How-to Guide:
Supporting Documentation

In Compliance with

2025 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 2025 NYCECC; 2) Not to replace or represent the entire 2025 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 2025 NYCECC and related regulations of the City of New York and the Department of Buildings.

NYC Buildings

How-to Guide:

- **BUILDING ENVELOPE COMPLIANCE ADDRESSES:**
  - **THERMAL PERFORMANCE**
    - OPAQUE ASSEMBLIES
    - FENESTRATION
    - THERMAL BRIDGES
  - **AIR LEAKAGE**
    - THERMAL ENVELOPE/AIR BARRIER (GENERAL)
      - INSTALLATION REQUIREMENTS
      - TESTING AND MAXIMUM AIR LEAKAGE RATE
    - ADDITIONAL INSULATION AND SEALING REQUIREMENTS

Opaque Envelope Assemblies Prescriptive Compliance Path Options

R402.1.2
R402.1.3
R402.1.5
C402.1.2,
C402.1.3,
C402.1.4,
5.5
5.6

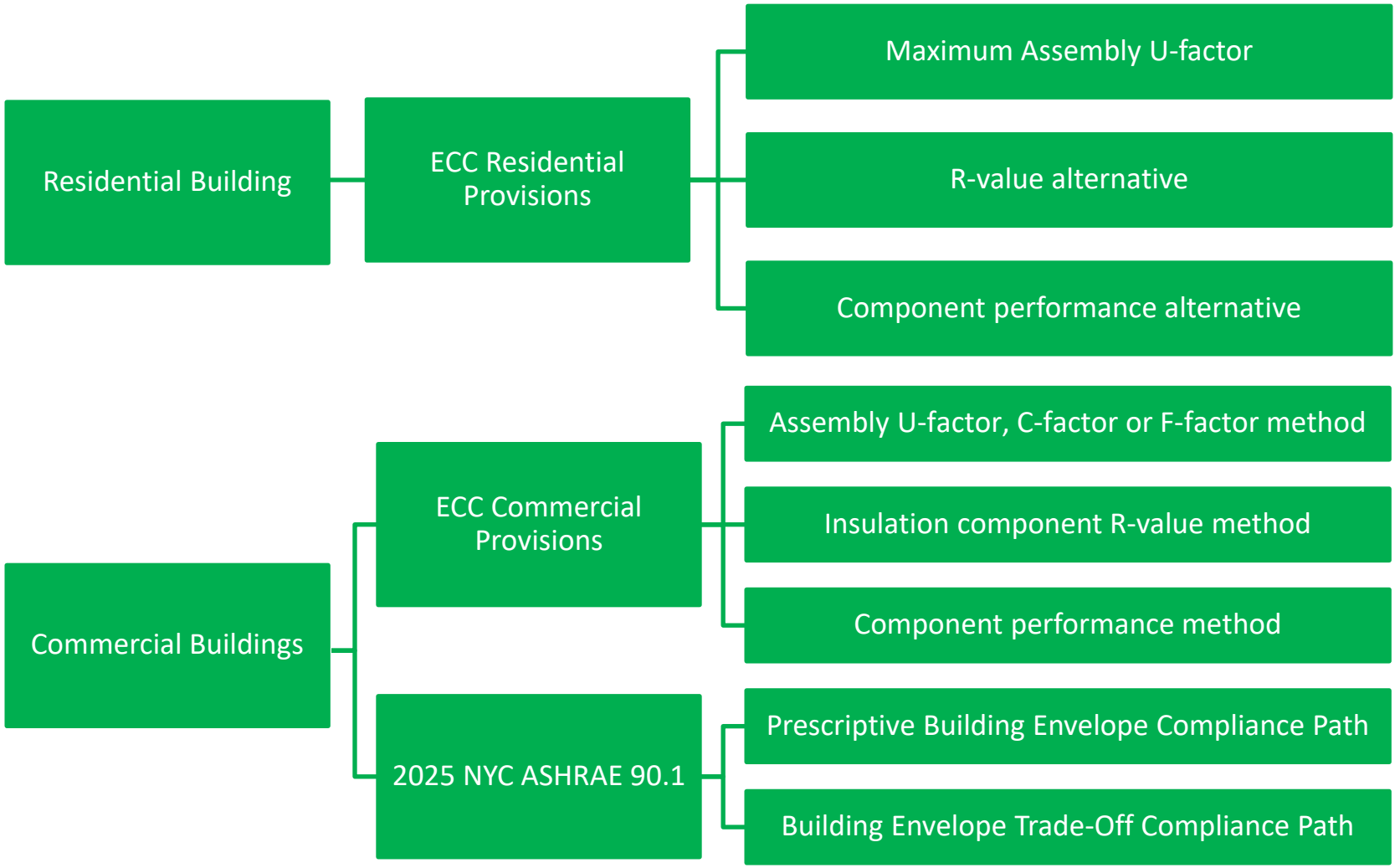


Figure BE-2.
Envelope Compliance Pathways

ENVELOPE-THERMAL PERFORMANCE (PRESCRIPTIVE)

▪ MAXIMUM ASSEMBLY U-FACTOR, C-FACTOR, F-FACTOR

R402.1.2
TABLE R402.1.2
C402.1.2,
TABLE C402.1.2
5.5.3
TABLE 5.5-4

- Tables R402.1.2, C402.1.2 and 5.5-4 establish maximum U-factors, C-factors, and F-factors for building envelope assemblies. Compliance involves calculating the U-factor for the entire assembly, considering all materials contributing to thermal performance.
- Construction types with reduced framing or thermal breaks may benefit from U-factor calculations.
- Multiple assemblies within one construction class enclosing the same space conditioning category can demonstrate compliance with an area-weighted U-factor of the assembly or by meeting the strictest requirement.
- This method applies to both opaque assemblies and fenestration.

NOTE:

- *Unlike R-values, which focus solely on insulation, U-factors account for all assembly components, such as exterior siding, gypsum board, and air films.*
- *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.*

Example:

NOTE INSULATION R-VALUE IS ABOVE TABLE 5.5-4 (ASHRAE) OR TABLE C402.1.3 (NYCECC)

Steel-Framed Wall 16” on center

DEPTH	6”
CAVITY INSULATION	R-13
CONTINUOUS INSULATION	R-10
ASSEMBLY U-FACTOR*	**0.054**

Steel-Framed Wall 24” on center

DEPTH	6”
CAVITY INSULATION	R-11
CONTINUOUS INSULATION	R-10
ASSEMBLY U-FACTOR*	**0.053**

NOTE CONTINUOUS INSULATION AND CAVITY INSULTATION R-VALUES DIFFER FROM WHAT IS PRESCRIBED BY TABLE 5.5-4 (ASHRAE) OR TABLE C402.1.3 (NYCECC)

MAXIMUM U-FACTOR REQUIRED BY CODE	0.061

Both assemblies comply with code

*The U-factor is already set and can be found in Table A3.3.3.1 of Appendix A from 2025 NYC ASHRAE 90.1. However, if your assembly is different from the assumed one, you need to calculate the U-factor using the procedure in Appendix A, Section A9.

BUILDING ENVELOPE ASSEMBLIES-THERMAL PERFORMANCE (PRESCRIPTIVE)

How to calculate assembly U-factor

Appendix RF
Appendix A

Acceptable methods for calculating an assembly's U-factor include:

- Predetermined values from 2025 NYC ASHRAE 90.1 Appendix A (Chapters A2 through A8) or Appendix RF.
- Two- or three-dimensional finite difference and finite volume computer models.
- Calculation based on methodology and assumptions from 2025 NYC ASHRAE 90.1 Appendix A Chapter A9.
- Testing:
    - For material R-values or thermal conductivity: ASTM C177, ASTM C518, or ASTM C1363.
    - For assembly U-factors: ASTM C1363.

Example:
A wood frame wall 16" on center, 5.5 deep with cavity insulation R-21 and continuous insulation R-9 can have its U-factor determined with Table A3.4.3.1

Table A3.4.3.1 Assembly *U-Factors* for Wood-Frame *Walls*

Framing Type and Spacing Width (Actual Depth)	Cavity Insulation *R-Value*: Rated (Effective Installed [see Table A9.4.3])	Overall *U-Factor* for Entire Base *Wall* Assembly	Overall *U-Factor* for Assembly of Base *Wall* Plus *Continuous Insulation* (Uninterrupted by Framing)																		
			Rated *R-Value* of *Continuous Insulation*																		
			R-1.00	R-2.00	R-3.00	R-4.00	R-5.00	R-6.00	R-7.00	R-8.00	R-9.00	R-10.00	R-11.00	R-12.00	R-13.00	R-14.00	R-15.00	R-20.00	R-25.00	R-30.00	R-35.00	R-40.00
Wood Studs at 16 in. on Center																					
3.5 in. depth	None (0.0)	0.292	0.223	0.181	0.152	0.132	0.116	0.104	0.094	0.086	0.079	0.073	0.068	0.064	0.060	0.056	0.053	0.042	0.035	0.030	0.026	0.023
	R-11 (11.0)	0.096	0.087	0.079	0.073	0.068	0.063	0.059	0.056	0.053	0.050	0.048	0.046	0.044	0.042	0.040	0.038	0.032	0.028	0.024	0.022	0.020
	R-13 (13.0)	0.089	0.080	0.074	0.068	0.063	0.059	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.040	0.038	0.037	0.031	0.027	0.024	0.021	0.019
	R-15 (15.0)	0.083	0.075	0.069	0.064	0.060	0.056	0.053	0.050	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.030	0.026	0.023	0.020	0.019
5.5 in. depth	R-19 (18.0)	0.067	0.062	0.058	0.054	0.051	0.048	0.046	0.044	0.042	0.040	0.038	0.037	0.036	0.034	0.033	0.032	0.027	0.024	0.021	0.019	0.018
	R-21 (21.0)	0.063	0.058	0.054	0.051	0.048	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.032	0.031	0.030	0.026	0.023	0.021	0.019	0.017
+ R-10 headers	R-19 (18.0)	0.063	0.059	0.055	0.052	0.049	0.047	0.045	0.043	0.041	0.039	0.038	0.036	0.035	0.034	0.033	0.031	0.027	0.024	0.021	0.019	0.017
	R-21 (21.0)	0.059	0.055	0.051	0.049	0.046	0.044	0.042	0.040	0.038	0.037	0.035	0.034	0.033	0.032	0.031	0.030	0.026	0.023	0.020	0.018	0.017

*Under section A3.4.1, appendix A indicates assumptions for the base assembly wall these U-factors are based on, these include 0.625" gypsum board on the interior, a second layer of 0.625" gypsum board on the exterior (R-0.56 each) and a stucco later with R-0.08

Figure BE-4.
Appendix A U-factor Table

BUILDING ENVELOPE ASSEMBLIES-THERMAL PERFORMANCE (PRESCRIPTIVE)

TABLE R402.1.2
C402.1.2.1
Appendix A

▪ Maximum Assembly U-factor supporting documents

Sections of walls, ceilings, floors, and slabs forming the building envelope must:

- Display and label every layer of the assembly.
- Specify the calculated U-factor.
- Include R-values for each component, along with their sources, in the U-factor calculations.
- Alternatively, if the U-factor is obtained from an approved source, provide the reference.
- Additional supporting documents for fenestration products can be found in the fenestration section.

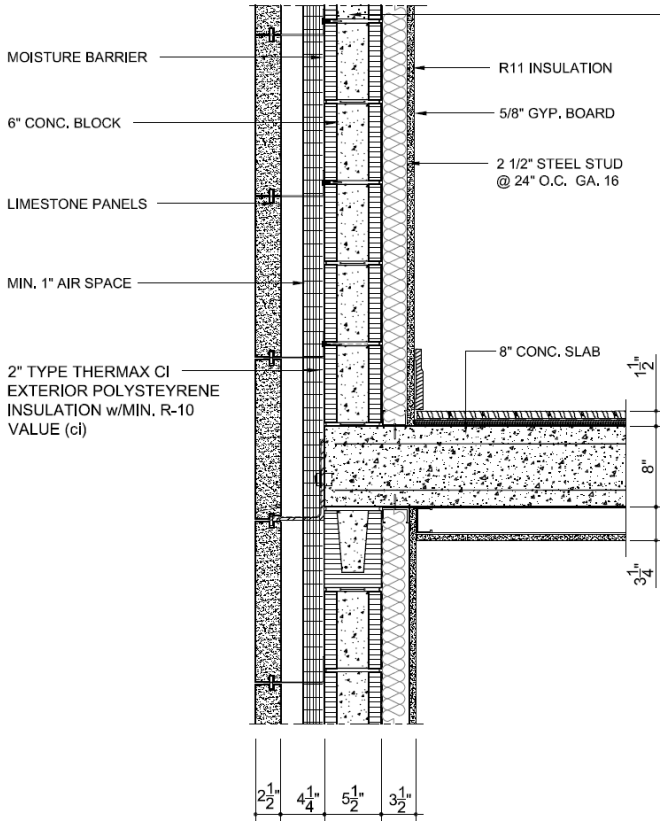


Figure BE-5.
Wall Section and U-factor Calculation

WALL TYPE T UL DESIGN # U902 U FACTORS WALL CONTRUCTION			16" THICK 4 HR RATED MASS.
U-FACTOR CALCS	**ELEMENT**	**R-VALUE**	**U-FACTOR***
Base Wall U-factor Calculations	2" R-10 Continuous Insulation	10.00	
	6" CMU, normal weight, partly grouted, cells empty (Table A3.1-3)	1.67	
	2.5" steel framing at 24" o.c. w/R-11 Batt Insulation (Table A3.1-4)	3.60	
	Wall Assembly Value	**15.27**	**0.0655**
Slab Assembly U-factor Calculations	2" R-10 Continuous Insulation	10.00	
	Concrete Slab Uninsulated (8"). Normal weight	1.35	
	Wall Assembly Value	**11.35**	**0.0881**

WALL TYPE T			
Weighted Wall assembly U-factor calculation derated for differentiation in thermal properties at slab edge			
Typical 10'-0" Floor to Floor Height			
Wall	**Height**	**U-Factor***	**UA**
Base Wall U-factor	9'-4"	0.0655	0.6112
Slab Assembly U-factor	0'-8"	0.0881	0.0587
Total	**10'-0"**		**0.6700**

*U-factor values based on ASHRAE 90.1-2019 Appendix A

BUILDING ENVELOPE ASSEMBLIES- THERMAL PERFORMANCE (PRESCRIPTIVE)

R402.1.4
C402.1.3
5.5.3

R-value alternative

- Assemblies that meet or exceed the insulation material R-values in Tables R402.1.3, C402.1.3 or 5.5-4 can be an alternative to the U-factor.
- For simple buildings using common insulation products, compliance is often achieved directly through the R-values in Table C402.1.3 or 5.5-4 in ASHRAE.
- This applies to opaque assemblies; fenestration still needs to meet the U-factor requirements of Table C402.1.2.
- Multiple assemblies within one construction class enclosing the same space conditioning category can demonstrate compliance by meeting the strictest requirement.

R-value computation

- Sum the R-values of cavity insulation layers alone for multiple layers to meet Table R402.1.3/C402.1.3/5.5-4 requirements.
- Sum the R-values of continuous insulation layers for multiple layers to meet continuous insulation requirements in Table R402.1.3/C402.1.3/5.5-4.
- Do not add separate R-values required for cavity and continuous insulation to demonstrate compliance with Table R402.1.3/C402.1.3/5.5-4 .
- For blown insulations, use the manufacturer's settled R-value to demonstrate compliance with Table R402.1.3/C402.1.3/5.5-4 requirements.

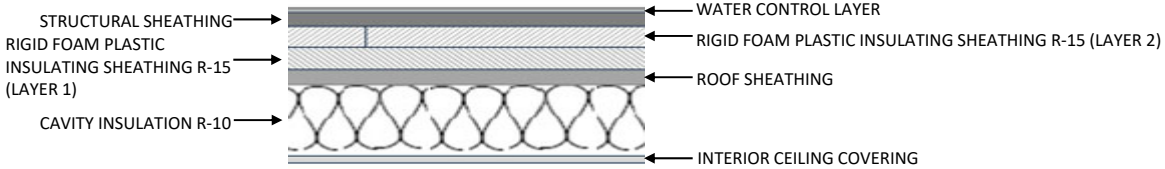
R-value alternative supporting documents

Sections of walls, ceilings, and floors forming the building envelope must:

- Display and label all assembly components.
- Illustrate how layered insulation combines to meet the minimum required R-value.
- Perform separate calculations for cavity and continuous insulation.
- For additional documents supporting fenestration compliance, refer to the fenestration section.

NOTE:

- *Table C402.1.3 assumes a "default" wall assembly used in developing the prescriptive R-value requirements for Table C402.1.3.*
- *Values are based on a default framing condition of 16 inches (406 mm) on center, and any greater spacing of framing is permissible.*
- *Where insulated siding is used, the R-value of the insulated siding must be reduced by subtracting R-0.6 from the manufacturer's labeled R-value. This reduction is required because the R-values for insulation required for wood frame walls in Table R402.1.3 are based on the presence of an assumed noninsulating siding with a nominal R-value of 0.6.*



CEILING DETAIL

Figure BE-6.
Wall Section and R-value Calculation

INSULATION R-VALUE CALCULATION

INSULATION	CONTINUOUS	CAVITY
RIGID FOAM PLASTIC INSULATING SHEATHING R-15 (LAYER 1)	R-15	
RIGID FOAM PLASTIC INSULATING SHEATHING R-15 (LAYER 2)	R-15	
CAVITY INSULATION R-49		R-10
TOTAL	R-30	R-10

CODE REQUIREMENT (TABLE R402.1.3): R-49 CAVITY INSULATION **OR** R-30 CONTINOUS INSULATION. **COMPLIES**

BUILDING ENVELOPE ASSEMBLIES -ENVELOPE TRADEOFFS

R402.1.5
C402.1.4
5.6

ECC Component Performance Method (Commercial and Residential)

- Allows **trade-offs between envelope assemblies** such as walls, roofs, floors, slabs, and fenestration.
- Compliance is achieved when the **total thermal conductance of the proposed envelope is less than or equal to the reference envelope permitted by code**.

Proposed envelope heat transfer ≤ Code reference envelope heat transfer

- The calculation includes:
  - **U-factor × Area** of opaque assemblies
  - **F-factor × slab perimeter**
  - **C-factor × below-grade walls**
  - **Thermal bridge effects (ψ and χ factors)** where applicable
- Fenestration may be subject to prescriptive limits

ASHRAE 90.1 Envelope Trade-Off Method

- Envelope Performance Factor (EPF) method
- The proposed design must perform **equal to or better than the base design**

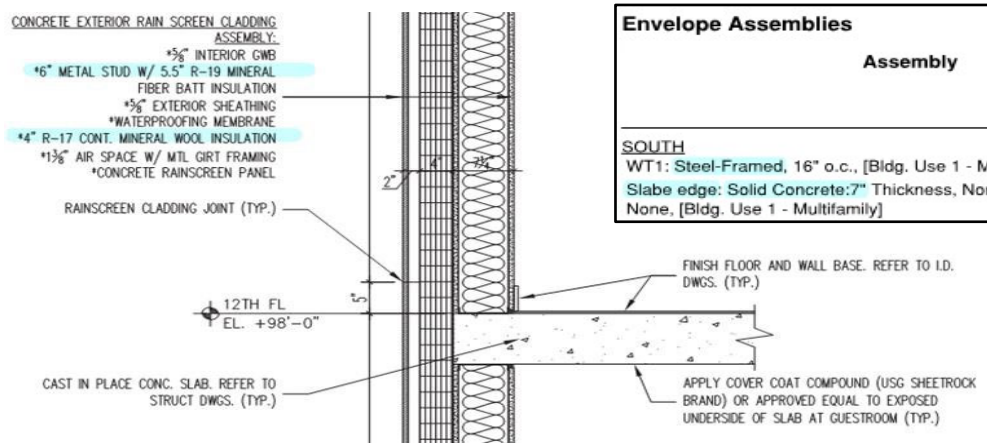
Proposed ≥ Base performance

Demonstrating compliance

Provide either:

- **Envelope trade-off calculation**, or
- A compliance report generated using:
  - **COMcheck** *(commercial buildings)*
  - **REScheck** *(residential buildings)*

These tools **automatically perform the required envelope trade-off calculations** and generate documentation for submission.



Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
SOUTH					
WT1: Steel-Framed, 16" o.c., [Bldg. Use 1 - Multifamily]	5360	19.0	17.0	0.038	0.061
Slabe edge: Solid Concrete:7" Thickness, Normal Density, Furring: None, [Bldg. Use 1 - Multifamily]	378	---	17.0	0.053	0.086

Figure BE-7.
Sample Slab Edge Detail &
Matching Envelope COMcheck Report

WINDOWS & DOORS – FENESTRATION IN THE ENVELOPE

U-factor and SHGC values

R402.4
C402.5
5.5.4.3
5.5.4
1 RCNY §5000-01 (g)(1)(i)
R402.4
C402.6.3/ 5.8.3.2

- For each fenestration type (e.g., fixed/operable window, skylight, exterior door, storefront, etc.), Assembly 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. For Commercial building windows, the maximum assembly U-factors depend on the vertical location of the window on the above-grade wall, with more stringent U-factors for windows installed below 95' above-grade. See page [BE-3]. The 95' demarcation line must be indicated on building elevation drawings for Commercial buildings.

R303.1.3
C303.1.3/ C402.5 / 5.5.4.6

- Next to the U-factor and SHGC values specified in the schedule, provide the fenestration assembly manufacturer's information (e.g., '*ABC Windows/xyz 9000 series, or Approved equal*') that will satisfy the U-factor and SHGC requirements. U-factors shall be determined by a third-party accredited, independent laboratory, recognized by ANSI, ILAC MRA and labeled and certified by the manufacturer.

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.
- 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.

WINDOW & DOOR SCHEDULE								
TAG	TYPE	FRAME MATERIAL	NOMINAL DIM. (W X H)	MANUFACTURER - MODEL NO.	ASSEMBLY U-FACTOR	SHGC	VT	AIR LEAKAGE RATE (CFM/SF)
W1	FIXED	METAL	7'-0" X 7'-0"	ABC WINDOWS - D999 SERIES OR APPROVED EQUAL	0.28	0.34	0.50	0.16
W2	CASEMENT - OPERABLE	METAL	4'-6" X 2'-3"	ABC WINDOWS -EF00 SERIES OR APPROVED EQUAL	0.38	0.34	0.50	0.18
SW1	SKYLIGHT	METAL	2'-10" X 5'-2"	SKL CORP. - GHT000 SERIES OR APPROVED EQUAL	0.46	0.38	0.54	0.18
W5	STOREFRONT - FIXED GLAZING	METAL	VARIES; SEE A-301 ~305 FOR LOCATIONS & DIM.	GLD CO. - STR #Z111 OR APPROVED EQUAL	0.30	0.34	0.50	0.05
D1	STOREFRONT - ENTRANCE GLASS DOOR	METAL	3'-0" X 7'-6"	GLD CO. - STR #Z111 OR APPROVED EQUAL	0.70	0.36	0.52	0.80
D2	OPAQUE SWINGING DOOR	METAL	3'-0" X 7'-0"	OPQ COMPANY RST-#22-33 OR APPROVED EQUAL	0.48	N/A	N/A	0.80

Figure BE-8. Sample Window & Door 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.*

SPANDREL PANEL EFFECTIVE U-FACTORS

C303.1.5
5.5.3

TABLE C303.1.5
DEFAULT EFFECTIVE U-FACTORS FOR SPANDREL PANELS[a]

RATED *R*-VALUE OF INSULATION BETWEEN FRAMING MEMBERS		None	R-4	R-7	R-10	R-15	R-20	R-25	R-30
Frame Type	Spandrel Panel	Default *U*-factor							
Aluminum without thermal break[b]	Single glass pane, stone, or metal panel	U-0.445	U-0.285	U-0.259	U-0.247	U-0.236	U-0.230	U-0.226	U-0.224
	Double glazing with no low-e coatings	U-0.356	U-0.273	U-0.254	U-0.244	U-0.234	U-0.229	U-0.226	U-0.223
	Triple glazing or double glazing with low-e glass	U-0.313	U-0.263	U-0.249	U-0.241	U-0.233	U-0.228	U-0.225	U-0.223
Aluminum with thermal break[c]	Single glass pane, stone, or metal panel	U-0.429	U-0.243	U-0.212	U-0.197	U-0.184	U-0.176	U-0.172	U-0.169
	Double glazing with no low-e coatings	U-0.328	U-0.228	U-0.205	U-0.193	U-0.182	U-0.175	U-0.171	U-0.168
	Triple glazing or double glazing with low-e glass	U-0.277	U-0.217	U-0.199	U-0.189	U-0.180	U-0.174	U-0.170	U-0.167
Structural glazing[d]	Single glass pane, stone, or metal panel	U-0.428	U-0.217	U-0.180	U-0.161	U-0.145	U-0.136	U-0.130	U-0.126
	Double glazing with no low-e coatings	U-0.316	U-0.199	U-0.172	U-0.157	U-0.143	U-0.135	U-0.129	U-0.126
	Triple glazing or double glazing with low-e glass	U-0.257	U-0.186	U-0.165	U-0.152	U-0.140	U-0.133	U-0.128	U-0.125
No framing or insulation is continuous[e]	Single glass pane, stone, or metal panel	U-0.445	U-0.160	U-0.108	U-0.082	U-0.058	U-0.045	U-0.037	U-0.031
	Double glazing with no low-e coatings	U-0.356	U-0.147	U-0.102	U-0.078	U-0.056	U-0.044	U-0.036	U-0.030
	Triple glazing or double glazing with low-e glass	U-0.313	U-0.139	U-0.098	U-0.076	U-0.055	U-0.043	U-0.035	U-0.030

a. Extrapolation outside of the table and interpolation between values in the table shall not be permitted. Assemblies with distance between framing less than 30 inches (762 mm), or not included in the default table, shall have a *U*-factor determined by testing in compliance with ASTM C1363 or modeling in compliance with ANSI/NFRC 100. Spandrel panel assemblies in the table do not include metal backpans. For designs with metal backpans, multiply the *U*-factor by 1.20. U-factors for spandrel panels include a 3/4 in. air gap and 5/8 in. gypsum board with R-value of 0.56 for the interior finish. The gypsum board is assumed to span between the window sill and a channel at the floor.
b. This frame type shall be used for systems that do not contain a non-metallic element that separates the metal exposed to the exterior from the metal that is exposed to the interior condition.
c. This frame type shall be used for systems where a urethane or other non-metallic element separates the metal exposed to the exterior from the metal that is exposed to the interior condition.
d. This frame type shall be used for systems that have no exposed mullion on the exterior.
e. This frame type shall be used for systems where there is no framing, or the insulation is continuous across and uninterrupted by the framing (also known as mullion wrap).

- *NOTE 1: To demonstrate compliance, provide COMcheck envelope analysis by:*

  - entering the Proposed Spandrel panel U-factor value identified from the Table C303.1.5; and

  - choosing the Baseline U-factor of metal-framed walls (U-0.061).

- *NOTE 2: If the Proposed Spandrel panel type is not found in the Table – e.g., Assembly with backpans, Assembly with no insulation – THERM Analysis must be performed and documented on drawings.*

  Info for THERM is found in the link below.
  https://windows.lbl.gov/software/therm

COMMERCIAL BUILDING FENESTRATION MAXIMUM U-FACTORS

C402.5
5.5.4.3

TABLE C402.5
BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS[c]

CLIMATE ZONE	4		5	6
	Vertical fenestration			
	U-factor[a]			
	Below 95'[d]	Above 95'[d]		
Metal framing, Fixed fenestration	U-0.30	U-0.34	U-0.34	U-0.34
Metal framing, Operable fenestration	U-0.40	U-0.42	U-0.43	U-0.41
Nonmetal framing, all fenestration	U-0.28	U-0.28	U-0.27	U-0.27
Entrance doors	U-0.63		U-0.63	U-0.63
SHGC[b]				
PF < 0.2	0.33		0.33	0.34
0.2 ≤ PF < 0.5	0.40		0.40	0.41
PF ≥ 0.5	0.53		0.53	0.54
Skylights				
U-factor	U-0.48		U-0.48	U-0.48
SHGC[b]	0.38		0.38	0.38

a. U-factor shall be rated in accordance with NFRC 100. U-factor shall reflect project-specific sizes, and include framing components plus glazing. SHGC shall be rated in accordance with NRFC 200.
b. SHGC shall reflect project-specific sizes, and include framing components plus glazing. SHGC of the center-of-glass shall be an acceptable alternative for determining compliance with the SHGC requirements for the overall fenestration area.
c. Fixed fenestration shall include glazed curtain walls, pre-fabricated storefronts and factory assembled fixed window units.
d. Where a portion of the fenestration frame is installed at or above 95 feet above grade, the unit may meet the requirements for 95 feet and above.

- *NOTE: Where any portion of the window unit is installed above 95' above-grade, U-factor requirement of 95' and above may apply.*

FENESTRATION AREA

The *Window-to-Wall Ratio (WWR)* -- the ratio (%) of vertical fenestration area to gross above-grade wall area (or gross wall area for 2025 NYC ASHRAE 90.1 applications) -- must be noted on an EN- labeled drawing in conjunction with building envelope diagrams and the envelope energy analysis. The building envelope diagrams must list all opaque wall areas and vertical fenestration areas per each building orientation. The area values of each opaque wall type and fenestration type listed in the envelope diagrams must match the values entered in the envelope energy analysis (e.g., 'Gross Area' values in COMcheck).

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

C402.5.1

- *Maximum WWR*: 30%
- *Maximum WWR*: 40% *permitted with certain requirements including daylight responsive controls*
- *When WWR* > 40%: ASHRAE must be chosen as Code Compliance Path, as ECC does not allow WWR > 40%.

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

- *Maximum WWR*: 40%
- *When WWR* > 40%: Energy Code compliance may be demonstrated through either
  a) COMcheck (with envelope tradeoff) envelope analysis, or
  b) Energy Modeling (total building performance) energy analysis.

NOTE:

ASHRAE allows an exception for ground-level street-facing fenestration that has: *5.5.4.2.1 5.6*

- *Height limit: 20 ft.*
- *Overhang : PF > 0.5.*
- *Fenestration area < 75% of wall area.*

Separate calculations needed, no averaging for compliance. No credit for underutilization.

▪ Maximum Skylight Fenestration Area

C402.5.1 5.5.4.2.2

- *Maximum* skylight fenestration area: 3% of the gross roof area
- *Maximum* skylight fenestration area: 6% of the gross roof area *permitted with daylight responsive controls*

▪ Minimum Skylight Fenestration Area

C402.5.2 5.5.4.2.3

- For an enclosed space ▯ ≥ 2,500 sf, and directly under a roof with ceiling height > 15' and
  - of space types including office, lobby, atrium, concourse, corridor, warehouse storage, among others

Minimum skylight fenestration *area requirement*: *Minimum 3%* of the gross roof area, *or*
Minimum 1% 'Skylight Effective Aperture'

- See Section C402.5.2 and 5.5.4.2.3 for complete applicable space types, minimum total daylight area requirement, and definition of 'Skylight Effective Aperture.'

AIR BARRIER

- **Continuous Air Barrier (Drawings must show):**
  - Air barrier components and location within the building thermal envelope
  - A continuous air barrier plane across all assemblies
  - Boundaries between:
    - Conditioned and unconditioned space

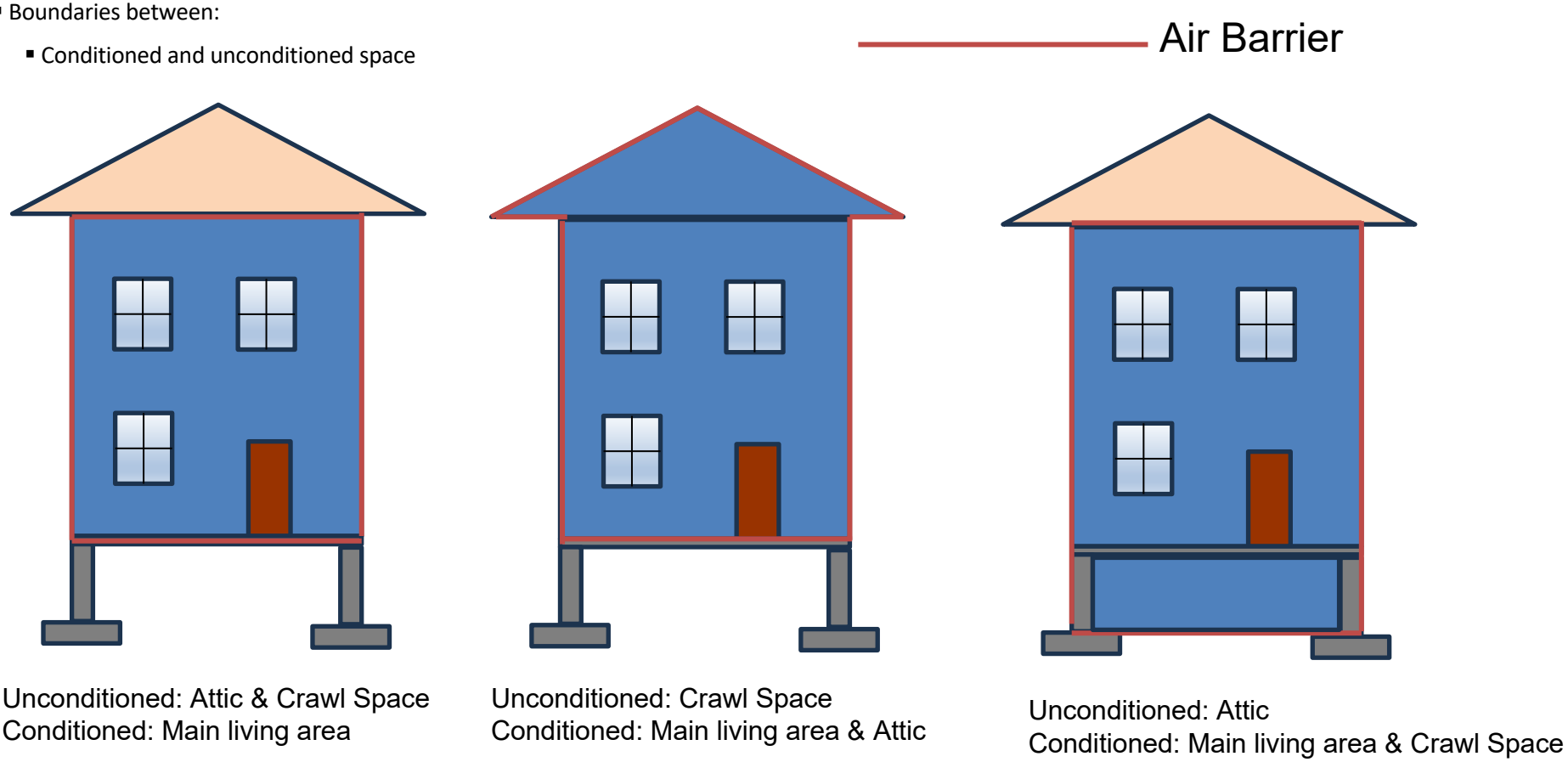


Figure BE-12. Air Barrier around building

AIR BARRIER

- **Drawings must clearly identify:**
  - Location of the air barrier within each assembly
  - A continuous air barrier plane across:
    - Walls
    - Roofs
    - Floors
- **Continuity must be demonstrated at:**
  - Wall-to-roof (including parapets and copings)
  - Wall-to-floor and foundation
  - Corners and transitions between assemblies
  - Fenestration and door interfaces
  - Penetrations (MEP, Structural, attachments)
- **Typical representation methods:**
  - Wall-to-roof (including parapets and copings)
  - Continuous line (often highlighted in details)
  - Notes identifying air barrier materials
  - Keyed details showing transitions and sealing methods

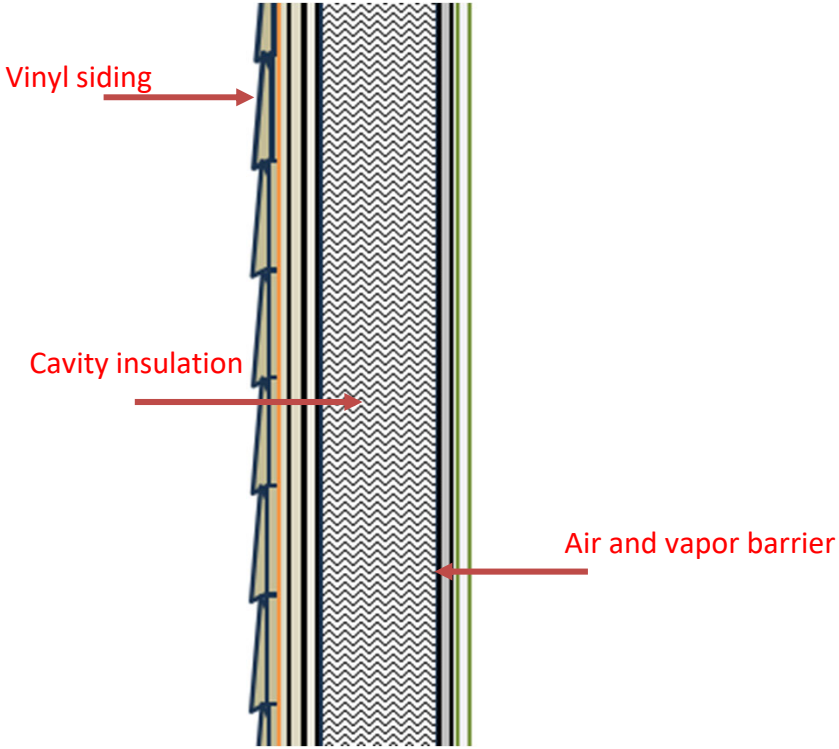


Figure BE-13. Air Barrier- Wall Section

AIR BARRIER

Openings in the Building Envelope

Drawings must identify specific construction measures, configuration, devices and/or performance standards to limit air leakage in particular envelope areas including, but not limited to, the following: *C402.6/5.4.3*

1) Fenestration and doors: Maximum allowed air leakage. *C402.6.3/5.8.3.2*
2) Outdoor air intakes and exhaust openings: Motorized Shutoff dampers are required unless gravity dampers are allowed. *C402.6.5/6.4.3.4*
3) Doors/Access Openings to shafts, chutes, vents, stairways and elevator lobbies: Gasketing, weatherstripping, and sealing. *C402.6.4/5.4.3.2*
4) Loading dock: Weatherseals to restrict infiltration. *C402.6.7/5.4.3.3*
5) Vestibules*: Plan configuration and self-closing devices on doors. *C402.6.6/5.4.3.4*
6) Recessed lighting: Luminaires installed in building envelope must be: *C402.6.1.2.1/5.4.3.1.1*
   a) IC-rated,
   b) Labeled with the Code-prescribed maximum air leakage rate, *and*
   c) Sealed with gasket or caulk.

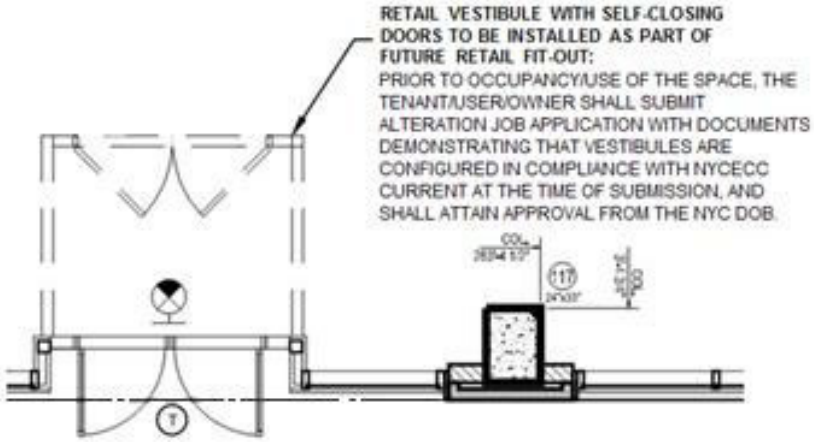


Figure BE-14.-1
A Sample Acceptable Plan with Specific Notes Requiring Future Compliance

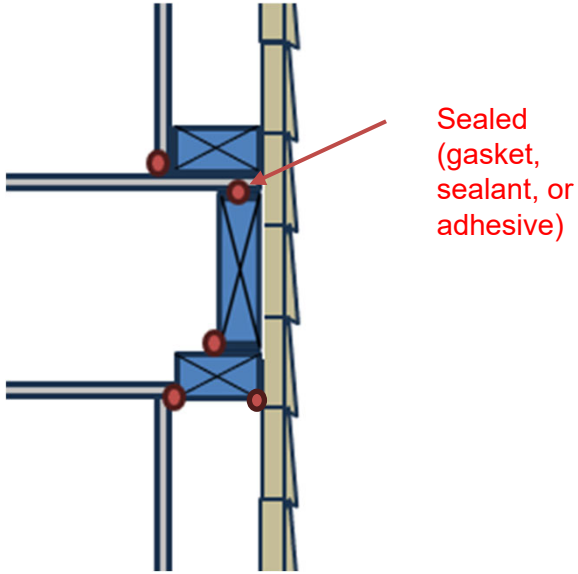


Figure BE-14.-2
Wall section illustrating key air barrier transition points requiring continuous sealing (e.g., gasket, sealant, or adhesive) to maintain air barrier continuity.

AIR BARRIER

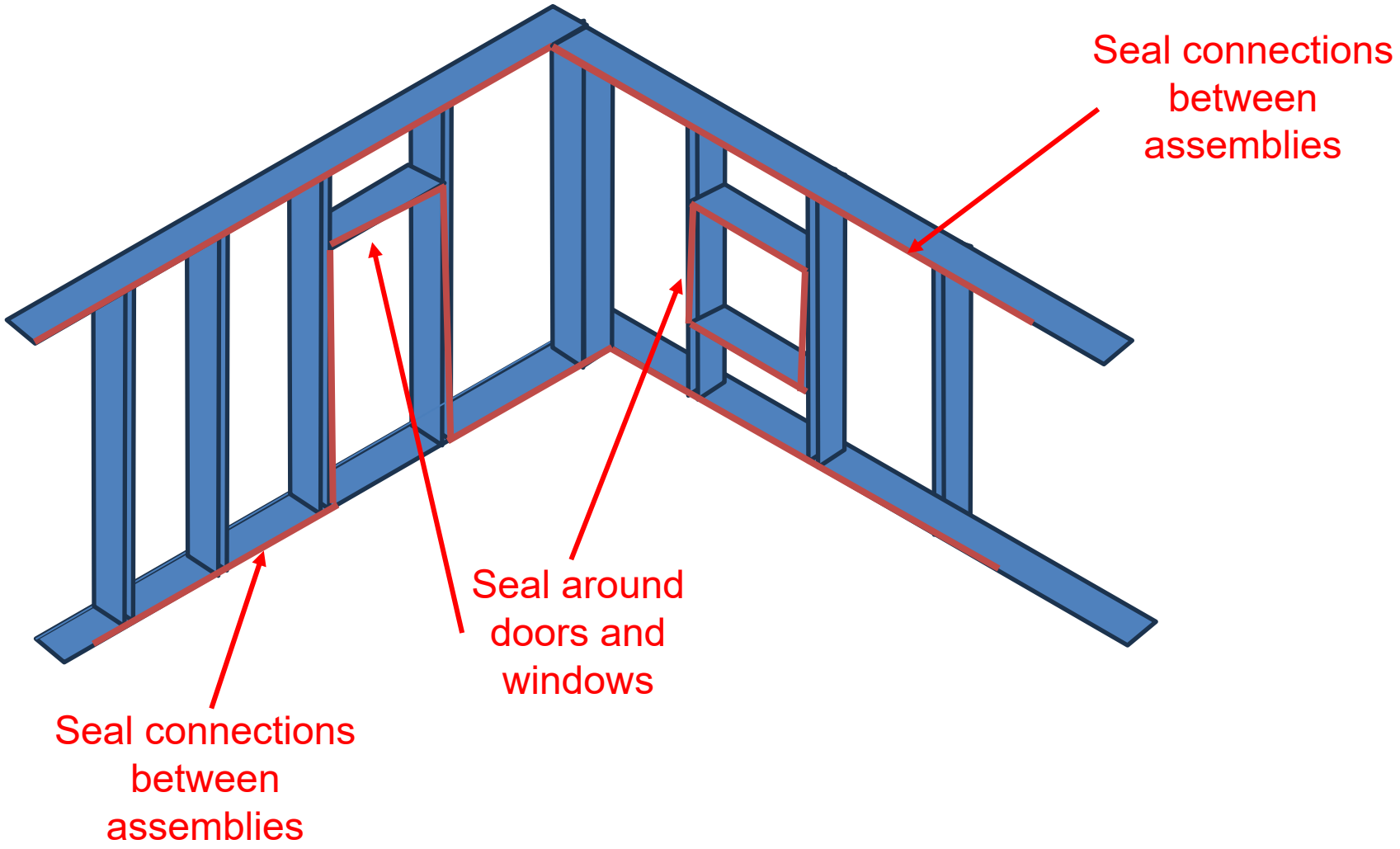


Figure BE-15.
Where sealants (represented by the red lines) should be applied to all assemblies

AIR LEAKAGE TESTING

General Requirements

C402.6.2/5.4.3
R402.5.1.2/R402.5.1.3/
R402.5.1.4

All buildings must undergo air leakage testing by an approved third party.

- **Maximum Air Leakage limits:**
  - Commercial: 0.35 cfm/ft² at 75 Pa (0.3 in. w.g.)
  - Residential: 3.0 ACH at 50 Pa
- **Testing Protocol:**
  - Third party testing required
  - ASTM E779, ASTM E1827, ASTM E3158, or an approved equivalent method.
  - Pressurization and depressurization
  - Multi-point regression method.
- **Required Documentation**
  - Envelope test area
  - Building volume
  - Number of stories
  - Measured leakage rate

Large Buildings (> 50,000 ft²)

👉 **Testing is still required — no exemption**
Guarded testing (ASTM E3158) is permitted as an alternative method

- Must include critical areas:
  - Roofs
  - Entrances / loading docks
  - Floors over unconditioned space
- ≥25% of above-grade wall area tested
- Area-weighted average must comply with whole-building limit

EQUIPMENT PENETRATIONS IN BUILDING ENVELOPE

Calculation of Equipment Penetration Areas

C402.1.2.1.8
5.5.3

When mechanical equipment listed in Table C403.3.2(4) or Table 6.8.1-4 are proposed:

- 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

C402.1.2.1.8
5.6.1.1.1

- 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 or published and approved U-factor for that equipment*.
- 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	0.086
Window - WF1: Metal Frame:Fixed, >= 95' above-grade, Perf. Specs.: Product ID WF1, SHGC 0.36, >= 95' above-grade, [Bldg. Use 1 - Multifamily] (c)	78	---	---	0.350	0.360
Window - WO1: Metal Frame:Fixed, 95' above-grade, Perf. Specs.: Product ID WO1, SHGC 0.36, < 95' above-grade, [Bldg. Use 1 - Multifamily] (c)	1568	---	---	0.420	0.300
Mech PTAC Units Through-Wall: Other Mass Wall, Heat capacity 5.0, [Bldg. Use 1 - Multifamily] (b)	462	---	---	0.500	0.086

Figure BE-17.
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.

R402.1.6
C402.1.5

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.

R402.1.6
C402.1.5

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.

R402.5.2
C402.2.8

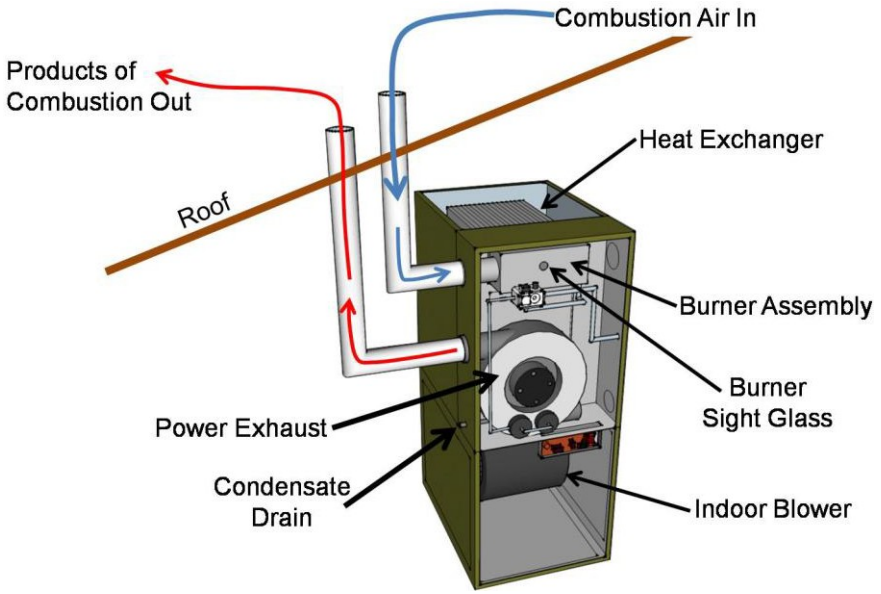


Figure BE-18. A direct-vent sealed-combustion furnace with dedicated pipes for combustion air and exhaust installed continuous to the outside
Source: basc.pnnl.gov/images

FENESTRATION ORIENTATION – ASHRAE-ONLY, PRESCRIPTIVE[1] 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).

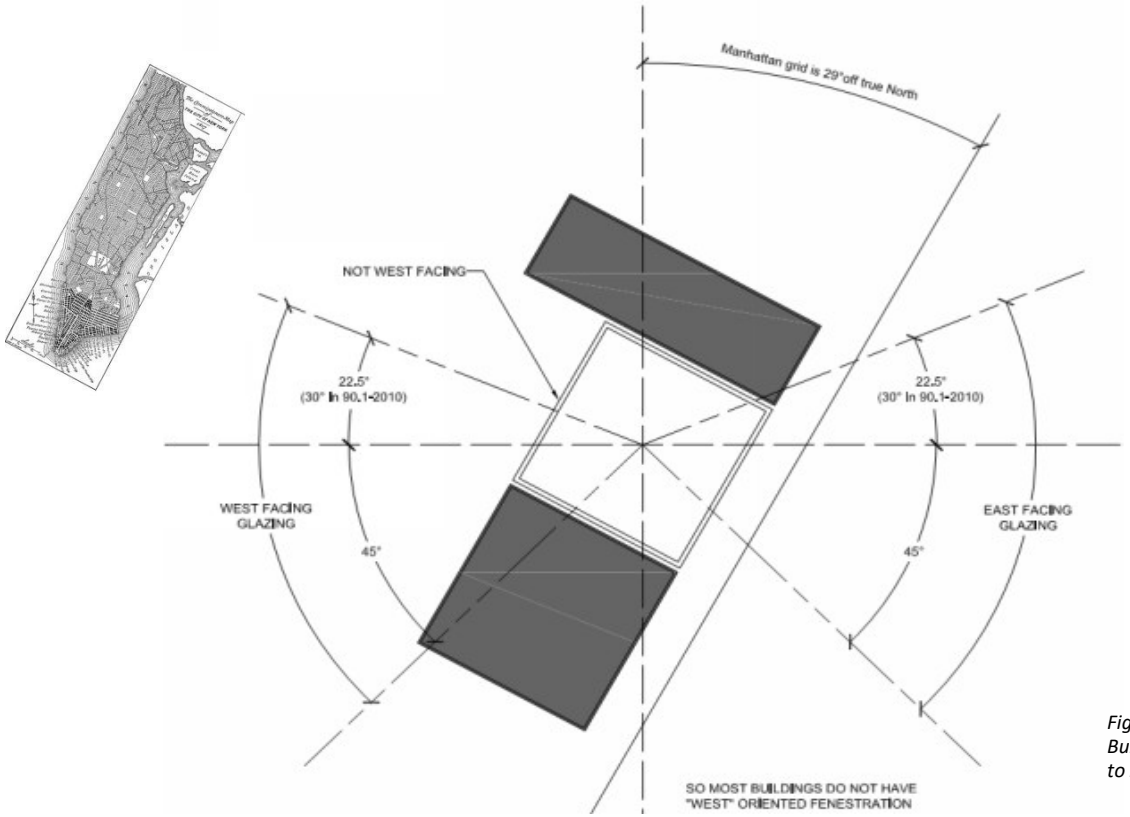


Figure BE-19.
Buildings on Manhattan's grid ± 29°off of true north are likely to have no West-oriented vertical fenestration

1. *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 slab perimeter with minimum R-10. For Heated slab floors on-grade, R-10 insulation must be provided under the full heated slab area in addition to the required slab perimeter insulation of minimum R-10. *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. *R402.5.6*

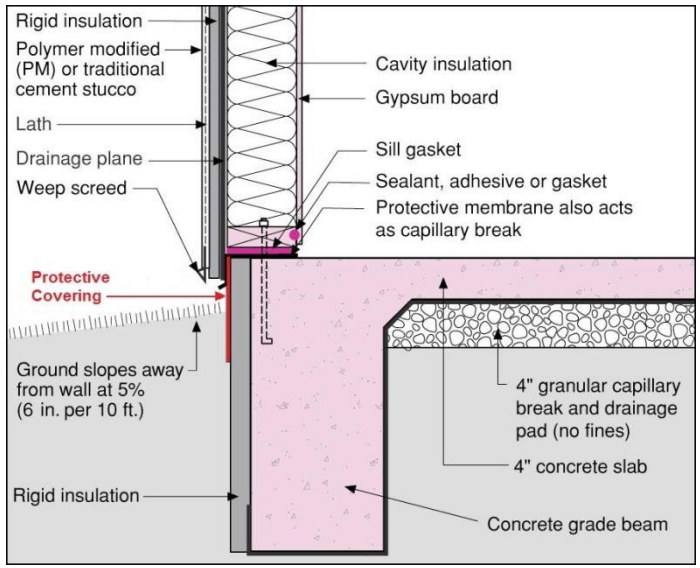


Figure BE-20.a.
Protection of Insulation Over the Grade Beam
Source: basc.pnnl.gov/images

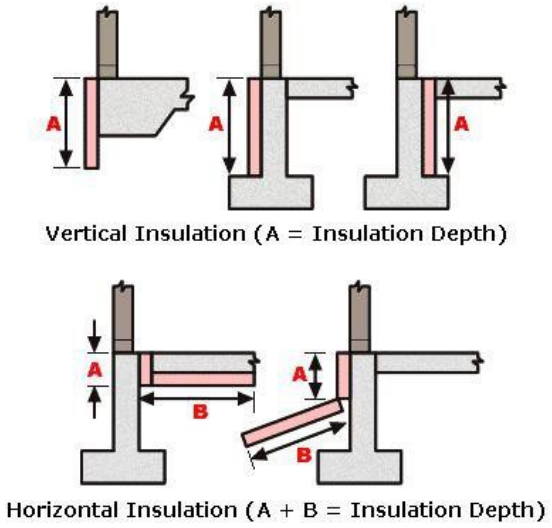


Figure BE-20.b.
Slab Insulation Methods
Source: basc.pnnl.gov/images

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). *R402.2.5*

Sunroom Insulation and Fenestration

- Sunrooms enclosing conditioned space must meet the Residential building envelope insulation and fenestration requirements. *R402.2.13*
- 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.

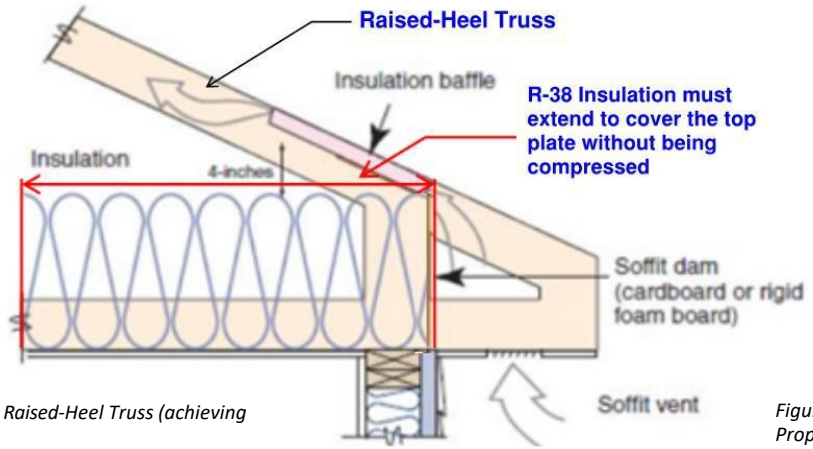


Figure BE-21-a Raised-Heel Truss (achieving Energy Truss)

Source: basc.pnnl.gov/images

Figure BE-21-b Access Hatch Properly Insulated

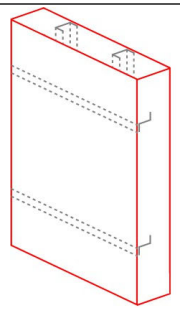
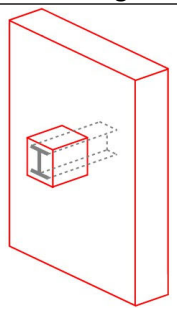
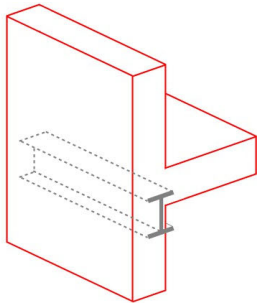
Source: basc.pnnl.gov/images

THERMAL BRIDGES IN RESIDENTIAL BUILDING ENVELOPE

▪ Documentation of Thermal Bridges

1 RCNY §5000-01
R402.7

- Architectural plan set drawings must report all thermal bridges in the building thermal envelope in *three categories* below.
- Documentation requirements apply to Residential and Commercial buildings for all New buildings, Additions, and Alterations to the building envelope work scope.

Category	CLEAR FIELD Thermal Bridge	POINT Thermal Bridge	LINEAR Thermal Bridge
Definition	Area-based thermal transmittance associated with elements of a building envelope assembly which repeat at regular intervals. Most clear field thermal bridges are taken into account in the assembly types found in 2025 NYC ASHRAE 90.1 Appendix A.	Element-based thermal transmittance associated with a discrete element that penetrates the building envelope. Point thermal transmittance is heat flow divided by the temperature difference between the interior and exterior sides of the assembly, represented by a X-value (Chi-Value) in units Btu/hr•°F.	Length-based thermal transmittance associated with horizontal, vertical, or diagonal elements within the building envelope Linear thermal transmittance is heat flow divided by length and by the temperature difference between the interior and exterior sides of the assembly, represented by a Ψ-value (Psi-Value) in units Btu/hr•ft•°F.
Typical Assemblies	Wall assembly with metal studs, or brick ties, or z-girts	A beam penetrating a wall, A column penetrating a roof or floor, An anchor or connection used to attach an element to the building	Balcony, Floor, Fenestration perimeter transition, Parapet, Floor slab edge, Shelf angle
Sample Illustration			
Documentation Requirements on Architectural Plan Set	- List of CLEAR FIELD Thermal Bridges - How they are entered in Envelope energy analysis - Reference section detail locations	- List of POINT Thermal Bridges ≥ 8 in^2 for Residential buildings, and ≥ 12 in^2 for Commercial buildings - Size and quantity of each thermal bridge type - Reference section detail locations	- List of LINEAR Thermal Bridges - Ψ-value of each thermal bridge type and its source - Total length of each thermal bridge - How they are entered in Envelope energy analysis - Reference section detail locations

[EXAMPLE] DOCUMENTATION OF THERMAL BRIDGES (REQUIRED IN ARCHITECTURAL PLANS)

CLEAR FIELD Thermal Bridges

CFTB.no	Assembly/Thermal Bridge Description	Assembly ID in Energy Analysis[1]	Section Detail Location
CFTB.1	Concrete roof deck with R-33ci	RF-1	A-502/4
CFTB.2	Concrete roof deck with R-30ci	RF-2	A-502/5
CFTB.3	CMU wall, EIFS finish	WT-1	A-501/1
CFTB.4	CMU wall, Metal panel cladding	WT-2	A-501/2
CFTB.5	Spandrel wall – Aluminum frame w. thermal break, Single pane glass, Metal panel	WT-3	A-508/4
CFTB.6	Mass floor over parking garage	FL-1	A-503/5
CFTB.7	Mass floor over unconditioned space at courtyard	FL-2	A-503/6

1. Envelope ResCheck report on EN-004

POINT Thermal Bridges

PTB.no	Assembly/Thermal Bridge Description	Size [sq. inches]	Number of Occurrence	Section Detail Location
PTB.1	Structural beam penetration on walls @ courtyard	14	6	A-502/7
PTB.2	Structural column (pilotis) penetrating 2nd floor slab/soffit @ courtyard	21	4	A-504/1
PTB.3	Main entrance canopy structural member penetration on walls	9	2	A-504/2

LINEAR Thermal Bridges

LTB.no	Type of Thermal Bridge	Ψ- Value [Btu/hr•ft•°F]	Ψ- Value Source/ Calculation	Total Length [ft]	Assembly ID in Energy Analysis[1]	Section Detail Location
LTB.1	Parapet	0.42	Default value from Table C402.6	284	n/a	A507/1
LTB.2	Balcony	0.45	Ψ- Value of better performing details per BC Hydro Building Envelope Thermal Bridging Guide v.1.2	34	WT-B	A507/7
LTB.3	Floor Slab Edge-1	0.44	Default value from Table C402.6	72	WT-SE1	A507/2
LTB.4	Floor Slab Edge-2	0.40	Ψ- Value of better performing details per BC Hydro Building Envelope Thermal Bridging Guide v.1.2	21	WT-SE2	A507/3
LTB.5	Fenestration Perimeter	0.32	Default value from Table C402.6	617	n/a	A702/1, A702/2, A702/5, A702/6
LTB.6	Shelf Angle	0.41	Default value from Table C402.6	65	n/a	A508/2, A508/3

1. Envelope ResCheck report on EN-004

Thermal Bridges in Commercial Building Envelope

Thermal Bridges Must Be Identified

Construction documents must evaluate and detail thermal bridges at key envelope intersections, including:

Structural elements

- Structural framing and members
- Cladding attachment systems

Assembly intersections

- Roof edge / parapet
- Intermediate floor to wall
- Balcony or overhang to wall
- Balcony at vertical fenestration
- Cladding support locations
- Wall to vertical fenestration

Compliance Must Be Documented

Applicants must indicate whether each thermal bridge is:

Mitigated or **Unmitigated**

and provide the corresponding **Ψ (psi)** or **χ (chi)** factors using one of the following:

- Default values from **ECC Table C402.1.4**
- Default values from **2025 NYC ASHRAE 90.1 Table A10.1**
- Calculations in accordance with **ASHRAE 90.1 Section A10**
- Approved **thermal analysis or testing**

Compliance Path Determines the Approach

1 RCNY §5000-01
C402.7
5.5.5

Component Performance / Trade-Off Path

- Identify all thermal bridges
- Provide ψ or χ factors for each bridge

Prescriptive Path

Thermal bridges must be mitigated in accordance with:

- ECC Section C402.7, or
- ASHRAE 90.1 Sections 5.5.5.1 – 5.5.5.5

Thermal Bridge Type	Total Length / Quantity	Detail Location	Mitigated	Ψ-value / χ-value
Intermediate floor slab edge	180 ft	Wall Section A-501	Yes	0.04
Balcony slab connection	24 units	Detail 3/A-602	No	0.18
Window perimeter	1,250 ft	Window Detail A-701	Yes	0.03

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

Balconies and concrete floor decks (Prescribed mitigation method ECC)

C402.7.2.1

Balconies and floor decks should not interrupt the thermal envelope; however, when they do, they need to comply with one of the following:

- Continuous insulation
- An approved thermal break device rated at least R-10
- If Above-grade wall compliance is determined through area weighted U-factor, areas where balconies or floor decks penetrate the thermal envelope should be factored into the calculation with a default U-factor of 0.8 Btu/h-°F-ft^2.

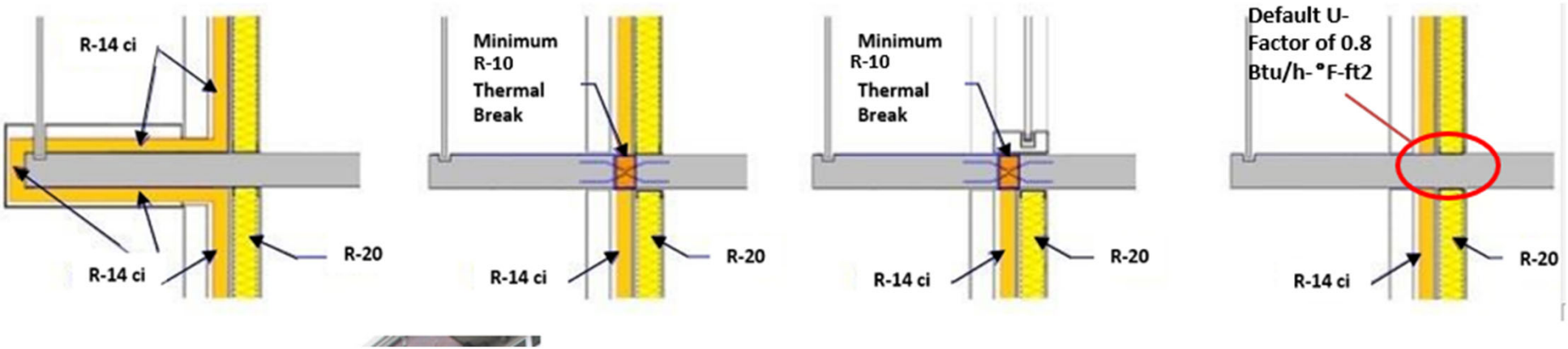


Figure BE-25
Thermal Bridge mitigation for balconies (ECC)

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

Walls & Intermediate Floor Intersections (ASHRAE)

At floor-to-exterior wall intersections, insulation must be continuous across the floor edge based on wall type and insulation location.

- Prescriptive Options (by wall type)
  - **Continuous insulation walls**
    - Exterior continuous insulation extends past the floor edge
  - **Cavity insulation walls (>50% of R-value)**
    - Insulation extends to the underside of the floor deck
    - May be interrupted by framing members
  - **Mass walls (exterior or integral insulation)**
    - Insulation extends past the floor edge, OR
    - Provide R-5 insulation at floor edge
  - **Mass walls (interior insulation)**
    - Interior insulation extends to underside of floor, AND
    - Provide additional R-5 insulation at floor edge, OR
    - Adjust wall performance per Table 5.5.5.2.1

Balconies / Floor Overhangs (ASHRAE)

- Limited to 35% of building perimeter, unless:
  - Thermally broken (≥ R-12)

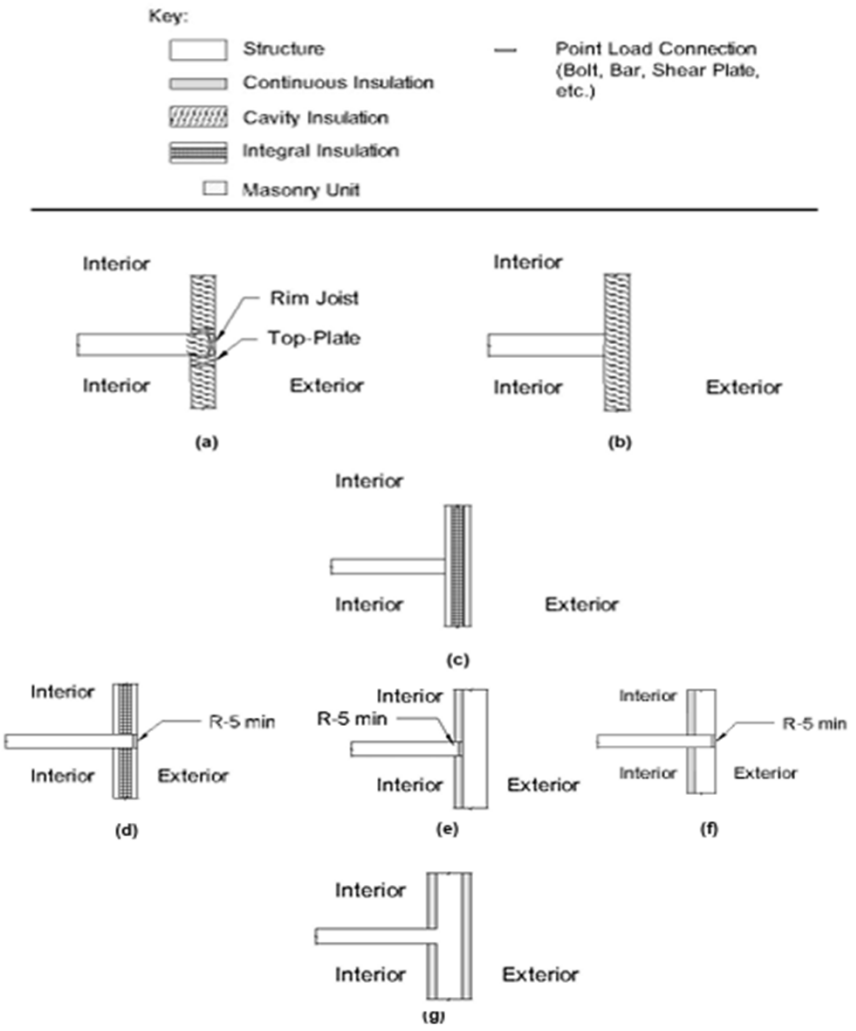
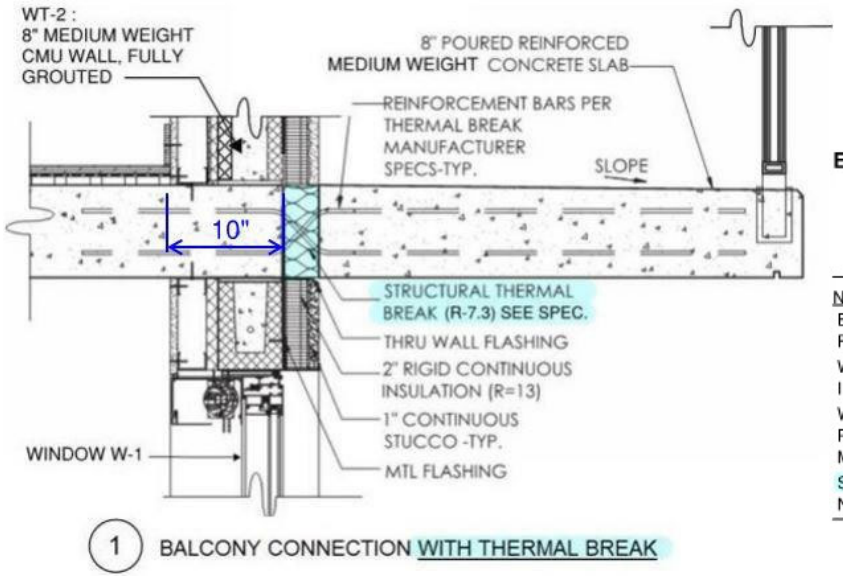


Figure K-4

a. Wall with cavity insulation (Section 5.5.5.2.1[b])
b. Wall with cavity insulation (Section 5.5.5.2.1[b])
c. Wall with integral insulation (Section 5.5.5.2.1[c])
d. *Mass wall* with integral insulation (Section 5.5.5.2.1[c])
e. *Mass wall* with interior insulation (Section 5.5.5.2.1[d][1])
f. *Mass wall* with interior insulation (Section 5.5.5.2.1[d][2])
g. *Mass wall* with exterior *continuous insulation* plus interior insulation (Section 5.5.5.2.1[e])

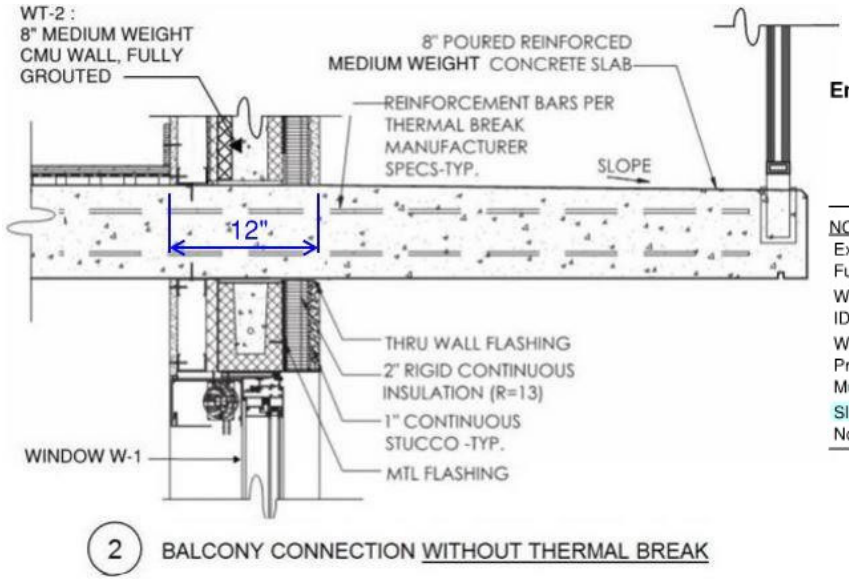
Figure BE-26
Thermal Bridge mitigation for balconies and intermediate floors (ASHRAE)
Source of image: ASHRAE 90.1 Appendix K

DOCUMENTING THERMAL BRIDGES IN BALCONY SLAB



Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
NORTH					
Exterior Wall 1: Concrete Block:8", Solid Grouted, Medium Density, Furring: None, [Bldg. Use 1 - Multifamily]	3780	---	13.0	0.066	0.086
Window 1: Metal Frame:Fixed, 95' above-grade, Perf. Specs.: Product ID WT1, SHGC 0.36, < 95' above-grade, [Bldg. Use 1 - Multifamily] (b)	580	---	---	0.380	0.300
Window 2: Metal Frame:Fixed, >= 95' above-grade, Perf. Specs.: Product ID WT2, SHGC 0.36, >= 95' above-grade, [Bldg. Use 1 - Multifamily] (b)	720	---	---	0.380	0.360
Slab edge1: Solid Concrete:10" Thickness, Medium Density, Furring: None, [Bldg. Use 1 - Multifamily]	255	---	7.3	0.103	0.086



Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
NORTH					
Exterior Wall 1: Concrete Block:8", Solid Grouted, Medium Density, Furring: None, [Bldg. Use 1 - Multifamily]	3780	---	13.0	0.066	0.086
Window 1: Metal Frame:Fixed, 95' above-grade, Perf. Specs.: Product ID WT1, SHGC 0.36, < 95' above-grade, [Bldg. Use 1 - Multifamily] (b)	580	---	---	0.380	0.300
Window 2: Metal Frame:Fixed, >= 95' above-grade, Perf. Specs.: Product ID WT2, SHGC 0.36, >= 95' above-grade, [Bldg. Use 1 - Multifamily] (b)	720	---	---	0.380	0.360
Slab edge1: Solid Concrete:12" Thickness, Medium Density, Furring: None, [Bldg. Use 1 - Multifamily]	255	---	0.0	0.450	0.086

Figure BE-27.
Sample Balcony Edge Details &
Matching Envelope COMcheck Reports

BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

C402.7.2.2

Cladding supports ECC (Prescriptive)

Cladding supports shall maintain the effectiveness of continuous insulation and minimize thermal bridging:

- Offset supports from structure (clip angles)
- Clip-and-rail systems
- Hat channels

The choice of approach depends on project-specific needs and requires coordination with the structural engineer.

Cladding supports (Prescribed mitigation method ASHRAE)

Shelf angles shall be:

- Offset from floor edge, or
- Supported using point connections

Point connection area shall not exceed:

- 1.5 in^2/ft (carbon steel)
- 2.3 in^2/ft (stainless steel)

Cladding supports penetrating continuous insulation shall:

- Use point connections, and
- Allow full depth of continuous insulation

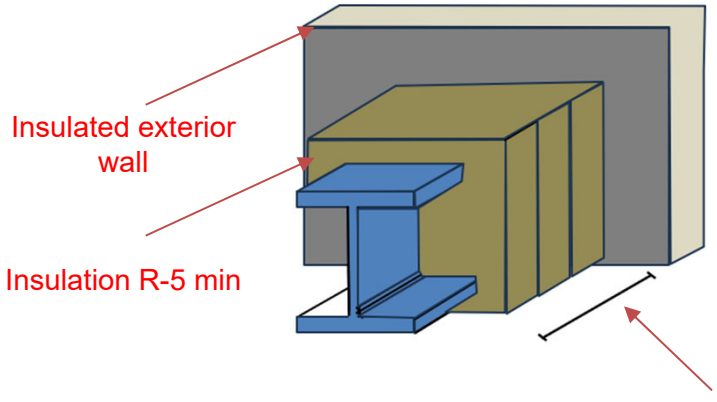
BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

▪ Structural beams and columns ECC (Prescribed)

C402.7.2.3

When structural elements penetrate the thermal envelope, they shall:

- Be insulated with minimum R-5, extending ≥ 2 ft beyond the insulation plane, OR
- Include an approved thermal break device.



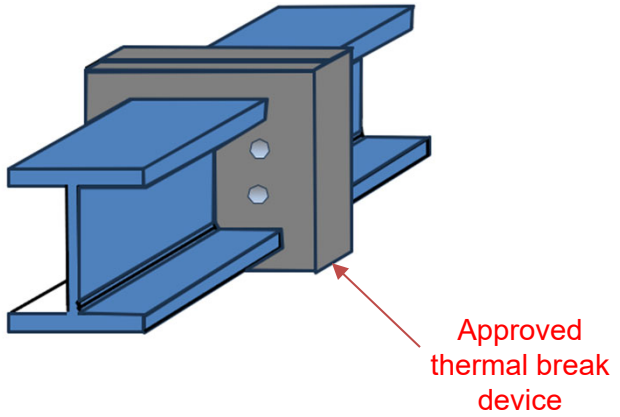


Figure BE-29
Thermal Bridge mitigation for structural beams

👉 **ASHRAE does NOT prescribe R-values for this type of thermal Bridge**

▪ Structural Beams and Columns – ASHRAE 90.1 (Prescriptive)

- Thermal bridges at structural penetrations shall be addressed through continuous insulation and assembly design
- No fixed R-value or thermal break requirement is prescribed
- Compliance is typically achieved by:
  - Maintaining continuous insulation continuity, or
  - Accounting for the thermal bridge through assembly performance (U-factor)

BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

Vertical fenestration (Prescriptive)

C402.7.2.4

At window-to-wall intersections, thermal bridging shall be mitigated by:

- Aligning glazing or thermal break within 2 in of the insulation plane
    - Insulating rough openings:
        - Minimum R-3, or
        - ≥ 1.5 in wood buck
- Spandrel systems shall be detailed to address thermal bridging (ECC)
- At fenestration–spandrel interfaces provide a thermal break (≤ 3.6 Btu·in/h·ft²·°F) (ASHRAE)

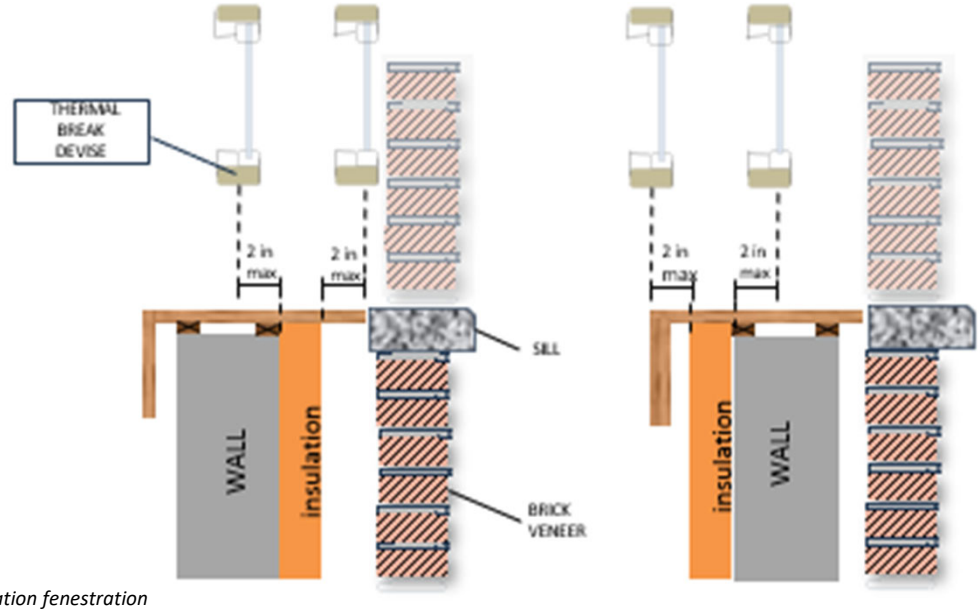


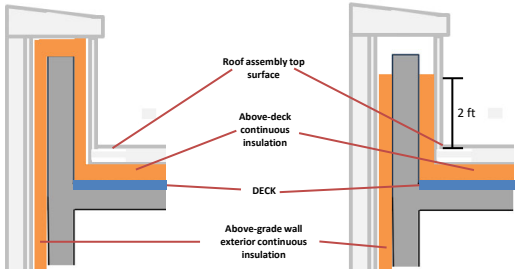
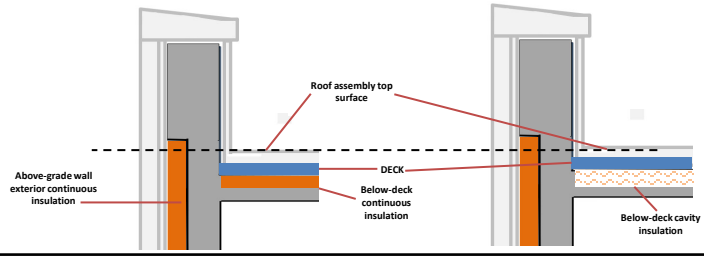
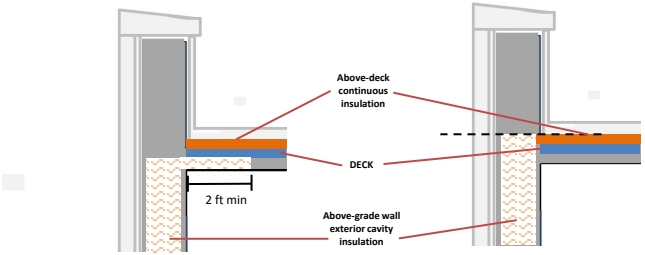
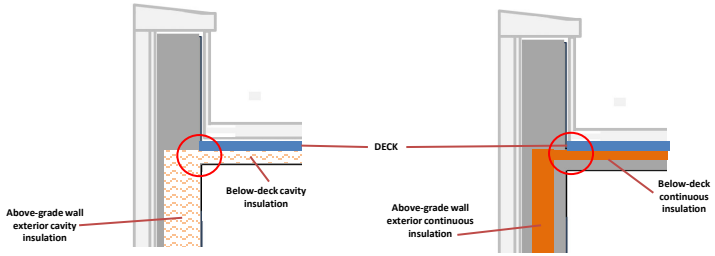
Figure BE-30
Thermal Bridge mitigation fenestration

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

- Parapets ECC (Prescriptive)

C402.7.2.5

Insulation when not using a thermal break devise.

INSULATION LOCATION/TYPE	ILLUSTRATION	REQUIREMENT
ABOVE-GRADE WALL: - EXTERIOR/CONTINUOUS ROOF: -ABOVE DECK/CONTINUOUS		CONTINUOUS INSULATION FROM BOTH WALL AND ROOF SHALL EXTEND UP THE PARAPET 2 FEET OR TO THE TOP AND AROUND THE PARAPET (WHICHEVER IS LESS)
ABOVE-GRADE WALL: - EXTERIOR/CONTINOUS ROOF: -BELOW DECK/CONTINUOUS		CONTINOUS INSULATION FROM THE WALL SHALL RUN UP THE PARAPET TO AT LEAST THE SAME LEVEL OF THE TOP SURFACE OF THE ROOF ASSEMBLY
ABOVE-GRADE WALL: - INTERIOR/CAVITY OR CONTINUOUS ROOF: -ABOVE DECK/CONTINUOUS		INSULATION FROM THE WALL SHALL RUN UP THE PARAPET TO AT LEAST THE SAME LEVEL OF THE EXTERIOR FACE OF THE ROOF INSULATION OR INSULATION WITH THE EQUIVALENT R-VALUE SHALL BE INSTALLED BELLOW THE DECK AND EXTEND NO LESS THAN 2 FT HORIZONATALLY
ABOVE-GRADE WALL: - INTERIOR/CAVITY (OR CONTINUOUS) ROOF: -BELOW DECK/CONTINUOUS OR CAVITY		INSULATION FROM BOTH THE WALL AND ROOF SHALL BE INSTALLED SO THAT THEY ARE ADJACENT TO EACH OTHER IN THE ROOF-CEILING-WALL INTERSECTION

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

Parapets ASHRAE (Prescriptive)

- Continuous insulation shall:
  - Extend across both sides of parapet, OR
- Where wall insulation >50% of total R-value:
  - Provide one of the following:
    - Extend insulation within parapet cavity
    - Extend insulation to underside of roof deck (≥ 2 ft)
    - Provide R-5 insulation at roof edge
- Insulation values may require adjustment per:
- Tables 5.5.5.1.1-1 and 1.2

Roof Edges Without Parapets ASHRAE (Prescriptive)

Roof insulation shall extend to:

- Exterior wall edge, OR
- Where wall insulation >50%:
  - Provide:
    - Continuous insulation across roof-wall intersection, OR
    - Insulation below roof deck (≥ 2 ft), OR
    - R-5 at roof edge

Figure BE-32
Thermal Bridge mitigation parapets (ASHRAE)
Source: ASHRAE 90.1-Appendix K

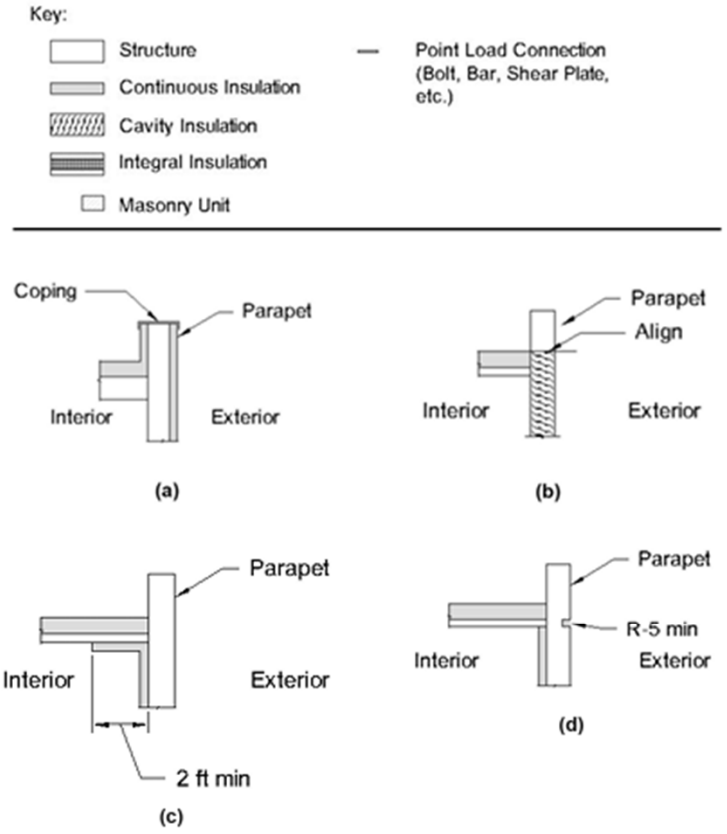


Figure K-2

a. Wall with exterior *continuous insulation* (Section 5.5.5.1.2[a])
b. Wall with cavity insulation (Section 5.5.5.1.2[b][1])
c. *Mass wall* with interior insulation (Section 5.5.5.1.2[c][1])
d. *Mass wall* with interior insulation (Section 5.5.5.1.2[c][2])

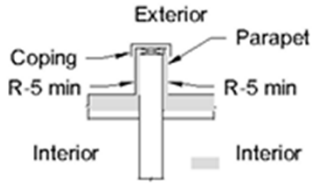


Figure K-3 Parapet within field of roof (Section 5.5.5.1.3).

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE: THERMAL BRIDGES (PRESCRIPTIVE)

Other Elements and Building Assembly Intersections (ASHRAE)

- Applies to thermal bridges not addressed in Sections 5.5.1–5.5.4
- Thermal bridges shall satisfy:

347 Btu·in./(ft²·h·°F) × 0.003% × Above-grade area of the building envelope ≥ ($k_1 \times A_1$) + ($k_2 \times A_2$) + ($k_3 \times A_3$) +

k= Thermal conductivity of material (Btu·in/hr·ft²·°F)
A= Total cross-sectional area of thermal bridges (ft²)
The right side is the sum of all point and linear thermal bridges for each material type

NOTE:
Point thermal bridges with areas below what is shown under Table 5.5.5.5 do not need to be included in the calculations

Alternative compliance - ψ and χ factors (Table A10.1)

- Calculated ψ and χ values (per Appendix A) shall be ≤ the "Default" values in Table A10.1

Table A10.1 Thermal Bridging Psi-Factors and Chi-Factors for Thermal Bridges

			Unmitigated		Default	
Class of Construction—Wall, above Grade	Thermal Bridge Type	Section	Psi-Factor, Btu/(h·ft·°F)	Chi-Factor Btu/(h·°F)	Psi-Factor, Btu/(h·ft·°F)	Chi-Factor, Btu/(h·°F)
Steel framed and *metal buildings*	*Roof* edge	5.5.5.1.1	0.450	N/A	0.140	N/A
	Parapet	5.5.5.1.2	0.289		0.151	
	Intermediate floor to *wall* intersection	5.5.5.2.1	0.487		0.177	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.487		0.177	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2.2	0.974		0.177	
	Cladding support	5.5.5.3	0.314		0.217	
	Wall to *vertical fenestration* intersection	5.5.5.4	0.262		0.112	
	Other element and assembly intersections	5.5.5.5	N/A	0.73	N/A	0.91
Mass (exterior or integral)	*Roof* edge	5.5.5.1.1	0.500	N/A	0.100	N/A
	Parapet	5.5.5.1.2	0.238		0.125	
	Intermediate floor to *wall* intersection	5.5.5.2	0.476		0.179	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.476		0.179	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2	0.974		0.177	
	Cladding support	5.5.5.3	0.270		0.186	
	Wall to *vertical fenestration* intersection	5.5.5.4	0.188		0.131	
	Other element and assembly intersections	5.5.5.5	N/A	0.91	N/A	0.19

N/A = not applicable

"Default" values in Table A10.1 represent mitigated (compliant) thermal bridge conditions

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE:

Thermal Bridges - Component Performance Alternative (ECC)

- Thermal bridges are included in the component performance calculation
- They represent additional heat loss (e.g., balconies, slab edges, penetrations)

Equation 4-1 $A_P + B_P + C_P + T_P \leq A_T + B_T + C_T + T_T + V_F - V_S$

T_p = Heat loss from thermal bridges in the proposed design
T_t = Heat loss from thermal bridges in the code reference design

Based on:

- **Linear thermal bridges (ψ × length)**
- **Point thermal bridges (χ × quantity)**

👉 Higher **T_p** = more heat loss = harder to comply

TABLE C402.1.4
PSI- and CHI-FACTORS TO DETERMINE THERMAL BRIDGES FOR THE COMPONENT PERFORMANCE METHOD

THERMAL BRIDGE PER SECTION C402.7	THERMAL BRIDGE COMPLIANT WITH SECTION C402.7		THERMAL BRIDGE NONCOMPLIANT WITH SECTION C402.7	
	Psi-Factor (Btu/h × ft × °F)	Chi-Factor (Btu/h × °F)	Psi-Factor (Btu/h × ft × °F)	Chi-Factor (Btu/h × °F)
C402.7.1 Balconies and floor decks	0.2	N/A	0.5	N/A
C402.7.2 Cladding supports	0.2	N/A	0.3	N/A
C402.7.3 Structural beams and columns	N/A	1.0 carbon steel 0.3 concrete	N/A	2.0 carbon steel 1.0 concrete
C402.7.4 Vertical fenestration	0.15	N/A	0.3	N/A
C402.7.5 Parapets	0.2	N/A	0.4	N/A

For SI: 1 W/m × K = 0.578 Btu/h × ft × °F, 1 W/K = 1.9 Btu/h × °F. N/A = Not Applicable.

Use when thermal bridge details:
- Do not comply with Section C402.7

Code reference (baseline) values (used for T_t)

Proposed design values (used for T_p)
- Use when complying with C402.7

👉 **Alternative ψ and χ values may be used for T_p when supported by approved analysis or testing.**

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE:

Thermal Bridges -Envelope Trade-off (ASHRAE)

Thermal bridges shall be included in the overall envelope heat transfer (U_t)

- U_t accounts for:
  - Linear thermal bridges (ψ × length)
  - Point thermal bridges (χ × quantity)

$$U_t = \Sigma(U_o \times A) + \Sigma(\psi \times L) + \Sigma(\chi \times n)$$

Determining ψ and χ Values

ψ and χ shall be determined per Appendix A (A10.1):

- Simulation (ISO 10211)
- Testing (ASTM C1363)
- Approved calculation method
- Table A10.1

Use when thermal bridge does NOT meet prescriptive requirements

Use when thermal bridge meets prescriptive requirements

Table A10.1 Thermal Bridging Psi-Factors and Chi-Factors for Thermal Bridges

			Unmitigated		Default	
Class of Construction—Wall, above Grade	Thermal Bridge Type	Section	Psi-Factor, Btu/(h·ft·°F)	Chi-Factor, Btu/(h·°F)	Psi-Factor, Btu/(h·ft·°F)	Chi-Factor, Btu/(h·°F)
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	Parapet	5.5.5.1.2	0.289		0.151	
	Intermediate floor to *wall* intersection	5.5.5.2.1	0.487		0.177	
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	Cladding support	5.5.5.3	0.314		0.217	
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	Other element and assembly intersections	5.5.5.5	N/A	1.73	N/A	0.91
Mass (exterior or integral)	*Roof* edge	5.5.5.1.1	0.500	N/A	0.100	N/A
	Parapet	5.5.5.1.2	0.238		0.125	
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	Wall to *vertical fenestration* intersection	5.5.5.4	0.188		0.131	
	Other element and assembly intersections	5.5.5.5	N/A	0.91	N/A	0.19

N/A = not applicable

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE:

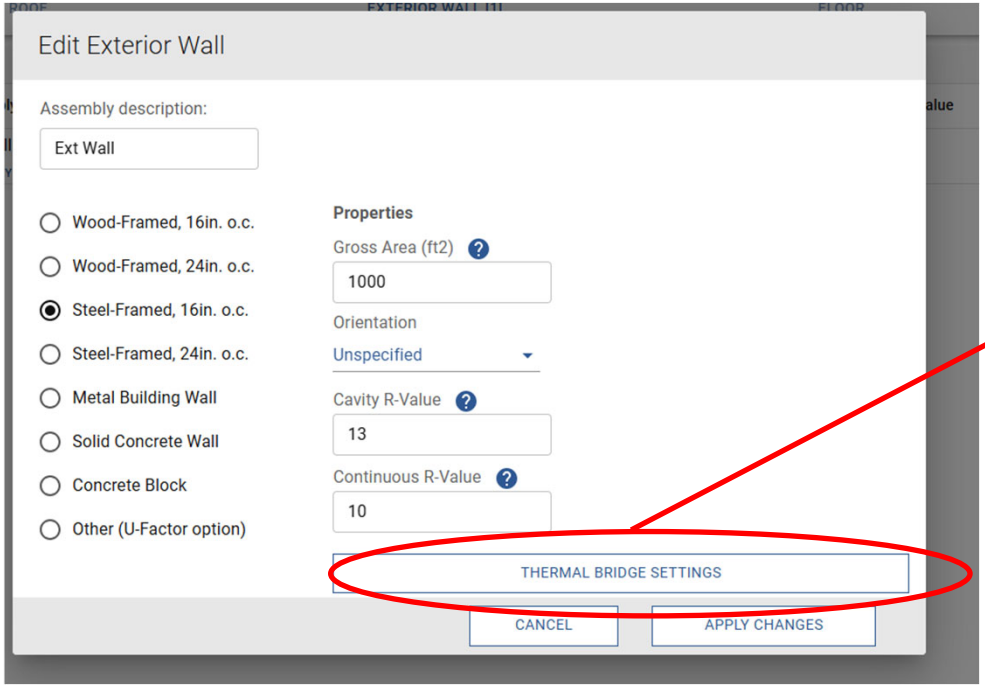
Thermal Bridges in Practice (ECC & ASHRAE)

- Thermal bridge effects are accounted for within approved compliance tools, such as COMcheck, when using performance-based methods
- These tools incorporate thermal bridge impacts using standardized assumptions and default values

What This Means for Designers

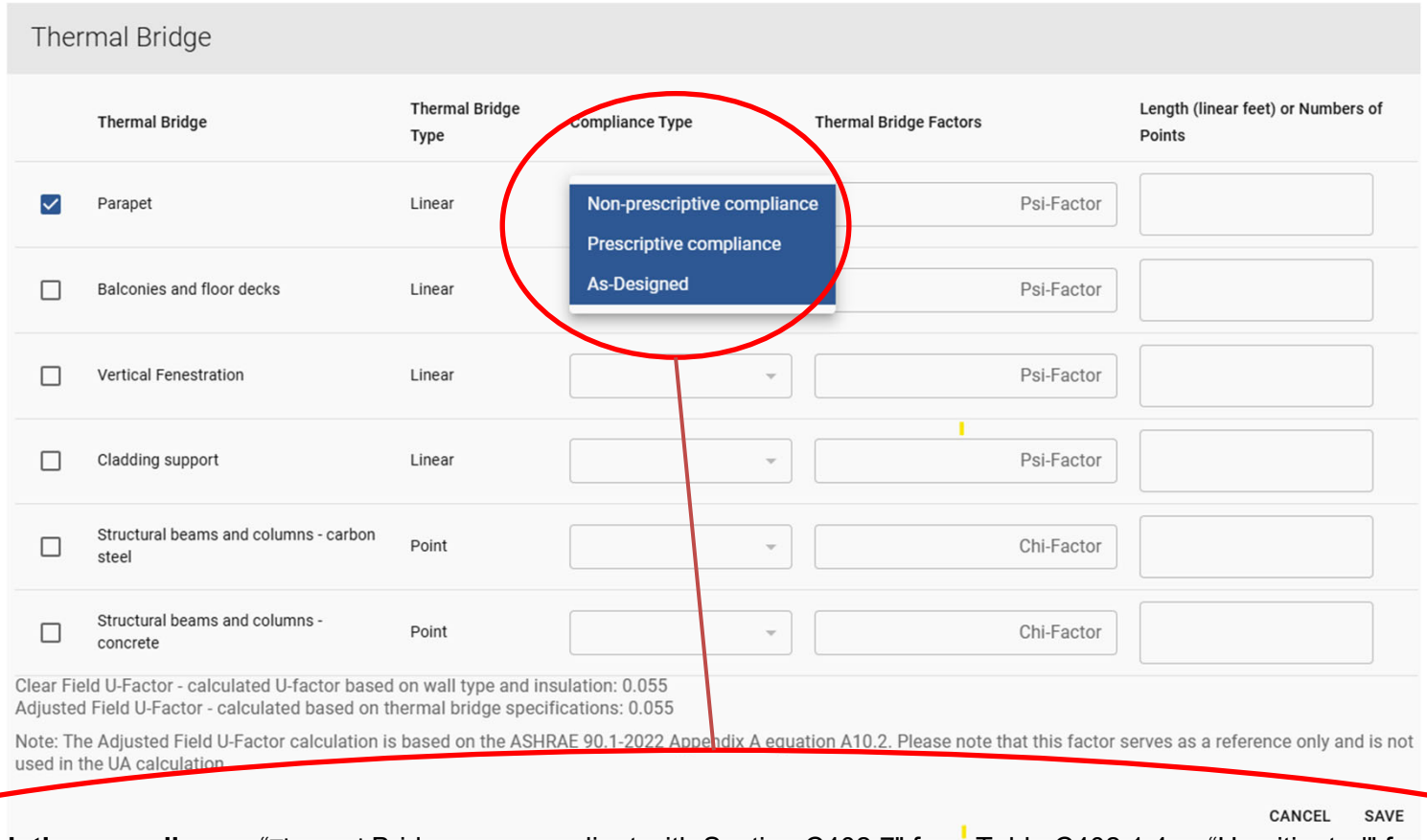
ψ and χ shall be determined per Appendix A (A10.1):

- Manual ψ and χ calculations are typically not required for standard compliance workflows
- Compliance can generally be demonstrated using approved software tools without explicitly modeling each thermal bridge
- Detailed thermal bridge analysis is typically only needed for:
  - Custom or non-standard details
  - High-performance buildings
  - Projects pursuing optimized envelope performance



When editing an exterior wall, click on “Thermal Bridge Settings” to add thermal bridge information.

COMMERCIAL BUILDING ENVELOPE – THERMAL PERFORMANCE:



Non-prescriptive compliance: "Thermal Bridge non-compliant with Section C402.7" from Table C402.1.4 or "Unmitigated" from Table A10.1
Prescriptive compliance: "Thermal Bridge compliant with Section C402.7" from Table C402.1.4 or "Default" from Table A10.1
As-Designed: Applicant inputs Psi-or Chi Factor based on testing or approved sources.

👉 Key Takeaway

For most projects, thermal bridge impacts are incorporated within compliance tools (e.g., COMcheck), and do not require separate manual calculations