



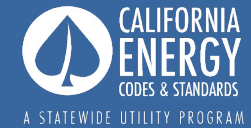
**TITLE 24, PART 6** 2025 CODE CYCLE

# Multifamily Restructuring

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring – Envelope & HVAC



Elizabeth McCollum  
February 21, 2023



# Multifamily Restructuring Topic Context

## 2022 Changes

- Reorganized multifamily requirements into standalone chapters within Title 24 Part 6 with 2022 update
- Increased uniformity across multifamily buildings with three or fewer habitable stories and buildings with four or more habitable stories

## 2025 Measures

- Align requirements across multifamily buildings of all heights
- Expand application of compliance options
- Reorganize and clean up additions, alterations, and repairs chapter for clarity and ease of use

# Multifamily Restructuring Measures

## February 14, 2023 Stakeholder Meeting

- Snapshot Quality Insulation Installation (QII)

## February 21, 2023 Stakeholder Meeting

- Additions and Alterations Clean-Up
- Skylight Properties (Additions and Alterations)
- Visible Transmittance
- Slab Perimeter Insulation
- Verification (HERS/ATT) Clean-Up
- Central Ventilation Shaft Sealing

# Poll Request

- **Measure Name:** MF Restructuring
- **Type of Poll:** Open response
- **Question:** What are your perceptions of the 2022 multifamily chapters? How can we further improve them?
- **Answers:** Open response
- **Placement:** After MF restructuring topic context
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y



## Multifamily Restructuring: Envelope

Additions and Alterations Clean Up *25 min*

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Skylight Properties (Additions and Alterations) *20 min*

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Visible Transmittance *15 min*

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Slab Perimeter Insulation *20 min*

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Break *10 min*





**TITLE 24, PART 6** 2025 CODE CYCLE

# Additions and Alterations Clean Up

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring



Elizabeth McCollum  
February 21, 2023



# Proposed Code Change

This measure does not include changes to the code requirements.

Draft code language for this measure is available in Handouts.

## *Description of change:*

### **Restructure additions and alterations requirements for ease of use.**

- Consistency with structure of Sections 160 and 170
- Organization by:
  - 180.1 Addition and 180.2 Alteration
  - (a) Mandatory, (b) Prescriptive, (c) Performance
  - Building component (e.g., 1. Envelope, 2. Mechanical Ventilation, 3. Space Conditioning...)
  - Dwelling unit vs Common use area (where applicable)
- Limit broad reference to other chapters
- Place exceptions in context of the applicable requirement
- Clean up language to clarify circumstances when requirements apply

- Several years ago, the Statewide Utility Compliance Improvement Team identified opportunity to improve structure of the residential and nonresidential additions, alterations, and repairs chapters.
- Code language and structure were borrowed (without edit) from residential and nonresidential chapters in creating the 2022 multifamily additions, alterations, and repairs chapter
  - Requires clarity about application of various requirements
  - References to other chapters requires jumping from chapter to chapter to understand requirements

# Additions Reorganization

Purple: Mandatory requirements referenced more directly  
 Green: Prescriptive requirements referenced more directly  
 Orange: Relocated to mandatory section

2022 Outline	2025 Proposed Outline
<p>Additions, alterations and repairs... shall meet the requirements specified in:</p> <ul style="list-style-type: none"> <li>Sections 100.0 through 110.10, <b>160.1, and 160.3 through 170.2...</b>, and</li> <li>performance compliance approach <b>or</b> prescriptive compliance approach</li> </ul>	<p>Additions, alterations and repairs... shall meet the requirements specified in:</p> <ul style="list-style-type: none"> <li>mandatory, <b>and</b></li> <li>prescriptive compliance <b>or</b> performance compliance approach</li> </ul>
<p>Additions.... shall meet the applicable requirements of Sections 110.0 through 110.9; <b>Sections 160.0, 160.1, and 160.2(c) and (d); Sections 160.3 through 160.7;</b> and either Section 180.1(a) or 180.1(b).</p> <p>(a) Prescriptive approach</p> <ol style="list-style-type: none"> <li>Envelope             <ol style="list-style-type: none"> <li>Additions greater than 700 square feet</li> <li>Additions 700 square feet or less</li> </ol> </li> <li><b>Mechanical ventilation for indoor air quality</b></li> <li>Water heater</li> </ol> <p>(b) Performance approach</p> <ol style="list-style-type: none"> <li>For additions alone</li> <li>Existing plus alteration plus addition</li> <li><b>Mechanical ventilation for indoor air quality</b></li> </ol>	<p>Additions...shall meet the applicable requirements of Sections 110.0 through 110.9; Section 180.1(a); and either Section 180.1(b) or 180.1(c).</p> <p><b>(a) Mandatory</b></p> <ol style="list-style-type: none"> <li><b>Envelope</b></li> <li><b>Mechanical ventilation for indoor air quality</b></li> <li><b>Space conditioning systems</b></li> <li><b>Water heating systems and equipment</b></li> <li><b>Mechanical acceptance testing</b></li> <li><b>Lighting</b></li> <li><b>Elevators</b></li> <li><b>Pool and spa systems</b></li> <li><b>Solar ready</b></li> </ol> <p>(b) Prescriptive approach</p> <ol style="list-style-type: none"> <li>Envelope</li> <li><b>Space conditioning</b></li> <li>Water heater</li> <li><b>Lighting</b></li> </ol> <p>(c) Performance approach</p> <ol style="list-style-type: none"> <li>For additions alone</li> <li>Existing plus alteration plus addition</li> </ol>

# Alterations Reorganization

Purple: Mandatory requirements referenced more directly  
 Green: Prescriptive requirements referenced more directly  
 Orange: Relocated to mandatory section  
 Blue: Reorganized for consistent structure

2022 Outline	2025 Proposed Outline
Additions, alterations and repairs... shall meet the requirements specified in: <ul style="list-style-type: none"> <li>Sections 100.0 through 110.10, <b>160.1, and 160.3 through 170.2...</b>, and</li> <li>performance compliance approach <b>or</b> prescriptive compliance approach</li> </ul>	Additions, alterations and repairs... shall meet the requirements specified in: <ul style="list-style-type: none"> <li>mandatory section, <b>and</b></li> <li>prescriptive compliance <b>or</b> performance compliance approach</li> </ul>
Alterations... shall meet Item (a), and either Item (b) or (c) below: <p>(a) Mandatory</p> <ol style="list-style-type: none"> <li><b>1. Roof/ceiling insulation</b></li> <li><b>2. Wall insulation</b></li> <li><b>3. Floor insulation</b></li> </ol> <p>(b) Prescriptive approach</p> <ol style="list-style-type: none"> <li>Envelope</li> <li>Space conditioning systems</li> <li>Hot water systems</li> <li>Lighting                             <ol style="list-style-type: none"> <li><b>A. Dwelling unit lighting</b></li> <li>Common use area lighting, sign lighting, and <b>electrical power distribution</b></li> </ol> </li> <li><b>5. Mechanical ventilation for dwelling units</b></li> </ol> <p>(c) Performance approach</p> <ol style="list-style-type: none"> <li><b>1. Mandatory requirements of 160 Sections, and mechanical ventilation</b></li> <li>Standard design</li> <li>Proposed design</li> </ol>	Alterations... shall meet the applicable requirements of Sections 110 through 110.9, Section 180.2(a); and either Section 180.2(b) or 180.2(c). <p>(a) Mandatory</p> <ol style="list-style-type: none"> <li><b>1. Envelope</b></li> <li><b>2. Mechanical ventilation and indoor air quality</b></li> <li><b>3. Space conditioning systems</b></li> <li><b>4. Water heating systems and equipment</b></li> <li><b>5. Mechanical acceptance testing</b></li> <li><b>6. Lighting (dwelling unit, common use area controls)</b></li> <li><b>7. Electric power distribution</b></li> <li><b>8. Elevators</b></li> <li><b>9. Pool and spa systems</b></li> </ol> <p>(b) Prescriptive approach</p> <ol style="list-style-type: none"> <li>Envelope</li> <li>Space conditioning systems</li> <li>Hot water systems</li> <li>Lighting (common use areas, outdoor, sign lighting)</li> </ol> <p>(c) Performance approach</p> <ol style="list-style-type: none"> <li>Standard design</li> <li>Proposed design</li> </ol>

# Draft Code Change Language

We are looking for suggestions (general and specific) on improving Subchapter 12: Additions, Alterations, and Repairs to Existing Multifamily Buildings.

- Clarifications
- Reorganizations
- Discrepancies
- Pain points
- Typos

Draft code language available for review in Handouts and downloadable.

Please provide Feedback to CASE Author by **March 7th**.

**Please look at the proposed code language and let us know if you believe the proposed reorganization results in an unintended change in requirements.**

# Poll Request

- **Measure Name:** Additions and Alterations
- **Type of Poll:** Open response
- **Question:** Where do you anticipate challenges with the 2022 MF Additions, Alterations, and Repairs chapter? How can this chapter be improved?
- **Answers:** Open response
- **Placement:** After A+A context and history
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y

# Thank You

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**TITLE 24, PART 6** 2025 CODE CYCLE

# Skylight Properties

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring



Grant Marr  
February 21, 2023



This proposed skylight properties measure would align alterations requirements for skylights to be the same across all multifamily buildings, regardless of number of stories. For some buildings, the current code requires skylight specifications that are generally not technically feasible or available in the market. This would correct that oversight and make the code simpler.

## Context and History

- Skylights are rare in multifamily buildings
- **U-factor** and **SHGC**: These ratings describe the heat gain and loss of windows and skylights
- **Visible Transmittance**: This rating describes how much visible light comes through
- Code history
  - Requirements for 3 or fewer stories originally came from residential code
  - Requirements for 4 or greater stories originally came from nonresidential code
- Why are we proposing this measure?
  - Aiming to align multifamily requirements for all buildings regardless of number of stories
  - Some of the current skylight requirements are not technically feasible for many replacements

Skylights in multifamily buildings are rare. In a review of 90 existing multifamily buildings by Evergreen Economics, only three had skylights over a residential floor. In a review of the last 10 years of multifamily new construction projects designed by a multifamily focused architect interviewed by the Statewide CASE Team, only one building had skylights over a residential floor.

# Proposed Code Change

## *Description of change to alterations requirements:*

- Apply the prescriptive alteration requirements for "Skylights, 4 habitable stories and greater" to all multifamily buildings with any number of stories
- Change SHGC for CZ1 to match other climate zones (fixes a clerical error)
- Bring back some exception for skylight replacements (for small replacements, <50ft<sup>2</sup> total)
- Remove an exception for "per dwelling unit" amounts of added skylights in an alteration

Draft code language for this measure is available in Handouts.



We're proposing keeping exceptions at the building level instead of the dwelling unit level to simplify the code. Buildings altering three dwelling units with 16sqft of skylights each would still fall under the 50sqft exemption as proposed.

# Current Code Requirements

- Existing Requirements in Title 24, Part 6
  - Skylight **alterations**
    - Exception for added skylights: under 50ft<sup>2</sup> total, or under 16ft<sup>2</sup> per dwelling unit
    - (No exception for replaced skylights -- was removed in 2022 code)
  - Requirements also apply to skylights **in additions** of 700ft<sup>2</sup> or less

	U-factor	Solar Heat Gain Coefficient (SHGC)	Visible Transmittance
3 or fewer habitable stories	0.30	NA, 0.23, or 0.30	NA
4 or greater habitable stories	0.46	0.25 or 0.35	0.49

## Minor Proposal: Fixing Clerical Error

	U-factor	Solar Heat Gain Coefficient (SHGC)	Visible Transmittance
3 or fewer habitable stories	0.30	NA, 0.23, or 0.30	NA
4 or greater habitable stories	0.46	0.25 or 0.35	0.49

The SHGC requirement in red is a clerical error listed for one climate zone. Proposing changing it to 0.25, as originally intended (from nonresidential code)

# Current Skylight Alteration Requirements vs. Proposal

Existing Requirements in Title 24, Part 6:

	U-factor	Solar Heat Gain Coefficient (SHGC)	Visible Transmittance
3 or fewer habitable stories	0.30	NA, 0.23	NA
4 or greater habitable stories	0.46	0.25	0.49

- Exception for under 50ft<sup>2</sup> total added skylights
- Exception for under 16ft<sup>2</sup> added skylights per dwelling unit

Proposed Requirements:

	U-factor	Solar Heat Gain Coefficient (SHGC)	Visible Transmittance
All multifamily buildings	0.46	0.25	0.49

- Exception for under 50ft<sup>2</sup> total added skylights
- Exception for under 50ft<sup>2</sup> skylight replacement

Existing requirements are on top, with the proposal on the bottom half. RED text shows the parts of the code that we are proposing to remove. 0.30 U-factor with 0.23 SHGC is a technically feasible requirement for many windows, but not for most skylights. These numbers are generally only found in tubular daylighting devices, and so can't be met for many skylight replacements. Under both the current code AND the proposed code, a skylight replacement or addition would be very unlikely to exceed the exceptions and be held to the numbers in the table. But to simplify the code, we're proposing keeping exceptions at the building level instead of the dwelling unit level. This should have very little impact, because all multifamily skylights we've found in our research are above common use areas anyway, not above dwelling units. Also, none of the buildings in our research had 50 sqft of skylights total – this is a lot of skylights.) Even if we remove the 16sqft exception, as proposed, buildings could still add 16sqft of skylights above each of 3 dwelling units and this would still fall under the 50sqft exception.

In BLUE is the exception for replacing skylights. An exception for replacements was removed when creating the multifamily

chapter, but we are proposing bringing it back for replacements of up to 50sqft. This way, replacing skylights is not held to a more stringent requirement than adding entirely new skylights.

## Market Overview and Technical Considerations

- Skylights are not very common in multifamily buildings
- The current requirements for skylights in  $\leq 3$  habitable story buildings (.30 U-factor, .23 SHGC) are likely only achievable with highly efficient "solar tube" tubular daylighting devices. This is not feasible for many replacement scenarios.
- This measure applies the more technically feasible 0.46 u-factor / 0.25 SHGC / to all alterations (and changes some exceptions to this requirement)



# Poll Request

- **Measure Name:** skylights
- **Type of Poll:** Open response
- **Question:** What initial feedback do you have about these simplified requirements and exceptions?
- **Answers:** Open response
- **Placement:** After market overview and technical considerations
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y

# Compliance and Verification Process



## Design Phase:

- The **contractor** specifies skylight product
- The **energy consultant** identifies relevant compliance path options (in more comprehensive retrofit scenarios).
- **Designers** provide skylight areas and performance specifications.



## Permit Application Phase:

- The **energy consultant** completes Certificate of Compliance (in more comprehensive retrofit scenarios)
- The **contractor** applies for the permit.



## Construction Phase:

- The **contractor** installs products and populates Certificate of Installation that documents the skylight performance values.



## Inspection Phase:

- **Plan checker and building inspector** verify that installed skylights match those submitted in compliance documentation.

This slide outlines the market actors that are involved in skylight alterations – contractors, consultants, designers, plan checkers, building inspectors. This proposed measure simplifies the requirements and exceptions, but no significant changes are expected to the compliance process.

# Thank You

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**TITLE 24, PART 6 2025 CODE CYCLE**

# Visible Transmittance

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring



Grant Marr  
February 21, 2023



Visible transmittance, or VT, describes how much visible light comes through a window. Currently there are VT requirements for buildings with 4 or more habitable stories, but not for those with fewer. This measure would apply the requirements for minimum VT levels to common use areas across all multifamily buildings.

# Proposed Code Change

*Description of change:*

- Apply prescriptive visible transmittance (VT) requirements to common use areas only
- Remove mention of four or more habitable stories in Table 170.2-A

This is a clean-up measure to return requirements to intended application and does not result in energy savings.

Draft code language available for review in Handouts.

Please provide Feedback to CASE Author by **March 7th**.

## Context and History

Visible transmittance (VT) requirements were introduced into nonresidential requirement to protect energy savings from automatic daylighting controls in daylit areas.

2022 multifamily restructuring consolidated all multifamily requirements into three standalone chapters and carried VT requirement over from nonresidential (and high-rise residential) requirements.

- Multifamily envelope requirements contain no distinction between dwelling unit and common use area
- Applied VT requirement to high-rise dwelling units, where no automatic daylighting control requirements exist
- Excluded common use areas in buildings up to 3 habitable stories, where there are automatic daylighting requirements

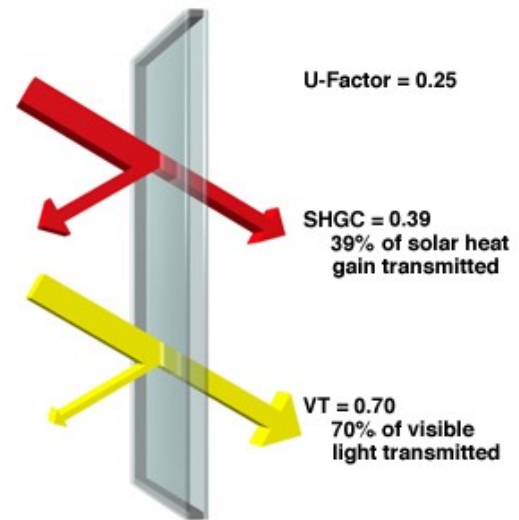


Image: K&J Windows, "Visible Transmittance," accessed 2023, <https://kjwindows.com/for-homeowners/visible-transmittance/>

Presented at Utility Sponsored Stakeholder Meeting on February 21, 2023 | Visible Transmittance

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To explain in another way: The code requires a minimum VT for certain windows, which allows more visible light to come in. The energy savings from VT comes from daylighting controls, since more light coming in means less electric lighting is needed. Daylighting controls are only required in common use areas like corridors, and shared multifamily spaces – not in dwelling units. So this proposed measure would make VT requirements apply only where it would result in energy savings – to all common use areas of all multifamily buildings (with any number of stories), but there would be no VT minimum for dwelling units.

# Current Code Requirements

## Existing Requirements in Title 24, Part 6:

- No VT requirement for fenestration in multifamily buildings with three or fewer habitable stories
- VT requirement for fenestration in multifamily buildings with four or more habitable stories
  - 0.46 for curtainwall/storefront
  - 0.37 for NAFS Performance Class AW
- No automatic daylighting control requirements for dwelling units
- Automatic daylighting control requirements for daylit (skylit, primary sidelit, and secondary sidelit) zones in common use areas



Current code does not require a minimum VT for other fenestration that does not fall under curtainwall/storefront, or NAFS Performance Class AW windows. This proposed cleanup measure would keep the VT requirements only to these two types of windows where it is already a requirement.

Nothing in this proposal requires that designer use different windows in different parts of a building. Dwelling units can still have windows with higher VT if desired.

# Poll Request

- **Measure Name:** Visible Transmittance
- **Type of Poll:** Multiple choice
- **Question:** Which is the most appropriate change to the visible transmittance requirements for multifamily fenestration?
- **Answers:**
  - Application to common use areas only
  - Application to all fenestration in multifamily buildings
  - There should be no change
  - Other (please include suggestions in the chat)
- **Placement:** after slide current code requirements
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y



# Thank You

**Grant Marr, TRC**

Visible Transmittance Measure Lead

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**TITLE 24, PART 6 2025 CODE CYCLE**

# Slab Perimeter Insulation

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring



Grant Marr  
February 21, 2023



Currently, perimeter insulation for slab on grade foundations is prescriptively required for multifamily buildings with three or fewer habitable stories, in climate zone 16. This proposed measure would extend the same prescriptive requirement for slab perimeter insulation for all new multifamily buildings, still only in climate zone 16.



## Background

- Code Change Proposal
- 2022 Code Requirements
- Context and History

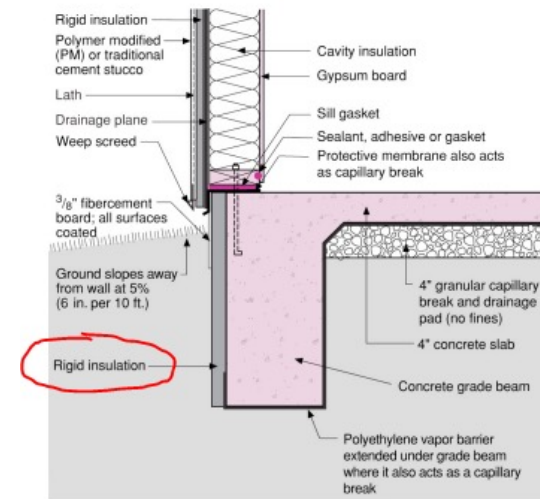
# Proposed Code Change

- Extend the slab perimeter insulation requirement for multifamily buildings—currently only prescriptively required for applicable multifamily buildings with three or fewer habitable stories—to all applicable multifamily buildings with any number of habitable stories, for consistency across all multifamily buildings
- Would change a prescriptive requirement
  - Would change the standard design for multifamily buildings with 4 or greater habitable stories
- Would still only apply to Climate Zone 16

Draft code language for this measure is available in **Handouts**.

Image: Building America Program, "BSC Information, Slab Edge Insulation for All Climates." 2009.  
[https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/slab\\_edge\\_insulation.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/slab_edge_insulation.pdf)

Perimeter Insulation of Monolithic Slab-Grade Beam



To emphasize: This proposed measure would not affect many dwelling units. Our construction forecasts assume only about 100 mid-rise and high-rise dwelling units being built in CZ16 per year – that's about one or two buildings. And this requirement only applies if the slab on grade foundation is part of the thermal envelope, as explained in a coming slide.

# Current Code Requirements



## Existing Requirements in 2022 Title 24, Part 6 – Multifamily Prescriptive Approach (Standard Design)

- Slab Perimeter, 3 habitable stories or less
  - Climate Zone 16: insulation  $R \geq 7.0$ , or F-factor  $\leq 0.58$
  - All other Climate Zones: No requirement
  - Minimum depth of the insulation shall be 16 inches or the depth of the footing of the building, whichever is less

## Existing Model Code Requirements:

- **ASHRAE 90.1** and **IECC Commercial** both require slab edge insulation for most climate zones in California, for multifamily buildings with 4+ stories

Image from CEC - EZ Building Climate Zone Search Tool. December 2023. <https://caenergy.maps.arcgis.com/apps/webappviewer/index.html?id=5cfefd9798214bea91cc4fddaa7e643f>

# Context and History



Slab perimeter insulation / slab edge insulation:

- Helps insulate a slab-on-grade foundation
- Reduces heat loss through the slab, and reduces energy loss, especially in cold climates
- Also helps prevent moisture/condensation issues from temperature difference, and therefore helps prevent mold (indoor air quality)

## *Why this proposal?*

- Aiming to align multifamily requirements for all buildings regardless of number of stories
- Would save some energy in Climate Zone 16
- ASHRAE 90.1 and IECC Commercial require slab edge insulation for multifamily buildings with 4+ stories





## Market Overview

- Current Market Conditions
- Market Trends
- Potential Market Barriers and Solutions

# Market Overview and Analysis

## Current Market

- Market for slab edge insulation already established through requirement for buildings up to three habitable stories.
  - Same products can be applied to buildings with four or more habitable stories.
- Very few 4+ story multifamily buildings are built in Climate Zone 16 each year. Very few of those, if any, have slab-on-grade foundations

## Market Barriers

- California examples of slab edge insulation in multifamily buildings are rare. Some designers and builders may be unfamiliar with design and installation.
  - There are examples in colder parts of the country where ASHRAE 90.1 and IECC Commercial standards have been adopted.

**Do you agree with  
this description?  
What else should we  
know?**



# Poll Request

- **Measure Name:** Slab Perimeter Insulation
- **Type of Poll:** Multiple choice (multiple answer)
  - **Question:** Do you know of any 4+ story multifamily building with a slab-on-grade foundation in CZ16, with conditioned space on the ground floor?
- **Answers:**
  - Yes
  - No (and I DO have knowledge of buildings in CZ16)
  - No (but I am NOT familiar with buildings in CZ16)
- **Placement:** after Market Overview and Analysis (Slab Edge)
- **Broadcast results to attendees as they respond:** (Y)
- **Make poll public during presentation:** (Y)

Measure Name - Go to Insert > Footer to Apply Change to All Slides

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Slab-on-grade foundation with conditioned space on the ground floor – this means that there is no bottom floor parking garage. The slab on grade has to have conditioned space above it for this requirement to apply. Some of the most populated places in CZ16 are: Lake Tahoe area, Truckee, Tehachapi, Susanville, Mammoth Lakes



# Technical Considerations

- Technical Considerations
- Potential Barriers and Solutions

# Technical Considerations

## Technical Considerations

- Proposal does not require change in standard design practices
- Various types of insulation are appropriate – XPS, rigid fiberglass, rock wool

## Technical Barriers and Potential Solutions

- Water absorption rate, water vapor permeance, protection from physical damage and UV deterioration
  - Already addressed in Single Family code. Proposing the same clarification for Multifamily.
- Termite damage
  - Addressed by termite inspection gap or using a protective membrane

**Are there other technical considerations that apply especially to taller buildings?**

**Do you agree with this description?  
What else should we know?**

# Energy and Cost Impacts Per Dwelling Unit

## *Methodology and Assumptions*

- Energy Savings Methodology and Results
- Cost Impacts Methodology and Results
  - Incremental costs
  - Energy cost savings



# Methodology for Energy Impacts Analysis

- Modified Loaded Corridor prototype as the baseline, to model a 4-story multifamily building with a slab-on-grade foundation
- Climate Zone 16 only



## Standard Design

No slab-edge insulation



## Proposed Design

With R-7 slab-edge insulation

# Preliminary Energy Savings Estimates Per Dwelling Unit

<b>Annual Electricity Savings</b>	-3 kWh/yr
<b>Annual Natural Gas Savings</b>	310 kBtu/yr
<b>Peak Demand Reduction</b>	-70 W
<b>Annual LSC Savings (2026 PV\$)</b>	\$366/year
<b>Annual Source Energy Savings</b>	277 kBTU/yr

## Key Assumptions:

- CZ16 energy modeling uses weather data from Blue Canyon, CA
- Gas heating
- 4-story building

# Incremental Cost Information

## Cost Information Sources:

- Insulation cost from one contractor for materials and labor in CZ16 (per linear foot)
- Protection board and flashing cost from RS Means database for materials and labor, adjusted for CZ16 (per square foot of material)

## Included as proposed technology costs:

- Insulation: 16" deep, 1.5" extruded polystyrene insulation, R7.5
- Protection board: 14" deep fiber cement board, panel siding, 8" above grade, 6" below
- Metal flashing: to protect top of insulation, 6"

For the prototype building  
(522 linear feet of perimeter):

**Insulation estimate:**  
\$8,743

**Protection board and  
flashing estimate:**  
\$5,807

# Incremental Per Dwelling Unit Cost

Over 30-Year Period of Analysis

Incremental First Cost	
Materials	\$130
Labor	\$167
<b>Total</b>	<b>\$297</b>

Incremental Maintenance Cost	
Equipment Replacement	\$0
Annual Maintenance	\$0
<b>Total</b>	<b>\$0</b>

Total incremental cost over 30-year period of analysis: **\$297**

- Insulation cost came from one contractor estimate
- Protection board and flashing cost estimate came from RS Means



# Cost Effectiveness

<b>Climate Zone</b>	<b>Benefits</b> <i>LSC Savings + Other PV Savings</i> <b>(2026 PV\$)</b>	<b>Costs</b> <i>Total Incremental PV Costs</i> <b>(2026 PV\$)</b>	<b>Benefit-to- Cost Ratio</b>
<b>16</b>	<b>\$366</b>	<b>\$297</b>	<b>1.23</b>

## Poll Request

- **Measure Name:** Slab edge
- **Type of Poll:** open response
- **Question:** What questions or comments do you have about the technical feasibility or cost and energy analysis for slab edge insulation?
- **Placement:** after cost-effectiveness
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y



## Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection
- Revisions to Compliance Software

# Compliance and Verification Process



## Design Phase:

Architect and energy consultant would follow minimum slab edge requirements or greater.



## Permit Application Phase:

- Energy consultant would document relevant insulation Certificate of Compliance documents
- General contractor would apply for the building permit with slab edge insulation shown on the Certificate of Compliance.
- Plans examiner would verify slab edge insulation information on the construction documents is consistent with requirements on compliance documents.



## Construction Phase:

A contractor would install slab edge insulation according to design details, before or after concrete is poured, and complete Certificate of Installation.



## Inspection Phase:

Building inspector would visit the site to verify slab edge insulation.

The biggest change here would be constructing and inspecting the slab edge insulation, adding additional processes for applicable buildings. If there are folks on the call that have experience with slab edge insulation on multifamily buildings, we'd love your feedback on how this affects compliance and verification.

# Review of Code Language Markup



## Draft Code Change Language

### Changes:

- Remove "three habitable stories or less" from prescriptive requirements
- Change "U-factor" to be "F-factor" (the correct metric) and reference relevant table
- Add mandatory requirements around protecting slab edge insulation, same as Single Family code

Draft code language available for review in Handouts and downloadable.



## Discussion and Next Steps

# Thank You

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## Multifamily Restructuring: HVAC

Verification Clean Up	<i>25 min</i>
Central Ventilation Shaft Sealing	<i>20 min</i>
Discussion and Wrap Up	<i>20 min</i>





**TITLE 24, PART 6** 2025 CODE CYCLE

# Verification Clean Up

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring



Lucy Albin  
February 21, 2023





## Background

- Code Change Proposal
- 2022 Code Requirements
- Context and History

## Proposed Code Change

- Align HERS compliance credits currently applicable to dwelling units in multifamily buildings with three or fewer habitable stories across all multifamily buildings with HVAC systems serving individual dwelling units, regardless of number of stories
- Language clean up:
  - Add relevant and remove irrelevant measures to HERS compliance options list
  - Clean up “low-rise residential” and “high-rise residential” language in the Residential and Nonresidential Appendices

Draft code language for this measure is available in Handouts



# Context and History

HERS compliance options fall into 2 general categories for alignment across multifamily buildings

- New credits not currently available to buildings with four or more habitable stories
  - More flexibility through performance approach
- Existing performance credits which currently require no verification in buildings with four or more habitable stories
  - Collect feedback to understand the necessity for requiring verification for existing performance credits in buildings with four or more habitable stories



# Current Compliance Options, Buildings up to 3 Stories

## New compliance options for buildings with four or more habitable stories, if extended

- **Low Leakage Air-handling Units –**  
Verify low leakage air handler and ducts installed and system leakage rate meets or exceeds rate specified on Certificate of Compliance
- **Variable Capacity Heat Pump (VCHP) –**  
Verify system equipment is listed in Energy Commission low-static pressure systems, non-continuous fan operation, refrigerant charge, low leakage ducts in conditioned space, ductless system in conditioned space, airflow to all habitable spaces, wall-mounted thermostats for zones >150 ft<sup>2</sup>, ducted airflow, and air filter pressure drop
- **Central Fan Ventilation Cooling System –**  
Verify system airflow and fan efficacy meet or exceed requirements of Certificate of Compliance.
- **Whole House Fan –**  
Verify airflow rate and watt draw. Calculate efficacy (w/cfm). Confirm airflow rate and efficacy meet or exceed requirements of Certificate of Compliance.
- **Evaporatively Cooled Condensers –**  
Verify low leakage ducts, refrigerant charge, time delay response, listed equipment, and system efficiencies

## Poll Request

- **Measure Name:** Verification Clean Up
- **Type of Poll:** Open ended
- **Question:** Would any of proposed measures require additional training or a change in procedure to extend to multifamily buildings with four or more stories?
- **Placement:** after slide 57 (Current Compliance Options, Verification Clean Up)
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y

# Current Compliance Options, Buildings up to 3 Stories

**Additional verification for credits already available to buildings with four or more habitable stories**

- **Verified Energy Efficiency Ratio (EER/EER2) and Seasonal Energy Efficiency Ratio (SEER/SEER2) and Heating Seasonal Performance Factor (HSPF/HSPF2) –**  
Verify system equipment is listed in approved directory and necessary information is provided
- **Rated Heat Pump Capacity Verification –**  
Verify system equipment is listed in approved directory and heating capacities are greater than or equal to values specified on Certificate of Compliance



## Poll Request

- **Measure Name:** Verification Clean Up
- **Type of Poll:** Open ended
- **Question:** Would requiring HERS verification for relevant measures increase energy savings in buildings with four or more stories?
- **Placement:** after slide 59 (Current Compliance Options, Verification Clean Up)
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y

# Poll Request

- **Measure Name:** Verification Clean Up Options, Verification Clean Up)
- **Type of Poll:** Multiple choice (multiple responses)
- **Question:** Do any of the measures below not apply to multifamily buildings with four or more habitable stories?
- **Answers:**
  - Low Leakage Air-handling Units
  - Verified EER/EER2 and SEER/SEER2
  - Rated Heat Pump Capacity Verification
  - Evaporatively Cooled Condensers
  - Variable Capacity Heat Pump (VCHP) Compliance Option
  - Whole House Fan
  - Central Fan Ventilation Cooling System
  - All measures are applicable to buildings with four or more habitable stories
- **Placement:** after slide 59 (Current Compliance
- **Broadcast results to attendees as they respond:** Y
- **Make poll public during presentation:** Y



## Market Overview

- Current Market Conditions
- Potential Market Barriers and Solutions
- Potential Technical Barriers and Solutions
- Cost Information

# Market Overview and Analysis

## Current Market

- HERS raters already performing verification tests in multifamily buildings of all heights
- Mandatory measures in all MF include whole dwelling unit ventilation and kitchen exhaust fan
- Majority uptake for certain HERS compliance options in buildings with three or fewer habitable stories: Verified EER/EER2 and SEER/SEER2, Rated Heat Pump Capacity Verification



# Market and Technical Barriers

## Market Barriers

- HERS Raters have limited experience with less common compliance options
- Increased HERS Rater demand not anticipated as a barrier based on stakeholder feedback

## Technical Barriers

- No issues identified in stakeholder interviews
- New technical issues may arise if multifamily market implements measures with low uptake in multifamily buildings to date



## Incremental Cost Information

- Verification time and cost implications will be collected through interviews with HERS raters
  - Costs may include labor, travel, equipment, and materials
  - Estimated per dwelling unit
- Hourly field billing rate for HERS Rater: \$90
- Increased cost efficiencies from multiple HERS measures

Cost information for each measure will be explored, but a full cost-effectiveness analysis will not be conducted for adding/modifying compliance options





## Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection
- Revisions to Compliance Software

# Compliance and Verification Process



## Design Phase

- Project team would identify compliance credits to pursue
- Project team would develop details and **specifications** accordingly



## Permit Application Phase

Verification requirements would be included in energy compliance documentation



## Construction Phase

Contractor would document installation and verification procedures via compliance documentation



## Inspection Phase



- **HERS Rater or ATT would conduct verification test**
- **Code official would confirm results are submitted if compliance option is claimed**

### Updates may include:

- Updates to compliance forms



# Standard and Proposed Designs

		
Measure	Standard Design	Proposed Design
<b>Low-leakage Air-handling units</b>	Non-certified air handler	CEC certified air-handling unit with lower leakage
<b>Verified EER/EER2, SEER/SEER2, HSPF/HSPF2</b>	Federal minimum	More efficient AC or HP
<b>Verified Heat Pump Capacity</b>	Slightly oversized heat pump	Right-sized for average dwelling unit
<b>Evaporatively Cooled Condensers</b>	Split-system AC Federal minimum	Evaporatively cooled condenser, verified refrigerant charge, higher EER/EER2, lower duct leakage
<b>VCHP</b>	Non-verified VCHP and refrigerant charge, default duct leakage, default airflow	CEC verified VCHP system, verified refrigerant charge, low leakage ducts in conditioned space, airflow verification
<b>Whole House Fan</b>	Default airflow and watt draw	Higher than default air flow
<b>Central Fan Ventilation</b>	Default airflow and fan efficacy	Higher than default air flow

# Context and History

	HERS	Either	Mechanical Systems ATT	
Mandatory and Prescriptive Ventilation		<ul style="list-style-type: none"> <li>Whole-dwelling unit mechanical ventilation</li> <li>Kitchen exhaust fan HVI or AHAM airflow, sound, and capture efficiency ratings</li> <li>HRV/ERV performance verification</li> </ul>	<ul style="list-style-type: none"> <li>Common use area mechanical systems</li> <li>Parking garage and elevator ventilation</li> </ul>	
Mandatory and Prescriptive Space conditioning	<p><b>Dwelling unit</b> mechanical systems:</p> <ul style="list-style-type: none"> <li>Duct sealing (three or fewer habitable stories)</li> <li>Supply duct location, surface area, and R-value</li> <li>Low-leakage ducts in conditioned space</li> <li>Low-leakage air handlers</li> <li>Return duct design</li> <li>Air filter device design, MERV rating, and labeling</li> </ul>	<ul style="list-style-type: none"> <li>Refrigerant charge in ducted split-system and ducted packaged unit air conditioners and heat pumps, and mini-split systems</li> <li>Refrigerant fault indicator display (FID)</li> <li>System airflow</li> <li>Air handler fan efficacy</li> </ul>	<ul style="list-style-type: none"> <li>Common use area duct sealing</li> </ul>	<p><b>Common use area</b> mechanical systems:</p> <ul style="list-style-type: none"> <li>Constant volume, single zone air conditioning and heat pump unit controls</li> <li>Duct systems</li> <li>Air economizers</li> </ul>
Space Heating Compliance Options	<p><b>Dwelling unit</b> mechanical systems:</p> <ul style="list-style-type: none"> <li>Bypass duct prohibition</li> <li>EER/SEER</li> <li>Heat pump rated heating capacity</li> <li>Maximum rated total cooling capacity</li> </ul>	<ul style="list-style-type: none"> <li>Evaporatively-cooled condensers</li> <li>Central fan-integrated ventilation cooling systems</li> <li>Zonal controls</li> </ul>		

# Poll Request

- **Measure Name:** Verification Clean-up
- **Type of Poll:** Multiple choice (one answer)
- **Question:** Do you agree with maintaining the division of dwelling unit and common use area verification measures between HERS Raters and ATTs?
- **Answers:**
  - Yes
  - No, compliance options should be allowed to be verified by multiple entities
  - No, other reason
  - I don't know
- **Placement:** after Context and History (slide 69)
- **Broadcast results to attendees as they respond:** (Y)
- **Make poll public during presentation:** (Y)

# Poll Request

- **Measure Name:** Verification Clean-up
- **Type of Poll:** Open response
- **Question:** If the current division of verification measures between HERS Raters and ATTs is maintained, does the structure of the Reference Appendices make sense? How could it be improved?
- **Placement:** after Context and History (slide 69)
- **Broadcast results to attendees as they respond:** (Y)
- **Make poll public during presentation:** (Y)

# Review of Code Language Markup

Draft Code Change Language





## Discussion and Next Steps

# Thank You

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**TITLE 24, PART 6** 2025 CODE CYCLE

# Central Ventilation Shaft Sealing

Codes and Standards Enhancement (CASE) Proposal  
Multifamily | Restructuring



Lucy Albin  
February 21, 2023







## Background

- Code Change Proposal
- 2022 Code Requirements
- Context and History

# Proposed Code Change

- Extend existing central ventilation shaft sealing requirement for multifamily buildings with four or more habitable stories to all multifamily buildings with central ventilation (including buildings with three habitable stories or fewer) for consistency across all multifamily buildings
  - [Section 160.2\(b\)2C: Multifamily Building Central Ventilation System Field Verification](#)
- Mandatory requirement for sealing and testing of **central ventilation shafts** in new multifamily buildings
  - Applies to central exhaust shafts and central ventilation shafts
  - 6 percent allowable leakage of rooftop fan flowrate
  - Conduct test using ASHRAE Standard 215-2018

**Draft code language  
for this measure is  
available in  
Handouts**

# Current Code Requirements

## Existing Requirements in Title 24, Part 6

- MF buildings with four or greater habitable stories: Mandatory requirement for central shaft sealing and testing
- MF buildings with three or fewer habitable stories: No requirement for central shaft sealing or testing

## Other relevant resources:

- Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) has shaft sealing guidelines, but they are not required by code
- ASHRAE Standard 215: "Method of Test to Determine Leakage of Operating HVAC Air-Distribution Systems," for testing leakage

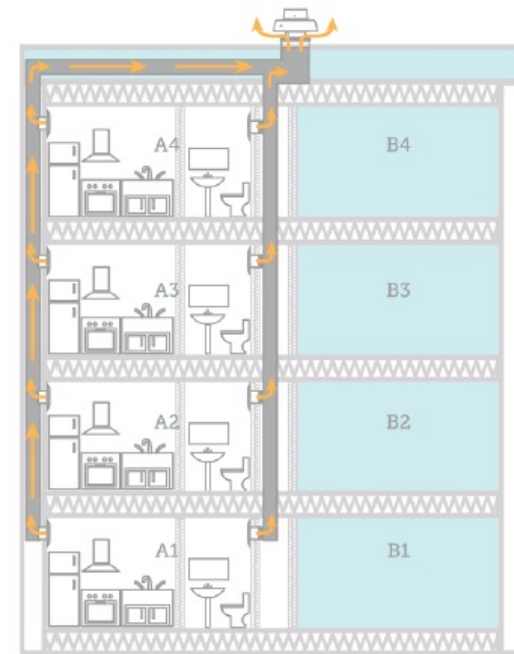


Image: Central exhaust shaft. Source: Center for Energy and Environment. [https://www.mncee.org/getattachment/Resources/Projects/Reducing-the-Energy-Cost-of-Effective-Ventilation/V15-Multifamily-Ventilation-Assessment-Training\\_Feb-2016\\_cbastian.pdf.aspx](https://www.mncee.org/getattachment/Resources/Projects/Reducing-the-Energy-Cost-of-Effective-Ventilation/V15-Multifamily-Ventilation-Assessment-Training_Feb-2016_cbastian.pdf.aspx)

# Context and History

- Align multifamily requirements for all buildings regardless of number of stories
- Measure introduced for multifamily buildings with four or more habitable stories in 2022 code cycle
- Improved IAQ for multifamily residents:
  - Central exhaust shafts: Improves removal of bathroom and cooking pollution
  - Central supply ventilation shafts: Helps ensure supply air is evenly distributed
- Energy savings:
  - Reduce ventilation fan power
  - Reduce heating and cooling energy from less air leakage from conditioned space

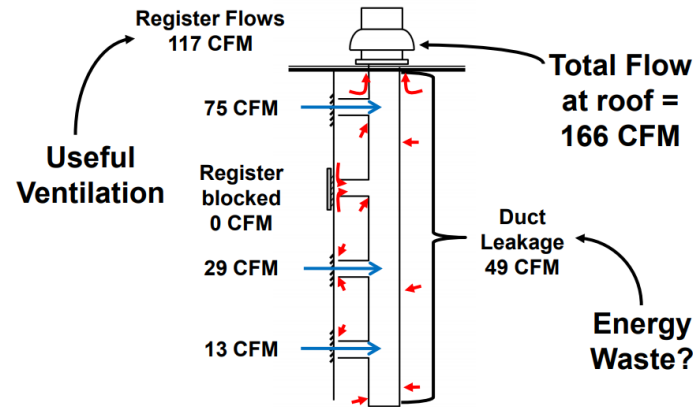


Image: Duct leakage. Source Steven Winter Associates, 2013. [https://www.energy.gov/sites/prod/files/2013/12/f5/carb\\_ventilation\\_webinar.pdf](https://www.energy.gov/sites/prod/files/2013/12/f5/carb_ventilation_webinar.pdf)



## Market Overview & Technical Considerations

- Current Market Conditions
- Potential Market Barriers
- Technical Considerations
- Potential Technical Barriers

# Market Overview

## Current Market Conditions

- Central ventilation in low-rise buildings is not common
- Measuring airflow of rooftop fan and through each exhaust grill is typical through "TAB" (Testing and Balancing)

## Market Barriers

- Project teams are unaccustomed to sealing to a maximum leakage value prior to 2022 Energy Code requirement
- Low-rise market not familiar with ASHRAE Standard 215, although generally uses same methods as TAB with additional calculations



# Technical Considerations

## Technical Considerations

- Sealing to 6 percent can be achieved with traditional sealing

## Technical Barriers and Potential Solutions

- Visual inspection of shaft and sealing during construction to confirm proper sealing or identify leakage points





# Energy and Cost Impacts Per Unit

## *Methodology and Assumptions*

- Energy Savings Methodology and Results
- Cost Impacts Methodology and Results
  - Incremental costs
  - Energy cost savings





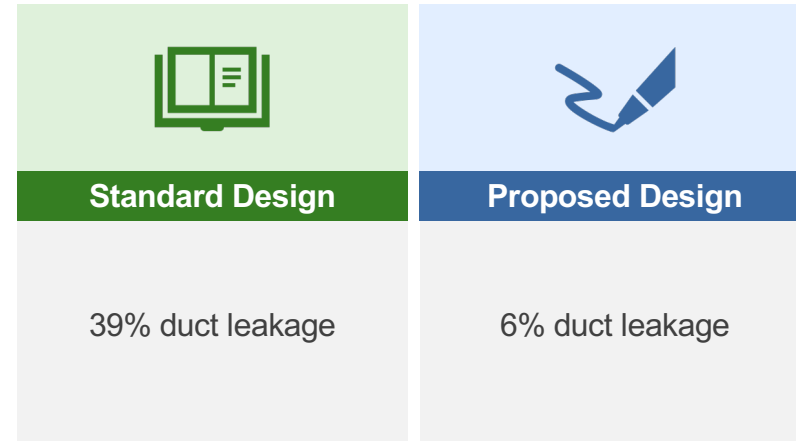
# Methodology and Assumptions for Energy Impacts Analysis

## Prototypes analyzed:

- Low-rise Loaded Corridor only, modified to include central ventilation shafts
- Low-rise Garden Style excluded because central ventilation unlikely for this building style

## Climate zones analyzed:

- All 16



# Preliminary Energy Savings Estimates Per Dwelling Unit

## Key Assumptions:

- 39% leakage base case
- 6% leakage proposed case

Energy & Energy Cost Impacts - New Construction & Additions – Loaded Corridor					
Climate Zone	First-Year Electricity Savings (kWh)	First-Year Peak Electrical Demand Reduction (kWh)	First-Year Natural Gas Savings (kBtu)	First-Year Source Energy Savings (kBtu)	Total LSC Savings (2026 PV\$)
CZ01	34.91	9.14	104.50	189.45	\$397.66
CZ02	36.39	10.63	0.00	107.76	\$284.77
CZ03	36.34	9.46	0.00	110.92	\$283.46
CZ04	37.37	8.57	0.00	95.98	\$287.50
CZ05	35.68	9.66	0.00	101.21	\$269.50
CZ06	11.16	1.14	0.00	18.00	\$77.00
CZ07	14.19	0.42	0.00	18.43	\$103.40
CZ08	34.83	2.17	0.00	49.52	\$221.73
CZ09	34.31	3.66	0.00	60.86	\$231.98
CZ10	40.27	5.81	0.00	56.17	\$264.27
CZ11	57.21	11.45	0.00	114.63	\$413.80
CZ12	41.49	10.58	0.00	104.05	\$320.77
CZ13	52.40	7.86	0.00	87.14	\$373.99
CZ14	48.74	10.89	0.00	106.56	\$352.18
CZ15	56.57	0.26	0.00	27.59	\$335.71
CZ16	14.70	0.36	427.58	401.80	\$618.08

# Incremental Per Dwelling Unit Cost

*Over 30-Year Period of Analysis*

Incremental First Cost	
Materials	\$11.70
Labor	\$35.21
Verification	\$40.00
<b>Total</b>	<b>\$86.91</b>

No incremental maintenance or replacement costs anticipated

- Cost data came from:**
- Contractors for duct sealing and testing
  - Material, labor, and mark-up costs
  - Verification labor rates

## Cost Effectiveness Over 30-Year Period of Analysis

Climate Zone	Benefits <i>LSC Savings + Other PV Savings</i> (2026 PV\$)	Costs <i>Total Incremental PV Costs</i> (2026 PV\$)	Benefit-to- Cost Ratio
1	\$397.66	\$84.47	4.71
2	\$284.77	\$111.66	2.55
3	\$283.46	\$99.22	2.86
4	\$287.50	\$110.51	2.60
5	\$269.50	\$107.97	2.50
6	\$77.00	\$84.30	0.91
7	\$103.40	\$83.90	1.23
8	\$221.73	\$84.07	2.64
9	\$231.98	\$83.95	2.76
10	\$264.27	\$84.18	3.14
11	\$413.80	\$85.69	4.83
12	\$320.77	\$86.91	3.69
13	\$373.99	\$86.16	4.34
14	\$352.18	\$83.72	4.21
15	\$335.71	\$83.72	4.01
16	\$618.08	\$86.72	7.13

## Poll Request

- **Measure Name:** Central Ventilation Shaft Sealing
- **Type of Poll:** Open response
- **Question:** Do you agree with the cost and energy modeling assumptions?
- **Placement:** after Cost Effectiveness (slide 87)
- **Broadcast results to attendees as they respond:** (Y)
- **Make poll public during presentation:** (Y)



## Compliance and Enforcement

- Design
- Permit Application
- Construction
- Inspection
- Revisions to Compliance Software

# Compliance and Verification Process



## Design Phase

- Project team would identify location of central ventilation shafts and specifies sealing materials and sealing strategies
- Project team would develop details and specifications supporting a tight air barrier



## Permit Application Phase

- Project team would submit design documents showing location of central ventilation shafts and sealing materials
- Verification requirements included in energy compliance documentation



## Construction Phase

Project team would seal each central ventilation shaft documenting installation and verification procedures via compliance documentation



## Inspection Phase

- ATT to conduct leakage test, documenting the results in order to meet compliance
- Code official would confirm leakage results are submitted and meet requirements

# Compliance and Verification

Compliance and verification processes already in place for buildings with four or greater habitable stories.

- Processes are the same for buildings with three or fewer habitable stories

Market actors involved in implementing this measure include:

- Project Team (building owners/architects/builders): Develops and implements central shaft sealing plan
- ATT: Conducts shaft sealing test and records results
- Code Official: Reviews shaft sealing test result

Software Updates:

- Software revisions necessary to apply central ventilation shaft sealing requirement to multifamily buildings with three habitable stories or fewer





# Review of Code Language Markup

Draft Code Change Language



# Draft Code Change Language

## **Section 160.2(b)2C: Multifamily Building Central Ventilation System Field Verification**

- No changes necessary. Language does not specify applicability to buildings with four or more habitable stories.

## **Reference Appendix NA7.18.3: Central Ventilation System Duct Leakage Acceptance**

- No changes necessary. No proposed changes to verification procedures.

## **Reference Appendix NA7.1: Purpose and Scope**

- Replace “high-rise residential” with “multifamily”

Draft code language available for review in Handouts and downloadable.

Please provide feedback to CASE Author by **March 7th, 2023.**



## Discussion and Next Steps

# We want to hear from you!

## **POLL QUESTION NEXT SLIDE:**

Provide **any last comments or feedback** on this presentation now, verbally, or in Questions Pane.

More information on pre-rulemaking for the 2025 Energy Code at <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2025-building-energy-efficiency>

**Comments on all the measures presented today are due by March 7th.** Please send comments to [info@title24stakeholders.com](mailto:info@title24stakeholders.com) and copy CASE Authors (see contact info on following slide).

# Thank You

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