



EarthCraft Light Commercial  
Technical Guidelines  
Version 2.0

October 2017

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## Introduction

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The EarthCraft Light Commercial Technical Guidelines apply to all new construction projects in the EarthCraft Light Commercial program. When verifying items for an EarthCraft project, EarthCraft Technical Advisors shall reference these Guidelines to ensure all requirements have been met.

If local building codes conflict with or are more stringent than the EarthCraft Technical Guidelines, the local code shall be followed.

Materials and methods described are representative of typical strategies that meet the intent of the criteria, but do not represent all strategies that may be used. The project team may request permission from EarthCraft to meet the intent of the credit using a different approach. Approval from EarthCraft must be obtained prior to implementation.

The EarthCraft Light Commercial program prioritizes resource efficiency and smart construction practices. It is organized into with primary categories, each of which details specific criteria. The primary categories are:

SITE PLANNING	SP
CONSTRUCTION WASTE MANAGEMENT	CW
RESOURCE EFFICIENCY	RE
DURABILITY & WATER MANAGEMENT	DU
INDOOR ENVIRONMENTAL QUALITY	IEQ
HIGH-PERFORMANCE BUILDING ENVELOPE	BE
ENERGY-EFFICIENT BUILDING SYSTEMS	ES
WATER EFFICIENCY	WE
EDUCATION AND OPERATIONS	EO

Projects seeking to further distinguish themselves for building performance and/or occupant health and safety may seek additional certification packages. These packages, or certification badges, fall into two (2) categories:

### **Health Badge**

The Health badge includes high performance outdoor air ventilation systems and increased attention to finish materials.

### **Performance Badge**

The Performance badge supports building construction practices and materials supporting a commercial structure exceeding the energy code for energy and water efficiency.

Badges are optional add-ons for any EarthCraft certified project. Each has its own requirements that projects must meet in order to obtain the badge. Since these badges serve to enhance different areas of the EarthCraft Light Commercial program, their specific requirements may be distributed within multiple sections of the EarthCraft Light Commercial worksheet.

### **Major Renovation Projects**

Major Renovation Projects are projects that take place in an existing building where the scope includes partial modifications or complete replacement of mechanical, plumbing, interior partitions and possibly elements of the building envelope. The Major Renovations pathway is designed to provide project teams' insight into delivering a high performing renovation project.

Major Renovation projects pursue the same Requirements and Points Items as new construction, but for some of the Requirements and Points Items they may achieve the criteria by using alternative methods depending on project and building condition.

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## Certification Process

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### 1. Project Eligibility

- Projects must be a commercial building under 50,000 gross floor area and must be located in U.S. Climate Zones 2a, 3a or 4a.
- New Construction or Major Renovation Projects
- Must be a complete build-out project (up to 15% of the project can be shell space)
- Simple HVAC systems (systems cannot include cooling towers, chillers, boilers or exhaust systems greater than 3,000 cfm)
- Projects must achieve a minimum of 50 points to be certified. 75 points are required for Gold and 100 points are required for Platinum.

### 2. Registration

To initiate a new EarthCraft project, a project registration form must be completed. A project may be registered by any individual involved with the project. The registration fee must be paid in full before certification will be awarded.

The Technical Advisor (TA) will track the project throughout the certification process and provide all EarthCraft verification, diagnostic and energy modeling services as they apply to the EarthCraft Light Commercial certification path.

If assigning registration responsibility to the Technical Advisor or another representative from the builder company, provide registrant with all of the information needed to complete the registration form:

- Building type
- Conditioned square footage
- Number of stories
- Project address
- Billing contact
- Permit date

### Technical Advisor Responsibilities

Ensure the project has been registered with EarthCraft

- A project must be registered with EarthCraft prior to the mid-construction review

***A \$75 fine shall be issued to the Technical Advisor whenever a project is registered after the start of the mid-construction review***

### **3. Design Reviews**

The Design Reviews are opportunities to identify project goals and ensure measures are in place to meet all of the criteria set by EarthCraft. If applicable, the preliminary energy model will be used to estimate performance and determine if any improvements are needed to achieve compliance.

There will be two design review meetings:

- A. Design and Planning Review, which takes place earlier in the design phase of the project.
- B. Pre-construction Meeting, which takes place with the General Contractor before construction begins.

#### **Architect and Contractor Responsibilities**

Send the following documents to the Technical Advisor for review:

- Completed construction specification sheet demonstrating how the project will meet EarthCraft requirements
- If applicable, completed project worksheet with optional badges that will be pursued selected
- Drawings and specifications
- Identify all areas of uncertainty
- The architect and contractor shall note any areas of the worksheet they have questions on so that potential issues may be resolved during the design phase of the project

#### **Technical Advisor Responsibilities**

Review all materials provide by the architect and contractor

- Determine the projects' ability to achieve certification
  - If necessary, develop options to meet program criteria
- Address all questions and concerns presented by the architect and contractor
  - Contact Southface if further clarification is needed
- Identify effective cost trade-offs for improving building performance
- Identify areas of potential confusion or failure
- If applicable, complete preliminary energy model

#### 4. Mid-construction Reviews

During the Mid-construction reviews, the TA will begin to gather verification documentation and conduct new construction pre-drywall inspections.

There will be two mid-construction reviews:

- A. Initial Project Walkthrough and Air Sealing Inspection
- B. Pre-Drywall Inspection

#### General Contractor Responsibilities

Schedule the initial mid-construction inspection with your TA

- Inspection occurs after plumbing, electrical and HVAC rough-in air sealing, but before insulation installation and drywall has been hung
- Ensure the project is ready for inspection: Framing, rough-in and air sealing must be complete and ready for visual inspection. The TA must be able to visually verify that framing and air sealing requirements have been met.
- Schedule second inspection upon completion of first

Note: The minimum insulation installation that should be installed during the mid-construction review is for exterior wall insulation. If necessary, the TA may visually inspect attic and floor insulation during a final inspection. Builders shall discuss when all areas of insulation will be inspected with their TA during the design review, or prior to completing all inspections during the mid-construction review.

#### Technical Advisor Responsibilities

Follow up with general contractor to ensure the inspection is scheduled during the appropriate time of construction

Perform the inspection

- Verify applicable worksheet items

If applicable, confirm the energy model represents the home as constructed

Inform the contractor whether or not the project passed inspection

- If necessary, outline items that need correction or further attention

Complete the mid-construction inspection report

- This must be completed no later than thirty (30) days after the first mid-construction inspection.

***A \$75 fine shall be issued to the Technical Advisor for any submittal package sent to EarthCraft more than thirty (30) days after the first mid-construction inspection. In order to avoid this fine, please contact EarthCraft if circumstances will prevent a submittal package from being submitted prior to this deadline.***

## **5. Final Review**

As construction activities near completion, the Technical Advisor will verify all remaining worksheet items and conduct final diagnostic testing.

### **General Contractor Responsibilities**

Schedule the final inspection with your TA

- Inspection shall occur after all interior finishing work has been completed, but prior to occupancy

Ensure the project is ready for inspection

- All unverified worksheet items must be completed and accessible

### **Technical Advisor Responsibilities**

Follow up with contractor to ensure the inspection is scheduled during the appropriate time of construction

Perform the inspection

- Conduct diagnostic testing
- Verify applicable worksheet items
- If applicable, confirm the energy model represents the home as constructed

Inform the contractor whether or not the project passed inspection

- If necessary, outline items that need correction or further attention



## 6. Certification

At certification the TA will provide EarthCraft with all documentation necessary for review. After EarthCraft has reviewed and accepted all documentation the certificate will be awarded.

### Technical Advisor Responsibilities

Complete the final inspection report

- This must be completed no later than thirty (30) days after the first final inspection.
- In Salesforce, create a final inspection report, populate the required input fields, then click save. This single report will contain all of the data from the inspections.

Assemble the certification submittal package

- Final worksheet
- Worksheet cover, signed by contractor and TA

Submit all submittal documents to EarthCraft

This must be completed no later than thirty (30) days after the first final inspection.

***A \$75 fine shall be issued to the Technical Advisor for any submittal package sent to EarthCraft more than thirty (30) days after the first final inspection. In order to avoid this fine, please contact EarthCraft if circumstances will prevent a submittal package from being submitted prior to this deadline.***

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## **Variance Procedure**

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In the event an extenuating circumstance (such as physical parameters or other insurmountable conditions) prohibits a project from its ability to achieve a specific program requirement, it is possible a request for variance may be granted.

### **Variance Request**

#### Who may Request the Variance:

The variance can be submitted by any member of the project team to the Technical Adviser. The Technical Adviser will then submit to the ECLC Technical Review Team for consideration.

#### Variance Request Format:

A signed affidavit identifying the requirement of consideration, describing the circumstance surrounding the project's inability to meet the criteria outlined in the Technical Guidelines, and a proposed alternative to meet the intent or "purpose" of the relevant Requirement or Point Item.

### **Variance Approval**

Variance requests are approved by the ECLC Technical Review Team on a case-by-case basis. The approval of the request is largely based on the project's ability to meet the intent of the requirement. If a request is not granted, the participant must meet the criteria of the requirement outlined in the Technical Guidelines in order to achieve certification.

Variances Requests are not publicized and ECLC will maintain anonymity of both the project and the EarthCraft Technical Review Team members involved in the Variance Process.

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## Site Planning

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**SP R1: Site Best Practices (Requirement)**

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**PURPOSE**

Reduce water pollution from land disturbing activities. Discourage dumping of pollutants into drains connected to streams and rivers within the watershed.

**CRITERIA****SP R1.1 Erosion and Sedimentation Control (ESC) Plan**

Create an Erosion and Sedimentation Control Plan (ESC Plan) consistent with state or local best practices. The erosion control measures and plan should be provided to the ECLC Technical Advisor, maintained by the on-site contractor and adjusted as necessary throughout all construction phases.

Projects that are not required by local jurisdictions to provide an E&SC Plan that is stamped by an engineer should, at minimum, include the following measures/information for Erosion and Sediment Control Best Practices on the Project's Site Plan:

- Location of major roadways, streams and other bodies of water within 50 feet of the Project Boundary
- Major topographic features, streams, existing soil types and vegetation located within the Project Boundary, as well as existing and proposed topographic contours greater than two feet
- Location and extent of erosion and sediment control measures, including both vegetative and structural practices, such as:
  - Topsoil Protection – during construction, excavated topsoil should have properly installed perimeter silt fencing and be protected from erosion using one or more of the following measures: temporary seeding, mulch, compost, and/or breathable tarps
  - Perimeter silt fencing - installed and maintained properly to control runoff and siltation
  - Storm sewer inlets - protected with straw bales, compost socks, silt stacks or comparable measure
  - Erosion control blanket - used on steep slopes (greater than or equal to 15% change in elevation – a 1.5 foot rise over a 10-foot horizontal run constitutes a 15% slope)
  - Stabilization for all disturbed areas - stabilize with temporary seeding, straw, wood mulch or permanent vegetation immediately after rough grading is completed if a delay in finished grade is expected
  - Construction exit - to prevent construction debris from being tracked from vehicles onto public rights-of-way or into storm drains: at minimum, provide a stone-stabilized pad (minimum thickness of 6" and at least 20' x 20' in size) located at any point where traffic will be leaving the site to a public right-of-way, street, sidewalk, parking area
  - Name(s) and phone number(s) for personnel responsible for Erosion and Sedimentation Control on site

**SP R1.2 Label All Storm Drains and Storm Inlets**

If stormwater inlets are within the Project Boundary, then all drains must be labeled to indicate its connection to streams and rivers within the watershed. Label can be in the form of an affixed medallion, or a clearly legible stencil application.

**VERIFICATION**

- Construction Documents include Erosion and Sedimentation Control Plan and ESC Inspection Reports (spot check only)
- Construction Documents include labeled storm inlets
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

EPA's National Pollutant Discharge Elimination System (NPDES) Website

[www.epa.gov/npdes](http://www.epa.gov/npdes)

Georgia Erosion and Sedimentation Control Manual

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

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**SP R2: Stormwater Management (Requirement)**

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**PURPOSE**

Maintain the natural hydrologic cycle, prevent an increased risk of flooding, prevent stream erosion, and protect water quality.

**CRITERIA**

Work with a civil engineer and/or registered landscape architect to create a Stormwater Management Plan which incorporates Low Impact Development Best Management Practices (LID BMP) and reduction of hardscape areas to decrease stormwater runoff from the site.

The Stormwater Management Plan should integrate native and adaptive landscaping into the design and minimize the dependency on detention. The Plan must also include the area of disturbed site, type and location of LID BMP's, and address the following as applicable to the design:

- Peak discharge control
- Downstream impact (peak flow analysis)
- Treatment of runoff
- Infiltration and the capture/reuse of water on-site as necessary
- Water quality

Percent reduction is based on the project's pre-construction site conditions:

**Previously Developed Sites**

- Design project site to infiltrate 30% of one-year, 24-hour storm-generated runoff volume across the site

**Previously Undeveloped Sites**

- Design project site to infiltrate 50% of one-year, 24-hour storm-generated runoff volume across the site

**VERIFICATION**

- Copy of Hydrology Report.
- Construction Documents include Stormwater Management Plan
- Stormwater Management Infiltration Calculator
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

Urban Design Tools, Low Impact Development

[www.lid-stormwater.net](http://www.lid-stormwater.net)

National Resources Defense Council, Low Impact Development

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

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**SP 1: Hardscape Thermal Performance (1 point)**

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**PURPOSE**

Reduce heat island effect by creating shade over paved surfaces, such as parking lots and patio areas.

**CRITERIA**

50% of hardscape is shaded with vegetation and/or has an SRI value of at least 29. For example, the credit would be met if the project has 20% shaded hardscape and 30% SRI 29 paved surfaces. Areas that overlap can only be counted once for this percentage.

Shade can be in the form of natural tree canopy cover and/or a combination of trees and site structure, such as a canopy, awning or pavilion that shades hardscape area. For shade structures, other than those providing renewable energy sources (such as a solar panel array that shields parking), the top surface must meet the minimum SRI of 29.

Establish a plan with appropriate heights and widths of planting material or other site structures to meet the following criteria:

- Tree shade should be calculated by estimating the tree canopy diameter approximately ten years from the day of tree installation
- Shade is calculated as the arithmetic mean of shade at 10:00 AM, 12:00 PM and 3:00 PM on summer solstice.
- Trees cannot be listed on USDA or state agency lists as invasive species
- Provide a shade calculation on the Landscape Plan indicating that at least 50% of hardscape areas will be shaded by trees or other site structures
  - For the purpose of this calculation, the shaded area for each source of shade is considered to be the same as the area covered by the tree canopy or site structures (direct overhead aerial perspective)

Note: If also attempting SP 6: Tree Planting, then must also meet 2.5" caliper criteria for associated trees.

**VERIFICATION**

- Landscape Plan includes tree specifications, total area of hardscape and percent of area to be covered by shade, as specified in the criteria
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

The United States National Arboretum  
[www.usna.usda.gov](http://www.usna.usda.gov)

Southeast Exotic Pest Plant Council  
[www.se-eppc.org](http://www.se-eppc.org)

Arbor Day Foundation  
[www.arborday.org](http://www.arborday.org)

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**SP 2: Water Permeable Materials for Hardscape Areas (1-2 points)**

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**PURPOSE**

Reduce stormwater runoff by providing permeable areas that allow for water infiltration.

**CRITERIA**

Hardscape (non-vegetated) areas, such as walkways, plazas, and parking lots consist of water permeable material such as pervious concrete, open-grid pavers or compacted gravel. Sub-base material for these areas must also be permeable.

Select one option:

Option A. 50% of Hardscape Areas (1 point)

Option B. 90% of Hardscape Areas (2 points)

**Example Calculation**

Calculations should include all hardscape area within the Project Boundary. A Project with 3,500 square feet of permeable hardscape and a total hardscape area of 5,800 square feet would calculate the percent of permeable hardscape as follows:

$$\frac{\text{Permeable Hardscape Area}}{\text{Total Hardscape Area}} = \frac{3,500 \text{ sf}}{5,800 \text{ sf}} \rightarrow \mathbf{60.3\%}$$

**VERIFICATION**

- Construction Documents indicate type(s) and location(s) of permeable material
- Provide calculations demonstrating percent permeability
- Site Inspection by ECLC Technical Advisor

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### SP 3: Exterior Lighting Designed to Reduce Light Pollution (1 point)

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#### PURPOSE

Reduce exterior light pollution and circadian disruption to surrounding environment.

#### CRITERIA

Ensure all outdoor specified lighting fixtures meet the below requirements. Projects attempted the **Health Badge** must achieve credit.

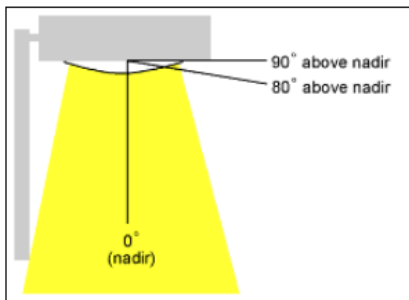
##### Site Lighting Certified or Qualified Full Cutoff (1 point)

All site and building facade lighting is certified under the International Dark-Sky Association's Fixture Seal of Approval (FSA) program or qualifies as full cutoff fixtures as defined by the Illuminating Engineering Society of North America (IESNA).

IESNA classifications are defined as follows (IESNA 2000):

Full cutoff—The luminous intensity (in candelas) at or above an angle of 90° above nadir is zero, and the luminous intensity (in candelas) at or above a vertical angle of 80° above nadir does not numerically exceed 10% of the luminous flux (in lumens) of the lamp or lamps in the luminaire.

**Figure 11. Angles referenced by the IESNA cutoff classifications**



Source: Adapted from Bullough 2002  
© IESNA, used with permission

The following exterior lighting can be considered exempt if equipped with an independent control device:

- Specialized signal, directional, and marker lighting associated with transportation
- Advertising or directional signage
- Lighting for athletic playing areas
- Lighting used to highlight features of public monuments and registered historic landmark structures or buildings

#### VERIFICATION

- Construction Documents clearly outline the location of exterior lighting and specifications for light fixtures and lighting schedule must list lighting source color temperature

#### RESOURCES

International Dark-Sky Association's Fixture Seal of Approval (FSA) Criteria 2015

<http://darksky.org/fsa/apply-fsa/>

International Dark-Sky FSA Compliant Products

<http://darksky.org/fsa/fsa-products/>

Illuminating Engineering Society of North America

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



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**SP 4: Alternative Transportation Accommodations (1-2 points)**

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**PURPOSE**

Reduce negative environmental impacts and improve outdoor air quality by providing convenient alternative transportation options.

**CRITERIA**

Provide alternative transportation accommodations and include type(s) and location(s) on Site Plan.

**1. Standard Alternative Transportation Accommodations (Select minimum 2 options for 1 point):****Option A. Bicycle Rack Accommodations**

Provide bike rack near the main entryway.

**Option B. Provide Shower**

Provide shower to encourage alternative transportation for building occupants

**Option C. Preferred Parking for Carpools and/or Alternative Fuel Vehicles**

Provide parking that is in addition and equivalent to at least 50% of that required by ADA (handicapped) parking spaces. Parking spaces should be striped or signed for preferred parking for carpools or alternative fuel vehicle use only and located secondary to the ADA spaces near main entryways.

**Option D. Provide Sidewalks Along Streets Adjacent to the Building Site**

Only projects where sidewalks are not required by jurisdiction.

**2. Advanced Alternative Transportation Accommodations (2 points):**

Must achieve Standard Alternative Transportation Accommodations first.

**Option E. Alternative Vehicle Charging/Fueling Station**

Provide a biodiesel, electric, ethanol, hydrogen, natural gas or propane vehicle charging/fueling station.

**VERIFICATION**

- Construction Documents detail location and type of alternative transportation accommodations
- Site Inspection by ECLC Technical Advisor

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**SP 5: Design Around Trees (1 point)**

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**PURPOSE**

Use mature vegetation to aid in mitigation of heat island effect, preserve habitat and aid in stormwater mitigation.

**CRITERIA**

Preserve at least 25% of existing trees that have a chest-height (four feet above the ground) diameter of eight inches for overhead trees and four inches for understory trees. The tree root zones of the selected trees must be protected with a physical barrier placed in ground along the outside edge of overhead canopy during all site clearing, grading and construction activities. Create a Tree Preservation Plan that typically includes the following:

**Tree Survey**

- Consult with a certified arborist, licensed landscape architect and/or qualified professional to assess the existing tree stock prior to establishing the building footprint and provide a written plan.
- Determine which trees are in good health and have cultural, native, aesthetic and/or monetary significance.

**Tree Protection**

- Clearly indicate tree save areas and protection measures in Construction Documents.
- Tree(s) should be fenced around the drip line throughout the construction process with tall, bright, protective fencing.
- Avoid soil being placed on top of any root zone for trees that are designated for preservation. Ensure the protected tree species' needs for growth, sunlight and water integrate well with the new building design.
- Avoid any type of compaction of existing soil within dripline of tree.

**VERIFICATION**

- Construction Documents include Tree Preservation Plan and tree survey created by qualified professional
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

North Carolina State University, Construction and Tree Protection  
[www.ces.ncsu.edu](http://www.ces.ncsu.edu)

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## SP 6: Tree Planting (1-2 points)

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### PURPOSE

Reduce heat island effect, improve air quality, aid in stormwater mitigation and improve natural ecosystems.

### CRITERIA

#### Fulfill one of the options below:

#### Option 1: Standard Tree Planting (1 point)

Create open space areas for tree conservation and restoration. Preserve or restore soil.

- A. For project sites with existing tree canopy coverage of 40% or more of the total lot area:
  1. conduct a tree survey noting total tree canopy
  2. new tree canopy must equal the pre- development conditions
- B. For Project sites with existing tree canopy coverage below 40% of the total lot area:
  1. Plant a minimum number of native trees according to lot coverage of building thresholds as listed below:
    - o Building covers 40% or less of total lot area: 40% tree canopy is required
    - o Building covers 41% - 60% of total lot area: 30% tree canopy is required
    - o Building covers 61% or more of total lot area: 20% tree canopy is required

*Canopy coverage is measured at 10 year tree maturity.*

For both conditions, projects must include the following:

1. All new trees to comply with the following:
  - a. ANSI Nursery Stock Standards
  - b. Minimum 2.5 caliper inch for all new overstory trees
  - c. Minimum 8 feet height for all new understory trees
  - d. Trees should be native to the region of the project site
  - e. Trees should have at least 50 cubic feet of amended soil volume with no dimension smaller than 24 inches.  
Amend soil as needed to match soil preferences for selected tree
2. Trees for preservation should be inspected by a certified arborist (International Society of Arboriculture) and approved as a healthy, viable tree
3. Follow written recommendations of a certified arborist (International Society of Arboriculture) for any to be preserved tree based on a pre-construction inspection
4. All areas of open space to have soil loosened and amended to a minimum depth of 12 inches
5. Install trees to provide maximum amount of shade for the building and/or site hardscapes
6. Avoid any planting location that is conflicting with overhead or underground utility, or any clear zone easements
7. All areas of open space to have stabilized cover via mulch and/or groundcover, shrubs or turf
8. Trees should be watered and maintained through establishment

#### Option 2: Advanced Tree Planting (2 points)

1. Fulfill Option 1 criteria in addition to planting at least one tree per 8 parking spaces, planted within parking island that is a minimum of 6 feet in any direction with a minimum area of 36 square feet.

### VERIFICATION

- Tree Survey
- Landscape Plan details requirements listed above
- Site Inspection by ECLC Technical Advisor

### RESOURCES

Tree Sizing Guide

<https://www.arboday.org/trees/righttreeandplace/size.cfm>

ANSI Nursery Stock Standard

[https://americanhort.org/documents/ANSI\\_Nursery\\_Stock\\_Standards\\_AmericanHort\\_2014.pdf](https://americanhort.org/documents/ANSI_Nursery_Stock_Standards_AmericanHort_2014.pdf)

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**SP 7: Greenspace Preservation or Habitat Restoration (2 points)**

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**PURPOSE**

Preserve and create natural ecosystems and habitat to Southeast topography, climate zone and ecology.

**CRITERIA**

Select one applicable compliance path below.

**SP 8.1 Greenspace Preservation**

Protect ecosystem function by avoiding development of existing natural areas that provide habitat and promote biodiversity.

Preserve and protect a minimum of 25% of existing natural and vegetative space within the project boundary. Calculate the percent of site area preserved within the project boundary (including the building footprint) and provide details on Landscape Plan. Qualifying greenspace cannot have been graded, cleared or disturbed prior to or by the project pursuing certification, with the exception of that required for minimal utility infrastructure installation.

Create a Greenspace Restoration Plan which includes at the following:

- Plan to be carried out during construction
- Project Boundary area (including the building footprint)
- Appropriate barriers prior to tree-clearing activities (such as tree protection fence, wire-backed silt fence, etc.)
- Zero trespass policy in greenspace area during construction activities
- Spaces are to be free of invasive materials

**SP 8.2 Habitat Restoration**

Provide necessary habitat restoration for 25% of site area within project boundary (excluding the building footprint + zoning requirements) to natural conditions through remediation, soil improvements, removal of invasive species, installation of natural and adaptive plant material, wetland repair, natural hydrology restoration and related techniques that foster support of habitats and ecosystems.

Create a Greenspace Restoration Plan which includes at the following:

- Project Boundary area (excluding the building footprint)
- Restoration area
- Narrative of actions taken to restore the area to natural conditions

**Example**

A project located on a previously developed site sets aside a third of the project site area (not including the building footprint) to restore to a natural landscape. All hardscape and invasive species (such as privet and kudzu) were removed, the soil infrastructure was improved/amended for pH, compaction and drainage and the area was planted with native and adaptive plant material.

**VERIFICATION**

- **SP 8.1 Greenspace Preservation**: Provide a landscape plan with protected greenspace identified. Create a Greenspace Protection Plan that includes the following measures: installation of appropriate barriers prior to tree-clearing activities (such as tree protection fence, wire-backed silt fence, etc.) and a zero trespass policy in the greenspace area during construction activities
- **SP 8.2 Habitat Restoration**: Provide a site drawing showing entire site area and highlighting restored or protected area. Clearly show that the areas comply with the requirement.
- Exception: Projects that comply with exception must provide site drawing showing the development perimeter is a minimum of 75% of the project perimeter and Growth Management Plan (as applicable).

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# Construction Waste Management

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**CW R<sub>1</sub>: Construction Waste Management Plan (Requirement)**

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**PURPOSE**

Create protocols to effectively divert construction waste from landfills through recycling and/or re-use strategies.

**CRITERIA**

Create a Construction Waste Management Plan and provide a copy to ECLC Technical Advisor prior to construction.

Clearly post construction waste recycling protocols at job site and on associated containers, educate subcontractors on aspects of the plan that pertains to their work, and enforce these measures to all those involved in construction activities.

**Construction Waste Management Plan must include, at minimum:**

- Percent of waste diversion planned (by weight). 20% minimum is required.
- Name of responsible party for managing the placement of containers, scheduling of container service and collecting waste haul receipts
- Summary of waste recycling efforts
- List of materials that will be diverted
- Name of the waste hauler(s), materials and methods of recycling

**VERIFICATION**

- Construction Waste Management Plan

**RESOURCES**

ECLC Construction Waste Management Plan Template  
<http://www.earthcraft.org/builders/resources/>

RecycleABulb  
<http://recycleabulb.veoliaes.com/home>

Earth911 (places to recycle in your state)  
[earth911.com](http://earth911.com)

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**CW 1: Landfill Waste Diversion (1-2 points)**

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**PURPOSE**

Reduce the amount of construction waste sent to landfills through recycling protocols outlined in the Construction Waste Management Plan.

**CRITERIA**

Provide receipts or spreadsheet from waste haul service provider. Receipts or spreadsheet should include the total amount of waste hauled and total amount of waste diverted by weight, as well as a percent breakdown of each type of waste diverted. If providing a spreadsheet, it must be signed by a representative from the waste haul service.

Select one option below:

**Option A. Divert 75% of Construction Waste (1 point)**

**Option B. Divert 90% of Construction Waste (2 points)**

*Note: If materials from an existing building/structure demolition are not reused on site, all waste must be included in waste haul numbers. Do not include excavated soil and hazardous materials in the calculations.*

**VERIFICATION**

- Waste haul receipts or spreadsheet

**RESOURCES**

ECLC Construction Waste Management Plan Template

<http://www.earthcraft.org/builders/resources/>

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**CW 2: Source Waste Reduction (1 point)**

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**PURPOSE**

Reduce the amount of construction waste sent to landfills through source reduction activities during design and manufacture of building materials.

**CRITERIA**

Work to procure suppliers that reduce construction waste before materials are delivered to the project site. Engage suppliers early on to review how materials are being delivered, packaged and transported to the project site and select suppliers that make an effort to minimize waste at the source (e.g. manufacturing site, distribution center and transport). Focus on building material that has large quantities (e.g. cladding, glazing, etc.).

Incorporate the project team's construction waste source reduction goals within the construction waste management plan.

Projects shall provide documentation to support the selected supplier has developed a strategy to minimize waste.

**Example of Packaging Reduction**

- The project's team lighting supplier traditionally delivered light bulbs in cardboard boxes that are wrapped in plastic. This ensured safe delivery of product but also created construction waste. Through early on procurement discussions with multiple suppliers the project team selected a supplier that was to provide plastic bins to transport light bulbs. The product was delivered safely and plastic bins were sent back to the supplier creating zero waste.
- Use reusable blankets instead of crates, shrink-wrap, or cardboard for protection of materials during shipping, for example millwork.
- Reduce void spaces and fillers in packaging
- Eliminate plastic wherever possible
- Use reusable or easily recyclable materials
- Order materials in concentrated form
- Order materials delivered in returnable boxes or pallets

**VERIFICATION**

- Manufacturer/Supplier provided Construction Waste Reduction Plan describing means and methods.
  - Include comparison of conventional method and best practice method. Highlight waste eliminated through best practice method.
- Photo documentation of source reduction materials being delivered to site.

**RESOURCES**

EPA Waste Management Hierarchy

<https://www.epa.gov/sm/advancing-sustainable-materials-management-facts-and-figures>



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**CW 3: Reuse or Donation of Existing Building Materials (1 point)**

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**PURPOSE**

Minimize extraction of natural resources and reduce construction waste by repurposing existing building materials that may otherwise be sent to a landfill.

**CRITERIA**

Reduce demolition waste on the project site by reusing existing building material from the project site, from another building project and/or donating existing building material for reuse on another building project. Materials may be sourced from building material collection centers. The value of the material should be determined based on fair market value for its intended reuse.

The fair market value (or 50% of retail value) of all reused/donated material should be at least 1% of the total construction materials cost excluding site work, MEP, and FFE.

*Note: Any material documented to attempt this point item cannot be included in waste haul calculations for CW 1: Landfill Waste Diversion.*

**VERIFICATION**

- Construction Documents include size and location of existing building materials to be reused/donated
  - For materials onsite:
    - Show photographs of materials prior to disassembly as well as photographs of materials stockpiled ready for installation
  - For materials from other sites:
    - Show photographs of materials stockpiled ready for installation
    - Provide receipt or letter of donation

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# Resource Efficiency

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**RE R1: Construction Sustainable Procurement Policy (Requirement)**

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**PURPOSE**

Minimize the environmental impact of building materials procured during the construction process by specifications and/or a sustainable procurement policy to be used during design and construction.

**CRITERIA**

Projects are to write and implement a trade specific (HVAC, Plumbing, etc.) materials requirements list and/or specifications for each trade that will guide the project's purchasing of environmentally preferable products and materials in alignment with EarthCraft material goals.

**Example:**

If project team goal is to achieve RE 2 Environmentally Preferable Materials Option B and C - Wood Framing Package (contains 100% sustainable forestry products - SFI or FSC) this requirement should be listed in the sustainable procurement policy.

**VERIFICATION**

- Provide Trade Contractor Materials Requirements during pre-construction meeting for each subcontractor
- Provide signed Sustainable Procurement Policy (Southface will provide template)

**RESOURCES**

Sustainable Procurement Definition per United Nations Global Marketplace

<https://www.ungm.org/Public/KnowledgeCentre/SustainableProcurement>

Procuring the Future

Sustainable Procurement National Action Plan: Recommendations from the Sustainable Procurement Task Force

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/69417/pb11710-procuring-the-future-060607.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69417/pb11710-procuring-the-future-060607.pdf)

Reducing package waste

<https://www.nibusinessinfo.co.uk/content/reduce-packaging-use-construction-sites>

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**RE 1: Environmentally Preferable Materials (1-9 points)**

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**PURPOSE**

Promote the use of materials that have a minimal environmental impact.

**CRITERIA**

Specify materials that have verified improved environmental life cycle impacts, have a high recycled content or wood that is harvested from sustainably managed forests.

Select one or more of the options below:

**Option A. Product Declaration Forms for four products used on the project (1 point)**

Provide product declaration forms for four project products, found in the following databases: UL Spot Database, Portico, Perkins + Will Precautionary List, ICC Evaluation Service, Environmental Product Declaration Database.

**Option B. 100% Wood Framing (2 points)**

All structural framing is wood.

**Option C. Sustainable Certified Wood Framing Package (3 points)**

All structural framing is wood, and all wood framing consists of 100% sustainable forestry certified products (SFI or FSC).

**Option D. Exterior Cladding Recycle Content (1 point)**

At least 50% of exterior cladding contains a minimum of 25% recycled material.

**Option E. Envelope Insulation Recycle Content (1 point)**

The aggregate amount of recycled content in envelope insulation coverage (in square feet) must be a minimum of 25%. See below for example calculation. Use recycled content calculator in worksheet to calculate.

**Option F. Floor Covering (1 point)**

At least 70% of floor coverings contain a minimum of 25% recycled material.

**Insulation Recycled Content Example**

For example, a building has:

- A 400 sf roof with 5% recycled content
- 960 sf of perimeter wall
  - First layer of wall insulation has 25% recycled content
  - Second layer of wall insulation has 35% recycled content
- Total sf = 400 sf + 960 sf = 1,360 sf

	Square Footage	% Square Footage (SF)	% Recycled Content (RC)	Weighted Average of Recycled Content (% SF x % RC)
Roof	400	29.5	5	0.014
Perimeter Walls (2 layers of insulation)	960	70.5	Average the two layers: (25+35)/2 = 30	0.212
Total	1,360			0.014 + 0.212 = 0.226 or <b>23% Total Recycled Content</b>

**VERIFICATION**

- Provide product specifications and/or calculations
- Provide product declaration forms where applicable
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

Environmental Product Declaration (EPD)

<http://www.environdec.com/>

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## Durability and Water Management

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**DU 1: Continuous Foundation Termite Shield (1 point)**

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**PURPOSE**

Prevent structural damage due to termite infestation.

**CRITERIA**

In the Southeast, it is particularly important that foundation areas prone to termite infestation be addressed. Install a continuous termite shield that provides a turndown break between the framing and foundation stem wall, piers, slab perimeter and other potential entry points. The termite shield can be fabricated from metal or similar flashing material that forms a physical barrier to termites.

Install termite shields at foundation to wood transitions. All seams and penetrations in the termite shield must be effectively sealed to prevent termite entry and to maintain air tightness of building envelope.

**VERIFICATION**

- Construction Documents details indicate termite shield
- Provide photographs of termite shield prior to the first Site Visit if cannot be visually verified
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

2009 International Building Code (IBC), Section 1805.3 Waterproofing, Section 1805.4 Subsoil Drainage System  
[www.iccsafe.org](http://www.iccsafe.org)

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**DU 2: Vented Rainscreen (1 point)**

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**PURPOSE**

Reduce potential for water intrusion through exterior wall assemblies.

**CRITERIA**

Create a vented rain screen behind the building facade. A vented rain screen is simply an air space between the structure and the facade that provides a means for intruding water to escape by draining down and away from the building assembly within that air gap.

To achieve proper drainage, meet the following criteria:

- **Cladding**  
Install furring strips to maintain a minimum of 1/4" gap or an engineered rain screen product that provides an air space between the exterior cladding and weather-resistive air barrier. The system must be integrated with flashing and be designed and installed to minimize moisture migration between the exterior cladding and the wall sheathing. The system must be open at the bottom and may optionally vented at top. Consider installing an insect barrier at vent locations.
- **Masonry Veneer**  
Provide a minimum 1" air space (recommend 2") air space behind the masonry and full-head weep holes with a minimum 24" on center spacing at bottom of wall assembly.

**VERIFICATION**

- Construction Documents details indicate depth of air gap for vented rain screen
- Provide photographs of vented rain screen prior to the First Site Visit if cannot be visually verified
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

2009 International Building Code (IBC), Section 1805.3 Waterproofing, Section 1805.4 Subsoil Drainage System  
[www.iccsafe.org](http://www.iccsafe.org)

Whole Building Design Guide

[www.wbdg.org/systems-specifications/building-envelope-design-guide/wall-systems/masonry-wall-systems](http://www.wbdg.org/systems-specifications/building-envelope-design-guide/wall-systems/masonry-wall-systems)

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**DU 3: Back-primed Siding and Trim (2 points)**

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**PURPOSE**

Improve long-term weather resistance of wood, fiber-cement and cellulose-based materials.

**CRITERIA**

For wood and cellulose-based products, prime all six sides of painted or solid-stained exterior siding and trim prior to installation. Back-priming is required for semi-transparent and transparent stained exterior siding and trim, however it is acceptable to stain the remaining five sides.

**VERIFICATION**

- Construction Documents specifications detail back-priming requirements
- Provide photographs of back-priming prior to site visits if cannot be visually verified
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

2009 International Building Code (IBC), Section 1805.3 Waterproofing, Section 1805.4 Subsoil Drainage System  
[www.iccsafe.org](http://www.iccsafe.org)



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**DU 4: Water Leak Prevention (1-4 points)**

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**PURPOSE**

Reduce potential for damage due to leaks inside the building.

**CRITERIA**

Address areas of potential water leakage to the building interior caused by mechanical sources.

Select one or more of the options below:

**Option A. Water Heaters (1 point)**

All water heater tanks must have a plumbed Temperature Pressure Relief (TPR) valve, as well as drains or drain-pans that capture overflow or leaks, and that are directed to either a combined plumbing drainage system or a drain line to the building exterior.

**Option B. HVAC Condensate (1 point)**

In the HVAC contract, include a provision to have the condensate drain lines and emergency drain pans tested after installation for all systems on roof or within building envelope. Condensate drain lines that drain to the exterior must be properly piped away from the building.

**Option C. Condensation Prevention for Cold Water Pipes (1 point)**

Insulate all cold water pipes located inside conditioned spaces and in interstitial locations (e.g. in walls, floor cavities, etc.) with a minimum of ½" insulation or R-2 equivalent.

**Option D. Freeze Protection for All Water Pipes (1 point)**

For any plumbing piping that is located outside of conditioned space (i.e. the building thermal envelope), install a minimum of 1" insulation or R-4 equivalent on ALL cold and hot water piping. Insulation shall be continuous and sealed, with no gaps or breaks.

**VERIFICATION**

- Construction Documents detail condensate drain line and emergency drain pan test requirements
- Provide photographs of drain line and emergency drain pan tests
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

Uniform Plumbing Code UPC 605

<http://codes.iapmo.org/home.aspx?code=UPC>

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## Indoor Environmental Quality

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**IEQ R1: Minimum Outside Air Requirements (Requirement)**

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**PURPOSE**

According to the EPA, air inside buildings can be more polluted than outside air. Provide sufficient filtered outside air to promote acceptable indoor air quality to building occupants.

**CRITERIA**

Provide outside air either for prescriptive default occupant density or for known density per ASHRAE 62.1-2016.

*Select one option below:*

**Option A. Default Occupancy Prescriptive Outside Air Requirements**

Introduce outside air based on space type and square footage. Refer to [Appendix E: Prescriptive Outside Air Requirements](#) for a table of prescriptive outside air CFM requirements according to space type.

**Example Calculation:** A small office building has the following space types and determines the outside air required using the table in [Appendix E: Prescriptive Outside Air Requirements](#).

<u>Space Type</u>	<u>Square Footage</u>	<u>OA Requirement</u>
Office space	500 sf	0.09 cfm/sf
Reception area	200 sf	0.21 cfm/sf
Corridor	50 sf	0.06 cfm/sf
Restroom	100 sf	n/a

*Outside Air Requirements = Square Footage of Spaces × CFM per SF Requirements*

$$\text{Outside Air Requirements} = (500 \times 0.09) + (200 \times 0.21) + (50 \times 0.06) + (100 \times 0) = \mathbf{90 \text{ cfm}}$$

**Option B. Meet ASHRAE Standard 62.1-2016, Ventilation for Acceptable Indoor Air Quality**

Provide documentation to demonstrate the requirements for outside air as outlined in ASHRAE 62.1-2016 have been met.

**MAJOR RENOVATIONS:** Deliver 10 CFM outside air per person.

**VERIFICATION**

- Construction Documents include a table for outside air requirements
- Outside air flow rates confirmed by Test and Balance Report (per [IEQ R7: Third Party Test and Balance Report](#))

**RESOURCES**

Environmental Protection Agency (EPA)

<https://www.epa.gov/indoor-air-quality-iaq/inside-story-guide-indoor-air-quality>

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

<https://www.ashrae.org/>

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**IEQ R2: Automatic Exhaust Controls (Requirement)**

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**PURPOSE**

Ensure building exhaust fans are capable of automatic shutoff.

**CRITERIA**

Specify and install automatic shut-off controls (such as timer controls for public restrooms or occupancy sensors for private restrooms) to turn off ALL exhaust ventilation when affected space is not occupied.

**VERIFICATION**

- Construction Documents indicate locations and rates of exhaust, airflow balance chart, and locations of controls
- Site Inspection by ECLC Technical Advisor

**RESOURCES****International Mechanical Code**

IMC Domestic Kitchen Section 5.5.2, Commercial Kitchen Section 505, 506, 507, 508

**American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)**

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

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### **IEQ R3: Minimize Indoor Air Contamination: HVAC (Requirement)**

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#### **PURPOSE**

Reduce indoor air pollutants through filtration and equipment location.

#### **CRITERIA**

##### **IEQ R3.1 MERV 8 Filter or Better**

Install a filter of Minimum Efficiency Reporting Value (MERV) eight or higher for all heating and cooling systems.

If the air handlers are used during construction and/or building flush-out, project must install air filter/cleaner on all systems with a MERV 8 or higher. **All filters must be replaced prior to occupancy with a MERV 8 filter at minimum.**

Ensure that installed equipment has capacity to handle potential pressure drop from filtration media.

Ductless Mechanical Systems: Equipment that provides heating/cooling without distributing the supply air through a duct system is exempt from the MERV-8 filtration requirements, provided that the following requirements are satisfied:

- The highest MERV filter available by the system manufacturer is utilized
- The central ventilation system supplying outside air to the zone heating/cooling equipment contains a MERV-8 filter or better

##### **IEQ R3.2 Locate Outside Air Intakes Away from Contaminant Sources**

Intake duct must be at least two feet above roof surface and duct and air sealed to the envelope.

Intakes must be located at least 15 feet from moderate contaminant sources:

- exhaust outlets
- plumbing stacks
- garbage pick-up/dumpster areas
- garage entries
- condensing units

Intakes must be located at least 25 feet from high contaminant sources:

- truck loading docks
- vehicle idling areas and high vehicle traffic areas
- cooling tower exhaust

Intakes must be located at least 30 feet from class 4 contaminant sources:

- commercial kitchen grease hood

##### **IEQ R3.3 No Air Handler Equipment in Garage, Parking Decks or Loading Dock Areas**

Air handler and all associated supply and return ductwork must be isolated from garage, parking decks, loading docks or other areas for high potential of vehicle exhaust contaminants.

##### **IEQ R3.4 Air Handler Must be Accessible and Labeled**

Air handler equipment must be easily accessible for maintenance purposes. Each AHU, condensing unit and thermostat shall be labeled to uniquely identify each system.

#### **VERIFICATION**

- Construction Documents indicate locations and types of filters, adequate filter access clearance, locations of outside air intakes and location of air handling equipment
- Site Inspection by ECLC Technical Advisor

#### **RESOURCES**

##### **International Mechanical Code**

IMC Domestic Kitchen Section 5.5.2, Commercial Kitchen Section 505, 506, 507, 508

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## **IEQ R4: Indoor Air Quality Management Plan during Construction (Requirement)**

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### **PURPOSE**

Promote a safe working environment for construction workers. Minimize the introduction of indoor air contaminants to the building during the construction process.

### **CRITERIA**

Reduce the exposure of building materials to moisture and other factors that may degrade or promote mold growth. Create and enforce protocols for the order, delivery, acceptance and on-site protection of materials. The plan must be communicated to all trades/sub-contractors before and during construction.

#### **IEQ R4.1 Indoor Air Quality (IAQ) Management Plan during Construction shall include at minimum:**

- Create and present the plan at site start-up meetings with relevant trades
- Identify responsible individuals for IAQ Management Plan
- Guidelines on HVAC protection, source control, pollutant pathway interruption, housekeeping and scheduling to follow in accordance with Sheet Metal and Air Contractors' National Association (SMACNA) IEQ Guidelines for Occupied Buildings under Construction

#### **IEQ R4.2 HVAC Protection**

- All ductwork in building (staged or installed) is protected from dust and debris until all sanding, grinding and polishing activities are complete
- If mechanical system is used during construction install at minimum a new MERV 8 filter prior to occupancy

#### **IEQ R4.3 Source Control**

- Staged delivery, with materials covered, elevated and protected from moisture and dust
- No paper-faced drywall installed until building is fully dried in
- All sprayed polyurethane foam (SPF) must follow industry safe installation guidelines
- Prohibit the use of tobacco products inside the building and within 25 feet (8 meters) of the building during construction

#### **IEQ R4.4 Pathway Interruption**

- Limit contaminant exposure to construction workers by incorporating various pathway interruption applications through appropriate strategies
- For example, depressurize the work area or erect barriers to contain construction activity

#### **IEQ R4.5 Housekeeping**

- Create and implement a Housekeeping plan to address dust and construction debris which can become airborne and distributed if build-up is allowed. Consider the following strategies:
  - Establish a cleaning schedule for floors to reflect construction activities
  - Incorporate a wet mop application if high dust construction activities occur
  - Vacuum with HEPA filter

### **VERIFICATION**

- Indoor Air Quality Management Plan during Construction should be established before building is dried-in
- Five photos of efforts at two different stages of construction (minimum 10 photos total)
- Site Inspection by ECLC Technical Advisor

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**IEQ R5: Safe Combustion Equipment (Requirement)**

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**PURPOSE**

Reduce risk of carbon monoxide and other combustion byproduct exposure.

**CRITERIA**

All combustion equipment must be sealed combustion / direct vented with dedicated combustion air provided from outside.

- Examples of combustion equipment include (but not limited to) fireplaces, furnaces, boilers and water heaters

**Exceptions:**

Gas cooking equipment with code mandated exhaust to outside.

**VERIFICATION**

- Construction Documents include location and type of gas-fired equipment
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

International Fuel Gas Code

<https://codes.iccsafe.org/public/document/toc/547/>

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**IEQ R6: Building Designed for Positive Pressure (Requirement)**

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**PURPOSE**

Reduce risk of contaminant infiltration caused by undesirable negatively pressurized spaces.

**CRITERIA**

Design the building such that the overall building pressure, with all air moving equipment in normal operation, is slightly positively pressurized with reference to outside.

During the Final Site Inspection, the ECLC Technical Advisor will test the building pressure differential. If a negative indoor pressure of more than three Pascals with reference to the outdoors is measured, the ECLC Technical Advisor will advise the project to make adjustments to supply and/or exhaust rates.

**Example:** Airflow Balance Chart

SYSTEM	<b>AIRFLOW BALANCE</b>	
	OUTSIDE AIR (CFM)	EXHAUST AIR (CFM)
HOOD 1	1520	1900
HOOD 2	1520	1900
HOOD 3	1280	1600
AHU-4	200	-
AHU-5	200	-
KITCHEN SUBTOTAL	4720	5400
AHU-1	400	-
AHU-2	400	-
AHU-3	400	-
EF-1	-	275
<b>TOTAL:</b>	<b>5920</b>	<b>5675</b>
<b>NET:</b>	<b>245 (CFM POSITIVE)</b>	

**VERIFICATION**

- Provide air balance summary table to demonstrate total system OA exceeds total system exhausts. See example above
- Building Pressure Differential Test by ECLC Technical Adviser

**RESOURCES**

Associated Air Balance Council

[www.aabc.com](http://www.aabc.com)



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## IEQ R7: Third-party Test and Balance Report (Requirement)

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### PURPOSE

Ensure HVAC systems are providing airflow rates as designed.

### CRITERIA

Retain an independent, third-party testing agent to perform a test and balance of the system's airflow distribution for all field-installed ductwork. The test and balance report must follow equipment test sheets and communicate required data per Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). The third party must be an AABC or NEBB certified organization.

Demonstrate that air system is balanced to within +/- 10% of the Design Air Flow Values at each register per the Test and Balance report.

Refer to ES R5: Duct System Requirements for a complete list of ductwork requirements.

At minimum, the report should include the following Design and Actual values:

- Supply airflow for each air handling unit and each register
- Return airflow for each air handling unit and each register
- Outside airflow for each air handling device
- Percent difference for each of the above measurements
- Exhaust rates per fan and each register (including all hoods and make-up air)
- Minimum and maximum airflows for terminal units

#### Ductless Mechanical Systems

Ductless heating/cooling equipment does not need to be tested, adjusted or balanced by a third-party test and balance technician. However, all projects must receive a test and balance report to ensure that exhaust and outside air flow rates comply with the design.

### VERIFICATION

- Provide third party test and balance report

### RESOURCES

Associated Air Balance Council

[www.aabc.com](http://www.aabc.com)

National Environmental Balancing Bureau

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

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**IEQ R8: Minimum Requirements for Indoor Materials (Requirement)**

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**PURPOSE**

Minimize building occupant exposure to volatile organic compounds (VOCs) mold growth and improve indoor air quality with proper material selections.

**CRITERIA**

Projects are to follow the following minimum indoor material requirements:

**No vapor impermeable wall coverings****Low VOC paints and finishes**

Include maximum VOC emission limits for paints, stains and sealer products in Construction Documents and ensure that site-applied products do not exceed the below specified maximum VOC limits (as referenced by SCAQMD Rule 1168).

Product Type	VOC Limit
Primers	50 g/L
Flat Topcoat Paint	50 g/L
Non-flat Topcoat Paint	50 g/L
Anti-corrosive Paints and Primers	100 g/L
Stains	100 g/L
Sealer	100 g/L
Waterproof Sealer	100 g/L

*Note: VOC thresholds for paints, stains and sealers apply only those used on the interior of the building.*

**Low-VOC adhesives (less than 100 g/L)**

Carpet adhesive, carpet pad adhesive, wood flooring adhesive, rubber floor adhesive, subfloor adhesive, duct mastic, fireproofing mastic, ceramic tile adhesive, Vinyl composition tile (VCT) adhesive, drywall and panel adhesive, cove base adhesive, and multipurpose construction adhesive

**Mold Resistant Materials (wet areas only)**

Specify mold resistant gypsum board for all "wet walls" (any wall that contains structural plumbing) in all wet areas.

- For example, paperless gypsum products, PURPLE® drywall
- Not compliant: water resistant "greenboard"

**VERIFICATION**

- Construction documents must indicate material selections
- Provide Safety Data Sheets(s) (SDS) for site-applied paints, stains and sealers as well as site applied adhesives

**RESOURCES**

Green Seal, GS-11 Standard for Paints and Coatings (Third Edition) and GS-47 Standard for Stains and Finishes  
[www.greenseal.org](http://www.greenseal.org)

South Coast Air Quality Management District (SCAQMD),  
Rule 1168 Adhesive and Sealant Applications (Amended January 7, 2005)  
[www.aqmd.gov](http://www.aqmd.gov)

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**IEQ R9: Indoor Air Flush-out Prior to Occupancy (Requirement)**

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**PURPOSE**

Minimize the building occupant's exposure to indoor air contaminants inadvertently introduced during the construction phase.

**CRITERIA**

Despite attempts to reduce the amount of Volatile Organic Compounds (VOCs), flame retardants and other chemicals in applied products during construction, it is typical for building materials and furniture to off-gas during the first 14-90 days after construction. In addition, a considerable amount of particulate matter can remain in the air following construction.

Upon substantial completion of construction (after all sanding, finishing, carpet and furniture installation activities are complete) run HVAC system at maximum outside air (OA dampers open fully) 24 hours a day for 2 weeks to flush the building of particulates and chemical off-gassing. All interior doors to regularly occupied spaces must be opened for the duration of the flush-out. Building move-in and occupancy can take place during the flush-out, in order to meet project schedule requirements.

Note: If a test and balance is done prior to procedure, ensure that the correct outside air damper positions are clearly labeled to denote design airflow rates so that dampers can be returned to design outdoor air positions after flush-out procedure is completed.

Perform the building flush-out using one or both of the following procedures:

- **Flush-out with HVAC Equipment**
  - Install a minimum of MERV 8 filtration on all air handlers prior to and replace ALL filters with clean filtration media of MERV 8 or higher immediately after flush-out
  - Ensure all outside dampers are 100% open
  - Set fan to "on" (not automatic) to ensure air handler is running continuously
  - Run for 24 hours a day for 14 consecutive days
  - Reset outside air damper position to design air flow rate

**VERIFICATION**

- Construction Documents include narrative detailing Indoor Air Flush-Out procedures
- Photo documentation of filter installation and replacement, dampers, and HVAC controls setting

**RESOURCES**

Well Certified Air Flush

<http://standard.wellcertified.com/air/air-flush>

ASHRAE IAQ

<http://iaq.ashrae.org/>

EPA IAQ

<https://www.epa.gov/indoor-air-quality-iaq/office-building-occupants-guide-indoor-air-quality>

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**IEQ 1: Decoupled Ventilation (1-4 points)**

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**PURPOSE**

Provide dedicated system for outside air ventilation to optimize thermal comfort, moisture control and energy performance.

**CRITERIA**

Projects fulfill applicable options:

**Option A: Dedicated Outside Air System (DOAS) (1 point)**

Decouple outside air introduction from the building's heating and cooling systems by installing a DOAS for at least 90% of outside air flow rate requirements. Ventilation air must be pre-conditioned before it is introduced into heating and cooling system or conditioned spaces. System must have filter that is accessible for maintenance.

**Option B: Pre-Conditioning Outside Ventilation Air with Energy Recovery (3 points)**

Employ pre-conditioning strategies to temper incoming ventilation air using an energy recovery ventilation (ERV) system. System must be easily accessible and have a filter that is accessible for maintenance.

**VERIFICATION**

- Construction Documents indicate DOAS and ventilation pre-conditioning strategies
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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

<http://doas-radiant.psu.edu/IAQ8.pdf>

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**IEQ 2: Demand Controlled Ventilation (1-2 points)**

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**PURPOSE**

Maintain air quality and decrease energy consumption by delivering outside air (OA) based on occupancy.

**CRITERIA**

Ventilation of outside air (OA) shall be automatically adjusted based on occupancy. Sensors shall be tied to the ventilation control and increase/decrease OA flow rates in response to occupancy. Install a minimum of one sensor per each 500 CFM of OA. Refer to ASHRAE Standard 62.1-2016, Table 6.2.2.1 Minimum Ventilation Rates in Breathing Zone and 6.2.7.1 Demand Control Ventilation. See also ASHRAE 90.1-2013, Section 6.4.3.8 Ventilation Controls for High Occupancy Areas.

Projects to fulfill applicable options:

**Option A. Carbon dioxide (CO<sub>2</sub>) sensor based demand control ventilation (2 points)**

- In rooms requiring 500 CFM of outside air (OA)
- In rooms greater than 500 sf with an occupant density of 25 people per 1000 sq.ft. (40 sq.ft. per person)
- CO<sub>2</sub> sensors must measure CO<sub>2</sub> levels in the breathing zone relative to OA levels
- Wall-mounted CO<sub>2</sub> sensors are acceptable

**Option B. Occupancy sensor based demand control ventilation (1 point)**

- Occupancy sensor controlled ventilation can be reduced to zero at times of no occupancy for all allowed spaces denoted by Note H in ASHRAE 62.1-2016 Table 6.2.2.1
- Example spaces include lecture halls, classrooms, offices, corridors, lobbies, breakrooms, etc
- For a list of all allowable spaces in ASHRAE 62.1-2016, refer to Appendix E. Prescriptive Outside Air Requirements

**VERIFICATION**

- Construction Documents indicate locations of CO<sub>2</sub> sensors and mechanical notes describing control sequence
- Site Inspection by ECLC Technical Advisor

**DEFINITION**

Breathing zone – the zone in occupied space between three inches and 72 inches (6 ft.) above the floor and more than two ft. from fixed AC equipment.

**RESOURCES**

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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

Energy Codes

[https://www.benergycodes.gov/sites/default/files/documents/cn\\_demand\\_control\\_ventilation.pdf](https://www.benergycodes.gov/sites/default/files/documents/cn_demand_control_ventilation.pdf)

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**IEQ 3: Air Filtration Media: MERV 11 or Higher (1 point)**

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**PURPOSE**

Improve air quality by installing high-efficiency filtration media.

**CRITERIA**

Increasing the efficiency of air filtration media will assist in reducing the amount of fine particulates and improve the quality of indoor air. Install air filters that have a Minimum Efficiency Reporting Value (MERV) of 11 or higher for all applicable air handling equipment. Ensure that installed equipment has capacity to handle potential pressure drop from filtration media.

If the air handlers are used during construction and/or building flush-out, project may install air filter/cleaner on all systems with a MERV 8 or higher. **All filters must be replaced prior to occupancy with a minimum MERV 11 filter.**

All filters must be easily accessible and provide safe and adequate clearance for maintenance. Ensure that installed equipment has capacity to handle potential pressure drop from filtration media.

Consider using a thicker media filter to increase effective surface area and reduce pressure drop.

**VERIFICATION**

- Construction Documents indicate air filtration media criteria
- Site Inspection by ECLC Technical Advisor

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**IEQ 4: Radon Exposure Prevention (1-3 points)**

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**PURPOSE**

Reduce occupant exposure to radon.

**CRITERIA**

*Select one option below:*

**Option A. Radon Test After Substantial Completion (1 point)**

Project team shall conduct a radon test of the building and provide test results to the building owner. Radon test must comply with EPA guidelines. If test indicates a radon concentration greater than four picocuries per liter (pCi/L), project must follow EPA guidelines to reduce levels to below 4 picocuries per liter (pCi/L).

**Option B. Install Soil Gas Vent System (3 points)**

A passive radon vent system shall be installed in compliance with EPA guidelines for "Model Standards and Techniques for Control of Radon in New Residential Buildings." After substantial completion, perform radon test as indicated in Option A. If radon levels greater than four picocuries per liter are measured, convert passive system to active system with fan(s) and retest. Repeat modifications and testing until radon level is below acceptable level.

**VERIFICATION**

- Construction Documents include soil gas vent system
- Provide radon test results to owner and ECLC Technical Advisor
- Site Inspection by ECLC Technical Advisor or photo documentation

**RESOURCES**

EPA Radon Resource Page  
[www.epa.gov/radon](http://www.epa.gov/radon)

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## IEQ 5: Certified Flooring (1-2 points)

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### PURPOSE

Reduce building occupant exposure to volatile organic compounds (VOCs).

### CRITERIA

#### Carpet and Rug Institute's (CRI) GREEN LABEL PLUS® program

Installed carpet and associated adhesives are certified by the Carpet and Rug Institute's (CRI) GREEN LABEL PLUS® program. Cradle to Cradle® certification or Declare Red List Free® certification are acceptable alternatives.

#### Non-Carpeted Flooring

All of the following installed non-carpeted flooring and related adhesives are certified by at least one of the below third-party certifications:

- FloorScore®
- GREENGUARD®
- Cradle to Cradle®
- Declare Red List Free®

**Note: Ceramic tile and concrete are exempt**

*Select one option:*

**Option A: 70% of Flooring is Certified (1 point)**

**Option B: 100% of Flooring is Certified (2 points)**

### VERIFICATION

- Product Specifications indicating CRI GREEN LABEL PLUS®, Cradle to Cradle®, FloorScore®, GREENGUARD® label or Declare Red List Free®.

### RESOURCES

The Carpet and Rug Institute

[www.carpet-rug.org](http://www.carpet-rug.org)

The Resilient Floor Covering Institute

[www.rfci.com](http://www.rfci.com)

GREENGUARD® Environmental Institute

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

Cradle to Cradle®

[www.c2ccertified.org](http://www.c2ccertified.org)

Declare®

<https://living-future.org/declare/>



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**IEQ 6: Composite Wood Contains No Added Urea-Formaldehyde (1 point)**

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**PURPOSE**

Reduce building occupant exposure to urea-formaldehyde.

**CRITERIA**

All interior composite wood products contain no added urea-formaldehyde (NAUF).

- For example, particleboard, medium density fiberboard (MDF), plywood, laminated shelving, wood doors, blocking, millwork

**VERIFICATION**

- Product Safety Data Sheets(s) (SDS) stating NAUF for all composite wood products used inside the building envelope

**RESOURCES**

Formaldehyde Standards

<http://www.hpva.org/formaldehyde-standards>

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## IEQ 7: Product Transparency Label Material Selection (1-5 points)

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### PURPOSE

Reduce building occupant exposure to indoor air contaminants and harsh chemicals by eliminating the use of worst-in-class ingredients/chemicals used inside the building envelope.

### CRITERIA

Projects are to incorporate a list of products identified as contributing to positive IAQ into the specification package and into project's Sustainable Procurement Policy. Project teams must procure materials with the Red List Free Label, Declare label, Health Product Declaration (HPD) or located within the Pharos database. Project teams must create and implement a process for confirming all identified transparency labeled products are within the building. Projects attempting the **Health Badge** must fulfill at least one option.

*Select at least one option-potential for 5 total points:*

**Option Interior Finishes – minimum 5 products with product transparency label (1 point)**

**Option FF&E – minimum 10 products with product transparency label (2 points)**

**Option Building Structural/Envelope Elements – minimum 12 products with product transparency label (1 point)**

**Option MEP – minimum 5 products with product transparency label (1 point)**

Sample of Red List ingredients that would be prohibited in a project. Complete list contains over 777 prohibited ingredients:

- |   |   |
|---|---|
| - Alkylphenols  | - Halogenated Flame Retardants (HFRs)                       |
| - Asbestos  | - Lead (added)  |
| - Bisphenol A (BPA)   | - Mercury   |
| - Cadmium   | - Polychlorinated Biphenyls (PCBs)                          |
| - Chlorobenzenes  | - Perfluorinated Compounds (PFCs)                           |
| - Chlorinated Polyvinyl Chloride (CPVC)                           | - Phthalates  |
| - Formaldehyde (added)  | - Polyvinylidene Chloride (PVDC)                            |
| - Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) | - Volatile Organic Compounds (VOCs) in wet applied products |

### DEFINITIONS

**Declare** - is a "nutrition label" and online database for building materials. Declare labels clearly indicate whether a product is Red List Free or not. (Source *Living Building Institute*)

**Health Product Declaration (HPD)** - provides a standardized way of reporting the material contents of building products, and the health effects associated with these materials. The HPD is developed according to the directions set forth by the Health Product Declaration Collaborative, and is considered to be complementary to life cycle documentation such as LCA and EPD. (Source *Health Product Declaration Collaborative*)

### VERIFICATION

- Provide Sustainable Procurement Policy and/or Specifications.
- Product Safety Data Sheets(s) (SDS) or other verified collateral stating Red List Free compliance.
- Site Inspection by ECLC Technical Advisor.

### RESOURCES

Toxicological Effects of Methylmercury

<https://www.nap.edu/catalog/9899/toxicological-effects-of-methylmercury>

Declare Product Database

[access.living-future.org/declare-products](https://access.living-future.org/declare-products)

Health Product Declaration (HPD)

<http://www.hpd-collaborative.org/>

Pharos Database

<http://pharosproject.net/>

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# High Performance Building Envelope

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## BE R1: Envelope Design (Requirement)

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### PURPOSE

Reduce heat loss or gain through building thermal envelope components. Minimize energy loss and increase durability by providing better moisture control with a closed crawlspace. Avoid using an energy source for attic ventilation to prevent creation of an undesirable pressure profile.

### CRITERIA

Fulfill the following criteria (as applicable):

- Fulfill minimum envelope requirements in BE R1.1 Minimum Prescriptive R-Values for Building Envelope through prescriptive or trade off method via *COMcheck*
- No vented crawlspace and no power attic ventilation

The project must meet or exceed portions of ASHRAE Standard 90.1-2013 Section 5 Building Envelope. Compliance with insulation and fenestration requirements may be verified using either the "Prescriptive Building Envelope Option" or the "Building Envelope Trade-Off Option". All mandatory provisions apply. Architectural Drawings must indicate insulation and fenestration values for each building envelope component. In addition, *COMcheck* shall be completed (refer to [Appendix A: COMcheck Overview](#) and [Appendix B: COMcheck Envelope](#)).

Vestibules or revolving doors are required in climate zone 3 if the building is  $\geq 10,000$  square feet and 4 stories or more above grade; they are required in climate zone 4 if the building is  $\geq 1,000$  square feet. Vestibules or revolving doors are not required in climate zones 1 and 2. Refer to ASHRAE Standard 90.1-2013, Section 5.4.3.4.



Demonstrate compliance with *COMcheck* through one of the following options:

- A. **Prescriptive Option:** Insulation and fenestration properties shall meet requirements in ASHRAE Standard 90.1-2013 Tables 5.5-1 through 5.5-8, and summarized in Table 1.

A project may select the prescriptive option if the design meets the following conditions:

- Vertical glazing does not exceed 40% of the gross wall area
- Skylight glazing does not exceed 3% of the gross roof area

To demonstrate compliance through *COMcheck*, meet or exceed R-Value, U-Factor and Solar Heat Gain Coefficient (SHGC) requirements for each applicable thermal envelope component.

**BE R1.1 Minimum Prescriptive R-Values for Non-Residential Building Envelopes**

Opaque Elements	Climate Zone 2	Climate Zone 3	Climate Zone 4
<b>Roofs*</b>			
Insulation Entirely above Deck	R-25.0 c.i.	R-25.0 c.i.	R-30.0 c.i.
Metal Building	R-10.0 + R-19.0 FC	R-10.0 + R-19.0 FC	R-19.0 + R-11 Ls or R-25 + R-8 Ls
Attic and Other	R-38.0	R-38.0	R-49.0
<b>Walls, Above Grade</b>			
Mass	R-5.7 c.i.	R-7.6 c.i.	R-9.5 c.i.
Metal building	R-0.0 + R9.8 c.i.	R-0.0 + R9.8 c.i.	R-0.0 + R-15.8 c.i.
Steel-Framed	R-13.0 + R-3.8 c.i.	R-13.0 + R-5 c.i.	R-13.0 + R-7.5 c.i.
Wood-Framed and Other	R-13.0	R-13.0	R-13.0 + R-8 c.i.
<b>Walls, Below-Grade</b>			
Below-grade walls	NR	NR	R-7.5 c.i.
<b>Floors</b>			
Mass	R-6.3 c.i.	R-10 c.i.	R-14.6 c.i.
Steel-Joist	R-30	R-30	R-30
Wood-Framed and Other	R-30	R-30	R-30
<b>Slabs</b>			
Unheated	NR	NR	R-15.0 for 24"
Heated	R-10.0 for 24"	R-15.0 for 24"	R-20.0 for 24"
<b>Opaque Doors</b>			
Swinging	U-0.70	U-0.70	U-0.50
Non-swinging	U-0.50	U-0.50	U-0.50
<b>Vestibules</b>			
At building entrance	NR	yes for +10K sf	Yes

Source: ASHRAE Standard 90.1-2013 Tables 5.5.1-5.5.4

c.i. – continuous insulation  
 NR – no (insulation) requirement  
 Ls – Liner system  
 FC – filled cavity

\*High Albedo Roof required with some exceptions

**BE R1.2 Minimum Fenestration Performance for Non-Residential Building Envelopes**

Glazed Fenestration	Climate Zone 2	Climate Zone 3	Climate Zone 4
<b>Vertical Fenestration (max. 40%)</b>			
Nonmetal frame	U-0.40 / SHGC-0.25	U-0.35 / SHGC-0.25	U-0.35 / SHGC-0.40
Metal frame, fixed	U-0.57 / SHGC-0.25	U-0.50 / SHGC-0.25	U-0.42 / SHGC-0.40
Metal frame, operable	U-0.65 / SHGC-0.25	U-0.60 / SHGC-0.25	U-0.50 / SHGC-0.40
Metal frame, entrance door	U-0.83 / SHGC-0.25	U-0.77 / SHGC-0.25	U-0.77 / SHGC-0.40
<b>Skylight (max 3% of roof)</b>			
All types	U-0.65 / SHGC-0.35	U-0.55 / SHGC-0.35	U-0.50 / SHGC-0.40

**B. COMcheck Trade-Off Option** (Refer to ASHRAE Standard 90.1-2013, Section 5.6)

For projects that do not qualify for the Prescriptive path, or prefer to redistribute insulation values for various envelope components to better serve the building design, the Trade-Off option may be used.

An energy simulation per Chapter 11 of ASHRAE Standard 90.1-2013 may be used as an alternative to the prescribed criteria for meeting this requirement if approved by the ECLC Technical Advisor.

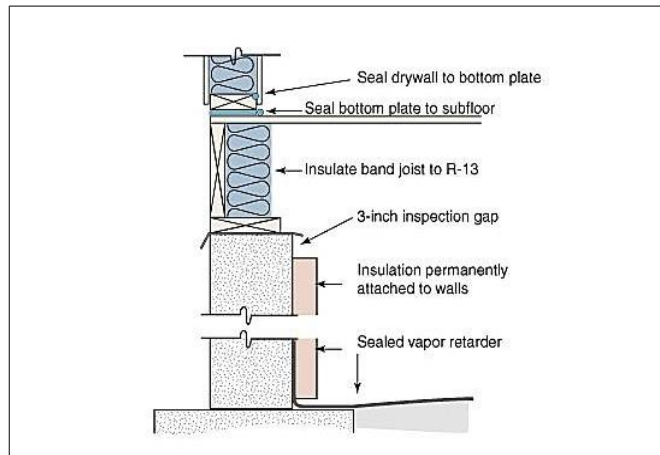
**MAJOR RENOVATIONS:** Alterations to the building envelope should follow ASHRAE 90.1-2013, Section 5.1.3.

**Closed Crawlspace**

If a crawlspace foundation is constructed, provide a closed crawlspace for the project. Carefully consider moisture management, combustion safety and termite control issues in the design of the crawlspace. A closed crawlspace located within the 100-year flood plain must have smart vents that are normally closed.

Include the following details in the design and construction of the closed crawlspace:

- No venting allowed - all penetrations in crawlspace walls and floor to conditioned space above must be sealed
- Wall connections are sealed with caulk, foam sealant and/or gasket:
  - Foundation stem wall and the sill plate
  - Sill plate and band joist
  - Band joist and subfloor
- Termite shield or sill seal between foundation stem wall and the bottom plate (i.e. sill plate)
- A minimum Class I, 6-mil (0.15 mm) polyethylene vapor retarder must be installed and secured to cover all exposed earth and extended at least six inches up foundation wall or above exterior ground grade level - overlap joints at least six inches and apply sealant
- Non-residential buildings with crawlspace walls must be continuously insulated to the following minimum levels (insulation may be located on the interior or exterior surface of the crawlspace walls):
  - Climate Zone 2: R-5.7
  - Climate Zone 3: R-7.6
  - Climate Zone 4: R-9.5
- A 3 inch inspection gap must be included immediately below wood floor joists/sill plate to allow inspection for termites. A removable insulation piece shall plug this opening during normal operation.
- Insulated and air sealed band joists - minimum R-13
- Access doors completely weather stripped and insulated to the same level as the crawlspace walls - ensure access doors have adequate protection from bulk water intrusion
- Install a dehumidification system to maintain relative humidity at levels of < 60%
- Install humidity sensor with alarm capability.



*Note: The 2009 IBC does not specifically allow closed crawlspaces (refer to section 1203.3 Under-floor ventilation); however, closed crawlspaces may be installed in accordance with the 2009 IBC section 104.11 Alternative materials, design and methods of construction and equipment. Check with local/state building codes for potential conflicts.*

### **No Power Attic Ventilation**

Vented attics should be passively ventilated.

*Note: EarthCraft Light Commercial encourages unvented attic assemblies.*

### **VERIFICATION**

- Construction documents clearly identify types and properties of insulation and fenestration materials
- COMcheck file and COMcheck Envelope Compliance Certificate must be submitted before construction for Option A or Option B
- Leave NFRC label on glazing for Site inspection OR provide photographs before removing
- For Site-fabricated glazing, provide Certificate of Compliance
- Construction Documents clearly indicate closed crawlspace details
- ECLC Technical Advisor will perform Site inspection

### **RESOURCES**

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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

COMcheck Software

[www.energycodes.gov](http://www.energycodes.gov)

ASHRAE Standard 90.1-2013, Section 5.4.3 Air Leakage

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

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**BE R2: Complete Insulation Coverage (Requirement)**

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**PURPOSE**

Reduce energy loss and increase building durability by creating a complete thermal boundary at the building envelope.

**CRITERIA**

Installed insulation shall be free of defects in accordance with manufacture requirements (Grade I). Projects must fulfill the minimum envelope design requirements described below for thermal break for mass and/or steel framed walls (as applicable) and proper insulation installation. Even with trade-off, a **minimum thermal break of R-3** is required.

**Thermal Break Required for Mass Wall and/or Steel Framed**

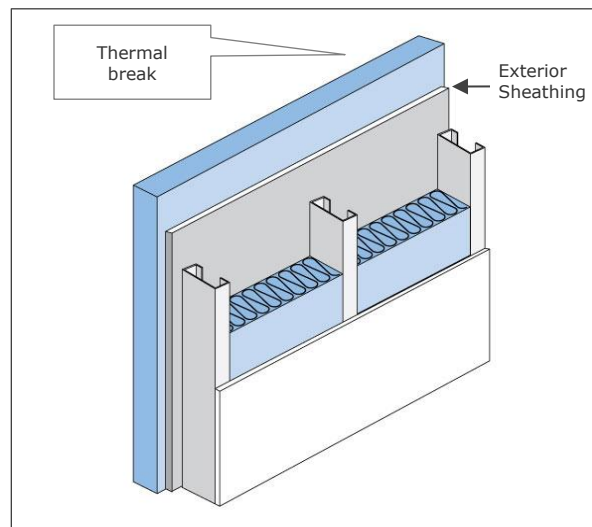
Projects complying with BE R1 Option A: Prescriptive Option must fulfill the following:

**BE R2.1: Prescriptive required thermal break for energy code compliance (non-residential buildings).**

Wall, Above Grade	Climate Zone 2	Climate Zone 3	Climate Zone 4
Steel Framed	R-3.8	R-5	R-7.5
Mass	R-5.7	R-7.6	R-9.5

Projects complying with BE R1 Option B: COMcheck Trade-Off Option must fulfill the following:

Projects that have mass and/or steel framed walls as a component of the building envelope assembly must have a **minimum thermal break of R-3** in the form of exterior continuous insulation, regardless of energy code compliance pathway. Projects are to document with COMcheck.



Steel Stud Framed Wall Section Perspective

**Grade I Insulation Coverage**

The building thermal envelope is comprised of two components: insulation and an air barrier. All insulation must be continuous (no gaps or missing pieces) and in direct contact with the building's continuous air barrier.

The quality of the insulation application will be graded upon inspection: Grade I is required. Ensure careful installation at narrow cavities and cavities that contain plumbing or electrical work.



Meet the following requirements below, as applicable:

❑ **Insulation Application**

Installation must be a minimum of Grade I quality. Any project receiving a Grade II or Grade III upon inspection must resolve deficiencies and supply photos to demonstrate that corrections have been made.

❑ **Loose-fill Attic Insulation**

Any applied loose-fill attic insulation must have an attic card (listing type of insulation, bag count and appropriate depth) located near the access, and rulers must be present every 300 square feet. For vented attics, insulation dams and ventilation baffles shall be installed to provide insulation coverage over top plates (prior to insulation). Loose-fill insulation shall not be used in attic roof spaces when the slope of the ceiling is more than 3:12.

❑ **Band/Rim Joists**

Band/rim joists must be insulated to a minimum of R-13, regardless of energy code compliance pathway.

❑ **Chase Penetrations**

All chases must be completely sealed and insulated where they penetrate the building thermal envelope.

❑ **Cantilevers and Overhangs**

Ensure there is complete insulation coverage where cantilevers or overhangs intersect with installed blocking above supporting wall.

❑ **Parapet Walls**

Insulation must be in direct contact with the building's continuous air barrier.

❑ **Insulated Attic Access**

R-value to be same as attic insulation.

**Performance Badge** must meet the following criteria:

Band/rim joists must be insulated with rigid or spray applied insulation to a minimum of R-13, regardless of energy code compliance pathway.

#### VERIFICATION

- Construction Documents indicate the following:
  - R-value of thermal break
  - Insulation requirements listed in architectural set notes
  - Details of thermal envelope connections
- Photographs if cannot be Site Inspected:
  - Thermal break installation
  - Envelope insulation coverage

#### RESOURCES

North American Insulation Manufacturers Association (NAIMA)

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

## BE R3: Envelope Air Tightness Performance Test (Requirement)

### PURPOSE

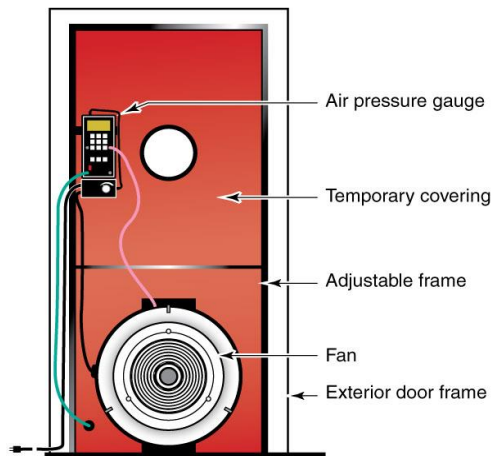
Ensure envelope construction meets air tightness requirements through verified performance testing.

### CRITERIA

Building envelope air tightness must meet or exceed the performance target of 0.40 cfm/sf when tested in accordance with ASTM E779. A multi-point Envelope Air Tightness Performance Test will be performed during the Final Site Inspection using calibrated blower door diagnostic test equipment. The test result is expressed in terms of Envelope Leakage Ratio (ELR<sub>75</sub>) at 75 Pascals of pressure difference between the building interior and exterior.

$$ELR_{75} \leq 0.40$$

Additional points can be achieved for better performance results (i.e. BE 1: Exceed Envelope Air Tightness Performance Test).



**Blower Door Assembly**

### ENVELOPE AIR TIGHTNESS PERFORMANCE TEST

*A blower door test shall be conducted with intentional building penetrations (such as exhaust and outside air intakes) sealed. Reference ECLC Envelope Air Leakage Testing Protocol.*

*During the test, all HVAC systems and combustion appliances will be turned off and the building will be depressurized to multiple test pressures including -75 Pascals (Pa).*

*Note: If the results of the Envelope Air Tightness Test exceed 0.40 ELR<sub>75</sub> (0.25 ELR<sub>75</sub> for **Performance Badge**) then leakage pathways must be identified and sealed, and a re-test will be required (at additional cost) before a project can be certified.*

Building testing will follow the ECLC Envelope Air Leakage Testing Protocol.

### VERIFICATION

- Final Site Inspection – Envelope Air Tightness Performance Test

### DEFINITIONS

#### **ELR<sub>75</sub> (Envelope Leakage Ratio at 75 Pa)**

The Envelope Leakage Ratio (ELR) is the quantity of air leakage expressed in cubic feet per minute at an induced pressure difference of 75 Pa (CFM<sub>75</sub>) divided by the total square footage of the building's thermal envelope (shell area).

#### **CFM<sub>75</sub> (Cubic Feet per Minute at 75 Pa)**

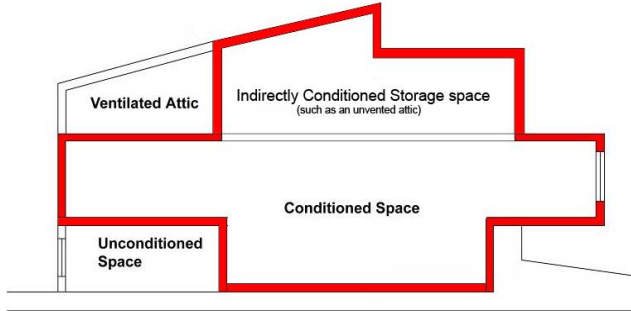
The volume of air in cubic feet per minute moved through a fan that is set to induce a 75 Pa pressure differential between conditioned and unconditioned space.

#### **Shell Area**

The total square footage of a building's thermal envelope: Building Envelope Floor + Envelope Ceiling/Roofline + Exterior Envelope Wall. Typically, these are insulated areas.

**Pascal**

A Pascal (Pa) is a small metric unit of pressure and is commonly used in lieu of inches of water column (1" water column = 248 Pa; 75 Pa = 0.3 inches of water column).



**Building Thermal Envelope**

The building thermal envelope is the portion of the building envelope that is comprised of the continuous air barrier and insulation and separates conditioned space from unconditioned space.

**Example Calculation**

A 7,600 square foot building (First floor: 3,600 square feet and second floor: 4,000 square feet) has a shell area of 13,920 square feet. The blower door test measures a flow of 3,340 CFM<sub>75</sub>.

and second floor: 4,000 square feet) has a shell area of 13,920 square feet. The blower door test measures a flow of 3,340 CFM<sub>75</sub>.

What is the Envelope Leakage Ratio at 75 Pa?

ELR<sub>75</sub> is calculated by dividing the measured CFM<sub>75</sub> by the total shell area of the envelope.

$$\text{Shell Area} = 4000\text{ft}^2 + 4000\text{ft}^2 + 5920\text{ft}^2 = 13,920\text{ft}^2$$

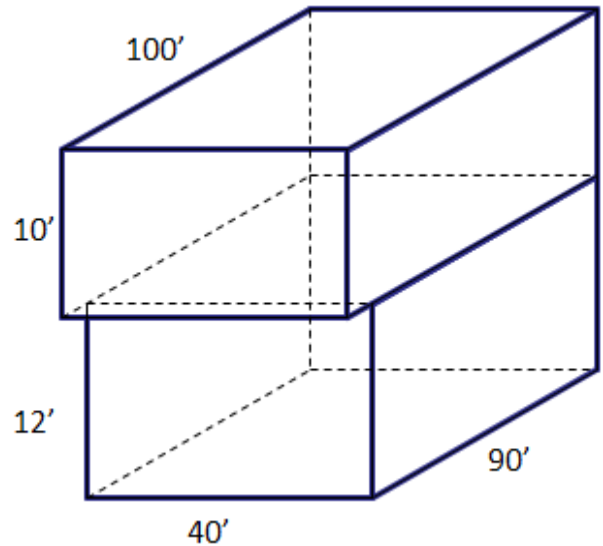
$$\text{BD Fan Flow Measurement} = 3,340 \text{ CFM}_{75}$$

$$ELR_{75} = \frac{CFM_{75}}{\text{Shell Area}}$$

$$ELR_{75} = \frac{3,340 \text{ CFM}_{75}}{13,920 \text{ sf}}$$

$$ELR_{75} = 0.24$$

*Envelope passes program requirement and earns additional points*



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**BE 1: Exceed Envelope Air Tightness Performance Test (1-3 points)**

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**PURPOSE**

Increase energy efficiency and indoor environmental quality by designing and installing an air tight building envelope system.

**CRITERIA**

Building envelope air tightness must meet or exceed the performance targets below when tested in accordance with ASTM E779. An Envelope Air Tightness Performance Test will be performed during the Final Site Inspection using calibrated blower door diagnostic test equipment. The test result is expressed in terms of Envelope Leakage Ratio at 75 Pascals ( $ELR_{75}$ ) of pressure difference between the building interior and exterior.

Projects attempting to achieve the **Performance Badge** must fulfill **Option B**.

Select one option below:

- A. Measured  $ELR_{75} \leq 0.30$  (1 points)
- B. Measured  $ELR_{75} \leq 0.25$  (2 points)

For an explanation of Envelope Leakage Ratio ( $ELR_{75} = CFM_{75}/SFBE$ ) calculations and minimum performance requirements, refer to [BE R3: Envelope Air Tightness Performance Test](#).

**VERIFICATION**

- Final Site Inspection – Envelope Air Tightness Performance Test

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**BE 2: Insulate Slab Edges and Foundation Walls (1 point)**

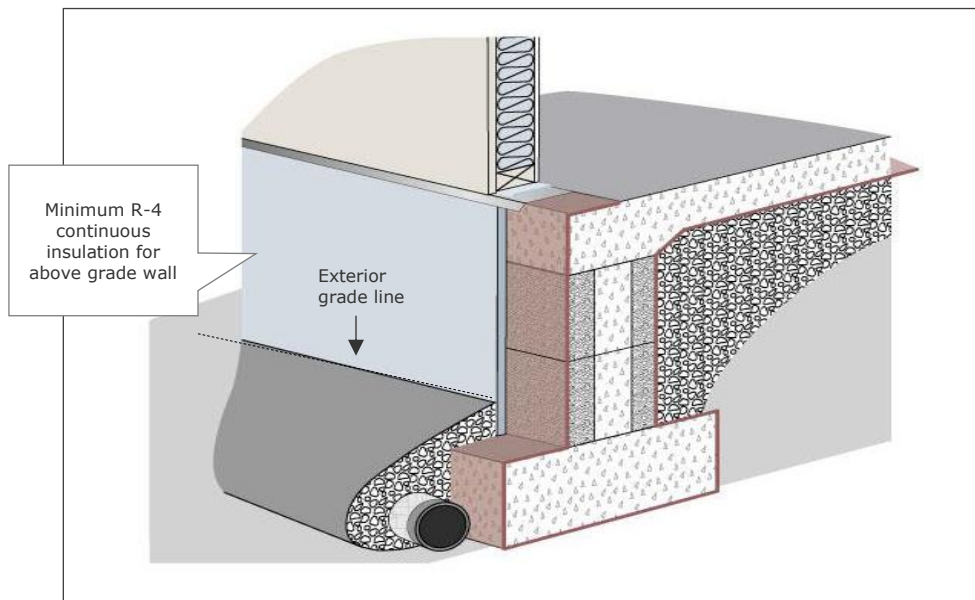
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**PURPOSE**

Reduce energy loss through areas prone to thermal bridging, such as slab edges, foundation walls and contiguous slab locations.

**CRITERIA**

Provide a minimum R-4 thermal break at the exterior of slab edges and foundation walls down to the frost line. Install minimum 1/2" expansion joints at contiguous slab locations to create a thermal break between areas connecting conditioned and unconditioned spaces. Ensure that construction documents appropriately detail insulation protection, termite resistance measures, flashing and air sealing.

**Insulation at Slab/Footing Foundation****VERIFICATION**

- Construction Documents clearly indicate location and R-value of slab edge and/or foundation wall insulation
- Inspection by ECLC Technical Advisor

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**BE 3: ENERGY STAR Qualified Roof (2 points)**

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**PURPOSE**

Reduce energy loads and heat island effect by applying highly reflective and low thermal emittance roofing materials.

**CRITERIA**

Install ENERGY STAR qualified roofing material for at least 90% of roofing.

ENERGY STAR criteria:

- Low Slope roofs must have an initial solar reflectance of  $\geq 0.65$   
After 3 years, the solar reflectance must be  $\geq 0.50$
- Steep Slope roofs must have an initial solar reflectance of  $\geq 0.25$   
After 3 years, the solar reflectance must be  $\geq 0.15$

Note - One benefit of earning this credit is that ASHRAE 90.1-2013 prescriptively requires either increased insulation levels or a reflective roof for climate zones 1 – 3. Some exceptions apply, see ASHRAE 90.1-2013 Section 5.5.3.1.1 for details.

**VERIFICATION**

- Construction Documents specifications must list ENERGY STAR qualified roofing
- Roofing manufacture specification sheet
- Site Inspection by ECLC Technical Advisor

**DEFINITIONS**

**Heat Island Effect** – The heat island effect is a temperature phenomenon in which heat-absorbing buildings (and hardscape materials), especially those with dark roofs and non-reflective surfaces, release heat absorbed from sunlight into the surrounding atmosphere. The resulting effect is an increase in outdoor air temperature in a specific area, or “island” which contributes to generation of poor outdoor air quality such as smog. Increases in local air temperature caused by the heat island effect generally occur in urban areas and centers where many buildings with dark roofs are concentrated in a small area.

**RESOURCES**

ENERGY STAR

[www.energystar.gov](http://www.energystar.gov)

Cool Roof Rating Council

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

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**BE 4: Minimize East/West Fenestration (1 point)**

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**PURPOSE**

Optimize fenestration orientation to reduce solar heat gain.

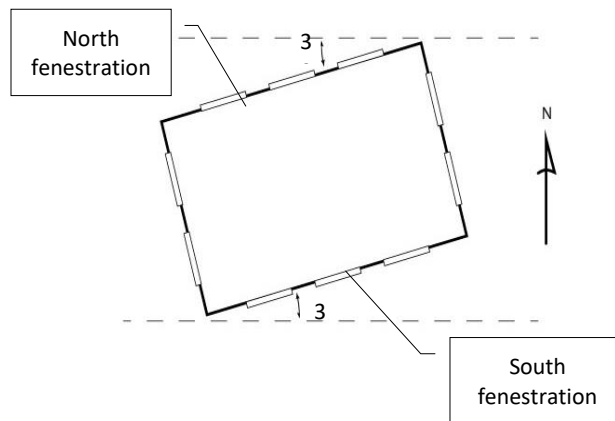
**CRITERIA**

Design the building so that the majority of fenestration is on north and south facades to maximize use of natural light, while minimizing heat gain on the east and west orientations. The sum of east and west fenestration must not exceed 30% of the total fenestration area.

Note: Fenestration that is oriented to within 30 degrees of true north or south will be considered as north or south glazing.

**Example Calculation**

Determine the percentage of east and west fenestration area as it relates to the total fenestration area. A project with 480 square feet of East and West fenestration and a total fenestration area of 2,000 square feet would calculate the percentage of East and West fenestration as follows:



$$\text{Percentage of East and West Fenestration Area} = \frac{\text{East and West Fenestration Area}}{\text{Total Fenestration Area}} = \frac{480 \text{ sf}}{2,000 \text{ sf}} \rightarrow \mathbf{24.0\%}$$

**VERIFICATION**

- Construction Documents include building orientation
- East and West fenestration area calculations
- Window-to-Wall Ratio Calculation

**DEFINITIONS**

Fenestration – all areas (including the frames) in the building envelope that let in light, including windows, plastic panels, clerestories, roof monitors, skylights, doors that are more than one-half glass and glass block walls.

Fenestration area - total area of the fenestration measured using the rough opening and including glazing, sash, and frame. For doors where the glazed vision area is less than 50% of the door area, the fenestration area is the glazed vision area. For all other doors, the fenestration area is the door area.

Window-to-wall - The window-to-wall ratio is defined as: glazing area divided by gross exterior wall area (floor-to-ceiling height).

**BE 5: Glazing Performance (1-3 points)**

**PURPOSE**

Reduce heat gain and loss through the building envelope glazing by meeting the prescriptive glazing requirements.

**CRITERIA**

Specify and install glazing that has better than energy code-required maximum weighted-average U-Factors for all vertical glazing, including doors with greater than 50% glass. Effective SHGC of less than or equal to 0.25 meets or exceeds ASHRAE 90.1-2013 through glazing only or glazing plus projection factor. **Performance Badge** projects must earn Options A, B and C.

Select all applicable options:

- A. Maximum glazing weighted-average U-Factor of 0.33 (2 pts)
- B. Maximum glazing weighted-average SHGC is  $\leq 0.25$  (4 pts)  
See BE 6.1: SHGC Multiplier for Permanent Projections below. See ASHRAE 90.1-2013, Table 5.5.4.4.1.

BE 6.1: SHGC Multiplier for Permanent Projections

SHGC Multiplier for Permanent Projections		
Projection Factor	SHGC Multiplier (All Other Orientations)	SHGC Multiplier (North-Oriented)
0-0.10	1.00	1.00
>0.10-0.20	0.91	0.95
>0.20-0.30	0.82	0.91
>0.30-0.40	0.74	0.87
>0.40-0.50	0.67	0.84
>0.50-0.60	0.61	0.81
>0.60-0.70	0.56	0.78
>0.70-0.80	0.51	0.76
>0.80-0.90	0.47	0.75
>0.90-1.00	0.44	0.73

BE 6.2: Worst Case SHGC/Overhang to not exceed 0.25 Effective SHGC

Projection Factor	Max Glazing SHGC to not exceed Effective 0.25 (All Other Orientations)	Max Glazing SHGC to not exceed Effective 0.25 (North-Oriented)
0-0.10	0.250	0.250
>0.10-0.20	0.275	0.263
>0.20-0.30	0.305	0.275
>0.30-0.40	0.338	0.287
>0.40-0.50	0.373	0.298
>0.50-0.60	0.410	0.309
>0.60-0.70	0.446	0.321
>0.70-0.80	0.490	0.329
>0.80-0.90	0.532	0.333
>0.90-1.00	0.568	0.342

- C. Skylights are ENERGY STAR Labeled or meet the following performance requirements (2pts)

Skylights must meet the following requirements	Climate Zone 2	Climate Zone 3	Climate Zone 4
Area (maximum 1% of gross roof over conditioned space)	0.01	0.01	0.01
U-factor	$\leq 0.65$	$\leq 0.55$	$\leq 0.50$
SHGC	$\leq 0.35$	$\leq 0.35$	$\leq 0.40$
<b>Tubular Skylights must be ENERGY STAR certified</b>			



### Example 1

**Question:** How much SHGC reduction credit does a 4' overhang with a 2' distance to top of window attain for a 5 x 5 north facing window (glazing SHGC 0.28)? Use the **Table: SHGC Multipliers for Permanent Projections** provided above.

**Answer:**

$$PF = \frac{4}{7} = 0.57$$

From chart, North SHGC Multiplier = 0.81

Effective SHGC = 0.28 x 0.81 = 0.23  
(project achieves credit Option B)



### Example 2

**Question:** The project has already specified a 9' south facing window and the distance from the top of window to overhang is 1'. The selected glazing has a SHGC of 0.33. What size overhang will be required to guarantee an Effective SHGC of 0.25 is met? Use the **Table: SHGC Multipliers for Permanent Projections** provided above.

**Answer:**

From chart, a projection factor of greater than 0.3 will satisfy the requirement.

$$PF = 0.3 = \text{depth} / 10'$$

$$\text{Depth} > 0.3 \times 10'$$

$$\text{Depth must be } > 3'$$

Project complies with Option C criteria if depth exceeds 3'.



### VERIFICATION

- Construction Documents indicate U-factor for all glazing components
- Site Inspection – Leave NFRC label on glazing OR provide photographs
- For Site fabricated glazing provide Certificate of Compliance

### DEFINITIONS

**Solar Heat Gain Coefficient (SHGC)** – the ratio of incident solar radiation admitted through a window, both directly transmitted and absorbed and subsequently released inward. SHGC is expressed as a number between zero and one. The lower a window's solar heat gain coefficient, the less solar heat it transmits.

**Projection Factor (PF)** – the ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the sum of the height to the bottom of the farthest point of the external shading projection, in consistent units.

### RESOURCES

National Fenestration Rating Council

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

ASHRAE 90.2-1013

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

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**BE 6: Architectural Solar Heat Gain Reduction Strategies (1-3 points)**

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**PURPOSE**

Use architectural features of the building to reduce solar heat gain and improve energy performance.

**CRITERIA**

Provide shading in the form of louvers, overhangs, or parts of the building facade that extend over the glazing at a minimum of 0.50 Projection Factor.

Include the Projection Factor on the COMcheck entries for each area of glazing that is shielded (refer to [Appendix B: COMcheck Envelope](#) for more information regarding Projection Factor calculations and a guide to entering information into COMcheck).

Select one option below:

- D. For 90% of South Glazing (2 pts)
- E. For 90% of South, East, and West Glazing (2pts)

**VERIFICATION**

- Construction Documents include shading detail(s) and dimensions
- COMcheck file and signed COMcheck Envelope Compliance Certificate
- Provide calculations that express percentage of glazing with at least a 0.50 projection factor
- Site Inspection to be conducted by ECLC Technical Advisor

**DEFINITIONS**

**Projection Factor (PF)** – the ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection, in consistent units.

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**BE 7: Daylighting Design Strategies (1-3 points)**

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**PURPOSE**

Reduce the need for artificial lighting while supporting occupant wellbeing by incorporating natural light into the building design.

**CRITERIA**

Significant savings and improved wellbeing can be realized by incorporating strategies that can provide adequate light levels through the use of natural light. Minimum VTL of 0.35 required.

Factors that affect daylighting:

- Programming of spaces that can benefit from natural lighting
- Size, placement and performance of glazing
- Specifications of finishes and furnishings
- Integration of electric lighting and controls
- Glare control through use operable blinds or shades

The Prescriptive Daylighting Strategy (Options A-C) is a side-lighting approach to daylighting. Applications that incorporate more sophisticated strategies should pursue a comprehensive Computational Daylighting Analysis (Option D), which includes a calculated design solution to appropriately size openings to avoid glare, unwanted heat gain, and direct light strikes. Projects achieving the **Health Badge** must achieve Option B. Prescriptive Daylighting for 50% of Total Floor Area.

Select Prescriptive Daylighting Strategy or Computational Daylighting Analysis Option:

**Prescriptive Daylighting Strategy****Determine percentage of floor area that qualifies as daylit zones:**

- Side Lit Daylight zones are spaces within 15 feet of an exterior wall with minimum 20% glazing-to-wall ratio
- Top Lit Daylight zones are spaces within the footprint of the skylight + 70% of the ceiling height added to each side of the footprint
- Spaces excluded from total floor area calculation; mechanical, electrical and storage areas. Restrooms and circulation floor areas are not required but may be included if daylighting strategies are applied

**Daylit zones must meet the following criteria:**

- Ceiling finish shall have a Light Reflectance Value (LRV) of 0.80 or greater
- Provide glare control for glazing on south, east, and west facing facades (blinds, roller shades, etc)
- Light fixtures within 15 feet of the exterior wall in daylit zones shall be controlled separately. Lighting controls may be manual, bi-level or dimming.
- Additional points may be earned in [ES10: Automatic Daylight Sensors in Daylit Zones](#)

**Option A. Prescriptive Daylighting for 25% of Total Floor Area (1 point)****Option B. Prescriptive Daylighting for 50% of Total Floor Area (2 points)****Option C. Prescriptive Daylighting for 75% of Total Floor Area (3 points)****Option D. Computational Daylighting Analysis (2 points)**

- 75% of floor area must meet Computational Daylighting Analysis requirements
  - Exclude mechanical, electrical and storage from floor area to be analyzed. Restrooms and circulation floor areas are not required but may be included if daylighting strategies are applied
- Provide a narrative describing the use of computational tools throughout the design process
- Include the analysis of light levels and/or daylight autonomy, as well as glare
- Final analysis of proposed space should include a representation of furniture and partitions proposed for the space

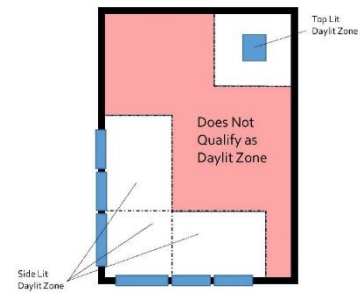
- Spaces that do not have a tenant or final end use should propose a reasonable configuration of furniture and partitions for the anticipated end use of the space
  - Use analysis points which correspond to desktops, workstations, or representative tasks for the end use (e.g. a regular distance along shelf faces in retail applications) demonstrate either of the following:
    - I. Daylight Autonomy of at least 50% of Occupied Daylit Hours at 20 footcandles (DA20fc) Utilizing Energy Plus weather data (.epw file)
    - II. Time specific analysis factoring actual sun angle at 9 a.m., 12 p.m., and 3 p.m. on the Equinox, and on the Summer and Winter Solstices, using full sunlight sky conditions. At least 50% of the total point readings must be 30fc or above
  - Provide glare control for glazing on south, east, and west facing facades (blinds, roller shades, etc)
  - Luminaires serving the daylit space shall have manual control, through zoning, bi-level switching or dimming to allow lighting within 15 feet of the exterior wall to be switched off independently from interior fixtures. Additional points may be earned by incorporating the criteria of ES10: Automatic Lighting Controls in Daylit Zones
  - Computational Daylighting Analysis Summary must include the following:
    1. Rendered views to demonstrate space geometry
    2. Screen captures of glazing and material inputs
    3. Plan view of analysis grid demonstrating light levels:
      - At 30 inches above the finished floor
      - Maximum grid size is 10 feet x 10 feet
      - Set grid points 2 feet from walls
      - Minimum of two data points per enclosed space

**Example:**

The building shown is 40 ft. by 60 ft. and features glazing on the front and left side with a skylight in the right rear corner. The daylit area is 1,300 sq.ft. (non daylit area is 1,100 sq.ft.).

Determine percent daylit zone = 1,300 sq.ft. / 2,400 sq.ft. = 54%

Assuming the ceiling has an LRV of at least 0.80, the glazing has appropriate glare control and the daylit zone lighting fixtures have separate controls, option B is achieved.



**DEFINITIONS**

**Daylit Zones** - For vertical glazing, the daylit floor area is calculated by adding 2 feet to either side of the wall containing the window and projecting 15 feet into the space. For top glazing, the daylit floor area is the footprint of the skylight + 70% of the ceiling height added to each side of the footprint. Daylit floor area terminates at full-height vertical partitions.

**VERIFICATION**

Options A - C

- Construction Documents include the following details:
  - Marked up plans showing daylit zones per example above
  - Elevations illustrating glazing with minimum 20% glazing-to-wall ratio
  - Interior sections and/or elevations showing interior partitions
  - Product data for ceiling finish stating Light Reflectance Value (LRV) of the exposed surface
  - Glazing specifications (U-factors, Solar Heat Gain Coefficients, Visual Light Transmittance)

Option D

- Computational Daylighting Analysis Summary

**RESOURCES**

Advanced Buildings Institute, Daylighting Pattern Guide  
[www.patternguide.advancedbuildings.net](http://www.patternguide.advancedbuildings.net)

Energy Center of Wisconsin Daylighting Collaborative  
[www.daylighting.org](http://www.daylighting.org)

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**BE 8: Operable Windows (2 points)**

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**PURPOSE**

Provide natural ventilation and allow occupants to control thermal comfort.

**CRITERIA**

Regularly occupied spaces must have operable windows with occupant-accessible controls providing natural ventilation and daylight. Consider including insect screens depending on locale.

**DEFINITIONS**

**Regularly Occupied Spaces** - Spaces that are used 4 hours or more a day on a regular basis, such as private offices, open offices and classrooms

**VERIFICATION**

- Construction Documents detail operable window locations
- Site Inspection by ECLC Technical Advisor

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## Energy Efficient Building Systems

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**ES R1: Meet ASHRAE 90.1-2013: HVAC, Lighting, Water Heating (Requirement)**

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**PURPOSE**

Design and install energy efficient heating, ventilating and air conditioning systems.

**CRITERIA**

Project must meet or exceed ECLC Minimum HVAC requirements which are based ASHRAE Standard 90.1-2013 Section 6.3 Simplified Approach (regardless of building size) or satisfy the Mandatory and Prescriptive requirements of ASHRAE Standard 90.1-2013 Sections 6.4 and 6.5. Projects with a furnace must use a condensing furnace with a minimum 92% AFUE. Package systems must achieve a minimum 80% AFUE.

**Select one of the following options:****A. Simplified Approach** (refer to ASHRAE Standard 90.1-2013, Section 6.3)

To demonstrate compliance, each HVAC system in the building must comply with the requirements listed in ASHRAE Standard 90.1-2013, Section 6.3.2. Sign/complete an ECLC Simplified Approach for HVAC Compliance Certificate and demonstrate with COMcheck.

The Simplified Approach was designed for buildings 2 stories or fewer in height with a gross floor area of less than 25,000 square feet. ECLC permits this compliance path for projects with appropriate mechanical systems regardless of building size.

**The following is a summary of the eighteen Simplified Approach requirements:**

- a) Each system must serve a single zone
  - b) Equipment must meet variable flow requirements
  - c) Cooling must be packaged or split system (either air or evaporative cooled) and meet minimum equipment efficiencies
  - d) Economizers may be required in certain circumstances
  - e) Heating must be packaged or split system heat pump, gas, electric or hot water and meet minimum efficiencies
  - f) Exhaust air energy recovery requirements
  - g) Manual changeover or dual set point thermostat is required
  - h) When possible, heat pump feature will always provide heating
  - i) No reheat or simultaneous heating and cooling allowed for humidity control
  - j) Systems larger than 15,000 Btu/h and ¾ HP fan motor requires a time clock control
  - k) Meet minimum piping insulation and weather protection requirements
  - l) Meet minimum ductwork and plenum sealing and insulation requirements
  - m) Ducted systems must be air balanced in accordance with industry accepted procedures
  - n) Outdoor air and exhaust system requirements
  - o) Separate thermostats must be interlocked to prevent simultaneous heating and cooling
  - p) Systems greater than 10,000 CFM must have optimum start controls
  - q) Demand control ventilation requirements
  - r) Door switch requirements
- 
- B. Prescriptive and Mandatory Approach**
- (refer to ASHRAE Standard 90.1-2013, Sections 6.4 and 6.5)
- For projects following the Prescriptive Path, compliance must be demonstrated with COMcheck. Note that simultaneous heating and cooling/reheat is not allowed in most cases by energy code and is strongly discouraged by the ECLC Program. Refer to [Appendix A: COMcheck Overview](#) for more information about COMcheck and [Appendix C: COMcheck Mechanical](#) for a guide to entering information into COMcheck for mechanical systems.

ES R1.1: ECLC Minimum HVAC Efficiency based on ASHRAE 90.1-2013, Table 6.8.1

Unitary Air Conditioners and Condensing Units, Electrically Operated					
Equipment Type	Size	Heating Type	Subcategory	Minimum Efficiency	Test Procedure
Air Conditioners, Air Cooled (Cooling Mode)	<65,000 Btu/h	All	Split System	14.0 SEER*	AHRI 210/240
			Single Package	14 SEER	
	≥65,000 Btu/h and <135,000 Btu/h	None	Split System and Single Package	11.2 EER 12.9 IEER	AHRI 340/360
		All Other	Split System and Single Package	11.0 EER 12.7 IEER	
	≥135,000 Btu/h and <240,000 Btu/h	None	Split System and Single Package	11 EER 12.4 IEER	
		All Other	Split System and Single Package	10.8 EER 12.2 IEER	
Air Cooled (Heating Mode)	<65,000 Btu/h	-	Split System	8.2 HSPF	AHRI 210/240
			Single Package	8.0 HSPF	
	≥65,000 Btu/h and <135,000 Btu/h	-	47 F db/43 F wb Outdoor Air	3.3 COP <sub>47</sub>	AHRI 340/360
			17 F db/15 F wb Outdoor Air	2.25 COP <sub>17</sub>	
	≥135,000 Btu/h	-	47 F db/43 F wb Outdoor Air	3.2 COP <sub>47</sub>	
			17 F db/15 F wb Outdoor Air	2.05 COP <sub>17</sub>	
Through the wall, air cooled	≤ 30,000 Btu/h	None	Split System and Single Package	12.0 SEER	AHRI 210/240
PTAC (Cooling Mode)	All Capacities	None	Split System and Single Package	14.0 - (0.300 x Cap/1000) EER	AHRI 310/380
PTHP (Cooling Mode)	All Capacities		95°F db outdoor air	14.0 - (0.300 x Cap/1000) EER	
PTHP (Heating Mode)	All Capacities			3.7 - (0.052 x Cap/1000) COP <sub>47</sub>	
VRF Air Cooled (Cooling Mode)	<65,000 Btu/h	All	Multisplit	13.0 SEER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	None	Multisplit	11.0 EER 12.3 IEER	
		None	Multisplit with Heat Recovery	10.8 EER 12.1 IEER	
VRF Air Cooled (Heating Mode)	<65,000 Btu/h	-	Multisplit	7.7 HSPF	
	≥65,000 Btu/h and <135,000 Btu/h	-	47degree F db/43d F wb Outdoor Air	3.3 COP <sub>47</sub>	
			17degree F db/15d F wb Outdoor Air	2.25 COP <sub>43</sub>	

\*13 SEER for Northern Climates. Note - For all systems not listed see ASHRAE 90.1-2013

**MAJOR RENOVATIONS:** Major Renovation projects must meet all ASHRAE requirements. Refer to ASHRAE Standard 90.1-2013, Section 6.1.1.3 for potential exceptions.

**VERIFICATION**

- Construction Documents include Mechanical Plans and Schedules
- Simplified Approach – COMcheck File, signed/completed ECLC Simplified Approach for HVAC Compliance Certificate – submitted prior to start of construction
- Prescriptive and Mandatory Approach - COMcheck File, and a signed/completed COMcheck Mechanical Compliance Certificate – submitted prior to start of construction

**RESOURCES**

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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

COMcheck Software

[www.energycodes.gov](http://www.energycodes.gov)



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**ES R2: No Electric Resistance as Primary Heating Source (Requirement)**

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**PURPOSE**

Discourage the use of inefficient heating systems.

**CRITERIA**

Use of electric resistance heating is not allowed as the building's primary heating source.

**VERIFICATION**

- Equipment submittals
- Site Inspection by ECLC Technical Advisor

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**ES R3: All Air Handlers and Ductwork within Building Thermal Envelope (Requirement)**

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**PURPOSE**

Eliminate HVAC system air leakage to unconditioned space and reduce thermal losses and gains.

**CRITERIA**

All air handling units and ductwork must be located within the building thermal envelope.

Exceptions: Package units are permitted with < eight foot insulated duct terminating directly into thermal envelope.

**VERIFICATION**

- Verified in Construction Documents
- Site Inspection by ECLC Technical Advisor

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## ES R4: Duct System Requirements (Requirement)

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### PURPOSE

Reduce energy loss typically associated with air distribution equipment.

### CRITERIA

Ducted systems must meet the following minimum criteria:

- **Duct Design Documentation**

At a minimum, provide a scaled single line drawing that indicates duct layout, duct sizes, outside air intake location(s) and supply/return register size and location. Design CFM's shall be included and used as the basis for [IAQ R7: Third Party Test and Balance Report](#).
- **Rigid Supply and Return Trunks**

Design and install all duct systems using the "trunk and branch" configuration. The trunk and branch configuration requires that each HVAC system has at least one rigid supply trunk with multiple, short branch take-offs to each supply register.
- **All Supplies and Returns Must Be Fully Ducted**

Building cavities may not be used as ducts or plenums (e.g. stud cavity, joist space and above-ceiling plenums not allowed).
- **Outside Air Ducting**

Outside air shall generally be ducted directly into the return air plenum to provide for intentional mixing and must have balancing dampers in order to regulate outside airflow. Exceptions for other ventilation systems (e.g. DOAS) are permissible. Shut off dampers are required, reference ASHRAE 90.1-2013 Section 6.4.3.4.
- **Maximum Flex Duct Run is 10 Feet**

All flexible ductwork must be supported properly and pulled tight, with no pinching or compression.
- **Minimum R3 insulation for all supply ducts to prevent condensation**
- **Solid Connectors for All Flex to Flex Connections**

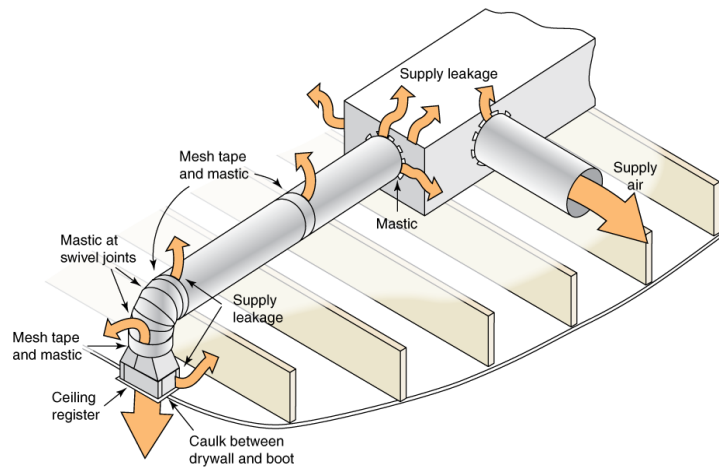
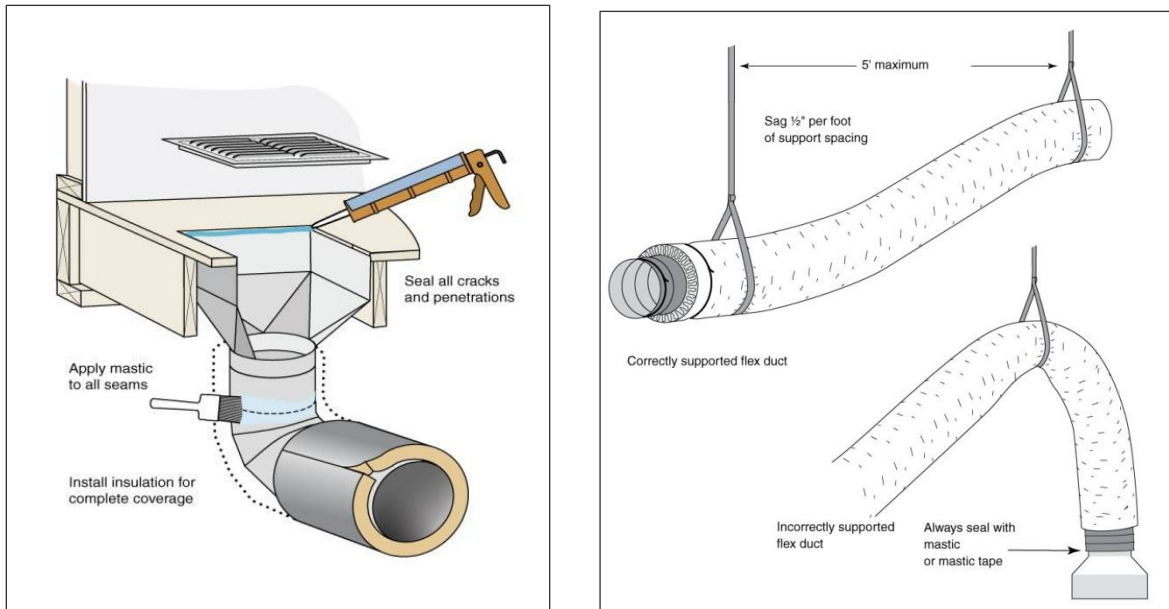
Use rigid connectors or sleeves on all flex-to-flex duct connections. Flex duct liner must be connected to sleeve using a duct tie and sealed with mastic or mastic tape (mastic tape must be UL181-compliant butyl rubber-backed foil tape).
- **No Ductwork Displaces Insulation in Building Thermal Envelope Walls, Ceilings or Roofline**
- **Duct System Must be Sealed**

Seal all seams, joints, collars and connections in forced-air delivery systems using mastic or mastic tape (mastic tape must be UL181-compliant butyl rubber-backed foil tape):

  - Supply and return boots
  - Supply and return plenums
  - Duct-to-plenum connections
  - Y-splits, butt joints and boot connections
  - Outside air intakes
  - Filter housing to plenum/cabinet
  - Air handler condensate, refrigerant line and wire penetrations, and unused holes in the air handling unit cabinet

**MAJOR RENOVATIONS:** Projects are strongly encouraged to implement all criteria on existing duct systems in order to meet [IAQ R7: Third Party Test and Balance Report](#).

ES R4.1: Diagram Illustrating Duct Sealing Locations at Trunk and Branches (Note – System is within building envelope)



**VERIFICATION**

- Construction Documents include duct design and all additional criteria for ductwork.

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**ES R5: Right-sized Heating and Cooling Equipment or Variable Capacity System (Requirement)**

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**PURPOSE**

Optimize system performance to maintain desired indoor temperature and humidity conditions.

**CRITERIA**

Installed system total cooling capacity is sized with 95% to 115% of cooling load and 125% for heat pump.

All variable capacity heating and cooling equipment shall be considered right-sized, regardless of system type, if the capacity of the equipment meets the following criteria:

- Cooling capacity can throttle below peak design load.
- Heat pump plus supplemental heating capacity can meet or exceed peak design load.

System capacity range shall be determined based on the estimated capacity for the entire system, including all fan coil units and condensing units, at design conditions and anticipated building loads. In most cases, Variable Refrigerant Flow systems will satisfy this credit.

**VERIFICATION**

- Mechanical submittals
- Load calculations
- Site Inspection by ECLC Technical Advisor

**ES 1: Equipment Efficiency: Space Cooling (1-3 points)**

**PURPOSE**

Encourage increased energy efficiency through space cooling equipment selection.

**CRITERIA**

Exceed ASHRAE Standard 90.1-2013 minimum efficiency requirements for **100%** of installed cooling capacity.

Select one option below:

- A. 2 SEER or 1 EER Better Than ASHRAE 90.1-2013 (1 point)
- B. 3 SEER or 2 EER Better Than ASHRAE 90.1-2013 (2 points)
- C. Meet the chart (3 points)

**ES 1.1: HVAC Enhanced Efficiency Chart**

Unitary Air Conditioners and Condensing Units, Electrically Operated						
Equipment Type	Size	Heating Type	Subcategory	Minimum Efficiency	Test Procedure	
Air Conditioners, Air Cooled (Cooling Mode)	<65,000 Btu/h	All	Split System	15.0 SEER	AHRI 210/240	
			Single Package	12.5 EER		
	≥65,000 Btu/h and <135,000 Btu/h	All Other	Electric Resistance (or none)	Split System and Single Package	12.2 EER 14.0 IEER	AHRI 340/360
			All Other	Split System and Single Package	12.0 EER 13.8 IEER	
	≥135,000 Btu/h and <240,000 Btu/h	All Other	Electric Resistance (or none)	Split System and Single Package	12.2 EER 13.2 IEER	
			All Other	Split System and Single Package	12.0 EER 13.0 IEER	
	≥240,000 Btu/h and <760,000 Btu/h	All Other	Electric Resistance (or none)	Split System and Single Package	10.0 EER 11.6 IEER	
			All Other	Split System and Single Package	9.8 EER 11.4 IEER	
	Air Cooled (Heating Mode)	<65,000 Btu/h	-	Split System	9.0 HSPF	AHRI 210/240
				Single Package	8.5 HSPF	
≥65,000 Btu/h and <135,000 Btu/h		-	47 F db/43 F wb Outdoor Air	3.4 COP	AHRI 340/360	
			17 F db/15 F wb Outdoor Air	2.4 COP		
≥135,000 Btu/h		-	47 F db/43 F wb Outdoor Air	3.2 COP		
	17 F db/15 F wb Outdoor Air		2.1 COP			
Water Source (Cooling Mode)	<135,000 Btu/h	All	86 Entering Water	14.0 EER	ISO 13256-1	
Water Source (Heating Mode)	<135,000 Btu/h		68 Entering Water	4.6 COP	ISO 13256-1	
PTAC (Cooling Mode)	All Capacities		95°F db outdoor air	14.1 - (0.300 x Cap/1000) EER	AHRI 310/380	
PTHP (Cooling Mode)	All Capacities		95°F db outdoor air	14.1 - (0.300 x Cap/1000) EER		
PTHP (Heating Mode)	All Capacities			3.3 - (0.26 x Cap/1000) COP		

(Source: New Construction Guide by New Buildings Institute Table 2.9.1)

VRF Air Multi-Split Heat Pump					
Equipment Type	Size	Heating Type	Subcategory	Minimum Efficiency	Test Procedure
VRF Air Cooled (Cooling Mode)	<65,000 Btu/h	All	Multisplit	15.0 SEER	AHRI 1230
			Multisplit	12.5 EER	
	≥65,000 Btu/h and <135,000 Btu/h	-	Multisplit with Heat Recovery	11.1 EER 14.0 IEER	
			Multisplit	10.6 EER 11.8 IEER	
	≥135,000 Btu/h and <240,000 Btu/h	-	Multisplit with Heat Recovery	10.4 EER 11.6 IEER	
			Multisplit	9.5 EER 10.6 IEER	
≥240,000 Btu/h	-	Multisplit with Heat Recovery	9.3 EER 10.4 IEER		
VRF Air Cooled (Heating Mode)	<65,000 Btu/h	-	Multisplit	9.0 HSPF	
			47degree F db/43d F wb Outdoor Air	3.3 COP 2.4 COP	
	≥65,000 Btu/h and <135,000 Btu/h	-	17degree F db/15d F wb Outdoor Air	3.2 COP 2.1 COP	
			47degree F db/43d F wb Outdoor Air	3.2 COP	
	≥135,000 Btu/h	-	17degree F db/15d F wb Outdoor Air	2.05 COP	
Ground Source Heat Pump	ENERGY STAR (except for 3 phase), closed loop, demand based pumping; sized for full heating and cooling load with expected ground temperature changes due to heat pump; pump max 10 hp/100 tons; min grout conductivity of 0.8 Btu/hr-ft-F; DOAS only plus ERV				

(Sources: New Construction Guide by New Buildings Institute Table 2.9.1 and ASHRAE 90.1 – 2013 Table 6.8)

Note: For systems with IEER or IPLV ratings, check with ECLC Technical Advisor for efficiency conversion equivalencies.

#### VERIFICATION

- Construction documents indicate performance levels
- Mechanical submittals
- COMcheck file
- COMcheck Mechanical Compliance Certificate signed
- Site Inspection

---

## ES 2: Equipment Efficiency: Space Heating (1-3 points)

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### PURPOSE

Encourage increased energy efficiency through space heating equipment selection.

### CRITERIA

Exceed ASHRAE Standard 90.1-2013 minimum efficiency requirements for 100% of installed heating capacity.

Projects attempting **Performance Badge** must fulfill Option B.

#### Option A. (1 point)

- Furnace efficiency of 92% AFUE or better
- Air source heat pumps efficiency of 8.5 HSPF or 2.5 COP<sub>H,47</sub> or better

#### Option B. (3 points)

- Furnace efficiency of 95% AFUE or better
- Meet performance levels of the HVAC enhanced efficiency chart, see [ES 1 Increased Cooling Equipment Efficiency](#)

### VERIFICATION

- Construction documents indicate performance levels
- Mechanical submittals
- COMcheck file
- COMcheck Mechanical Compliance Certificate signed
- Site Inspection

### RESOURCES

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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



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**ES 3: Variable Capacity HVAC Equipment (3 points)**

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**PURPOSE**

Improve humidity control and provide greater efficiency at part load conditions. HVAC equipment that can slow itself down to match the load on the building at a given point in time offers greater comfort and efficiency than single speed equipment. Because the majority of building operation occurs at off-peak conditions, equipment that can modulate to the actual conditions offers improved savings and enhanced comfort.

**CRITERIA**

Use minimum two-stage compressor, blower, and gas burner for all HVAC equipment. Include compatible controls for modulating output based on actual building load. Low stage capacity must be less than peak load as determined by load calculations. Low or minimum fan speed shall be used during periods of low cooling load and ventilation-only operation.

**VERIFICATION**

- Heating and cooling load calculations
- Mechanical Submittals
- Inspection by ECLC Technical Advisor

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**ES 4: Temperature Control: Occupant Access (1 point)**

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**PURPOSE**

Promote occupant comfort by providing access to temperature controls.

**CRITERIA**

Provide accessible temperature controls for 75% (by room) of the following areas:

- Open offices
- Private offices
- Multi-purpose rooms (classrooms, training rooms)
- Conference rooms and meeting spaces

**VERIFICATION**

- Construction Documents shall indicate temperature control locations
- Inspection by ECLC Technical Advisor

---

**ES 5: High Performance Duct System (1 point)**

---

**PURPOSE**

Reduce fan energy loss associated with pressure drop in overall duct distribution. Ensure ductwork installation is consistent with the duct design in order to provide efficient air distribution.

**CRITERIA**

For ducted systems, ductwork should be installed in a manner consistent with the duct design documentation required as part of [ES R5: Duct System Requirements](#). Points are awarded if installation does not significantly deviate from the design.

Create a duct distribution design that supports efficient airflow patterns and minimizes pressure drop. Installed ductwork must meet the following criteria:

- Provide at least 2 feet of straight supply trunk between the fan discharge and the first turn
- Branch take-offs from supply trunk must begin at least 2 feet away from fan discharge
- Branch take-offs on same side of supply trunk must be spaced at least 6 inches apart
- Use radius elbows or turning vanes on square/rectangular ducts for turns greater than 45 degrees
- Use smooth wye branch fittings rather than right angle fittings for supply take-offs and transitions where applicable.
- Size return duct cross sectional area to be at least 10% larger than supply ducts for each HVAC system

**Example Calculation**

Determine the return to supply duct cross sectional area ratio originating from the plenum. For example, the return to supply duct ratio for an HVAC system with ten 12" diameter supply ducts and two 18" x 36" rectangular return ducts would be calculated as follows:

$$\text{Total Supply Duct Cross Sectional Area} = \text{No. of Ducts} \times \text{Area} = 10 \times (\pi \times 6^2) = 1,130 \text{ in}^2$$

$$\text{Total Return Duct Cross Sectional Area} = \text{No. of Ducts} \times \text{Area} = 2 \times (18 \times 36) = 1,296 \text{ in}^2$$

$$\text{Return to Supply Duct Ratio} = \frac{\text{Total Return Duct Cross Sectional Area}}{\text{Total Supply Duct Cross Sectional Area}} = \frac{1,296 \text{ in}^2}{1,130 \text{ in}^2} \rightarrow 14.7\%$$

Ductless systems are eligible for this credit, provided that the entire HVAC system has been constructed per design. Ductless systems must comply with the following criteria:

- Any ductwork is installed according to plan (including dampers)
- FCU's and AHU's are installed according to design
- Outdoor (condensing) unit location is installed according to design
- Refrigerant lines are installed according to design
- Condensate removal is installed according to design
- Ventilation system and OA intakes are installed according to design

**VERIFICATION**

- Construction Documents include Duct Design Documentation (refer to [ES R5: Duct System Requirements](#)) and detail distribution efficiency criteria
- Calculation: return-to-supply duct ratio per system
- Inspection by ECLC Technical Advisor

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## ES 6: Lighting Efficiency: Interior (1-3 points)

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### PURPOSE

Reduce energy consumption through efficient lighting design, selection and installation.

### CRITERIA

Interior Lighting Power Density (LPD) is less than the maximum allowed per ASHRAE Standard 90.1-2013. Lighting efficiency improvement is demonstrated through COMcheck, and installed lighting must be consistent with COMcheck values. Projects attempting **Performance Badge** must achieve Option B, at a minimum.

Select one option below:

- A. LPD reduction = 10% or greater (1 point)
- B. LPD reduction = 20% or greater (1 point)
- C. LPD reduction = 30% or greater (1 point)

To determine percentage reduction from code:

$$\left(1 - \frac{\text{Total Proposed Wattage}}{\text{Total Allowed Wattage}}\right) \times 100 = \text{LPD \% reduction from code}$$

Example:

Lighting design proposed wattage is 14,568 watts. The space-by-space approach determines the total allowed wattage to be 20,966 watts.

$$\left(1 - \frac{14,568 \text{ watts}}{20,966 \text{ watts}}\right) \times 100 = 31 \% \text{ reduction from code}$$

**MAJOR RENOVATIONS:** Major Renovation projects must select "New Construction" as the Project Type in COMcheck to demonstrate LPD improvement percentage. Selecting "Alteration" will only demonstrate whether the project passes or fails.

### VERIFICATION

- Construction Documents include interior lighting schedule consistent with COMcheck and detail fixture types, lamp wattages, lamps per fixture, fixture wattages and number of fixtures
- COMcheck File and a signed/completed COMcheck Interior Lighting and Power Compliance Certificate – submitted prior to start of construction
- Inspection by ECLC Technical Advisor

### RESOURCES

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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

COMcheck Software

[www.energycodes.gov](http://www.energycodes.gov)

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**ES 7: Interior Fixtures: Certified LED (1 point)**

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**PURPOSE**

Reduce energy consumption through efficient lighting design, selection and installation.

**CRITERIA**

Project must install Light Emitting Diode (LED) interior lighting per requirements below:

- 90% of all interior lighting fixtures or lamps, including display lighting, must be LED
- 90% of all lamps (bulbs) must be listed on the most recent version of either ENERGY STAR, Design Lighting Consortium (DLC) or Lighting Design Lab (LDL) Qualified products list. Lighting integral to equipment is excluded.
- 90% of all task lighting must be LED

**VERIFICATION**

- Construction Documents indicate qualified lighting on lighting survey
- Site Inspection by ECLC Technical Advisor

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**ES 8: Interior Fixtures: Automatic Controls (1-8 points)**

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**PURPOSE**

Reduce energy consumption through efficient lighting control design, selection and installation.

**CRITERIA**

Follow the applicable options below for relevant space type.

Select all option(s) that apply:

**100% of Intermittently Occupied Spaces:** (e.g.; stairwells, hallways, restrooms, mechanical rooms and storage areas)

**Option A. (2 points)**

Lighting in all enclosed stairwells, corridors and hallways, shall have one or more control devices to automatically reduce lighting power by at least 50% within 15 minutes of vacancy.

**Option B. (2 points)**

Lighting in all restrooms, mechanical rooms and storage areas shall have vacancy/occupancy sensors (set time out at a recommended 5 min., 15 min. max).

**100% of Regularly Occupied Spaces:** (e.g.; offices, classrooms, multipurpose and meeting spaces)

**Option C. (3 points)**

Lighting in all regularly occupied spaces shall have multi-level lighting control capability to reduce lighting power load by a minimum of 50%.

**Option D. (1 point)**

Lighting in all regularly occupied spaces shall have vacancy sensor controls (set time out at a recommended 5 min., 15 min. max); occupancy sensors not eligible.

**DEFINITIONS**

Regularly Occupied Spaces - spaces that are typically in use for 4 hours or more a day on a regular basis.

Intermittently Occupied Spaces - spaces that are typically accessed at irregular intervals throughout the day.

**VERIFICATION**

- Construction Documents indicate type and location of controls
- Site Inspection by ECLC Technical Advisor

## ES 9: Automatic Lighting Controls: Daylit Zones (1 point)

### PURPOSE

Automatically reduce artificial light energy load when natural daylight is available.

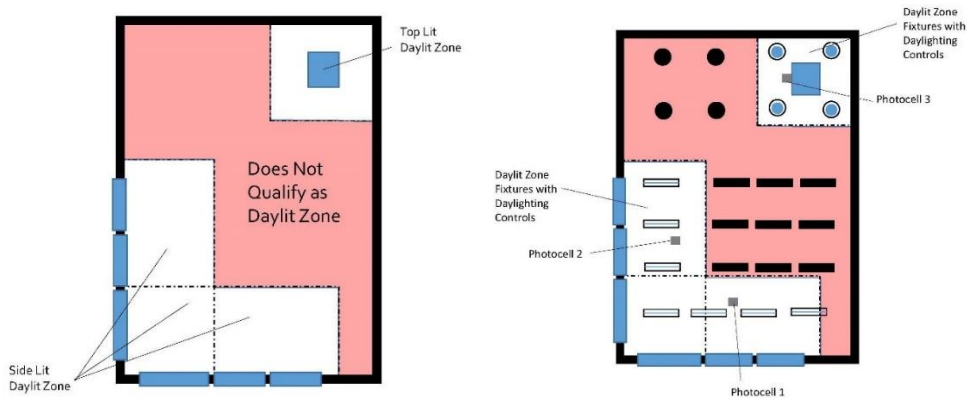
### CRITERIA

Provide automatic lighting controls for 80% of fixtures that fall within the Daylit Zones of the building. Install photocell sensors in combination with artificial lighting that provide multi-level or dimmable lighting based on the amount of natural light available to achieve appropriate light levels.

### Example:

The building shown is 40 ft. by 60 ft. and features glazing on the front and left side with a skylight in the right rear corner. The daylit area is 1,300 sq.ft. (non daylit area is 1,100 sq.ft.).

Determine percent daylit zone =  $1,300 \text{ sq.ft.} / 2,400 \text{ sq.ft.} = 54\%$



### DEFINITIONS

Daylit Zones - areas naturally lit by top or side glazing. For vertical glazing, the daylit floor area is calculated by adding two feet to either side of the wall containing the window and projecting 15 feet into the space. For top glazing, the daylit floor area is the footprint of the skylight + 70% of the ceiling height added to each side of the footprint. Daylit floor area terminates at full-height vertical partitions.

### VERIFICATION

- Construction Documents indicate Daylit Zones and include a Lighting Schedule, detailing types and locations of controls
- Inspection by ECLC Technical Advisor

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**ES 10: Exterior Fixtures: Certified LED (1 point)**

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**PURPOSE**

Reduce energy consumption through efficient lighting design.

**CRITERIA**

All exterior lighting within scope and control of project including parking lot and signage must be LED lighting. All lighting shall be certified ENERGY STAR, Design Lighting Consortium (DLC) or Lighting Design Lab (LDL).

**VERIFICATION**

- Construction Documents include exterior lighting schedule consistent with *COMcheck* and detail fixture types, lamp wattages, lamps per fixture, fixture wattages and number of fixtures
- *COMcheck* file and a signed/completed *COMcheck* exterior lighting compliance certificate – submitted prior to start of construction
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

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

*COMcheck* Software

[www.energycodes.gov](http://www.energycodes.gov)



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**ES 11: Exterior Lighting: Controls (1-3 points)**

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**PURPOSE**

Reduce unnecessary energy use from exterior lighting.

**CRITERIA**

Add controls to exterior lighting to enhance energy-saving potential. Projects attempting **Performance Badge** must achieve Option B and Option C.

Select all that apply:

**A. Automatic "After-hours" Shut-off Controls (1 point)**

Add automatic after-hours controls to shut-off the following exterior lighting during unoccupied periods:

- ALL exterior signage, except main entrance sign (one sign only)
- ALL exterior decorative lighting

**B. Curfew Lighting (1 point)**

- All building façade and landscape lighting shall be automatically shut off between midnight or business closing whichever is later, and 6 am or business opening whichever comes first.
- All other outdoor lighting must be automatically reduced by at least 50% after business hours or when no activity is detected after 15 minutes.

**C. Parking Garages (1 point)**

Lighting must be reduced by 30% minimum when no activity is detected for 20 minutes. Areas along the perimeter must have automatic daylight sensor or astronomical time switch. Daylight transition zones (entryways) shall have automatic controls that turn lighting on during the day and off at sunset to help people adapt easier to the change in light level upon entering the garage.

**VERIFICATION**

- Construction Documents indicate after-hours shut-off control and/or curfew lighting control locations and time settings.

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**ES 12: High Efficiency Water Heaters (2 points)**

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**PURPOSE**

Promote energy saving through the use of high efficiency water heaters.

**CRITERIA**

Meet the following minimum Energy Factor (EF) for all installed water heaters. Fulfill as many options as applicable.

Projects attempting to achieve **Performance Badge** must achieve all options for applicable conditions.

- A. Condensing gas tank water heaters with an EF of 0.90 or better
- B. Condensing gas tankless water heaters with an EF of 0.92 or better
- C. Heat pump water heaters with an EF of 2.50 or better
- D. Electric Point-of-Use water heaters with an EF of 0.98 or better
- E. All service water heating equipment shall be ENERGY STAR certified (where available)

**VERIFICATION**

- Plumbing Submittals
- Inspection by ECLC Technical Advisor

**RESOURCES**

Pipe Volume Calculator

[www.rhomarwater.com/calculators/pipe-volume-calculator](http://www.rhomarwater.com/calculators/pipe-volume-calculator)

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**ES 13: Hot Water Distribution Efficiency (1 point)**

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**PURPOSE**

Reduce energy loss caused by long pipe-to-fixture runs.

**CRITERIA**

Install short plumbing runs and efficient water heating sources in order to maximize efficiency of hot water delivery. Locate fixtures no more than 20 feet away from water heating sources. Distribution systems must be minimal volume (maximum 0.25 gallon between hot water source and fixture) and recirculation systems must be demand-controlled.

Projects attempting the **Performance Badge** must achieve one point at a minimum.

Select one option below:

**Option A. Central Tank or Tankless Water Heater or Point-of-Use Electric Water Heaters (1 point)**

- All water fixtures shall have less than 20 feet of pipe connecting them to a central or point-of-use water heater and no continuous recirculation pump.

**Option B. Recirculating Hot Water Systems: (1 point)**

- Install pipe insulation on full system (supply and return)
- Controls shall be demand-based
- Recirculation systems must be demand initiated and store no more than 0.125 gallons between the loop and fixture (piping must be insulated).

Water Volume per foot of Pipe Chart:

Nominal Pipe Size (in)	Water C	
	Volume	
	(in <sup>3</sup> /ft)	(gallons/ft)
1/4	0.59	0.003
3/8	1.33	0.006
1/2	2.36	0.010
3/4	5.30	0.023
1	9.43	0.041
1 1/4	14.7	0.064
1 1/2	21.2	0.092
2	37.7	0.163
2 1/2	58.9	0.255
3	84.8	0.367

*\*provided by engineeringtoolbox.com*

**VERIFICATION**

- Construction documents indicate water heater location and efficiency
- Plumbing Submittals
- Inspection by ECLC Technical Advisor

**RESOURCES**

2012 IAPMO Green Plumbing Code

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

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**ES 14: Heat Recovery Water Heating (1 point)**

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**PURPOSE**

Conserve energy by reusing waste heat produced on site for water heating.

**CRITERIA**

Recover waste heat by using technology such as desuperheaters (capturing waste heat from mechanical equipment, including ground source heat pumps, air source heat pumps, refrigeration equipment, etc.) or drain-water heat recovery systems.

**VERIFICATION**

- Construction Documents detail waste heat recovery system
- Inspection by ECLC Technical Advisor

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**ES 15: ENERGY STAR Labeled Appliances and Equipment (1-5 points)**

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**PURPOSE**

Provide additional energy reduction during operations by installing ENERGY STAR Labeled products.

**CRITERIA**

Specify and install ENERGY STAR Labeled products as listed below.

Only new equipment is required to meet the following criteria. All existing equipment is exempt but it is recommended to create a phase out plan for non-compliant equipment.

Select one or more of the options below (If pursuing **Performance Badge**, select all that apply):

- A. **100% of Appliances (1 point)**  
Includes residential and commercial clothes washers, residential dishwashers, residential freezers, residential refrigerators, water coolers
- B. **100% of Office Equipment and Electronics (1 point)**  
Includes audio/video equipment, battery chargers, computers, displays, enterprise servers, imaging equipment (copiers, scanners, etc.), televisions
- C. **100% of Vending Machines (1 point)**
- D. **Commercial Food Service Equipment (1-2 points)**
  - a. **50% of Equipment (1 point)**
  - b. **100% of Equipment (2 points)**  
Includes commercial fryers, commercial griddles, commercial hot food holding cabinets, commercial ice machines, commercial ovens, commercial refrigerators and freezers, commercial steam cookers  
Exception - An ENERGY STAR Label is only required on available commercial appliances. Projects may be required to prove that no ENERGY STAR Label equipment is available.

**VERIFICATION**

- Construction documents should have equipment list indicating ENERGY STAR label (as applicable)
- Manufacture specifications for equipment that does not have visible ENERGY STAR label validation on appliance
- Inspection by ECLC Technical Advisor

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**ES 16: Commercial Kitchen Requirements (1-2 points)**

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**PURPOSE**

Provide additional energy reduction during operations by installing ENERGY STAR Labeled products and high efficiency exhausts.

**CRITERIA**

Select one or both of the options below:

**Option A. Exhaust Requirements (1 point)**

- Side panels are required on hoods
- VAV demand-based exhaust (for kitchens with total hood exhaust air flow rate over 2000 cfm)

**Option B. Refrigeration Requirements for walk-in units (1 point)**

- ENERGY STAR Qualified walk-in refrigerators and freezers
- 6" insulation on low-temp walk-in equipment
- Condensing unit must be outside

**VERIFICATION**

- Manufacture specifications for equipment that does not have visible ENERGY STAR Label validation on appliance

**RESOURCES**

ENERGY STAR Labeled Products

[www.energystar.gov](http://www.energystar.gov)

Energy Design Resources by California Public Utilities Commission

[Design Brief: Commercial Kitchen Ventilation Design](#)

Food Service Consultants Society International

[HVAC-Handbook-Commercial-Kitchen-Ventilation-Best-Practice.pdf](#)

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## Water Efficiency

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**WE R1: WaterSense® Water Fixtures (Requirement)**

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**PURPOSE**

Conserve water through use of water-efficient fixtures.

**CRITERIA**

All projects must meet minimum water efficiency criteria for the following fixtures, as listed below.

The table below outlines maximum flow rates per fixture:

<b>FIXTURE</b>	<b>MAXIMUM FLOW RATES</b>
Standard Tank Toilets	1.28 GPF
Flushometer-Valve Toilets	1.6 GPF
Dual Flush Tank Toilets	Full flush 1.6 GPF / Partial flush 1.0 GPF (or equivalent to 1.28 GPF or less)
Urinals	0.50 GPF
Lavatory Faucets	0.50 GPM
Metering Faucets	0.25 GPC
Shower Heads	2.0 GPM
Kitchen/Bar Faucets	2.0 GPM
Pre-Rinse Spray Valves	1.28 GPM

GPF = gallons per flush, GPM = gallons per minute, GPC = gallons per cycle

**VERIFICATION**

- Construction Documents or Plumbing manufacture sheets include flow rates and flush volumes for all fixtures; toilets, lavatory faucets, shower heads, urinals, pre-rinse spray valves
- Inspection by ECLC Technical Advisor

**RESOURCES**

Environmental Protection Agency - WaterSense®  
<https://www3.epa.gov/WaterSense/>



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**WE R2: Water Efficient Landscaping and Irrigation (Requirement)**

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**PURPOSE**

To reduce or eliminate the use of potable water and groundwater for exterior landscaping irrigation.

**CRITERIA**

Any permanently installed irrigation system must include shut-off controls. Irrigation system must be timer controlled at a minimum and must be indicated on landscape plans.

Specified plant material shall consist of drought-tolerant, native or adaptive varieties and constitutes the majority of the landscape design. Native plants occur naturally in a given area and are well-suited to the surrounding climate, while adaptive plant materials (though not native to the area) have similar water, sun and soil requirements and are well-suited for the given climate. Installing these plant materials reduces the need for irrigation, as well as for fertilizer and pesticide use.

Landscaping must be designed according to the following prescriptive measures:

- 75% of landscaped area is a combination of drought-tolerant, native or adaptive perennial plant material
- No invasive species allowed; any invasive species on the project site must be removed
- Soil is analyzed for nutritional requirements (i.e. fertilizer, lime, organic content, etc.) and percolation rate - AND - amended or cultivated to provide good aeration and drainage while retaining adequate moisture and nutrients for optimum root growth
- Provide a minimum of four inch mulch depth for all planting areas, excluding lawns

**VERIFICATION**

- Landscape Plan must have vegetation schedule and percentage of landscape area that is to meet the requirement indicated.
- Landscape plan to include location and types of shut-off controls
- Inspection by ECLC Technical Advisor

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**WE 1: High Efficiency Water Fixtures (1-5 points)**

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**PURPOSE**

Reduce the amount of potable water used by installing efficient fixtures.

**CRITERIA**

Increase the efficiency of water use in the building design by specifying high efficiency fixtures.

Select all applicable options:

**Option A. High Efficiency Toilets and/or Dual Flush Toilets (2 points)**

Specify toilet fixture with a 1.0 GPF maximum or dual flush toilet fixture with a full flush 1.06 GPF and partial flush 0.8 GPF (or equivalent of 0.89 GPF)

Dual Flush Calculation:

To calculate the equivalent gallons per flush for dual flush toilets, simply add one full flush and two half flushes and divide by three. For example, a dual flush toilet that provides 1.6 GPF for solid and 0.5 GPF for liquid waste results in 0.69 GPF equivalent, as compared to the standard toilet water use.

$$\text{dual flush equivalent} = \frac{(\text{full flush}) + (\text{half flush}) + (\text{half flush})}{3} = \frac{1.06 + 0.8 + 0.8}{3} \rightarrow \mathbf{0.89\ gpf}$$

**Option B. Pint Flush or Waterless Urinals (1 point)**

All installed urinal fixtures must use 0.125 GPF or less.

**Option C. Automatic Faucets (1 point)**

Projects are to specify all automatic faucets to fulfill credit.

**Option D. High Efficiency Showerheads (1 point)**

All showerheads installed in the project are 1.5 GPM or less

**VERIFICATION**

- Construction Documents should list fixture schedule with flush volumes and flow rates.
- Manufacturer's documentation must include the WaterSense® mark if applicable
- Inspection by ECLC Technical Advisor

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**WE 2: Xeriscape Landscape Plan (1 point)**

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**PURPOSE**

Reduce water used for landscaping through plant selection and soil preparation.

**CRITERIA**

Plant material consists of drought-tolerant, native or adaptive varieties and constitutes the majority of the landscape design.

Native plants occur naturally in a given area and are well-suited to the surrounding climate, while adaptive plant materials (though not native to the area) have similar water, sun and soil requirements and are well-suited for the given climate. Installing these plant materials reduces the need for irrigation, as well as for fertilizer and pesticide use.

A Landscape Plan for 100% of landscaped area is planned, designed and stamped by a registered landscape architect that is consistent with Xeriscape design principles and is specific to the geographic region of the project. A maintenance plan that includes mowing, watering and mulching schedules, in addition to soil percolation rates and composition testing, must be provided to the owner.

**VERIFICATION**

- Landscape Plan includes prescriptive or Xeriscape™ measures and vegetation schedule
- Site Inspection by ECLC Technical Advisor

**RESOURCES**

The United States National Arboretum, Invasive Plants  
[www.usna.usda.gov](http://www.usna.usda.gov)

Southeast Exotic Pest Plant Council  
[www.se-eppc.org](http://www.se-eppc.org)

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**WE 3: Efficient Irrigation System or No Irrigation System Installed (1-3 points)**

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**PURPOSE**

Minimize water waste through efficient irrigation strategies.

**CRITERIA**

Point is achieved by installing the following sensor (does not apply to Option C) and either option A, B or C.

**WaterSense® Weather-based Irrigation Controller or Soil Moisture Sensors**

Irrigation systems shall be equipped with technology that inhibits or interrupts operation of the irrigation system during periods of rainfall or sufficient soil moisture.

***Select one of the options below:*****Option A. Zoned Irrigation System (1 point)**

Meet specific water needs for each planting area by isolating areas that require more or less water and by delivering water to each independently.

**Option B. 100% Drip Irrigation System (1 point)**

In lieu of spray irrigation system.

**Option C. No irrigation System Installed (3 points)****VERIFICATION**

- Landscape Irrigation Plan
- Inspection by ECLC Technical Advisor

**RESOURCES**

EPA Irrigation Controllers

<https://www.epa.gov/watersense/irrigation-controllers>

Irrigation Best Management Practices

<https://energy.gov/eere/femp/best-management-practice-5-water-efficient-irrigation>

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**WE 4: Non-potable Water Source Used for Irrigation (2 points)**

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**PURPOSE**

Minimize water waste through efficient irrigation strategies.

**CRITERIA**

Use alternative water sources such as rainwater, greywater or condensate for irrigation in lieu of potable water.

**VERIFICATION**

- Landscape Plan detailing non-potable source and irrigation system design
- Inspection by ECLC Technical Advisor

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## Education and Operations

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**EO R1: Utility Tracking (Requirement)**

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**PURPOSE**

Track actual energy and water performance data for the project in order to monitor performance

**CRITERIA**

All projects seeking certification must be independently metered for energy and water usage. Building owners must enter their building into ENERGY STAR Portfolio Manager (ESPM) as well as input their metering into ESPM. The login info must be shared with the EarthCraft team.

**VERIFICATION**

- Portfolio Manager Account information form completed and signed (account must be shared with EarthCraft)

**RESOURCES**

ENERGY STAR Portfolio Manager

[www.energystar.gov/](http://www.energystar.gov/)

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**EO R2: Facility Operations and Maintenance Manual (Requirement)**

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**PURPOSE**

Educate owner and facility management on building operation and maintenance best practices to maximize performance.

**CRITERIA**

Supply owner/occupant with a concise document describing proper building maintenance and operations.

**EO R2.1 Facility Operations Manual Minimum Requirements:****General**

- Measures on how to maintain water, energy and indoor air quality performance
- Narrative for each system intended to operate including at a minimum: HVAC and water heating equipment, landscape systems, and lighting
- Maintenance schedules for all items requiring regular maintenance

**Equipment**

- All equipment operation (e.g. elevator, HVAC, roll-up garage door, etc.)
- HVAC setpoints and schedules recorded on control drawings and on control device(s) (digital controls shall have setpoints listed in programming notes and schedules)
- A written test and balance report of HVAC systems per IAQ R7 Third Party Test and Balance Report

**Landscape**

- Landscape irrigation systems (such as non-potable water sources, rain water capture, irrigation schedules)

**Lighting**

- Submittal data including, at a minimum; lamps, ballasts, drivers, and lighting schedules with controls listed
- Digital controls shall have programming listed in programming notes and schedules

**EO R2.2 Facility Maintenance Manual Minimum Requirements:****Equipment Maintenance Intervals**

- Equipment size and options for maintenance
- Lighting – include re-lamping and cleaning schedule and recalibrating lighting controls
- Filter MERV rating, size(s) of filtration media, frequency of replacement
- Filter change log

**Service Agency**

- Name and addresses for at least one service agency for MEP equipment

**Special Systems Maintenance (as applicable)**

- Non-potable water collection devices (rainwater, condensate or greywater collection)
- Low water use fixtures (e.g. low-flow urinals)

**Landscape**

- Irrigation system check-ups, nontoxic pest treatment, etc.

**VERIFICATION**

- Provide confirmation that facility manuals have been reviewed with owner/ facility management
- Provide Facility Operations Manual and Facility Maintenance Manual



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**EO R3: No Smoking Policy (Requirement)**

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**PURPOSE**

Reduce exposure to environmental tobacco smoke (ETS) by removing pollutant source from occupant breathing zones.

**CRITERIA**

Provide a No Smoking Policy and locate all smoking areas outside and at least 25 feet away from operable doors, windows, and outside air intakes. Cigarette receptacles are not allowed within the 25-foot buffer zone. Have signage supporting the no smoking policy and signage to designate smoking area (if applicable).

**VERIFICATION**

- Provide signed "No Smoking Policy" statement
- Construction Documents indicate location(s) of any outdoors smoking areas, cigarette receptacles and signage location

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**EO R4: Tenant Recycling (Requirement)**

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**PURPOSE**

Encourage the reduction of building waste from landfill.

**CRITERIA**

Designate areas with clearly marked receptacles for recycling aluminum, plastic, paper, glass and cardboard. If the building has more than one floor, then there must be provisions for recycling on each floor.

Project must have collection provided by either private or municipal recycling services. At a minimum, the collection should include plastic, paper, cardboard, and aluminum materials.

**VERIFICATION**

- Construction Documents indicate designated areas for recyclables collection
- Site Inspection by ECLC Technical Advisor

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**EO 1: Building Systems Commissioning (3 points)**

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**PURPOSE**

Ensure energy and water systems are installed and operating as designed.

**CRITERIA**

Engage a third-party Commissioning Agent to ensure that the project's energy-related systems perform as intended. The following should be included as part building systems commissioning:

- HVAC and controls
- Lighting and daylighting controls
- Water heating systems
- Renewable energy systems
- Automatic irrigation systems

The commissioning process should include at a minimum:

- **Design Phase**
  - Owner's Project Requirements (OPR)
  - Basis of Design (BOD) Documentation
  - Building System's Commissioning Plan
- **Construction Phase**
  - Commission all energy and irrigation systems
  - Systems Start-up
  - Final Report

**VERIFICATION**

- Copy of Commissioning Report

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**EO 2: Advanced Tenant Recycling (2-5 points)**

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**PURPOSE**

Encourage a firm commitment to recycling.

**CRITERIA**

Project must create and implement a recycling waste plan for the following options:

**Select all options that apply:****A. Composting Organic Waste (3 points)**

Building operations must provide access to composting of organic waste.

**B. Hard to Recycle Materials (2 points)**

Building operations must provide collection for hard to recycle materials. For example; glass, electronics, light bulbs, etc.

**VERIFICATION**

- Provide copy of signed contract or evidence of municipal recycling waste program
- Provide recycling waste plan

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# Innovation

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## INNOVATION

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### PURPOSE

Reward project team for going above and beyond the measures outlined in the EarthCraft Light Commercial program.

### CRITERIA

In order to be considered, the team must submit a narrative of the measures employed and provide supporting documentation in the form of specifications, calculations and/or photographs for verification purposes. Project teams can submit up to four Innovation credits for consideration. Project teams can review the Innovation Library for credit opportunities.

Project teams may submit new Innovation Credit ideas for consideration and must include the Purpose, Criteria, and Verification.

Below are examples for consideration (this list is not all inclusive):

- On-site solar, fuel cell, or co-generation system for 25% or more of annual energy use.
- Advanced framing strategies for wood framed construction
- Excavated trees milled for lumber used on project (not shredded or mulched)
- Process water reduction or greywater reuse system
- Vegetated "green" roof regularly accessible to building occupants
- Compost toilet system (less than 0.1 gpf)
- Company sustainability policy: include guidelines and tracking process (including carpooling, recycling, green purchasing, green cleaning, carbon offsets, employee incentives, etc)
- Alternative fuel company vehicle (e.g. electric, bio-diesel, natural gas, LP, Prius or equivalent mileage)
- Green cleaning policy and contract
- Edible garden within project site boundary
- Storm water - mimic natural hydrological processes using appropriately-sized water management systems that treats, infiltrates or reuses all storm water on-site. Off-site systems will be considered on a case by case basis
- Plant selection includes 40% or more wildlife foraging

### VERIFICATION

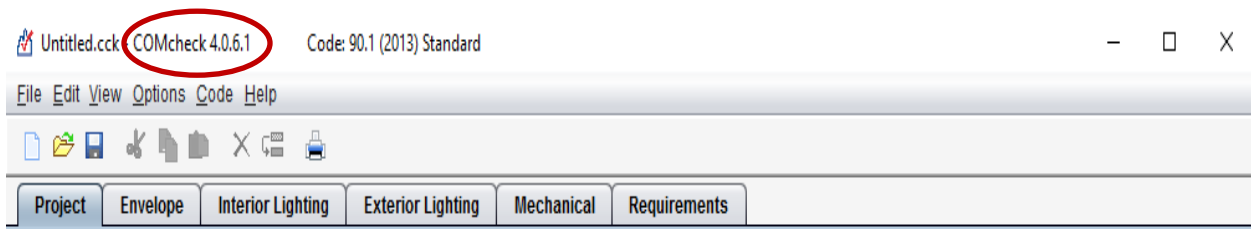
- Narrative of measure employed
- Supporting documentation: e.g. specifications, calculations, photographs
- Innovation Credit Library: Follow documentation requirements

# Appendix A: COMcheck Overview

COMcheck is commercial energy code compliance software developed by Pacific Northwest National Laboratory for the U.S. Department of Energy's Office of Codes and Standards. COMcheck can be used to demonstrate a commercial project design complies with ASHRAE Standard 90.1-2013. The software provides a highly flexible way to demonstrate compliance with minimal input. The envelope section allows tradeoffs between envelope components, including roofs, walls, windows, floors and skylights. The lighting section enables you to quickly determine if your lighting design meets interior-lighting power limits. The mechanical section enables you to assemble a customized list of code requirements that are applicable to the systems and equipment in your building.

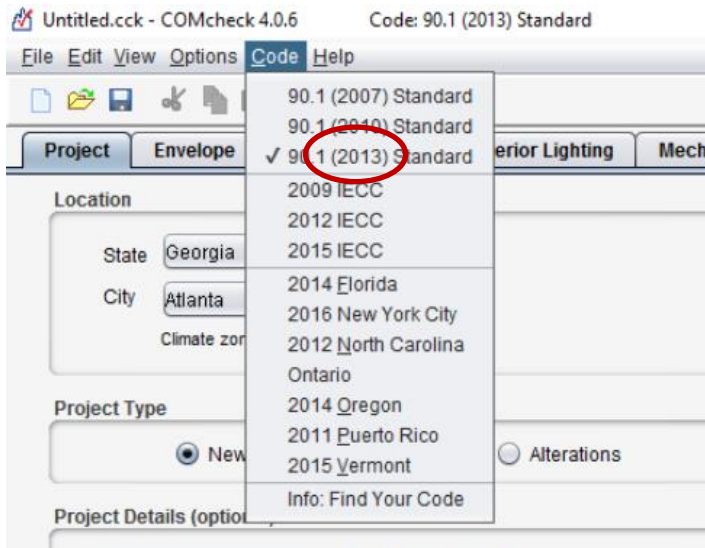
## How To Download

COMcheck can be downloaded from [www.energycodes.gov](http://www.energycodes.gov), projects are required to use version 4.0.6.1 or later (the version number can be found in the upper left corner).



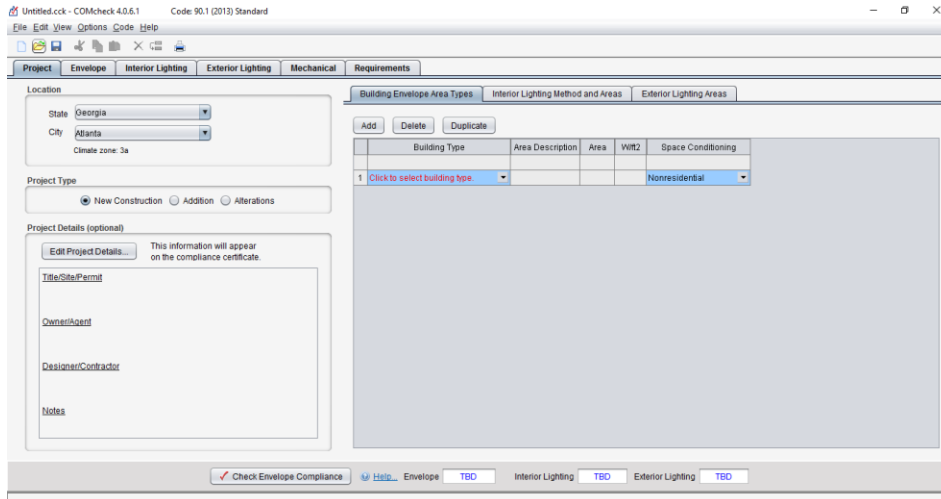
## Code Menu

Use the Code menu to select which code version you want the program to use when determining compliance. All ECLC projects should use ASHRAE Standard 90.1-2013.



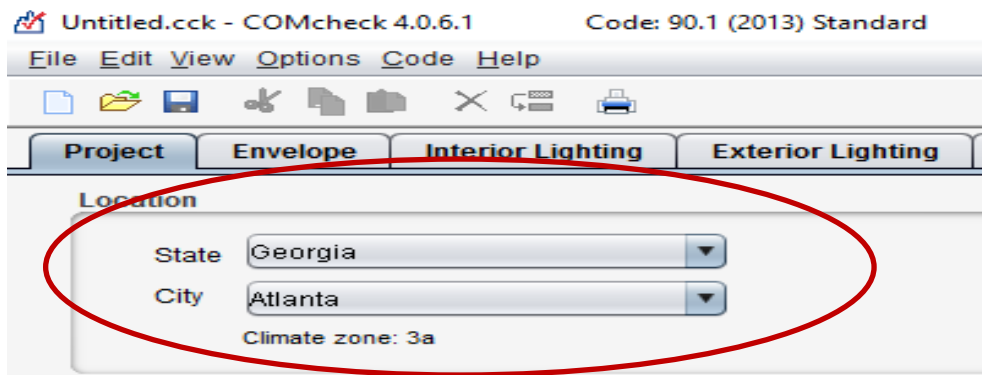
## Project Screen

The Project screen is used to provide the software with information such as the location of the proposed building (state and city) and the building use category and area. You may also enter specific project information that identifies and describes your project which will be printed on your certificate.



## Location

The software lists the available cities for each state. If your city is not listed, choose the closest city with similar weather conditions.

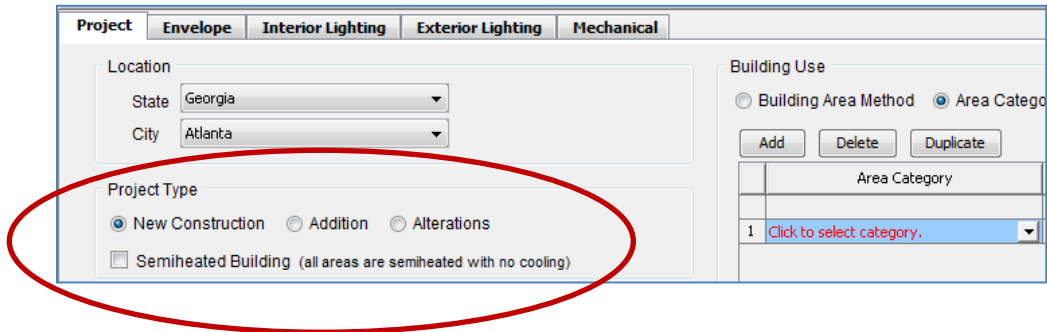


## Project Type

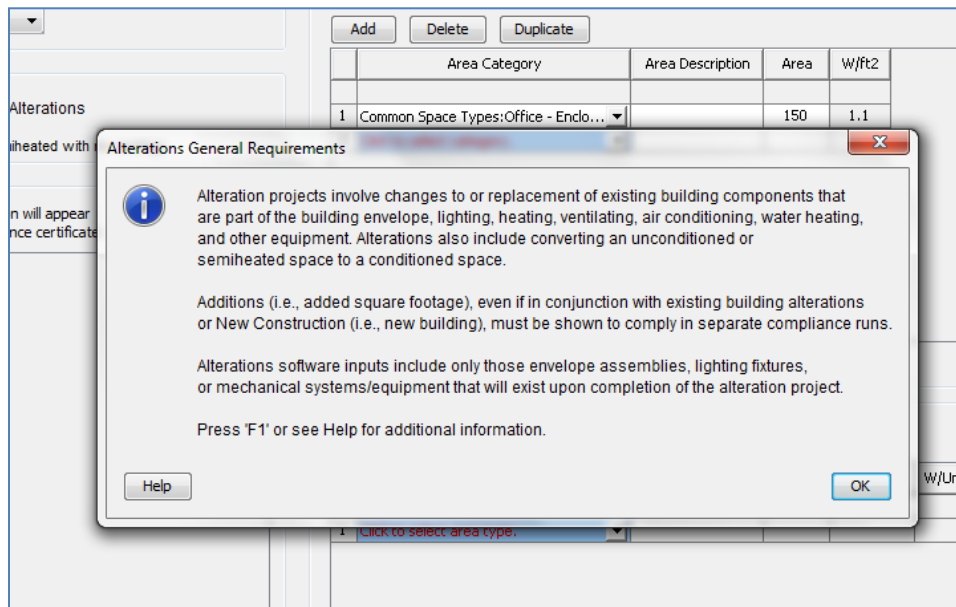
Projects should select New Construction, Addition or Alterations. The selection will be included on the compliance report although the trade-off calculations remain the same for New Construction and Addition.

Additions are treated the same way as New Construction, ignoring the common walls between the existing building and the addition. All new systems being added must be entered in the software and must comply with the requirements. Existing systems simply extended into an addition do not have to be included.



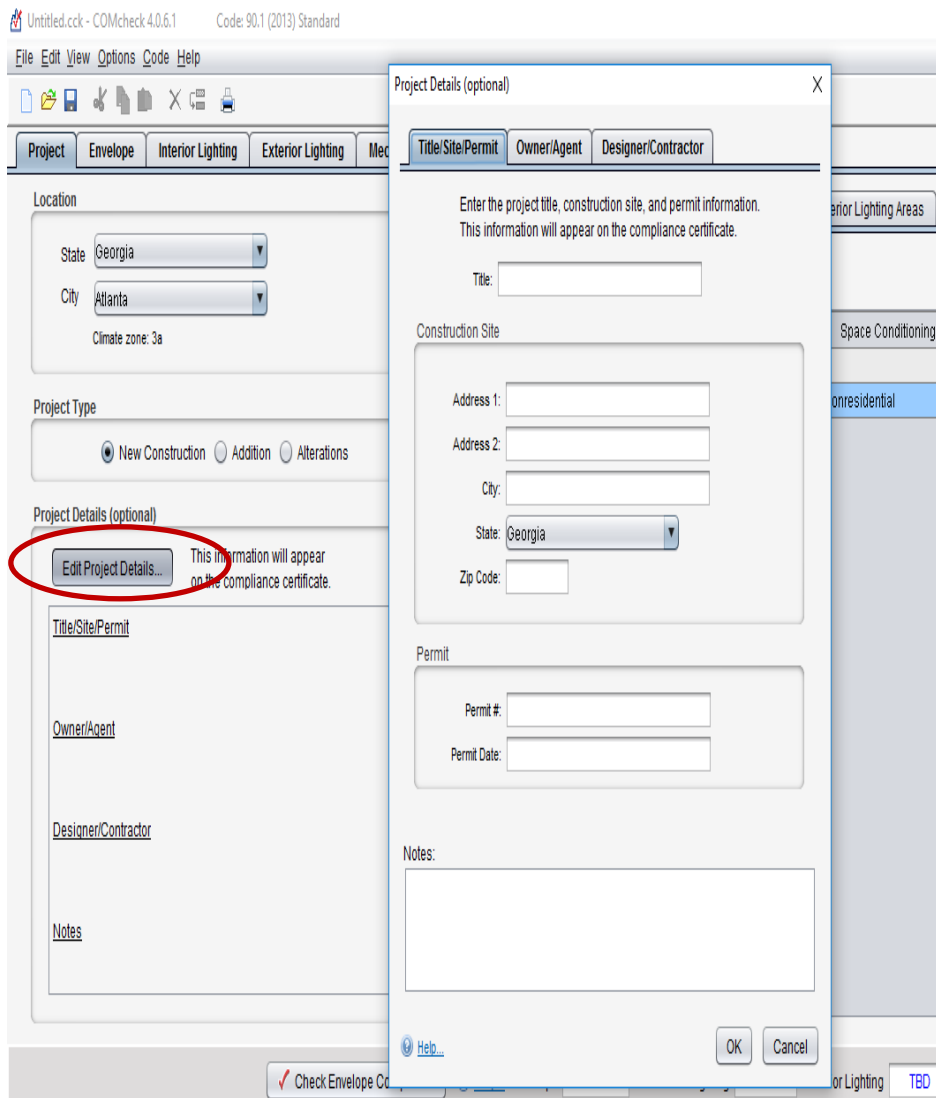


Alterations include only those envelope components, lighting fixtures, or mechanical systems and equipment that will exist upon completion of the alteration project. Compliance is shown as Pass/Fail for Envelope and Lighting.



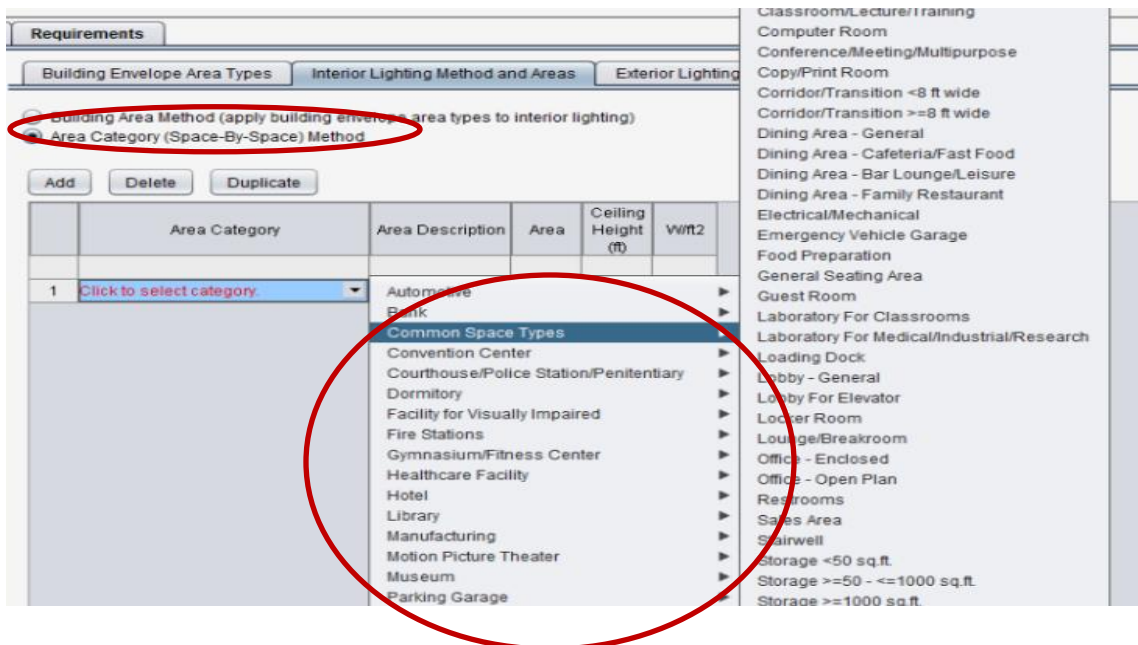
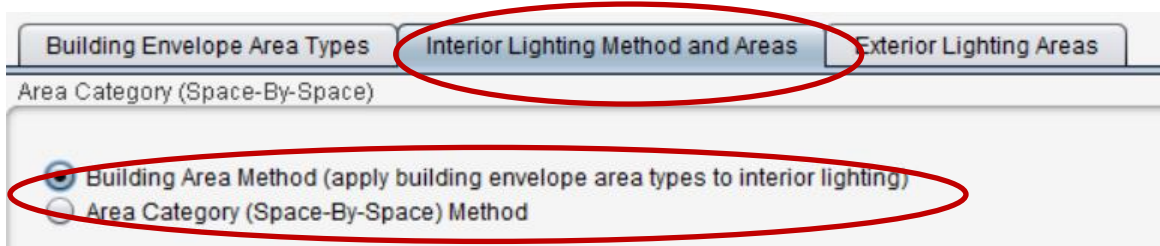
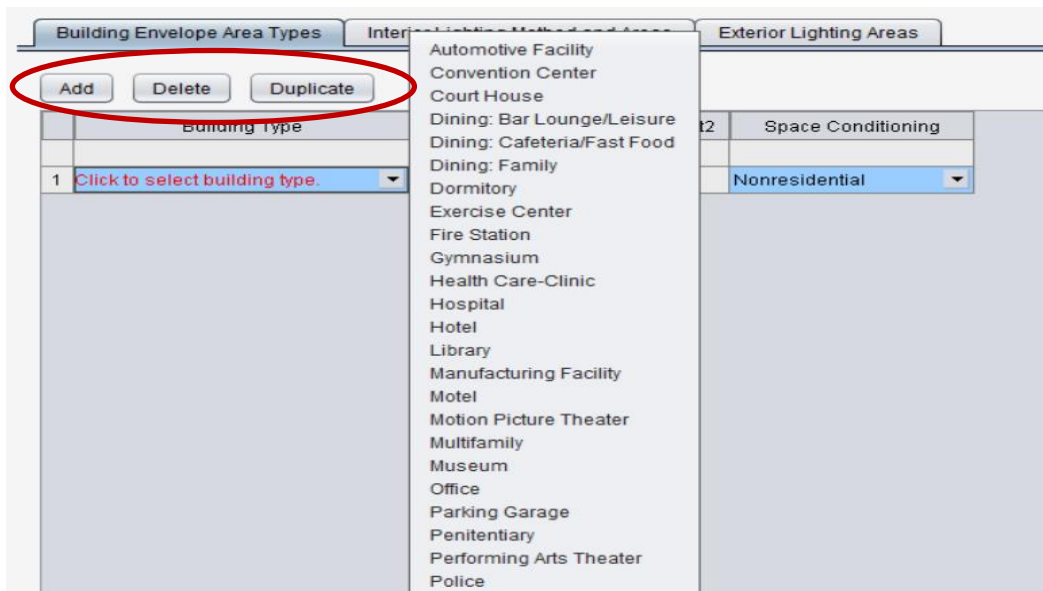
## Project Details

The Project Details section has input fields entitled Title/Site/Permit, Owner/Agent and Designer/Contractor. All of the information entered in these fields is included in your project report. None of this information is required by the software program to determine compliance with the code. This information may be useful, however, to the building department or as a way to track and label your reports.

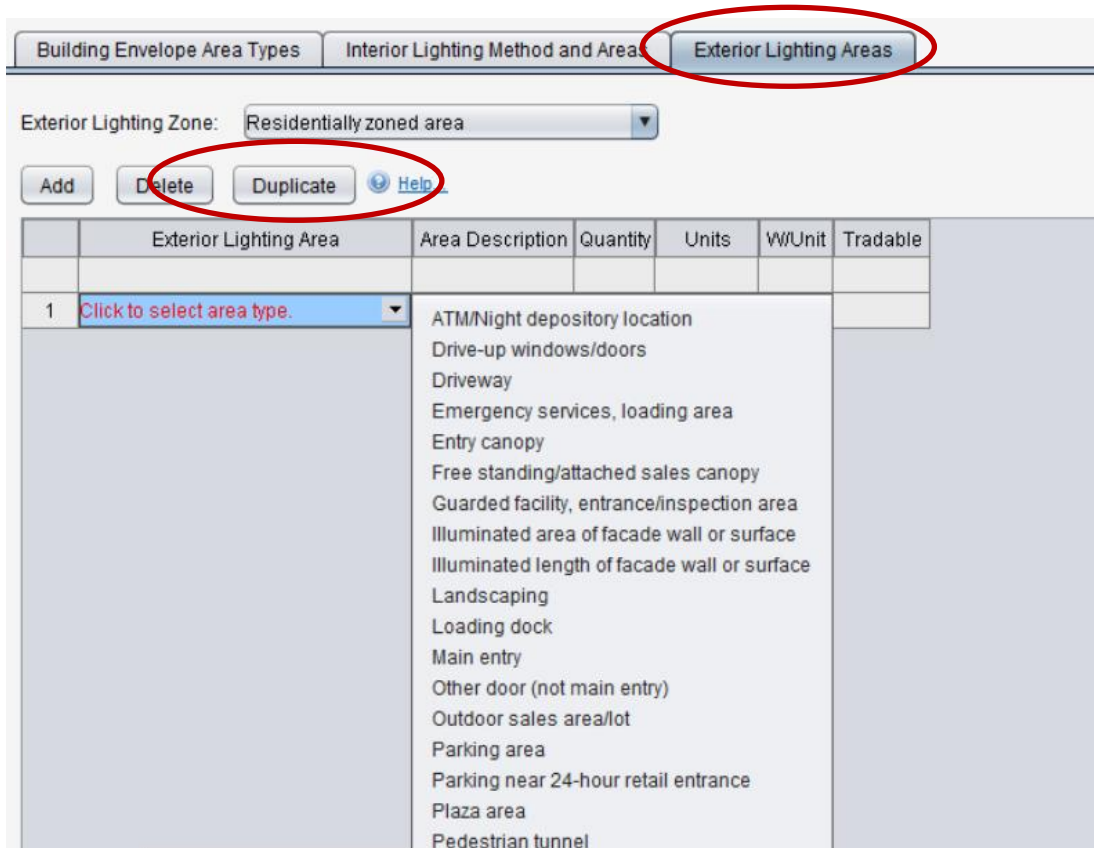
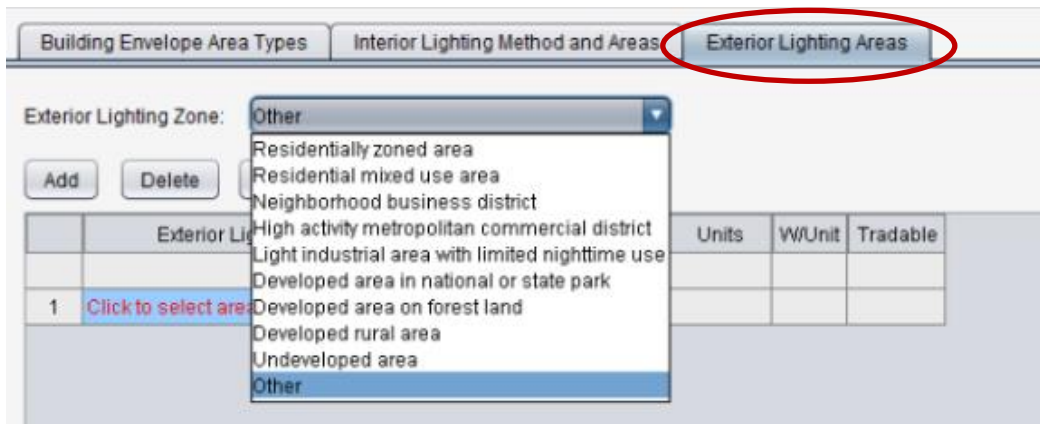


## Building Use

Use the Whole Building compliance method for buildings that entirely match one of the available building types or use the Area Category (Space-By-Space) compliance method when detailed information about space usage is available. The ECLC program participants are encouraged to use the Area Category (Space-By-Space) Method. A list of building types or area categories is displayed when you click the left mouse button in the Whole Building Type or Area Category column of the Building Use table. Fill in the square footage of the whole building or each space.



Select the applicable Exterior Lighting Areas and enter the appropriate quantities.



Once all the information is completed on the Project Screen the building can be evaluated on energy code compliance for the following components:

- Envelope
- HVAC
- Service water heating
- Interior lighting
- Exterior lighting

# Appendix B: COMcheck Envelope

Use COMcheck to demonstrate that the building envelope complies with ASHRAE Standard 90.1-2007 either prescriptively or through the simple trade-off approach.

## Prescriptive Envelope Values

The following are Nonresidential prescriptive envelope values for climate zones 2, 3 and 4. Refer to ASHRAE Standard 90.1-2013 to Table 5.5-3 for Residential or Semi-heated prescriptive envelope values.

## Building Envelope Requirements for Residential and Non-Residential

Table 5.5-2 Building Envelope Requirements for Climate Zone 2 (A,B)\*

Opaque Elements	Nonresidential		Residential		Semiheated				
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value			
<i>Roofs</i>									
Insulation Entirely above Deck	U-0.039	R-25 c.i.	U-0.039	R-25 c.i.	U-0.173	R-5 c.i.			
Metal Building <sup>a</sup>	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.096	R-16			
Attic and Other	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19			
<i>Walls, above Grade</i>									
Mass	U-0.151 <sup>b</sup>	R-5.7 c.i. <sup>b</sup>	U-0.123	R-7.6 c.i.	U-0.580	NR			
Metal Building	U-0.094	R-0 + R-9.8 c.i.	U-0.094	R-0 + R-9.8 c.i.	U-0.162	R-13			
Steel Framed	U-0.084	R-13 + R-3.8 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13			
Wood Framed and Other	U-0.089	R-13	U-0.089	R-13	U-0.089	R-13			
<i>Wall, below Grade</i>									
Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR			
<i>Floors</i>									
Mass	U-0.107	R-6.3 c.i.	U-0.087	R-8.3 c.i.	U-0.322	NR			
Steel Joist	U-0.038	R-30	U-0.038	R-30	U-0.069	R-13			
Wood Framed and Other	U-0.033	R-30	U-0.033	R-30	U-0.066	R-13			
<i>Slab-on-Grade Floors</i>									
Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR			
Heated	F-0.900	R-10 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.			
<i>Opaque Doors</i>									
Swinging	U-0.700		U-0.500		U-0.700				
Nonswinging	U-0.500		U-0.500		U-1.450				
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Fenestration, 0%–40% of Wall</i>									
		(for all frame types)			(for all frame types)				
Nonmetal framing, all	U-0.40			U-0.40			U-0.93		
Metal framing, fixed	U-0.57			U-0.57			U-1.20		
Metal framing, operable	U-0.65	SHGC-0.25	1.10	U-0.65	SHGC-0.25	1.10	U-1.20	NR	NR
Metal framing, entrance door	U-0.83			U-0.77			U-0.83		
<i>Skylight, 0%–3% of Roof</i>									
All types	U-0.65	SHGC-0.35	NR	U-0.65	SHGC-0.35	NR	U-1.80	NR	NR

\* The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = fluid cavity (see Section A2.3.2.3), Ls = linear system (see Section A2.3.2.4), NR = no (insulation) requirement.  
<sup>a</sup> When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).  
<sup>b</sup> Exception to Section 5.5.3.2 applies for mass walls above grade.

Table 5.5-3 Building Envelope Requirements for Climate Zone 3 (A,B,C)\*

Opaque Elements	Nonresidential		Residential		Semiheated				
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value			
<i>Roofs</i>									
Insulation Entirely above Deck	U-0.039	R-25 c.i.	U-0.039	R-25 c.i.	U-0.119	R-7.6 c.i.			
Metal Building <sup>a</sup>	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.096	R-16			
Attic and Other	U-0.027	R-38	U-0.027	R-38	U-0.053	R-19			
<i>Walls, above Grade</i>									
Mass	U-0.123	R-7.6 c.i.	U-0.104	R-9.5 c.i.	U-0.580	NR			
Metal Building	U-0.094	R-0 + R-9.8 c.i.	U-0.072	R-0 + R-13 c.i.	U-0.162	R-13			
Steel Framed	U-0.077	R-13 + R-5 c.i.	U-0.064	R-13 + R-7.5 c.i.	U-0.124	R-13			
Wood Framed and Other	U-0.089	R-13	U-0.064	R-13 + R-3.8 c.i. or R-20	U-0.089	R-13			
<i>Wall, below Grade</i>									
Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR			
<i>Floors</i>									
Mass	U-0.074	R-10 c.i.	U-0.074	R-10 c.i.	U-0.137	R-4.2 c.i.			
Steel Joist	U-0.038	R-30	U-0.038	R-30	U-0.052	R-19			
Wood Framed and Other	U-0.033	R-30	U-0.033	R-30	U-0.051	R-19			
<i>Slab-on-Grade Floors</i>									
Unheated	F-0.730	NR	F-0.540	R-10 for 24 in.	F-0.730	NR			
Heated	F-0.860	R-15 for 24 in.	F-0.860	R-15 for 24 in.	F-1.020	R-7.5 for 12 in.			
<i>Opaque Doors</i>									
Swinging	U-0.700		U-0.500		U-0.700				
Nonswinging	U-0.500		U-0.500		U-1.450				
Penetration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC
<i>Vertical Penetration, 0%–40% of Wall</i>									
	(for all frame types)			(for all frame types)			(for all frame types)		
Nonmetal framing, all	U-0.35			U-0.35			U-0.87		
Metal framing, fixed	U-0.50			U-0.50			U-1.20		
Metal framing, operable	U-0.60	SHGC-0.25	1.10	U-0.60	SHGC-0.25	1.10	U-1.20	NR	NR
Metal framing, entrance door	U-0.77			U-0.68			U-0.77		
<i>Skylight, 0%–3% of Roof</i>									
All types	U-0.55	SHGC-0.35	NR	U-0.55	SHGC-0.35	NR	U-1.70	NR	NR

\* The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), Ls = linear system (see Section A2.3.2.6), NR = no (insulation) requirements.  
<sup>a</sup> When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).

Table 5.5-4 Building Envelope Requirements for Climate Zone 4 (A,B,C)\*

Opaque Elements	Nonresidential			Residential			Semiheated			
	Assembly Maximum	Insulation Min. R-Value		Assembly Maximum	Insulation Min. R-Value		Assembly Maximum	Insulation Min. R-Value		
<i>Roof</i>										
Insulation Entirely above Deck	U-0.032	R-30 c.i.		U-0.032	R-30 c.i.		U-0.093	R-10 c.i.		
Metal Building <sup>a</sup>	U-0.037	R-19 + R-11 La or R-25 + R-8 La		U-0.037	R-19 + R-11 La or R-25 + R-8 La		U-0.082	R-19		
Attic and Other	U-0.021	R-49		U-0.021	R-49		U-0.034	R-30		
<i>Walls, above Grade</i>										
Mass	U-0.104	R-9.5 c.i.		U-0.090	R-11.4 c.i.		U-0.580	NR		
Metal Building	U-0.060	R-0 + R-15.8 c.i.		U-0.050	R-0 + R-19 c.i.		U-0.162	R-13		
Steel Framed	U-0.064	R-13 + R-7.5 c.i.		U-0.064	R-13 + R-7.5 c.i.		U-0.124	R-13		
Wood Framed and Other	U-0.064	R-13 + R-3.8 c.i. or R-20		U-0.064	R-13 + R-3.8 c.i. or R-20		U-0.089	R-13		
<i>Wall, below Grade</i>										
Below Grade Wall	C-0.119	R-7.5 c.i.		C-0.092	R-10 c.i.		C-1.140	NR		
<i>Floors</i>										
Mass	U-0.057	R-14.6 c.i.		U-0.051	R-16.7 c.i.		U-0.107	R-6.3 c.i.		
Steel Joint	U-0.038	R-30		U-0.038	R-30		U-0.052	R-19		
Wood Framed and Other	U-0.033	R-30		U-0.033	R-30		U-0.051	R-19		
<i>Slab-on-Grade Floors</i>										
Unheated	F-0.520	R-15 for 24 in.		F-0.520	R-15 for 24 in.		F-0.730	NR		
Heated	F-0.843	R-20 for 24 in.		F-0.688	R-20 for 48 in.		F-0.900	R-10 for 24 in.		
<i>Opaque Doors</i>										
Swinging	U-0.500			U-0.500			U-0.700			
Nonswinging	U-0.500			U-0.500			U-1.450			
Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Min. VT/SHGC	
<i>Vertical Fenestration, 0%-40% of Wall</i>										
		(for all frame types)				(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.35			U-0.35			U-0.51			
Metal framing, fixed	U-0.42			U-0.42			U-0.73			
Metal framing, operable	U-0.50	SHGC-0.40	1.10	U-0.50	SHGC-0.40	1.10	U-0.81	NR	NR	
Metal framing, entrance door	U-0.77			U-0.68			U-0.77			
<i>Skylight, 0%-3% of Roof</i>										
All types	U-0.50	SHGC-0.40	NR	U-0.50	SHGC-0.40	NR	U-1.15	NR	NR	

\* The following definitions apply: c.i. - continuous insulation (see Section 3.2), IC - R-Board cavity (see Section A2.3.2.5), La - linear system (see Section A2.3.2.4), NR - no (insulation) requirement.  
<sup>a</sup> When using the R-value compliance method for metal building roofs, a thermal spacer block is required (see Section A2.3.2).

## Envelope Screen

Use the buttons at the top of the Envelope screen to create a list of building components present in your proposed design. Each component you select is added to the building components displayed on the Envelope screen. For each component, enter appropriate values for all fields with white. These fields may include the assembly type, gross area (or perimeter), cavity R-value, continuous R-value, assembly U-factor, construction details, SHGC solar heat gain coefficient and/or projection factor.

The screenshot shows the 'Envelope' tab selected in the software. Below the navigation tabs, a table lists building components. The table has columns for Component, Assembly, Building Area Type, Orientation, Fenestration Details, Construction Details, Gross Area, Cavity Insulation R-Value, Continuous Insulation R-Value, U-Factor, SHGC, Projection Factor, and VT. Three components are listed: Roof1, Window1, and Door1. The Door1 row is highlighted in blue.

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
▼	Building												
1	Roof1	Insulation Entirely Abo...	1 - Gymnasiu...				2000 ft2		20.0	0.048			
2	Window1	Metal Frame Operable	1 - Gymnasium (...)	Unspecified	Code default ...	Glazing: Tripl...	500 ft2			0.700	0.60	0.00	0.59
3	Door1	Glass (> 50% glazing)...	1 - Gymnasium (...)	Unspecified	Code default ...	Glazing: Clear	0 ft2			1.250	0.82	0.00	0.76

Concrete slab-on-grade components require a perimeter entered in linear feet (ft). All other components require an area entered in square feet (ft2). The cavity R-value input is used for insulation placed between structural members, while the continuous R-value input is used for insulation that is continuous across the structure such as rigid-roof insulation or insulating wall sheathing.

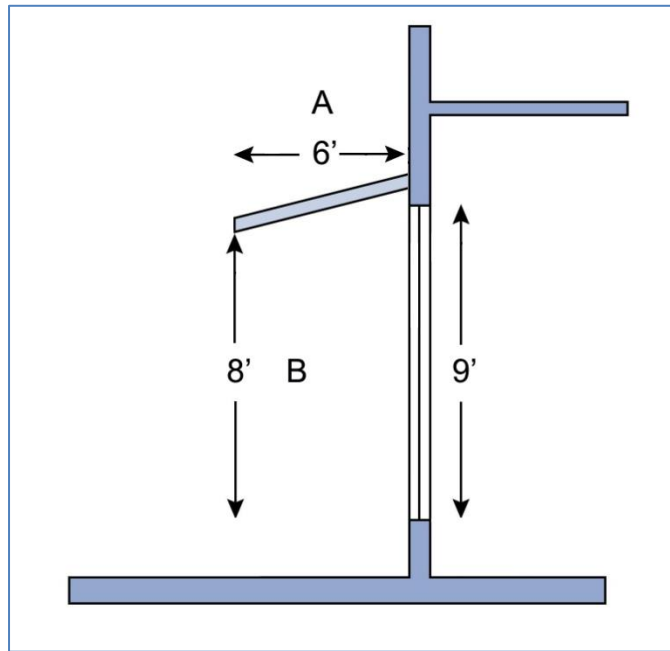
After you have completed the description of each new component, the program automatically updates the compliance results. The results are displayed at the bottom of the screen in the *Envelope* box. If *TBD* (to be determined) is displayed in this field, you have not filled in all necessary fields. To determine which data are missing or invalid, look for fields with white-on-red text. In addition to providing inputs for all white-on-red fields, you must select at least one building use type and provide its area on the *Project* screen before the software can determine compliance.

## Projection Factor

Projection factors can be used to reduce the SHGC requirements. To calculate the projection factor, take the exterior horizontal shading projection depth divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the external shading projection in units consistent with the projection depth.

$$\text{Projection Factor} = \frac{A}{B} = \frac{6}{8} \rightarrow 75\%$$





### Envelope Alterations

Envelope alteration exceptions may be taken if the project chooses “Alterations” under project type. Include only the components that will exist after alterations are complete. As you enter the applicable components, alteration detail dialogs will appear asking that the appropriate alteration option be selected that may include one or more exemptions to code compliance for that component. Depending on which option is selected, the dialogs may change and further details may need to be entered.

### Roof Alterations

The alteration detail dialog for roof components requires that the appropriate option be selected. Depending upon the roof assembly type, the options may include the following:

- Alteration replaces a roof membrane that DOES NOT expose the sheathing/deck or rooftop insulation
- Alteration replaces a roof membrane where insulation exists below the roof sheathing/deck
- Alteration exposes a roof cavity but the cavity is completely filled with minimum R-3/inch insulation
- No exemptions apply to this assembly.

### Skylight Alterations

The alteration detail dialog for skylight Glazing requires that the appropriate option be selected. The options include the following:

- Alteration ONLY replaces glazing (i.e., glass units) in existing sash or frame. To claim this exemption, the ‘altered’ skylight U-factor and SHGC solar heat gain coefficient cannot be higher than that of the replaced glazing.

- Alteration replaces less than 25% of existing fenestration area (glass plus frame). To claim this exemption, the replaced skylight U-factor and SHGC cannot be higher than that of the original glazing AND the percent of skylight area replaced must qualify.
- No exemptions apply to this assembly.

### **Exterior Wall Alterations**

The alteration detail dialogs for exterior and interior wall Opaque portion of the building envelope components require that the appropriate option be selected. The options include the following:

- Alteration modifies wall areas without an existing cavity and no cavity will be created
- Alteration exposes a wall cavity but the cavity is completely filled with minimum R-3/inch insulation
- No exemptions apply to this assembly.

### **Window Alterations**

The alteration detail dialog for windows requires that the appropriate option be selected. The options include the following:

- Alteration ONLY installs storm windows over existing glazing
- Alteration ONLY replaces glazing (i.e., glass units) in existing sash or frame. To claim this exemption, the 'altered' window SHGC cannot be higher than that of the original glazing.
- Alteration replaces less than 25% of existing building fenestration area (glass plus frame). To claim this exemption, the altered window U-factor and SHGC cannot be higher than that of the original glazing AND the percent of vertical fenestration area (windows + glass doors) replaced must qualify.
- No exemptions apply to this assembly.

### **Basement Wall Alterations**

The alteration detail dialog for basement walls requires that the appropriate option be selected. The options include the following:

- Alteration modifies wall areas without an existing cavity and no cavity will be created
- Alteration exposes a wall cavity but the cavity is completely filled with minimum R-3/inch insulation
- No exemptions apply to this assembly.

### **Floor Alterations**

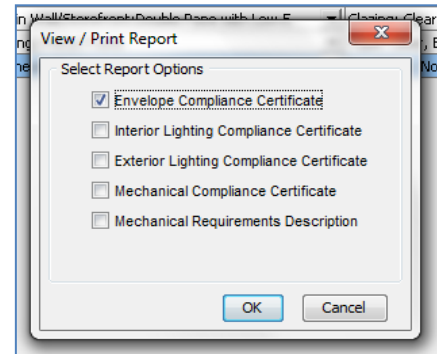
The alteration detail dialog for floor components requires that the appropriate option be selected. Depending upon the floor assembly type, the options may include the following:

- Alteration modifies floor areas without an existing cavity and no cavity will be created
- Alteration exposes a floor cavity but the cavity is completely filled with minimum R-3/inch insulation
- No exemptions apply to this assembly.

## Envelope Compliance Certificate

Print an Envelope Compliance Certificate when all envelope component inputs are complete and the project PASSES code. Click on the File menu and choose View / Print Report.

Check or indicate Not Applicable for every item under Inspection Checklist and sign/date under Compliance Statement and Post Construction Compliance Statement.



## Sample Envelope Compliance Certificate



COMcheck Software Version 4.0.6.1

## Envelope Compliance Certificate

### Project Information

Energy Code: 90.1 (2013) Standard  
 Project Title: Sample Project  
 Location: Atlanta, Georgia  
 Climate Zone: 3a (weather data: TBD)  
 Project Type: New Construction  
 Vertical Glazing / Wall Area: 100%  
 Performance Sim. Specs: EnergyPlus Version 8.1.0.009

Construction Site:  
 1660 Peachtree  
 Atlanta, GA 30309

Owner/Agent:

Designer/Contractor:

### Building Area

### Floor Area

1-Gymnasium : Nonresidential	2000
------------------------------	------

### Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U- Factor <sub>(a)</sub>
Roof 1: Insulation Entirely Above Deck, Cool roof performance data NA, [Bldg. Use 1 - Gymnasium]	2000	—	20.0	0.048	0.039
Window 1: Metal Frame:Operable, Perf. Type: Energy code default, Triple Pane with Low-E, Clear , SHGC 0.60, VT 0.59, [Bldg. Use 1 - Gymnasium]	500	—	—	0.700	0.600
Door 1: Glass (> 50% glazing):Metal Frame, Entrance Door, Perf. Type: Energy code default, Single Pane, Clear , SHGC 0.82, VT 0.76, [Bldg. Use 1 - Gymnasium]	0	—	—	1.250	0.770

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

**Envelope TBD: Invalid Area(s)**

# Appendix C: COMcheck Mechanical

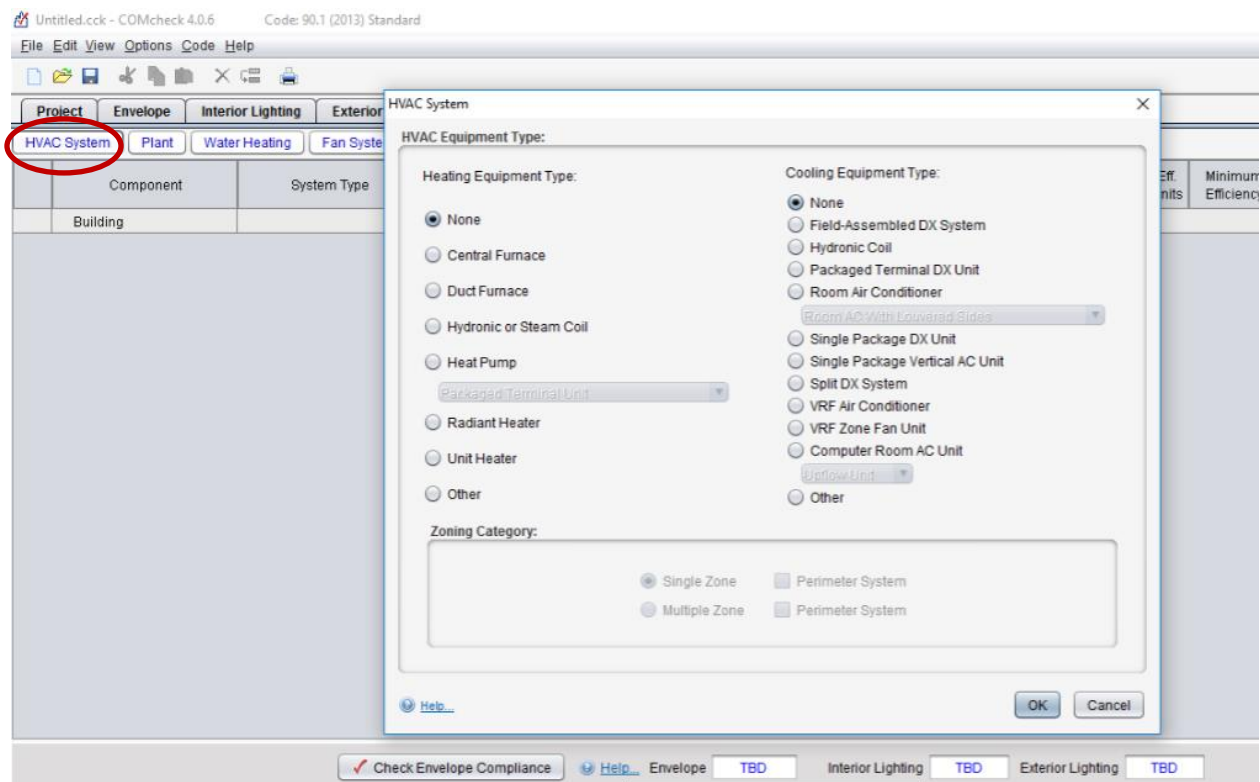
Use COMcheck to demonstrate that HVAC and Service Water Heating systems comply with ASHRAE Standard 90.1-2013.

## HVAC System

The HVAC System button helps you identify key characteristics of the HVAC systems in your building. The term HVAC systems refers to secondary HVAC systems, including controls, fans, terminal boxes, radiators, coils and package HVAC equipment, not primary HVAC system components such as boilers, chillers, cooling towers and pumps. The characteristics you select determine which requirements apply.

The HVAC System entries enable you to describe the HVAC system features in your building in sufficient detail to exclude large numbers of requirements that do not apply to your systems. The resulting simplification facilitates both designing for compliance with the code and code enforcement.

Round buttons (radio buttons) permit only one selection from each group, square boxes (checkboxes) permit multiple selections from a group of inputs and gray text indicates that the option is unavailable because it is incompatible with other selection(s) that have been made on the current or a previous screen.



When multiple different HVAC systems are used within a single building, you may select the HVAC System button multiple times to enter more than one system. When multiple identical (or nearly identical) systems are used, describe them once and use the quantity field to indicate the number of such systems present.

Note that some of the inputs are interdependent. If you select Heat Pump as the Heating Equipment Type, you will not be able to select a Cooling Equipment Type because it is assumed to be DX (direct expansion). If you select Unit Heater for Heating Equipment Type or Packaged Terminal DX Unit for Cooling Equipment Type, you will not be able to select Multiple Zone A space or group of spaces within a building with any combination of heating, cooling, or lighting requirements sufficiently similar so that desired conditions can be maintained throughout by a single controlling device or check the Perimeter System box under Zoning Category because these equipment types are not compatible.

## **Heating Equipment Type**

Central Furnace - A central furnace is a self-contained, indirect-fired or electrically heated furnace supplying heated air through ducts to spaces. A central furnace can be a stand-alone unit, but is typically integral to a rooftop-DX (direct expansion) system or split DX system air conditioner. Though less common, a central furnace may also contain a hydronic coil that would be used for air conditioning.

Duct Furnace - A duct furnace is a furnace normally installed in distribution ducts of air-conditioning systems to supply warm air. A duct furnace usually does not have its own supply fan and uses air supplied through the ducts by other supply fans such as a fan for a central air conditioner.

Hydronic or Steam Coil - A hydronic coil is an array of tubing, placed in a supply air stream, through which hot or cold water passes, heating or cooling the supply air stream to provide heating or air conditioning to a space. Hydronic coils, central furnaces and DX coils are used in various configurations of heating and air-conditioning systems. A steam coil is an array of tubing, placed in a supply air stream, through which steam passes to provide heat to a space.

Heat Pump - A heat pump is a DX air conditioner with a reversing valve, allowing it to operate in two refrigeration modes. When the refrigeration system is reversed, the heat pump absorbs heat from the outdoor air and rejects it to the indoor environment, providing heat to the space. Heat pumps are manufactured in several configurations, including packaged terminal, rooftop package, split system, water loop and ground coupled.

*Packaged Terminal Unit* - A packaged terminal heat pump (PTHP) is a self-contained heat pump typically installed through a wall. It discharges warm or cool air directly to the space without the use of ducts for distribution.

*Rooftop Packaged Unit* - A rooftop packaged heat pump is also known as a unitary single-packaged heat pump. This unit is a self-contained heat pump, typically installed on the roof of a building using ducts to distribute cool air to the conditioned space. It can be used in single-zone and multiple-zone applications, and can also be equipped with a constant-volume or variable-volume fan. Depending on the cooling capacity and climate, rooftop packaged DX units may be equipped with an air economizer.

*Single Package Vertical Unit* - A factory-installed single package heat pump which may contain cooling components. The unit is intended for exterior mounting on, adjacent interior to, or through, an outside wall. Unit major components are arranged vertically and may contain various ventilation options including ductwork. Its primary heating means shall be reverse cycle refrigeration, with secondary supplemental heating by means of electrical resistance, steam, hot water, or gas.

*Split System* - A split system heat pump is also known as a unitary split system heat pump. It consists of two factory-made assemblies: a condensing unit that uses outside air as the heat sink (during cooling) and heat source (during heating), and an indoor DX coil with integral supply fan. Because the indoor unit is usually located a long distance from outside walls, it is difficult to equip a split system with an air economizer.

*Water Loop Heat Pump* - A water loop heat pump is a heat pump with a refrigerant-to-water heat exchanger. During cooling mode, the heat exchanger serves as the condenser, rejecting heat from the refrigerant to the water. During heating, the heat exchanger serves as the evaporator, absorbing heat from the water. The refrigerant-to-water heat exchanger is typically connected to a circulating water loop that also serves many other water loop heat pumps.

*Other* - Any type of heat pump, which is not described by one of the types listed above, is classified as Other.

Radiant Heater - A radiant heater is a heater that transfers heat to objects and surfaces within the heated space primarily (>50%) by infrared radiation. Radiant heaters can be direct- or indirect-fired with a heating fuel, have electric heating elements, or use hydronic coils or steam coils.

Unit Heater - A unit heater is a self-contained piece of heating equipment that requires connections only to energy sources. Unit heaters are installed in the spaces they are intended to heat and do not use ductwork to distribute heat. They are sometimes controlled in sequence with a separate air conditioner serving the same space. Unit heaters can be direct- or indirect-fired with a heating fuel, have electric heating elements, or use hydronic coils or steam coils.

Other - any other type not represented in the above choices.

## **Cooling Equipment Type**

Field-Assembled DX System - This type is used for DX systems that are not manufactured (and rated) as single packages but rather are assembled at the building site from separately manufactured components. DX stands for direct expansion cooling. In DX cooling equipment, a refrigerant coil is placed directly in the supply air stream. As the refrigerant evaporates and expands, it removes energy, lowering the temperature of the supply air stream.

Hydronic Coil - A hydronic coil is an array of tubing, placed in a supply air stream, through which hot or cold water passes, heating or cooling the supply air stream to provide heating or air conditioning to a space. Hydronic coils, central furnaces and DX coils are used in various configurations of heating and air-conditioning systems.

Packaged Terminal DX Unit - A packaged terminal DX air conditioner (PTAC) is a self-contained air-conditioning unit typically installed through a wall. It discharges cool air directly to the space without the use of ducts for distribution. PTACs are often equipped with electric resistance heating elements and sometimes are equipped with hydronic coils or steam coils for heating.

Rooftop Package DX Unit - A rooftop packaged DX unit is also known as a unitary single-packaged air conditioner. This unit is a self-contained DX air conditioner, typically installed on the roof of a building using ducts to distribute cool air to the conditioned space. It can be used in single-zone or multiple-zone applications, and can also be equipped with a constant-volume or variable-volume fan. These units are often combined, within the same assembly, with a central furnace, hydronic coils, or steam coils. Depending on the cooling capacity and climate, rooftop packaged DX units may often be equipped with an air economizer.

Single Package Vertical AC Unit - A factory-assembled single package to provide cooling with controlled temperature and dehumidification. The unit is intended for exterior mounting on, adjacent interior to, or through, an outside wall. Unit major components are arranged vertically and may contain various ventilation options including ductwork.

Split DX System - A split DX system is also known as a unitary split system air conditioner or split system. It consists of two factory-made assemblies: a condensing unit that uses outside air as the heat sink, and an indoor DX coil with integral supply fan. The indoor unit is often combined, within the same assembly, with a central furnace or hydronic coils or steam coils. Because the indoor unit is usually located a long distance from outside walls, it is difficult to equip a split system with an air economizer.

Other - any other type not represented in the above choices.

### Zoning Category

Single Zone - A single-zone system serves only one thermostatic control zone. The system is usually controlled by a single thermostatic control, and only maintains comfort conditions for the space where the temperature control is located.

Multiple-Zone - A multiple-zone system is designed to meet space-conditioning loads in multiple thermostatic control zones at the same time. Multiple-zone systems usually use a common air distribution system and employ terminal units to vary the flow and temperature of air to meet the differing space-conditioning loads of each zone.

Perimeter System - A perimeter system is designed to offset only envelope heat losses and gains.

### HVAC System COMcheck Inputs

Untitled.cck - COMcheck 4.0.6 Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

HVAC System Plant Water Heating Fan Systems

	Component	System Type	Quantity	Capacity	Cap. Units	Fuel Type/Heat Source	Condenser Type	System Details	Fan System Details	Proposed Efficiency	Eff. Units	Minimum Efficiency
▼ Building												
1	▼ HVAC System 1	HVAC System	1					Single zone system	FAN SYS...			
2	Heating equipment	Duct Furnace	1	7	kBtu/h	Gas				0.00	% Ec	80.00 % Ec
3	Cooling equipment	Single Package DX Unit	1	7	kBtu/h		Water-Coo...			0.00	EER	12.10 EER

Equipment Capacity - Enter the cooling capacity range for the cooling equipment selected and the heating capacity for the heating equipment selected.

Fuel Type/Heat Source - Select the Fuel Type, the Heat Source and provide the Equipment Capacity for the heating equipment. If you select Hydronic or Steam Coil as the Heating Equipment Type, select the Heat Source for this equipment. If you select Central Furnace or Duct Furnace, select the Fuel Type for this equipment. If you select Radiant Heater or Unit Heater, you may choose from either the Fuel Type or Heat Source options.

**Condenser Type** - The condenser of an air conditioner is where refrigerant rejects heat absorbed during the process of cooling indoor spaces. As the refrigerant passes through the heat exchanger it rejects heat to the surrounding fluid, usually air or water. If the equipment is a heat pump, the condenser becomes an evaporator during heating mode. As the refrigerant passes through the heat exchanger, it absorbs heat from the surrounding fluid, causing the refrigerant to change from a liquid to a gas (or evaporate).

*Air Cooled* - An air-cooled condenser is a refrigerant-to-air heat exchanger exposed to outdoor conditions. As refrigerant passes through the coils of the heat exchanger, heat is rejected to outdoor air (during cooling) and absorbed from outdoor air (during heating).

*Evaporatively Cooled* - An evaporatively-cooled condenser is similar to an air-cooled condenser with the exception that during cooling, the heat exchanger is sprayed with water, increasing the heat rejection. Heat pumps and air conditioners equipped with evaporatively cooled condensers are typically more efficient than their air-cooled counterparts.

*Groundwater Coupled* - A groundwater-coupled condenser is similar to a water-cooled condenser except that groundwater will always be the heat source (or sink) for the condenser. As refrigerant passes through the coils of the heat exchanger, heat is rejected to groundwater (during cooling) and absorbed from groundwater (during heating).

## Water Heating System

The Water Heating button enables you to enter the service water heating system(s) in your building. Water heater types allowed are Storage Water Heaters or Instantaneous Water Heaters. Storage Water Heater refers to a water heater that heats and stores water within the water heater for delivery on demand and has an input rating of less than 4,000 Btu/hour per gallon of stored water. Instantaneous Water Heater means a water heater that has an input rating equal to or greater than 4,000 Btu/hour per gallon of stored water.

Component	System Type	Quantity	Capacity	Cap. Units	Fuel Type/ Heat Source	Condenser Type	System Details	Fan System Details	Proposed Efficiency	Eff. Units	Minimum Efficiency
▼ Building											
1	▼ HVAC System 1	HVAC System	1				Single zone system	FAN SYS...			
2	Heating equipment	Duct Furnace	1	7	kBtu/h	Gas			0.00	% Ec	80.00 % Ec
3	Cooling equipment	Single Package DX Unit	1	7	kBtu/h		Water-Coo...		0.00	EER	12.10 EER
4	Plant 1	Heating: Hot Water	1	0	kBtu/h	Select...	Click here...		--	--	--
5	Water Heater 1	Storage Water Heater	1	0	Gallo...	Gas			--	--	--
6	Plant 2	Cooling: Water Chiller	1	0	tons				0.000	KW/...	0.610 KW/...

Service Water Heating

Water Heater Type:

Storage Water Heater

Instantaneous Water Heater

OK Cancel

Where multiple different water heating systems are present within the building, you may select the Water Heating button multiple times to enter more than one system. Where multiple identical (or nearly identical) systems are present, describe them once and use the Quantity field to indicate the number present.



## Service Water Heating COMcheck Inputs

Project												
Envelope		Interior Lighting		Exterior Lighting		Mechanical		Requirements				
HVAC System		Plant		Water Heating		Fan Systems						
	Component	System Type	Quantity	Capacity	Cap. Units	Fuel Type/ Heat Source	Condenser Type	System Details	Fan System Details	Proposed Efficiency	Eff. Units	Minimum Efficiency
▼ Building												
1	▼ HVAC System 1	HVAC System	1					Single zone system	FAN SYS...			
2	Heating equipment	Duct Furnace	1	7	kBtu/h	Gas				0.00	% Ec	80.00 % Ec
3	Cooling equipment	Single Package DX Unit	1	7	kBtu/h		Water-Coo...			0.00	EER	12.10 EER
4	Plant 1	Heating: Hot Water	1	0	kBtu/h	Select...		Click here...		--	--	--
5	Water Heater 1	Storage Water Heater	1	0	Gallo...	Gas				0.000	KW/...	0.610 KW/...
6	Plant 2	Cooling: Water Chiller	1	0	tons							

Equipment Capacity - Equipment Capacity refers to the rated storage volume of the water heater in gallons.

Fuel Type/Heat Source - Fuel Type/Heat Source refers to the principle water heater fuel source. Options shown are Electricity, Natural Gas (including propane) and Oil.

System Details - Checkboxes are provided to allow more details to be noted.

*System Has a Circulation Pump* - A circulation pump is used in a service water heating system served by a continuous water loop. The circulation pump is controlled to circulate hot water from the water heating equipment as necessary to maintain a certain hot water temperature at all times in the circulation loop.

*Heat Trace Tape Installed in the System* - Heat trace tape is tape with embedded electric resistance heating elements. Heat trace tape is adhered to hot water piping. It is energized as necessary to deliver hot water at the desired temperature.

*Heated Swimming Pool System* - If a heated swimming pool exists in the building, this box should be checked.

*Combined Space/SWH System* - Check this box if the same heating equipment is used to serve both hydronic space heating as well as service water heating needs.

*Input Rating* - The Input Rating is the rated fuel input of the water heater in Btu/hour. The rated input is typically shown on the nameplate of the water heater. Inputs are required only for water heaters using gas or oil fuel types.

Service Water Heating Details

System Has a Circulation Pump

Heat Trace Tape Installed in the System

Heated Swimming Pool System

Combined Space/SWH System

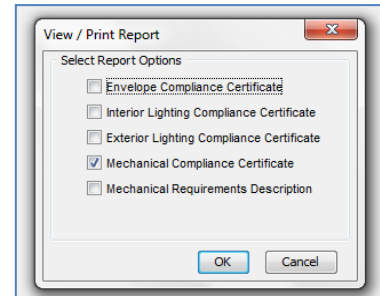
Input Rating (kBtu/h):

Help OK Cancel

## Mechanical Compliance Certificate

Print a Mechanical Compliance Certificate when all HVAC and heating equipment inputs are complete. Click on the File menu and choose View / Print Report.

Check or indicate Not Applicable for every item under Inspection Checklist and sign/date under Compliance Statement and Post Construction Compliance Statement.



## Sample Mechanical Compliance Certificate



**COMcheck Software Version 4.0.6.1**  
**Mechanical Compliance Certificate**

**Project Information**

Energy Code:	90.1 (2013) Standard
Project Title:	Sample Project
Location:	Atlanta, Georgia
Climate Zone:	3a (weather data: TBD)
Project Type:	New Construction

Construction Site:	Owner/Agent:	Designer/Contractor:
1500 Peachtree Atlanta, GA 30309		

**Mechanical Systems List**

Quantity	System Type & Description
1	<b>HVAC System 1 (Single Zone):</b> Heating: 1 each - Duct Furnace, Gas, Capacity = 7 kBtu/h Proposed Efficiency = 90.00% Ec, Required Efficiency = 80.00% Ec Cooling: 1 each - Single Package DX Unit, Capacity = 7 kBtu/h, Water-Cooled Condenser Proposed Efficiency = 15.00 EER, Required Efficiency: 12.10 EER + 12.3 IEER Fan System: FAN SYSTEM 1 - Compliance (Motor nameplate HP method) : Fails: Fan system has no supply fan  <b>Fans:</b> FAN 1 Exhaust, Constant Volume, 150 CFM, 2.0 motor nameplate hp, 1.0 fan efficiency FAN 2 Return, Multi-Zone VAV, 1000 CFM, 3.0 motor nameplate hp, 1.5 fan efficiency
1	<b>Plant 1:</b> Heating: Hot Water Boiler, Capacity 10 kBtu/h, Gas No minimum efficiency requirement applies
1	<b>Plant 2:</b> Cooling: Water Chiller, Capacity 5 tons, Condenser Water-Cooled, Standard Centrifugal Chiller, Heat Rejection Equipment: Propeller or Axial Fan Open-Circuit Cooling Tower Proposed Efficiency: 0.53 kWton-FL (Refer to mech. plans for proposed IPLV), Required Efficiency: 0.610 kWton-FL + 0.550 kWton-IPLV or 0.895 kWton-FL + 0.440 kWton-IPLV
1	<b>Water Heater 1:</b> Gas Storage Water Heater, Capacity: 5 gallons, Input Rating: 75 Btu/h No minimum efficiency requirement applies

**Mechanical Compliance Statement**

Compliance Statement: The proposed mechanical design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 90.1 (2013) Standard requirements in COMcheck Version 4.0.6.1 and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title	Signature	Date
--------------	-----------	------

Project Title: Sample Project	Report date: 06/21/17
Date filename: Untitled.cck	Page 1 of 12

# Appendix D: COMcheck Interior and Exterior Lighting

Use COMcheck to demonstrate that the interior and exterior lighting complies with ASHRAE Standard 90.1-2007.

## Lighting Screens

Use the buttons at the top of the screen to create a list of lighting fixtures present in your proposed design. Each fixture type you select is added to the lighting fixtures list displayed on the screen. For each fixture type, you must enter a ballast type (if applicable), the number of lamps per fixture, quantity and the fixture input wattage. Input wattage is the electrical power input to the lamp and ballast combination.

After entering complete information for each new fixture, the software automatically updates the compliance results once you hit the Enter key or click in another cell. The results are displayed at the bottom of the screen in the compliance box. If TBD (to be determined) is displayed in this field, you most likely have not yet filled in the fixture wattage or quantity for one or more components. To determine which data are missing or invalid, look for fields with white-on-red text. In addition to providing inputs for all white-on-red fields, you must select at least one building use type and its corresponding area on the Project screen before the software can determine compliance.

## Interior Lighting Screen

Untitled.cck - COMcheck 4.0.6 Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Add Fixture Fixture Library

Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage	Track Lighting Wattage
▼ Building	Allowed wattage = 1880 Proposed wattage = 1000							
1 ▼ Gymnasium (2000 sq.ft)	Allowed wattage = 1880 Proposed wattage = 1000							
2 LED 1			LED MR 3.2W		4	6	100	
3 Incandescent 1			LED MR		2W	3	50.0	
4 Compact Fluorescer			LED PAR		3.2W	3	50.0	
5 Linear Fluorescent 1			LED A Lamp		3.9W	2	50.0	
			LED Linear		4W			
			LED Panel		6W			
			LED Undercabinet Unit		7W			
			LED Roadway-Parking Unit		8W			
			LED Other Fixture Unit		10W			
			Other					

## Exterior Lighting Screen

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Add Fixture Fixture Library

Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage	Track Lighting Wattage
▼ Exterior Lighting Areas:	Invalid number of fixtures							
1 ▼ 1000 (Parking area 1 ft2)	Invalid number of fixtures							
2 LED 1			LED MR 4W		4	0	0	
3 100 (Main entry 1 ft of door wid		Tradable Wattage: Allowed = 20	LED MR		2W			
4 50 (Other door (not main entry		Tradable Wattage: Allowed = 60	LED PAR		3.2W			
			LED A Lamp		3.9W			
			LED Linear		4W			
			LED Panel		6W			
			LED Undercabinet Unit		7W			
			LED Roadway-Parking Unit		8W			
			LED Other Fixture Unit		10W			
			Other					

## Lighting Screen Inputs

Untitled.cck - COMcheck 4.0.6 Code: 90.1 (2013) Standard

File Edit View Options Code Help

Project Envelope Interior Lighting Exterior Lighting Mechanical Requirements

Add Fixture Fixture Library

	Component	Fixture ID	Fixture Description	Lamp Description/ Wattage Per Lamp	Ballast	Lamps Per Fixture	Number of Fixtures	Fixture Wattage	Track Lighting Wattage
	▼ Exterior Lighting Areas:	Tradable Wattage: Allowed = 90 Proposed = 1050 Supplemental wattage: 1300 (see Help for details)							
1	▼ 1000 ( Parking area 1 ft2)	Tradable Wattage: Allowed = 0 Proposed = 1050							
2	LED 1			LED MR 2W		1	5	75	
3	Halogen 1			Halogen 55W		3	4	75.0	
4	Compact Fluorescent 1			Twin Tube 5W	Magnetic	2	5	75.0	
5	20 ( Main entry 1 ft of door width)	Tradable Wattage: Allowed = 30 Proposed = 0							
6	10 ( Other door (not main entry)	Tradable Wattage: Allowed = 60 Proposed = 0							

**Fixture ID** - The Fixture ID field shows the fixture ID you have entered. You can associate the fixture with a fixture type designation used on the lighting fixture schedule and elsewhere in the construction documents; e.g., F1 for fixture type 1. Fixture ID is an optional field that you may leave blank, but it is recommended as it enables fixtures to be clearly defined.

**Fixture Description** - The Fixture Description field is for descriptions of fixtures that you enter. Fixture Description is an optional field that you may leave blank. However, fixture descriptions can help you keep track of the fixtures in the list, avoid errors and oversights and facilitate plan review and inspections because this information is included on the compliance certificate. Fixture descriptions may include manufacturer and part number, dimensions (e.g., 2x4), mounting type (e.g., recessed, surface, suspended) or other distinguishing characteristics.

**Lamp Description/Wattage Per Lamp** - Click the left mouse button in the Lamp Description/Wattage Per Lamp field to select from a drop-down list of available lamp types. The drop-down list contains the most commonly used lamp and ballast combinations. Select Other if the lamp type you intend to use does not match one of the listed types.

**Ballast** - The ballast type is entered by selecting from a drop-down list. (Incandescent and halogen fixtures do not require a ballast entry.) Available ballast types are magnetic, electronic, premium efficiency, standard and pulse start. The following definitions have been used in determining default input wattages. You should use these definitions in describing the ballast type in the fixtures you intend to use.

*Magnetic* - applies to CFL and linear fluorescent; the standard CFL or linear fluorescent ballast that incorporates large inductive components and operates around 60 Hz.

*Electronic* - applies to CFL and linear fluorescent; a CFL or linear fluorescent ballast comprised of electronic and semiconductor components with only very small inductive components that operates at high frequencies in the 20-40 Hz range.

*Premium Efficiency* - applies to 4 foot T8 linear fluorescent; a linear 4-foot T8 instant-start, programmed-start, or dimmable NEMA BL2 rated high frequency electronic ballast that exhibits high efficiency in the 88-96 lumen/watt range.

*Standard* - applies to all HID High intensity discharge. Generic term describing mercury vapor, metal halide, high pressure sodium and (informally) low pressure sodium light sources and

luminaires; a standard High Intensity Discharge (HID) ballast not incorporating Pulse-start technology.

*Pulse Start* - applies to Metal Halide (MH) and Ceramic Metal Halide (CMH); a ballast that uses an igniter in place of an additional probe for starting an MH or CMH lamp.

Lamps Per Fixture - Enter the number of lamps per fixture.

Number of Fixtures - Enter the number of fixtures.

Fixture Wattage - Enter the fixture wattage.

You can enter the fixture wattage directly or have the software provide a typical wattage for that fixture. To input a typical wattage, click in the cell and then click the right mouse button in the Fixture Wattage field to display the pop-up context menu. The software will provide a typical input wattage for the fixture. Not all possible lamp and ballast combinations are included-only those for which adequate data were available. If the Use Default option is gray, a typical wattage is not available. Input wattage is the related electrical power input to the lamp and ballast combination.

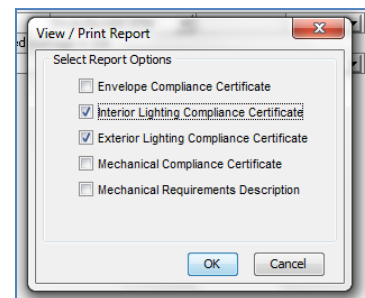
You may either use the typical input wattage provided by the software or override it with a value based on the equipment you intend to install. In either case, you should be prepared to provide supporting documentation based on manufacturer's literature to the building department.

Track Lighting Wattage - Select the criteria and provide associated inputs.

### **Interior and Exterior Lighting Compliance Certificates**

Print Lighting Compliance Certificates when lighting is entered and inputs are complete. Click on the File menu and choose View / Print Report.

Check or indicate Not Applicable for every item under Inspection Checklist and sign/date under Compliance Statement and Post Construction Compliance Statement.



## Sample Interior Lighting Compliance Certificate



COMcheck Software Version 4.0.6.1

# Interior Lighting Compliance Certificate

### Project Information

Energy Code: 90.1 (2013) Standard  
 Project Title: Sample Project  
 Project Type: New Construction

Construction Site: 1660 Peachtree Atlanta, GA 30309  
 Owner/Agent:  
 Designer/Contractor:

### Allowed Interior Lighting Power

A Area Category	B Floor Area (ft <sup>2</sup> )	C Allowed Watts / ft <sup>2</sup>	D Allowed Watts (B X C)
1-Gymnasium	2000	0.94	1880
Total Allowed Watts =			1880

### Proposed Interior Lighting Power

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
<u>1-Gymnasium</u>				
LED 1: LED MR 3.2W:	4	6	100	600
Incandescent 1: Incandescent 25W:	3	3	50	150
Compact Fluorescent 1: Reflector 26W: Magnetic:	3	3	50	150
Linear Fluorescent 1: 72" T8 HO 65W: Electronic:	4	2	50	100
Total Proposed Watts =				1000

**Interior Lighting PASSES: Design 47% better than code**

### Interior Lighting Compliance Statement

*Compliance Statement:* The proposed interior lighting design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed interior lighting systems have been designed to meet the 90.1 (2013) Standard requirements in COMcheck Version 4.0.6.1 and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title

Signature

Date

# Certificate Sample Exterior Lighting Compliance



COMcheck Software Version 4.0.6.1

## Exterior Lighting Compliance Certificate

### Project Information

Energy Code: 90.1 (2013) Standard  
 Project Title: Sample Project  
 Project Type: New Construction  
 Exterior Lighting Zone: 4 (High activity metropolitan commercial district)

Construction Site: 1660 Peachtree Atlanta, GA 30309  
 Owner/Agent:  
 Designer/Contractor:

### Allowed Exterior Lighting Power

A Area/Surface Category	B Quantity	C Allowed Watts / Unit	D Tradable Wattage	E Allowed Watts (B X C)
1000 (Parking area)	100	0.13	Yes	0
20 (Main entry)	1 ft of door	30	Yes	30
10 (Other door (not main entry))	3 ft of door	20	Yes	60

Total Tradable Watts (a) = 90  
 Total Allowed Watts = 90  
 Total Allowed Supplemental Watts (b) = 1300

(a) Wattage tradeoffs are only allowed between tradable areas/surfaces.  
 (b) A supplemental allowance equal to 1300 watts may be applied toward compliance of both non-tradable and tradable areas/surfaces.

### Proposed Exterior Lighting Power

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
<b>1000 ( Parking area 100): Tradable Wattage</b>				
LED 1: LED Panel 19W:	1	5	20	100
Compact Fluorescent 1: Twin Tube 5W, Magnetic:	2	5	75	375
LED 2: LED MR 2W:	2	5	30	150
<b>20 ( Main entry 1 ft of door width): Tradable Wattage</b>				
LED 3: LED MR 10W:	2	5	50	250
<b>10 ( Other door (not main entry) 3 ft of door width): Tradable Wattage</b>				
LED 4: LED MR 4W:	1	5	60	300
Total Tradable Proposed Watts =				1175

**Exterior Lighting PASSES: Design 16% better than code**

### Exterior Lighting Compliance Statement

Compliance Statement: The proposed exterior lighting design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed exterior lighting systems have been designed to meet the 90.1 (2013) Standard requirements in COMcheck Version 4.0.6.1 and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title \_\_\_\_\_ Signature \_\_\_\_\_ Date \_\_\_\_\_

Project Title: Sample Project  
 Data filename: Untitled.cck

Report date: 06/21/17  
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## Appendix E: Prescriptive Outside Air Requirements

Projects using the prescriptive approach to outside air requirements must introduce outside air based on space type and square footage. The table below lists outside air CFM requirements per space type.

### Prescriptive Outside Air Requirements

Space Type	cfm/sf
<b>Educational Facilities</b>	
Daycare (through age 4)	0.43
Daycare sickroom	0.43
Classrooms (ages 5–8)	0.38
Classrooms (age 9 plus)	0.46
Lecture classroom	0.52
Lecture hall (fixed seats)	1.20
Art classroom	0.38
Science laboratories	0.43
University/college laboratories	0.43
Wood/metal shop	0.38
Computer lab	0.38
Media center	0.38
Music/theater/dance	0.42
Multi-use assembly	0.80
<b>Food and Beverage Service</b>	
Restaurant dining rooms	0.70
Cafeteria/fast-food dining	0.90
Bars, cocktail lounges	0.90
<b>General</b>	
Break rooms	0.25
Coffee stations	0.22
Conference/meeting	0.30
Corridors	0.06
Storage rooms	0.12
<b>Miscellaneous Spaces</b>	
Bank vaults/safe deposit	0.09
Computer (not printing)	0.08
Electrical equipment rooms	0.06
Elevator machine rooms	0.12
Pharmacy (prep. area)	0.23
Photo studios	0.17
Shipping/receiving	0.12
Transportation waiting	0.80
Warehouses	0.06

Space Type	cfm/sf
<b>Office Buildings</b>	
Office space	0.09
Reception areas	0.21
Telephone/data entry	0.36
Main entry lobbies	0.11
<b>Public Assembly Spaces</b>	
Auditorium seating area	0.75
Places of religious worship	0.72
Courtrooms	0.42
Legislative chambers	0.3
Libraries	0.17
Lobbies	0.75
Museums (children's)	0.44
Museums/galleries	0.36
<b>Retail</b>	
Sales (except as below)	0.24
Mall common areas	0.36
Barbershop	0.25
Beauty and nail salons	0.625
Pet shops (animal areas)	0.26
Supermarket	0.12
Coin-operated laundries	0.22
<b>Sports and Entertainment</b>	
Sports arena (play area)	0.30
Gym, stadium (play area)	0.30
Spectator areas	1.20
Swimming (pool & deck)	0.48
Disco/dance floors	2.10
Health club/aerobics room	0.88
Health club/weight rooms	0.26
Bowling alley (seating)	0.52
Gambling casinos	1.08
Game arcades	0.34
Stages, studios	0.77