III. Envelope Compliance Guide

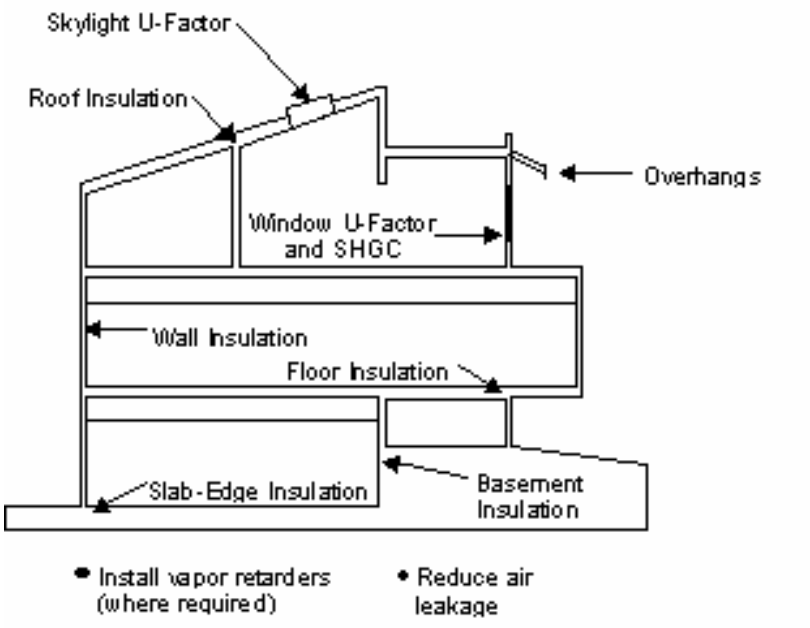
Envelope Requirements

This guide covers the energy code requirements for building envelope and provides a simple prescriptive method (manual method) for demonstrating compliance to the *2002 Energy Conservation Construction Code of New York*. This guide contains requirements for New York's climate, as well as instructions on how to demonstrate compliance with these requirements.

Energy Code Envelope Provisions

To promote energy efficiency in building envelopes of commercial and high-rise residential buildings, the energy code requires that

- insulation R-values and glazing and door U-factors be certified by the National Fenestration Rating Council (NFRC) or by using default values in Table 102.5.2(1) and 102.5.2(2).
- vapor retarders be installed in nonvented framed ceiling, wall, and floor areas. This guide contains requirements for vapor retarders.
- insulation levels for walls, roofs, and below-grade walls and glazing areas, and U-factors for windows and skylights meet or exceed minimum efficiency levels – these minimums are listed in the prescriptive package tables for New York included in this guide. This guide contains instructions on how to determine if your design complies with these levels.
- air leakage be limited through the building envelope. This guide contains requirements for limiting air leakage.



What the Energy Code Covers

Demonstrating Compliance

This method (prescriptive compliance path) requires minimal calculations and is the simplest way to comply. It is a package approach that requires all components in your design to meet or exceed prescribed efficiency levels contained in the prescriptive package table for your building. If one component does not meet the prescribed efficiency level, you must use the *COMcheck-EZ* software method (or other compliance option available under the code) to demonstrate compliance. Prescriptive package tables for New York with instructions are provided in this guide. To demonstrate compliance, complete the *Envelope Compliance Certificate* included with this guide.

Building Component Certification

Insulation R-values and glazing and door U-factors must be clearly marked on building plans or specifications. If two or more different insulation levels exist for the same building component, record each level separately on the plans or specifications. For example, if the walls adjacent to an unheated warehouse have less insulation than the building's exterior walls, record both insulation levels.

You must provide component R-values and U-factors so compliance can be determined. These values may be provided on product labels - For example, the R-value of the insulation is often printed directly on the insulation or can be determined from a code. Window U-factors are often included on the manufacturer label posted directly on the window.

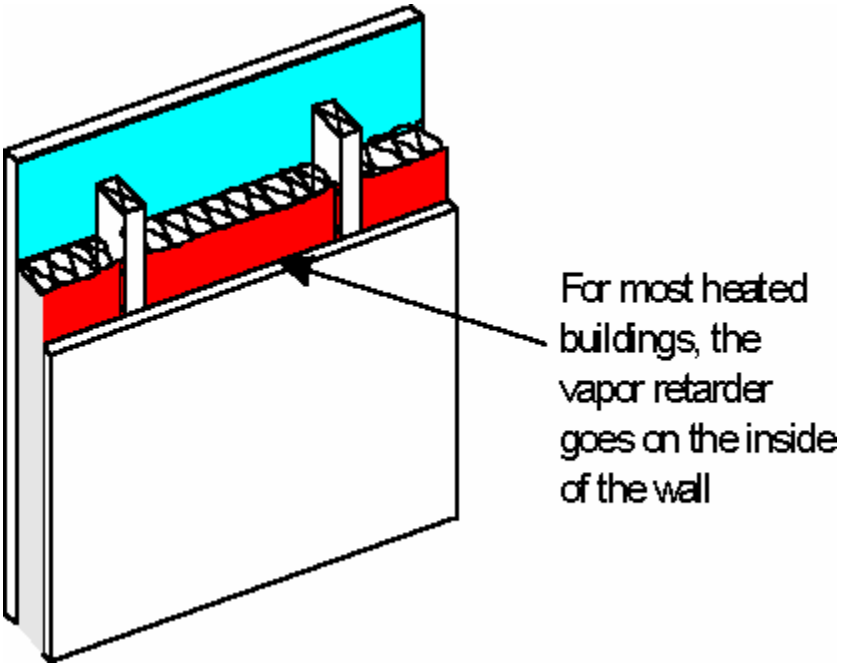
For blown or sprayed insulation, the initial installed thickness, settled thickness, coverage area, and number of bags used must be clearly posted at the job site. For components having a manufacturer's guaranteed R-value rating, thickness markers must be placed at least every 300 ft^2. For components without a manufacturer's guaranteed R-value rating, contact the Insulation Contractors

Association of America for an approved way to ensure proper insulation levels are obtained.

Vapor Retarders

Vapor retarders must be installed in all nonvented framed areas in ceilings, walls, and floors. Nonvented areas are framed cavities without vents or other openings to allow for free air movement. The vapor retarder must have a perm rating of 1.0 or less and must be installed on the warm-in-winter side of the insulation (between the insulation and conditioned space).

Vapor retarders are not required where moisture or its freezing will not damage materials or where other approved measures are taken to avoid condensation.



Location of Vapor Retarders

Insulation and Window Requirements

The manual method prescribes insulation levels, glazing areas, and glazing U-factors. The software method provides additional flexibility because these requirements can be traded against each other.

The Window Wall Ratio (WWR) is the gross window area divided by the gross wall area.

The gross wall area includes

- the opaque area of all above-grade exterior walls enclosing conditioned spaces (including above-grade portions of basement wall assemblies but excluding walls separating conditioned from unconditioned space)
- the area of the band joist and subfloor between floors
- the area of all doors and windows.

The gross window area includes the rough-opening area of the window, not just the transparent-glass area.

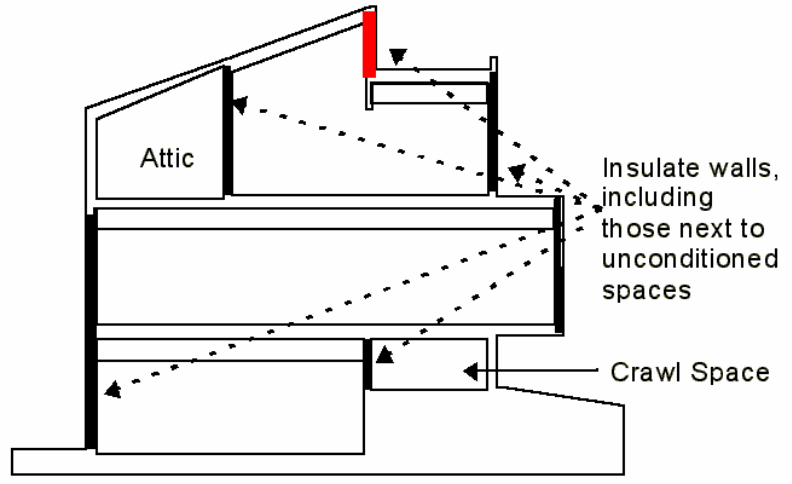
To determine if your proposed design complies with the New York-specific requirements

- determine the WWR category for your design (0-10%, 10-25%, 25-40%, 40-50%)
- find the prescriptive package table for New York
- select the package from the table that best fits your design's construction characteristics based on WWR
- find the corresponding requirements for walls, windows, skylights, roof, floors, and basement walls
- determine if your design complies based on criteria contained in the following sections.

You cannot use the manual method for buildings with WWR over 50%. For these buildings, use either the *COMcheck-EZ* software or another compliance method permitted under the code such as the ASHRAE 90.1 Section 11, Energy Cost Budget Method.

Above-Grade Walls

Your design complies with the wall insulation requirement if the proposed wall insulation has an R-value equal to or greater than the requirement in the prescriptive package. Wall insulation requirements apply to both exterior and interior walls that separate conditioned from unconditioned space. The wall type, WWR, and whether the wall is on the exterior or just separating conditioned from unconditioned space, may affect the wall insulation requirement.



Location of Wall Insulation

To demonstrate compliance, enter the R-value of the insulation to be installed in each wall component in the *Proposed R-Value* column on the *Envelope Compliance Certificate*. R-values for walls represent wall cavity insulation and/or continuous insulation (insulating sheathing), depending on the package selected.

For example, if R-19 batt insulation is to be used with R-3 insulating sheathing, enter "R-19 + R-3" in the *Proposed R-Value* column.

All wall components with the same R-value may be combined and entered as a single component on the certificate, provided these walls are of the same construction class (i.e., wood, metal, masonry).

Concrete Masonry Unit Walls

Concrete masonry unit walls may be insulated by filling the empty core with perlite, vermiculite, or some other insulating material. Even with filled cores, these wall types require additional insulation.

Metal Building Walls and Roofs

Special attention to the design and construction of metal buildings is required to ensure these buildings meet the code requirements. Two key elements exist in metal buildings that are not found in other building classes – thermal bridging effects between the purlin and metal roof sheet and compression of insulation behind wall girths and roof purlins.

The New York envelope requirements for metal building are provided in the Building Envelope Tables under the “Roofs Metal Purlin” category for roofs and the “Metal Buildings” category for walls.

There are two options for complying with the requirements of metal building roofs. One option is to insulate between or drape over framing members with fiberglass batt or other insulation type to achieve a minimum R-30. This option requires the installation of thermal blocks between the purlins and the metal structure. The thermal blocks consist of foam blocks or other materials/techniques that prevent heat from migrating from the purlin directly to the metal roof sheet. Fiberglass batt insulation which is draped over the purlin and compressed at the support, does not qualify as a thermal block.

The second option is to install continuous insulation to a minimum level of R-20 to R-24 depending on the Window Wall Ratio (WWR). Continuous insulation is defined as insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings. This is best achieved with a built-up foam roof system in which the insulation is neither compressed nor penetrated by conductive structural elements.

The requirement in New York for metal building walls is usually accomplished by using fiberglass batt insulation that is allowed to compress at the horizontal girders. As with the roof, compressed fiberglass batt insulation does not qualify as a thermal block. Therefore, to improve the thermal performance of the wall system and reduce losses due to thermal bridging through the steel members, a second layer of rigid foam sheathing can be installed between the metal framing and exterior metal skin.

Steel Framed Walls

In New York, exterior walls framed with steel studs require continuous insulation between R-3 and R-13, depending on the WWR, in addition to the cavity insulation requirement. This additional insulation compensates for the thermal losses through the metal framing and provides a thermal break. According to ASHRAE 90.1-1999, the effective R-value of R-19 insulation installed between the steel framing in the wall cavity is only R-7.1. Additional foam sheathing is required according to the levels indicated in the “Metal framing” category of the New York Building Envelope Requirements Table.

Doors

Glazed doors must meet the same SHGC and U-factor requirements as windows from the prescriptive package tables. Opaque doors just need to meet the U-factor requirements for windows from the tables. If doors have been specified that do not meet these requirements, compliance must be demonstrated using the software or other approved method.

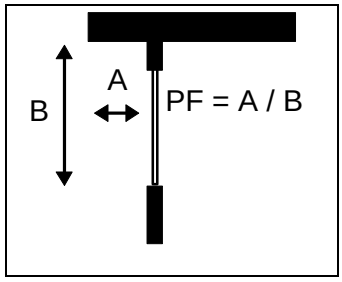
Windows

Your design complies with the window U-factor requirement if the proposed windows have a U-factor less than or equal to that in the prescriptive package. In most cases, the WWR will affect the window requirement.

A window U-factor is based on the interior-surface area of the entire assembly, including glazing, sash, and other framing elements. Center-of-glass U-factors cannot be used.

Your design must also have a Solar Heat Gain Coefficient (SHGC) less than or equal to that shown in the prescriptive package. The SHGC specifies the glazing's effectiveness in rejecting solar heat gain. SHGC is part of a system for rating window performance used by the National Fenestration Rating Council (NFRC). SHGC is gradually replacing the older index, shading coefficient (SC), in product literature and design standards. If you are using glass whose performance is listed in terms of SC, you may convert to SHGC by multiplying the SC value by 0.87. The SHGC requirement is affected by the projection factor (PF) of qualifying overhangs.

The projection factor is based on the ratio of the overhang depth to the overhang height above the window sill.



Projection Factor

Question
What is the projection factor of an overhang that extends 3 ft out and is 6 ft above the bottom window sill?
Answer
The projection factor is A divided by B. If A is 3 ft and B is 6 ft, the projection factor is 3/6 or 0.5.

For compliance, the SHGC cannot be modified to account for the effects of interior-shading devices. It can be modified for permanently attached devices

that shade the exterior of the window. Examples of these devices include shade screens and architectural shade structures.

U-factors and SHGCs for glazing must be tested and documented by the manufacturer in accordance with the NFRC test procedure. Default U-factor and SHGC values for windows and skylights are shown in the tables below. You may use these values to check compliance prior to selecting actual glazing products. However, the actual ratings for products installed in the building must meet or exceed (i.e., be no higher than) the values you assume in the compliance analysis.

In most cases you should use the NFRC rating numbers if they are available. If they are not available, then you can use the default numbers below, but be aware that many of these numbers will not be allowed under the prescriptive path. Using these default values will likely make it more difficult for your building to comply.

Glazing Layers	Window Frame Type		
	Metal	Metal with Thermal Break	Wood or Vinyl
Single	1.2	1.1	1.0
Double	0.7	0.7	0.6
Double Low-e	0.6	0.6	0.5
Triple	0.6	0.5	0.5
Triple Low-e	0.5	0.5	0.4

Default Window U-Factors

Glazing Layers	Glass Type		
	Clear	Tinted	Reflective
Single	0.8	0.7	0.5
Double	0.7	0.6	0.4
Double Low-e	0.7	0.6	0.4
Triple	0.7	0.5	0.4
Triple Low-e	0.7	0.5	0.4

Default Glass SHGC Values

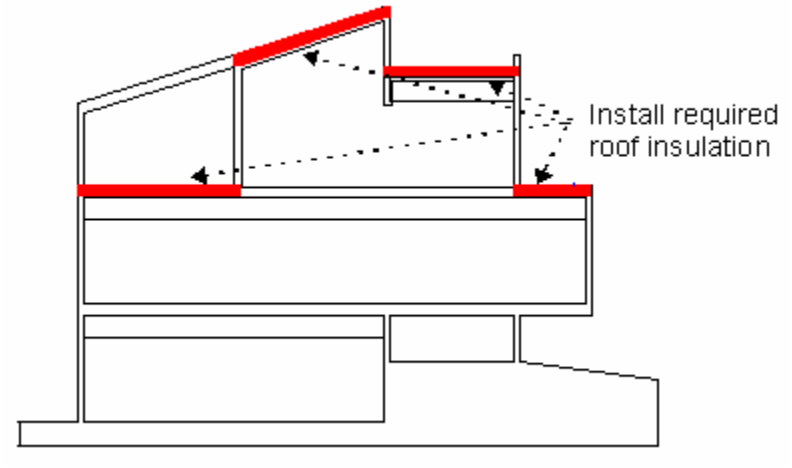
To demonstrate compliance, enter the proposed window U-factors in the *Proposed U-Factor* column and the proposed SHGC in the *Proposed SHGC* column on the *Envelope Compliance Certificate*.

Roofs

Your design complies with the roof insulation requirement if the proposed roof insulation has an R-value equal to or greater than that in the prescriptive package. In some cases, the WWR will affect the roof insulation requirement.

Roof insulation in buildings with attics must be installed to allow for free circulation of air through the attic eave vents. To demonstrate compliance, enter

the R-value of the insulation to be installed in each roof component in the *Proposed R-Value* column on the *Envelope Compliance Certificate*. R-values for roofs represent cavity insulation and/or insulating sheathing (depending on the package selected). For example, if R-19 batt insulation is to be used with R-4 insulating sheathing, enter "R-19 + R-4" in the *Proposed R-Value* column.



Location of Roof Insulation

All roof components with the same R-value and construction class may be combined and entered as a single component on the certificate.

Skylights

Your design complies with the skylight U-factor requirement if the proposed skylights have a U-factor less than or equal to that in the prescriptive package. The packages restrict the total skylight area to 3% or less of the gross roof area. In addition different criteria may apply depending on whether the glazing is glass or plastic and the overall percentage of skylight area to gross roof area.

A skylight U-factor is based on the interior-surface area of the entire assembly, including glazing, sash, curbing, and other framing elements. Center-of-glass U-factors cannot be used.

Skylights	**SHGC**	**U-factor**
Skylight with Curb, Glass,% of Roof		
0.0 - 2.0%	$SHGC_{all}$ - 0.68	U_{all} - 0.60
2.1 - 5.0%	$SHGC_{all}$ - 0.49	U_{all} - 0.60
Skylight with Curb, Plastic,% of Roof		
0.0 - 2.0%	$SHGC_{all}$ - 0.71	U_{all} - 0.60
2.1 - 5.0%	$SHGC_{all}$ - 0.71	U_{all} - 0.60
Skylight without Curb, All,% of Roof		
0.0 - 2.0%	$SHGC_{all}$ - 0.49	U_{all} - 0.58
2.1 - 5.0%	$SHGC_{all}$ - 0.49	U_{all} - 0.58

Skylight Requirements

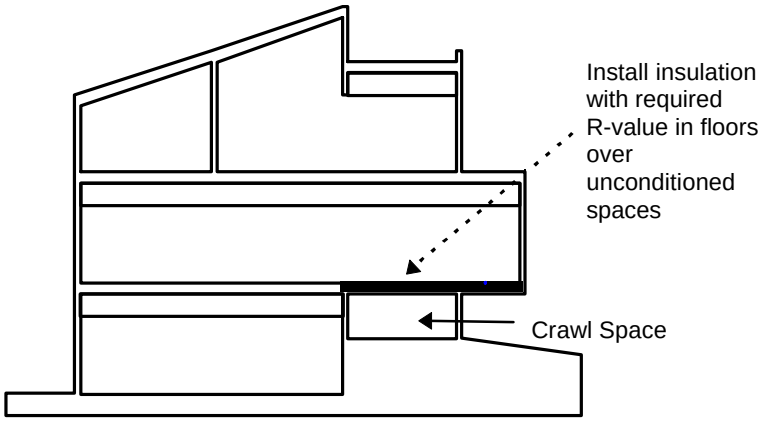
U-factors for skylights must be tested and documented by the manufacturer in accordance with the NFRC test procedure. If an NFRC U-factor rating is available for your skylight, you should use its BB-Size (i.e., 48 by 48 in.) rating.

To demonstrate compliance, enter the proposed skylight U-factors in the *U-Factor* column on the *Envelope Compliance Certificate*.

Floors Over Un-conditioned Space

Your design complies with the floor insulation requirement if the proposed floor insulation has an R-value equal to or greater than that in the prescriptive package. Floor insulation requirements apply where the underside of a floor is exposed to the outdoors or unconditioned space.

To demonstrate compliance, enter the R-value of the insulation to be installed in each floor component in the *Proposed R-Value* column on the *Envelope Compliance Certificate*. R-values for floors represent cavity insulation, spray-on insulation, and insulating sheathing (depending on the package selected).

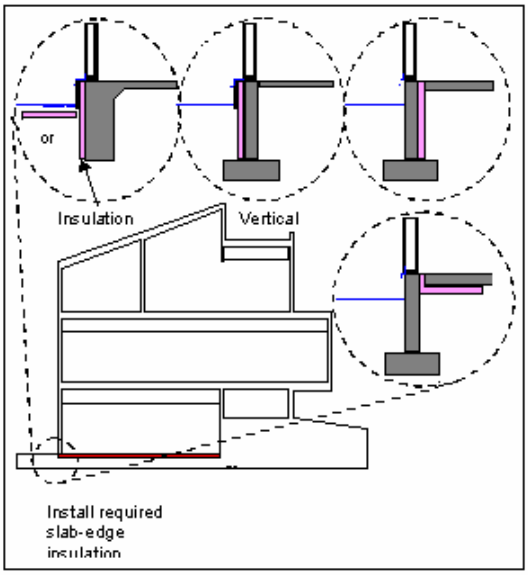


Location of Raised-Floor Insulation

All floor components with the same R-values and construction class may be combined and entered as a single component on the certificate.

Slab-On-Grade

The edges of concrete slab floors may need to be insulated. The following diagram shows several common ways to effectively insulate a slab edge.



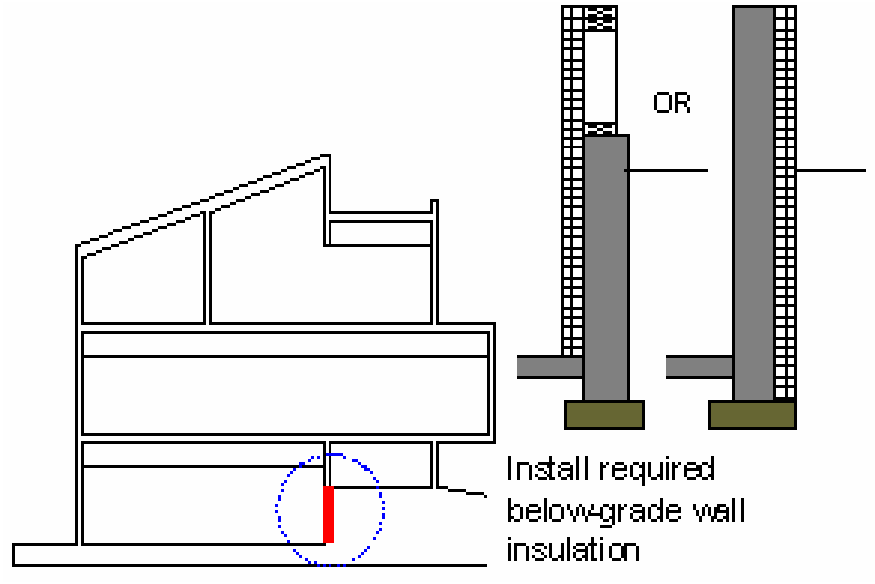
Location of Slab-Edge Insulation

Slab-edge insulation may be installed vertically or horizontally on the inside or outside of foundation walls. If installed vertically, it must extend downward from the top of the slab to the top of the footing (or 48 inches, whichever is less). If installed horizontally, it must cover the slab edge and then extend horizontally (to the interior or exterior) for a minimum distance of 48 inches.

Heated slabs on grade that contain radiant heating systems must be insulated to R-10 under the entire slab, in addition to the slab edge requirements.

Below-Grade Walls

In most cases, if the basement is considered conditioned space then the basement walls must be insulated. For purpose of this requirement, a wall is considered to be below grade when at least 85% of its surface area is in direct contact with the earth. The insulation must extend 10 ft below finish grade or to the level of the below-grade floor (i.e., the lowest floor), whichever is less. Your design complies with the basement wall insulation requirement if the proposed insulation has at least a value specified in the prescriptive tables.



Location of Basement Wall Insulation

To demonstrate compliance, enter the R-value of the insulation to be installed in the basement wall component in the *Proposed R-Value* column on the *Envelope Compliance Certificate*. R-values for basement walls represent cavity insulation or insulating sheathing (depending on the package selected).

All basement wall components with the same R-value and construction class may be combined and entered as a single component on the certificate.

Air Leakage

All joints and penetrations in the building envelope that are potential sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed in an approved manner.

The following areas in the building envelope must be sealed:

- exterior joints around window and door frames
- areas between wall sole plates, floors, and exterior-wall panels
- openings for plumbing, electricity, refrigerant, and gas lines in exterior walls, floors, and roofs
- openings in the attic floor (e.g., where ceiling panels meet interior and exterior walls and masonry fireplaces)
- service and access doors or hatches
- all other similar openings in the building envelope.

Dampers

Dampers integral to the building envelope must be equipped with motorized dampers with a maximum leakage rate of 3 cfm/ft^2 at 1.0 in w.g.

Loading Docks

Cargo doors and loading docks must be equipped with weather seals to restrict infiltration when vehicles are parked in the doorway.

Vestibules

All major entry and exit doors that separate conditioned space from the exterior must be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices.

Recessed Light Fixtures

Recessed lighting fixtures must be air-tight and rated for insulation contact (IC); i.e., rated for direct contact with insulation. A non-IC rated fixture is acceptable if installed in a sealed, airtight box and is not in direct contact with insulation according to code.

Windows, Doors and Curtain Wall Assemblies

The code specifies maximum air leakage rates for manufactured windows and doors. Windows and doors certified by an accredited laboratory (such as the National Wood Window and Door Association [NWWDA], the Architectural Aluminum Manufacturers Association [AAMA] or the National Fenestration Rating Council [NFRC]) meet these requirements and are labeled. For noncertified windows and doors, check manufacturers' test reports to verify compliance with these air leakage requirements.

Frame Type	**Windows** (cfm per ft of operable sash crack)	**Doors** (cfm per sq. ft of door area)	
		Sliding	**Swinging**
Wood	0.25	N/A	0.25
Aluminum	0.37	0.37	1.25
PVC	0.37	0.37	N/A

Maximum Allowed Air Leakage Rates

The air infiltration rate for commercial entrance doors should not exceed 1.75 CFM/ft^2.

Completing Envelope Compliance Certificate

Blank *COMcheck-EZ* Envelope Compliance Certificate forms are included at the end of this chapter. For each project fill out a blank certificate and check off all information in the boxes provided on the form. Enter "NA" if a particular requirement is not applicable; submit the completed certificate to the code official with the permit application package.

Prequalifying Project Design

Before using the *Envelope Compliance Certificate*, determine if your proposed design is qualified to use the *COMcheck-EZ* manual method to demonstrate compliance.

To determine if your design qualifies, calculate the WWR for the design using the following equation. If the design WWR exceeds 50%, if the skylight area exceeds 5% of the gross roof area, or the prescriptive path cannot be followed in its entirety, a nonprescriptive code approach must be used. The *COMcheck-EZ* software provides an optional way to demonstrate compliance through a system performance path. Refer to the *COMcheck-EZ Software Compliance Guide* for instructions on using the software.

If the WWR is less than 50% and you choose to use the manual prescriptive path rather than the COM*check-EZ* software then refer to one of the following four prescriptive envelope tables in Appendix A of this chapter.

Low Fenestration (WWR 0%-10%)

Medium Fenestration (WWR >10% but <25%)

High Fenestration (WWR >25% but <40%)

Very High Fenestration (WWR >40% but <50%)

ECCC of New York State Envelope Compliance Certificate

ALL INFORMATION MUST BE FILLED IN - PRINT CLEARLY

Section 1 - Project Information

Project Name		Permit #
Address		Date
Owner/Agent	Telephone	Checked By
Documentation Author	Telephone	Date *For Department Use Only*

Section 2 - General Information

Building Floor Area _____ sq ft.

Window -Wall Ratio (WWR) (Gross Fenestration Area ____ ft² ?Gross Exterior-Wall Area ____ ft²) x 100 = Design WWR ____

Project Description: ? New Construction ? Addition ? Alteration ? Unconditioned Shell

Section 3 - Requirements Checklist

Envelope Requirements	Check Items	Notes
• Component R-values and U-factors are labeled as certified		
• Vapor retarders installed		
• All joints and penetrations are caulked, gasketed, w eatherstripped, or otherw ise sealed		
• Loading docks have proper w eather seals.		
• Window s, doors, and skylights certified as meeting leakage requirements		
• Major entries and exits have enclosed vestibule		
• Recessed lighting fixtures are IC rated or properly sealed		

Climate-Specific Requirements

	Description	Proposed R-Value	Minimum R-Value	Check Items
Wall Type 1				
Wall Type 2				
Wall Type 3				
Roof Type 1				
Roof Type 2				
Floor Type 1				
Floor Type 2				
Slab				

	Description	Proposed U-Factor	Maximum U-Factor	Check Items
Window 1				
Window 2				
Window 3				
Door 1				
Door 2				

	Exterior Shading	Proposed SHGC	Maximum SHGC	Check Items
Window 1	Y / N PF*			
Window 2	Y / N PF			
Window 3	Y / N PF			

*PF = Projection Factor

Skylights less than 5% of the Total Roof Area: ____ % of Roof

Skylight type: __ curb, glass __ curb, plastic __ no curb

	Proposed SHGC	Required SHGC	Proposed U all	Required U all	Check Items
Skylight 1					
Skylight 2					

Section 4 - Compliance Statement

The proposed envelope design represented in these documents is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed envelope system has been designed to meet the 2002 Energy Conservation Construction Code

Owner/Owner Representative - Name	**Signature**	**Date**