COMMERCIAL ENERGY CODE
DIFFERENCES BETWEEN
2015 IECC & ASHRAE 90.1 -2013

Presented by Southface: Mike Barcik

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=> Education => Our Courses => Energy Code => GA Energy Code

ABOUT SOUTHFACE

Building a Regenerative Economy, Responsible Resource Use & Social Equity Through a Healthy Built Environment for All
LEARNING OBJECTIVES

- Understand the major differences between IECC 2015 and ASHRAE 90.1-2013 in commercial buildings

- Apply design and construction strategies in building projects to comply with ASHRAE 90.1-2013 / IECC 2015

- Appreciate COMcheck software and its application in helping show compliance with either code
SIMILAR SCOPE FOR COMMERCIAL CODES

IECC 2015 Commercial
C1 – Scope and Admin
C2 – Definitions
C3 – General Requirements
C4 – Comm. Energy Efficiency
  • Building Envelope Requirements
  • Building Mechanical Systems
  • Service Water Heating
  • Lighting
  • Total Building Performance
C5 – Referenced Standards

ASHRAE 90.1-2013
• Section 1-4 – General
• Section 5 – Building Envelope
• Section 6 – HVAC
• Section 7 – Water Heating
• Section 8-9 – Power & Lighting
• Section 10 – Other Equipment
• Section 11 – Energy Cost Budget Method

ROAD MAP OF COMPLIANCE PATHWAYS

Mandatory Requirements
Envelope, Lighting, & Mechanical Requirements
Prescriptive charts (IECC 2015 Comm.) or (ASHRAE 90.1-2013)
Simple Tradeoff COMcheck for either code
Building Simulation (IECC 2015 TBP) or ECB from (ASHRAE 90.1-2013)
Plan Review and Field Inspection
**APPLYING THE CODE – 90.1**

**Conditioned space**
- Cooled (>5 Btu/hr-ft²)
- Heated (>10 Btu/hr-ft² for CZ3)
- Indirectly Conditioned (essentially, reasonably connected to a conditioned space)

**Semi-heated space**
- for CZ3, heated by system supplying between 3.4 and 10 Btu/h-ft² (e.g., warehouse with freeze protection)

**Unconditioned space**
- neither of the above (e.g., crawlspaces, attics, parking garages)

- **ASHRAE space categories** (3 columns in tables)
  - *Nonresidential* – most commercial buildings
  - *Residential* – hotels, dorms, multifamily buildings over 3 stories
  - *Semiheated* – minimal space heating (e.g., freeze protection)

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**APPLYING THE CODE - IECC**

**Conditioned space**
- An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent conditioned space.

**Low energy buildings** (exempt from code)
- Design rate energy use less than 3.4 btu/h per ft² or 1.0 watt/ft²
- Buildings that do not contain conditioned space
- Greenhouses

- **IECC Building categories** (2 columns in tables)
  - *Nonresidential “All Other”* – most commercial buildings
  - *Residential “Group R”* – hotels, dorms, multifamily buildings over 3 stories

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GA AMENDMENT TO IECC

SECTION C202 GENERAL DEFINITIONS

*Delete definition of ‘CONDITIONED SPACE’ and substitute the following:

SPACE. An enclosed space within a building. The classifications of spaces are as follows for the purpose of determining building envelope requirements:

(a) Conditioned space: a cooled space, heated space, or indirectly conditioned space is defined as follows:
   (1) Cooled space: an enclosed space within a building that is cooled by a cooling system whose sensible output capacity exceeds 5 Btuh ft² of floor area.
   (2) Heated space: an enclosed space within a building that is heated by a heating system whose output capacity relative to the floor area is greater than or equal to 5 Btuh ft².
   (3) Indirectly conditioned space: an enclosed space within a building that is not a heated space or a cooled space, containing un-insulated ducts, or containing the heating equipment or which is heated or cooled indirectly by being connected to adjacent space(s), provided that air from heated or cooled spaces is transferred (naturally or mechanically) into the space. Unvented Attic Assemblies meeting the requirements of the IRC are an approved indirectly conditioned space.

(b) Semi-heated space: an enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btuh ft² of floor area but is not a conditioned space.

(c) Unconditioned space: an enclosed space within a building that is not a conditioned space or a semi-heated space. Crawls, spaces, attics, and parking garages with natural or mechanical ventilation are not considered enclosed spaces.

(Effective January 1, 2020)

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90.1 SECTION 2: SCOPE

Scope
New buildings and their systems
New portions of buildings and their systems
New systems and equipment in existing buildings

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ALTERATIONS

- Alterations shall comply with 90.1 (eight exceptions)

 alteration: a replacement or addition to a building or its systems and equipment, routine maintenance, repair, and service or a change in the building’s use classification or category shall not constitute an alteration.

C401.2.1 Application to replacement fenestration products. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC in Table C402.3.

Exception: An area-weighted average of the U-factor of replacement fenestration products being installed in the building for each fenestration product category listed in Table C402.3 shall be permitted to satisfy the U-factor requirements for each fenestration product category listed in Table C402.3. Individual fenestration products from different product categories listed in Table C402.3 shall not be combined in calculating the area-weighted average U-factor.

Exceptions: The following alterations need not comply with these requirements, provided such alterations will not increase the energy usage of the building:

1. Installation of storm windows or glazing panels over existing glazing, provided the storm window or glazing panel contains a low-emissivity coating. However, a low-emissivity coating is not required where the existing glazing already has a low-emissivity coating. Installation is permitted to be either on the inside or outside of the existing glazing.
2. Replacement of glazing in existing sash and frame, provided the U-factor and SHGC will be equal to or lower than before the glass replacement.
3. Alterations to roof/ceiling, wall, or floor cavities that are insulated to full depth with insulation having a minimum nominal value of R-3.0/ft.
4. Alterations to walls and floors, where the existing structure is without framing cavities and no new framing cavities are created.
5. Roof recovering.
6. Removal and replacement of a roof membrane where there is existing roof insulation integral to or below the roof deck.
7. Replacement of existing doors that separate a conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided that an existing vestibule that separates a conditioned space from the exterior shall not be removed.
8. Replacement of existing fenestration, provided that the area of the replacement fenestration does not exceed 25% of the total fenestration area of an existing building and that the U-factor and SHGC will be equal to or lower than before the fenestration replacement.
BUILDING ENVELOPE REQUIREMENTS

Compliance Paths – (choose one)
IECC 2015 – Commercial Section 402
ASHRAE 90.1-2013 – Section 5

Main Elements
Insulation
Fenestration
Air Leakage

IECC / ASHRAE 90.1 CLIMATE ZONES

Note: GA is Climate Zone (CZ) 2A, 3A and 4A
ENVELOPE KEY CONCEPTS

- R-values are for components, U-factors for assemblies
- Buildings limited to 30%/40% Glass to Wall area (prescriptive)
- Daylighting “required” for some spaces

Metal Buildings
- Walls: R-9.8 c.i. (ASHRAE)
  Or, R-13+R-6.5 c.i. (IECC)
- Roof: R-10+R-19 FC;
  Min. R-3.5 thermal spacer block (ASHRAE)
  Or, R-19+R-11 LS (IECC)

METAL BUILDING ROOFS

ENERGY SAVER FP R-VALUES

ROOF SYSTEM R-VALUES (Pre-installed)

Single Layer Systems
- R-19 6" Single Layer
- R-25 8" Single Layer
- R-30 9 ½" Single Layer

Double Layer Systems
- R-20 6" Double Layer (R-10 + R-10)
- R-26 8" Double Layer (R-13 + R-13)
- R-30 9 ½" Double Layer (R-19 + R-11)
- R-32 10" Double Layer (R-19 + R-13)
- R-35 11" Double Layer (R-25 + R-10)
- R-36 11 ½" Double Layer (R-25 + R-11)
- R-38 12" Double Layer (R-25 + R-13)
- R-40 12" Double Layer (R-30 + R-10)
BUILDING ENVELOPE

Important Appendices

Appendix A: Rated R-value of Insulation and Assembly U-, C-, and F-factor Determinations

TABLE A2.3.3 Assembly U-Factors for Metal Building Roofs

<table>
<thead>
<tr>
<th>Insulation System</th>
<th>Rated R-Value of Insulation</th>
<th>Overall U-Factor for Entire Base Roof Assembly</th>
<th>Overall U-Factor for Assembly of Base Roof Plus Continuous Insulation (Uninterrupted by Framing)</th>
<th>Rated R-Value of Continuous Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing Seam Roofs with Thermal Spacer Blocks*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.280</td>
<td>0.137</td>
<td>0.951</td>
<td>0.073</td>
</tr>
<tr>
<td>R-10</td>
<td>1.115</td>
<td>0.066</td>
<td>0.546</td>
<td>0.461</td>
</tr>
<tr>
<td>R-11</td>
<td>1.070</td>
<td>0.063</td>
<td>0.525</td>
<td>0.435</td>
</tr>
<tr>
<td>R-13</td>
<td>1.010</td>
<td>0.061</td>
<td>0.515</td>
<td>0.424</td>
</tr>
<tr>
<td>R-16</td>
<td>0.965</td>
<td>0.059</td>
<td>0.494</td>
<td>0.403</td>
</tr>
<tr>
<td>R-19</td>
<td>0.922</td>
<td>0.053</td>
<td>0.454</td>
<td>0.366</td>
</tr>
<tr>
<td>R-10 + R-10</td>
<td>0.885</td>
<td>0.056</td>
<td>0.447</td>
<td>0.401</td>
</tr>
<tr>
<td>R-10 + R-11</td>
<td>0.886</td>
<td>0.055</td>
<td>0.447</td>
<td>0.401</td>
</tr>
<tr>
<td>R-11 + R-11</td>
<td>0.886</td>
<td>0.055</td>
<td>0.436</td>
<td>0.394</td>
</tr>
</tbody>
</table>

Metal Framing (Thermal Bridging) Effects

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Air Film</td>
<td>1-inch Exterior foam sheathing (R-3.8) with Stucco</td>
<td>2 x 4 Metal Studs with R-13 in the Cavity</td>
<td>1/2 in. Gypsum Board</td>
<td></td>
</tr>
</tbody>
</table>

Inside Air Film

TABLE A9.2B Effective Insulation/Framing Layer R-Values for Wall Insulation Installed Between Steel Framing

<table>
<thead>
<tr>
<th>Nominal Depth of Cavity, in.</th>
<th>Actual Depth of Cavity, in.</th>
<th>Rated R-Value of Airspace on Insulation</th>
<th>Effective Framing/Cavity R-Value at 16 in. on Center</th>
<th>Effective Framing/Cavity R-Value at 24 in. on Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Cavity, No Insulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3.5</td>
<td>R-0.91</td>
<td>0.79</td>
<td>0.91</td>
</tr>
<tr>
<td>Insulated Cavity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3.5</td>
<td>R-11</td>
<td>5.5</td>
<td>6.6</td>
</tr>
<tr>
<td>4</td>
<td>3.5</td>
<td>R-13</td>
<td>6.0</td>
<td>7.2</td>
</tr>
<tr>
<td>4</td>
<td>3.5</td>
<td>R-15</td>
<td>6.4</td>
<td>7.8</td>
</tr>
</tbody>
</table>
BUILDING ENVELOPE

General

Space-Conditioning Categories:

• Nonresidential conditioned space (90.1)
• Commercial conditioned space (IECC)

“All occupancies other than residential”

BUILDING ENVELOPE

General

Space-Conditioning Categories

• Residential conditioned space (90.1)
• Group R conditioned space (IECC)

residential: spaces in buildings used primarily for living and sleeping. Residential spaces include, but are not limited to, dwelling units, hotels, motels, guest rooms, dormitories, nursing homes, patient rooms in hospitals, lodges, houses, fraternity/ sorority houses, hostels, prisons, and fire stations.

IECC Residential (Group R) - places providing accommodations for overnight stay (excluding institutional). Examples: houses, apartment buildings, hotels, and motels.
SECTION 5: BUILDING ENVELOPE
(ASHRAE 90.1 ONLY)

5.1 - General
Space-Conditioning Categories

- Semiheated space (ASHRAE Only)
  
  "an enclosed space within a building that is heated by a heating system
  whose output capacity is greater than or equal to 3.4 Btu/h·ft² of floor area
  but is not a conditioned space."

  “In climate zones 3 through 8, a space may be designated as either
  semiheated or unconditioned only if approved by the building official.”

SECTION 5.4: MANDATORY ENVELOPE

5.4 - Mandatory Provisions

Insulation
Glazed Fenestration and Doors
Air Leakage
SECTION 5.4: BUILDING ENVELOPE

5.4.1 Mandatory Provisions

Insulation (details 5.8.1)

- Labeling of envelope insulation
- Install in compliance with manufacturer’s requirements (exception for metal buildings)
- Insulation in substantial contact with air barrier
- Extent of insulation – full component area
- No loose-fill insulation in attic when ceiling is more than 3:12 slope (baffles at eave vents)
- Recessed equipment – effect on insulation
- Insulation protected from sun, moisture, landscapers, access & maintenance, and wind
- Stagger joints of multilayered rigid insulation

90.1-2013: PRESCRIPTIVE CHART – CZ3
### 90.1-2013: PRESCRIPTIVE CHART – CZ2

<table>
<thead>
<tr>
<th>Opaque Elements</th>
<th>Nonresidential</th>
<th>Residential</th>
<th>Semihated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roofs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Entirely above Deck</td>
<td>U-0.039</td>
<td>R-25 c.f.</td>
<td>U-0.039</td>
</tr>
<tr>
<td>Metal Building</td>
<td>U-0.081</td>
<td>R-10 + R-19 FC</td>
<td>U-0.081</td>
</tr>
<tr>
<td>Arctic and Other</td>
<td>U-0.027</td>
<td>R-30</td>
<td>U-0.027</td>
</tr>
<tr>
<td><strong>Walls, above Grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>U-0.156</td>
<td>R-0.71 c.f.</td>
<td>U-0.123</td>
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<tr>
<td>Metal Building</td>
<td>U-0.094</td>
<td>R-0.98 c.f.</td>
<td>U-0.094</td>
</tr>
<tr>
<td>Steel Framed</td>
<td>U-0.084</td>
<td>R-13 + R-3.8 c.f.</td>
<td>U-0.064</td>
</tr>
<tr>
<td>Wood Framed and Other</td>
<td>U-0.089</td>
<td>R-13</td>
<td>U-0.089</td>
</tr>
<tr>
<td><strong>Wall, Below Grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below Grade Wall</td>
<td>C-1.140</td>
<td>NR</td>
<td>C-1.140</td>
</tr>
<tr>
<td><strong>Floors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>U-0.107</td>
<td>R-6.3 c.f.</td>
<td>U-0.087</td>
</tr>
<tr>
<td>Steel Joint</td>
<td>U-0.038</td>
<td>R-30</td>
<td>U-0.038</td>
</tr>
<tr>
<td>Wood Framed and Other</td>
<td>U-0.033</td>
<td>R-30</td>
<td>U-0.033</td>
</tr>
<tr>
<td><strong>Slab-on-Grade Floors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unheated</td>
<td>F-0.730</td>
<td>NR</td>
<td>F-0.730</td>
</tr>
<tr>
<td>Heated</td>
<td>F-0.900</td>
<td>R-15 for 24 in.</td>
<td>F-0.860</td>
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<tr>
<td><strong>Opaque Doors</strong></td>
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<td></td>
</tr>
<tr>
<td>Swinging</td>
<td>U-0.700</td>
<td>U-0.500</td>
<td>U-0.700</td>
</tr>
<tr>
<td>Nonswinging</td>
<td>U-0.700</td>
<td>U-0.500</td>
<td>U-0.700</td>
</tr>
</tbody>
</table>

### 90.1-2013: PRESCRIPTIVE CHART – CZ4

<table>
<thead>
<tr>
<th>Opaque Elements</th>
<th>Nonresidential</th>
<th>Residential</th>
<th>Semihated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roofs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Entirely above Deck</td>
<td>U-0.032</td>
<td>R-30 c.f.</td>
<td>U-0.032</td>
</tr>
<tr>
<td>Metal Building</td>
<td>U-0.087</td>
<td>R-19 + R-11.1 c.f.</td>
<td>U-0.087</td>
</tr>
<tr>
<td>Arctic and Other</td>
<td>U-0.021</td>
<td>R-49</td>
<td>U-0.021</td>
</tr>
<tr>
<td><strong>Walls, above Grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>U-0.104</td>
<td>R-0.95 c.f.</td>
<td>U-0.090</td>
</tr>
<tr>
<td>Metal Building</td>
<td>U-0.060</td>
<td>R-0.9 + R-15.8 c.f.</td>
<td>U-0.050</td>
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<tr>
<td>Steel Framed</td>
<td>U-0.064</td>
<td>R-13 + R-7.5 c.f.</td>
<td>U-0.064</td>
</tr>
<tr>
<td>Wood Framed and Other</td>
<td>U-0.064</td>
<td>R-15 + R-3.8 c.f.</td>
<td>U-0.064</td>
</tr>
<tr>
<td><strong>Wall, Below Grade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below Grade Wall</td>
<td>C-0.119</td>
<td>R-7.5 c.f.</td>
<td>C-0.092</td>
</tr>
<tr>
<td><strong>Floors</strong></td>
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</tr>
<tr>
<td>Mass</td>
<td>U-0.067</td>
<td>R-14.6 c.f.</td>
<td>U-0.051</td>
</tr>
<tr>
<td>Steel Joint</td>
<td>U-0.038</td>
<td>R-30</td>
<td>U-0.038</td>
</tr>
<tr>
<td>Wood Framed and Other</td>
<td>U-0.033</td>
<td>R-30</td>
<td>U-0.033</td>
</tr>
<tr>
<td><strong>Slab-on-Grade Floors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unheated</td>
<td>F-0.520</td>
<td>R-15 for 24 in.</td>
<td>F-0.520</td>
</tr>
<tr>
<td>Heated</td>
<td>F-0.683</td>
<td>R-20 for 24 in.</td>
<td>F-0.683</td>
</tr>
<tr>
<td><strong>Opaque Doors</strong></td>
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<td></td>
</tr>
<tr>
<td>Swinging</td>
<td>U-0.700</td>
<td>U-0.500</td>
<td>U-0.700</td>
</tr>
<tr>
<td>Nonswinging</td>
<td>U-0.700</td>
<td>U-0.500</td>
<td>U-0.700</td>
</tr>
</tbody>
</table>
**Unacceptable Design:**

- Batts over suspended ceiling tiles
  - Poor pressure boundary caused by tile grid, porous tiles, lighting vent holes
  - Poor durability - maintenance disrupts batts, exposure to fiberglass dust
  - Many thermal breaks due to ductwork, light fixtures, grid, and support wires

**Note:** Both codes ban insulation on top of suspended ceiling (90.1 section 5.8.1.8; IECC section C402.2.2)
BUILDING ENVELOPE EXAMPLE: ROOFS

▪ Unacceptable Design: Batts over suspended ceiling tiles

▪ Okay Design:
  Insulation above hard ceiling
  - Example: taped gypsum; similar to residential construction
  - Ductwork is inside but must limit and seal HVAC, plumbing, and electrical penetrations through pressure boundary
  - Thermal bridging from metal roof trusses
BUILDING ENVELOPE EXAMPLE: ROOFS

- Very Good Design:
  - Spray foam insulation against underside of roof deck
  - Minimal thermal breaks and continuous pressure boundary
  - HVAC equipment and ductwork located within conditioned space
  - Good durability
  - Retrofit option

BUILDING ENVELOPE EXAMPLE: ROOFS

Retrofit Option:
- Sprayed foam against underside of roof deck
- Preschool installed new lighting and R-20 foam along roofline
- Load reduced from 12 tons to 8
BUILDING ENVELOPE EXAMPLE: ROOFS

- **Best Design:**
  - Rigid insulation above roof deck
  - No thermal breaks and continuous pressure boundary
  - HVAC equipment and ductwork located within conditioned space
  - Good durability

REFLECTIVE ROOF REQUIREMENT

Reflective roofs are now required in CZ 1-3 or else R-value must be increased from R-25 to R-33

---

**Table 5.5.3.1.1 Increased Roof Insulation Levels**

<table>
<thead>
<tr>
<th>Opaque Elements</th>
<th>Assembly Maximum</th>
<th>Insulation Min. R-Value</th>
<th>Assembly Maximum</th>
<th>Insulation Min. R-Value</th>
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</thead>
<tbody>
<tr>
<td>Insulation entirely above deck</td>
<td>U-0.030</td>
<td>R-33</td>
<td>U-0.029</td>
<td>R-34</td>
</tr>
<tr>
<td>Metal buildings</td>
<td>U-0.028</td>
<td>R-35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Atlanta 1972**

**Atlanta 1993**
SECTION 5.5.3.1.1:
REFLECTIVE ROOF EXCEPTIONS
Cool Roofs required in CZ 1-3

5.5.3.1.1 Roof Solar Reflectance and Thermal Emissivity. Roofs in Climate Zones 1 through 3 shall have one of the following:
   a. A minimum three-year aged solar reflectance of 0.55 and a minimum three-year aged thermal emissivity of 0.75 when tested in accordance with CRRC-1 Standard
   b. A minimum Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 Btu/h·ft²·°F, based on three-year aged solar reflectance and three-year aged thermal emissivity tested in accordance with CRRC-1 Standard
   c. Increased roof insulation levels found in Table 5.5.3.1.1

- 3 yr reflectance of ≥ 0.55 and 3 yr thermal emittance ≥ 0.75
- SRI ≥ 64
- R-33-35

IECC 402.3 REFLECTIVE ROOFS
Cool Roofs required in CZ 1-3

C402.3.1.1 Aged roof solar reflectance. Where an aged solar reflectance required by Section C402.3.3 is not available, it shall be determined in accordance with Equation 4-3.

\[ R_{aged} = 0.2 + 0.7(R_{initial} - 0.2) \]  

where:
- \( R_{aged} \) = The aged solar reflectance.
- \( R_{initial} \) = The initial solar reflectance determined in accordance with CRRC-1.
SECTION 5.5: BUILDING FENESTRATION

5.5.4 - Prescriptive

Fenestration

- Vertical Glazing ≤ 40 (< 30% for IECC)
- Skylights ≤ 3-6% of roof
- Daylighting is “required”

% Glazing Example

% Glazing = Fenestration Area / Gross Wall Area

What is the % Glazing for a 100’×150’ building with 20’ high walls and 3,000 sq ft of windows and glass doors?
FENESTRATION U-FACTOR & SHGC

Lower **U-factor** = Better insulated \((U = 1/R)\)

U-factor applies to:
- Windows
- Skylights
- Doors

Solar Heat Gain Coefficient

- **Single Pane**
  - \(U = 1.05\)

- **Double Pane**
  - \(U = 0.55\)

- **Triple Pane**
  - \(U = 0.35\)

- **SP clear glass**
  - SHGC: 0.8

- **DP clear glass**
  - SHGC: ~ 0.6-0.7

- **DP low-e**
  - SHGC: < 0.2-0.4

FENESTRATION & DOORS

Energy Performance of Glazing

Fenestration Terminology

- **U-Factor**
- **Solar Heat Gain Coefficient (SHGC)**
- **Air Leakage**
- **Visible Light Trasmittance (VLT)**

- Okay to use weighted average for U-factor and SHGC as long as for a common class of construction or space-conditioning category
SECTION 5.4.2: FENESTRATION & DOORS

5.8.2 - Mandatory Provisions

Fenestrations and Doors

- Rating, Labeling, & Determination of Fenestration Products: U-factor, SHGC, air leakage, VLT
SECTION 5.5.4.4.1: OVERHANGS

Projection Factor (PF) and SHGC

PF = Ratio of overhang projection divided by height from window sill to bottom of overhang (must be permanent)

![Diagram of Projection Factor (PF) and SHGC]

| PF = A/B |

| B |

| A |

TABLE 5.5.4.4.1 SHGC Multipliers for Permanent Projections

<table>
<thead>
<tr>
<th>Projection Factor</th>
<th>SHGC Multiplier (All Other Orientations)</th>
<th>SHGC Multiplier (North-Oriented)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 – 0.09</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;0.10 – 0.20</td>
<td>0.91</td>
<td>0.95</td>
</tr>
<tr>
<td>&gt;0.20 – 0.30</td>
<td>0.92</td>
<td>0.91</td>
</tr>
<tr>
<td>&gt;0.30 – 0.40</td>
<td>0.74</td>
<td>0.87</td>
</tr>
<tr>
<td>&gt;0.40 – 0.50</td>
<td>0.67</td>
<td>0.84</td>
</tr>
<tr>
<td>&gt;0.50 – 0.60</td>
<td>0.61</td>
<td>0.81</td>
</tr>
<tr>
<td>&gt;0.60 – 0.70</td>
<td>0.56</td>
<td>0.78</td>
</tr>
<tr>
<td>&gt;0.70 – 0.80</td>
<td>0.51</td>
<td>0.76</td>
</tr>
<tr>
<td>&gt;0.80 – 0.90</td>
<td>0.47</td>
<td>0.75</td>
</tr>
<tr>
<td>&gt;0.90 – 1.00</td>
<td>0.44</td>
<td>0.73</td>
</tr>
</tbody>
</table>
IECC 402.4 – U<sub>FACTOR</sub> & SHGC

Projection Factor (PF) and SHGC

PF = Ratio of overhang projection divided by height from window sill to bottom of overhang (must be permanent)

\[ PF = \frac{A}{B} \]

SECTION 5.5.4.4.1: OVERHANGS

Must last as long as the building itself (ineligible)
90.1 DAYLIGHTING DETAILS

5.5.4.2.2 Max. Skylight Fenestration Area
- Total skylight area shall not exceed 3% of gross roof area
- May go to 6% of gross roof area provided design meets all criteria

5.5.4.2.3 Minimum Skylight Fenestration Area
- for any enclosed space in a building (all of the following):
  - ≥2,500 sq. ft.
  - Directly under a roof with ceiling heights greater than 15 feet
  - One of the following space types: office, lobby, atrium, concourse, corridor, warehouse, gym, convention center, courtroom automotive service, fire station engine room, manufacturing, retail, library, distribution/sorting, transportation baggage and seating, or workshop
- Minimum 50% of floor area is daylit area and either:
  - Provide skylight to daylight area of 3% and VT of 0.4
  - Minimum skylight effective aperture of 1%
- Many exceptions based on LPD, space type, and side daylighting

90.1 DAYLIGHTING EXCEPTIONS

Exceptions:
1. Enclosed spaces in Climate Zones 6 through 8
2. Enclosed spaces where it is documented that existing structures or natural objects block direct beam sunlight on at least half of the roof over the enclosed space for more than 1500 daytime hours per year between 8 a.m. and 4 p.m.
3. Enclosed spaces where the daylight area under roof monitors is greater than 50% of the enclosed space floor area
4. Enclosed spaces where it is documented that 90% of the daylight area is shaded on June 21 in the Northern Hemisphere (December 21 in the Southern Hemisphere) at noon by permanent architectural features of the building
5. Enclosed spaces where the total area minus the primary and secondary sidelighted area(s) is less than 2500 ft² and where the lighting is controlled according to sidelight requirements described in Section 9.4.1.1(e).
IECC DAYLIGHTING
Near Identical Requirements

SECTION 5.5.4.4: FENESTRATION SHGC

- Vertical Glazing SHGC shall be ≤ 0.25
  - Exceptions
    - Opaque and partially opaque permanent projections are credited (calculations)
    - Glazing using the street-level exception for SHGC
      - Street level story ≤ 20’
      - Overhang > 0.5 PF
      - Fenestration area of street level is < 75% of the gross wall area of the street side
      - Separate calculations required
    - Dynamic glazing calculated separately
    - North oriented glazing allowed 0.05 higher SHGC (0.30)
    - Separate details for skylight SHGC (with exceptions)
SECTION 5.5.4.5: OPTIMAL FENESTRATION ORIENTATION

- Area of vertical fenestration on east and west facades may not exceed 25% of total area of vertical glazing

5.5.4.5 Fenestration Orientation. The vertical fenestration shall comply with either (a) or (b):

a. \[ A_f \leq \left( \frac{A_e}{4} \right)^4 \text{ and } A_f \leq \left( \frac{A_w}{4} \right)^4 \]

b. \[ A_f \times \text{SHGC} \leq (A_e \times \text{SHGC}_e) / 4 \text{ and } A_f \times \text{SHGC}_w \leq (A_w \times \text{SHGC}_w) / 4 \]

Exceptions:

1. Vertical fenestration that complies with Exception (a) Section 5.5.4.4.1.
2. Buildings that have an existing building or existing permanent infrastructure within 20 ft to the south (north in the southern hemisphere) that is at least half as tall as the proposed building.
3. Buildings with shade on 75% of the west- and east-oriented vertical fenestration areas from permanent projections, existing buildings, existing permanent infrastructure, or topography at 9 a.m. and 3 p.m. on the summer solstices (June 21 in the northern hemisphere).
4. Alterations and additions with no increase in vertical fenestration area.
5. Buildings where the west-oriented and east-oriented vertical fenestration area (as defined in Section 5.5.4.5) does not exceed 20% of the gross wall area for each of those facades, and SHGC on those facades is no greater than 90% of the criteria in Tables 5.5-1 through 5.5-8.

https://vimeo.com/169382048/c973625071

SECTION 5.5.4.6: VT/SHGC RATIO

- Where automatic daylighting controls are required, the Visible Transmittance / SHGC ratio shall be \( \geq 1.1 \) 90.1 only!

Exceptions:

1. A light-to-solar-gain ratio (LSG) of not less than 1.25 is allowed to be used as an alternative to VT/SHGC. When using this option, the center-of-glass VT and the center-of-glass SHGC shall be determined in accordance with NFRC 300 and NFRC 301, determined by an independent laboratory or included in a database published by a government agency, and certified by the manufacturer.
2. Fenestration not covered in the scope of the NFRC 200.
3. Enclosed spaces where the daylight area under rooftop monitors is greater than 50% of the enclosed space floor area.
4. Enclosed spaces with skylight(s) that comply with Section 5.5.4.2.3.
5. Enclosed spaces where the sidelighting effective aperture is greater than or equal to 0.15.
6. For dynamic glazing, the VT/SHGC ratio and the LSG shall be determined using the maximum VT and maximum SHGC. Dynamic glazing shall be considered separately from other fenestration, and area-weighted averaging with other fenestration that is not dynamic glazing shall not be permitted.
COMCHECK™ SOFTWARE

Software evaluates specific designs quickly

Allows trade-offs (web-based or downloadable)

- Building Envelope components
- Lighting and Power components
- Mechanical components

www.energycodes.gov

ENVELOPE TRADE-OFFS

90.1 Section 11 - Energy Cost Budget Method

- Must comply with mandatory provisions

3. The requirements of Sections C402.5, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C407. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

C407.3 Performance-based compliance. Compliance based on total building performance requires that a proposed building (proposed design) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design. Energy prices shall be taken from a source approved by the code official, such as the Department of Energy. Energy Information Administration's State Energy Price and Expenditure Report. Code officials shall be permitted to require time-of-use pricing in energy cost calculations.

The reduction in annual energy cost of the proposed design associated with on-site renewable energy shall be not more than 5% of the total annual energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the standard reference design and the proposed design.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

(Effective January 1, 2020)
SECTION 5.4: BUILDING ENVELOPE

5.4.3.1.3 Continuous Air Barrier

The air barrier shall be designed and noted:

- Air barrier components shall be identified on construction documents
- Joints, interconnections, and penetrations of air barrier including lighting fixtures shall be detailed or otherwise noted
- Continuous air barrier shall extend over all surfaces of the envelope
- Air barrier shall be designed to resist positive and negative pressures from wind, stack effect, and vent fans

Acceptable air barrier materials/assemblies

- 3/8” plywood & OSB
- ½” XPS & poly-iso
- ½” Gyp board
- ½” Cement board
- Built up, modified bit, & adhered single-ply roof membranes
- ½” cement parge, stucco or gyp board
- Concrete
- Sheet metal
- 1” (1.5”) Closed cell foam
- 4.5” Open cell foam
- CMU walls – painted/grouted
- Sheet steel/aluminum

SECTION 5: ENVELOPE AIR SEALING

5.4 - Mandatory Provisions

Air Leakage - Fenestration and Doors (5.4.3.2)

Air leakage ≤ 1.0 cfm/ft² for glazed swinging & revolving doors
Air leakage ≤ 0.06 cfm/ft² for curtainwall & storefront glazing
Air leakage ≤ 0.3 cfm/ft² for skylights
Air leakage ≤ 1.3 cfm/ft² for nonswinging doors for vehicles & materials
Air leakage ≤ 0.2-0.4 cfm/ft² for others

*Exception: Field-fabricated fenestration and doors, semi-heated space metal coiling doors and buildings that pass blower door test of 0.40 ELR75

Also, (5.4.3.3) - Loading dock weatherseals in CZ4-8
SECTION 5: ENVELOPE AIR SEALING

5.4 - Mandatory Provision

- Air Leakage – Vestibules (5.4.3.4)

Vestibules are required in CZ 3-8 for entrances in buildings

- All doors must be equipped with self-closing devices
- Interior and exterior doors at least 7 ft* apart
- Floor area of vestibule < 50 s.f. or 2% of gross area of floor
- Envelope of unconditioned vestibule (interior/exterior) meets semi-heated

Exceptions:

- revolving doors, non-entrance doors, and dwelling unit doors
- not required in CZ 1-2
- Entrances in CZ 3 for buildings < 4 stories and < 10,000 s.f.
- Entrances in CZ 4-8 for buildings < 1,000 s.f.
- Doors from a space < 3,000 s.f. and separate from the entrance

*16' if building > 40k s.f.
C402.4.8: RECESSED LIGHTING

Air Leakage – Recessed Luminaires
Recessed lights must be air sealed to limit air leakage between conditioned and unconditioned space

- Insulation may cover over (IC-rated)
- Air tight (not more than 2.0 cfm leakage at 75 Pa)
MAJOR AIR LEAKAGE SITES

- Cavities above suspended ceilings
- Plenum return spaces (Highly depressurized)
- Ventilated walls
- Equipment tunnels and chases
- Mechanical rooms and mezzanines
- Unconditioned adjacent space (storage, plant, warehouse, etc.)

ENVELOPE – AIR SEALING

Air sealing – mandatory requirement and cannot be traded off
ENERGY EFFICIENT BUILDING ENVELOPE

Blower Door Testing – Recognized by IECC
- Prove Air Sealing
- Envelope Integrity

C402.5 Air leakage—thermal envelope (Mandatory). The thermal envelope of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building thermal envelope shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft² (0.2 L/s · m²). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

\[
\text{ELR}_{75} = \frac{\text{CFM}_{75}}{\text{shell area}}
\]

\[
\text{ELR}_{75} \leq 0.40
\]

MULTI-BLOWER DOOR – ENVELOPE LEAKAGE TEST

![Blower Door Testing Image]
INTERIOR & EXTERIOR LIGHTING CONTROLS

Fostering human habits proves to save energy

- Vacancy sensors preferred
- Occupancy sensors (no daylight)
- Multi-level controls
- Photosensors for daylit areas
- Automatic shut-offs
- Building automation systems or scheduled auto off
- Controls: KISS principle and verify/Cx
SECTION 9: LIGHTING

Key Section Changes 90.1-2007 vs. 2013

- Lighting Alterations must meet Lighting Power Density (LPD)
  - Now take effect at > 10% replacement
  - Include exterior areas
  - Include renovations where just the lamp / ballast is replaced
  - Require compliance with auto shut off controls

Lighting Power
- LPD tables changes (~ 15% reduction overall)
- Bonus LPD now available for advanced control spaces
- Retail allowances have been reduced
- Exterior LPD now based on 5 lighting zones

Lighting Controls
- Bi-level control requirement added
- Auto shut off now required in all buildings
- Auto shut off required for more spaces
- Functional testing now required
- Daylight harvesting required in certain situations

SECTION 9: LIGHTING

9.1.1 Scope:
- Interior spaces of buildings
- Exterior building features
- Exterior lighting powered through building

Exceptions:
- Emergency lighting that is normally off
- Lighting required by life safety statute
- Lighting within dwelling units of buildings
- Decorative gas lighting
SECTION 9: LIGHTING

How this presentation considers lighting

**Interior**
- Budget
- Installed Design (exemptions)
- Controls

**Exterior**
- Budget
- Installed Design (exemptions)
- Controls

SECTION 9.5&6: INTERIOR LIGHTING BUDGET

**Interior Lighting Power Budget**

9.5 Building Area Method

or

9.6 Space by Space Method

- Trade-offs not allowed between different methods
- Actual installed interior lighting fixtures ≤ allowance
SECTION 9.5: INTERIOR LIGHTING BUDGET

9.5.1 - Building Area Method

Used for projects involving

- An entire building
- A single, independent, and separate occupancy in a multi-occupancy building

Most Building Types listed

- “Selection of a reasonably equivalent type” is permitted

Multiply Gross Lighted Floor Area (measured from the exterior faces of the exterior walls or from the centerline of walls separating buildings) by allowance from Table 9.5.1

What is “budget” for a 10k office building?
Answer: 8,200 W
SECTION 9.6: INTERIOR LIGHTING BUDGET

9.6.1 – Space-by-Space Method

Identify different space types in your project
Determine gross lighted area of all space types
Calculate lighting power allowance per LPD table
Sum all the allowances for each space type
Trade-offs between subspaces are permitted

Advantages

- More flexible
- Applicable to more building types
- Opportunity for additional allowances

SECTION 9.6.1: SPACE BY SPACE SAMPLE TABLE
SECTION 9.6: INTERIOR LIGHTING BUDGET

9.6.2 - Space-by-Space Method

Additional Interior Lighting Power

Decorative / highlighting luminaires

- 1.0 W/ft² in space where used

Retail Sales Area (Base 1.68 W/ft²)

Additional Allowance = 1000 watts

+ (Retail Area 1 x .6 W/ft²)
+ (Retail Area 2 x .6 W/ft²)
+ (Retail Area 3 x 1.4 W/ft²)
+ (Retail Area 4 x 2.5 W/ft²)

Retail 1 – All goods not covered in 2, 3, 4
Retail 2 – vehicles, sporting goods, small electronics
Retail 3 – furniture, clothing, cosmetics, artwork
Retail 4 – jewelry, crystal, china

SECTION 9: INTERIOR LIGHTING BUDGET

9.6.3 – Space-by-Space Method

Additional Interior Lighting Power

Using Better Controls (5% to 30% bonus)*

*Additional interior lighting control = lighting power under control X control factor (per table 9.6.3)

<table>
<thead>
<tr>
<th>Additional Control Method (in Addition to Mandatory Requirements)</th>
<th>Space Type</th>
<th>Conference Room</th>
<th>Meeting Room</th>
<th>Classroom</th>
<th>Lobby</th>
<th>Atrium</th>
<th>Corridors/ Stairways, Gym, Pool, Mall Concourse, Parking Garage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open Office</td>
<td>Private Office</td>
<td>Retail Area</td>
<td>Sales Area</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Manual, continuous dimming control or programmable multilevel</td>
<td>0.05</td>
<td>0.05</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>dimming control</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programmable multilevel dimming control using programmable time</td>
<td>0.05</td>
<td>0.05</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
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<td>workstation specific luminaries with continuous dimming to off</td>
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<td></td>
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<tr>
<td>capabilities</td>
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</tr>
<tr>
<td>Occupancy sensors controlling the daylight component of</td>
<td>0.30b</td>
<td>0</td>
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<td>workstation specific luminaries with continuous dimming to off</td>
<td></td>
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<td>operation, in combination with personal continuous dimming control</td>
<td></td>
<td></td>
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<tr>
<td>of daylight illumination by workstation occupant</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Automatic continuous daylight dimming in secondary undelighted</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
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<td>areas</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Control factor is limited to workstations occupied by single-occupant employees. Workspaces containing an open office environment (indicated by a solid line) shall be controlled by a single occupant as per the control option specified in Table 5.1.4.2a. The control factor shall be limited to the control of the space where the single occupant is located. The control factor shall not apply to areas occupied by multiple persons. The control factor shall be limited to the control of the space where the single occupant is located. The control factor shall be limited to the control of the space where the single occupant is located. The control factor shall be limited to the control of the space where the single occupant is located. The control factor shall be limited to the control of the space where the single occupant is located.

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SECTION 9: INTERIOR LIGHTING BUDGET

9.6.4 – Space-by-Space Method

Room Geometry Adjustment

(20% LPD bonus if calculated RCR is greater than RCR threshold)

$$\text{RCR} = 2.5 \times \text{room cavity height}^* \times \text{room perimeter length} / \text{room area}$$

*Room cavity height = luminaire mounting height - workplane

Example: 30'x40' open office with 16.5' fixture height:

$$\text{RCR} = 2.5 \times 14 \times (140/1200) = 4.1$$

SECTION 9.2.2.3: LIGHTING DESIGN

Interior Lighting Power Allowance Exemptions

(often require separate control)

- Display or accent lighting for galleries, museums, and monuments
- Lighting integral to equipment or instrumentation
- Medical and dental procedures
- Refrigerator and freezer cases
- Lighting for food warming
- Life support for non-humans
- Retail display windows (enclosed by ceiling height partitions)
- Registered historic landmarks
- Advertising or directional signage
- Exit signs
- Sale or lighting educational demonstration systems
- Theatrical, stage, film, and video production
- TV broadcasting in sporting activity areas
- Casino gaming areas
- Furniture mounted task lighting
- Mirror lighting in dressing rooms + religious pulpit & choir accent lighting
- Parking garage transition lighting

*Lighting exempt from code still offer lots of opportunities for saving energy – make sure it’s LED!!!
SECTION 9.1.4: LIGHTING DESIGN WATTAGE

Luminaire Wattage – “the rules”

Luminaires not containing permanently installed ballasts, transformers, etc. = max. labeled wattage of the luminaire
Luminaires with permanently installed or remote ballasts, transformers, etc. = operating input wattage of the lamp/auxiliary combination*

Line-voltage track =
- Minimum 30 W per foot
- Or limit of system’s circuit breaker
- Or wattage of other current-limiting device

Low-voltage track = transformer wattage
All others as specified

*based on manufacturer’s data, lab results, or max labeled wattage of luminaire (exception for adjustable ballast factors)

SECTION 9.1.4: LIGHTING DESIGN WATTAGE

Example: Installed Interior Lighting Design

Calculate the total lighting wattage of a room containing the following fixtures:

+ Eight 4’ Fluorescent Fixtures
  - Three 4’ fluorescent T8 lamps per fixture, 32 Watts
  - One three-lamp electronic ballast, Input Wattage – 90 Watts

+ Six Incandescent Downlights
  - Specified Lamps – 60 Watt, A-line, Medium Screw Base
  - Maximum labeled wattage of fixture – 75 Watts

+ 16 Feet of Line Voltage Track
  - Specified – 5 Track Heads
  - 90 Watts Halogen PAR38 Lamps

Interior Lighting Wattage Calculation

8 Fixtures x 90 Ballast Input Watts = 720 Watts
6 Downlights x 75 Watt Labeled A-line = 450 Watts
16’ Track x 30 Watts/Foot = 480 Watts

Total Wattage = 1,650 Watts
SECTION 9.4.1: LIGHTING CONTROL

9.4.1.1 Interior Lighting Controls

Minimum Control Requirements (a-i) from Table 9.6.1

1. Local Controls (for small/big spaces)
   Local control – Requires one or more manual control in the space that controls all the lighting in that space.
   Each control device will control a maximum of:
   - 2,500 ft² in spaces ≤ 10,000 ft²
   - 10,000 ft² in spaces > 10,000 ft²
   - Readily accessible so occupants can see the controlled lighting when using the control device

   Exceptions:
   - Remote location for safety & security
     (requires pilot indicator and lighting clearly labeled)
SECTION 9.4: MANDATORY PROVISIONS

9.4.1.1– Lighting Control

b. Restricted to Manual ON
None of the lighting shall be automatically turned ON

Exceptions: (spaces where full automatic-on is allowed)
Areas where manual-on would endanger safety or security of the room or building occupants

c. Restricted to Partial Automatic ON
Maximum of 50% of the lighting power for general lighting is allowed to be automatically turned on and none of the remaining shall be auto ON
SECTION 9.4.1: LIGHTING CONTROL

9.4.1.1 Lighting Control

d. Bilevel Lighting Controls
The general lighting shall be controlled to have at least one step between 30% and 70% power (in addition to full on / off)

![Inboard Only, Outboard Lamps, Full On]

SECTION 9.4.1: LIGHTING CONTROL

9.4.1.1 Lighting Control

e. Auto Daylight Controls - Sidelighting
- Photocontrols required for any space with primary sidelighting $> 150$ W
- Photocontrols required for any space with combined primary and secondary sidelighting $> 300$ W

Photocontrols shall:
- Have readily accessible calibration adjustments
- Have secondary sidelighting controls separate from primary sidelighting
- Reduce electric lighting based on available daylight using continuous or 4-step staged dimming

Exceptions for sidelights with tall adjacent structures, < 20 s.f. of glazing, retail spaces
SIDELIGHTED AREA - PRIMARY

A primary sidelighted area is the total primary sidelighted area within each space. Each primary sidelighted area is directly adjacent to vertical fenestration below the ceiling (see Figure 3.2.3).

a. The primary sidelighted area width is the width of the vertical fenestration plus, on each side, the smaller of:
   1. one half of the vertical fenestration head height (where head height is the distance from the floor to the top of the glazing) or
   2. the distance to any 5 ft or higher opaque vertical obstruction.

b. The primary sidelighted area depth is the horizontal distance perpendicular to the vertical fenestration which is the smaller of:
   1. one vertical fenestration head height or
   2. the distance to any 5 ft or higher opaque vertical obstruction.

SECTION 9.4.1: LIGHTING CONTROL

9.4.1.1 Lighting Control

f. Auto Daylight Controls - Toplighting

- Photocontrols required for general lighting in any space top-lit by ≥ 150 W
  Photocontrols shall:
  - Have readily accessible calibration adjustments
  - Reduce electric lighting based on available daylight using continuous or 4-step staged dimming
  - Combine controls for overlapping top- and sidelighted areas and lighting shall be controlled by toplighting

Exceptions for Toplighting with tall adjacent shading, skylight VT < 0.4, spaces in CZ 8 < 200 W
DAYLIGHTED AREA – ROOF MONITORS

daylighted area: the floor area substantially illuminated by daylight.

daylight area under roof monitors: the daylight area under roof monitors is the combined daylight area under each roof monitor within each space. The daylight area under each roof monitor is the product of

a. the width of the vertical fenestration above the ceiling level plus, on each side, the smallest of
   1. 2 ft,
   2. the distance to any 5 ft or higher vertical obstruction, or
   3. the distance to the edge of any primary side-lighted area

and

b. the smaller of the following horizontal distances inward from the bottom edge of the vertical fenestration (see Figure 3-2-1):
   1. The monitor sill height (MSH) (the vertical distance from the floor to the bottom edge of the monitor glazing)
   2. The distance to the nearest face of any opaque vertical obstruction, where any part of the obstruction is farther away than the difference between the height of the obstruction and the monitor sill height (MSH – OH).

DAYLIGHTED AREA - SKYLIGHTS

daylighted area: the floor area substantially illuminated by daylight.

daylight area under skylights: the daylight area under skylights is the combined daylight area under each skylight within a space. The daylight area under each skylight is bounded by the opening beneath the skylight and horizontally in each direction (see Figure 3-2-2), the smaller of

a. 70% of the ceiling height (0.7 × CH), or
b. the distance to the nearest face of any opaque vertical obstruction, where any part of the obstruction is farther away than 70% of the distance between the top of the obstruction and the ceiling (0.7 × [CH – OH]), where CH = the height of the ceiling at the lowest edge of the skylight and OH = the height to the top of the obstruction.)
SECTION 9.4.1: LIGHTING CONTROL

9.4.1.1 Lighting Control

g. Auto Partial OFF- (full OFF complies)
• General lighting shall be auto reduced by at least half within 20 minutes of being unoccupied

HID exception if meet all:
Space LPD is \( \leq 0.8 \text{ W/s.f.} \), only HID fixtures are used in the space, and general lighting is reduced at least 30% within 20 minutes of unoccupied

h. Auto Full OFF
• All lighting shall be auto shut off within 20 minutes of being unoccupied
  • Maximum control device area served is 5000 s.f.

Exceptions:
• General and task lighting in shop and lab classrooms
• General and task lighting where it would endanger safety or security of the room or building occupants
• Lighting for 24/7 operation
SECTION 9.4.1: LIGHTING CONTROL

9.4.1.1 Lighting Control

i. Scheduled Shutoff

- All non-exempt lighting shall be auto shut off during periods when space is scheduled to be unoccupied
- Options include:
  - Time of day controller
  - Signal from other such as alarm/security
  - Max area of 25,000 s.f. on one floor, account for weekends and holidays, max. 2 hour override

Exceptions:
- Lighting for 24/7 operation
- Patient care spaces
- General and task lighting where it would endanger safety or security of the room or building occupants

SPECIAL APPLICATIONS

9.4.1.3 Special Applications

a. The following lighting shall be separately controlled from the general lighting in all spaces:
   1. Display or accent lighting
   2. Lighting in display cases
   3. Nonvisual lighting, such as for plant growth or food warming
   4. Lighting equipment that is for sale or used for demonstrations in lighting education

b. Guestrooms
   1. All lighting and all switched receptacles in guestrooms and suites in hotels, motels, boarding houses, or similar buildings shall be automatically controlled such that the power to the lighting and switched receptacles in each enclosed space will be turned off within 20 minutes after all occupants leave that space.
      **Exception:** Enclosed spaces where the lighting and switched receptacles are controlled by captive key systems and bathrooms are exempt.
   2. Bathrooms shall have a separate control device installed to automatically turn off the bathroom lighting within 30 minutes after all occupants have left the bathroom.
      **Exception:** Night lighting of up to 5 W per bathroom is exempt.
   3. All supplemental task lighting, including permanently installed undershelf or undercabinet lighting, shall be controlled from either (1) a control device integral to the luminaires or (2) by a wall-mounted control device that is readily accessible and located so that the occupant can see the controlled lighting.
9.4.2: EXTERIOR LIGHTING POWER

9.4.2 Exterior Building Lighting Power

Exterior Building Lighting Power Budget:

- Sum of the base site allowance
- Individual allowances from the exterior LPD table (9.4.2.2) based on lighting zone

<table>
<thead>
<tr>
<th>Lighting Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Undeveloped areas within national parks, state parks, forest land, rural areas, and other undeveloped areas as defined by the authority having jurisdiction</td>
</tr>
<tr>
<td>1</td>
<td>Developed areas of national parks, state parks, forest land, and rural areas</td>
</tr>
<tr>
<td>2</td>
<td>Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas</td>
</tr>
<tr>
<td>3</td>
<td>All other areas</td>
</tr>
<tr>
<td>4</td>
<td>High-activity commercial districts in major metropolitan areas as designated by the local jurisdiction</td>
</tr>
</tbody>
</table>

Installed power shall not exceed budget. Trade-offs are allowed only among “tradable surfaces.” Lighting zone is determined per table 9.4.2.1.

9.4.2: EXTERIOR LIGHTING POWER

9.4.2 Exterior Building Lighting Power

Exterior lighting used for the following applications equipped with a dedicated control device is exempt:

1. Lighting used for the following exterior applications is exempt when equipped with a control device that complies with the requirements of Section 9.4.1.4 and is independent of the control of the nonexempt lighting:
   a. Lighting that is integral to signage and installed in the signage by the manufacturer
   b. Lighting for athletic playing areas
   c. Lighting for industrial production, materials handling, transportation sites, and associated storage areas
   d. Theme elements in theme/amusement parks
   e. Lighting used to highlight features of public monuments and registered historic landmark structures or buildings
   f. Lighting for water features
2. Lighting used for the following exterior applications is exempt when controlled separately:
   a. Specialized signal, directional, and marker lighting associated with transportation
   b. Lighting integral to equipment or instrumentation and installed by its manufacturer
   c. Lighting for theatrical purposes, including performance, stage, film production, and video production
   d. Temporary lighting
   e. Lighting for hazardous locations
   f. Lighting for swimming pools
   g. Searchlights
### 9.4.2: EXTERIOR LIGHTING POWER

#### TABLE 9.4.2-2 Individual Lighting Power Allowances for Building Exteriors

<table>
<thead>
<tr>
<th>Zone 0</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Site Allowance (base allowance may be used in tradable or non-tradable surfaces)</strong></td>
<td>No base site in Zone 0</td>
<td>500 W</td>
<td>600 W</td>
<td>750 W</td>
</tr>
<tr>
<td>** Tradable Surfaces**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Uncovered Parking Areas</strong></td>
<td>No allowance</td>
<td>0.04 W/R²</td>
<td>0.06 W/R²</td>
<td>0.10 W/R²</td>
</tr>
<tr>
<td><strong>Building Grounds</strong></td>
<td>No allowance</td>
<td>0.7 W/linear foot</td>
<td>0.7 W/linear foot</td>
<td>0.8 W/linear foot</td>
</tr>
<tr>
<td><strong>Walkways 10 ft wide or greater</strong></td>
<td>No allowance</td>
<td>0.14 W/R²</td>
<td>0.14 W/R²</td>
<td>0.16 W/R²</td>
</tr>
<tr>
<td><strong>Plaza areas</strong></td>
<td>No allowance</td>
<td>0.75 W/R²</td>
<td>1.0 W/R²</td>
<td>1.0 W/R²</td>
</tr>
<tr>
<td><strong>Stairways</strong></td>
<td>No allowance</td>
<td>0.15 W/R²</td>
<td>0.2 W/R²</td>
<td>0.2 W/R²</td>
</tr>
<tr>
<td><strong>Landscaping</strong></td>
<td>No allowance</td>
<td>0.04 W/R²</td>
<td>0.05 W/R²</td>
<td>0.05 W/R²</td>
</tr>
<tr>
<td><strong>Building Entrances, Exits, and Loading Docks</strong></td>
<td>No allowance</td>
<td>20 W/lin ft of door width</td>
<td>20 W/lin ft of door width</td>
<td>30 W/lin ft of door width</td>
</tr>
<tr>
<td><strong>Main entries</strong></td>
<td>No allowance</td>
<td>20 W/lin ft of door width</td>
<td>20 W/lin ft of door width</td>
<td>30 W/lin ft of door width</td>
</tr>
<tr>
<td><strong>Other doors</strong></td>
<td>No allowance</td>
<td>20 W/lin ft of door width</td>
<td>20 W/lin ft of door width</td>
<td>20 W/lin ft of door width</td>
</tr>
<tr>
<td><strong>Entry canopies</strong></td>
<td>No allowance</td>
<td>0.25 W/R²</td>
<td>0.25 W/R²</td>
<td>0.4 W/R²</td>
</tr>
<tr>
<td><strong>Loading docks</strong></td>
<td>No allowance</td>
<td>0.5 W/R²</td>
<td>0.5 W/R²</td>
<td>0.5 W/R²</td>
</tr>
<tr>
<td><strong>Sales Canopies</strong></td>
<td>No allowance</td>
<td>0.6 W/R²</td>
<td>0.6 W/R²</td>
<td>0.8 W/R²</td>
</tr>
<tr>
<td><strong>Outdoor Sales</strong></td>
<td>No allowance</td>
<td>0.25 W/R²</td>
<td>0.25 W/R²</td>
<td>0.5 W/R²</td>
</tr>
<tr>
<td><strong>Street frontage for vehicle sales lots in addition to “open area” allowance</strong></td>
<td>No allowance</td>
<td>No allowance</td>
<td>No allowance</td>
<td>No allowance</td>
</tr>
</tbody>
</table>

### 9.4.2: EXTERIOR LIGHTING BUDGET

#### Nontradable Surfaces

(Nontradable Surface calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)

<table>
<thead>
<tr>
<th>Zone 0</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Building facades</strong></td>
<td>No allowance</td>
<td>No allowance</td>
<td>No allowance</td>
<td>No allowance</td>
</tr>
<tr>
<td><strong>Automated teller machines and night depositories</strong></td>
<td>No allowance</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
<td>270 W per location plus 90 W per additional ATM per location</td>
</tr>
<tr>
<td><strong>Entrances and gatehouse inspection stations at guarded facilities</strong></td>
<td>No allowance</td>
<td>0.75 W/R² of uncovered area</td>
<td>0.75 W/R² of uncovered area</td>
<td>0.75 W/R² of uncovered area</td>
</tr>
<tr>
<td><strong>Loading areas for law enforcement, fire, ambulance, and other emergency service vehicles</strong></td>
<td>No allowance</td>
<td>0.5 W/R² of uncovered area</td>
<td>0.5 W/R² of uncovered area</td>
<td>0.5 W/R² of uncovered area</td>
</tr>
<tr>
<td><strong>Drive-through windows/doors</strong></td>
<td>No allowance</td>
<td>400 W per drive-through</td>
<td>400 W per drive-through</td>
<td>400 W per drive-through</td>
</tr>
<tr>
<td><strong>Parking near 24-hour retail entrances</strong></td>
<td>No allowance</td>
<td>800 W per main entry</td>
<td>800 W per main entry</td>
<td>800 W per main entry</td>
</tr>
</tbody>
</table>
SECTION 9.4.1.4: LIGHTING CONTROLS

9.4.1.4 – Exterior Lighting Control

Three requirements:

a. Automatic off control when daylight is available
b. Curfew hours for façade and landscape lighting (midnight – 6am or close to open)
c. Other exterior lighting (including advertising) must automatically reduce power by a minimum of 30% either:
   1. Midnight – 6am (or 1 hour after business close until open)
   2. Motion sensor control (any period of inactivity greater than 15 min)

Exceptions:

- Lighting for covered vehicle entrances or exits where required for safety, security or eye adaptation
- Lighting integral to signage

Note: controls must retain settings during power outage

SECTION 9.4.1: LIGHTING CONTROLS

9.4.1.2 – Parking Garage Control

a) Automatic shut off is required per 9.4.1 (i)
b) Lighting must auto step-back to a minimum 30% power after 20 minutes (max zone 3,600 ft²)
   Daylight “transition zones” and ramps without parking exempt
c) Covered vehicle entrance and exit lighting must have separate auto-control to reduce lighting by ≥ 50% from sunset to sunrise
d) Daylight sensor control required to auto reduce power for luminaires within 20 ft of any perimeter wall with net opening to wall ratio ≥ 40% or more and no exterior obstructions within 20 ft

Exceptions:

- Daylight transition zones and ramps without parking
SECTION 9.4.3: FUNCTIONAL TESTING

Control devices and systems must be tested to ensure hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with CD’s and manufacturer’s instructions

• Must be independent from design & construction team
• Must provide documentation that the controls meet performance requirements
• The following controls require detailed functional testing as per 9.4.3 and proper operation must be confirmed and documented:
  • Occupant sensors
  • Auto Time switches and programmable schedule devices
  • Photo-sensor controls

SECTION 9: LIGHTING

COMcheck is the easiest way to show lighting compliance – it is 100% identical to 90.1

• Determines budget – Interior & Exterior
• Creates lighting fixture schedule
• Provides checklist of mandatory items
SECTION 8: POWER

Conductor sizes and Switched Receptacles:

8.4 Mandatory Provisions
8.4.1 Voltage Drop

Exception: Feeder conductors and branch circuits that are dedicated to emergency services

8.4.1.1 Feeders. Feeder conductors shall be sized for a maximum voltage drop of 2% at design load.

8.4.1.2 Branch Circuits. Branch circuit conductors shall be sized for a maximum voltage drop of 3% at design load.

8.4.2 Automatic Receptacle Control. The following shall be automatically controlled:

a. At least 50% of all 125-volt 15- and 20-amp receptacles in all private offices, conference rooms, rooms used primarily for printing and/or copying, functions, break rooms, classrooms, and individual workstations.

b. At least 25% of branch circuit feeders installed for modular furniture not shown on the construction documents

This control shall function on:

a. a schedule basis using a time-of-day operated control device that turns receptacles off at specific programmed times—an independent program schedule shall be provided for controlled areas of no more than 5000 ft² and not more than one floor (the occupant shall be able to manually override the control device for up to two hours).

b. an occupant sensor that shall turn receptacles off within 20 minutes of all occupants leaving a space, or

c. an automated signal from another control or alarm system that shall turn receptacles off within 20 minutes after determining that the area is unoccupied.

All controlled receptacles shall be permanently marked to visually differentiate them from uncontrolled receptacles and are to be uniformly distributed throughout the space. Plug-in devices shall not be used to comply with Section 8.4.2.

Exceptions: Receptacles for the following shall not require an automatic control device:

1. Receptacles specifically designated for equipment requiring continuous operation (24 hours/day, 365 days/year)

2. Spaces where an automatic control would endanger the safety or security of the room or building occupant(s).

SECTION 8: POWER

Energy Monitoring and Recording:

8.4.3 Electrical Energy Monitoring
8.4.3.1 Monitoring. Measurement devices shall be installed in new buildings to monitor the electrical energy use for each of the following separately:

a. Total electrical energy
b. HVAC systems
c. Interior lighting
d. Exterior lighting
e. Receptacle circuits

For buildings with tenants, these systems shall be separately monitored for the total building and (excluding shared systems) for each individual tenant.

Exception: Up to 10% of the load for each of the categories (b) through (e) shall be allowed to be from other electrical loads.

8.4.3.2 Recording and Reporting. The electrical energy usage for all loads specified in Section 8.4.3.1 shall be recorded a minimum of every 15 minutes and reported at least hourly, daily, monthly, and annually. The data for each tenant space shall be made available to that tenant. The system shall be capable of maintaining all data collected for a minimum of 36 months.

Exceptions to 8.4.3.1 and 8.4.3.2:

1. Building less than 25,000 ft²
2. Individual tenant spaces less than 10,000 ft²
3. Dwelling units
4. Residential buildings with less than 10,000 ft² of common area
5. Critical and Equipment branches of NEC Article 517
C405: LIGHTING SYSTEMS

Major Items of Note

- Dwelling units shall comply by having 75% of installed fixtures be high efficacy (R404.1)
- Lighting control requirements are similar to 90.1 but worded very differently
- Occupancy sensor controls required in 12 spaces

C405.2.1 Occupant sensor controls. Occupant sensor controls shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges.
5. Employee lunch and break rooms.
6. Private offices.
7. Restrooms.
8. Storage rooms.
10. Locker rooms.
11. Other spaces 300 square feet (28 m²) or less that are enclosed by floor-to-ceiling height partitions.
12. Warehouses.

C405: LIGHTING SYSTEMS

Major Items of Note (cont.)

Time-switch controls required:

- 7-day clock with seven different daily programs
- automatic holiday "shutoff"
- 10 hour power backup for settings
- 2-hour manual override for up to 5,000 s.f. area

Exceptions for:

- sleeping units,
- patient care,
- safety or security,
- continuous operation lighting,
- shop and laboratory classrooms

Light-reduction controls required

Exception for daylit zones (with compliant daylight responsive controls):

- 50% power reduction
- dimming or alternate lamp switching

Manual Controls:

- Readily accessible,
- Located in space with fixture or status indicator required,
C405: LIGHTING SYSTEMS

Major Items of Note (cont.)

Daylight responsive controls required:

- Electric general lighting > 150 Watts in daylit zones
- Sidelight daylit zones separate from Toplight zones

Exceptions for:
- Sleeping units,
- Patient care,
- Exempted lighting

Specific applications (Separate controls) required for:

- Display & Accent Lighting
- Case lighting
- Hotel/motel sleeping unit – master control for luminaires and switched receptacles (auto-off within 20 minutes)
  - Exceptions for captive key system
- Supplemental task lighting
- Non-visual lighting (plant growth and food warming)
- Lighting sales demonstration
C405: LIGHTING SYSTEMS

Major Items of Note (cont.)

Exterior Lighting controls (keep settings for 10 hour backup)
- Auto-off when available daylight
- Façade or landscape light controls dawn/dusk and opening/closing time
- Curfew lighting for other exterior fixtures (minimum 30% reduction)

Exit signs – max 5 W per side (no longer in 90.1)

Connected lighting may not exceed budget
- List of exempt lighting

Lighting power budget (Building Area vs. Space-by-Space)

Additional lighting power for retail & decorative lighting
- No RCR or Additional Control wattage allowance

Exempt outdoor lighting
- Special signal and transportation directional light
- Advertising or directional signage
- Integral to equipment
- Theatrical lighting
- Athletic playing areas
- Temporary lighting
- Industrial production lighting
- Theme lighting in amusement parks
- Public monument lighting
- No zone 0 for Exterior Lighting Zone
THE BIG CHANGES TO 90.1-2013

The most significant changes included are as follows:

a. Building Envelope. Opaque elements and fenestration requirements have been revised to increase stringency while maintaining a reasonable level of cost-effectiveness. Opaque and fenestration assemblies in Tables 5.5-1 through 5.5-8 are revised in most climates. These changes include:
   1. criteria requiring double-glazed fenestration in many climates;
   2. minimum VT/SHGC ratio to enable good daylighting with minimum solar gain, while not restricting triple and quadruple glazing; and
   3. simplification of the skylighting criteria.

b. Lighting. These changes include improvements to daylighting and daylighting controls, space-by-space lighting power density limits, thresholds for toplighting, and revised controls requirements and format. LPD's changed in the 2010 version.

c. Mechanical. Equipment efficiencies were revised upward for heat pumps, packaged terminal air conditioners (PTAC), single-package vertical heat pumps and air conditioners (SPVHP and SPVAC), and evaporative condensers. Also, fan efficiency requirements were introduced for the first time. Additional provisions that have been included address commercial refrigeration equipment, improved controls on heat rejection and boiler equipment, requirements for expanded use of energy recovery, small motor efficiencies, and fan power control and credits. Control revision requirements were added to the standard, such as DDC controls in many applications. Finally, the 2013 edition completes the work that was begun on equipment efficiencies for chillers in the 2010 edition.

d. Energy Cost Budget (ECB) and Modeling. Improvements were made to the ECB and Appendix G provisions in the standard to clarify the use of the prescriptive provisions when performing building-energy-use modeling. In addition, these sections were revised to enhance capturing daylighting when performing the modeling calculations.
HVAC: 90.1 SECTION 6 / IECC C403

**Key Code Concepts:**
- Load calcs are required
- All equipment has a minimum efficiency
- Ductwork must be sealed and insulated and balanced
- Fan motor power must be under a certain limit
- All systems must be capable of automatic setback/up during unoccupied times
- Some degree of Commissioning (CX)

**ONLY IN 90.1 SECTION 6.3: HVAC**

6.3 - Simplified Approach
Applies to 80-85% of all commercial buildings
If the 18 requirements are met, the building complies
More restrictive, but simpler
Limited to:
- 1 or 2 story buildings
- Buildings less than 25,000 sq. ft.
- Each HVAC system must comply
ONLY IN 90.1
SECTION 6.3: HVAC
6.3.2 - Simplified Approach

a. Each system must serve a single zone
b. Variable airflow requirements must be met (6.5.3.2.1)
c. Cooling shall be packaged or split system either air or evaporative cooled (and meet min. efficiencies, 6.8.1)
d. Economizers required in most circumstances (6.5.1)
e. Heating shall be packaged or split system heat pump, gas, electric, or hot water (and meet min. efficiencies, 6.8.1)
f. System shall meet exhaust air energy recovery requirements (6.5.6.1)

90.1 SECTION 6.3: HVAC
6.3.2 - Simplified Approach (Economizer Details)

• For systems ≥ 5 tons, economizers required everywhere except CZ1 (Ten exceptions, 6.5.1-1)
• Computer room economizers never required in CZ 2a, 3a, and 4a (Table 6.5.1-2)
• Economizers may be traded off with more efficient equipment
• Not all control options allowed in all CZ’s
• List of 10 exceptions (supermarkets, etc.)
ONLY IN 90.1 SECTION 6.3: HVAC

6.3.2 - Simplified Approach

g. Requires manual changeover or dual set point thermostat

h. When possible, heat pump feature will always provide heating (minimal resistance backup, <40°F lockout)

i. No reheat or simultaneous heating and cooling

j. Control for systems larger than 15k Btu/h and 3/4 HP fan motor requires a 7-day/week time clock with 10 hr power loss programming backup, 2-hr override plus temperature setback to 55°F and setup to 90°F (exception for guest rooms and continuously operating systems)

k. Piping insulation and weather protection (6.8.3)

l. Ductwork/plenums insulated (6.8.2) & sealed (6.4.4.2.1)

m. CD’s show ducted systems must be air balanced to industry standards (~10% of design)

n. Outdoor air and exhausts shall comply with motorized dampers & controls (some exceptions, 6.4.3.4)

o. Separate thermostats interlocked to prevent simultaneous heating and cooling

p. System greater than 10,000 cfm shall have optimum start controls

q. Demand control ventilation required in high occupancy situations (6.4.3.8)

r. Door switch requirements complied with (6.5.10)
90.1 SECTION 6.4: HVAC – MANDATORY ITEMS

6.4 – Mandatory Provisions
(for non-simple HVAC systems)

Overview
Must be met whether using prescriptive or performance (ECB method) path

Mandates include:

• 6.4.1 - Equipment efficiency
• 6.4.2 - Calculations (loads, pump sizing)
• 6.4.3 – Controls (zone T-stat, deadband, overlap, off-hour, automatic shutdown, setback, optimum start, zone isolation, ventilation, HP auxiliary heat, humidification & dehumidification, freeze protection & snow melt, demand control ventilation, vestibule heating, DDC)
• 6.4.4 - Construction and insulation (duct & plenum, piping, site built walk-in coolers, refrigerated display cases)
• Submittals and Completion documentation

90.1 SECTION 6.5: HVAC – PRESCRIPTIVE

6.5 – Prescriptive Items

• Economizers – (6.5.1)
• Simultaneous heating & cooling – (6.5.2)
• Air system design and control – (6.5.3)
• Hydronic design & control – (6.5.4)
• Heat rejection equipment – (6.5.5)
• Energy recovery – (6.5.6)
• Exhaust systems – (6.5.7)
• Radiant heating – (6.5.8)
• Hot gas bypass limitation – (6.5.9)
• Door switches – (6.5.10)
• Refrigeration systems – (6.5.11)
90.1 SECTION 6.5: HVAC – PRESCRIPTIVE

6.5 – Prescriptive
Air system design and control – (6.5.3)
Must satisfy either
• Option 1 (Nameplate motor hp calculation), or
• Option 2 (Fan System bhp)
Strong incentive for variable speed systems

Impact:
• To efficiently move air, ducts must be sufficiently large enough to provide required CFM
• Designers must provide adequate room for properly sized ducts to deliver needed airflow
IECC C403 BUILDING MECHANICAL SYSTEMS

Mandatory Requirements
• Load calcs & equipment sizing
• HVAC equipment minimum efficiency
• Controls (Tstat, HP, Deadband, Overlap, Off-hour, Setback, Automatic shutdown & startup),
• Dampers, Zone isolation, Snow/ice melt & freeze protection,
• Economizer Fault Detection & Diagnostic (FDD), Boiler reset,
• Ventilation (DCV, Parking garage, ERV, kitchen exhaust),
• Duct/plenum insulation and sealing, Piping, CX (Functional Performance Testing),
• Fan motors over 5 hp must meet fan power limitations and minimum efficiency
• Outdoor heating must be radiant (controls)
• Refrigeration equipment, walk-in coolers, refrigerated warehouses, display cases

IECC C402 & C403 – GA AMENDMENTS

Commercial Amendments to IECC only!
• 403.2.3 - Equipment efficiencies shall use 90.1-2013 tables
• 403.2.8 - Kitchen exhaust hood requirements deleted
• 403.2.9 - Duct and plenum insulation and sealing 
(revised to allow spray foam as sealant) 
(Joints, seams and connections shall be sealed with mastic 
and spray foam is allowed option)
• 403.3 - Economizer exception added for computer rooms 
(aligns with 90.1 exception)
• 403.4.2.6 - Revised Pump isolation details
• 407.3 - Energy simulation compliance –limits renewables to 
maximum of 5% credit in model
• 408 - Substitute word “Commissioning” with “Functional Performance Testing”
IECC C406 – CHOOSE YOUR “BONUS”

Additional Efficiency

- Projects must comply with at least one option
- Two are HVAC related
  - More efficient equipment (10%)
  - DOAS

RESOURCES

- www.southface.org
  - Education
  - Our Courses
  - Energy Code
  - GA Energy Code

- www.ashrae.org
- www.energycodes.gov
- www.dca.ga.gov
- www.iccsafe.org