Decoding QII

Let's Talk HERS Quality Insulation Installation

HELPING YOU PLAY YOUR CARDS RIGHT

This program is funded by California utility customers and administered by Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E®), Southern California Edison Company (SCE), and Southern California Gas Company (SoCalGas®) under the auspices of the California Public Utilities Commission.

EnergyCode Ace™

Helping you play your cards right

Who Are We?

Gina Rodda, Gabel Energy
gina@gabelenergy.com

GABEL ENERGY
BUILDING ENERGY ANALYSIS + ENERGY CODE COMPLIANCE

Host: Gina Rodda

Gina Rodda, our host for the Decoding Talk series, is a Certified Energy Analyst (CEA), and LEED Accredited Professional (AP).

She is involved in providing residential and non-residential energy calculations for a variety of building types throughout California; an instructor of full day trainings; and host of various webinars specific to Title 24 (Part 6) Building Energy Efficiency Standards.

Gina has been in the energy modeling field since 1991, starting the *ninth* California building energy code cycle of her career.

Who Are We?

Russ King, CalCERTS, Inc.
russ@calcerts.com

CalCERTS, Inc.
HERS PROVIDER

Co-Host: Russ King

Russell King, M.E. is a professional mechanical engineer licensed in California, Nevada and Hawaii.

He has over 25 years of experience in the areas of HVAC design, diagnostics and consulting, as well as energy code compliance and consulting. He has taught professional level training on all of these topics. Russ is currently the Senior Director of Technical Services at CalCERTS, Inc., a California HERS Provider.

He earned a Bachelor of Science Degree in Environmental Resources Engineering with an Energy Resources Emphasis from Humboldt State University.

Handouts

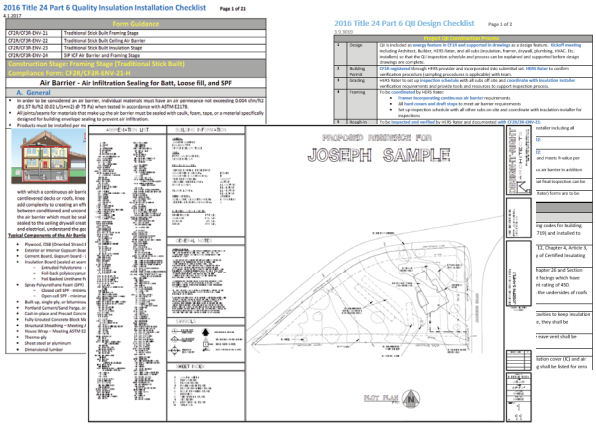
Quality Insulation Installation (QII) Handbook

For Installers and HERS Raters (2016 Energy Code)

Note: Structural Insulated Panels (SIPs) and Insulated Concrete Forms (ICFs) are not covered in this document – Refer to RA3.5 for these types of insulated assemblies.

Tools For You

- CalCERTS QII Handbook
- Sample Design Set
- Checklist for Contractors
- Checklist for Design Set



How can the energy code be:

How can the design documents support a project being successful when pursuing QII verification;

Knowing *when* the HERS rater must be integrated into the project schedule and construction verification process;

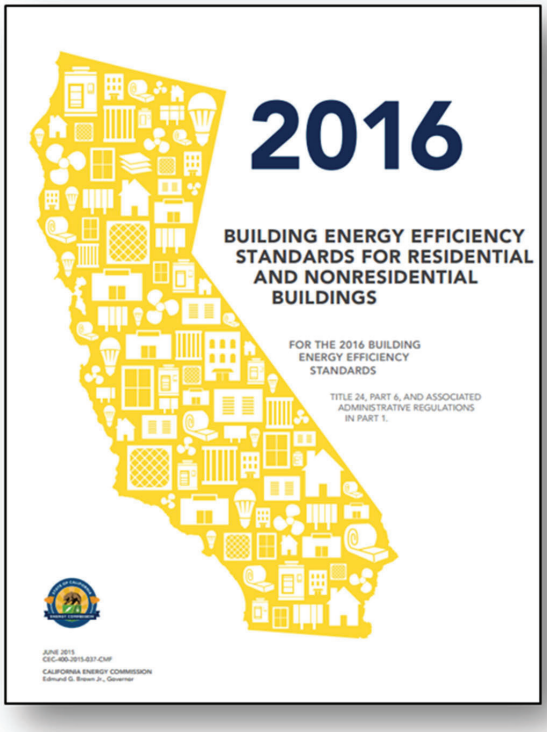
Being aware of the multiple inspections required by the HERS rater for QII, and how to be prepared for them.

Why?

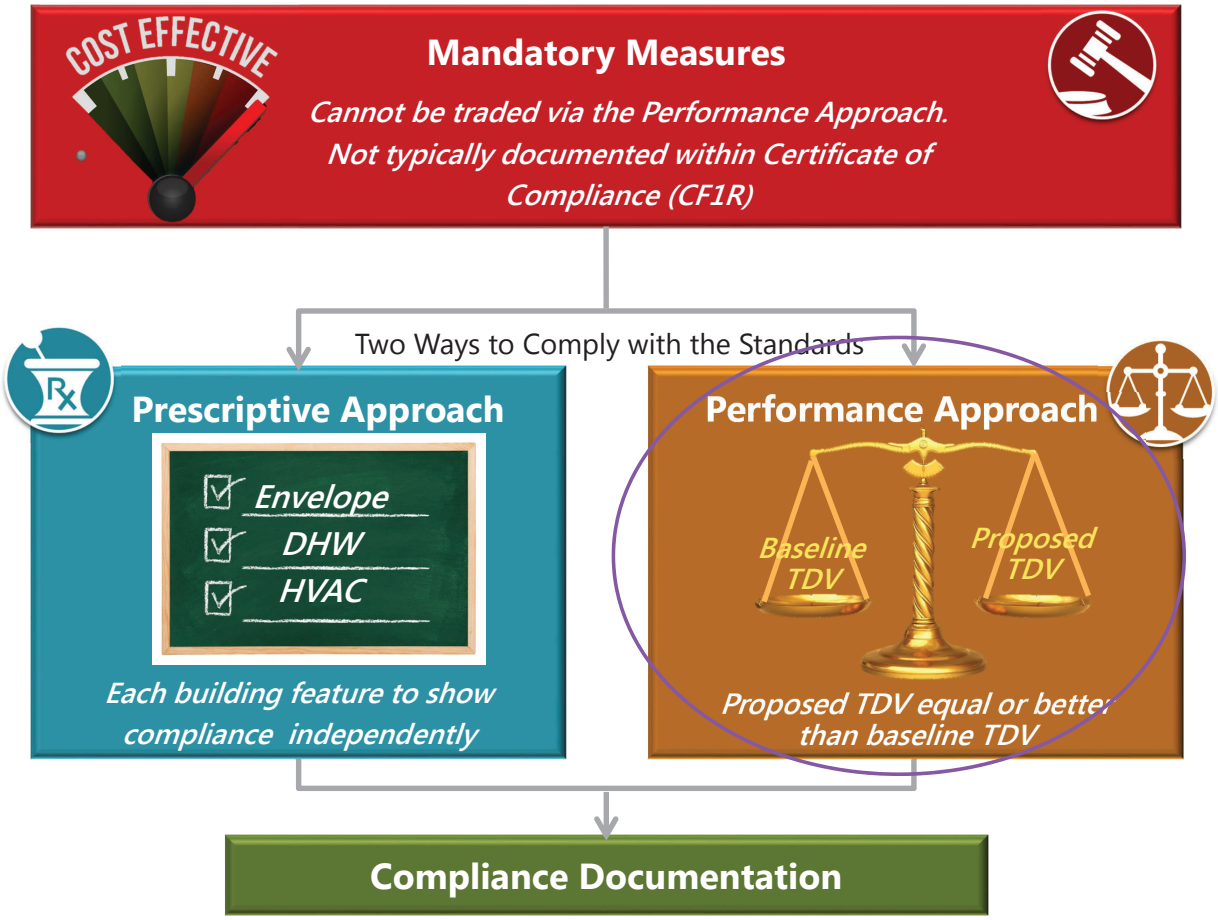
HELPING YOU PLAY YOUR CARDS RIGHT

Which Code Year Applies? Permit pulled....

Jan. 2017- Dec. 2019



Jan. 2020- Dec. 2023



What's Changing for 2019

QII

Will move from a performance credit to a prescriptive requirements for:

- ❑ New homes
- ❑ Additions over 700 ft^2
  - ❑ Exceptions to QII requirements:
    - Existing window and door headers do not need to be insulated
    - Air sealing shall not be required when the existing air barrier is not being removed or replaced

HERS Raters

Who *is* the HERS Rater and why are they in charge?

Special Inspectors

- Special Inspectors to the AHJ (building departments)
- Trained and maintained by their HERS provider
  - CHEERS (www.cheers.org)
  - CalCERTS (www.calcerts.com)
- Inspection features determined by Energy Commission per Reference Appendices

Under Contract to..

- Hired by the building owner or contractor
  - MUST be 3rd party
    - Not under the employment of the contractor
    - Not financially involved in project
  - Can be a consultant *and* the HERS rater (i.e. energy consultant)

Our Question To You

1. Are you aware of the QII requirements for the 2019 code?
2. *What is your biggest challenge regarding HERS verified Quality Insulation Installation (QII)?*
3. What are your top 3 wishes being successful with QII?
4. *If you could wave your magic wand, the QII process would include _____ to make your job easier in understanding and implementing QII?*

Getting contractors to realize QII is required before construction

QII instructional "how to" booklet

1. *Good communication with contractors*
2. *Contractors understanding of the requirements*
3. *enforcement of the requirements*

61% said "no"

Let's Talk

HELPING YOU PLAY YOUR CARDS RIGHT

Challenges

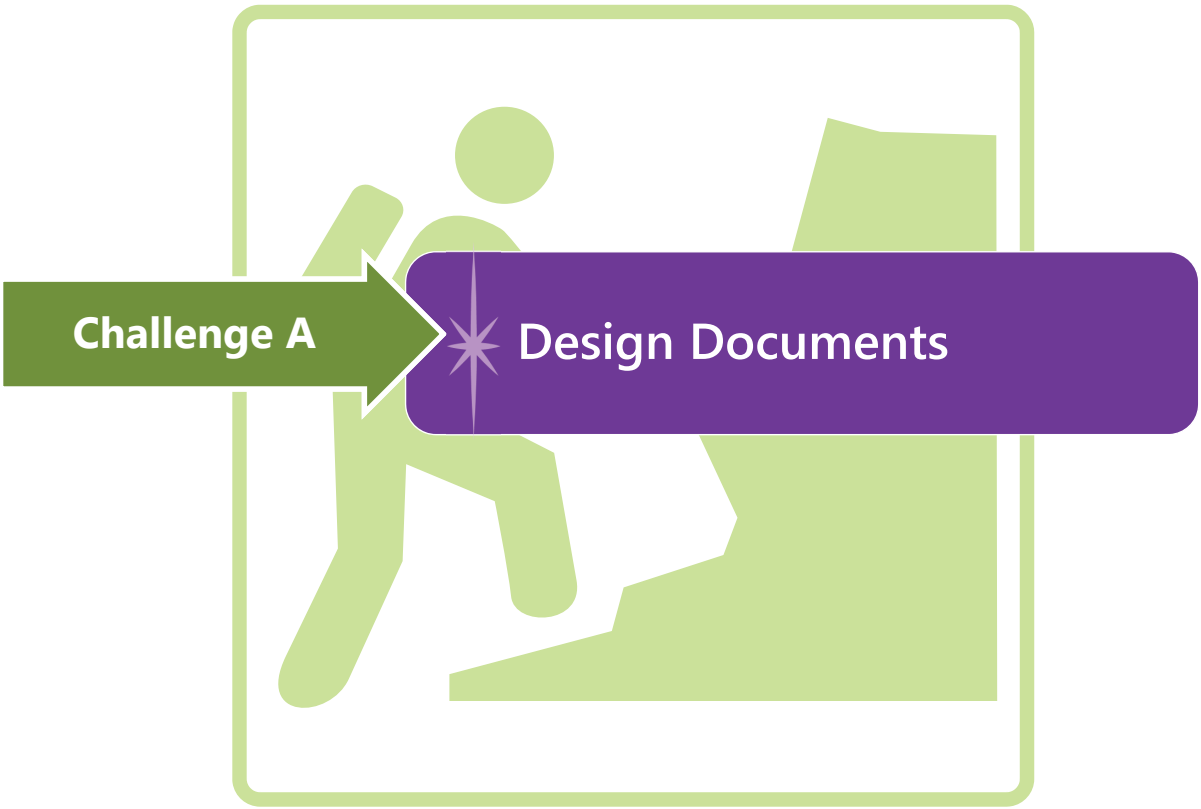
- **Challenge A:**
  - **Design Documents**

- **Challenge B:**
  - **Atypical Scenarios**

- **Challenge C:**
  - **Project Scheduling**

- **Challenge D:**
  - **Project Overview**

Challenge A



Why Does it Exist?

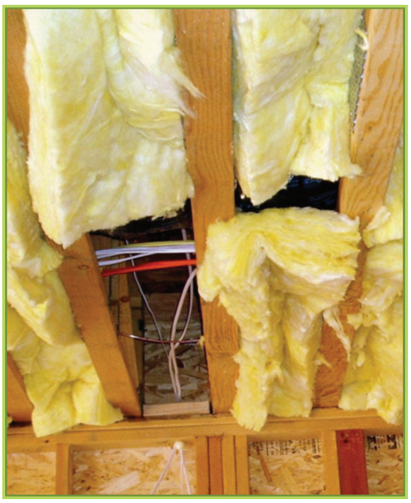


Photo courtesy of Douglas Beaman Associates LLC

What *IS* QII?

- Quality Insulation Installation:
  - A HERS rater makes sure that insulation is installed right to realize the FULL R-value of the assembly and the air infiltration rate.
    - **No HERS verification:**
      - *The assembly U-factor is derated by as much as **13.3%** due to poor installation being common practice.*
    - **QII HERS verification:**
      - *The full assembly U-factor is modeled (not derated).*

Why Use QII?

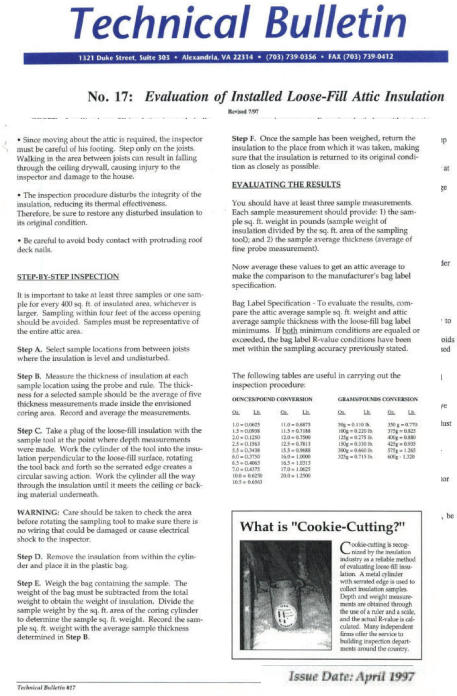
Design MUST support the QII features so that construction of project is *successful!*

- 2016 Code Cycle: QII is a decision to use "extra credit" associated with QII typically to trade energy towards difficult design features.
- 2019 Code Cycle: Will be prescriptively required for all new homes and additions over 700 square feet.
  - You can "trade away" in the performance approach, but the "TDV" energy associated with QII is high, and only building features equal or greater can be used to "trade" it away

Why Did California DO This?

Industry Standards

- The inspection requirements are based on the insulation manufacturer installation directions



Technical Bulletin

1321 Duke Street, Suite 303 • Alexandria, VA 22314 • (703) 739-0356 • FAX (703) 739-0412

No. 17: *Evaluation of Installed Loose-Fill Attic Insulation*

Revised 7/97

• Since moving about the attic is required, the inspector must be careful of his footing. Step only on the joists. Walking in the area between joists can result in falling through the ceiling drywall, causing injury to the inspector and damage to the house.

• The inspection procedure disturbs the integrity of the insulation, reducing its thermal effectiveness. Therefore, be sure to restore any disturbed insulation to its original condition.

• Be careful to avoid body contact with protruding roof deck nails.

STEP-BY-STEP INSPECTION

It is important to take at least three samples or one sample for every 400 sq. ft. of insulated area, whichever is larger. Sampling within four feet of the access opening should be avoided. Samples must be representative of the entire attic area.

Step A. Select sample locations from between joists where the insulation is level and undisturbed.

Step B. Measure the thickness of insulation at each sample location using the probe and rule. The thickness for a selected sample should be the average of five thickness measurements made inside the envisioned coring area. Record and average the measurements.

Step C. Take a plug of the loose-fill insulation with the sample tool at the point where depth measurements were made. Work the cylinder of the tool into the insulation perpendicular to the loose-fill surface, rotating the tool back and forth so the serrated edge creates a circular sawing action. Work the cylinder all the way through the insulation until it meets the ceiling or backing material underneath.

WARNING: Care should be taken to check the area before rotating the sampling tool to make sure there is no wiring that could be damaged or cause electrical shock to the inspector.

Step D. Remove the insulation from within the cylinder and place it in the plastic bag.

Step E. Weigh the bag containing the sample. The weight of the bag must be subtracted from the total weight to obtain the weight of insulation. Divide the sample weight by the sq. ft. area of the coring cylinder to determine the sample sq. ft. weight. Record the sample sq. ft. weight with the average sample thickness determined in **Step B**.

Step F. Once the sample has been weighed, return the insulation to the place from which it was taken, making sure that the insulation is returned to its original condition as closely as possible.

EVALUATING THE RESULTS

You should have at least three sample measurements. Each sample measurement should provide 1) the sample sq. ft. weight in pounds (sample weight of insulation divided by the sq. ft. area of the sampling tool), and 2) the sample average thickness (average of fine probe measurement).

Now average these values to get an attic average to make the comparison to the manufacturer's bag label specification.

Bag Label Specification - To evaluate the results, compare the attic average sample sq. ft. weight and attic average sample thickness with the loose-fill bag label minimums. If both minimum conditions are equaled or exceeded, the bag label R-value conditions have been met within the sampling accuracy previously stated.

The following tables are useful in carrying out the inspection procedure:

OUNCES/POUND CONVERSION

Oz.	Lb.	Oz.	Lb.
1.0 = 0.0625		11.0 = 0.6875	
1.5 = 0.0938		11.5 = 0.7188	
2.0 = 0.1250		12.0 = 0.7500	
2.5 = 0.1563		12.5 = 0.7813	
3.0 = 0.1875		13.0 = 0.8125	
3.5 = 0.2188		13.5 = 0.8438	
4.0 = 0.2500		14.0 = 0.8750	
4.5 = 0.2813		14.5 = 0.9063	
5.0 = 0.3125		15.0 = 0.9375	
5.5 = 0.3438		15.5 = 0.9688	
6.0 = 0.3750		16.0 = 1.0000	
6.5 = 0.4063		16.5 = 1.0313	
7.0 = 0.4375		17.0 = 1.0625	
7.5 = 0.4688		17.5 = 1.0938	
8.0 = 0.5000		18.0 = 1.1250	
8.5 = 0.5313		18.5 = 1.1563	
9.0 = 0.5625		19.0 = 1.1875	
9.5 = 0.5938		19.5 = 1.2188	
10.0 = 0.6250		20.0 = 1.2500	
10.5 = 0.6563			

GRAMS/POUNDS CONVERSION

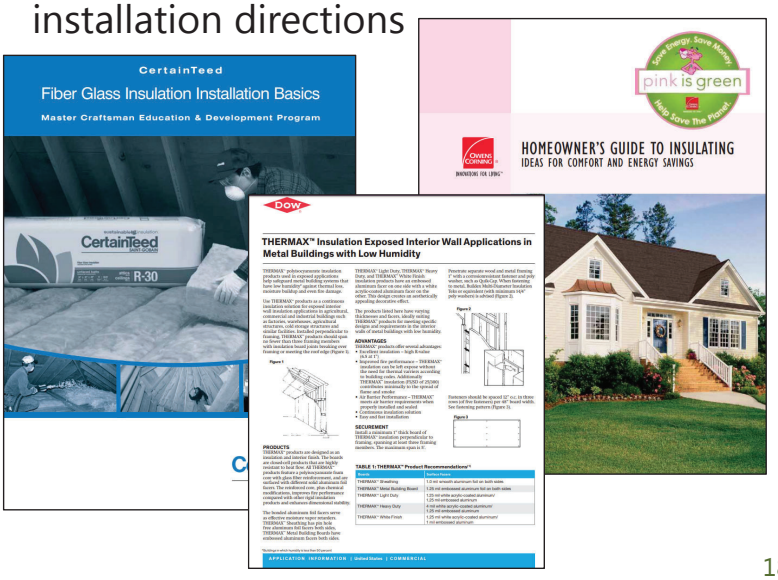
Gr.	Lb.	Gr.	Lb.
50g = 0.110 lb.		350 g = 0.770	
100g = 0.220 lb.		372g = 0.820	
125g = 0.275 lb.		400g = 0.880	
150g = 0.330 lb.		425g = 0.935	
200g = 0.460 lb.		575g = 1.265	
325g = 0.715 lb.		600g - 1.320	

What is "Cookie-Cutting?"

Cookie-cutting is recognized by the insulation industry as a reliable method of evaluating loose-fill insulation. A metal cylinder with serrated edge is used to collect insulation samples. Depth and weight measurements are obtained through the use of a ruler and a scale, and the actual R-value is calculated. Many independent firms offer the service to building inspection departments around the country.

Issue Date: April 1997

Technical Bulletin #17



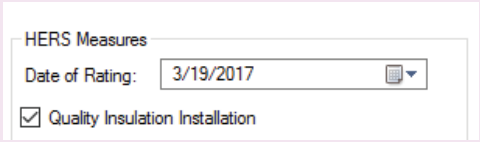
2016: Example Project

Not Including QII

- CZ 12 (Stockton)
  - -10.7% TDV
    - **Walls: 2 x 6 with R-19**
      - *Not a high performance wall meeting prescriptive requirements*
- CZ 3 (San Francisco)
  - -12.3% TDV

Including QII

- CZ 12 (Stockton)
  - +0.8% TDV (+11.5 TDV)



- CZ 3 (San Francisco)
  - +4.9% TDV (+17.2 TDV)

2019: Example Project

Not Including QII

- CZ 12 (Stockton)
  - Same Building as 2016 but including prescriptive PV
    - -19.7% TDV
- CZ 3 (San Francisco)
  - -15.8% TDV

Including QII

- CZ 12 (Stockton)
  - -8.4% TDV (+11.3 TDV)
- CZ 3 (San Francisco)
  - -4.1% TDV (+11.7 TDV)

Show CF1R with QII

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD — CF1R-PRF-01

Project Name: Sample House — **Calculation Date/Time:** 19:00, Sun, Mar 19, 2017 — Page 2 of 9

Calculation Description: Title 24 Analysis — **Input File Name:** Sample T24 v7 QII.ribd16x

ENERGY DESIGN RATING

Energy Design Rating (EDR) is an alternate way to express the energy performance of a building using a scoring system where 100 represents the energy performance of the Residential Energy Services (RESNET) reference home characterization of the 2006 International Energy Conservation Code (IECC). A score of zero represents the energy performance of a building that combines high levels of energy efficiency with renewable generation to"zero out" its TDV energy. Because EDR includes consideration of components not regulated by Title 24, Part 6 (such as domestic appliances and consumer electronics), it is not used to show compliance with Part 6 but may instead be used by local jurisdictions pursuing local ordinances under Title 24, Part 11 (CALGreen).

As a Standard Design building under the 2016 Building Energy Efficiency Standards is significantly more efficient than the baseline EDR building, the EDR of the Standard Design building is provided for information. Similarly, the EDR score of the Proposed Design is provided separately from the EDR value of installed PV so that the effects of efficiency and renewable energy can both be seen

EDR of Standard Design	EDR of Proposed Design	EDR Value of Proposed PV	Final EDR of Proposed Design
47.8	47.4	0.0	47.4

☐ Design meets Tier 1 requirement of 15% or greater code compliance margin (CALGreen A4.203.1.2.1) and QII verification prerequisite.

☐ Design meets Tier 2 requirement of 30% or greater code compliance margin (CALGreen A4.203.1.2.2) and QII verification prerequisite.

☐ Design meets Zero Net Energy (ZNE) Design Designation requirement for Single Family in climate zone CZ12 (Sacramento) (CALGreen A4.203.1.2.3) including on-site photovoltaic (PV) renewable energy generation sufficient to achieve a Final Energy Design Rating (EDR) of zero or less. The PV System must be verified.

REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- Whole house fan
- Cool roof
- Window overhangs and/or fins
- Ducts in crawl space

HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the building components tables below.

Building-level Verifications:
- High quality insulation installation (QII)
- IAQ mechanical ventilation

Cooling System Verifications:
- Minimum Airflow
- Verified EER
- Refrigerant Charge
- Fan Efficacy Watts/CFM

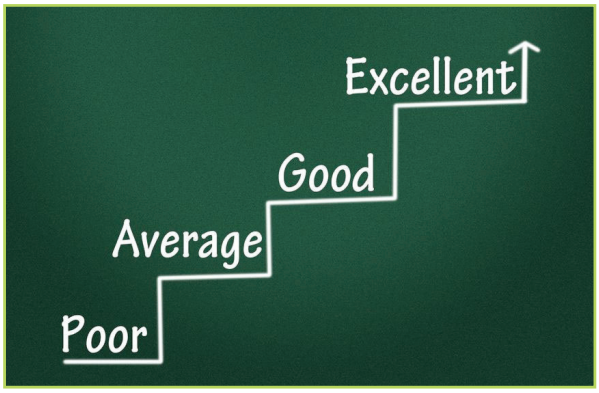
HVAC Distribution System Verifications:
- Duct Sealing

Domestic Hot Water System Verifications:
- -- None --

Registration Number: — Registration Date/Time: — HERS Provider:

CA Building Energy Efficiency Standards - 2016 Residential Compliance — Report Version - CF1R-03032017-695 — Report Generated at: 2017-03-19 19:01:04

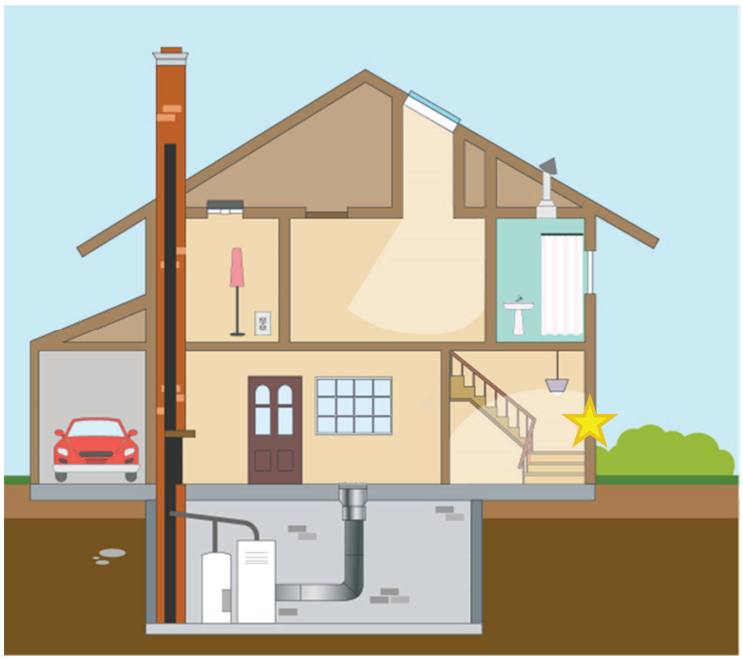
Provide Guidance



- Be aware of the design changes that need to happen for QII.
  - Incorporate those design features into the design set
- Help the project be successful, on time AND on budget.
  - The more guidance the design set provides, the more likely the entire team will be on the same page.

What Can Be Supported in Design?

Problem Features



★ Framed Corners

Framed Corners
(CF2R/3R-ENV-21-H *C10*)

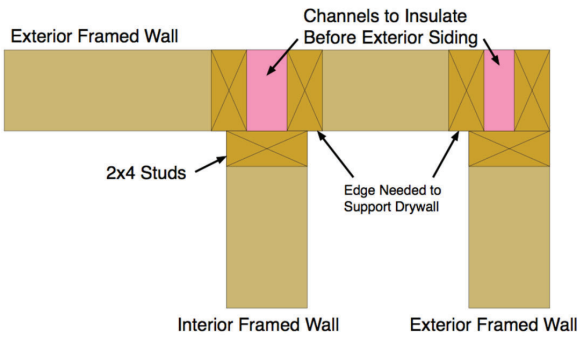
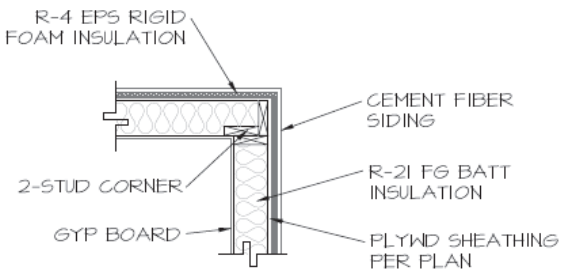


Image from CalCERTS QII Handbook



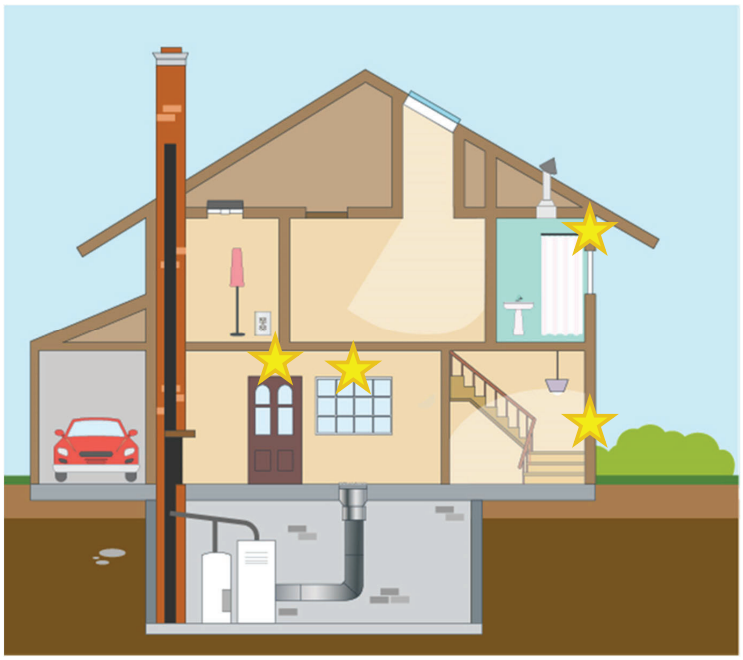
Example Detail

★ Cavities in corner channels or wall intersections that will become inaccessible shall be completely filled with insulation and verified **before the exterior sheathing is installed.**

- ✧ Alternative framing can be used to eliminate this problem:
  - When batt insulation is used, it must be cut to fit around framing.

What Can Be Supported in Design?

Problem Features



Framed Corners

★ Insulated Headers

Insulated Headers
(CF2R/3R-ENV-21-H *C13*)

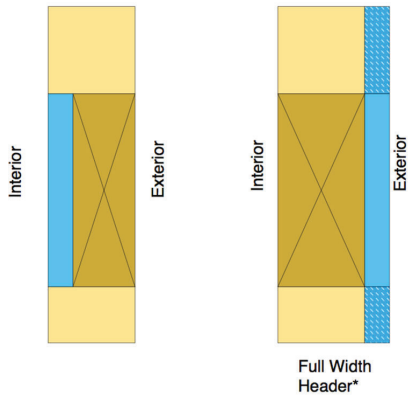
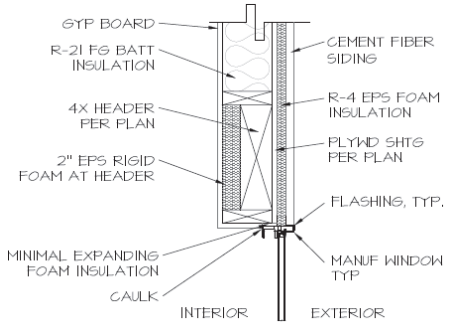


Image from CalCERTS QII Handbook



Example Detail

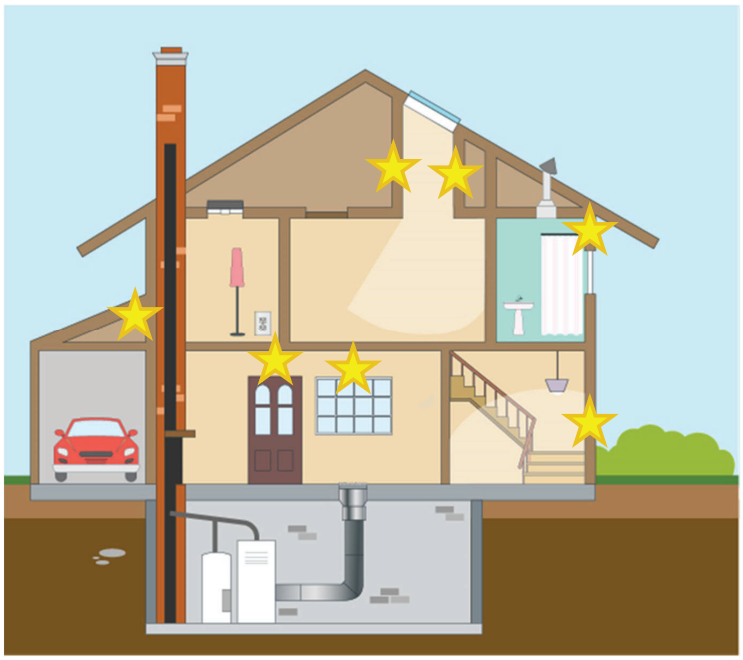
★ All single-member window and door headers shall be insulated to a minimum of:

- **R-3 for a 2x4 framing, or equivalent width,**
- **R-5 for all other assemblies.**

Insulation is to be placed between the interior face of the header and inside surface of the interior wall finish.

What Can Be Supported in Design?

Problem Features



Framed Corners

Insulated Headers

★ Knee Walls and Skylight Shafts

Knee Walls/Skylight Shafts
(CF2R/3R-ENV-21-H *F2*)

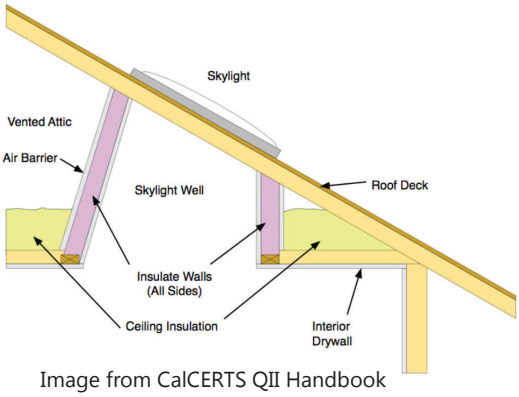
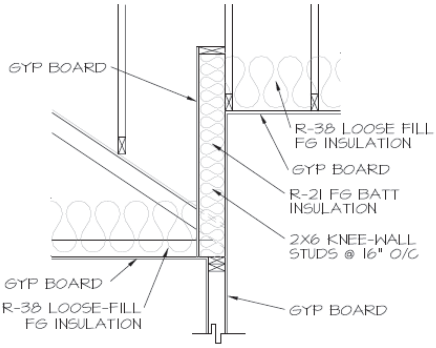


Image from CalCERTS QII Handbook



Example Detail

★ Insure all wall insulation is in contact with the air barrier on all six sides. Exterior air barrier is often missed when an attic is attached to an exterior wall.

- ✧ Insulation values for these areas **shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.**

QII Checklist

Based on QII Instructions from CEC

❖

Brings in CF2R and CF3R guidance for each inspection point

❖

QII Schedule and Design Document Note block included

2016 Title 24 Part 6 Quality Insulation Installation Checklist Page 1 of 23

4.1.2017

Why Does this HERS Verification Credit Exist?

Many insulation installations have flaws that degrade thermal performance. Four problems are generally responsible for this degradation:

1. *There is an inadequate air barrier in the building envelope, or holes and gaps within the air barrier system inhibit the ability to limit air leakage.*
2. *Insulation is not in contact with the air barrier, creating air spaces that short-circuits the thermal barrier of the insulation when the air barrier is not limiting air leakage properly.*
3. *The insulation has voids or gaps, resulting in portions of the construction assembly that are not insulated and, therefore, has less thermal resistance than other portions of the assembly.*
4. *The insulation is compressed, creating a gap near the air barrier and/or reducing the thickness of the insulation.*

A performance energy credit for correctly installing an air barrier and insulation to eliminate or reduce common problems associated with poor installation is provided in the RA3.5 for new residential homes and additions including single family and low-rise multi family. ***See the CF1R-PRF-01-E for the project to see if "HERS QII" is required for the project.***

There is no claim, promise, or guarantee of any kind about the accuracy, completeness, or adequacy of the content of this resource.

QII Schedule on Site

Timing for QII Tasks	Task
Establishing Sub's for project	Engage HERS rater *early* to have them review plans and schedule inspections
Framing Stage	Air barrier inspection (before ANY INSULATION installed)
Insulation Installation	Roof, walls and floors insulation installation must be inspected before closing up building feature (BEFORE finishing)
Final for Occupancy Permit	Final paperwork (CF2R and CF3R's) coordinated for final inspection by Building Inspector.

QII Note Block

Common Thermal Specifications

- ☐ Materials shall comply with, and be installed in conformance with, all applicable building codes for building. California Building Code (including, but not limited to, California Electric Code Section 719) and installed to meet all applicable fire codes.
- ☐ Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
- ☐ Materials shall comply with flame spread rating and smoke density requirements of Chapter 26 and Section 706 of the Title 24, Part 2: all installations with exposed facings must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings that do not touch a ceiling, wall, or floor surface, and faced batts on the undersides of roofs with an air space between the ceiling and facing are considered exposed applications.
- ☐ Materials shall be installed according to manufacturer specifications and instructions.
- ☐ Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.
- ☐ Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent shall be maintained.

Schedule QII for Success

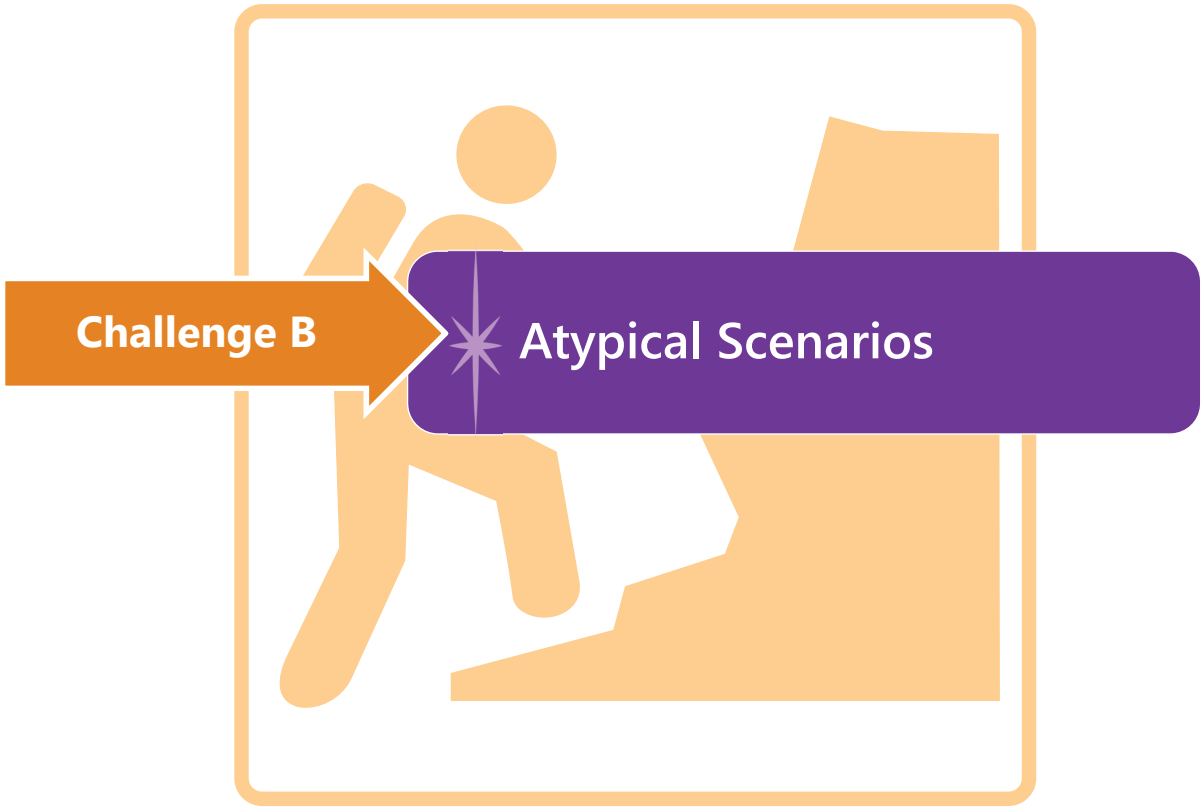
- QII doesn't happen the same way all the other HERS measures happen:
  - HERS rater has to be out EARLIER
  - HERS rater has to be there more than once for the same measure
  - HERS rater becomes the educator

Set Up QII for Success

- Provide a note block that gives an overview of what will be expected.
  - *The resource provided with this Decoding Talk is available for your use with the intent to get the process started, and to be customized to match the needs of the specific project.*

QII Note Block	
Common Thermal Specifications	
☐	Materials shall comply with, and be installed in conformance with, all applicable building codes for building. California Building Code (including, but not limited to, California Electric Code Section 719) and installed to meet all applicable fire codes.
☐	Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
☐	Materials shall comply with flame spread rating and smoke density requirements of Chapter 26 and Section 706 of the Title 24, Part 2: all installations with exposed facings must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings that do not touch a ceiling, wall, or floor surface, and faced batts on the undersides of roofs with an air space between the ceiling and facing are considered exposed applications.
☐	Materials shall be installed according to manufacturer specifications and instructions.
☐	Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.
☐	Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent shall be maintained.
☐	Eave vent baffles shall be installed to prevent air movement under or into the batt.
☐	Insulation shall cover all recessed lighting fixtures. If the fixtures are not rated for insulation cover (IC) and air tight, the fixtures shall be replaced. All recessed light fixtures that penetrate the ceiling shall be listed for zero clearance insulation contact (IC), have a label that certifies it as airtight with leakage less than 2.0 cfm @ 75 Pa when tested to ASTM E283, and shall be sealed with a gasket or caulk between the light's housing and the ceiling.
☐	Insulation shall be installed so that they will be in contact with the air barrier.
☐	Insulation shall fill the cavity. Sized to fit, no compression, fill voids etc.
R-Value Measurement	
☐	The HERS rater shall verify the installed thickness of insulation in all assemblies and locations on walls, roof/ceilings, and floors, and to ensure that insulation levels and installation integrity meet the R-value specified on the Certificate of Compliance, and all other required compliance documentation.
Walls	
☐	Bottom plates of framed and non-framed and other wall type assemblies shall be sealed to the ground subfloor or slab, and above ground subfloor.
☐	Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space. All plumbing and wiring penetrations through the top and bottom plates and electrical boxes that penetrate the sheathing shall be sealed. All gaps in the air barrier shall be caulked, taped, or sealed with minimally expansive foam.
Rim-Joists	
☐	All rim-joists shall be insulated to the same R-Value as the adjacent walls.
Kneewalls, Skylight Shafts, and Gable Ends	
☐	Framing for kneewalls, skylight shafts and gable ends that separate conditioned from unconditioned space shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.
☐	The insulation shall be installed without gaps and with minimal compression.
☐	For steel-framed kneewalls, skylight shafts, and gable ends, external surfaces of steel studs shall be covered with insulation unless otherwise specified on the **CF1R Certificate of Compliance**.
☐	The house side of the insulation shall be in contact with the drywall or other wall finish.
☐	The insulation shall be supported so that it will not fall down by either friction fitting to the framing, inset or face stapling of flanges, or using other support such as netting.
☐	Insulation for all kneewall and skylight shafts shall be completely enclosed by vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.
☐	In unvented attics, where insulation is applied directly to the underside of the roof deck, kneewalls, skylight shafts, and gable ends shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.
CF2R Certificate of Installations Forms	
☐	The **CF2R-ENV forms (Insulation Certificate of Installation)** shall be signed by the SPF applicator stating that the installation is consistent with the plans and specifications for which the building permit was issued shall be provided. The certificate shall also state the installing company name, insulation manufacturer's name and material identification, and that the labeled installed nominal thickness, and installed R-value for SPF insulation meets those specified in Section 3, Thermal Specification. The SPF applicator shall also attach an R-value chart or an ICC ESR showing compliance with AC377 for each SPF insulation material used.
☐	**It is the installer's responsibility to ensure the products are installed properly, and it is the HERS rater's responsibility to verify proper installation.**

Challenge B



Atypical Scenarios

Dropped Ceiling
- Prepare them early

Double /Staggered Stud Walls
- Tricks for success

Difficult Building Features
- Atriums
- Knee Walls
- Wall Intersections/Framed corners

Multi-Family
- No metal framing (not eligible for QII)
- Air barrier between units and common areas

Dropped Ceilings (CF2R/3R-ENV-21-H *D4*)

Dropped ceilings should have hard covers sealed to surrounding framing.

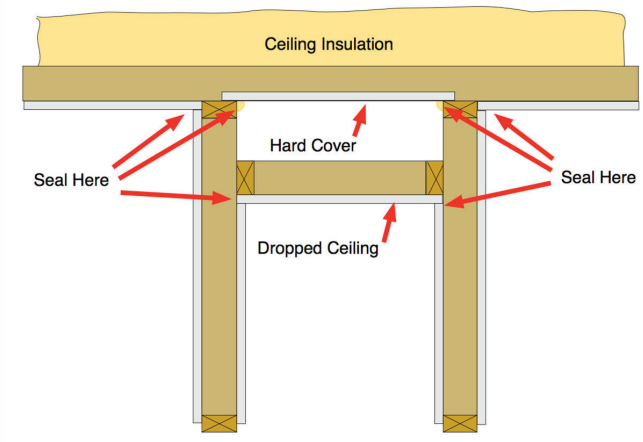
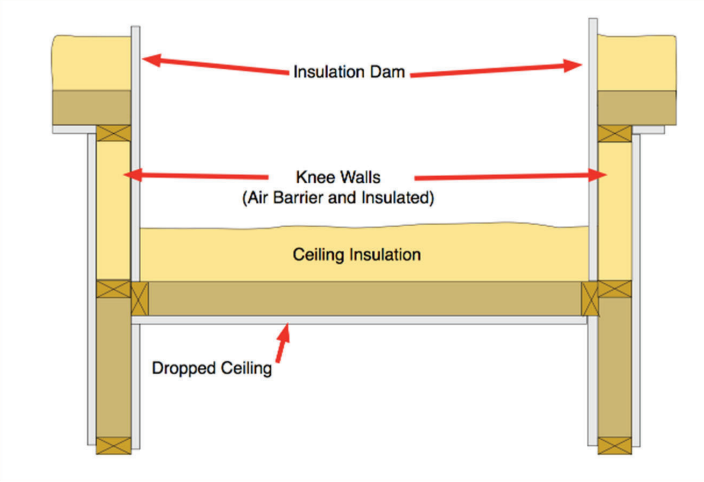


Image Courtesy of CalCERTS, Inc.

- If the hard cover wasn't there the insulation would fall into the dropped area.
- All sheet rock edges should be sealed to prevent air moving from conditioned space to unconditioned space.
- What if the dropped area is a large area, like an entire bedroom?

Dropped Ceilings (CF2R/3R-ENV-21-H *D4*)

If a dropped area is too big for a hard cover, the walls should be treated as knee walls.



- These knee walls are additional surface area that need to be modeled.
- Sheet rock edges still need to be sealed.

Image Courtesy of CalCERTS, Inc.

Ceiling (CF2R/3R-ENV-21&22-H)

Reliance on fire stops and fire blocking for air barrier.

Photo courtesy of Rick Chitwood

- Continuous and air tight ceiling air barrier (usually the drywall)
- Insulation stuffed in openings for fire stops does not count as an air barrier

Photo courtesy of Rob Starr

Ceiling (CF2R/3R-ENV-21&22-H)

All penetrations in the air barrier must be sealed.

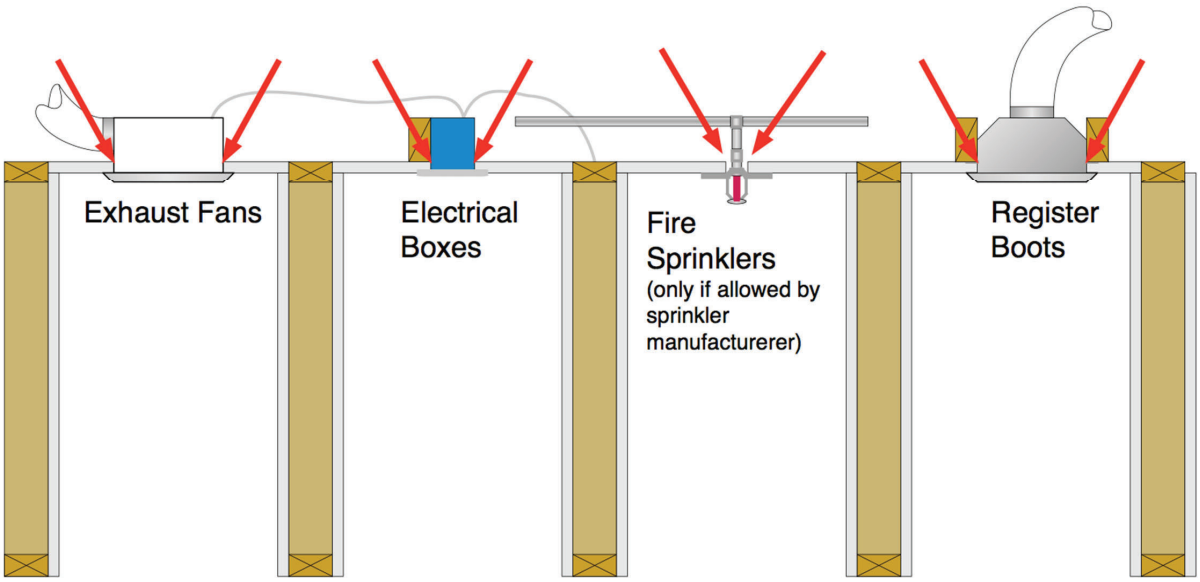


Image from CalCERTS QII Handbook

Double /Staggered Stud Walls (CF2R/3R-ENV-21-H *D9)*

Photo courtesy of DOE

Photo courtesy of Bright Green Strategies

Be Prepared!

- Builder needs to determine the best location for the installation of an additional air barrier to create a standard size cavity so the insulation can be in contact with all six sides
- Staggered studs provide a great thermal break, but can be more difficult to install insulation due to the unusual shape of the cavity

Difficult Building Features

Architectural "bump outs" can be a real challenge.

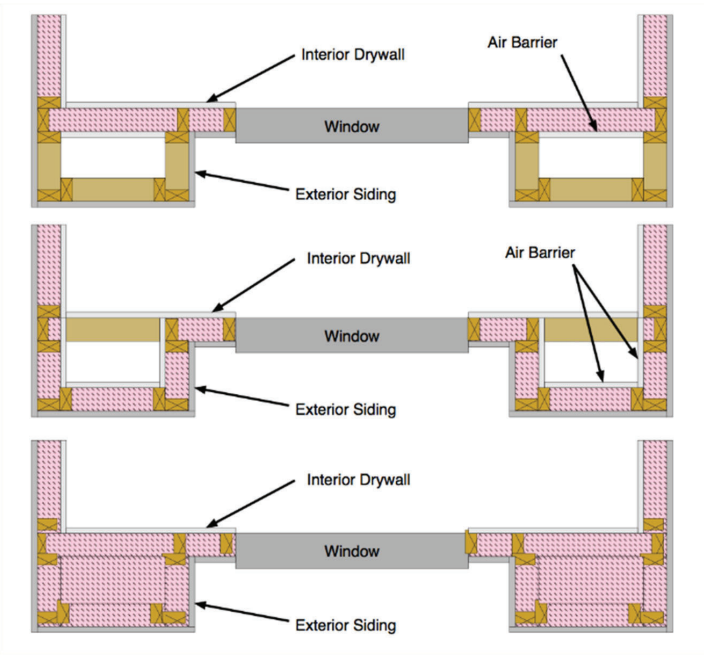


Image from CalCERTS QII Handbook

- Identify these types of features on the plans early.
- Everyone needs to agree where the air barrier is going to be.

Difficult Building Features

Photo courtesy of Rick Chitwood

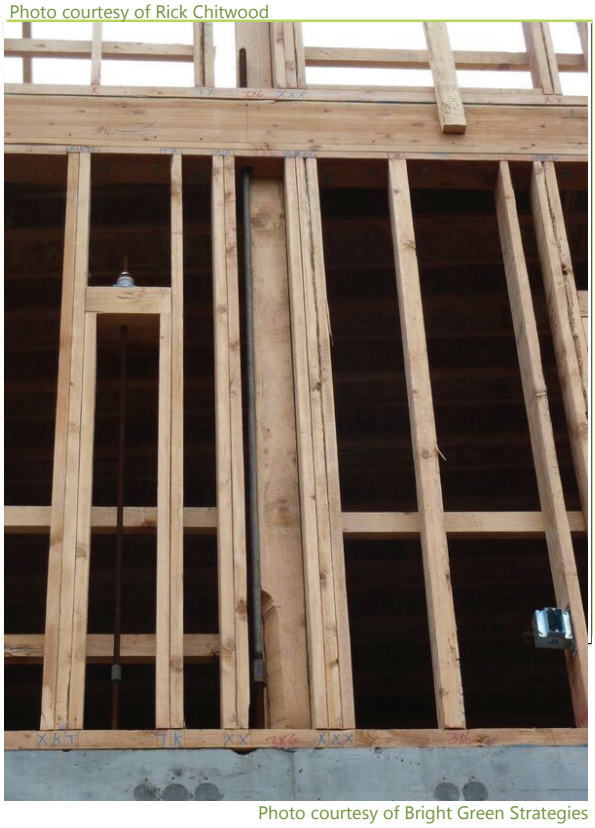


Photo courtesy of Bright Green Strategies

How will this work?

- Atriums:
  - This picture is the perfect example of a unique architectural feature that can be quite difficult to bring into compliance with QII Standards
- Attic Knee Walls
  - Are hard
- Wall Intersections
  - Can you insulated them easily?

Multi Family (CF2R/3R-ENV-21-H *H1-8)*

How Is It Different?

- Multi Family is not much different from Single Family
- It does have some features that are unique, but the overall goal is the same

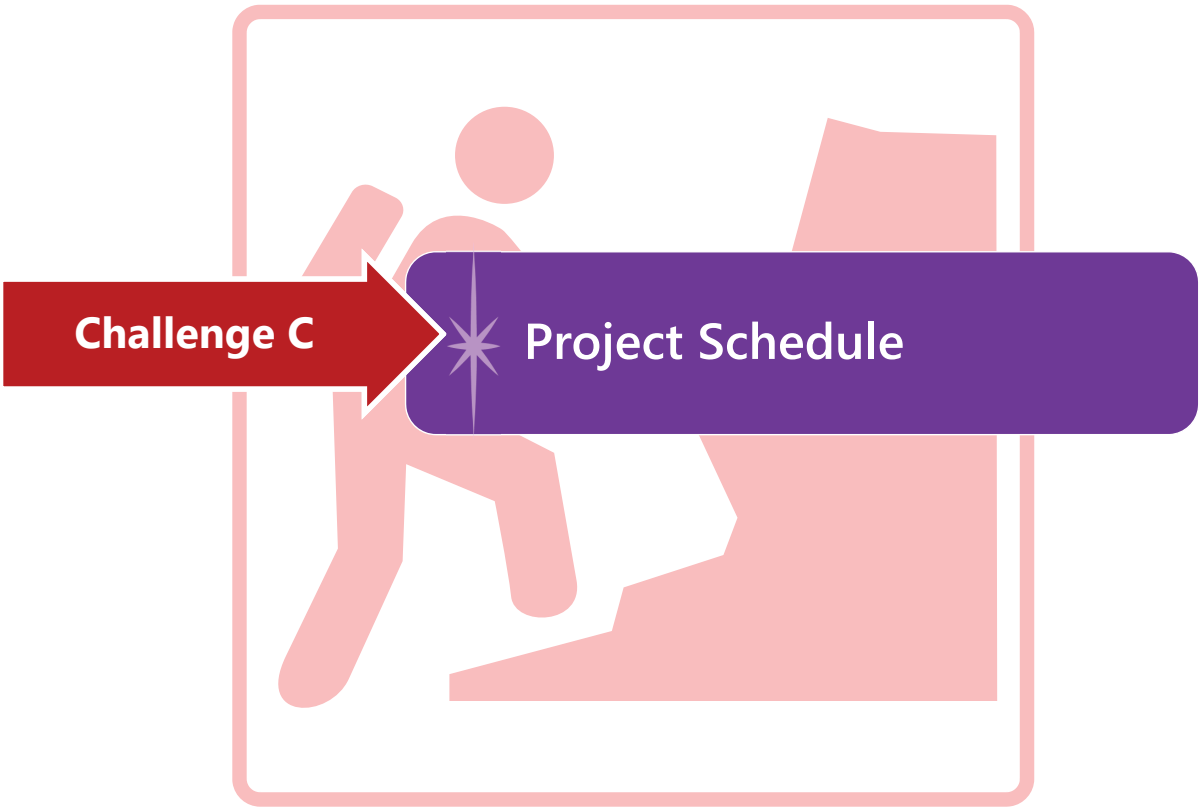
Multifamily Air Barrier		
☐	See A – F Above	1. *Multifamily buildings require all the above plus each unit. When fire rating is required, fire barrier putty pads should be used per the manufacturer's instructions.*
☐	Between Units	2. *Floor AND Ceiling of each Dwelling Unit – All penetrations through the floor and ceiling of each unit must be sealed including, electric and gas utilities, water pipes, drain pipes, fire protection service pipes, communication wiring etc.*
☐	Multi-Level Spaces	3. *Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatch, plumbing stacks, etc. sealed to reduce air transfer from attached spaces.*
☐	Common Walls	4. *Common Walls – Bottom plate between units must be sealed to the subfloor. All penetration in the common walls is sealed. Interior walls that open into the common walls must be sealed.*
☐	Chases at Units	5. *Vertical Chases – All vertical chases are sealed at the floor and ceiling of each unit so air cannot transfer from first floor to second floor around chase.*
☐	Vertical Chases	6. *Vertical Chases –The chases such as garbage chutes, elevator shafts, and HVAC ducting are sealed to stop air movement through the chase to surrounding spaces.*
☐	Hallways	7. *Common Hallways – Penetrations between dwelling unit and common hallways are sealed, including doors to the dwelling unit, are gasketed or made substantially airtight.*

Multi Family (CF2R/3R-ENV-21-H *H1-8)*

Air Barrier Layout – Be Prepared!

- Unconditioned corridors
- Cross Hatch: Conditioned units above 1st floor unconditioned spaces

Challenge C



Building Schedule

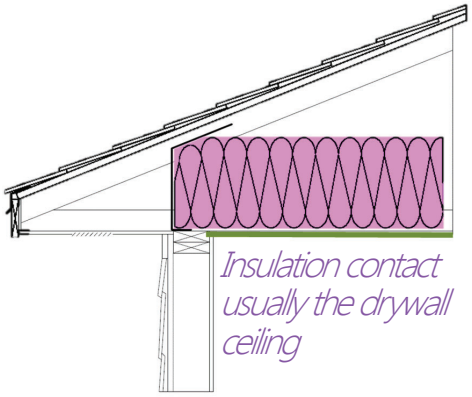
1	**Design**	QII is included as **energy feature in CF1R and supported in drawings** as a design feature. **Kickoff meeting** including Architect, Builder, HERS Rater, and all subs (insulation, framer, drywall, plumbing, HVAC. Etc. installers) so that the QII inspection schedule and process can be explained and supported before design drawings are complete.
2	Building Permit	**CF1R registered** through HERS provider and incorporated into submittal set. **HERS Rater** to confirm verification procedure (sampling procedures is applicable) with team.
3	Grading	HERS Rater to set up **inspection schedule** with all subs off site and **coordinate with insulation installer** verification requirements and provide tools and resources to support inspection process.
4	Framing	To be **coordinated** by HERS Rater: • **Framer incorporating continuous air barrier** requirements • All **hard covers and draft stops** to meet air barrier requirements • Set up inspection schedule with all other subs on site and coordinate with insulation installer for inspections
5	Rough-In	To be **inspected and verified** by HERS Rater and documented **with CF2R/3R-ENV-21**: • Pre-Insulation inspection to **confirm continuous air barrier** w/insulation installer including all penetrations by various subs have been caulked and sealed
6	Insulation	To be **inspected and verified** by HERS Rater and documented **with CF2R/3R-ENV-22**: • **Batt insulation** inspections to confirm direct contact with air barrier
7	Drywall	To be **inspected and verified** by HERS Rater and documented **with CF2R/3R-ENV-22**: • **Loose-fill insulation** inspections to confirm direct contact with air barrier and meets R-value per manufacturer's instructions • **All penetrations caulked and sealed** of all provided to maintain continuous air barrier in addition to **sealing of drywall**
8	Finish	All **CF2R/CF2R forms** to be finished up and **registered through HERS** provider so that final inspection can be scheduled.
9	Final Inspection	All registered CF2R (provided by the Contractors) and CF3R (provided by the HERS Rater) forms are to be **provided to the building occupant**.

Building Process

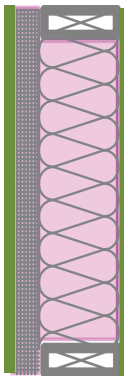
	Predesign **1**	Design **2**	Design Review **3**	Grading **4**	Framing **5**	Rough-In **6**	Insulation **7**	Drywall **8**	Finish **9**	Final Inspection **10**
Energy Consultant **A**	Specifies QII	Kickoff Meeting	Register CF1R, assign Rater in registry							
Builder/ Architect **B**	Approves, selects Rater	Kickoff Meeting	Sign CF1R							Provide all documents to occupant
HERS Rater **C**		Kickoff Meeting Explain QII	Work out sampling details (if any)	Coordinate with trades off site	Coordinate with trades on site	ENV-21 inspections	ENV-22 inspections	ENV-23 inspections	Finish CF3Rs in registry	
Insulation Installer **D**		Kickoff Meeting		Acknowledges QII requirements	Understands QII requirements	Pre-insulate ENV-21	Install batt and other insulation ENV-22	Loose fill ceiling insulation ENV-23	Finish CF2Rs	
Framer **E**		Kickoff Meeting			Frame continuous air barrier					
Drywall Installer **F**		Kickoff Meeting						install and seal drywall		
Misc Trades **G**		Kickoff Meeting			Hard covers and draft stops	Caulk and seal ENV-21		Caulk and seal		
	1	2	3	4	5	6	7	8	9	10

Image Courtesy CalCERTS, Inc.

Insulation Performance Factors



Insulation contact usually the drywall ceiling



Insulation contact on 6 sides

Air Barrier and Insulation

1. Continuous air barrier
   - ✧ CF2R/3R-ENV-21&22-H
2. Insulation in contact with the air barrier(s)
   - ✧ CF2R/3R-ENV-23 or 24-H

1st Inspection

Penetrations (CF2R/3R-ENV-21/22-H)

Wall/Roof/Floor

- *All electrical boxes including knockouts that penetrate the air barrier to unconditioned space are sealed*
- *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*

Photos courtesy of Rob Starr

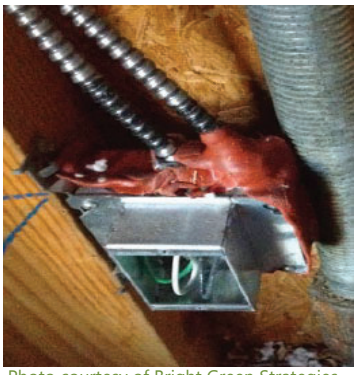


Photo courtesy of Bright Green Strategies

Wall (CF2R/3R-ENV-21-H *C2*)

Sealed to the top and bottom plate in *each* stud bay

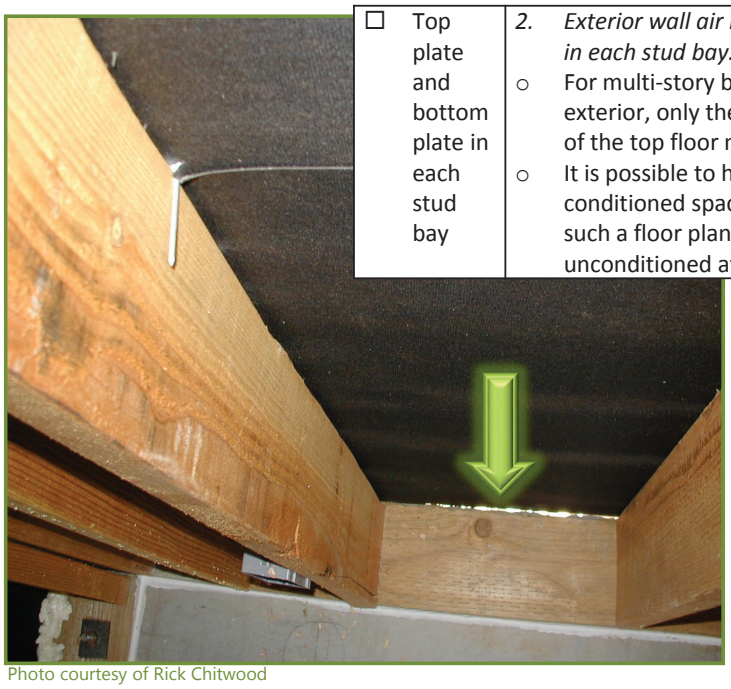


Photo courtesy of Rick Chitwood

☐ Top plate and bottom plate in each stud bay	2. *Exterior wall air barrier is sealed to the top plate and bottom plate in each stud bay.* ○ For multi-story buildings that have a continuous air barrier on the exterior, only the bottom plate of the first floor and the top plate of the top floor need to be sealed to the exterior air barrier. ○ It is possible to have a two-story house where the upstairs conditioned space has a smaller footprint than the first story. In such a floor plan, top plates of a first story wall exposed to an unconditioned attic would be sealed to the exterior air barrier.

Wall (CF2R/3R-ENV-21-H *C6*)

Photo courtesy of Rob Starr

Windows and Doors

- Coordinate between trades who is responsible.
  - Window installer *or*
  - Framer *or*
  - Insulation installer.

☐ Windows and doors	6. *All gaps around windows and doors are sealed. The sealant used follows window manufacturer specifications.*

Ceiling (CF2R/3R-ENV-21-H *D4-5*)

Hard covers for drop ceilings and chases

Photos courtesy of Rob Starr

☐ Dropped Ceilings	*4. All dropped ceilings are covered with hard covers and sealed to framing.* ○ *The 2008 RA allowed the entire drop area to be filled with insulation level with the rest of the attic. This is no longer allowed under the 2013/2016 Standards; hard covers are required.* ○ *Framing of soffits or drop ceilings should be done inside the Air Barrier. This means the drywall has been installed and sealed as required before the soffit or drop ceiling is framed out.*
☐ Chases	*5. All chases are covered with hard covers and sealed to framing.* ○ *All vertical chases shall have hard covers sealed to the framing at each plate level.* ○ *See notes for #4 above.*

Roof (CF2R/3R-ENV-22-H *B2*)

Chimney/Flue

Photos courtesy of DOE

☐ Chimney/ Flue	*2. 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.*

Floor (CF2R/3R-ENV-21-H *B3/4*)

Reliance on sub-floor as the air barrier.

Photo courtesy of Rob Starr

☐	Penetrations	3. *All plumbing and electrical wires that penetrate the floor are sealed.*

Photo courtesy of Rick Chitwood

☐	Subfloor	4. *Subfloor sheathing is glued or sealed at all exterior panel edges to create a continuous air tight subfloor.*

Floor (CF2R/3R-ENV-21-H *C7 and G1-2*)

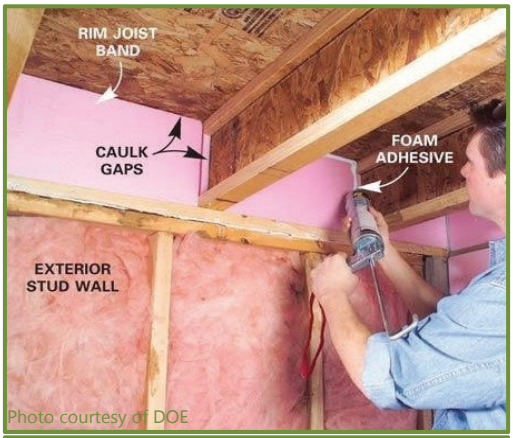


Photo courtesy of DOE

Rim Joists and Blocking

☐	Rim joists	7. *Rim joists gaps/openings are fully sealed*
☐	Blocking	1. *Airtight blocking is installed between joists where the wall rim joist would have been located in the absence of a cantilever.* ○ Blocking must be installed any time joists goes over an exterior wall or opens into an unconditioned space.
☐	Cantilever	2. *Exterior sheathing is installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R-value as would be required for the subfloor prior to closing*

Photos courtesy of Rob Starr

Floor (CF2R/3R-ENV-21-H *C7 and G1-2*)

Cantilever Floors

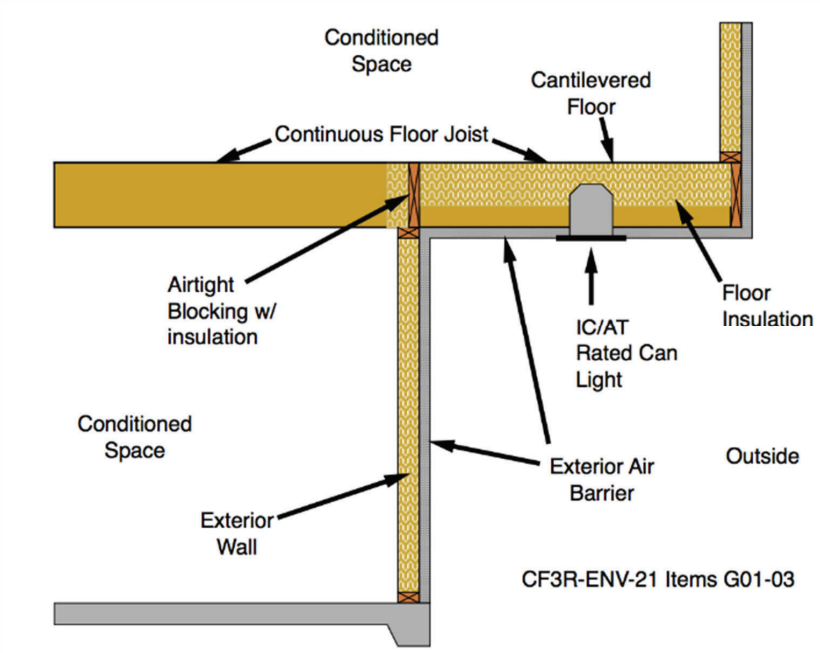


Image from CalCERTS QII Handbook

- Pay special attention to where the floor meets the wall.
- Makes sure air cannot get around insulation

Floor (CF2R/3R-ENV-21-H *C5*)

Photos courtesy of Rob Starr

Exterior Bottom Plates

☐	Exterior bottom plates	5. *Exterior bottom plates (all stories) are sealed to the floor using the appropriate sealing method.* ○ If the exterior air barrier is continuous (from the bottom story to the top story), then the bottom plate of first floor only needs to be sealed. ○ In order to verify that the bottom plate is sealed, the following are allowed: • Use a gasket material that is 3.5 inches wide on 2x4, 5.5 inches wide on 2x6; or • Seal the bottom plate on the inside at junction of concrete and plate with caulk or foam; or • Watch sealing of the bottom plate to foundation during framing.

Next Inspection(s)

Ceiling (CF2R/3R-ENV-22-H *A13*)

Photo courtesy of Rick Chitwood

All top plates are sealed to drywall.

☐ Top Plates	*13. All top plates of interior and exterior walls are sealed to drywall.* **Interior Walls** ○ Top plates do not need to be sealed unless there is an unconditioned space above. ○ Sealing of the top plate can be done from the attic after all the drywall is installed, or from below before drywall is installed. ○ If sealing from the attic after drywall is installed, use caulk or foam to seal all top plates to the drywall. ○ If sealing from below when the drywall is installed at a later date, a gasket type material must be used. The gasket must be thick enough to fill any irregularities (approximately 1/4 inch thick) between the two surfaces and the gasket must remain flexible so that it can expand/compress and still seal the two materials together when they meet.

Ceiling (CF2R/3R-ENV-23-H *C1/15/16*)

Insulation is in direct contact with ceiling so there are no gaps between the ceiling and the insulation.

Photo courtesy of Rick Chitwood

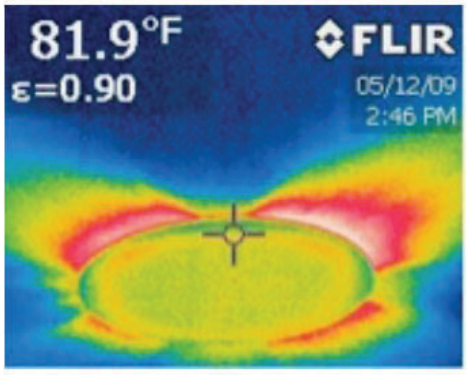
Photo courtesy of Rob Starr

☐	Attic Rulers	*15. Attic rulers appropriate to the material are installed and evenly distributed throughout the attic to verify Depth (one ruler for every 250 ft2) The rulers are clearly readable from the attic access and scaled to read inches of insulation and the R-value installed.*
☐	Loose-fill and SPF	*16. Loose-fill and SPF insulation - a HERS rater shall measure the installed thickness (include low and high areas) and density of insulation in at least 6 random locations on walls, roof/ceilings and floors to ensure minimum thickness levels and the installed density meets the R-value specified on the CF1R, and are consistent with the manufacturer's coverage chart.*

Ceiling (CF2R/3R-ENV-22-H *A5*)

Can lights

Photos courtesy of DOE



Air leakage around recessed light.
As shown in this image taken with an infrared camera, hot attic air can leak into a home around a recessed can light in summer. In winter, warm, conditioned air can be pulled out of the house and into the attic.

☐	Can Lights	*5. All installed recessed light fixtures that penetrate the ceiling to unconditioned space are rated to be Insulation Contact and Airtight (IC and AT) which allows direct contact with insulation. The housing is sealed to the drywall.*

Wall (CF2R/3R-ENV-23-H *D1-3*)

Photo courtesy of Bright Green Strategies

The bad…

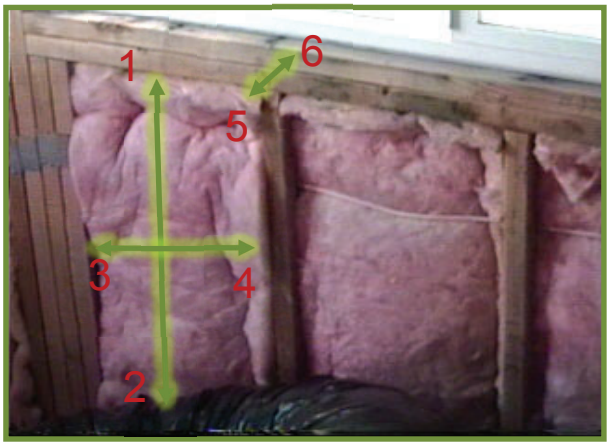
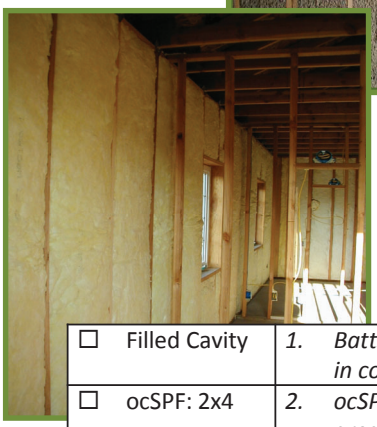


Photo courtesy of Rick Chitwood

☐	Filled Cavity	1. *Batts, loose fill mineral fiber, mineral and natural wool, and cellulose: fills cavity and is in contact with air barrier on six sides.*
☐	ocSPF: 2x4	2. *ocSPF: completely fill cavities of 2x4 inch framing or less. Not required to fill cavities greater than 2x4 inch framing unless required to meet R-value.*
☐	ccSPF: R-value	3. *ccSPF: insulation is not required to fill the cavities of framed assemblies unless required to meet R-value.*

Wall (CF2R/3R-ENV-23-H *D1-3*)



The good..

Photos courtesy of Rick Chitwood

☐	Filled Cavity	1. *Batts, loose fill mineral fiber, mineral and natural wool, and cellulose: fills cavity and is in contact with air barrier on six sides.*
☐	ocSPF: 2x4	2. *ocSPF: completely fill cavities of 2x4 inch framing or less. Not required to fill cavities greater than 2x4 inch framing unless required to meet R-value.*
☐	ccSPF: R-value	3. *ccSPF: insulation is not required to fill the cavities of framed assemblies unless required to meet R-value.*

Wall (CF2R/3R-ENV-23-H *B7*)

Photos courtesy of Rob Starr

Batt insulation is delaminated around all plumbing and electrical lines in ceilings, walls and floors.

☐	Batt: Delaminated	*7. Batt insulation is delaminated around all plumbing and electrical lines in ceilings, walls and floors.*

Wall (CF2R/3R-ENV-23-H *D7-9*)

Photo courtesy of Rick Chitwood

Skylights

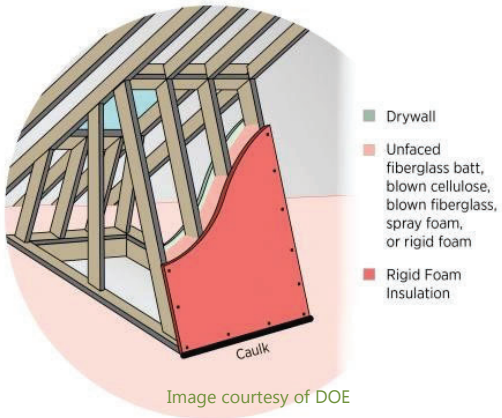
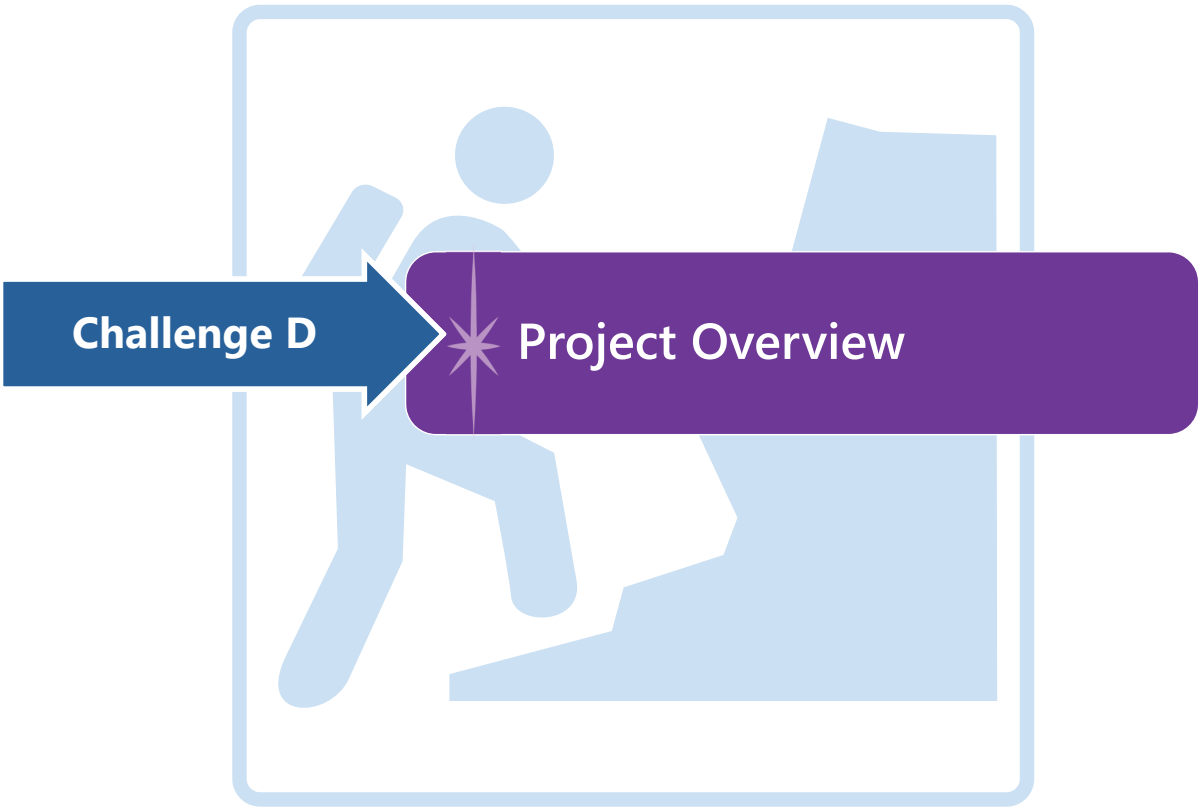


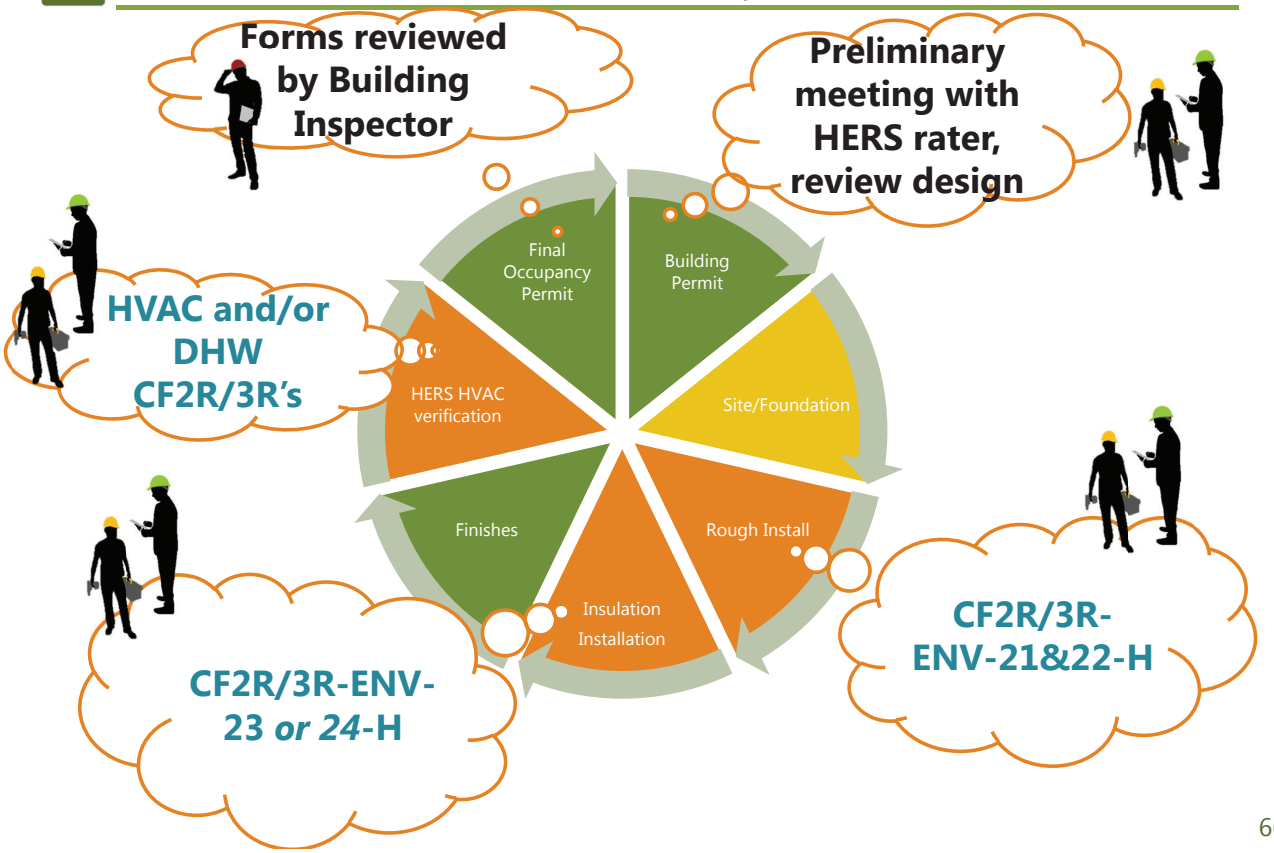
Image courtesy of DOE

☐	Skylights and Knee Walls	*7. Skylight shafts and attic knee wall insulation must meet all the requirements for walls and is in contact with the air barrier on six sides unless SPF is used.*
☐	Skylights and Knee Walls	*8. Skylight shafts and attic kneewalls insulation shall be in full contact with the drywall or other interior wall finish. Batt insulation must be cut to fit around 2x4's that are laid flat.*
☐	Skylights and Knee Walls	*9. Skylight shafts and attic kneewalls shall be completely enclosed by vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.*

Challenge D



Certificate of Installation/Verification



CF2R/3R Form Clean Up

Form		2016	2019
CF2R	ENV-21	**Framing Stage – Batt, Loose fill** No checklist, just signature	**Framing Stage and Sealing - All Types** *Now an itemized checklist*
CF3R	ENV-21	**Framing Stage – Batt, Loose fill** Itemized Checklist	**Framing Stage and Sealing - All Types** Itemized Checklist
CF2R	ENV-22	**Ceiling Air Barrier** No checklist, just signature	**Insulation Stage- All Types** *Now an itemized checklist*
CF3R	ENV-22	**Ceiling Air Barrier** Itemized Checklist	**Insulation Stage - All Types** Itemized Checklist
~~CF2R~~	~~ENV-23~~	~~**Insulation Stage**~~ ~~No checklist, just signature~~	**Gone** *Consolidated into ENV-21/22*
~~CF3R~~	~~ENV-23~~	~~**Insulation Stage**~~ ~~Itemized Checklist~~	**Gone** *Consolidated into ENV-21/22*
~~CF2R~~	~~ENV-24~~	~~**Framing stage – SIP, ICF**~~ ~~No checklist, just signature~~	**Gone** *Consolidated into ENV-21/22*
~~CF3R~~	~~ENV-24~~	~~**Framing stage – SIP, ICF**~~ ~~Itemized Checklist~~	**Gone** *Consolidated into ENV-21/22*

Next Steps

Ace Training | Decoding Talks™

Coming Soon!
Decoding Healthcare
In July

Rerun of
Decoding Rebuild

EnergyCodeAce.com/training

CalCERTS, Inc

Please contact
Holly Walsh
Holly@calcerts.com

Free Training!

- CalCERTS, Inc., the leading HERS Provider in California, has discovered that many Building Departments are not taking advantage of compliance tools within the CalCERTS Registry. These tools were built in conjunction with the California Energy Commission to specifically assist Building Departments.
  - Building Departments that have learned how to use these tools have found them invaluable for tracking forms and checking the status of projects registered within their jurisdiction.
  - This is a free, concise, 1-hour course that can be delivered at your Building Department or at an ICC Chapter meeting in your area. The course has been approved for .10 ICC CEUs.

DOE Building America Solutions Center

https://basc.pnnl.gov/

Building Components

The Building Components tool will help you find new and existing homes guides. Click the images below for a list of subcategories corresponding to each of the primary categories. Select one category to display a list of related guides.

Contact Us | Web Site Policies | U.S. Department of Energy | USA.gov

Ace Tools™

A variety of tools to help you identify the forms, installation techniques, and standards relevant to building projects in California.

Ace it

Ace Training™

Targeted classroom and online training on Title 24, Part 6 and Title 20 addressing a variety of stakeholders and measures.

Ace it

Ace Resources™

Application Guides, Facts Sheets, Trigger Sheets and Checklists to help you understand how and when to comply with California's building and appliance energy efficiency standards.

Ace it

Wrap Up

HELPING YOU PLAY YOUR CARDS RIGHT

Quality Insulation Installation (QII) Handbook

For Installers and HERS Raters (2016 Energy Code)

Note: Structural Insulated Panels (SIPs) and Insulated Concrete Forms (ICFs) are not covered in this document – Refer to RA3.5 for these types of insulated assemblies.

October 2018

Table of Contents

Contents

Table of Contents 2
Introduction 4
General Organization of this Document 5
Certificates (see RA3.5.X.1.3) 6
Certificates and Availability (see RA3.5.X.1.4) 6
Coordination is Critical 6
Quality Insulation Installation Procedures 7
Purpose and Scope of these Procedures (see RA3.5.1) 7
Definitions (see RA3.5.2) 8
The Importance of Defining the Thermal Boundary 19
Special Requirements for Sealing Against Air Movement 22
Thermal Specifications 24
Thermal Specifications: **Batts and Blankets** (see RA3.5.3.1) 24
Thermal Specifications: **Loose fill** (see RA3.5.4.1) 25
Thermal Specifications: **Rigid Board** (see RA3.5.5.1) 26
Thermal Specifications: **Spray-on Polyurethane Foam** (see RA3.5.6.1) 27
R-Value Measurement 30
R-Value Measurement: **Batt** (see RA3.5.3.1.2) 30
R-Value Measurement: **Blown In** (see RA3.5.4.1.2) 30
R-Value Measurement: **Rigid** (see RA3.5.5.1.2) 31
R-Value Measurement: **SPF** (see RA3.5.6.1.4) 31
General Requirements for **Walls, Roof/Ceilings and Floors** (see RA3.5.X.1.1) 32
Walls, Roof/Ceilings and Floors: **All Materials** 32
Walls, Roof/Ceilings and Floors: **Batt and Blanket** 33
Walls, Roof/Ceilings and Floors: **Loose Fill** 33
Walls, Roof/Ceilings and Floors: **Rigid Board** 33
Walls, Roof/Ceilings and Floors: **SPF** 34
Specific Requirements for **Wall Insulation** (see RA3.5.X.2) 35
Wall Insulation: **All Materials** 35
Wall Insulation: **Batt and Blanket** 35
Wall Insulation: **Loose Fill** 36

Wall Insulation: **Rigid** 36
Wall Insulation: **SPF** 37
Wall Insulation: **Special Situations** 37
Narrow-Framed Cavities (see RA3.5.X.2.1) 37
Wall Insulation: Installation Prior to Exterior Sheathing or Lath (see RA3.5.X.2.2) 38
Rim Joists (see RA3.5.X.2.4) 39
Kneewalls, Skylight Shafts, and Gable Ends (see RA3.5.X.2.5) 40
HVAC/Plumbing Closet (see RA3.5.X.2.6) 42
Double Walls and Framed Bump-Outs (see RA3.5.X.2.7) 43
Structural Bracing, Tie-downs, Steel Structural Framing (see RA3.5.X.2.8) 43
Special Situations--Window and Door Headers (see RA3.5.X.2.9) 44
Specific Requirements for **Roof/Ceilings** (see RA3.5.3.3) 45
Roof Ceilings: **Batt and Blanket** 45
Roof Ceilings: **Loose Fill** 46
Roof Ceilings: **Rigid** 49
Roof Ceilings: **SPF** 49
Roof Ceilings: **Special Situations** 50
Enclosed Rafter Ceilings (see RA3.5.X.3.1) 50
Attics and Cathedral Ceilings (see RA3.5.X.3.2) 51
HVAC Platform (see RA3.5.X.3.3) 52
Attic Access (see RA3.5.X.3.4) 53
Specific Requirements for **Raised Floors** (see RA3.5.X.4) 54
Homes with Conditioned Space Over Garage (see RA3.5.X.4.2) 55
Homes with Unconditioned Space Over Garage (see RA3.5.X.4.3) 56
The “Cookie Cutter” Test 57
The QII Checklists 59
How to Read the Insulation Requirements on a CF1R-PRF-01 64

Introduction

Quality Insulation Installation (QII) is a procedure for ensuring that thermal insulation has been properly installed and that air sealing has been properly done in a home. It is based on industry standards (NAIMA) and similar to widely recognized national standards (RESNET and Energy Star), but it also has some unique requirements. Much of QII is simply installing insulation as the manufacturers intended.

QII is triggered when, using the performance compliance approach, the energy consultant/designer takes an optional compliance "credit" for QII. Actually, it is not a credit but the removal of a penalty that is otherwise applied to a typical house. This penalty was put in place in the 2005 Energy Code after a very extensive study showed that standard industry practice was to install insulation very poorly. So poorly, in fact that the insulative properties were dramatically reduced. The study also found that the building envelope was almost never properly sealed, making the problem even worse.

In an effort to improve standard practice in the industry, the CEC developed the QII protocols. Rather than just requiring all homes to meet these requirements, the compliance modeling software takes a "guilty until proven innocent" approach and will automatically derate the insulation by as much as 13.3%, unless the user specifies QII. This then triggers the requirement for HERS verification.

When QII is required, it will be clearly indicated on the CF1R-PRF-01-E form and the appropriate CF2R Certificates of Installation and CF3R Certificates of Verification will be required to be completed and signed in the HERS registry.

It is worth noting that of all the HERS verified measures, QII has the highest fail rate. This is partly due to the fact that it requires very precise coordination between the Rater, the installer, and the general contractor/builder. It is also partly due to the fact that the industry still has a long way to go until standard practice is anything near what would pass QII. High turnover by installers is a known issue, as well. It is difficult to keep trained installers from moving on to more prestigious (and less itchy) construction jobs.

The current state of industry standard practice did not get this bad overnight, it evolved over time. One of the causes is the common use of paying installers for "piece work." That is, paying them for each house completed, rather than paying them by the hour. This encourages installers to work faster and results in generally sloppy work. Passing the QII protocols requires that the installers slow down and exercise much more care and precision, attention to detail is critical. Although it has been deemed cost-effective by the CEC, QII can have a significant impact on the cost of installation. Installing contractors need to be very aware of the requirements and should bid jobs accordingly.

Coordination between designers and the trades is critical. Passing QII is not completely the responsibility of the installer. Architects and framers are finding that they too have gotten sloppy on how a home's thermal boundary and air barrier are defined and constructed. Framing details need to be clearly spelled out to show a continuous air barrier, for example: where a wall transitions from an exterior wall to an attic knee wall, or when floor joists extend to an attic.

General Organization of this Document

This document is essentially a simplified, yet enhanced version of the official QII protocols, Reference Appendices Section RA3.5. The text from that document has been simplified to eliminate repetitive sections and is enhanced with diagrams, photos and explanations. If there is a conflict between this document and RA3.5, RA3.5 always takes precedence.

In this document, when you see an RA section number that has an "X" in it, such as RA3.5.X.2.1, this means that repetitive text from multiple sections in the Reference Appendices has been combined into a single section in this document. To determine the original RA3.5 section for a specific type of insulating material, replace the X with:

"3" for Batt and Blanket
"4" for Loose fill
"5" for Rigid
"6" for Spray-on Polyurethane Foam (SPF)

*Because so few **SIP** and **ICF** projects have been registered since the 2013 Energy Code went into effect (less than one half of one percent of all QII projects), we decided not to cover those insulation products in this document. They are not as prone to some of the most common installation issues and are covered well in sections RA3.5.7 and RA3.5.8.*

For example, notice how the text in these three sections is almost identical:

RA3.5.3
*These procedures detail the installation and inspection protocols necessary to qualify for Quality Insulation Installation (QII) of **batt and blanket** insulation. These procedures must be field verified before the building construction permit is finalized in order to claim QII energy compliance.*

RA3.5.4
*These procedures detail the installation and inspection protocols necessary to qualify for Quality Insulation Installation (QII) of **loose-fill** insulation. These procedures must be field verified before the building construction permit is finalized in order to claim QII energy compliance.*

RA3.5.5
*These procedures detail the installation and inspection protocols necessary to qualify for Quality Insulation Installation (QII) of **rigid board insulation sheathing material**. These procedures must be field verified before the building construction permit is finalized in order to claim QII energy compliance.*

In this document, it was all combined into:

*RA3.5.**X***
These procedures detail the installation and inspection protocols necessary to qualify for Quality Insulation Installation (QII) of (all types of insulation). These procedures must be field verified before the building construction permit is finalized in order to claim QII energy compliance.

The Compliance Process: 1 – 2 – 3

In concept, the compliance process is quite simple.

- **Step 1 – Determine what is required.** This is done by the energy consultant and/or designer. The insulation requirements are documented on the CF1R-PRF-01, which must be consistent with the plans and specifications.
- **Step 2 – Install insulation that meets the requirements**. This is documented on the
  - CF2R-ENV-03 (a detailed list of the assemblies and products used)
  - CF2R-ENV-21 (a declaration by the installer that all applicable framing stage requirements of QII were met. See *QII Checklists*)
  - CF2R-ENV-22 (a declaration by the installer that all applicable ceiling and roof deck requirements of QII were met. See *QII Checklists*)
  - CF2R-ENV-23 (a declaration by the installer that all applicable insulation installation requirements of QII were met. See *QII Checklists*)
- **Step 3 – Verify what was installed**. This is documented on the: CF3R-ENV-21, 22 and 23, which correspond to the like-numbered CF2R forms but are filled out and signed by the HERS Rater.

In reality, without proper communication and coordination compliance can be quite complicated.

Certificates (see RA3.5.X.1.3)

Insulation Certificates of Installation (CF2Rs) signed by the insulation installer shall be completed in the HERS registry and state the installation is consistent with the CF1R, and plans and specifications for which the building permit was issued. The insulation installer shall also attach a product specification or data sheet for every insulation material used.

Certificates and Availability (see RA3.5.X.1.4)

The Insulation Certificates of Installation (CF2Rs), with insulation material labels or specification/data sheets attached, signed by the insulation installer shall be available on the building site for each of the HERS Rater's verification inspections. The HERS Rater cannot verify compliance credit without these completed forms. This can be done digitally if the information is available in electronic format (PDF or scanned images).

Coordination is Critical

It is very important that the general contractor, the insulation installer and the HERS Rater work very closely together. Everyone needs to know exactly what is expected BEFORE the HERS Rater does the inspections. If there are any strange situations or if any of the requirements are unclear, they should be discussed in advance. Sometimes unique situations may require the involvement of CalCERTS Field Support or even Energy Commission staff.

The most difficult part of QII is probably the logistics of getting the HERS Rater out during a very small window of opportunity before the insulation gets covered up. **If insulation gets covered up prior to the HERS Rater seeing it, this is an automatic FAIL**. Your choices at that point are to expose the insulation (remove the sheetrock) or have the energy consultant re-run the energy calculations without the QII credit. This will require that other energy credits be substituted for the QII credit.

Quality Insulation Installation Procedures

Purpose and Scope of these Procedures (see RA3.5.1)

RA3.5 is a procedure for ***verifying*** the quality of insulation installation and air leakage control used in low rise residential buildings. This procedure is to be followed by the insulation installer via CF2Rs and a qualified Home Energy Rating System (HERS) Rater must verify its conformance for meeting the requirements of Sections 150.1(c), and 110.7 of the Standards via CF3Rs.

> *Section 110.7, in its entirety, reads, "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."*

The procedure applies to wood and metal construction of framed and non-framed envelope assemblies. Framed assemblies include wall stud cavities, roof/ceiling assemblies, and floors typically insulated with:

(1) Batts of mineral fiber and mineral wool;
(2) Loose-fill materials of mineral fiber, mineral wool, and cellulose;
(3) Spray polyurethane foam; and,
(4) Rigid board sheathing materials.

Non-framed assemblies include wall, roof/ceiling, and floors constructed of

(1) Structural insulated panels (SIP)* and
(2) Insulated concrete forms (ICF)*.

Note 1: This procedure applies to the entire thermal envelope of the building. In many instances, residential homes will use several types of insulation material, even in the same framed assembly. Each insulation material and the integrity of air leakage control for the building's entire thermal envelope must be verified by the HERS Rater for the home to comply with the Standards.

Note 2: Structural bracing, tie-downs, and framing of steel or specialized framing used to meet structural requirements of the California Building Code (CBC) are allowed. These areas shall be called out on the building plans with diagrams and/or specific design drawings indicating the R-value amount and fastening method to be used. All structural framing areas shall be insulated in a manner that resists thermal bridging from the outside to the inside of the assembly separating conditioned from unconditioned space. The insulation and air barrier integrity shall be verified by the HERS Rater.

***Not covered in this Guide.**

Definitions (see RA3.5.2)

Continuous Air Barrier

A combination of interconnected materials and assemblies joined and sealed together to provide a continuous barrier to air leakage through the building envelope separating conditioned from unconditioned space, or adjoining conditioned spaces of different occupancies or uses. An air barrier is required in all thermal envelope assemblies to limit air movement between unconditioned/outside spaces and conditioned/inside spaces and must meet some very technical test requirements.

*Tip: The continuous air barrier will define the thermal boundary of a house. Designers and architects should decide very early in the design process **exactly** where the thermal boundary of a house is going to be. This seems trivial, but it really is not. Examples: bump-outs and fireplaces.*

If unsure of the materials, the completed building can be tested to demonstrate that the air leakage rate of the building envelope does not exceed 0.40 cfm/ft2 at a pressure differential of 0.3 in w.g. (1.57 psf) (2.0 L/s.m2 at 75 pa) in accordance with ASTM E779 or an equivalent approved method.

*Note that this allows non-tested materials to be used as long as the house passes a blower door test with a special target of 0.40 cfm**75** for every square foot of conditioned floor area. Example: a 2100 square foot home would have a target of 840 cfm at 75 Pa.*

Individual materials and assemblies of materials that can demonstrate compliance with the air barrier testing requirements must be installed according to the manufacturer's instructions and a HERS Rater shall verify the integrity of the installation. Below are example materials meeting the air permeance testing performance levels above. Manufacturers of these and other product types must provide a specification or product data sheet showing compliance to the ASTM testing requirements to be considered as an air barrier.

- Plywood – minimum 3/8 inch
- Oriented strand board – minimum. 3/8 inches
- Extruded polystyrene insulation board – minimum. ½ inch
- Foil-back polyisocyanurate insulation board – minimum. ½ inch
- Extruded polystyrene insulation board – minimum ½ inch
- Foil backed urethane foam insulation (1 inch)
- Closed cell spray polyurethane foam with a minimum density of 2.0 pcf and a minimum thickness of 2.0 inches
- Open cell spray polyurethane foam with a minimum density of 0.4 to1.5 pcf and a minimum thickness of 5½ inches
- Exterior or interior gypsum board - minimum 1/2 inch
- Cement board - minimum 1/2 inch
- Built up roofing membrane
- Modified bituminous roof membrane
- Particleboard-minimum1/2 inch

- Fully adhered single-ply roof membrane
- Portland cement/sand parge, or gypsum plaster minimum 5/8 inch
- Cast-in-place and precast concrete
- Fully grouted uninsulated and insulated concrete block masonry
- Sheet steel or aluminum

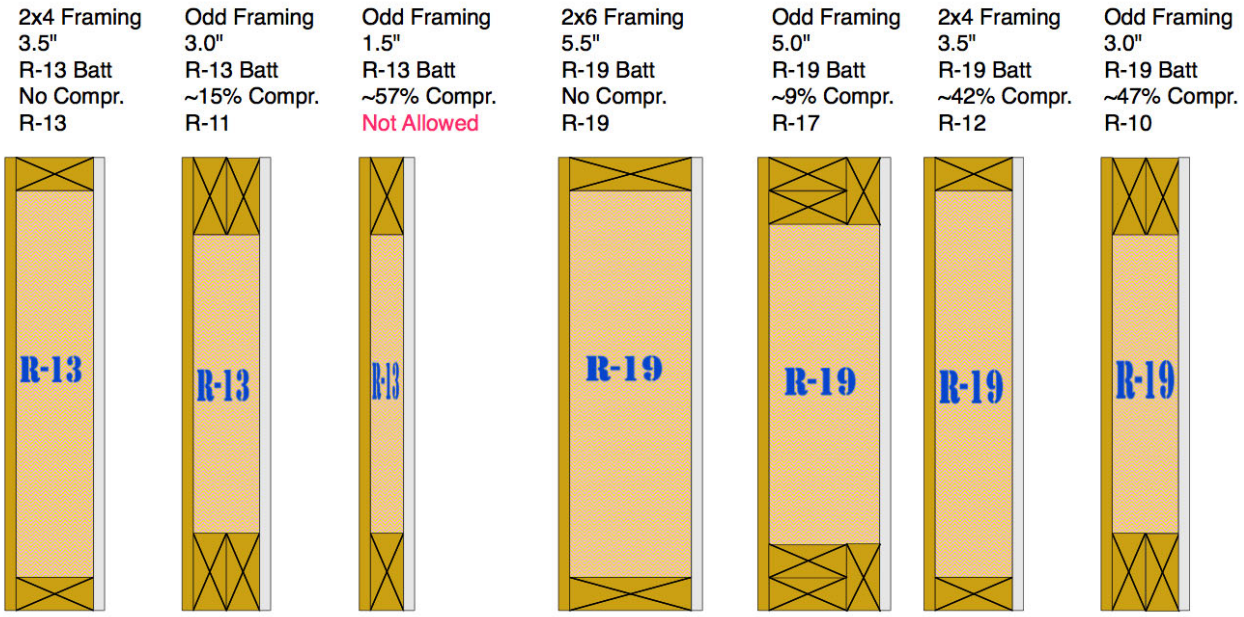
Air-tight

Limiting the passage of air either in or out of the building envelope.
Note: Thermal envelope assemblies (such as wall assemblies) shall be built to minimize air movement. Air movement brings unconditioned air and moisture through or into the assembly. For these procedures, air-tight shall be defined as an assembly or air barrier with all openings caulked, or sealed with minimally expansive foam, or taping/sealing of adjoining surfaces of air barrier materials and assemblies.

Compression

The compacting of insulation in an assembly resulting in the elimination of air pockets which results in a diminished R-value. Batt insulation should be fully "lofted" while loose-fill and spray foam materials should be properly applied to meet the manufacturer's specified density in order to achieve its full R-value. Limited compression is ONLY allowed at plumbing, vents and other obstructions as well as in cavities of non-standard framing. **Compression of insulation in these situations by more than 50% is excessive and shall not be allowed.**

Note that R-value is proportional to thickness and that compression does affect R-Value. You cannot cram an R-19 batt into a 2x4 wall and expect it to still be R-19. When the compression is more than 50% it begins to significantly affect the R-value per inch because the fibers are closer together and conduct heat better.



Delaminated

Separation of the insulation's full thickness to facilitate its installation around or between obstructions. Batt and blanket insulation are often split or delaminated to fit around electrical wires and plumbing runs through a wall cavity. The delamination must ensure that the full thickness of the insulation is installed between the obstruction and the finish material covering the framing. For example, an electrical wire located one-third of the distance from the front of the cavity should have batt insulation delaminated so that two thirds of the batt is installed towards the outside wall surface and one-third is installed towards the inside wall surface from the wire.

Draft Stops

A material, device or construction installed to prevent the movement of air within open spaces of concealed areas of building components, such as crawl spaces, floor/ceiling assemblies, wall assemblies, roof/ceiling assemblies and attics. Note: Draft stops are important components of the air barrier and shall be airtight. Fire blocks constructed of porous insulation materials cannot serve as draft stops since they are not airtight.

This photo shows a draft stop cut from OSB to fit around two ducts going up through a large square chase. This is a smoke/fire requirement in many cases. Notice the open corners in the cut out holes where air can leak through (red arrows). These should be sealed with expansive foam or other approved material.

SPF can serve as a draft stop as long as it meets the minimum thickness required to be an air barrier.

Friction Fit

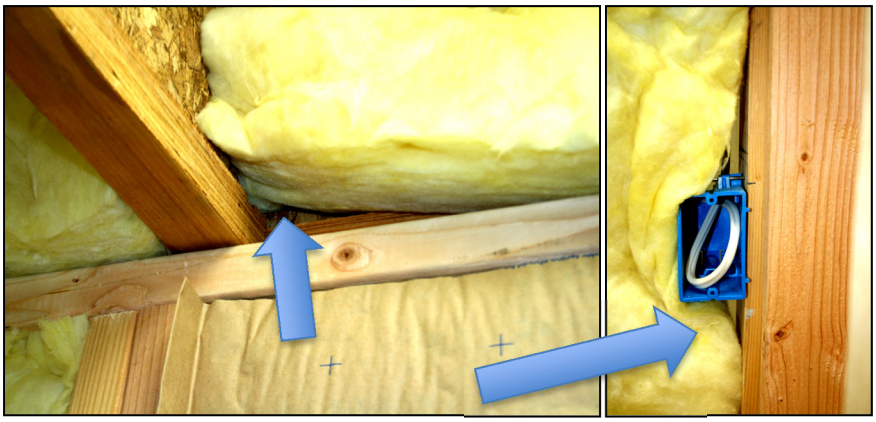
A means of attaching insulation within the framed cavity without the use of mechanical fasteners such that the material's full thickness in all directions is sufficient to maintain its installation integrity. In standard framing dimensions of 2x4' and 2x6" @ 16" oc and 24" oc, batt and blanket insulation materials have enough side-to-side frictional force to hold the insulation in place without any other means of attachment.

Note: Friction fitting of faced batt and blanket insulation, with or without an attachment flange, is allowed provided the insulation's installation integrity can be maintained.

Friction fitting may not be adequate in some cases, especially on walls where it may not get immediately covered up with an air barrier or sheathing material. Straps may be used as shown in this photo.

Gaps

Uninsulated areas at the edge of insulation where insulation is not in contact with framing members or other materials at the edge of the insulation. Gaps occur when insulation length and width is too short for the cavity. Gaps in insulation are avoidable and are not permitted.



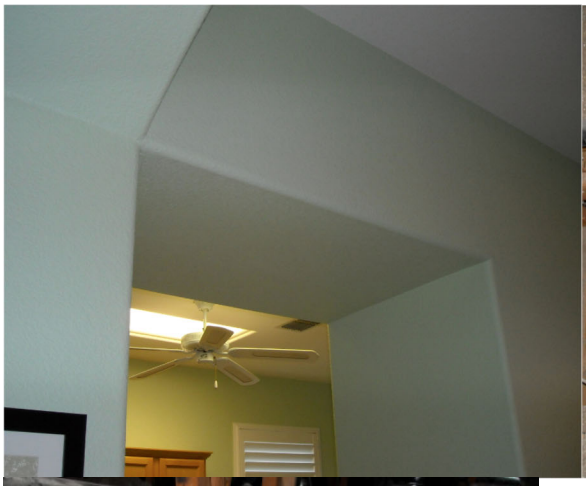
Hard Covers

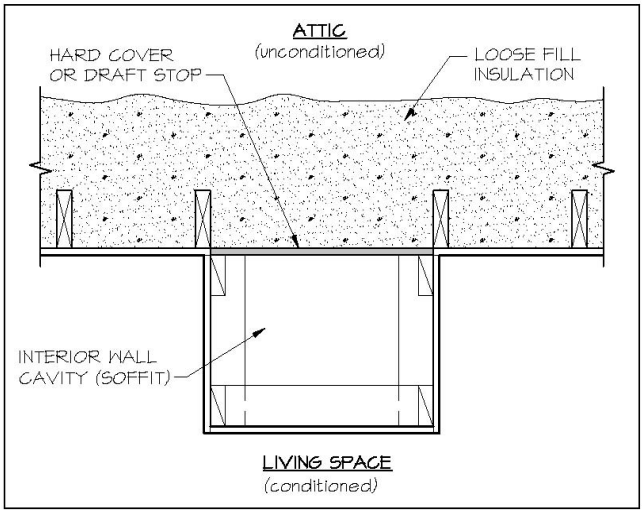
Building materials, such as plywood or gypboard, which become part of the ceiling air barrier. Note: Hard covers shall be installed above areas where there is a drop ceiling. For example, a home with 10ft ceilings may have an entry closet with a ceiling lowered to 8ft. In this case, a hard cover is installed at the 10ft level above the entry closet. Hard covers become part of the ceiling air barrier and shall be air-tight.

The Importance of Hard Covers

The first photo shows a typical dropped soffit inside a house that separates the kitchen from the family room. The second and third photos are from the attic looking down into this dropped soffit. You can see how the loose fill insulation has fallen down into the dropped area. This results in the upper portion of the dropped area being uninsulated. The diagram shows how a correctly installed hard cover would have prevented this.

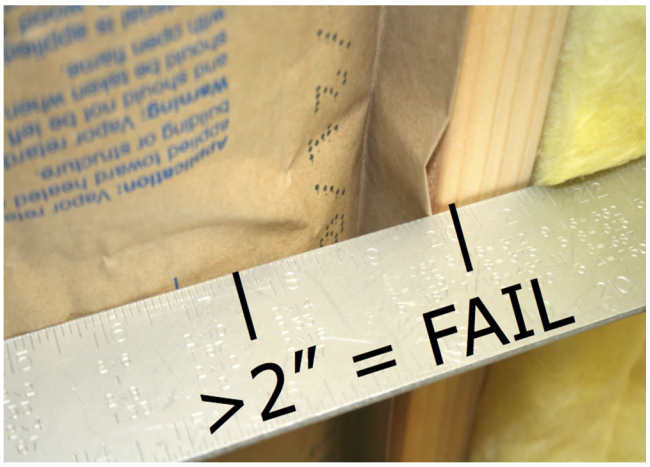
Completely filling the dropped area with insulation is an inferior alternative. It creates substantially more surface area through which heat can conduct, plus the extra insulation needed is rarely accounted for and ends up stealing insulation from the rest of the attic.





Inset Stapling

A method of attaching faced batt or blanket insulation to wood framing. The flange of the insulation facing is pushed inside the face of the framing member and stapled as opposed to stapling over the face of the studs, which can interfere with the gypboard. In windy areas installers often staple the flanges of faced batts to the sides of the stud in order to assure that the insulation remains in place until covered with drywall, particularly on the wall between the house and the garage where there isn't any exterior sheathing to help keep the insulation in place. The void created by the flange inset shall not extend more than two inches from the stud on each side.

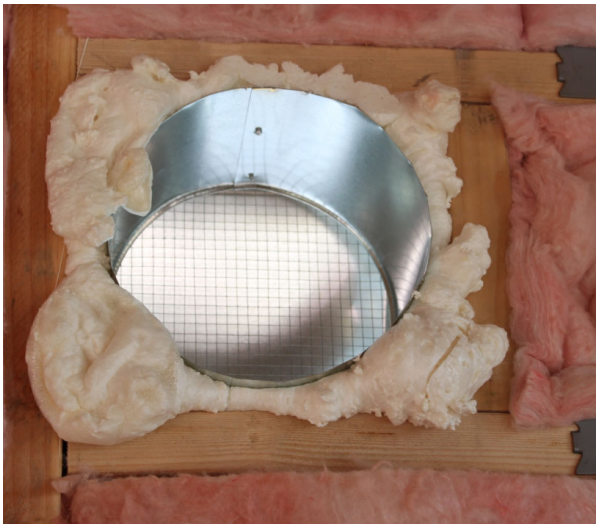


"Faced insulation" is a fiberglass batt with a paper glued to one face. This paper is called kraft paper and is impregnated with asphalt so that it performs as a vapor barrier (not an air barrier). Because it traps moisture, it is important that it not be installed on the side that gets cold in the winter because this could cause the moisture to condense on the paper, inside the wall. It should always be installed on the "warm in winter side."

It is sometimes used purely as a support for insulation in walls that may not be covered for a while, such as the wall between the house and the garage which may have no backing until the sheetrock gets installed on both sides, unlike an exterior wall, which may have exterior siding holding up the insulation on one side. Stapling the paper to the studs will prevent this insulation from falling out. Even so, the paper needs to be installed to the garage side.

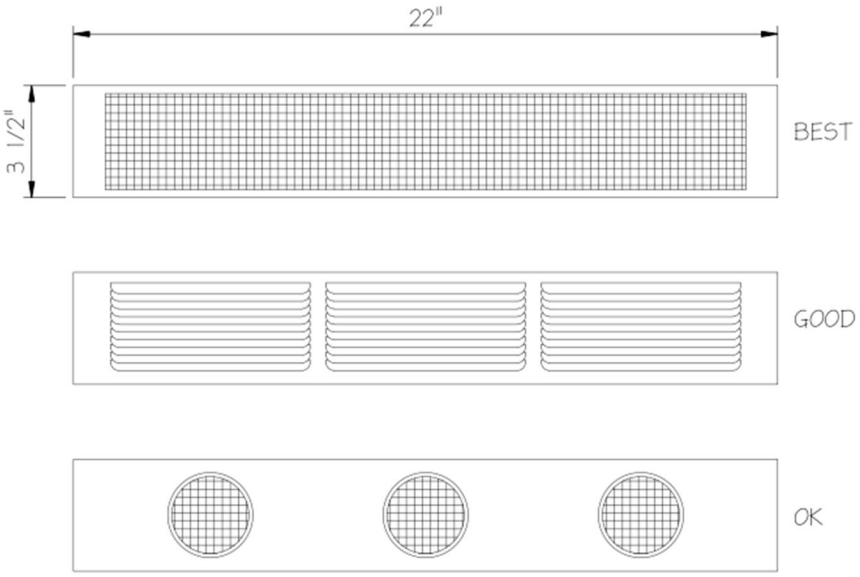
Minimally Expansive Foam Sealing Material

A single-component polyurethane foam system typically formulated in a handheld can or portable container to seal and fill construction gaps and crevasses, holes, and cracks without distorting adjacent framing. These materials are not used for insulation purposes, rather as agents for air sealing of gaps and crevasses that are too small to be insulated.



Net Free-Area

The net free-area of a vent cover is equal to the total vent opening less the interference to air flow caused by a screen or louver used for ventilation. Screened or louvered vent opening covers are typically marked by the manufacturer with the "net free-area." For example a 22.5 in. by 3.5 in. eave vent screen with a total area of 78.75 square inches may have a net free-area of only 45 square inches.



The Importance of Attic Ventilation

A great deal of research has gone into the benefits of preventing heat buildup in attics in the summer. Especially given that ducts are often located in the attic. The energy code encourages radiant barrier, insulation at the roof deck of a vented attic, and some means of mechanically ventilating an attic, such as whole house fans.

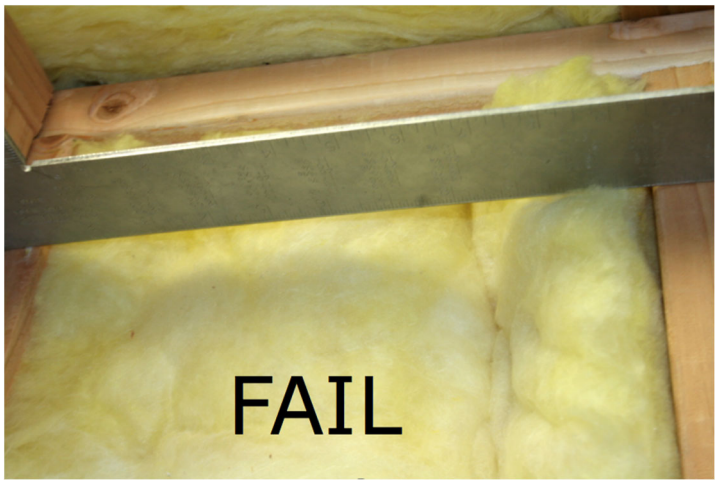
One of the most effective tools for removing heat from an attic is attic vents. Poor attic ventilation alone has been known to cause air conditioners to run at night even when it is cool outside, due to the trapped heat in the attic. There are a variety of types of vents: gable end, eyebrow, dormer, cloaked dormer, and eve vents. The latter being the most common, but also the most likely to be affected by improper installation of ceiling insulation and poor framing practices. It's not uncommon to look into a screened eve vent (top example above) and see nothing but insulation. While insulation is very poor at stopping airflow into or out of a house, it can be quite effective at reducing attic air movement.

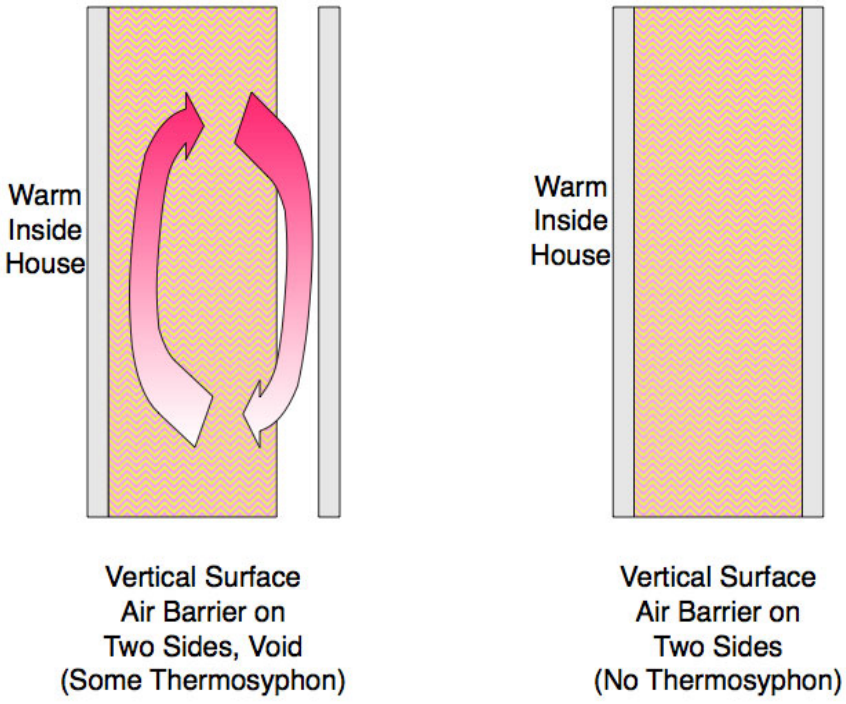
HERS Raters will check to make sure that whatever the required vent area is at the vent is unobstructed all the way to the main volume of the attic. Obstructions by framing or improperly baffled insulation will result in a failed inspection. Designers are encouraged to install more ventilation than is allowed by code. The code minimum is actually not intended for the heat removal that we desire. More is generally better.

Voids & Air Spaces

An uninsulated space within an enclosed building assembly created where the assembly has been insulated by partial filling of the framed cavity. The partial fill results in an air space (void) between the insulation surface and the assembly's exterior or interior layers that form the assembly's air barrier.

Some voids are allowed with SPF only. See Thermal Specifications section.





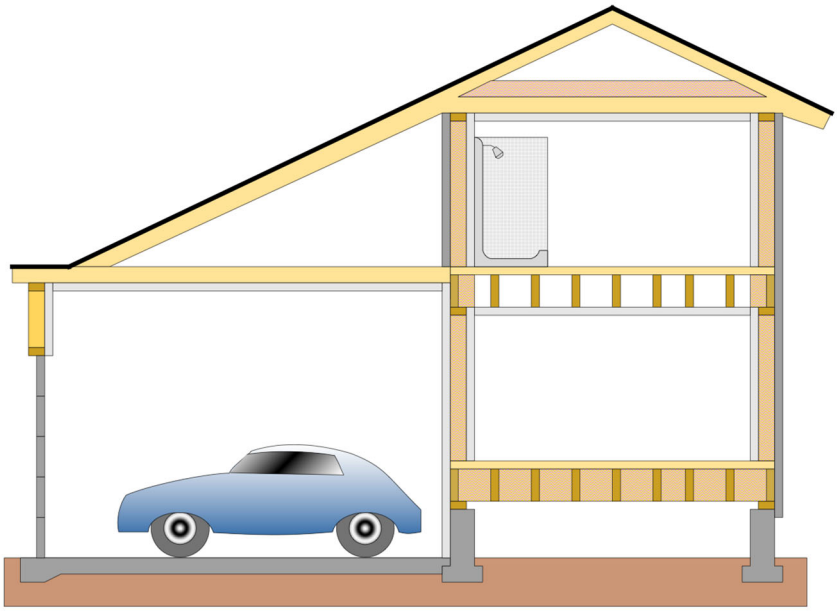
Vertical Surface Air Barrier on Two Sides, Void (Some Thermosyphon)

Vertical Surface Air Barrier on Two Sides (No Thermosyphon)

A void in a wall allows air to move more freely. Even small voids on one side of the insulation can allow air to rise or fall depending on its relative density. Warmer air is less dense and will rise, and visa versa. This is called thermosyphoning and it causes increased heat transfer through the wall compared to if it did not have any voids.

The Importance of Defining the Thermal Boundary

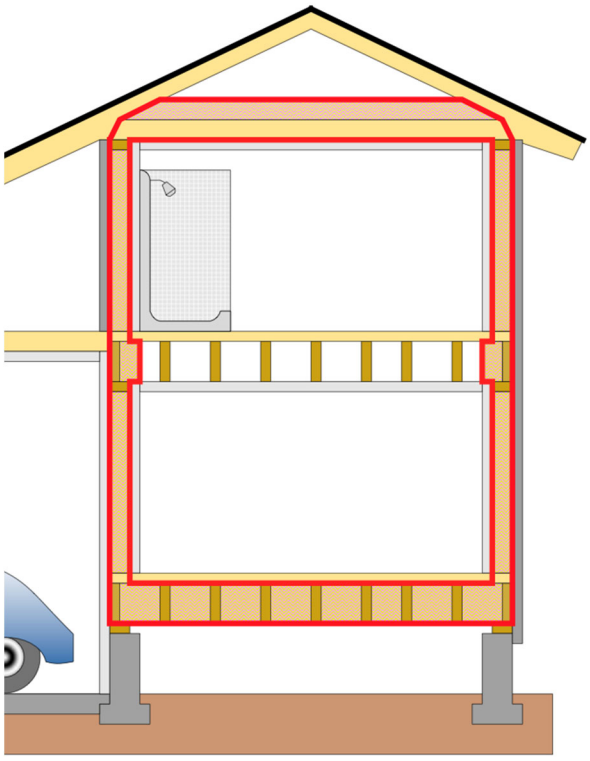
Coordination between trades is critical, as is the need for the designer of the house to really plan ahead on what exactly constitutes the thermal boundary. It can help to think of the thermal boundary as having two sides, an interior side and an exterior side. For ceilings, roofs, and rim joists, only one side needs to be in contact with an air barrier. With walls, **both** the interior and exterior surfaces need to be in *continuous* contact with an air barrier.



Consider the schematic section of this house:

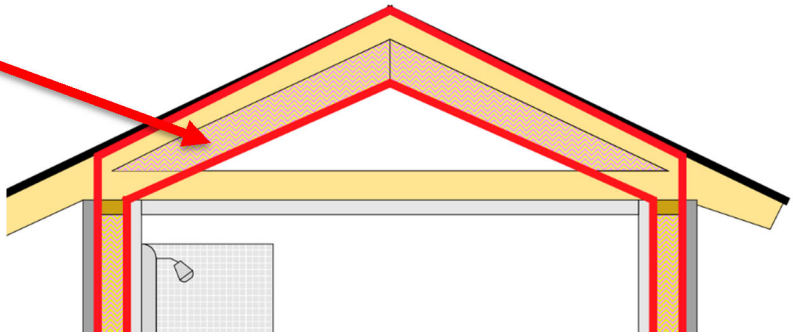
It has two stories, an attached garage with attic above, a vented unconditioned attic above living space, a vented unconditioned crawlspace, and a fiberglass shower insert against an exterior wall (in this case a kneewall).

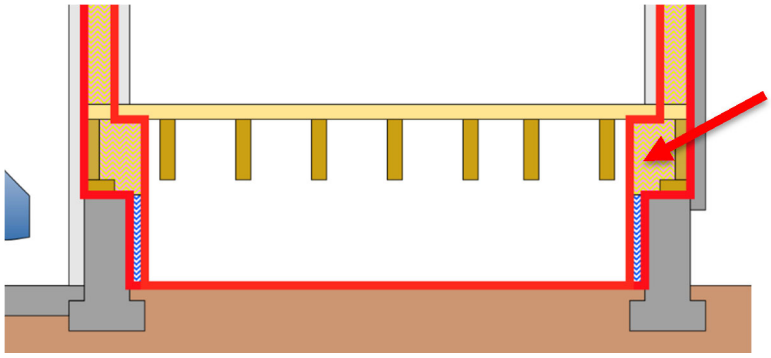
The interior and exterior surface of the conditioned boundaries are shown here in red.



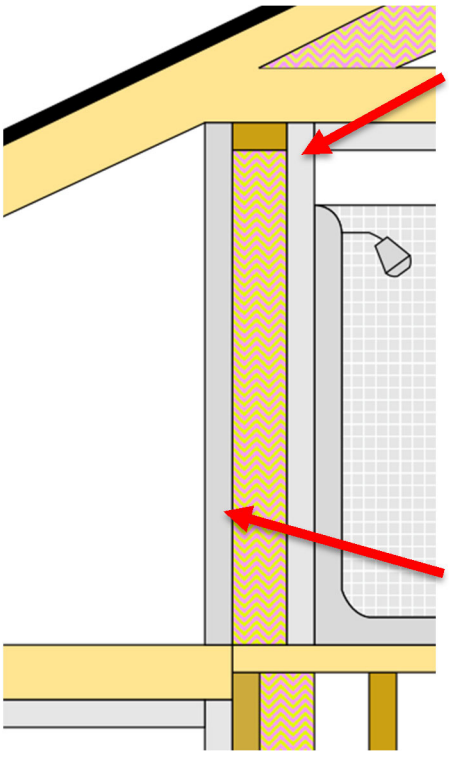
Notice the **air barrier** must be continuous, without any breaks or interruptions where air could readily pass between conditioned and unconditioned spaces. The entire boundary is also properly insulated, except at normal framing members. These should be minimized where possible.

If the home had an unvented, conditioned attic, with insulation under the roof deck the conditioned boundary would be substantially different.





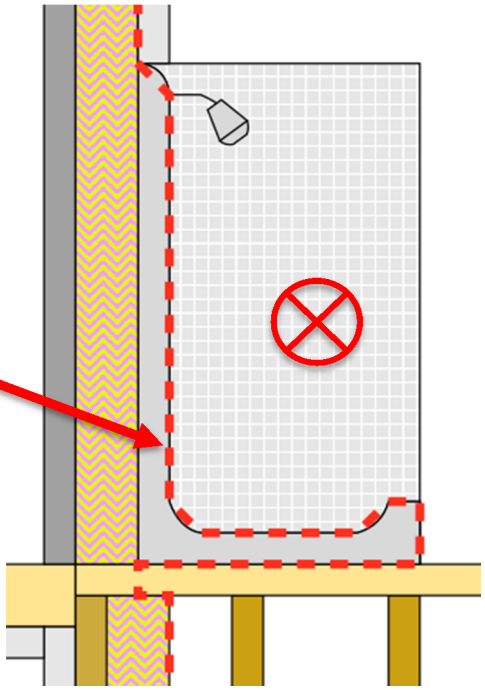
Similarly, if the home had an unvented, conditioned crawlspace, with insulation at the foundation walls the conditioned boundary would again be substantially different. Conditioned crawlspaces also require a plastic vapor barrier over any bare dirt.



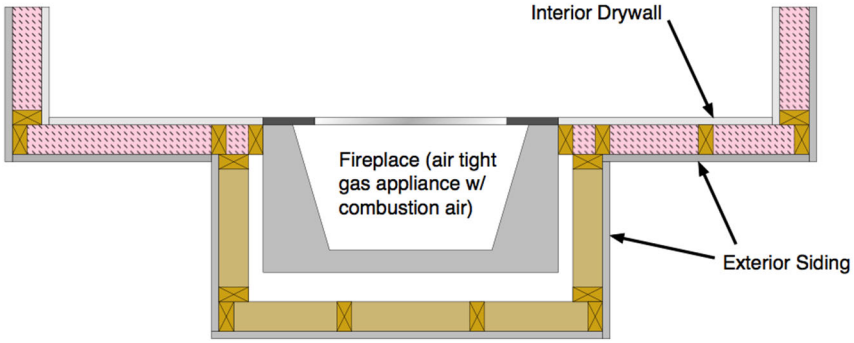
Note that the shower insert has an air barrier installed behind it. This is required by QII.

If there is no air barrier behind the shower, the interior surface of the air barrier would be the backside of the fiberglass shower insert. This would not meet the QII protocols.

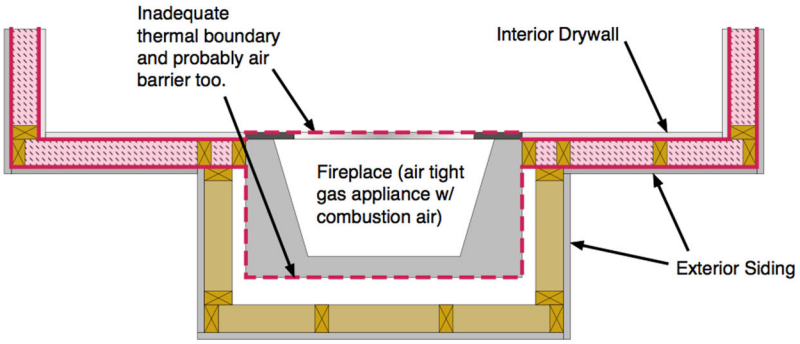
Also note that there is an air barrier on the attic side of the kneewall. This can be a particular challenge that requires extra coordination.



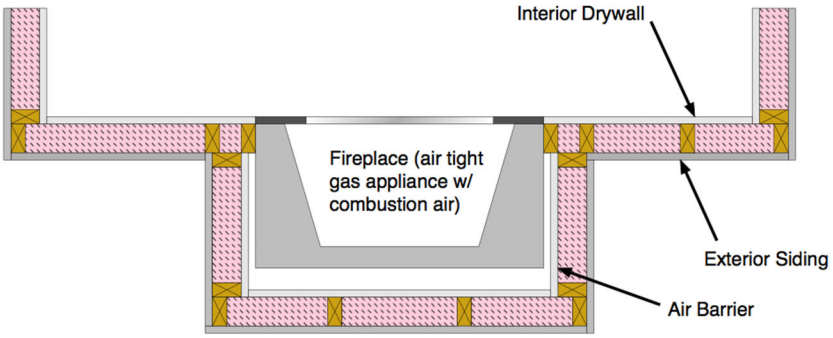
Frequently encountered challenges are exterior pop-outs for fireplaces. Historically, these have been treated like this, with the wall insulation stopping at the edge of the fireplace:



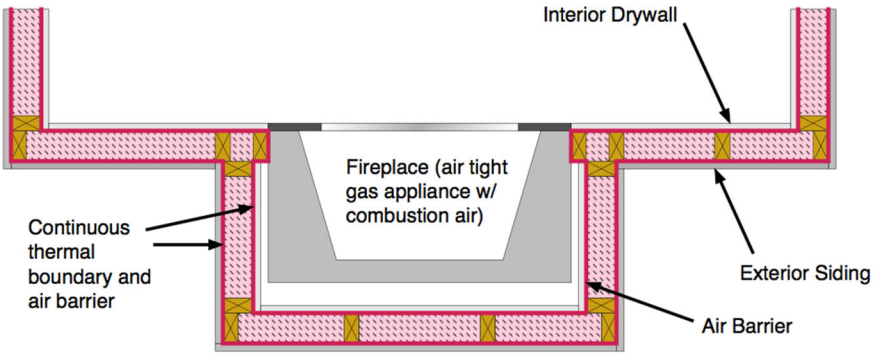
However, this is not acceptable practice to meet QII because it results in an inadequate thermal boundary.



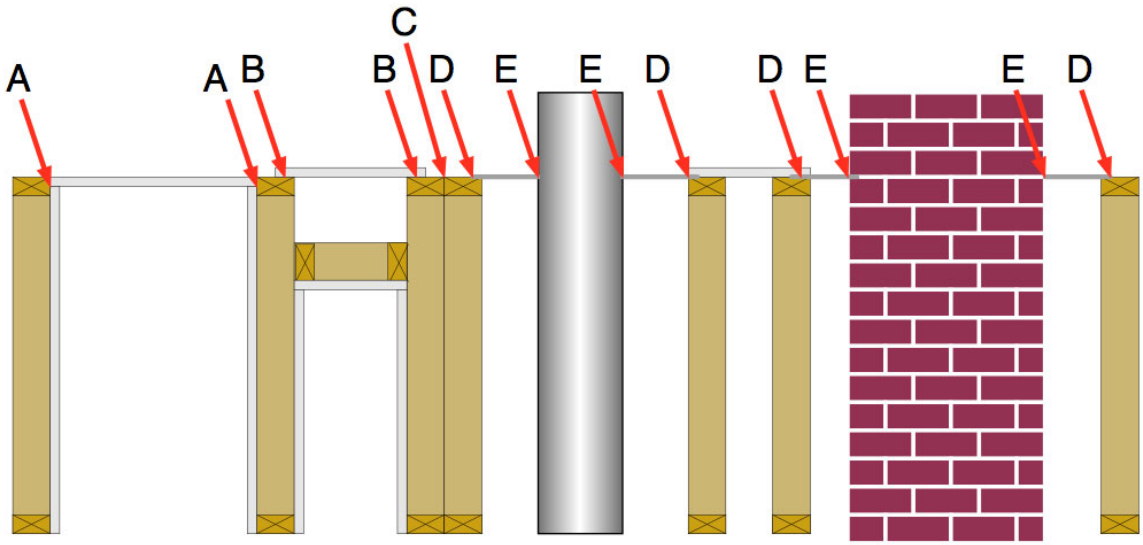
This approach would meet QII:



Note that at some point the pop-out will have a top, which must also be insulated. The flue will need to have an air tight flashing around it. See items D and E, next page.

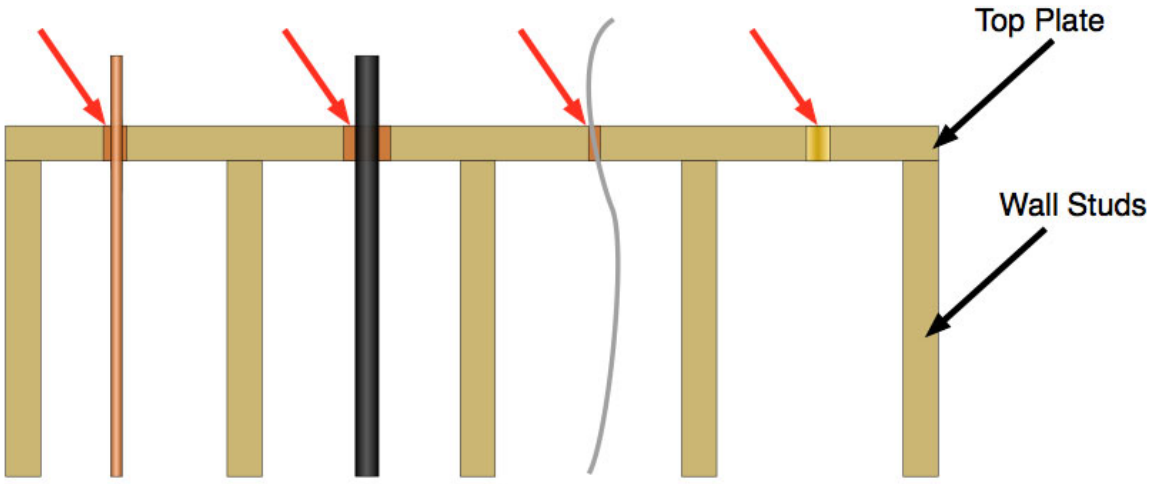


Special Requirements for Sealing Against Air Movement

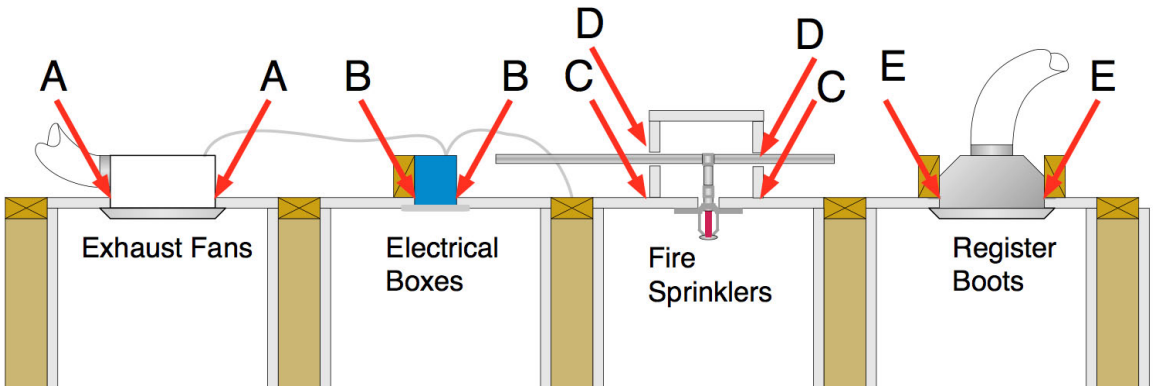


There must be a continuous air barrier at the ceiling level when there is unconditioned space above. Best practice is to also do this when there is a floor above.

A. Seal where the sheet rock on the wall meets the top plate.
B. Seal all hard covers to top plate.
C. Seal any gaps between adjacent top plates of double walls.
D. Seal metal flashing to top plates.
E. Seal metal flashing to flues or chimneys with fire caulking as required by fire code.

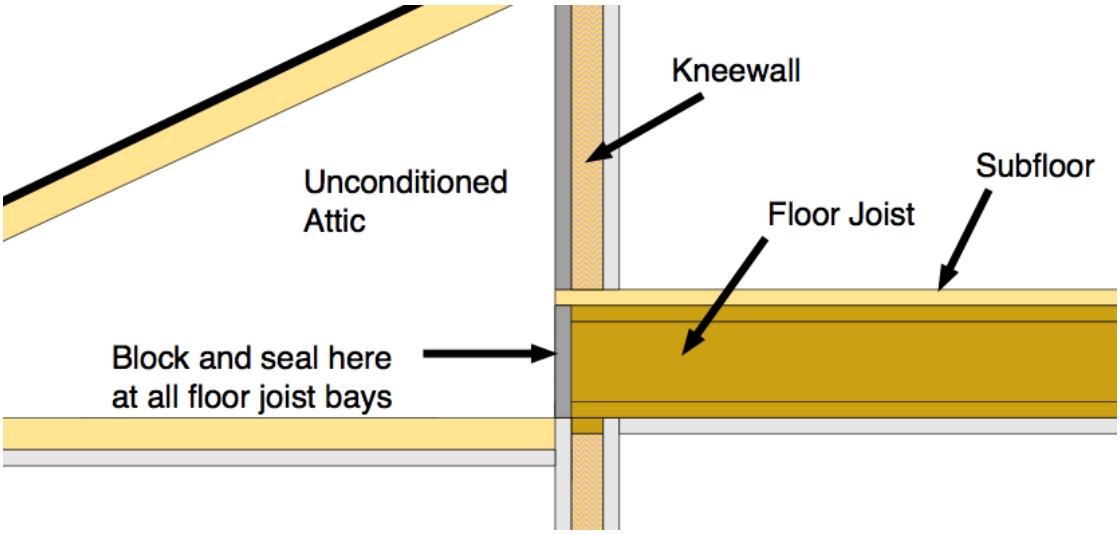


Seal all penetrations in top plates on interior and exterior walls for plumbing, vents, wires or any other holes when there is unconditioned space above. Best practice is to also do this when there is a floor above.



Seal all penetrations to the ceiling drywall when there is unconditioned space above. Best practice is to also do this when there is a floor above.

A. Seal exhaust fan housing to drywall.
B. Seal all electrical boxes that penetrate drywall to drywall.
C. Seal all fire sprinklers to drywall.
D. If sprinkler manufacturer does not allow sealing around the sprinkler head, an air tight box can be built over sprinkler. All penetrations in the box must be sealed as well as where box meets drywall.
E. Seal around all HVAC supply and return register boots.



Where a kneewall sits on a subfloor the spaces between the floor joists must be blocked and sealed to prevent air from moving between the attic and floor joist bays.

Thermal Specifications: **Batts and Blankets** (see RA3.5.3.1)

Definition: Batt and blanket insulation is made of mineral fiber and mineral wool -- either processed fiberglass, rock or slag wool -- and is used to insulate below floors, above ceilings, below roofs, and within walls.

This insulation type is manufactured in different widths, lengths, and thicknesses and is available with or without a facing. Faced batts and blanket insulation material is also available with or without an attachment flange. Specific product R-values are readily available from the manufacturer for the specific materials being installed and the R-value of the product is marked on the face of the product (faced or unfaced material). The installed insulation must meet the R-value stated on the compliance documentation.

Thermal Specifications: **Loose fill** (see RA3.5.4.1)

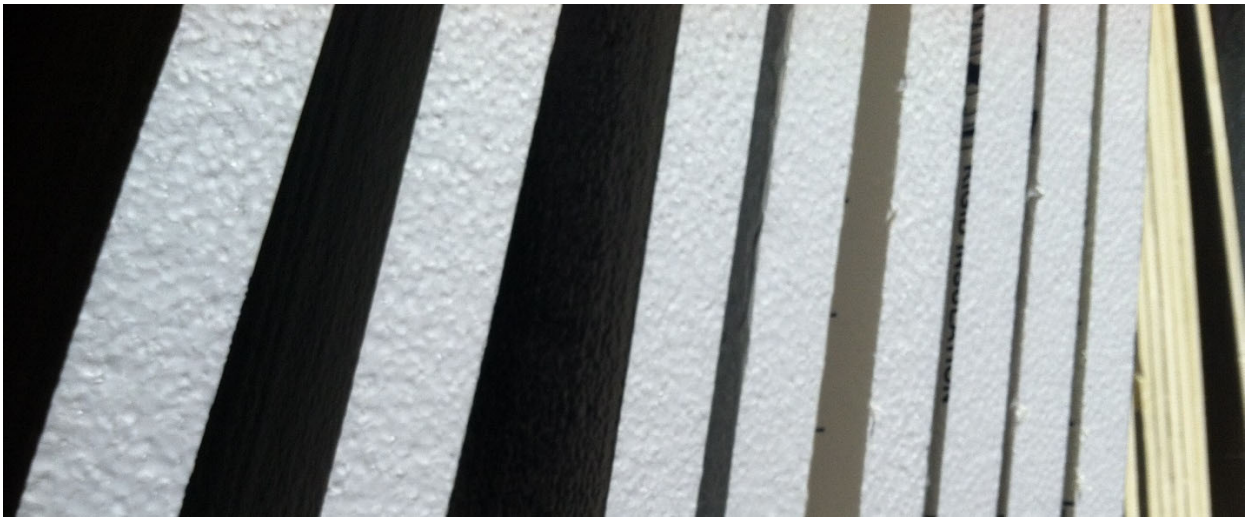
Definition: Loose-fill insulation includes loose fibers or fiber pellets that are blown into building cavities or attics using special equipment. Loose-fill insulations typically are produced using mineral fiber, mineral wool, or cellulose. They are installed in walls, floors, attics and below roofs using a dry-pack process or a moist-spray technique, and may include a netting material.

This insulation type is manufactured to be blown or sprayed into framed cavity walls, floors, and ceilings. It is installed with or without a net depending on the loose-fill type or in special installations where netting is required, such as below a roof deck or under floors. Its overall R-value is dependent on the installed density and installed thickness. Specific product R-values are readily available from the manufacturer for the specific materials being installed. R-value and coverage chart of the product is typically marked on the bag which the insulation was drawn from and from the manufacturer's product data sheet or product specification information. The installed insulation must meet the R-value stated on the compliance documentation.

Thermal Specifications: **Rigid Board** (see RA3.5.5.1)

Definition: Rigid board insulation sheathing is made from fiberglass, expanded polystyrene (EPS), extruded polystyrene (XPS, e.g., Styrofoam™), polyisocyanurate, or polyurethane. This type of insulation is used for above roof decks, exterior walls, cathedral ceilings, basement walls, as perimeter insulation at concrete slab edges, and to insulate special framing situations such as window and door headers, and around metal seismic bracing. Rigid board insulation may also be integral to exterior siding materials.

This insulation type is manufactured of different materials and is in sheet or board form. Rigid board insulation materials are typically used on the exterior side of framed wall assemblies and over the top of exterior roof decks. These products also may be used for special situations in rafter spaces of cathedral ceilings, floors, at floor rim joists, and within or on the outside of window and door headers. This insulation type may also be integral to exterior siding materials. Rigid board insulation material most often is used in conjunction with other insulation materials installed within the framed cavity. The R-value is dependent on the type of material and its thickness. Specific product R-values are readily available from the manufacturer for the specific materials being installed. R-value of the product is typically marked on the product. The installed insulation must meet the R-value stated on the compliance documentation.



Thermal Specifications: **Spray-on Polyurethane Foam** (see RA3.5.6.1)

Definition: Spray-on Polyurethane Foam (SPF) is a two-part liquid foamed plastic (such as polyurethane or modified urethane) material formed by the reaction of an isocyanurate and a polyol that uses a blowing agent to develop a cellular structure when spray applied onto a substrate. SPF insulation is a two-component reactive system mixed at a spray gun or a single-component system that cures by exposure to humidity. The liquid is sprayed through a nozzle into wall, roof/ceiling, and floor cavities. SPF insulation can be formulated to have specific physical properties (i.e., density, compressive strength, fire resistance and R-value).

There are two basic types of SPF based on their density and cellular structure: Closed Cell and Open Cell. Closed Cell has a default R-value of R-5.8 per inch. Open Cell has a default R-value of R-3.6 per inch. Alternatively, the total R-value may be calculated based on the thickness of insulation multiplied by the "tested R-value per inch" as listed in the Table of R-values or R-value Chart from the manufacturer.

These photos show SPF being installed and the trailer or truck-mounted equipment needed to properly apply it.

Thermal Specifications: Closed Cell SPF - ccSPF (see RA3.5.6.1.1)

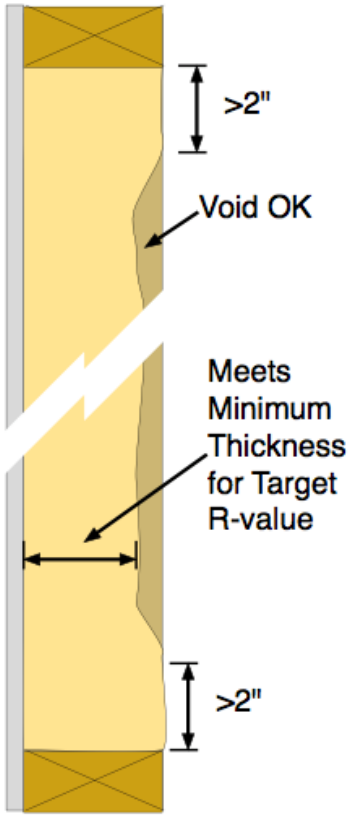
Definition: A spray applied polyurethane foam insulation having a closed cellular structure resulting in an installed nominal density of **1.5** to less than **2.5** pounds per cubic foot (pcf).

R-value: The total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by a thermal resistivity of **5.8** per inch. The R-value of ccSPF insulation shall meet or exceed the installed thickness specified in Table 3.5-1 below.

The R-value of the installed insulation shall be based on the verified thickness at an R-value of **5.8** per inch unless an Evaluation Service Report (ESR) is provided with compliance documentation that verifies use of other values (see previous discussion).

Nominal Thickness: ccSPF sprayed into framed cavities or on flat surfaces will expand with variable thicknesses, visibly appearing as undulations on the surface of the insulation. The average thickness of the foam insulation must meet or exceed the required R-value. Depressions in the foam insulation's surface shall not be greater than **1/2-inch** (less than) the required thickness at any given point of the surface area being insulated.

Filling of Framed Assemblies: ccSPF insulation is not required to fill the cavities of framed assemblies provided the installed thickness of insulation conforms to compliance documentation and that the bottom and top plates of vertical framing and both ends of horizontal framing, including band and rim joists, are sprayed to completely fill the cavity adjacent to and in contact with the framing to a distance of **2.0** inches away from the framing for ccSPF insulation, or filled to the thickness meeting ASTM testing as an air barrier.



ccSPF Stud Bay
(Side View)

Air Barrier: ccSPF installed as an air barrier shall be a minimum of **2.0** inches in thickness; alternatively, ccSPF insulation shall be installed at a thickness that meets an air permeance no greater than 0.02 L/s-m2 at 75 Pa pressure differential when tested in accordance to ASTM E2178 or ASTM E283.

Table RA3.5-1-CC: Required Thickness of ccSPF Insulation to Achieve Specified R-values

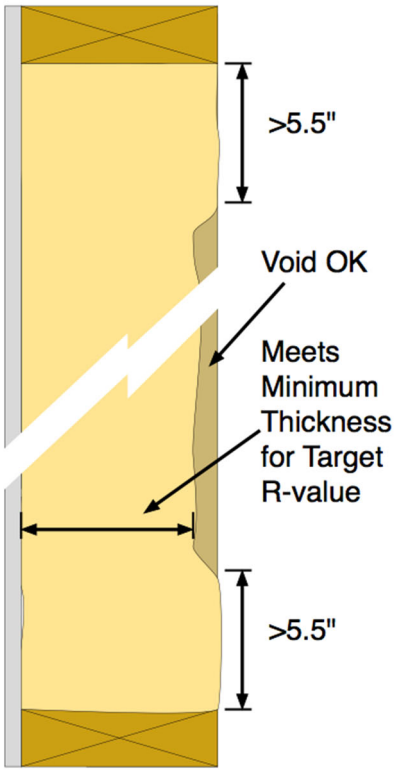
Equivalent R-Values for SPF insulation	R-11	R-13	R-15	R-19	R-21	R-22	R-25	R-30	R-38
Required thickness of ccSPF insulation @ R5.8/inch	2.00”	2.25”	2.75”	3.5”	3.75”	4.00”	4.50”	5.25”	6.75”

*Thermal Specifications: **Open Cell SPF - ocSPF** (see RA3.5.6.1.2)*

A spray applied polyurethane foam insulation having an open cellular structure resulting in an installed nominal density of **0.4** to less than **1.5** pounds per cubic foot (pcf).

R-value: The total R-value shall be calculated based on the nominal required thickness of the insulation multiplied by a thermal resistivity of **3.6** per inch. The R-value of ocSPF insulation shall meet or exceed the installed thickness specified in Table 3.5-1 below.

The R-value of the installed insulation shall be based on the verified thickness at an R-value of **3.6** per inch unless an ESR is provided with compliance documentation that verifies use of other values.



ocSPF Stud Bay
> 2 x 4
(Side View)

Nominal Thickness: ocSPF sprayed into framed cavities or on flat surfaces will expand with variable thicknesses, visibly appearing as undulations on the surface of the insulation. The average thickness of the foam insulation must meet or exceed the required R-value. Depressions in the foam insulation surface shall not be greater than **1-inch** of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.

Filling of Framed Assemblies: ocSPF insulation shall completely fill cavities of 2x4 inch framing or less. Cavities greater than 2x4 inch framing dimensions may be filled to the thickness that meets the required R-value used for compliance provided that the bottom and top plates of vertical framing and both ends of horizontal framing, including band and rim joists, are sprayed to completely fill the cavity adjacent to and in contact with the framing to a distance of **5.5** inches away from the framing for ocSPF insulation, or filled to the thickness meeting ASTM testing as an air barrier.

Air Barrier: ocSPF installed as an air barrier shall be a minimum of **5.5** inches in thickness; alternatively, ocSPF insulation shall be installed at a thickness that meets an air permeance no greater than 0.02 L/s-m2 at 75 Pa pressure differential when tested in accordance to ASTM E2178 or ASTM E283.

Table RA3.5-1-OC: Required of ocSPF Insulation to Achieve Specified R-values

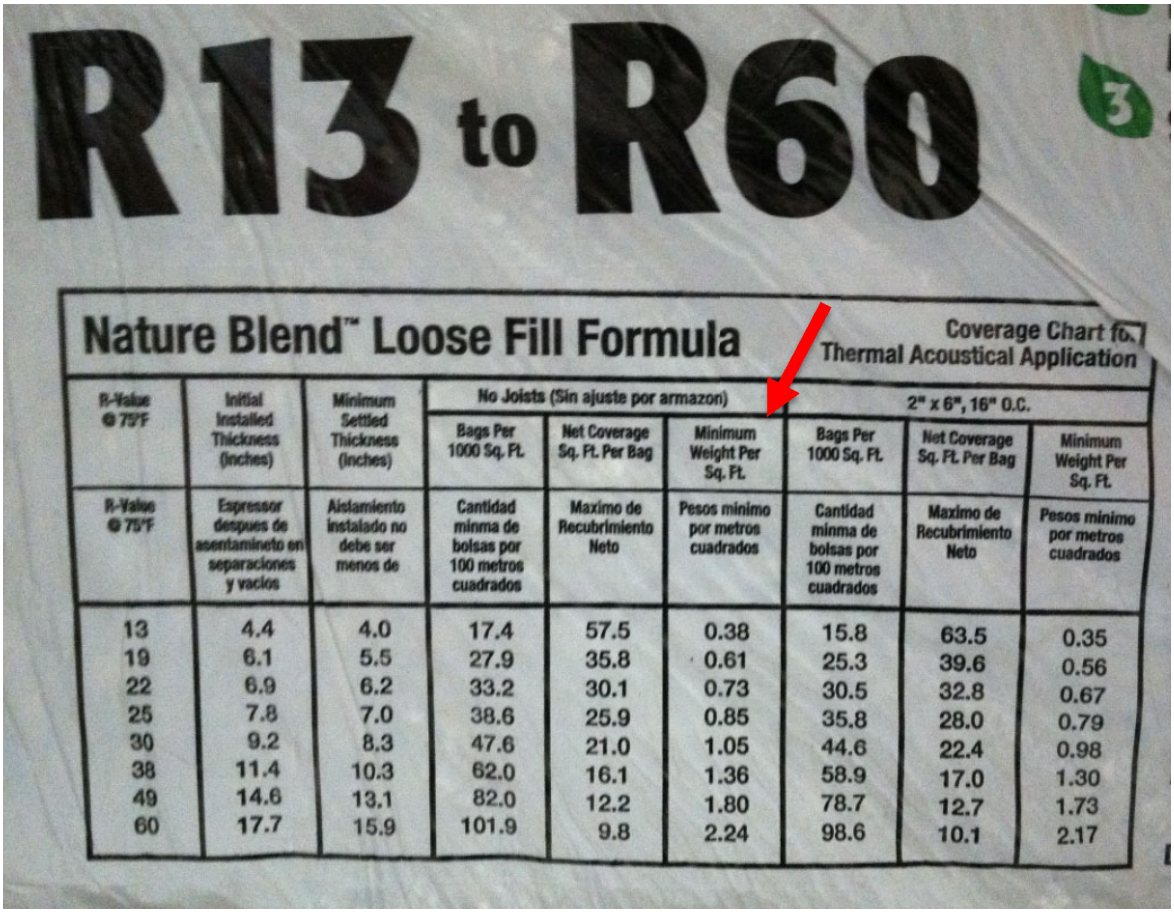
Equivalent R-Values for SPF insulation	R-11	R-13	R-15	R-19	R-21	R-22	R-25	R-30	R-38
Required thickness of ocSPF insulation@ R3.6/inch	3.0”	3.5”	4.2”	5.3”	5.8”	6.1”	6.9’	8.3”	10.6”

R-Value Measurement: **Batt** (see RA3.5.3.1.2)

The HERS Rater shall verify the installed thickness of insulation in all assemblies and locations on walls, roof/ceilings, and floors, and to ensure that insulation levels and installation integrity meet the R-value specified on the Certificate of Compliance, and all other required compliance documentation.

R-Value Measurement: **Blown In** (see RA3.5.4.1.2)

The HERS Rater shall measure the installed thickness (inches) and density (lbs per square feet) of insulation on walls, roof/ceilings and floors to ensure minimum thickness levels and the installed density meets the R-value specified on the Certificate of Compliance, and all other required compliance documentation. For walls, measurement areas shall include low and high areas of the insulated assembly and the HERS Rater shall verify density measurements are consistent with the manufacturer's coverage chart. (See "*Cookie Cutter Test*" section at end of this document.)



R-Value @ 75°F	Initial Installed Thickness (Inches)	Minimum Settled Thickness (Inches)	Bags Per 1000 Sq. Ft.	Net Coverage Sq. Ft. Per Bag	Minimum Weight Per Sq. Ft.	Bags Per 1000 Sq. Ft.	Net Coverage Sq. Ft. Per Bag	Minimum Weight Per Sq. Ft.
R-Value @ 75°F	Espressor despues de asentamineto en separaciones y vacios	Aistamiento instalado no debe ser menos de	Cantidad minma de bolsas por 100 metros cuadrados	Maximo de Recubrimiento Neto	Pesos minimo por metros cuadrados	Cantidad minma de bolsas por 100 metros cuadrados	Maximo de Recubrimiento Neto	Pesos minimo por metros cuadrados
13	4.4	4.0	17.4	57.5	0.38	15.8	63.5	0.35
19	6.1	5.5	27.9	35.8	0.61	25.3	39.6	0.56
22	6.9	6.2	33.2	30.1	0.73	30.5	32.8	0.67
25	7.8	7.0	38.6	25.9	0.85	35.8	28.0	0.79
30	9.2	8.3	47.6	21.0	1.05	44.6	22.4	0.98
38	11.4	10.3	62.0	16.1	1.36	58.9	17.0	1.30
49	14.6	13.1	82.0	12.2	1.80	78.7	12.7	1.73
60	17.7	15.9	101.9	9.8	2.24	98.6	10.1	2.17

R-Value Measurement: **Rigid** (see RA3.5.5.1.2)

The HERS Raters shall verify the installed thickness of insulation in all assemblies and locations on walls, roof/ceilings, and floors, and to ensure that insulation levels and installation integrity meet the R-value specified on the Certificate of Compliance, and all other required compliance documentation. Different products will have different R-values per inch.

Note: Rigid insulation is sometimes referred to as "sheathing" or "continuous" insulation on the CF1R-PRF-01. Sometimes the surface will be named something like "R-15+4 wall", meaning that there is R-15 in the cavity (between studs) and R-4 continuous insulation, usually on the exterior of the wall. It is important to realize that the name of a surface on the CF1R is just a text field and has no impact on the simulation results. You have to look at the detailed description and U-factor to determine what is actually required. In other words, a surface mis-named "R-13 wall" may have actually been modeled as an R-15+4 wall. This can easily cause a lot of confusion.

R-Value Measurement: **SPF** (see RA3.5.6.1.4)

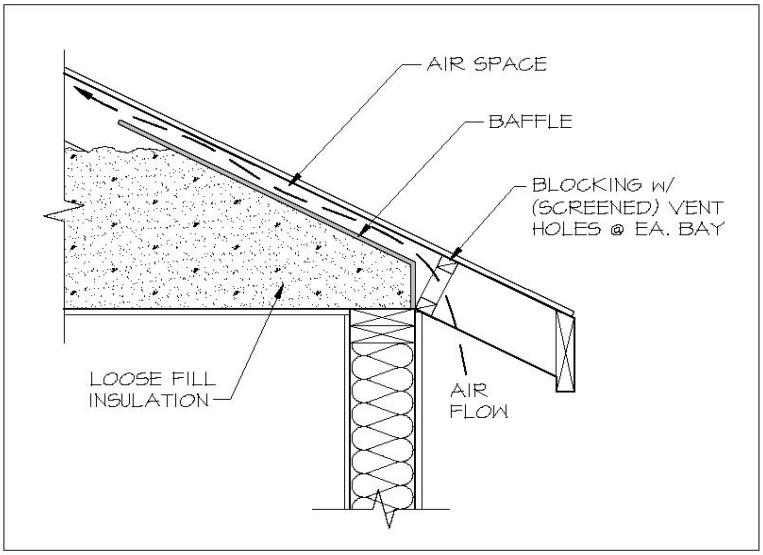
The HERS Rater shall measure the installed thickness of insulation in at least 6 random locations on walls, roof/ceilings and floors (i.e., 6 measurements per opaque surface type: wall, roof/ceiling or floor) to ensure minimum thickness levels necessary to meet the R-value specified on the Certificate of Compliance, and all other required compliance documentation. Measurement areas shall include low and high areas of the SPF insulated surface.

Probes are typically used for inspection and measurement of installed thickness of SPF insulation. The insulation thickness shall be verified by using a probe, gauge or device capable of measuring the installed thickness of insulation. A pointed measurement probe or other gauge or device, capable of penetrating the full thickness of the insulation, shall be used having measurements marked by at least one-eighth inch increments. Insulation thickness measurement probes and gauges or devices shall be accurate to within ±1/8 inch and shall be designed and used in a manner to cause minimal damage to the insulation. A metal skewer and ruler are commonly used.

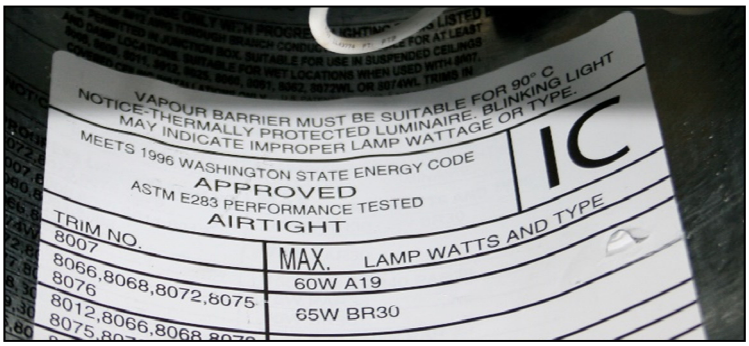
General Requirements for **Walls, Roof/Ceilings and Floors** (see RA3.5.X.1.1)

Walls, Roof/Ceilings and Floors: **All Materials**

- Materials shall comply with, and be installed in conformance with, all applicable building codes for building.
- Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
- Materials shall comply with flame spread rating and smoke density requirements of Chapter 26 and Section 720 of the Title 24, Part 2: all installations with exposed facings must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings that do not touch a ceiling, wall, or floor surface, and faced batts on the undersides of roofs with an air space between the ceiling and facing are considered exposed applications.
- Materials shall be installed according to manufacturer specifications and instructions.
- Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed. (See example in Definitions section)
- Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent shall be maintained. (See example in *Definitions* section)
- Eave vent baffles shall be installed to prevent air movement under or into the insulation material.

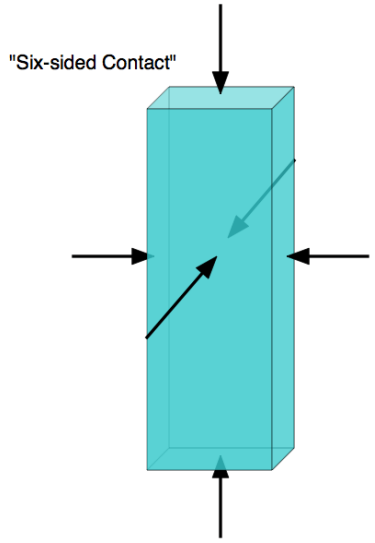


- Insulation (except SPF) shall cover all recessed lighting fixtures. All recessed light fixtures that penetrate the ceiling shall be listed for zero clearance insulation contact (IC), have a label that certifies it as airtight when tested to ASTM E283.



Walls, Roof/Ceilings and Floors: **Batt and Blanket**

- Batt and blanket insulation shall be correctly sized to fit snugly at the sides and ends. (aka, Six-sided Contact)
- Batt and blanket insulation shall be installed so that they will be in contact with the air barrier.
- Where necessary, batt and blanket insulation shall be cut to fit properly - there shall be no gaps, nor shall the insulation be doubled-over or compressed.
- When batt and blanket insulation are cut to fit a non-standard cavity, they shall be snuggly fitted to fill the cavity without excessive compression.
- Batt and blanket insulation shall be cut to butt-fit around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.
- For batts and blanket insulation that is taller than the trusses, full-width batts shall be used so that they expand to touch each other over the trusses.



Walls, Roof/Ceilings and Floors: **Loose Fill**

- Loose-fill insulation must completely fill the framed cavity.
- Loose-fill insulation shall be installed so that they will be in contact with the air barrier.

Walls, Roof/Ceilings and Floors: **Rigid Board**

- Rigid board insulation shall be attached according to the manufacturer's specifications.
- Rigid board insulation may be used as the air barrier provided it has been tested to conform to the air barrier performance conditions of the Standards.

Walls, Roof/Ceilings and Floors: **SPF**

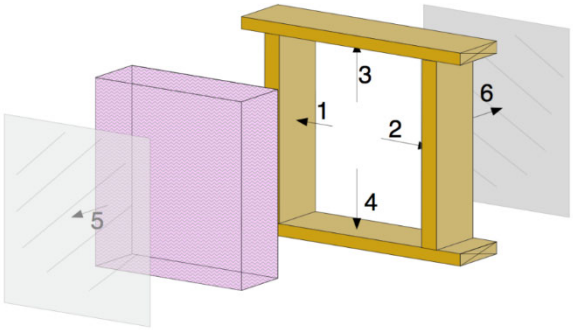
- The installer shall determine and the HERS Rater shall verify that the manufacturer's nominal insulation thickness has been installed and certified and that all requirements of the Certificate of Verification have been met.
- The installer shall determine and the HERS Rater shall verify that insulation is in substantial contact with the assembly air barrier. When SPF insulation is being used to provide air barrier control, the SPF insulation must cover and be in contact with the entire surface of the framing, filling the cavity to a distance away from the framing specified in "Filling of Framed Assemblies" above.
- SPF insulation shall be applied by SPF applicators trained and experienced in the use and maintenance of high-pressure, plural-component equipment. SPF applicators shall be certified by the SPF insulation manufacturer for the application of SPF insulation systems.
- SPF insulation shall be spray-applied to fully adhere to assembly framing, floor and ceiling, the joists, and other framing surfaces within the construction cavity. When multiple layers of SPF material are applied, each foam lift (i.e. spray application) shall have adhesion at substrate and foam interfaces.
- SPF insulation shall not exhibit areas that:
    1. Have voids or gaps in the uniformity of the insulation
    2. Are extremely soft or spongy
    3. Show the presence of liquid
    4. Have blistering between lifts
    5. Show differences in coloration of adjacent foam layers
    6. Indicate the presence of other materials between lifts
- SPF insulation shall be installed in conformance with the manufacturer's specifications, recommendations and temperature/humidity limitations.
- Substrates to which SPF insulation is applied shall be secure and free of surface moisture, frost, grease, oils, dirt, dust or other contaminants that would adversely affect SPF adhesion.
- SPF shall be separated from occupied spaces by an approved thermal barrier, such as 0.5 inch gypsum wallboard or other approved material, or show equivalence through testing.

- **SPF shall not be applied directly to recessed lighting fixtures**

- Recessed light fixtures in ceilings insulated with SPF insulation shall be protected from contact with SPF by a combination of one or more of the following methods:
    1. Be covered with a minimum of 1.5 inches of mineral fiber insulation, or
    2. Be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8inch hard board or gypboard.

Specific Requirements for **Wall Insulation** (see RA3.5.X.2)

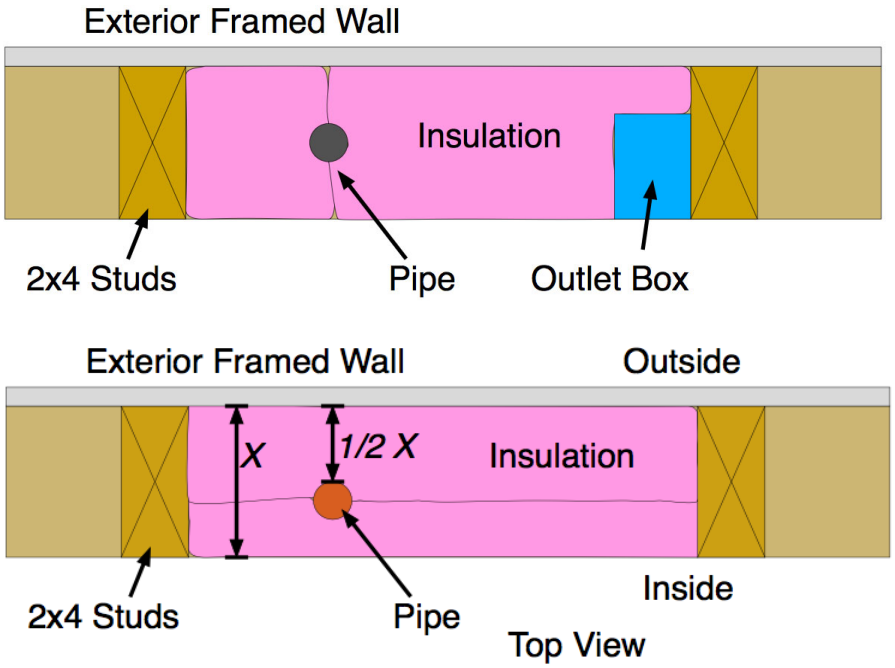
Wall Insulation: **All Materials**



- Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space.
- All plumbing and wiring penetrations through the top and bottom plates and electrical boxes that penetrate the exterior sheathing shall be sealed.
- All gaps in the air barrier shall be caulked, taped, or sealed with minimally expansive foam.
- Bottom plates of framed and non-framed assemblies shall be sealed to the ground subfloor or slab, and above ground subfloor.
- Insulation shall uniformly fill the cavity side-to-side, top-to-bottom, and front-to-back.

Wall Insulation: **Batt and Blanket**

- Batt insulation shall fill the cavity by friction fitting, inset or face stapling of flanges of faced batts, or by other support methods as necessary.
- Batt and blanket insulation shall be installed to fill the cavity and be in contact with the sheathing on the back and the wallboard on the front - no gaps or voids.
- Non-standard-width cavities shall be filled with insulation fitted into the space without excessive compression.
- Batt insulation shall be cut to fit snugly around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.



Wall Insulation: **Loose Fill**

- Loose fill insulation shall be installed to fill the cavity and be in contact with the sheathing on the back and the wallboard on the front - no gaps or voids.

- Loose fill wall insulation shall be installed to fit around wiring, plumbing, and other obstructions.

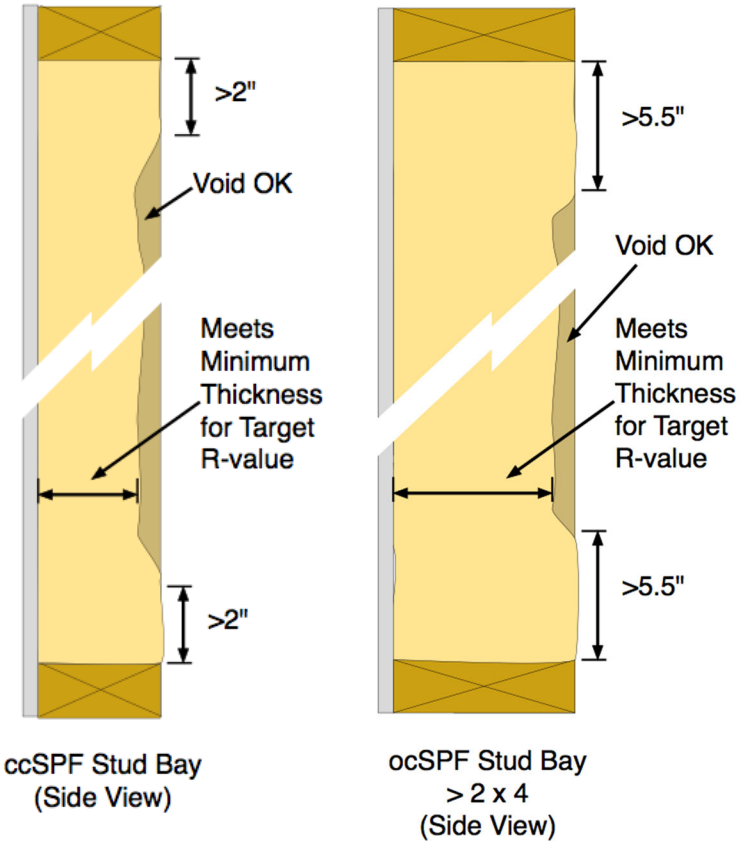
Wall Insulation: **Rigid**

- Installation shall uniformly fit across the plane of the wall and **taping** and/or **caulking** of all joints and seams of the insulation shall be maintained to be considered as the air barrier.

Wall Insulation: **SPF**

- SPF insulation shall be applied to provide an air-tight envelope to the outdoors and between adjoining cavity surfaces of conditioned and unconditioned space, such as the: attic, garage, and crawl space. See **Thermal Specifications** section for more detail.

.



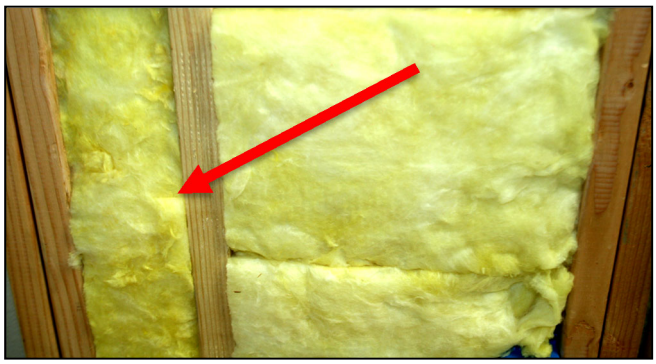
ccSPF Stud Bay
(Side View)

ocSPF Stud Bay
> 2 x 4
(Side View)

Wall Insulation: **Special Situations**

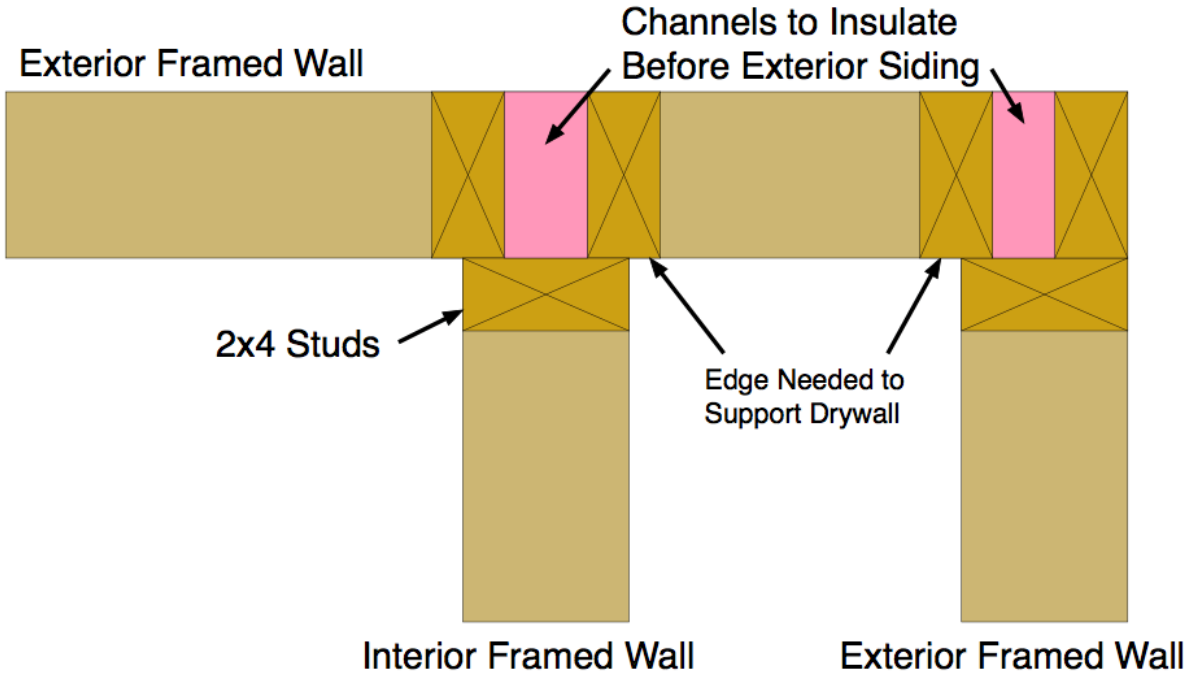
Narrow-Framed Cavities (see RA3.5.X.2.1)

- Non-standard width cavities shall be filled with insulation to snugly fit into the space, or with minimally expansive foam sealing material.
- Narrow spaces less than 1 inch in width at windows and door jambs, shall be filled with minimally expansive foam sealing.
- Narrow spaces less than 2 inches in width, such as between studs at building corners, and at the intersection of interior partition walls to exterior walls, shall be filled with insulation snuggly fitted in the space, or with minimally expansive foam sealing.



Wall Insulation: Installation Prior to Exterior Sheathing or Lath (see RA3.5.X.2.2)

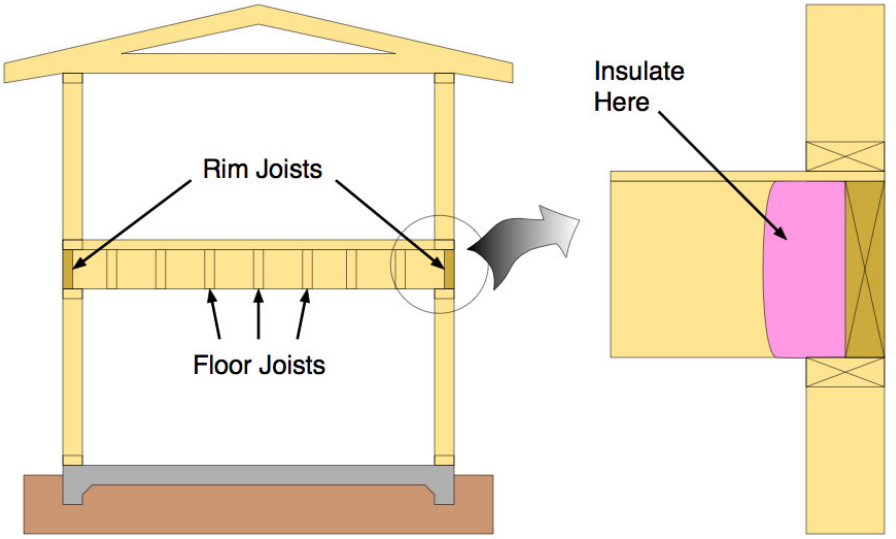
- Hard to access wall stud cavities, such as corner channels, wall intersections, and behind tub/shower enclosures shall be insulated to the proper R-value. In most cases this can only be completed prior to the installation of the tub/shower enclosure, the exterior sheathing, or the exterior stucco lath.
- An air barrier shall be installed on the inside of the exterior wall(s) directly adjacent to the tub/shower enclosure.



These two photos show bath tubs against exterior walls. When this happens an air barrier must be installed on the inside surface of the wall. The photo on the right shows the air barrier installed. You can also see a metal access door, this door needs to be insulated much the same way an attic access would be insulated. Rigid board insulation would work well here.

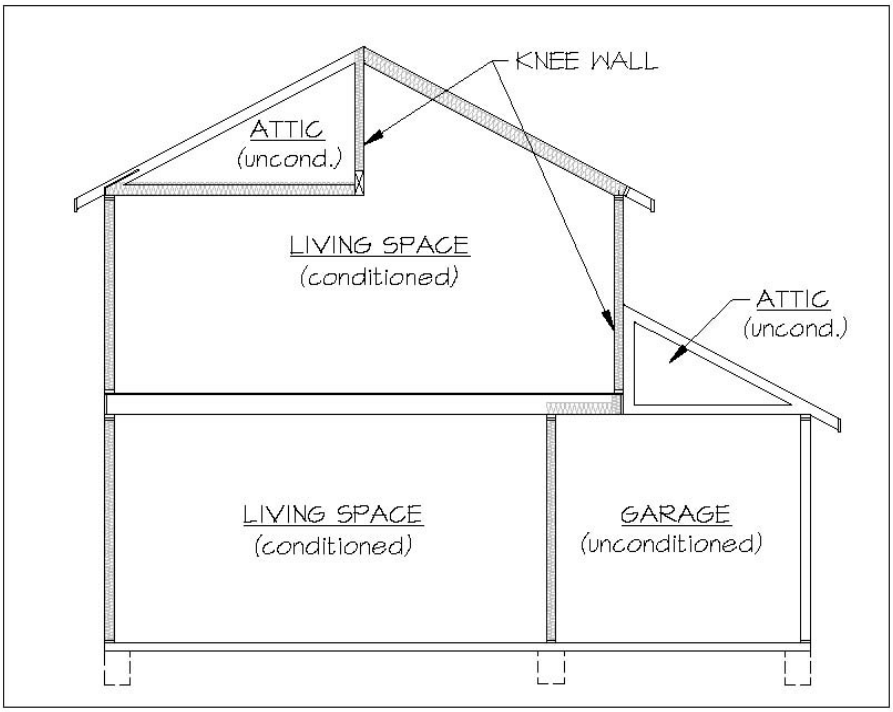
Rim Joists (see RA3.5.X.2.4)

- All rim-joists shall be insulated to the same R-value as the adjacent walls.
- The insulation shall be installed without gaps, voids, or compression.



This photo shows rim joists that have been insulated. Unfortunately, the work is too sloppy to meet QII. There is too much compression and there are too many voids.

Kneewalls, Skylight Shafts, and Gable Ends (see RA3.5.X.2.5)



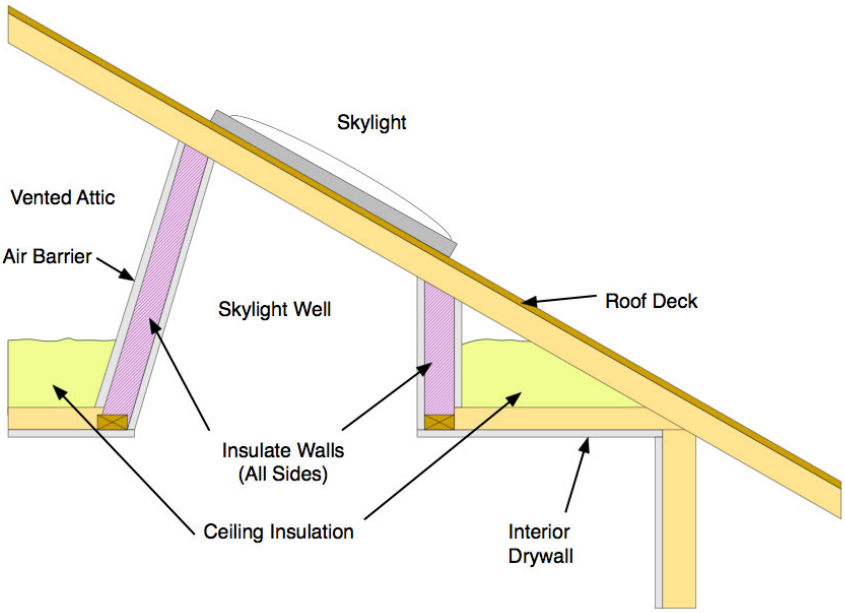
- A kneewall is any vertical wall that separates conditioned space from an unconditioned attic.

- Framing for kneewalls, skylight shafts and gable ends that separate conditioned from unconditioned space shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation. They can be specifically modeled in a performance run, but must meet or exceed the performance level of how they were modeled. If they are not specifically called out, they must meet the same U-factor as the rest of the walls with similar framing.

- For steel-framed kneewalls, skylight shafts, and gable ends, external surfaces of steel studs shall be covered with insulation unless otherwise specified on the Certificate of Compliance.

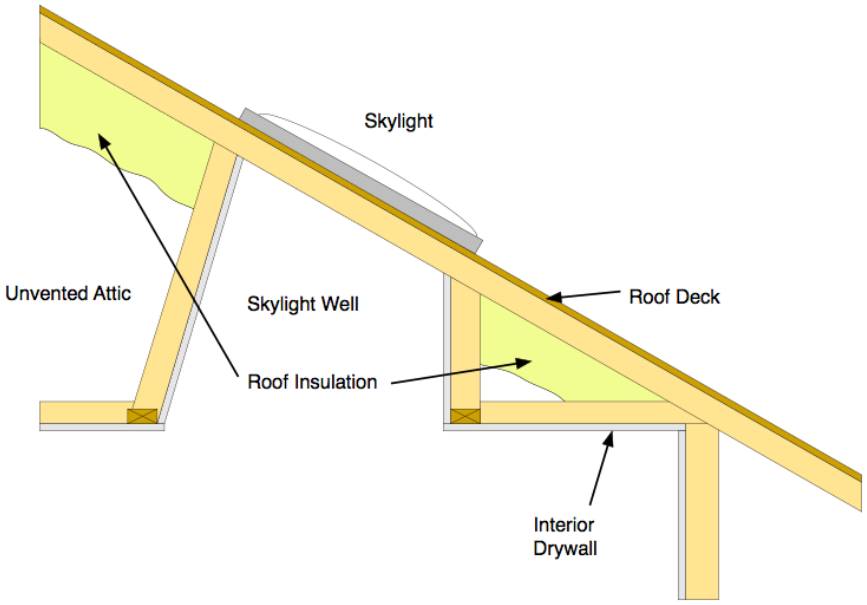
- **The exposed attic side of insulation shall be completely covered with rigid board insulation or an air barrier.**

- The house side of the insulation shall be in contact with the drywall or other wall finish.
- The insulation shall be supported so that it will not fall down by either friction fitting to the framing, inset or face stapling of flanges, or using other support such as netting.



- Insulation for all kneewall and skylight shafts shall be completely enclosed by vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.

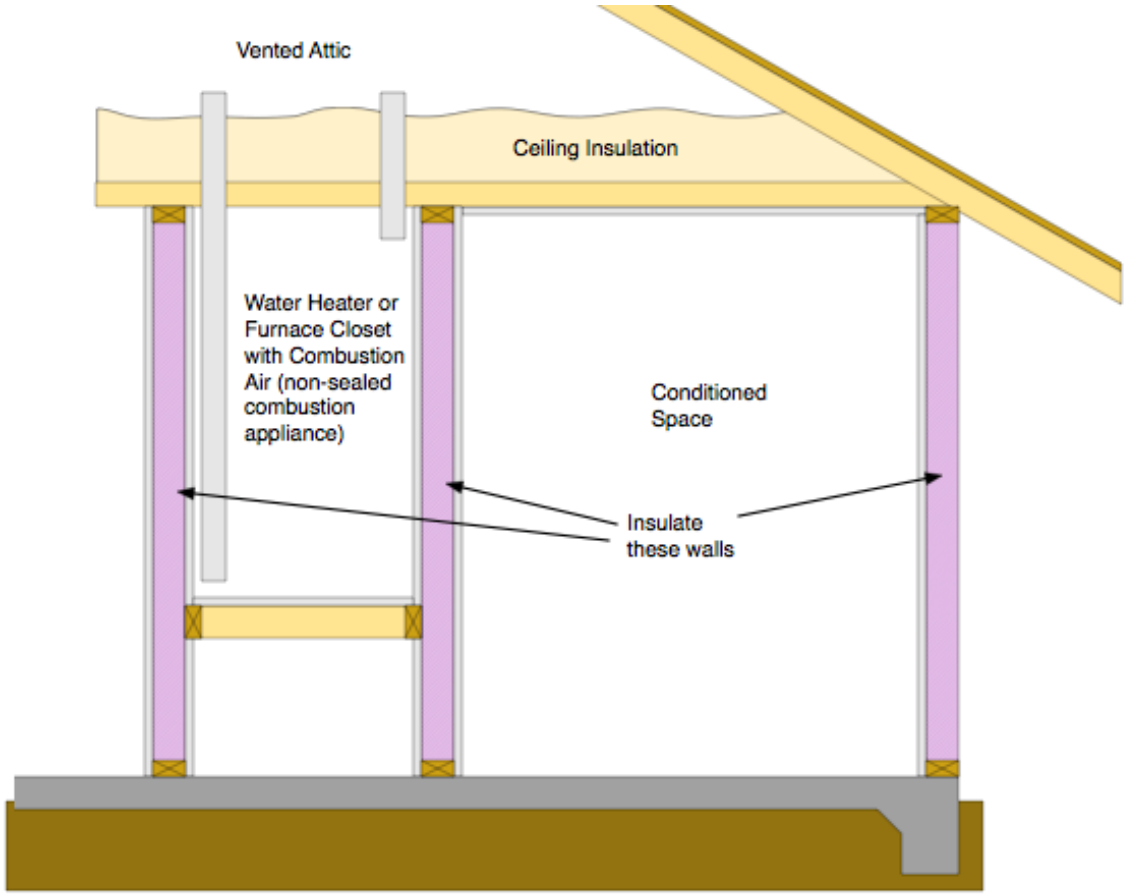
- In unvented (conditioned) attics, where insulation is applied directly to the underside of the roof deck, kneewalls, skylight shafts, and gable ends shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation (only where they separate conditioned and unconditioned space).



HVAC/Plumbing Closet (see RA3.5.X.2.6)

- Walls of interior closets for HVAC and/or water heating equipment, which require combustion air venting, shall be insulated to the same R-value as the exterior walls as specified in compliance documentation. The fact that these closets exchange air freely with unconditioned space (attic or crawlspace) makes them
- also unconditioned space. They, therefore, must be insulated wherever they are adjacent to conditioned space.

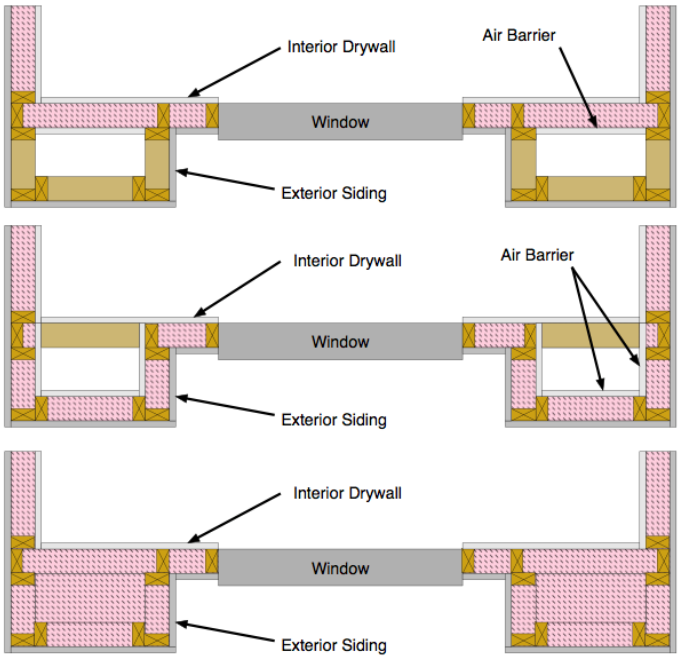
- Sealed combustion furnaces and water heaters with combustion air piped in via PVC pipe need not be installed in a closet that is vented. Similarly for heat pump fan coil units, electric water heaters, hydronic fan coils, and other appliances that do not burn gas. Unvented closets need not be insulated.



Double Walls and Framed Bump-Outs (see RA3.5.X.2.7)

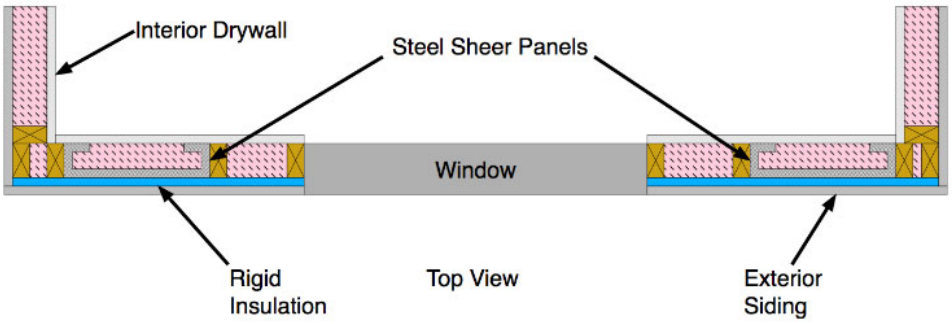
- Insulation shall fill the entire cavity; or, an additional air barrier shall be installed inside the double wall or bump-out and in contact with the insulation so that the insulation fills the cavity formed with the additional air barrier.

- Entire double walls and framed bump-outs shall be air-tight.



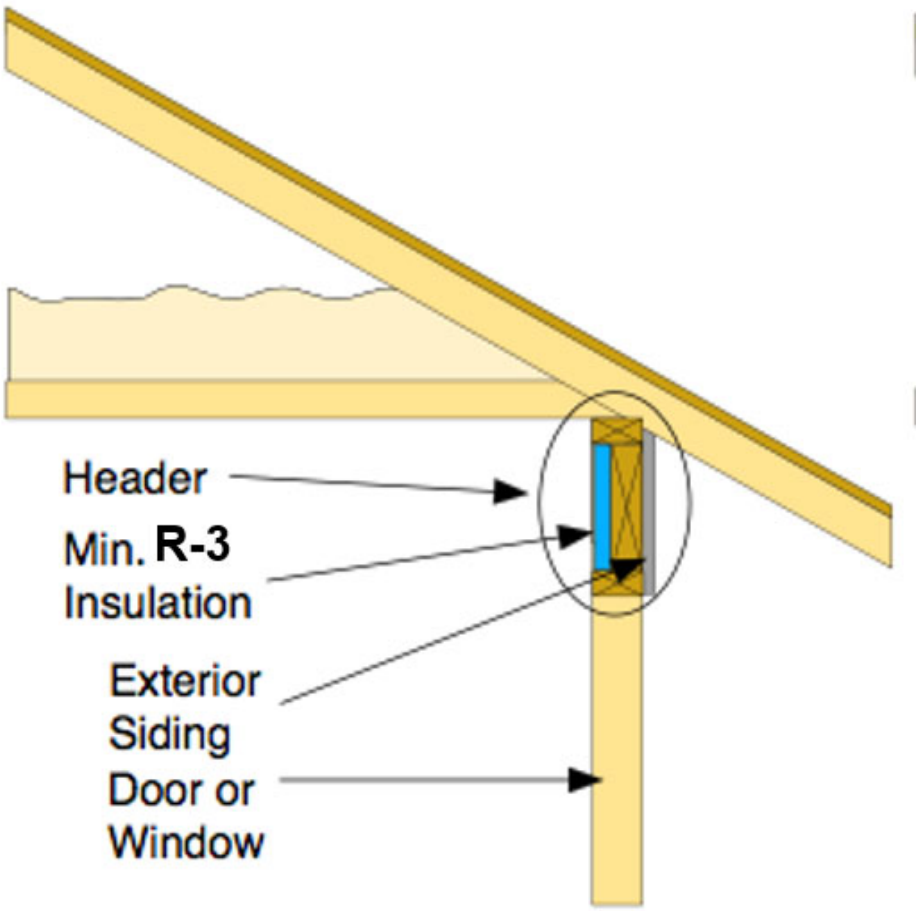
Structural Bracing, Tie-downs, Steel Structural Framing (see RA3.5.X.2.8)

- Framing and bracing used for structural purposes shall be identified on plan documents with diagrams and/or design drawings.
- Insulation shall be installed in a manner that restricts thermal bridging through the structural framing assembly.
- Insulation shall be applied to fully enclose and/or adhere to all sides and ends of structural assembly framing that separate conditioned from unconditioned space.
- The structural portions of assemblies shall be air-tight.



Special Situations--Window and Door Headers (see RA3.5.X.2.9)

- All window and door headers shall be insulated to a minimum of R-3 between the exterior face of the header and inside surface of the finish wall material.
- Insulation must be installed on the interior side of the header to facilitate verification.
- If exterior rigid sheathing is installed on the entire wall, headers do not need to be inslated.

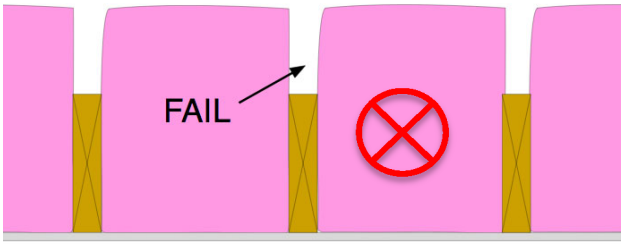


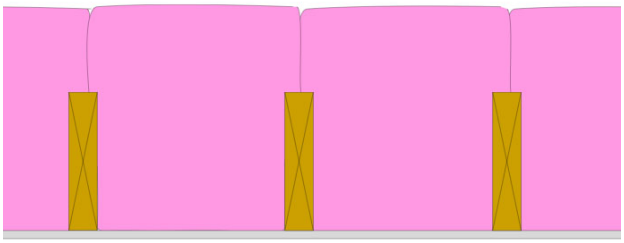
Insulated Header

Specific Requirements for **Roof/Ceilings** (see RA3.5.3.3)

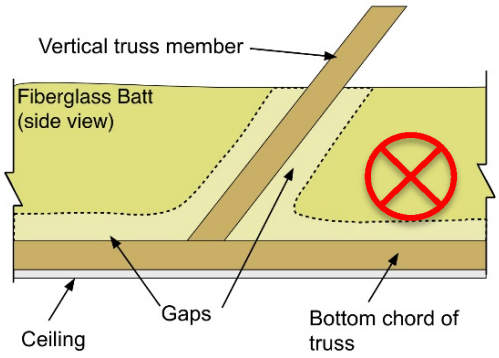
Roof Ceilings: **Batt and Blanket**

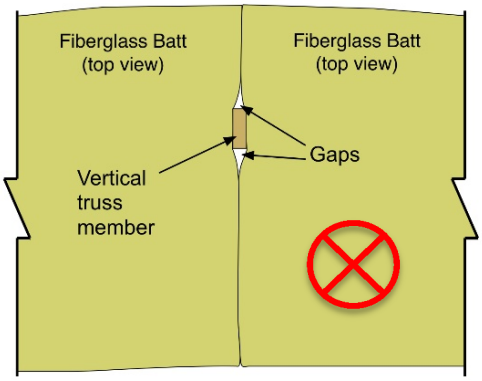
- Batt and blanket insulation shall be correctly sized to fit snugly at the sides and ends.
- Batt and blanket insulation shall be installed to be in contact with the air barrier.
- Where necessary, batt and blanket insulation shall be cut to fit properly - there shall be no gaps, nor shall the insulation be doubled-over or compressed.
- When batt and blanket insulation are cut to fit a non-standard cavity, they shall be snuggly fitted to fill the cavity without compression.
- Batt and blanket insulation shall be cut to butt-fit around wiring and plumbing, or be split (delaminated) so that one layer can fit behind the wiring or plumbing, and one layer fit in front.
- Batt and blanket insulation that is thicker
- than rafter depth shall be installed so that the insulation expands to touch adjoining cavity over each rafter.
- Baffles shall be placed at eaves or soffit vents of vented attics to keep insulation from blocking eave ventilation and prevent air movement under the insulation. The required net free-ventilation shall be maintained.





Note: It has been determined that it is virtually impossible to meet the QII requirements with **batts** in an attic ceiling with common roof **trusses** due to the gaps caused by the vertical truss cords.





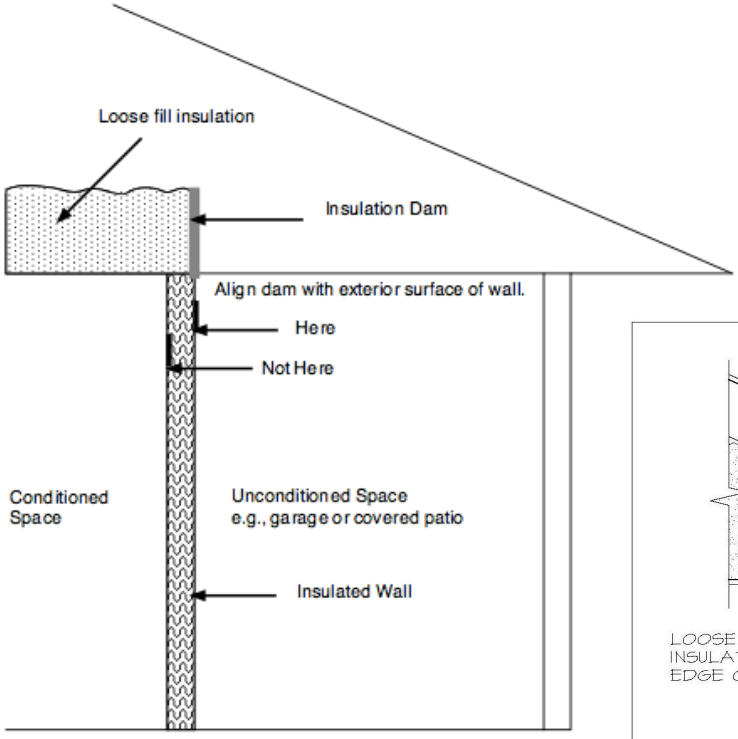
Roof Ceilings: **Loose Fill**

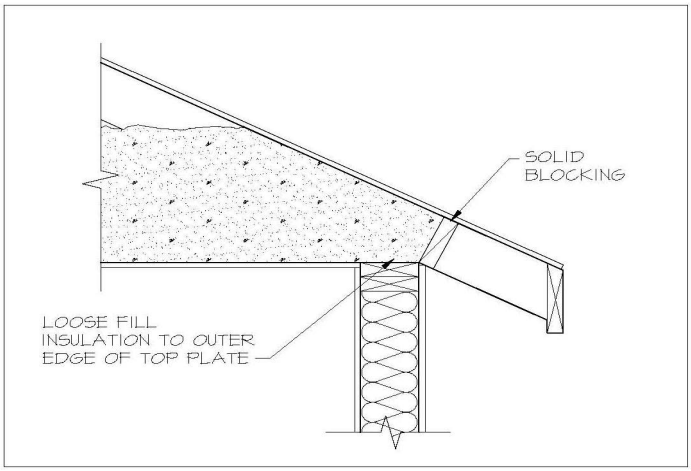
- Attic rulers appropriate to the material shall be installed and evenly distributed throughout the attic to verify depth: one ruler for every 250 square feet and clearly readable from the attic access. (*Note: The intent of this requirement is to make it as easy as possible for depth to be verified by the HERS Rater and building inspector. If rulers are not clearly visible from the attic access due to architectural constraints, work with the inspector and HERS Rater to come up with an alternative.)* Attic rulers shall be scaled to read inches of insulation and the R-value installed. *(Note that attic rulers are specific to each brand and type of installation and may not be interchanged.)*

- Insulation shall be applied underneath and on both sides of obstructions such as cross-bracing and wiring.
- Insulation shall be kept away from combustion appliance flues in accordance with flue manufacturer's installation instructions or labels on the flue.
- Insulation shall be blown to a uniform thickness throughout the attic with all areas meeting or exceeding the insulation manufacturer's minimum requirements for **depth and weight-per-square-foot**.

- The installer shall certify on the Certificate of Installation (CF2R) forms that the manufacturer's minimum weight per- square-foot requirement has been met.
- The HERS Rater shall verify that the manufacturer's minimum weight-per-square-foot requirement has been met for attics insulated with loose-fill insulation. *See "Cookie Cutter Test".*
- The HERS Rater shall verify that the manufacturer's minimum insulation thickness has been installed.

- Loose fill insulation shall be applied all the way to the outer edge of the exterior wall's top plate. *(Note: This may require an insulation dam where the attic extends over unconditioned space.)*

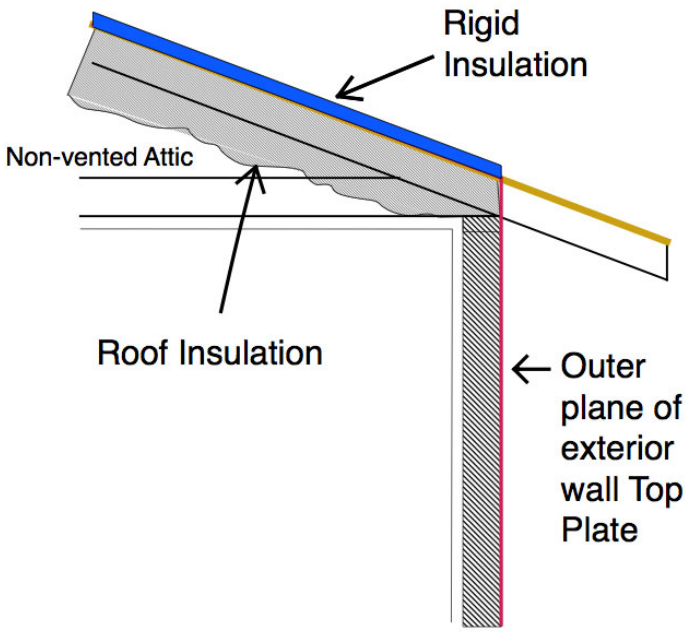




- Because cellulose insulation is relatively dense and settles over time, this verification shall take into account the time that has elapsed since the insulation was installed. Refer to insulation manufacturer's specifications related to settling.

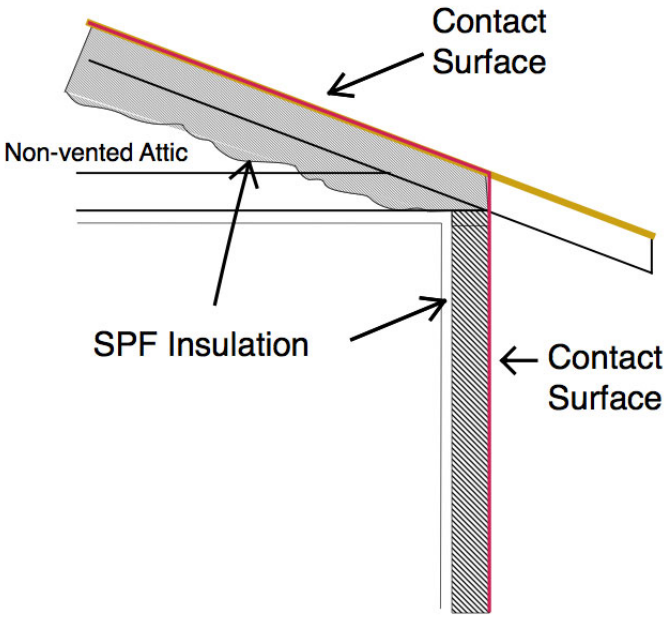
Roof Ceilings: **Rigid**

- Rigid board insulation installed above the roof deck shall be applied (so that it extends) to the outer edge of the plane of the wall top plate.



Roof Ceilings: **SPF**

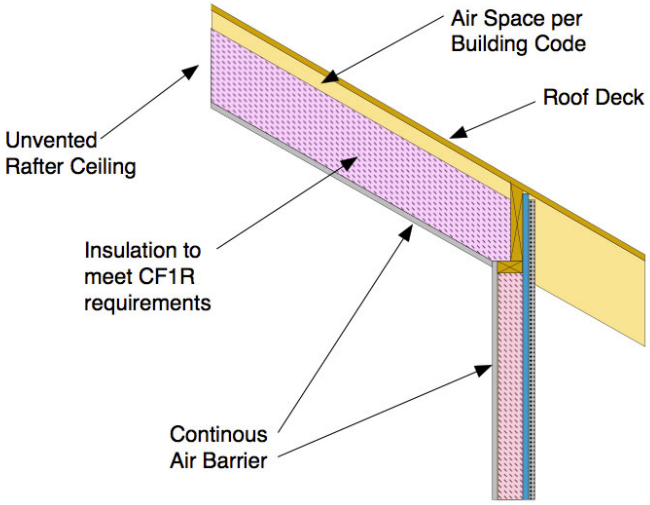
- SPF insulation shall be applied to fully adhere to the substrate of the ceiling or roof deck.
- SPF insulation shall be applied to fully adhere to the joist and other framing faces to form a complete air seal within the construction cavity.

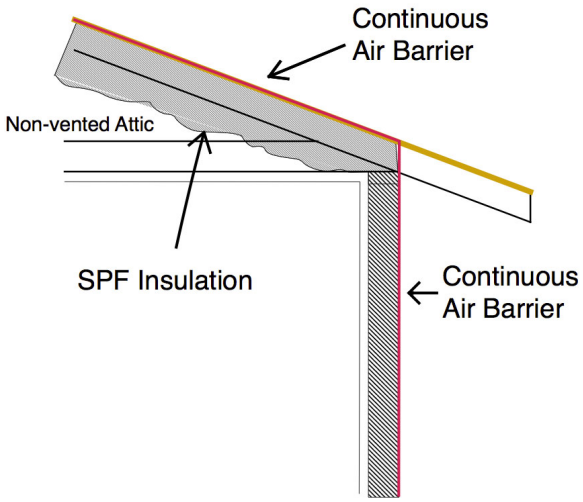


Roof Ceilings: **Special Situations**

Enclosed Rafter Ceilings (see RA3.5.X.3.1)

- An air space shall be maintained between the insulation and roof sheathing per California Building Code, Sections 1203.2 and R806.3, or as specified by the local building department.
- Facings and insulation shall be kept away from combustion appliance flues in accordance with flue manufacturers' installation instructions or labels on the flue.
- Insulation installed in unvented rafter ceilings or to the underside of unvented roofs with an attic below shall have an R-value conforming to compliance documentation and the air barrier shall be uniform across the transition of roof to wall. The insulation shall be in contact with the air barrier.
- SPF insulation installed in unvented rafter ceilings or to the underside of unvented roofs with an attic below shall have an R-value conforming to compliance documentation and the air barrier shall be uniform across the transition of roof to wall. The insulation shall be in contact with the air barrier.

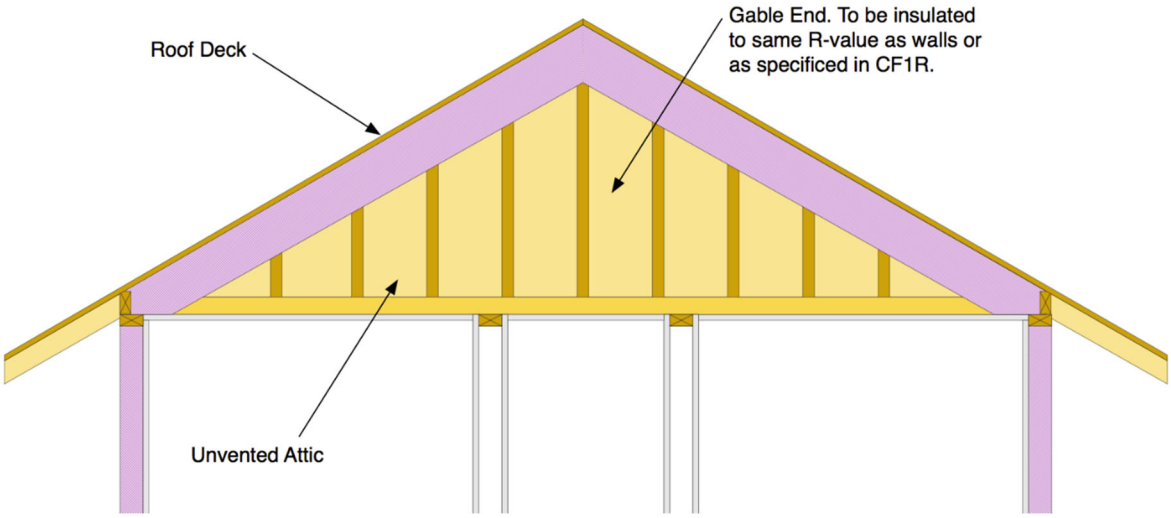




Attics and Cathedral Ceilings (see RA3.5.X.3.2)

- In unvented attics, where insulation is applied directly to the underside of the roof deck, all gable ends shall be insulated to the same R-value as the exterior walls as specified in the compliance documentation.

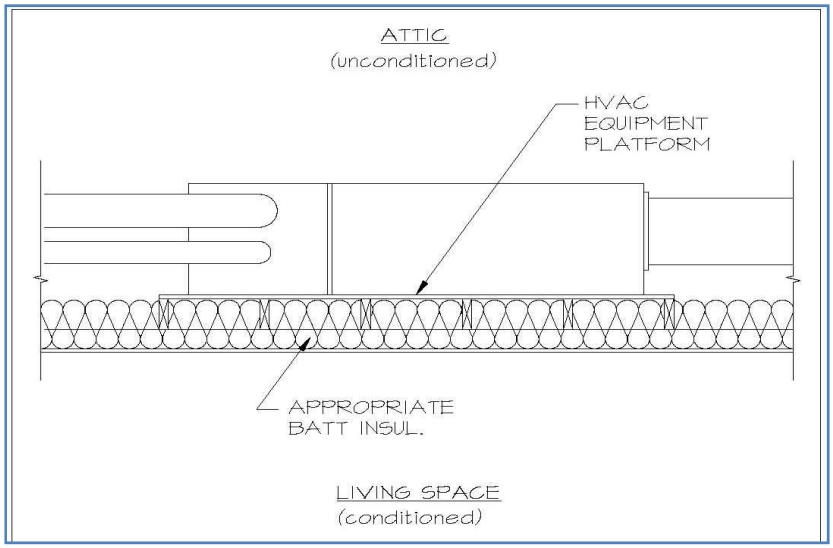
- In attics where entry is made for the service of utilities, SPF shall be protected from ignition in accordance with CBC, Part 2, Section 2603, and Part 2.5, Section R316 or the SPF assembly must have been tested in accordance with ICC Evaluation Service Acceptance Criteria AC377. (b).



HVAC Platform (see RA3.5.X.3.3)

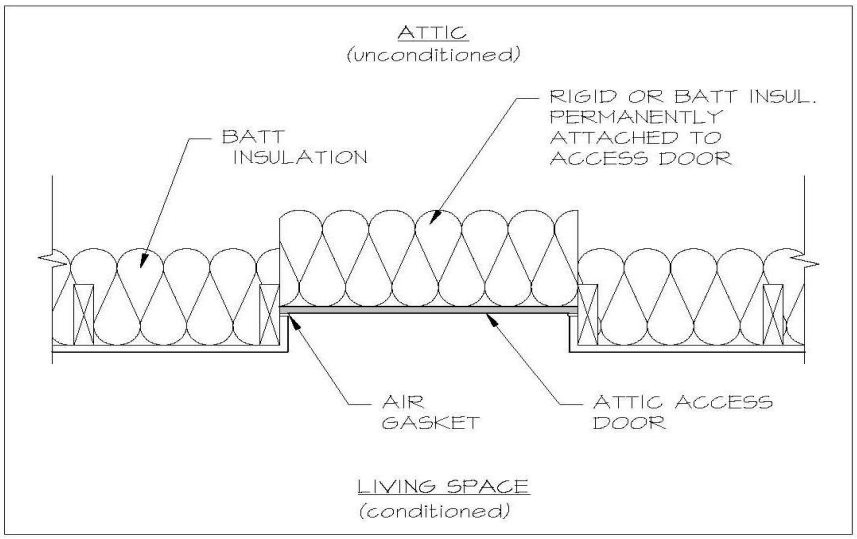
It is very common for HVAC equipment to be located in the attic, directly above conditioned space. The mechanical code requires easy access to the equipment, this is usually accomplished by building a flat platform out of plywood or OSB. A typical platform size for a single furnace is about 5' x 10'. If it is not near the attic access code also requires a 3' wide "catwalk". The platform and catwalk are usually supported by a reinforced bottom cord of the roof trusses and are often only 6-8" above the ceiling sheetrock. This means that they may interfere with the ceiling insulation. If so, the area under the platform and catwalk needs to be modeled as having a lower R-value than the rest of the ceiling. This will be shown in the Opaque Surfaces section of the CF1R-PRF-01.

- Batt and blanket insulation shall be placed below any platform or cat-walk for HVAC equipment installation and access. (assuming vented attic)
- Batt and blanket insulation shall be installed so that they will be in contact with the air barrier.
- If SPF is used, a minimum of 3 inches of ccSPF insulation or 5.3 inches of ocSPF shall be placed below any platform or cat-walk access ways installed in vented attics for HVAC equipment or other needs.
- The overall assembly R-value shall meet the required R-values specified in the compliance documentation.
- Note: If the platform is taller than the required height of the insulation, it does not need to be in contact with the insulation. The platform is not intended to be an air barrier.



Attic Access (see RA3.5.X.3.4)

- Permanently attach rigid board insulation or batt or blanket insulation with the appropriate R-value to the access door using adhesive or mechanical fastener.
- The bottom of the attic access shall be gasketed to prevent air leakage of conditioned air to the unconditioned attic.
- A minimum of 3 inches of ccSPF or 5.3 inches of ocSPF insulation shall be applied to the access door assuring good adhesion to the door surface.
- Alternatively, permanently attach rigid foam or batt insulation with adhesive or mechanical fastener.
- The overall assembly R-value shall meet the required values specified in the compliance documentation.
- Note: For loose fill insulation, an insulation dam may be required to keep insulation from falling into the access hole and maintaining the minimum insulation depth. Insulation should not be tapered near the access.

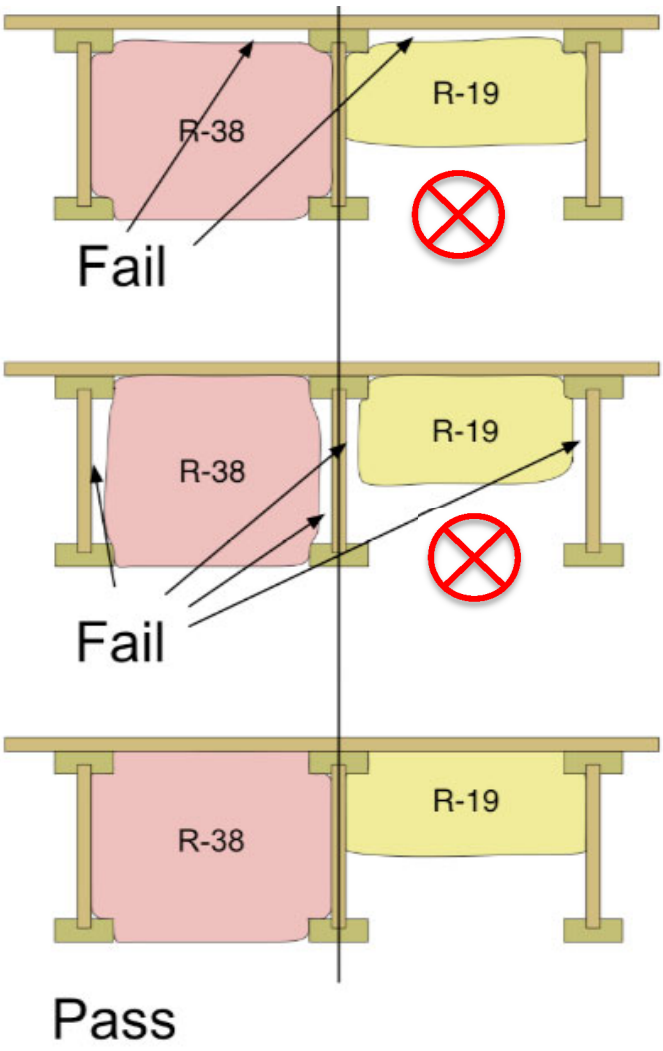


Attic access cover insulated with fiberglass batt. Notice the straps holding insulation in place.

Specific Requirements for **Raised Floors** (see RA3.5.X.4)

- Batt and blanket insulation shall be correctly sized to fit snugly at the sides and ends.
- Batt and blanket insulation shall be cut to fit properly without gaps.
- Insulation shall not be doubled-over or compressed.
- Batt and blanket insulation shall be in contact with the air barrier - usually the subfloor.
- SPF insulation shall be spray-applied to fully adhere to the bottom side of the floor sheathing.

Note: "TJI" floor joists pose a particular problem for batt insulation. Make sure that the batts are in contact with the subfloor and are full width batts so that they expand into the side pockets created by the I-beam shape of the joists.



Homes with Conditioned Space Over Garage (see RA3.5.X.4.2)

- The floor over the garage shall be insulated with batt or blanket insulation against the subfloor of the conditioned space.
- The garage and the adjacent conditioned space (house) shall be insulated up to the subfloor.
- All rim and band joists adjoining conditioned space shall be air tight and insulated.

SPF:

- The floor over the garage shall be insulated by spraying SPF insulation to fully adhere to the subfloor of the conditioned space.
- The garage and the adjacent conditioned space (house) shall be insulated up to the subfloor.
- SPF insulation shall cover any gaps between the header and the floor joist.

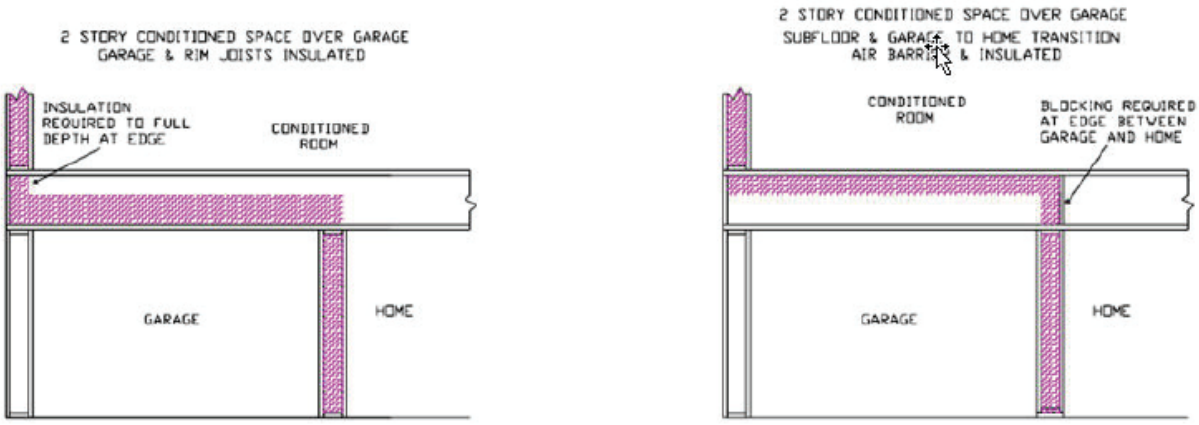
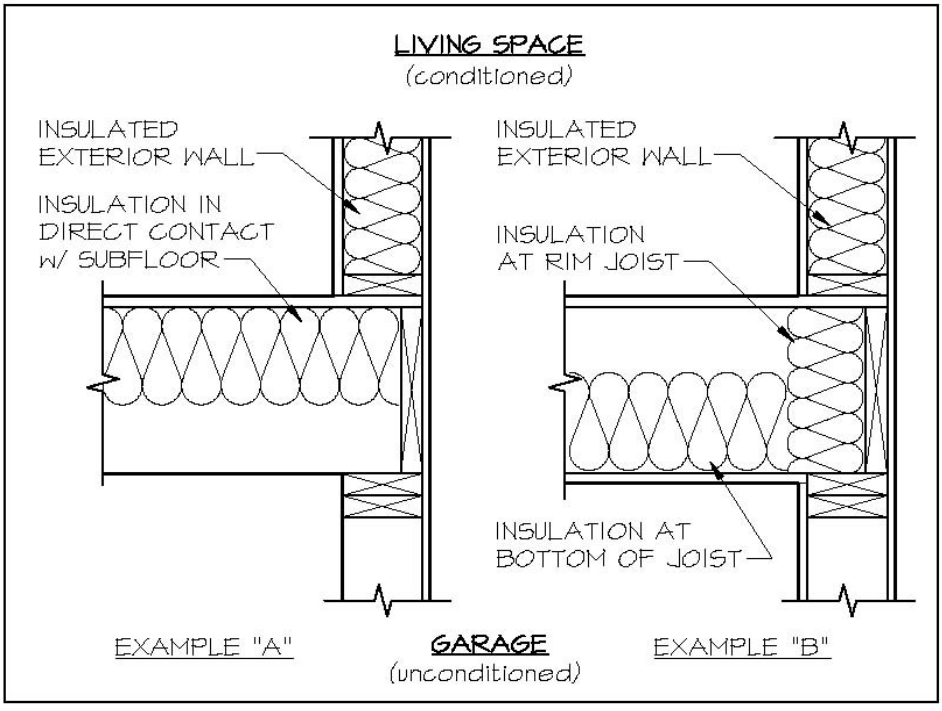


Figure RA3.5-1 Homes with Conditioned Space Over Garage – Batt and Blanket Insulation



Homes with Unconditioned Space Over Garage (see RA3.5.X.4.3)

- The band joist where the garage transitions to an attic above conditioned space shall have an air barrier installed in contact with the edge of the attic insulation.

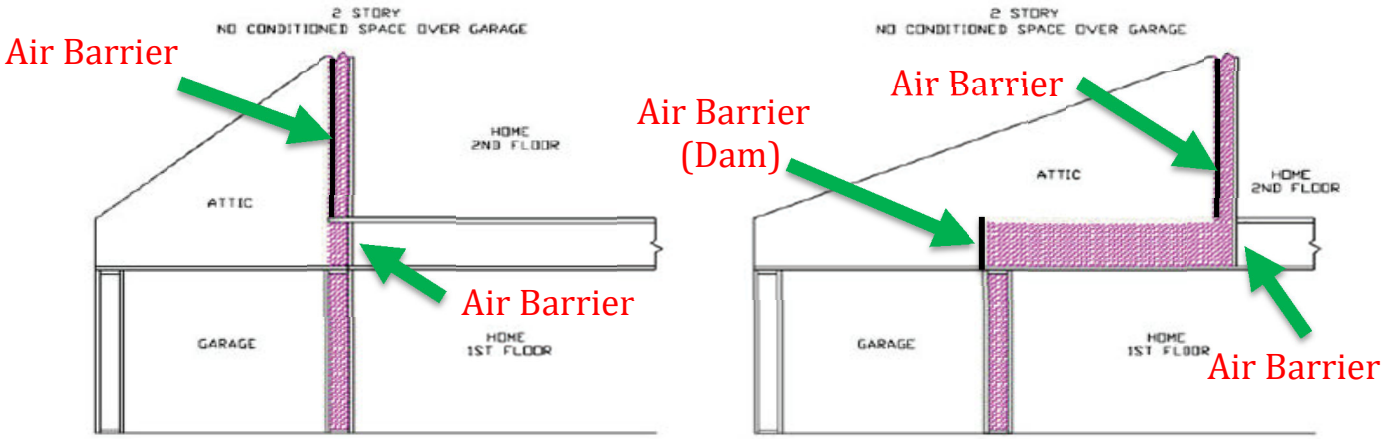


Figure RA3.5-2 Homes with No Conditioned Space Over Garage – Batt and Blanket Insulation

The “Cookie Cutter” Test

- The HERS Rater shall verify that the manufacturer's minimum weight-per-square-foot requirement has been met for attics insulated with loose-fill mineral-fiber insulation (not cellulose). Verification shall be determined using the methods of the Insulation Contractor’s Association of America (ICAA) Technical Bulletin #17 except that only one sample shall be taken in the area that appears to have the least amount of insulation. The Rater shall record the weight-per-square-foot of the sample on the Certificate of Field Verification (CF-3R) and Diagnostic Testing.

  Instructions:
  Carefully work the cookie cutter down into the insulation until it sits squarely on the ceiling drywall.

  Remove all the insulation and stuff it into a plastic bag.

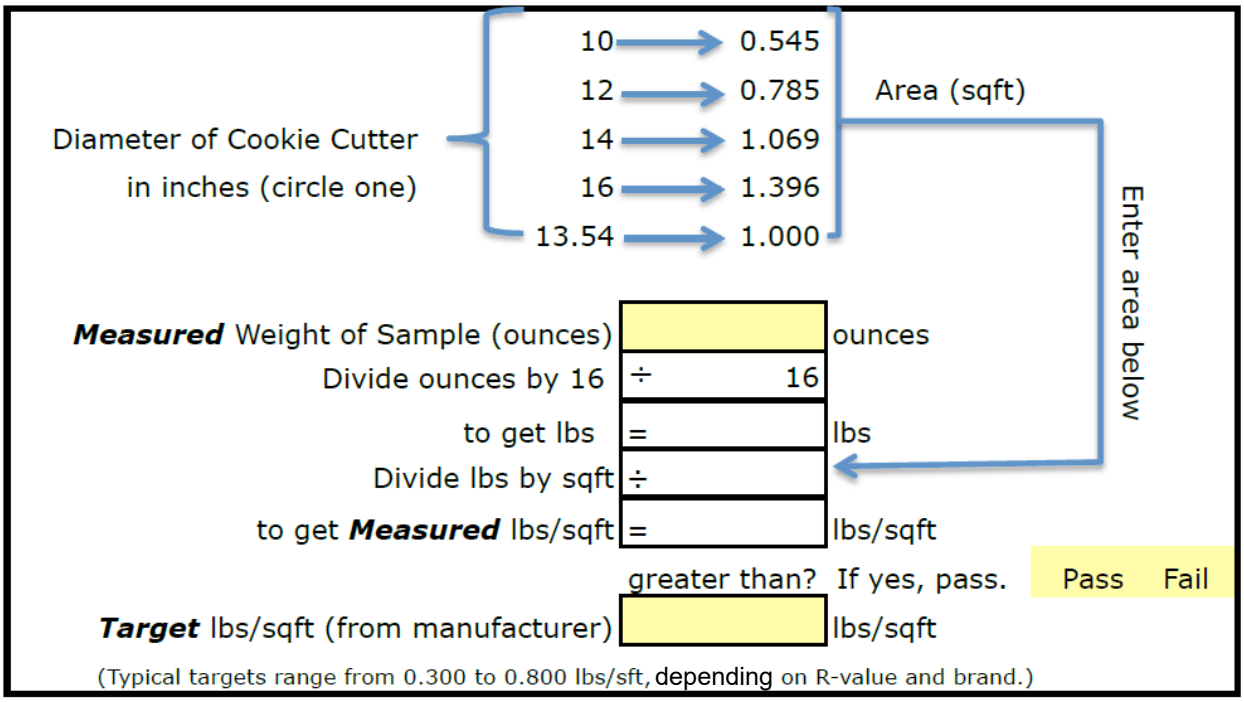
  Weigh the bag.

  Divide weight of bag in pounds by the area of the cookie cutter in square feet.

  The final value must be greater than the target from the CF2R-ENV-01.

  Replace the insulation and fluff it back up as best as you can.

Calculation Worksheet for "Cookie Cutter" Test



The QII Checklists

The HERS Rater will perform their QII inspections with the help of CF3R checklists. The CF2R forms used by the installers no longer have these checklist items. It is very important that the installer know exactly what the Rater will be looking for. For that reason, we have created these QII checklists. Each item on the checklist is cross referenced with a section of this document for additional detail.

QII Checklist

ENV-21

A. Air Infiltration and Insulation Installation (QII) – Framing Stage

01 The requirements below cover the required air sealing and installation of insulation that must occur in the framing stage.

02 An air barrier is required in all thermal envelope assemblies to limit air movement between unconditioned/outside spaces and conditioned/inside spaces and must meet one of the following:

1. Using individual materials that have an air permeance not exceeding 0.004 cfm/ft_2 under pressure differential of 0.3 in w.g. (1.57 psf) (0.02 L/s.m_2 at 75 pa) when tested in accordance with ASTM E2178; or a list of example materials meeting the air permeance testing performance levels of 1 above is available in RA3.5.2.
2. Using assemblies of materials and components that have an average air leakage not to exceed 0.04 cfm/ft_2 under a pressure differential of 0.3 in w.g. (1.57 psf) (0.2 L/s.m_2 at 75 pa) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680 or ASTM E283; or
3. Testing the complete building and demonstrating that the air leakage rate of the building envelope does not exceed 0.4 cfm/ft_2 at a pressure differential of 0.3 in w.g. (1.57 psf) (2.0 L/s.m_2 at 75 pa) in accordance with ASTM E779 or an equivalent approved method.

B. Raised Floor Air Barrier

01 All gaps in the raised floor are sealed.

02 All chases sealed at floor level using a hard cover and the hard cover is sealed.

03 All plumbing and electrical wires that penetrate the floor are sealed.

04 Subfloor sheathing is glued or sealed at all exterior panel edges to create a continuous air tight subfloor.

C. Walls/Knee Wall Air Barrier

01 All penetrations through the exterior wall air barrier are sealed to provide an air-tight envelope to unconditioned spaces such as the outdoors, attic, garage, and crawl space.

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 using the appropriate sealing method.

06 All gaps around windows and doors are sealed. The sealant used follows window manufacturer specifications.

07 Rim joists gaps/openings are fully sealed.

08 Fan exhaust ducts that run between conditioned floors to exterior walls including damper at the exterior wall.

09 Metal tie downs are insulated between exterior framing and tie down.

10 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 lath.

11 Insulation is installed behind tub, shower, or fireplace enclosures, and exterior stairwells to the R-value listed on the CF1R when located against exterior walls. Insulation is installed before tub, shower, and fireplace are installed.

12 A solid air barrier is installed, from floor to ceiling, on the inside of exterior walls directly adjacent to tub, shower, or fireplace enclosures. Insulation shall contact all six sides of the air barrier on exterior walls.

13 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. Insulation is to be placed between the interior face of the header and inside surface of the interior wall finish. If continuous exterior rigid insulation is used an insulated header is not required.

14 Knee walls have solid and sealed blocking at the bottom, top, left and right sides.

D. Ceiling/Attic Air Barrier

01 For vented attics much of the ceiling air barrier is verified after the ceiling drywall is installed using the ENV-22.

02 For unvented attics ensure all penetrations through the roof deck and gable ends are sealed and airtight.

03 All eave/soffits vents are covered with a rigid ventilation baffle that maintains the net free ventilation area.

04 All dropped ceilings are covered with hard covers and sealed to framing.

05 All chases are covered with hard covers and sealed to framing.

06 Where HVAC ducts travel down a chase, the chase is sealed at the ceiling level.

07 Chimneys and flues require sheet metal flashing. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.

08 All eave/soffit baffles are installed to stop air movement around the baffle and into insulation. Net free-ventilation of the eave/soffit shall be maintained.

09 Double walls that open to the attic are covered with an air barrier and cover has an air tight seal to the framing.

E. Conditioned Space Above or Adjacent to Garage Air Barrier

01 All penetrations in the subfloor above the garage into conditioned space must follow the raised floor air barrier requirements above.

02 Infiltration between the space above the garage and subfloor is prevented by one of the following methods:

- Seal all edges of the garage ceiling (typically drywall) at the perimeter of the garage to create a continuous air tight surface between the garage and adjacent conditioned envelope. Seal all plumbing, electrical, and mechanical penetrations between the garage and adjacent conditioned space. For an open-web truss, airtight blocking is added on four sides of the garage perimeter. Insulation can be placed on the garage ceiling.
- Seal the band joist above the wall at the garage to conditioned space transition. Seal all subfloor seams and penetrations between the garage and adjacent conditioned space. Insulation must be placed in contact with the subfloor below the conditioned space.

F. Walls for Attached Porch, Attic, Double Wall Air Barrier

01 All walls that separate conditioned and unconditioned space include a continuous air barrier on the interior and exterior wall.

02 An exterior wall air barrier is required at the intersection of the porch and exterior wall when there is conditioned space on the other side. The exterior wall includes an air barrier where the attic attaches to the conditioned space.

03 Truss framing blocking is used at the top and bottom of each wall/roof section.

G. Cantilevered Floor Air Barrier

01 Airtight blocking is installed between joists where the wall rim joist would have been located in the absence of a cantilever.

02 Exterior sheathing is installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R-value as would be required for the subfloor prior to closing.

03 Any gaps, cracks or penetrations in the air barrier of the cantilever are sealed. Can lights in the cantilever are IC and AT rated and properly sealed to sheathing.

H. Multifamily Air Barrier

01 Multifamily buildings must meet all air sealing requirements for single family buildings listed above.

02 Each dwelling unit must be air sealed to stop air movement from one unit to another.

03 Floor AND Ceiling of each dwelling unit – all penetrations through the floor and ceiling of each unit are sealed, including electric and gas utilities, water pipes, drain pipes, fire protection service pipes, and communication wiring.

04 Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatch, and plumbing stacks are all sealed to reduce air transfer from attached spaces.

05 Common Walls – the bottom plate between units is sealed to the subfloor. All penetrations in the common walls are sealed, including electrical boxes, wiring, and plumbing penetrations. Perpendicular interior walls that open into the common walls are sealed.

06 Vertical Chases for garbage chutes, elevator shafts, and HVAC ducting plumbing must be sealed to the floor and ceiling of each unit to stop air movement up and around the chase due to stack effect.

07 Vertical chases such as garbage chutes, elevator shafts, HVAC ducting, plumbing, wiring, etc. must be sealed to stop air movement through the chase to the surrounding spaces.

08 Common hallways – penetrations between dwelling units and common hallways are sealed, including doors to dwelling units which shall be gasketed or made substantially airtight.

ENV-22

- ✓ *For typical vented attics where the insulation is at the roof deck/ceiling, the air barrier must be verified after the ceiling drywall is installed and before attic insulation is installed.*
- ✓ *If spray polyurethane foam (SPF) will be used in the attic, this can be considered the air barrier.*
- ✓ *Soffits and chases must be covered, and chimneys and flues require metal flashing.*
- ✓ *For buildings with unvented (conditioned) attics, all air sealing requirements appropriate for the roof must be verified.*

A. Ceiling Inspection – Vented Attics

(Refer to the definition of a continuous air barrier, air tight, draft stops, hard covers, and the sections “The Importance of Defining the Thermal Boundary” and “Special Requirements for Sealing Against Air Movement” in the CalCERTS QII Handbook.)

01 There is a continuous air barrier at the ceiling level. All openings into walls, drops, chases, or double walls are sealed.

02 Chimneys and flues require sheet metal flashing. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.
03 All penetrations through the top plate of interior and exterior walls are sealed.
04 Electrical boxes, fire alarm boxes, and fire sprinklers cut into ceilings are sealed to the surrounding drywall. If it is not possible to seal the fixture directly, a secondary air barrier shall be created around the fixture.
05 All installed recessed light fixtures that penetrate the ceiling to unconditioned space are rated to be Insulation Contact and Airtight (IC and AT) which allows direct contact with insulation. The housing is sealed to the drywall.
06 Exhaust fan housing is sealed to the surrounding drywall and all holes and seams in the housing are sealed.
07 All soffits and chases are covered with a hard cover that is sealed to the framing with caulk or foam.
08 Double walls that open to the attic are covered and the cover is sealed to the framing.
09 Attic access forms an airtight seal between conditioned space and unconditioned space. Vertical attic access requires mechanical compression using screws or latches.
10 Knee walls require solid and sealed blocking at the bottom, top, left, and right sides.
When the knee wall is placed on top of a subfloor the open cavity between the subfloor and the ceiling below is sealed.
11 Where HVAC ducts travel down a chase, the chase is sealed at the ceiling level.
12 HVAC boots that penetrate the ceiling are sealed to the surrounding drywall.
13 All top plates of interior and exterior walls are sealed to drywall.
14 Attic access must be surrounded with a dam at least the same depth as the insulation to prevent loss of ceiling insulation.
15 There must be a dam placed at the exterior edge of all knee walls and at all edges of insulation to stop air movement through the insulation.

B. Roof Inspection – Unvented attics

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 for plumbing, electrical, etc. in the roof deck and gable ends are sealed.

ENV-23

A. Quality Insulation Installation (QII) Preparation for Insulation

01 Air barrier installation and preparation for insulation was done and verified at framing stage prior to insulation being installed. Where applicable, CF3R-ENV21 and 22 compliance documents have been signed off.
02 All structural framing areas shall be insulated in a manner that resists thermal bridging of the assembly separating conditioned from unconditioned space. Structural bracing, tie-downs, and framing of steel, or specialized framing used to meet structural requirements of the CBC are allowed and must be insulated. These areas shall be called out on the building plans with diagrams and/or specific design drawings indicating the R-value of insulation and fastening method to be used. It is recommended that spray foam be used.
03 All insulation was installed to the manufactures insulation installation instructions.

B. Quality of All Installed Insulation

01 Installed insulation R-values are the same or greater than specified on the CF1R.
02 No gaps or voids between the insulation and framing.
03 Gaps between studs shall be filled with insulation.
04 Batt - ensure the ends are cut so there are no gaps.
05 Batt - insulation is cut around obstructions like electrical boxes and no gaps exist.
06 Batt - insulation is not compressed (no stuffing of the insulation into the cavity).
07 Batt insulation is delaminated around all plumbing and electrical lines in ceilings, walls and floors.
08 An air barrier is installed at all exposed edge faces of batt, loose fill and SFP insulation.
09 Loose-fill insulation installed to the minimum installed weight per ft^2 per the manufacturer's labeled R-value specification.
10 SPF insulation shall be spray-applied to fully adhere to structural assembly framing, floor and ceiling joists, and other framing surfaces within the construction cavity.
11 SPF - with multiple layers applied, each foam lift (i.e. spray application) adheres to the substrate and foam interfaces.
12 SPF - if values other than R-5.8 per inch for closed-cell SPF (ccSPF) and R-3.6 per inch for open-cell SFP (ocSPF) are used, the ICC Evaluation Service Report (ESR) number (e.g. ESR-xxxx) will be documented on the CF2R-ENV-03.
13 ccSPF - in areas where an air barrier is required the foam is at least 2 inches thick.
14 ocSPF depressions in the foam insulation surface are not greater than 1-inch of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.
15 ocSPF insulation completely fills cavities of 2x4 inch framing or less.

16 ocSPF cavities greater than 2x4 inch framing are filled to the thickness that meets the required R-value used for compliance.
17 SPF installed as an air barrier is sprayed at a minimum of 5.5 inches in thickness for open cell and 2.0 inches for closed cell.
18 The insulation installer provided a CF2R-ENV-03. Labels or specification/data sheets are attached to the CF2R-ENV-03 for each insulating material. The material datasheet for the installed material meets the performance specifications of the required R-Values. Blown in material also includes insulation material bag labels or coverage charts.

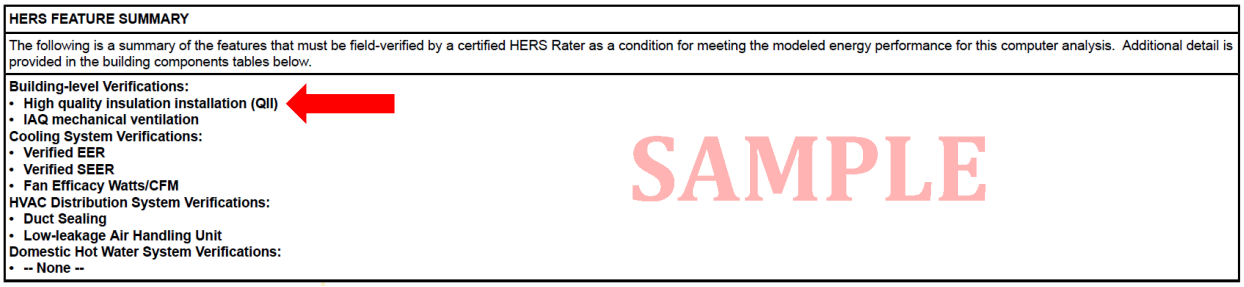
C. Ceiling/Roof Insulation

01 Insulation extends to the outside edge of the exterior top plates and is flush against any ventilation dams/baffles.
02 Insulation is in direct contact with ceiling so there are no gaps between the ceiling and the insulation.
03 Chimneys and flues (except for zero clearance) require sheet metal collar around the stack. The collar must be at least as tall as the depth of the insulation. The collar shall be 1" from the chimney/flue for double wall vent, and 6" from the chimney/flue for single wall vent" unless manufacturer requires otherwise. The collar must be sealed to the ceiling with high temperature sealant to prevent air leakage. The insulation is in contact with the sheet metal collar.
04 Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent is maintained
05 Eave vent baffles are installed to prevent air movement under, or into, the ceiling insulation.
06 Recessed downlights are covered with insulation, if not using SPF. If they are not covered to the same depth as required by the CF1R for ceiling insulation then an area weighted calculation is required. Recessed downlights are AT and IC rated.
07 SPF insulation shall not be applied directly to recessed lighting fixtures. Recessed downlights where SPF insulation is installed shall:
(a) be covered with a minimum of 1.5 inches of mineral fiber insulation, or
(b) be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8 inch hard board or gypboard. Hard board or gypboard do not cause a recessed downlights to meet the zero clearance insulation contact requirements.
08 Walkways and mechanical platforms are insulated to the same R-value as required by the CF1R for ceiling insulation. If not an area weighted calculation is completed and turned in with this compliance document.
09 Soffits, chasses, drops have a sealed hard cover and the insulation is in direct contact with the hard cover.
10 Knee walls – an air dam the full depth of the ceiling insulation is added to the exterior edge of the knee wall so the ceiling insulation overlaps the knee wall to the full depth of the ceiling insulation.
11 Attic access doors are insulated to the same R-value required by the CF1R for roof insulation and the insulation is permanently attached using adhesive or mechanical fasteners. Preferred method is rigid insulation.
12 Attic access forms airtight seal from conditioned space to unconditioned space. Vertical attic access requires mechanical compression using screws, or latches.
13 Attic access must have a dam around the access to at least the same depth as the insulation.
14 Insulation batts must be cut to fit around cross bracings and truss webs.
15 Attic rulers appropriate to the material are installed and evenly distributed throughout the attic to verify Depth (one ruler for every 250 ft_2) The rulers are clearly readable from the attic access and scaled to read inches of insulation and the R-value installed.
16 Loose-fill and SPF insulation - a HERS Rater shall measure the installed thickness (include low and high areas) and density of insulation in at least 6 random locations on walls, roof/ceilings and floors to ensure minimum thickness levels and the installed density meets the R-value specified on the Certificate of Compliance, and are consistent with the manufacturer's coverage chart.
17 Steel-framed kneewalls, skylight shafts, and gable ends, external surfaces of steel studs are covered with insulation

How to Read the Insulation Requirements on a CF1R-PRF-01

The CF1R-PRF-01-E (CF1R) lists the energy features required to meet the Title 24 Energy Code. It will include areas and orientations of all the surfaces of the home that impact the home's energy use: windows, skylights walls, doors, floors, ceilings, attics and roof. Different walls with different thermal properties (2x4 walls with R-15 vs 2x6 walls with R-21) will be modeled differently. The following steps will help you determine the minimum insulation required in all of the surfaces.

1. **Make sure the CF1R is registered.**
    a. It should have a CalCERTS logo watermark (a light image of the CalCERTS logo behind the text of the document on every page).
    b. It should also have a certificate number at the bottom of each page of the format 217-X#########X-###-###-#######-####" where "#" is a numeral and "X" is a letter.
2. **Make sure the CF1R is current.**
    a. Contact the "Responsible Designer" who signed the last page.
    b. Confirm with them that the registration date/time at the bottom of each page is the most current and that it is the one you should be bidding from. Ask if the project is participating in any above-code requirements. It is possible that the requirements might be different.
3. **Confirm details in "General Information Section"** – first section on first page.
4. **Determine if QII is required**.
    a. Find the "HERS Feature Summary" section, usually near the top of the second or third page.
    b. Look for the statement "• **High quality insulation installation (QII)**". If it is on the list, QII is required.



HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the building components tables below.

Building-level Verifications:
- **High quality insulation installation (QII)**
- **IAQ mechanical ventilation**

Cooling System Verifications:
- **Verified EER**
- **Verified SEER**
- **Fan Efficacy Watts/CFM**

HVAC Distribution System Verifications:
- **Duct Sealing**
- **Low-leakage Air Handling Unit**

Domestic Hot Water System Verifications:
- **-- None --**

    c. If QII is required,
        i. Evaluate plans very carefully. Look for unclear parts of thermal boundary. (knee walls, hard covers, bump outs, fire places, etc.) These are common causes of fails.
        ii. Define responsibilities for trades. (air barriers, blocking, attic vents, sealing around fans, electrical boxes, insulated headers, etc.)
        iii. Contact the HERS Rater for the project as soon as possible. Ask them for checklists, other informational materials.
        iv. Meet at project early to discuss details of the QII requirements.
        v. Learn to use CalCERTS registry.

5. **Find the "Opaque Surfaces" section**. This will show the walls, floors, and ceilings.
    a. Column 01 is the name of each surface being modeled. This is just a text field and has no impact on the simulation. Do not trust names like "R-15 Wall". The actual R-value needs to be verified in the "Opaque Surfaces Construction" section.
    b. Column 02 is the name of the "zone" that the surface is adjacent to. If it shows two zones, such as "Main Conditioned Space>>>Garage", this means that the surface separates these two zones. Even though the garage may have been modeled, it is not conditioned space and it would be very unusual to require insulation in the exterior walls of the garage. The surfaces that just say "garage" can usually be ignored.
    c. Column 03 is a construction assembly name that references a later section in the CF1R, "Opaque Surface Constructions" where there will be a detailed description of the construction of the surface (discussed below).
    d. Column 04 is the azimuth (direction) of the surface. 0=north, 90=east, 180=south, 270=west.
    e. Column 05 describes the side of the house that the surface is on.
    f. Column 06 is the gross area of the surface (includes windows and doors).
    g. Column 07 is the window and door area in that surface. Subtract column 07 from column 06 to get the net surface area (the area to be insulated). If any of these numbers deviate from your take-offs using the plans, you should contact the "Documentation Author" who signed the last page of the CF1R.
    h. Column 08 is the tilt of the surface. 0=horizontal, 90=vertical.

OPAQUE SURFACES							
01	02	03	04	05	06	07	08
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft^2)	Window & Door Area (ft^2)	Tilt (deg)
Front Wall 1	Main Conditioned Space	Construction Assembly 3	0	Front	160	60	90
Left Wall	Main Conditioned Space	Construction Assembly 3	90	Left	472	78	90
Back Wall 1	Main Conditioned Space				450	175	90
Right Wall 1	Main Conditioned Space				612	83.5	90
Front Interior Wall	Main Conditioned Space>>Garage				290	21.5	
Left Interior Wall 1	Main Conditioned Space>>Garage				137	0	
Ceiling (below attic) 1	Main Conditioned Space				2600		
Front Exterior Wall 1	Garage	Construction Assembly 7	0	Front	290	168	90
Left Exterior Wall 1	Garage	Construction Assembly 7	90	Left	185	21.5	90
Ceiling (below attic) 2	Garage	Construction Assembly 8			636		

6. **Find the "Attic" section**. This will tell you if the attic is ventilated or not and if ventilated, whether it is a "high performance attic (HPA)" or not. HPAs are ventilated attics with insulation at the attic floor (ceiling of house) **and** either above or below the roof deck.
    a. Column 01 is the Attic surface name. This is just a text field. Do not trust any R-values shown in the name. They should be confirmed in the "Opaque Surfaces Construction" section.
    b. Column 02 is a construction assembly name that references a later section in the CF1R, "Opaque Surface Constructions" where there will be a detailed description of the construction of the surface (discussed below).
    c. Column 03 will tell you if it is ventilated or not.

d. Columns 04-08 describe the roof and any cool roof products or radiant barrier.

ATTIC							
01	02	03	04	05	06	07	08
Name	Construction	Type	Roof Rise	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof
Attic	Construction Assembly 5	Ventilated	5			No	No

7. **Find the "Opaque Surface Constructions" section**. This is where the details of the construction assemblies can be found.
   a. Column 01 are the construction assembly names that were referenced in column 03 of the Opaque Surfaces section and column 02 of the Attic section. Again, names are always just text fields typed in by the documentation author. Do not trust R-values that appear in this column.
   b. Column 02 is the surface type
   c. Column 03 is the construction type.
   d. Column 04 describes the framing of the surface.
   e. Column 05 describes the R-value of the insulation installed in the surface cavity (between framing members).
   f. Column 06 describes the overall assembly U-factor. This is actually the most important number in terms of performance and compliance. It accounts for the entire assembly. If the U-factor is not met, it doesn't matter what R-value is installed.
   g. Column 07 describes the assembly layers. Look for insulation called "continuous" or "sheathing". This will be things like R-4 rigid polystyrene insulation installed on the exterior of the framing for 1-coat stucco systems.

OPAQUE SURFACE CONSTRUCTIONS						
01	02	03	04	05	06	07
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Winter Design U-value	Assembly Layers
Construction Assembly 2	Ceilings (below attic)	Wood Framed Ceiling	2x4 Bottom Chord of Truss @ 24 in. O.C.	R 38	0.025	• *Inside Finish: Gypsum Board* • *Cavity / Frame: R-9.1 / 2x4 Btm Chrd* • *Over Ceiling Joists: R-28.9 insul.*
Construction Assembly 3	Exterior Walls	Wood Framed Wall	2x6 @ 24 in. O.C.	R 24	0.045	• *Inside Finish: Gypsum Board* • *Cavity / Frame: R-24 / 2x6* • *Sheathing / Insulation: Wood Siding/sheathing/decking* • *Exterior Finish: R4 Synthetic Stucco*
Construction Assembly 5	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.478	• *Inside Finish: Gypsum Board* • *Cavity / Frame: no insul. / 2x4 Top Chrd* • *Roof Deck: Wood Siding/sheathing/decking* • *Roofing: 10 PSF (RoofTile)*
Construction Assembly 6	Interior Walls	Wood Fr			0.058	• *Inside Finish: Gypsum Board* • *Cavity / Frame: R-24 / 2x6* • *Other Side Finish: Gypsum Board*
Construction Assembly 7	Exterior Walls	Wood Fr			0.361	• *Inside Finish: Gypsum Board* • *Cavity / Frame: no insul. / 2x4* • *Exterior Finish: 3 Coat Stucco*
Construction Assembly 8	Ceilings (below attic)	Wood Fra			0.481	• *Inside Finish: Gypsum Board* • *Cavity / Frame: no insul. / 2x4 Btm Chrd*

8. **Find the "Slab Floor" section.** Check column 05 of the for slab edge insulation. It's not very common, but if it's modeled, it must be installed.
9. **The "Building Envelope – HERS Verification Section" will reiterate that QII is required**.

Blank Page

CalCERTS, Inc.
31 Natoma Street, suite 120
Folsom
CA 95630

916-985-3400
field@calcerts.com

QII Process by Construction Phase

	Predesign **1**	Design **2**	Design Review **3**	Grading **4**	Framing **5**	Rough-In **6**	Insulation **7**	Drywall **8**	Finish **9**	Final Inspection **10**
Energy Consultant **A**	Specifies QII	Kickoff Meeting	Register CF1R, assign Rater in registry							
Builder/ Architect **B**	Approves, selects Rater	Kickoff Meeting	Sign CF1R							Provide all documents to occupant
HERS Rater **C**		Kickoff Meeting Explain QII	Work out sampling details (if any)	Coordinate with trades off site	Coordinate with trades on site	ENV-21 inspections	ENV-22 inspections	ENV-23 inspections	Finish CF3Rs in registry	
Insulation Installer **D**		Kickoff Meeting		Acknowledges QII requirements	Understands QII requirements	Pre-insulate ENV-21	Install batt and other insulation ENV-22	Loose fill ceiling insulation ENV-23	Finish CF2Rs	
Framer **E**		Kickoff Meeting			Frame continuous air barrier					
Drywall Installer **F**		Kickoff Meeting						install and seal drywall		
Misc Trades **G**		Kickoff Meeting			Hard covers and draft stops	Caulk and seal ENV-21		Caulk and seal		
	1	2	3	4	5	6	7	8	9	10

A1 Energy Consultant (EC) determines that QII is required to meet T-24 Energy Code.

B1 Builder/Architect (B/A) approves CF1R with QII, acknowledges challenges and additional costs.

A2-G2 All parties attend kickoff meeting. HERS rater is given opportunity to explain QII and cover items in Kickoff Meeting QII checklists.

A3 EC registers CF1R in CalCERTS registry, signs as "Documentation Author", assigns rater, and transfers project to rater.

B3 B/A signs CF1R in registry as "Responsible Designer". Agrees to notify all trades of CF1R requirements. Specifies special QII requirements in contract with Insulation subcontractor, framer and all other affected trades. Determines sampling details with Rater.

C3 Rater to propose sampling approach, details to B/A and trades. Set up sampling in registry.

C4 Rater to coordinate QII details with affected trades, especially if sampling. Make sure they all have user access to registry.

D4 Insulation installer to review and understand QII requirements (Handbook, etc.)

C5 Rater meets affected trades at a framed house to work out details.

E5 Framer to install framing according to plans and CF1R, paying special attention to continuous air barrier requirements.

G5 Responsible trade to install hard covers and draft stops

C6 Rater to complete ENV-21 checklist after D6 and G6 are completed.

D6 Insulation contractor to pre-insulate all cavities that might get covered up (exterior wall channels, behind tub and shower enclosures, etc. Complete appropriate parts of the CF2R-ENV-21

G6 Responsible trade to caulk and seal all framing penetrations, sign CF2R-ENV-21 in registry when complete

C7 Rater to complete ENV-22 checklist after D7 is complete

D7 Insulation contractor to install all insulation (except loose fill ceiling insulation) according to QII protocols. Complete and sign CF2R-ENV-03 and CF2R-ENV-21 in registry when complete.

C8 Rater to complete ENV-23 checklist after D8, F8, and G8 are complete.

D8 After F8, installation and sealing of drywall, Insulation contractor to install loose fill ceiling insulation according to QII protocols. Complete and sign CF2R-ENV-23 in registry when complete.

F8 Drywall contractor to install drywall and caulk and seal all penetrations according to QII protocols.

G8 Responsible trade to caulk and seal all remaining penetrations in drywall (register boots, ceiling fans, sprinklers, etc.).

C9 Rater to finalize all CF3R forms in registry.

D9 Insulation contractor to finalize all CF2R forms in registry.

B10 Builder to make sure all trades have completed their CF2R forms (ALL Green Dots) and provide documentation packet to homeowner upon final inspection (can be done electronically).

ABBREVIATION LIST

&	AND
L	ANGLE
@	AT
℄	CENTERLINE
ø	DIAMETER
#	POUND
ℙ	PROPERTY LINE
AFF	ABOVE FINISH FLOOR
ACC	ACCESSIBLE
ADDL	ADDITIONAL
ADJ	ADJACENT
A/C	AIR CONDITIONING
ALT	ALTERNATE
ALUM	ALUMINUM
AB	ANCHOR BOLT
APPROX	APPROXIMATE
ARCH	ARCHITECT(URAL)
AC	ASPHALTIC CONCRETE
BM	BEAM
BET	BETWEEN
BLKG	BLOCKING
BD	BOARD
BOT	BOTTOM
BUR	BUILD UP ROOFING
BLDG	BUILDING
CAB	CABINET
CBC	CALIFORNIA BUILDING CODE
CLG	CEILING
CEM	CEMENT
CTR	CENTER
CER	CERAMIC
CO	CLEAN OUT
CLR	CLEAR
COMP	COMPOSITION
CONC	CONCRETE
CMU	CONCRETE MASONRY UNIT
CONST	CONSTRUCTION
CONT	CONTINUOUS
CJ	CONTROL JOINT
COORD	COORDINATE
CG	CORNER GUARD
DEMO	DEMOLITION
DEPT	DEPARTMENT
DET	DETAIL
DIAG	DIAGONAL
DIM	DIMENSION
DISP	DISPENSER
DSA	DIV. OF STATE ARCH.
DF-L	DOUGLAS FIR
DBL	DOUBLE
DS	DOWNSPOUT
DWR	DRAWER
DNG(S)	DRAWING(S)
DF	DRINKING FOUNTAIN
EA	EACH
EF	EACH FACE
ES	EACH SIDE
E	EAST
EP	EDGE OF PAVEMENT
ELEC	ELECTRICAL
ENL	ENLARGED
ELEV	ELEVATOR
ENGR	ENGINEER
EQ	EQUAL
EQUIP	EQUIPMENT
ETC	ETCETERA
(E)	EXISTING
EXP	EXPANSION
EJ	EXPANSION JOINT
EXT	EXTERIOR
FOB	FACE OF BLOCK
FOC	FACE OF CONCRETE
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUD
FS	FAR SIDE
FRP	FIBERGLASS REINFORCED PANEL
FIN	FINISH
FF	FINISH FLOOR
FE	FIRE EXTINGUISHER
FEC	FIRE EXTINGUISHER CABINET
FPRF	FIREPROOFING
FR	FIRE RATING
FHMS	FLAT HEAD MACHINE SCREW
FHWS	FLAT HEAD WOOD SCREW
FLR	FLOOR
FD	FLOOR DRAIN
FS	FLOOR SINK
FT	FOOT OR FEET
FTG	FOOTING
FDN	FOUNDATION
FUT	FUTURE
GA	GAUGE
GALV	GALVANIZED
GI	GALVANIZED IRON
GL	GLASS
GLB	GLUED LAMINATED BEAM
GB	GRAB BAR
GR	GRADE
GND	GROUND
GYP	GYPSUM
HDWD	HARDWOOD
HD	HEAD
HDR	HEADER
HVAC	HEATING/ VENTILATING/ AIR CONDITIONING
HT	HEIGHT
HC	HOLLOW CORE
HM	HOLLOW METAL
HORIZ	HORIZONTAL
HB	HOSE BIB
INCAND	INCANDESCENT
IN	INCH
INCL	INCLUDE
ID	INSIDE DIMENSION/ DIAMETER
INSUL	INSULATION
INT	INTERIOR
ICBO	INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS
JAN	JANITOR
JT	JOINT
JST	JOIST
LAB	LABORATORY
LAM	LAMINATED
LAV	LAVATORY
MB	MACHINE BOLT
MH	MANHOLE
MANUF	MANUFACTURER
MATL	MATERIAL
MAX	MAXIMUM
MECH	MECHANICAL
MC	MEDICINE CABINET
MTL	METAL
MEZZ	MEZZANINE
MIN	MINIMUM
MR	MIRROR
MISC	MISCELLANEOUS
NS	NEAR SIDE
(N)	NEW
NOM	NOMINAL
N	NORTH
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
NO	NUMBER
O.C.	ON CENTER
OPNG	OPENING
OPP	OPPOSITE
ORIG	ORIGINAL
OD	OUTSIDE DIMENSION/ DIAMETER
O/	OVER
O/O	OVER AND OUT
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED, OWNER INSTALLED
PR	PAIR
PTD	PAPER TOWEL DISPENSER
PTR	PAPER TOWEL RECEPTACLE
PART	PARTIAL
PRTN	PARTITION
PERF	PERFORATED
PA	PLANTED AREA
PLAS	PLASTER
PLASLAM	PLASTIC LAMINATE
PL	PLATE
PLBG	PLUMBING
PLYWD	PLYWOOD
POC	POINT OF CONNECTION
PVC	POLYVINYL CHLORIDE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PREFAB	PREFABRICATED
PREFIN	PREFINISHED
PT	PRESSURE TREATED
PROJ	PROJECTION
PL	PROPERTY LINE
QT	QUARRY TILE
R	RADIUS
REC	RECESSED
REDWD	REDWOOD
REF	REFERENCE/REFER
RFG	REFRIGERATOR
REINF	REINFORCED (ING) (MENT)
REQ'D	REQUIRED
RET	RETAINING
RTN	RETURN
REV	REVISION
ROW	RIGHT OF WAY
RM	ROOM
RD	ROOF DRAIN
RO	ROUGH OPENING
RHWD	ROUND HEAD WOOD SCREW
RR	REST ROOM
SND	SANITARY NAPKIN DISPENSER
SNR	SANITARY NAPKIN RECEPTOR
SSMH	SANITARY SEWER MANHOLE
SCHED	SCHEDULE
SCD	SEAT COVER DISPENSER
SECT	SECTION
SPTD/NR	SERIES PAPER TOWEL DISPENSER/ WASTE RECEPTACLE
STSC/TTD	SERIES TOILET SEAT COVER/ TOILET TISSUE DISPENSER
SHTG	SHEATHING
SHT	SHEET
SM	SHEET METAL
SMS	SHEET METAL SCREW
SIM	SIMILAR
SOG	SLAB ON GRADE
SD	SOAP DISPENSER
SC	SOLID CORE
S	SOUTH
SPEC(S)	SPECIFICATION(S)
SB	SPLASH BLOCK
SQ	SQUARE
SF	SQUARE FOOT/ FEET
SY	SQUARE YARD
SS	STAINLESS STEEL OR SANITARY SEWER
STD	STANDARD
STL	STEEL
STOR	STORAGE
ST	STREET
STR	STRUCTURAL
SUSP	SUSPENDED
SYM	SYMMETRICAL
TEL	TELEPHONE
TEMP	TEMPERED
THK	THICK(NESS)
TPH	TOILET PAPER HOLDER
T&G	TONGUE AND GROVE
T&B	TOP AND BOTTOM
TC	TOP OF CONCRETE/ CURB
TOD	TOP OF DECK
TOF	TOP OF FOOTING
TOJ	TOP OF JOIST
TOP	TOP OF PARAPET
TOS	TOP OF SHEATHING
TOSL	TOP OF SLAB
TOS	TOP OF STEEL
TOW	TOP OF WALL
TOPO	TOPOGRAPHIC
TB	TOWEL BAR
T	TREAD/ TOILET
TYP	TYPICAL
UG	UNDERGROUND
UNFIN	UNFINISHED
UBC	UNIFORM BUILDING CODE
U.O.N.	UNLESS OTHERWISE NOTED
UR	URINAL
UTL	UTILITY
VIF	VERIFY IN FIELD
VERT	VERTICAL
VCT	VINYL COMPOSITION TILE
VWC	VINYL WALL COVERING
WC	WATER CLOSET
WH	WATER HEATER
WR	WATER RESISTANT
WTRP	WATERPROOF
WP	WEATHERPROOF
WT	WEIGHT
W	WEST/ WASTE/ WATER
WDW	WINDOW
WG	WIRE GLASS
W/	WITH
W/O	WITHOUT
WD	WOOD
WS	WOOD SCREW

BUILDING INFORMATION

OWNER:
JOSEPH SAMPLE
P.O. BOX 555
STOCKTON, CA 95201

SITE:
15555 JACKSON RD.
STOCKTON, CA

PROJECT SCOPE:

SINGLE FAMILY RESIDENCE

OCCUPANCY GROUP:	R3/U1
OCCUPANCY CATEGORY:	II
SITE ELEVATION:	<2000'
GROUND SNOW LOAD:	20#/SF
ROOF LOAD:	LL=20#/SF DL=10#/SF
FLOOR LOAD:	LL=40#/SF DL=10#/SF
WIND SPEED:	85MPH
SOILS SITE CLASSIFICATION:	D (ASUMED)
SEISMIC DESIGN CATAGORY:	C

BUILDING CALCULATIONS

MAIN FLOOR	1751 S.F.
GARAGE	576 S.F.
PORCH	217 S.F.
DECK	333 S.F.

GENERAL NOTES

GENERAL NOTES:
1. ALL WORK SHALL CONFORM TO MINIMUM STANDARDS OF THE 2016 EDITION OF THE CBC, CMC, CPC, CEC, CFC, CALIFORNIA TITLE-24, AND LOCAL ORDINANCES AND MUNICIPAL CODE.

2. ALL WORK DESCRIBED IN THE DRAWINGS SHALL BE VERIFIED FOR DIMENSION, GRADE, EXTENT, AND COMPATIBILITY TO THE EXISTING SITE. ANY DISCREPANCIES AND UNEXPECTED CONDITIONS THAT AFFECT OR CHANGE THE WORK DESCRIBED IN THE DOCUMENTS SHALL BE BROUGHT TO THE DESIGNERS AND ENGINEERS ATTENTION IMMEDIATLY. DO NOT PROCEED WITH THE WORK IN THE AREA OF DISGREPANCIES UNTIL ALL SUCH DISCREPANCIES ARE RESOLVED. IF THE CONTRACTOR CHOOSES TO DO SO, HE SHALL BE PROCEEDING AT HIS OWN RISK.

3. DIMENSIONS SHOWN SHALL TAKE PRECEDENCE OVER DRAWING SCALE OR PROPORTION. LARGER SCALE DRAWINGS SHALL TAKE PRECEDENCE OVER SMALLLER SCALE DRAWINGS.

4. ALL GRADES ADJACENT TO BUILDINGS SHALL SLOPE AWAY FROM THE BUILDING AT 5% SLOPE FOR A MIN. DISTANCE OF 10 FEET.

5. WATER DRAINAGE IS OF EXTREME CONCERN DURING AND AFTER CONSTRUCTION. IT SHALL BE THE CONTRACTORS RESPONSABILITY TO TAKE PRECAUTIONARY STEPS TOWARD PREVENTING THE INTRUSION OF WATER IN AND UNDER THE BUILDING SITE. THE INSTALLATION OF DRAIN PIPES AND/OR SURFACE DRAINAGE MAY BE REQUIRED IN PREVENTING WATER INTRUSION. ALL DRAIN PIPES SHALL BE PROPERLY INSTALLED SO THAT WATER IS DIVERTED AROUND THE SITE AND SHALL EXTEND TO DAYLIGHT.

SYMBOLS

DETAIL REF / SHEET REF

SECTION REF / SHEET REF

INTERIOR ELEVATIONS

REFERENCE NORTH

REVISION 8 OF REVISIONS

WALL TYPES LABEL

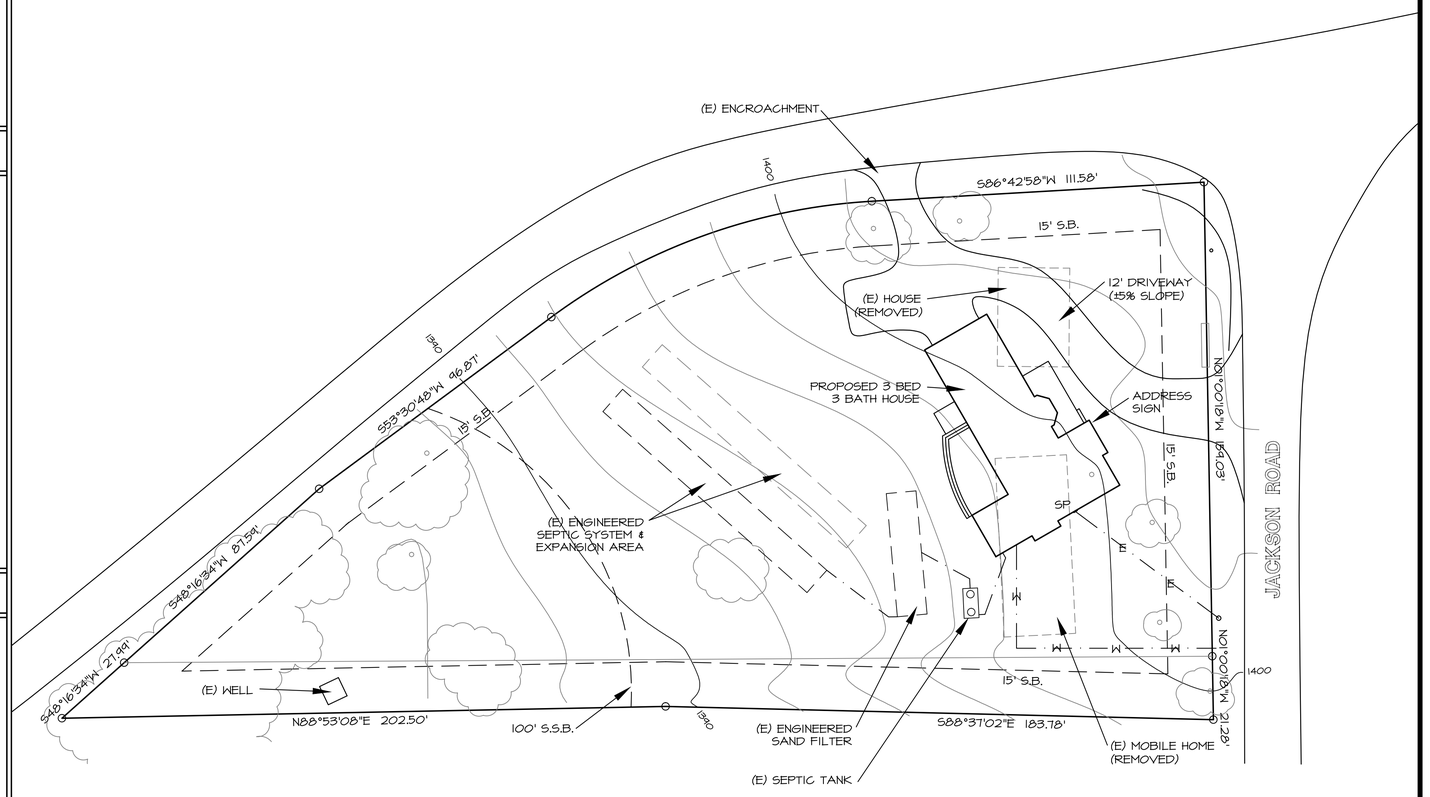
±0" ELEVATION LEVEL LABEL

SHEET INDEX

1	COVER SHEET
2	ELEVATIONS
3	FLOOR PLAN
4	FOUNDATION PLAN
5	FLOOR FRAMING PLAN
6	ROOF FRAMING PLAN
7	DETAILS
8	SHEARWALL PLAN
9	SECTIONS
10	ELECTRICAL PLAN
11	TITLE-24

PROPOSED RESIDENCE FOR

JOSEPH SAMPLE



PLOT PLAN
1"=50'

DESIGN-IT-RIGHT ARCHITECTS
456 BROWN STREET, SAN FRANCISCO CA
PH: (415) 356-4833 FAX 861-5304

SITE INFORMATION:
15555 JACKSON RD.
STOCKTON, CA

PROPOSED PROJECT FOR:
JOSEPH SAMPLE

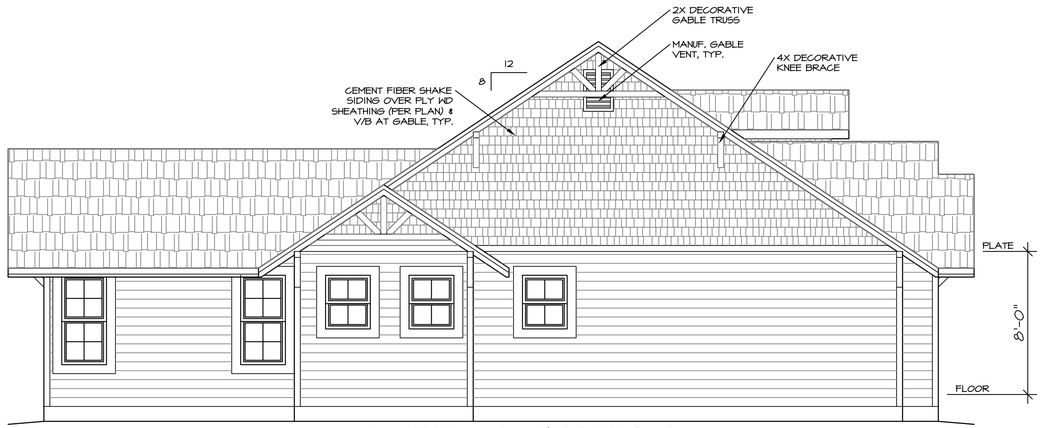
DRAWING DESCRIPTION
COVER

REVISION DATE	BY

DRAWN BY	R BRIAN SELBY
DATE	JAN 2017
SCALE	1/4"=1'-0"
JOB NAME	SAMPLE
ACAD DWG	SAMPLE
SHEET NO	1
OF	11

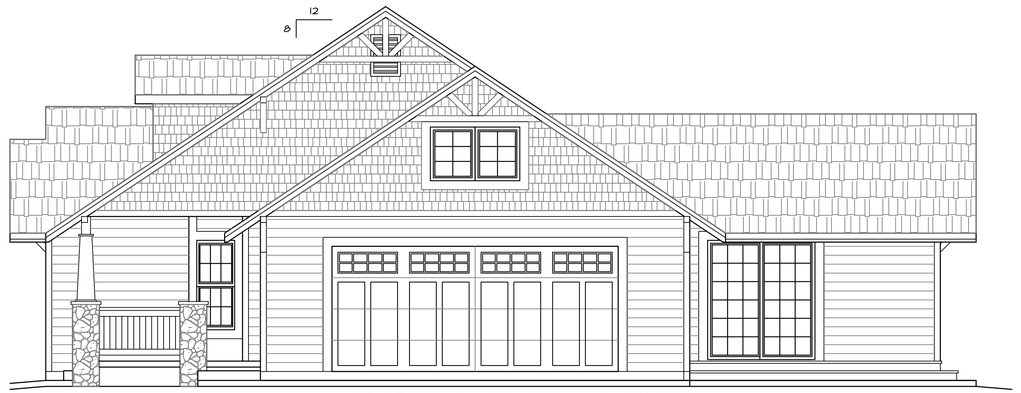
FRONT ELEVATION

NORTHEAST 1/4"=1'-0"



LEFT ELEVATION

SOUTHEAST 1/4"=1'-0"



RIGHT ELEVATION

NORTHWEST 1/4"=1'-0"

LEFT ELEVATION

SOUTHWEST 1/4"=1'-0"

DESIGN-IT-RIGHT ARCHITECTS
456 BROWN STREET, SAN FRANCISCO CA
PH: (415) 356-4833 FAX 861-5304

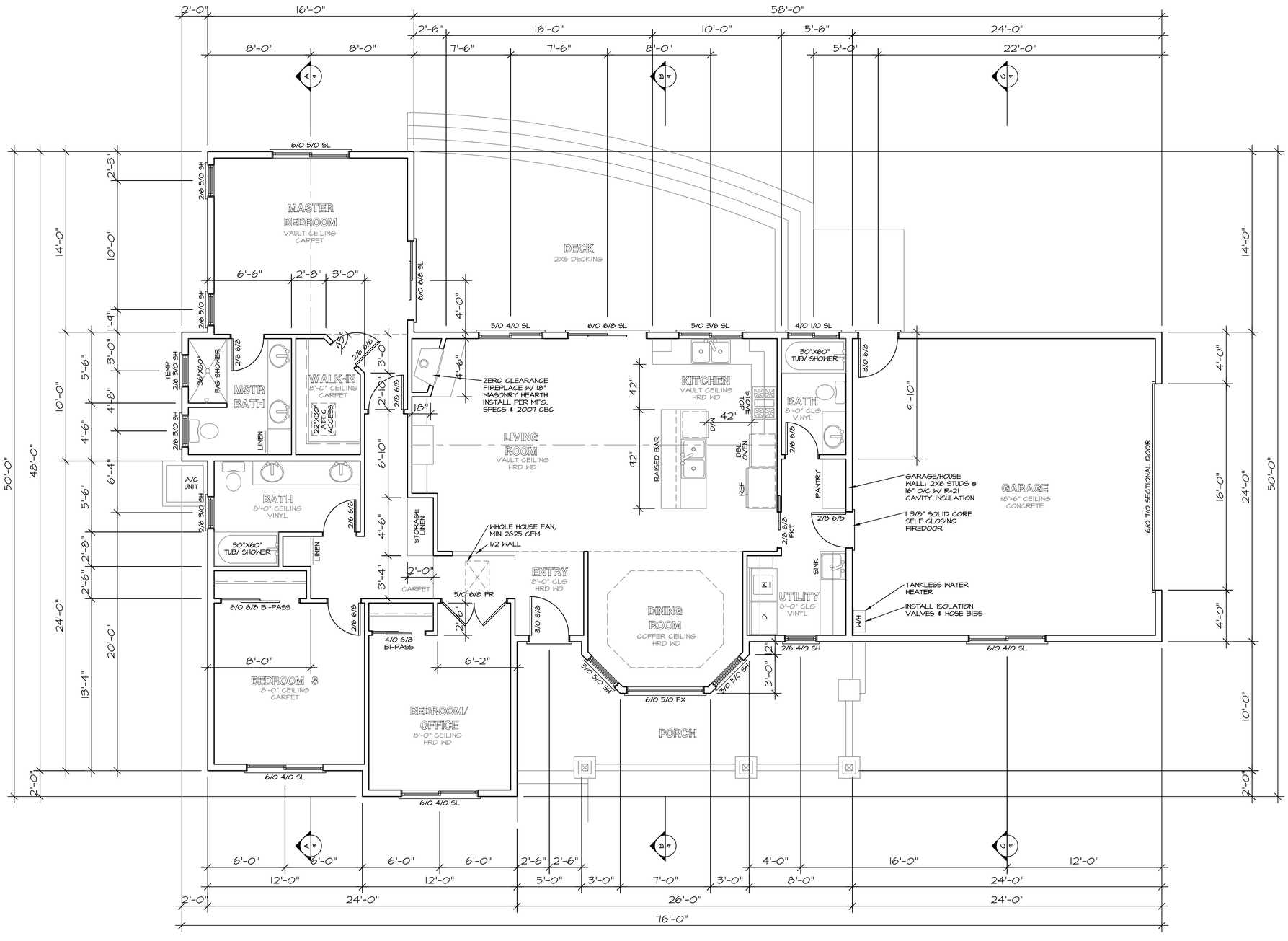
SITE INFORMATION:
15555 JACKSON RD.
STOCKTON, CA

PROPOSED PROJECT FOR:
JOSEPH SAMPLE

DRAWNING DESCRIPTION
ELEVATIONS

REVISION DATE	BY

DRAWN BY
R BRIAN SELBY
DATE
JAN 2017
SCALE
1/4"=1'-0"
JOB NAME
SAMPLE
ACAD DWG
SAMPLE
SHEET NO
2
OF
11



FLOOR PLAN NOTES:

INSULATION

1. ROOF/ATTIC: INSTALL R-38 LOOSE-FILL FIBERGLASS INSULATION IN CEILING & R-18 LOOSE-FILL INSULATION W/ BOX NETTING BELOW ROOF DECK (PER MFG SPECS).
2. EXTERIOR WALLS: INSTALL R-21 FIBERGLASS BATT INSULATION IN 2X6 WALL CAVITY & R-4 EPS RIGID FOAM INSULATION OVER SHEATHING.
3. GARAGE TO HOUSE WALLS: INSTALL R-21 FIBERGLASS BATT INSULATION IN 2X6 WALL CAVITY.
4. KNEE WALLS: INSTALL R-21 FIBERGLASS BATT INSULATION IN 2X6 WALL CAVITY.
5. FLOORS: INSTALL R-19 FIBERGLASS BATT INSULATION BETWEEN FLOOR JOISTS, FASTEN W/LIGHTNING RODS @ 24A O/C.
6. ATTIC ACCESS PANEL SHALL HAVE AN R-38 INSULATION BATT ATTACHED & PANEL SHALL BE WEATHERSTRIPPED.

WINDOWS & DOORS

6. ALL WINDOWS SHALL BE "REALLY GOOD WINDOW CO." SERIES: "BEST EVER" VINYL FRAMED & NFRC RATED WITH A MAXIMUM U-FACTOR OF 0.32 AND A MAXIMUM SHGC OF 0.25.
7. ALL WINDOWS SHALL BE HAVE A MINIMUM OF (1) TEMPERED PANE OR GLASS BLOCK, OR HAVE A FIRE-RESISTANCE RATING OF NOT LESS THAN 20 MINUTES.
8. AT LEAST ONE WINDOW IN EACH BEDROOM SHALL MEET EMERGENCY ESCAPE REQUIREMENTS. A MINIMUM NET CLEAR OPENING OF 5 SQUARE FEET; MINIMUM NET CLEAR OPENING HEIGHT OF 24 INCHES; MINIMUM NET CLEAR OPENING WIDTH OF 20 INCHES; AND A CLEAR OPENING MAX HEIGHT NOT TO EXCEED 44 INCHES ABOVE THE FLOOR.
9. ALL EXTERIOR DOORS SHALL HAVE DEAD BOLTS W/ STEEL PLATE @ THE DEAD BOLT STRIKER, SOLID SHIM 6" ABOVE & BELOW W/ 2-#8X2" SCREWS.
10. FRONT DOOR SHALL HAVE A PEEP HOLE OR VISION PANEL
11. ALL EXTERIOR DOORS SHALL BE OF APPROVED NONCOMBUSTIBLE CONSTRUCTION OR SOLID CORE WOOD AND HAVING STILES & RAILES NOT LESS THAN 1 3/8" THICH W/ INTERIOR FIELD PANELS NO LESS THAN 1 1/4" THICK, OR SHALL HAVE A FIRE RESISTANCE RATING OF NOT LESS THAN 20 MINUTES.
12. ALL LANDINGS W/ SLIDERS OR IN SWING DOORS SHALL HAVE A MAXIMUM STEP DOWN OF 7 3/4" MEASURED FROM TOP OF FLOOR.
13. ALL DOORS SHALL MEET THE MINIMUM STANDARDS AS ESTABLISHED BY THE I.B.C. TITLE-24 STANDARDS.

MECHAINCAL & PLUMBING

1. ALL DUCTS SHALL BE R-8 FLEX DUCTING IN ATTIC. SEAL ALL CONNECTIONS & PENETRATIONS. HERS VERIFIED DUCT LEAKAGE
2. PERMANENT LABEL AT RETURN FILTER GRILL SHALL READ "USE ONLY REPLACEMENT FILTERS WITH AN INTIAL RESISTANCE LESS THAN 0.032 AT 400 CFM AIRFLOW RATE"
3. INDOOR AIR QUALITY MIN VENTILATION AIRFLOW RATE = 47.5 CFM.
4. WHOLE HOUSE FAN MIN AIRFLOW RATE = 2625.5 CFM
5. INSTALL ISOLATION VALVES AND HOSE BIBS AT TANKLESS WATER HEATER
6. INSULATE ALL HOT WATER PIPES W/ MIN 1" PIPE INSULATION
7. T&P VALVE ON WATER HEATER DRAINED TO OUTSIDE
8. GAS LINE TO WATER HEATER W/ 200 KBTU/H SUPPLY CAPACITY
9. MAXIMUM FLUSH VOLUME OF ALL WATER CLOSETS SHALL BE NO MORE THAN 1.6 GALLONS
10. ALL TUB/ SHOWER OPENINGS SHALL BE RODENT PROOF, WITH 1" CEMENT COVERING IN AN APPROVED MANNER
11. ALL SHOWERS AND TUB/ SHOWER WALLS SHALL HAVE SMOOTH, HARD, NONABSORBENT SURFACE OVER A MOISTURE RESISTANT UNDERLAYMENT TO A HEIGHT OF 70" ABOVE DRAIN INLET.
12. DRYER DUCT TO BE SMOOTH METAL DUCT THAT EXTENDS TO OUTSIDE WITH A BACKDRAFT DAMPER, 14' MAX LENGTH, ONCLUDING (2) 90° ELBOWS PER CMC.

MECHANICAL SCHEDULE

SYSTEM TYPE	SYSTEM REQUIREMENTS	NOTES
HEATING	GAS FURNACE, 60 KBTU/H OUTPUT, 92% AFUE	LOCATED IN ATTIC
COOLING	SPLIT 3 1/2 TON AC UNIT, 14 SEER, 12.2 EER. 42 KBTU/H TOTAL OUTPUT	HERS VERIFIED AIRFLOW, FAN EFFICIENCY, REFIGERANT CHARGE
DUCTS	R-8 FLEX DUCTS (IN ATTIC) - MIN. 350 CFM/TON OR MIN GRILL SIZE TABLE 150.0-B OR C	HERS VERIFIED DUCT LEAKAGE, MIN MERV 6 FILTER MEDIA ON RETURN
WHOLE HOUSE FAN	QUIET COOL MODEL QC ES-3100, 2685 CFM, 266 WATTS	N/A
INDOOR AIR QUALITY (IAQ)	PANASONIC, MODEL FV05VS3, 60 CFM 16.3 WATTS	LOCATED IN LAUNDRY ROOM
DOMESTIC HOT WATER (DHW)	0.95 EF TANKLESS WATER HEATER, 0.0 GAL, 199.9 KBTU/H	ALL H/W PIPES INSULATED (NO HERS)

MAIN FLOOR PLAN

1/4"=1'-0"

BUILDING CALCULATIONS

MAIN FLOOR	1751 S.F.
GARAGE	576 S.F.
PORCH	217 S.F.
DECK	333 S.F.

DESIGN-IT-RIGHT ARCHITECTS
456 BROWN STREET, SAN FRANCISCO, CA
PH: (415) 255-1933 FAX: 861-3504

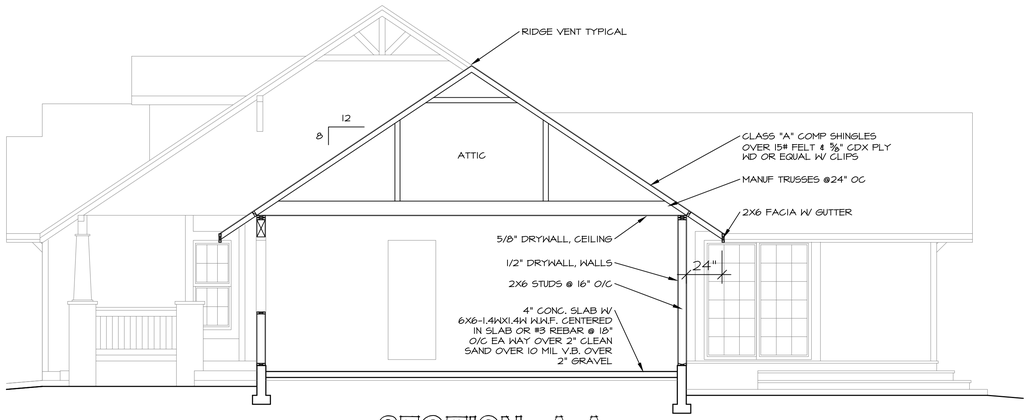
SITE INFORMATION:
15555 JACKSON RD.
STOCKTON, CA

PROPOSED PROJECT FOR:
JOSEPH SAMPLE

DRAWING DESCRIPTION
MAIN FLOOR PLAN

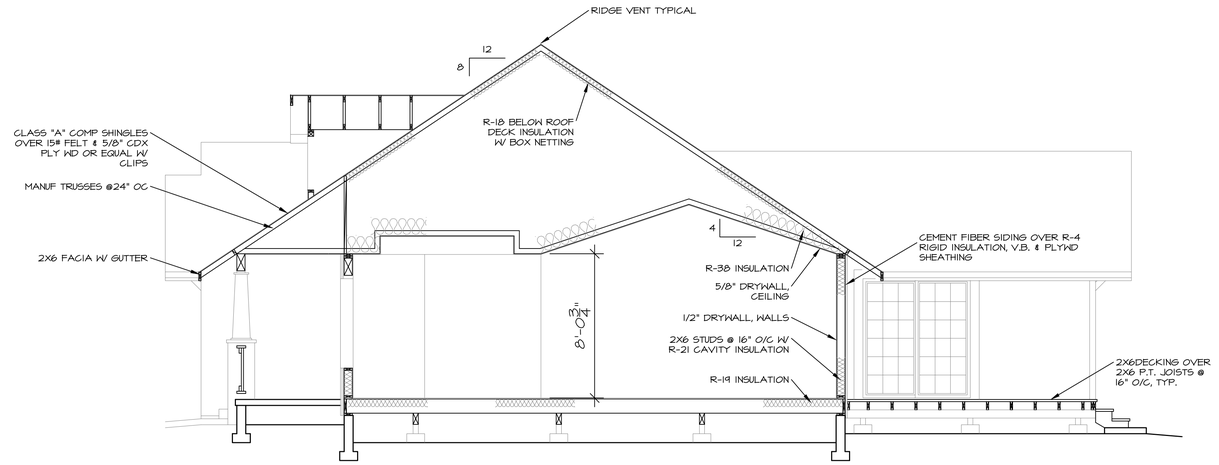
REVISION DATE	BY

DRAWN BY
R BRIAN SELBY
DATE
JAN 2017
SCALE
1/4"=1'-0"
JOB NAME
SAMPLE
ACAD DWG
SAMPLE
SHEET NO
3
OF
11



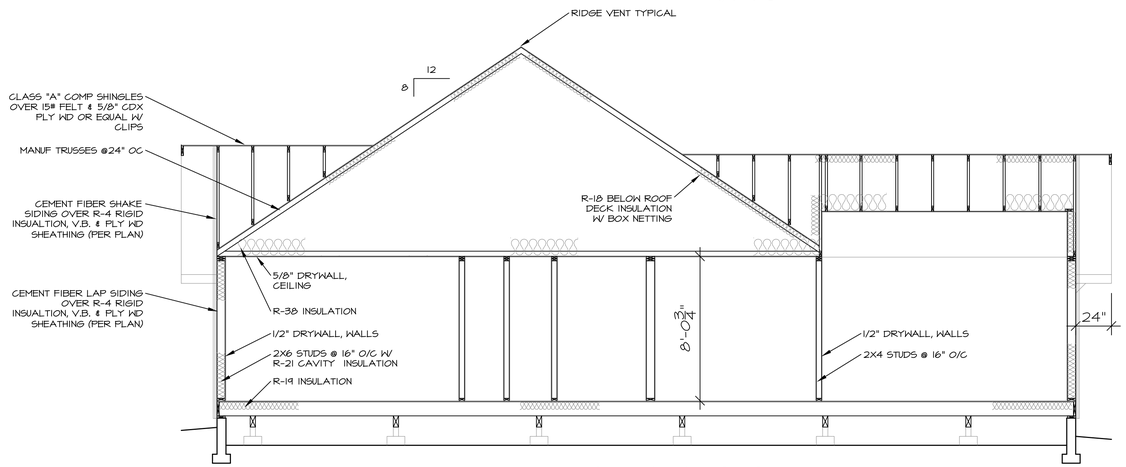
SECTION A-A

1/4"=1'-0"



SECTION B-B

1/4"=1'-0"



SECTION C-C

1/4"=1'-0"

DESIGN-IT-RIGHT ARCHITECTS
456 BROWN STREET, SAN FRANCISCO, CA.
PH: (415) 356-4833 FAX: 861-5304

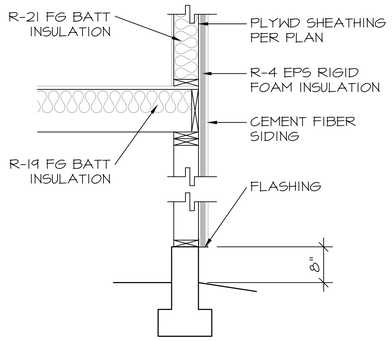
SITE INFORMATION:
15555 JACKSON RD.
STOCKTON, CA

PROPOSED PROJECT FOR:
JOSEPH SAMPLE

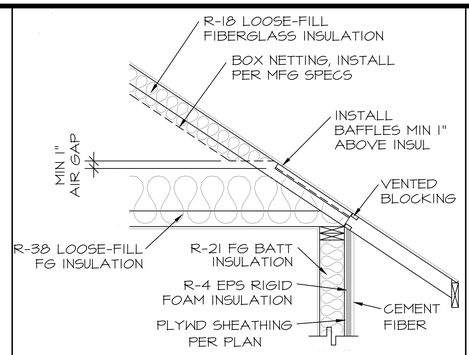
DRAWNING DESCRIPTION
SECTIONS

REVISION DATE	BY

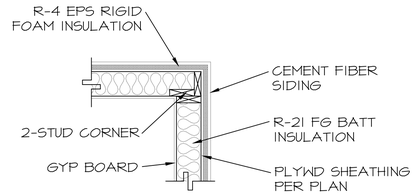
DRAWN BY
R BRIAN SELBY
DATE
JAN 2017
SCALE
1/4"=1'-0"
JOB NAME
SAMPLE
ACAD DWG
SAMPLE
SHEET NO
9
OF
11



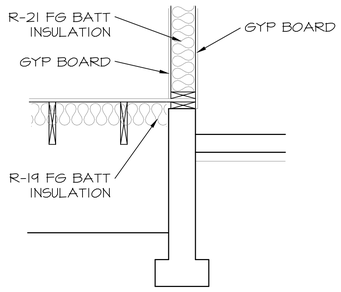
INSULATION AT FLOOR/WALL 1/10
3/4"=1'-0"



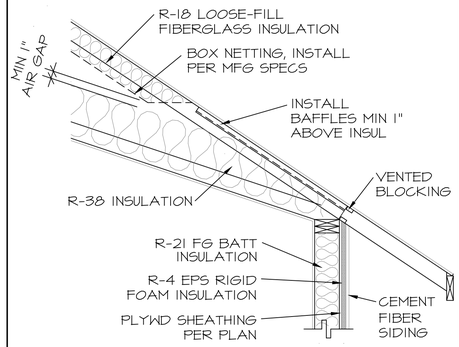
ROOF INSULATION AT WALL/ROOF 5/10
3/4"=1'-0"



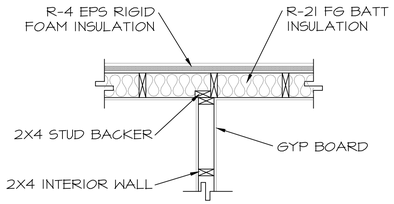
INSULATION @ WALL CORNER 9/10
3/4"=1'-0"



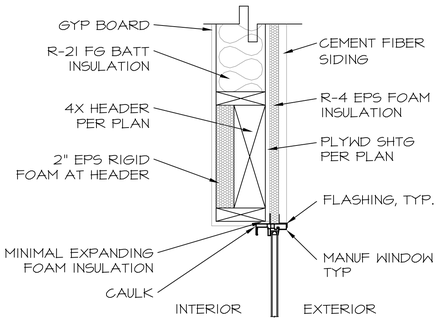
INSULATION AT HOUSE/GARAGE 2/10
3/4"=1'-0"



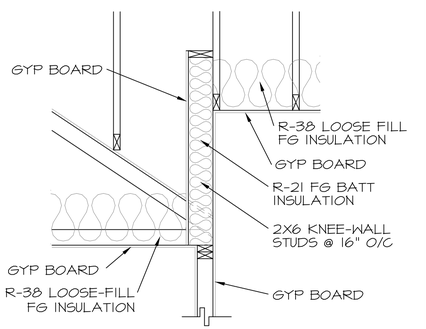
ROOF INSULATION AT VAULT 6/10
3/4"=1'-0"



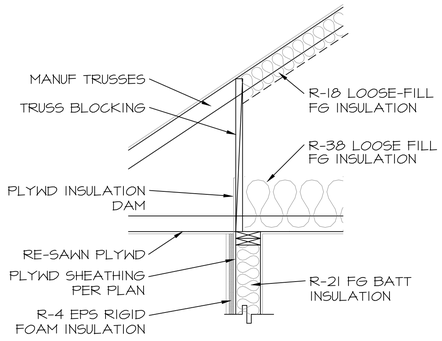
INSULATION @ INTERIOR WALL 10/10
3/4"=1'-0"



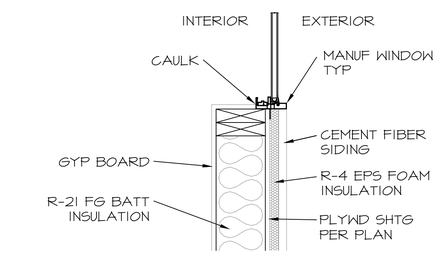
INSULATION AT HEADERS 3/10
1 1/2"=1'-0"



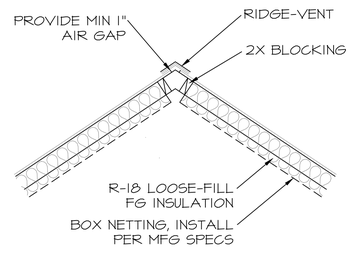
INSULATION AT KNEE WALL 7/10
3/4"=1'-0"



INSULATION @ PORCH 11/10
3/4"=1'-0"



INSULATION AT WINDOWS 4/10
1 1/2"=1'-0"



ROOF INSULATION AT RIDGE 8/10
3/4"=1'-0"

QII Schedule on Site

Timing for QII Tasks	Task
Establishing Sub's for project	Engage HERS rater *early* to have them review plans and schedule inspections
Framing Stage	Air barrier inspection (before ANY INSULATION installed)
Insulation Installation	Roof, walls and floors insulation installation must be inspected before closing up building feature (BEFORE finishing)
Final for Occupancy Permit	Final paperwork (CF2R and CF3R's) coordinated for final inspection by Building Inspector.

QII Note Block

Common Thermal Specifications

- ☐ Materials shall comply with, and be installed in conformance with, all applicable building codes for building. California Building Code (including, but not limited to, California Electric Code Section 719) and installed to meet all applicable fire codes.
- ☐ Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
- ☐ Materials shall comply with flame spread rating and smoke density requirements of Chapter 26 and Section 706 of the Title 24, Part 2: all installations with exposed facings must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings that do not touch a ceiling, wall, or floor surface, and faced batts on the undersides of roofs with an air space between the ceiling and facing are considered exposed applications.
- ☐ Materials shall be installed according to manufacturer specifications and instructions.
- ☐ Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.
- ☐ Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent shall be maintained.
- ☐ Eave vent baffles shall be installed to prevent air movement under or into the batt.
- ☐ Insulation shall cover all recessed lighting fixtures. If the fixtures are not rated for insulation cover (IC) and air tight, the fixtures shall be replaced. All recessed light fixtures that penetrate the ceiling shall be listed for zero clearance insulation contact (IC), have a label that certifies it as airtight with leakage less than 2.0 cfm @ 75 Pa when tested to ASTM E283, and shall be sealed with a gasket or caulk between the light's housing and the ceiling.
- ☐ Insulation shall be installed so that they will be in contact with the air barrier.
- ☐ Insulation shall fill the cavity. Sized to fit, no compression, fill voids etc.

R-Value Measurement

- ☐ The HERS rater shall verify the installed thickness of insulation in all assemblies and locations on walls, roof/ceilings, and floors, and to ensure that insulation levels and installation integrity meet the R-value specified on the Certificate of Compliance, and all other required compliance documentation.

Walls

- ☐ Bottom plates of framed and non-framed and other wall type assemblies shall be sealed to the ground subfloor or slab, and above ground subfloor.
- ☐ Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space. All plumbing and wiring penetrations through the top and bottom plates and electrical boxes that penetrate the sheathing shall be sealed. All gaps in the air barrier shall be caulked, taped, or sealed with minimally expansive foam.

Windows

- ☐ All gaps around windows and doors are sealed. The sealant used follows window manufacturer specifications. Coordinate between trades who is responsible.

Rim-Joists

- ☐ All rim-joists shall be insulated to the same R-Value as the adjacent walls.

Kneewalls, Skylight Shafts, and Gable Ends

- ☐ Framing for kneewalls, skylight shafts and gable ends that separate conditioned from unconditioned space shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.

DESIGN-IT-RIGHT ARCHITECTS
456 BROWN STREET, SAN FRANCISCO, CA
PH: (415) 356-4833 FAX 867-5504

SITE INFORMATION:
15555 JACKSON RD.
STOCKTON, CA

PROPOSED PROJECT FOR:
JOSEPH SAMPLE

DRAWING DESCRIPTION
SECTIONS

REVISION	DATE	BY

DRAWN BY
R BRIAN SELBY
DATE
JAN 2017
SCALE
1/4"=1'-0"
JOB NAME
SAMPLE
ACAD DWG
SAMPLE
SHEET NO
10
OF
12

4.1.2017

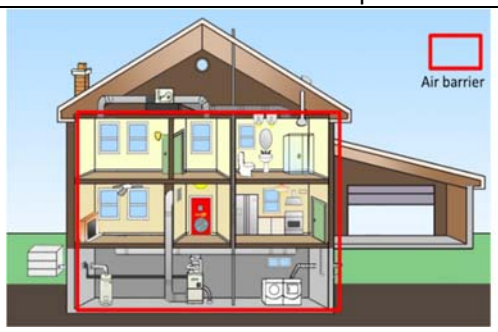
Form Guidance	
CF2R/CF3R-ENV-21	Traditional Stick Built Framing Stage
CF2R/CF3R-ENV-22	Traditional Stick Built Ceiling Air Barrier
CF2R/CF3R-ENV-23	Traditional Stick Built Insulation Stage
CF2R/CF3R-ENV-24	SIP ICF Air Barrier and Framing Stage

Construction Stage: Framing Stage (Traditional Stick Built)
Compliance Form: CF2R/CF3R-ENV-21-H

Air Barrier - Air Infiltration Sealing for Batt, Loose fill, and SPF

A. General

- In order to be considered an air barrier, individual materials must have an air permeance not exceeding 0.004 cfm/ft2 @1.57 lb/ft2 (0.02 L/(s•m2) @ 75 Pa) when tested in accordance with ASTM E2178.
- All joints/seams for materials that make up the air barrier must be sealed with caulk, foam, tape, or a material specifically designed for building envelope sealing to prevent air infiltration.
- Products must be installed per manufacturer instructions.



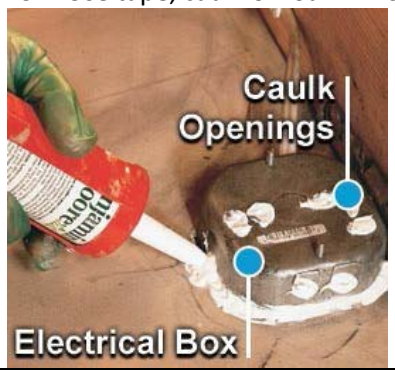
Continuous Air Barrier - A combination of interconnected materials and assemblies joined and sealed together to provide a continuous barrier to air leakage through the building envelope, separating conditioned from unconditioned space, or adjoining conditioned spaces of different occupancies.

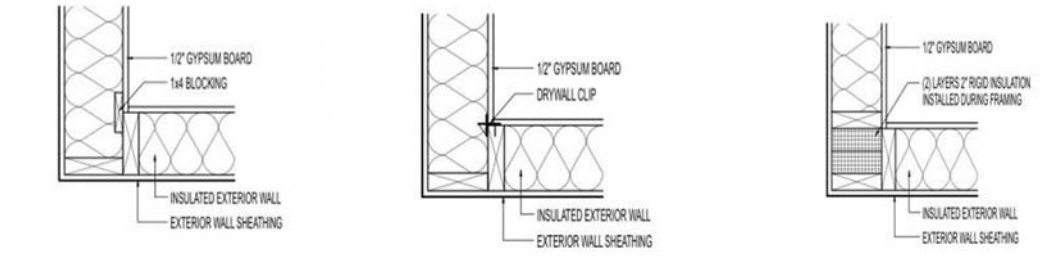
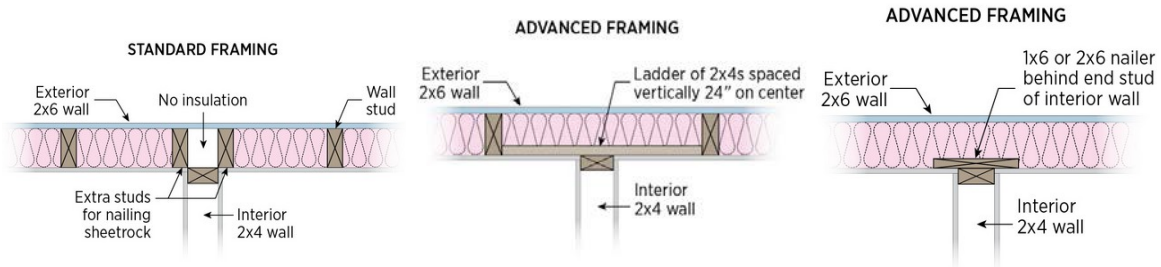
The term "sealed" implies the use of tape, gasket, caulk, foam or other air-sealing product. All materials used to form an air-barrier shall be sealed at seams and edges per manufacturer's recommendations.

- The complexity of architectural design is in direct opposition to the ease with which a continuous air barrier can be established and verified. Changes in plate height, dropped ceilings, soffits, cantilevered decks or roofs, knee walls, double framed walls, pop-outs, mechanical chases, chimneys and stairways all add complexity to creating an effective air barrier. The air barrier must form a continuous, un-broken boundary between conditioned and unconditioned space. Often overlooked is the connections between different components of the air barrier which must be sealed. For example, the external (OSB) sheathing must be sealed to the top-plate which is sealed to the ceiling drywall creating a "continuous" air barrier. It is important that all trades, particularly mechanical and electrical, understand the goal of creating an 'air-tight' envelope when penetrations in the air-barrier are required.

Typical Components of the Air Barrier

- Plywood, OSB (Oriented Strand Board) - 3/8 inch min.
- Exterior or Interior Gypsum Board (drywall) - 1/2 inch min.
- Cement Board, Gypsum board - 1/2 inch min.
- Insulation Board (sealed at seams per Mfg. recommendations)
  - Extruded Polystyrene - minimum ½ inch
  - Foil-back polyisocyanurate - minimum ½ inch
  - Foil Backed Urethane Foam Insulation - minimum 1 inch
- Spray Polyurethane Foam (SPF)
  - Closed cell SPF - minimum thickness of 2.0 inches
  - Open cell SPF - minimum thickness of 5.5 inches
- Built up, single-ply, or bituminous Roofing Membrane
- Portland Cement/Sand Parge, or Gypsum Plaster - minimum 5/8 inch
- Cast-in-place and Precast Concrete
- Fully Grouted Concrete Block Masonry
- Structural Sheathing – Meeting ASTM E2178
- House Wrap – Meeting ASTM E2178
- Thermo-ply
- Sheet steel or aluminum
- Dimensional lumber

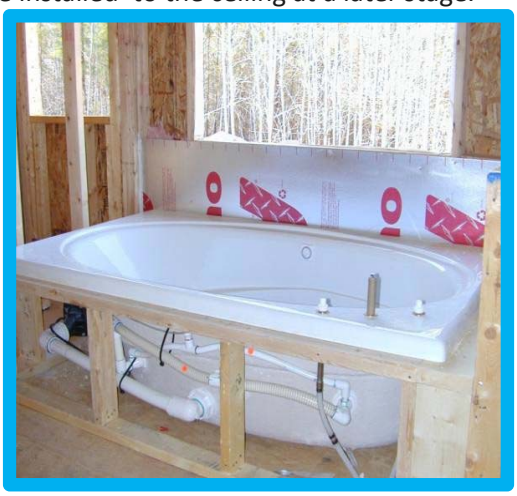
B. Raised Floor	
☐ Gaps	*1. All gaps in the raised floor are sealed.*
☐ Chases	*2. All chases sealed at floor level using a hard cover and the hard cover is sealed*
☐ Penetrations	*3. All plumbing and electrical wires that penetrate the floor are sealed.*
☐ Subfloor	*4. Subfloor sheathing is glued or sealed at all exterior panel edges to create a continuous air tight subfloor.*
C. Walls/Knee Walls	
☐ Penetrations through the exterior wall	1. *All penetrations through the exterior wall air barrier are sealed to provide an air-tight envelope to unconditioned spaces such as the outdoors, attic, garage, and crawl space.* 5. If stucco or similar air tight products will be applied to the outside of the building, only penetrations in that air barrier need to be sealed. Example: Lineset, electrical boxes. 6. If no additional outside air barrier will be installed, then all penetrations, joints/seams where individual materials meet must be sealed with caulk, foam, tape, or a material specifically designed for building envelope sealing to prevent air infiltration. If foam board is the air barrier then it must be taped at all seams. Edges of foam board must be sealed to the surrounding air barrier. 7. House wrap can be used as an air barrier when it meets ASTM E2178. All seams, edges and penetrations in the house wrap must be sealed. 8. If OSB, plywood, cement board, Thermo-ply, or dimensional lumber are the exterior air barrier, all of the seams and penetrations must be sealed.
☐ Top plate and bottom plate in each stud bay	2. *Exterior wall air barrier is sealed to the top plate and bottom plate in each stud bay.* o For multi-story buildings that have a continuous air barrier on the exterior, only the bottom plate of the first floor and the top plate of the top floor need to be sealed to the exterior air barrier. o It is possible to have a two-story house where the upstairs conditioned space has a smaller footprint than the first story. In such a floor plan, top plates of a first story wall exposed to an unconditioned attic would be sealed to the exterior air barrier.
☐ Electrical boxes	3. *All electrical boxes including knockouts that penetrate the air barrier to unconditioned space are sealed.* o Seal electrical boxes to the surrounding air barrier. o Seal openings (knockouts) in the electrical box. o Use tape, caulk or foam. Ensure sealing products do not enter into the electrical box. 
☐ Penetrations in top and bottom plate	*4. 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.*
☐ Exterior bottom plates	*5. Exterior bottom plates (all stories) are sealed to the floor using the appropriate sealing method.* o If the exterior air barrier is continuous (from the bottom story to the top story), then the bottom plate of first floor only needs to be sealed. o In order to verify that the bottom plate is sealed, the following are allowed: • Use a gasket material that is 3.5 inches wide on 2x4, 5.5 inches wide on 2x6; or • Seal the bottom plate on the inside at junction of concrete and plate with caulk or foam; or • Watch sealing of the bottom plate to foundation during framing.
☐ Windows and	6. *All gaps around windows and doors are sealed. The sealant used follows window manufacturer*

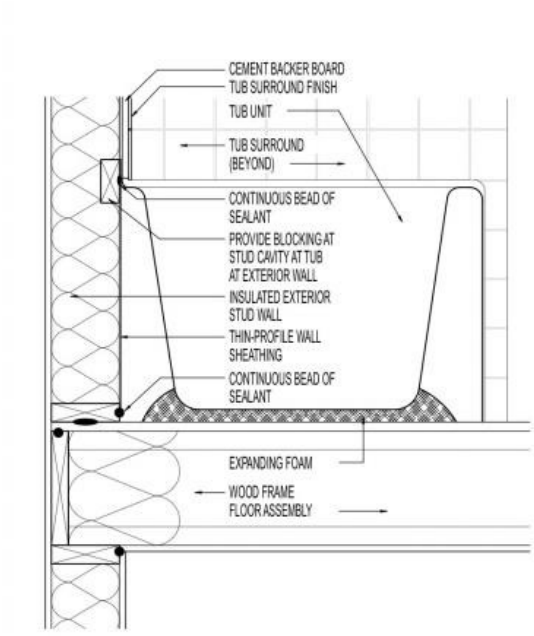
doors	*specifications.*
☐ Rim joists	7. *Rim joists gaps/openings are fully sealed.*
☐ Exhaust fan ducts	8. *Fan exhaust ducts that run between conditioned floors to exterior walls including damper at the exterior wall.*
☐ Metal tie downs	9. *Metal tie downs are insulated between exterior framing and tie down.* o Metal tie downs shall be fully insulated in a manner that resists thermal bridging through the structural framing assembly. o If there is room behind the tie down and the exterior framing, ensure it is insulated. It is not required to move the tie down to add insulation.
☐ Corner channels and/or wall intersections	10. *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 lath.* o Cavities in corner channels or wall intersections that will become inaccessible shall be completely filled with insulation and verified before the exterior sheathing is installed. o Alternative framing details shown below can be used to eliminate cavities that would become inaccessible after exterior sheathing is installed. 1. NOTE: When batt insulation is used, it must be cut to fit around framing. Corner Channels are typically framed in a U-channel. Insulation must be inserted in this space from the outside before the exterior wall sheathing is installed. It is recommended that the advanced framing methods shown below be used. **2-stud corner with 1x4 backer** **2-stud corner with drywall clips** **3-stud corner with rigid insulation**  **Wall Intersections** where interior walls intersect exterior walls, builders will typically use a conventional T-post detail. Insulation must be inserted in this space from the outside before the exterior wall sheathing is installed. It is recommended that the advanced framing methods shown below are used. In advanced framing, batt insulation must be cut to fit around the 2x4 ladders and the 1x6 or 2x6 nailers. 
☐ Tub, shower, fireplace enclosures, exterior stairwells	11. *Insulation is installed behind tub, shower, or fireplace enclosures, and exterior stairwells* o Insulation to match the R-value listed on the CF1R when located against exterior walls. o Insulation is installed before tub, shower, and fireplace are installed;
☐ Tub, shower, fireplace enclosures	12. *A solid air barrier is installed, from floor to ceiling, on the inside of exterior walls directly adjacent to tub, shower, or fireplace enclosures.* o Insulation shall contact all six sides of the air barrier on exterior walls. o When tubs, showers, fireplace enclosures, or stairwells are installed on exterior walls, builders may forget to insulate and air seal the exterior wall behind those locations. For QII

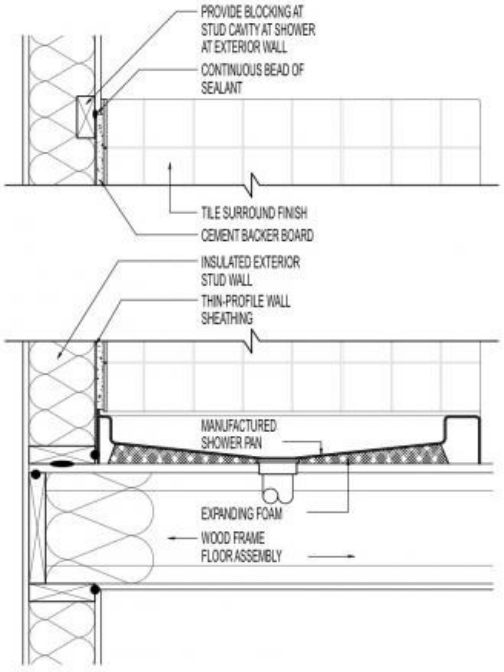
the HERS Rater must visually verify that these locations are properly air sealed and insulated before they become inaccessible.

- The insulation behind the tub or shower must be equivalent to the insulation in adjacent exterior walls and covered with an air barrier that is sealed at all edges and seams to provide a continuous air barrier. Any type of insulation may be installed as long as it completely fills the void and is in full contact on all six sides of the air barrier.

NOTE: The bath tub air barrier is not required to extend to the ceiling at framing stage. Drywall will be installed to the ceiling at a later stage.



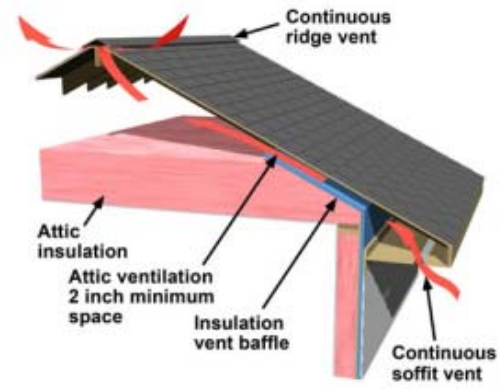




☐ Window and door headers

13. 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. Insulation is to be placed between the interior face of the header and inside surface of the interior wall finish.
    - The Building Energy Efficiency Standards provide Quality Insulation Installation (QII) compliance credit for R-3 or R-5 insulated headers. Insulation or wood must fill the cavities, leaving no air gaps in or around the header.
    - Three options meet the insulated header requirement:
    1. Two-member header with insulation in between. The header and insulation must fill the wall cavity. Example: a 2x4 wall with two 2x nominal headers, or a 2x6 wall with a 4x nominal header and a 2x nominal header. Insulation is required to fill the wall cavity and must be

	installed between the headers. 2. Single-member header, less than the wall width, with insulation on the interior face. The header and insulation must fill the wall cavity. Example: a 2x4 wall with a 3 1/8 inch wide header, or 2x6 wall with a 4x nominal header. Insulation is required to fill the wall cavity and must be installed to the interior face of the wall. 3. Single-member header, same width as wall. The header must fill the wall cavity. Example: a 2x4 wall with a 4x nominal header or a 2x6 wall with a 6x nominal header. No additional insulation is required because the header fills the cavity.
D. Ceiling/Attic	
☐ Vented Attics	*1. For vented attics much of the ceiling air barrier is verified after the ceiling drywall is installed using the **CF3R-ENV-22.***
☐ Unvented Attics	*2. For unvented attics ensure all penetrations through the roof deck and gable ends are sealed and airtight.*
☐ Eave/soffit Vents	*3. All eave/soffits vents are covered with a rigid ventilation baffle that maintains the net free ventilation area.*
☐ Dropped Ceilings	*4. All dropped ceilings are covered with hard covers and sealed to framing.* o *The 2008 RA allowed the entire drop area to be filled with insulation level with the rest of the attic. This is no longer allowed under the 2013/2016 Standards; hard covers are required.* o *Framing of soffits or drop ceilings should be done inside the Air Barrier. This means the drywall has been installed and sealed as required before the soffit or drop ceiling is framed out.* 
☐ Chases	*5. All chases are covered with hard covers and sealed to framing.* o *All vertical chases shall have hard covers sealed to the framing at each plate level.* o *See notes for #4 above.*
☐ HVAC Chases	*6. Where HVAC ducts travel down a chase, the chase is sealed at the ceiling level.*
☐ Chimney/Flue	*7. Chimneys and flues require sheet metal flashing. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.*
☐ Eave/soffit Baffles	*8. All eave/soffit baffles are installed to stop air movement around the baffle and into insulation. Net free-ventilation of the eave/soffit shall be maintained.*

	
☐ Double Walls	9. *Double walls that open to the attic are covered with an air barrier and cover has an air tight seal to the framing.* o *Double walls that open to the attic or subfloor must be covered. See notes for #4 above.* o *For double walls on the exterior. An air barrier must be installed covering the double wall if insulation is going to be installed on the exterior wall.*  *In this picture an air barrier is not required at the double wall because insulation will be installed on the interior wall.*
E. Conditioned Space Above or Adjacent Garage	
☐ Penetrations	1. *All penetrations in the subfloor above the garage into conditioned space must follow the raised floor air barrier requirements above.*
☐ Infiltration Sealing	2. *Infiltration between the space above the garage and subfloor is prevented by one of the following methods:* o All seams where components (including the rim joists, closures, top plates, and subfloor) come together must be sealed with caulk, spray foam, or foam gaskets/tape. Sole plates at the slab of the common wall are to be caulked, foamed, or gasketed to prevent air migration. o When garage ceiling joists extend across both the living space and the garage, the joist bay cavities above any common walls must be closed off and sealed to prevent air movement within the frame assembly.

Incorrect – Joist bay cavities not sealed

Correct – Joist bays with blocking and sealed

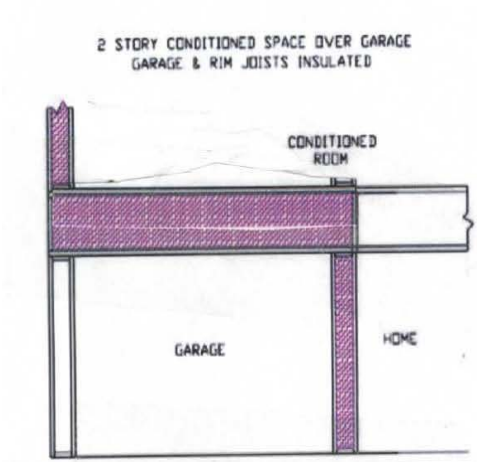
- Insulation can be placed on the ceiling of the garage or in contact with the conditioned subfloor above. Where the insulation will be installed effects the location of the air barrier and sealing.
- Option 2 below is the preferred method.

Option 1 – Insulation is placed in contact with the garage ceiling, with a void between the insulation and the conditioned subfloor above. When using this option, the air barrier for the conditioned space above the garage is the garage ceiling and the perimeter blocking.

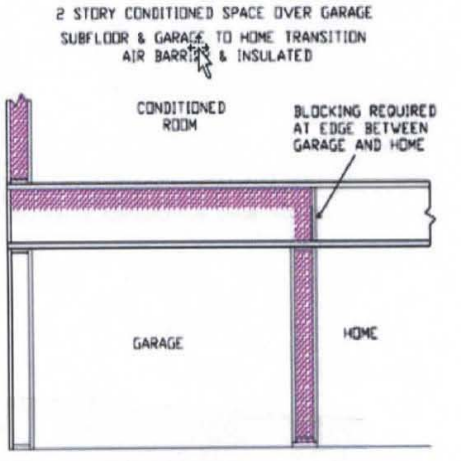
- Perimeter of insulation must be full depth. Filling space from ceiling to subfloor.
- Seal all edges of the garage ceiling (typically drywall) at the perimeter of the garage to create a continuous air tight surface between the garage and adjacent conditioned space.
  - The blocking at the garage and the adjacent conditioned space (house) shall be insulated up to the subfloor.

Option 2 – Insulation is placed in contact with the conditioned subfloor (this is the preferred method). When using this option, the air barrier is the subfloor alone.

- Seal all subfloor seams and penetrations between the garage and adjacent conditioned space.
- The garage and the adjacent conditioned space (house) shall be insulated up to the subfloor.

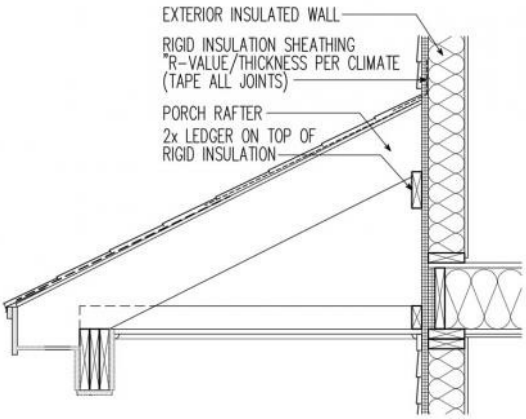


Option 1 – Insulation goes from ceiling to subfloor around perimeter.



Option 2 – Insulation goes from ceiling to subfloor at blocking to house.

F. Walls for Attached Porch, Attic, Double Wall

☐ Continuous air barrier	1. *All walls that separate conditioned and unconditioned space include a continuous air barrier on the interior and exterior wall.*
☐ Porch	2. *An exterior wall air barrier is required at the intersection of the porch and exterior wall when there is conditioned space on the other side. The exterior wall includes an air barrier where the attic attaches to the conditioned space.* o Insure all wall insulation is in contact with the air barrier on all six sides. Exterior air barrier is often missed when an attic is attached to an exterior wall. o Insulation values for these areas must be the same as the rest of the walls. If rigid insulation is installed on the walls it must also be installed in these areas.  
☐ Truss Blocking	3. *Truss framing blocking is used at the top and bottom of each wall/roof section.*
G. Cantilevered Floor Air Barrier	
☐ Blocking	1. *Airtight blocking is installed between joists where the wall rim joist would have been located in the absence of a cantilever.* o Blocking must be installed any time joists goes over an exterior wall or opens into an unconditioned space. 
☐ Cantilever	2. *Exterior sheathing is installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R-value as would be required for the subfloor prior to closing*
☐ Can Lights	3. *Any gaps, cracks or penetrations in the air barrier of the cantilever are sealed. Can lights in the cantilever are IC and AT rated and properly sealed to sheathing.*
H. Multifamily	
☐ Blocking	1. *Airtight blocking is installed between joists where the wall rim joist would have been located in*

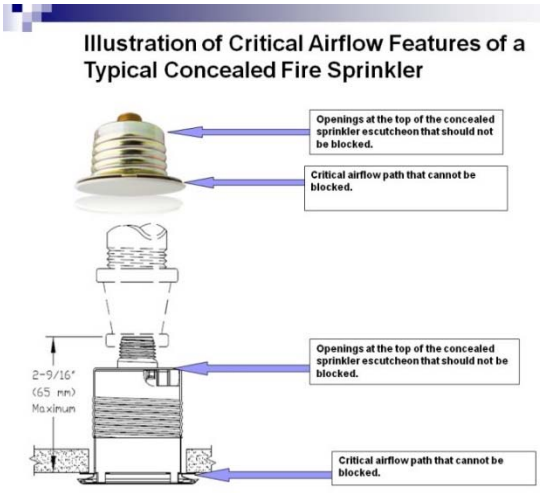
	the absence of a cantilever.
☐ Between Units	*2. Each dwelling unit must be air sealed to stop air movement from one unit to another.*
☐ Floor and Ceiling	*3. Floor AND Ceiling of each dwelling unit – all penetrations through the floor and ceiling of each unit are sealed, including electric and gas utilities, water pipes, drain pipes, fire protection service pipes, and communication wiring.*
☐ Multi-Level Spaces	*4. Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatch, and plumbing stacks are all sealed to reduce air transfer from attached spaces.*
☐ Common Walls	*5. Common Walls – the bottom plate between units is sealed to the subfloor. All penetrations in the common walls are sealed, including electrical boxes, wiring, and plumbing penetrations. Perpendicular interior walls that open into the common walls are sealed.*
☐ Vertical Chases to Units	*6. Vertical Chases for garbage chutes, elevator shafts, and HVAC ducting plumbing must be sealed to the floor and ceiling of each unit to stop air movement up and around the chase due to stack effect.*
☐ Vertical Chases	*7. Vertical chases such as garbage chutes, elevator shafts, HVAC ducting, plumbing, wiring, etc. must be sealed to stop air movement through the chase to the surrounding spaces.*
☐ Hallways	*8. Common hallways – penetrations between dwelling units and common hallways are sealed, including doors to dwelling units which shall be gasketed or made substantially airtight.*

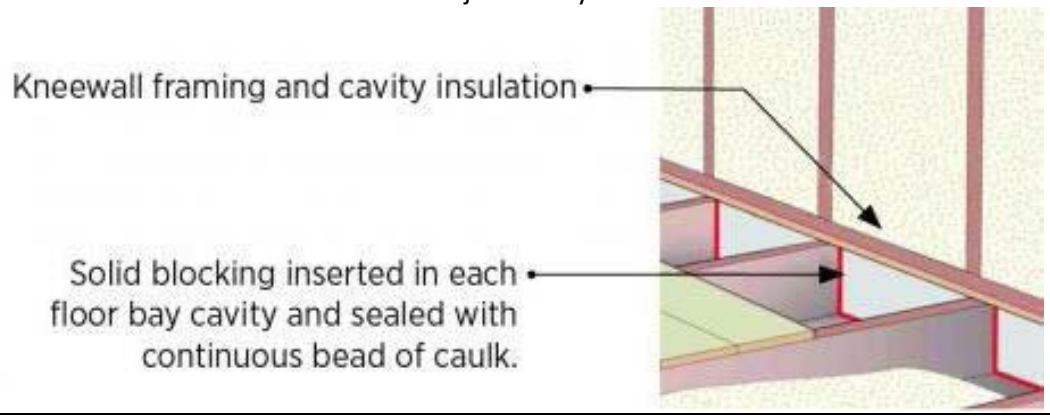
Construction Stage: Framing Stage (Traditional Stick Built)
Compliance Form: CF2R/CF3R-ENV-22-H

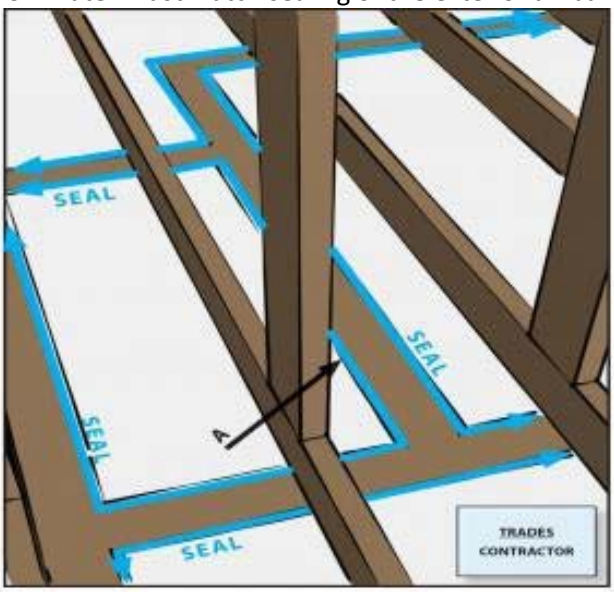
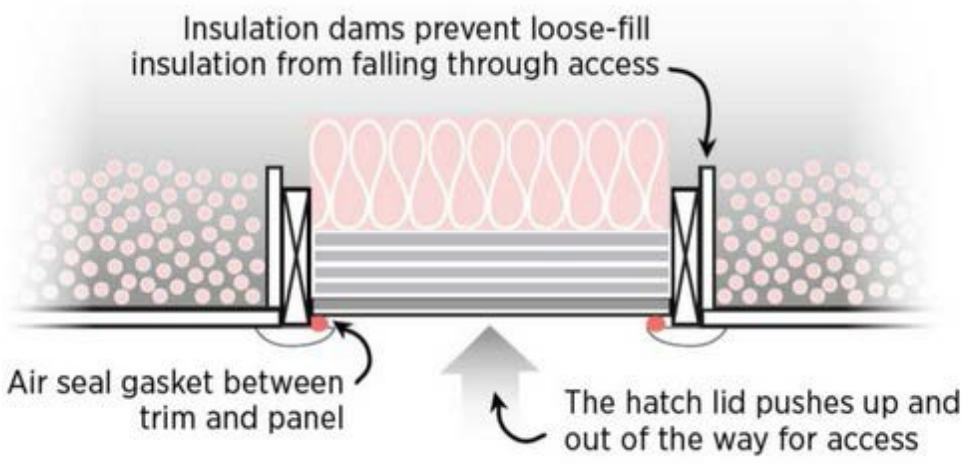
Air Barrier - Air Infiltration Sealing – Ceiling/Roof Deck

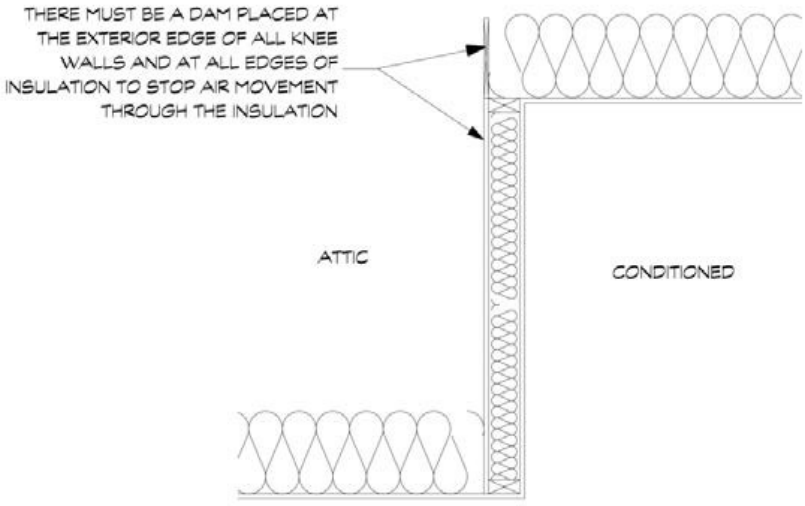
A. Ceiling Inspection – Vented Attics

For typical vented attics where the insulation is at the roof deck/ceiling the air barrier must be verified after the ceiling drywall is installed and before attic insulation is installed. If spray polyurethane foam (SPF) will be used in the attic this can be considered the air barrier. Soffits and chases must be covered, and chimneys and flues require metal flashing. For buildings with an unvented attic, all air sealing requirements appropriate for the roof must be verified.

☐ Continuous Air Barrier	1. *There is a continuous air barrier at the ceiling level. All openings into walls, drops, chasses, or double walls are sealed.* (See **CF2R/CF3R-ENV-21-H** above for examples)
☐ Chimney/Flue	2. *Chimneys and flues require sheet metal flashing. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.*
☐ Top Plate	3. *All penetrations through the top plate of interior and exterior walls are sealed.*
☐ Ceiling Penetrations	4. *Electrical boxes, fire alarm boxes, and fire sprinklers cut into ceilings are sealed to the surrounding drywall. If it is not possible to seal the fixture directly, a secondary air barrier shall be created around the fixture.* **Sealing of the above items are required only when they penetrate the ceiling to unconditioned space.** o Seal electrical boxes to the surrounding air barrier. o Seal openings (knockouts) in the electrical box. o Use tape, caulk or foam. Ensure sealing products do not enter into the electrical box.  **Fire Sprinklers** o Concealed fire sprinklers have openings at the top of the sprinkler that shall not be blocked, sealed or have a secondary air barrier. o When sprinklers are installed in the ceiling air barrier where the back opens into the attic, it is recommended that flush mount or non-vented recessed sprinklers be used. These do not require air flow through the sprinkler to activate and they can be sealed to the ceiling air barrier. o See California State Fire Marshal Bulletin 13-007 link: http://osfm.fire.ca.gov/informationbulletin/pdf/2013/IB-13007_ResFireSpklrsEnergyRegs.pdf o Additional link on proper installation: http://osfm.fire.ca.gov/codedevelopment/pdf/califfiresprinklercoalition/OSFMCEC10142013.zip  

☐ Can Lights	5. *All installed recessed light fixtures that penetrate the ceiling to unconditioned space are rated to be Insulation Contact and Airtight (IC and AT) which allows direct contact with insulation. The housing is sealed to the drywall.*
☐ Exhaust Fan	6. *Exhaust fan housing is sealed to the surrounding drywall and all holes and seams in the housing are sealed.* o Sealing of the exhaust fan only required when they penetrate the ceiling to unconditioned space. o Seal all gaps and holes to unconditioned space with caulk, foil backed HVAC duct tape, or foam. Fibrous insulation is not an air barrier and cannot be used for sealing gaps.
☐ Soffits/Chases	7. *All soffits and chases are covered with a hard cover that is sealed to the framing with caulk or foam.*
☐ Double Walls	8. *Double walls that open to the attic are covered and the cover is sealed to the framing.*
☐ Attic Access	9. *Attic access forms an airtight seal between conditioned space and unconditioned space. Vertical attic access requires mechanical compression using screws or latches.* o To air seal the attic access, weather stripping must be added to the frame of the attic access panel. Vertical attic access in a wall requires mechanical compression using screws or latches that will pull the access door tight to the weatherstripping for an airtight seal. A standard door knob, dead-bolt or similar latching mechanism will work to provide mechanical compression for vertical access. 
☐ Knee Walls	10. *Knee walls require solid and sealed blocking at the bottom, top, left, and right sides. When the knee wall is placed on top of a subfloor the open cavity between the subfloor and the ceiling below is sealed.* o Air Barrier must be added to the joist cavity below the knee wall and sealed. 
☐ HVAC Chase	11. *Where HVAC ducts travel down a chase, the chase is sealed at the ceiling level.*
☐ HVAC Boots	12. *HVAC boots that penetrate the ceiling are sealed to the surrounding drywall.*
☐ Top Plates	13. *All top plates of interior and exterior walls are sealed to drywall.* **Interior Walls** o Top plates do not need to be sealed unless there is an unconditioned space above. o Sealing of the top plate can be done from the attic after all the drywall is installed, or from below before drywall is installed. o If sealing from the attic after drywall is installed, use caulk or foam to seal all top plates to the drywall. o If sealing from below when the drywall is installed at a later date, a gasket type material must

	be used. The gasket must be thick enough to fill any irregularities (approximately 1/4 inch thick) between the two surfaces and the gasket must remain flexible so that it can expand/compress and still seal the two materials together when they meet. **Exterior Walls** o For multi-story buildings and a continuous air barrier is used (like stucco) only the bottom plate of the first story and the top plate of the top story need to be sealed. o Use a gasket material that hangs down below the top plate so that it can be verified at a later date; or o Seal the exterior air barrier to the top plate from the interior so that it can be verified; or o Rater must watch sealing of the exterior air barrier to the top plate during construction. 
☐ Attic Access	*14. Attic access must be surrounded with a dam at least the same depth as the insulation to prevent loss of ceiling insulation.* o A dam must be installed around the attic access that is at least the same depth as the required attic insulation to ensure full depth around the attic access. o Most insulation manufacturer instructions require a rigid dam around the attic access for all types of insulation. Check insulation manufacturer instructions. o R-38 insulation would require a 13 ¾" to 14 ½ " dam. R-48 insulation would require a 17" dam in most situations. o The depth of the dam would be measured from the ceiling to the top of the dam. 
☐ Knee Wall Dam	*15. There must be a dam placed at the exterior edge of all knee walls and at all edges of insulation to stop air movement through the insulation.*

	o The dam must be at least the same depth as the attic insulation to ensure full depth and to stop air migration into the insulation. 

B. Roof Inspection – Unvented attics

☐ Continuous Air Barrier	*1. There is a continuous air barrier at the roof deck and gable ends.*
☐ Chimney/Flue	*2. 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.*
☐ Penetrations	*3. All penetrations for plumbing, electrical, etc. in the roof deck and gable ends are sealed.*

Construction Stage: Insulation Installation (Traditional Stick Built)
Compliance Form: CF2R/CF3R-ENV-23-H

QII – Insulation Installation

Insulation is installed at different stages during the construction process. It is incumbent upon the Rater and builder to coordinate schedules to insure access for verification. Insulation shall be uniformly installed to completely fill the building cavity without any voids, gaps or excessive compression. The installed insulation shall be in full and secure contact with its associated air barriers and form a continuous thermal barrier around all of conditioned space.

Goal: Insulation Installation

1. Insulation in each assembly shall meet or exceed the R-value claimed on the CF-1R;
2. Insulation shall be installed with full and secure contact to the air barrier(s);
3. Insulation shall uniformly fill cavities without any voids, gaps or compressions.

In vertical cavities such as stud bays and attic knee walls, the installed insulation shall fill the cavity front to back, side to side and top to bottom. Stud bays must be substantially airtight with an air barrier on six sides and the installed insulation shall be in full and secure contact on all six sides (e.g. exterior sheathing, interior drywall, studs and plates). The requirement for an air barrier on six sides includes attic knee walls and skylight shafts.

Often overlooked, an interior air barrier must also be provided behind tubs, showers, stairways, fireplaces and other similar building assemblies that are set on an exterior wall. Often times these features are set during the framing stage so the Rater must arrange to inspect for both air barrier and insulation at these locations before they are covered up and become inaccessible. If the Rater cannot see it then it cannot be verified.

The trades involved with installing tubs, showers, stairs and other hard-to-access building assemblies need to know ahead of time when they are responsible for installing components to meet QII air barrier and insulation requirements.

Insulation in ceilings and floors shall fully fill the joist bays side to side, end to end, and be in full and secure contact with the associated air barrier. Mechanically supporting insulation between floor joists to maintain its contact with the subfloor air barrier is always problematic and should receive special attention during verification. When insulation installed in a joist bay exceeds the height of the joist, the void created above the joist height shall be uniformly filled with insulation. Gaps, voids or excessive compression are not allowed.

A. Quality Insulation Installation (QII) Preparation for Insulation

☐ Continuous Air Barrier Verified	1. *Air barrier installation and preparation for insulation was done and verified at framing stage prior to insulation being installed.*
☐ Structural Framing	2. *All structural framing areas shall be insulated in a manner that resists thermal bridging of the assembly separating conditioned from unconditioned space.* o *Structural bracing, tie-downs, and framing of steel, or specialized framing used to meet structural requirements of the CBC are allowed and must be insulated.* o ***These areas shall be called out on the building plans with diagrams and/or specific design drawings indicating the R-value of insulation and fastening method to be used.*** o *It is recommended that spray foam be used.*
☐ Manufacturer's Instructions	3. *All insulation was installed to the manufactures insulation installation instructions.*

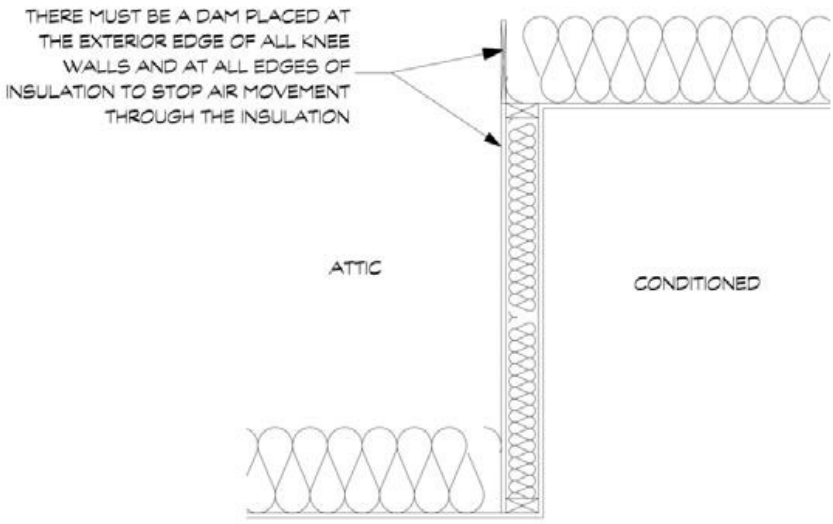
B. Quality of All Installed Insulation

☐ Match CF1R	1. *Installed insulation R-values is the same or greater than specified on the **CF1R**.*
☐ No Gap/Voids	2. *No gaps or voids between the insulation and framing.*
☐ Studs Filled	3. *Gaps between studs shall be filled with insulation.*
☐ Batt-Ends Cut	4. *Batt - ensure the ends are cut so there are no gaps.*
☐ Batt-No Gaps	5. *Batt - insulation is cut around obstructions like electrical boxes and no gaps exist.*
☐ Batt:Compression	6. *Batt - insulation is not compressed (no stuffing of the insulation into the cavity).*
☐ Batt:Delaminated	7. *Batt insulation is delaminated around all plumbing and electrical lines in ceilings, walls and floors.*
☐ Air Barrier	8. *An air barrier is installed at all exposed edge faces of batt, loose fill and SFP insulation.*

	o This is to stop air movement into the insulation and to ensure full depth of insulation. o Typical locations where this occurs is on top of knee walls, around fireplace and flues. o SPF does not require an air barrier if it can be installed to its full depth.
☐ Loose-Fill	9. *Loose-fill insulation installed to the minimum installed weight per ft2 per the manufacturer's labeled R-value specification.*
☐ SPF-Adhered	10. *SPF insulation shall be spray-applied to fully adhere to structural assembly framing, floor and ceiling joists, and other framing surfaces within the construction cavity.*
☐ SPF-Adhered	11. *SPF - with multiple layers applied, each foam lift (i.e. spray application) adheres to the substrate and foam interfaces.*
☐ SPF-ESR#	12. *SPF - if values other than R-5.8 per inch for closed-cell SPF (ccSPF) and R-3.6 per inch for open-cell SFP (ocSPF) are used, the ICC Evaluation Service Report (ESR) number (e.g. ESR-xxxx) will be documented on the **CF2R-ENV-03.***
☐ ccSPF-Air Barrier	13. *ccSPF - in areas where an air barrier is required the foam is at least 2 inches thick.*
☐ ocSPF-Depressions	14. *ocSPF depressions in the foam insulation surface are not greater than 1-inch of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.*
☐ ocSPF-Filled	15. *ocSPF insulation completely fills cavities of 2x4 inch framing or less.*
☐ ocSPF-Filled	16. *ocSPF cavities greater than 2x4 inch framing are filled to the thickness that meets the required R-value used for compliance.*
☐ SPF-Air Barrier	17. *SPF installed as an air barrier is sprayed at a minimum of 5.5 inches in thickness for open cell and 2.0 inches for closed cell.*
☐ CF2R-ENV-03	18. *The insulation installer provided a **CF2R-ENV-03**. Labels or specification/data sheets are attached to the CF2R-ENV-03 for each insulating material. The material datasheet for the installed material meets the performance specifications of the required R-Values. Blown in material also includes insulation material bag labels or coverage charts.*

C. Ceiling/Roof Insulation

☐ Top Plates	1. *Insulation extends to the outside edge of the exterior top plates and is flush against any ventilation dams/baffles.*
☐ Ceiling	2. *Insulation is in direct contact with ceiling so there are no gaps between the ceiling and the insulation.*
☐ Chimney/Flue	3. *Chimneys and flues (except for zero clearance) require sheet metal collar around the stack. The collar must be at least as tall as the depth of the insulation. The collar shall be 1" from the chimney/flue for double wall vent, and 6" from the chimney/flue for single wall vent" unless manufacturer requires otherwise. The collar must be sealed to the ceiling with high temperature sealant to prevent air leakage. The insulation is in contact with the sheet metal collar.*
☐ Eave Ventilation	4. *Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent is maintained*
☐ Vent Baffles	5. *Eave vent baffles are installed to prevent air movement under, or into, the ceiling insulation.*
☐ Can Lights	6. *Recessed downlights are covered with insulation. If they are not covered to the same depth as required by the CF1R for ceiling insulation, then an area weighted calculation is required. Recessed downlights are AT and IC rated.*
☐ SPF-Can Lights	7. *SPF insulation shall not be applied directly to recessed lighting fixtures. Recessed downlights where SPF insulation is installed shall:* *(a) be covered with a minimum of 1.5 inches of mineral fiber insulation, or* *(b) be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8 inch hard board or gypboard. Hard board or gypboard do not cause a recessed downlights to meet the zero clearance insulation contact requirements.*
☐ Walkways and Mechanical Platforms	8. *Walkways and mechanical platforms are insulated to the same R-value as required by the CF1R for ceiling insulation. If not, an area weighted calculation is completed and turned in with this compliance document.*
☐ Hard Cover	9. *Soffits, chasses, drops have a sealed hard cover and the insulation is in direct contact with the*

	hard cover.
☐ Knee Walls	*10. Knee walls – an air dam the full depth of the ceiling insulation is added to the exterior edge of the knee wall so the ceiling insulation overlaps the knee wall to the full depth of the ceiling insulation.* o The dam must be at least the same depth as the attic insulation to ensure full depth and to stop air migration into the insulation. 
☐ Attic Access	*11. Attic access doors are insulated to the same R-value required by the CF1R for roof insulation and the insulation is permanently attached using adhesive or mechanical fasteners. Preferred method is rigid insulation.*
☐ Attic Access	*12. Attic access forms airtight seal from conditioned space to unconditioned space. Vertical attic access requires mechanical compression using screws, or latches.*
☐ Attic Access	*13. Attic access must have a dam around the access to at least the same depth as the insulation.* o A dam must be installed around the attic access that is at least the same depth as the attic insulation to ensure full depth around the attic access. o Most insulation manufacturer instructions require a rigid dam around the attic access for all types of insulation. Check insulation manufacturer instructions. o For R38 most insulation would require a 13 ¾ to 14 ½" dam. R48 would require a 17" dam in most situations. o The depth of the dam would be measured from the ceiling to the top of the dam.
☐ Bracings/Truss	*14. Insulation batts must be cut to fit around cross bracings and truss webs.*
☐ Attic Rulers	*15. Attic rulers appropriate to the material are installed and evenly distributed throughout the attic to verify Depth (one ruler for every 250 ft2) The rulers are clearly readable from the attic access and scaled to read inches of insulation and the R-value installed.*
☐ Loose-fill and SPF	*16. Loose-fill and SPF insulation - a HERS rater shall measure the installed thickness (include low and high areas) and density of insulation in at least 6 random locations on walls, roof/ceilings and floors to ensure minimum thickness levels and the installed density meets the R-value specified on the CF1R, and are consistent with the manufacturer's coverage chart.*
☐ Steel Framing	*17. Steel-framed kneewalls, skylight shafts, and gable ends, external surfaces of steel studs are covered with insulation*
D. Wall Insulation	
☐ Filled Cavity	*1. Batts, loose fill mineral fiber, mineral and natural wool, and cellulose: fills cavity and is in contact with air barrier on six sides.*
☐ ocSPF: 2x4	*2. ocSPF: completely fill cavities of 2x4 inch framing or less. Not required to fill cavities greater than 2x4 inch framing unless required to meet R-value.*
☐ ccSPF: R-value	*3. ccSPF: insulation is not required to fill the cavities of framed assemblies unless required to meet R-value.*
☐ Double Walls and	*4. Double walls and bump-outs - insulation fills the cavity, or additional air barrier is installed so the*

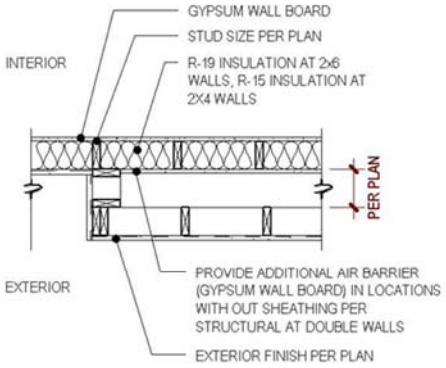
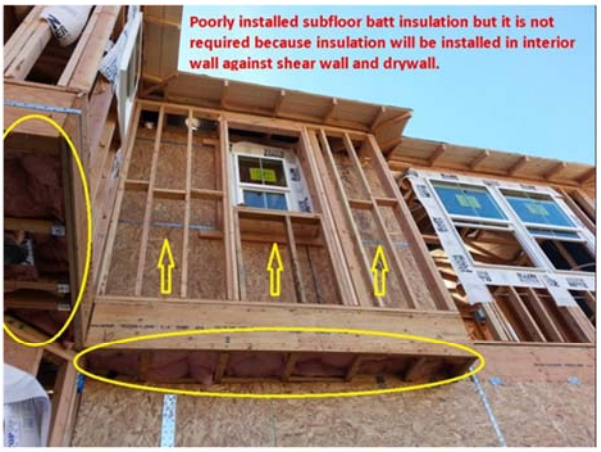
Bump Outs	*insulation fills the cavity and is in contact with the insulation on all six sides unless SPF is used. Insulation shall be installed on the exterior of the double walls/bump-outs.* o All wall insulation must be in contact with the air barrier on all six sides, unless SPF is used. o Allowed materials that can be used as the interior air barrier are listed in the CF2R-ENV-21 and must be installed per manufacturer instructions. Verify if house wrap manufacturer instructions allow material to be installed in these locations. o To keep the integrity of the building envelope it is best to keep the air barrier and insulation in one continuous plane. In situations where there is a double wall or bump out it is best to keep the insulation on the interior wall. An air barrier must be added to the exterior of the insulation so it is in contact with air barrier on all six sides. The form will be changed in the future to not require insulation on the exterior.    *Figure 1 In this example 2 inch spacers are added to the exterior air barrier. Insulation is only required on the interior side of the air barrier not between the spacers.*

	 *Figure 2 In this example it would be best to insulate the interior wall. An air must be added to the interior wall that is sealed to the bottom plate, top plate, and all penetrations sealed. Ensure interior bottom plate is sealed to subfloor.*
☐ Windows and Doors	5. *Low expanding foam used around windows and doors, if allowed by the manufacturer. If not allowed fill cavity with insulation. Batts are not allowed to be stuffed into space.*
☐ Electrical Panel	6. *Electrical panel in exterior insulated wall the panel is air tight and insulation is installed behind the panel.* o When an electric panel is installed on insulated wall the panel must be sealed. o Seal parameter of electrical panel to the exterior air barrier. o Seal all openings in the panel. o Use tape, caulk or foam. Ensure sealing products do not enter into the electrical pane.
☐ Skylights and Knee Walls	7. *Skylight shafts and attic knee wall insulation must meet all the requirements for walls and is in contact with the air barrier on six sides unless SPF is used.*
☐ Skylights and Knee Walls	8. *Skylight shafts and attic kneewalls insulation shall be in full contact with the drywall or other interior wall finish. Batt insulation must be cut to fit around 2x4's that are laid flat.*
☐ Skylights and Knee Walls	9. *Skylight shafts and attic kneewalls shall be completely enclosed by vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.*
☐ Band/Rim Joists	10. *Band/Rim joists are insulated to the same R-value as the wall.*
E. Raised Floor Insulation Quality	
☐ Subfloor	1. *Insulation is in full contact with subfloor.*
☐ Hangers	2. *Insulation hangers are spaced at 18 inches or less, insulation hangers do not compress insulation.*
☐ Netting/Mesh	3. *Netting, or mesh, can be used if the cavity under the floor is filled and in contact with the subfloor.*
☐ Conditioned Basements	4. *When daylight basements are adjacent to crawlspaces, if the basement is conditioned the walls adjacent to the crawlspace are insulated to the R-value listed on the CF1R. This includes framed stem walls, and vertical concrete retaining walls.*
☐ Crawlspace Access	5. *If access to the crawlspace is from the conditioned area the raised floor includes an airtight insulated access hatch. Where possible locate crawl space access from the exterior.*
F. Floor Above Garage Insulation Quality	
☐ Subfloor	1. *Insulation must be in full contact with subfloor if the air barrier is at the band joist at the garage house wall.*
☐ Hangers	2. *Insulation hangers spaced at 18 inches or less, insulation hangers must not compress insulation.*
☐ Netting/Mesh	3. *Netting or mesh can be used if the cavity under the floor is filled and in contact with the subfloor.*
☐ Subfloor of Floor Above	4. *If air barrier is at the perimeter of the garage below the conditioned subfloor then the insulation may be placed on the garage ceiling. Perimeter of subfloor must also be insulated.*

G. Cantilevered Floor Insulation Quality	
☐ Subfloor	1. *Insulation is in full contact with cantilevered subfloor. Insulation hangers are spaced at 18 inches or less, insulation hangers do not compress insulation. Netting or mesh can be used if the cavity under the floor is filled and in contact with the subfloor.*
☐ Blocking	2. *Sealed Blocking shall be installed between joists where the wall rim joist would have been located in the absence of a cantilever. Insulation shall be placed on both sides of this block.*
H. Attached Porch Roof Insulation Quality	
☐ Exterior Wall	1. *Exterior wall at the intersection of the porch roof is fully insulated above, below and behind the roof line.*
☐ Truss Framing	2. *Where truss framing is used, airtight blocking is used at the top and bottom of each wall/roof section and insulated.*

Construction Stage: Insulation Installation (NOT Traditional Stick Built)
Compliance Form: CF2R/CF3R-ENV-24-H

QII – Air Infiltration Sealing - Framing Stage for SIP and ICF

A. Installation

☐ R-Value	1. *The R-value of all SIP/ICF products is the same or better than listed on the **CF1R**.*
☐ Density	2. *If modeled on the **CF1R**, the density of the installed product is the same as installed.*
☐ Manufacturer's Instructions	3. *SIP/ICF products have been installed per manufacturer installation instructions.*

B. Raised Floor

☐ Gaps	1. *All gaps in the raised floor are sealed.*
☐ Chases	2. *All chases sealed at floor level using a hard cover, and the hard covers are sealed.*
☐ Penetrations	3. *All Plumbing and electrical wires that penetrate the floor must be sealed.*
☐ Subfloor	4. *Subfloor sheathing is glued or sealed at all exterior panel edges, to create a continuous air tight subfloor.*

C. Walls/Knee Walls

☐ Multiple floors	1. *Exterior walls are sealed to every floor on every story.*
☐ Gaps	2. *All gaps around windows and doors are sealed. Proper sealant used was as specified by window manufacturer.*
☐ Gaps Insulated	3. *All gaps around windows and doors are filled with insulation. Batt insulation is not allowed to be stuffed into gap.*
☐ Penetrations	4. *All plumbing and wiring penetrations through the top and bottom of panels, and electrical boxes that penetrate the wall are sealed.*
☐ SIP Joints	5. *All SIP panel joints sealed at the interior of the wall and the exterior of each panel.*
☐ Exhaust Fans	6. *Fan exhaust ducts that run between conditioned floors to exterior walls must include a damper at the exterior wall.*
☐ Headers	7. *Header sealed to wall with continues foam, or caulk per manufacturer directions.*
☐ Knee Walls	8. *Knee walls have solid and sealed blocking at the bottom, top, left side and right side of the knee wall.*

D. SIP Ceiling (Non-Vented)

☐ Vented Attics	1. *For vented attics use the **CF2R/ CF3R-ENV-22**.*
☐ Penetrations	2. *For non-vented attics ensure all penetrations through the roof deck and gable ends are sealed and air tight.*

E. Conditioned Space Above or Adjacent to Garage Air Barrier

☐ See B. Raised Floors above	1. *All penetrations in the subfloor above the garage into conditioned space must follow the raised floor air barrier requirements above.*
☐ Infiltration	2. *Infiltration between the space above the garage and subfloor is prevented by one of the two following methods:* o Seal all edges of garage ceiling (typical drywall) at the perimeter of the garage to create a continuous air tight surface between the garage and adjacent conditioned envelope. Seal all plumbing, electric and mechanical penetrations between the garage and the adjacent conditioned space on. For an open-web truss, airtight blocking must be added on four sides of the garage perimeter. Insulation can be placed on the garage ceiling. o Seal band joist above the wall at the garage to conditioned space transition. Seal all subfloor seams and penetrations between the conditioned space and the garage. Insulation must be placed in contact of subfloor below conditioned space.

F. Cantilevered Floor Air Barrier	
☐ Blocking	1. *Airtight blocking shall be installed between joists where the wall rim joist would have been located in the absence of a cantilever.*
☐ Sheathing	2. *Exterior sheathing shall be installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R-value as for the subfloor.*
☐ Penetrations	3. *Any gaps, cracks or penetrations in the air barrier of the cantilever shall be sealed. Recessed down lights in the cantilever is IC and AT rated and properly sealed to sheathing.*
G. Multifamily Air Barrier	
☐ See A – F Above	1. *Multifamily buildings require all the above plus each unit. When fire rating is required, fire barrier putty pads should be used per the manufacturer's instructions.*
☐ Between Units	2. *Floor AND Ceiling of each Dwelling Unit – All penetrations through the floor and ceiling of each unit must be sealed including, electric and gas utilities, water pipes, drain pipes, fire protection service pipes, communication wiring etc.*
☐ Multi-Level Spaces	3. *Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatch, plumbing stacks, etc. sealed to reduce air transfer from attached spaces.*
☐ Common Walls	4. *Common Walls – Bottom plate between units must be sealed to the subfloor. All penetration in the common walls is sealed. Interior walls that open into the common walls must be sealed.*
☐ Chases at Units	5. *Vertical Chases – All vertical chases are sealed at the floor and ceiling of each unit so air cannot transfer from first floor to second floor around chase.*
☐ Vertical Chases	6. *Vertical Chases –The chases such as garbage chutes, elevator shafts, and HVAC ducting are sealed to stop air movement through the chase to surrounding spaces.*
☐ Hallways	7. *Common Hallways – Penetrations between dwelling unit and common hallways are sealed, including doors to the dwelling unit, are gasketed or made substantially airtight.*

All graphics not marked are from ENERGY STAR® 10-12-14 U.S. Environmental Protection Agency and U.S. Department of Energy and can be found at www.energystar.gov. and https://basc.pnnl.gov/

2016 Title 24 Part 6 QII Design Checklist

3.9.3019

Project QII Construction Process		
1	Design	QII is included as **energy feature in CF1R and supported in drawings** as a design feature. **Kickoff meeting** including Architect, Builder, HERS Rater, and all subs (insulation, framer, drywall, plumbing, HVAC. Etc. installers) so that the QII inspection schedule and process can be explained and supported before design drawings are complete.
2	Building Permit	**CF1R registered** through HERS provider and incorporated into submittal set. **HERS Rater** to confirm verification procedure (sampling procedures is applicable) with team.
3	Grading	HERS Rater to set up **inspection schedule** with all subs off site and **coordinate with insulation installer** verification requirements and provide tools and resources to support inspection process.
4	Framing	To be **coordinated** by HERS Rater: • **Framer incorporating continuous air barrier** requirements • All **hard covers and draft stops** to meet air barrier requirements • Set up inspection schedule with all other subs on site and coordinate with insulation installer for inspections
5	Rough-In	To be **inspected and verified** by HERS Rater and documented **with CF2R/3R-ENV-21**: • Pre-Insulation inspection to **confirm continuous air barrier** w/insulation installer including all penetrations by various subs have been caulked and sealed
6	Insulation	To be **inspected and verified** by HERS Rater and documented **with CF2R/3R-ENV-22**: • **Batt insulation** inspections to confirm direct contact with air barrier
7	Drywall	To be **inspected and verified** by HERS Rater and documented **with CF2R/3R-ENV-22**: • **Loose-fill insulation** inspections to confirm direct contact with air barrier and meets R-value per manufacturer's instructions • **All penetrations caulked and sealed** of all provided to maintain continuous air barrier in addition to **sealing of drywall**
8	Finish	All **CF2R/CF2R forms** to be finished up and **registered through HERS** provider so that final inspection can be scheduled.
9	Final Inspection	All registered CF2R (provided by the Contractors) and CF3R (provided by the HERS Rater) forms are to be **provided to the building occupant**.

QII Note Block

Common Thermal Specifications

- ☐ Materials shall comply with, and be installed in conformance with, all applicable building codes for building. California Building Code (including, but not limited to, California Electric Code Section 719) and installed to meet all applicable fire codes.
- ☐ Materials shall meet California Quality Standards for Insulating Material, Title 24, Part 12, Chapter 4, Article 3, listed in the California Department of Consumer Affairs Consumer Guide and Directory of Certified Insulating Materials.
- ☐ Materials shall comply with flame spread rating and smoke density requirements of Chapter 26 and Section 706 of the Title 24, Part 2: all installations with exposed facings must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings that do not touch a ceiling, wall, or floor surface, and faced batts on the undersides of roofs with an air space between the ceiling and facing are considered exposed applications.
- ☐ Materials shall be installed according to manufacturer specifications and instructions.
- ☐ Hard covers or draft stops shall be placed over all drop ceiling areas and interior wall cavities to keep insulation in place and stop air movement. If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.
- ☐ Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent shall be maintained.
- ☐ Eave vent baffles shall be installed to prevent air movement under or into the batt.
- ☐ Insulation shall cover all recessed lighting fixtures. If the fixtures are not rated for insulation cover (IC) and air tight, the fixtures shall be replaced. All recessed light fixtures that penetrate the ceiling shall be listed for zero

clearance insulation contact (IC), have a label that certifies it as airtight with leakage less than 2.0 cfm @ 75 Pa when tested to ASTM E283, and shall be sealed with a gasket or caulk between the light's housing and the ceiling.

- ☐ Insulation shall be installed so that they will be in contact with the air barrier.
- ☐ Insulation shall fill the cavity. Sized to fit, no compression, fill voids etc.

R-Value Measurement

- ☐ The HERS rater shall verify the installed thickness of insulation in all assemblies and locations on walls, roof/ceilings, and floors, and to ensure that insulation levels and installation integrity meet the R-value specified on the Certificate of Compliance, and all other required compliance documentation.

Walls

- ☐ Bottom plates of framed and non-framed and other wall type assemblies shall be sealed to the ground subfloor or slab, and above ground subfloor.
- ☐ Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space. All plumbing and wiring penetrations through the top and bottom plates and electrical boxes that penetrate the sheathing shall be sealed. All gaps in the air barrier shall be caulked, taped, or sealed with minimally expansive foam.

Windows

- ☐ All gaps around windows and doors are sealed. The sealant used follows window manufacturer specifications. Coordinate between trades who is responsible.

Rim-Joists

- ☐ All rim-joists shall be insulated to the same R-Value as the adjacent walls.

Kneewalls, Skylight Shafts, and Gable Ends

- ☐ Framing for kneewalls, skylight shafts and gable ends that separate conditioned from unconditioned space shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.
- ☐ The insulation shall be installed without gaps and with minimal compression.
- ☐ For steel-framed kneewalls, skylight shafts, and gable ends, external surfaces of steel studs shall be covered with insulation unless otherwise specified on the **CF1R Certificate of Compliance**.
- ☐ The house side of the insulation shall be in contact with the drywall or other wall finish.
- ☐ The insulation shall be supported so that it will not fall down by either friction fitting to the framing, inset or face stapling of flanges, or using other support such as netting.
- ☐ Insulation for all kneewall and skylight shafts shall be completely enclosed by vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.
- ☐ In unvented attics, where insulation is applied directly to the underside of the roof deck, kneewalls, skylight shafts, and gable ends shall be insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.

CF2R Certificate of Installations Forms

- ☐ The **CF2R-ENV forms (Insulation Certificate of Installation)** shall be signed by the SPF applicator stating that the installation is consistent with the plans and specifications for which the building permit was issued shall be provided. The certificate shall also state the installing company name, insulation manufacturer's name and material identification, and that the labeled installed nominal thickness, and installed R-value for SPF insulation meets those specified in Section 3, Thermal Specification. The SPF applicator shall also attach an R-value chart or an ICC ESR showing compliance with AC377 for each SPF insulation material used.
- ☐ **It is the installer's responsibility to ensure the products are installed properly, and it is the HERS rater's responsibility, as a Special Inspector to the Building Departments, to verify proper installation.**