

We will be starting soon!

Thanks for joining us



Detailing for High Performance Roofs and Walls



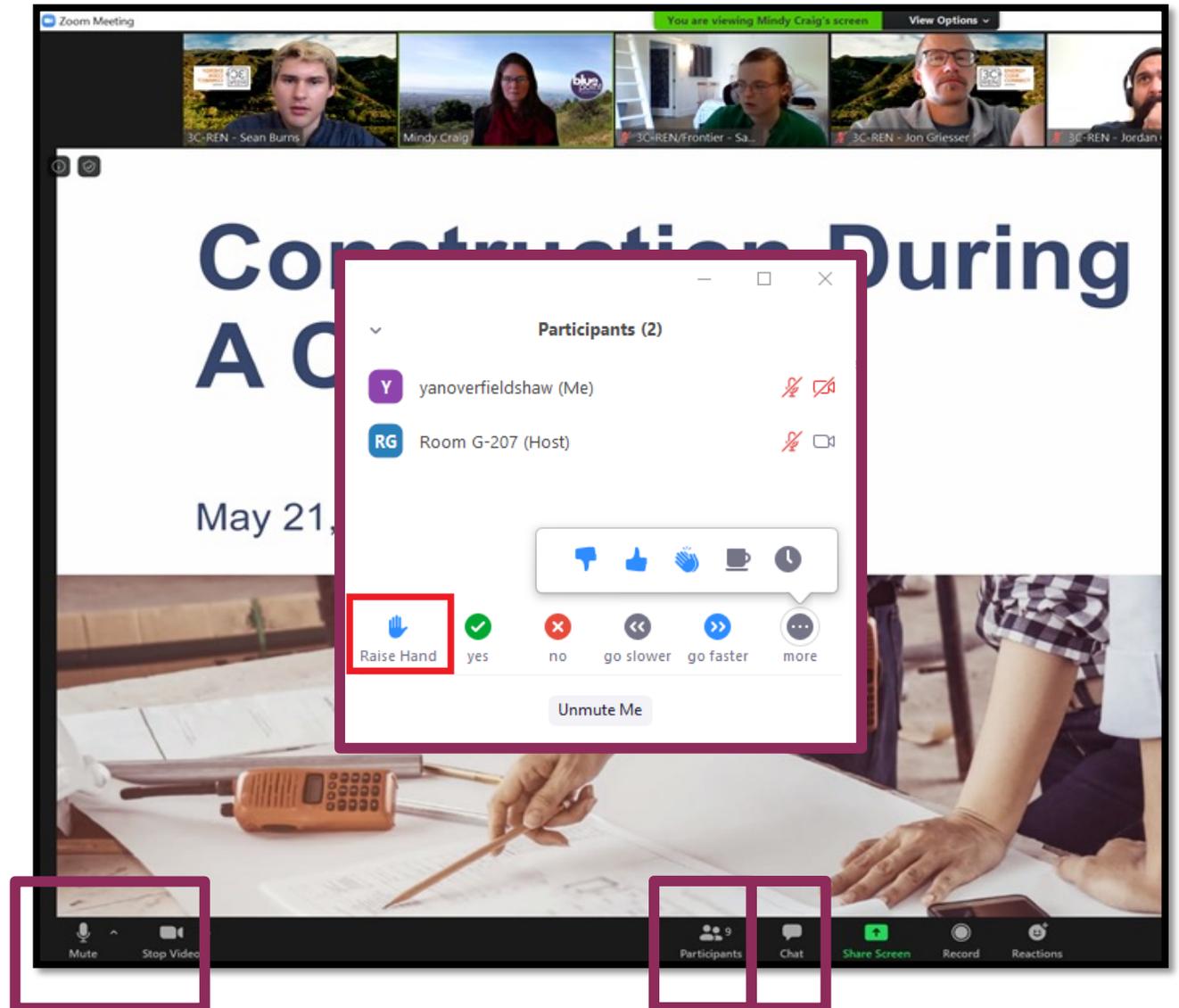
Jennifer Rennick, AIA, CEA – In Balance Green Consulting
Andy Pease, AIA, LEED AP– In Balance Green Consulting

March 21, 2024



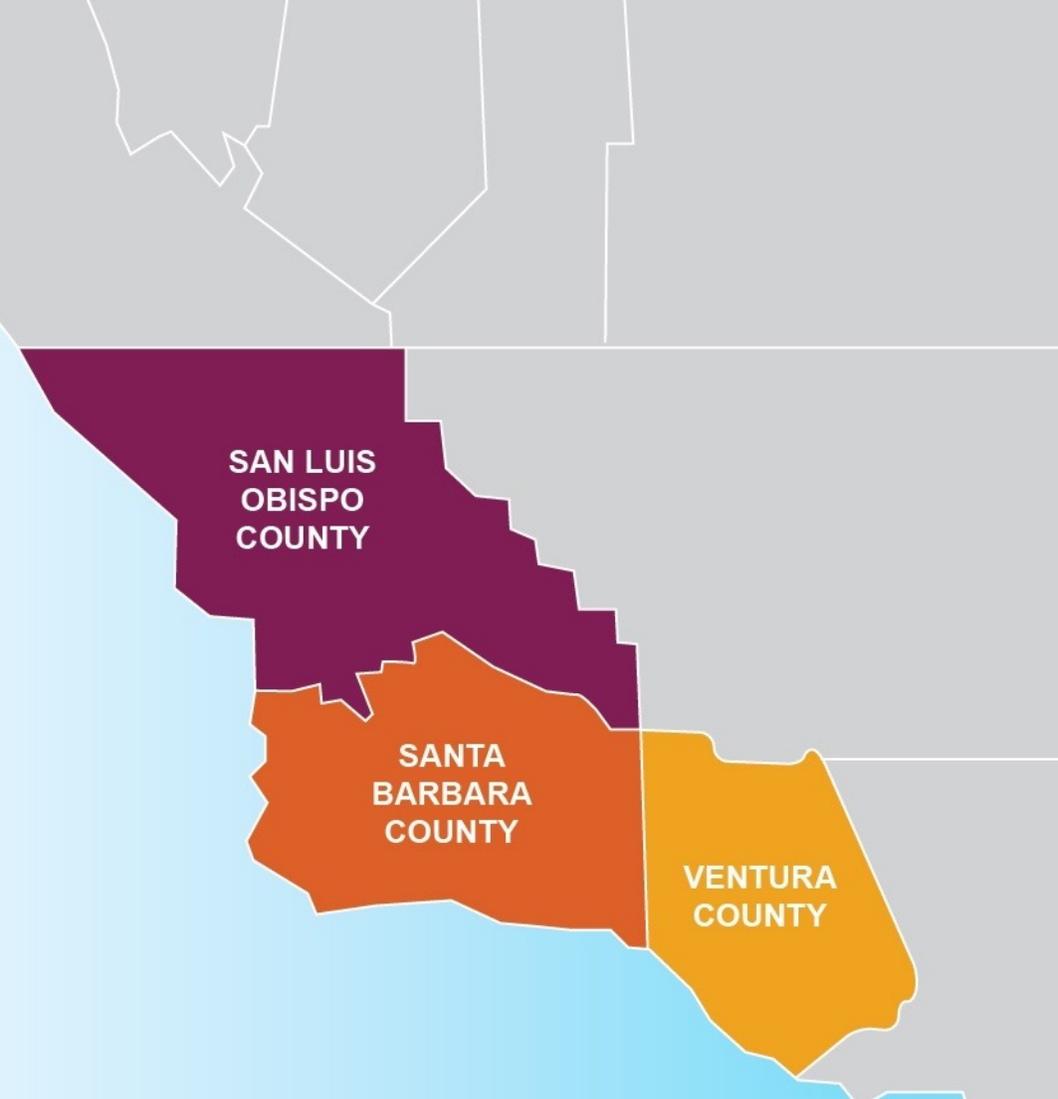
Zoom Orientation

- Please be sure your full name is displayed
- Please **mute** upon joining
- Use "Chat" box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be **recorded** and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
 - **Building Professionals:** industry events, training, and energy code compliance support
 - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region





ENERGY
CODE
CONNECT

- Serves all building professionals
- Three services –
 - **Energy Code Coach**
 - **Training and Support**
 - **Regional Forums**
- Makes the Energy Code easy to follow

Energy Code Coach:
3c-ren.org/codes
805.781.1201

Event Registration:
3c-ren.org/events





BUILDING PERFORMANCE TRAINING

- Serves current and prospective building professionals
- Expert instruction:
 - **Technical skills**
 - **Soft skills**
- Helps workers to thrive in an evolving industry

Event Registration:
3c-ren.org/events





HOME
ENERGY
SAVINGS

Multifamily (5+ units)

- No cost technical assistance
- Rebates up to \$750/apartment plus additional rebates for specialty measures like heat pumps

Single Family (up to 4 units)

- Sign up to participate!
- Get paid for the metered energy savings of your customers

Enrollment:
3C-REN.org/contractor-participation



Today's Learning Objectives

- Review how building science for heat transfer and condensation can help with selecting envelope components
- Be able to identify common strategies for incorporating continuous exterior insulation
- Understand options for insulation and membrane products, best applications, and local availability
- Learn resources for 'standard' details and what to watch for in specific applications

Learning Units:

- 1.0 AIA HSW LU approved for this course
- 0.10 ICC CEU approved for this course

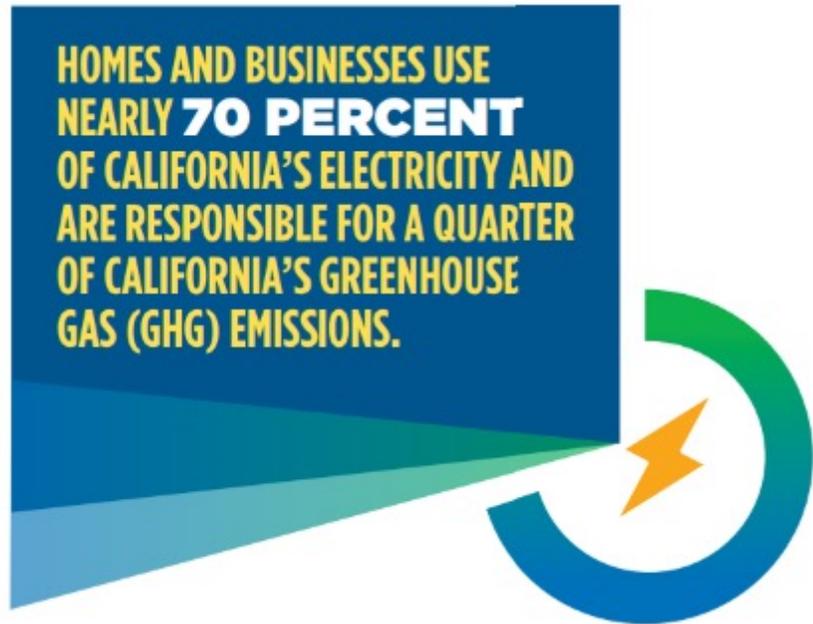


Agenda

1. Building Science Review
2. Walls:
 1. Wall to Foundation and Floors
 2. Wall Openings: Windows, Pipes, Ducts
 3. Wall to Roof/Ceiling
3. Roofs:
 1. Vented or Un-vented with Attic
 2. Ceiling as Air Barrier
 3. Vented or Un-vented Rafter Roof
4. Outside Air Ventilation



Big Picture Goals for the 2022 Code Updates



- Encourage heat pump technology for space and water heating
- Establish electric-ready requirements for single family homes
- Expand PV systems and battery storage standards
- Strengthen ventilation standards



Building Science Review



Term Review

- **Air Leakage** – Uncontrolled air movement through building assemblies
- **Infiltration** – Air leakage from outdoors to indoors
- **Exfiltration** – Air leakage from indoors to outdoors
- **Vapor** – Water in a gaseous state
- **Condensation** – Change of state from vapor to liquid
- **Moisture** – liquid water
- **Capillary Action of Water** – the movement of water within the spaces of a porous material due to the forces of adhesion, cohesion, and surface tension.

Concept Review

- **Air Barrier** – Air control layer limiting airflow between conditioned and unconditioned spaces
- **Thermal Barrier** – Component of an assembly or material that controls the transfer of thermal (heat) energy
- **Rain Screen** – Outer layer (cladding) of a wall assembly that is used as a rainwater control strategy allowing for water drainage behind the cladding
- Vapor is more buoyant than air
- Warm air is more buoyant than cool air
- Warm air can hold more moisture than cool air



Standard Definitions

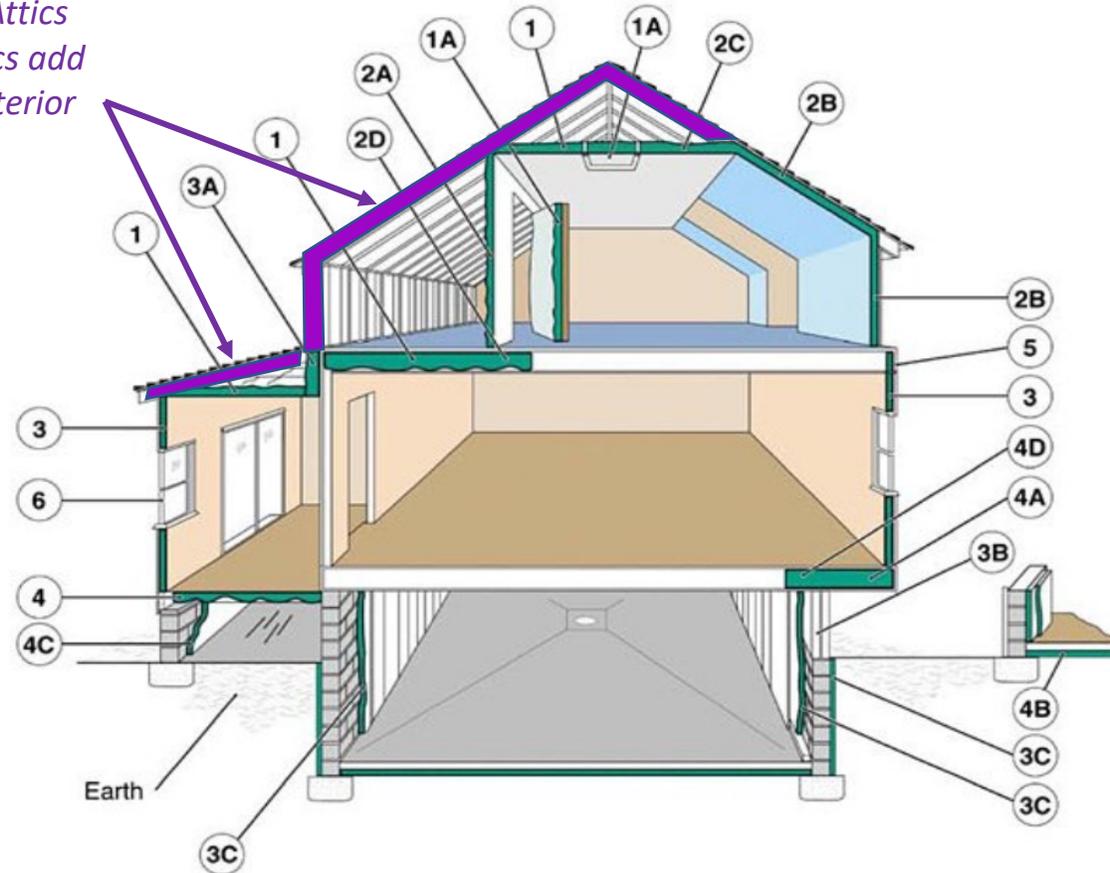
- Per ASTM E-96 Test Method A: Measure of a material's ability to limit water transfer through vapor diffusion
 - Class I Vapor Barrier: Material with permeance of 0.1 perm or less
 - Class II Vapor Retarder: Material with permeance of 1.0 perm or less and greater than 0.1 perm
 - Class III Vapor Retarder: Material with permeance of 10 perms or less and greater than 1.0 perm
- Vapor Permeable: Material with vapor permeance greater than 10 perms
- Air-Impermeable Material: Air Barrier with an air permeance equal to or less than 0.02 l/s-m² at 75 Pa pressure differential per ASTM E 2178 or E 283
- Air Permeable Material: Material with greater than an air permeance of 0.02 l/s-m² at 75 Pa



Thermal Boundary

- Our buildings at a minimum were meant to keep us warm...
- Now we expect them to keep us comfortable and dry for low cost/energy

High Performance Attics or Conditioned Attics add insulation to the exterior surfaces



Examples of where to insulate.

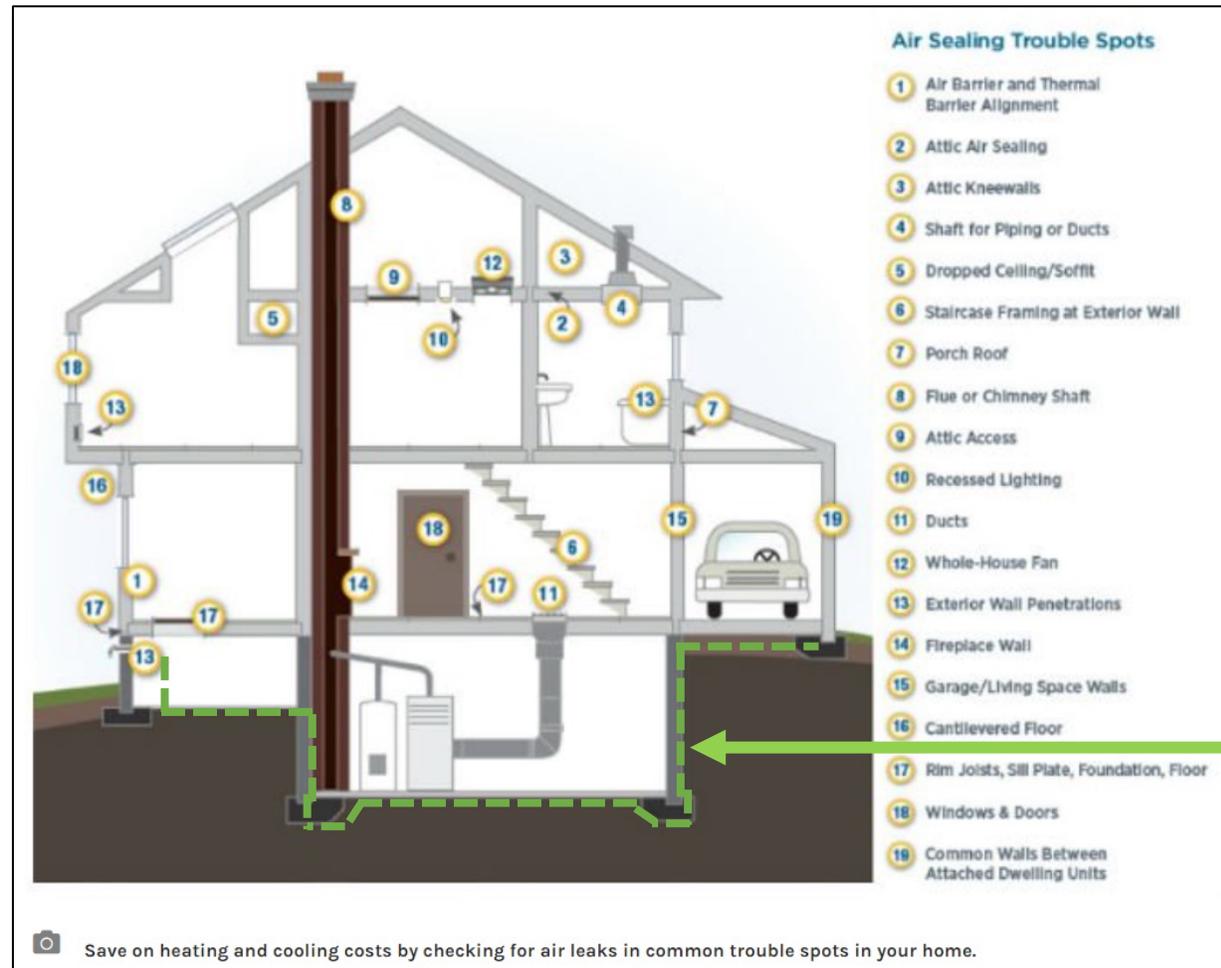
Oak Ridge National Laboratory

www.energy.gov/energysaver



Air and Moisture Barriers

- ...And now we expect them to energy efficient, resilient, durable, mold-free, and comfortable!
- ...*air sealing is part of the energy code too*



*Add to the list –
moisture and radon
protection at the
foundation:*

- *moisture/water barrier at ground level at a crawl space*
- *under slab membrane*
- *Retaining wall water proofing*





Walls (Wood Framed):

Wall to Foundation and Floors

Wall Openings: Windows, Pipes, Ducts

Wall to Roof/Ceiling

Base of the Wall: Foundation to Vapor Barrier –Raised Floor

Membrane is securely attached to the foundation



Class I Vapor Barrier < 0.1 perms
Prevents Vapor Drive and
Moisture Migration



Stego Wrap Vapor Barrier 15 mil
Water Vapor Permeance: 0.0086 perms
Can be used to stop moisture and radon.

Sheet material is seam sealed and
taped for a continuous barrier.

STEGO SOLUTIONS
BELOW-SLAB BARRIERS AND CONCRETE ACCESSORIES

 CONCRETE ACCESSORIES	 VAPOR INTRUSION BARRIER	 VAPOR BARRIERS AND VAPOR RETARDERS	 TERMITE AND VAPOR BARRIER	 CRAWL SPACE ENCAPSULATION	 BELOW-SLAB VAPOR PROTECTION
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Since 1998, Stego has revolutionized the way the construction industry protects the *First Side of the Building*™ by defending against harmful moisture vapor and soil gases with its flagship product: Stego® Wrap Vapor Barrier – which dramatically improves performance against moisture intrusion.

In addition to Stego Wrap Vapor Barriers, Retarders, and Accessories, we have the following high-performance product offerings: StegoCrawl® Wrap for crawl space encapsulation, StegoHome® Below-Slab Vapor Protection for residential construction, Pango® Wrap Termite and Vapor Barrier, Drago® Wrap Vapor Intrusion Barrier, and Beast® Concrete Accessories.

PROFESSIONAL DESIGN RESOURCES
SYSTEMS DOCUMENTATION, TECHNICAL DETAILS, AND SPECIFICATIONS

Support the success of every project with comprehensive documentation.

Stego offers the following Printed Binder and a Digital Binder – to streamline the specification process and ensure effortless access to product information.

[View Digital Binder](#)



Resources and Product
Line Guide



Under the Vapor Barrier –Slab on Grade

American Concrete Institute (ACI 302.1 R-15) recommends 10 mil minimum vapor barrier meeting ASTM E96 for permeability and calls for the concrete to be placed **directly on** the vapor barrier.

REBAR

GRADE BEAM

MASTIC



Mastic is brush applied to concrete footing or grade beam

Stego 15 mil vapor barrier is applied directly over aggregate.

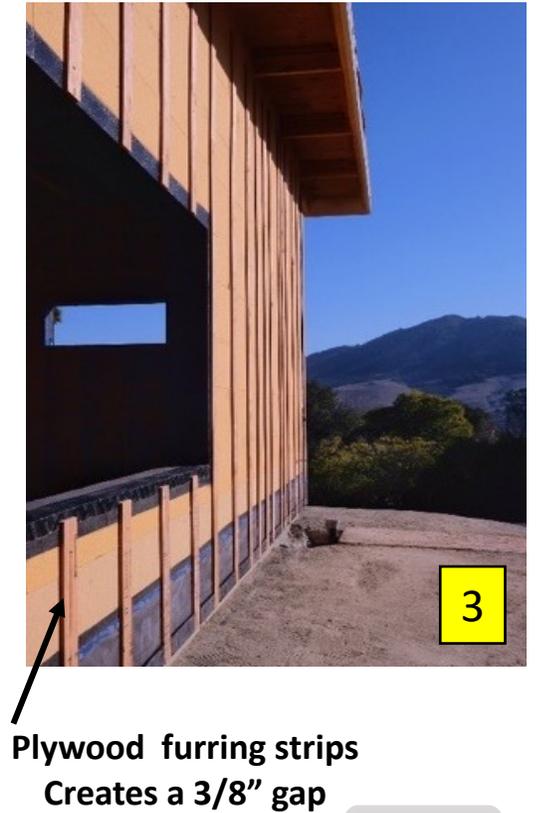
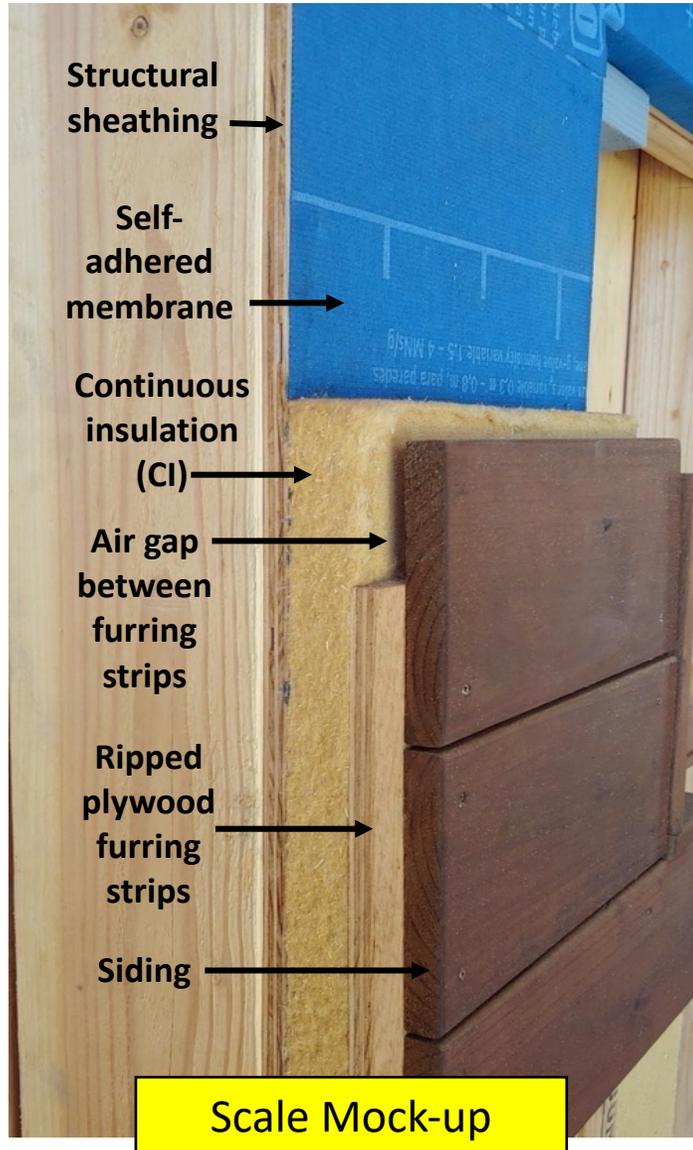


Gravel aggregate is stamped in place

Note:
Sand adds moisture and extended dry times.
Choose under-slab materials with insulative value (Gravel, rigid Insulation, etc)



Wall Assembly - Continuous Insulation with Rain Screen



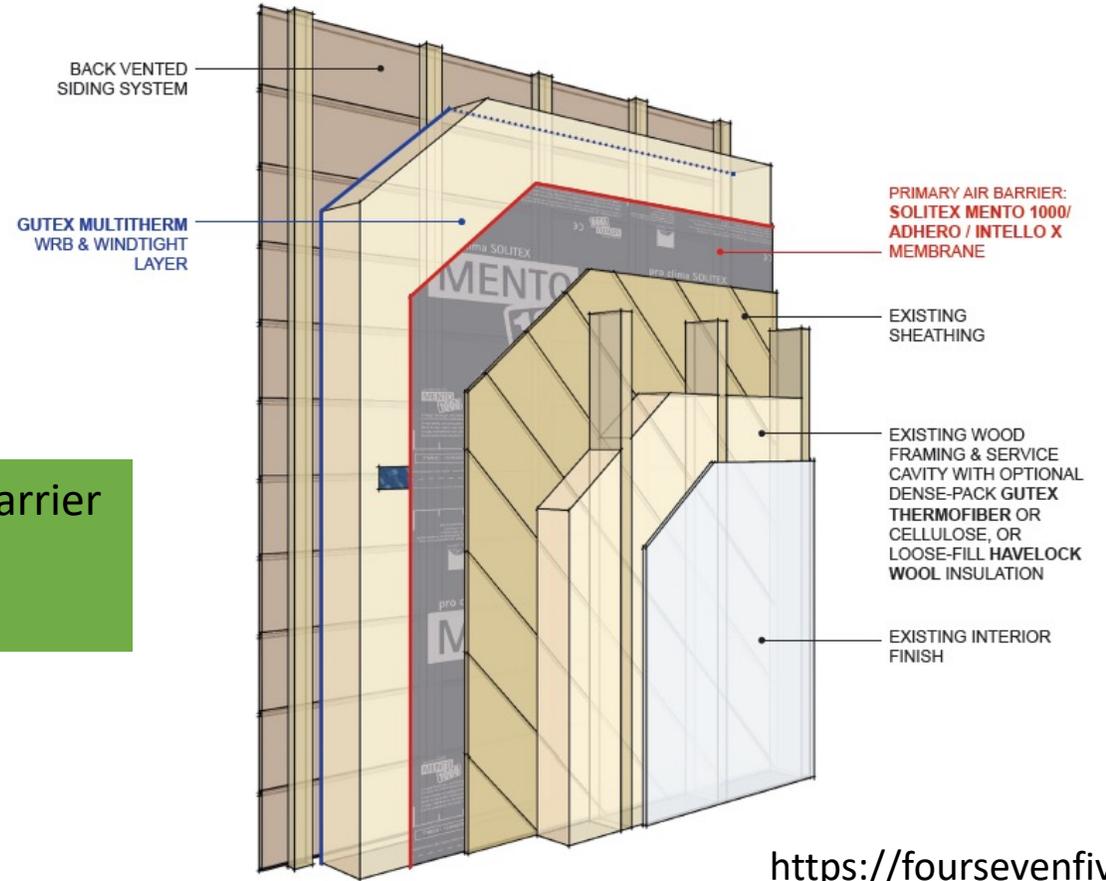
Credit: Cairn Collaborative



Layered Wall Assembly Example



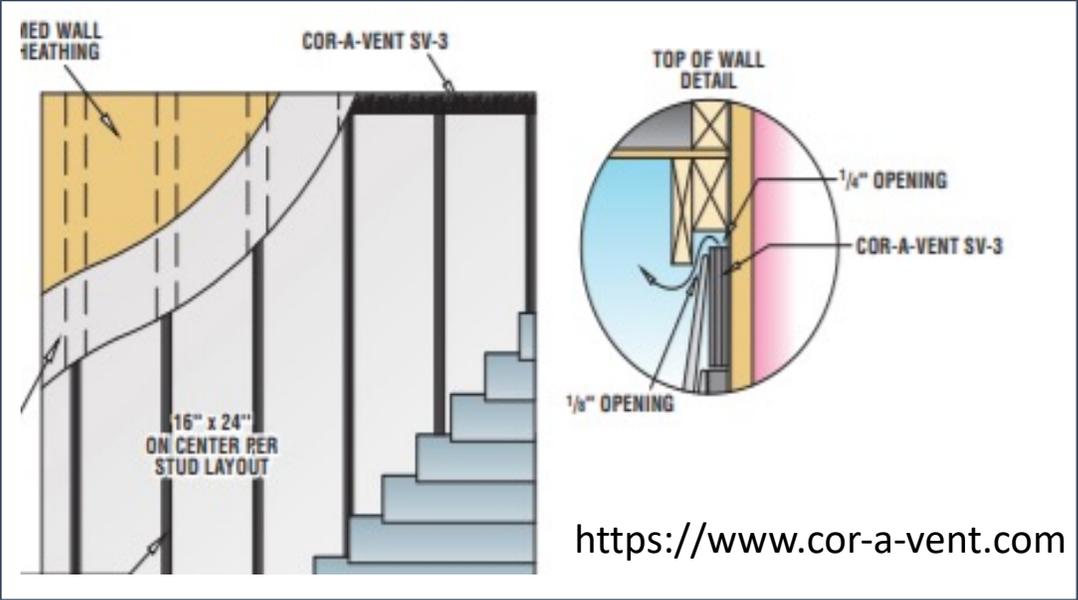
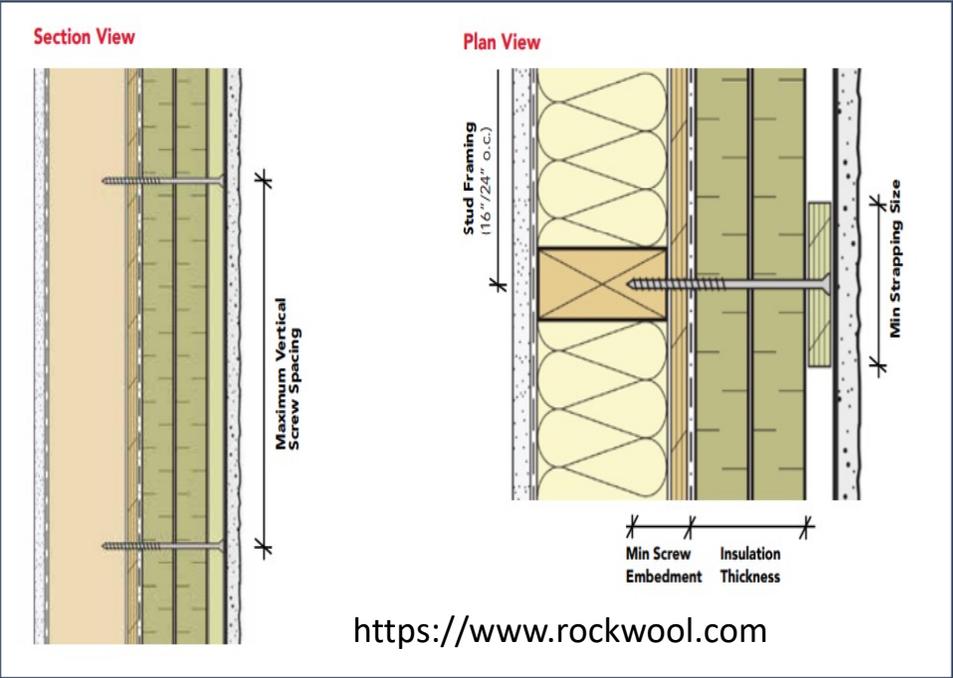
Primary Air Barrier
Self Adhering
Membrane



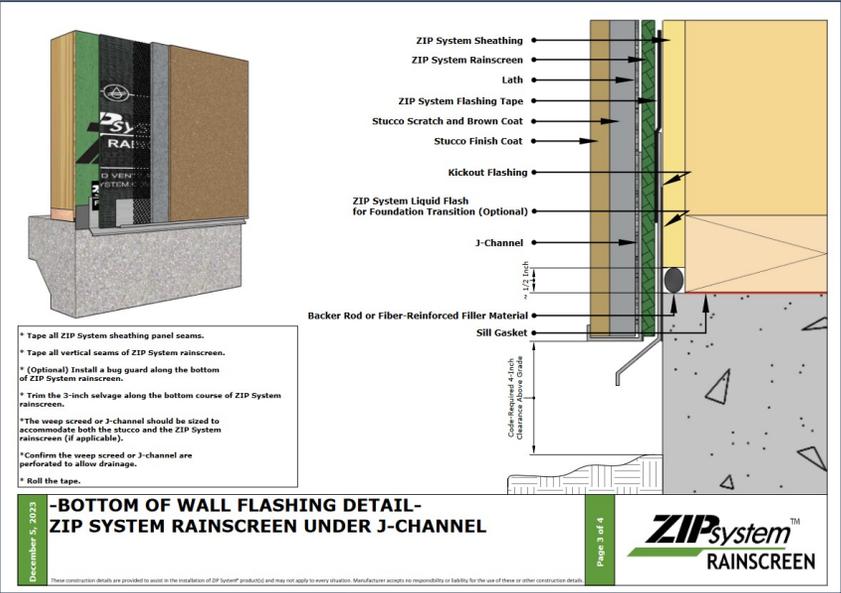
Example of layered wall assembly looking from interior to exterior



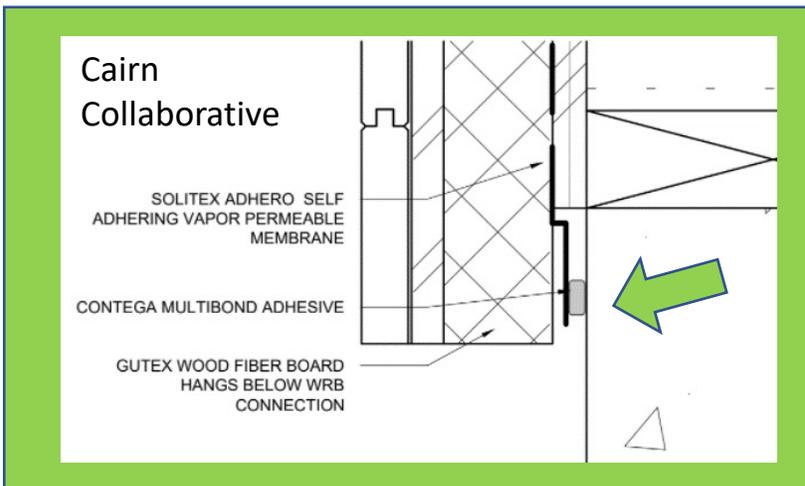
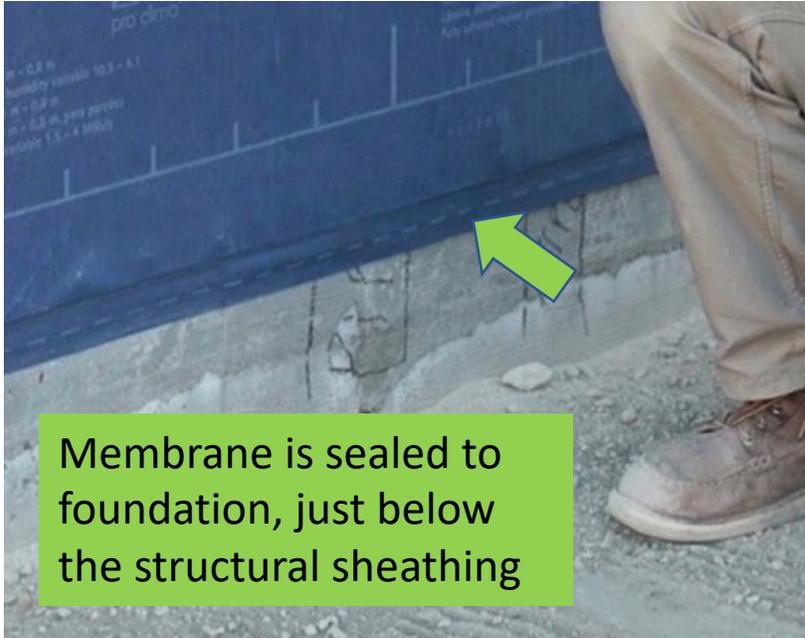
Rainscreen Wall Assembly Examples



Think Layers... Rainscreen allow drainage if/when water gets on the wall. Allows for faster drying.



Wall to Foundation Air-tight Connection



Many manufactures offer a suite of chemically compatible liquid membranes, sheet membranes, tapes, and sealants for air-tight construction.



Structural sheathing is ready for a liquid applied membrane, self-adhered membrane, or drainage plane stucco wrap.

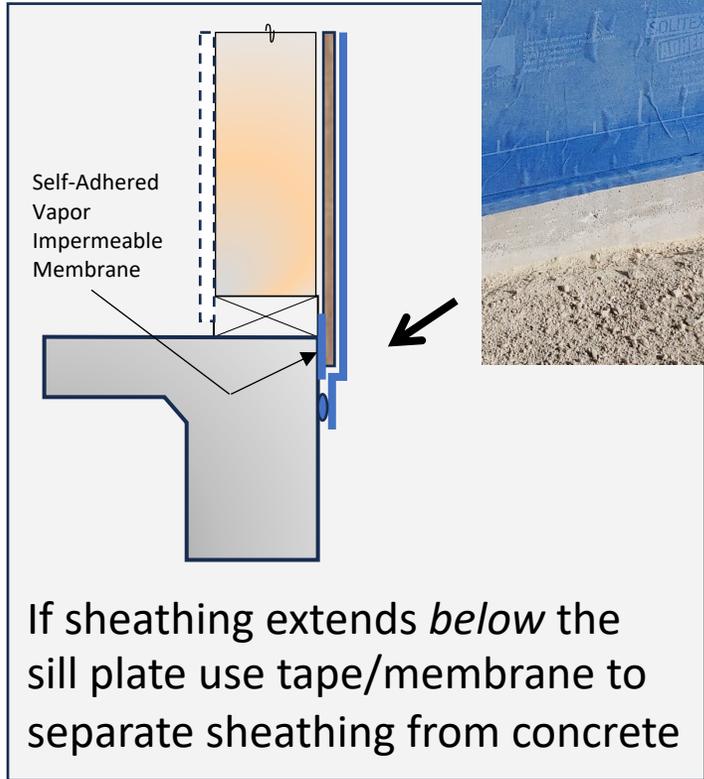


System Details –Structural Sheathing ‘Length’ at Foundation/Sill Plate

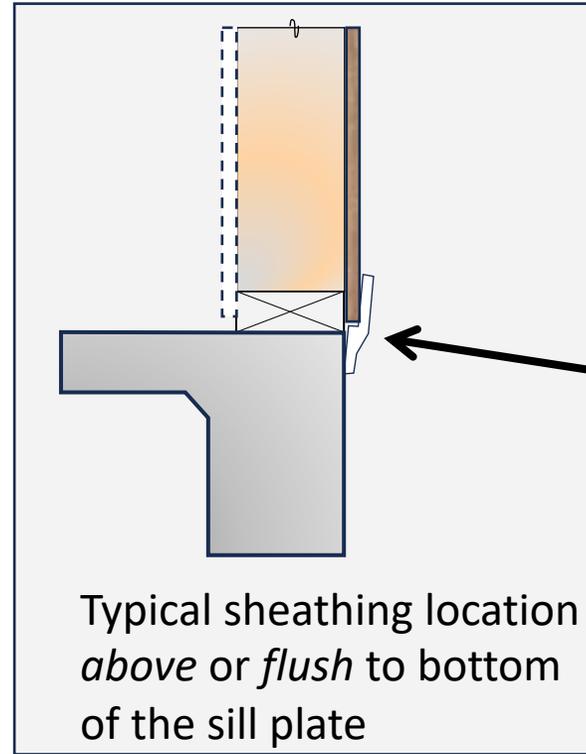
Self-Adhered Membrane



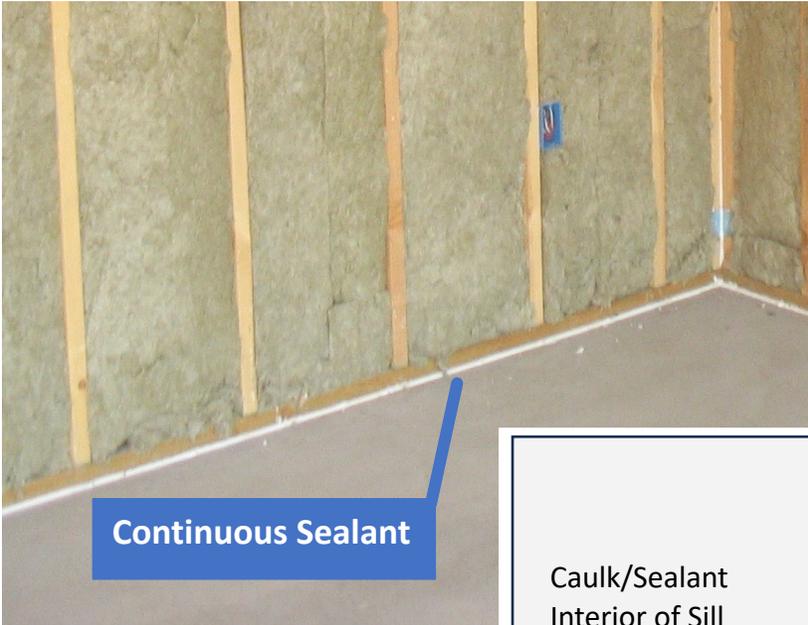
Membrane is Adhered to Foundation



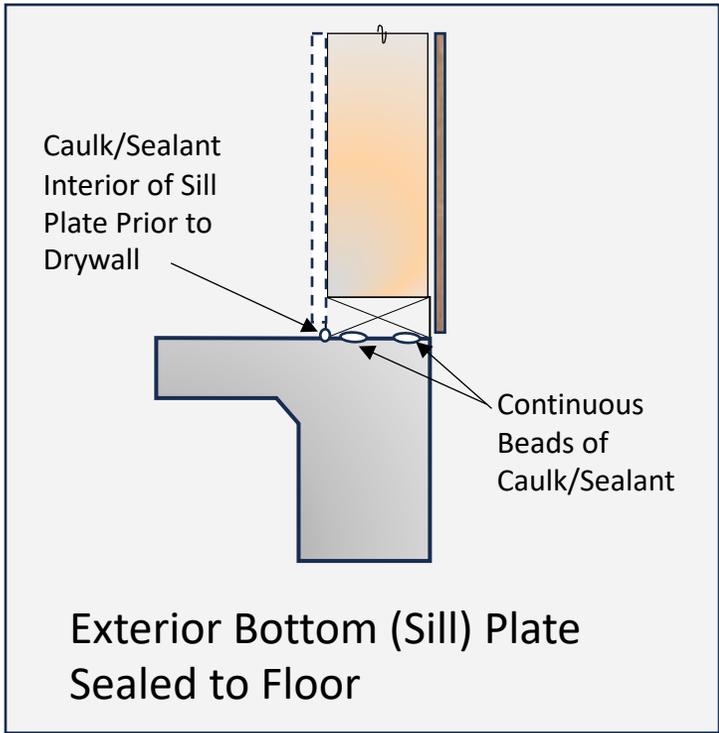
Liquid Applied Membrane



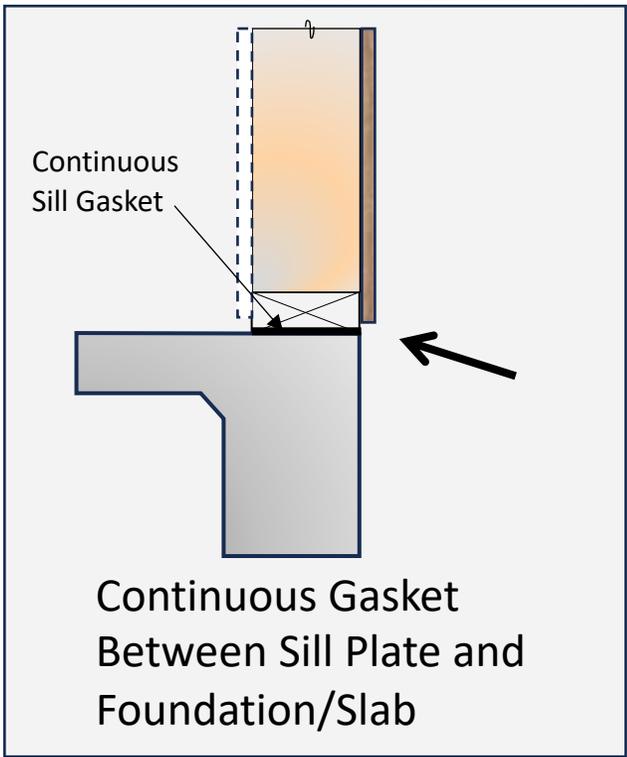
Wall to Floor Air-Tight Connection at Sill Plate



Continuous Sealant



Continuous Gasket between Plate and Concrete



Air Leakage and Windows

California Energy Code: Mandatory Requirements

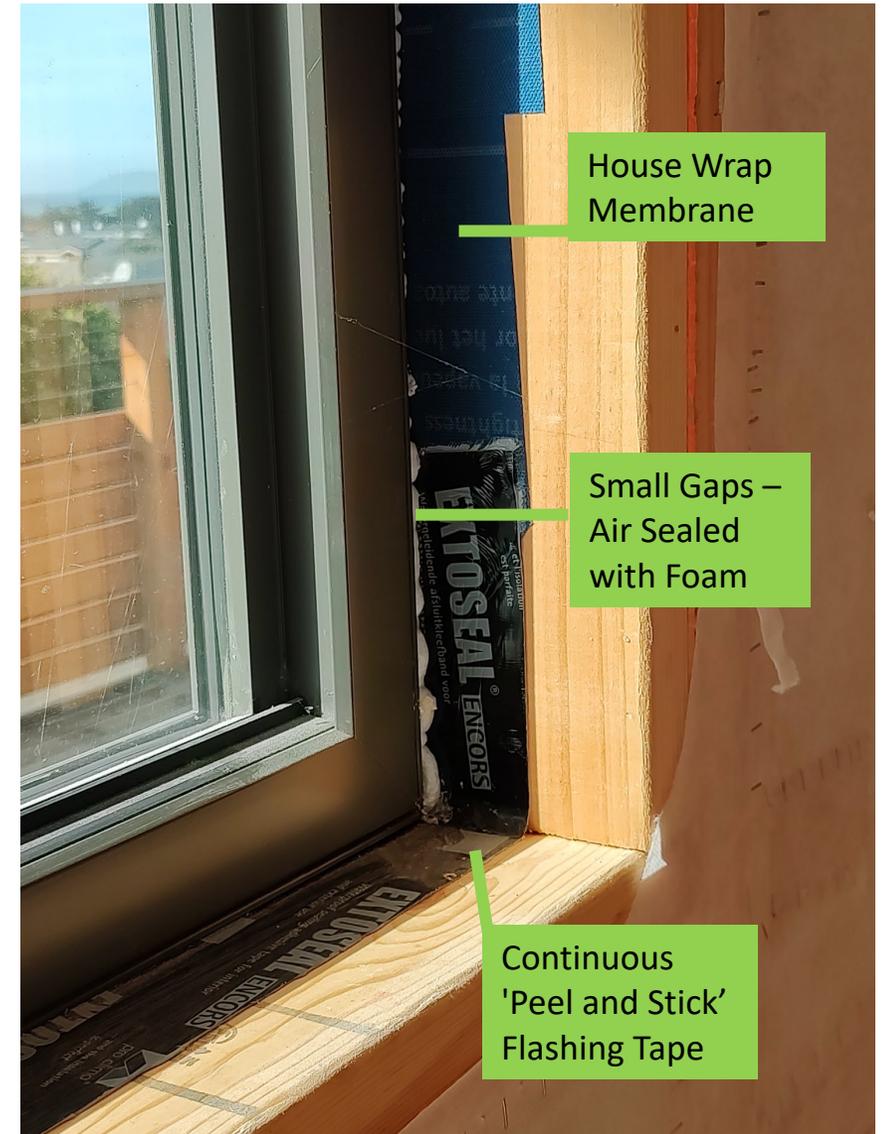
To Limit Air Leakage. All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit infiltration and exfiltration.

Certification of Fenestration and Doors. Air Leakage. Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding:

- 0.3 cfm/ft² of window area,
- 0.3 cfm/ft² of door area for residential doors,
- 0.3 cfm/ft² of door area for nonresidential single doors (swinging and sliding), and
- 1.0 cfm/ft² for nonresidential double doors (swinging),

when tested according to NFRC-400 or ASTM E283 at a pressure differential of 75 pascals

- Applies to Pet Doors too
- Exception: Field fabricated doors and windows



Window Details – Resources are Available

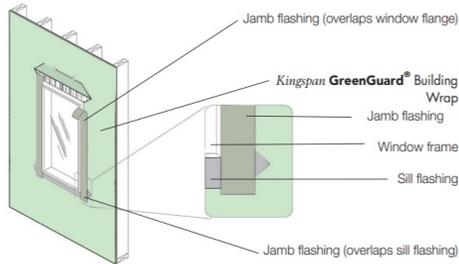


Figure 9: Installation of Jamb Flashing

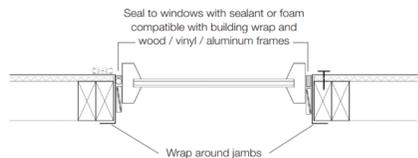
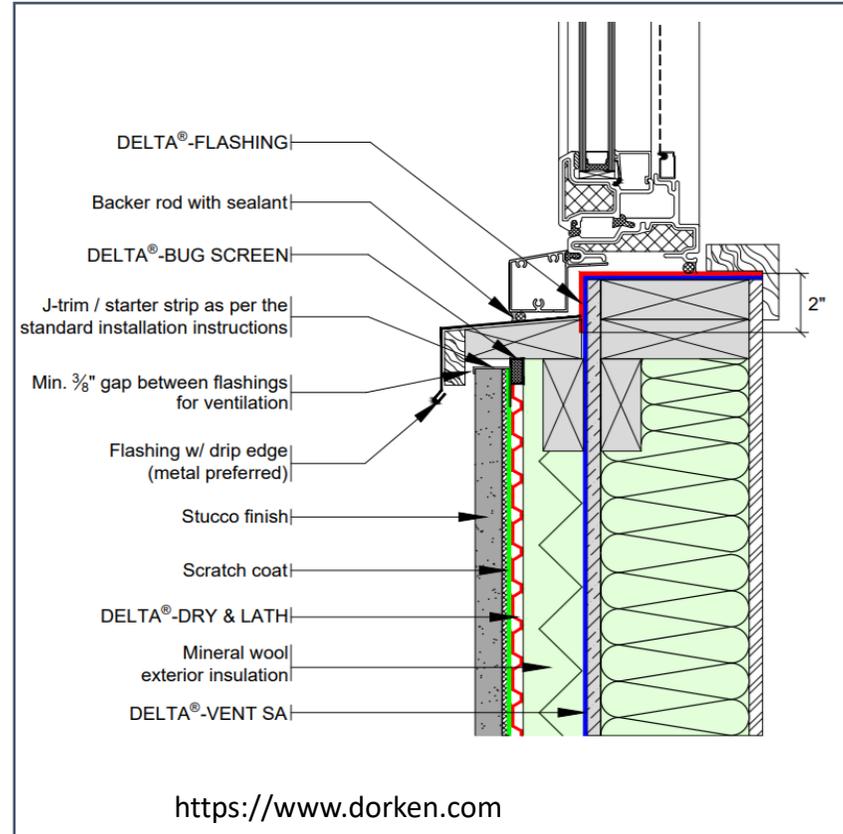
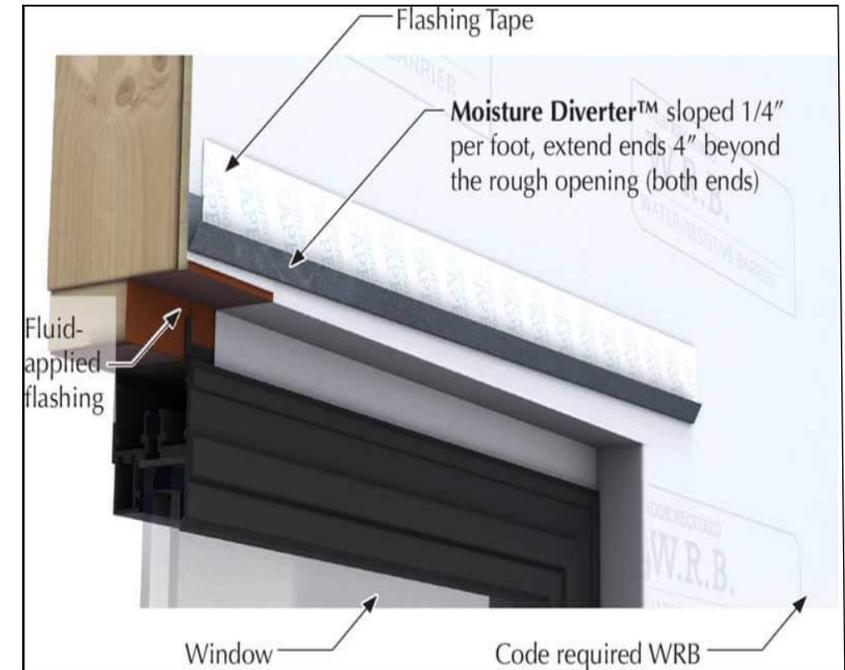


Figure 4: Window frame cross-section

Excerpts from GreenGuard_Building Wrap and Flashing_Residential_Installation Guide_US



Sill with Exterior CI



<https://www.mtidry.com/>

Diverter at Window Head



QII – Expanding Foam for Narrow Cavities and Windows



QII - AIR INFILTRATION SEALING – FRAMING STAGE

CALIFORNIA ENERGY COMMISSION

CEC-CF2R-ENV-21-H

SAMPLE FORM – NOT VALID FOR SUBMISSION TO BUILDING DEPARTMENTS

C. Walls Adjacent to Unconditioned Space

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.

01	All penetrations through the exterior wall air barrier are sealed to provide an airtight envelope to unconditioned spaces such as the outdoors, attic, garage, and crawlspace.
02	Exterior wall air barrier is sealed to the top plate and bottom plate in each stud bay.
03	All electrical boxes, including knockouts, that penetrate the air barrier to unconditioned space are sealed.
04	All openings in the top and bottom plate, including all interior and exterior walls, to unconditioned space are sealed; such as holes drilled for electrical and plumbing.
05	Exterior bottom plates (all stories) are sealed to the floor.
06	All gaps around windows and doors are sealed. The sealant used follows manufacturer specifications.
07	Rim joist gaps and openings are fully sealed.
08	Fan exhaust duct outlet/damper at the exterior wall are sealed.
09	Knee walls have solid and sealed blocking at the bottom, top, left, and right sides to prevent air movement into insulation.

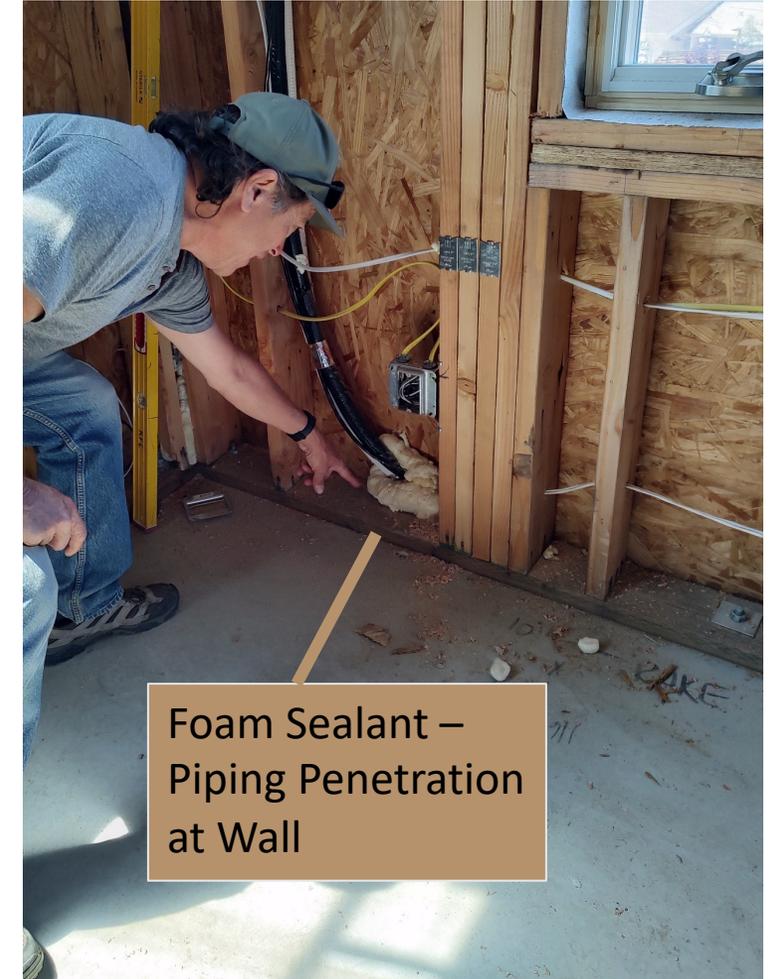


Conditioned 'Daylit' Basement to Crawl Space – Penetrations are air sealed and walls will be insulated.



Narrow cavities are filled with expanding foam... And it air seals too

Openings and Penetrations in Wall Assemblies



QII – Insulation Installation and Electrical Wiring

CF2R-ENV-03-E Mandatory and Part of QII



CALIFORNIA ENERGY COMMISSION

INSULATION INSTALLATION

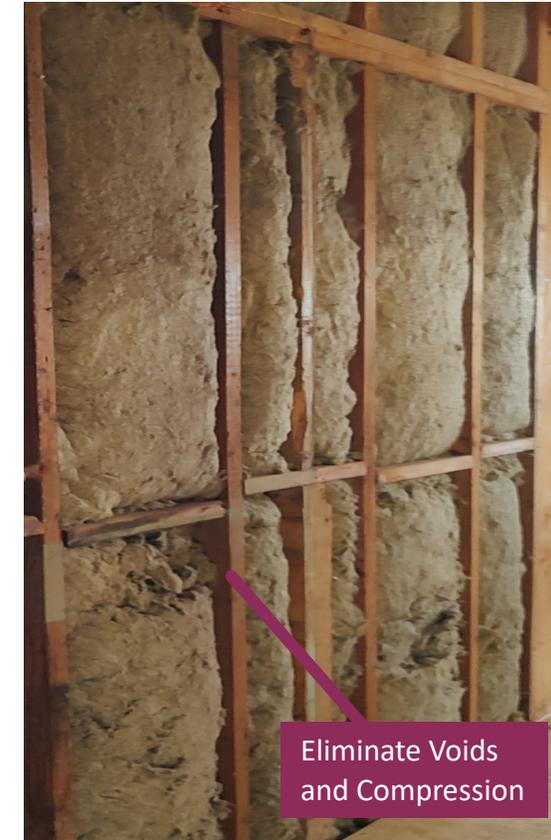
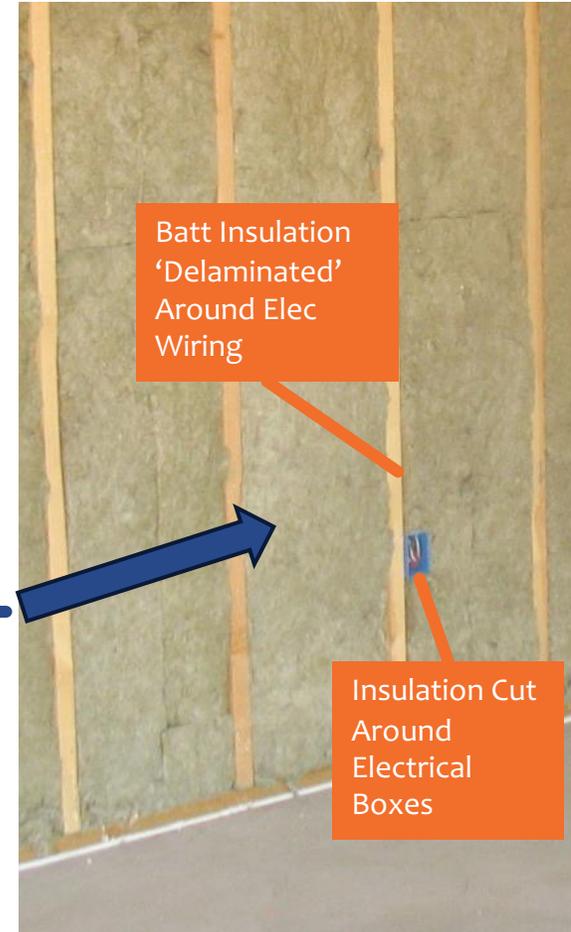
CEC-CF2R-ENV-03-E

H. Installed Insulation

Field	Field Description
01	Installed insulation R-values are the same or greater than listed on the CF1R.
02	No gaps or voids between the insulation and framing.
03	No gaps between the sides or ends of batt insulation.
04	Loose-fill insulation must be installed to the minimum installed weight per square foot (density) of the manufacturer's cut sheet for the proposed R-value.
05	Batt insulation is not compressed (no stuffing of the insulation into the cavity) and is installed to its full thickness.
06	Insulation is cut around obstructions such as electrical boxes.
07	Batt insulation is delaminated around all plumbing and electrical lines in ceilings, walls, and floors.
08	Band joists are insulated to the same R-value as the wall.
09	In all narrow cavities the insulation shall be cut to fit or filled with expanding foam.
10	Insulation was installed per manufacturer instructions.

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.

PASS on the Left, FAIL on the Right.



Insulation was compressed at the framing members.

QII – Made Easy with Blown-in Products



CALIFORNIA ENERGY COMMISSION

INSULATION INSTALLATION

CEC-CF2R-ENV-03-E

H. Installed Insulation

Field	Field Description
01	Installed insulation R-values are the same or greater than listed on the CF1R.
02	No gaps or voids between the insulation and framing.
03	No gaps between the sides or ends of batt insulation.
04	Loose-fill insulation must be installed to the minimum installed weight per square foot (density) of the manufacturer's cut sheet for the proposed R-value.
05	Batt insulation is not compressed (no stuffing of the insulation into the cavity) and is installed to its full thickness.
06	Insulation is cut around obstructions such as electrical boxes.
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08	Band joists are insulated to the same R-value as the wall.
09	In all narrow cavities the insulation shall be cut to fit or filled with expanding foam.
10	Insulation was installed per manufacturer instructions.

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.

I. Wall Insulation



QII – Tub and Shower Enclosures



CALIFORNIA ENERGY COMMISSION

QII – INSULATION INSTALLATION

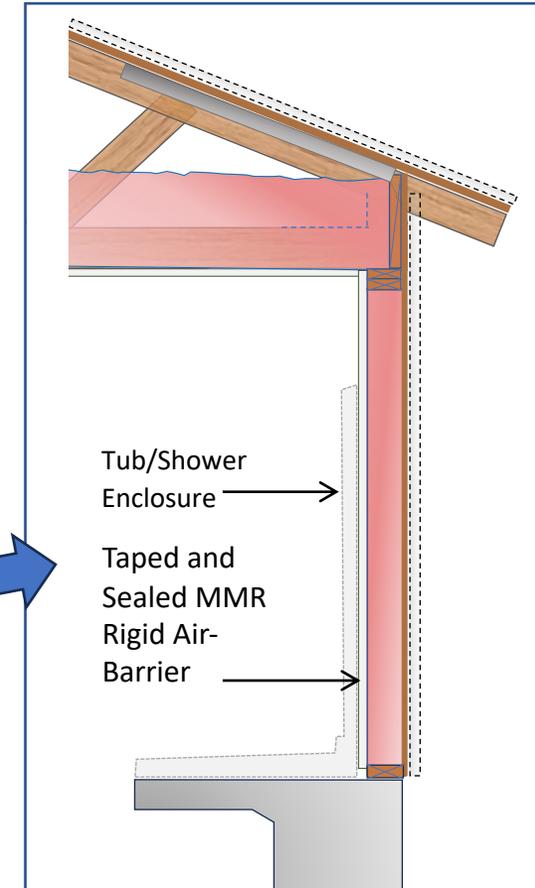
CEC-CF3R-ENV-22-H

SAMPLE FORM – NOT VALID FOR SUBMISSION TO BUILDING DEPARTMENTS

D. Wall Adjacent to Unconditioned Space

01	Insulation quality was verified prior to the installation of the interior air barrier (typically gypsum board).	
02	Loose-fill and batt insulation is in contact with all six sides of wall cavities (top, bottom, back, left, right, front [to be installed later]) with no gaps, voids, or compression. Special Situation: Where framing depth is greater than required insulation thickness (e.g., double walls or framed bump-outs) a secondary air barrier shall be installed and in contact with the insulation, so that the insulation fills the cavity formed by the additional air barrier.	
03	Insulation fits snugly around obstructions (e.g., electrical boxes, plumbing and wiring) with no gaps, voids or compression.	
04	Structural metal tie-downs and shear panels are insulated between exterior air barrier and metal.	
05	Hard to access wall stud cavities, such as corner channels or wall intersections, are insulated to the proper R-value prior to the installation of exterior sheathing or exterior stucco lathe.	
06	Insulation and interior air barrier are installed behind tub, shower, fireplace enclosures and stairwells to the R-value listed on the Certificate of Compliance when located against exterior walls.	
07	All single-member window and door headers shall be insulated to a minimum of R-3 for a 2x4 framing, or equivalent width, and a minimum of R-5 for all other assemblies. No header insulation is required for single-member headers that are the same width as the wall, provided that the entire wall has at least R-2 insulation.	
08	After insulation is installed: All insulated walls have interior and exterior air barriers, including kneewalls and walls of skylight wells. Exception: Rim joists. Interior air barrier (typically gypsum board) is sealed to top plate.	
09	Verification Status	<input type="checkbox"/> Pass - all applicable requirements are met; or <input type="checkbox"/> Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or <input type="checkbox"/> All N/A - This entire table is not applicable.
10	Correction Notes	

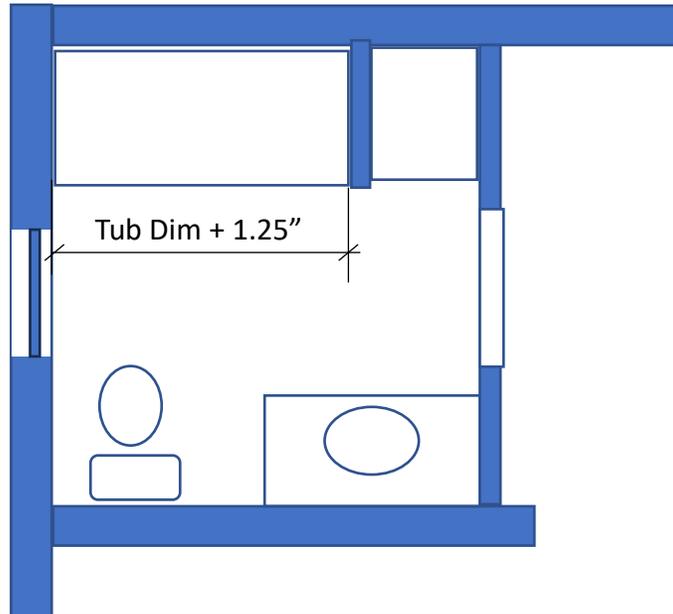
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.



Exterior Wall with a Continuous Air and Thermal Boundary – Install before the Tub/Shower is Installed



Dimension Plans and Notes Re: Install air-barrier material, add 5/8" per surface. Install prior to setting tub.



- When installing a shower or tub on an exterior wall, it is essential to air seal and insulate the wall cavity behind the shower and tub enclosure to prevent thermal bypasses that can result in moisture getting into the walls and cold tubs.
- If the tub or shower is on an exterior wall and the cement board will serve as an air barrier over the insulation, apply a thick bead of caulk to the surface of the exposed studs, wood blocking, and top and bottom plates before attaching the air barrier material to the studs.
- Resource: Build America <https://basc.pnnl.gov/resource-guides>



Proper insulation and air-barrier missing behind tub at the exterior walls.





Roofs:

Vented or Unvented Roofs with Attic Ceiling as Air Barrier

Vented or Unvented Rafter Roof

New Mandatory Measure – Vented Attic, with Ducts in the Attic

Climate Zones (CZ) 4 and 8-16:

- Weighted average U-factor of roof deck assembly cannot exceed U-0.184
- Applies to insulation either above or below the roof deck or a combination of the two
- Examples: R-19 under roof-deck or R-5 exterior continuous insulation.

New Requirement for
2022 Code

Prescriptive

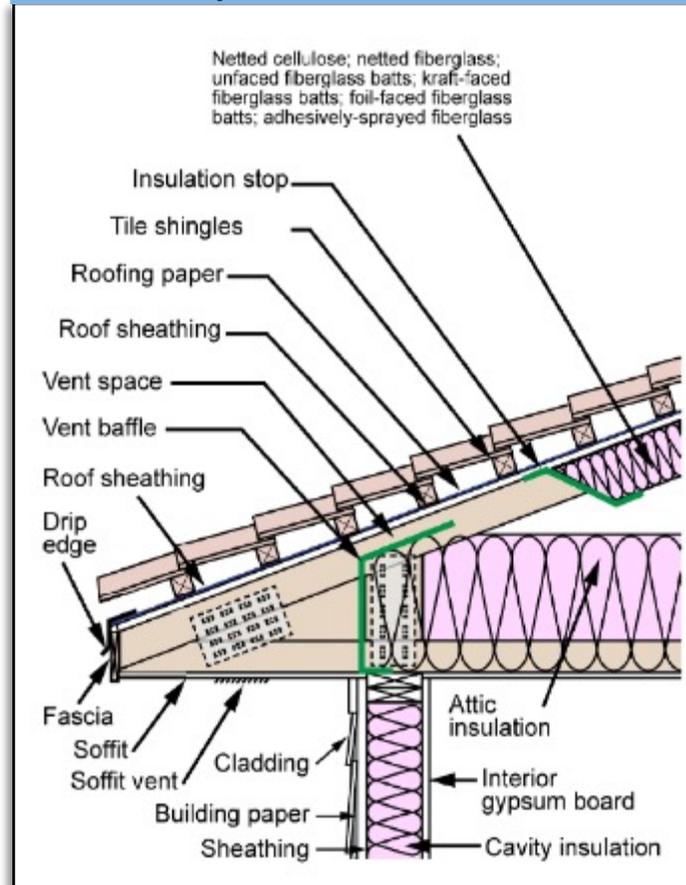


Image credit: CEC

Performance

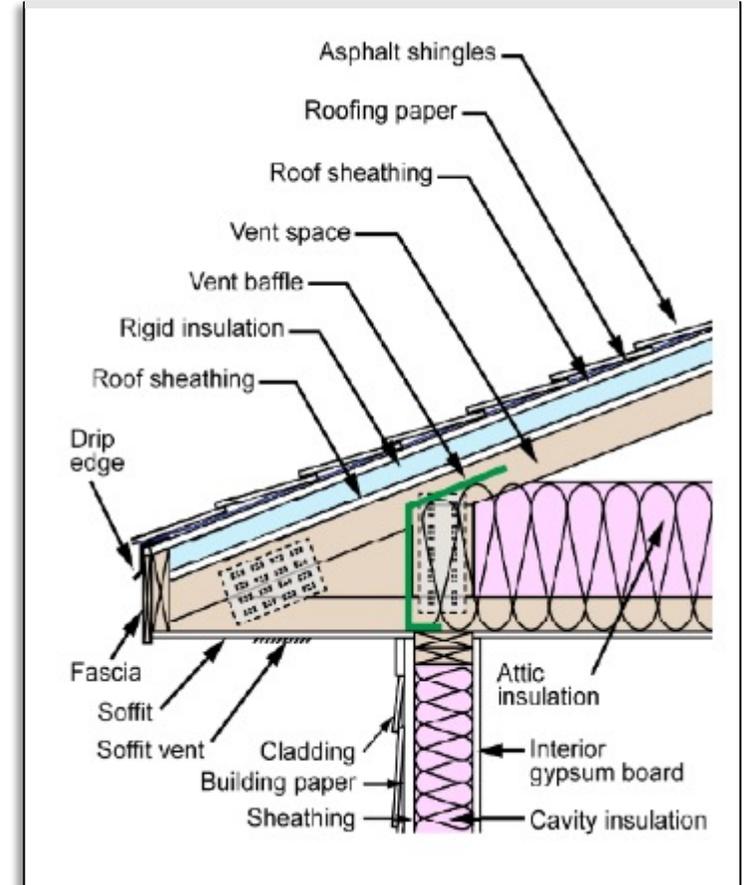
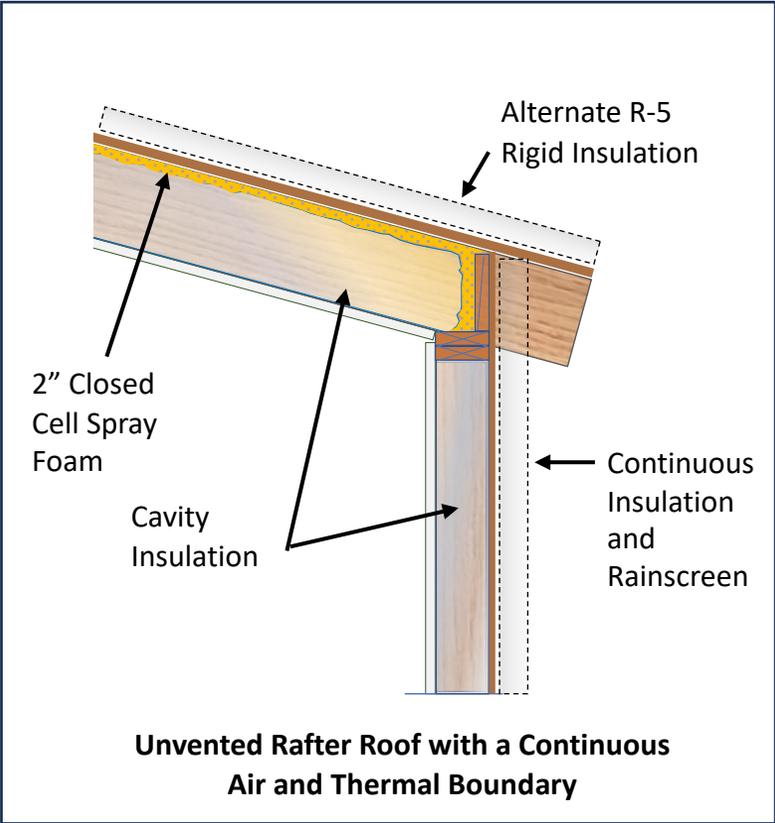


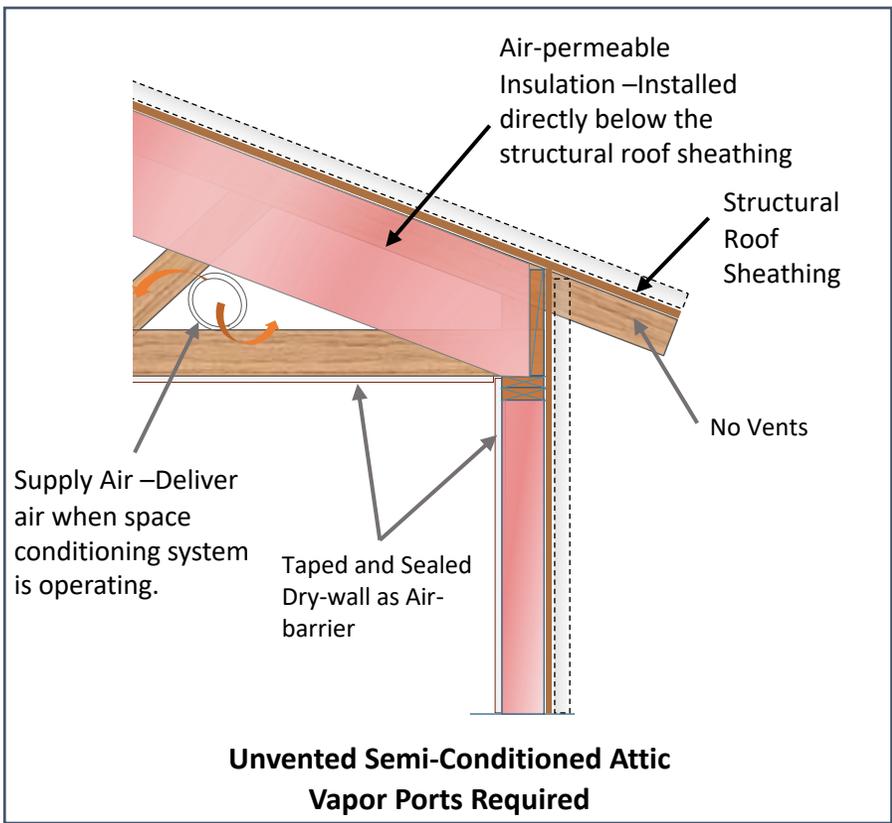
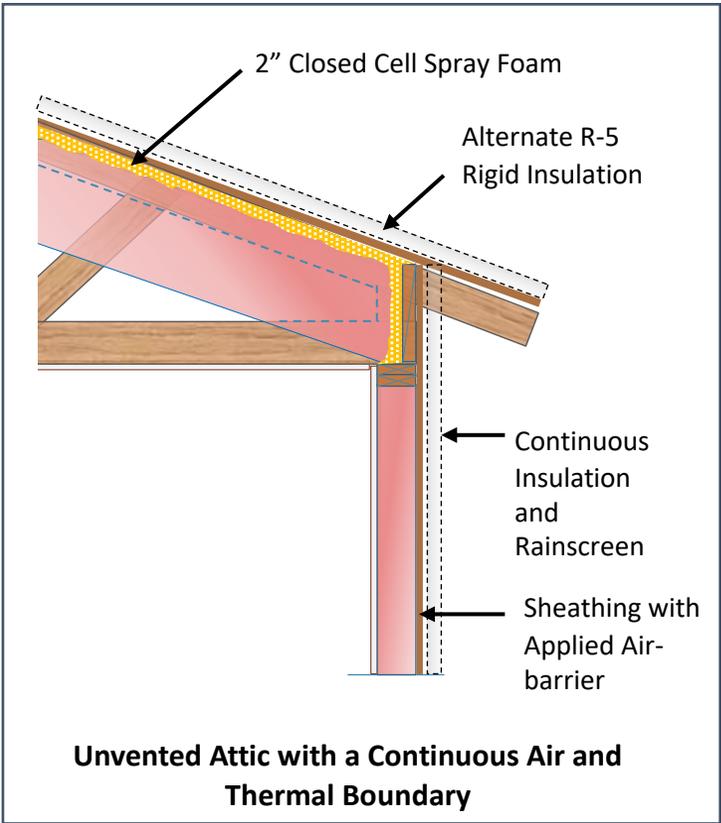
Image credit: CEC

Other Assemblies – Performance Method

Rafter Roof Assemblies – Vented or Unvented



Un-Vented Attics



Performance Method –Key Attributes (Inputs)

Vented or Unvented Attic

Re: Insulation Depth at Roof Deck

Location and Total R-value, with or without Framing

General JA4 Residential T24 Performance Layers

Attic

Unventilated

Truss Heel Height: 9.5 inches

Insulation covers framing at underside of roof deck

This tab is used to edit the attributes of the assembly used for Residential Title 24 Performance calculations in the software.

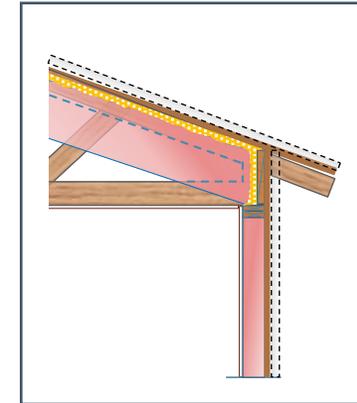
Insulation

Location	Insulation	Framing	Thickness
Ceiling:	- no insulation -	2x4 @ 24 in. O.C.	
Above Roof Deck:	0 R-value	None	0 inches
Below Roof Deck:	30 R-value	Wood	3.5 inches

Other

Exterior Wall Finish: Stucco

Non standard spray foam insulation requiring QII Inspection



Unvented Attic with a Continuous Air and Thermal Boundary

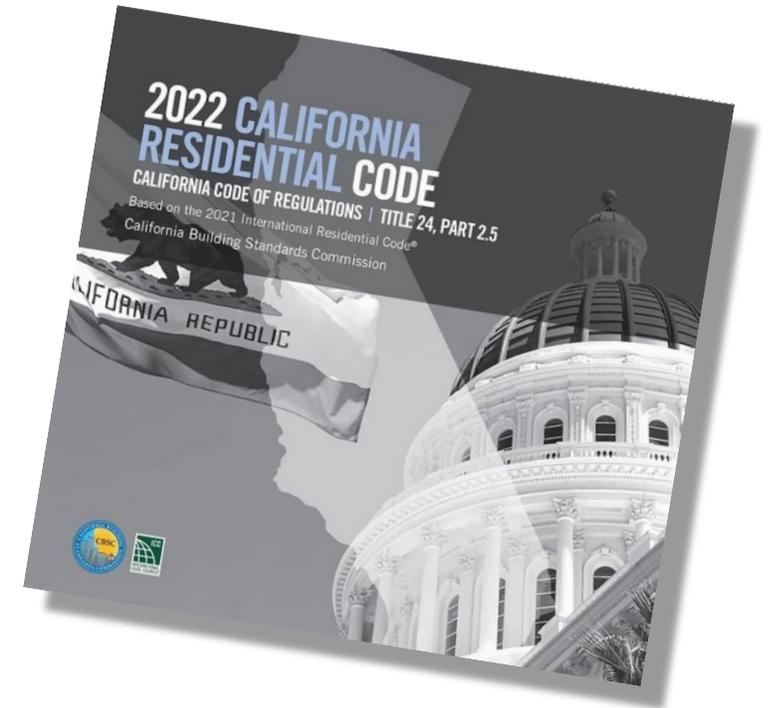


Note: The Energy Code does not specifically address condensation potential , nor the amount and area of attic ventilation or vapor diffusion, nor insulation type(s)... those regulations are in the Residential Code

California Residential Code – Title 24, Part 2.5

R806.5 Unvented Attic and Unvented Enclosed Rafter Assemblies

- Section R806.5 –Primary intention is to mitigate against condensation at the roof structural sheathing.
- ‘Spells out’ the requirements for use of air-permeable and air-impermeable insulations.
- List the requirements for unvented attics that use *only* air-permeable insulation for IECC Climate Zones 1,2, & 3
 - Vapor diffusion ports (20 perm min rating), and shall serve as an air barrier between the attic and the exterior of the building
 - Where only air-permeable insulation installed directly below the roof structural sheathing, an air supply flow rate of 50 cfm per 1,000 sf of ceiling area must be provided



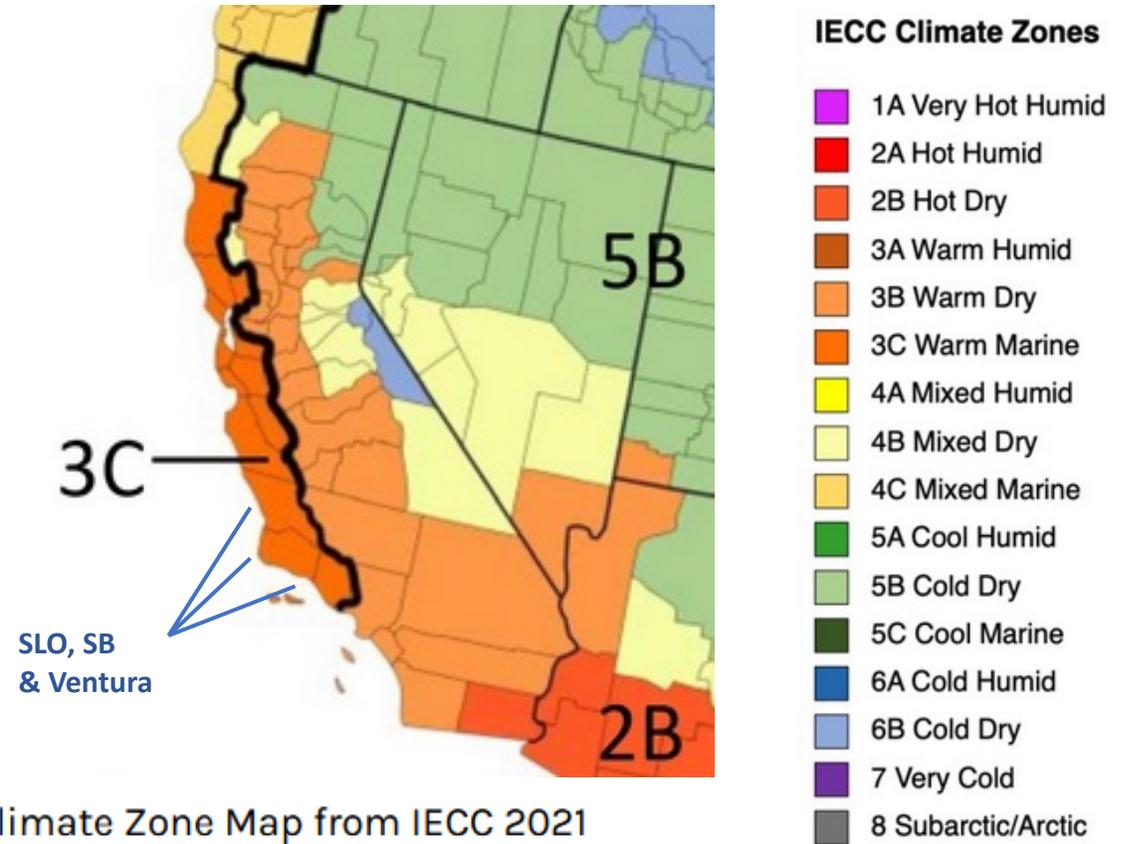
Part 2.5 is Based on the International Energy Conservation Code (IECC)

TABLE R806.5

INSULATION FOR CONDENSATION CONTROL

CLIMATE ZONE	MINIMUM RIGID BOARD ON AIR-IMPERMEABLE INSULATION R-VALUE ^{a, b}
2B and 3B tile roof only	0 (none required)
1, 2A, 2B, 3A, 3B, 3C	R-5
4C	R-10
4A, 4B	R-15
5	R-20
6	R-25
7	R-30
8	R-35

b. Alternatively, sufficient continuous insulation shall be installed directly above the structural roof sheathing to maintain the monthly average temperature of the underside of the structural roof sheathing above 45°F (7°C). For calculation purposes, an interior air temperature of 68°F (20°C) is assumed and the exterior air temperature is assumed to be the monthly average outside air temperature of the three coldest months.



Keep in Mind:
The IECC Climate Zones Differ from California's Energy Code Climate Zones



T24, Part 2.5

Chapter 7 Walls

Section R702

3C-REN is comprised of San Luis Obispo, Santa Barbara, and Ventura Counties, and are IECC climate zone '3C' or '3(marine)'

TABLE R702.7(5)
IECC VS. CALIFORNIA ENERGY CODE CLIMATE ZONE COMPARISON

IECC ^a	CALIFORNIA ENERGY CODE	DESCRIPTION ^b
6	16	Includes Alpine, Mono Counties
5	11, 12, 16	Includes Siskiyou, Modoc, Lassen, Plumas, Sierra, Nevada Counties
4 (marine)	1, 2, 16	Includes Del Norte and Humboldt Counties
4	2, 12, 13, 16	Includes Inyo, Trinity, Lake, El Dorado, Amador, Calaveras, Tuolumne, Mariposa Counties
3	8, 9, 10, 11, 12, 13, 14, 15, 16	Includes Shasta, Tehama, Butte, Glenn, Colusa, Yuba, Contra Costa, Sutter, Yolo, Sacramento, Placer, San Joaquin, Solano, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, Kern, Ventura, Los Angeles, Orange, San Bernardino, Riverside Counties
3 (marine)	1, 2, 3, 4, 5, 6, 9, 12, 16	Includes Mendocino, Sonoma, Marin, San Francisco, San Mateo, Alameda, Santa Cruz, Monterey, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Diego Counties
2	14, 16	Includes Imperial County

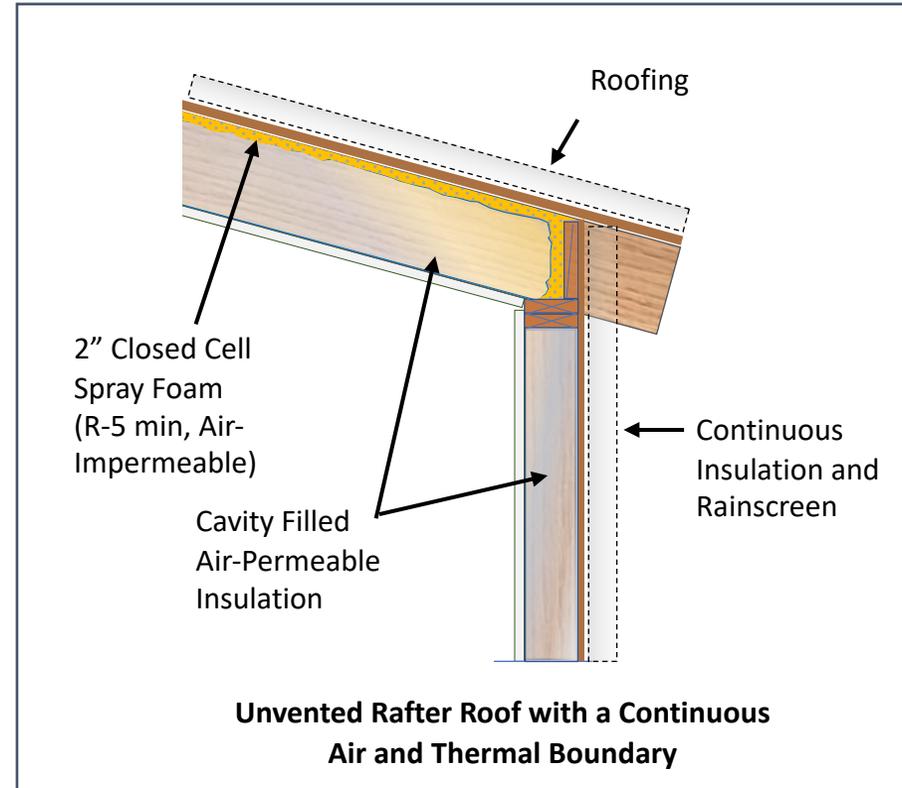
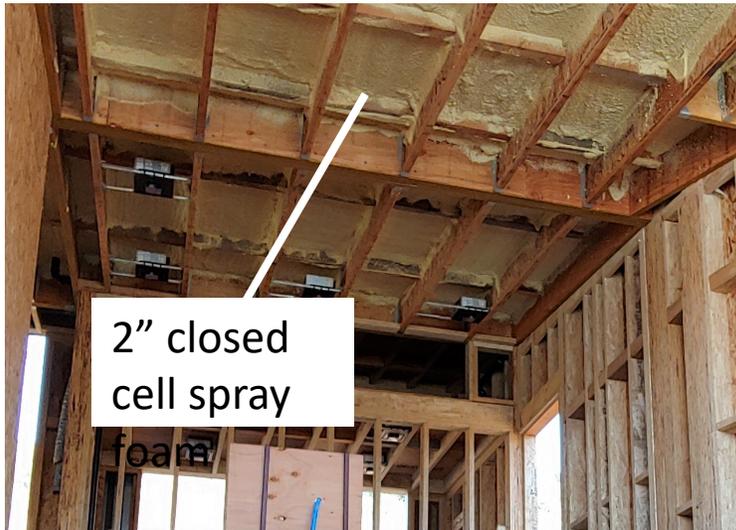
a. IECC Climate Zones 1, 7 and 8 do not occur in California, nor do any IECC moist climate zones.

b. IECC boundaries are defined by county political boundary lines. California Energy Code boundaries are based on metes and bounds specifications aligned with climate-affecting geographic features, which often do not coincide with county lines.



Unvented Rafter Roof –Blown-in over Spray Foam

Keep in Mind:
Typically, 2” of Closed-Cell
Spray Foam is needed as
an Air-Impermeable
Insulation



Excerpts from R806.5.5.1.3

- Where both [air-impermeable](#) and [air-permeable](#) insulation are provided, the [air-impermeable insulation](#) shall be applied in direct contact with the underside of the structural roof sheathing...
- ...[meet the] R-values in Table R806.5 for condensation control.
- ... [air-permeable](#) insulation shall be installed directly under the [air-impermeable insulation](#).

Reminder:

Table R806.5 for IECC Climate Zone 3C is R-5 for condensation control.

Unvented Rafter Roof – Batt over Spray Foam

Excerpt from form CEC-CF2R-ENV-21-QII-H:

A. Air Barrier Materials

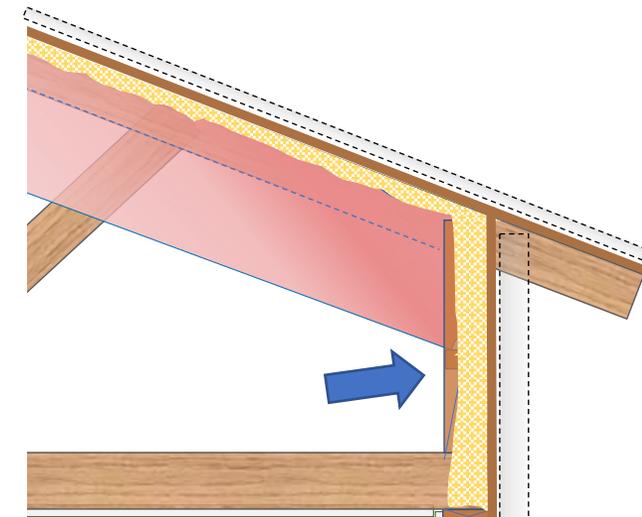
Note: SPF insulation is an acceptable air barrier and sealant when installed to a minimum thickness of 2 inches for closed cell and 5.5 inches for open cell, except where not allowed by manufacturer (e.g., flues, vents, can lights, etc.).



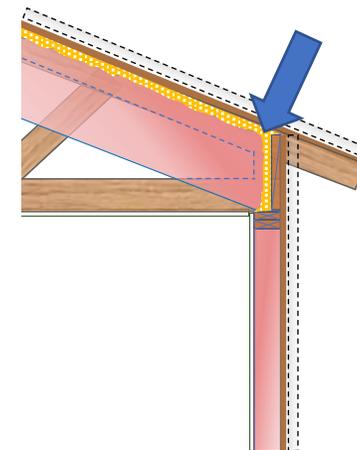
2" Closed Cell Spray Foam is adhered to underside of roof deck.



Remaining cavity is filled with Batt Insulation. (Blown-in insulation would also be acceptable.)

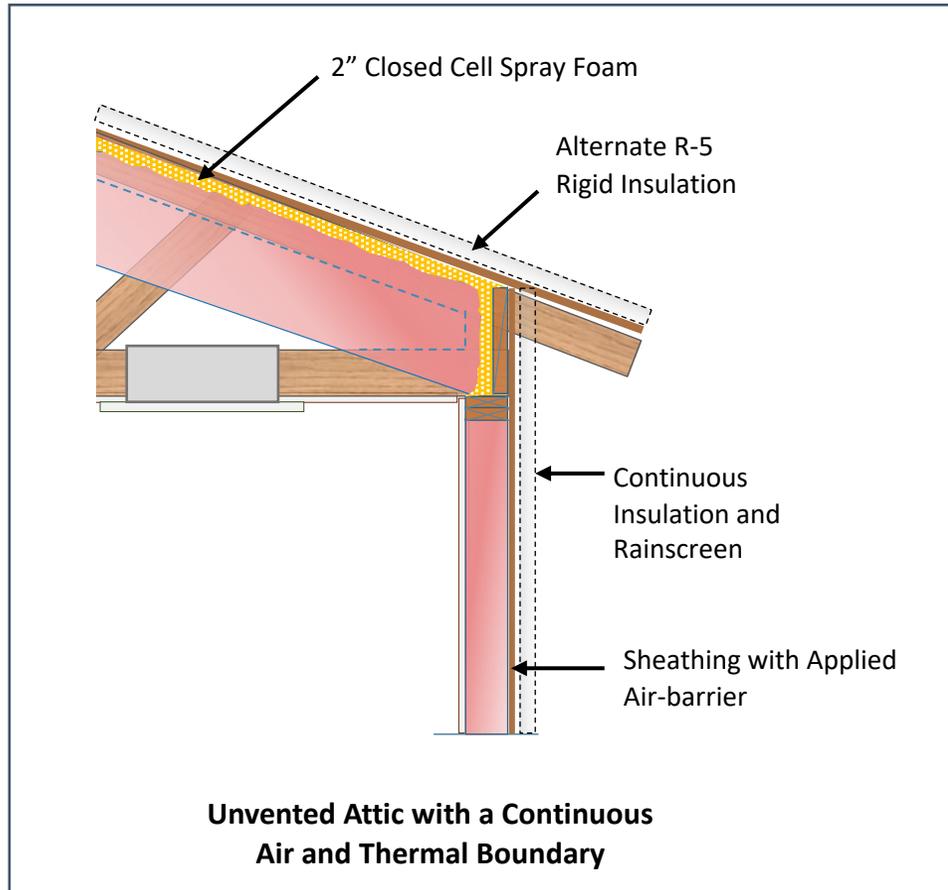


Include the heels and walls of the attic

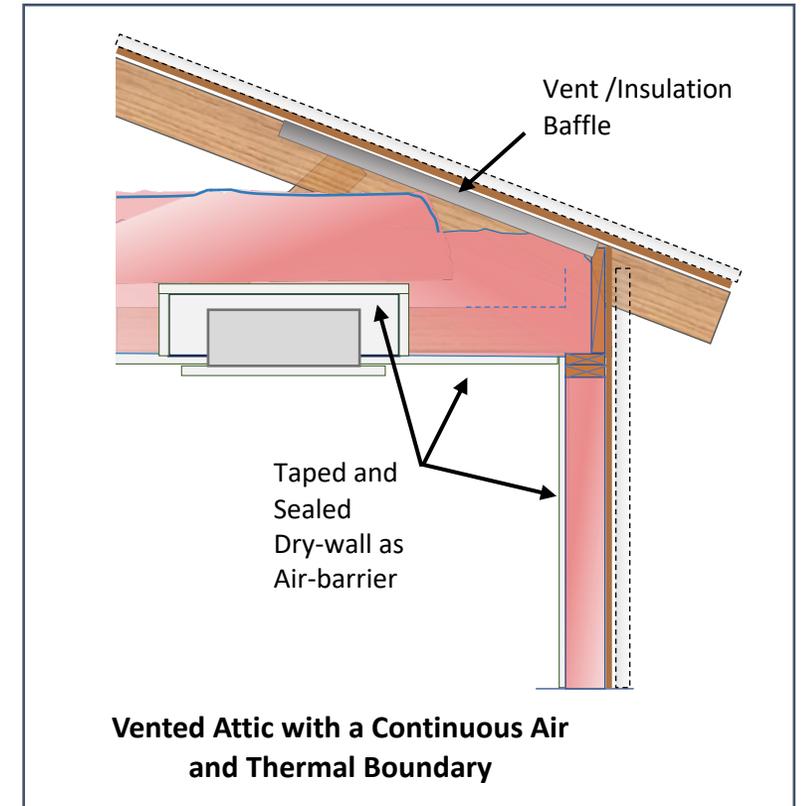


Reminder: VCHP Compliance Option –Ceiling Recessed Units Impacts Envelope Enclosure

Indoor units shall be installed within the air and thermal boundaries



Ductless Recessed-Ceiling



A Vented Rafter Roof Assembly with a 'Smart' Membrane

Run 'sleepers' along top of trusses or 2x rafters

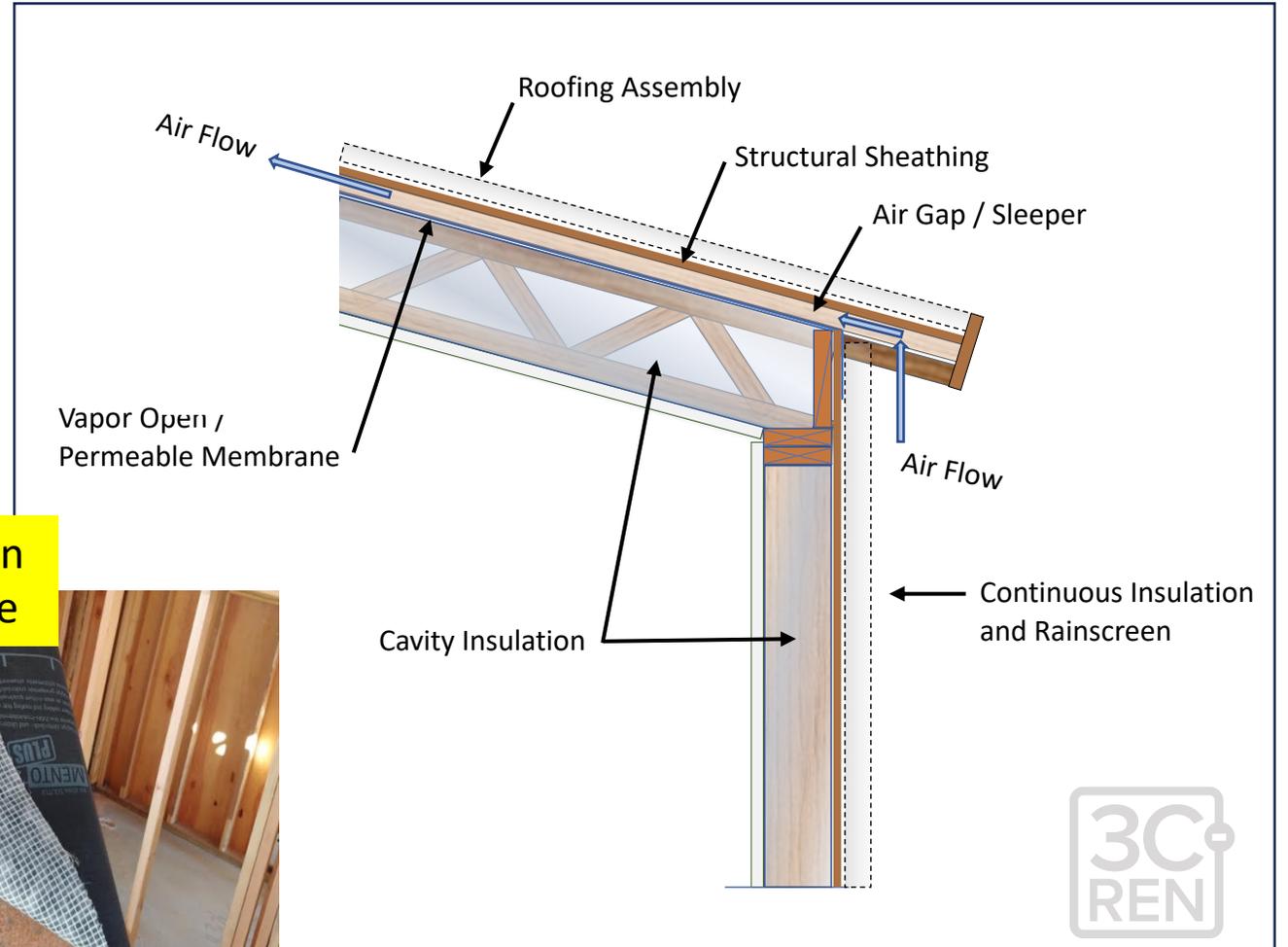


Photo/Project Credit: Cairn Collaborative



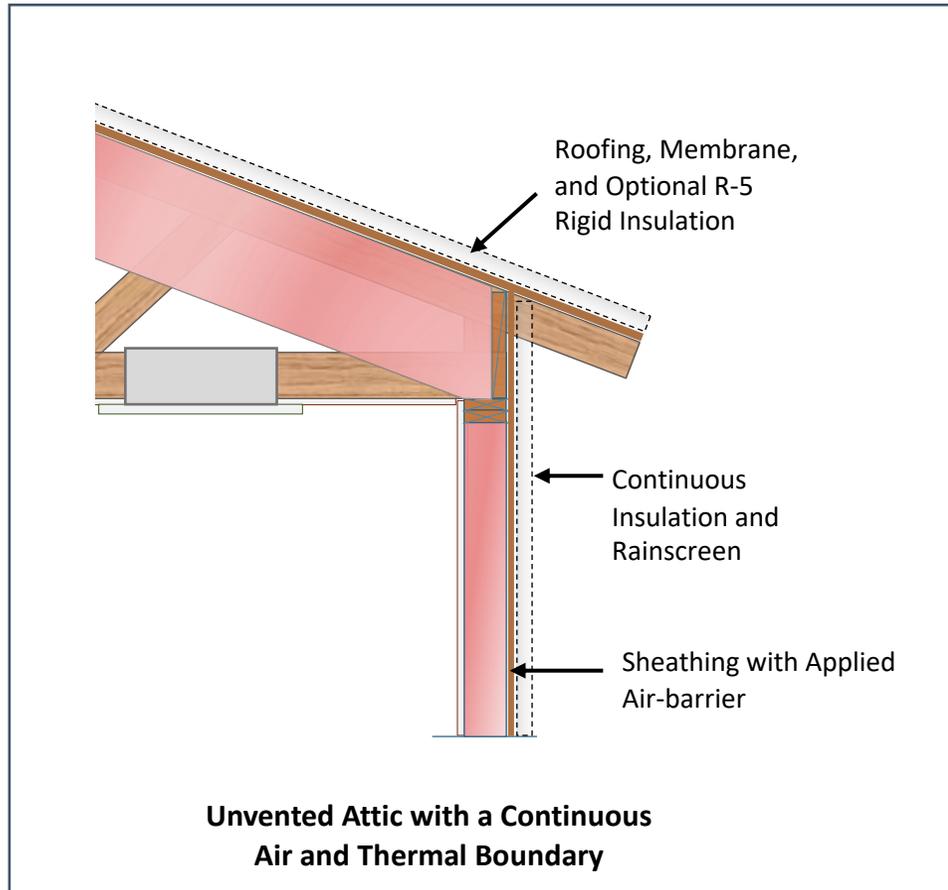
Looking from below before insulation

Vapor open membrane

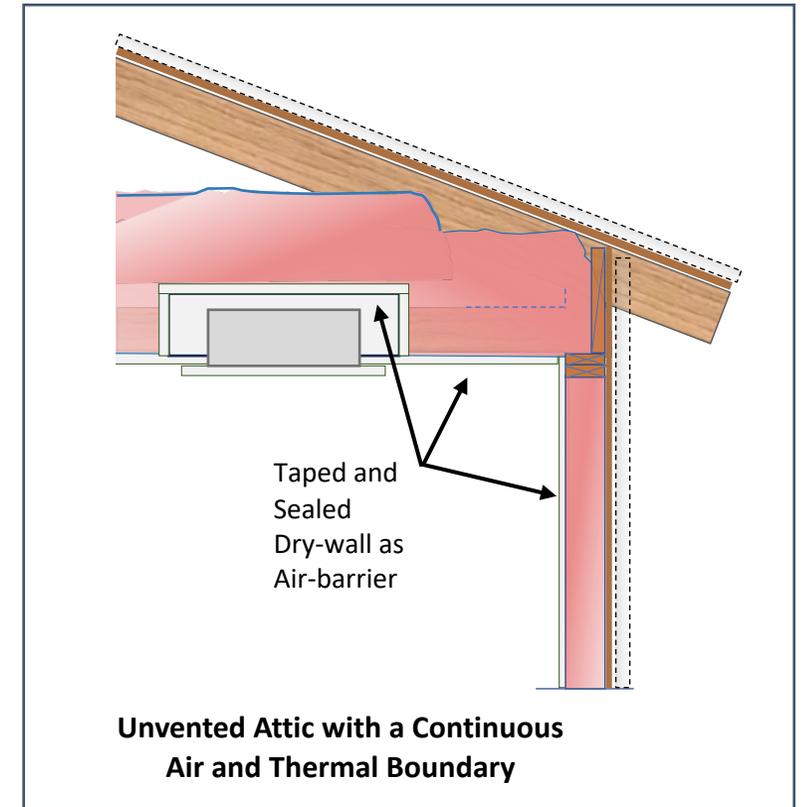


Not a fan of foam?

Note: Air-Permeable Insulation can be used, but only with added vapor diffusion port detailing.



Ductless Recessed-Ceiling Unit and Lighting Fixtures



Un-vented Attic with Air-Permeable Insulation at Roof

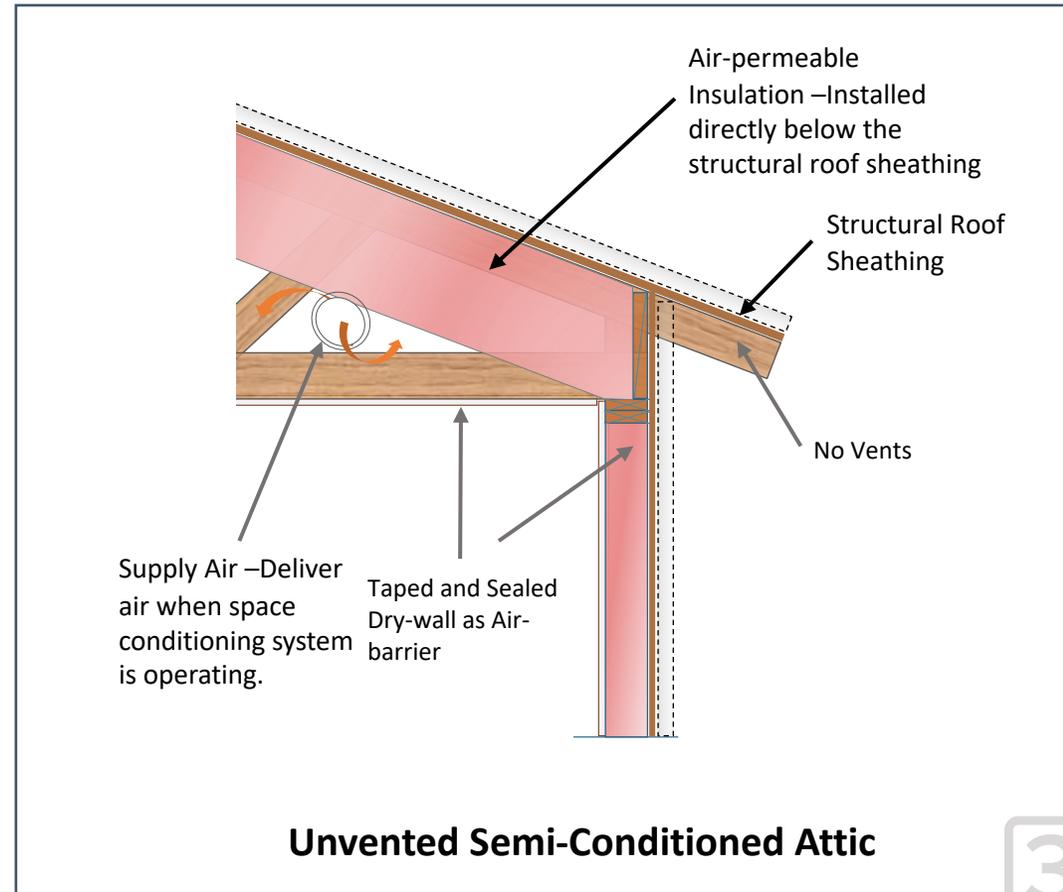
Requires Vapor Diffusion Port and Supply Air

R806.5, 5.2.10. Supply Air CFM

Where air-permeable insulation is used and is installed directly below the roof structural sheathing, air shall be supplied at a flow rate greater than or equal to 50 CFM (23.6 L/s) per 1,000 square feet (93 m²) of ceiling.

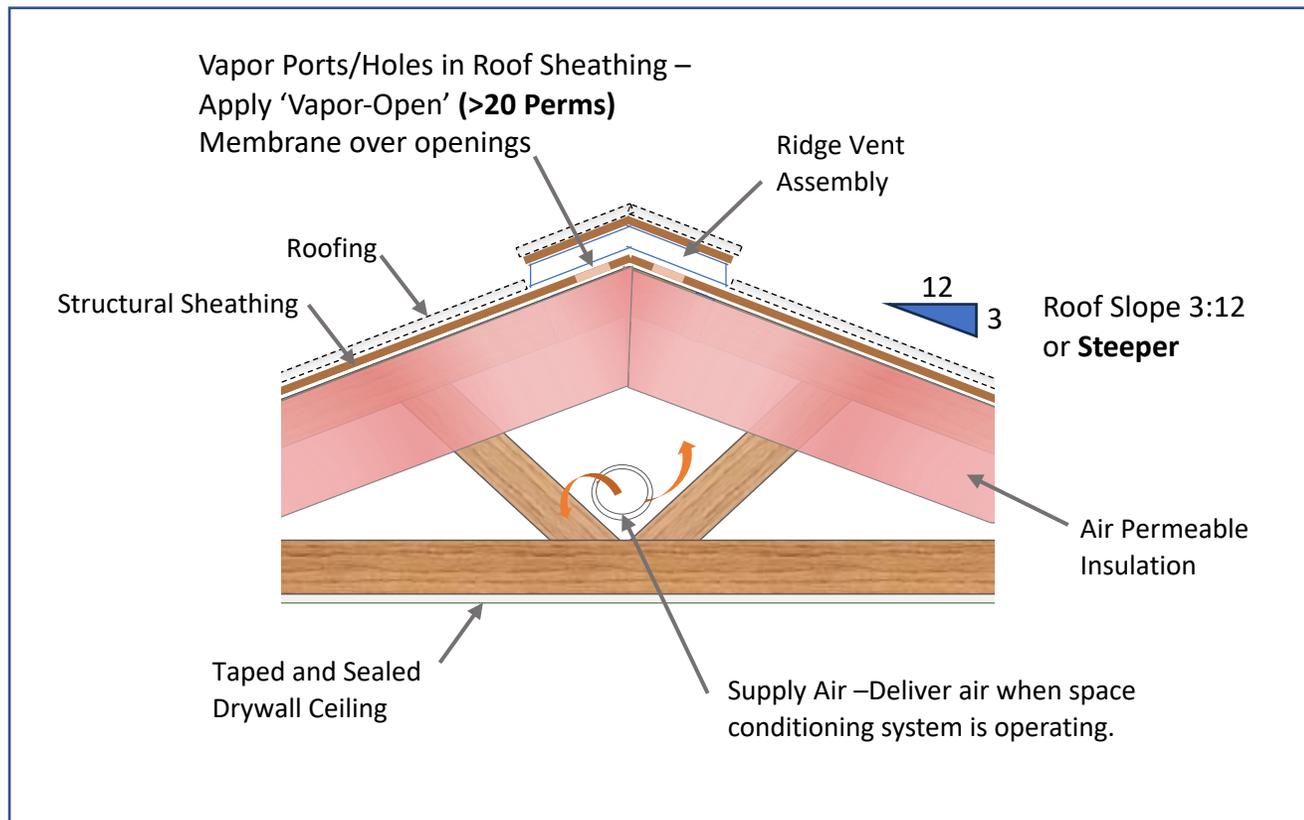
The air shall be supplied from ductwork providing supply air to the occupiable space when the conditioning system is operating.

Alternatively, the air shall be supplied by a supply fan when the conditioning system is operating.



Un-vented Attic with Air-Permeable Insulation at Roof

Requires Vapor Diffusion Port and Supply Air



Semi-Conditioned Un-Vented Attic with Vapor Diffusion Port at Roof Ridge

R806.5, 5.2.2. Vapor Port Area

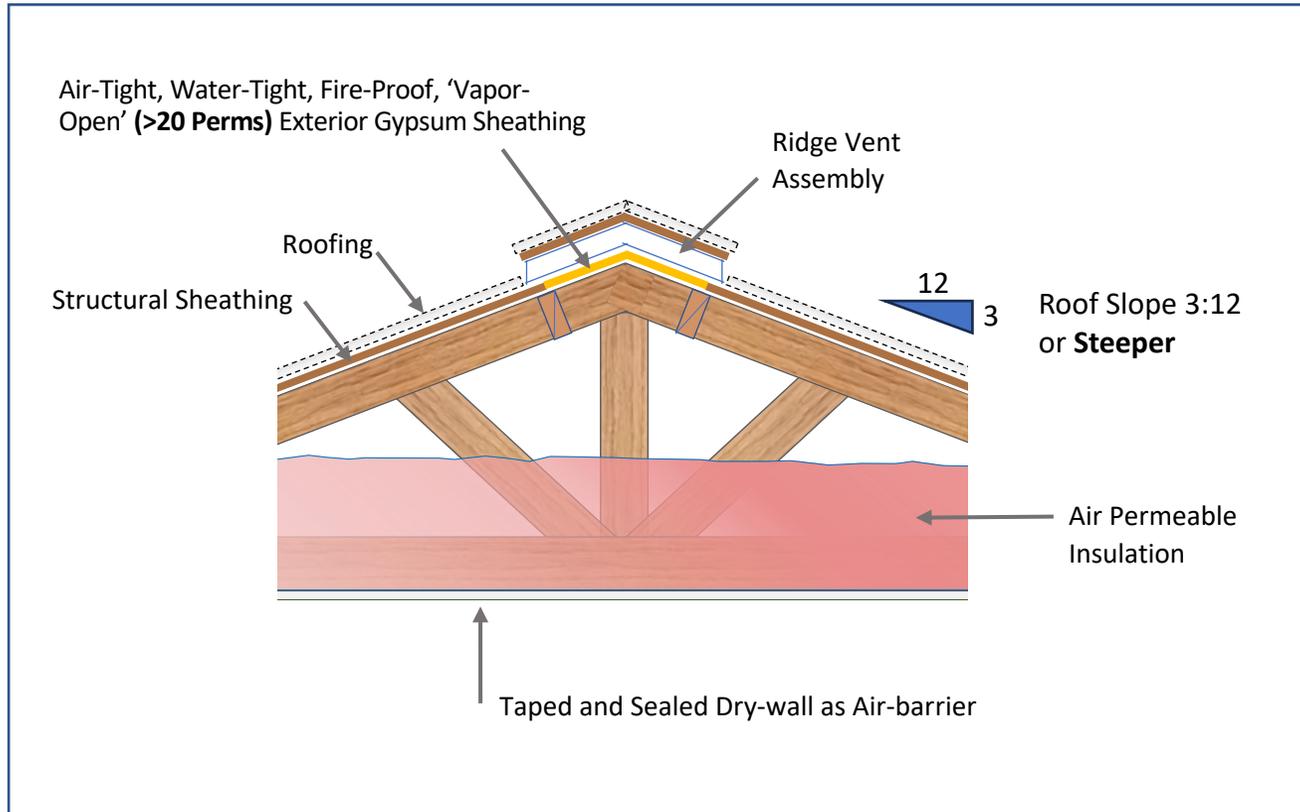
- Net Free Area of Ridge Diffusion Ports/Holes = 1:600 of Ceiling Area
- Example:** 1000 sq ft ceiling requires min 1.67 sq ft of opening or 240 sq inches of net free area. (50) 2.5" dia holes = 245 sq inches.

R806.5, 5.2.10. Supply Air CFM

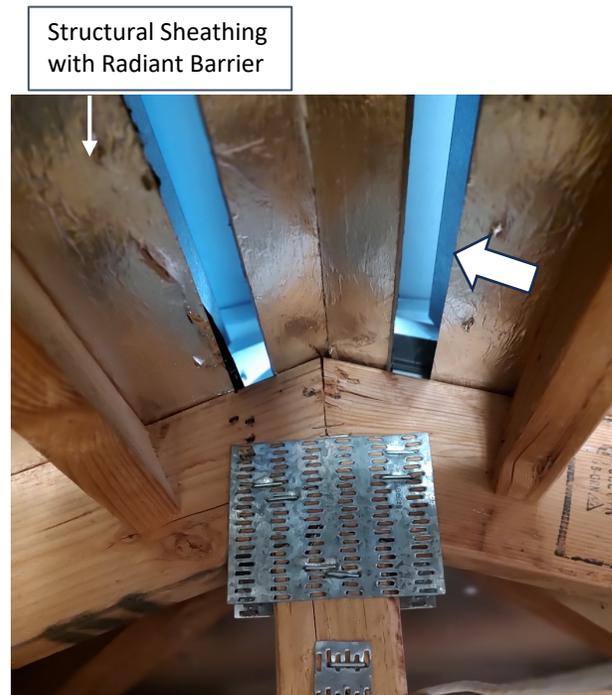
- Supply Air = 50 cfm per 1000 sq ft of Ceiling Area
- Rule of thumb:** 6" dia duct per each 1000 sq ft of ceiling area.



Un-vented Attic with Air-Permeable Insulation at Ceiling



Un-Vented Attic with Vapor Diffusion Port at Roof Ridge

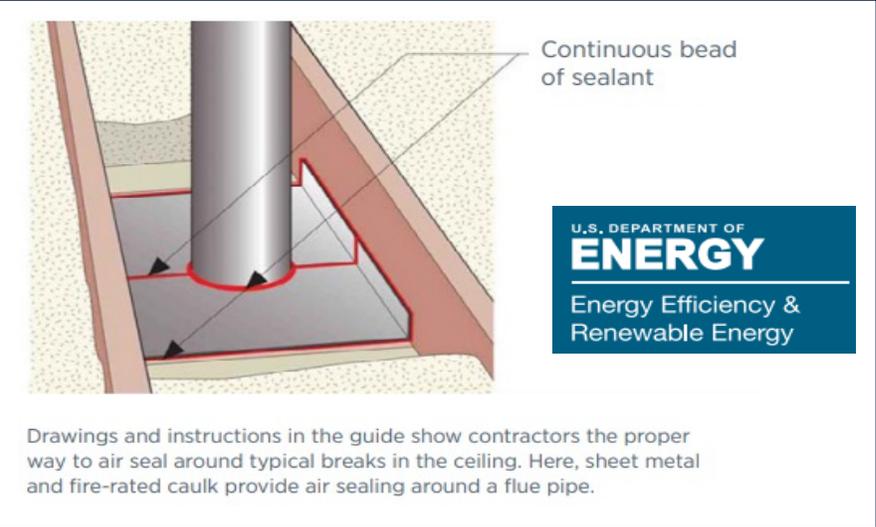


Vented Attic with Traditional Ridge Vent

Can use standard ridge vent assemblies. As a 'vapor-port' the vent openings could be covered by vapor-open membrane (>20 Perms)



QII - Air Infiltration Sealing CF2R-ENV-21-H

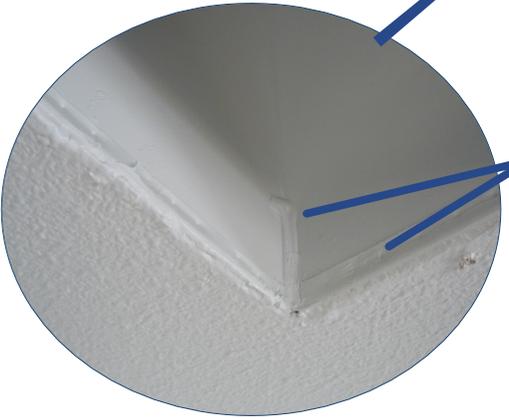


Before



Common Problem Area – Connection to Drywall

After



Joints Caulked and Boot Sealed to Drywall



QII - AIR INFILTRATION SEALING – FRAMING STAGE



CALIFORNIA ENERGY COMMISSION

CEC-CF2R-ENV-21-H

SAMPLE FORM – NOT VALID FOR SUBMISSION TO BUILDING DEPARTMENTS

E. Roof Air Barrier – Unvented Attics Adjacent to Unconditioned Space

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.

01	There is a continuous air barrier at the roof deck and gable ends.
02	Chimneys and flues require sheet metal flashing at the roof deck. The flashing is sealed to the chimney/flue with fire rated caulk. The flashing is sealed to the surrounding framing.
03	All penetrations in the roof deck and gable ends for plumbing, electrical, etc. are sealed.

Ducts in Conditioned Space HERS Credit

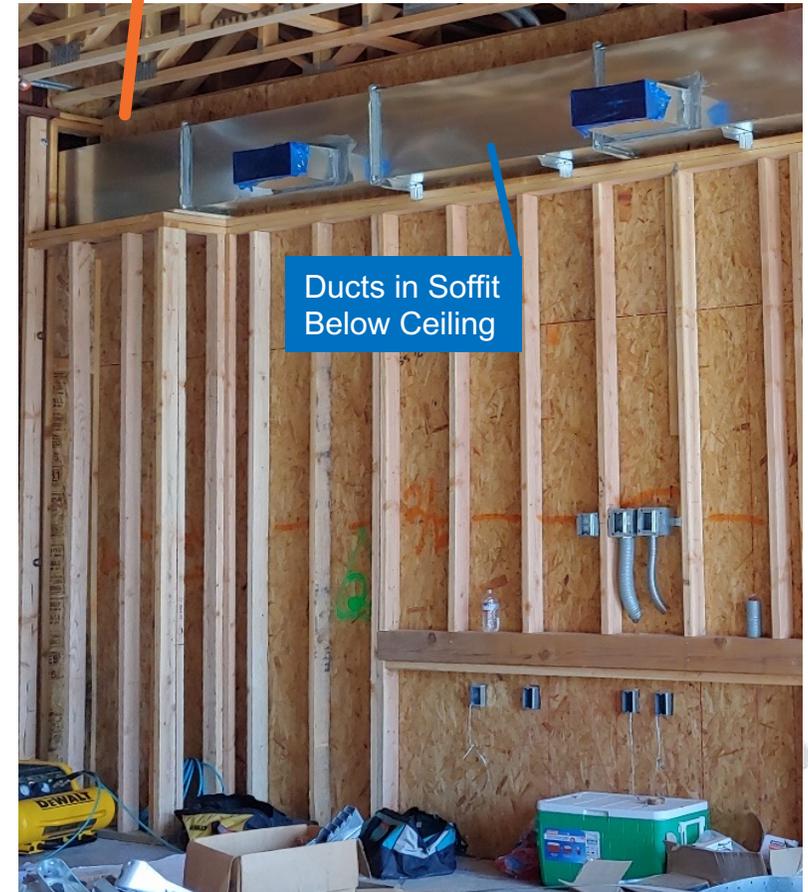
Is also a ceiling/attic detailing *opportunity*

 CALIFORNIA ENERGY COMMISSION		DUCT LOCATION	CEC-CF3R-MCH-21-H
SAMPLE FORM – NOT VALID FOR SUBMISSION TO BUILDING DEPARTMENTS			
CERTIFICATE OF VERIFICATION Note: This table completed by HERS Registry.			
Project Name:		Enforcement Agency:	
Dwelling Address:		Permit Number:	
City and Zip Code:		Permit Application Date:	
A. General Information Note: Submit one Installation Certificate for each duct system that is taking credit for duct location.			
01	SC System Identification or Name		
02	SC System Location or Area Served		
03	Indoor Unit Name or Description of Area Served		
04	Status – Less than 12 ft Ducts in Conditioned Space Performance Credit		
05	Status – Ducts Located In Conditioned Space Performance Credit		
06	Status – Duct System Located Entirely in Directly Conditioned Space, No Insulation Requirement		
07	Status – Portions of Ducts Located in Conditioned Space, R-6 Exception		
B. 12 Linear Feet or Less of Duct Located Outside of Conditioned Space - RA3.1.4.1.2			
01	A visual inspection shall confirm space conditioning systems with air handlers located outside the conditioned space have 12 linear feet or less of duct located outside the conditioned space including air handler and plenum.		
02	Verification Status:	<input type="checkbox"/> Pass - all applicable requirements are met; or <input type="checkbox"/> Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or <input type="checkbox"/> All N/A - This entire table is not applicable	
03	Correction Notes:		
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.			
C. Ducts Located In Conditioned Space - RA3.1.4.1.3			
01	A visual inspection shall confirm the space conditioning system is located entirely in conditioned space.		
02	Verification Status:	<input type="checkbox"/> Pass - all applicable requirements are met; or <input type="checkbox"/> Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or <input type="checkbox"/> All N/A - This entire table is not applicable	
03	Correction Notes:		

Benefits:

- Performance Method 'Credit' for improved energy efficiency
- Trade-Off 'Credit' can be used to off-set other energy losing features
- Ducts entirely in conditioned space - insulation not required

Drywall and Taped Ceiling for Continuous Air Barrier -- Soffit needs a 'Lid' at Ceiling





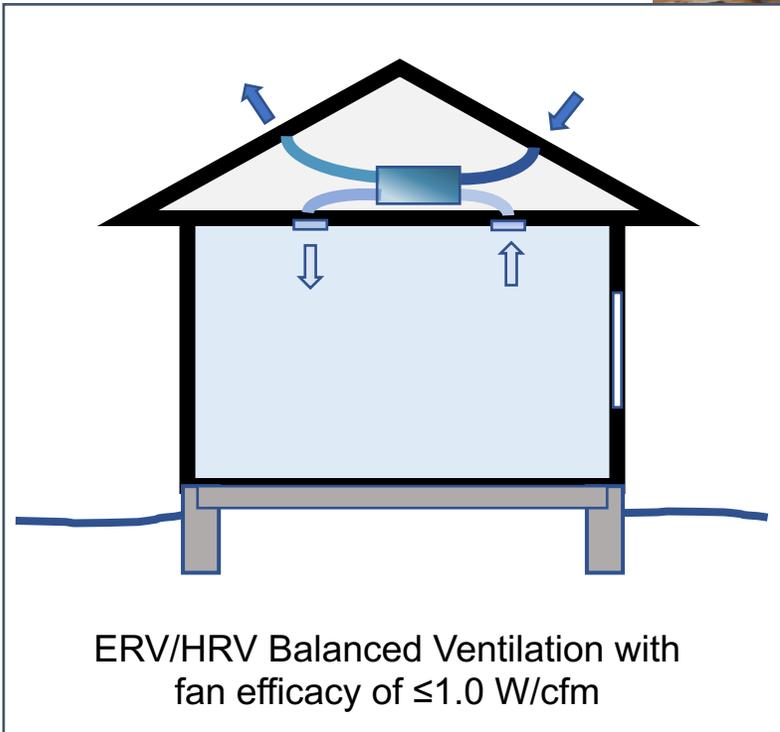
Outside Air Ventilation



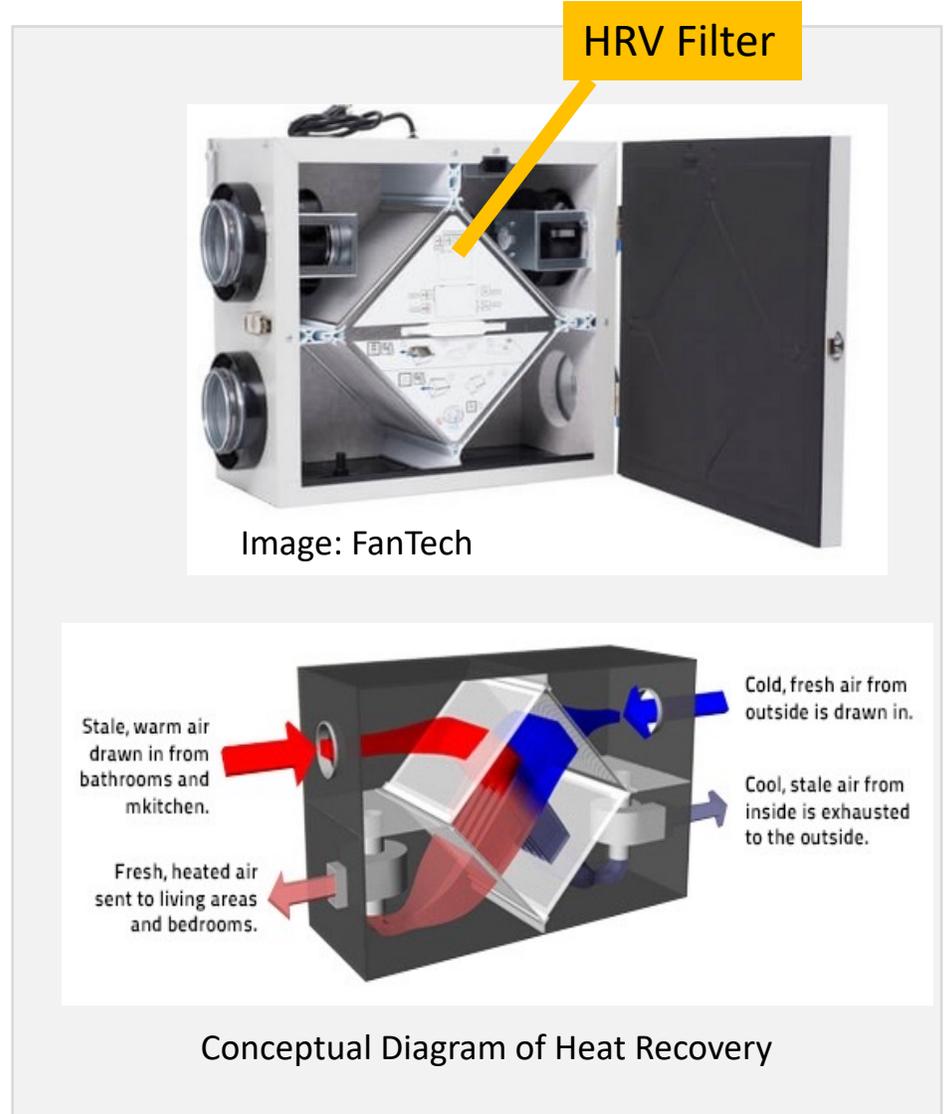
Balanced Ventilation with Heat Recovery (HRV)

Two Basic Types:

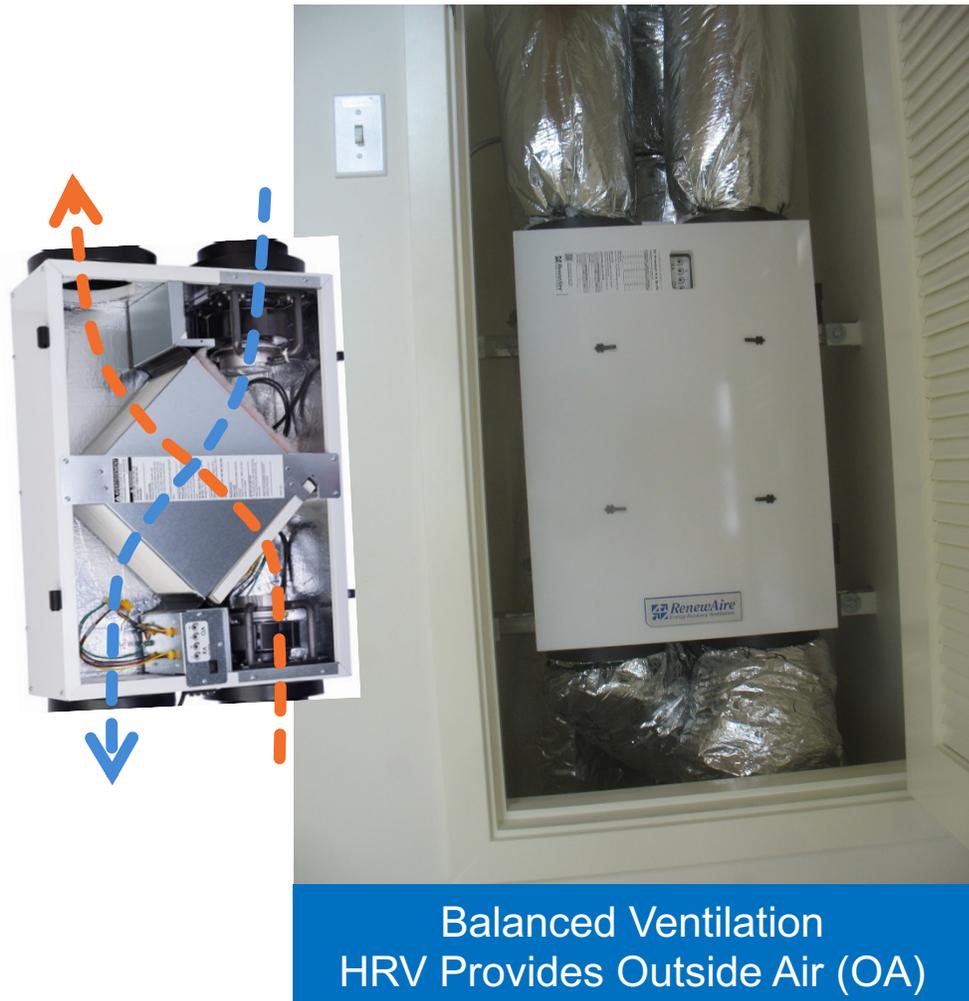
- Whole House Systems
- 'Spot' HRV/ERVs



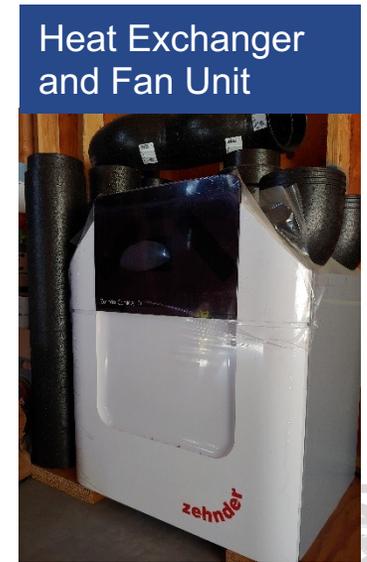
- Performance Credit Available
- Must be HVI –Certified Products Directory listed for credit (HVI.org)



IAQ – Indoor Air Quality Ventilation



Duct System
'Home Runs' to
the Heat
Exchanger and
Fan Unit



ERV / HRV Balanced Ventilation Example
ERV = Energy Recovery Ventilation
HRV = Heat Recovery Ventilation

Consider Including Key Energy Measures on the Cover Sheet

If a project design includes HERS measures (See CF1R or LMCC) consider calling that out on the Cover Sheet, suggested locations:

- ‘Code Summary’
- ‘Code Analysis’
- ‘Supporting Documents’
- ‘HERS Summary’

Also, consider including additional notes from the sample CF2R’s that directly address insulation and air sealing details.

EXAMPLE PROJECT
4630 NOGALES AVE., ATASCADERO, CA 93422
INITIAL SUBMITTAL DATE: _____
PICT # _____

GENERAL NOTES

PROJECT DATA

SHEET INDEX

SUPPORTING DOCUMENTS

VICINITY MAP

EXAMPLE PROJECT

T1.1

SUPPORTING DOCUMENTS

- TITLE 24 ENERGY REPORT
- NOTE: HERS MEASURES REQUIRED ON THIS PROJECT:
 - QII AND AIR SEALING REQUIRED
 - EQUIPMENT VERIFICATION –HERS
 - VCHP – CREDIT

‘Design – Construction – Verification’ is a Team Sport

- Work with your consultants for detail consistency.
- Reach out to manufactures for detail and product support.
- Follow up with each consultant to ensure one person’s design/specification is not undermining the another person’s work.



Friendly Energy Analyst

- Well executed job site work flow makes HERS Duct Leakage Testing, QII, and Envelope Air Leakage Sealing go smoothly and easily.
- Follow up with each trade to ensure one trades person is not undermining the other trades person’s work.



Friendly HERS Rater



Questions about Title 24?

3C-REN offers a *free* Code Coach Service



Online:
3c-ren.org/codes

Call:
805.781.1201

Energy Code Coaches are local experts who can help answer your Title 24 questions. Coaches have decades of experience in green building and energy efficiency improvements. They can provide citations and offer advice for your project to help your plans and forms earn approval the first time.

Closing

- Continuing Education Units Available
 - Contact itzel.torres@ventura.org for AIA and ICC LUs
- Coming to Your Inbox Soon!
 - Slides, Recording, & Survey – Please Take It and Help Us Out!
- Upcoming Courses:
 - March 28th - [Multi-Family Domestic Hot Water](#)
 - April 2nd - [Introduction to Passive House Standard](#)
 - April 4th - [Why Energy Consultants Should Learn to do Residential HVAC Design](#)
 - April 9th - [Blower Door Basics and Beyond](#)
- Visit www.3c-ren.org/events for our full catalog of trainings.





Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org



TRI-COUNTY REGIONAL ENERGY NETWORK
SAN LUIS OBISPO • SANTA BARBARA • VENTURA