NYCECC COMMERCIAL ENVELOPE OVERVIEW: 2016 NYC Energy Conservation Code

Effective October 3, 2016

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NYC Buildings

presented by

Bill de Blasio, Mayor

Melanie La Rocca, Commissioner

ACKNOWLEDGEMENTS

One City: Built to Last

We wish to acknowledge Mayor Bill de Blasio for his commitment to 80% reduction of Greenhouse Gas Emissions by 2050, over 2005 levels.

- A sweeping plan to retrofit public and private buildings to reduce the City's contributions to climate change.
- This makes New York the largest city to commit to the 80% reduction by 2050.
- It charts a long-term path for investment in renewable sources of energy and a total transition from fossil fuels.

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INTRODUCTION

Welcome to the New York City Department of Buildings Energy Code Training Modules!

This COMMERCIAL ENVELOPE OVERVIEW Module addresses:

- Technical issues and strategies related to the 2016 NYCECC
- Applicability of the 2016 NYCECC
- NYC DOB Energy Code Submission Requirements
- NYC DOB Progress Inspection Requirements

INTRODUCTION

(continued)

This COMMERCIAL ENVELOPE OVERVIEW Module addresses:

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.

OVERVIEW: TRAINING MODULE ORGANIZATION

- 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.

OVERVIEW: SLIDE NAVIGATION GUIDE

Look for the following icons:

The **NYC Buildings** logo takes you to the 2016 NYCECC 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.

OVERVIEW: SLIDE NAVIGATION GUIDE

Look for the following icons:

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.

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.

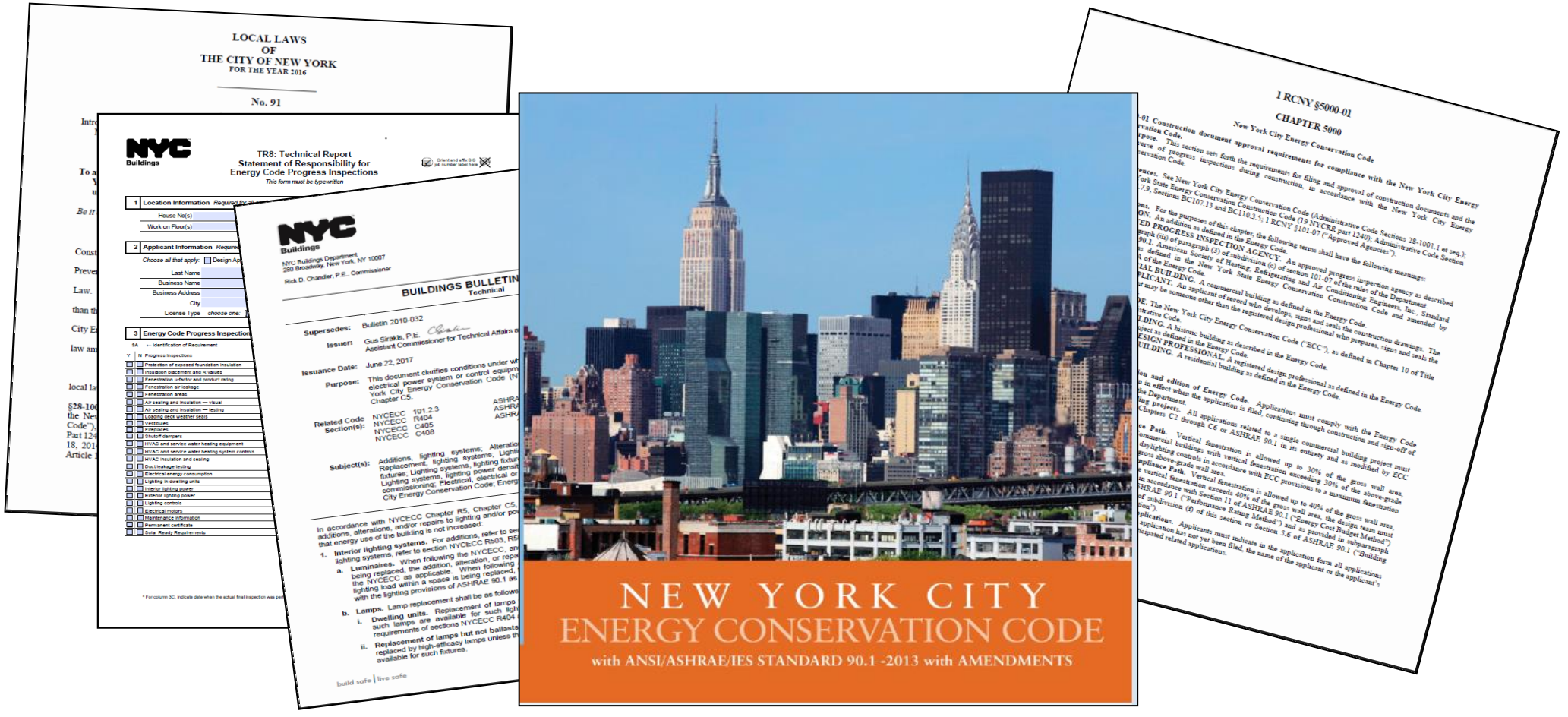
ENVELOPE MODULE MENU

1. WHAT'S NEW IN 2016 NYCECC	Key Updates • Current Local Laws, Rules and Buildings Bulletins	12
2. CODE APPLICABILITY	New Buildings & Additions • Existing Buildings • Historic Buildings	16
3. METHODS OF COMPLIANCE	Mandatory Provisions • Compliance Paths • ANSI/ASHRAE/IESNA 90.1 - 2013	37
4. KEY THERMAL PROPERTIES	R-Values • Insulation Materials • Thermal Bridging • U, F, & C-Factors	55
5. ABOVE GRADE WALLS	Steel Frame Wall • Metal Building Wall • Mass Wall • Wood Framed Wall	75
6. ROOFS	Insulation Above Deck • Metal Building • Attic & Other • Re-roofing Scenarios	96

ENVELOPE MODULE MENU

1. BUILDING ENVELOPE REQUIREMENTS

Slides 11 to 15



1. WHAT'S NEW IN THE NYCECC: OVERVIEW

In this section you will learn about:

- Key changes and additions in the 2016 NYCECC related to building envelope; and
- Current local laws, rules, & bulletins affecting envelope compliance.

1. KEY UPDATES FOR THE 2016 NYCECC

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

Major changes to the envelope provisions:

- Below-grade walls and slabs require insulation
- Isolation of open-air combustion fuel-burning appliances
- Increased Vertical Fenestration area with Daylighting Controls
- Minimum Skylight Fenestration Area
- Assign R-0.5 to through-wall mechanical equipment
- New section requiring additional air barrier testing

1. LOCAL LAWS, RULES & BULLETINS

What NYCECC-Related Local Laws, Rules, or Bulletins Affect Residential Buildings?

Local Laws

- LL91-2016 – Established the current 2016 NYCECC
- LL125-2016 – Clean up Bill

Rules

- 1 RCNY §5000-01
  - Energy Code submission procedures , including progress inspections in drawings
- 1 RCNY §101-07
  - Qualification requirements for individuals performing progress inspections

1. LOCAL LAWS, RULES & BULLETINS

What NYCECC-Related Local Laws, Rules, or Bulletins Affect Residential Buildings?

Bulletins

- Buildings Bulletins 2017-004, 2017-005, 2017-006
  - Provide interpretations of Energy Code applicability to HVAC, service water, lighting, electrical power, and envelope systems in additions, alterations, renovations, or repairs

2. CODE APPLICABILITY

Slides 16 to 36

2. CODE APPLICABILITY- 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;
- Allowable Exemptions and Exceptions related to Building Envelope;
- Factory Manufactured Home and Mobile Homes;
- Mixed occupancy; and
- Historic buildings.

2. CODE APPLICABILITY: GENERAL TERMINOLOGY - 1

What's the Terminology used by DOB related to Code Applicability?

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

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

2. CODE APPLICABILITY: GENERAL TERMINOLOGY-2

What's the Terminology used by DOB related to Code Applicability?

Exemptions

- Exemptions define specific building types, applications, or building elements that are not required to meet the Code, and are addressed in the PW1 form when they constitute the entire application (1 through 4 below, as listed on the PW1)

- The following are the ONLY allowed exemptions to the NYCECC:
  1. Historic buildings (per NYCECC Section C501.6, LL 91 of 2016, LL 125 of 2016, 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

Historic-Buildings: C202, C501.6; LL 91 of 2016; LL 125 of 2016; 1 RCNY §5000-01;
Low Energy Buildings: NYCECC R402.1 & C402.1.1; Form PW1

2. CODE APPLICABILITY: GENERAL TERMINOLOGY-2

What's the Terminology used by DOB related to Code Applicability?

Exemptions *(continued)*

2. The **envelopes** of unconditioned or low-energy buildings or spaces (low energy is <3.4 BTU/H or 1 Watt/SF peak design rate for space conditioning) and the scope of work is limited to the envelope.

3. Temporary structures under BC § 3103 and 28-111.1
   - The following work types, categorized as not affecting energy use:
     - Buildings certified as eligible for the designations above
     - City level FA (fire alarm), FP (fire suppression in a range hood), SD (standpipe), FS (fuel storage), EQ (construction equipment), CC (curb cut), OT/BPP (builder's pavement plan), OT/FPP (fire protection plan)

4. A post-approval amendment of an application that is exempt under a prior edition of the Energy Code

*(*Numbers correspond to the exemptions listed on the PW1, Section 10)*

2. CODE APPLICABILITY: GENERAL TERMINOLOGY-3

What's the Terminology used by DOB related to Code Applicability?

Exceptions

- Exceptions are conditions under which specific provisions of the Code may not be required
  - Many exceptions are defined under Chapters R5 and C5 of the NYCECC. These types of exceptions typically define NYCECC alternates; i.e., a system requirement may not be required if other alternative measures are incorporated
- Exceptions specifically applicable to Alterations are defined in Sections R503 and C503 of the NYCECC
  - Apply only if they do not result in increased energy use of the building
- Clarifications of potential exceptions in additions, alterations/renovations, and repairs are provided in Building Bulletins 2017-004, 2017-005, 2017-006

Exemptions, exceptions and other conditions relieved from compliance by the NYCECC § R503 and C503 must be identified in the submitted Energy Analysis, with citations to Code, 1 RCNY § 5000-01 and/or Bulletins provided.

2. CODE APPLICABILITY: NYCECC §C503.1

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

Per NYCECC C503.1:

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

- DOB Interpretation
  - (per Bulletin 2017-006)
  - 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 C503.1 must be identified in the applicant's energy analysis, with citations to Code, 1 RCNY § 5000-01 and/or Bulletins provided.

2. CODE APPLICABILITY: NYCECC §C503.1

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

Per NYCECC C503.1:

- Storm windows installed over existing fenestration
- Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided the code does not require the glazing or fenestration to be replaced.
- Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.
- Construction where the existing roof, wall or floor cavity is not exposed.
- Roof recover
- Air barriers shall not be required for roof recover and roof replacement where the alterations or renovations to the building do not include alterations, renovations or repairs to the remainder of the building envelope.

2. CODE APPLICABILITY: NYCECC §C503.1

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

Per Buildings Bulletin 2017-006:

- 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

2. CODE APPLICABILITY: DIFFERENT SCOPES OF WORK

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 when the scope of work is limited to the envelope. If the scope entails more than the envelope, then the application is not exempt.

Additions

- Must comply either:
  - As a stand-alone addition, or
  - Along with the existing building as a single entity, or
  - Where the building with the addition uses no more energy than the existing building

Applicability: ECC 101.4; Definitions: C202; Chapter C4, Chapter C5; DOB Buildings Bulletin 2017-006

2. CODE APPLICABILITY: DIFFERENT SCOPES OF WORK

Alterations / Renovations

- Only applies to scope of alteration work; unaltered portions are not required to comply
- Some exceptions may apply (see NYCECC C503.1 and per Bulletin 2017-006)
- Shall be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration.

Repairs

- Technically applies even if a permit is not required (e.g., window or roof replacements or repairs)
- The following are considered repairs (See Section C504.2 for full list of repairs):
  1. Glass-only replacements in an existing sash and frame.
  2. Roof repairs.
  3. Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided that the replacement does not increase the installed interior power.

2. CODE APPLICABILITY: BY BUILDING TYPE

Which chapters of the Code apply to different building types?

RESIDENTIAL

R-3 (detached one- and two-family dwellings, and multiple single-family dwellings)

AND

R-2 (Multifamily > 2-family) ≤ 3-stories Factory-manufactured Homes and Mobile Homes

→ Residential NYCECC Chapter R4

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

Building Type includes Group I, H

→ Commercial (Update) NYCECC Chapter C4 OR Appendix CA as modified by NYC

Scope: 101.2; Applicability: 101.4; Definitions of Residential & Commercial Building: R202, C202

2. CODE APPLICABILITY: FACTORY MANUFACTURED

FACTORY MANUFACTURED HOME AND MOBILE HOMES

- Individual modular homes are certified by NYS **not** the total home assembly
- Total home assembly needs to be submitted to the Department
- What is needed on drawings to show compliance?
  - Statement that the home is certified by NY State, and meets the energy code.
  - Documentation will need to be provided showing that the home was certified by NY State
- Ensuring modular construction is up to the NYCECC standards:
  - Inspections: Per RCNY §5000-01 minimum inspections include:
    1. Air sealing and insulation - visual - IA6
    2. Air sealing and insulation - testing - IA7
    3. Electrical energy consumption - IC1
    4. Maintenance Information - ID1
    5. Permanent Certificate – ID
    6. Solar Ready Requirements - ID3

Applicability: 101.4; Inspections: 104; Definitions of Residential & Commercial Building: C202 and Appendix CA

2. CODE APPLICABILITY: MIXED OCCUPANCY

A mixed-occupancy building is one that contains both residential and commercial uses.

Each occupancy shall be separately considered

- Chapters R2, R3, R4, and R5 for residential
- Residential portions/occupancies are classified as Group R when determining the insulation requirements
- Chapters C2, C3, C4, and C5 or ASHRAE 90.1-2013 (Appendix CA) for commercial
  - Cannot mix and match codes for commercial portion – same code version must be followed and applied in its entirety
- Do not include the floors or walls that separate commercial from residential. Include only the exterior thermal envelope.

2. CODE APPLICABILITY: MIXED OCCUPANCY

Scenarios

- Buildings greater than 3 stories are categorized as commercial even if residential occupancies exist
- Use accessory area requirements (Major occupancy > 90% of floor area)*

100% APARTMENTS
100% APARTMENTS
100% RETAIL

FLOOR	PROVISION
3	Residential
2	Residential
1	Commercial

100% APARTMENTS
100% APARTMENTS
≤ 10% RETAIL

FLOOR	PROVISION
3	Residential
2	Residential
1	Residential

100% APARTMENTS
100% APARTMENTS
> 90% RETAIL

FLOOR	PROVISION
3	Residential
2	Residential
1	Commercial

100% APARTMENTS
100% APARTMENTS
60% RETAIL 40% APARTMENTS

FLOOR	PROVISION
3	Residential
2	Residential
1	60% Commercial 40% Residential

100% APARTMENTS
100% APARTMENTS
100% APARTMENTS
100% RETAIL

FLOOR	PROVISION
4	Commercial
3	Commercial
2	Commercial
1	Commercial

** Requires code official approval*

2. CODE APPLICABILITY

KEY COMMERCIAL TERMINOLOGY

Dwelling Unit

- Single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking & sanitation

Building Thermal Envelope (also called Thermal Boundary)

- The planes or surfaces of the building or structure that physically separate conditioned space from the unconditioned exterior or unconditioned space.
- The thermal boundary must be continuous and closed, and insulated per NYCECC requirements. Air and moisture barriers must be maintained to protect the integrity of the thermal boundary.

2. CODE APPLICABILITY

KEY COMMERCIAL TERMINOLOGY

Commercial Provisions: Appendix CA

- This appendix provides the modifications to the nationally recognized standard ASHRAE 90.1-2013, providing the minimum requirements for energy-efficient design of most buildings, except for low-rise residential buildings

- As per CA102.1 Commercial buildings shall be constructed in accordance with Chapter C4 of the code or in accordance with ASHRAE 90.1. Refer to the rules of the department for any subsequent additions, modifications or deletions that may have been made to this standard in accordance with Section 28-103.19 of the Administrative Code

2. CODE APPLICABILITY: HISTORIC BUILDINGS

Alterations vs. Additions on 'Historic building'

- Repair, restoration and alterations work, and change of occupancy to 'Historic Building' are exempt from the ECC compliance requirements
- The basis for exemption must be stated in the Professional Statement
- **Limitations:**
  - The ECC exemption for 'Historical Building' is *limited to the National or New York State Historic Buildings*,
    - - i.e., buildings that are registered or eligible for registration as a National or New York State Historic Building, or designated as a contributing building in a National or State Historic District
    - *New York City-designated* historic buildings are NOT exempt from the NYCECC
    - The NYCECC also does not recognize buildings that have Landmark designated status
- For the complete definition of 'Historic Buildings,' refer to Section R202, C202, or ASHRAE 90.1 2013 (Appendix CA)

2. CODE APPLICABILITY: HISTORIC BUILDINGS

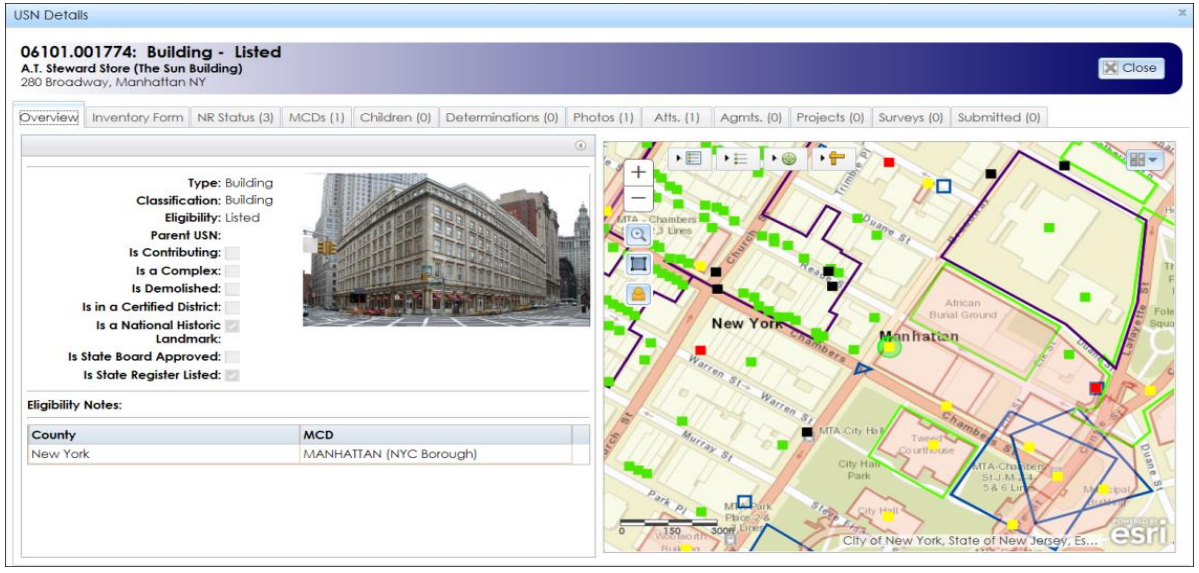
- **Alterations vs. Additions on 'Historic building'**
  - Job applications declaring exemptions of ECC compliance for the reason of 'Historic Buildings' must present evidence of such eligibility by submitting:

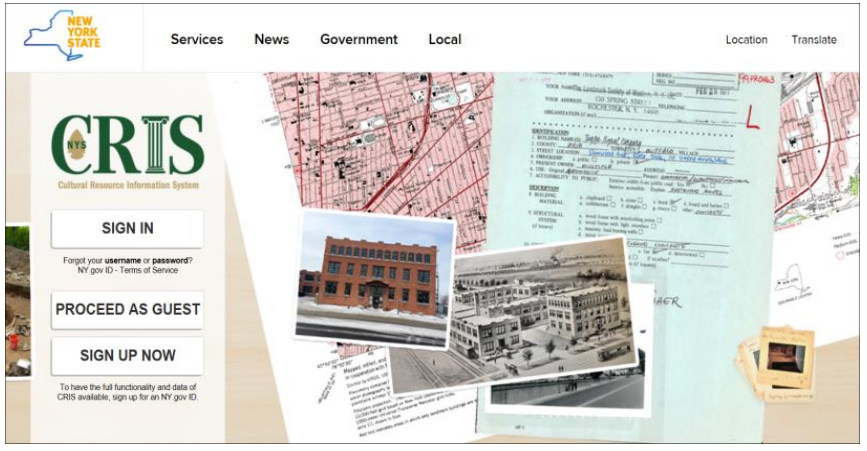
    1). A letter from the NYC Landmarks Preservation Commission accompanied by a visual representation of the Cultural Resource Information System (CRIS) map indicating the eligible designation, or

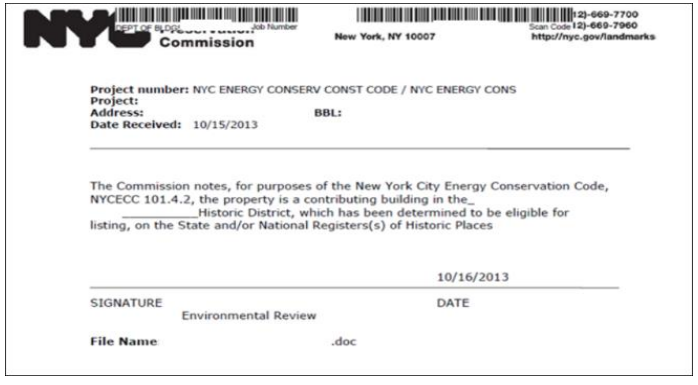
    2). a letter from the State Historic Preservation Office verifying the eligibility in response to a Request for Evaluation of Eligibility.
- **Exception:**
  - Additions to 'Historic Buildings' are NOT exempt from the ECC, and thus the 'Added' portion to the Historic Building must demonstrate compliance with the ECC according to Provisions under Section R502, C502 or ASHRAE 90.1 2013 (Appendix CA).
  - Any vertical or horizontal enlargement to an eligible historic building is considered "new construction" and must meet all the requirements of the NYCECC.

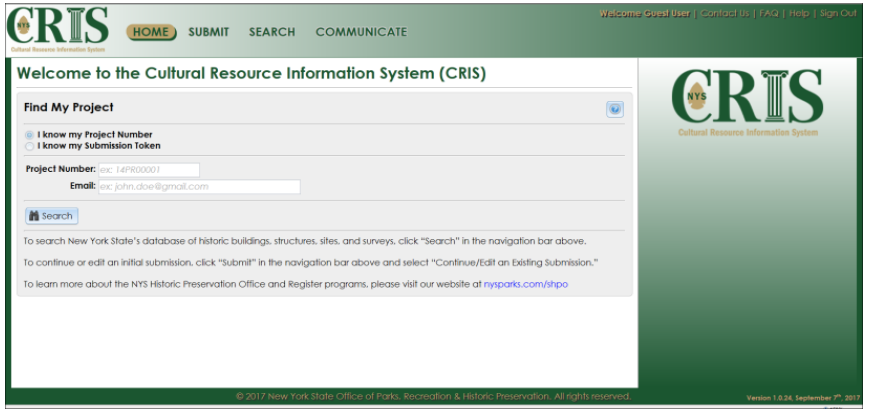
Building: R202, C202, R501.6, C501.6, Appendix CA
Cultural Resource Information System (CRIS): https://cris.parks.ny.gov/Login.aspx?ReturnUrl=%2j

2. CODE APPLICABILITY: HISTORIC BUILDINGS





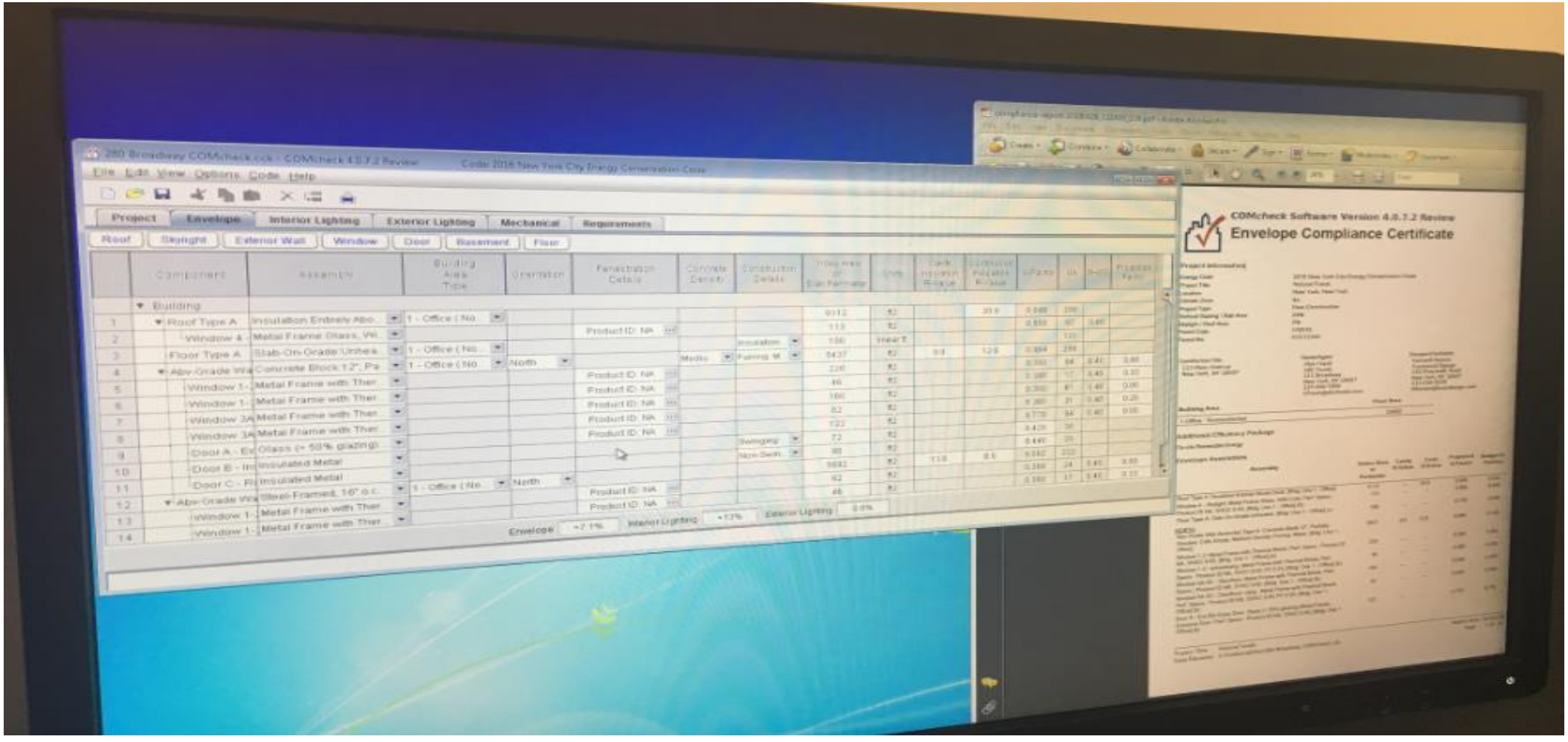




Cultural Resource Information System (CRIS): https://cris.parks.ny.gov/Login.aspx?ReturnUrl=%2f

3. METHODS OF COMPLIANCE

Slides 37 to 54



3. METHODS OF COMPLIANCE: OVERVIEW

In this section you will learn about:

- Mandatory provisions of the NYCECC related to Envelope design
- Prescriptive vs. Performance-based compliance pathsUsing the ANSI/ASHRAE/IESNA Standard 90.1-2013 (Appendix CA) instead of NYCECC Chapters C4 & C5

3. METHODS OF COMPLIANCE: CODE STRUCTURE

Mandatory Requirements

May include design features and construction practices

NOT subject to Trade-offs

Requirements common to all Compliance Paths

+

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*

*only when following ASHRAE

3. METHODS OF COMPLIANCE: CODE STRUCTURE

Mandatory Requirements

May include design features and construction pra

Prescriptive or Performance Targets

Minimum criteria apply
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NOT subject to Tr

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Requirements c
to all Complianc

ce Paths:
/ Trade-off/
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***only when following ASHRAE**

It is important to understand the basic structure of the Energy Code. Mandatory requirements are defined throughout Chapters R4 and C4 of the NYCECC, and are not subject to any type of Trade-off.

Additional NYCECC provisions can be satisfied through Prescriptive compliance or Trade-offs.

The Performance-based approach can only be used when following ASHRAE 90.1 Section 11 or Appendix G.

3. METHODS OF COMPLIANCE: MANDATORY PROVISIONS

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

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.

Vapor Retarders:

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

3. METHODS OF COMPLIANCE: COMPLIANCE PATHS

Options:

- 2016 NYCECC offers two compliance methods for envelope:
  1. **Prescriptive**
     - Through Opaque Assembly and Fenestration Tables
  2. **Trade-off**
     - Through U-Factor approach and COMCheck
- Code also allows use of the ANSI/ASHRAE/IESNA 90.1-2013 standard ("ASHRAE 90.1") as an alternative compliance method
  - ASHRAE 90.1 also offers Prescriptive, Trade-off & Performance Paths

3. METHODS OF COMPLIANCE: PATH 1: PRESCRIPTIVE

Level of effort: Simplest

- Prerequisites:
  - WWR (Window Wall Ratio): Must be ≤ 30%
  - 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.

NYC BOROUGHS (Climate Z	All Other	Group R,
Prescriptive R-Value Table	Commercial	> 3 stories
Roofs		
Insulation Entirely above deck	R-30ci	R-30ci
Metal buildings	R-19 + R-11 LS	R-19 + R-11 LS
Attic & Other	R-38	R-38
Walls, Above Grade		
Mass	R-9.5ci	R-11.4ci
Metal buildings	R-13 + R-13ci	R-13 + R-13ci
Metal framed	R-13 + R-7.5ci	R-13 + R-7.5ci
Wood frame and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20
Walls, Below Grade	R-7.5ci	R-7.5ci
Floors		
Mass	R-10ci	R-10.4ci
Joist/framing	R-30	R-30
Slab-on-grade floors		
Unheated slabs	R-10 for 24" below	R-10 for 24" below
Heated slabs	R-15 for 24" below	R-15 for 24" below
Opaque Doors		
Nonswinging	R-4.75	R-4.75

NYCECC Table C402.1.3

3. METHODS OF COMPLIANCE: PATH 2: TRADE-OFF

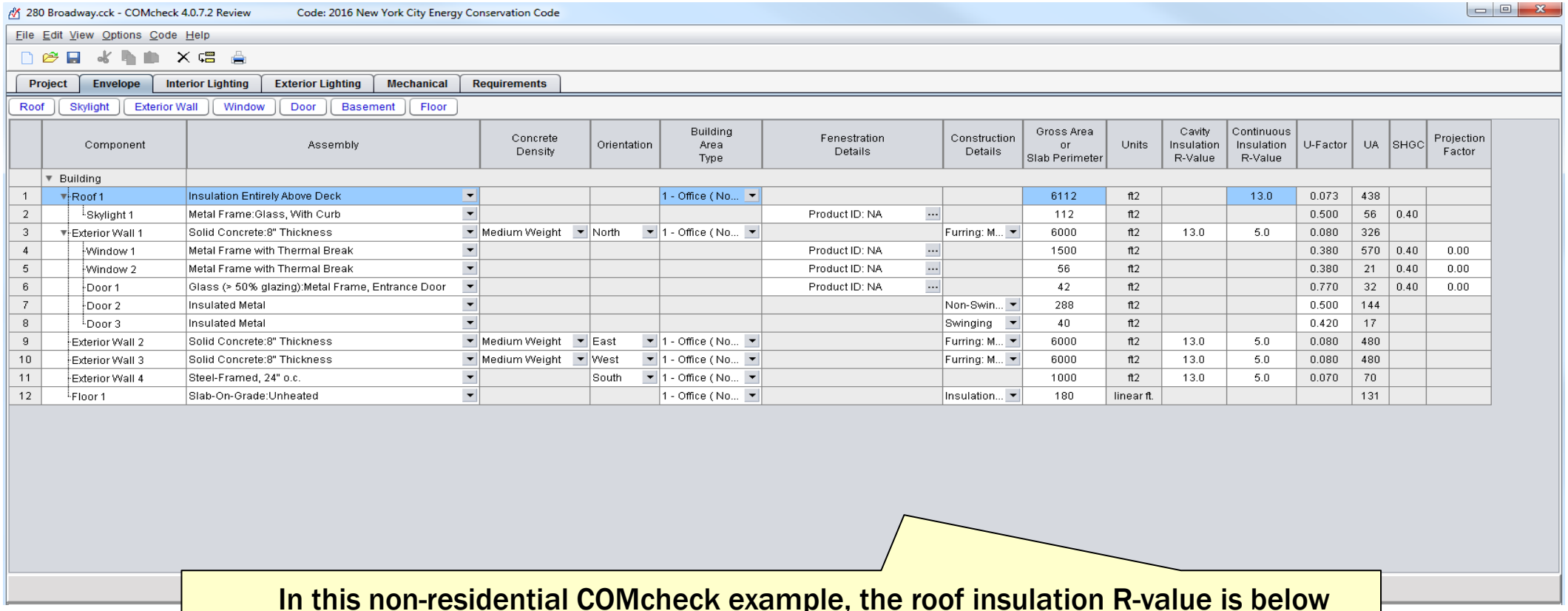
Level of Effort: Simple to Moderate

- Prerequisites:
  - WWR ≤ 30%
  - 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)

NYC BOROUGHS (Climate Zone 4) U-Factor Alternative Table		All Other Commercial	Group R, > 3 stories
Roofs			
	Insulation Entirely above deck	U-0.032	U-0.032
	Metal buildings	U-0.035	U-0.035
	Attic & Other	U-0.027	U-0.027
Walls, Above Grade			
	Mass	U-0.104	U-0.090
	Metal buildings	U-0.052	U-0.052
	Metal framed	U-0.064	U-0.064
	Wood frame and other	U-0.064	U-0.064
Walls, Below Grade		C-0.119	C-0.119
Floors			
	Mass	U-0.076	U-0.074
	Joist/framing	U-0.033	U-0.033
Slab-on-grade floors			
	Unheated slabs	F-0.54	F-0.54
	Heated slabs	F-0.65	F-0.65
Opaque Doors			
	Swinging	U-0.61	U-0.61

3. METHODS OF COMPLIANCE: PATH 2

TRADE-OFF: ComCheck Example



280 Broadway.cck - COMcheck 4.0.7.2 Review Code: 2016 New York City Energy Conservation Code

File Edit View Options Code Help

Project | Envelope | Interior Lighting | Exterior Lighting | Mechanical | Requirements

Roof | Skylight | Exterior Wall | Window | Door | Basement | Floor

	Component	Assembly	Concrete Density	Orientation	Building Area Type	Fenestration Details	Construction Details	Gross Area or Slab Perimeter	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor
	Building														
1	Roof 1	Insulation Entirely Above Deck			1 - Office (No...			6112	ft2		13.0	0.073	438		
2	Skylight 1	Metal Frame:Glass, With Curb				Product ID: NA		112	ft2			0.500	56	0.40	
3	Exterior Wall 1	Solid Concrete:8" Thickness	Medium Weight	North	1 - Office (No...		Furring: M...	6000	ft2	13.0	5.0	0.080	326		
4	Window 1	Metal Frame with Thermal Break				Product ID: NA		1500	ft2			0.380	570	0.40	0.00
5	Window 2	Metal Frame with Thermal Break				Product ID: NA		56	ft2			0.380	21	0.40	0.00
6	Door 1	Glass (> 50% glazing):Metal Frame, Entrance Door				Product ID: NA		42	ft2			0.770	32	0.40	0.00
7	Door 2	Insulated Metal					Non-Swin...	288	ft2			0.500	144		
8	Door 3	Insulated Metal					Swinging	40	ft2			0.420	17		
9	Exterior Wall 2	Solid Concrete:8" Thickness	Medium Weight	East	1 - Office (No...		Furring: M...	6000	ft2	13.0	5.0	0.080	480		
10	Exterior Wall 3	Solid Concrete:8" Thickness	Medium Weight	West	1 - Office (No...		Furring: M...	6000	ft2	13.0	5.0	0.080	480		
11	Exterior Wall 4	Steel-Framed, 24" o.c.		South	1 - Office (No...			1000	ft2	13.0	5.0	0.070	70		
12	Floor 1	Slab-On-Grade:Unheated			1 - Office (No...		Insulation...	180	linear ft				131		

In this non-residential COMcheck example, the roof insulation R-value is below the prescriptive requirement of R-30; however overall envelope compliance has been achieved through improved performance of the exterior walls, windows, and doors.

3. METHODS OF COMPLIANCE: PATH 3

TOTAL BUILDING PERFORMANCE: ComCheck Example

Level of Effort: High

- Energy Modeling, per Section 11 or Appendix G from ASHRAE 90.1, is used to demonstrate compliance
- Budget Building Design:
  - Meets mandatory & prescriptive Code requirements
  - Follows modeling protocol
- 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)

3. METHODS OF COMPLIANCE: PATH 2

TRADE- OFF: ComCheck Example

When Would a Project Pursue the Total Building Performance Approach?

Envelope–related Scenarios:

- Fenestration Area exceeds 40% of wall or 3% of roof
- Fixed Fenestration does not meet SHGC of 0.38
  - 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:

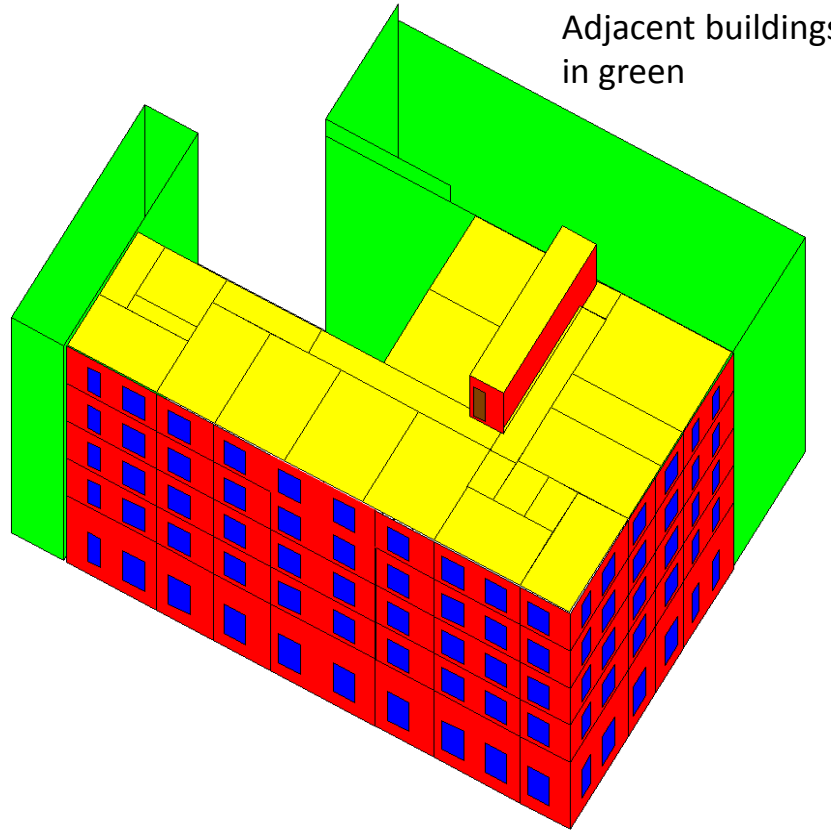
- Project exceeds prescriptive interior Lighting Power Densities
- Project is pursuing a LEED rating, and requires energy modeling
- Project is pursuing energy-efficiency incentives (e.g., NYSERDA, Con Edison), and requires energy modeling
- Project uses Trade-offs among disciplines

3. METHODS OF COMPLIANCE

Multi-Story Residential Building

Residential Scenario:

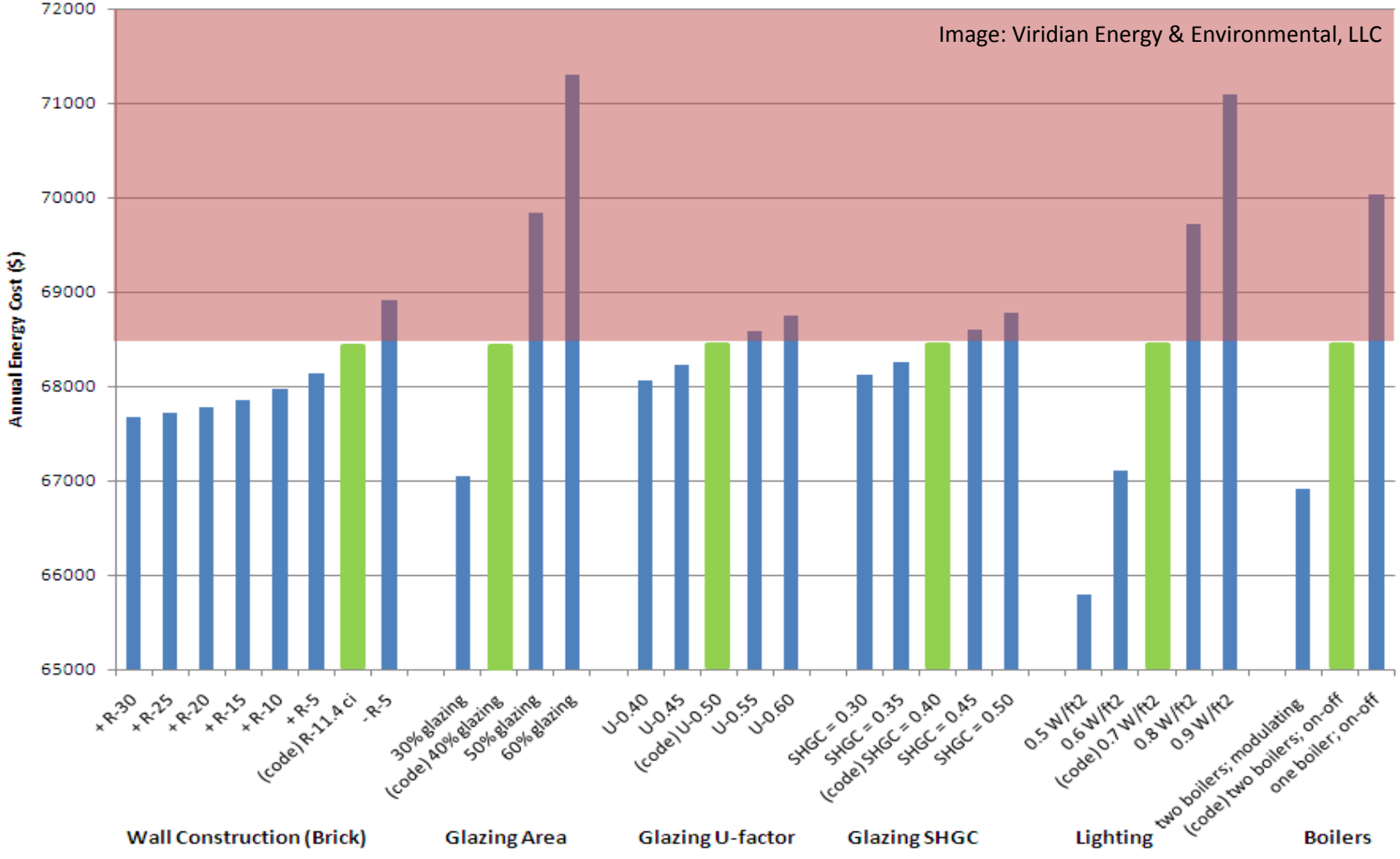
- Modeling is used to assess the effects of varying:
  - (WWR)
  - Glazing Wall insulation values
  - Glazing areas U-Factor
  - Glazing Solar Heat Gain Coefficient
  - Lighting Power (owner-installed)
  - Equipment selection (PTAC v. VRF)
  - Equipment Efficiencies (boilers)



Sample Multi-story Residential Building
Analysis Using DOE-2 Software

3. METHODS OF COMPLIANCE: ENERGY MODELING

Example -2: Multi-Story Residential Building



3. METHODS OF COMPLIANCE: ENERGY MODELING

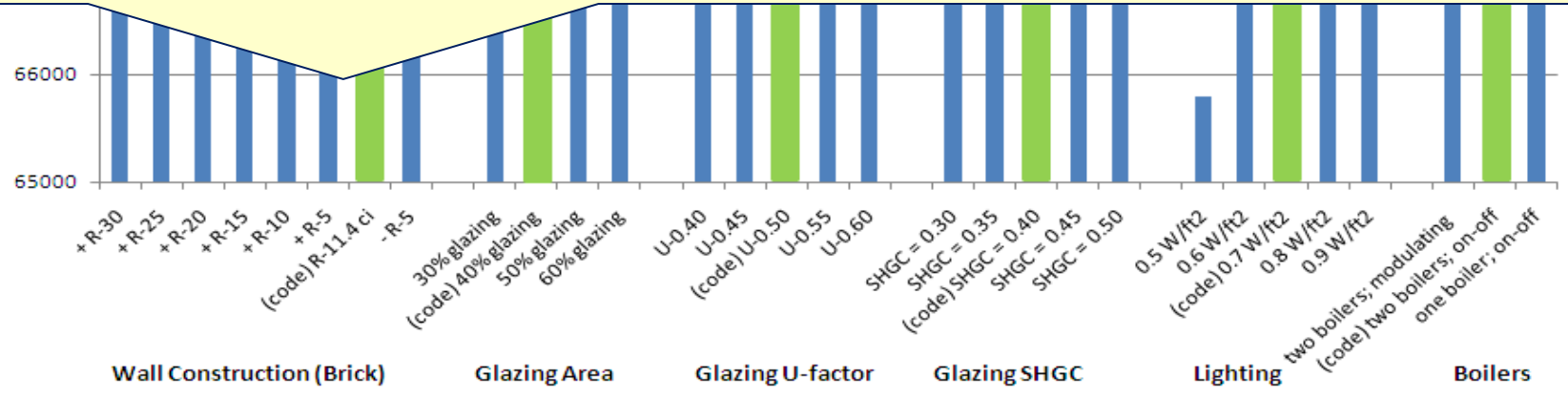
Example -2: Multi-Story Residential Building

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 ASHRAE 90.1 requirement. Measures to the left of the green bar perform better than the required 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.



3. METHODS OF COMPLIANCE

ANSI/ASHRAE/IESNA 90.1 - 2013

When would ASHRAE 90.1 be used to demonstrate 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 > 30%, 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 6% SRR allowed in prescriptive path
- When the HVAC systems do not use economizers

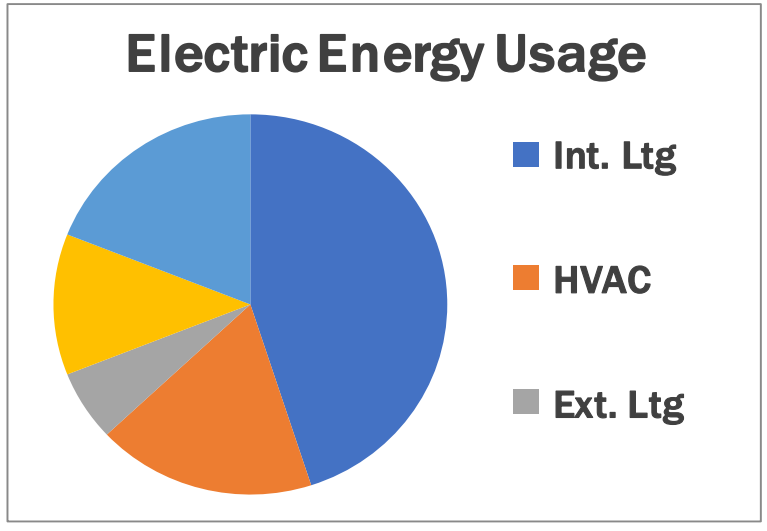
3. METHODS OF COMPLIANCE

ANSI/ASHRAE/IESNA 90.1 - 2013

What are the differences of using ASHRAE vs. the NYCECC?

More Extensive Mandatory Provisions:

- Electrical Energy Monitoring, Section 8.4.3, requires measurement devices to be installed in new buildings greater than 25,000 sq. ft. to monitor the electrical energy use for each of the following:
  - Total electrical energy
  - HVAC systems
  - Interior lighting
  - Exterior lighting
  - Receptacle circuits



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

REVIEW QUESTION #1

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?

3. METHODS OF COMPLIANCE

REVIEW QUESTION #1

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: **Yes**

The vertical glazing area of the **entire building** does not exceed 30% of the total wall area, so the prescriptive method can be used following either NYCECC Chapter C4 or ASHRAE 90.1-2013 (Appendix CA)

4. THERMAL PROPERTIES

Slides 55 to 74

4. THERMAL PROPERTIES: 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.

4. THERMAL PROPERTIES: OPAQUE ENVELOPE, THERMAL PROPERTIES

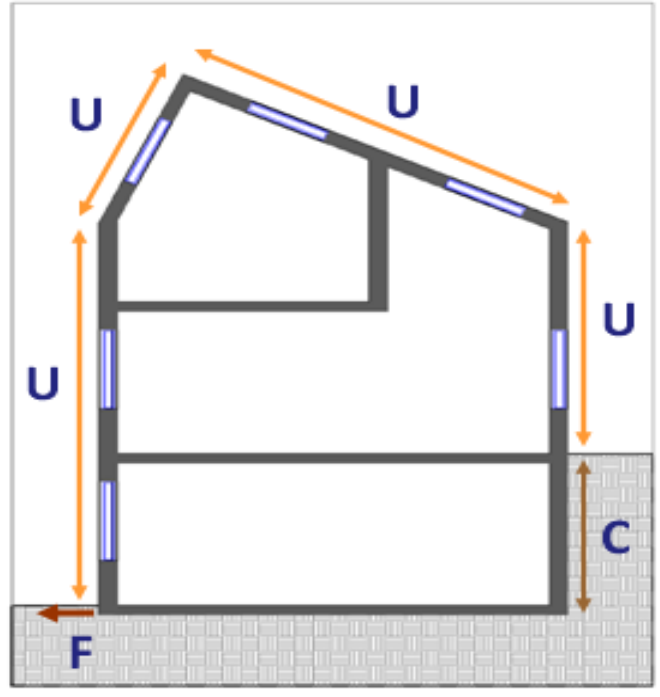
Which thermal property applies to which envelope component?

R-Value
- Thermal Resistance
- Applies to all material components
- Unit: **hr • ft² • °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 • ft2 • **°F**

C-Factor
- Thermal Conductance
- Applies to below-grade wall assemblies
- Unit: Btu / hr • **ft2** • **°F**

F-Factor
- Perimeter Heat Loss Factor
- Applies to Slabs on grade
- Unit: Btu / hr • ft • °F



4. THERMAL PROPERTIES: INSULATION PROPERTY: R-VALUE

What is the most common thermal property referred to in the Code?

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 demonstrate compliance using the Prescriptive Method

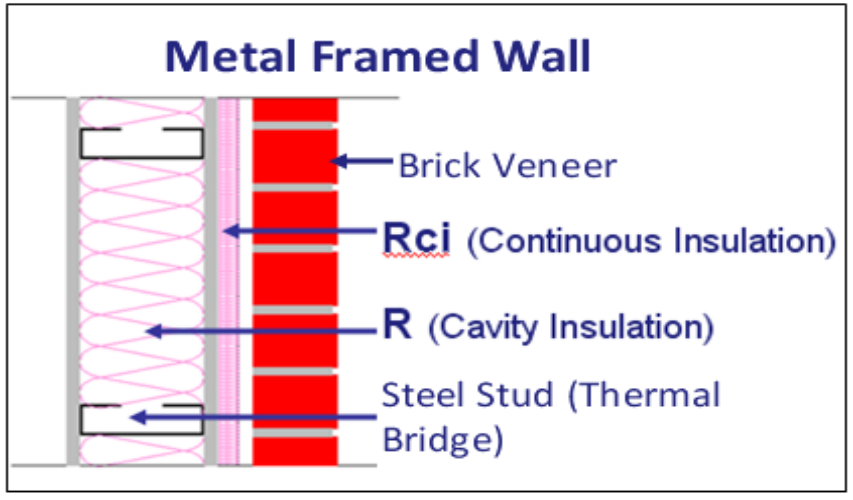
4. THERMAL PROPERTIES: R-VALUE NAMING CONVENTION

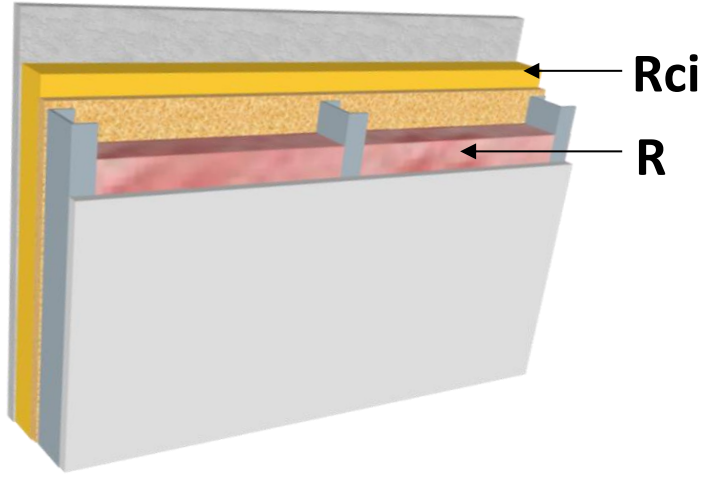
What is the Difference Between R and Rci?

R:
- Insulation installed within the cavity between framing members R-Value of Insulation installed within the cavity between framing members

Rci:
- Continuous insulation uninterrupted by framing, most commonly installed exterior to framing R-Value of continuous insulation uninterrupted by framing, most commonly installed exterior to framing
- Typically required in assemblies subject to thermal bridging Typically required in assemblies where thermal bridging is significant

Code Requirement Examples:
- Roof (attic) - R-38: cavity only requirement
- Roof (metal buildings): R-19+R-11LS (Liner System)
- Walls (mass) – R11.4ci: continuous only
- Walls (metal-framed) - R-13 (cavity) and R-7.5ci





4. THERMAL PROPERTIES: R-VALUE: PRESCRIPTIVE METHOD

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 ≤ 30%)
- Skylights: (SRR ≤ 3%)
- WWR may be increased to 40% and SRR to 5% with provision of daylight responsive controls

STEP 3: Determine Minimum R + Rci Values

- Table C402.1.3: 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		All Other Commercial	Group R, > 3 stories
Roofs			
	Insulation Entirely above de	R-30ci	R-30ci
	Metal buildings	R-19 + R-11 LS	R-19 + R-11 LS
	Attic & Other	R-38	R-38
Walls, Above Grade			
	Mass	R-9.5ci	R-11.4ci
	Metal buildings	R-13 + R-13ci	R-13 + R-13ci
	Metal framed	R-13 + R-7.5ci	R-13 + R-7.5ci
	Wood frame and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20
Walls, Below Grade		R-7.5ci	R-7.5ci
Floors			
	Mass	R-10ci	R-10.4ci
	Joist/framing	R-30	R-30
Slab-on-grade floors			
	Unheated slabs	R-10 for 24" below	R-10 for 24" below
	Heated slabs	R-15 for 24" below	R-15 for 24" below
Opaque Doors			
	Nonswinging	R-4.75	R-4.75

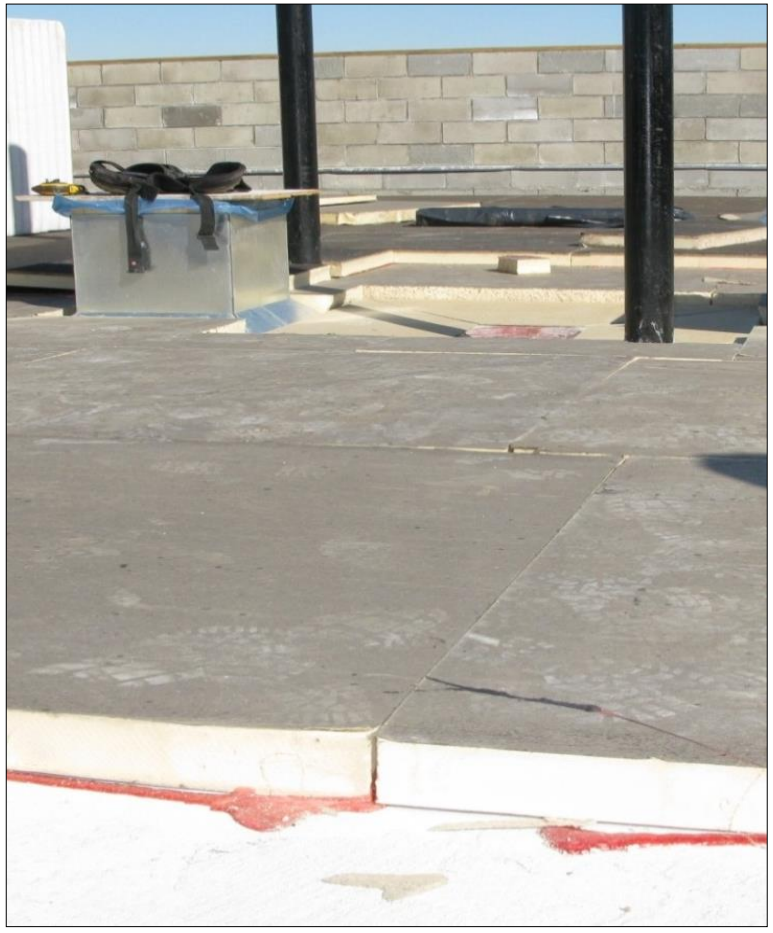
NYCECC Table C402.1.3, C402.4

4. THERMAL PROPERTIES: INSULATION MATERIALS – 1

What are the Most Common Types of Insulation Materials Used?

Batt Insulation	
Fiberglass Batts	R-3.1 to R-4.3 / inch
Rock Wool Batts	R-3.2 to R-3.9 / inch
Cotton Batts	R-3.7 / inch

Rigid Foam Boards	
Expanded Polystyrene	R-3.9 to R-4.2 / inch
Extruded Polystyrene	R-5.0 / inch
Polyisocynurate	R-5.6 to R-7.0 / inch
Polyurethane	R-5.6 to R-7.0 / inch



4. THERMAL PROPERTIES: INSULATION MATERIALS – 2

What are the Most Common Types of Insulation Materials Used?

Loose-Fill (Blown In)	
Cellulose	R-3.1 to R-3.7 / inch
Fiberglass	R-2.2 to R-2.9 / inch
Fiberglass (Dense-Pack)	R-3.4 to R-4.2 / inch
Mineral Wool	R-2.2 to R-2.9 / inch

Spray-In Place	
Polyurethane Foam	R-5.6 to R-6.2 / inch
Low Density Urethane Foam	R-3.6 to R-4.3 / inch
Magnesium Silicate Foam	R-3.9 / inch
Wet-Spray Cellulose	R-2.9 to R-3.4 / inch
Spray-in Fiberglass	R-3.7 to R-3.8 / inch


Photo: Courtesy of DOE/NREL

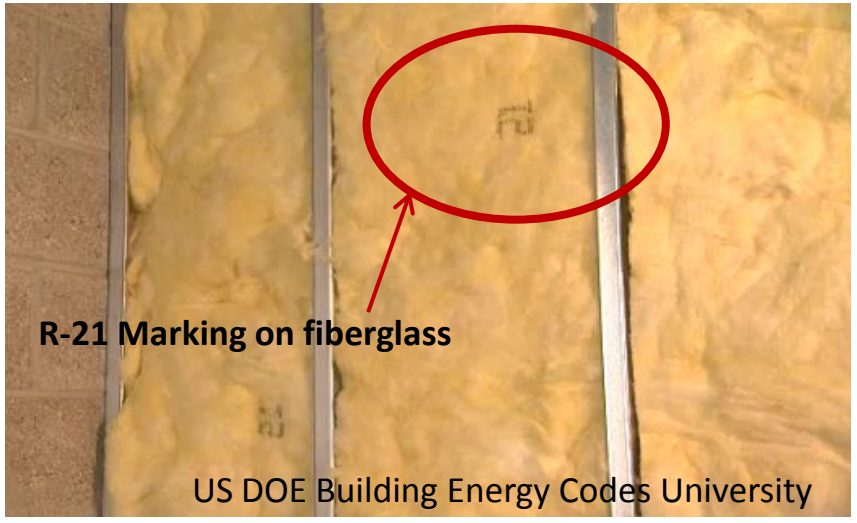

Photo: Courtesy of DOE/NREL

4. THERMAL PROPERTIES: IDENTIFYING R-VALUES IN THE FIELD

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



4. THERMAL PROPERTIES: U-FACTOR – 1

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

U-Factor – Thermal Transmittance

- Conductance of a Total Assembly (Btu/H.ft^2.F)
- Inverse of an assembly's R-Value

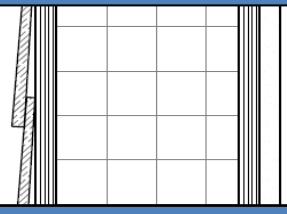
☑ **Lower U-Factor is Better**

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

$$U = \frac{(U1 \bullet A1) + (U2 \bullet A2) + \ldots}{A1 + A2 + \ldots}$$

  - 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)`



Material	R-Value
Outside Air Film	0.17
Wood Shingles	0.87
Air Infiltration Barrier	--
5/8" Exterior Plywood Sheathing	0.85
5 ½" Thick EPS Board Insulation	22
5/8" Interior Plywood Sheathing	0.85
5/8" Gypsum Wallboard	0.57
Inside Air Film	0.68
TOTAL R-Value for Assembly:	**25.99**
U-Factor for Assembly (1/R)	**0.0385**

4. THERMAL PROPERTIES: U-FACTOR – 2

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

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**

4. THERMAL PROPERTIES: U-FACTOR – 2

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

Common Mistake:

Averaging R-Values of different assemblies i

- Example for Exterior Wall:
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What is the Weighted Average Thermal Resi

☒ If you average R-Values: **R-12**

☑ If you average U-Factors: U = 0.273, o

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.

4. THERMAL PROPERTIES: C-FACTOR AND F-FACTOR

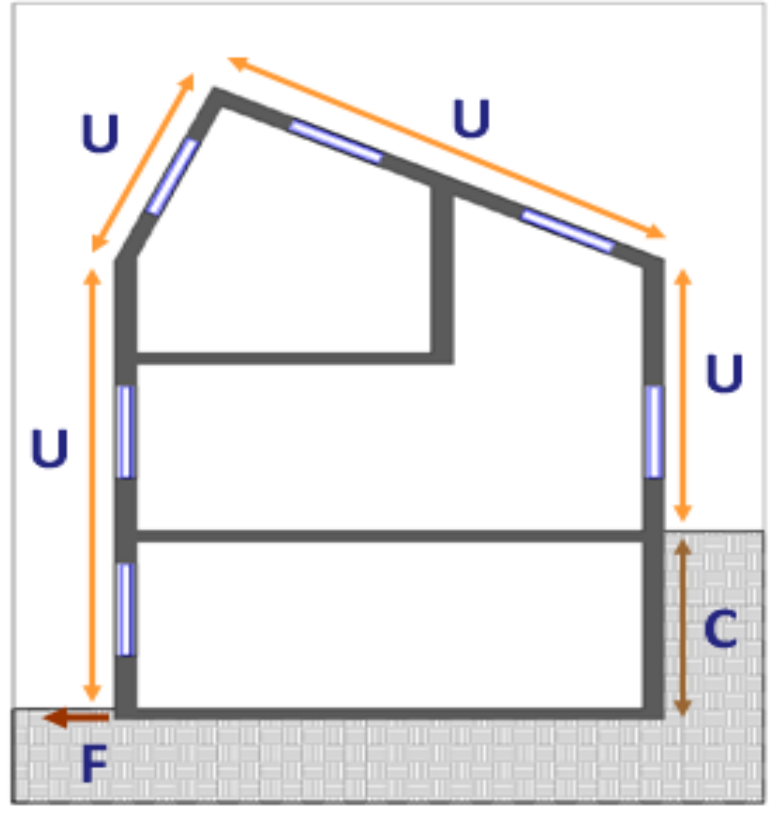
How do C-Factors and F-Factors Differ from U-Factors?

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



4. THERMAL PROPERTIES: U-VALUE CALCULATION METHODS

What are the Approved Methods to Calculate U-Factors?

Software Programs

- COMCheck
  - Also does an overall weighted average calculation among envelope elements
- HVAC Load analysis programs
  - Must be approved by Secretary of State of NYS and by the Commissioner of NYC Buildings
- Approved energy analysis programs
  - Energy Plus, Trane Trace, and IES VE
  - eQUEST, DOE 2.1 E, and Visual DOE
- ERI

ASHRAE 90.1-2013, Appendix A - Rated R Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations

- Typical construction assemblies shown with U-Factor, C-Factor and F-Factor values

Manual Calculations

- Refer to ASHRAE Fundamentals textbook
  - Series Method
  - Parallel Path Method
  - Other methods are not approved for residential buildings

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- ERI

Comcheck is a free software program developed & distributed by the U.S. Department of Energy (DOE). (routinely check website for most up to date version)

ASHRAE 90.1-2013, Appendix A - Rated R Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations

- Typical construction assemblies shown with U-Factor, C-Factor and F-Factor values

Manual Calculations

- Refer to ASHRAE Fundamentals textbook
  - Series Method
  - Parallel Path Method
  - Other methods are not approved for residentia

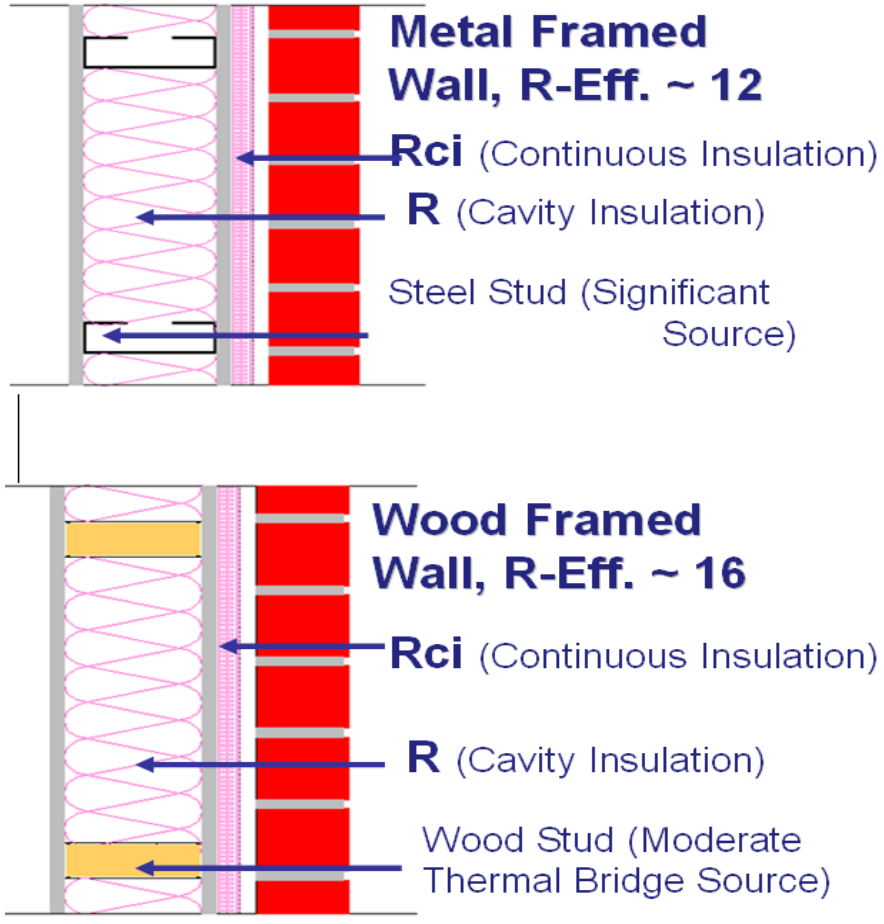
For most users, the ASHRAE look-up tables will be the easiest way to determine U-Factor, C-Factor, or F-Factor values. If an applicant is submitting an energy analysis using these factors, be sure to cite the ASHRAE table or the calculation method used.

4. THERMAL PROPERTIES: THERMAL BRIDGING – 1

How does Thermal Bridging Impact the Effective R-Value?

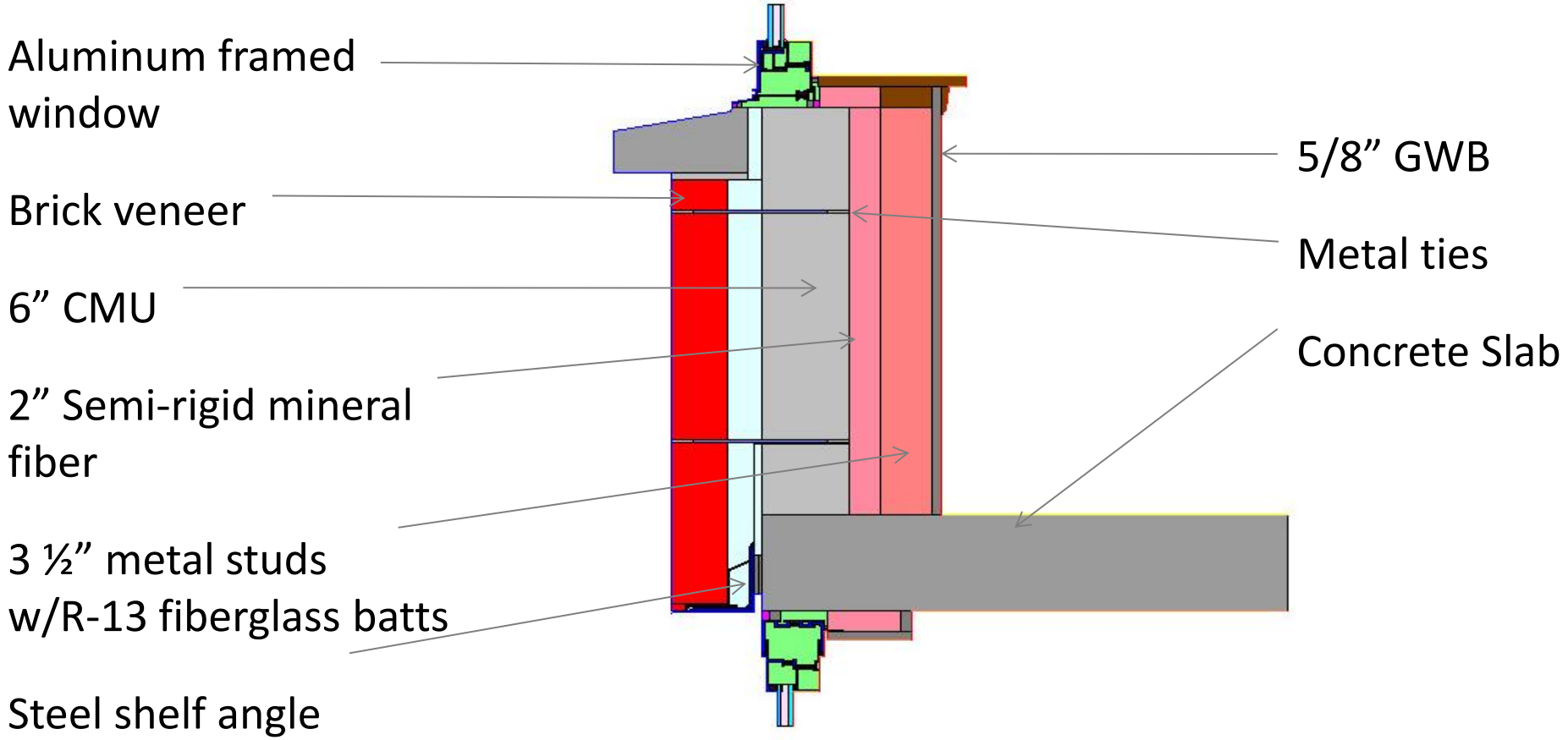
Thermal bridging is caused by heat transfer through highly-conductive materials

- 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)



4. THERMAL PROPERTIES: THERMAL BRIDGING – 2

Masonry Wall / Concrete Slab Example



Nominal R-Value = 22

4. THERMAL PROPERTIES: THERMAL BRIDGING – 2

Masonry Wall / Concrete Slab Example

Aluminum framed window

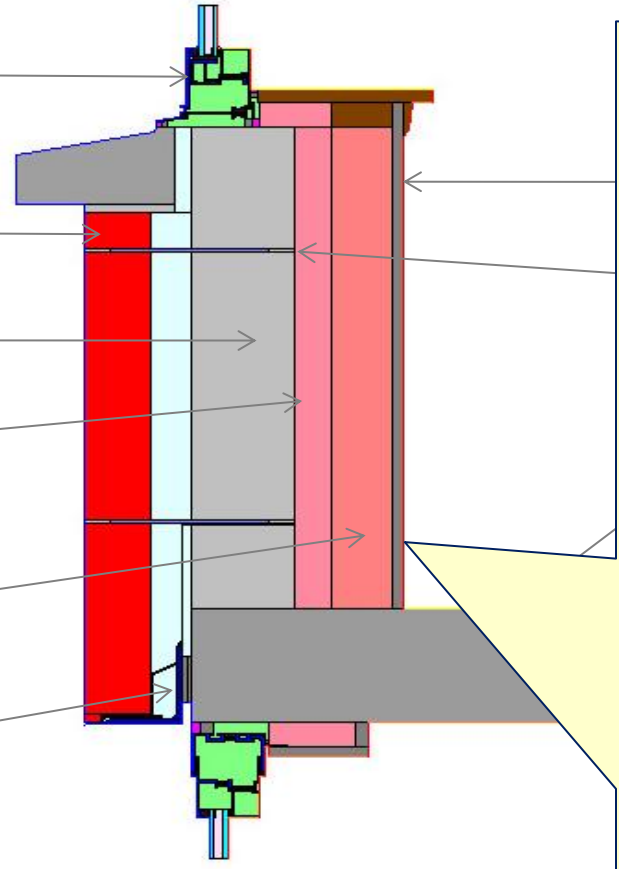
Brick veneer

6” CMU

2” Semi-rigid mineral fiber

3 ½” metal studs w/R-13 fiberglass batts

Steel shelf angle



Nominal R-Value = 22

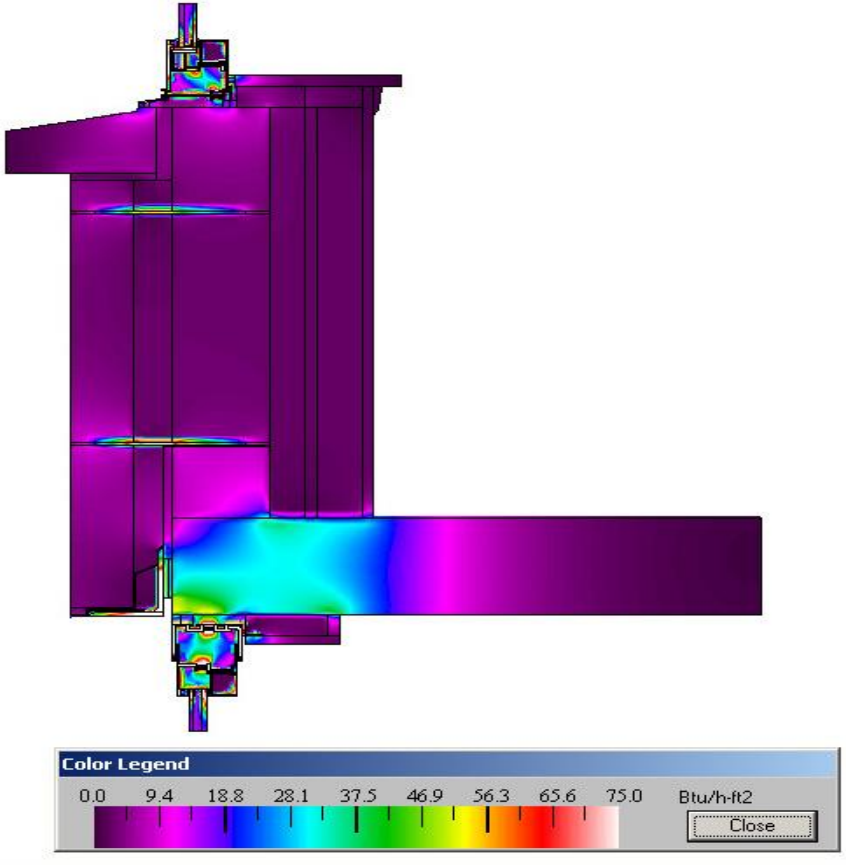
Thermal bridging occurs through many types of building assemblies. This example shows a vertical section through a masonry cavity wall at a concrete floor slab. Aluminum-framed windows are also shown above the wall and below the slab.

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.

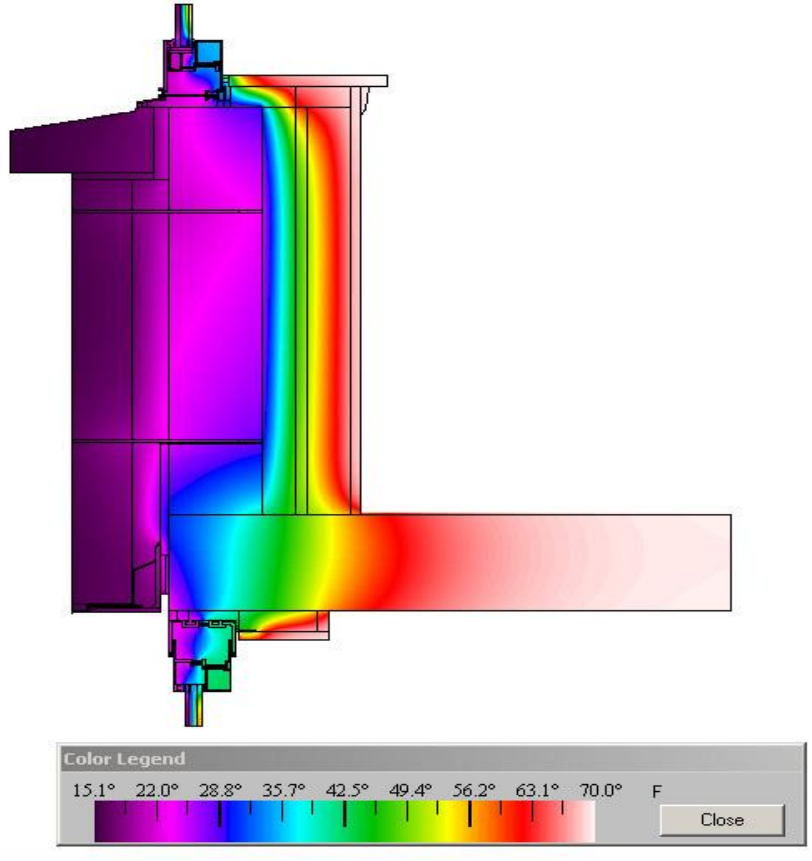
Without accounting for thermal bridging, this assembly would have a nominal R-Value of 22.

4. THERMAL PROPERTIES: THERMAL BRIDGING – 3

Analysis Performed Using 2-Dimensional Heat Flow Software



Heat Flux Profile

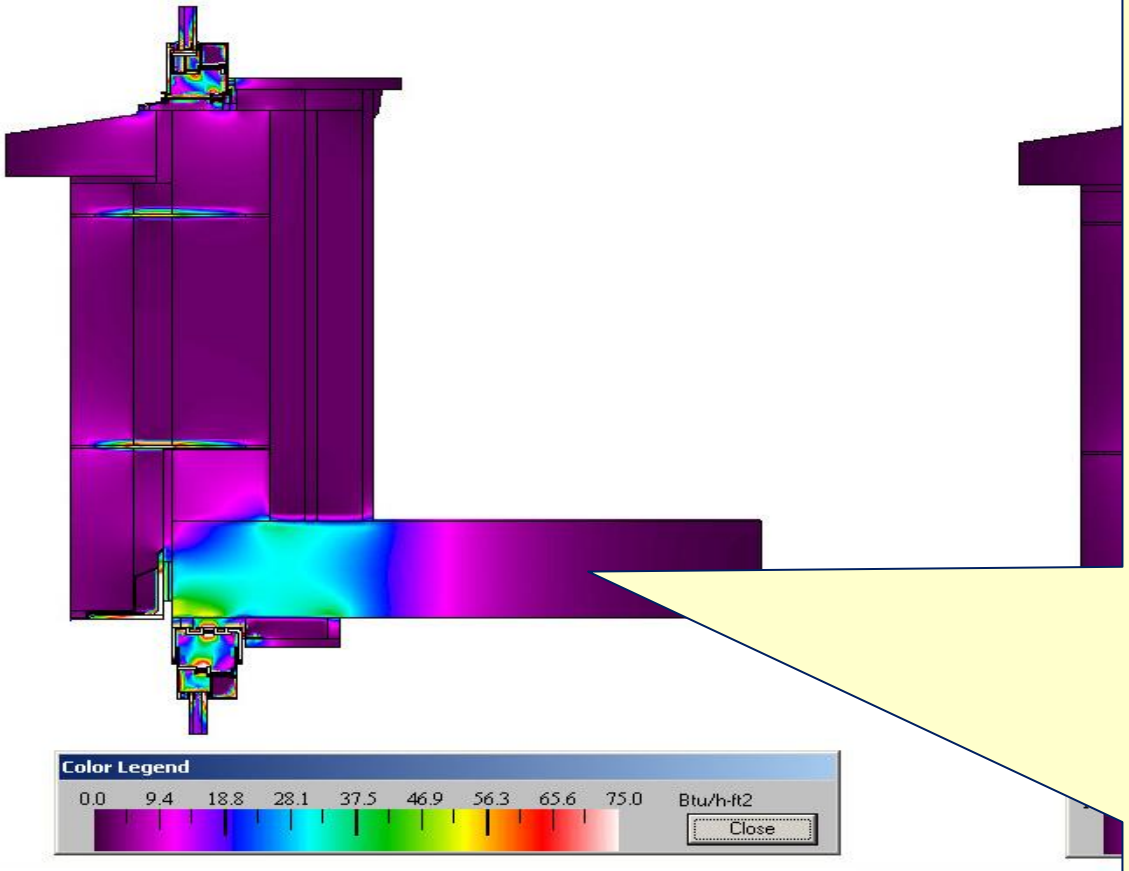


Temperature Profile

Calculated R-Value = 5.6

4. THERMAL PROPERTIES: THERMAL BRIDGING – 3

Analysis Performed Using 2-Dimensional Heat Flow Software



Heat Flux Profile

Ter

Calculated R-Value = 5.

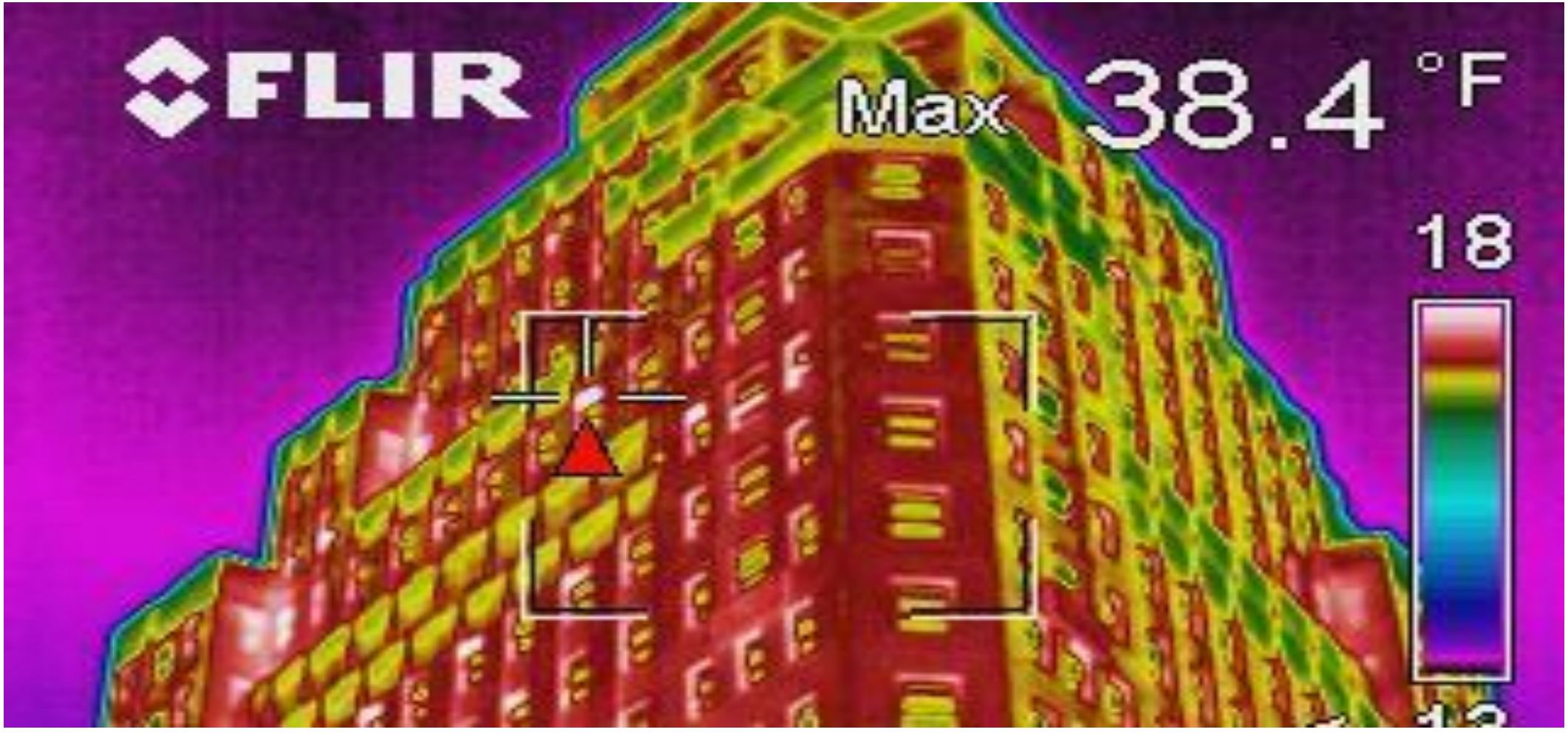
In actuality, thermal bridging occurs in several areas within this assembly. As reviewed in previous slides, the cavity insulation within the metal stud wall is subject to thermal bridging effects. In addition, as shown in this THERM computer analysis, the edge of the concrete slab, which is connected 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.

5. ABOVE GRADE WALLS

Slides 75 to 95



5. ABOVE GRADE WALLS: 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.

5. ABOVE GRADE WALLS: WALL TYPES

What are the Major Types of Above-Grade Walls?

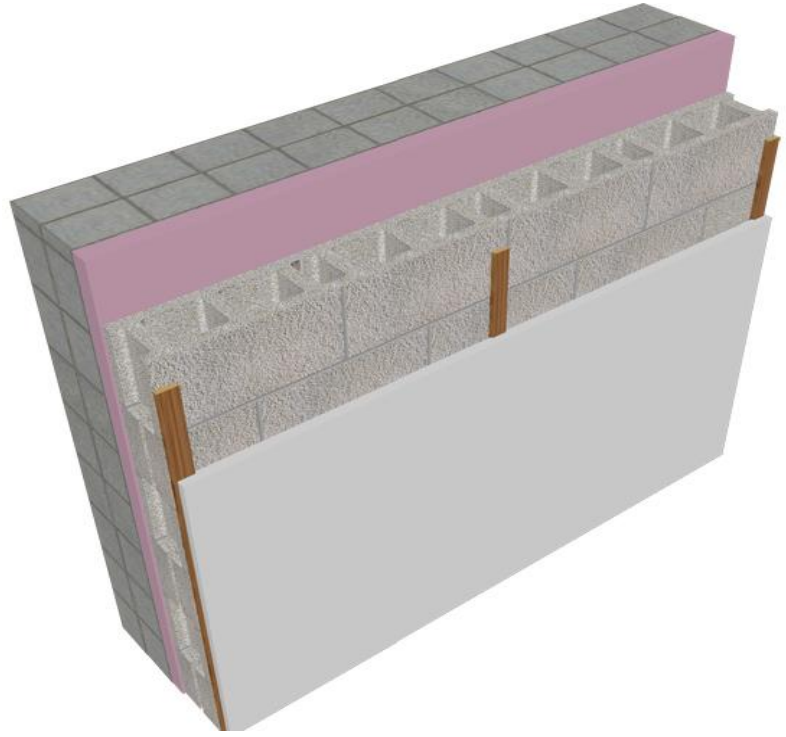
Type	Mass Wall	Metal Framed Wall	Metal Building Wall	Wood Framed Wall
Typical Construction	Brick / Brick-CMU / CMU / Concrete walls	Steel Stud walls	Steel Structural Member (Z-girt walls)	Wood Stud walls
Prescriptive Insulation R-Values	Others: R-9.5ci Group R: R-11.4ci	All building types: R-13 + R-7.5ci	All building types: R-13 + R-13.ci	All building types: R-13 + R-3.8ci or R-20

5. ABOVE GRADE WALLS: MASS WALL – QUALIFICATION

What Qualifies as a Mass Wall?

Mass Wall Descriptions

- "Mass walls" shall include walls:
  - Weighing not less than 35 psf (170 kg/m_2) of wall surface area.
  - Weighing not less than 25 psf (120 kg/m_2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m_3).
  - Having a heat capacity exceeding 7 Btu/ft_2 . °F (144 kJ/m_2 .K).
  - Having a heat capacity exceeding 5 Btu/ft_2 . °F (103 kJ/m_2 .K), where the material weight is not more than 120 pcf (1900 kg/m_3).



5. ABOVE GRADE WALLS: MASS WALL – EXAMPLES

What Qualifies as a Mass Wall?

Q: Which of the following can qualify as Mass Walls?

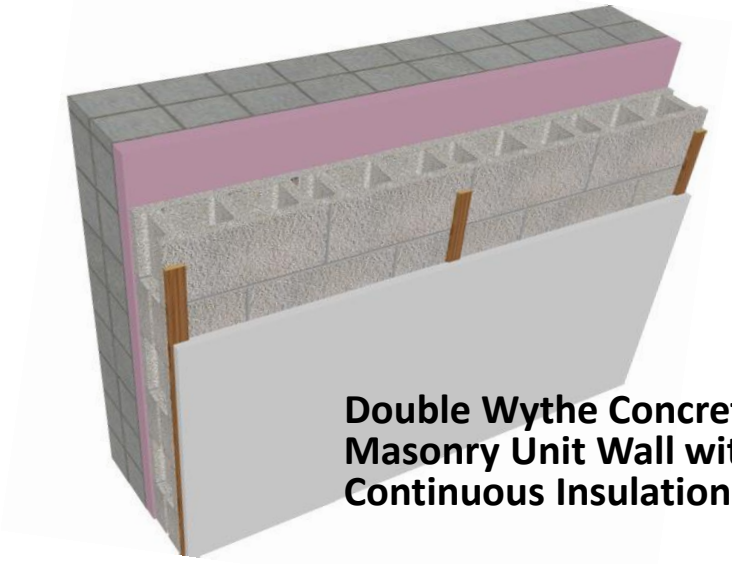
- ☑ Solid Concrete (145 pcf): 3” thick or more: **Yes**
- ☑ 5-5/8” thick CMU wall, no grout – minimum 125 pcf: **Yes**
- ☑ 3-5/8” Solid-Face Brick (minimum 120 pcf – typical density varies between 70 to 140 pcf) with stud backing: **Potentially**
- ☒ 1” Face brick with stud backing: **No**
- ☒ 3” thick Fly ash concrete wall: **No**
- ☒ Plastered EIFS walls with metal stud Framing: **No**

5. ABOVE GRADE WALLS: MASS WALL – INSULATION

What are the Insulation Requirements for Mass Walls?

Mass Wall Insulation Requirements:

NYC BOROUGHS (Climate Zone 4A)		All Other Commercial	Group R, >3 Stories
Mass Walls, Above Grade			
	Prescriptive Insulation R-value	R-9.5ci	R-11.4ci
	Alternative U-Factor	U - 0.104	U - 0.09
	Effective Assembly R-value	R-9.6	R-11.1



Double Wythe Concrete Masonry Unit Wall with Continuous Insulation

Insulation inserts within CMUs - No Credit allowed in R-Value Method (Use U-Factor Alternative)

5. ABOVE GRADE WALLS: MASS WALL – INSULATION

What are the Insulation Requirements for Mass Walls?

Mass Wall Insulation Requirements:

- 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

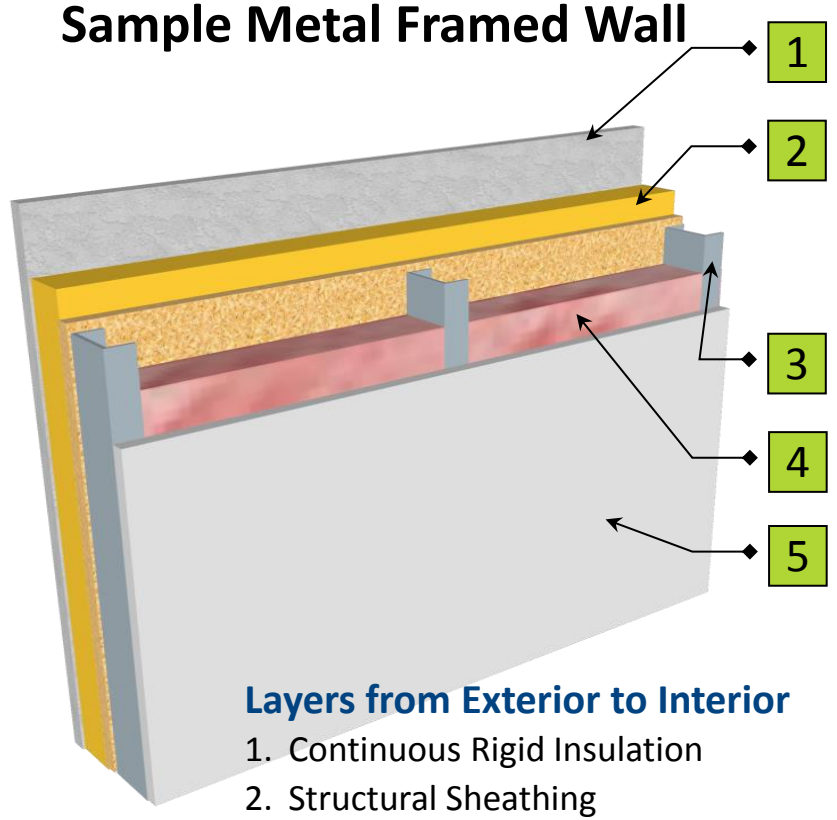
5. ABOVE GRADE WALLS: METAL FRAMED WALLS

What are the Insulation Requirements for Mass Walls?

Steel Studs Walls

- Typical walls are 4” or 6” steel studs, at 16” or 24” spacing

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

5. ABOVE GRADE WALLS: METAL FRAMED WALLS

What are the Requirements for Metal Framed Walls?

Insulation Requirements

NYC BOROUGHS (Climate Zone 4A)		All Other Commercial	Group R, >3 Stories
Metal Framed Walls, Above Grade			
	Prescriptive Insulation R-value	R-13 + R-7.5ci	R-13 + R-7.5ci
	Alternative U-Factor	U - 0.064	U - 0.064
	Effective Assembly R-value	R-15.625	R-15.625

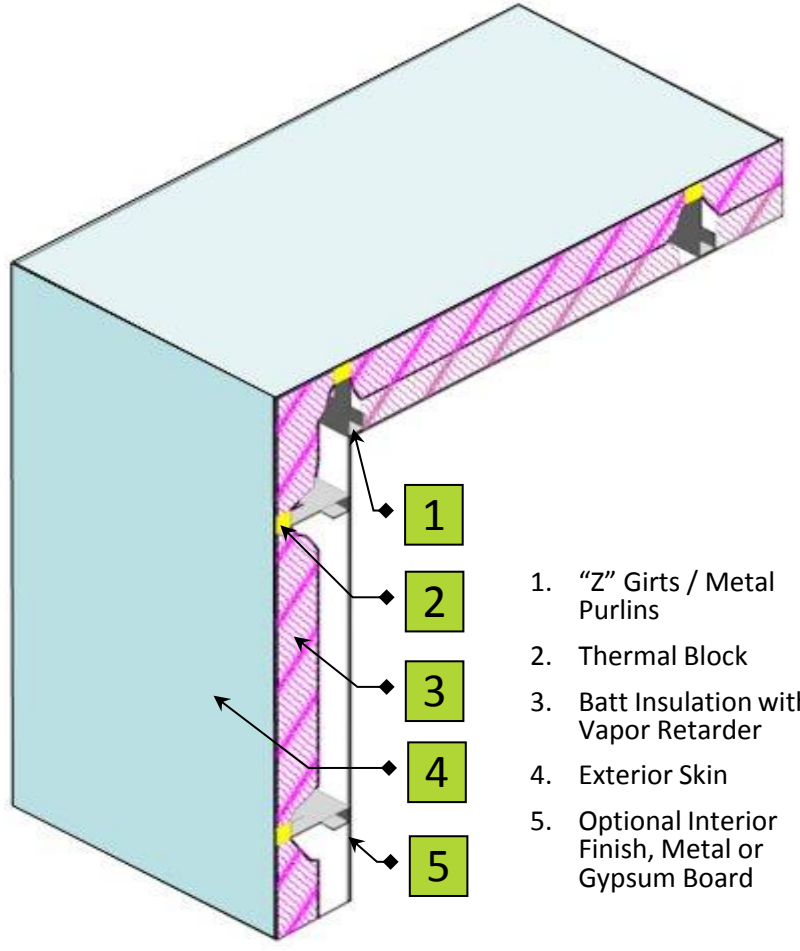
- Insulation is both exterior and continuous (to mitigate thermal bridging)
- Cavity insulation can be removed if continuous insulation is increased and U-Factor method is used

5. ABOVE GRADE WALLS: METAL BUILDING WALL

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

5. ABOVE GRADE WALLS: METAL BUILDING WALL

What are the Insulation Requirements for Metal Building Walls?

Insulation Requirements

NYC BOROUGHS (Climate Zone 4A)	All Other Commercial	Group R, >3 Stories
Metal Building Walls, Above Grade		
Prescriptive Insulation R-value	R-13 + R-13ci	R-13 + R-13ci
Alternative U-Factor	U-0.052	U-0.052
Effective Assembly R-value	R-19.2	R-19.2

- U-Factors calculated in ASHRAE 90.1 Table A3.2.3
- 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

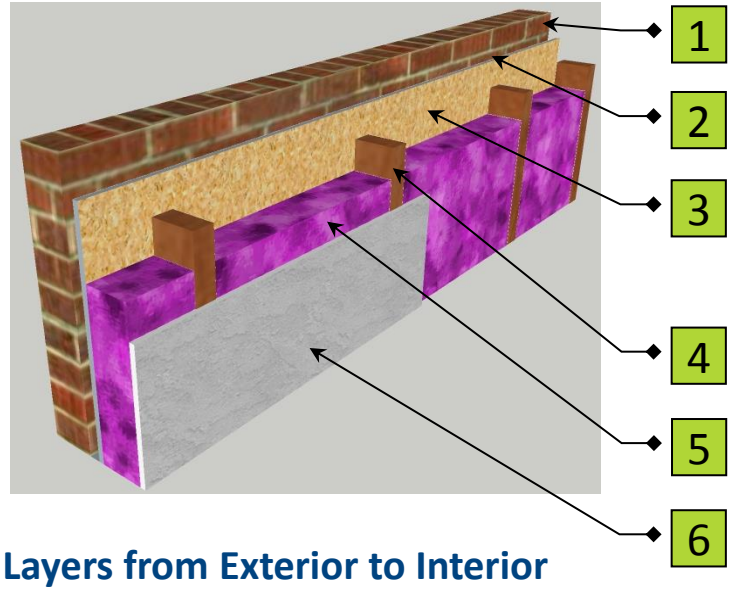
5. ABOVE GRADE WALLS: WOOD FRAMED WALL

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.

Brick Cavity Wall



Layers from Exterior to Interior

1. Brick Wall – 4” to 12” thick
2. 1” Air space minimum
3. Structural Sheathing
4. Framing – Wood or Steel Studs
5. Cavity Insulation
6. Gypsum Wall Board

5. ABOVE GRADE WALLS: WOOD FRAMED WALL

What are the Prescriptive Requirements for Wood Framed Walls?

Insulation Requirement

NYC BOROUGHS (Climate Zone 4A)		All Other Commercial	Group R, >3 Stories
Wood Frame & Other Walls, Above Grade			
	Prescriptive Insulation R-value	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20
	Alternative U-Factor	U-0.064	U-0.064
	Effective Assembly R-value	R-15.6	R-15.6

- 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

5. ABOVE GRADE WALLS: OTHER WALL TYPES

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


Photo: Courtesy of DOE/NREL

SIPS

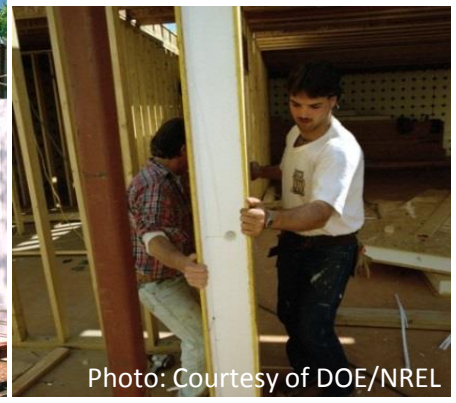


Photo: Courtesy of DOE/NREL


Photo: Courtesy of DOE/NREL

ICF

5. ABOVE GRADE WALLS: OPAQUE SECTIONS OF CURTAIN 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)

5. ABOVE GRADE WALLS: PROGRESS INSPECTIONS

What are the Applicable Progress Inspections for Above-Grade Walls?

Inspection / Test (As indicated on the TR8)	Frequency
Insulation placement and R-values (IIA2) 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.	As required to verify continuous enclosure while walls, ceilings and floors are open
Air sealing and insulation – visual (IIA6) 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 must observe the testing of the building and/or assemblies and verify that the building and/or assemblies meet the requirements of the standard, in accordance with the standard(s) cited in the approved plans.	As required during construction

TR8: http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf

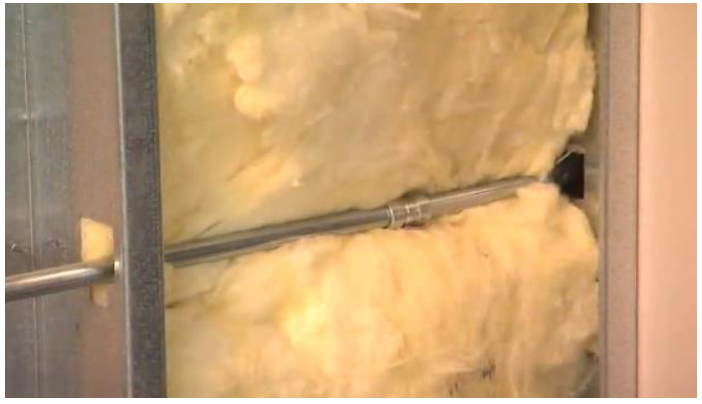
1 RCNY §5000-01 : https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

5. ABOVE GRADE WALLS

PROGRESS INSPECTION CHECKLIST

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



US DOE Building Energy Codes University

- 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.

5. ABOVE GRADE WALLS

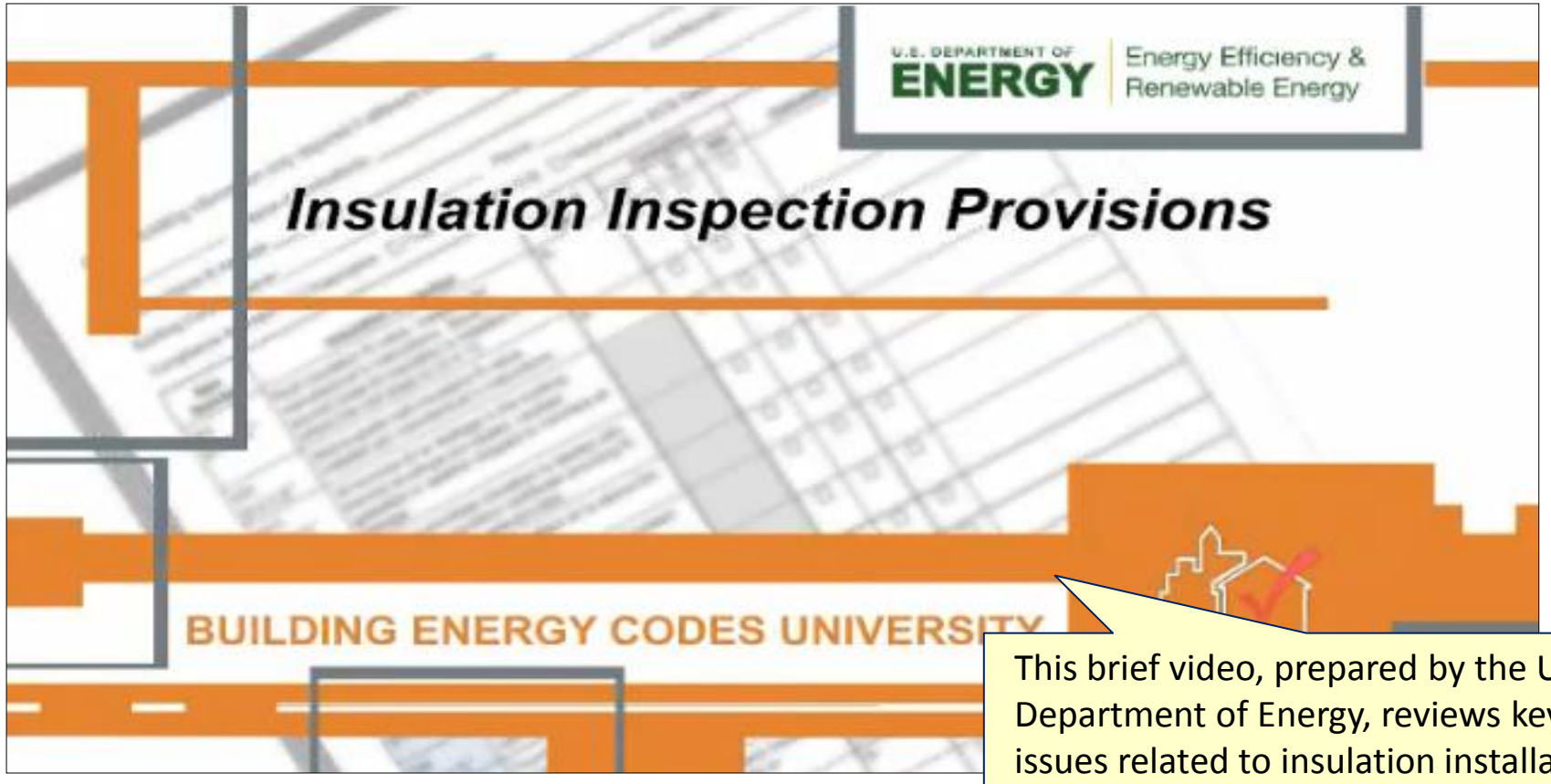
PROGRESS INSPECTION CHECKLIST

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
- 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: US DOE BUILDING

Inspection Video



Insulation Inspection Provisions (Length - 3:41)

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.

5. ABOVE GRADE WALLS: WALL RENOVATION

Scenario 1

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 C402.1.3

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

Exception: Existing ceiling, walls or floor cavities exposed during construction, provided that these cavities are filled with insulation.

5. ABOVE GRADE WALLS: WALL RENOVATION

Scenario 2

Q: A renovation involves the replacement of the interior wallboard along existing 3½" 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.

Exception: Ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.

6. ROOFS

Slides 96 to 110

6. ROOFS: 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.

6. ROOFS: ROOF / INSULATION CATEGORIES

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

Type	Insulation above Deck	Metal Building Roof	Attic & Other
Typical Construction	Structural decks (concrete or steel)	Metal roofs of pre-fabricated metal buildings	Attics with insulation within the attic floor, Sloped roofs with insulation within the rafter framing, Flat roofs with insulation underneath the deck
Prescriptive Insulation R-Values	R-30ci	All building types: R-19 + R-11 LS	All building types: R-38

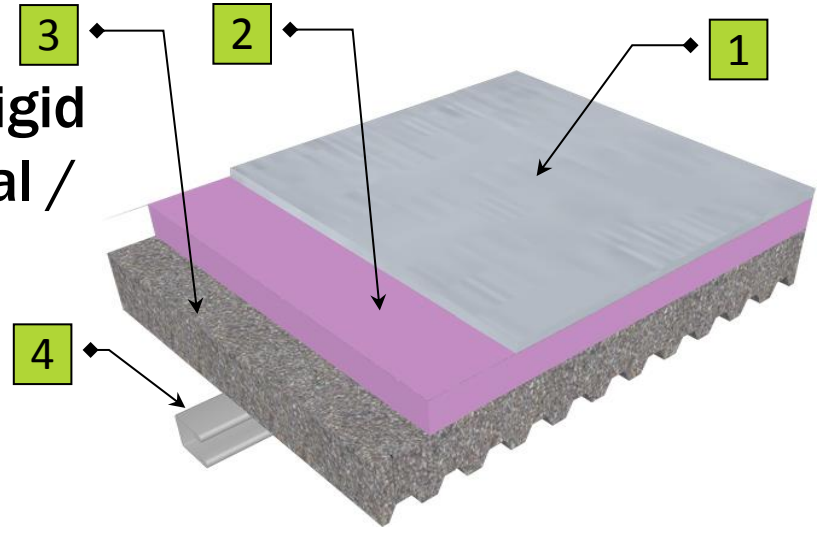
6. ROOFS: INSULATION ABOVE DECK

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-30ci
- U-0.032 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-30)
- Recommended Practice (beyond Code):
  - Joints between insulation sheets should be vertically staggered



Insulation Above Deck

1. Roof Membrane
2. Rigid Insulation
3. Metal Deck with Concrete
4. Structural Framing

6. ROOFS: METAL BUILDING ROOF

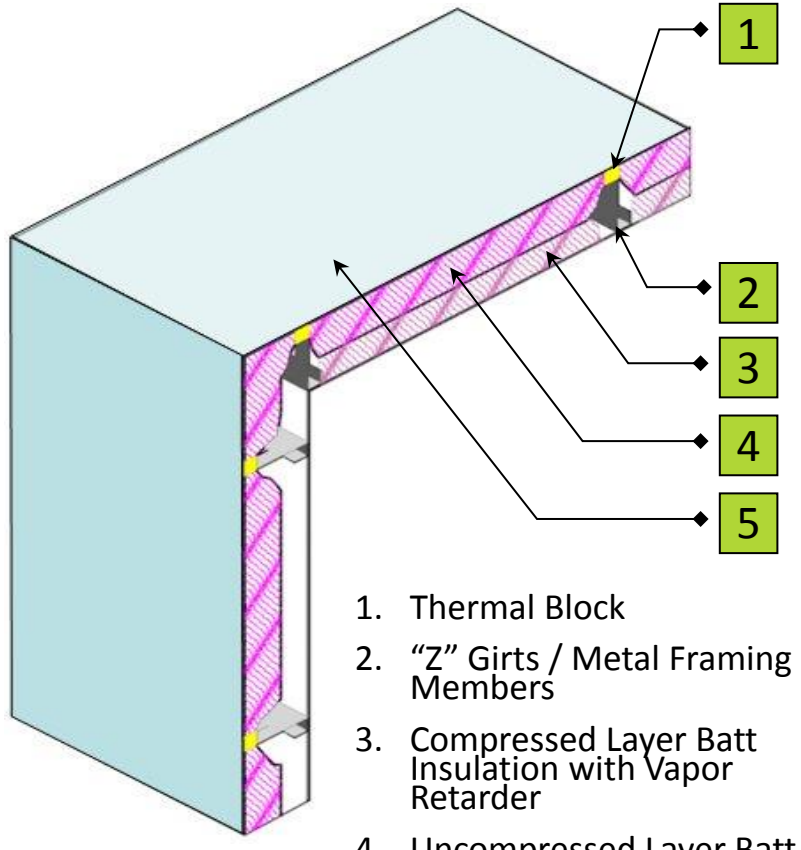
Roof Assembly Description

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

Insulation

- Other Commercial: R-19 + R-11 LS
- Group R Buildings: R-19 + R-11 LS
- Assembly U-0.035 or lower
  - Thermal insulation block (R-3) 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
  - See ASHRAE Appendix A for assembly descriptions

Typical Metal Roof Construction



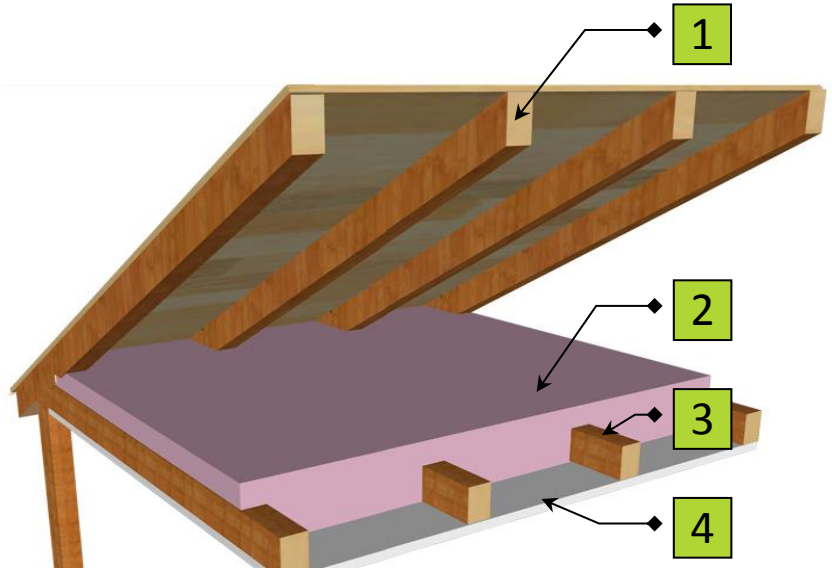
1. Thermal Block
2. "Z" Girts / Metal Framing Members
3. Compressed Layer Batt Insulation with Vapor Retarder
4. Uncompressed Layer Batt Insulation
5. Exterior Roof Skin

6. ROOFS: ATTICS & OTHER

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

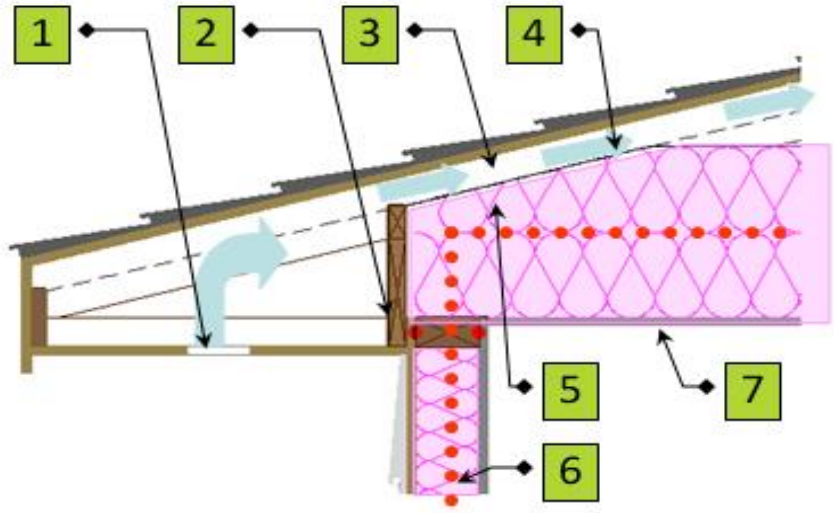
1. Roof Deck & Rafters
2. Insulation Layer
3. Purlins
4. Air Tight Ceiling

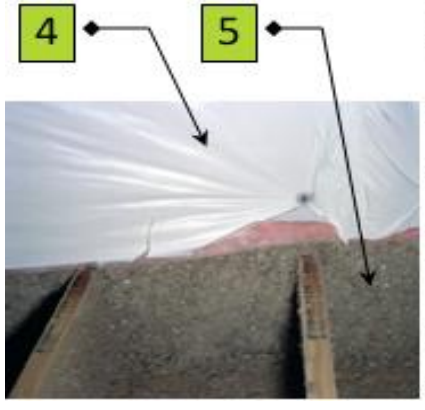
6. ROOFS: ATTICS & OTHER

Insulation:

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

Vented Attic – Insulation Details





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: ATTICS- VENTED

What are the Required Insulation Practices for Attics?

Baffles:

- **Baffles provide an air space** over the insulation to guide ventilation air from the soffit vents up along the underside **of the roof deck**

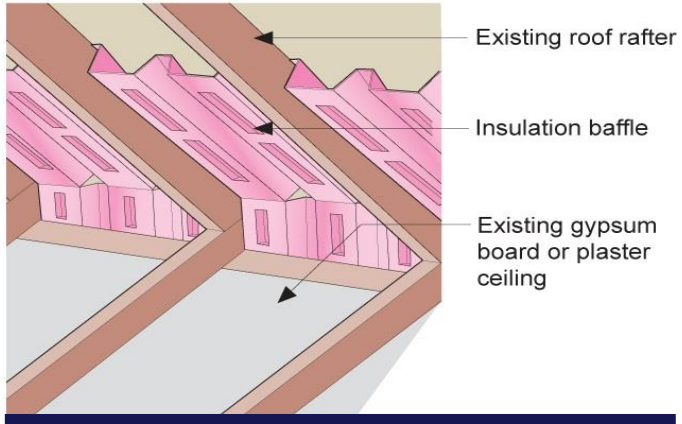


Image: Courtesy of basc.pnnl.gov

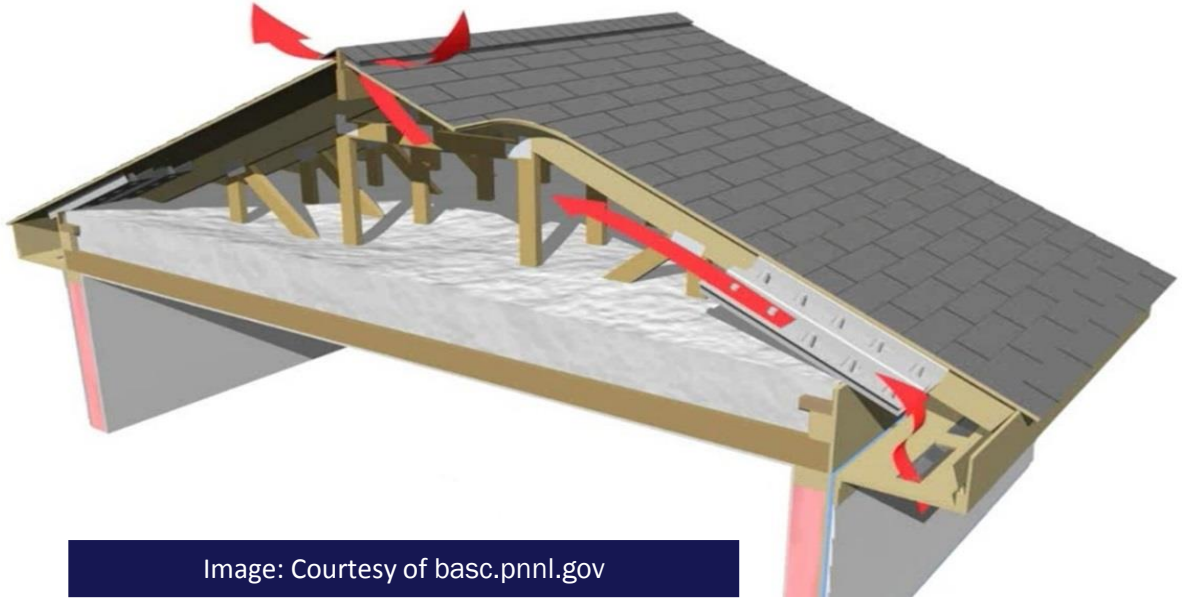


Image: Courtesy of basc.pnnl.gov

6. ROOFS

ADDITIONAL ROOF INSULATION REQUIREMENTS

- 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

6. ROOFS: PROGRESS INSPECTIONS

What are the Applicable Progress Inspections for Roofs?

Inspection / Test (As indicated on the TR8)	Frequency
Insulation placement and R-values (IIA2) 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.	As required to verify continuous enclosure while walls, ceilings and floors are open
Air sealing and insulation – visual (IIA6) 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 must observe the testing of the building and/or assemblies and verify that the building and/or assemblies meet the requirements of the standard, in accordance with the standard(s) cited in the approved plans.	As required during construction

TR8:https://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
1 RCNY § 5000-01:
https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

6. ROOFS: PROGRESS INSPECTION CHECKLIST

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

6. ROOFS: PROGRESS INSPECTION CHECKLIST

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).

6. ROOFS: PROGRESS INSPECTION CHECKLIST

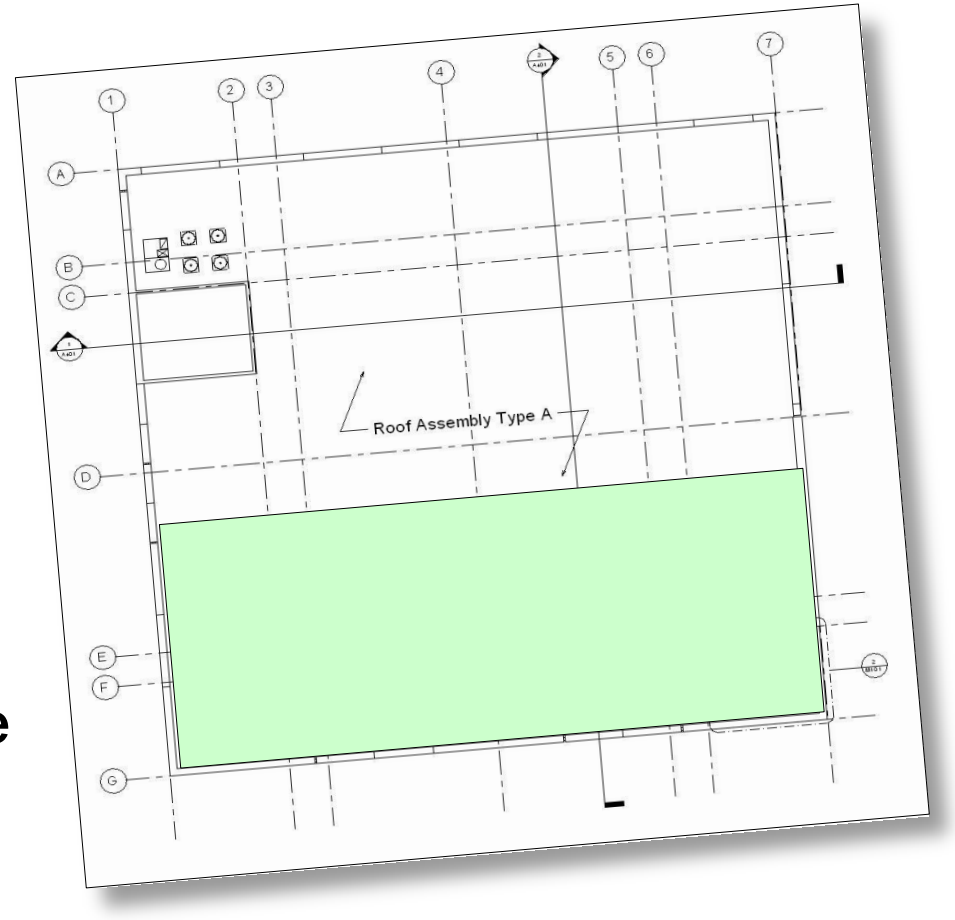
Key inspections for Opaque Roofs

- 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: REVIEW QUESTION

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.



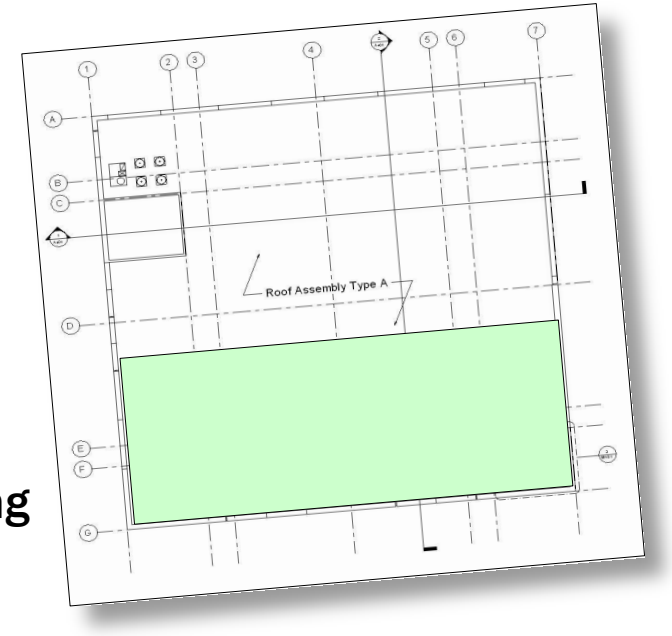
Is NYCECC-compliant insulation required?

6. ROOFS: REVIEW QUESTION

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 2017-006.

7. OTHER OPAQUE ASSEMBLIES

Slides 111 to 120

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.

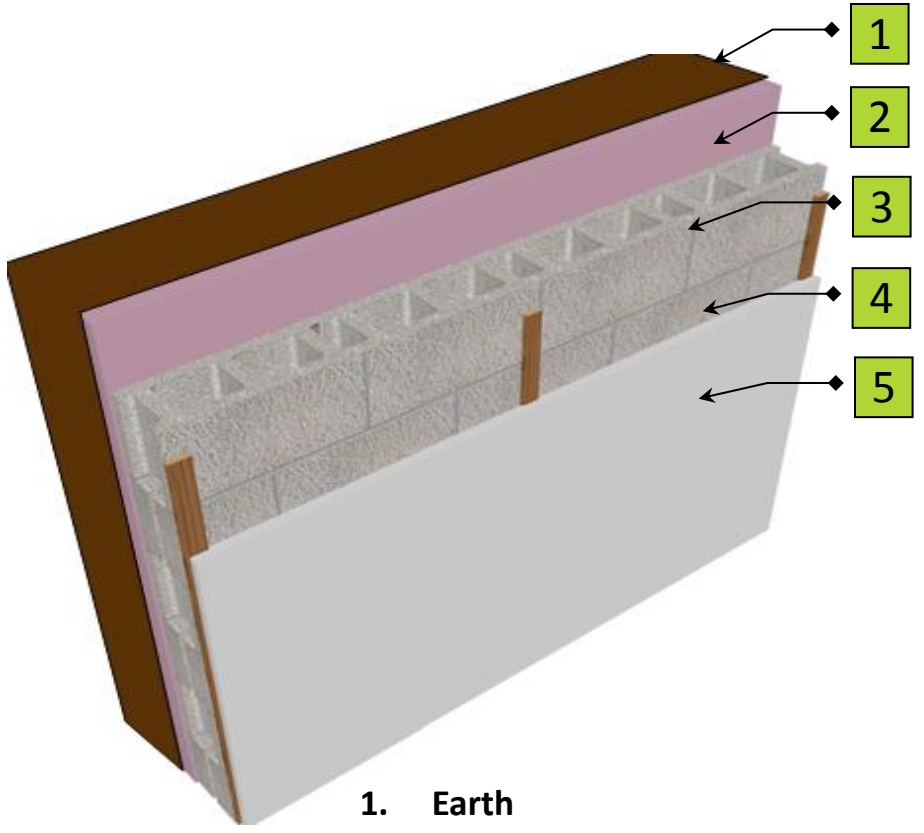
7. OTHER OPAQUE ASSEMBLIES: BELOW GRADE WALLS

Coverage

- ≥ 85% of the wall must be below grade to qualify and must be on the exterior of the building

Insulation

- R-7.5ci requirement
- 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

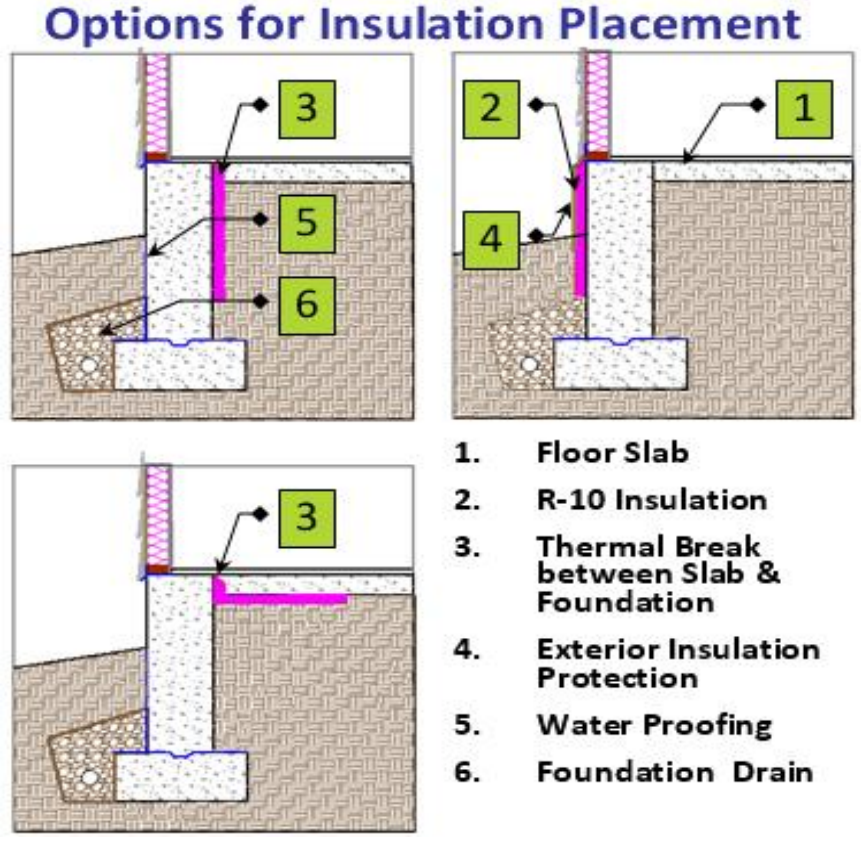


1. Earth
2. R-7.5ci Exterior Insulation
3. CMU
4. Furring Space
5. Gypsum Wall Board

7. OTHER OPAQUE ASSEMBLIES: SLAB-ON-GRADE FLOORS

Insulation (Prescriptive)

- Heated Slab (Radiant Heating)
  - R-15 extending 24” Below grade
- Unheated Slab
  - R-10 extending 24” below grade
- F-Factor Alternative
  - Heated Slab: Max. allowed F-0.65
    - Examples from ASHRAE 90.1-2013:
      - R-7.5 fully insulated (F-0.64)
  - Unheated: Max. allowed F-0.540
    - Examples from ASHRAE 90.1-2013:
      - R-10 extending 24” (F-0.54)
      - R-5 extending 48” (F-0.54)



7. OTHER OPAQUE ASSEMBLIES: FLOORS

FIOORS OVER UNCONDITIONED SPACES

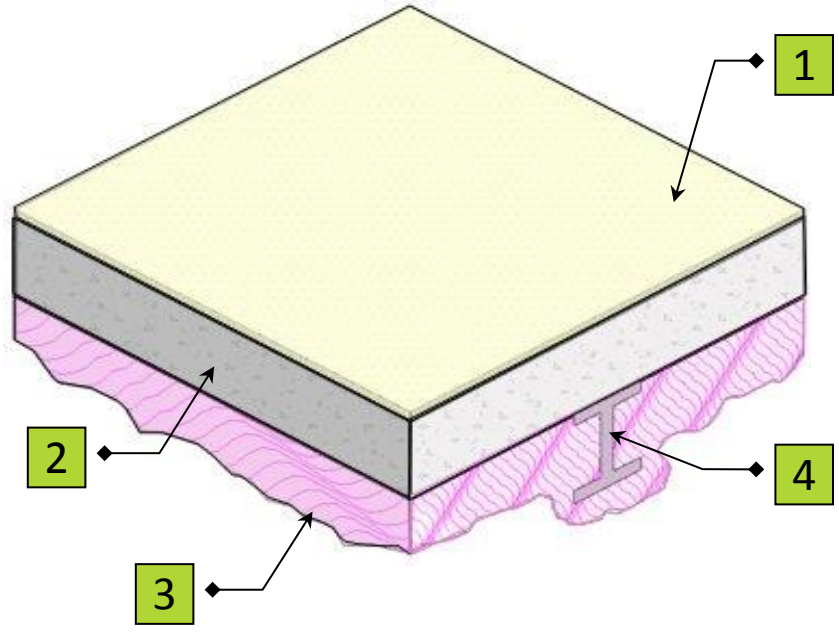
Coverage

- Any floor over unconditioned space
- 2 classes:
  1. Mass Floor
     - Must weigh 35 lbs/SF of floor surface area, or
     - 25 lbs/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

7. OTHER OPAQUE ASSEMBLIES: OPAQUE DOORS

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-0.61 or less
- Nonswinging doors: R-4.75 or more

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.

7. OTHER OPAQUE ASSEMBLIES: PROGRESS INSPECTIONS

What are the Applicable Progress Inspections?

Inspection / Test (As indicated on the TR8)	Frequency
Protection of exposed foundation insulation (IIA1) **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.	As required during foundation work and prior to backfill
Insulation placement and R-values (IIA2) 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.	As required to verify continuous enclosure while walls, ceilings and floors are open
Air sealing and insulation - visual (IIA6) 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 must observe the testing of the building and/or assemblies and verify that the building and/or assemblies meet the requirements of the standard, in accordance with the standard(s) cited in the approved plans.	As required during construction

Additional requirements for doors are included under the Fenestration section of this module.

TR8:https://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
1 RCNY § 5000-01:
https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

7. OTHER OPAQUE ASSEMBLIES

PROGRESS INSPECTION CHECKLIST

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

7. OTHER OPAQUE ASSEMBLIES

PROGRESS INSPECTION CHECKLIST

Key inspections for Below Grade Walls, Floors over unconditioned space, 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

7. OTHER OPAQUE ASSEMBLIES

PROGRESS INSPECTION CHECKLIST

Key inspections for Below Grade Walls, Floors over unconditioned space, & Opaque Doors

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

8. FENESTRATION

Slides 121 to 142

8. FENESTRATION: OVERVIEW

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.

8. FENESTRATION: IMPORTANCE OF 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 = **0.45**
    (7 times 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

8. FENESTRATION: IMPORTANCE OF FENESTRATION

Why is Fenestration so Important to Building Energy Use?

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

8. FENESTRATION: THERMAL & SOLAR PROPERTIES

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:

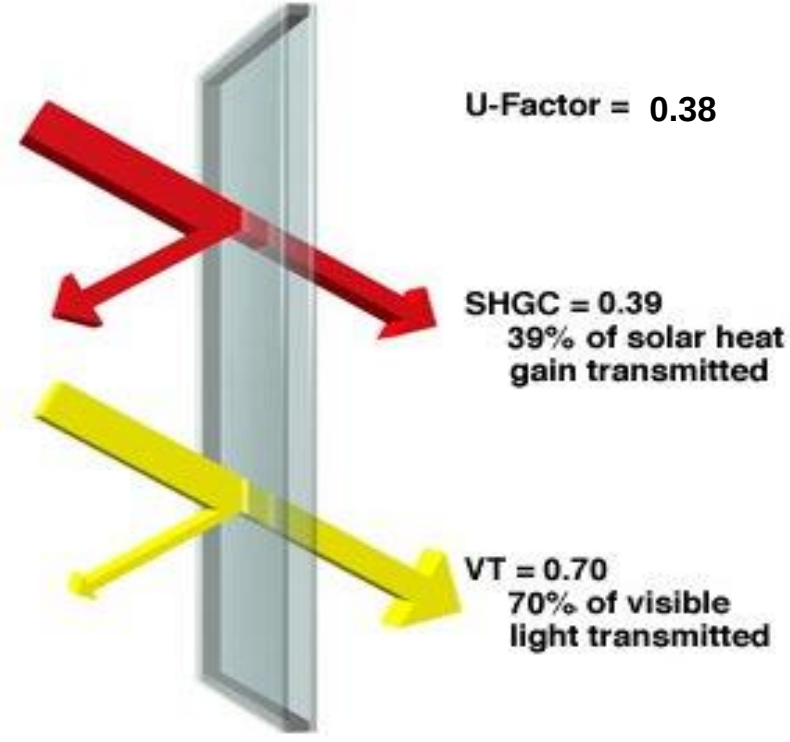
- Ratio of Solar Heat gain entering the space to the total solar radiation incident on the fenestration unit
- Lower is better
- Verified through the NFRC 200 Standard

Shading Coefficient (SC):

- Older metric based on relative scale to single pane glass
- SC x 0.87 = SHGC

Visible Light Transmittance (VLT):

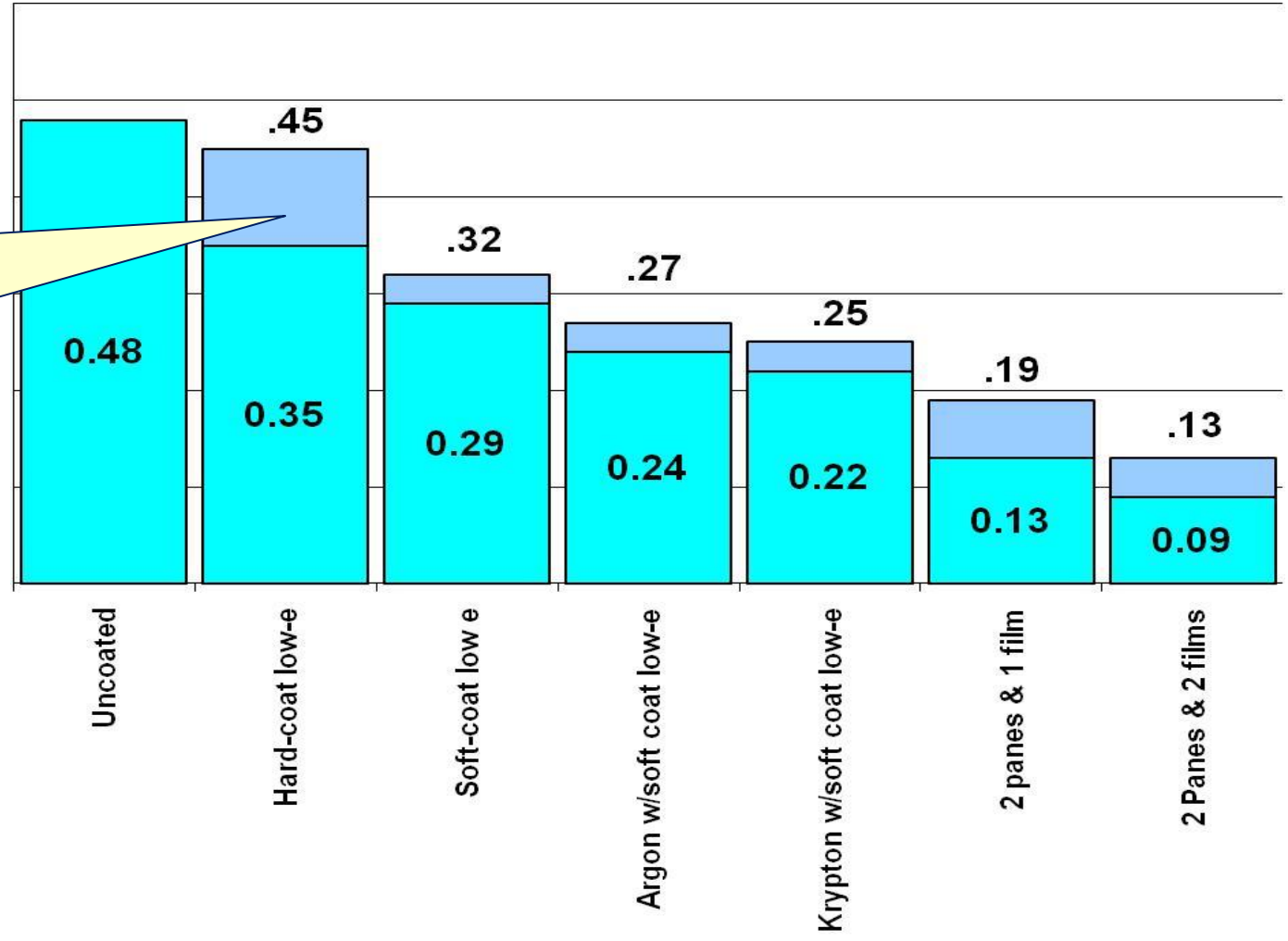
- The fraction of the visible light spectrum that is allowed to pass through the window assembly



8. FENESTRATION: CENTER OF GLASS U-FACTORS

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.

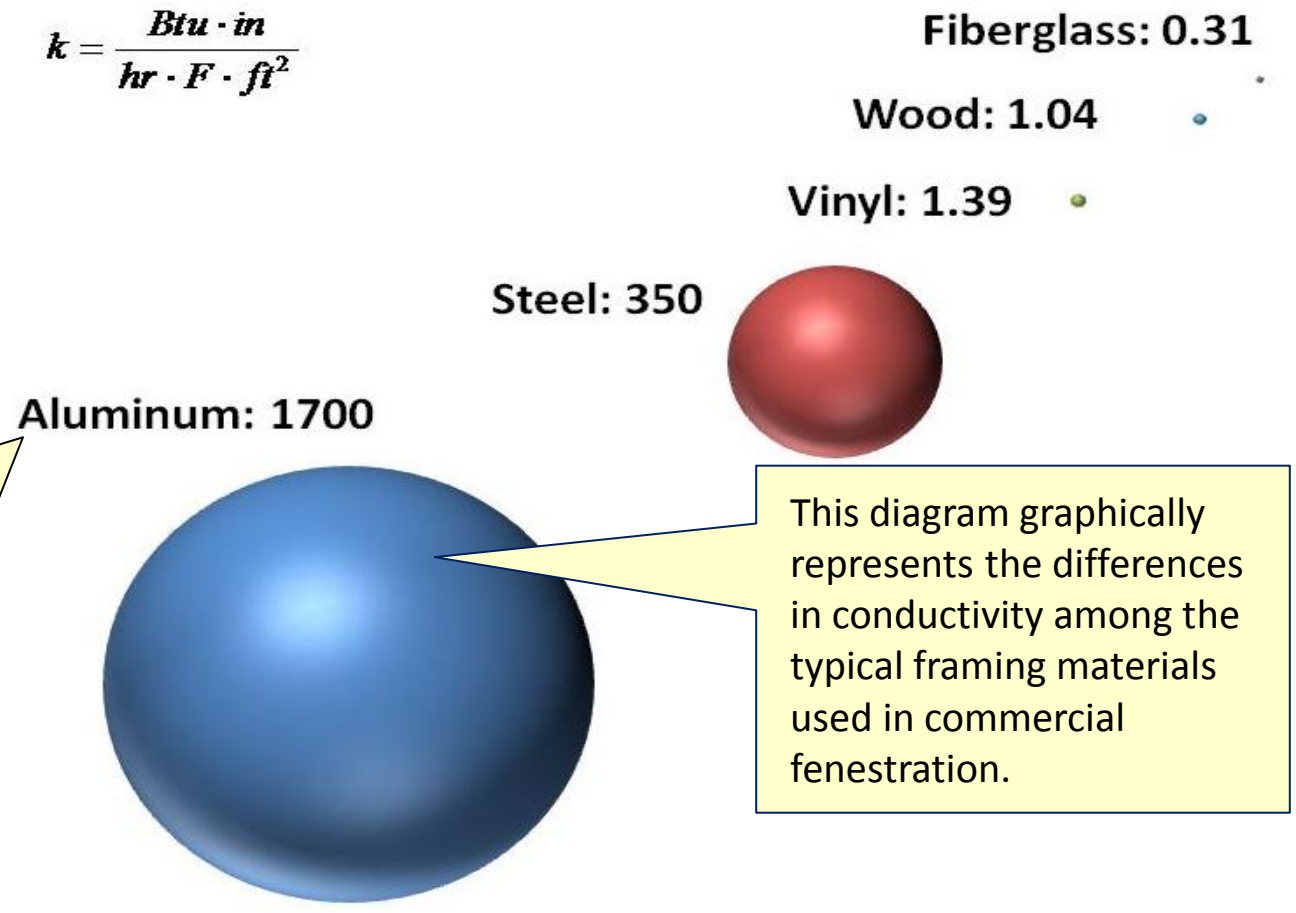


8. FENESTRATION: CONDUCTIVITY (K) OF FRAME MATERIALS

Why Does the Frame Material Significantly Impact Thermal Performance?

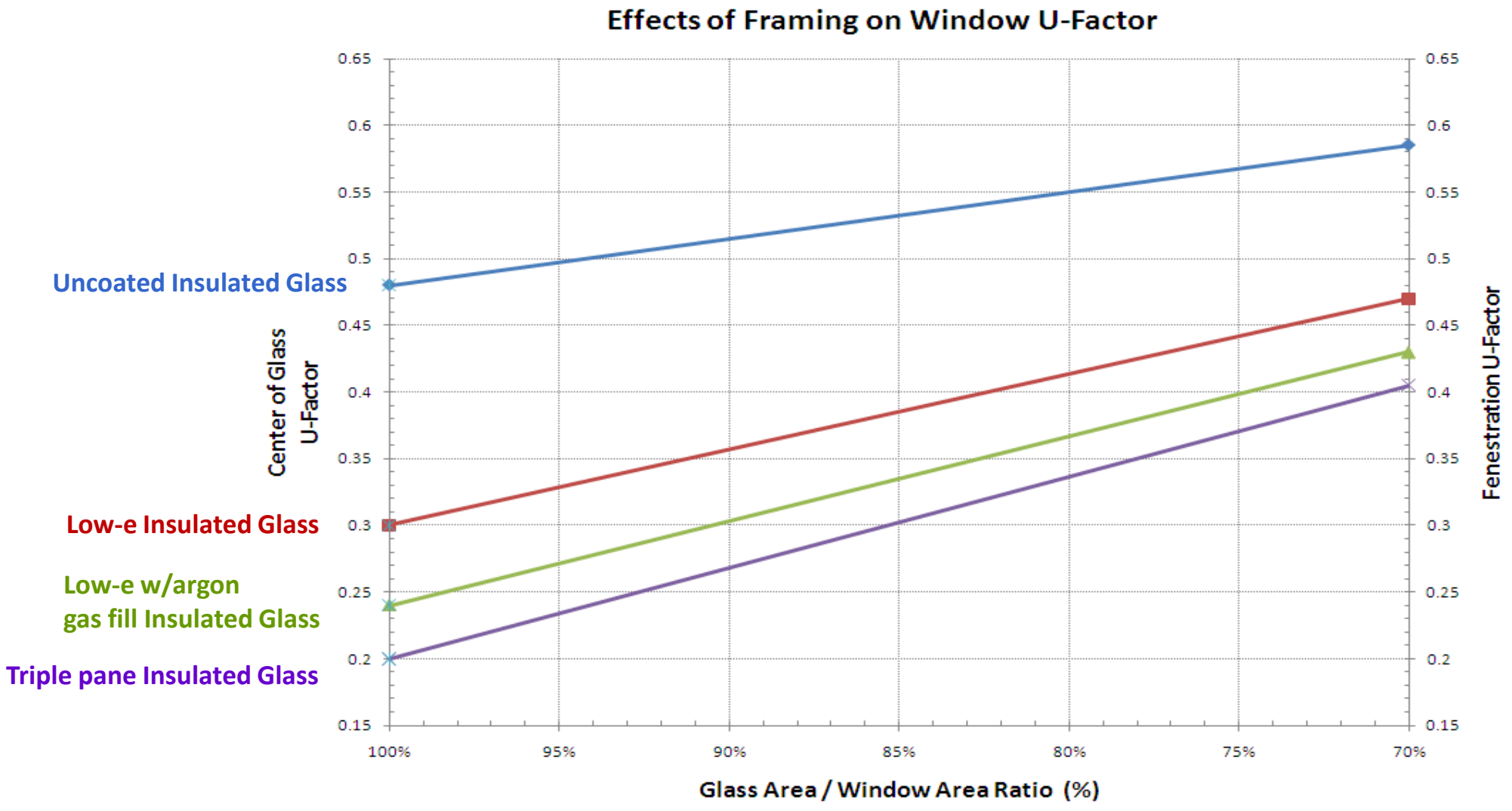
The conductivity of different frame materials varies enormously. Even though the frame typically makes up only 10-30% of a fenestration assembly, the most conductive frame types (aluminum and steel) will significantly reduce the overall U-Factor.

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



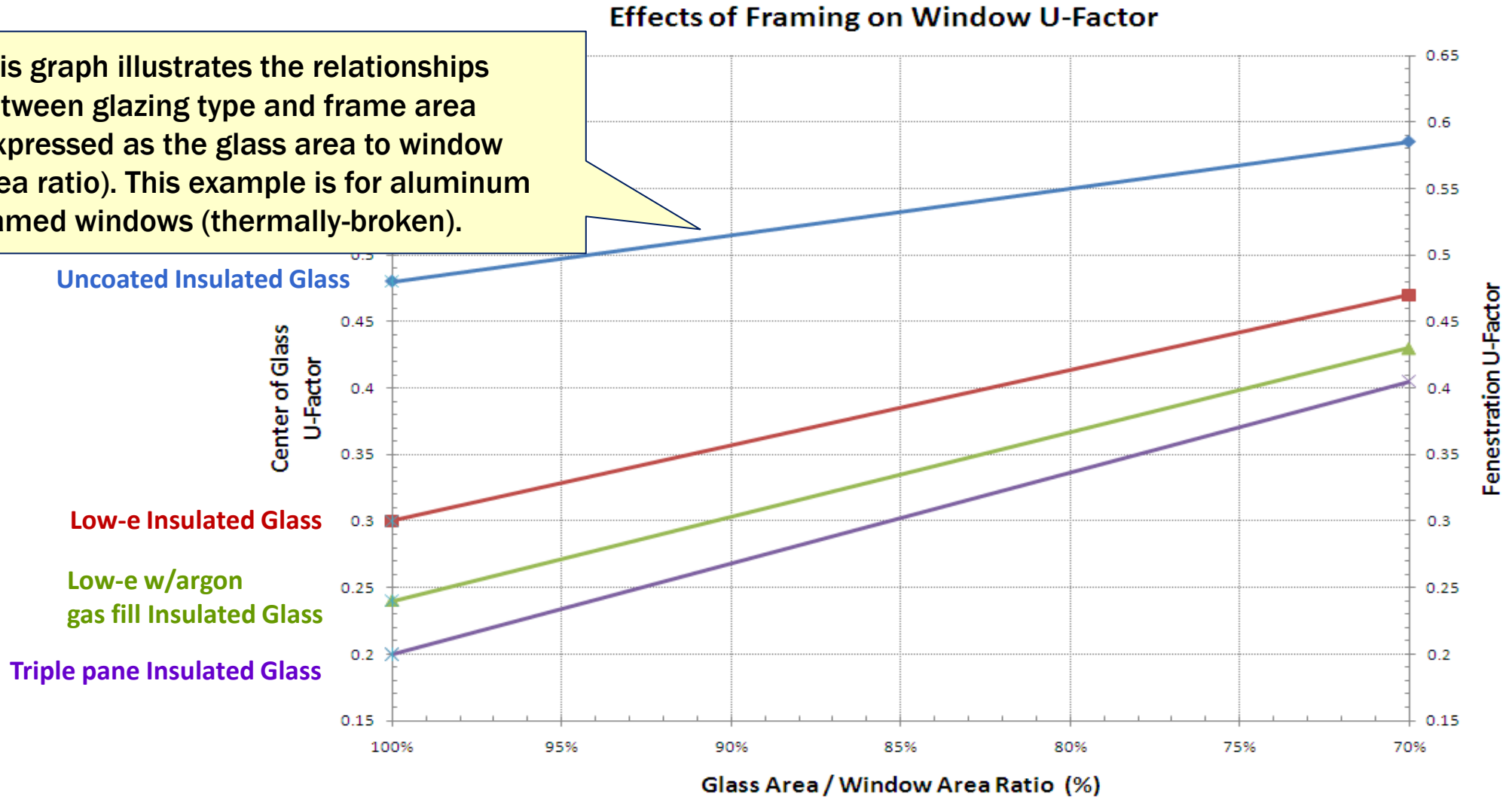
This diagram graphically represents the differences in conductivity among the typical framing materials used in commercial fenestration.

8. FENESTRATION: SYSTEM U-FACTOR VS. % OF GLASS AREA



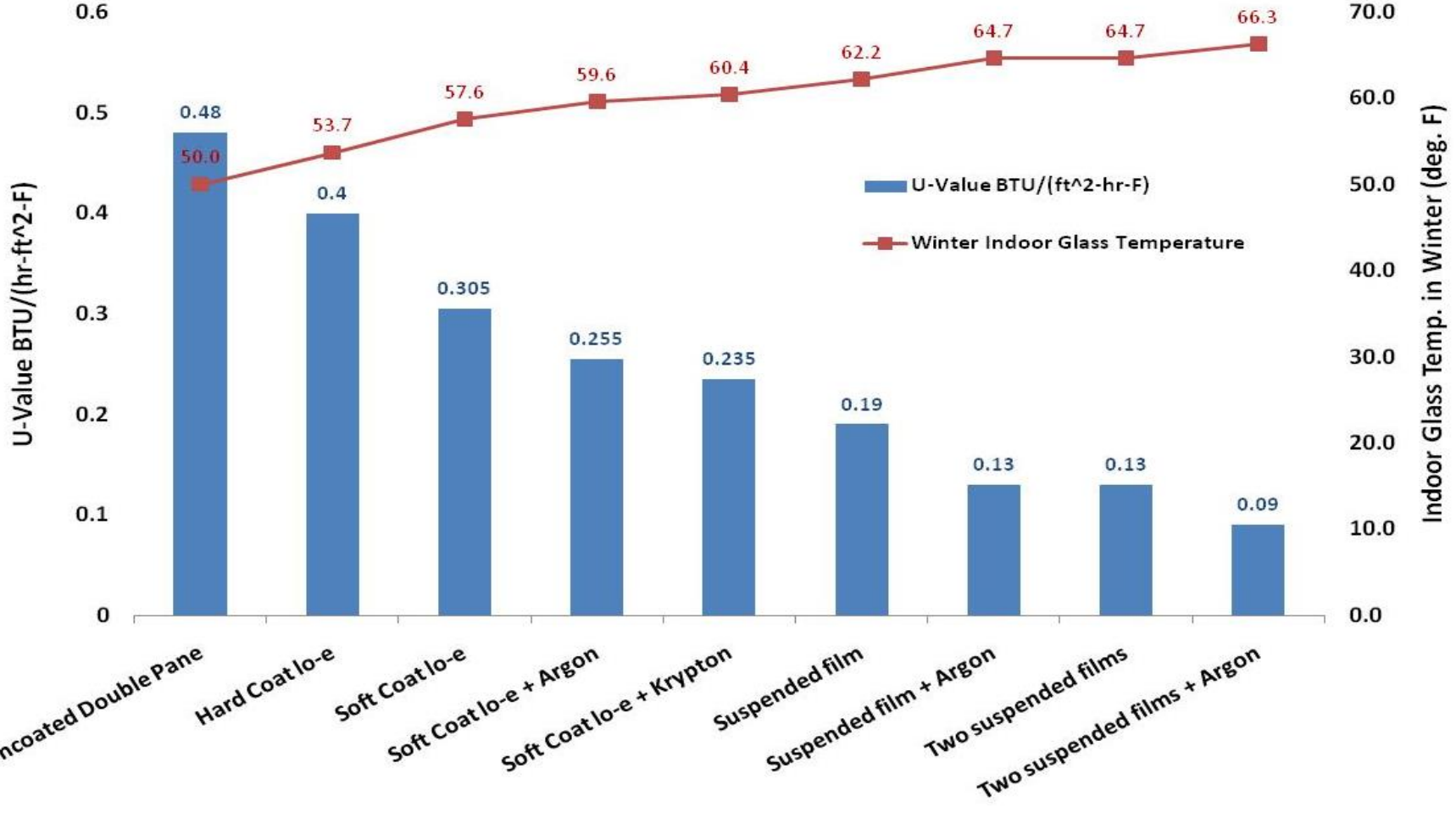
8. FENESTRATION: SYSTEM U-FACTOR VS. % OF GLASS AREA

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).



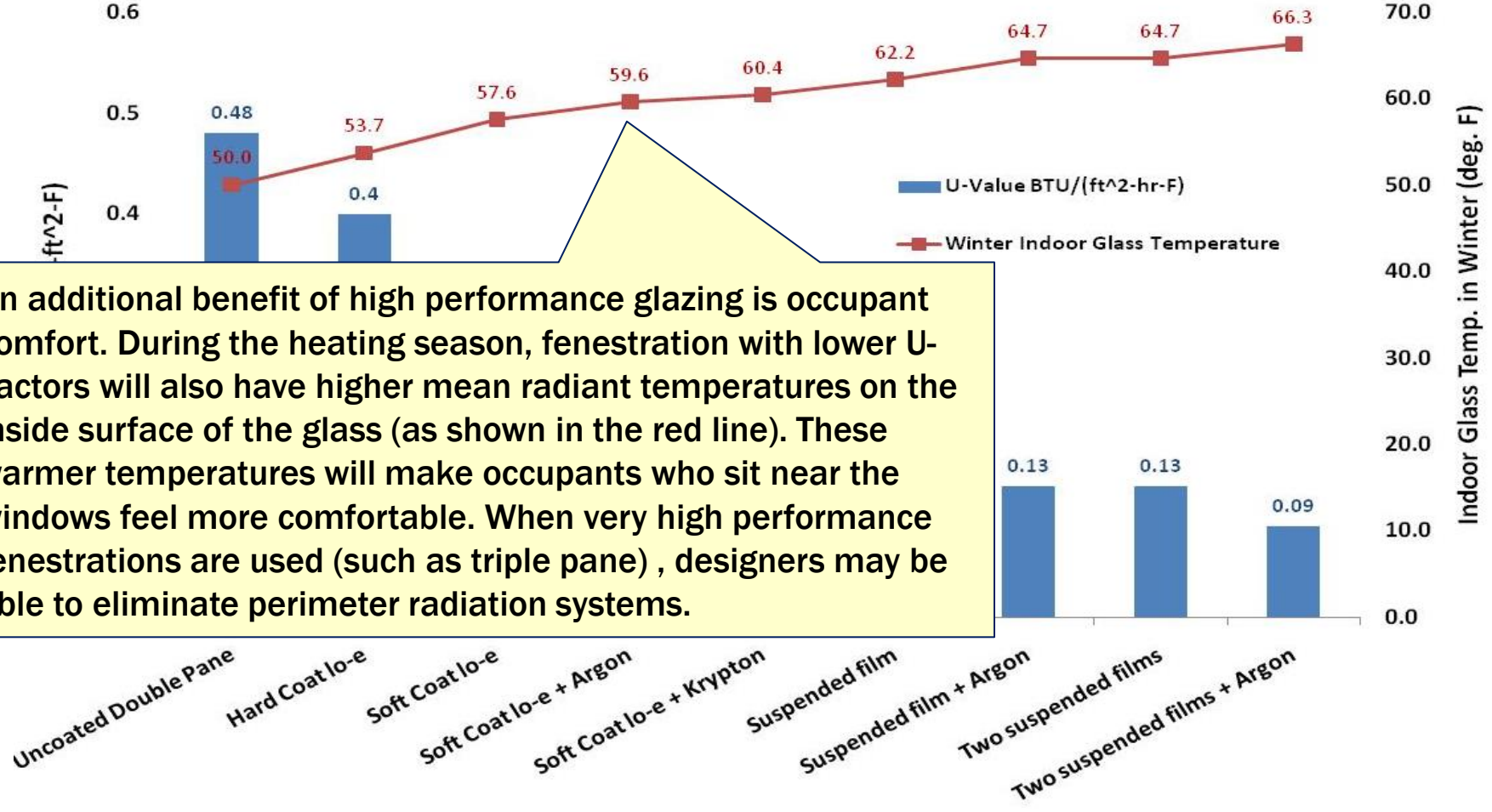
8. FENESTRATION: GLASS

U-Factors & Indoor Glass



8. FENESTRATION: GLASS

U-Factors & Indoor Glass Temperatures



An additional benefit of high performance glazing is occupant comfort. During the heating season, fenestration 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 fenestrations are used (such as triple pane) , designers may be able to eliminate perimeter radiation systems.

8. FENESTRATION: SOLAR HEAT GAIN CONTROL

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

Examples of LSG Values			
Glass Type	**VLT**	**SHGC**	**LSG**
Uncoated Clear IGU	0.79	0.70	1.13
Good Low-e coating, clear glass	0.70	0.38	1.84
Low-e coating + green tint	0.60	0.31	1.94
Low-e coating + 50% frit, clear glass	0.44	0.26	1.69
Superior Low-e coating, low-iron glass	0.64	0.27	2.37

Light to Solar Heat Gain Ratio (LSG)

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

8. FENESTRATION: FENESTRATION COVERAGE

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 for alterations:

- Storm Windows installed over existing fenestration
- Surface-applied window film installed on existing single-pane fenestration assemblies reducing solar heat gain, provided the code does not require the glazing or fenestration to be replaced.

8. FENESTRATION: DIMENSIONAL PROPERTIES

What are the Key Fenestration Dimensional Properties Addressed in the NYCECC?

Fenestration Area:

- Includes gross area covering outer boundaries of the frame, typically measured at rough opening

Window to Wall Ratio (WWR):

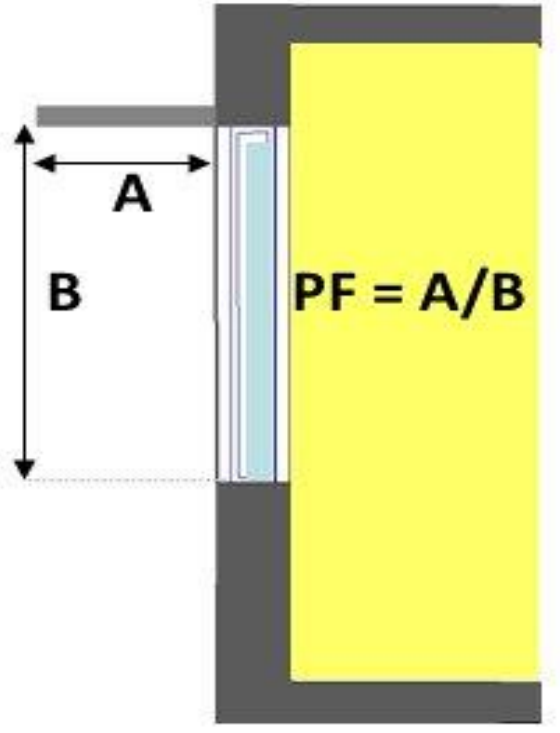
- Ratio of vertical fenestration to gross exterior above-grade wall area
- For Prescriptive method WWR ≤ 30%

Skylight to Roof Ratio (SRR):

- Ratio of horizontal fenestration to gross roof area
- For Prescriptive method SRR ≤ 3%

PF - Projection Factor:

- Ratio of horizontal projection of shading device to the vertical height from sill level of fenestration
- PF = A / B



8. FENESTRATION: PRESCRIPTIVE COMPLIANCE APPROACH

What are the Steps in Complying Via the Prescriptive Approach?

Process

- Determine type of vertical fenestration
  - Fixed
  - Operable
  - Entrance Doors
- Determine Shading Projection Factor
- Use NYCECC Table C402.4 for maximum allowed assembly U-Factor & SHGC

NYC BOROUGHS (Climate Zone 4A)		
Vertical Fenestration Type		**U-Factor**
	Fixed Glazing	U-0.38
	Operable Glazing	U-0.45
	Entrance Door	U-0.77
Projection Factor		**SHGC**
	PF < 0.2	0.40
	0.2 ≤ PF < 0.5	0.48
	PF ≥ 0.5	0.64
Skylights		U-0.50

8. FENESTRATION: U-FACTOR & SHGC VERIFICATION

What Documentation Verifies Typical Window/Door/Storefront Performance?

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.

8. FENESTRATION: CURTAIN WALLS & WINDOW WALLS

How are Curtain Walls and Window Walls Addressed?

Curtain Walls

- Entirely in front of structure
- Typically, U=0.35-0.38 for thermally improved or thermally broken assemblies

Window Walls

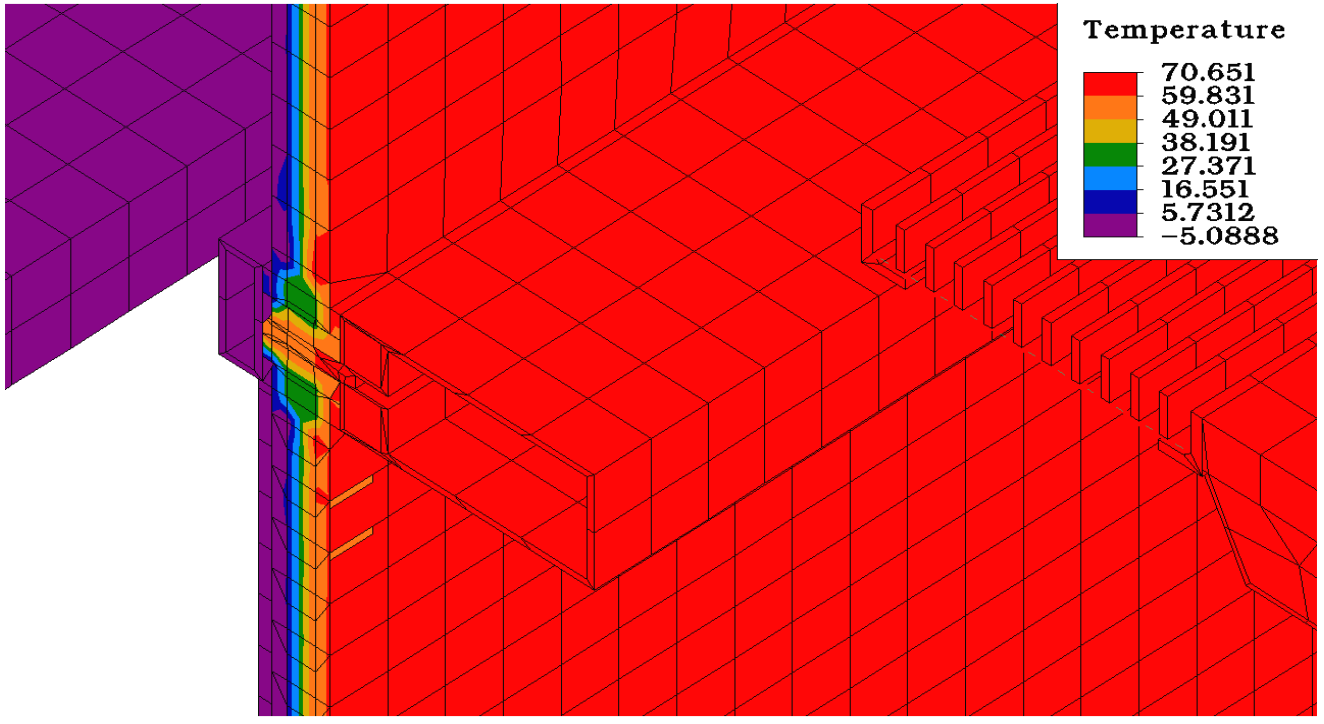
- Rest on each floor, so slab edge is often exposed, or covered but not insulated
- Typically, U=0.38-0.40 (thermally broken), excusive of slab edge

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)

8. FENESTRATION: U-FACTOR & SHGC VERIFICATION

What Documentation Verifies Custom Curtainwall Performance?



COMPONENT U-Factor

#	COMPONENTS	U-Value [Btu/(hft²F)]	A [ft²]	UxA [Btu/hF]
WWT/GASKET TYPICAL VISION				
1	WWT Mullion Left	1.25	1.57	1.96
3	Gasket Mullion Right	0.92	1.17	1.08
5	WWT Mullion Left Edge	0.33	1.96	0.65
7	Gasket Mullion Right Edge	0.27	1.96	0.53
9	Gutter Bottom Side	2.01	0.8	1.61
10	Intermediate Top Side	1.8	0.54	0.97
11	Gutter Bottom Edge	0.31	0.89	0.28
12	Intermediate Top Edge	0.3	0.89	0.27
13	Vision Glass	0.29	37.28	10.81
		Totals =	47.06	18.15
			U-Factor = 0.386	Btu/(hft²F)

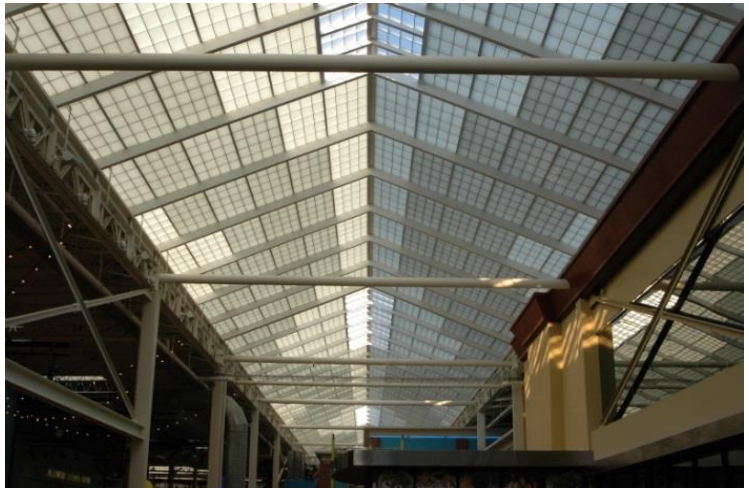
The U-Factor of custom curtainwall assemblies is typically provided by the manufacturer using 2 or 3-dimensional heat flow analysis software, and following the protocols of NFRC 100. Applicants should have reports available as back-up if an audit is conducted.

8. FENESTRATION: SKYLIGHTS

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: 0.50 maximum
- Assembly SHGC: 0.40 maximum
- Values verified through NFRC 100 and 200

8. FENESTRATION: UNLABELED FENESTRATION

How is Site Built /Unlabeled Fenestration Addressed?

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

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			SINGLE	DOUBLE
Metal	1.20	0.80	2.00	1.30
Metal with thermal break	1.10	0.65	1.90	1.10
Nonmetal or metal clad	0.95	0.55	1.75	1.05
Glazed block	0.60			

8. FENESTRATION: PROGRESS INSPECTIONS

What are the Applicable Progress Inspections for Fenestration?

Inspection / Test (As indicated on the TR8)	Frequency
Fenestration U-factor and product rating (IIA3) **U-Factors, SHGC and VT values of installed fenestration shall be visually inspected** for conformance with the U-Factors, SHGC and VT values identified in the construction drawings by verifying the manufacturer's NFRC labels or, where not labeled, using the ratings in ECC Tables C303.1.3(1), (2) and (3).	As required during installation
Fenestration air leakage (IIA4) Windows and sliding or swinging door assemblies, except site-built windows 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.	As required during installation; prior to final construction inspection
Fenestration areas (IIA5) Dimensions of windows, doors and skylights shall be **verified by visual inspection**.	Prior to final construction inspection
Air Sealing and insulation – visual inspection (IIA6) 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 must observe the testing of the building and/or assemblies and verify that the building and/or assemblies meet the requirements of the standard, in accordance with the standard(s) cited in the approved plans.	As required during construction

TR8: https://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
1 RCNY § 5000-01: https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

8. FENESTRATION: PROGRESS INSPECTION CHECKLIST

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

Slides 143 to 161

9. AIR LEAKAGE CONTROL: OVERVIEW

In this section you will learn about:

- Concepts & terminology related to Air Leakage;
- Air leakage control requirements mandated in the NYCECC;
- Mandatory air leakage testing;
- Air Barrier Continuity Plan; and
- Air Barrier Systems.

9. AIR LEAKAGE CONTROL: MANDATORY PROVISIONS

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 (*z*
  Boroughs are Climate Zone 4A)

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

§ 1405.3 Vapor retarders. Class I or II vapor retarders shall be provided on the interior side of frame walls in Zones 5, 6, 7, 8 and Marine 4.

Exceptions:

1. Basement walls
2. Below-grade portion of any wall
3. Construction where moisture or its freezing will not damage materials.

§ 1403.7 Thermal and condensation resistance. The exterior wall envelope shall be designed and constructed as required to meet the requirements of the New York City Energy Conservation Code.

9. AIR LEAKAGE CONTROL: AIR LEAKAGE RATES

How is Air Leakage Measured in Materials and Assemblies?

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 testing (mandatory testing in certain buildings)
- Buildings greater than 50,000 sq. ft. are required to submit Air Barrier Continuity (ABC) plan

9. AIR LEAKAGE CONTROL: FENESTRATION

Air Leakage Limits for Fenestration

- Windows: 0.2 cfm/SF
  Doors: 0.2 cfm/SF
  - Tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or
  - Certified & labeled following NFRC 400
- Curtainwalls & Storefront Glazing:
  0.06 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

NFRC Labels must be reviewed as part of the Progress Inspections

9. AIR LEAKAGE CONTROL: CONTINUOUS AIR BARRIERS

Why are Air Barriers Important?

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

9. AIR LEAKAGE CONTROL: CONTINUOUS AIR BARRIERS

Why are Air Barriers Important?

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

9. AIR LEAKAGE CONTROL

Measuring Air Barrier Compliance

Air Barrier Compliance Options:

- A continuous air barrier for the opaque building envelope shall comply with Section C402.5.1.2.1 or C402.5.1.2.2.

Individual Materials Section C402.5.1.2.1:

- 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 Section C402.5.1.2.2:

- 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
  - ASTM E 283: Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Difference Across the Specimen.

9. AIR LEAKAGE CONTROL

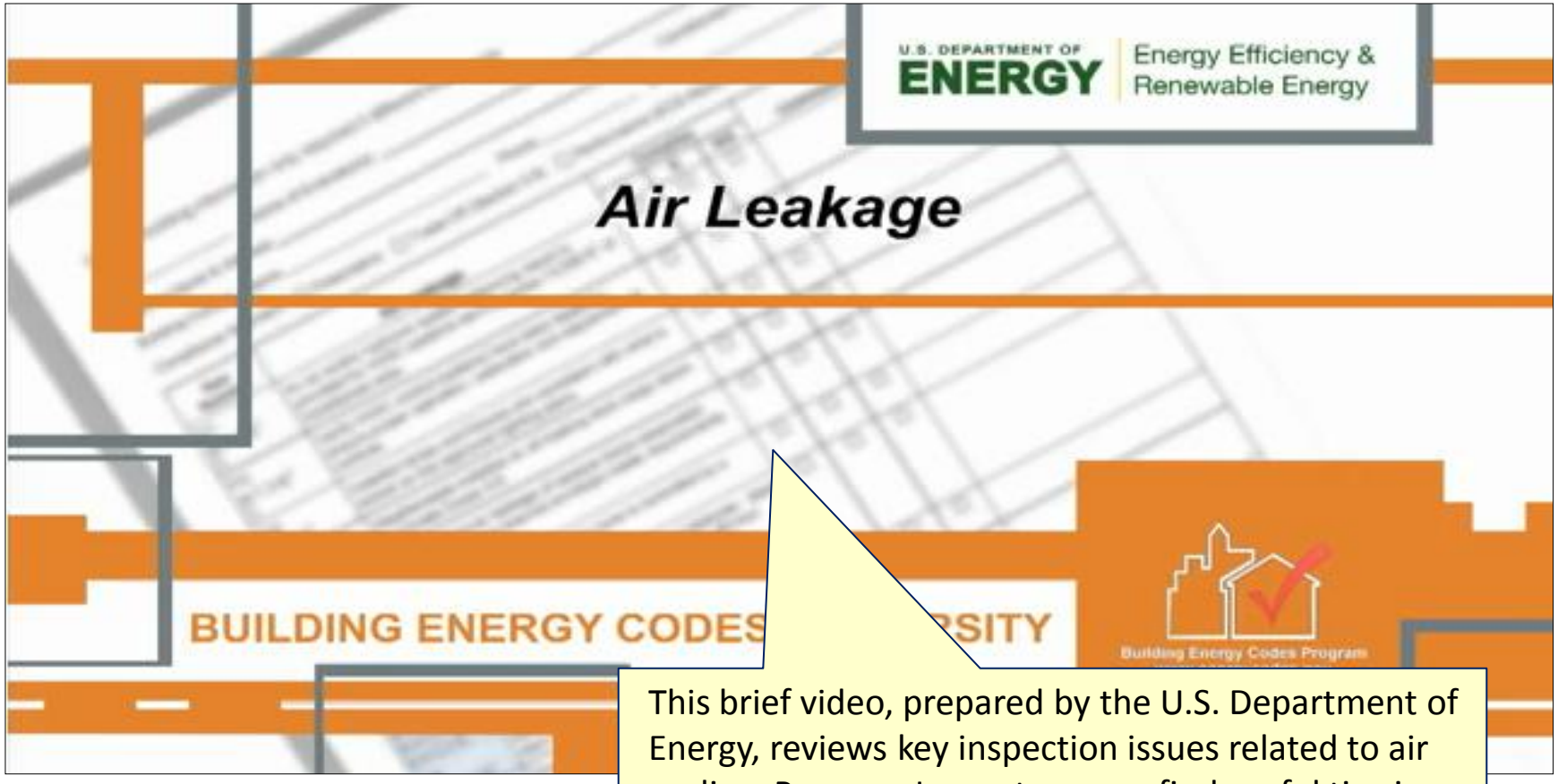
Measuring Air Barrier Compliance

Certain whole buildings must perform air barrier testing Section C402.5.1.3:

- New buildings of a certain size must comply with the following requirements:
  1. New buildings 25,000 square feet (2322.6 m_2) and greater, but less than 50,000 square feet (4645.2m_2) and less than or equal to 75 feet (22.86 m) in height must show compliance through testing in accordance with ASTM E 779 and department rules.
  2. New buildings 50, 000 square feet (4645.2 m_2) and greater, shall test or inspect each type of unique air barrier joint or seam in the building envelope for continuity and defects, as per an Air Barrier Continuity Plan developed by a registered design professional and department rules.
  3. Rules governing air barrier testing promulgated by the department.

9. AIR LEAKAGE CONTROL

US DOE BUILDING INSPECTION VIDEO



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)

9. AIR LEAKAGE CONTROL

ADDITIONAL MANDATORY FEATURES

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
  - Doors that open directly from a space less than 1,000 square feet (92.9 m_2) in area, in buildings 75 feet (22.86 m) and greater in height
  - Doors that have an air curtain (not in ASHRAE 90.1)

DOE Vestibule Inspection Video

Loading Dock Weatherseals:

- Required at cargo or loading dock doors

DOE Loading Dock Inspection Video

9. AIR LEAKAGE CONTROL

ADDITIONAL MANDATORY FEATURES

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 (249 Pa)

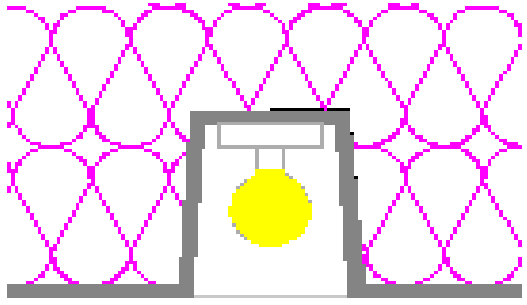
- Exceptions where gravity (nonmotorized) dampers are allowed:
  - In buildings less than 3 stories in height above grade plane
  - Where the design exhaust capacity is not greater than 300 cfm

9. AIR LEAKAGE CONTROL

ADDITIONAL MANDATORY FEATURES

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



"IC" Rated Luminaire

9. AIR LEAKAGE CONTROL: PROGRESS INSPECTIONS

What are the Applicable Progress Inspections for Air Leakage?

Inspection / Test (as seen on the TR8)	Frequency
Fenestration air leakage(IIA4) 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.	As required during installation; prior to final construction inspection
Air sealing and insulation – visual (11A6) 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 must observe the testing of the building and/or assemblies and verify that the building and/or assemblies meet the requirements of the standard, in accordance with the standard(s) cited in the approved plans.	As required during construction
Air sealing and insulation – testing (IIA7) Testing must be performed in accordance with section ECC C402.5.1.3 or ASHRAE 90.1 section 5.4.3.5, and shall be accepted if the building and/or its air-barrier assemblies meet the requirements detailed in such section. Testing must be performed by a third-party independent of the contractor and acceptable to the department.	As required during construction, or prior to final construction inspection

TR8: https://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
1 RCNY § 5000-01: https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

9. AIR LEAKAGE CONTROL

PROGRESS INSPECTION CHECKLIST

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

9. AIR LEAKAGE CONTROL

PROGRESS INSPECTION CHECKLIST

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

PROGRESS INSPECTION CHECKLIST

Mandatory Testing

- For new buildings 25,000 to 49,999 sf in the
- Conditioned space floor area, and 75 ft or less in height
- The air leakage rate must not exceed 0.4 cfm/ft2 of envelope area at 75 Pascals
- For new buildings 50,000 sf and greater, each type of unique air barrier joint or seam in the envelope must be tested for continuity and defects as per an connections, and other similar conditions

9. AIR LEAKAGE CONTROL

PROGRESS INSPECTION CHECKLIST

ABC Plan

- ❑ For new buildings 50,000 sf or greater in the *conditioned space floor area*
- ❑ It should specify
  - List of typical joint and seam conditions
  - Testing method options
  - Sampling rates of test
  - Quality control process in test
  - Guidelines for test reports and final certificates
- ❑ Air sealing and insulation visual (IIA6 on TR8) is required

9. AIR LEAKAGE CONTROL

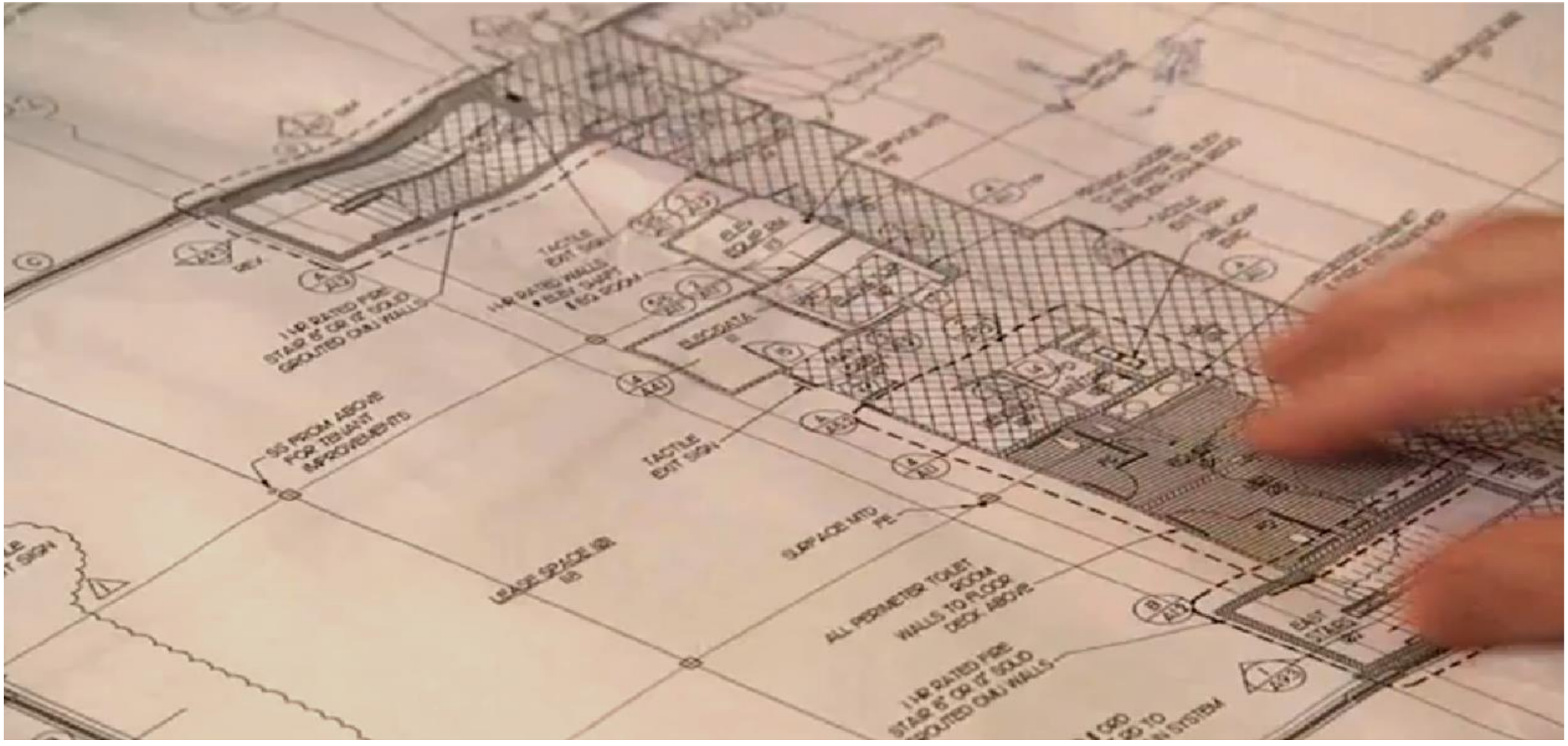
PROGRESS INSPECTION CHECKLIST

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

10. SUBMISSIONS & INSPECTIONS

Slides 162 to 198



10. SUBMISSIONS & INSPECTIONS: OVERVIEW

In this section you will learn about:

- Envelope-related requirements for NYCECC Submissions, including:
  - Energy Analysis, and
  - Supporting Documentation; and
- Applicable Progress Inspections associated with building envelope

10. SUBMISSIONS & INSPECTIONS: NYCECC AND APPLICATIONS

What are the Application Requirements Related to the NYCECC?

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.

10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

What Types of Energy Analysis are Allowed?

Per 1 RCNY § 5000-01:

- Tabular Analysis
- COMcheck software
- Energy Modeling
- Alternative Formats

10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

How Should the Envelope be Addressed in the Energy Analysis?

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.)

10. SUBMISSIONS & INSPECTIONS: TABULAR ANALYSIS

ANALYSIS- 1 Examples of Notes for Commercial Alterations / Renovations

ITEM DESCRIPTION	PROPOSED DESIGN VALUE	CODE PRESCRIPTIVE VALUE AND CITATION	SUPPORTING DOCUMENTATION
BUILDING ENVELOPE			
Replace roof membrane and add insulation SRR = 2.2%	Roof Type 1: 6" XPS (R -30) continuous insulation above deck	Minimum R-30 continuous insulation NYCECC Table C402.1.3	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 = 28% PF = 0	Window Type A: U = 0.45, SHGC = 0.29, Air leakage ≤ 0.10 cfm/SF Window Types B + C: U = 0.41, SHGC = 0.31, Air leakage ≤ 0.20 cfm/SF Window Type D: U = 0.41, SHGC = 0.23, Air leakage ≤ 0.20 cfm/SF	Window Types A-D: Maximum U-Factor = 0.45 Maximum SHGC = 0.40 NYCECC Table C402.4 Maximum Air Leakage = 0.20 cfm/SF NYCECC Table C402.5.2	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 C503.1 Exception 3: Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.	A-102-104 (Floor Plans) 1-2/A-305 (Interior Elevations)

10. SUBMISSIONS & INSPECTIONS: TABULAR ANALYSIS

ANALYSIS- 1 Examples of Notes for Commercial Alterations / Renovations

ITEM DESCRIPTION	PROPOSED DESIGN VALUE	CODE PRESCRIPTIVE VALUE AND CITATION	SUPPORTING DOCUMENTATION
BUILDING ENVELOPE			
Replace roof membrane and add insulation SRR = 2.2%	Roof Type 1: 6" XPS (R -30) continuous insulation above deck	Minimum R-30 continuous i[illegible] NYCECC Table C402[illegible]	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 = 28% PF = 0	Window Type A: U = 0.45, SHGC = 0.29, Air leakage ≤ 0.10 cfm/SF Window Types B + C: U = 0.41, SHGC = 0.31, Air leakage ≤ 0.20 cfm/SF Window Type D: U = 0.41, SHGC = 0.23, Air leakage ≤ 0.20 cfm/SF	[illegible] Maximum Air Leakage = 0.20 cfm/SF NYCECC Table C402.5.2	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 C503.1 Exception 3: Existing ceiling, wall or floor cavities exposed during construction, provided that these cavities are filled with insulation.	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: ENERGY ANALYSIS

How Should the Envelope be Addressed in the Energy Analysis?

Option 2: COMcheck submissions

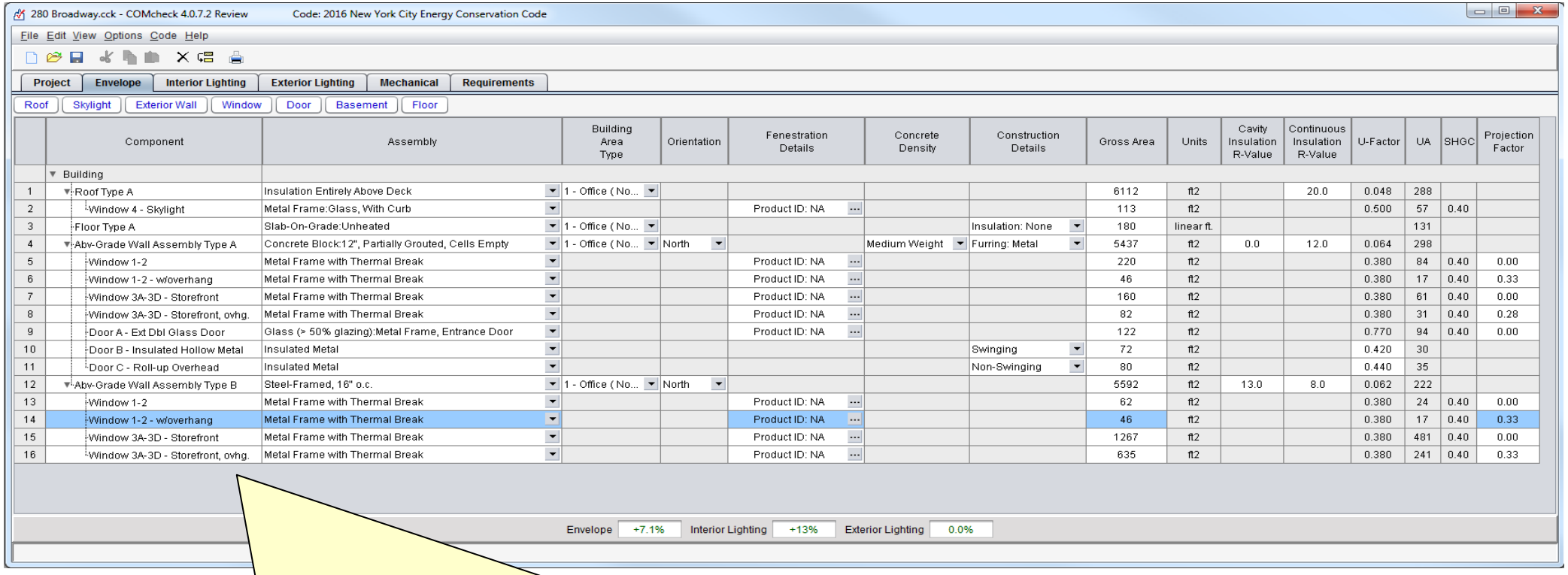
- COMcheck software, available for free from the US Department of Energy, can be used to prepare Energy Code compliance calculations
  - Demonstrates Prescriptive Compliance, with Trade-offs allowed among different envelope assemblies (roofs, walls, glazings, etc.)
  - Only NYCECC or ASHRAE-90.1 COMcheck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

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.)

10. SUBMISSIONS & INSPECTIONS

SAMPLE COMCHECK INPUT



280 Broadway.cck - COMcheck 4.0.7.2 Review Code: 2016 New York City Energy Conservation Code

File Edit View Options Code Help

Project | Envelope | Interior Lighting | Exterior Lighting | Mechanical | Requirements

Roof | Skylight | Exterior Wall | Window | Door | Basement | Floor

	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Concrete Density	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA	SHGC	Projection Factor
	Building														
1	Roof Type A	Insulation Entirely Above Deck	1 - Office (No...					6112	ft2		20.0	0.048	288		
2	Window 4 - Skylight	Metal Frame:Glass, With Curb			Product ID: NA			113	ft2			0.500	57	0.40	
3	Floor Type A	Slab-On-Grade:Unheated	1 - Office (No...				Insulation: None	180	linear ft.				131		
4	Abv-Grade Wall Assembly Type A	Concrete Block:12", Partially Grouted, Cells Empty	1 - Office (No...	North		Medium Weight	Furring: Metal	5437	ft2	0.0	12.0	0.064	298		
5	Window 1-2	Metal Frame with Thermal Break			Product ID: NA			220	ft2			0.380	84	0.40	0.00
6	Window 1-2 - w/overhang	Metal Frame with Thermal Break			Product ID: NA			46	ft2			0.380	17	0.40	0.33
7	Window 3A-3D - Storefront	Metal Frame with Thermal Break			Product ID: NA			160	ft2			0.380	61	0.40	0.00
8	Window 3A-3D - Storefront, ovhg.	Metal Frame with Thermal Break			Product ID: NA			82	ft2			0.380	31	0.40	0.28
9	Door A - Ext Dbl Glass Door	Glass (> 50% glazing):Metal Frame, Entrance Door			Product ID: NA			122	ft2			0.770	94	0.40	0.00
10	Door B - Insulated Hollow Metal	Insulated Metal					Swinging	72	ft2			0.420	30		
11	Door C - Roll-up Overhead	Insulated Metal					Non-Swinging	80	ft2			0.440	35		
12	Abv-Grade Wall Assembly Type B	Steel-Framed, 16" o.c.	1 - Office (No...	North				5592	ft2	13.0	8.0	0.062	222		
13	Window 1-2	Metal Frame with Thermal Break			Product ID: NA			62	ft2			0.380	24	0.40	0.00
14	Window 1-2 - w/overhang	Metal Frame with Thermal Break			Product ID: NA			46	ft2			0.380	17	0.40	0.33
15	Window 3A-3D - Storefront	Metal Frame with Thermal Break			Product ID: NA			1267	ft2			0.380	481	0.40	0.00
16	Window 3A-3D - Storefront, ovhg.	Metal Frame with Thermal Break			Product ID: NA			635	ft2			0.380	241	0.40	0.33

Envelope +7.1% Interior Lighting +13% Exterior Lighting 0.0%

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).

10. SUBMISSIONS & INSPECTIONS: ENERGY ANALYSIS

How Should the Envelope be Addressed in the Energy Analysis?

Option 3: Energy Modeling

- Either the Energy Cost Budget Method (Section 11) or Performance Rating Method (Appendix G) 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, Trane Trace, IES VE)

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 entered in the EN1

10. SUBMISSIONS & INSPECTIONS

SAMPLE EN1 Form - ENVELOPE INPUT

6	Energy Inputs and Supporting Documentation Index
a	Above-Grade Wall & Fenestration Areas

		Baseline Case			Proposed Case				
	Orientation	Window + Wall Area (ft^2)	Vertical Glazing Area (ft^2)	(%)	Window + Wall Area (ft^2)	Vertical Glazing Area (ft^2)	(%)	Supporting Doc. Location	Model Output Report
Above-Grade Wall & Vertical Glazing Area by Orientation	North	105252	41172	39.1	105252	48592	46.2	EN-006	LV-D
	East	19720	8281	42	19720	9774	47.4	EN-006	LV-D
	South	105708	41424	39.2	105708	48889	46.5	EN-006	LV-D
	West	20388	9547	46.8	20388	11268	54.7	EN-006	LV-D
	Total	251072	100425	40	251072	118524	47.2	EN-006	LV-D
Roof & Skylight Area	Roof + Skylight Area (ft^2)		Skylight Area (ft^2)	(%)	Roof + Skylight Area (ft^2)	Skylight Area (ft^2)	(%)	Supporting Doc. Location	Model Output Report
	Total	51607	0	0	51607	0	0	EN-006	LV-D

Applicants are required to submit the Energy Modeling reports to verify the inputs listed on the EN1 form.

10. SUBMISSIONS & INSPECTIONS

SIMULATED PERFORMANCE ALTERNATIVE - 2

Software Tools

- Must be approved by the NYS Secretary of State and the DOB Commissioner
- Approved programs:
  - DOE2 or updates of DOE2, VisualDOE, EnergyPlus and eQuest
  - Trane Trace, IES VE

Compliance materials: ECC 101.5.1, https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf, http://www.doe2.com/, https://energyplus.net/

10. SUBMISSIONS & INSPECTIONS

What Type of Supporting Documentation Should be Provided?

Supporting Documentation should:

- Support the values submitted in the Energy Analysis
- Verify mandatory requirements of the NYCECC are met
- Supporting documentation should be in the format of the Supporting Documentation Index

SUPPORTING DOCUMENTATION INDEX Code chapter and/or standard used for design Climate Zone 4A		
Code Section	**Item Description**	**Supporting Documentation Location**
(List specific code section)	(List all elements of the scope of work in the detail that they are addressed by the energy code.)	(List the drawing page number and/or section title.)

- List and describe each applicable progress inspection as required based on the scope of work, per Table I of 1 RCNY §5000-01
- See the supporting documentation How to Guide for additional information

How to Guide:
https://www1.nyc.gov/assets/buildings/pdf/h2g_all.pdf;
1 RCNY §5000-01:
http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

10. SUBMISSIONS & INSPECTIONS

What Type of Supporting Documentation Should be Provided?

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)

10. SUBMISSIONS & INSPECTIONS

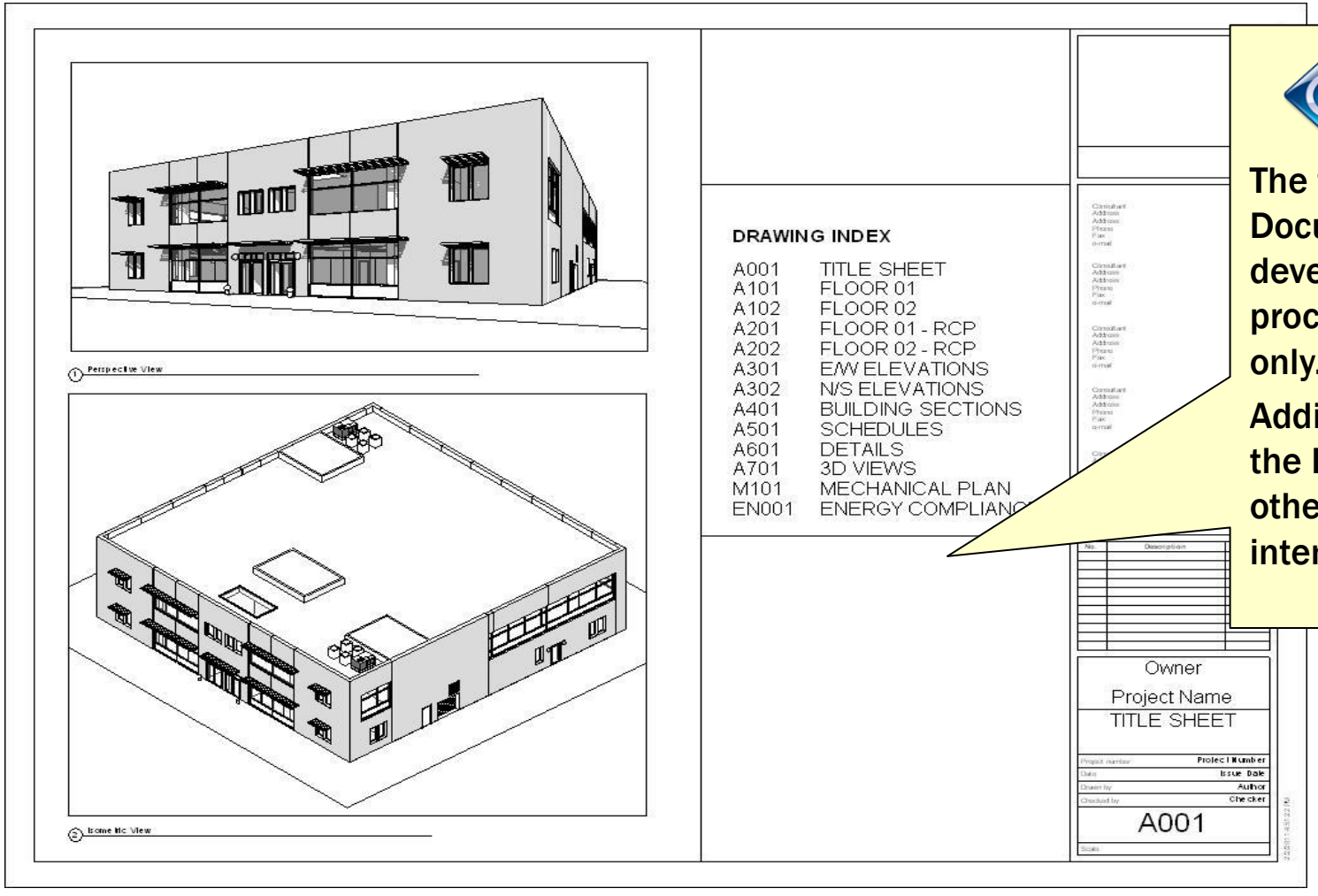
What Type of Supporting Documentation Should be Provided?

Supporting Documentation details for Envelope:

- 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

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation: New Office Facility



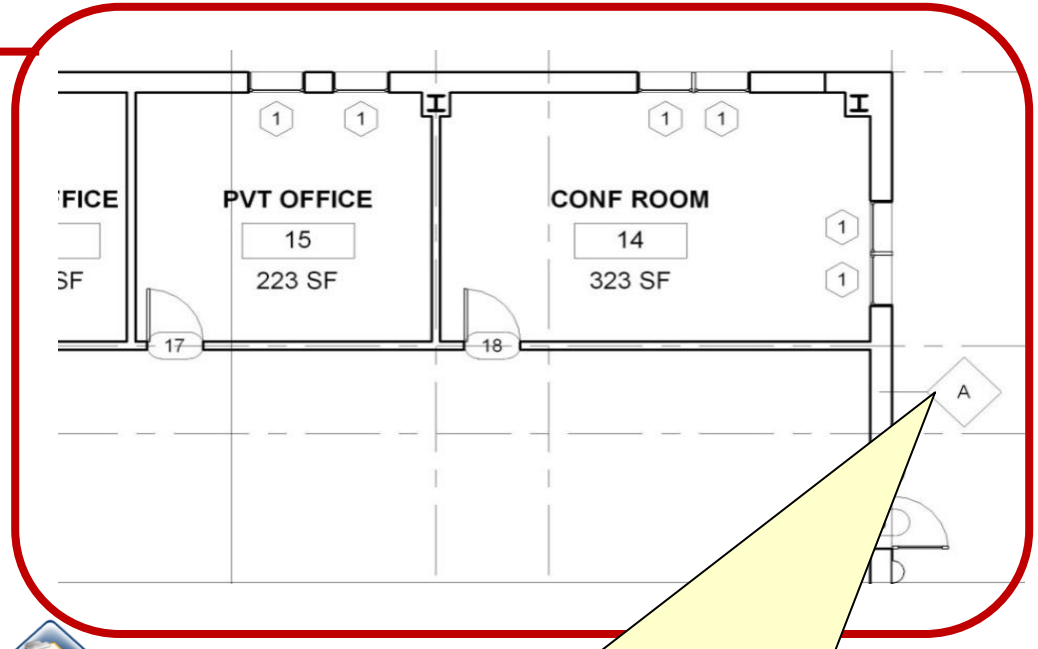
The following Sample Supporting Documentation has been developed to illustrate compliance procedures related to the NYCECC only.

Additional Information required by the DOB related to zoning and other Code provisions is intentionally omitted.

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation

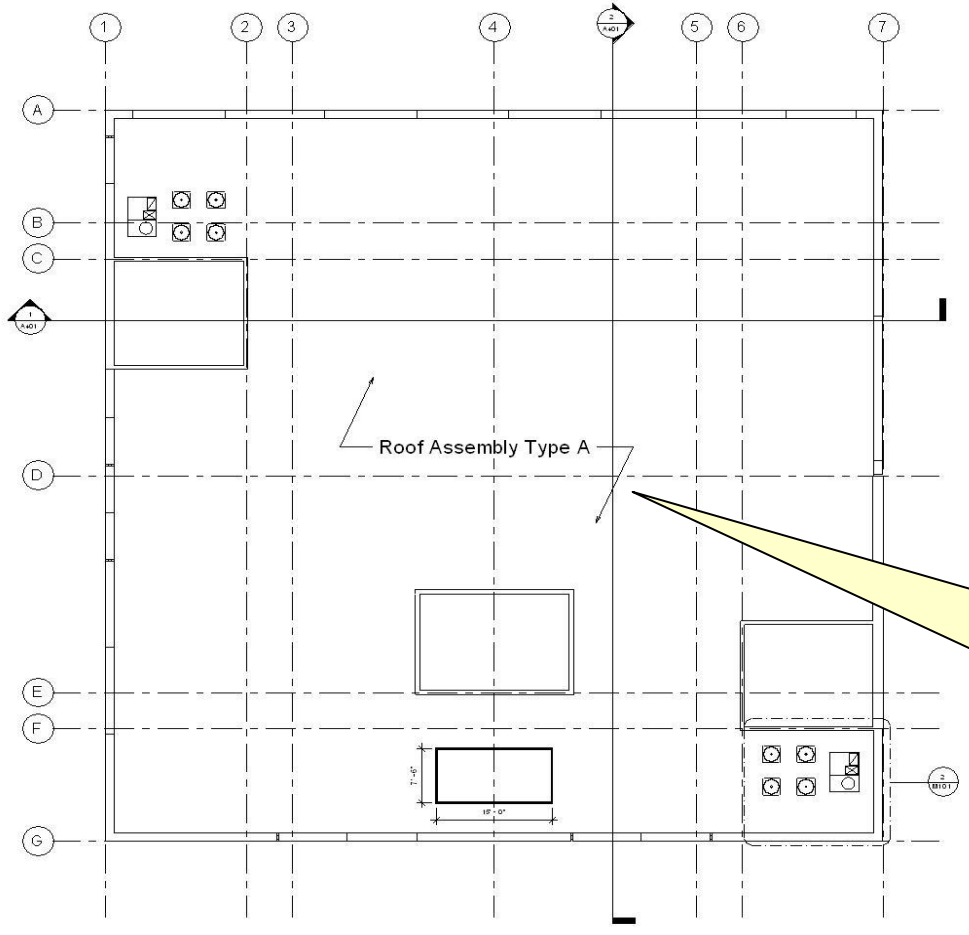
1st FLOOR PLAN



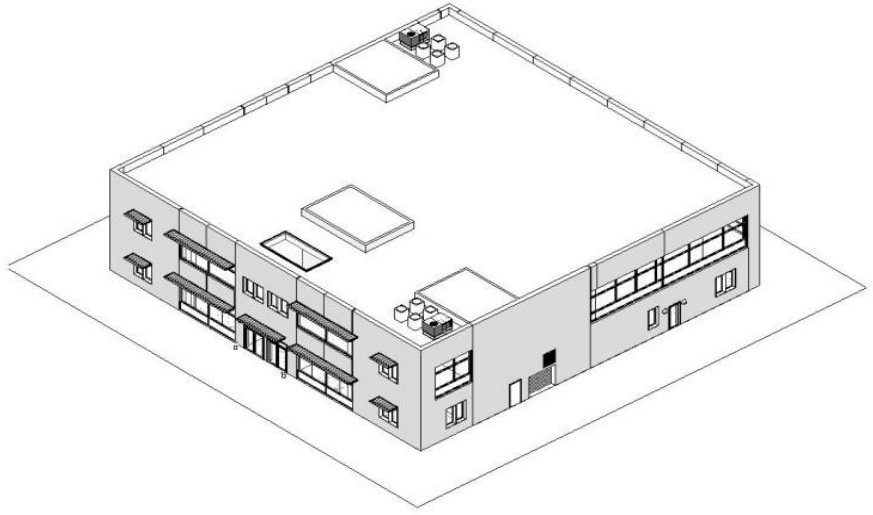
Fenestration types, door types, and exterior wall types should be clearly marked in the plans of the Supporting Documentation.

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation



ROOF PLAN



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.

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation

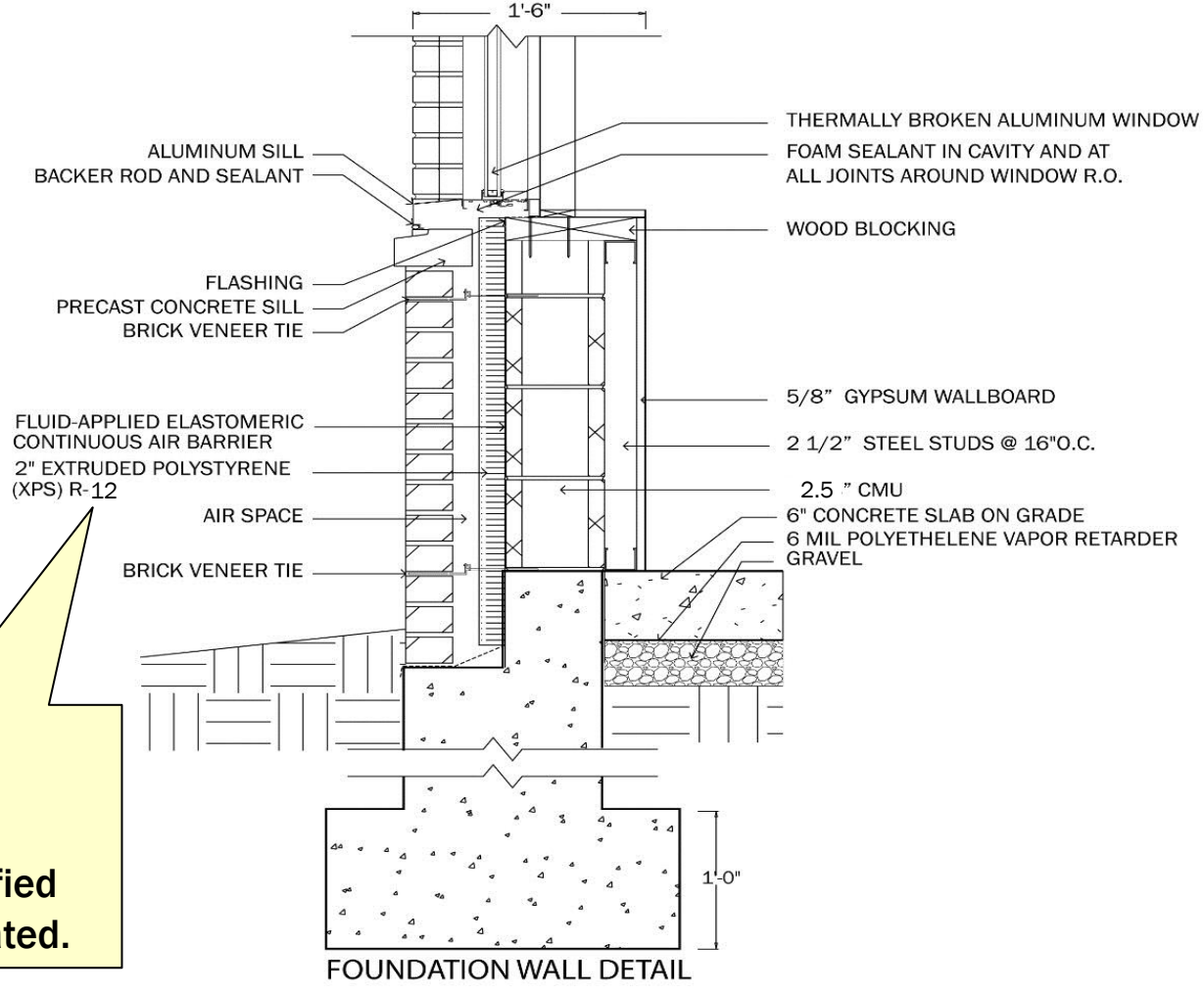
Fenestration types and door types should be clearly called out on the project elevations in the Supporting Documentation. These should be keyed into the submitted Window/Fenestration and Door Schedules.

SOUTH ELEVATION

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation

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



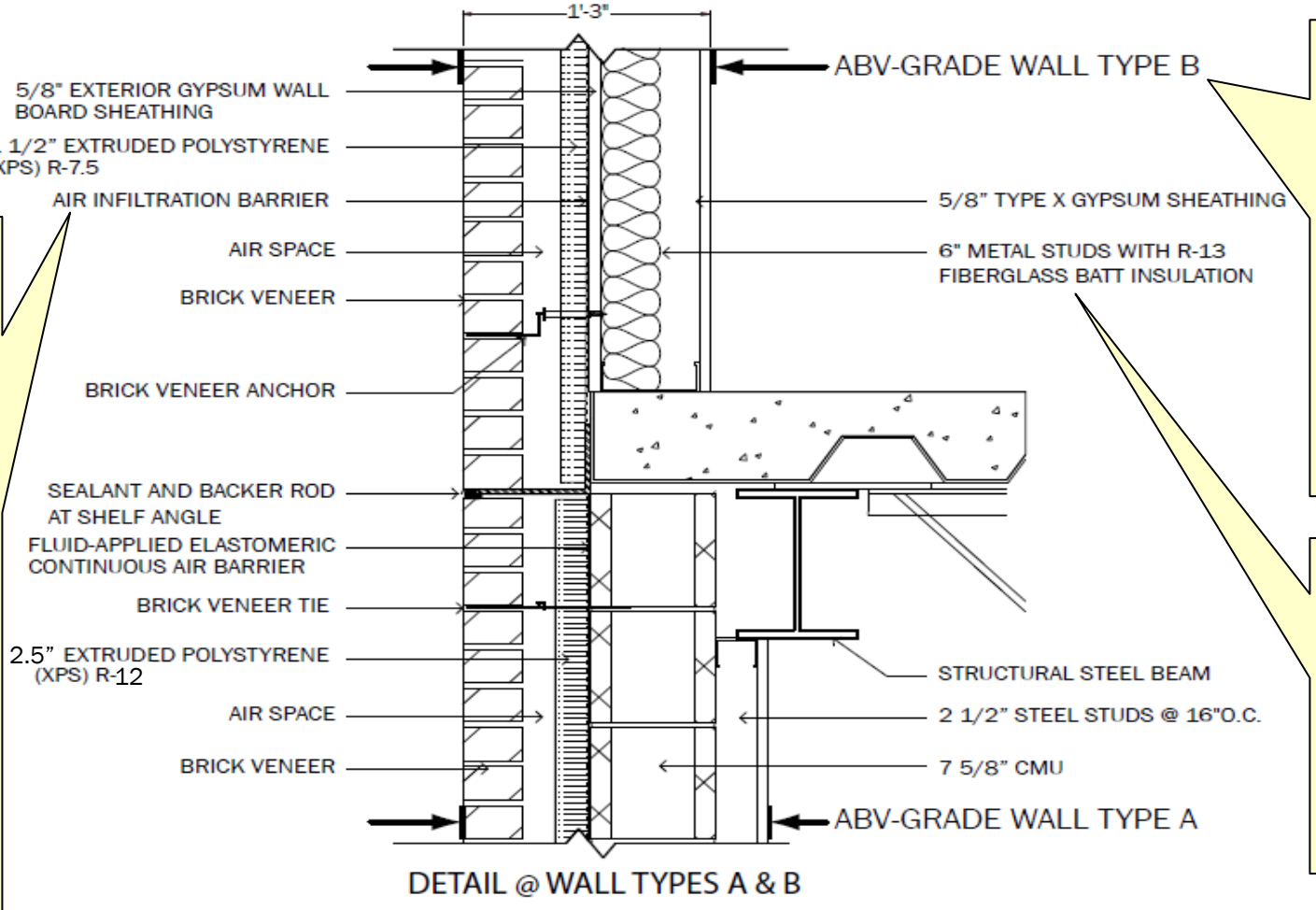
FOUNDATION WALL DETAIL

Insulation types should be identified and R-Values stated.

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation

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



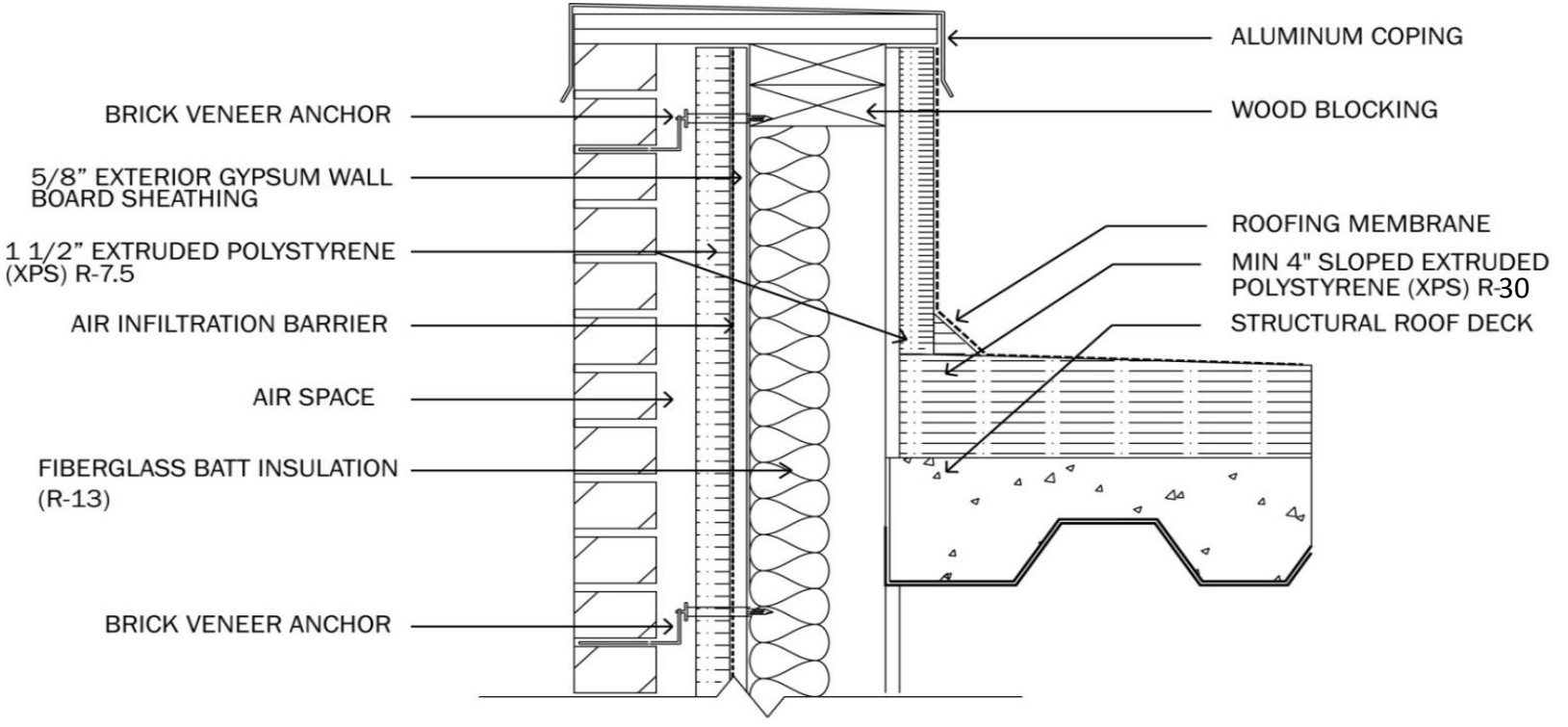
DETAIL @ WALL TYPES A & B

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

Insulation types should be identified and R-values stated.

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation



PARAPET DETAIL @ ROOF TYPE A

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

Sample Supporting Documentation

Window / Storefront / Skylight Schedule

Type	Description	R.O. / M.O.	Glass Type	U-Factor	SHGC	Air Leakage	Manufacturer	Catalog #	Notes
1	Alum-Framed Dbl. Casement	3' - 4" x 6' - 8"	IGU, low-e, clear	0.38	0.31	≤ 0.30 cfm/SF	XYZ Inc.	C100-4080	1
2	Alum-Framed Dbl. Casement	3' - 4" x 5' - 4"	IGU, low-e, clear	0.38	0.31	≤ 0.30 cfm/SF	XYZ Inc.	C100-4064	1
3A	Alum-Framed Storefront System	17' - 4" x 11' - 4"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3, 4
3B	Alum-Framed Storefront System	17' - 4" x 8' - 0"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3
3C	Alum-Framed Storefront System	12' - 0" x 8' - 0"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3
3D	Alum-Framed Storefront System	11' - 4" x 8' - 0"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3
4	Alum-Framed Fixed Skylight	7' - 6" W x 15' - 0" L	IGU, low-e, tinted	0.50	0.20	≤ 0.10 cfm/SF	HLS Inc.	FS400 Series	2, 4

Notes:

1. Air leakage: Provide flashing, window dams, expandable foam sealant, and caulking 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 caulking at rough opening/skylight frame joints to create a continuous air barrier with surrounding roof system.
3. See Dwg. A-605 for detailed storefront elevations.
4. Manufacturer's air infitration rates based on 6.24 psf (300 Pa) static pressure differential, tested per ASTM E 283.

Exterior Door Schedule

Type	Description	R.O. / M.O.	Glass Type	U-Factor	SHGC	Infiltration Value (cfm/SF)	Manufacturer	Catalog #	Notes
A	Aluminum/Glass Double Door w/Fixed Transom	6' - 4" x 9' - 4"	IGU, low-e, clear	0.77	0.26	≤ 1.00 cfm/SF	HLS Inc.	Y-100 Series	1, 2
B	Insulated Hollow Metal Door	3' - 4" x 7' - 4"	N/A	0.61	N/A	N/A*	EJA Inc.	IHM3684	1
C	Insulated Roll-up Overhead Metal Door	10' - 0" x 8' - 0"	0.77	0.44	N/A	N/A	CJA Inc.	IHM12096	1

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-605 for detailed entry door elevations.

* Doors will be field-fitted with weatherstripping per ECC Section 502.4.1

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation

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

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			Glass Type	U-Factor	SHGC	Air Leakage	Manufacturer	Catalog #	Notes
		3' - 4" x 6' - 8"	IGU, low-e, clear	0.38	0.31	≤ 0.30 cfm/SF	XYZ Inc.	C100-4080	1
		3' - 4" x 5' - 4"	IGU, low-e, clear	0.38	0.31	≤ 0.30 cfm/SF	XYZ Inc.	C100-4064	1
		17' - 4" x 11' - 4"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3, 4
		17' - 4" x 8' - 0"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3
		12' - 0" x 8' - 0"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3
		11' - 4" x 8' - 0"	IGU, low-e, clear	0.38	0.32	≤ 0.06 cfm/SF	ABC Inc.	X-100 Series	1, 3
4	Alum-Framed Fixed Skylight	7' - 6" W x 15' - 0" L	IGU, low-e, tinted	0.50	0.20	≤ 0.10 cfm/SF	HLS Inc.	Series	2, 4

Notes:

1. Air leakage: Provide flashing, window dams, expandable foam sealant, and caulking at rough opening/window fra
2. Air leakage: Provide flashing, expandable foam sealant, and caulking at rough opening/skylight frame joints to cr
3. See Dwg. A-605 for detailed storefront elevations.
4. Manufacturer's air infiltration rates based on 6.24 psf (300 Pa) static pressure differential, tested per ASTM E 283.

Manufacturers and Catalog Numbers are optional for the NYCECC submission.

Exterior Door Schedule

Type	Description	R.O. / M.O.	Glass Type	U-Factor	SHGC	Infiltration Value (cfm/SF)	Manufacturer	Catalog #	Notes
A	Aluminum/Glass Double Door w/Fixed Transom	6' - 4" x 9' - 4"	IGU, low-e, clear	0.77	0.26	≤ 1.00 cfm/SF	HLS Inc.	Y-100 Series	1, 2
B	Insulated Hollow Metal Door	3' - 4" x 7' - 4"	N/A	0.61	N/A	N/A*	EJA Inc.	IHM3684	1
C	Insulated Roll-up Overhead Metal Door	10' - 0" x 8' - 0"	0.77	0.44	N/A	N/A	CJA Inc.	IHM12096	1

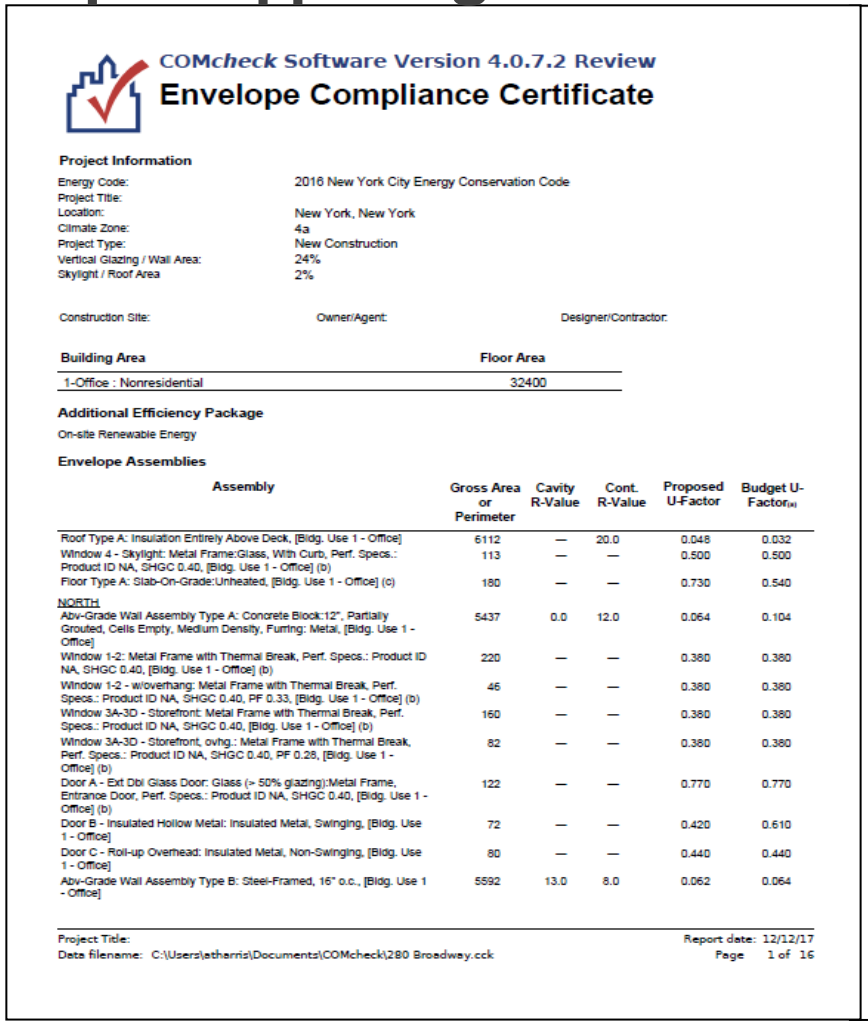
Notes:

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-605 for detailed entry door elevations.

* Doors will be field-fitted with weatherstripping per ECC Section 502.4.1

10. SUBMISSIONS & INSPECTIONS

Sample Supporting Documentation: COMcheck Report



COMcheck Software Version 4.0.7.2 Review

Envelope Compliance Certificate

Project Information

Energy Code:	2016 New York City Energy Conservation Code
Project Title:	
Location:	New York, New York
Climate Zone:	4a
Project Type:	New Construction
Vertical Glazing / Wall Area:	24%
Skylight / Roof Area	2%

Construction Site: Owner/Agent: Designer/Contractor:

Building Area	Floor Area
1-Office : Nonresidential	32400

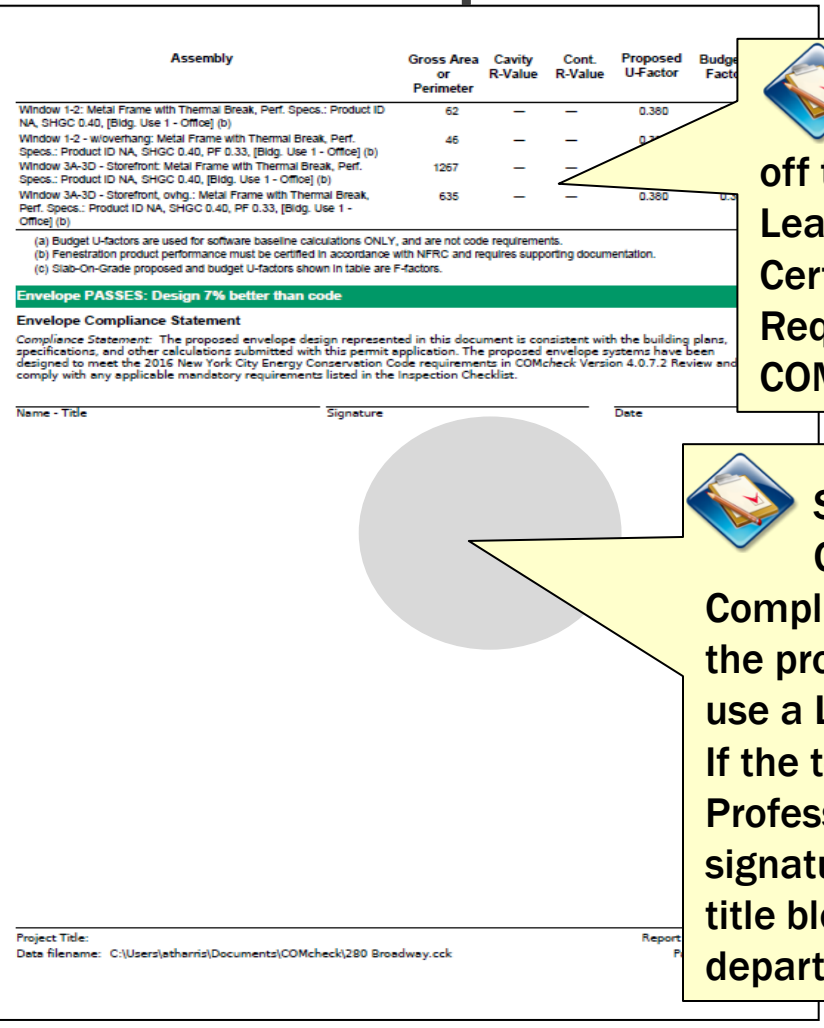
Additional Efficiency Package

On-site Renewable Energy

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Roof Type A: Insulation Entirely Above Deck, [Bldg. Use 1 - Office]	6112	—	20.0	0.048	0.032
Window 4 - Skylight: Metal Frame:Glass, With Curb, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	113	—	—	0.500	0.500
Floor Type A: Slab-On-Grade:Unheated, [Bldg. Use 1 - Office] (c)	180	—	—	0.730	0.540
NORTH					
Abv-Grade Wall Assembly Type A: Concrete Block:12", Partially Grouted, Cells Empty, Medium Density, Furring: Metal, [Bldg. Use 1 - Office]	5437	0.0	12.0	0.064	0.104
Window 1-2: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	220	—	—	0.380	0.380
Window 1-2 - w/overhang: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, PF 0.33, [Bldg. Use 1 - Office] (b)	46	—	—	0.380	0.380
Window 3A-3D - Storefront: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	160	—	—	0.380	0.380
Window 3A-3D - Storefront, ovhg.: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, PF 0.28, [Bldg. Use 1 - Office] (b)	82	—	—	0.380	0.380
Door A - Ext Dbl Glass Door: Glass (> 50% glazing):Metal Frame, Entrance Door, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	122	—	—	0.770	0.770
Door B - Insulated Hollow Metal: Insulated Metal, Swinging, [Bldg. Use 1 - Office]	72	—	—	0.420	0.610
Door C - Roll-up Overhead: Insulated Metal, Non-Swinging, [Bldg. Use 1 - Office]	80	—	—	0.440	0.440
Abv-Grade Wall Assembly Type B: Steel-Framed, 16" o.c., [Bldg. Use 1 - Office]	5592	13.0	8.0	0.062	0.064

Project Title: Report date: 12/12/17
Data filename: C:\Users\atharris\Documents\COMcheck\280 Broadway.cck Page 1 of 16



Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budge Facto
Window 1-2: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	62	—	—	0.380	
Window 1-2 - w/overhang: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, PF 0.33, [Bldg. Use 1 - Office] (b)	46	—	—	0.3	
Window 3A-3D - Storefront: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	1267	—	—		
Window 3A-3D - Storefront, ovhg.: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, PF 0.33, [Bldg. Use 1 - Office] (b)	635	—	—	0.380	0.3

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
(b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.
(c) Slab-On-Grade proposed and budget U-factors shown in table are F-factors.

Envelope PASSES: Design 7% better than code

Envelope Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed envelope systems have been designed to meet the 2016 New York City Energy Conservation Code requirements in COMcheck Version 4.0.7.2 Review and comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title Signature Date

Project Title: Report
Data filename: C:\Users\atharris\Documents\COMcheck\280 Broadway.cck P

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.

10. SUBMISSIONS & INSPECTIONS

Sample Energy Analysis: Detail from COMcheck Report

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.

Envelope PASSES: Design 7% better than code

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
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Window 1-2: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	220	---	---	0.380	0.380
Window 1-2 - w/overhang: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, PF 0.33, [Bldg. Use 1 - Office] (b)	46	---	---	0.380	0.380
Window 3A-3D - Storefront: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	160	---	---	0.380	0.380
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Window 3A-3D - Storefront: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, [Bldg. Use 1 - Office] (b)	1267	---	---	0.380	0.380
Window 3A-3D - Storefront, ovhg.: Metal Frame with Thermal Break, Perf. Specs.: Product ID NA, SHGC 0.40, PF 0.33, [Bldg. Use 1 - Office] (b)	635	---	---	0.380	0.380

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
(b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.
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Name - Title _____ Signature _____ Date _____

10. SUBMISSIONS & INSPECTIONS

Sample Energy Analysis

	Inspection/Test	Periodic (minimum)	Reference Standard (See ECC Chapter C6) or Other Criteria	ECC or Other Citation
IIA	**Envelope Inspections**			
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.	As required during foundation work and prior to backfill	Approved construction documents	C303.2.1; ASHRAE 90.1 - 5.8.1.7
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.	As required to verify continuous enclosure while walls, ceilings and floors are open	Approved construction documents	C303.1, C303.1.1, C303.1.2, C402.1, C402.2; ASHRAE 90.1 - 5.5, 5.6, 5.8.1, 11 or Appendix G
IIA3	**Fenestration U-factor and product ratings:** U-Factors, SHGC and VT values of installed fenestration shall be visually inspected for conformance with the U-Factors, SHGC and VT values identified in the construction drawings by verifying the manufacturer's NFRC labels or, where not labeled, using the ratings in ECC Tables C303.1.3(1), (2) and (3).	As required during installation	Approved construction documents; NFRC 100, NFRC 200	C303.1, C303.1.3, C402.4; ASHRAE 90.1 - 5.5; 5.6, 5.8.2, 11 or Appendix G
IIA4	**Fenestration air leakage:** Windows and sliding or swinging door assemblies, except site- built windows 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.	As required during installation; prior to final construction inspection	NFRC 400, AAMA/WDMA/CSA 101/I.S.2/A440 ASTM E283; ANSI/DASMA 105	C402.5.2; ASHRAE 90.1 - 5.4.3.2, 5.8.2.2
IIA5	**Fenestration areas:** Dimensions of windows, doors and skylights shall be verified by visual inspection.	Prior to final construction inspection	Approved construction documents	C402.4; ASHRAE 90.1 – 5.5.4.2, 5.6, 11 or Appendix G
IIA6	**Air sealing and insulation – visual inspection:** 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 must observe the testing of the building and/or assemblies and verify that the building and/or assemblies meet the requirements of the standard, in accordance with the standard(s) cited in the approved plans.	As required during construction	Approved construction documents; ASTM E2178, ASTM E2357, ASTM E1677, ASTM E779, ASTM E283	C402.5; ASHRAE 90.1 – 5.4.3.1, 5.4.3.5
IIA7	**Air sealing and insulation testing:** Testing must be performed in accordance with section ECC C402.5.1.3 or ASHRAE 90.1 section 5.4.3.5, and shall be accepted if the building and/or its air-barrier assemblies meet the requirements detailed in such section. Testing must be performed by a third-party independent of the contractor and acceptable to the department.	As required during construction, or prior to final construction inspection	Approved construction documents, ASTM E 779	C402.5.1.3; ASHRAE 90.1 – 5.4.3.5
IIA8	**Loading dock weatherseals:** Weatherseals at loading docks shall be visually verified.	Prior to final construction inspection	Approved construction documents	C402.5.6; ASHRAE 90.1 – 5.4.3.3
IIA9	**Vestibules:** Required entrance vestibules shall be visually inspected for proper operation.	Prior to final construction inspection	Approved construction documents	C402.5.7; ASHRAE 90.1 – 5.4.3.4

10. SUBMISSIONS & INSPECTIONS

Sample Energy Analysis

	Inspection/Test	Periodic (minimum)	Reference Standard (See ECC Chapter C6) or Other Criteria	ECC or Other Citation
IIA	**Envelope Inspections**			
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.	As required during foundation work and prior to backfill	Approved construction documents	C303.2.1; ASHRAE 90.1 - 5.8.1.7
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.	As required to verify continuous enclosure while walls, ceilings and floors are open	Approved construction documents	C303.1, C303.1.1, C303.1.2, C402.1, C402.2; ASHRAE 90.1 - 5.5, 5.6, 5.8.1, 11 or Appendix G
IIA3	**Fenestration U-factor and product ratings:** U-Factors, SHGC and VT values of installed fenestration shall be visually inspected for conformance with the U-Factors, SHGC and VT values identified in the construction drawings by verifying the manufacturer's NFRC labels or, where not labeled, using the ratings in ECC Tables C303.1.3(1), (2) and (3).	As required during installation	Approved construction documents; NFRC 100, NFRC 200	C303.1, C303.1.3, C402.4; ASHRAE 90.1 - 5.5; 5.6, 5.8.2, 11 or Appendix G
IIA4	**Fenestration air leakage:** Windows and sliding or swinging door assemblies, except site- built windows 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.	As required during installation; prior to final construction inspection	NFRC 400, AAMA/WDMA/CSA 101/I.S.2/A440 ASTM E283; ANSI/DASMA 105	C402.5.2; ASHRAE 90.1 - 5.4.3.2, 5.8.2.2
IIA5	**Fenestration areas:** Dimensions of windows, doors and skylights shall be verified by visual inspection.	Prior to final construction inspection	Approved construction documents	C402.4; ASHRAE 90.1 – 5.5.4.2, 5.6, 11 or Appendix G
IIA6	**Air sealing and insulation – visual inspection:** Openi… …velope including site-built fenestration and doors, shall be visually inspected to verify that a continuous air barrier … …gress inspector shall visually inspect to verify that materials and/or … and verify that th…	As required during	Approved construction documents; ASTM E2178, ASTM	C402.5; ASHRAE 90.1 –
IIA7	**Air sealing an…** accepted if the bu… the contractor an…			90.1 –
IIA8	**Loading dock…**			0.1 –
IIA9	**Vestibules:** Required entrance vestibules shall be visually inspected for proper operation.	Prior to final construction inspection	Approved construction documents	0.1 – 5.4.3.4

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.

10. SUBMISSIONS & INSPECTIONS

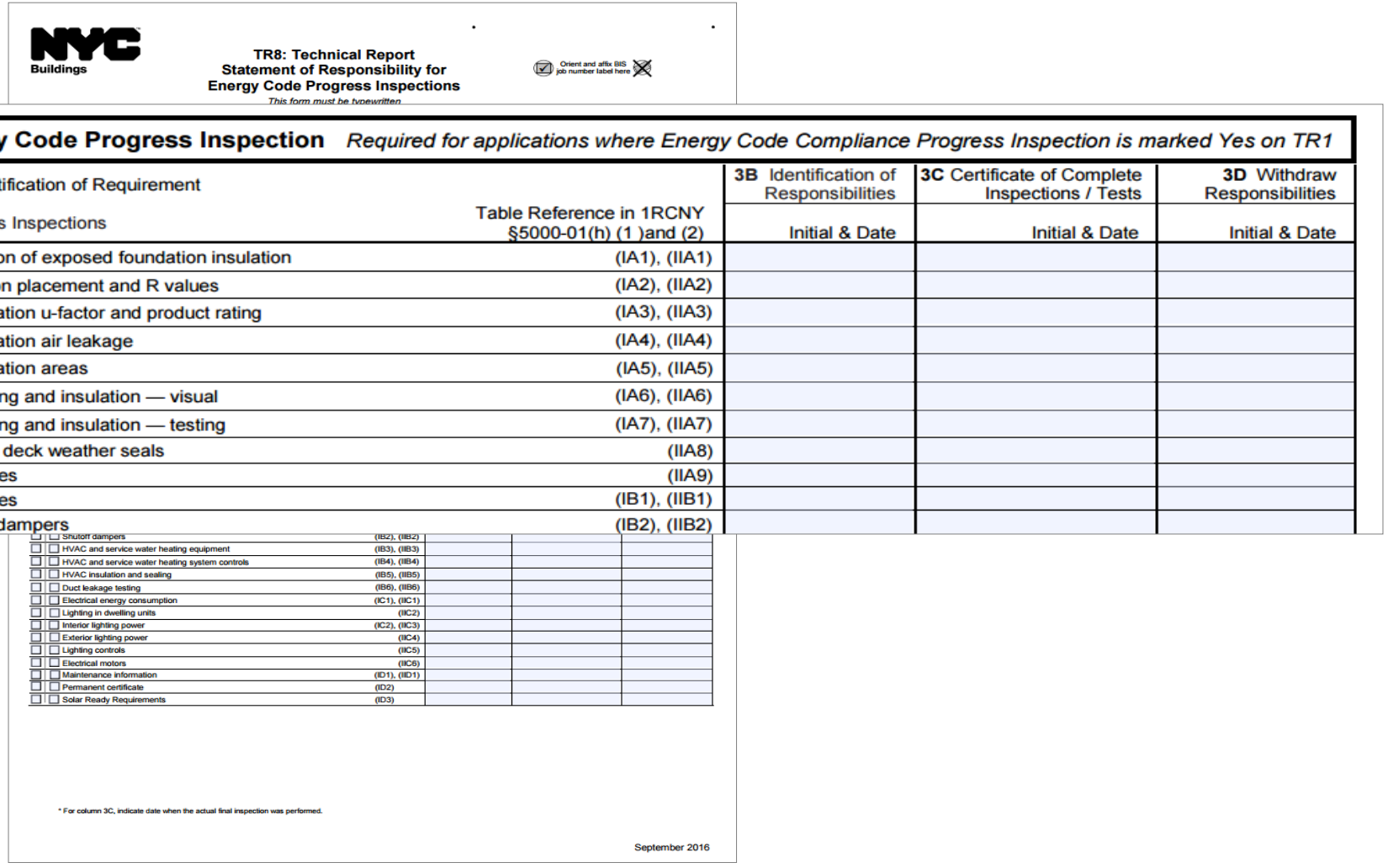
PROGRESS INSPECTIONS REVIEW- What Type of Supporting Documentation Should be Provided?

Inspection / Test (as seen on the TR8)	Frequency
Protection of exposed foundation insulation (IIA1)	As required during foundation work and prior to backfill
Insulation placement and R-values (IIA2)	As required to verify continuous enclosure while walls, ceilings and floors are open
Fenestration U-factor and product ratings (IIA3)	As required during installation
Fenestration air leakage (IIA4)	As required during installation; prior to final construction inspection
Fenestration areas (IIA5)	Prior to final construction inspection
Air sealing and insulation – visual (IIA6)	As required during construction
Air sealing and insulation – testing (IIA7)	As required during construction, or prior to final construction inspection
Loading dock weatherseals (IIA8)	Prior to final construction inspection
Vestibules (IIA9)	Prior to final construction inspection

TR8: http://www1.nyc.gov/assets/buildings/pdf/tr8.pdf
1 RCNY §5000-01: https://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – TR8 REPORT



NYC Buildings

TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections
This form must be typewritten

Orient and affix BIS job number label here

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

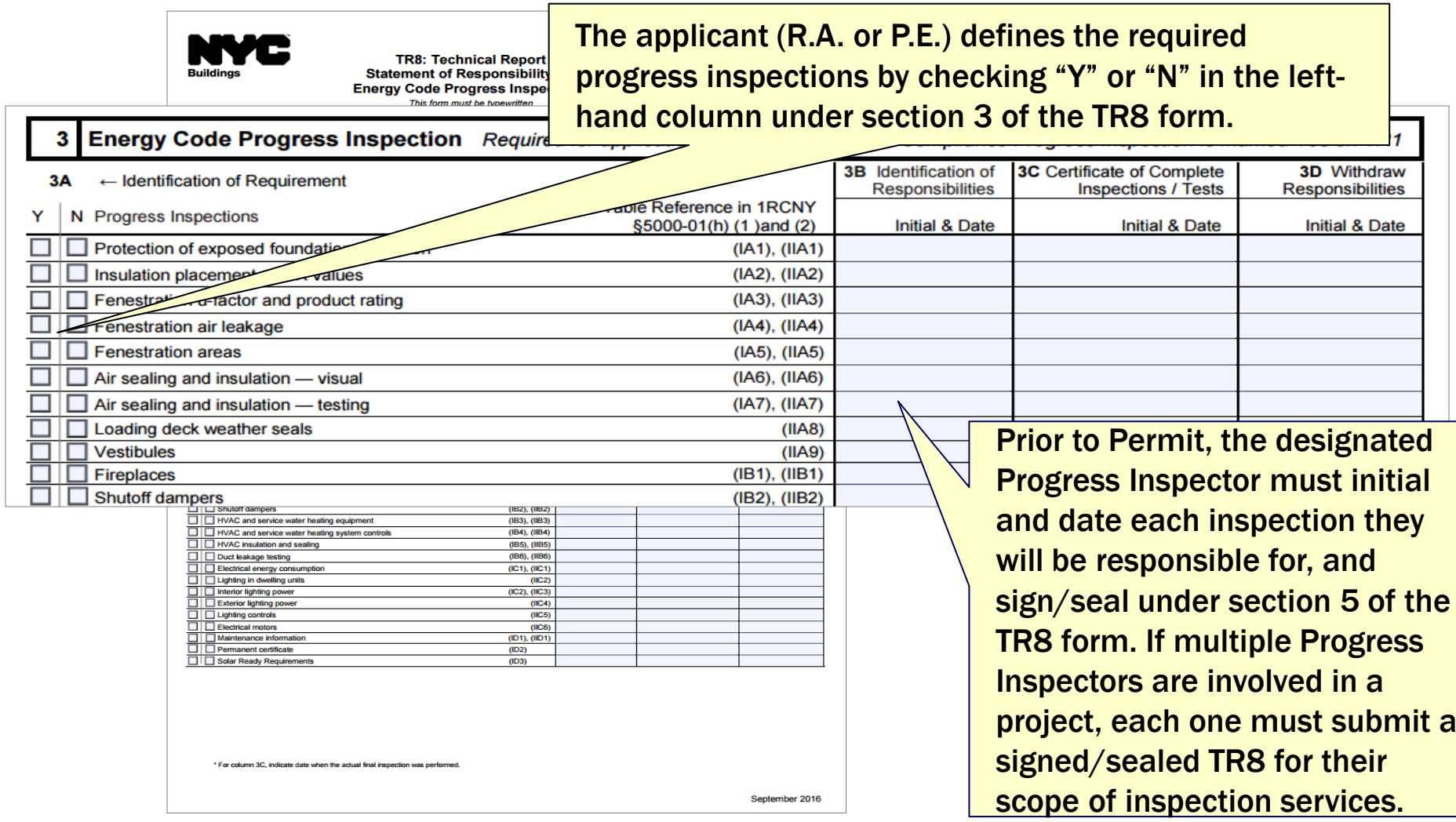
3A ← Identification of Requirement			3B Identification of Responsibilities	3C Certificate of Complete Inspections / Tests	3D Withdraw Responsibilities
Y	N Progress Inspections	Table Reference in 1RCNY §5000-01(h) (1)and (2)	Initial & Date	Initial & Date	Initial & Date
☐	☐ Protection of exposed foundation insulation	(IA1), (IIA1)			
☐	☐ Insulation placement and R values	(IA2), (IIA2)			
☐	☐ Fenestration u-factor and product rating	(IA3), (IIA3)			
☐	☐ Fenestration air leakage	(IA4), (IIA4)			
☐	☐ Fenestration areas	(IA5), (IIA5)			
☐	☐ Air sealing and insulation — visual	(IA6), (IIA6)			
☐	☐ Air sealing and insulation — testing	(IA7), (IIA7)			
☐	☐ Loading deck weather seals	(IIA8)			
☐	☐ Vestibules	(IIA9)			
☐	☐ Fireplaces	(IB1), (IIB1)			
☐	☐ Shutoff dampers	(IB2), (IIB2)			
☐	☐ HVAC and service water heating equipment	(IB3), (IIB3)			
☐	☐ HVAC and service water heating system controls	(IB4), (IIB4)			
☐	☐ HVAC insulation and sealing	(IB5), (IIB5)			
☐	☐ Duct leakage testing	(IB6), (IIB6)			
☐	☐ Electrical energy consumption	(IC1), (IIC1)			
☐	☐ Lighting in dwelling units	(IIC2)			
☐	☐ Interior lighting power	(IC2), (IIC3)			
☐	☐ Exterior lighting power	(IIC4)			
☐	☐ Lighting controls	(IIC5)			
☐	☐ Electrical motors	(IIC6)			
☐	☐ Maintenance information	(ID1), (IID1)			
☐	☐ Permanent certificate	(ID2)			
☐	☐ Solar Ready Requirements	(ID3)			

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – TR8 REPORT



NYC Buildings

TR8: Technical Report
Statement of Responsibility
Energy Code Progress Inspe

This form must be typewritten

3 Energy Code Progress Inspection *Require*

3A ← Identification of Requirement			3B Identification of Responsibilities	3C Certificate of Complete Inspections / Tests	3D Withdraw Responsibilities
Y	N	Progress Inspections	Table Reference in 1RCNY §5000-01(h) (1)and (2)	Initial & Date	Initial & Date	Initial & Date
☐	☐	Protection of exposed foundati…	(IA1), (IIA1)			
☐	☐	Insulation placement … values	(IA2), (IIA2)			
☐	☐	Fenestrat… u-factor and product rating	(IA3), (IIA3)			
☐	☐	Fenestration air leakage	(IA4), (IIA4)			
☐	☐	Fenestration areas	(IA5), (IIA5)			
☐	☐	Air sealing and insulation — visual	(IA6), (IIA6)			
☐	☐	Air sealing and insulation — testing	(IA7), (IIA7)			
☐	☐	Loading deck weather seals	(IIA8)			
☐	☐	Vestibules	(IIA9)			
☐	☐	Fireplaces	(IB1), (IIB1)			
☐	☐	Shutoff dampers	(IB2), (IIB2)			
☐	☐	HVAC and service water heating equipment	(IB3), (IIB3)			
☐	☐	HVAC and service water heating system controls	(IB4), (IIB4)			
☐	☐	HVAC insulation and sealing	(IB5), (IIB5)			
☐	☐	Duct leakage testing	(IB6), (IIB6)			
☐	☐	Electrical energy consumption	(IC1), (IIC1)			
☐	☐	Lighting in dwelling units	(IIC2)			
☐	☐	Interior lighting power	(IC2), (IIC3)			
☐	☐	Exterior lighting power	(IIC4)			
☐	☐	Lighting controls	(IIC5)			
☐	☐	Electrical motors	(IIC6)			
☐	☐	Maintenance information	(ID1), (IID1)			
☐	☐	Permanent certificate	(ID2)			
☐	☐	Solar Ready Requirements	(ID3)			

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

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.

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – TR8 REPORT

NYC Buildings

TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections
This form must be typewritten

Orient and affix BIS job number label here

1 **Location Information** *Required for all applications.*

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)*

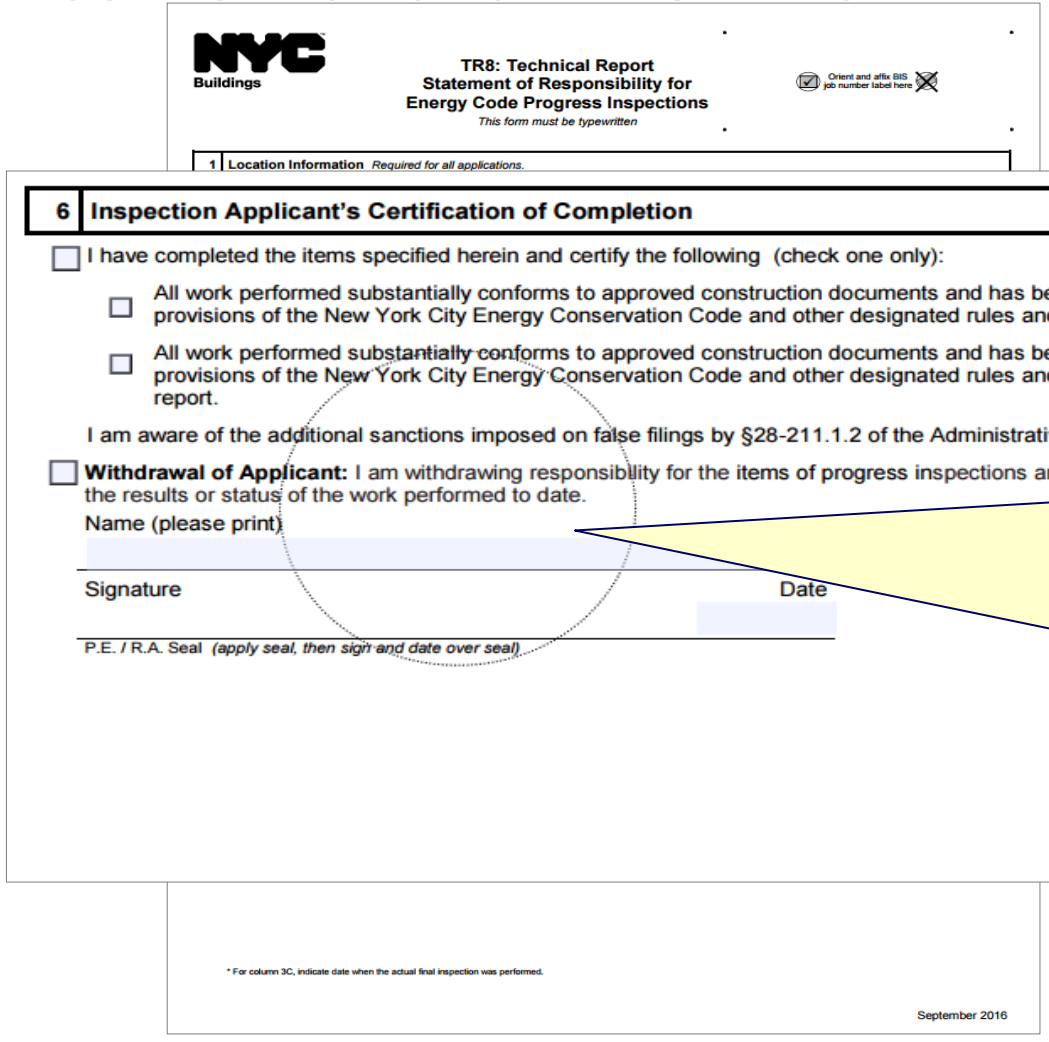
September 2016

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – TR8 REPORT



NYC Buildings

TR8: Technical Report
Statement of Responsibility for
Energy Code Progress Inspections
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☐ **Withdrawal of Applicant:** I am withdrawing responsibility for the items of progress inspections and/or tests 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)*

* For column 3C, indicate date when the actual final inspection was performed.

September 2016

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.

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – BACK-UP

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

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – EN2 FORM

NYC Buildings

EN2: As Built Energy Analysis

This form must be typewritten and submitted in person to the Certificate of Occupancy Division's Borough Office where energy analysis was reviewed.

Orient and affix BIS job number label here

1 Progress Inspector Information *Required for all applications.*

Last Name	First Name		Middle Initial
Business Name			Business Telephone
Business Address			Business Fax
City	State	Zip	Mobile Telephone

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.

negligently falsified or allowed to be falsified any certificate, form, signed statement, application, report or certification of the correction of a violation required under the provisions of this code or of a rule of any agency, I may be barred from filing further applications or documents with the Department.

I, _____, a registered design professional who performed or supervised the progress inspections for _____ (envelope, or HVAC/service water heating, or electrical/lighting work), certify that, to the best of my knowledge and professional judgment, the above checked statement(s) are true with respect to the progress inspections I completed as indicated on my signed, sealed and submitted TR8.

Name (please print)

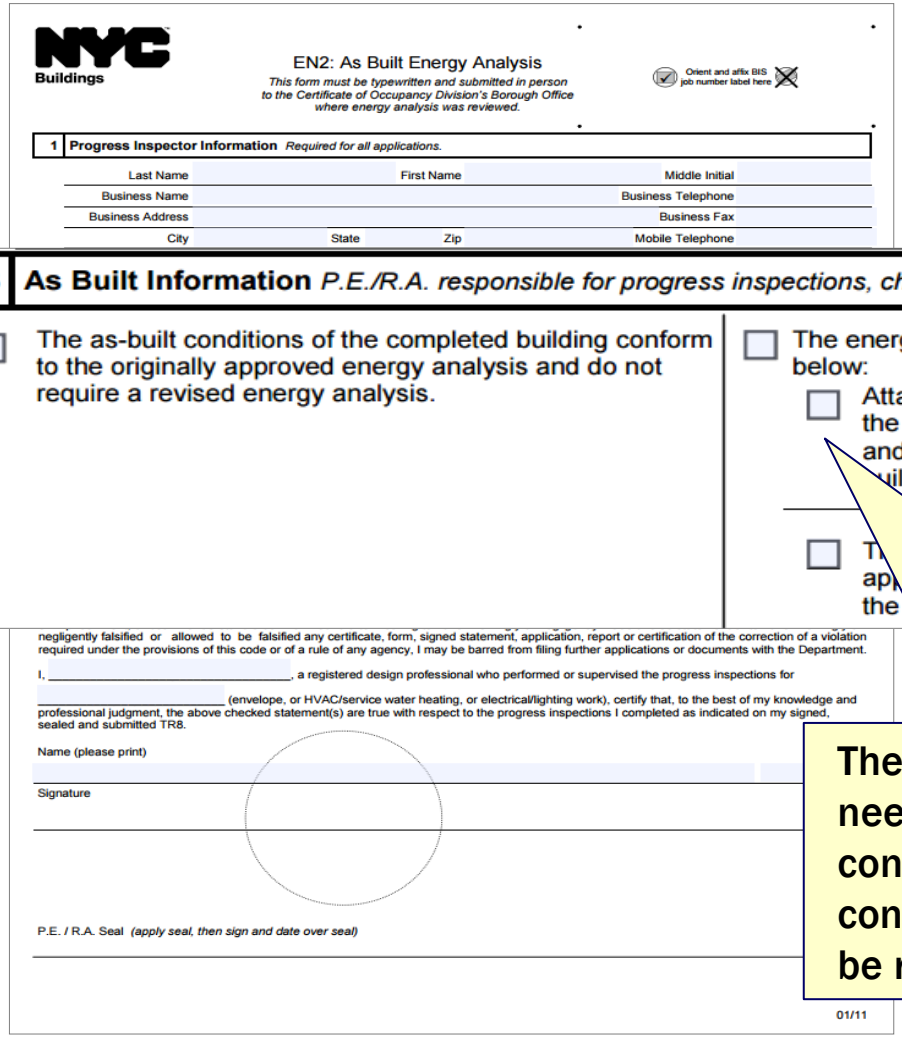
Signature Date

P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

01/11

10. SUBMISSIONS & INSPECTIONS

PROGRESS INSPECTIONS – EN2 FORM



NYC Buildings

EN2: As Built Energy Analysis

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Orient and affix BIS job number label here

1 Progress Inspector Information *Required for all applications.*

Last Name | First Name | Middle Initial

Business Name | Business Telephone

Business Address | Business Fax

City | State | Zip | Mobile Telephone

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.

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☐ The 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.

negligently falsified or allowed to be falsified any certificate, form, signed statement, application, report or certification of the correction of a violation required under the provisions of this code or of a rule of any agency, I may be barred from filing further applications or documents with the Department.

I, _____, a registered design professional who performed or supervised the progress inspections for _____ (envelope, or HVAC/service water heating, or electrical/lighting work), certify that, to the best of my knowledge and professional judgment, the above checked statement(s) are true with respect to the progress inspections I completed as indicated on my signed, sealed and submitted TR8.

Name (please print)

Signature

P.E. / R.A. Seal *(apply seal, then sign and date over seal)*

01/11

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

Slides 199 to 205

11. RESOURCES: OVERVIEW

In this section you will learn about:

- Resources and links;
- DOB assistance; and
- Image/Photo Credits & Copyrights.

11. RESOURCES AND LINKS

The resources below have been referenced in this module:

Resource	Link
2016 NYCECC	http://www1.nyc.gov/site/buildings/codes/2016-energy-conservation-code.page
Local Law 91 of 2016	http://www1.nyc.gov/assets/buildings/local_laws/ll91of2016.pdf
Local Law 125 of 2016	http://www1.nyc.gov/assets/buildings/local_laws/ll125of2016.pdf
Code Notes	http://www1.nyc.gov/site/buildings/codes/list-code-notes.page
NYCECC FAQ	http://www1.nyc.gov/site/buildings/codes/nycecc-faq.page
UPDATED - Energy Code: Supporting Documents How to Guides	http://www1.nyc.gov/assets/buildings/pdf/h2g_all.pdf
1 RCNY § 5000-01	http://www1.nyc.gov/assets/buildings/rules/1_RCNY_5000-01.pdf

11. RESOURCES AND LINKS

(continued)

Resource	Link
1 RCNY § 101-07	http://www1.nyc.gov/assets/buildings/rules/1_RCNY_101-07.pdf
Buildings Bulletins	http://www1.nyc.gov/site/buildings/codes/building-bulletins/page
EN1, EN2, and TR8 Forms	http://www1.nyc.gov/site/buildings/codes/energy-code-forms.page
REScheck/COMcheck	https://www.energycodes.gov/
Blower Door Testing	https://www.energy.gov/energysaver/blower-door-tests
One City: Built to Last	http://www.nyc.gov/html/builttolast/pages/home/home.shtml
New York City Construction Codes	http://www2.iccsafe.org/states/newyorkcity/

11. RESOURCES: DOB ASSISTANCE

Questions on the NYCECC can be submitted to DOB at:

EnergyCode@buildings.nyc.gov

11. RESOURCES

IMAGES/PHOTO CREDITS & COPYRIGHTS

Company or Individual	Slide Numbers
NYC Department of Buildings	37, 45, 96, 111, 143, 157, 170, 181, 182, 183, 186, 187, 188, 192, 193, 194, 195, 199
US DOE Building Energy Codes University	61, 62, 63, 88, 91, 162
Basc.pnnl.gov	101, 102, 103, 106

11. RESOURCES

(continued)

Company or Individual	Slide Numbers
NFRC	135, 146
Viridian Energy & Environmental, LLC	49, 50


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Buildings
build safe | live safe