# 2021 WSEC Commercial

## KEY CHANGES TO THE BUILDING ENVELOPE AND AIR BARRIER PROVISIONS

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# WSEC Commercial Technical Support

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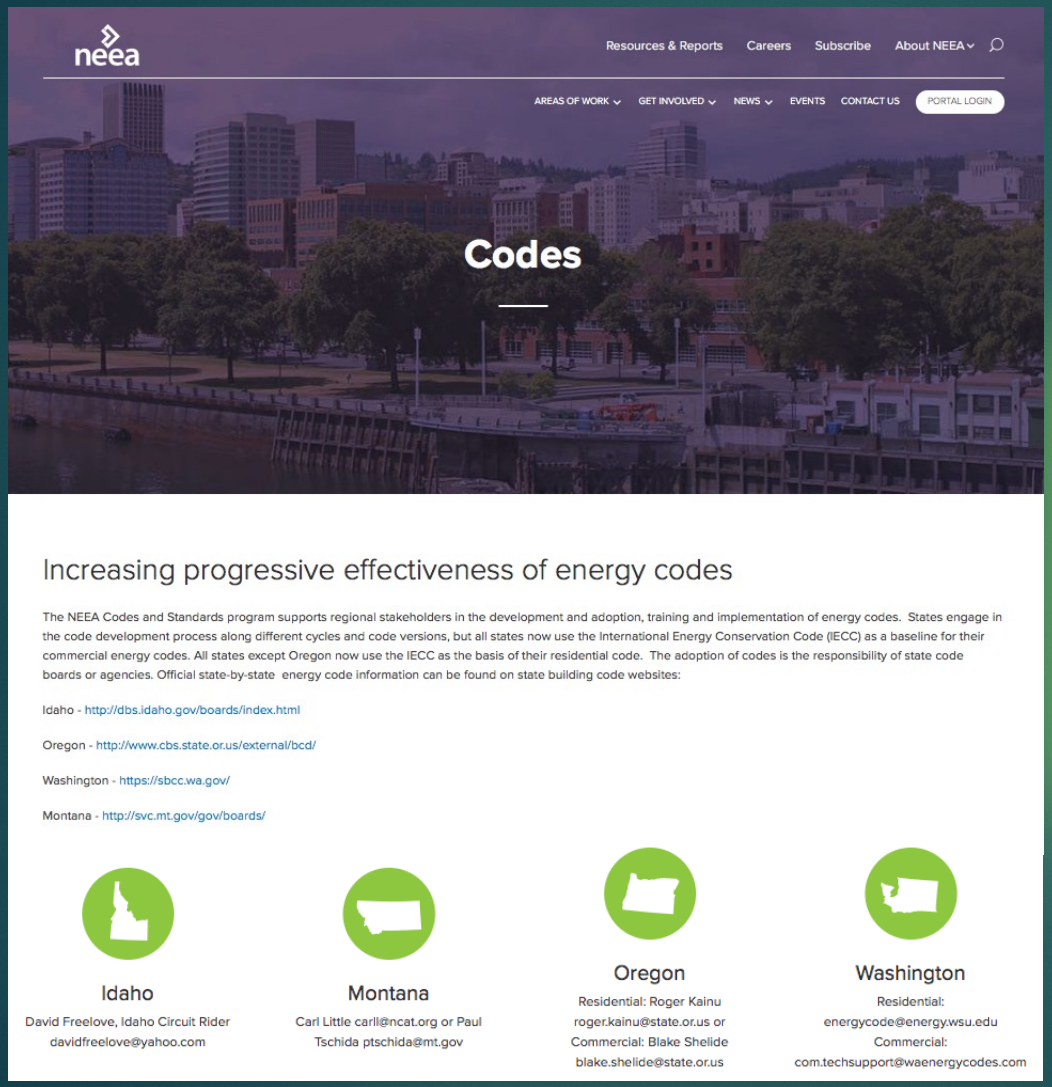


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**www.neea.org**

# Today's Presentation

- This presentation represents ETC's ***unofficial*** interpretation of code intent.
- Our technical support team is not an affiliate, nor do we speak for the Washington State Building Code Council (SBCC).
- The WSEC commercial technical support we provide is advisory only and non-binding.

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# 2021 WSEC-C topics we'll discuss today ~

1. Changes to the residential building definition
2. Roof, wall and door assembly performance updates
3. Requirements for decks, balconies & mass transfer deck slabs
4. Fenestration thermal performance updates
5. Building enclosure air leakage test procedures
6. Additional energy efficiency and load management measures
7. Thermal envelope certificate

# Group R-2 Multi-family Residential Buildings

# Residential Building Definition

**2021 WSEC-R DEFINITION**

- **RESIDENTIAL BUILDING.** *For this code, the following building types are residential buildings:*
  1. *Detached one- and two-family dwellings.*
  2. *Multiple single-family dwellings (townhouses).*
  3. *Group R-3 occupancy areas in buildings three stories or less in height above grade plane whose dwelling units are* ***accessed directly from the exterior.***
  4. *Group R-2 occupancy areas in buildings three stories or less in height above grade plane whose dwelling units are* ***accessed directly from the exterior.***
  5. *Accessory structures to residential buildings.*

**All Group R-2 buildings with dwelling units accessed from interior corridors or other interior spaces are no longer within the scope of the 2021 WSEC-R.**

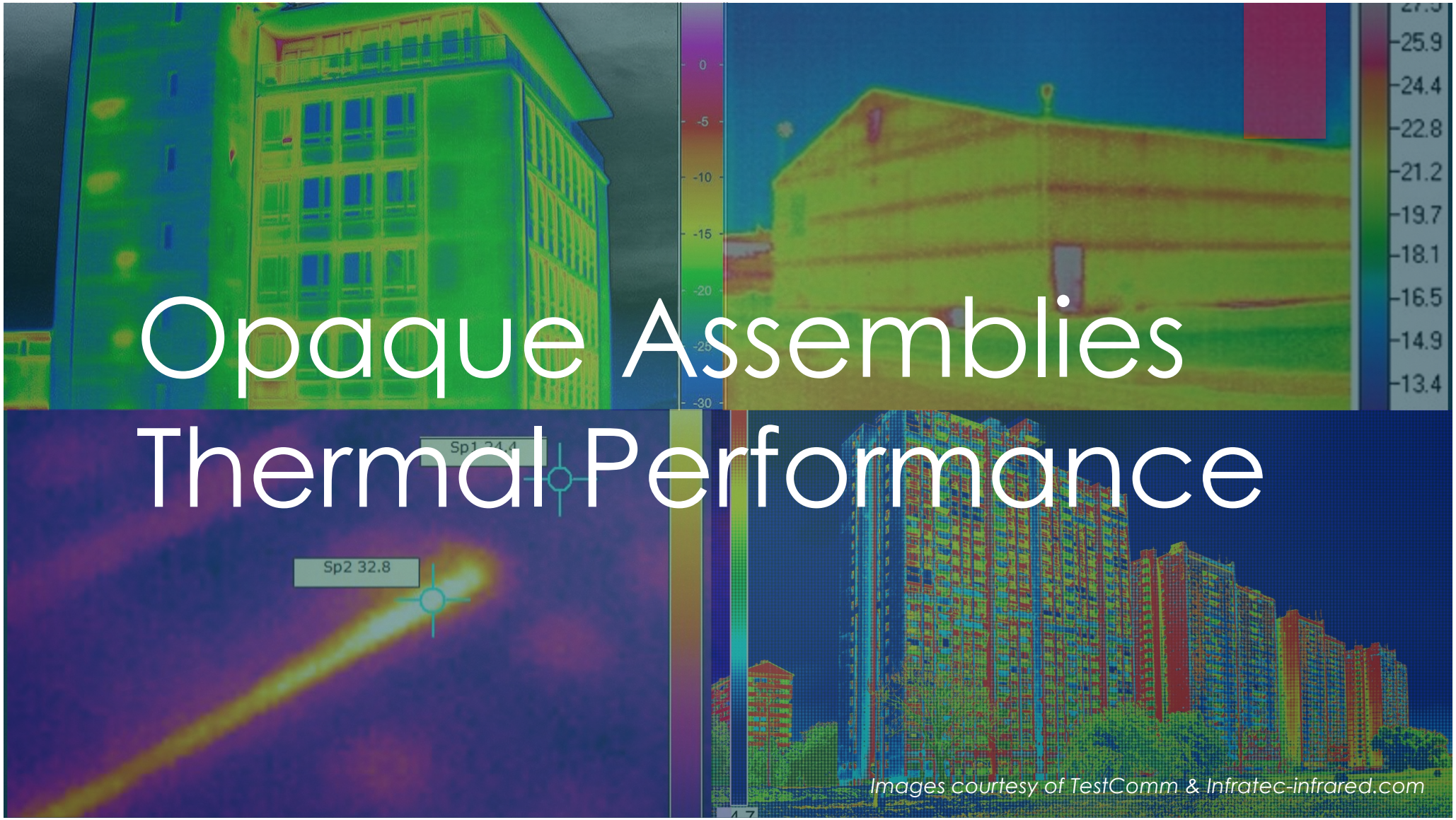
# Residential Building Definition

**Bottom Line**

All Group R-2 multi-family buildings less than 4 stories where dwelling units are accessed from interior corridors or other spaces (ie interior lobby) shall meet all applicable requirements of the WSEC-Commercial.

**Envelope related requirements include ~**

- Commercial Group R thermal envelope requirements
- Commercial building enclosure testing criteria
- U-factor requirement for mechanical equipment thru-wall penetrations
- Interlock large operable openings with HVAC controls
- Additional energy efficiency and load management measures




# Opaque Assemblies Thermal Performance

# 2021 WSEC-C – Roofs & Walls

| Table C402.1.3 - R-Value Method | | |
|---|---|---|
| **CLIMATE ZONE** | **5 AND MARINE 4** | |
| | **All Other** | **Group R** |
| **Roofs** | | |
| Insulation entirely above deck | R-38ci | R-38ci |
| Metal buildings | R-25 + ~~R-11~~ **R-22** LS | R-25 + ~~R-11~~ **R-22** LS |
| Attic and other | R-49 | R-49 |
| **Walls, Above Grade** | | |
| Mass | R-9.5ci | R-13.3ci |
| ~~Mass transfer deck slab~~ | ~~R-5~~ | ~~R-5~~ |
| Metal buildings | ~~R-19ci or R-13 + R-13ci~~ **R-13 + R-14ci** | ~~R-19ci or R-13 + R-13ci~~ **R-13 + R-14ci** |
| Steel framed | R-13 + R-10ci | R-19 + R-8.5ci |
| Wood framed and other | ~~R-21 int or R-15 + R-5ci std~~ **R-13 + R-7.5ci std or R-20 + R-3.8ci std** | R-13 + R-7.5ci std or R-20 + R-3.8ci std or R-25 std |

| Table C402.1.4 - U-Factor Method | | |
|---|---|---|
| **CLIMATE ZONE** | **5 AND MARINE 4** | |
| | **All Other** | **Group R** |
| **Roofs** | | |
| Insulation entirely above deck | U-0.027 | U-0.027 |
| Metal buildings | U-0.031 | U-0.031 |
| Attic and other | U-0.021 | U-0.021 |
| Joist or single rafter | U-0.027 | U-0.027 |
| **Walls, Above Grade** | | |
| Mass | U-0.104 | U-0.078 |
| Mass transfer deck slab | U-0.20 | U-0.20 |
| Metal buildings | ~~U-0.052~~ **U-0.050** | ~~U-0.052~~ **U-0.050** |
| Steel framed | U-0.055 | U-0.055 |
| Wood framed and other | ~~U-0.054~~ **U-0.051** | U-0.051 |

Insulation requirements for below grade walls are the same as for above grade walls

# Continuous Insulation Equivalents

## Alternate R-value Compliance Option

- Typical metal fasteners usually don't exceed the 0.04% allowance to qualify as CI
- Assemblies that may exceed CI allowance include stand-off brackets, C-channels, Z-furring, continuous metal framing members

**Table C402.1.3 (i) Continuous Insulation Equivalents**

| Column A | Column B | Column C |
|---|---|---|
| **Assemblies with continuous insulation (see definition)** | **Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%** | **Alternate option for assemblies with metal penetrations, greater than or equal to 0.08% but less than 0.12%** |
| R-9.5ci | R-11.9ci | R-13ci |
| R-11.4ci | R-14.3ci | R-15.7ci |
| R-13.3ci | R-16.6ci | R-18.3ci |
| R-15.2ci | ((~~R-19.0ci~~)) R-19ci | R-21ci |
| R-30ci | R-38ci | R-42ci |
| R-38ci | R-48ci | R-53ci |
| R-13 + R-7.5ci | R-13 + R-9.4ci | R-13 + R-10.3ci |
| R-13 + R-10ci | R-13 + R-12.5ci | R-13 + R-13.8ci |
| R-13 + R-12.5ci | R-13 + R-15.6ci | R-13 + R-17.2ci |
| R-13 + R-13ci | R-13 + R-16.3ci | R-13 + R-17.9ci |
| R-19 + R-8.5ci | R-19 + R-10.6ci | R-19 + R-11.7ci |
| R-19 + R-14ci | R-19 + R-17.5ci | R-19 + R-19.2ci |
| R-19 + R-16ci | R-19 + R-20ci | R-19 + R-22ci |
| R-20 + R-3.8ci | R-20 + R-4.8ci | R-20 + R-5.3ci |
| R-21 + R-5ci | R-21 + R-6.3ci | R-21 + R-6.9ci |

# Continuous Insulation Equivalents

**Table C402.1.3(i), Footnote 1b for Stainless Steel Fasteners**

- Stainless fasteners have a lower thermal bridging impact on CI
- Column B insulation values are allowed for % penetrations greater than 0.12% and lower than 0.24%
- Column C insulation values are allowed for % penetrations greater than 0.24% and lower than 0.48%

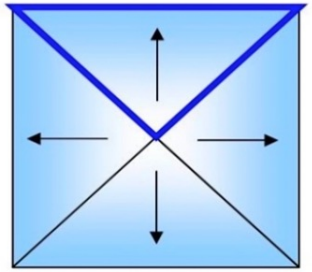
| Column B | Column C |
|---|---|
| **Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%** | **Alternate option for assemblies with metal penetrations, greater than or equal to 0.08% but less than 0.12%** |
| R-11.9ci | R-13ci |
| R-14.3ci | R-15.7ci |
| R-16.6ci | R-18.3ci |
| ((~~R-19.0ci~~)) R-19ci | R-21ci |
| R-38ci | R-42ci |
| R-48ci | R-53ci |
| R-13 + R-9.4ci | R-13 + R-10.3ci |
| R-13 + R-12.5ci | R-13 + R-13.8ci |
| R-13 + R-15.6ci | R-13 + R-17.2ci |
| R-13 + R-16.3ci | R-13 + R-17.9ci |
| R-19 + R-10.6ci | R-19 + R-11.7ci |
| R-19 + R-17.5ci | R-19 + R-19.2ci |
| R-19 + R-20ci | R-19 + R-22ci |
| R-20 + R-4.8ci | R-20 + R-5.3ci |
| R-21 + R-6.3ci | R-21 + R-6.9ci |

# Roof Insulation Details

**Roofs with variable depths of continuous insulation**

- Effective U-factor of tapered roof insulation shall be per default **Tables A102.2.6(1-3)**
- For roofs with variable depths of continuous insulation, the effective U-factor for code compliance shall be area-weighted

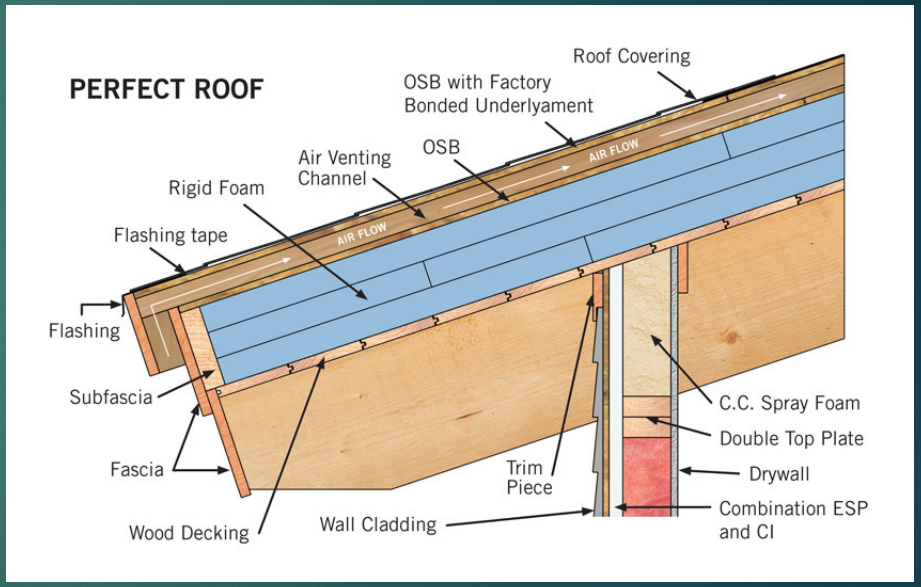
**TABLE A102.2.6(3)**
**ASSEMBLY U-FACTORS FOR ROOFS WITH TAPERED INSULATION ENTIRELY ABOVE DECK SLOPED TRIANGLE (ROOF WITH PERIMETER DRAINS)[e,f,g,h,i]**
**(UNINTERRUPTED BY FRAMING)**

| Rated R-value of Insulation at Minimum Condition ($R_{min}$[2]) | Rated R-Value of Insulation at Maximum Condition ($R_{max}$[3]) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| 1 | 0.562 | 0.363 | 0.273 | 0.224 | 0.193 | 0.170 | 0.153 | 0.139 | 0.128 | 0.119 | 0.111 | 0.105 | 0.099 |
| 5 | - | 0.173 | 0.138 | 0.118 | 0.104 | 0.094 | 0.086 | 0.079 | 0.074 | 0.070 | 0.066 | 0.062 | 0.059 |
| 10 | - | - | 0.093 | 0.081 | 0.073 | 0.067 | 0.062 | 0.058 | 0.054 | 0.051 | 0.049 | 0.046 | 0.044 |
| 15 | - | - | - | 0.063 | 0.058 | 0.053 | 0.050 | 0.047 | 0.044 | 0.042 | 0.040 | 0.038 | 0.037 |
| 20 |  | | | | 0.048 | 0.045 | 0.042 | 0.040 | 0.037 | 0.036 | 0.034 | 0.033 | 0.032 |
| 25 | | | | | - | 0.039 | 0.037 | 0.035 | 0.033 | 0.031 | 0.030 | 0.029 | 0.028 |
| 30 | | | | | - | - | 0.032 | 0.031 | 0.029 | 0.028 | 0.027 | 0.026 | 0.025 |
| 35 | | | | | - | - | - | 0.028 | 0.027 | 0.026 | 0.025 | 0.024 | 0.023 |
| 40 | | | | | - | - | - | - | 0.025 | 0.024 | 0.023 | 0.022 | 0.021 |
| 45 | | | | | - | - | - | - | - | 0.022 | 0.021 | 0.020 | 0.020 |
| 50 | | | | | - | - | - | - | - | - | 0.020 | 0.019 | 0.019 |
| 55 | | | | | - | - | - | - | - | - | - | 0.018 | 0.017 |
| 60 | | | | | - | - | - | - | - | - | - | - | 0.016 |

# Roof Insulation Details

**Continuous insulation criteria**

- Shall be installed in not less than 2 layers and the edge joints between each layer of insulation shall be staggered
- **Minimum thickness, lowest point** - Two layers are not required where insulation tapers to the roof deck, although minimum thickness shall be not less than 1-inch



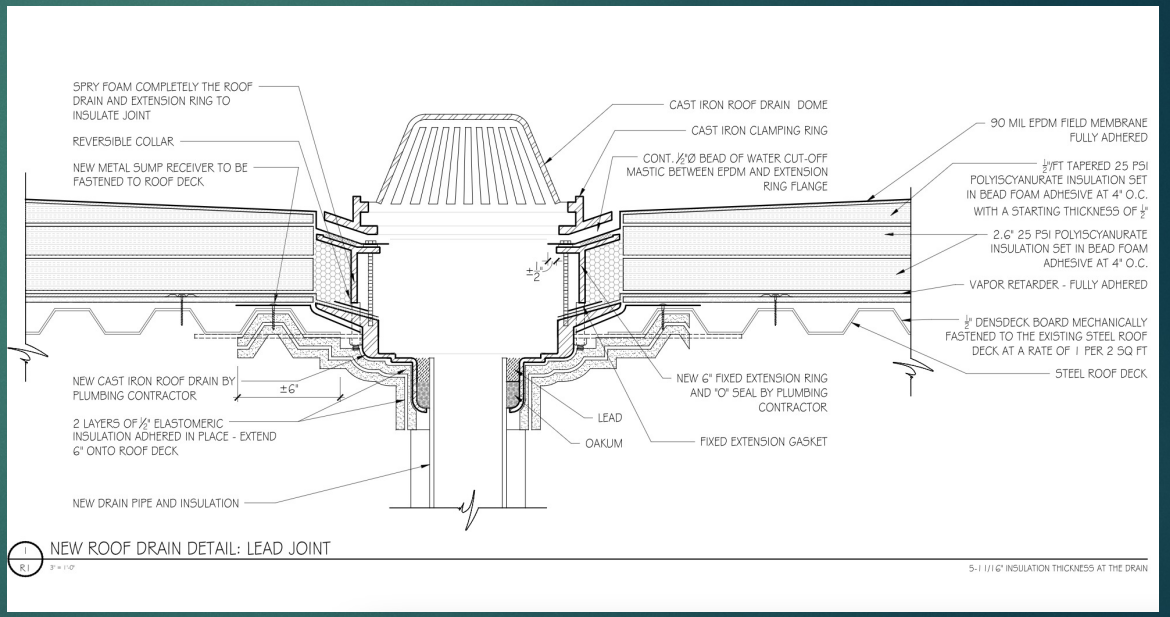

*Architecture + Construction Continuing Education Center*

**C402.1.4.1.2**
**C402.2.1.1**

# Roof Insulation Details

**Roof drains**

- The immediate 24-inch by 24-inch area around each roof drain shall have **at least R-13 insulation**
- Area around roof drains is not required to be included in the area-weighted effective U-factor calculation




*Courtesy of Roofing Magazine.com*

**C402.2.1**

# Walls

**Wall provisions that include mechanical systems criteria**

- C402.1.1.2 Semi-heated buildings and spaces
- C402.1.4.3 Thermal resistance of mechanical equipment penetrations

**In these cases, wall insulation requirements are defined by the proposed mechanical equipment type and/or installed capacity.**

# Space Conditioning Categories

- **Calculate envelope compliance separately by category**
  - Low energy exemption – Heating and/or cooling peak rate of energy usage for space conditioning cannot exceed ***3.4 Btu/h*** (1 Watt) per SF
  - **Semi-heated – No cooling and heating system total output capacity cannot exceed *8 btu/h* per SF**
  - Conditioned – Spaces that are not low energy or semi-heated
  - Walk-in& warehouse coolers – Storage spaces capable of being refrigerated to temps > 32°F and < 55°F
  - Walk-in& warehouse freezers – Storage spaces capable of being refrigerated to temps < 32°F
  - Greenhouse – Glazed spaces that are heated but not cooled

**Chapter 2 Definitions**

# Semi-heated Buildings & Spaces

- **PURPOSE – Exemption to wall insulation & vestibule requirements**
  - Exemption applies to walls separating semi-heated spaces from the exterior or low energy spaces
  - Component performance (UA calc) – Use code compliant U-factor for both the target and proposed UA so walls are neutral to the calculation
  - Fenestration located within walls enclosing a semi-heated space shall comply the same as for fully conditioned
- **UPDATED - Eligible heating system types**
  - Electric resistance heating systems including electric infrared equipment
  - Heat pumps without electric resistance back-up that are connected to a heating only thermostat
  - Fuel-fired equipment (pending)

**C402.1.1.2**

# Mechanical Equipment with Through-Wall Penetrations

**Thermal resistance of mechanical equipment penetrations**

- Applies to equipment listed in Table C403.3.2(4)
- Includes PTACs, PTHPs, single package vertical AC & HPs (SPVAC, SPVHP) and room air conditioners
- If total area of penetrations **exceeds 1%** of above-grade wall area ~
  - Total area of mechanical equipment penetrations shall be assigned a default U-factor of U-0.5
  - Mechanical equipment penetration area U-factor shall be area-weighted with the opaque above-grade wall area
  - Calculate the resulting overall effective wall U-factor for prescriptive or component performance compliance

**Table C402.1.4, Footnote k**
**C402.1.4.3**

# Mechanical Equipment with Through-Wall Penetrations

**Thermal resistance of mechanical equipment penetrations**

- **INTENT** – Reduce the impact of mechanical equipment through wall penetrations on overall building envelope thermal performance

- **Sample Area-Weighted Wall Assembly Calculation:**
  - Percent area of mechanical equipment penetrations = **2%**
  - Mechanical equipment penetrations default U-factor = **U-0.5**
  - Sample maximum allowed opaque wall U-factor = **U-0.051**

  **Area-weighted U-factor = (0.5 * 0.02) + (0.051 * 0.98) = U-0.060**

**Table C402.1.4, Footnote k**
**C402.1.4.3**

# 2021 WSEC-C – Floors & Opaque Doors

| Table C402.1.3 - R-Value Method | | |
|---|---|---|
| **CLIMATE ZONE** | **5 AND MARINE 4** | |
| | **All Other** | **Group R** |
| **Floors** | | |
| Mass | R-30ci | R-30ci |
| Joist/Framing | R-30 | R-30 |
| Steel floor joist system | R-38 + R-10ci | R-38 + R-10ci |
| **Slab-on-Grade Floors** | | |
| Unheated slabs | R-10 for 24" below | R-10 for 24" below |
| Heated slabs | R-10 perimeter & under entire slab | R-10 perimeter & under entire slab |
| ~~Opaque Doors~~ | | |
| ~~Non-swinging~~ | ~~R-4.75~~ | ~~R-4.75~~ |

| Table C402.1.4 - U-Factor Method | | |
|---|---|---|
| **CLIMATE ZONE** | **5 AND MARINE 4** | |
| | **All Other** | **Group R** |
| **Floors** | | |
| Mass | U-0.031 | U-0.031 |
| Joist/Framing | U-0.029 | U-0.029 |
| **Slab-on-Grade Floors** | | |
| Unheated slabs | F-0.54 | F-0.54 |
| Heated slabs | F-0.55 | F-0.55 |
| **Opaque Doors** | | |
| Non-swinging door | U-0.34 **U-0.31** | U-0.34 **U-0.31** |
| Swinging door | U-0.37 | U-0.37 |
| Garage door < 14% glazing | U-0.31 | U-0.31 |
| **Garage door ≥ 14% & ≥ 25% single row glazing** | **U-0.44** | **U-0.44** |
| **Garage door ≥ 14% & ≤ 50% glazing** | **U-0.34** | **U-0.34** |

**All opaque doors with > 50% glazed area are defined as Fenestration**

# Garage Doors

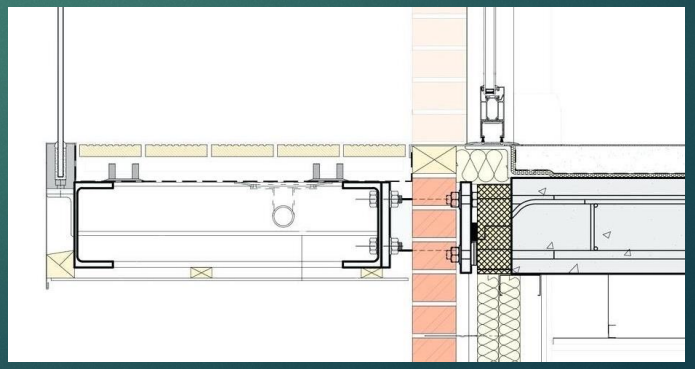
- **DOORS, NON-SWINGING.** Roll-up, tilt-up, metal coiling and sliding doors, access hatches, and all other doors that are not swinging doors or garage doors with less than or equal to 14% glazing.
- **DOORS, GARAGE.** Non-swinging doors rated by DASMA 105 with a single panel or horizontally hinged sectional panels.
- **Table C402.1.4, Footnote i** - Garage doors with a single row of fenestration may have a U-factor up to **U-0.44**
- All opaque doors (including frame) are included in the above-grade wall area

*Overhead-doors.com*

# Decks & Balconies

The thermal bridge at each balcony or deck can cause substantial heat loss, unless a thermal break is provided

**SOLUTIONS**



# Above-Grade Exterior Concrete Slabs & Mass Transfer Deck Slabs

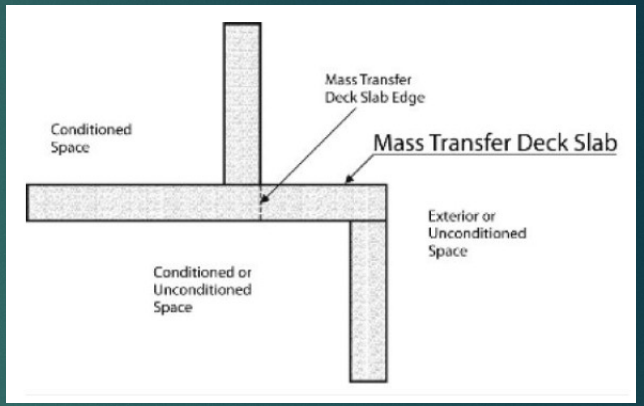
**Above grade exterior concrete slabs**

- Decks, balconies and other above-grade slabs shall each have at minimum a **R-10 thermal break** aligned with the primary insulating layer in the adjoining wall assemblies.
- Stainless steel reinforcing bars are permitted to penetrate the thermal break without penalty
- Where the thermal break does not comply with these requirements:
  - Above-grade exterior concrete slab shall be assigned an exposed concrete default U-factor from **Table A103.3.7.2 Peripheral Edges of Intermediate Concrete Floors**
  - R-value of exterior concrete slabs shall be area-weighted with the adjacent wall assemblies for code compliance

**C402.2.8**

# Above-Grade Exterior Concrete Slabs & Mass Transfer Deck Slabs

- **MASS TRANSFER DECK SLAB.** A concrete slab designed to transfer structural load from the building perimeter wall or column line above, laterally to an offset wall or column line below. It has conditioned or semi-heated space on the inside of the upper wall and exterior or unconditioned space on the outside of the upper wall.




- A mass transfer deck, due to its configuration, is not insulated.
- **Table C402.1.4 U-factor Method, Footnote j** - Projects with a mass transfer deck slab are required to comply via **component performance using a default U-factor of U-0.20**.

**Chapter 2 Definitions**

# Above-Grade Exterior Concrete Slabs & Mass Transfer Deck Slabs

| Table C402.1.4 - U-Factor Method | | |
|---|---|---|
| **Walls, Above Grade** | | |
| Mass | U-0.104 | U-0.078 |
| Mass transfer deck slab | U-0.20 | U-0.20 |
| Metal buildings | ~~U-0.052~~ U-0.050 | ~~U-0.052~~ U-0.050 |
| Steel framed | U-0.055 | U-0.055 |
| Wood framed and other | ~~U-0.054~~ U-0.051 | U-0.051 |

Typically requires component performance compliance and other assemblies with better than code U-factors

**TABLE A103.3.7.2**
**DEFAULT U-FACTORS FOR PERIPHERAL EDGES OF INTERMEDIATE CONCRETE FLOORS**

| Slab Edge Treatment | Average Thickness of Wall Above and Below | | | |
|---|---|---|---|---|
| | 6 inches | 8 inches | 10 inches | 12 inches |
| Exposed Concrete | 0.816 | 0.741 | 0.678 | 0.625 |
| R-5 Exterior Insulation | 0.161 | 0.157 | 0.154 | 0.152 |
| R-6 Exterior Insulation | 0.138 | 0.136 | 0.134 | 0.132 |
| R-7 Exterior Insulation | 0.122 | 0.120 | 0.118 | 0.116 |
| R-8 Exterior Insulation | 0.108 | 0.107 | 0.106 | 0.104 |
| R-9 Exterior Insulation | 0.098 | 0.097 | 0.095 | 0.094 |
| R-10 Exterior Insulation | 0.089 | 0.088 | 0.087 | 0.086 |
| R-11 Exterior Insulation | 0.082 | 0.081 | 0.080 | 0.079 |
| R-12 Exterior Insulation | 0.076 | 0.075 | 0.074 | 0.074 |
| R-13 Exterior Insulation | 0.070 | 0.070 | 0.069 | 0.068 |
| R-14 Exterior Insulation | 0.066 | 0.065 | 0.065 | 0.064 |
| R-15 Exterior Insulation | 0.062 | 0.061 | 0.061 | 0.060 |


# Fenestration Performance

*Images courtesy of TestComm & Infratec-infrared.com*

# 2021 WSEC-C – Vertical Fenestration

- Class AW Rated fenestration values have been lowered (more stringent)
- New category for operable or mulled windows with fixed and operable sections
- SHGCs no longer based on orientation, now divided by fixed versus operable fenestration

| Table C402.4 - U-Factor & SHGC | | |
|---|---|---|
| **CLIMATE ZONE** | **5 AND MARINE 4** | |
| **U-Factor for Class AW rated in accordance with AAMA/CSA101/I.S.2/A440, vertical curtain walls and site-built fenestration products** | | |
| Fixed U-factor | ~~U-0.38~~ U-0.34 | |
| Operable U-factor | ~~U-0.40~~ U-0.36 | |
| **Entrance doors** | | |
| U-factor | U-0.60 | |
| **U-factor for all other vertical fenestration** | | |
| Fixed U-factor | ~~U-0.30~~ U-0.26 | |
| Operable or mulled windows with fixed and operable sections U-factor | U-0.28 | |
| **SHGC for all vertical fenestration** | | |
| ~~Orientation~~ | ~~SEW~~ Fixed | ~~N~~ Operable |
| PF < 0.2 | 0.38 | ~~0.51~~ 0.33 |
| 0.2 ≤ PF < 0.5 | 0.46 | ~~0.56~~ 0.40 |
| PF ≥ 0.5 | 0.61 | ~~0.61~~ 0.53 |
| **Skylights** | | |
| U-factor | U-0.50 | |
| SHGC | 0.35 | |

# Interlock Operable Openings With HVAC System Controls

**Operable openings interlocking**

- Applies to operable openings **larger than 48 SF**
- Examples – Garage style doors in restaurants, large sliding glass doors from gathering space and living areas, retail entries (Costco), etc
- Activate HVAC operable opening controls once doors that open to the outdoors from a conditioned space **have been open for five (5) minutes**
- Exceptions include – Warehouses with loading docks, kitchens with appliances requiring make-up air, openings from spaces served by hydronic radiant heating & cooling systems, building alterations

**C402.5.11**


Building Enclosure
Air Leakage
25.9
22.8
21.2
19.7
18.1
16.5
14.9
13.4
0
-5
-10
-15
-20
-25
-30
Images courtesy of TestComm & Infratec-infrared.com

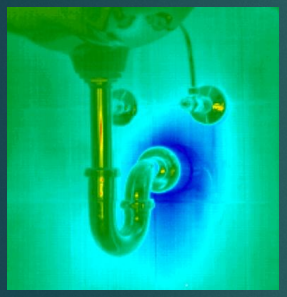
# Controlling Air Leakage

**All these requirements address building envelope air leakage**

- Continuous air barrier
- Sealing and gasketing requirements
- Low-leakage motorized dampers
- Vestibules
- Building enclosure testing

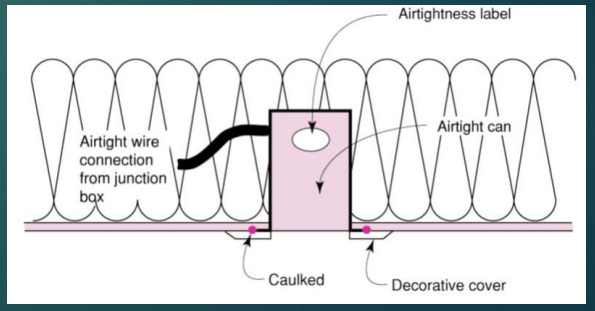

# Air Barrier Continuity

- Seal joints and seams in the air barrier including transitions and changes in materials
- Joints and seams shall be sealed for the entire length
- Seal around doors, windows, skylights, access openings (shafts, chutes, stairways and elevator lobbies)
- Penetrations shall be caulked, gasketed or otherwise sealed in a manner compatible with the construction material and location
- Penetrations include: ductwork, piping, conduit, fire sprinklers, recessed lights, etc



*Courtesy of Neudorfer*

*Courtesy of Insitu Arch*



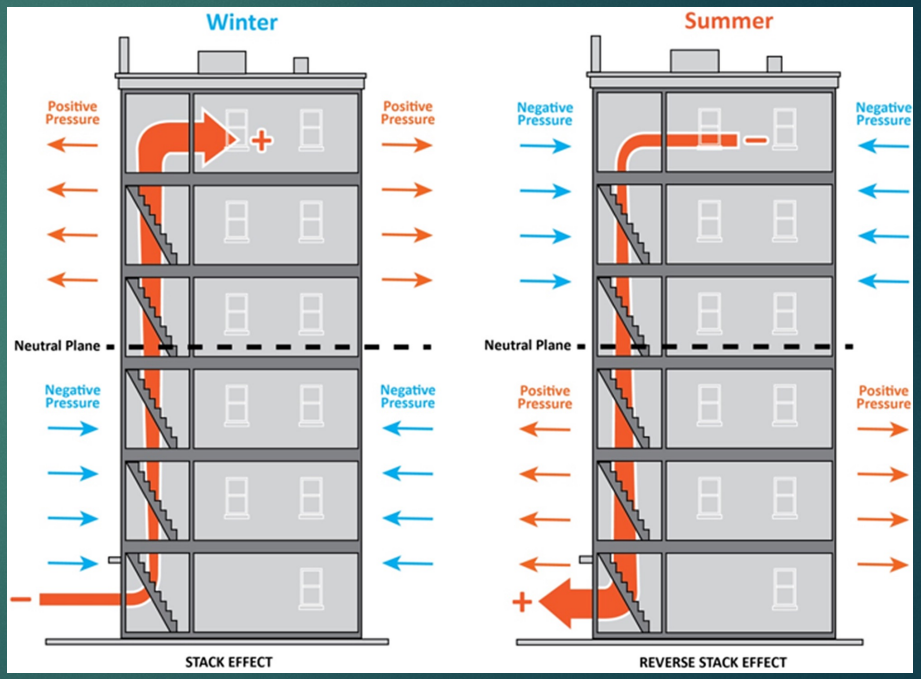

*Courtesy of Building America*

**C402.5.1.1**

# Air Barrier Durability

**Air barrier construction**

- Sealing at joints, seams, penetrations and between different air barrier materials shall allow for expansion and contraction from wind, stack affect and from mechanical vibration




C402.5.1.1

# Building Enclosure Testing Criteria

- Testing criteria per one of the following standards:
  - ASTM E779
  - ANSI/RESNET/ICC 380
  - ASTM E3158
  - ASTM E1827
  - Alternative method approved by the code official


*Images courtesy of Neudorfer Engineers*

- Report that demonstrates a **passing result of the air leakage test** shall be provided to the Code Official and building owner

**C402.5.2**
**C402.5.3**

# Applicability by Building Types

- **New construction** - Building enclosure testing requirements apply to all new buildings and building additions
- **C402.1.1.1 Low energy buildings & spaces** – **Exempt** from the building thermal envelope provisions of the code, including building enclosure testing
- **C402.1.1.2 Semi-heated buildings & spaces** – Shall comply with the same requirements as fully conditioned spaces, thus building enclosure testing **is** required

# What if the project is an alteration, renovation or repair that includes envelope assemblies?

- The building enclosure testing provision is **not intended** to apply to alterations, renovations or repairs as long as the alteration does not include a change in space conditioning or change in occupancy.

# Building Enclosure Testing

## Four test procedures defined in the 2021 WSEC-C

1. **C402.5.3 Standard test** - Measured air leakage **shall not exceed 0.25 cfm/SF** of the *building thermal area* at a pressure differential of 0.3 inch wg (75 Pa).
2. **C402.5.3 Weighted average test** – Portions of the building are tested and the measured air leakage results are area-weighted. Resulting area-weighted value shall not exceed 0.25 cfm/SF at 0.3 inch wg (75 Pa).
3. **C402.5.2 Weighted average test of dwelling/sleeping units accessed directly from the outdoors** –Test results of all units shall be area-weighted. Resulting area-weighted value **shall not exceed 0.25 cfm/SF at 0.2 inch wg (50 Pa)**. Same as 2021 WSEC-R.
4. **C402.5.4 Building test for mixed-use buildings** – For buildings 3 stories or less above grade, may test Group R-2/ R-3 areas separately from commercial via residential test procedure Section R402.4.1.2, **OR** test the whole building per **C402.5.3**.

# Standard Weighted-Average Test

**Test procedure must include the following:**

- Test all areas directly under a roof
- Test entire envelope area of all stories with a building entrance, exposed floor or loading dock, or that are below grade
- Test at least 25% of the wall area enclosing the remaining conditioned space
- Test via pressurization + depressurization, or by pressurization alone
- Total building air leakage shall be the weighted average of all testing unit results, weighted by each unit's enclosure area

**Testing criteria basics**

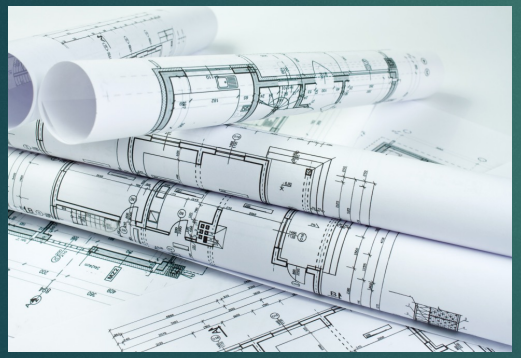
- SF = Square foot area of the air barrier boundary
- 6-sided enclosure - Includes roof or ceiling, walls, fenestration and floor over unconditioned space or the slab-on-grade floor

**C402.5.3**

# What if the building initially fails the building enclosure test?

- If measured or weighted-average air leakage rate **exceeds 0.25 cfm/SF**….
  - Conduct inspection of all air barrier elements
  - Corrective action shall be taken to seal leaks in the air barrier
  - **Must RE-TEST and continuous corrective actions until the building passes the 0.25 cfm/SF maximum allowed leakage rate**
  - A resulting failed test after corrective action is no longer allowed

# What do jurisdictions look for during plan review?



- Verify a **continuous air barrier boundary** is included in the project documents
- Confirm Architect of Record has calculated the total SF area of the air barrier boundary, which is used for testing calculations
- Confirm building enclosure testing and the requirement to pass the test is **included in the general project scope of work**

# What to jurisdictions look for during field inspection?

- Verify presence of air barrier materials in envelope assembly - **too often not installed at all**
- Inspect for continuity
  - Air barrier material **transitions** are sealed
  - **Penetrations** by trades in the air barrier are sealed
- **Request building enclosure test results** that includes tested surface area and floor area, and resulting measured air leakage rate and test pressure

# Additional Energy Efficiency and Load Management

# Additional Energy Efficiency & Load Management Measures

- In addition to complying with all applicable mandatory and prescriptive provisions, a project is also required to comply with a minimum number of additional energy efficiency and load management measures
- **Number of available additional energy efficiency measures has substantially expanded**
- **NEW – Load management measures**
- Number of required credits varies by occupancy group
- Credit value of each measure is based on modeled energy efficiency potential by occupancy group

**C406.2**

# Which project types are required to comply with additional energy efficiency measures?

- New buildings, including shell & core
- First occupancy build-out of a tenant space (initial TI)
- Building additions
- Existing building retrofits that require full compliance with 2021 WSEC-C are treated the same as a new building
- All levels of space conditioning – unconditioned, low energy, equipment buildings, semi-heated, fully conditioned, refrigerated warehouse coolers and freezers

**C406.1, C406.1.1**

# Which project types are required to comply with load management credit measures?

- **New buildings greater than 5,000 SF**
- Does not apply to:
  - First occupancy build-out of a tenant space (initial TI)
  - Building additions
  - Unconditioned and low energy spaces
  - Equipment buildings
  - Open and enclosed parking garages
  - Warehouses

**C406.1, C406.1.1**

# Envelope Additional Energy Efficiency Measures

**Enhanced Envelope Performance**

- Requires the component performance (UA calculation) compliance path
- Proposed Total UA of the building thermal envelope shall be **15% lower** than the Allowable Total UA

**Reduced Air Leakage**

- Measured air leakage shall be lower than the code maximum allowed rate of **0.25 cfm/SF** (test pressure per procedure type)
- Base Measure – **68%** of the max allowed = **0.17 cfm/SF**
- Enhanced Measure – **33%** of the max allowed = **0.066 cfm/SF**

**C406.2.12**
**C402.2.13**

# Envelope Load Management Measures

**Building Thermal Mass**

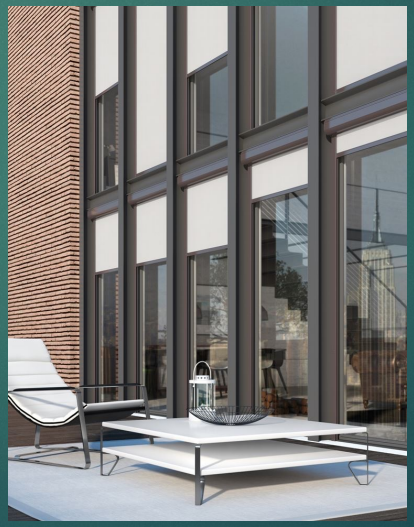
- Two Requirements – Passive interior mass and night-flush control of HVAC
- Mass envelope construction – Interior facing mass walls and floors shall be in direct contact with the air in conditioned spaces.
- Summer mode night-flush controls – During evening unoccupied period, operate outdoor air economizers at low fan speed until average indoor air temperature is lowered to the occupied heating setpoint.

**C406.3.7**

# Automated shading

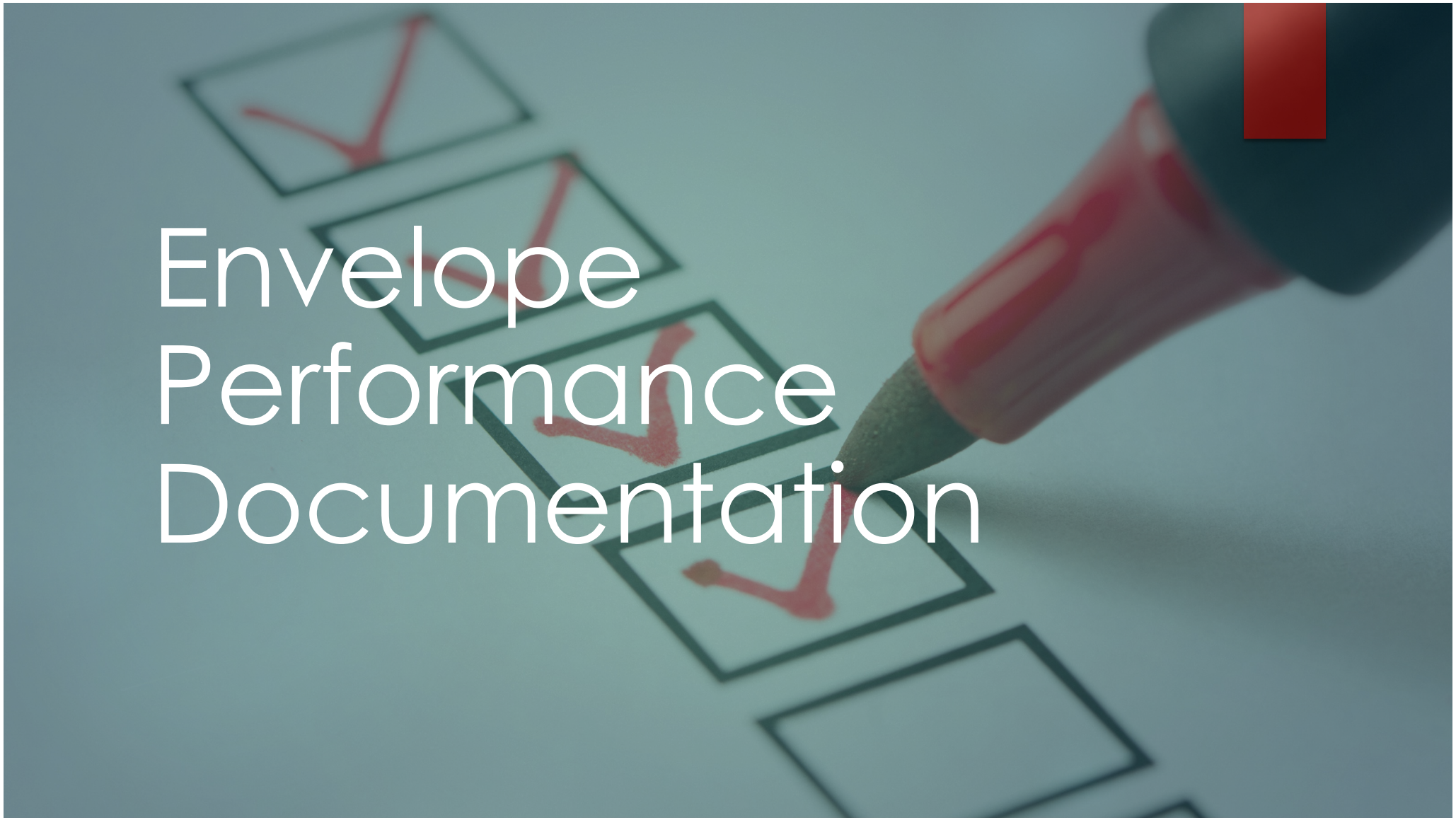
- Applicable where the window-to-wall ratio of south & west facing building thermal envelope exceeds 20%
- Configure automatic controls for moveable exterior shading or dynamic glazing to reduce fenestration solar gain by ≥ 50%
- Eligible types – exterior roller, moveable blind or movable shutter shading devices
- Not eligible types - fixed overhangs, screens or shutter shading

*Optics & Photonics News*



*Courtesy of Bandalux*

**C406.3.3**


Envelope
Performance
Documentation

# Required Envelope Performance Documentation

**Construction documents**

- **Energy compliance path** per Section C401 or C501 – Prescriptive, Total Building Performance (C407) or Appendix F Outcome-Based Energy Budget
- Insulation materials and their R-values per C303
- Fenestration U-factors and SHGCs
- Area-weighted envelope assembly values, where applicable
- Location of **daylight zones** on floor plans
- **Air barrier details** including all air barrier boundaries and associated SF calculations on all six sides of the air barrier

# Required Envelope Performance Documentation

**NEW Thermal envelope certificate**

- Certificate shall be posted where space conditioning equipment is located, within a utility room or other approved location
- A copy shall be included in project construction documents
- Certificate details shall include:
  - Insulation R-values – Ceilings, roofs, walls, foundations & slabs, crawlspace walls & floors, ducts outside conditioned space
  - Fenestration U-factors and SHGCs
  - Area-weighted envelope assembly values, where applicable
  - Results from building envelope air leakage testing

**C401.3**

# Training Topics Highlights

- Group R-2 buildings with dwelling units accessed from interior corridors or other interior spaces are no longer within the scope of the 2021 WSEC-R
- Prescriptive wood-framed wall assemblies require continuous insulation
- In some cases, mechanical equipment type influences envelope assembly requirements (mech equip with thru-wall penetrations, heating equip for semi-heated spaces)
- Vertical fenestration SHGC requirements are not longer based on orientation
- Commercial buildings ***must pass*** the building enclosure air leakage test
- There are more options available for additional energy efficiency measures
- New requirements for load management measures
- Thermal Envelope Certificate must be provided to owner at project close-out

# Thank you!

## 2021 WSEC-C – KEY CHANGES TO THE BUILDING ENVELOPE AND AIR BARRIER PROVISIONS

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