

# AIA NWW & AIA Seattle

## 2021 WSEC COMMERCIAL PROVISIONS – KEY CHANGES AND TECHNICAL RESOURCES



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# WSEC Commercial Technical Support

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  - ▶ Email inquiries – **[com.techsupport@waenergycodes.com](mailto:com.techsupport@waenergycodes.com)**
- ▶ Classroom and webinar training
- ▶ We administer the technical support and compliance documentation webtool



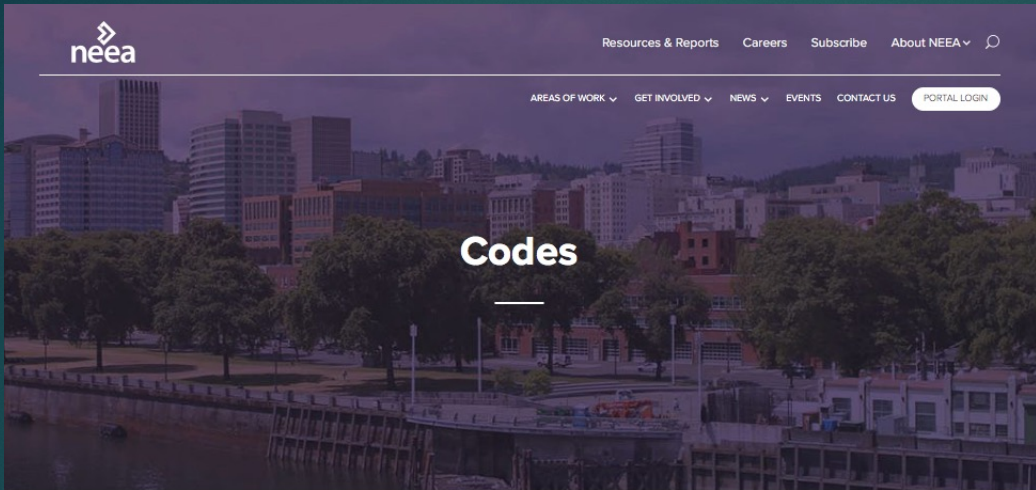
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## Increasing progressive effectiveness of energy codes

The NEEA Codes and Standards program supports regional stakeholders in the development and adoption, training and implementation of energy codes. States engage in the code development process along different cycles and code versions, but all states now use the International Energy Conservation Code (IECC) as a baseline for their commercial energy codes. All states except Oregon now use the IECC as the basis of their residential code. The adoption of codes is the responsibility of state code boards or agencies. Official state-by-state energy code information can be found on state building code websites:

Idaho - <http://dbs.idaho.gov/boards/index.html>

Oregon - <http://www.cbs.state.or.us/external/bcd/>

Washington - <https://sbcc.wa.gov/>

Montana - <http://svc.mt.gov/gov/boards/>



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WSEC technical support services are made possible thanks to the generous support of the Northwest Energy Efficiency Alliance

[www.neea.org](http://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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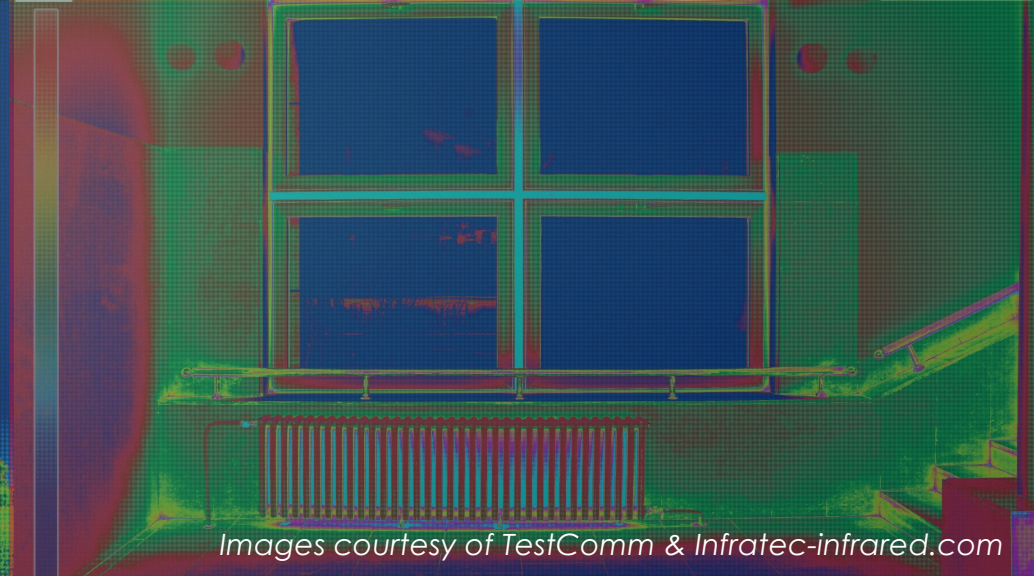
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# 2021 WSEC-C topics we'll discuss today ~

1. History of the WSEC-C
2. Changes to the residential buildings definition
3. Opaque assembly thermal performance
4. Fenestration performance
5. Building enclosure air leakage
6. Additional energy efficiency and load management measures
7. Renewable energy generation systems

# History of the WSEC-C



Images courtesy of TestComm & Infratec-infrared.com

# WSEC Milestones

1994 - Non-residential energy code (NREC) adopted

2000 – Mandatory commissioning added to general requirements

**2008 – Energy Code Act was amended to set a goal of a 70% reduction in energy use of new buildings by 2031**

2012 – Washington State adopts the International Energy Conservation Code as the model code

2015 – Dedicated outdoor air systems (DOAS) required for office, retail, schools, and fire stations. Additional efficiency credit requirements required.

2018 – Total system performance ratio (TSPR) standard implemented. Additional efficiency requirements expanded.

# WSEC-C Roadmap Findings

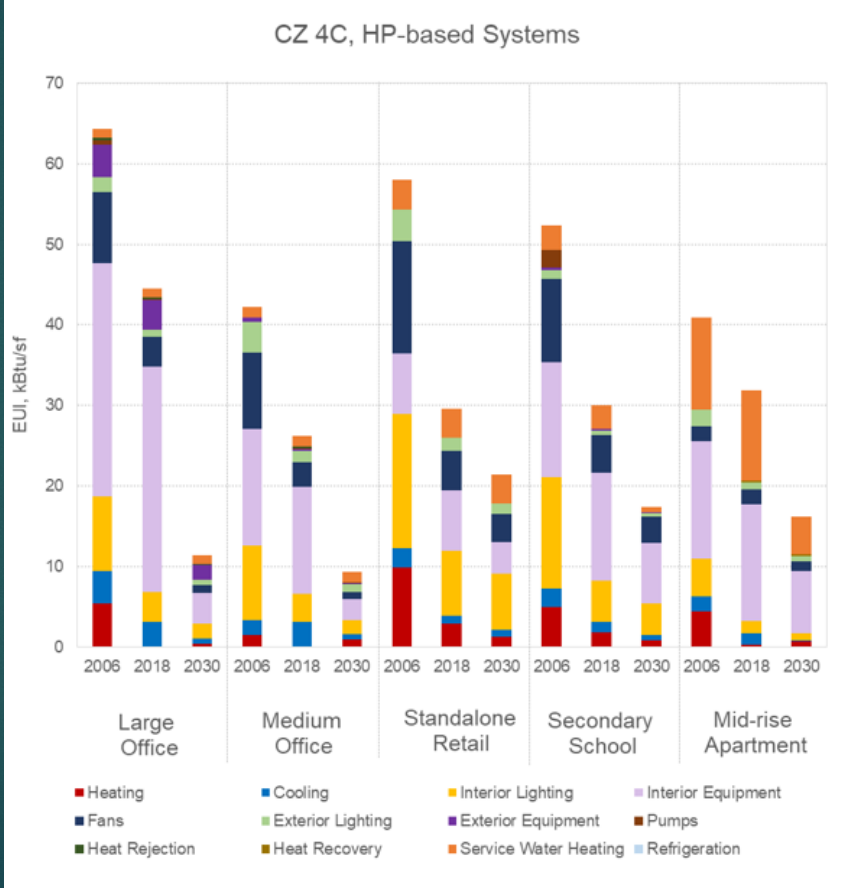
EUI may not be the best indicator of efficiency, but is consistent with the new WA State Dept of Commerce Clean Energy legislation and adoption of ASHRAE Standard 100 for existing buildings

TABLE ES1: PROTOTYPE ANNUAL EUI FOR 2006, 2018, AND 2030 ESEC EDITIONS

Prototype	Code Edition	Case	4C		5B	
			EUI, kBtu/sf	% EUI Savings	EUI, kBtu/sf	% EUI Savings
Large Office	2006	Base	64.28		67.49	
	2018	WSHP	44.47	31%	45.33	33%
	2030	WSHP	11.37	82%	12.21	82%
	2030	Radiant Floor	10.87	83%	11.42	83%
Medium Office	2006	Base	42.23		47.14	
	2018	WSHP	26.22	38%	26.96	43%
	2030	WSHP	9.35	78%	10.77	77%
	2030	Radiant Floor	8.33	80%	9.28	80%
Standalone Retail	2006	Base	58.03		69.45	
	2018	PSZ HP	29.60	49%	32.73	53%
	2018	PSZ DX AC/Gas Furnace	29.45	49%	34.97	50%
	2030	PSZ HP	21.44	63%	23.88	66%
Secondary School	2030	PSZ DX AC/Gas Furnace	21.59	63%	23.91	66%
	2006	Base	52.82		61.37	
	2018	PSZ HP	30.58	42%	33.59	45%
	2018	PSZ DX AC/Gas Furnace	31.83	40%	35.03	43%
Mid-rise Apartment	2030	PSZ HP	18.02	66%	19.87	68%
	2030	PSZ DX AC/Gas Furnace	19.66	63%	22.29	64%
	2006	Base	40.91		46.74	
	2018	Split HP	31.86	22%	33.40	29%
	2018	Split DX/Gas Furnace	32.59	20%	35.75	24%
Mid-rise Apartment	2030	Split HP	16.19	60%	17.62	62%
	2030	Split DX/Gas Furnace	18.16	56%	20.25	57%
	2030	VRF	16.09	61%	16.90	64%



# WSEC Roadmap Findings



Energy end-use profiles

# 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.*

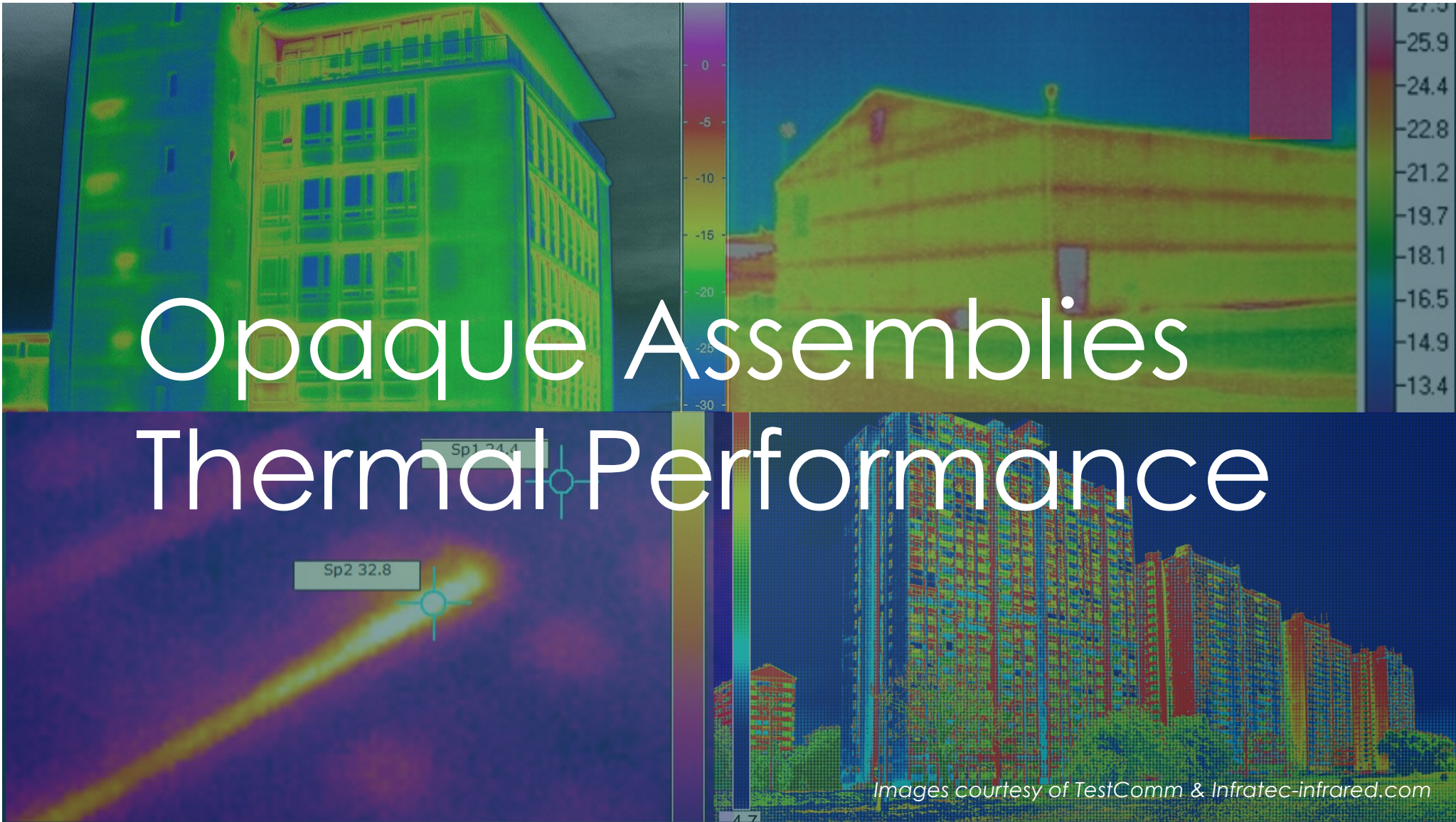
**Group R-2 buildings with dwelling units accessed from interior corridors or other interior spaces ARE NOT residential buildings.**

# Residential Building Definition

## 2021 WSEC-C Definition

- ▶ **RESIDENTIAL BUILDING.** *For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2 and R-3 buildings three stories or less in height above grade plane.*
- ▶ Even though the 2021 WSEC-C definition is unchanged, the new language in the 2021 WSEC-R for Group R-2 buildings with dwelling unit access from the building interior, moves this building type to the scope of the 2021 WSEC-C.

# Opaque Assemblies Thermal Performance



Images courtesy of TestComm & Infratec-infrared.com

# 2021 WSEC-C – Roofs & Walls

CLIMATE ZONE	5 AND MARINE 4	
	All Other	Group R
<b>Roofs</b>		
Insulation entirely above deck	R-38ci	R-38ci
Metal buildings	R-25 + <del>R-11</del> <b>R-22</b> LS	R-25 + <del>R-11</del> <b>R-22</b> LS
Attic and other	R-49	R-49
<b>Walls, Above Grade</b>		
Mass	R-9.5ci	R-13.3ci
<del>Mass transfer deck slab</del>	<del>R-5</del>	<del>R-5</del>
Metal buildings	<del>R-19ci or R-13 + R-13ci</del> <b>R-13 + R-14ci</b>	<del>R-19ci or R-13 + R-13ci</del> <b>R-13 + R-14ci</b>
Steel framed	R-13 + R-10ci	R-19 + R-8.5ci
Wood framed and other	<del>R-21 int or R-15 + R-5ci std</del> <b>R-13 + R-7.5ci std or R-20 + R-3.8ci std</b>	R-13 + R-7.5ci std or R-20 + R-3.8ci std or R-25 std

CLIMATE ZONE	5 AND MARINE 4	
	All Other	Group R
<b>Roofs</b>		
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
<b>Walls, Above Grade</b>		
Mass	U-0.104	U-0.078
Mass transfer deck slab	U-0.20	U-0.20
Metal buildings	<del>U-0.052</del> <b>U-0.050</b>	<del>U-0.052</del> <b>U-0.050</b>
Steel framed	U-0.055	U-0.055
Wood framed and other	<del>U-0.054</del> <b>U-0.051</b>	U-0.051

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

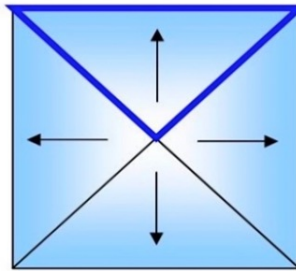
# Roof Insulation Details

## 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)<sup>e,f,g,h,i</sup>**  
**(UNINTERRUPTED BY FRAMING)**

		Rated R-Value of Insulation at Maximum Condition ( $R_{max}^3$ )												
		1	5	10	15	20	25	30	35	40	45	50	55	60
Rated R-value of Insulation at Minimum Condition ( $R_{min}^2$ )	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
- **C402.2.1.1 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

## ▶ 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



# Roof Retrofits

## Roof Retrofit Definitions

- ▶ **REROOFING** – Process of recovering or replacing an existing roof covering.
- ▶ **ROOF RECOVER** – Installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.
- ▶ **ROOF REPAIR** – Reconstruction or renewal of any part of an existing roof for the purpose of its maintenance.
- ▶ **ROOF REPLACEMENT** – The process of removing the existing roof coverings, repairing any damaged substrate and installing a new roof covering.

# Roof Retrofits

## C503.3.1 Roof replacement

- ▶ An existing roof shall be brought up to full compliance with the current code when:
  - Existing roof assembly is part of the *building thermal envelope*
  - Existing roof contains **no insulation** or the insulation is located **entirely above the roof deck**
  - In no case shall the R-value of the roof insulation be reduced or the U-factor of the roof assembly be increased as part of the roof replacement

# Walls

## Substantive Changes

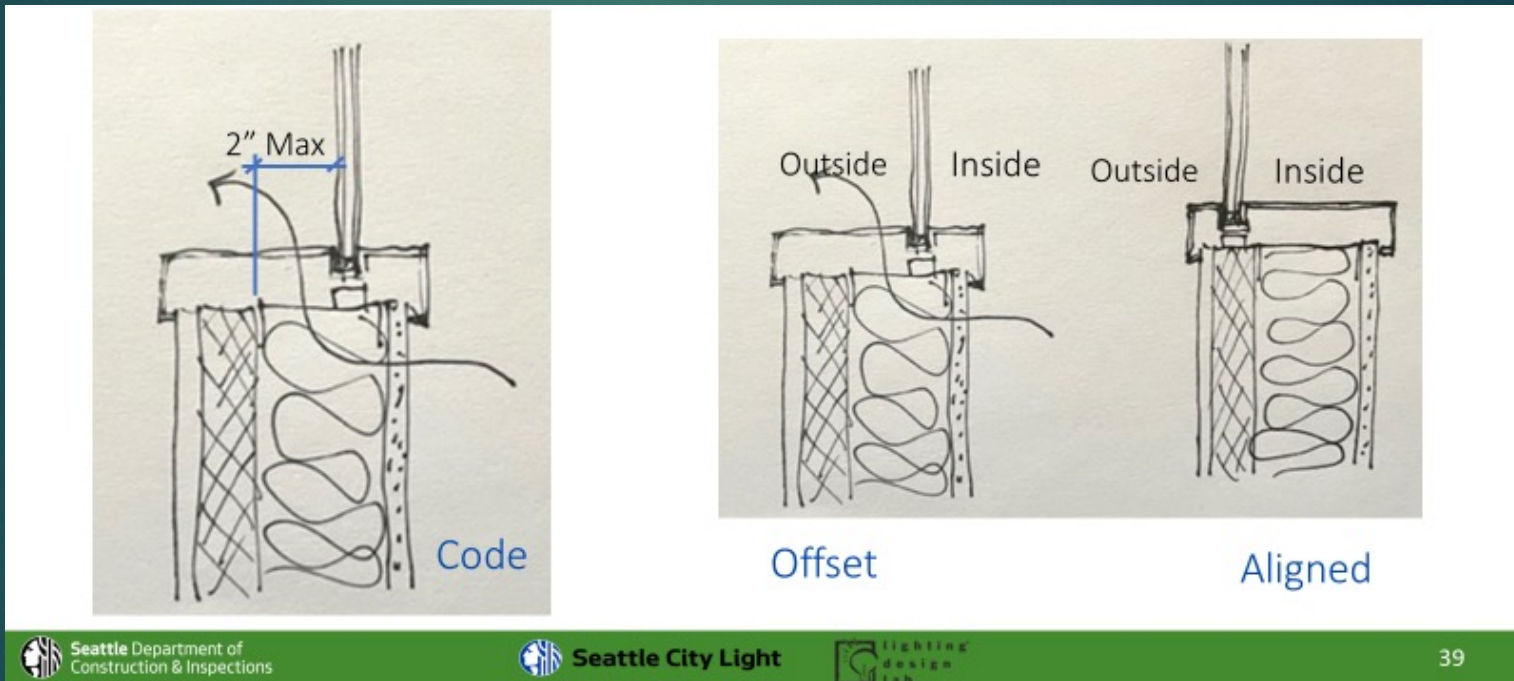
- ▶ C402.2.9 Vertical fenestration intersection with opaque walls
- ▶ C402.1.4.3 Thermal resistance of mechanical equipment penetrations
- ▶ **INTENT** – Reduce thermal bridging impact of common envelope elements, which can significantly reduce wall assembly thermal performance

# Fenestration Intersections with Opaque Walls

## **C402.2.9 – Applies to three vertical fenestration configurations**

- ▶ Wall assembly with continuous insulation (CI) – Glazing layer and frame thermal break shall be laterally aligned within 2-inches of the either face of the CI.
- ▶ Wall assembly without CI – Glazing layer and frame thermal break shall be laterally aligned within the thickness of the insulation layer, and not more than 2 inches from the exterior face of the outermost insulation layer.
- ▶ Exterior face of fenestration frame is inset from exterior surface of opaque wall rough opening – Exposed exterior portion of rough opening shall be covered with a material with at least R-3 thermal performance, or with a minimum 1.5-inch thickness of wood.

# Fenestration Intersections with Opaque Walls



# 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**

$$\text{Area-weighted U-factor} = (0.5 * 0.02) + (0.051 * 0.98) = \mathbf{U-0.060}$$



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
<b>Floors</b>		
Mass	R-30ci	R-30ci
Joist/Framing	R-30	R-30
Steel floor joist system	R-38 + R-10ci	R-38 + R-10ci
<b>Slab-on-Grade Floors</b>		
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
<b>Opaque Doors</b>		
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
<b>Floors</b>		
Mass	U-0.031	U-0.031
Joist/Framing	U-0.029	U-0.029
<b>Slab-on-Grade Floors</b>		
Unheated slabs	F-0.54	F-0.54
Heated slabs	F-0.55	F-0.55
<b>Opaque Doors</b>		
Non-swinging door	<del>U-0.34</del> <b><u>U-0.31</u></b>	<del>U-0.34</del> <b><u>U-0.31</u></b>
Swinging door	U-0.37	U-0.37
Garage door < 14% glazing	U-0.31	U-0.31
<b><u>Garage door &gt; 14% glazing and &lt; 50% glazing</u></b>	<b><u>U-0.34</u></b>	<b><u>U-0.34</u></b>

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



# Continuous Insulation Equivalents

## Alternate R-value Compliance Option

- ▶ Roof, wall and floor assemblies where the % penetration of metal fasteners in otherwise CI exceeds the 0.04% allowance

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

<u>Column A</u>	<u>Column B</u>	<u>Column C</u>
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%

<u>Column B</u>	<u>Column C</u>
<b>Alternate option for assemblies with metal penetrations, greater than 0.04% but less than 0.08%</b>	<b>Alternate option for assemblies with metal penetrations, greater than or equal to 0.08% but less than 0.12%</b>
R-11.9ci	R-13ci
R-14.3ci	R-15.7ci
R-16.6ci	R-18.3ci
<del>((R-19.0ci))</del> 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

# Garage Doors

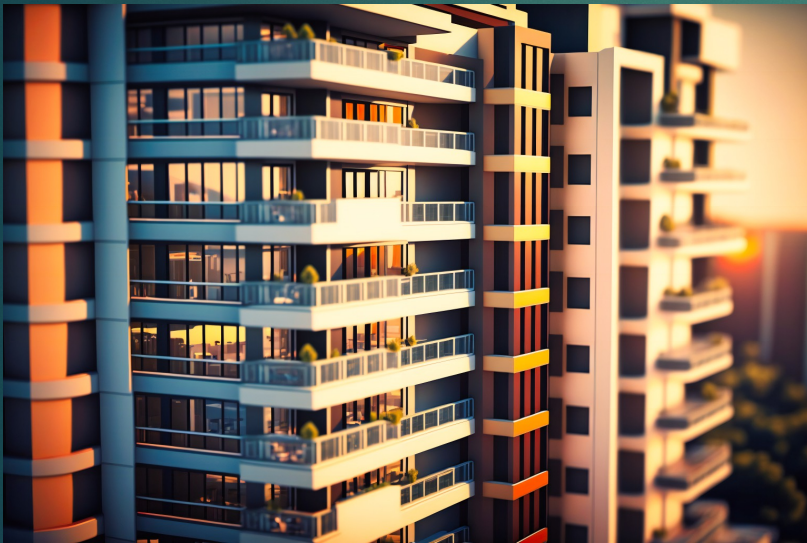
- ▶ **DOORS, NON-SWINGING.** Roll-up, tilt-up, metal coiling and sliding doors, access hatches, and all other doors that are not swinging doors or garage doors with less than or equal to 14% glazing.
- ▶ **DOORS, GARAGE.** Non-swinging doors rated by DASMA 105 with a single panel or horizontally hinged sectional panels.
- ▶ **Table C402.1.4, Footnote i** - Garage doors with a single row of fenestration with area  $\geq 14\%$  and  $\leq 25\%$  may have a U-factor up to **U-0.44**
- ▶ All opaque doors (including frame) are included in the above-grade wall area



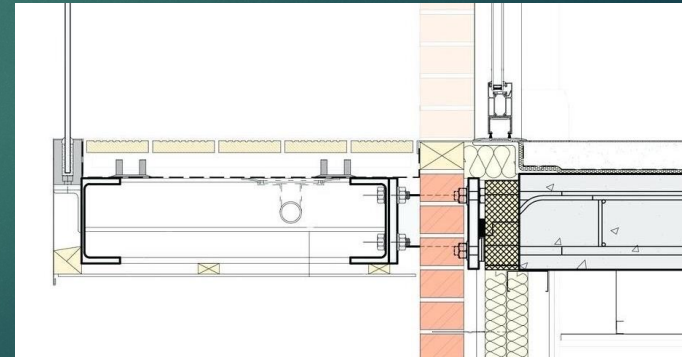
*Image source overhead-doors.com*

# Decks & Balconies

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



## SOLUTIONS



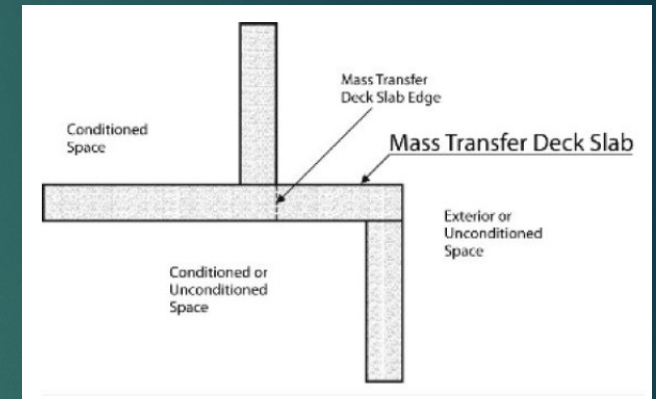
# Above-Grade Exterior Concrete Slabs & Mass Transfer Deck Slabs

## **C402.2.8 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

# 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.**



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
- ▶ **C402.1.1.2 Semi-heated buildings & spaces** – Fenestration shall comply with same requirements as fully conditioned

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 <b><u>U-0.34</u></b>	
Operable U-factor	U-0.40 <b><u>U-0.36</u></b>	
<b>Entrance doors</b>		
U-factor	U-0.60	
<b>U-factor for all other vertical fenestration</b>		
<b>Fixed</b> U-factor	U-0.30 <b><u>U-0.26</u></b>	
<b><u>Operable or mulled windows with fixed and operable sections U-factor</u></b>	<b><u>U-0.28</u></b>	
<b>SHGC for all vertical fenestration</b>		
<b>Orientation</b>	<b>SEW <u>Fixed</u></b>	<b>N <u>Operable</u></b>
PF < 0.2	0.38	<del>0.51</del> <b><u>0.33</u></b>
0.2 ≤ PF < 0.5	0.46	<del>0.56</del> <b><u>0.40</u></b>
PF ≥ 0.5	0.61	<del>0.61</del> <b><u>0.53</u></b>
<b>Skylights</b>		
U-factor	U-0.50	
SHGC	0.35	



# Interlock Operable Openings With HVAC System Controls

## **C402.5.11 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
- ▶ Does not apply to:
  - Warehouses that utilize overhead doors for the function of the occupancy (i.e. loading docks)
  - Kitchens with appliances requiring make-up air
  - Operable openings from spaces served by hydronic radiant heating and cooling systems due to slow response time of this system type
  - Building alterations

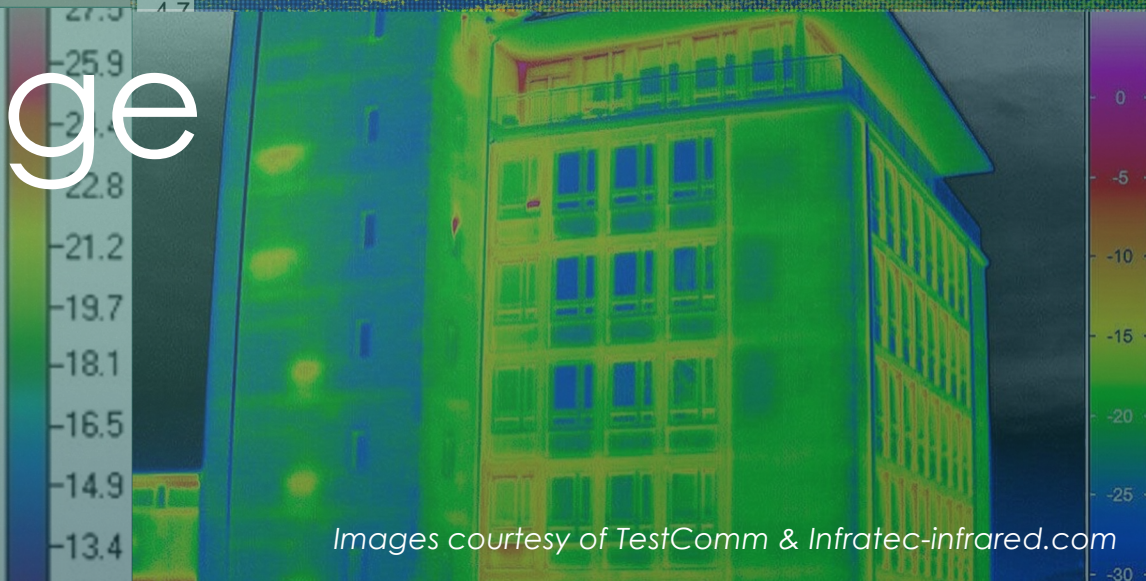
# Interlock Operable Openings With HVAC System Controls

## C403.4.1.6 Operable opening switches for HVAC system thermostatic control

- ▶ Activate HVAC operable opening controls once doors that open to the outdoors from a conditioned space **have been open for five (5) minutes**
- ▶ Disable mechanical heating to the zone or reset space heating temperature setpoint to 55°F
- ▶ Disable mechanical cooling to the zone or reset space cooling temperature setpoint to 85°F



# Building Enclosure Air Leakage



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

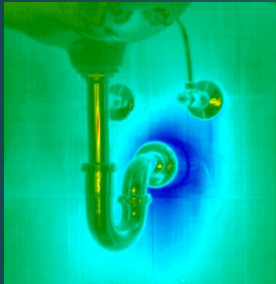


Image courtesy of Neudorfer



Image courtesy of Insitu Arch

- ▶ 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

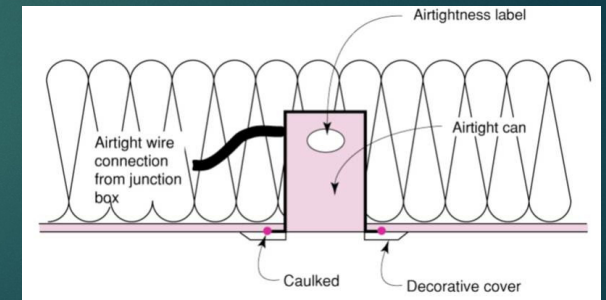
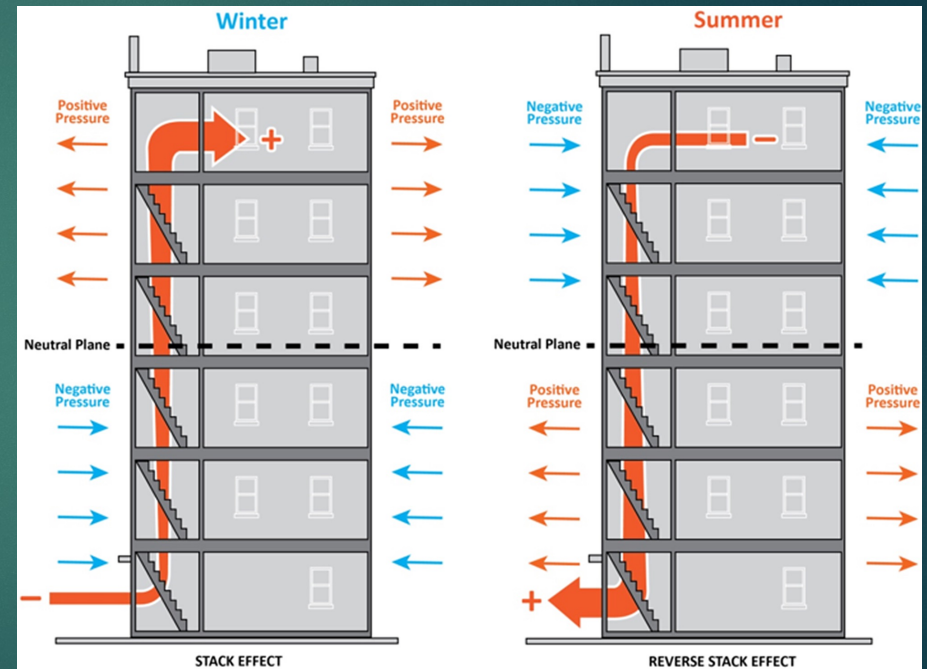


Image courtesy of Building America

# Air Barrier Durability

## C402.5.1.1 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



# 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

# Applicability to 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

## There are four test procedures defined in the 2021 WSEC-C

- ▶ **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).
- ▶ **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)**.
- ▶ **C402.5.2 Weighted average test of dwelling/sleeping units accessed directly from the outdoors** – Each unit shall be tested separately with an un-guarded blower door test. 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)**.
- ▶ **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**.

# Dwelling/Sleeping Unit Weighted-Average Test

- ▶ **Building type examples** – Group R-2/R-3 multi-family ( $\leq 3$  stories above grade); low-rise motels and resorts, etc
- ▶ Applies to buildings where multiple dwelling units, sleeping units and/or other occupiable conditioned spaces are contained within one building thermal envelope

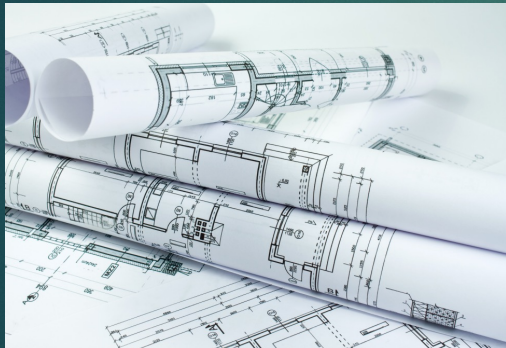


# What if the building initially fails the building enclosure test?



- ▶ 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

A close-up photograph of a red marker with a black cap writing red checkmarks on a checklist. The checklist consists of several square boxes arranged in a diagonal line. The marker is positioned over the fourth box from the top, which is currently empty. The other boxes above it contain red checkmarks. The background is a dark, slightly blurred surface.

# Envelope Performance Documentation

# Required Envelope Performance Documentation

## C103.2 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 C401.3 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



# Additional Energy Efficiency and Load Management

Additional Energy  
Efficiency Credits

# Multidiscipline Effort

- ▶ Measures include options for all primary disciplines (envelope, lighting/electrical, mechanical, SWH, misc)
- ▶ Multidiscipline collaboration to select which combination of credits are most suitable for the project
- ▶ Identify selected credits in permit submittals



# Two Types of Required Measures

## **C406.2 Additional Energy Efficiency Measures**

- ▶ **Purpose** – Focus of these measures is to enhance building systems energy performance
- ▶ In addition to complying with all applicable mandatory and prescriptive provisions, a project is required to comply with a minimum number of energy efficiency enhancements
- ▶ List of available credits has been expanded
- ▶ Number of required credits varies by occupancy group
- ▶ Credit value of each energy efficiency measure is based on modeled energy efficiency potential by occupancy group

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 coolers and freezers

# Number of Required Credits

- ▶ **Table C406.1 Exceptions** – Allows 50% of the minimum required number of credits in the following spaces:
  - Unconditioned spaces including open parking garages
  - Low energy spaces
  - Enclosed parking garages
  - Equipment buildings
  - Building additions less than 1,000 SF of conditioned floor area

Which existing building retrofits require full compliance with the current WSEC-C?

- ▶ Change in space conditioning
  - Space converted from low energy to semi-heated or conditioned space
  - Space converted from semi-heated to conditioned space
- ▶ Change in occupancy
  - Space converted from F, S or U occupancy to something other than F, S or U
  - Space converted to Group R from another use or occupancy
  - Group R dwelling unit converted to commercial use or occupancy if dwelling unit was permitted prior to July 1, 2002

# Two Types of Required Measures

## **NEW – C406.3 Load Management Measures**

- ▶ **Purpose** - Focus of these measures is automatic control of building systems based on demand and energy storage
- ▶ In addition to complying with energy efficiency measures, a project is required to comply with a minimum number of load management measures
- ▶ Number of required credits varies by occupancy group
- ▶ Credit value of each load management measure is based on modeled energy efficiency potential by occupancy group



Which project types are required to comply with load management 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

# 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.

# 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  $\geq 50\%$
- ▶ Eligible types – exterior roller, moveable blind or movable shutter shading devices
- ▶ Not eligible types - fixed overhangs, screens or shutter shading



*Optics & Photonics News*



*Image courtesy of Bandalux*





# Renewable Energy Generation Systems

# Renewable Energy Generation Systems

**There are now THREE elements to the renewable energy provisions**

- ▶ C411.1 On-site renewable energy
- ▶ C411.2 On-site and off-site renewable energy accounting
- ▶ C411.3 Solar readiness



# On-site & Off-site Renewable Energy

## When is renewable energy generation required?

- ▶ **C411.1 On-site renewable energy** – All new buildings or building additions **greater than 10,000 SF** of gross conditioned floor area

## What is required?

- ▶ Minimum energy generation capacity not less than **0.5 watt/SF or 1.7 Btu/SF** multiplied by sum of all gross conditioned floor areas of the building or addition
- ▶ Exceptions for buildings with limited available roof area or where > 50% of roof area is shaded
- ▶ Application to C406.2 Additional energy efficiency credit measures
  - Buildings that qualify for an exception to C411.1 must achieve an additional 18 energy efficiency credit measures from Table C406.2
  - This additional credits requirement can be reduced based on a prorated fraction of renewable capacity installed on-site

# On-Site Renewable Energy



## Multi-Discipline Requirements

- ▶ Renewable energy generation systems shall be located on the building or on another structure elsewhere on the project site
- ▶ ARCHITECT - Provide designated areas that are free of obstructions to accommodate renewable energy generation systems
- ▶ STRUCTURAL - Design building structure to accommodate future loading of renewable energy generation systems
- ▶ ELECTRICAL - Design electrical systems to accommodate interconnection to energy generation systems
- ▶ Comply with all applicable IFC requirements

# Off-site Renewable Energy

## **C411.2.1. Qualifying types of off-site renewable energy systems**

- ▶ Self-generation – Off-site renewable energy generation system owned by the building project owner
- ▶ Community renewable energy facility systems complying with **C411.2.2 Documentation requirements for off-site renewable energy systems**
- ▶ Purchase contracts complying with **C411.2.3 Renewable energy certificate (REC) tracking**
- ▶ Each source of renewable energy delivered to or credited to the building project shall be connect to the Western Interconnection and Energy, or capacity shall be multiplied by factors in Table C411.2.1



**Table C411.2.1 Multipliers for Renewable Energy Procurement Methods**

Location	Renewable Energy Source	Renewable Energy Factor		
		In the state of Washington	Western Interconnected	In the states of Oregon or Idaho
On-site	On-site renewable energy system	1	NA	NA
Off-site	Directly owned off-site renewable energy system that begins operations after submission of the initial permit application	0.95	0.75	0.85
Off-site	Community renewable energy facility that begins operation after submission of the initial permit application	0.95	0.75	0.85
Off-site	Directly owned off-site renewable energy system that begins operations before submission of the initial permit application	0.75	0.55	0.65
Off-site	Community renewable energy facility that begins operation before submission of the initial permit application	0.75	0.55	0.65
Off-site	Renewable Power Purchase Agreement (PPA)	0.75	0.55	0.65

Off-site Energy Factors vary depending on when the energy facility begins operation, relative to date of the initial permit application

# Off-site Renewable Energy

## **C411.2.3 Renewable energy certificate (REC)**

- ▶ May be utilized to demonstrate compliance with renewable energy minimum capacity requirements
- ▶ Applies to on-site or off-site renewable energy systems
- ▶ Contract with building owner of on-site or off-site renewable energy source shall be for a duration not less than 15 years
- ▶ **Submit certificate to the code official as part of permit application**
- ▶ REC tracking for multi-tenant buildings – Where RECs are transferred to tenants, define procedure for transfer, tracking of quantity, vintage and retirement schedule of RECs per Green-e Framework for Renewable Energy Certification.

# Solar Zone

## When is a solar zone area required?

- ▶ **C411.3 Solar readiness** – All buildings **20 stories or less** in height above grade plane

## What requirements apply to the solar zone?

- ▶ Minimum required solar zone area shall be either:
  - 40% of the roof area less skylights, occupied roof decks, mechanical equipment service clearances and planted areas
  - 20% of the electrical service size. Required solar zone area based on 10 peak watts of photovoltaic per SF
  - Impracticality exception allows lesser area with jurisdiction pre-approval
- ▶ May be comprised of separate subzones, each being at least 5 feet wide in the narrowest dimension
- ▶ Shall be free of obstructions such as pipes, vents, ducts, HVAC equipment, skylights and other obstructions
- ▶ Shall be setback from any existing or new object that is S,E,W of the solar zone

# Thank you!

## 2021 WSEC COMMERCIAL PROVISIONS – KEY CHANGES AND TECHNICAL RESOURCES



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