NYC Buildings

How-to Guide:
Supporting Documentation

In Compliance with

2016 New York City Energy Conservation Code

- GENERAL
- **BUILDING ENVELOPE**
- MECHANICAL SYSTEMS
- LIGHTING & ELECTRICAL POWER
- OTHER REQUIREMENTS

NOTE: In this *How-To Guide: Supporting Documentation*, selected Energy Code provisions have been generalized, summarized, rephrased, and/or highlighted. This guide is intended: 1) To provide general guidance for the job applications seeking compliance with the 2016 NYCECC; 2) Not to replace or represent the entire 2016 NYCECC and related regulations of the City of New York and the Department of Buildings; and 3) Not to provide complete compliance solutions for any particular type of job or work. Comprehensive mandates, applicability, exemptions, exceptions and options will be found in the 2016 NYCECC and related regulations of the City of New York and the Department of Buildings.

OPAQUE ENVELOPE ASSEMBLIES

Minimum R-value

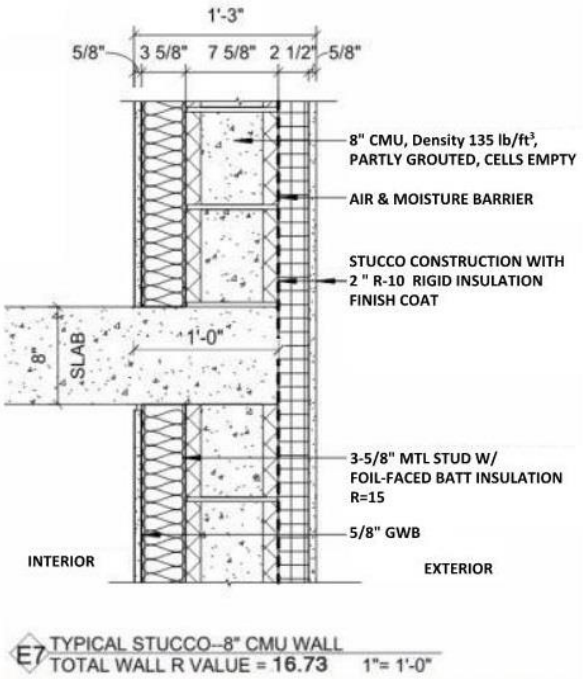
- For each building envelope type (e.g., roof, above-grade/below-grade walls, floors over unconditioned space, etc.), its section detail must indicate that the R-value of the insulation meets or exceeds the minimum allowed R-value prescribed for the envelope type (e.g., R-values shown in Table C402.1.3).
- Specifically, in the assembly details, clearly call out each of the proposed *insulation type, thickness and the manufacturer-published R-value* to satisfy the thermal requirements for the envelope assembly type.

R402.3
C402.1.3
5.5.3

Maximum U-factor

- Alternatively, it must be demonstrated that the proposed assembly's calculated U-factor value does not exceed the maximum allowed U-factor value prescribed for the envelope type (e.g., U-factors shown in Table C402.1.4).
- In the calculation of the overall assembly's U-factor, thermal performance values (e.g., R-value, U-factor, C-factor, etc.) corresponding to the assembly detail must be quoted from Appendix A of ASHRAE 90.1-2013. U-factor calculation methods must also be in accordance with Appendix A.

R402.3
C402.1.4
5.5.3



WALL TYPE E7	
Wall Assembly	**R-Value**
2" R-10 Rigid Insulation	10
8" CMU, Partly Grouted, Cells Empty	1.83 (a)
3-1/2 " R-15 Foil-faced Batt Insulation	4.9 (b)
Total R-Value of Wall Assembly	16.73
U-Factor of Wall Assembly (= 1/16.73)	**0.060**
(a) Assembly R_U for Concrete Block Walls from ASHRAE Table A3.1-3	
(b) Effective R-Value from ASHRAE Table A3.1-4	
Slab Assembly	**R-Value**
2 " R-10 Rigid Insulation	10
12"-Thick Solid Concrete Wall (Density: 144 lb/ft³)	1.60 (c)
Total R-Value of Slab Assembly	11.60
U-Factor of Slab Assembly (=1/11.60)	**0.086**
(c) Assembly R_U for Concrete from ASHRAE Table A3.1-2	

Area-Weighted Assembly U-factor Calculation for the Unit Wall			
Typical 10'-6" floor to floor height (8" slab + 9'-10" wall height)			
Assembly	**U-Factor**	**Height (in)**	**UA**
Wall Assembly	**0.060**	118	7.053
Slab Assembly	**0.086**	8	0.690
Total		126	7.743
Area-Weighted Assembly U-factor (=7.743/126)			**0.061**
Code-Allowed Maximum U-Factor (ASHRAE Table 5.5-4)			*0.090*

Figure BE-1. ***Sample Wall Assembly & Area-Weighted U-factor Calculation***

- *NOTE: One common error in the U-factor calculation is misrepresenting thermal values of assembly layers (e.g., face brick, gypsum board, air films, etc.) from unapproved sources.*

DOORS & WINDOWS – FENESTRATION IN THE ENVELOPE

U-factor and SHGC values

- For each fenestration type (e.g., fixed/operable window, skylight, exterior door, storefront, etc.), *U-factor* and *Solar Heat Gain Coefficient (SHGC)* values must be specified *in the window/door schedule* on drawings and must not exceed the maximum allowed values in the fenestration requirements (e.g., Table C402.4).

R402.3
C402.4
5.5.4.3
5.5.4.4

- Next to the U-factor and SHGC values specified in the schedule, provide the fenestration assembly manufacturer's information (e.g., '*ABC Windows/def 9000 series, or Approved equal*') that will satisfy the U-factor and SHGC requirements.

Air Leakage Rate and Visible Transmittance (VT)

- The window/door schedule on drawings must specify the *air leakage rate* of each proposed fenestration assembly type to demonstrate that the air leakage of fenestration assemblies do not exceed the maximum allowed leakage rate.

R402.4/C402.5.2
5.4.3.2

- Where required, the window/door schedule must identify Visible Transmittance (VT) of the proposed glazed fenestration products to meet the provisions in the applicable Code sections.

R303.1.3/C303.1.3
C402.4, C405.2.3
5.5.4.6

WINDOW & DOOR SCHEDULE								
TAG	TYPE	MATERIAL	NOMINAL DIM. (W X H)	MANUFACTURER - MODEL NO.	ASSEMBLY U-FACTOR	SHGC	VT	AIR LEAKAGE RATE (CFM/SF)
W1	FIXED	ANNO. ALUMINUM	7'-0" X 7'-0"	ABC WINDOWS - D999 SERIES OR APPROVED EQUAL	0.33	0.38	0.51	0.16
W1A	FIXED & CASEMENT	ANNO. ALUMINUM	7'-0" X 7'-0"	ABC WINDOWS - D999 SERIES OR APPROVED EQUAL	0.35	0.39	0.51	0.18
W2	CASEMENT	ANNO. ALUMINUM	4'-6" X 2'-3"	ABC WINDOWS -EF00 SERIES OR APPROVED EQUAL	0.42	0.39	0.51	0.18
SW1	SKYLIGHT	ANNO. ALUMINUM	2'-10" X 5'-2"	SKL CORP. - GHT000 SERIES OR APPROVED EQUAL	0.40	0.38	0.5	0.18
W5	STOREFRONT - FIXED GLAZING	ANNO. ALUMINUM	VARIES; SEE A-301 ~305 FOR LOCATIONS & DIM.	GLD CO. - STR #Z111 OR APPROVED EQUAL	0.36	0.38	0.53	0.05
D1	STOREFRONT - ENTRANCE GLASS DOOR	GLASS/ METAL	3'-0" X 7'-6"	GLD CO. - STR #Z111 OR APPROVED EQUAL	0.60	0.38	0.53	0.18
D2	OPAQUE SWINGING DOOR	METAL	3'-0" X 7'-0"	OPQ COMPANY RST-#22-33 OR APPROVED EQUAL	0.55	N/A	N/A	0.18

Figure BE-2. ***Sample Windows & Doors Schedule***

- *Fenestration U-factor values must be the 'whole assembly' U-factor, instead of 'center-of-glass' U-factor, and must be furnished by the manufacturer.*
- *Differentiate Fixed and Operable windows' U-factor values in the window schedule where required, as the Code-prescribed maximum U-factors for Fixed and Operable windows may vary depending on the referenced Code.*

FENESTRATION AREA

▪ Maximum Vertical Fenestration Area *(when following **ECC**)*

- ***Maximum*** vertical fenestration area (excl. opaque doors & spandrel panels): **30%** of the gross *above-grade wall* area — *C402.4.1, C502.2.1*
- ***Maximum*** vertical fenestration area (excl. opaque doors & spandrel panels): **40%** of the gross *above-grade wall* area *with certain requirements*

  See *Section* C402.4.1.1 for *all requirements.* << (e.g., *daylight responsive controls*).
- The *percentage value* of the total vertical fenestration area of job applications must be *computed and noted* on an EN- labeled drawing in conjunction with building elevations or elevation diagrams.
- ***When vertical fenestration area*** **> 40%**: **ASHRAE** must be chosen as Code Compliance Path; ECC does not allow > 40%. (Either COMcheck or Energy Modeling may be used for the energy analysis.)

▪ Maximum Vertical Fenestration Area *(when following **ASHRAE**)*

- ***Maximum*** vertical fenestration area (excluding opaque doors and spandrel panels): **40%** of the gross *wall* area — *5.5.4.2.1*
- When vertical fenestration area **> 40%**, Energy Code compliance may be demonstrated through either COMcheck (with envelope tradeoff) or Energy Modeling (total building performance) energy analysis method.

▪ Skylight Fenestration Area *(when following **ECC**)*

- ***Maximum*** skylight fenestration area: **3%** of the gross roof area — *C402.4.1, C402.4.2*
- ***Maximum*** skylight fenestration area *with daylight responsive controls*: **5%** of the gross roof area
  When > 5%: *ASHRAE must be chosen.*
- ***Minimum skylight fenestration area requirement:***
  Minimum 3% of the gross roof area, *or* ***Minimum 1%*** 'Skylight Effective Aperture'
  >> See Section C402.4.2 for the spaces where *minimum skylight fenestration area* is required.
  >> For 'Skylight Effective Aperture,' refer to Equation 4-4 in Section C402.4.2.

▪ Skylight Fenestration Area *(when following **ASHRAE**)*

- ***Maximum*** skylight fenestration area: **3%** of the gross roof area — *5.5.4.2.2, 5.5.4.2.3*
- ***Maximum*** skylight fenestration area *with certain requirements*: **6%** of the gross roof area
  >> See Section 5.5.4.2.2 for *all requirements.*
  When > 6%: *Either COMcheck (with envelope tradeoff) or Energy Modeling may be used to demonstrate compliance.*
- ***Minimum skylight fenestration area requirement:***
  Minimum 3% of the gross roof area, *or* ***Minimum 1%*** 'Skylight Effective Aperture'
  >> See Section 5.5.4.2.3 for the spaces where *minimum skylight fenestration area* is required.

AIR BARRIER

Continuous Air Barrier

To ensure air barrier continuity in the building thermal envelope, drawings must specify applicable air barrier construction methods (Section C402.5.1.1), and indicate that the building envelope is composed of 1) building materials not exceeding maximum allowed air permeability (Section C402.5.1.2.1), and/or 2) assemblies not exceeding allowed maximum air leakage (Section C402.5.1.2.2).

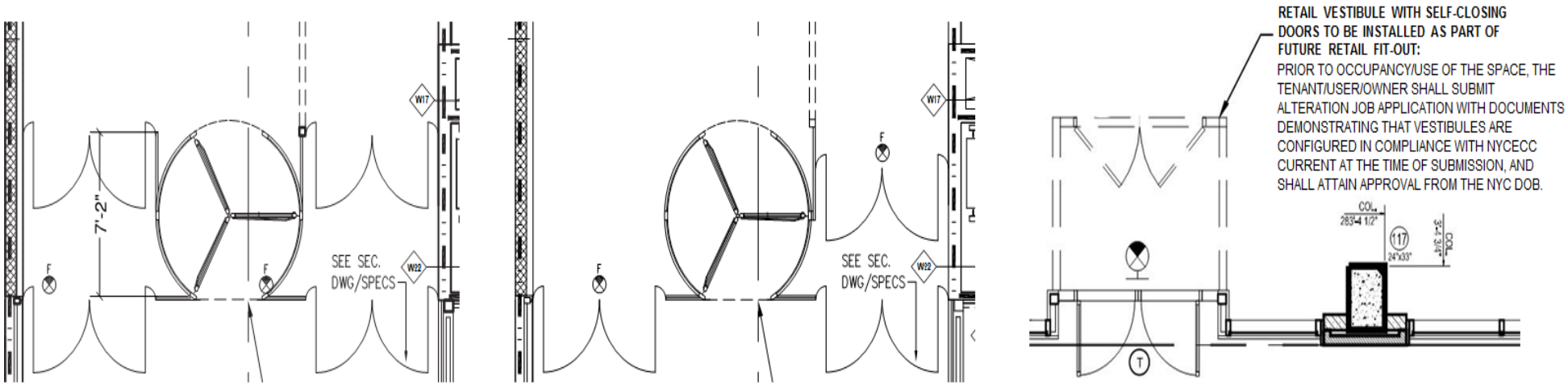
C402.5.1
5.4.3.1.2
5.4.3.1.3

Openings in the Building Envelope

Drawings must identify specific construction methods, configuration, devices and/or performance standards to limit air leakage in particular envelope areas including, but not limited to, the following:

C402.5/5.4.3.1.1

1) **Fenestration and doors**: Maximum allowed air leakage. *C402.5.2/5.4.3.2*
2) **Outdoor air intakes and exhaust openings**: Shutoff dampers – Motorized unless gravity dampers are allowed. *C402.5.5/6.4.3.4*
3) **Doors/Access Openings to shafts, chutes, vents, stairways and elevator lobbies**: Gasketting, weatherstripping, and sealing. *C402.5.4*
4) **Loading dock**: Weatherseals to restrict infiltration.
5) **Vestibules**: Plan configuration and self-closing devices on doors. *C402.5.6/5.4.3.3* *C402.5.7/5.4.3.4*
6) **Recessed lighting**: Luminaires installed in building envelope to be: a) IC-rated, b) Labeled with the Code-prescribed maximum air leakage rate, *and* c) Sealed with gasket or caulk. *C402.5.8/5.4.3.1.1*



a) Code-Compliant Plan *b) Non-Compliant Plan* *c) Acceptable Plan with specific notes requiring future compliance*

Figure BE-4.
Sample Vestibule Plan Configurations

AIR LEAKAGE TESTING & AIR BARRIER CONTINUITY PLAN

Whole Building Air Leakage Testing

- For new Residential buildings, mandatory air leakage testing must be specified to ensure the air leakage rate does not exceed 3 air changes per hour (3 ACH) at 50 Pascals. *R402.4.1.2 R402.4.1.3 C402.5.1.3 5.4.3.5*
- For Residential buildings with 2 to 7 dwelling units within the building envelope, and with 8 or more dwelling units within the building envelope, drawings may identify alternate testing procedures of sample "testing unit" verification methods as specified in the Code.
- For new Commercial buildings 25,000 to 49,999 sf in the *conditioned space floor area*, and 75 ft or less in height, mandatory air leakage testing must be specified to ensure the air leakage rate does not exceed 0.4 cfm/ft^2 of envelope area at 75 Pascals.

Air Barrier Continuity Plan

- For new Commercial buildings 50,000 sf or greater in the *conditioned space floor area*, an Air Barrier Continuity Plan must be prepared and implemented. *C402.5.1.3 5.4.3.5*
- The Air Barrier Continuity Plan must specify (1) List of typical joint and seam conditions, (2) Testing method options for each, (3) Sampling rates of test, (4) Quality control process in test, and (5) Guidelines for test reports and final certificates.

Figure BE-5. ***Blower door installed for air leakage testing at a construction site***
Source: energycodes.gov/resource-center/resource-guides

- ***Meeting the Air Leakage Requirements of the 2012 IECC*** *is a general air leakage reference guide provided by the U.S. Department of Energy: Building Energy Codes Program.*

  Please use the guide in the link for general reference purposes only as 2016 NYCECC is in parallel with 2015 IECC, a more recent IECC Code version.

THERMAL BRIDGING IN BUILDING ENVELOPE

Address the Thermal Bridging!

- Drawings must address all thermal-bridging-prone areas in the building envelope either by specifying supplemental insulation materials in such areas (*prescriptive* path), or by reporting the inferior thermal resistance values of the areas individually in the energy analysis (envelope *trade-off* path). *R402 C402*
- Thermal bridging commonly occurs in floor slab/joist edges, floor and balcony connections, slab-on-grade conditions, and roof and wall connection areas among others.
- Job applications seeking to meet the building envelope requirements *prescriptively* must prove that *each* of the thermal-bridging-prone areas meet the minimum insulation requirement.

Trade-Offs in the Envelope for Residential Buildings – Total UA Alternative

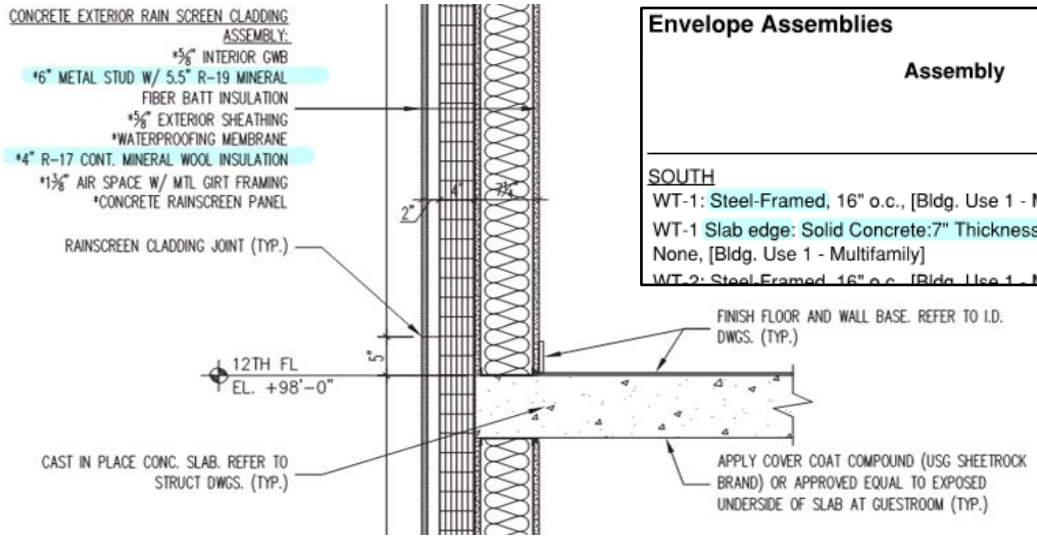
- Alternatively, for *Residential* buildings, assembly details for building envelope components must demonstrate that: *R402.1.5*

  Total building thermal envelope UA < **Total UA resulting from the Code-prescriptive U-factors**

  (Sum of Assembly area x its U-factor) *(Sum of Assembly area x Code U-factor value for the assembly type)*
- This could be verified by the *REScheck* envelope energy analysis by entering all building envelope components of varying thermal resistance values.

Trade-Offs in the Envelope for Commercial Buildings – Component Performance Alternative

- Alternatively, for *Commercial* buildings, assembly details for building envelope components must demonstrate the compliance with insulation requirements by satisfying the formula in Section C402.1.5. *C402.1.5 5.6.1.1*
- Compliance could be verified with the *COMcheck* envelope energy analysis by entering all building envelope components' varying thermal values, as this Alternative method has been built into the COMcheck software.

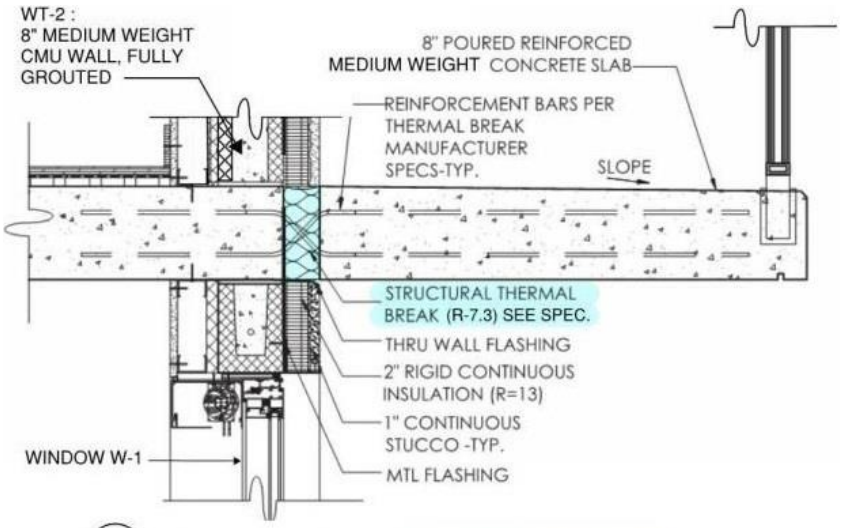


Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
SOUTH					
WT-1: Steel-Framed, 16" o.c., [Bldg. Use 1 - Multifamily]	5360	19.0	17.0	0.038	0.064
WT-1 Slab edge: Solid Concrete:7" Thickness, Normal Density, Furring: None, [Bldg. Use 1 - Multifamily]	378	---	17.0	0.053	0.090
WT-2: Steel-Framed, 16" o.c., [Bldg. Use 1 - Multifamily]	426	13.0	10.0	0.055	0.064

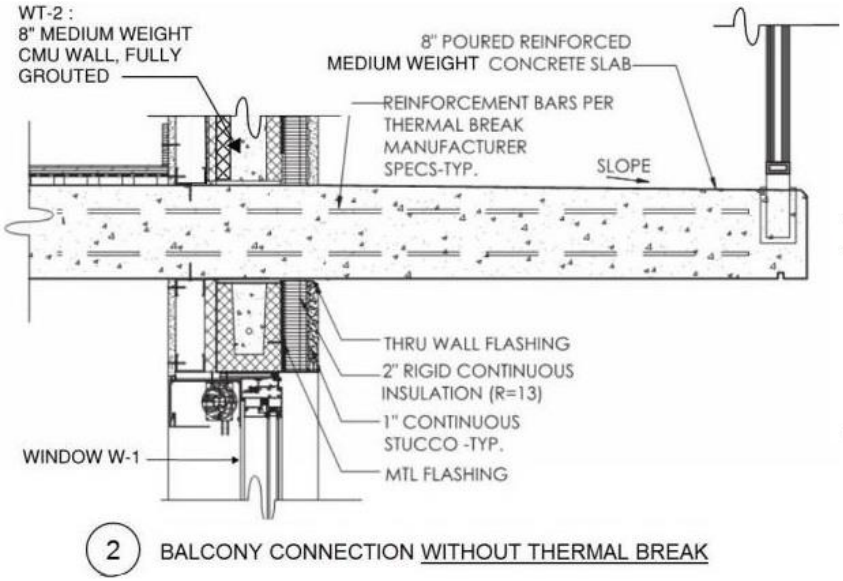
Figure BE-6.
Sample Slab Edge Detail & Matching Envelope COMcheck Report

THERMAL BRIDGING IN BUILDING ENVELOPE



Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
NORTH					
WT-2: Concrete Block:8", Solid Grouted, Medium Density, Furring: Metal, [Bldg. Use 1 - Multifamily]	3780	0.0	13.0	0.062	0.090
Window 1: Metal Frame:Fixed, Perf. Specs.: Product ID fixed window, SHGC 0.39, [Bldg. Use 1 - Multifamily] (b)	580	---	---	0.280	0.380
WT-2 Slab Edge: Solid Concrete:10" Thickness, Medium Density, Furring: None, [Bldg. Use 1 - Multifamily]	255	---	7.3	0.103	0.090



Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
NORTH					
WT-2: Concrete Block:8", Solid Grouted, Medium Density, Furring: Metal, [Bldg. Use 1 - Multifamily]	3780	0.0	13.0	0.062	0.090
Window 1: Metal Frame:Fixed, Perf. Specs.: Product ID fixed window, SHGC 0.39, [Bldg. Use 1 - Multifamily] (b)	580	---	---	0.280	0.380
WT-2 Slab Edge: Solid Concrete:12" Thickness, Medium Density, Furring: None, [Bldg. Use 1 - Multifamily]	255	---	0.0	0.450	0.090

Figure BE-7.
Sample Balcony Edge Details & Matching Envelope COMcheck Reports

EQUIPMENT PENETRATIONS IN BUILDING ENVELOPE

Calculation of Equipment Penetration Areas

When mechanical equipment listed in Table C403.2.3(3) or Table 6.8.1-4 are proposed in a *New Commercial* building application:

C402.1.4.2
5.5.3

- Drawings must identify the calculated total area of the equipment penetrations in the opaque above-grade walls by the supporting diagrammatic building elevations.
- Drawings must also identify the percentage of the total equipment penetration area out of the total opaque above-grade wall area.

U-factor 0.5 for Penetration Areas > 1% of Opaque Walls

C402.1.4.2
C402.1.5
5.6.1.1

- If the total area of penetrations from mechanical equipment specified above *exceeds 1%* of the total opaque above-grade wall area, the equipment penetration area must be identified as a separate wall assembly with a *default U-factor of 0.5*.
- Accordingly, in the envelope energy analysis (e.g., Component performance alternative calculation, COMcheck, or Energy Modeling) the total equipment penetration area must be entered as a separate exterior wall type of proposed U-factor 0.5 and budget U-factor identical to the surrounding wall.

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
SOUTH					
Exterior Wall - Type 1A: Concrete Block:8", Partially Grouted, Cells Empty, Normal Density, Furring: None, [Bldg. Use 1 - Multifamily]	4350	---	10.0	0.082	0.090
Window - WF1: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID WF1, SHGC 0.38, VT 1.00, [Bldg. Use 1 - Multifamily] (c)	78	---	---	0.350	0.380
Window - WO1: Metal Frame with Thermal Break:Operable, Perf. Specs.: Product ID WO1, SHGC 0.40, VT 1.00, [Bldg. Use 1 - Multifamily] (c)	1568	---	---	0.420	0.450
Mech PTAC Units Through-Wall: Other Mass Wall, Heat capacity 5.0, [Bldg. Use 1 - Multifamily] (b)	462	---	---	0.500	0.090

Figure BE-8.
Sample Envelope COMcheck report with Equipment Penetration Area entered as a separate opaque wall type

FUEL-BURNING APPLIANCES

Thermally Isolated and Insulated Rooms

When open combustion air ducts provide combustion air to open combustion fuel-burning appliances (e.g., natural draft boilers or furnaces) in a room, the room must be thermally isolated from the building it serves, and sealed and insulated to meet the requirements of Table R402.1.2, Table C402.1.3 or C402.1.4.

R402.4.4
C402.5.3

Direct Vent Appliances

If the fuel-burning appliances are to be located in a room within the building thermal envelope, the appliances must be identified as direct vent appliances with both intake and exhaust pipes installed continuous to the outside.

R402.4.4
C402.5.3

Fireplaces with Tight-fitting Doors or Dampers

Fireplaces or fireplace units that are designed to allow an open burn must be specified with tight-fitting flue dampers or tight-fitting doors labeled with applicable Code-required UL listings.

R402.4.2
C402.2.7

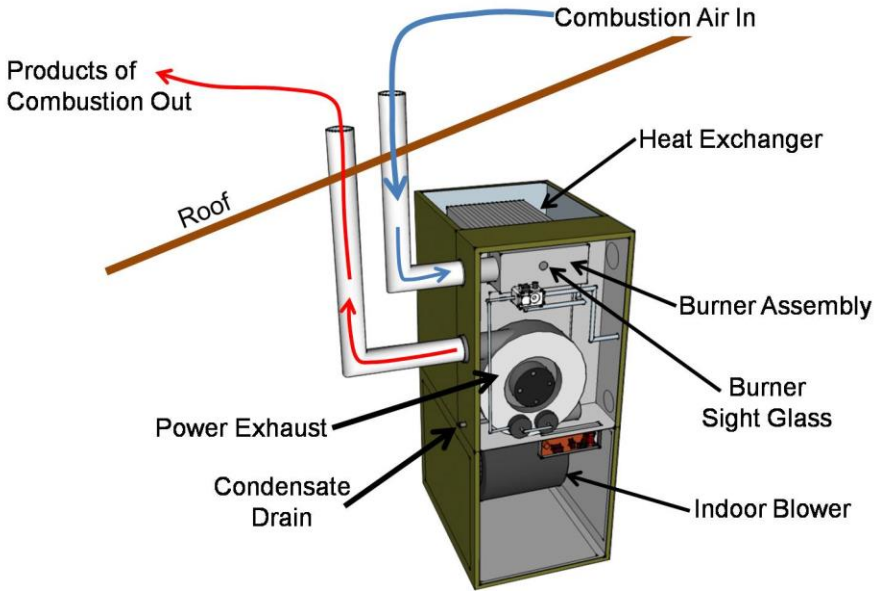


Figure BE-9. ***A direct-vent sealed-combustion furnace with dedicated pipes for combustion air and exhaust installed continuous to the outside***
Source: basc.pnnl.gov/images

FENESTRATION ORIENTATION – ASHRAE-ONLY, PRESCRIPTIVE* REQUIREMENTS

- **The Vertical Fenestration on the West- and East-Oriented Walls**
  (must comply with either ***A*** or ***B*** below)

A) Limiting Fenestration Area

5.5.4.5

West-oriented vertical fenestration area must be ≤ 1/4 of the Total vertical fenestration area,

and

East-oriented vertical fenestration area must be ≤ 1/4 of the Total vertical fenestration area.

B) Limiting SHGC Values

5.5.4.5

West-oriented vertical fenestration area x SHGC for West-oriented fenestration must be ≤
1/4 of the Total vertical fenestration area x Code-prescribed maximum SHGC for Climate Zone 4a (from Table 5.5-4),

and

East-oriented vertical fenestration area x SHGC for East-oriented fenestration must be ≤
1/4 of the Total vertical fenestration area x Code-prescribed maximum SHGC for Climate Zone 4a (from Table 5.5-4).

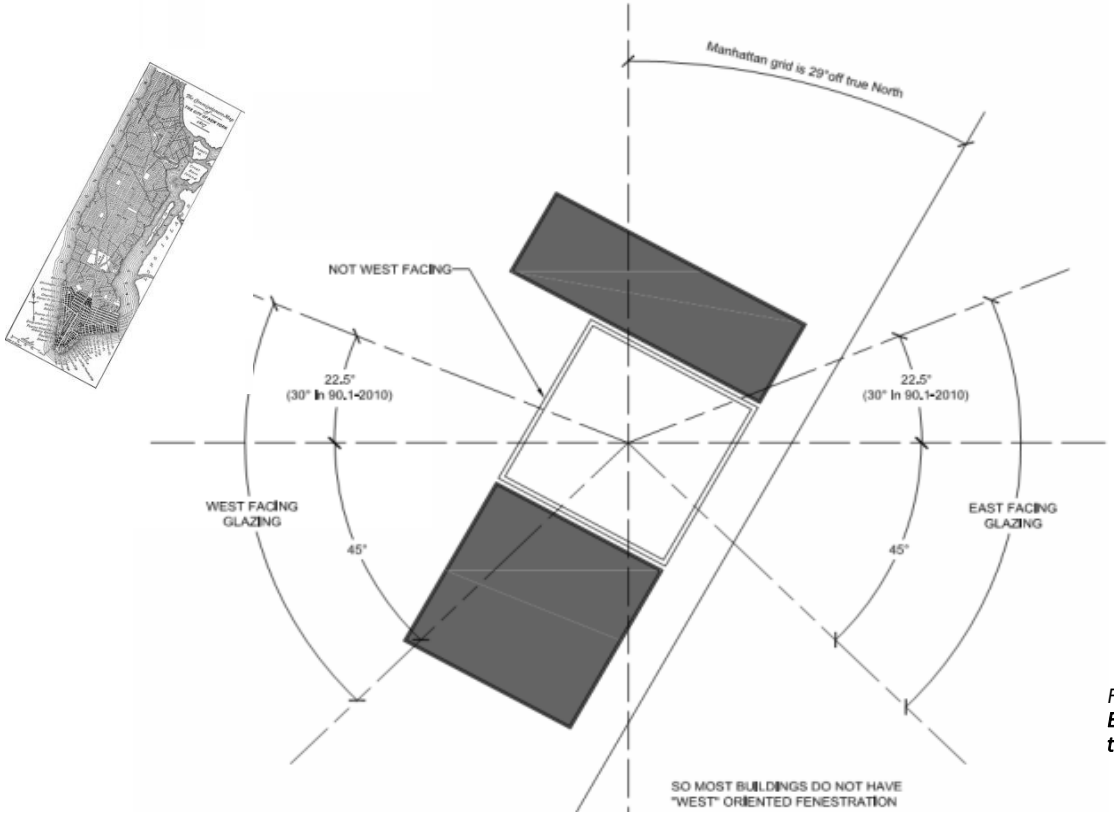


Figure BE-10.
Buildings on Manhattan's grid ± 29° off of true north are likely to have no West-oriented vertical fenestration

*
- ***Prescriptive*** *requirements MUST be met when Prescriptive energy analysis method (e.g., Tabular analysis) is chosen to demonstrate Energy Code compliance. If COMcheck or Energy Modeling is used for the energy analysis, the software program automatically takes into account the vertical fenestration areas and SHGC values on the west and east-oriented wall in its computation.*

RESIDENTIAL BUILDING ENVELOPE

Blown or Sprayed Roof/Ceiling Insulation

- The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) in the attic must be indicated on markers for every 300 sf. *R303.1.1.1*
- The markers must indicate minimum initial installed thickness with numbers of a minimum of 1 inch in height.

Protection of Exposed Foundation Insulation

Rigid, opaque and weather-resistant protective coverings must be applied to protect the insulation over the exterior of basement walls, crawl space walls and the perimeter of slab-on-grade floors. *R303.2.1*

Slab-on-Grade Floor Insulation at the Perimeter

- Slab-on-grade floors with a floor surface < 12" below grade must be insulated at the perimeter with minimum *R-10 for Unheated slab*, and minimum *R-15 for Heated slab*. *R402.2.10*
- The insulation must be extended downward or horizontally (as shown in the Figures below) a minimum of *4' for Climate Zone 4A*.
- Insulation extending away from the building must be protected by pavement or by minimum 10" of soil.

Insulation at Tenant Separation Walls

Fire-separated walls between dwelling units in two-family houses or townhouses must be insulated at a minimum R-value of R-10. *R402.4.6*

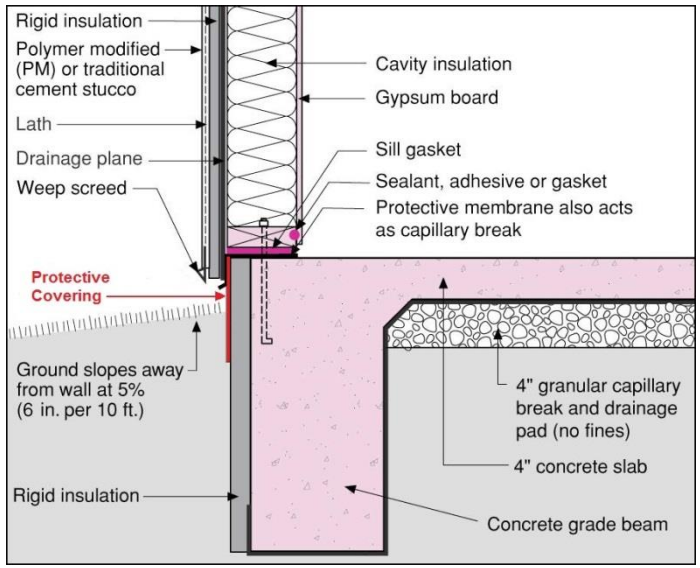


Figure BE-11.a.
Protection of Insulation Over the Grade Beam
Source: basc.pnnl.gov/images

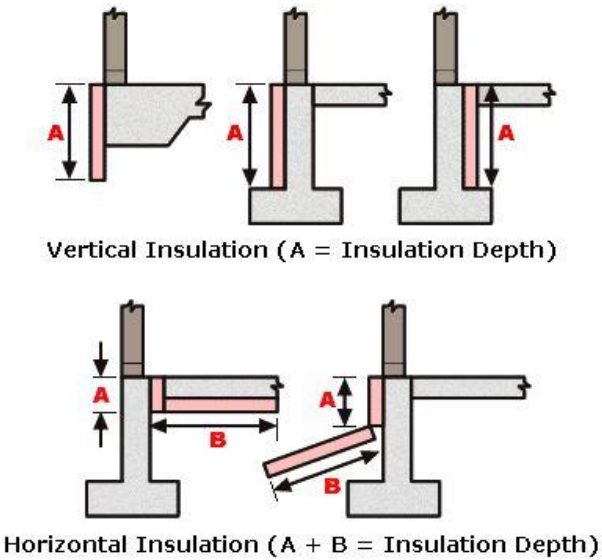


Figure BE-11.b.
Slab Insulation Methods
Source: basc.pnnl.gov/images

RESIDENTIAL BUILDING ENVELOPE

Insulation in Ceilings

- **Ceiling with Attic Spaces:** Minimum R-49; or *Uncompressed R-38* covering 100% of ceiling and extended over the wall top plate at the eaves (See Figures below). *R402.2.1 R402.2.2*
- **Ceiling without Attic Spaces:** When installation of required minimum R-49 insulation in 100% of the ceiling is unachievable, R-30 insulation is allowed for a maximum 500 sf or maximum 20% of the total insulated ceiling area, whichever is less. If partial R-30 insulation is proposed, provide roof area calculations with roof plan diagrams.

Access Hatches and Doors

Access doors to unconditioned spaces such as attics and crawl spaces must be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces (e.g., adjacent ceiling surface). *R402.2.4*

Sunroom Insulation and Fenestration

- Sunrooms enclosing conditioned space must meet the Residential building envelope insulation and fenestration requirements. *R402.2.13 R402.3.5*
- Sunrooms *with thermal isolation* and enclosing conditioned space must meet the following insulation and fenestration requirements:
  - **Ceiling Insulation**: Min. R-19
  - **Wall Insulation**: Min. R-13
  - **Vertical Fenestration**: Max. U-0.45
  - **Skylight**: Max. U-0.70
- Conditioned space *with thermal isolation* must be controlled as a separate zone for heating and cooling, or conditioned by separate equipment.

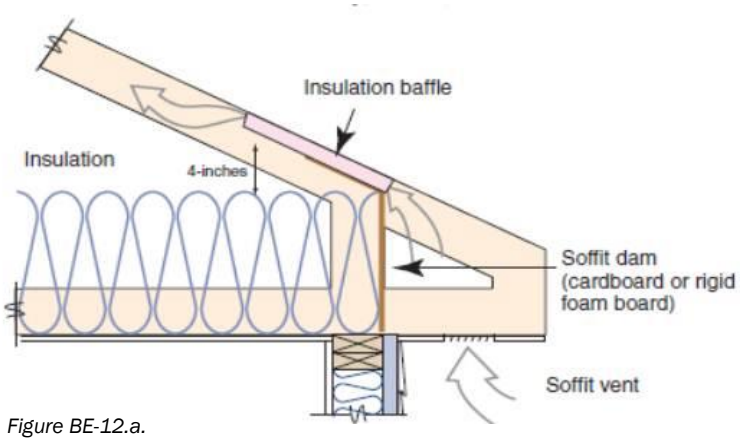


Figure BE-12.a.
Uncompressed Insulation Extended to Cover Wall Top Plate
Source: basc.pnnl.gov/images

Figure BE-12.b.
Access Hatch Properly Insulated
Source: basc.pnnl.gov/images