BUILDING ENVELOPE REQUIREMENTS

CHAPTER 5
COMMERCIAL ENERGY EFFICIENCY
2011 New York City Energy Conservation Code
Effective December 28, 2010
The New York City Department of Buildings wishes to acknowledge the generous grant from the United States Department of Energy under the American Recovery and Reinvestment Act, enacted by President Obama and Congress in 2009. This grant funded the creation of these training modules; without this support, these materials would not have been possible.

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This training module was developed by:

Viridian Energy & Environmental, LLC
Welcome to the New York City Department of Buildings Energy Code Training Modules!

This **ENVELOPE** Module addresses:

- Technical issues and strategies related to the 2011 NYCECC;
- Applicability of the 2011 NYCECC;
- NYC DOB Energy Code Submission Requirements; and
- NYC DOB Progress Inspection Requirements.

This module addresses envelope criteria related to all commercial building types, including Group R Buildings as follows: R-1 uses (any height); R-2 and R-3 residential uses when over 3 stories.

Envelope criteria related to low-rise residential buildings are covered under the NYC DOB Residential Training Module.
The ENVELOPE Module has been divided into a number of smaller sub-topics. These can be accessed either in-sequence or out-of-sequence through links in the main “Menu” slide.

Each sub-topic begins with a brief overview of the issues to be reviewed, and many end with a set of summary questions or exercises.

Many of the sub-topics are organized in a Q & A format. Code-related questions are posed at the top of a slide, with answers provided below, or in the following sequence of slides.
The **NYC Buildings** logo takes you to the NYCECC 2011 Training Modules home page.

The **Menu** icon takes you to the main menu page within each module.

The **Attention** icon brings up Callouts with key points and additional information.

The **Links** icon takes you to related DOB web pages or other resources.

The **Documentation** icon addresses DOB documentation issues and requirements.

The **Inspection** icon addresses DOB Progress Inspection issues and requirements.

The **Code Reference** icon refers to relevant Code sections.
Look for the Following Icons:

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The slides are enhanced with special icons that will help to focus on key points, or serve as links to external resources. The Attention icon brings up Callouts (like this one) with key points and additional information.
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## Envelope Module Menu

**Slide Navigation**

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<td>5. Above Grade Walls</td>
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The main menu slide is interactive; clicking on each line item will take you to the respective sub-module. Use this feature to navigate throughout the presentation. The menu icon at the bottom right corner of each slide will always bring you back to the main menu slide.
Building Envelope

1. What’s New in the 2011 NYCECC

Energy Conservation Construction Code of New York State

David A. Paterson  Governor
Lorraine Cortes-Vázquez  Secretary of State

2011 NYCECC
July 2011
1. What’s New in the NYCECC

Sub-Module Overview

In this section you will learn about:

- Key changes and additions in the 2011 NYCECC related to building envelope; and
- Current local laws, rules, & bulletins affecting envelope compliance.
Simplified, Streamlined & More Comprehensive:

- All new buildings, renovations, alterations & repairs are required to comply

- Climate zone classifications are simplified
  - Single zone for all NYC boroughs, both residential & commercial (Zone 4A)

- Commercial building definition (Group R) expanded
  - Now includes Group R-3 over 3 stories

- Section by section compliance no longer allowed
  - All NYCECC Chapter 5 - OR - All ASHRAE 90.1-2007
  - Chapters 1, 2, 3, & 6 of the NYCECC still apply in either scenario
1. What’s New

What are the Major Changes to the Envelope Section in the New Code?

Simplified, Streamlined & More Comprehensive:

- Performance requirements include U-Factor alternative
  - Offers Trade-offs within envelope assemblies without energy modeling

- Fenestration requirements are revised
  - Eliminates fenestration-to-wall area % factors, except the overall 40% threshold for prescriptive or envelope trade-off path (commercial only)
  - Includes options for frame types (commercial only)
  - Envelope & glazing tables fit in 1 page instead of 14

- Air leakage requirements are expanded
  - Limitations for opaque elements & fenestration
  - Requirements for air impermeable insulation
  - Continuous air barriers
  - Lighting fixtures recessed in thermal envelope
What are the Major Changes to the Envelope Section in the New Code?

Simplified, Streamlined & More Comprehensive

- Siding attachment requirements added for foam sheathing
- Vapor retarders & moisture control requirements are not mandated for NYC boroughs
  - Mandatory requirements apply to NYS Climate Zones 5 & 6, but not 4
  - See also NYC Building Code about vapor barriers
Local Laws

- LL1 – Established the current 2011 NYCECC

Rules

- 1 RCNY §5000-01
  - Defines Energy Code submission procedures, including requirements to include progress inspections in drawings

- 1 RCNY §101-07
  - Defines qualification requirements for individuals performing progress inspections

Bulletins

- Buildings Bulletin 2011–015
  - Provides interpretations of Energy Code applicability to envelope additions, alterations, renovations, or repairs
  - Additional details are provided in the Code applicability section of this module
Building Envelope

2. Code Applicability
2. Code Applicability

Sub-Module Overview

In this section you will learn about:

- DOB terminology related to NYCECC applicability;
- Differences in applicability for New Construction, Additions, Alterations, Renovations, and Repairs; and
- Allowable Exemptions and Exceptions related to Building Envelope.
The Code:
- The NYCECC is law.
- It applies to all buildings, new and existing, unless explicitly stated otherwise.

Rules:
- Rules are prepared by the DOB to implement the Code.
- Rules must go through a formal administrative public comment process.
- Rules have the force of law.

Bulletins:
- Bulletins are issued by the DOB, in part to clarify interpretations of the codes.
- They may change more frequently than laws or rules.

The DOB website is always updated to reflect all changes to laws, rules and bulletins. Check the website frequently.
Exemptions:

- Exemptions define specific building types or building elements that are not required to meet the Code, and are addressed in the PW1 form when they constitute the entire application.

- The following are the only allowed exemptions to the NYCECC:
  - Historic buildings (per §ECC 101.4.2, 1 RCNY §5000-01)
    - National or State designated historic buildings
    - Buildings certified as contributing buildings within a National or State historic district
    - Buildings certified as eligible for the designations above
    - City level certification does not qualify for exemptions
  - The envelopes of low-energy buildings (buildings with peak design rate of energy use <3.4 Btu/h/SF, or unconditioned buildings) or spaces
  - Temporary buildings under Administrative Code §28-111 and §BC 3203
  - The following work types, which are categorized as not affecting energy use:
    - FA (fire alarm), FP (fire suppression in a range hood), SD (standpipe), SP (sprinklers), FS (fuel storage), EQ (construction equipment), CC (curb cut), OT/BPP (Builder’s Pavement Plan), OT/FPP (Fire Protection Plan)
Exceptions:

- Exceptions are conditions under which specific provisions of the Code may not be required.

- Exceptions to Section NYCECC 101.4.3, Alterations, apply only if they do not result in increased energy use of the building.
  - There are 8 exceptions in this section; 6 of these exceptions apply to envelope.
§NYCECC 101.4.3

2. Code Applicability

What are the Potential Envelope Exceptions or Relief in Alterations/Renovations?

Per NYCECC 101.4.3:

- Work that creates:
  - Unsafe or hazardous conditions
  - Overloading of existing building systems

- DOB Interpretation (per Bulletin 2011-015)
  - Insulation of existing walls or portions of existing walls may be omitted if the applicant can demonstrate that the installation of insulation would create conditions such as freeze-thaw and cracking of the element, or mold in or around the element.

Exceptions and other conditions relieved from compliance by Section NYCECC 101.4.3 must be identified in the applicant’s energy analysis, with citations to Code, 1 RCNY §5000-01 and/or Bulletins provided.
§NYCECC 101.4.3

2. Code Applicability

What are the Potential Envelope Exceptions or Relief in Alterations/Renovations?

Per NYCECC 101.4.3:

- Storm windows installed over existing fenestration

- Glass-only replacements in an existing sash and frame
  - U-Factor and SHGC must be equal to or lower than existing glass
  - Per Bulletin: Exception includes glass-only replacements within curtain wall panels to remain

- Alterations of roof/ceiling, wall or floor cavity, if they are already filled to full depth with insulation of R-3/inch or more

- Alterations/renovations/repairs to walls and floors where the existing structure is without framing cavities, and no new cavities are created
§NYCECC 101.4.3

2. Code Applicability

What are the Potential Envelope Exceptions or Relief in Alterations/Renovations?

Per NYCECC 101.4.3:

- Re-roofing where neither sheathing nor insulation is exposed
- Replacement of existing exterior doors does not require installation of revolving doors or vestibules, but existing vestibules must not be removed.

Per Buildings Bulletin 2011–015:

- Additional interpretations are provided for:
  - Curtain wall panel replacements
  - Roofs, including roof setbacks
  - Ceilings under unconditioned roof attics
  - Below grade walls
  - Slabs-on-grade
  - Interior renovations
  - Sunrooms and greenhouses
  - Rainscreens
  - Sealing
  - Zoning and property line conflicts
  - Trade-offs
Applicability for Different Scopes of Work

2. Code Applicability

**New Buildings**
- All must comply via Prescriptive or Performance-Based Approaches (see topic 3 of this module)
- Only exemption is for envelope in low-energy/unconditioned buildings

**Additions**
- Must comply either:
  - As a stand-alone addition, or
  - Along with the existing building as a single entity

**Alterations / Renovations**
- Only applies to scope of alteration work; unaltered portions are not required to comply
- Some exceptions may apply (see NYCECC 101.4.3 and per Bulletin 2011-015)

**Repairs**
- Technically applies even if a permit is not required (e.g., window or roof replacements or repairs)
2. Code Applicability

Which Chapters of the Code Apply to Different Building Types?

**Residential**
R-2 and R-3
≤ 3 stories,
and manufactured homes

**Group R Buildings**
R-1 (Hotels/motels) any height
AND
R-2 (Multifamily > 2-family )
> 3 stories
AND
R-3 (One & Two Family)
> 3 stories

**All Other Buildings**
(Including Group I, H)

Residential
NYCECC Chapter 4

Commercial
NYCECC Chapter 5
### 3. Methods of Compliance

<table>
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<tr>
<th>Component</th>
<th>Assembly</th>
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<th>% Fit</th>
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<td>Floor 1</td>
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<td>Insulation, Vertical, 2 ft</td>
<td>190</td>
<td>0.60</td>
<td>0.70</td>
<td></td>
</tr>
</tbody>
</table>

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**Note:**
- Envelope PASSes: Design 2% better than code.
3. Methods of Compliance

Sub-Module Overview

In this section you will learn about:

- Mandatory Provisions of the NYCECC related to Envelope design;
- Prescriptive versus Performance-based Compliance Paths; and
- Using the ANSI/ASHRAE/IESNA Standard 90.1-2007 instead of the NYCECC.
3. Methods of Compliance

**Mandatory Requirements**

May include design features & construction practices

*NOT subject to Trade-offs*

**Prescriptive or Performance Targets**

Minimum criteria apply at the component, system, or whole building level

Trade-offs allowed, depending on compliance path

**Compliance Paths:**

Prescriptive / Trade-off / Performance-based

Requirements common to all Compliance Paths
3. Methods of Compliance

**Mandatory Requirements**

May include design features & construction practices

**NOT subject to Trade-offs**

**Prescriptive or Performance Targets**

Minimum criteria apply at the component, system, or whole building level

**Requirements subject to all Compliance Paths:**

- Mandatory
- Prescriptive or Trade-offs
- Performance-based

It is important to understand the basic structure of the Energy Code.

Mandatory requirements are defined throughout Chapters 4 and 5 of the NYCECC, and are not subject to any type of Trade-off.

Additional NYCECC provisions can be satisfied through Prescriptive compliance, Trade-offs, or a Performance-based approach.

The following slides describe each type of NYCECC provision in more detail.
3. Methods of Compliance

What are the Mandatory Provision Categories for Envelope Design?

**Air Leakage:**
- Includes provisions for:
  - Maximum allowable leakage of window, storefront, curtainwall, and door assemblies
  - Continuous Air Barriers
  - Outdoor Air Intakes and Exhaust Openings
  - Loading Dock Weatherseals
  - Vestibules
  - Recessed Lighting within the thermal envelope
  - See Topic 9 of this Module for further review of Air Leakage Requirements

**Vapor Retarders:**
- Vapor retarder requirements do **NOT** apply to NYC (Climate Zone 4a)

---

Even though the NYCECC does not require vapor retarders, the NYC Building Code does generally require them (with the noted exceptions).

**Per NYC Building Code, section BC 1403 - Performance requirements for Exterior Walls:**

1403.2 **Weather protection.** Protection against condensation in the exterior wall assembly shall be provided in accordance with the NYCECC.

1403.3 **Vapor Retarder.** An approved vapor retarder shall be provided.

Exceptions:
1. Where other approved means to avoid condensation and leakage of moisture are provided.
2. Plain and reinforced concrete or masonry exterior walls designed and constructed in accordance with Chaps. 19 and 21, as applicable.
Compliance Paths

3. Methods of Compliance

Options:

- 2011 NYCECC offers three compliance methods for envelope:
  
  1. **Prescriptive**
     - Through Opaque Assembly and Fenestration Tables
  
  2. **Trade-off**
     - Through U-Factor approach and COMCheck
  
  3. **Performance-based**
     - Through energy modeling

- Code also allows use of the ANSI/ASHRAE/IESNA 90.1-2007 standard (“ASHRAE 90.1”) as an alternative compliance method
  - ASHRAE 90.1 also offers Prescriptive, Trade-off & Performance Paths
Path 1: Prescriptive

3. Methods of Compliance

Level of effort: Simplest

- Prerequisites:
  - WWR (Window Wall Ratio): Must be ≤ 40%
  - SRR (Skylight-Roof Ratio): Must be ≤ 3%

- Each assembly must meet or exceed the prescribed thermal properties
  - R-Values of insulation for Walls, Roofs, Slabs
  - U Factors for doors and fenestration
  - SHGC for fenestration

Energy Analysis documentation will typically be through a Tabular Analysis or through COMCheck. See topic 10 of this module for details.

<table>
<thead>
<tr>
<th>NYC BOROUGHS (Climate Zone 4A)</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
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<tbody>
<tr>
<td>Insulation entirely above deck</td>
<td>R-20ci</td>
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<td>Metal buildings</td>
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<td>Attic &amp; Other</td>
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<td>Roll-Up Sliding Door</td>
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</tbody>
</table>
Path 2: Trade-Off

3. Methods of Compliance

Level of Effort: Simple to Moderate

- Prerequisites:
  - WWR ≤ 40%
  - SRR ≤ 3%

- Compliance is demonstrated through U-Factor Alternative approach
  - Based on U–Factor / C-Factor / F-Factor Tables

- Weighted average value per component type is allowed
  - Example: Non-compliance in one roof assembly can be compensated for by using more insulation in another roof assembly

- If COMcheck is used, Trade-offs can be performed among different envelope components (roofs, walls, fenestration)

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NYC BOROUGHS (Climate Zone 4A)
U-Factor Alternative Table

<table>
<thead>
<tr>
<th>Component</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
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<td>Roofs</td>
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<td>Heated Slab</td>
<td>F - 0.86</td>
<td>F - 0.86</td>
</tr>
</tbody>
</table>

NYCECC Table 502.1.2
3. Methods of Compliance

In this non-residential COMcheck example, the roof insulation R-value is below the prescriptive requirement of R-20; however overall envelope compliance has been achieved through improved performance of the exterior walls, windows, and doors.
Path 3: Total Building Performance

3. Methods of Compliance

**Level of Effort: High**

- Energy Modeling, per Section NYCECC 506 or using the Energy Cost Budget Method from ASHRAE 90.1, is used to demonstrate that:

  **Total Annual Energy Cost of the Proposed Building Design**
  
is less than or equal to
  
  **Total Annual Energy Cost of the Budget Building Design**

- Budget Building Design:
  - Meets mandatory & prescriptive Code requirements

- Proposed Building Design:
  - Meets mandatory requirements, but non-compliant parts (usually glass façade, sometimes lighting) are offset by high-performance parts (e.g., lighting, HVAC, central plant, cogeneration)
Path 3: Total Building Performance

3. Methods of Compliance

When Would a Project Pursue the Total Building Performance Approach?

Envelope–related Scenarios:
- Fenestration Area exceeds 40% of wall or 3% of roof
- Fenestration does not meet SHGC of 0.40
  - Example: Lower-performing low-e coating on clear glass
- Difficult or costly to insulate existing exterior walls to meet prescriptive R-Values or U-Factors

Other Potential Reasons:
- Project exceeds prescriptive interior Lighting Power Densities
- Project is pursuing a LEED rating, and requires energy modeling
- Project is pursuing energy-efficiency incentives (e.g., NYSERDA, Con Edison), and requires energy modeling
- Project uses Trade-offs among disciplines
Residential Scenario:
- Modeling is used to assess the effects of varying:
  - (WWR)
  - Glazing Wall insulation values
  - Glazing areas U-Factor
  - Glazing Solar Heat Gain Coefficient
  - Lighting Power (owner-installed)
  - Equipment Efficiencies (boilers)
Energy Modeling Example - 2

3. Methods of Compliance

Multi-Story Residential Building

Image: Viridian Energy & Environmental, LLC

Bar chart showing energy costs for various wall construction, glazing area, glazing U-factor, glazing SHGC, lighting, and boilers.
Energy Modeling Example - 2

This chart shows the energy use impact of different building components, as calculated through energy modeling of a sample multi-story residential building.

Different building systems (wall construction, glazing area, etc.) are shown in the six groups below. Within each group, the bar shaded in green represents the minimum prescriptive NYCECC requirement. Measures to the left of the green bar perform better than the Code minimum, while measures to the right perform worse. Any bars crossing into the red shaded portion of the graph perform worse than Code requirements.

The chart shows how certain design decisions, such as increasing the building’s glazing area above 40% WWR, correspondingly increase the building’s energy use. To achieve NYCECC compliance, the building must employ one or more counter-measures, such as reducing lighting power densities, utilizing modulating boilers, or improving the glazing U-Factor and SHGC.

Energy modeling is often used to assess these Trade-offs and define a path to overall NYCECC compliance.
Applicability:

- ASHRAE 90.1 is an approved alternative to the NYCECC
- If used, **ASHRAE 90.1 must be followed and applied for the entire project**
  - Applicants cannot mix compliance of one discipline in the NYCECC with another discipline in ASHRAE-90.1
- Prescriptive, Trade-off, or Performance-based paths can be used

Potential Reasons to Use ASHRAE:

- WWR > 40%, SRR> 3%
- Programs such as LEED, NYSERDA rebates, and Federal Tax credits are based on ASHRAE 90.1
- A few envelope measures are less stringent
  - Example: Up to 5% SRR allowed in prescriptive path
- Space-by-space lighting approach is allowed
More Extensive Mandatory Provisions:

- Power, Section 8.4, has maximum voltage drop requirements for main feeders (2%) and branch circuits (3%)

Although this item is not related to envelope, it is important to realize that pursuing compliance via ASHRAE 90.1 may have other repercussions that affect the applicant’s design.
3. Methods of Compliance

Q: A proposed office building has a 60% WWR on the front façade, shared party walls on the two sides with no windows, and a 10% WWF on the rear façade (which is equal in area to the front façade). Can the prescriptive path be used to show compliance?
A proposed office building has a 60% WWR on the front façade, shared party walls on the two sides with no windows, and a 10% WWF on the rear façade (which is equal in area to the front façade). Can the prescriptive path be used to show compliance?

Yes

The vertical glazing area of the entire building does not exceed 40% of the total wall area, so the prescriptive method can be used.
Building Envelope

4. Key Thermal Properties
4. Key Thermal Properties

Sub-Module Overview

In this section you will learn about:

- Key terminology used in describing the thermal properties of materials and assemblies, including:
  - R-Value, U-Factor, C-Factor, and F-Factor

- The R-Values of typical insulation materials, and how to verify R-Values in the field;

- The differences between continuous and cavity insulation; and

- How thermal bridging impacts the effectiveness of insulations and assemblies.
Opaque Envelope, Thermal Properties

4. Thermal Properties

Which Thermal Property Applies to Which Envelope Component?

R-Value
- Thermal Resistance
- Applies to all material components
- Unit: \( hr \cdot ft^2 \cdot ^\circ F / Btu \)

U-Factor
- Thermal Transmittance
- Applies to all assemblies except below grade walls and slabs on grade
- Includes exterior and interior air films
- Unit: \( Btu / hr \cdot ft^2 \cdot ^\circ F \)

C-Factor
- Thermal Conductance
- Applies to below-grade wall assemblies
- Unit: \( Btu / hr \cdot ft^2 \cdot ^\circ F \)

F-Factor
- Perimeter Heat Loss Factor
- Applies to Slabs on grade
- Unit: \( Btu / hr \cdot ft \cdot ^\circ F \)
R-Value (Resistance Value):

- Measures an individual material’s thermal resistance to heat flow
  
  ✅ Higher R-Value is Better

- R-Values can be added, but:
  - Only if materials are in series, and assuming there are no thermal bridging effects

- R-Values of insulation materials are used to show compliance using the Prescriptive Method

**Calculating the R-Value of a Simple Assembly (Structural Insulated Panel)**

<table>
<thead>
<tr>
<th>Material</th>
<th>R-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Air Film</td>
<td>0.17</td>
</tr>
<tr>
<td>Wood Shingles</td>
<td>0.87</td>
</tr>
<tr>
<td>Air infiltration barrier</td>
<td>--</td>
</tr>
<tr>
<td>5/8” Exterior Plywood Sheathing</td>
<td>0.85</td>
</tr>
<tr>
<td>5 ½” thick EPS Board Insulation</td>
<td>22</td>
</tr>
<tr>
<td>5/8” Interior Plywood Sheathing</td>
<td>0.85</td>
</tr>
<tr>
<td>5/8” Gypsum Wallboard</td>
<td>0.57</td>
</tr>
<tr>
<td>Inside Air Film</td>
<td>0.68</td>
</tr>
<tr>
<td><strong>TOTAL for Assembly: (“R-effective”)</strong></td>
<td><strong>25.99</strong></td>
</tr>
</tbody>
</table>
What is the Difference Between R and Rci?

R:
- Insulation installed within the cavity between framing members

Rci:
- Continuous insulation uninterrupted by framing, most commonly installed exterior to framing in climate zone 4
- Typically required in assemblies subject to thermal bridging

Code Requirement Examples:
- Roof (attic) - R-38: cavity only requirement
- Walls (mass) - R-9.5ci: continuous only requirement
- Walls (metal-framed) - R-13&R-7.5ci: continuous + cavity
R-Value: Prescriptive Method

4. Thermal Properties

How are R-Values Used to Determine Compliance in the Prescriptive Method?

Step 1: Determine Climate Zone:
- Zone 4A for all NYC Boroughs

Step 2: Confirm vertical fenestration & skylight area are below limits
- Vertical fenestration: (WWR ≤ 40%)
- Skylights: (SRR ≤ 3%)
  - ☒ If one of the above limits is exceeded, the Prescriptive method cannot be used

Step 3: Determine Minimum R + Rci Values
- Table 502.2(1): Based on Building Classification & Component type
- Each component must individually comply with the R-Value requirements

NYC BOROUGHS (Climate Zone 4A) Prescriptive R-Value Table

<table>
<thead>
<tr>
<th>NYC BOROUGHS (Climate Zone 4A)</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roofs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation entirely above deck</td>
<td>R-20ci</td>
<td>R-20ci</td>
</tr>
<tr>
<td>Metal buildings</td>
<td>R-13 + R13</td>
<td>R-19</td>
</tr>
<tr>
<td>Attic &amp; Other</td>
<td>R-38</td>
<td>R-38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Walls, Above Grade</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>R-9.5ci</td>
<td>R-11.4ci</td>
</tr>
<tr>
<td>Metal building</td>
<td>R-19</td>
<td>R-19</td>
</tr>
<tr>
<td>Metal framed</td>
<td>R-13 + R-7.5ci</td>
<td>R-13 + R-7.5ci</td>
</tr>
<tr>
<td>Wood frame and other</td>
<td>R-13</td>
<td>R-13 + R-3.8ci</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Below - Grade Walls</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NR</td>
<td>R-7.5ci</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Floors</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Floor</td>
<td>R-10ci</td>
<td>R-10ci</td>
</tr>
<tr>
<td>Joist / Framing / Steel / Wood Floor</td>
<td>R-30</td>
<td>R-30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Slabs</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Unheated Slab</td>
<td>NR</td>
<td>R-10 for 24 in Below</td>
</tr>
<tr>
<td>Heated Slab</td>
<td>R-15 for 24in Below</td>
<td>R-15 for 24in Below</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opaque Doors</strong></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Swinging Door</td>
<td>U-0.70</td>
<td>U-0.70</td>
</tr>
<tr>
<td>Roll-Up Sliding Door</td>
<td>U-0.50</td>
<td>U-0.50</td>
</tr>
</tbody>
</table>
### Batt Insulation

<table>
<thead>
<tr>
<th>Insulation Type</th>
<th>R-value Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiberglass Batts</td>
<td>R-3.1 to R-4.3 / inch</td>
</tr>
<tr>
<td>Rock Wool Batts</td>
<td>R-3.2 to R-3.9 / inch</td>
</tr>
<tr>
<td>Cotton Batts</td>
<td>R-3.7 / inch</td>
</tr>
</tbody>
</table>

### Rigid Foam Boards

<table>
<thead>
<tr>
<th>Insulation Type</th>
<th>R-value Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded Polystyrene</td>
<td>R-3.9 to R-4.2 / inch</td>
</tr>
<tr>
<td>Extruded Polystyrene</td>
<td>R-5.0 / inch</td>
</tr>
<tr>
<td>Polyisocynurate</td>
<td>R-5.6 to R-7.0 / inch</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>R-5.6 to R-7.0 / inch</td>
</tr>
</tbody>
</table>
## Insulation Materials - 2

### 4. Thermal Properties

**What are the Most Common Types of Insulation Materials Used?**

<table>
<thead>
<tr>
<th>Loose-Fill (Blown In)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>R-3.1 to R-3.7 / inch</td>
</tr>
<tr>
<td>fiberglass</td>
<td>R-2.2 to R-2.9 / inch</td>
</tr>
<tr>
<td>fiberglass (Dense-Pack)</td>
<td>R-3.4 to R-4.2 / inch</td>
</tr>
<tr>
<td>Mineral Wool</td>
<td>R-2.2 to R-2.9 / inch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spray-In Place</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyurethane Foam</td>
<td>R-5.6 to R-6.2 / inch</td>
</tr>
<tr>
<td>Low Density Urethane Foam</td>
<td>R-3.6 to R-4.3 / inch</td>
</tr>
<tr>
<td>Magnesium Silicate Foam</td>
<td>R-3.9 / inch</td>
</tr>
<tr>
<td>Wet-Spray Cellulose</td>
<td>R-2.9 to R-3.4 / inch</td>
</tr>
<tr>
<td>Spray-in Fiberglass</td>
<td>R-3.7 to R-3.8 / inch</td>
</tr>
</tbody>
</table>
4. Thermal Properties

How are R-Values Verified Through Progress Inspections?

Progress Inspection requirements for insulation placement and R-Values:

- Visual inspection required for installed insulation for each component of the conditioned space envelope, and junctions between components.

- Confirm that:
  - R-Values are marked
  - R-Values conform to those identified in the construction documents
  - The insulation is properly installed.

- Certifications for unmarked insulation shall be similarly visually inspected.
U-Factor – 1

4. Thermal Properties

What is U-Factor? When do You Use it Instead of R-Value?

U-Factor – Thermal Transmittance

- Conductance of a Total Assembly (Btu/H.ft².F)
- Inverse of an assembly’s R-Value
  - ✓ Lower U-Factor is Better

- Offers Flexibility for Trade-off Calculations:
  (Weighted-average Method)

  \[ U = \left( U_1 \cdot A_1 \right) + \left( U_2 \cdot A_2 \right) + \ldots \]

  \[ A_1 + A_2 + \ldots \]

  » U: U-Factor of material or assembly
  » A: Surface Area of the material or assembly

- ☒ Cannot be added in series
  (i.e., by layer of material)

- Accounts for thermal bridging
  (see later slides in this module)

Calculating the U-Factor of a Simple Assembly (Structural Insulated Panel)

<table>
<thead>
<tr>
<th>Material</th>
<th>R-Value</th>
</tr>
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<tbody>
<tr>
<td>Outside Air Film</td>
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<td>5/8” Gypsum Wallboard</td>
<td>0.57</td>
</tr>
<tr>
<td>Inside Air Film</td>
<td>0.68</td>
</tr>
<tr>
<td><strong>TOTAL R-Value for Assembly:</strong></td>
<td><strong>25.99</strong></td>
</tr>
<tr>
<td><strong>U-Factor for Assembly (1/R)</strong></td>
<td><strong>0.0385</strong></td>
</tr>
</tbody>
</table>
Common Mistake:
Averaging R-Values of different assemblies instead of U-Factors

- Example for Exterior Wall:
  - 50% of wall area has R-Value of 22 (opaque walls)
  - 50% of wall area has R-Value of 2.0 (fenestration)

What is the Weighted Average Thermal Resistance?

- If you average R-Values: **R-12**
- If you average U-Factors: **U = 0.273, or R-3.67**
Common Mistake:
Averaging R-Values of different assemblies in...

- Example for Exterior Wall:
  - 50% of wall area has R-Value of 22 (opaque walls)
  - 50% of wall area has R-Value of 2.0 (fenestration)

What is the Weighted Average Thermal Resistance?

- If you average R-Values: R-12
- If you average U-Factors: U = 0.273, or R-3.67

Heat travels through the path of least resistance. As shown in this example, the windows in a vertical wall assembly (which have a much lower R-value than the opaque wall areas) transmit heat at a much higher rate than the walls. When determining the overall wall performance, the U-Factors (which represent thermal transmittance) must be averaged. As shown in the example, averaging R-values will result in an exaggerated and incorrect value.

In this simple example, it can also be demonstrated that increasing the insulation levels in the opaque walls will result in little improvement overall, so long as the window values remain the same. Try increasing the wall R-value to 50 versus changing the window R-value to 3.0 – which has the greater impact? In buildings where the % of glazing is high, windows will dominate the overall heat loss performance of the wall.
C-Factor
- Only used for below-grade assemblies
  - Similar to U-Factor, but calculations omit exterior & interior air films and values for soil

F-Factor
- Only used for slabs-on-grade
  - Heat transfer is defined per linear foot, based on slab edge perimeter
How are U-Factors, C-Factors, and F-Factors Determined or Calculated?

ASHRAE 90.1-2007 Look-Up Tables
- Appendix A
  - Typical construction assemblies shown with U-Factor, C-Factor and F-Factor values

Software Programs
- COMcheck
- HVAC Load analysis programs
- LBL THERM (2-dimensional Heat Flow analysis)

Manual Calculations
- Refer to ASHRAE Fundamentals
  - Various methods defined based on type of assembly
    » e.g., Series Method, Parallel Path Method, Isothermal Method

For most users, the ASHRAE look-up tables will be the easiest way to determine U-Factor, C-Factor, or F-Factor values. If an applicant is submitting an energy analysis using these factors, be sure to cite the ASHRAE table or the calculation method used.
Thermal bridging is caused by heat transfer through highly-conductive materials

- Typically steel or aluminum framing members are of most concern, but other materials can also create thermal short circuits.

- Examples @ Cavity Wall assembly:
  - 3.5” Fiber glass insulation: R-13
  - + 1” Rigid XPS: Rci-3.8
  - + Other layers, R-2 approx. (Brick + Air Gap + Drywall + Air Films)
  - Total (Nominal) = R-18.8
- In a Metal Framed Wall, the effective value is R-12 (R-13 in cavity provides benefit of about R-7)
- In a Wood Framed Wall, the effective value is R-16 (R-13 in cavity provides benefit of R-10)
Thermal Bridging - 2

4. Thermal Properties

Masonry Wall / Concrete Slab Example

Aluminum framed window
Brick veneer
6” CMU
2” Semi-rigid mineral fiber
3 ½” metal studs w/R-13 fiberglass batts
Steel shelf angle

Nominal R-Value = 22
Thermal bridging occurs through many types of building assemblies. This example shows a vertical section through a masonry cavity wall at a concrete floor slab. Aluminum-framed windows are also shown above the wall and below the slab.

In this assembly, R-13 batt insulation is used within the cavities of an interior metal stud wall. In addition, a 2” thick semi-rigid mineral fiber batt is attached directly to the inside surface of the c.m.u. wall.

Without accounting for thermal bridging, this assembly would have a nominal R-Value of 22.

Nominal R-Value = 22
Thermal Bridging - 3

4. Thermal Properties

Analysis Performed Using 2-Dimensional Heat Flow Software

Calculated R-Value = 5.6
In actuality, thermal bridging occurs in several areas within this assembly. As reviewed in previous slides, the cavity insulation within the metal stud wall is subject to thermal bridging effects. In addition, as shown in this THERM computer analysis, the edge of the concrete slab, which is connected to both a steel shelf angle and the head of the aluminum window below, acts as a major short circuit for heat flow. In the THERM Heat Flux Profile, the lighter colors represent faster rates of heat flow through the assembly.

Overall, the thermal bridging effects reduce the effective R-value of this portion of the wall from R-22 to less than R-6.

A THERM analysis can also be used to evaluate the temperature profiles of the materials within an assembly. This can be useful in assessing where the dew point (and therefore condensation) may occur.

Calculated R-Value = 5.6
Building Envelope

5. Above-Grade Walls
5. Above Grade Walls

Sub-Module Overview

In this section you will learn about:

- Compliance criteria related to different wall types, including:
  - Mass Walls;
  - Metal Framed Walls;
  - Metal Building Walls;
  - Wood Framed Walls;
  - Structural Insulated Panels;
  - Insulated Concrete Forms; and
  - Opaque areas of Curtain Walls.
### Wall Types

#### 5. Above-Grade Walls

**What are the Major Types of Above-Grade Walls?**

<table>
<thead>
<tr>
<th>Type</th>
<th>Typical Construction</th>
<th>Prescriptive Insulation R-Values</th>
<th>Insulation R-Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Wall</td>
<td>Brick / Brick-CMU / CMU / Concrete walls</td>
<td>Others: R-9.5ci</td>
<td>Group R: R-11.4ci</td>
</tr>
<tr>
<td>Metal Framed Wall</td>
<td>Steel Stud walls</td>
<td>All building types: R-13 + R-7.5ci</td>
<td></td>
</tr>
<tr>
<td>Metal Building Wall</td>
<td>Steel Structural Member (Z-girt) walls</td>
<td>All building types: R-19 + Thermal Spacer</td>
<td></td>
</tr>
<tr>
<td>Wood Framed Wall</td>
<td>Wood Stud walls</td>
<td>Others: R-13</td>
<td>Group R: R-13 + R-3.8ci</td>
</tr>
</tbody>
</table>
Mass Wall - Qualification

5. Above-Grade Walls

What Qualifies as a Mass Wall?

Mass Wall Descriptions

- Load-bearing Brick
- Concrete Masonry Unit (CMU) backup with brick or other finish
- Poured Concrete
- Face Brick with Stud Backup, if the Face Brick is higher density

Weight criteria for mass wall classification

- >35 Lbs / ft² of surface area or
- ≥ 25 Lbs / ft² of surface area & ≤ 120 Lbs / ft³ of Volume
Q: Which of the following can qualify as Mass Walls?

☑ Solid Concrete (145 pcf): 3” thick or more: Yes

☑ 5-5/8” thick CMU wall, no grout – minimum 125 pcf: Yes

☑ 3-5/8” Solid-Face Brick (minimum 120 pcf – typical density varies between 70 to 140 pcf) with stud backing: Potentially

☒ 1” Face brick with stud backing: No

☒ 3” thick Fly ash concrete wall: No

☒ Plastered EIFS walls with metal stud Framing: No
**Mass Wall - Insulation**

### 5. Above-Grade Walls

**What are the Insulation Requirements for Mass Walls?**

#### Mass Wall Insulation Requirements:

<table>
<thead>
<tr>
<th>NYC BOROUGHS (Climate Zone 4A)</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Walls, Above Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescriptive Insulation R-value</td>
<td>R-9.5ci</td>
<td>R-11.4ci</td>
</tr>
<tr>
<td>Alternative U-Factor</td>
<td>U - 0.104</td>
<td>U - 0.09</td>
</tr>
<tr>
<td>Effective Assembly R-value</td>
<td>R-9.6</td>
<td>R-11.1</td>
</tr>
</tbody>
</table>

- Continuous insulation is placed to the exterior of the mass wall
- Use U-Factor table if:
  - Insulation inserts or fill (e.g., perlite) used within CMUs
  - Continuous insulation used on the winter-warm surface of the mass wall
  - Cavity wall insulation used on the winter-warm surface of the mass wall
- For Retrofits:
  - No insulation required if walls are not rebuilt and no cavity exists

**Double Wythe Concrete Masonry Unit Wall with Continuous Insulation**

**Insulation inserts within CMUs - No Credit allowed in R-Value Method (Use U-Factor Alternative)**
What are the Requirements for Metal Framed Walls?

**Steel Studs Walls**
- Typical walls are 4” or 6” steel studs, at 16” or 24” spacing

**Insulation Requirements**

<table>
<thead>
<tr>
<th>NYC BOROUGHS (Climate Zone 4A)</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metal Framed Walls, Above Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescriptive Insulation R-value</td>
<td>R-13 + R-7.5ci</td>
<td>R-13 + R-7.5ci</td>
</tr>
<tr>
<td>Alternative U-Factor</td>
<td>U - 0.064</td>
<td>U - 0.064</td>
</tr>
<tr>
<td>Effective Assembly R-value</td>
<td>R-15.625</td>
<td>R-15.625</td>
</tr>
</tbody>
</table>

- Insulation is both exterior and continuous (to mitigate thermal bridging)
- Cavity insulation can be removed if continuous insulation is increased and U-Factor method is used
- NYCECC Tables 502.2.8.1 & 502.2.8.2 define siding attachments over foam sheathing

**Sample Metal Framed Wall**

Layers from Exterior to Interior:
1. Continuous Rigid Insulation
2. Structural Sheathing
3. Steel studs
4. Cavity Insulation
5. Gypsum Wall Board
Metal Building Wall

5. Above-Grade Walls

How are Metal Walls Typically Constructed?

Wall Type Description

- Typically pre-fabricated

- Exterior metal skin attached to horizontal metal purlins that span between vertical building supports

- Insulation is draped over supports & compressed at the supports as exterior panels are fixed

- Rigid thermal blocks used at supports to mitigate thermal bridging

Typical Metal Wall Construction

1. “Z” Girts / Metal Purlins
2. Thermal Block
3. Batt Insulation with Vapor Retarder
4. Exterior Skin
5. Optional Interior Finish, Metal or Gypsum Board
### Insulation Requirements

<table>
<thead>
<tr>
<th>NYC BOROUGHS (Climate Zone 4A)</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metal Building Walls, Above Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescriptive Insulation R-value</td>
<td>R-19 + R-5 (Thermal Block)</td>
<td>R-19 + R-5 (Thermal Block)</td>
</tr>
<tr>
<td>Alternative U-Factor</td>
<td>U - 0.084</td>
<td>U - 0.084</td>
</tr>
<tr>
<td>Effective Assembly R value</td>
<td>R 11.9</td>
<td>R 11.9</td>
</tr>
</tbody>
</table>

- Constructions described in Table 502.2(2)
- U-Factors calculated in ASHRAE 90.1 Table A3.2
- Methods for computing U-Factor for custom types
  1. Manufacturer’s ratings
  2. Two dimensional heat flow modeling
  3. Three dimensional heat transfer modeling (more accurate)
  4. Laboratory testing of mock wall
Wood Framed Wall

5. Above-Grade Walls

What are the Prescriptive Requirements for Wood Framed Walls?

Wood Stud Walls

- Typical walls are 3.5” or 5.5” wood studs, at 16” or 24” o.c.

Insulation Requirements

<table>
<thead>
<tr>
<th>NYC BOROUGHS (Climate Zone 4A)</th>
<th>All Other Commercial</th>
<th>Group R, &gt;3 Stories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescriptive Insulation R-value</td>
<td>R-13</td>
<td>R-13 + R-3.8ci</td>
</tr>
<tr>
<td>Alternative U-Factor</td>
<td>U - 0.089</td>
<td>U - 0.064</td>
</tr>
<tr>
<td>Effective Assembly R-value</td>
<td>R-11.2</td>
<td>R-15.625</td>
</tr>
</tbody>
</table>

- Thermal bridging is not as significant as for steel stud walls, but:
  - For some building types, such as apartment buildings, wood studs and headers can account for 30-40% of the opaque wall area.
  - The fraction of wood is a consideration only when complying via U-Factor for assembly.

- NYCECC Tables 502.2.8.1 & 502.2.8.2 define siding attachments over foam sheathing
Other Wall Types

5. Above-Grade Walls

How do you Address Unconventional Wall Systems?

**Structural Insulated Panels (SIPS)**
- Also known as Stress Skin Panels
  - Rigid insulation sandwiched between shear panels (typically plywood or OSB)
  - Use U-Factor Method to demonstrate compliance
  - Manufacturers typically furnish assembly U-Factor data

**Insulated Concrete Forms (ICF)**
- Specially shaped insulation provides form work for concrete
  - Very good insulation values, but insulation needs to be protected on outside (stucco or other materials) and inside (GWB)
  - Use U-Factor Method to demonstrate compliance
  - Manufacturers typically furnish assembly U-Factor data
Opaque Sections of Curtain Walls

5. Above-Grade Walls

How are the Opaque Areas of Curtain Walls and Window Walls Addressed?

Code Insulation Requirements
- Use values for metal framed walls (Max. U = 0.064)

Curtain Walls
- Entirely in front of structure

Window Walls
- Rest on each floor, so slab edge is often exposed or covered, but not insulated

How are these U-Factors determined?
- From factory testing (uncommon)
- Through calculations
  - From NFRC calculations using two-dimensional heat flow modeling (typically THERM software)
  - From three-dimensional heat flow modeling (more accurate than 2D)
## Insulation Placement and R-Values

Installed insulation for each component of the conditioned space envelope and at junctions between components shall be **visually inspected to ensure that the R-Values are marked**, that such R-Values conform to the R-Values identified in the construction documents and that **the insulation is properly installed**. Certifications for unmarked insulation shall be similarly visually inspected.

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation Placement and R-Values</td>
<td>As required to verify continuous enclosure while walls, ceilings and floors are open</td>
</tr>
</tbody>
</table>

## Sealing

Openings and penetrations in the building envelope, including site-built fenestration and doors, shall be **visually inspected to verify that a continuous air barrier around the envelope forms and air-tight enclosure**. The Progress Inspector shall visually inspect to verify that materials and/or assemblies have been tested and meet the requirements of the respective standards, or that the building is tested and meets the requirements of the standard, in accordance with the standard(s) cited in the approved plans.

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealing</td>
<td>As required during construction</td>
</tr>
</tbody>
</table>
Key inspections for Above-Grade Opaque Walls

- Confirm R-Values of all installed insulation types
  - Verify values compared to approved drawings

- Check for continuity of the insulation at:
  - Corners
  - Window or door headers
  - Rim joists at floor framing
  - Junctions between different wall systems
  - Interior walls separating conditioned/unconditioned spaces

- Confirm proper installation of the insulation
  - Cavity insulation should fill the full width of the stud cavity
  - Batts should not be compressed behind piping, conduit, receptacles, etc.
  - Insulation should be replaced if severely ripped by piping, conduit, etc.
Key inspections for Above Grade Opaque Walls

- Confirm proper installation of the insulation (continued)
  - Blown-in, sprayed-in, or foamed-in-place insulations should fill all cavity voids – check behind framing, piping, receptacles, etc.
  - Continuous insulation boards should fit tightly together – no gaps
  - Fasteners for siding over foam sheathing should match NYCECC criteria

- Confirm proper documentation has been provided
  - Blown-in, sprayed-in, or foamed-in-place insulations should have R-Values verified through installer’s certificates

- Confirm joint sealing and the installation of a continuous air barrier system
  - See Air Leakage section of this module
5. Above-Grade Walls

This brief video, prepared by the U.S. Department of Energy, reviews key inspection issues related to insulation installation. Progress Inspectors may find useful tips in the video, even though it is not specific to the NYCECC.
Wall Renovation – Scenario 1

5. Above-Grade Walls

Q: A renovation involves the replacement of the interior wallboard along existing 6” deep steel stud exterior walls. The existing walls have 3.5” of fiberglass batt insulation (R-13). Does this insulation need to be improved?

A: Yes.

If the structure is unaltered, then insulation must be installed to full depth in wall cavity at a minimum.

If the structure is also fully rebuilt, Code mandates the assembly be brought to a U-Factor of 0.064 or lower.

R-7.5ci needs to be added to the wall if compliance is via R-value table 502.2(1)

Exception: Unaltered portions are not required to comply with NYCECC.

Exception: Alterations, renovations or repairs to wall which are insulated to full depth with insulation having a minimal nominal value of R-3.0/inch
A renovation involves the replacement of the interior wallboard along existing 3 1/2” deep steel stud exterior walls. The existing walls have 3.5” of fiberglass batt insulation (R-13). Does this insulation need to be improved?

A: No.

Allowed Exception.
Existing Insulation is at full depth and greater than R-3/inch.

Exception: Alterations, renovations or repairs to wall which are insulated to full depth with insulation having a minimal nominal value of R-3.0/inch.
Building Envelope

6. Roofs
6. Roofs

Sub-Module Overview

In this section you will learn about:

- Compliance criteria related to different roof / insulation assemblies, including:
  - Roofs with Insulation entirely above the Deck;
  - Roofs of Metal buildings (using thermal blocks at purlins); and
  - Roofs with Attics.
### Roof / Insulation Categories

#### 6. Roofs

**What are the Roof / Insulation Categories Addressed in the NYCECC?**

<table>
<thead>
<tr>
<th>Type</th>
<th>Insulation above Deck</th>
<th>Metal Building Roof</th>
<th>Attic &amp; Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Construction</td>
<td>Structural decks (concrete or steel)</td>
<td>Metal roofs of pre-fabricated metal buildings</td>
<td>Attics with insulation within the attic floor, Sloped roofs with insulation within the rafter framing, Flat roofs with insulation underneath the deck</td>
</tr>
<tr>
<td>Prescriptive Insulation R-values</td>
<td>All building types: R-20ci</td>
<td>Others: R-13+R-13 (with R-5 Thermal Block) Group R: R-19 (with R-5 Thermal Block)</td>
<td>All building types: R-38</td>
</tr>
</tbody>
</table>
### Roof Assembly Description
- Waterproof membrane + layer of Continuous Rigid insulation is attached on top of Concrete / Metal / Wood Deck

### Insulation
- Commercial or Group-R: R-20ci
- U-0.48 or lower
- If the Insulation is tapered for Drainage
  - The average area-weighted U-factor of the roof assembly with the varying insulation thicknesses must be equivalent to the same assembly with the NYCECC prescriptive R-value (R-20)
- Recommended Practice (beyond Code):
  - Joints between insulation sheets should be vertically staggered
Metal Building Roof

6. Roofs

Roof Assembly Description

- Metal skin exterior with metal purlin or joists support (typically every 4’)

Insulation

- Other Commercial: R13 + R13 (2 layers)
- Group R Buildings: R19 (1 layer)
- Assembly U-0.55 or lower
  - Thermal insulation block (R-5) is required to be installed between support purlin and exterior skin to reduce thermal bridging
  - First layer of insulation draped between thermal block & support – may get compressed at junctions
  - Second layer of insulation is required to be installed without any compression

Typical Metal Roof Construction

1. Thermal Block
2. “Z” Girts / Metal Framing Members
3. Compressed Layer Batt Insulation with Vapor Retarder
4. Uncompressed Layer Batt Insulation
5. Exterior Roof Skin
Roof Assembly Description:

All roof assemblies that:

- Do not have CONTINUOUS insulation above deck
- Are not metal building roofs
- Examples:
  - Roofs with attic
    - Ventilated attics with insulation installed over ceiling
    - Unventilated attics with insulation installed along slopes
  - Insulation between rafters of sloped roofs (cathedral ceilings)
  - Insulation above the deck of sloped roofs, interrupted by furring members which support the roofing
  - Insulation below flat decks (e.g., pin-impelled) - may NOT be placed above removable ceiling tiles.

Attic Roof:

1. Roof Deck & Rafters
2. Insulation Layer
3. Purlins
4. Air Tight Ceiling
Attics & Other

6. Roofs

**Insulation**
- Commercial or Group R: R-38
- Assembly U-0.027 or lower
- Air barrier details are critical

**Vented Attic – Insulation Details**
1. Soffit Vent
2. Vertical support for insulation
3. 2” clear air space for air flow
4. Polyethylene Baffle Membrane
5. R-38 Insulation required (Compression occurs at top plate & eaves)
6. Thermal Boundary
7. Air tight ceiling
6. Roofs

- Insulation installed over suspended ceilings that have removable panels cannot be counted for R-Value or U-Factor compliance.

- Loose-fill insulation is not permitted to be used in attic roof spaces when the slope of the ceiling is more than three in twelve.

- Air Barrier Control: Attic eave vents must have baffling to deflect the incoming air above the surface of the insulation.

- Lighting fixtures, HVAC, and other equipment should not be recessed in ceilings in such a manner that they might affect the insulation thickness.
### Progress Inspections

#### 6. Roofs

**What are the Applicable Progress Inspections for Roofs?**

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insulation Placement and R-Values</strong></td>
<td>As required to verify continuous enclosure while walls, ceilings and floors are open</td>
</tr>
<tr>
<td>Installed insulation for each component of the conditioned space envelope and at junctions between components shall be <strong>visually inspected to ensure that the R-Values are marked</strong>, that such R-Values conform to the R-Values identified in the construction documents and that the insulation is properly installed. Certifications for unmarked insulation shall be similarly visually inspected.</td>
<td></td>
</tr>
<tr>
<td><strong>Sealing</strong></td>
<td>As required during construction</td>
</tr>
<tr>
<td>Openings and penetrations in the building envelope, including site-built fenestration and doors, shall be <strong>visually inspected to verify that a continuous air barrier around the envelope forms and air-tight enclosure</strong>. The progress inspector shall visually inspect to verify that materials and/or assemblies have been tested and meet the requirements of the respective standards, or that the building is tested and meets the requirements of the standard, in accordance with the standard(s) cited in the approved plans.</td>
<td></td>
</tr>
</tbody>
</table>
Key inspections for Opaque Roofs

- Confirm R-Values of all installed insulation types
  - Verify values compared to approved drawings
  - If above deck tapered insulation is used, verify that pitching and thickness of insulation match or equal approved drawings
  - At metal buildings, confirm R-Value of thermal blocks
  - For loose fill or blown-in place insulation, confirm that R-Value depth markers have been installed

- Check for continuity of the insulation at:
  - Wall/ Roof connection at Eaves
  - Parapet walls
  - Skylight wells
  - Dunnage or other penetrations
Key inspections for Opaque Roofs

- Confirm proper installation of the insulation
  - Cavity insulation must fill the full width of the rafter or ceiling joist cavity.
  - Batts should not be compressed at roof eaves (pitched roofs).
  - Batts should not be compressed at ductwork, lighting fixtures, or other equipment.
  - Blown-in, sprayed-in, or foamed-in place insulations should fill all cavity voids.
  - Above deck insulation boards should fit tightly together – no gaps.
  - Where shown in drawings, rigid insulation should be provided at eaves or parapets.
  - Recessed light fixtures in the thermal envelope should have IC rating.
  - No insulation installed over removable ceiling tiles may be substituted for other insulation as shown on the drawings. (It does not count toward NYCECC compliance).
Key inspections for Opaque Roofs

- Confirm proper documentation has been provided
  - Blown-in, sprayed-in, or foamed-in-place insulations should have R-Values verified through installer’s certificates

- Confirm joint sealing and the installation of a continuous air barrier system
  - See Air Leakage section of this module
6. Roofs

Q: Partial Re-Roofing Scenario

This commercial building’s upper low-sloped roof (defined by the green shading) has an existing BUR membrane with negligible insulation. The roofing replacement project will require stripping the existing roofing down to the structural deck. The upper roof currently has only a 6” high parapet/curb. No renovation of the interior ceiling below the roof area is planned.

Is NYCECC-compliant insulation required?
**Q: Partial Re-Roofing Scenario**

This commercial building’s upper low-sloped roof (defined by the green shading) has an existing BUR membrane with negligible insulation. The roofing replacement project will require stripping the existing roofing down to the structural deck. The upper roof currently has only a 6” high parapet/curb. No renovation of the interior ceiling below the roof area is planned.

Is NYCECC-compliant insulation required?

**A: YES.**

Since the roofing is being stripped to the sheathing level, new insulation meeting NYCECC criteria must be added.

The Owner would need to determine if the preferred approach would entail exterior insulation (which could require raising the roof curb and possible adjustments at the bulkheads) or insulating from below.

See also Building Bulletin 2011-015.
Building Envelope

7. Other Opaque Assemblies
7. Other Opaque Assemblies

In this section you will learn about:

- Compliance criteria related to different opaque assemblies, including:
  - Below Grade Walls;
  - Slab on Grade Floors;
  - Floor Systems; and
  - Opaque Doors.
Below Grade Walls

7. Other Opaque Assemblies

Coverage

- ≥ 85% of the wall must be below grade to qualify

Insulation

- No requirement for non-Group R occupancy
- R-7.5ci required for Group-R occupancy
- Insulation to extend from top of wall to bottom of floor or to 10’ below grade, whichever is less
- C-Factor is used instead of U-Factor
- Protective coverings required for exposed exterior insulation

1. Earth
2. R-7.2ci Exterior Insulation (Group-R requirement)
3. CMU
4. Furring Space
5. Gypsum Wall Board
Insulation (Prescriptive)

- Heated Slab (Radiant Heating)
  - R-15 for 24” Below grade for Group R only

- Unheated Slab
  - No Requirement for commercial occupancy
  - R-10 for 24” below grade for Group R occupancy

- F-Factor Alternative
  - Heated Slab: Max. allowed F-0.860
    » Examples from ASHRAE 90.1-2007:
      ▪ R-10 for 36” (F-0.84)
      ▪ R-7.5 for 48” (F-0.85)
  - Unheated: F-0.730
  - Unheated (Group R): F-0.540
    » Examples from ASHRAE 90.1-2007:
      ▪ R-10 for 24” (F-0.54)
      ▪ R-5 for 48” (F-0.54)
Floors over Unconditioned Spaces

7. Other Opaque Assemblies

Coverage
- Any floor over unconditioned space
- 2 classes:
  1. Mass Floor
     » Must weigh 35#/SF of floor surface area, or
     » 25#/SF of floor surface area if material weight is not more than 120 pcf
  2. Floors with framing members
     » Joist/Framing, Steel or Wood

Insulation
- Mass Floors:
  ► R-10ci for non-Group R
  ► R-10.4ci for Group R
- Floors with framing members
  ► R-30

Typical Floor Insulation

1. Floor
2. Concrete Slab
3. Spray Insulation
4. Metal Beam
# Opaque Doors

## 7. Other Opaque Assemblies

### Door Classification
- Doors with less than 50% glass are considered opaque envelope
- Doors with 50% or more glass are regulated as Fenestration

### U-Factors for Opaque Doors
- Swinging Doors: U-0.70 or less
- Roll up or Sliding: U-0.50 or less

### Examples
- Steel or fiberglass doors with insulated cores
  - Fiberglass/Mineral Wool
  - Polystyrene
  - Polyurethane
- Many (but not all) wood doors

Be sure to obtain the manufacturer’s U-Factor for the full door assembly, not just the core insulation material. For example, a polystyrene core may have a U-Factor of 0.091, but the U-Factor of the overall steel door would be closer to 0.4.
# Progress Inspections

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protection of exposed foundation insulation</strong></td>
<td>As required during foundation work and prior to backfill</td>
</tr>
<tr>
<td>Insulation shall be visually inspected to verify proper protection where applied to the exterior of basement or cellar walls, crawl-space walls and/or the perimeter of slab-on-grade floors.</td>
<td></td>
</tr>
<tr>
<td><strong>Insulation Placement and R-Values</strong></td>
<td>As required to verify continuous enclosure while walls, ceilings and floors are open</td>
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</tr>
</tbody>
</table>

Additional requirements for doors are included under the Fenestration section of this module.
Key inspections for Below Grade Walls, Floors, & Opaque Doors

- Confirm R-Values of all installed insulation types
  - Verify values compared to submitted drawings

- Check for continuity of the insulation at:
  - Rim joists @ floor framing
  - Junctions between below grade walls and the floor structure above
  - Slab/Foundation wall connection

- Confirm proper installation of the insulation
  - Cavity insulation must fill the full width of the joist cavity
  - Batts in floor framing should be installed using wire supports or other means to keep them permanently in place
Key inspections for Below Grade Walls, FlooValues Opaque Doors

- Confirm proper installation of the insulation (continued)
  - Blown-in, sprayed-in, or foamed-in-place insulations should fill all cavity voids – check behind piping, receptacles, etc.
  - Rigid insulation boards should fit tightly together – no significant gaps
  - Exposed exterior insulation board at foundation wall or slab is covered with a protective coating that extends 6” or more below grade

- Confirm proper documentation has been provided
  - Blown-in, sprayed-in, or foamed-in-place insulations should have R-Values verified through installer’s certificates
  - U-Factors of full door assembly
  - Air leakage rating for manufactured door/frame assemblies
Key inspections for Below Grade Walls, Floors, & Opaque Doors

- Confirm joint sealing and the installation of a continuous air barrier system
  - See Air Leakage section of this module
Building Envelope

8. Fenestration
8. Fenestration

In this section you will learn about:

- Thermal & solar properties related to fenestration;
- Key dimensional metrics used in determining fenestration compliance; and
- Compliance criteria related to different fenestration types, including:
  - Unitary Windows;
  - Storefronts / Curtain Walls;
  - Skylights; and
  - Entrance Doors.
Importance of Fenestration

8. Fenestration

Why is Fenestration so Important to Building Energy Use?

Heat Loss

- Fenestration assemblies typically have much higher rates of heat loss vs. opaque walls
  - Example: Allowable metal framed wall U-Factor = 0.064
  - Allowable metal framed window U-Factor = 0.55
    - 8.6 x Higher

- Low surface temperatures of glazings can reduce occupant comfort
- Extensive glazing often requires perimeter radiation systems

Solar Heat Gain

- Solar heat gain through glazings can add substantially to the building cooling load
- High glazing-related peak loads can lead to larger AC system sizing
Daylighting

- Well-designed Fenestration systems can substantially reduce electric lighting loads through daylighting (often via automated dimming systems)

Air Leakage

- Fenestration systems (particularly operable windows and doors) and joints between Fenestration and walls are often the highest areas of air leakage in building assemblies
What are the Key Thermal and Solar Properties for Fenestration?

**U – Factor:**
- Heat transmission coefficient
- Lower is better
- Verified through the NFRC 100 Standard

**SHGC - Solar Heat Gain Coefficient:**
- Ratio of Solar Heat gain entering the space to the total solar radiation incident on the fenestration unit.
- Lower is better
- Verified through the NFRC 200 Standard

**Shading Coefficient (SC):**
- Older metric based on relative scale to single pane glass
- $SC \times 0.87 = SHGC$

**Visible Light Transmittance (VLT):**
- The fraction of the visible light spectrum that is allowed to pass through the window assembly
What are the Typical Ranges of Insulated Glazing Unit Performance?

The 2 different shades of blue in the bar graph represent the typical range of U-Factor values per glazing type.
The conductivity of different frame materials varies enormously. Even though the frame typically makes up only 10-30% of a fenestration assembly, the most conductive frame types (aluminum and steel) will significantly reduce the overall U-Factor.

\[ k = \frac{Btu \cdot in}{hr \cdot F \cdot ft^2} \]

Fiberglass: 0.31
Wood: 1.04
 VINYL: 1.39
Steel: 350
Aluminum: 1700

This diagram graphically represents the differences in conductivity among the typical framing materials used in commercial fenestration.
8. Fenestration

**System U-Factor vs. % of Glass Area**

**Effects of Framing on Window U-Factor**

- Uncoated Insulated Glass
- Low-e Insulated Glass
- Low-e w/argon gas fill Insulated Glass
- Triple pane Insulated Glass

---

**Glass Area / Window Area Ratio (%)**

**Center of Glass U-Factor**

**Fenestration U-Factor**

105
This graph illustrates the relationships between glazing type and frame area (expressed as the glass area to window area ratio). This example is for aluminum framed windows (thermally-broken).
8. Fenestration

Glass U-Factors & Indoor Glass Temperatures

- U-Value (BTU/ft²-hr-F)
- Winter Indoor Glass Temperature

<table>
<thead>
<tr>
<th>Glass Type</th>
<th>U-Value</th>
<th>Indoor Glass Temp (deg. F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncoated Double Pane</td>
<td>0.48</td>
<td>50.0</td>
</tr>
<tr>
<td>Hard Coat lo-e</td>
<td>0.4</td>
<td>53.7</td>
</tr>
<tr>
<td>Soft Coat lo-e</td>
<td>0.305</td>
<td>57.6</td>
</tr>
<tr>
<td>Soft Coat lo-e + Argon</td>
<td>0.255</td>
<td>59.6</td>
</tr>
<tr>
<td>Soft Coat lo-e + Krypton</td>
<td>0.235</td>
<td>60.4</td>
</tr>
<tr>
<td>Suspended film</td>
<td>0.19</td>
<td>62.2</td>
</tr>
<tr>
<td>Suspended film + Argon</td>
<td>0.13</td>
<td>64.7</td>
</tr>
<tr>
<td>Two suspended films</td>
<td>0.13</td>
<td>64.7</td>
</tr>
<tr>
<td>Two suspended films + Argon</td>
<td>0.09</td>
<td>66.3</td>
</tr>
</tbody>
</table>

2011 NYCECC
July 2011
An additional benefit of high performance glazing is occupant comfort. During the heating season, glazings with lower U-Factors will also have higher mean radiant temperatures on the inside surface of the glass (as shown in the red line). These warmer temperatures will make occupants who sit near the windows feel more comfortable. When very high performance glazings are used (such as triple pane), designers may be able to eliminate perimeter radiation systems.
Options to Control Solar Gain

- **Design Concept:**
  - Building massing, Façade Orientation
  - Shading from adjacent buildings, vegetation, etc.
- **Exterior Overhangs, Louvers, Shading Devices**
- **Glazing Options:**
  - Low-e Coatings
  - Tinted Glass
  - Ceramic Fritting Patterns

**Light to Solar Heat Gain Ratio (LSG)**

- Visible Light Transmittance (VLT) / Solar Heat Gain Coefficient (SHGC)
- Higher is better

### Examples of LSG Values

<table>
<thead>
<tr>
<th>Glass Type</th>
<th>VLT</th>
<th>SHGC</th>
<th>LSG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncoated Clear IGU</td>
<td>0.79</td>
<td>0.70</td>
<td>1.13</td>
</tr>
<tr>
<td>Good Low-e coating, clear glass</td>
<td>0.70</td>
<td>0.38</td>
<td>1.84</td>
</tr>
<tr>
<td>Low-e coating + green tint</td>
<td>0.60</td>
<td>0.31</td>
<td>1.94</td>
</tr>
<tr>
<td>Low-e coating + 50% frit, clear glass</td>
<td>0.44</td>
<td>0.26</td>
<td>1.69</td>
</tr>
<tr>
<td>Superior Low-e coating, low-iron glass</td>
<td>0.64</td>
<td>0.27</td>
<td>2.37</td>
</tr>
</tbody>
</table>
8. Fenestration

What Types of Fenestration are Covered in the NYCECC?

Coverage:

- Vertical Windows - Fixed & Operable
- Curtain Walls (Vision Panels)
- Storefront Systems
- Skylights & Roof Windows
- Doors (> 50% glazing)
- Glass Block Walls and Panels

Exceptions:

- Storm Windows installed over existing fenestration
- Glass only replacements in existing sash and frames
**Fenestration Area:**
- Includes gross area covering outer boundaries of the frame, typically measured at rough opening

**Window to Wall Ratio (WWR):**
- Ratio of vertical fenestration to gross exterior above-grade wall area
- For Prescriptive method $WWR \leq 40\%$

**Skylight to Roof Ratio (SRR):**
- Ratio of horizontal fenestration to gross roof area
- For Prescriptive method $SRR \leq 3\%$

**PF - Projection Factor:**
- Ratio of horizontal projection of shading device to the vertical height from sill level of fenestration
- $PF = A / B$
Process

- Determine type of vertical fenestration
  - Curtain Wall / Storefront
  - Entrance Door
  - All Other (Operable or Fixed Windows, Non-Entrance Doors)

- Determine Frame Type
  - **Non-Metal Framing**
    - Wood / Vinyl / Fiberglass
    - Metal Clad Wood or similar hybrids
  - **Metal Framing (with or without Thermal Break)**

- Determine Shading Projection Factor

- Use NYCECC Table 502.3 for maximum allowed assembly U-Factor & SHGC

<table>
<thead>
<tr>
<th>Vertical Fenestration Type</th>
<th>U Factor</th>
<th>SHGC, PF&lt;0.25</th>
<th>SHGC, PF&gt;0.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Metal Frame</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Framed - Curtain Wall / Store Front</td>
<td>0.50</td>
<td>0.4</td>
<td>NR</td>
</tr>
<tr>
<td>Metal Framed Window / All Other</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Framed Entrance Door</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The U-Factor and SHGC of window, storefront, and door assemblies is typically provided by the manufacturer in their product literature, based on NFRC 100 (U-Factor) and NFRC 200 (SHGC) testing protocols. During Progress Inspections, NFRC labels should be affixed to fenestration products, and should be used to verify the approved performance values.
Curtain Walls
- Entirely in front of structure
- Typically, \( U = 0.42 \text{ to } 0.48 \) for thermally improved or thermally broken assemblies

Window Walls
- Rest on each floor, so slab edge is often exposed, or covered but not insulated
- Typically, \( U = 0.48 \text{ to } 0.50 \) (thermally broken), exclusive of slab edge

How are these U-Factors determined?
- From factory testing (uncommon)
- Through calculations
  - From NFRC calculations using two-dimensional heat flow modeling (typically THERM software)
  - From three-dimensional heat flow modeling (more accurate than 2D)
The U-Factor of custom curtainwall assemblies is typically provided by the manufacturer using 2 or 3-dimensional heat flow analysis software, and following the protocols of NFRC 100. Applicants should have reports available as back-up if an audit is conducted.
What are the Prescriptive Requirements for Skylights?

Coverage:

- Glazing on horizontal or within 60° from horizontal are covered under skylights
- Glass or Polymer glazings

Requirements:

- For Prescriptive Method:
  - Skylight to Roof Ratio (SRR) must be less than or equal to 3%
- Assembly U-Factor: 0.60 maximum
- Assembly SHGC: 0.40 maximum
- Values verified through NFRC 100 and 200
Unlabeled Fenestration

- Default values must be used from NYCECC Section 303.1.3 (and be included in the Energy Analysis)

- Since the default values do NOT meet prescriptive criteria, Trade-off or performance-based compliance must be pursued

**TABLE 303.1.3(1)
DEFAULT GLAZED FENESTRATION U-FACTORS**

<table>
<thead>
<tr>
<th>FRAME TYPE</th>
<th>SINGLE PANES</th>
<th>DOUBLE PANES</th>
<th>SINGLE SKYLIGHT</th>
<th>DOUBLE SKYLIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal</td>
<td>1.20</td>
<td>0.80</td>
<td>2.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Metal with thermal break</td>
<td>1.10</td>
<td>0.65</td>
<td>1.90</td>
<td>1.10</td>
</tr>
<tr>
<td>Nonmetal or metal clad</td>
<td>0.95</td>
<td>0.55</td>
<td>1.75</td>
<td>1.05</td>
</tr>
<tr>
<td>Glazed block</td>
<td></td>
<td></td>
<td>0.60</td>
<td></td>
</tr>
</tbody>
</table>
### Inspection / Test

<table>
<thead>
<tr>
<th>Inspection thermal values and product ratings</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fenestration thermal values and product ratings</strong></td>
<td><strong>As required during installation</strong></td>
</tr>
<tr>
<td>U-Factors and SHGC values of installed fenestration shall be visually inspected for conformance with the U-Factors and SHGC values identified in the construction drawings by verifying the manufacturer’s NFRC labels or, where not labeled, using the ratings in NYCECC Tables 303.1.3(1), (2) and (3). Where ASHRAE 90.1 is used, visible light transmittance values shall also be verified.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fenestration and door assembly product ratings for air leakage</th>
<th><strong>As required during installation; prior to final construction inspection</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fenestration and door assembly product ratings for air leakage</strong></td>
<td></td>
</tr>
<tr>
<td>Windows and sliding or swinging door assemblies, except site-built windows and/or doors, shall be visually inspected to verify that installed assemblies are labeled by the manufacturer to the referenced standard. For curtain wall, storefront glazing, commercial entrance doors and revolving doors, the testing reports shall be reviewed to verify that the installed assembly complies with the standard cited in the approved plans.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sealing</th>
<th><strong>As required during construction</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sealing</strong></td>
<td></td>
</tr>
<tr>
<td>Openings and penetrations in the building envelope, including site-built fenestration and doors, shall be visually inspected to verify that a continuous air barrier around the envelope forms an air-tight enclosure. The progress inspector shall visually inspect to verify that materials and/or assemblies have been tested and meet the requirements of the respective standards, or that the building is tested and meets the requirements of the standard, in accordance with the standard(s) cited in the approved plans.</td>
<td></td>
</tr>
</tbody>
</table>
## Progress Inspections

### 8. Fenestration

#### What are the Applicable Progress Inspections for Fenestration?

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fenestration areas</td>
<td>Prior to final construction inspection</td>
</tr>
<tr>
<td>Dimensions of windows, doors and skylights shall be verified by visual inspection.</td>
<td></td>
</tr>
<tr>
<td>Projection factors</td>
<td>Prior to final construction inspection</td>
</tr>
<tr>
<td>Where the energy analysis utilized a projection factor &gt; 0, the projection dimensions of overhangs, eaves or permanently attached shading devices shall be verified against approved plans by visual inspection.</td>
<td></td>
</tr>
</tbody>
</table>
8. Fenestration

**Key inspections for Fenestration**

- Confirm areas of fenestration have not increased from approved drawings

- Confirm U-Factor, SHGC, & Air Leakage of all installed fenestration types
  - Verify values compared to submitted drawings

- Confirm Projection Factors of overhangs or shading devices match approved drawings

- Confirm joint sealing at the fenestration and integration with the continuous air barrier system
  - See Air Leakage section of this module

- Confirm proper documentation has been provided
  - Look for NFRC Labels or Test Results
9. Air Leakage Control

Building Envelope
9. Air Leakage Control

Learning Objectives

In this section you will learn about:

- Concepts & terminology related to Air Leakage;
- Air leakage control requirements mandated in the NYCECC; and
- Air Barrier Systems.
Air Leakage:

- Includes provisions for:
  - Maximum allowable leakage of window, storefront, curtainwall, and door assemblies
  - Continuous Air Barriers
  - Outdoor Air Intakes and Exhaust Openings
  - Loading Dock Weatherseals
  - Vestibules
  - Recessed Lighting

Vapor Retarders:

- NYCECC requirements do NOT apply to NYC (all Boroughs are Climate Zone 4A)

---

Per NYC Building Code, section BC §1403 - Performance requirements for Exterior Walls:

§1403.2 Weather protection. Protection against condensation in the exterior wall assembly shall be provided in accordance with the ECCNYS.

§1403.3 Vapor Retarder. An approved vapor retarder shall be provided.

Exceptions:
1. Where other approved means to avoid condensation and leakage of moisture are provided.
2. Plain and reinforced concrete or masonry exterior walls designed and constructed in accordance with Chapters. 19 and 21, as applicable.
Air Leakage Rates:

- Amount of air that can leak through an assembly at specific pressure differential

- CFM / SF @ PSF
  - CFM: Cubic Feet per Minute
  - SF: Surface Area in Square feet
  - PSF: Pressure in Pounds per Square Foot

- Compliance can be demonstrated for individual materials, assemblies, or whole buildings
Air Leakage Control: Fenestration

9. Air Leakage Control

Air Leakage Limits for Fenestration

- Windows: 0.3 cfm/SF
  Doors: 0.5 cfm/SF
  - Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or
  - Certified & labeled following NFRC 400

- Curtainwalls & Storefront Glazing:
  0.3 cfm/SF @ 1.57 psf (75 Pa)
  - Tested in accordance with ASTM E 283

- Glazed Entrance Doors
  (swinging & revolving):
  1.00 cfm/SF @ 1.57 psf (75 Pa)
  - Tested in accordance with ASTM E 283

---

**World's Best Window Co.**

Millennium 2000+
Vinyl-Clad Wood Frame
Double Glazing - Argon Fill - Low E
Product Type: Vertical Slider

**ENERGY PERFORMANCE RATINGS**

<table>
<thead>
<tr>
<th>U-Factor (U.S./I-P)</th>
<th>Solar Heat Gain Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>0.30</td>
</tr>
</tbody>
</table>

**ADDITIONAL PERFORMANCE RATINGS**

<table>
<thead>
<tr>
<th>Visible Transmittance</th>
<th>Air Leakage (U.S./I-P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.51</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer’s literature for other product performance information. www.nfrc.org

**NFRC Labels must be reviewed as part of the Progress Inspections**
Air Barrier:

- Required to prevent uncontrolled leakage of air through the envelope
  - Common problems due to air leakage:
    - Comfort issues,
    - Over-worked HVAC systems,
    - Degradation of insulation,
    - Moisture damage, mold growth, risk to structural integrity of envelope
Air Barrier:

NYCECC Requirements:
- A continuous system throughout the envelope
- Typically involves multiple materials working in concert, such as:
  - Seam sealers between foundations and structural framing
  - Elastomeric or liquid-applied membrane systems (typically used over masonry)
  - “House wrap” permeable air infiltration barriers
  - T&G or taped exterior gwb sheathing
  - Caulked and sealed joints and penetrations
  - Metal or membrane flashings
  - Expandable foam sealants at wall penetrations and fenestration/door openings
  - Rigid or spray applied foam insulations (rigid insulation boards must have joints taped)
  - Roofing paper or membranes
Measuring Air Barrier Compliance

9. Air Leakage Control

Individual Materials:
- 0.004 cfm/SF @ 0.3 in. water gauge
  - ASTM E 2178: Air Permeance of Materials
  - Typical: Use manufacturer’s tested values
    » Air Barrier Association of America, Inc. (ABAA) has directory of tested products

Assemblies:
- 0.04 cfm/ft² @ 0.3 in. water gauge
  - ASTM E 2357: Air Leakage of Air Barrier Assemblies, or
  - ASTM E 1677: Air Retarder (AR) Material or System for Systems Low-Rise Framed Building Walls
  - Typical: Use manufacturer’s tested value or test mock up assemblies of 8’x8’ sizes

Whole Buildings:
- 0.4 cfm/ft² @ 0.3 in. water gauge
  - ASTM E 779: Air Leakage Rate by Fan Pressurization
  - Best practice: Blower Door tests with infrared imaging during construction for detecting and correcting for leaks
This brief video, prepared by the U.S. Department of Energy, reviews key inspection issues related to air sealing. Progress Inspectors may find useful tips in the video, even though it is not specific to the NYCECC.

Air Leakage Inspection Issues
(Length - 0:52)
Vestibules:
- Required for Main Entrance Doors opening into a conditioned space over 3,000 SF
- Exceptions include:
  - Doors not used for entrances
  - Doors opening directly from Sleeping units or Dwellings unit
  - Revolving doors
  - Service doors

Loading Dock Weatherseals:
- Required at cargo or loading dock doors
Outdoor Air Intakes & Exhaust Openings:

- Class I motorized leakage-rated dampers are required at:
  - Stair & Elevator shafts
  - Other OA intakes & exhaust openings integral to the envelope
  - Maximum leakage rate 4 cfm/SF @ 1.0 in water gauge (1250 Pa)

- Exceptions:
  - In buildings less than 3 stories in height, non-motorized gravity dampers are allowed
Recessed Lighting:

- If installed in thermal envelope, must be sealed, gasketed, or caulked @ interior finish

- Must be IC- Rated (Insulation Contact Rated) and labeled as meeting ASTM E 283
  - Maximum 2.0 cfm at 1.57 psf pressure difference
Progress Inspections

9. Air Leakage Control

**What are the Applicable Progress Inspections for Air Leakage?**

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fenestration and door assembly product ratings for air leakage</strong></td>
<td></td>
</tr>
<tr>
<td>Windows and sliding or swinging door assemblies, except site-built windows and/or</td>
<td></td>
</tr>
<tr>
<td>doors, shall be <strong>visually inspected to verify that installed assemblies are labeled by the manufacturer to the referenced standard.</strong> For curtain wall, storefront glazing, commercial entrance doors and revolving doors, the testing reports shall be reviewed to verify that the installed assembly complies with the standard cited in the approved plans.</td>
<td>As required during installation; prior to final construction inspection</td>
</tr>
<tr>
<td><strong>Sealing of Openings and Penetrations</strong></td>
<td></td>
</tr>
<tr>
<td>Openings and penetrations in the building envelope, including site-built fenestration and doors, shall be <strong>visually inspected to verify that a continuous air barrier around the envelope forms an air-tight enclosure.</strong> The Progress Inspector shall visually inspect to verify that materials and/or assemblies have been tested and meet the requirements of the respective standards, or that the building is tested and meets the requirements of the standard, in accordance with the standard(s) cited in the approved plans.</td>
<td>As required during construction</td>
</tr>
</tbody>
</table>
Key inspections for Air Leakage Control

- Confirm the use of sill sealers, gaskets, caulking and other means where framing, masonry, or prefabricated wall panels meet a foundation wall or slab

- Confirm the main type(s) of air barrier materials used for the above-grade walls
  - Confirm the air permeance of the air barrier material or assembly

- Confirm the air leakage rate of all fenestration
  - Look for NFRC Labels for Windows, Doors
  - Obtain test results for Curtainwalls
Key inspections for Air Leakage Control

- Confirm the use of flashing, window dams, expandable foam sealant, and caulking at rough opening/fenestration joints to create a continuous air barrier with the surrounding wall system.

- Confirm the use of gaskets, backer rods, caulking and other means at all expansion joints, utility penetrations, roof/wall connections, and other similar conditions.
9. Air Leakage Control

**Key inspections for Air Leakage Control**

- Confirm IC rating recessed lighting fixtures in insulated ceilings, and sealing of fixtures against the finish ceiling

- Confirm vestibules are built per approved drawings
  - Confirm self-closers on doors

- Confirm loading dock weather seals are installed where applicable

- Confirm the use of motorized, leakage-rated dampers at applicable stairwells, elevator shafts, and other locations

- Confirm results of blower door testing, if utilized
Building Envelope

10. Submissions & Inspections

Photo: US DOE Building Energy Codes University
10. Submissions & Inspections

Learning Objectives

<table>
<thead>
<tr>
<th>In this section you will learn about:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope-related requirements for NYCECC Submissions, including:</td>
</tr>
<tr>
<td>- Energy Analysis, and</td>
</tr>
<tr>
<td>- Supporting Documentation; and</td>
</tr>
<tr>
<td>Applicable Progress Inspections associated with building envelope</td>
</tr>
</tbody>
</table>
Per 1 RCNY §5000-01:

- A Professional Statement
- An Owner Statement
- An Energy Analysis
- Supporting Documentation, including required Progress Inspections descriptions in drawings

This Envelope Module addresses only Energy Analysis, Supporting Documentation, and Progress Inspection issues. A full overview of the required submission documents, including Professional and Owner Statements, is included under the NYCECC Administrative Overview module in this series.
Per 1 RCNY §5000-01:

- Tabular Analysis
- COMcheck software
- Energy Modeling
- Alternative Formats
Option 1: Tabular Analysis

- The Tabular Analysis compares proposed values of each ECC-regulated item in the scope of work with the respective prescriptive values required by the Code.
  - Applicable to New Buildings, Additions, or Alterations
  - Demonstrates Prescriptive Compliance
  - Can be used with either NYCECC or ASHRAE 90.1

Envelope documentation should be sure to include:

- **ALL** assemblies related to the scope of work (roofs, above grade walls, fenestration, below grade walls, floors over unconditioned space, etc.)
- **ALL** significant variations of envelope assemblies (different wall assemblies, glazing types, roof assemblies, door types, etc.)
## Sample Tabular Analysis - 1

### 10. Submissions & Inspections

#### Examples of Notes for Commercial Alterations / Renovations

<table>
<thead>
<tr>
<th>ITEM DESCRIPTION</th>
<th>PROPOSED DESIGN VALUE</th>
<th>CODE PRESCRIPTIVE VALUE AND CITATION</th>
<th>SUPPORTING DOCUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUILDING ENVELOPE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace roof membrane and add insulation SRR = 2.2%</td>
<td>Roof Type 1: 4” XPS (R-20) continuous insulation above deck</td>
<td>Minimum R-20 continuous insulation NYCECC Table 502.2(1)</td>
<td>Roof Type 1: A-106 (Roof Plan) A-402 (Wall Sections) 6-8/A-603 (Roof Details)</td>
</tr>
<tr>
<td>Replace existing windows w/new aluminum framed windows, Floors 2 - 4 WWR = 32% PF = 0</td>
<td>Window Type A: U = 0.46, SHGC = 0.29, Air leakage ≤ 0.10 cfm/SF Window Types B + C: U = 0.41, SHGC = 0.31, Air leakage ≤ 0.30 cfm/SF Window Type D: U = 0.41, SHGC = 0.23, Air leakage ≤ 0.30 cfm/SF</td>
<td>Window Types A-D: Maximum U-Factor = 0.55 Maximum SHGC = 0.40 NYCECC Table 502.3 Maximum Air Leakage = 0.3 cfm/SF NYCECC 502.4.1</td>
<td>Window Types A-D: A-301-302 (Elevations) A-501 (Schedules)</td>
</tr>
<tr>
<td>Renovate interior side of exterior walls around new window openings – repair/replace gwb</td>
<td>N/A - No change proposed to existing 3 ½” metal stud furring walls which are completely filled with fiberglass batts (estimated R-3.1/inch).</td>
<td>NYCECC 101.4.3 Exception 3 – Alterations, renovations, or repairs to roof/ceiling, wall, or floor cavities which are insulated to full depth with insulation having a minimal nominal value of R-3.0/inch.</td>
<td>A-102-104 (Floor Plans) 1-2/A-305 (Interior Elevations)</td>
</tr>
</tbody>
</table>
### Sample Tabular Analysis - 1

10. Submissions & Inspections  **Examples of Notes for Commercial Alterations / Renovations**

<table>
<thead>
<tr>
<th>ITEM DESCRIPTION</th>
<th>PROPOSED DESIGN VALUE</th>
<th>CODE PRESCRIPTIVE VALUE AND CITATION</th>
<th>SUPPORTING DOCUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUILDING ENVELOPE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Replace roof membrane and add insulation  
SRR = 2.2% | Roof Type 1:  
4” XPS (R-20) continuous insulation above deck | Roof Type 1:  
A-106 (Roof Plan)  
A-402 (Wall Sections)  
6-8/A-603 (Roof Details) | |
| Replace existing windows w/new aluminum framed windows,  
Floors 2 - 4  
WWR = 32%  
PF = 0 | Window Type A:  
U = 0.46, SHGC = 0.29,  
Air leakage ≤ 0.10 cfm/SF  
Window Types B + C:  
U = 0.41, SHGC = 0.31,  
Air leakage ≤ 0.30 cfm/SF  
Window Type D:  
U = 0.41, SHGC = 0.23,  
Air leakage ≤ 0.30 cfm/SF | Maximum SHGC = 0.40  
NYCCEC Table 502.3  
Maximum Air Leakage = 0.3 cfm/SF  
NYCCEC 502.4.1 | Window Types A-D:  
A-301-302 (Elevations)  
A-501 (Schedules) |
| Renovate interior side of exterior walls around new window openings – repair/replace gwb | N/A - No change proposed to existing  
3 ½” metal stud furring walls which are completely filled with fiberglass batts (estimated R-3.1/inch). | NYCECC 101.4.3 Exception 3 – Alterations, renovations, or repairs to roof/ceiling, wall, or floor cavities which are insulated to full depth with insulation having a minimal nominal value of R-3.0/inch. | A-102-104 (Floor Plans)  
1-2/A-305 (Interior Elevations) |

Applicants must include reference to the applicable Supporting Documentation for EACH item within the Tabular Analysis.
### 10. Submissions & Inspections  | Examples of Notes for Commercial Alterations / Renovations

#### Sample Tabular Analysis - 2

<table>
<thead>
<tr>
<th>ITEM DESCRIPTION</th>
<th>PROPOSED DESIGN VALUE</th>
<th>CODE PRESCRIPTIVE VALUE AND CITATION</th>
<th>SUPPORTING DOCUMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUILDING ENVELOPE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add insulation/furring to existing basement walls</td>
<td>Wall Type 2: 1 ½&quot; rigid Extruded Polystyrene continuous insulation (R-7.5) adhered to existing concrete foundation walls</td>
<td>Minimum R-7.5 continuous insulation (Group R) Table 502.2(1)</td>
<td>Wall Type 2: A-100 (Basement Plan) 2/A-603 (Wall Detail)</td>
</tr>
<tr>
<td>New metal exterior egress doors in existing metal frames</td>
<td>Door Type 1: Insulated Steel Door U = 0.62</td>
<td>Maximum U-Factor = 0.70 Table 502.2(1)</td>
<td>Door Type 1: A-101 (1st Floor Plan) A-301 (Elevations) A-501 (Schedules)</td>
</tr>
<tr>
<td>Air Sealing @ replacement windows</td>
<td>Expandable spray-applied polyurethane foam sealant, continuous @ window rough openings</td>
<td>NYCECC 502.4.3 – Continuous Air Barrier</td>
<td>A-501 (Schedules) – see air sealing notes in Comments column of Window Schedule</td>
</tr>
<tr>
<td>New Vestibule at 1st Floor Entry</td>
<td>New 10’ deep vestibule @ building entrance. Two sets of swinging doors with self-closers.</td>
<td>NYCECC 502.4.6 - Vestibules</td>
<td>A-101 (1st Floor Plan) A-501 (Schedules) – see door closer notes in Comments column of Door Schedule</td>
</tr>
</tbody>
</table>
10. Submissions & Inspections

How Should the Envelope be Addressed in the Energy Analysis?

Option 2: COMcheck submissions

- COMcheck software, available for free from the US Department of Energy, can be used to prepare Energy Code compliance calculations.
  - Demonstrates Prescriptive Compliance, with Trade-offs allowed among different envelope assemblies (roofs, walls, glazings, etc.)
  - Only New York State NYCECC or ASHRAE-90.1 COMcheck forms are permitted (not IECC)

Envelope input in COMcheck should be sure to include:
- **ALL** assemblies related to the scope of work (roofs, above grade walls, fenestration, below grade walls, floors over unconditioned space, etc.)
- **ALL** significant variations of envelope assemblies (different wall assemblies, glazing types, roof assemblies, door types, etc.)
All Wall Types, Roof Types, Fenestration Types, Floor Types, and Door Types in the COMcheck analysis should use the same nomenclature as those shown in the Supporting Documentation (Drawings & Schedules).
Option 3: Energy Cost Budget Worksheet

- Either NYCECC Section 506 or the Energy Cost Budget Method of ASHRAE 90.1 can be used to demonstrate compliance.
  - Applicable to New Buildings, Additions, or Alterations
  - Requires computer energy modeling, using software programs approved by the Secretary of State of New York State and the NYC Commissioner of Buildings (e.g., DOE-2.1E, VisualDOE, Energy Plus, eQuest)
  - Compliance is demonstrated using the EN1 form

Envelope submissions should be sure to address:
- **ALL** assemblies related to the scope of work (roofs, above grade walls, fenestration, below grade walls, floors over unconditioned space, etc.)
- **ALL** significant variations of envelope assemblies (different wall assemblies, glazing types, roof assemblies, door types, etc.) – these will be averaged in the EN1
In the case of an NYCECC-related audit, Applicants may be asked to submit the Energy Modeling report or the calculations used to determine the average U-Factor and SHGC values entered in the EN1.
The overall regulated annual energy use and annual energy cost of the Proposed and Budget building designs are summarized at the end of the EN1 form, and this is where compliance with the NYCECC is demonstrated.

<table>
<thead>
<tr>
<th>Energy Cost Budget Conformance</th>
<th>Proposed Design Output</th>
<th>Budget (Standard Design) Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Regulated Energy Cost ($)</td>
<td>1,458,109</td>
<td>1,477,272</td>
</tr>
<tr>
<td>Annual Regulated Energy Use (BTU/NSF)</td>
<td>44,161</td>
<td>48,006</td>
</tr>
<tr>
<td>Annual Regulated Energy Cost Per Sq. Ft. ($)</td>
<td>2.31</td>
<td>2.34</td>
</tr>
</tbody>
</table>

### Energy Model Output Breakdown

<table>
<thead>
<tr>
<th>Energy Use Breakdown</th>
<th>Proposed Design Output (% BTU/yr)</th>
<th>Budget (Standard Design) Output (% BTU/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>24.2%</td>
<td>32.9</td>
</tr>
<tr>
<td>Cooling</td>
<td>13.9%</td>
<td>7.7</td>
</tr>
<tr>
<td>Heat rejection</td>
<td>3.9%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Fans</td>
<td>8.9%</td>
<td>8.6%</td>
</tr>
<tr>
<td>Pumps</td>
<td>1.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Lighting</td>
<td>19.3%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Unregulated loads (e.g., plug loads, elevators, escalators, kitchen, process equipment, exterior lighting)</td>
<td>28.5%</td>
<td>26.9%</td>
</tr>
</tbody>
</table>

Total: 100% 100%
Supporting Documentation should:

- Support the values submitted in the Energy Analysis;
- Verify mandatory requirements of the NYCECC are met; and
- Provide a listing of the applicable progress inspections required based on the scope of work of the project.
Supporting Documentation details for Envelope:

- Building wall sections and details for each unique type of:
  - Roof/ceiling assembly
  - Exterior wall type, and
  - Foundation, slab-on-grade, or basement wall assembly

- Building wall sections to show each layer of the assembly, including, but not limited to:
  - Insulation (labeled with R-value), and
  - Moisture control and vapor retarders (where used)

- Door, window and skylight schedules, including columns for U-Factor, SHGC, and VLT where applicable, and Air Leakage for each assembly type

- Details showing mandatory requirements to prevent air and moisture leakage
The following Sample Supporting Documentation has been developed to illustrate compliance procedures related to the NYCECC only. Additional Information required by the DOB related to zoning and other Code provisions is intentionally omitted.
Fenestration types, door types, and exterior wall types should be clearly marked in the plans of the Supporting Documentation.
10. Submissions & Inspections

Roof Types should be identified in the Roof Plans of the Supporting Documentation. If more than one type of roof assembly exists, show clear demarcation of the different roof assembly areas.
Fenestration types and door types should be clearly called out on the project elevations in the Supporting Documentation. These should be keyed into the submitted Window/Fenestration and Door Schedules.
Wall sections and details in the Supporting Documentation should note materials/techniques to meet mandatory NYCECC Air Leakage requirements.

Insulation types should be identified and R-Values stated.
10. Submissions & Inspections

Wall sections and details in the Supporting Documentation should note materials/techniques to meet mandatory NYCECC Air Leakage requirements.

All Wall Assembly Types should be identified, corresponding to those noted in the Plans.

Insulation types should be identified and R-values stated.
Wall sections and roof details in the Supporting Documentation should note the insulation type and state the R-Value. Where tapered insulation is used, Applicants should note the minimum and maximum thickness of the insulation.

Roof Assembly Types should be identified, corresponding to those noted in the plans.
## 10. Submissions & Inspections

### Window / Storefront / Skylight Schedule

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>R.O. / M.O.</th>
<th>Glass Type</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>Air Leakage</th>
<th>Manufacturer</th>
<th>Catalog #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alum Frames Dbl. Casement</td>
<td>8' - 4&quot; x 6' - 8&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.41</td>
<td>0.81</td>
<td>≤ 0.08 cfm/ft²</td>
<td>XYZ Inc.</td>
<td>C100 4082</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Alum Frames Dbl. Casement</td>
<td>8' - 4&quot; x 5' - 4&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.41</td>
<td>0.81</td>
<td>≤ 0.08 cfm/ft²</td>
<td>XYZ Inc.</td>
<td>C100+4084</td>
<td>1</td>
</tr>
<tr>
<td>3A</td>
<td>Alum Frames Storefront System</td>
<td>17' - 4&quot; x 11' - 4&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/ft²</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3, 4</td>
</tr>
<tr>
<td>3B</td>
<td>Alum Frames Storefront System</td>
<td>17' - 4&quot; x 8' - 0&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/ft²</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
</tr>
<tr>
<td>3C</td>
<td>Alum Frames Storefront System</td>
<td>12' - 0&quot; x 8' - 0&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/ft²</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
</tr>
<tr>
<td>3D</td>
<td>Alum Frames Storefront System</td>
<td>11' - 4&quot; x 8' - 0&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/ft²</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
</tr>
<tr>
<td>4</td>
<td>Alum Frames Fixed Skylight</td>
<td>7' - 0&quot; W x 14' - 0&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/ft²</td>
<td>HIL Inc.</td>
<td>FS400 Series</td>
<td>2, 4</td>
</tr>
</tbody>
</table>

**Notes:**
1. Air leakage: Provide flashing, window dams, expandable foam sealant, and caulk at rough opening/window frame joints to create a continuous air barrier with surrounding wall system.
2. Air leakage: Provide flashing, expandable foam sealant, and caulk at rough opening/skylight frame joints to create a continuous air barrier with surrounding roof system.
4. Manufacturer’s air infiltration rates based on 0.14 psf (500 Pa) static pressure differential, tested per ASTM E 283.

### Exterior Door Schedule

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>R.O. / M.O.</th>
<th>Glass Type</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>Infiltration Value (cfm/ft²)</th>
<th>Manufacturer</th>
<th>Catalog #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Aluminum/Glass Double Door w/Fixed Transom</td>
<td>6' - 4&quot; x 9' - 4&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.62</td>
<td>0.26</td>
<td>≤ 1.00 cfm/ft²</td>
<td>HIL Inc.</td>
<td>Y-100 Series</td>
<td>1, 2</td>
</tr>
<tr>
<td>B</td>
<td>Insulated Hollow Metal Door</td>
<td>3' - 4&quot; x 7' - 4&quot;</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>EIA Inc.</td>
<td>IHM1684</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>Insulated Roll-up Overhead Metal Door</td>
<td>10' - 0&quot; x 8' - 0&quot;</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>CIA Inc.</td>
<td>IHM12095</td>
<td>1</td>
</tr>
</tbody>
</table>

**Notes:**
1. Air leakage: Provide flashing, expandable foam sealant, and caulk at rough opening/door frame joints to create a continuous air barrier with surrounding wall system.
2. See Dwg. A-505 for detailed entry door elevations.
3. Doors will be field-fitted with weatherstripping per ECC Section 502.4.1
### 10. Submissions & Inspections

Schedules must include U-Factor, SHGC, and Air Leakage information and VLT where applicable.

### Sample Supporting Documentation

#### Window / Storefront Schedules

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>R.O. / M.O.</th>
<th>Glass Type</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>Air Leakage</th>
<th>Manufacturer</th>
<th>Catalog #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alum Framed</td>
<td>8&quot; IGU, low-e, clear</td>
<td>0.41</td>
<td>0.31</td>
<td>≤ 0.80 cfm/SF</td>
<td>XYZ Inc.</td>
<td>C100-4080</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Alum-Framed</td>
<td>4&quot; IGU, low-e, clear</td>
<td>0.41</td>
<td>0.31</td>
<td>≤ 0.80 cfm/SF</td>
<td>XYZ Inc.</td>
<td>C100-4084</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3A</td>
<td>Alum-Framed</td>
<td>1&quot; - 4&quot; IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/SF</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3, 4</td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>Alum-Framed</td>
<td>3&quot; IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/SF</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
<td></td>
</tr>
<tr>
<td>3C</td>
<td>Alum-Framed</td>
<td>2&quot; IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/SF</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
<td></td>
</tr>
<tr>
<td>5D</td>
<td>Alum-Framed</td>
<td>1&quot; IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/SF</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
<td></td>
</tr>
<tr>
<td>5E</td>
<td>Alum-Framed</td>
<td>0&quot; IGU, low-e, clear</td>
<td>0.49</td>
<td>0.32</td>
<td>≤ 0.06 cfm/SF</td>
<td>ABC Inc.</td>
<td>X-100 Series</td>
<td>1, 3</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Air leakage: Provide flashing, window dams, expandable foam sealant, and caulking at rough opening/window frame joints.
2. See Dwg. A-505 for detailed storefront elevations.
3. Manufacturer's air infiltration rates based on 6.24 psf (300 Pa) static pressure differential, tested per ASTM E 283.

### Exterior Door Schedule

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>R.O. / M.O.</th>
<th>Glass Type</th>
<th>U-Factor</th>
<th>SHGC</th>
<th>Infiltration Value (cfm/SF)</th>
<th>Manufacturer</th>
<th>Catalog #</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Aluminum/Glass Double Door w/ Fixed Transom</td>
<td>6&quot; - 4&quot; x 9&quot; - 4&quot;</td>
<td>IGU, low-e, clear</td>
<td>0.62</td>
<td>0.26</td>
<td>≤ 1.00 cfm/SF</td>
<td>HLS Inc.</td>
<td>Y-100 Series</td>
<td>1, 2</td>
</tr>
<tr>
<td>B</td>
<td>Insulated Hollow Metal Door</td>
<td>3&quot; - 4&quot; x 7&quot; - 4&quot;</td>
<td>N/A</td>
<td>0.42</td>
<td>N/A</td>
<td>N/A</td>
<td>EIA Inc.</td>
<td>IHM1684</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>Insulated Roll-up Overhead Metal Door</td>
<td>10&quot; - 0&quot; x 8&quot; - 0&quot;</td>
<td>N/A</td>
<td>0.44</td>
<td>N/A</td>
<td>N/A</td>
<td>CIA Inc.</td>
<td>IHM12095</td>
<td>1</td>
</tr>
</tbody>
</table>

**Notes:**
1. Air leakage: Provide flashing, expandable foam sealant, and caulking at rough opening/door frame joints to create a continuous air barrier with surrounding wall system.
2. See Dwg. A-505 for detailed entry door elevations.
3. Doors will be field-fitted with weatherstripping per ECC Section 502.4.1
Be sure to check-off the applicable Air Leakage & Component Certification Requirements in the COMcheck Summary.

Sign and Seal COMcheck Compliance Certificate if the project team does not use a Lead Professional. If the team uses a Lead Professional, the seal and signature should be at the title block. Also see department guidelines.
### Section 3: Requirements Checklist

**Envelopes PASSES: Design 2% better than code.**

#### Climate-Specific Requirements:

<table>
<thead>
<tr>
<th>Component Name/Description</th>
<th>Gross Area or Perimeter</th>
<th>Cavity R-Value</th>
<th>Cont. R-Value</th>
<th>Proposed U-Factor</th>
<th>Budget U-Factor(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Type A: Insulation Entirely Above Deck</td>
<td>9776</td>
<td>---</td>
<td>20.0</td>
<td>0.048</td>
<td>0.048</td>
</tr>
<tr>
<td>Window 4 - Skylight: Metal Frame with Thermal Break: Double Pane with Low-E, Tinted, SHGC 0.20</td>
<td>113</td>
<td>---</td>
<td>---</td>
<td>0.820</td>
<td>0.600</td>
</tr>
<tr>
<td>Floor Type A: Slab-On-Grade: Unheated</td>
<td>400</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Above Grade Wall Assembly Type A: Concrete Block: 12&quot;, Partially Grouted, Cells Empty, Medium Density, Furring: Metal</td>
<td>5437</td>
<td>0.0</td>
<td>10.0</td>
<td>0.076</td>
<td>0.104</td>
</tr>
<tr>
<td>Windows 1-2: Metal Frame with Thermal Break: Double Pane with Low-E, Clear, SHGC 0.31</td>
<td>220</td>
<td>---</td>
<td>---</td>
<td>0.410</td>
<td>0.550</td>
</tr>
<tr>
<td>Windows 1-2 - w/overhang: Metal Frame with Thermal Break: Double Pane with Low-E, Clear, SHGC 0.31, PF 0.33</td>
<td>46</td>
<td>---</td>
<td>---</td>
<td>0.410</td>
<td>0.550</td>
</tr>
<tr>
<td>Windows 3A-3D: Storefront: Metal Frame Curtain Wall/Storefront: Double Pane with Low-E, Clear, SHGC 0.32</td>
<td>160</td>
<td>---</td>
<td>---</td>
<td>0.490</td>
<td>0.500</td>
</tr>
<tr>
<td>Windows 3A-3D: Storefront, ovhd.: Metal Frame Curtain Wall/Storefront: Double Pane with Low-E, Clear, SHGC 0.32, PF 0.28</td>
<td>82</td>
<td>---</td>
<td>---</td>
<td>0.490</td>
<td>0.500</td>
</tr>
<tr>
<td>Door A - Ext Dbl Class Door: Class (&gt; 50% glazing): Metal Frame, Entrance Door, SHGC 0.26</td>
<td>122</td>
<td>---</td>
<td>---</td>
<td>0.620</td>
<td>0.860</td>
</tr>
<tr>
<td>Door B - Insulated Hollow Metal: Insulated Metal, Swinging</td>
<td>72</td>
<td>---</td>
<td>---</td>
<td>0.420</td>
<td>0.700</td>
</tr>
<tr>
<td>Door C - Roll-up Overhead: Insulated Metal, Non-Swinging</td>
<td>80</td>
<td>---</td>
<td>---</td>
<td>0.440</td>
<td>0.500</td>
</tr>
<tr>
<td>Above Grade Wall Assembly Type B: Steel-Framed, 16&quot; o.c.</td>
<td>5592</td>
<td>13.0</td>
<td>7.5</td>
<td>0.064</td>
<td>0.064</td>
</tr>
<tr>
<td>Windows 1-2: Metal Frame with Thermal Break: Double Pane with Low-E, Clear, SHGC 0.31</td>
<td>62</td>
<td>---</td>
<td>---</td>
<td>0.410</td>
<td>0.550</td>
</tr>
</tbody>
</table>

---

All Wall Types, Roof Types, Fenestration Types, Door Types, and Floor Types in the COMcheck analysis should use the same nomenclature as those shown in the Supporting Documentation.
## 10. Submissions & Inspections

<table>
<thead>
<tr>
<th>Inspection/Test</th>
<th>Frequency (minimum)</th>
<th>Reference Standard (See NYCECC Chapter 10) or Other Criteria</th>
<th>NYCECC or Other Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIA Envelope Inspections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIA1 Protection of exposed foundation insulation: Insulation shall be visually inspected to verify proper protection where applied to the exterior of basement or cellar walls, crawl-space walls and/or the perimeter of slab-on-grade floors.</td>
<td>As required during foundation work and prior to backfill</td>
<td>Approved construction documents</td>
<td>303.2.1</td>
</tr>
<tr>
<td>IIA2 Insulation placement and R-values: Installed insulation for each component of the conditioned space envelope and at junctions between components shall be visually inspected to ensure that the R-values are marked, that such R-values conform to the R-values identified in the construction documents and that the insulation is properly installed. Certifications for unmarked insulation shall be similarly visually inspected.</td>
<td>As required to verify continuous enclosure while walls, ceilings and floors are open</td>
<td>Approved construction documents</td>
<td>303.1, 303.1.1, 303.1.2, 502.1, 502.2</td>
</tr>
<tr>
<td>IIA3 Fenestration thermal values and product ratings: U-Factors and SHGC values of installed fenestration shall be visually inspected for conformance with the U-Factors and SHGC values identified in the construction drawings by verifying the manufacturer’s NFRC labels or, where not labeled, using the ratings in NYCECC Tables 102.1.3(1), (2) and (3). Where ASHRAE 90.1 is used, visible light transmittance values shall also be verified.</td>
<td>As required during installation</td>
<td>Approved construction documents; NFRC 100, NFRC 200</td>
<td>303.1, 303.1.3; 502.3</td>
</tr>
<tr>
<td>IIA4 Fenestration and door assembly product ratings for air leakage: Windows, skylights and sliding or swinging door assemblies, except site- built windows, skylights and/or doors, shall be visually inspected to verify that installed assemblies are listed and labeled by the manufacturer to the referenced standard. For curtain wall, storefront glazing, commercial entrance doors and revolving doors, the testing reports shall be reviewed to verify that the installed assembly complies with the standard cited in the approved plans.</td>
<td>As required during installation; prior to final construction inspection</td>
<td>NFRC 400, AAMA/WDMA/CSA 101/I.S.2/A440 ASTM E283; ANSI/DASMA 105</td>
<td>502.4</td>
</tr>
<tr>
<td>IIA5 Fenestration areas: Dimensions of windows, doors and skylights shall be visually inspected.</td>
<td>Prior to final inspection</td>
<td>Approved construction documents</td>
<td>502.3</td>
</tr>
<tr>
<td>IIA6 Sealing: Openings and penetrations shall be visually inspected to verify that a continuous air barrier has been installed. Door assemblies and window assemblies shall also be visually inspect to verify that materials meet the applicable standards, or that the building is in accordance with the plans.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IIA7 Projection factors: Where the envelopes enclosed by glass or roofing are permanently attached shading devices shall be inspected.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A Progress Inspections Table must be included in the Supporting Documentation drawings, noting all applicable inspections to be performed based on the scope of work, plus Reference Standards and NYCECC citations.

The design applicant must also include contract language requiring the contractor to identify time in the construction schedule for the progress inspections.
## Progress Inspections - Review

### 10. Submissions & Inspections

**What are the Applicable Progress Inspections for Building Envelope?**

<table>
<thead>
<tr>
<th>Inspection / Test</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection of exposed foundation insulation</td>
<td>As required during foundation work and prior to backfill</td>
</tr>
<tr>
<td>Insulation placement and R-values</td>
<td>As required to verify continuous enclosure while walls, ceilings and floors are open</td>
</tr>
<tr>
<td>Fenestration thermal values and product ratings</td>
<td>As required during installation</td>
</tr>
<tr>
<td>Fenestration and door assembly product ratings for air leakage</td>
<td>As required during installation; prior to final construction inspection</td>
</tr>
<tr>
<td>Fenestration areas</td>
<td>Prior to final construction inspection</td>
</tr>
<tr>
<td>Sealing (Openings, Penetrations, Air Barrier)</td>
<td>As required during construction</td>
</tr>
<tr>
<td>Projection factors</td>
<td>Prior to final construction inspection</td>
</tr>
<tr>
<td>Loading dock weatherseals</td>
<td>Prior to final construction inspection</td>
</tr>
<tr>
<td>Building entrance vestibules</td>
<td>Prior to final construction inspection</td>
</tr>
</tbody>
</table>

Reference: 1 RCNY §5000-01
## 10. Submissions & Inspections

### Energy Code Progress Inspection

**Required for applications where Energy Code Compliance Progress Inspection is marked Yes on TR1**

<table>
<thead>
<tr>
<th>Y</th>
<th>N</th>
<th>Progress Inspections</th>
<th>Table Reference in 1RCNY §BU00-U01(h)(1) and (2)</th>
<th>3B Identification of Responsibilities</th>
<th>3C Certificate of Complete Inspections / Tests</th>
<th>3D Withdraw Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Protection of foundation insulation</td>
<td>(IA1), (IIA1)</td>
<td>Initial &amp; Date</td>
<td>Initial &amp; Date</td>
<td>Initial &amp; Date</td>
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<tr>
<td></td>
<td></td>
<td>Insulation placement and R values</td>
<td>(IA2), (IIA2)</td>
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<tr>
<td></td>
<td></td>
<td>Fenestration thermal values and ratings</td>
<td>(IA3), (IIA3)</td>
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<tr>
<td></td>
<td></td>
<td>Fenestration ratings for air leakage</td>
<td>(IA4), (IIA4)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Fenestration areas</td>
<td>(IA5), (IIA5)</td>
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<tr>
<td></td>
<td></td>
<td>Air sealing and insulation — visual</td>
<td>(IA6), (IIA6)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Air sealing and insulation — testing</td>
<td>(IA7)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Projection factors</td>
<td>(IIA7)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Loading deck weather seals</td>
<td>(IIA8)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Vestibules</td>
<td>(IIA9)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Fireplaces</td>
<td>(IB1), (IIIB1)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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The applicant (R.A. or P.E.) defines the required progress inspections by checking “Y” or “N” in the left-hand column under section 3 of the TR8 form.

Prior to Permit, the designated Progress Inspector must initial and date each inspection they will be responsible for, and sign/seal under section 5 of the TR8 form. If multiple Progress Inspectors are involved in a project, each one must submit a signed/sealed TR8 for their scope of inspection services.
6 Inspection Applicant’s Certification of Completion

☐ I have completed the items specified herein and certify the following (check one only):

☑ All work performed substantially conforms to approved construction documents and has been performed in accordance with applicable provisions of the New York City Energy Conservation Code and other designated rules and regulations.

☐ All work performed substantially conforms to approved construction documents and has been performed in accordance with applicable provisions of the New York City Energy Conservation Code and other designated rules and regulations, except as indicated in the attached report.

I am aware of the additional sanctions imposed on false filings by §28-211.1.2 of the Administrative Code.

☐ Withdrawal of Applicant: I am withdrawing responsibility for the items of progress inspections and/or tests indicated herein and herewith submit the results or status of the work performed to date.

Name (please print)

Signature Date

P.E. / R.A. Seal (apply seal, then sign and date over seal)
10. Submissions & Inspections

Upon completion of the applicable inspections, the Progress Inspector initials and dates each inspection performed (column 3C). Any inspections assigned to the Progress Inspector that are not performed are addressed through column 3D (withdraw responsibilities). Final signatures and seals are provided in section 6 of the TR8 form.
Per NYC Administrative Code §28-116.2.3

- A record of all inspections shall be kept by the person performing the inspection.
  - The commissioner can require inspection reports to be filed with the department.
  - Records of inspections shall be maintained for a period of six years after sign-off, or for such other period of time as the commissioner may require.
  - Records of inspections shall be made available to the DOB upon request.

EN2 Form

- This DOB form is signed by the progress inspector, certifying that the values in the last-approved Energy Analysis or the as-built Energy Analysis represent values in the constructed building.

While a specific format is not stated, inspection records can include:

- Logs, reports, meeting minutes
- Photographs
- Annotated Drawings
3 As Built Information  P.E./R.A. responsible for progress inspections, choose one below and sign/seal.

☐ The as-built conditions of the completed building conform to the originally approved energy analysis and do not require a revised energy analysis.

☐ The energy analysis has been revised according to one of the statements below:

☐ Attached is a revised energy analysis, prepared, signed and sealed by the registered design professional who prepared the previously submitted and approved energy analysis. The as-built conditions of the completed building conform to this revised energy analysis.

☐ The last revised energy analysis was submitted and approved as a post approval amendment on ______________(date). The as-built conditions of the completed building conform to this revised energy analysis.

Sealed and submitted by:

Name (please print):

Signature: Dated:

P.E./R.A. Seal (apply seal, then sign and date over seal)
### 10. Submissions & Inspections

**Progress Inspections – EN2 Form**

#### 3 As Built Information

<table>
<thead>
<tr>
<th>P.E./R.A. responsible for progress inspections, choose one below and sign/seal.</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ The as-built conditions of the completed building conform to the originally approved energy analysis and do not require a revised energy analysis.</td>
</tr>
<tr>
<td>☐ The energy analysis has been revised according to one of the statements below:</td>
</tr>
<tr>
<td>☐ Attached is a revised energy analysis, prepared, signed and sealed by the registered design professional who prepared the previously submitted and approved energy analysis. The as-built conditions of the completed building conform to this revised energy analysis.</td>
</tr>
<tr>
<td>☐ The last revised energy analysis was submitted and approved as a post approval amendment on __________ (date). The as-built conditions of the completed building conform to this revised energy analysis.</td>
</tr>
</tbody>
</table>

The Progress Inspectors and design applicants will need to coordinate to ensure that the as-built conditions and approved Energy Analysis are consistent. An as-built Energy Analysis update may be required.
11. Resources
## Resources and Links

The resources below have been referenced in this module

<table>
<thead>
<tr>
<th>Resource</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York City Construction Codes</td>
<td><a href="http://www2.iccsafe.org/states/newyorkcity/">http://www2.iccsafe.org/states/newyorkcity/</a></td>
</tr>
</tbody>
</table>
Questions on the NYCECC can be submitted to the DOB at:

EnergyCode@buildings.nyc.gov
## 11. Resources

<table>
<thead>
<tr>
<th>Company or Individual</th>
<th>Slide Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samantha Modell</td>
<td>165</td>
</tr>
<tr>
<td>NFRC</td>
<td>111, 123</td>
</tr>
<tr>
<td>US DOE Building Energy Codes University</td>
<td>71, 127, 128</td>
</tr>
</tbody>
</table>