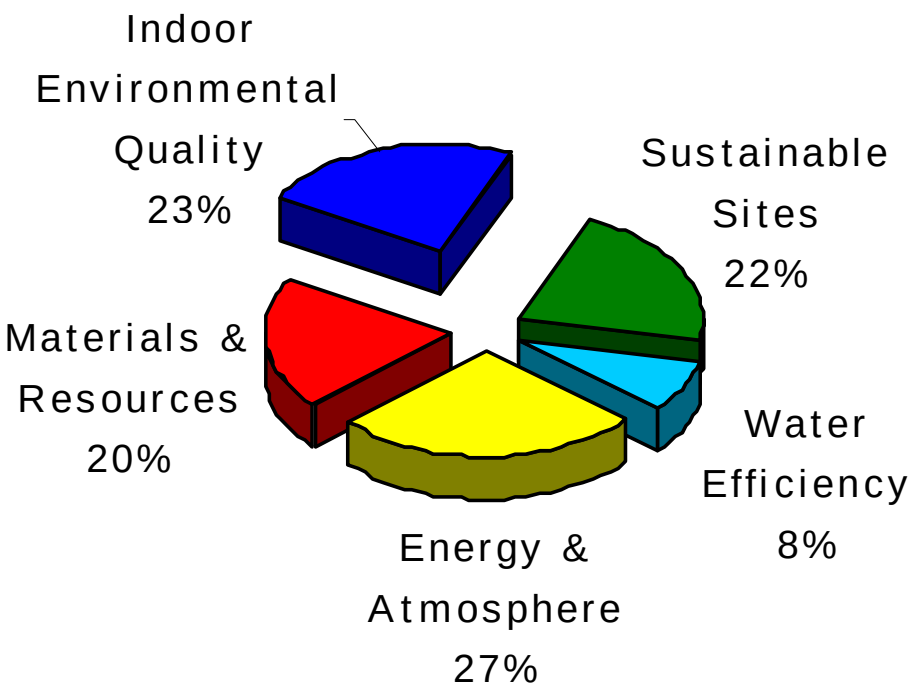
Innovation in Design

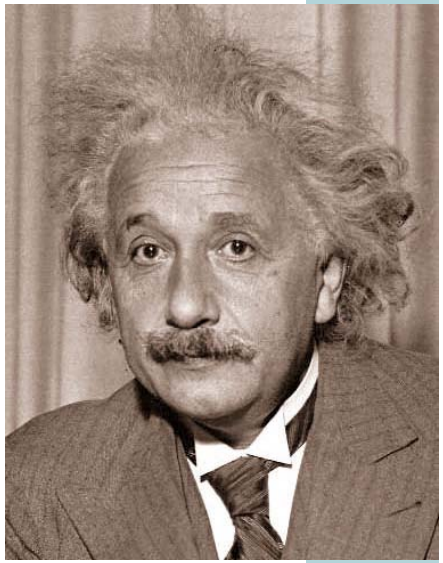


+ Innovation & Design Process

Innovation & Design

- Overview of section
- Review credit
- Discuss trickier credits

"Confusion of goals and perfection of means seems, in my opinion, to characterize our age. "



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IDc1: Innovation in Design

Intent: To award points for exceptional performance and/or innovative performance not specifically addressed by LEED.

Submittals: Design or Construction Submittal

- LEED Submittal Template
- Title for the credit & statement of intent
- Detailed approach to achieving the credit
- Drawings or exhibits that illustrate the approach

**Up to 4 different ID credits may be pursued .*

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IDc1: Innovation in Design

- **Every** project should submit.
- Credit for significantly exceeding existing LEED Credit thresholds.
- Credit for addressing environmental performance not already addressed by LEED.
- One Credit per Strategy (general rule).

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IDc1: Innovation in Design Common Examples

- 40% Locally manufactured and locally Extracted/Harvested/Recovered Materials
- 40% Water Use Reduction
- 100% reduction in potable water use for sewage conveyance
- Comprehensive Transportation Management Plan
- 15% salvaged or reused materials
- 30% materials with recycled content
- 5% rapidly renewable materials
- 95% Construction waste diverted
- Tenant Improvement Requirements in the Lease
- User Education Plan
- Green Cleaning Plan

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IDc1: Innovation in Design
Where else to look for ideas…

- LEED for Existing Buildings (O&M focus)
- LEED for Commercial Interiors (Tenant Interior focus)
- LEED for Core & Shell (Base Building focus)
- LEED-NC Credit Rulings on USGBC website
- LEED ID Credit Catalog

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Camille Kendall Academic Center at Shady Grove, Rockville, Maryland

Rendering by Cannon Design

- Pilot green project for University
- Largest building on campus
- Construction Complete 2007
- Achieved LEED-NC Gold certification

CANNONDESIGN

UNIVERSITY SYSTEM USM OF MARYLAND

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IDc1: Innovation in Design, User Education Plan

Case Study: Camille Kendall Academic Center at Shady Grove

User (student) education program

- Green classroom
- Green signage
- Demonstration projects
- 10 page brochure

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CREDIT COMPLIANCE

Please complete the following information to document credit compliance.

ID Credit Title	User Education
Narrative Statement of Credit Intent	To promote the benefits of green building to a broad audience by transforming thoughtful design into educational opportunities.
Narrative Statement describing Credit Requirements	Develop an actively instructional educational program that includes two of the following three elements: 1) A comprehensive signage program built into the building's spaces to educate the occupants and visitors of the benefits of green buildings. This program may include windows to view energy-saving mechanical equipment or signs to call attention to water-conserving landscape features. 2) An educational outreach program or guided tour could be developed to focus on sustainable living, using the project as an example. 3) The development of a manual, guideline or case study to inform the design of other buildings based on the successes of this project. This manual will be made available to the USGBC for sharing with other projects.
Narrative Describing Project's Approach to the credit	As a community interested in promoting the benefits of green building, the first two components were implemented into this project. 1) To increase the educational characteristic of the building and its surrounding, Prince Georges County Public Schools developed comprehensive signage placed in key areas highlighting and educating students, employees and visitors on the green features of the building and the LEED? process. 2) Prince Georges County Public Schools developed a guided tour/educational outreach program whose purpose is to highlight green architectural elements, specific green materials, energy efficient equipment, water resource saving systems for visitors and employees. This tour will first be presented to staff as part of their training before the beginning of the school year. The tour will also be available as an educational showcase during events such as the Maryland/ Virginia/DC green tours. Visitors will be provided with a brochure indicating the implementation of the green features.

IDc2: LEED Accredited Professional

Intent: To support and encourage the design integration required by a LEED Green Building project and to streamline the application and certification process.

Required: At least one principal participant of the project team that has successfully completed the LEED Accredited Professional exam

Submittals: Construction Submittal

- LEED Submittal Template
- Name & company of LEED AP
- Brief narrative of LEED AP's project role(s)
- Copy of LEED AP Certificate

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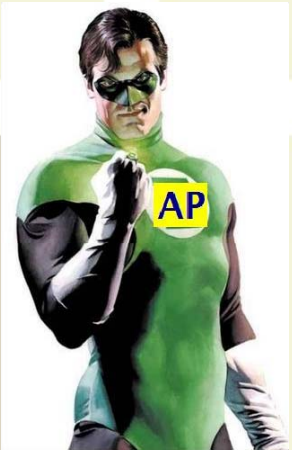
IDc2: LEED Accredited Professional

- Must Pass the LEED Professional Accreditation exam (LEED-NC 2.2 or another available)
- Exam Purpose
  - To ensure that a successful candidate has knowledge and skills necessary to participate in the design process, to support and encourage integrated design.
  - To test familiarity with LEED requirements, resources, and processes.



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IDc2: LEED Accredited Professional 2009+

LEED GREEN ASSOCIATE

LEED AP ID+C | LEED AP HOMES | LEED AP O+M | LEED AP ND | LEED AP BD+C

LEED AP FELLOW

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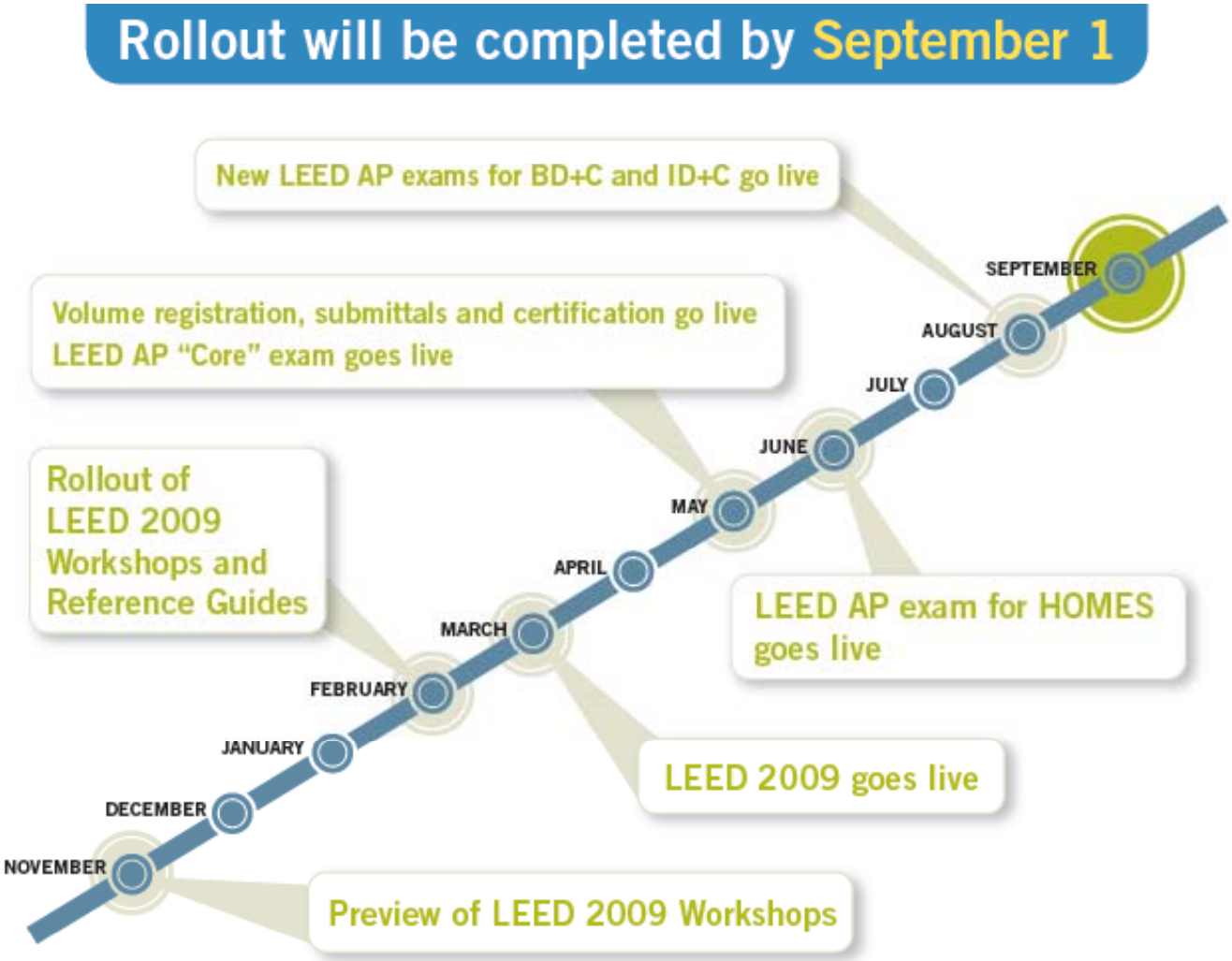
LEED 2009 & LEED v3



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LEED 2009 & LEED v3

LEED 2009 is the rating system itself

LEED Version 3 is the rating system, LEED Online upgrades, and 3rd Party Certification Program

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LEED 2009 & LEED v3

Significant Changes:

Point system of 110 points for all versions but distribution of points between versions varies. For LEED 2009 NC:

Sustainable Sites	26
Water Efficiency	10
Energy & Atmosphere	35
Materials & Resources	14
Indoor Env. Quality	15
Innovation in Design	6
Regional:	4
	110

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LEED 2009 & LEED v3

Significant Changes:

Certification Level Changes for all versions (LEED 2009 NC, CS, S, etc)

Certified	40 - 49
Silver	50 - 59
Gold	60 - 79
Platinum	80 +

Certification levels are harder to achieve. The bar has been “reset”

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LEED 2009 & LEED v3

Significant Changes:

Point system of 110 points for all versions is derived from a weighting tool that assigns valuation benefits to the range of environmental criteria. Weighting tool developed by USGBC is designed to be transparent and based on the best available science.

Certification process administered by GBCI, will be ISO-compliant, and performed by selected certification bodies / organizations, not by USGBC.

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Quiz time!

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Quiz Question 1:

The Owner and Design Engineer for a renovation decide to replace the existing plumbing fixtures. The new plumbing fixtures include a waterless urinal. Which of the following credits will be impacted? (Choose two.)

A. SS Credit 6.2, Stormwater, Quality Control

B. WE Credit 2, Innovative Wastewater Technologies

C. WE Credit 1, Water Efficient Landscaping

D. WE Credit 3, Water Use Reduction

E. MR Credit 3, Materials Reuse

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Quiz Question 2:

Which two of the following are considered sources of potable water in LEED? (Choose two.)

A. Irrigation wells

B. Captured rain water

C. Municipal water system

D. Municipally supplied reclaimed waste water

E. Water processed by a tertiary treatment system

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Quiz Question 3:

When documenting an Innovation in Design credit, the responsible party must include the following information: (Choose two.)

A. Statement of the proposed credit intent

B. Copy of the credit ruling that allows this credit

C. Description of the design approach used to meet the credit requirements

D. Estimate of how many points the credit should capture

E. Identification of the team members responsible for credit achievement

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Quiz Question 4:

In an office facility, the design includes a rainwater harvesting system that collects 16,000 gallons of water annually. The rainwater is used for flushing water closets. What information is necessary to calculate the reduction in potable water demand for building sewage conveyance for achieving WE Credit 2, Innovative Wastewater Technologies? (Choose three.)

A. Annual Work Days

B. Number of FTE building occupants

C. Total Daily Volume of wastewater generated

D. Flow rates of faucets

E. Total Daily Volume of Process Water generated

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Quiz Question 5:

Which of the following achievements are considered exemplary performance and eligible for an ID credit 1, Innovation in Design? (Choose three.)

A. Implement a Transportation Management Plan

B. 30% (post-consumer + 1/2 pre-consumer) Recycled Content

C. 30% Regional Materials

D. 40% Water Use Reduction

E. Daylight 90% of Spaces

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Q&A
(a.k.a. “Never assume with LEED”)

?

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