2018 IECC with Hawaii Amendments
Low-rise Residential Requirements

Webinar
May 12, 2021

Presentation Collaborators

HAWAII STATE Energy Office
AIA Honolulu
ASHRAE Hawaii Chapter
Hawai'i Energy
HAWAII
BOMA HAWAII

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Section 2
Overview & Definitions

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Tropical Zone Compliance Path

Section 4
Envelope

Section 5
Ventilation

Section 6
Systems

Section 7
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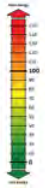

Section 9
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https://www.chgpowerwell.com/

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U.S. GREEN BUILDING COUNCIL USGBC HAWAII

BOMA HAWAII Building Owners and Managers Association

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

COURSE DESCRIPTION

This 90-minute webinar covers updates to the building energy code adopted by the State Building Code Council, moving Hawaii from the 2015 IECC to the 2018 IECC. The new code takes effect for State projects on December 14 of this year or earlier, and the date for other projects will depend on the adoption schedule in each county. This webinar will provide an overview of the low-rise residential code requirements with emphasis on the Hawaii amendments and updated requirements. Architects, engineers, project managers, county planning & permitting staff, developers and contractors are encouraged to attend.

LEARNING OBJECTIVES

At the end of this course, participants will be able to:

1. Identify applicable new requirements in the 2018 IECC, including Hawaii amendments
2. Determine applicability and requirements for the Tropical-Zone energy code compliance.
3. Identify complying energy-efficient residential envelope constructions.
4. Use energy code checklists to review designs for compliance

Introductions

Presenters

- Howard Wiig, State Energy Office
- Justin Bizer, Hawaii Energy
- Erik Kolderup, PE, Kolderup Consulting
- Peter Stone, Energy Consultant

Acknowledgments

- Sehun Nakama, Hawaii Energy
- Karen Shishido, Hawaii Energy
- Gail Suzuki-Jones, State Energy Office
- Kathy Yim, State Energy Office

Topics

Hawaii Energy Programs

Introduction & Scope

Overview & Definitions

Tropical Zone Option

Prescriptive Option

- Envelope
- Ventilation
- Systems
- Electrical & Lighting

Performance Compliance Options

Existing Building Compliance

- Additions
- Alterations

Hawaii Energy Incentives

RESIDENTIAL NEW CONSTRUCTION

New construction & major renovation projects can receive rebates for incorporating energy-efficient features into building designs and exceeding building code requirements.

Single Family Homes

Multifamily Projects

RESIDENTIAL NEW CONSTRUCTION

PRESCRIPTIVE APPROACH

Minimum Requirements

- LED Lighting
- 2 or more ENERGY STAR® Appliances
  - ENERGY STAR® certified (refrigerator, dishwasher, clothes washer, and clothes dryer)

Optional Incentives

- High SEER A/C
- Smart Thermostats
- Ventilation Fans (whole house fan)

RESIDENTIAL NEW CONSTRUCTION

FUTURE EFFORTS

- Increased involvement in the multifamily sector with potential enhanced incentives for affordable rental housing

- Include a performance based path to single family new construction (i.e. Home Energy Rating System Index)

Mahalo!

Stay Connected

Oahu: 537-5577 (Residential) **839-8880** (Business)

Neighbor Islands: 1-877-231-8222 toll-free

www.hawaiienergy.com

facebook.com/hawaiienergy @myhawaiienergy

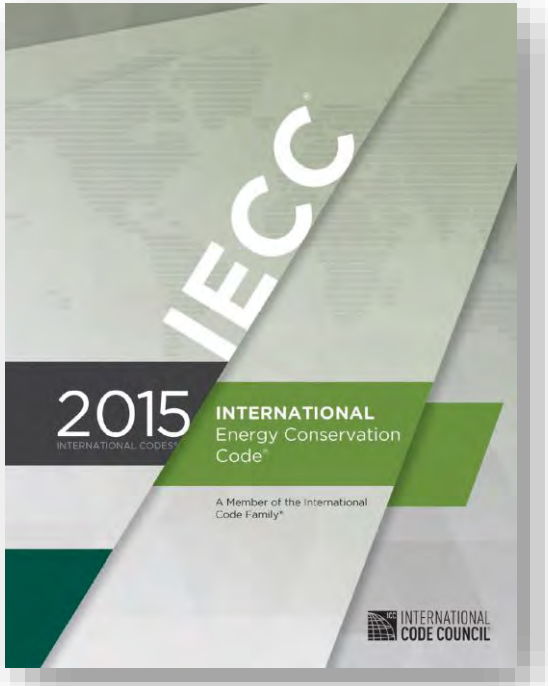
Next week!

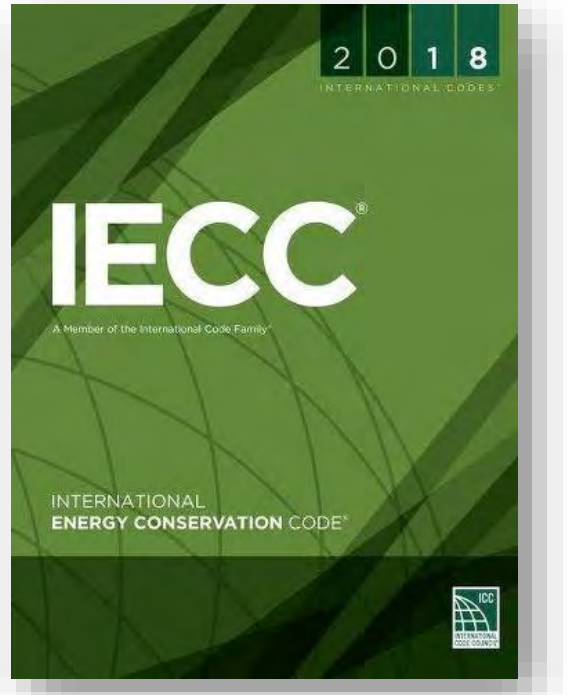
2018 IECC with Hawaii Amendments Commercial Requirements

Webinar
Wednesday, May 19, 2021
12:00 – 1:30pm

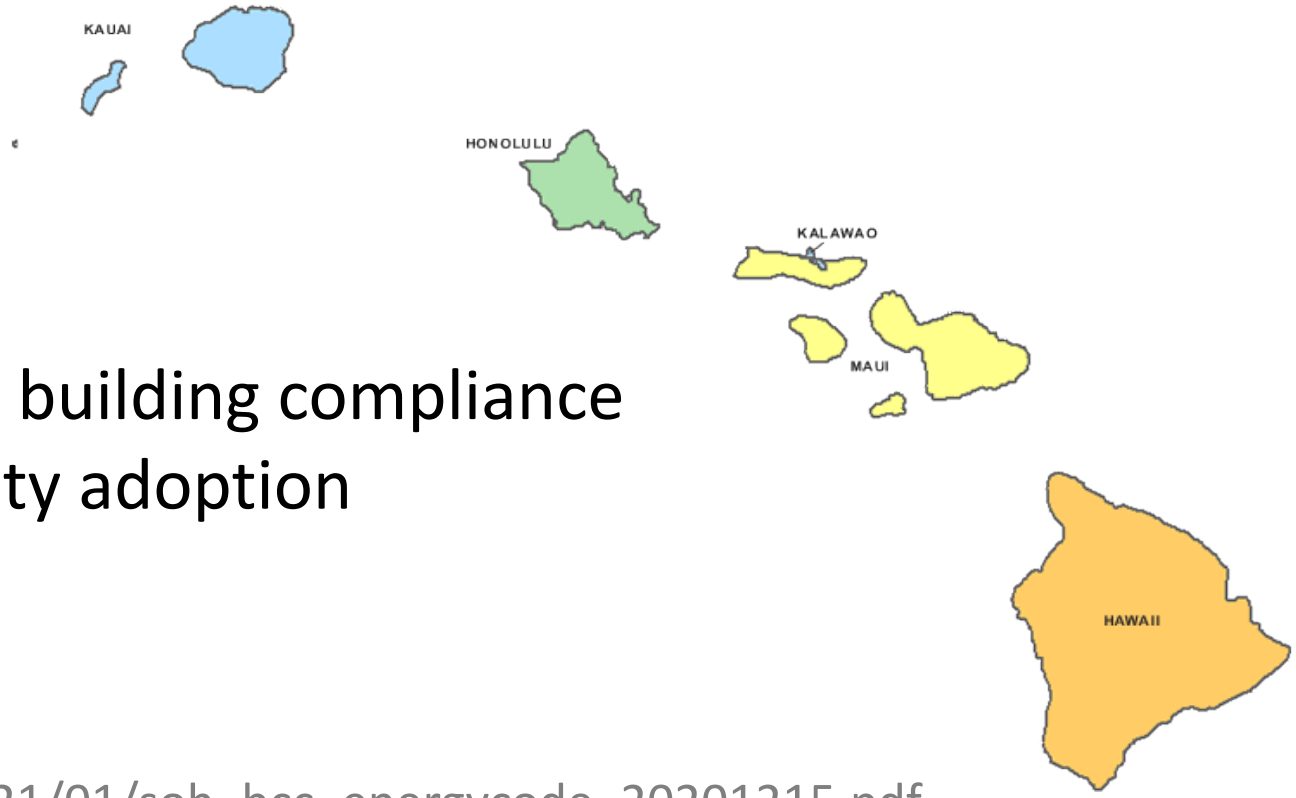
Section 1

Introduction & Scope





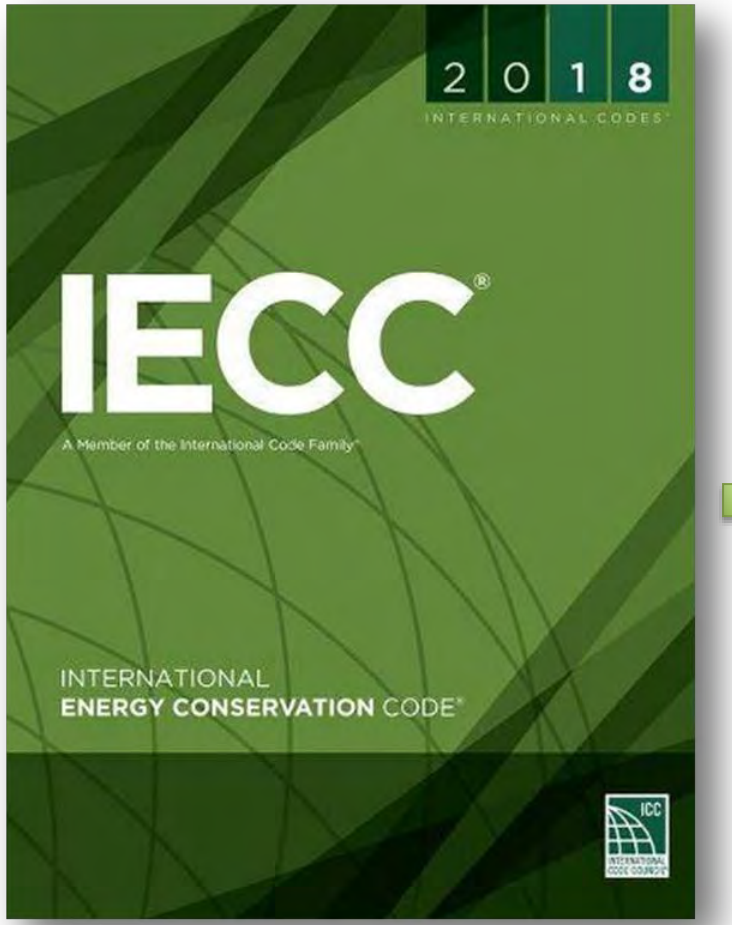
Adoption

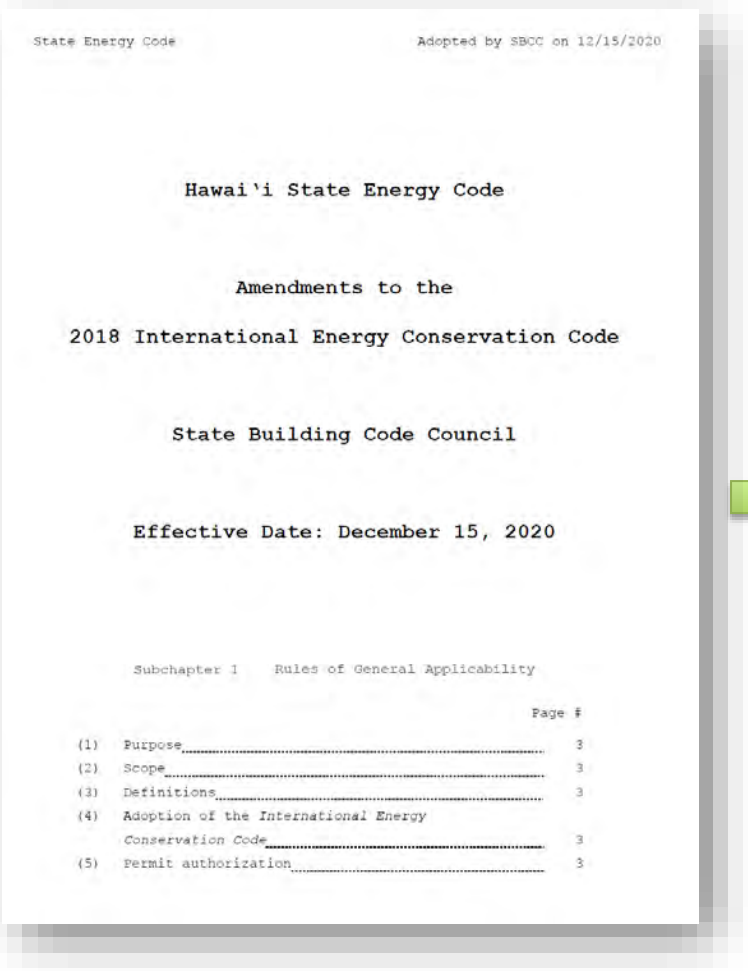


Dec. 15, 2020 – State adoption
Dec. 15, 2021 – Deadline for State building compliance
Dec. 15, 2022 – Deadline for County adoption

State amendments
https://ags.hawaii.gov/wp-content/uploads/2021/01/soh_bcc_energycode_20201215.pdf

2018 IECC
https://codes.iccsafe.org/content/iecc2018





State Energy Code — Adopted by SBCC on 12/15/2020

Hawai'i State Energy Code

Amendments to the

2018 International Energy Conservation Code

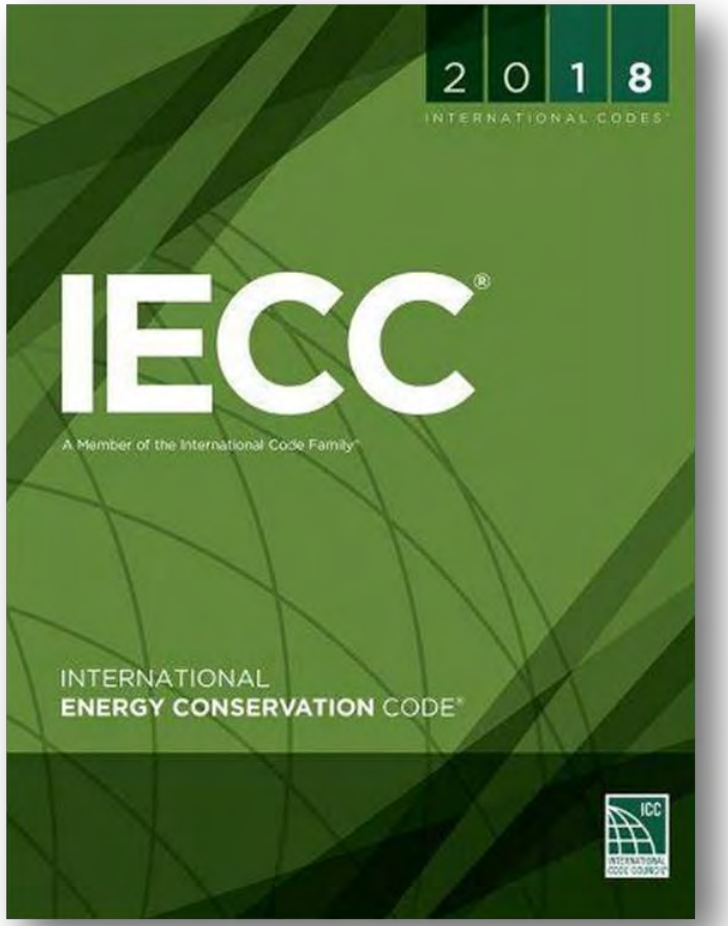
State Building Code Council

Effective Date: December 15, 2020

Subchapter 1 Rules of General Applicability

State amendments
12 pages

County amendments



Commercial Provisions

Chapter 1 – Scope and Administration

Chapter 2 – Definitions

Chapter 3 – General Requirements

Chapter 4 – Commercial Energy Efficiency

Chapter 5 – Existing Buildings

Chapter 6 – References Standards

Residential Provisions

Chapter 1 – Scope and Administration

Chapter 2 – Definitions

Chapter 3 – General Requirements

Chapter 4 – Residential Energy Efficiency

Chapter 5 – Existing Buildings

Chapter 6 – References Standards

Scope

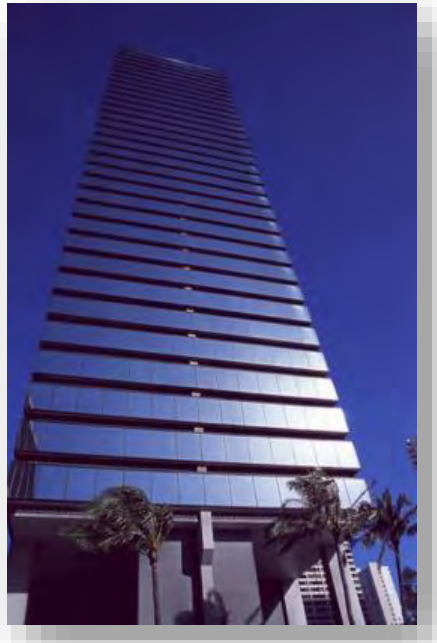
Residential

- 1- and 2-family dwellings (R-3)
- Multi-family (R-2 ≤ 3 stories)
- Residential care/assisted living (R-4 ≤ 3 stories)

Courtesy Daniel Sandomire, Armstrong Builders

Commercial

- All other buildings
  - Including R-1 (hotels) and R-2 ≥ 4 stories



Scope

Mixed use buildings

- Commercial code for commercial portion
- Residential code for residential portion
  ≤ 3 stories

https://www.drhorton.com/hawaii/oahu/ewa-beach/kohina-at-hoopili

Scope

New construction ➡

Additions (R502)

Alterations (R503)

- Change in space conditioning (R503.2)

Repairs (R504)

Change of occupancy (R505)

Applies to residential buildings and the building sites and associated systems and equipment.

Envelope

Air conditioning

Service hot water

Lighting

Compliance options

1. Tropical Zone
2. Prescriptive
3. Simulated performance alternative
4. Energy rating index

Scope

New construction

Additions (R502) ➡

Alterations (R503)

Change in space conditioning (R503.2)

Repairs (R504)

Change of occupancy (R505)

Options

1. New construction requirements for addition
2. Performance method for existing + addition
3. Existing + addition no more energy than existing

Envelope

Air conditioning

Service hot water

Lighting

Scope

New construction

Additions (R502)

Alterations (R503)

Change in space conditioning (R503.2)

Repairs (R504)

Change of occupancy (R505)

New construction requirements for altered portions

Several exceptions

Roof replacement (amendment), choose two:

1. R-30 insulation or cool roof
2. R-19 or cool roof (Tropical Zone)
3. Choose one
   1. Energy Star roof covering
   2. Radiant barrier
   3. Attic ventilation
   4. Two exceptions listed in C402.3

Scope

New construction

Additions (R502)

Alterations (R503)

Change in space conditioning (R503.2) ➡

Repairs (R504)

Change of occupancy (R505)

Nonconditioned or low-energy space that is altered to become *conditioned space* shall be required to be brought into full compliance.

Scope

New construction

Additions (R502)

Alterations (R503)

- Change in space conditioning (R503.2)

Repairs (R504) ➡

Change of occupancy (R505)

Compliance <u>not</u> required

- Routine maintenance
- Repairs exempt from permit
- Glass-only replacement
- Roof repairs
- Bulb and ballast replacement, if energy does not increase

Scope

New construction

Additions (R502)

Alterations (R503)

- Change in space conditioning (R503.2)

Repairs (R504)

Change of occupancy (R505) ➡

Compliance required

- Change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy, or
- Space is converted to a dwelling unit

Scope

Portions of buildings exempt from envelope requirements

- Peak AC energy demand less than 1.0 watt/ft^2
- Unconditioned space

2015 County Amendments

Kauai and Honolulu

- Peak AC energy demand less than 1.0 watt/ft^2
- Unconditioned space that does not contain habitable space

Maui adds

- Greenhouses, towers, walls, and similar uses

Hawai'i County adds

- Unconditioned dwellings with enclosed habitable areas less than 1,100 square feet
- Dwellings with permitted, off-grid, self supplying photovoltaic with battery back up

What’s changed vs. 2015?

2018 IECC vs. 2015 IECC

- High efficacy lighting 75% to 90%
- Pool cover exemption 70% to 75%
- Ducts buried in ceiling insulation

Changes vs. 2015 State amendments

- Deleted from IECC (left to Counties)
  - Certification
  - Construction documents
- Dropped required envelope compliance for habitable non-AC spaces
- Mass wall insulation exceptions
- Jalousie exempt
- Whole house fan as alternative to ceiling fans
- Roof replacement alternatives
- Mass wall points option table

What’s changed vs. 2015?

IECC Section	Description	Status
R103.1	Designer certification	Deleted (up to counties)
R103	Construction Documents	Deleted (up to counties)
R104	Fees	Deleted (up to counties)
R105	Inspections	Deleted (up to counties)
R108	Stop Work Order	Deleted (up to counties)
R109	Board of Appeals	Deleted (up to counties)
R401.2.1	Tropical Zone	Amended
R401.3	Sampling	Added
R402.1 & R402.2	Wall – mass (CMU or concrete)	Amended
R402.3	Windows	Amended
R403.5.5	Solar water heating	Added
R403.6.2	Ceiling fans	Added
R407	Points Option	Added
R503.1.1	Roof replacement	Amended

Resources

Checklist

RESIDENTIAL CHECKLIST
IECC 2018 with State Amendments

HAWAII STATE Energy Office

Hawaii Energy
YOUR CONSERVATION & EFFICIENCY PROGRAM

This checklist covers requirements of the 2018 IECC with State-adopted amendments, approved in December 2020. Check with individual Counties for County - adopted versions of the code. See https://energy.hawaii.gov/hawaii-energy-building-code.

Red text in this checklist indicates changes between this 2018 version of the code and the previous 2015 IECC with Hawaii Amendments.

SCOPE

Detached one- and two-family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane. The code applies to new construction, additions and alterations. See a separate Commercial Checklist for high-rise residential and commercial buildings.

RESIDENTIAL COMPLIANCE OPTIONS

Tropical Zone	Prescriptive	Simulated Performance Alternative	Energy Rating Index Compliance Alternative
Allowed when: 1. ≤50% air conditioned, 2. not heated, and 3. elevation < 2,400 feet.	Includes three options for walls and roof compliance: 1. Prescriptive 2. Total UA (typically with ResCheck software) 3. Points option (added by Hawaii amendment)	Simulated energy performance analysis for heating, cooling and SHW. Proposed design must have annual energy cost less than or equal to energy cost of reference design.	Third-party Home Energy Rating System (HERS) calculation. Allows the designer to pick and choose from many efficiency options. Scores range from 100 to 0. The 100 score indicates compliance with the 2006 IECC. Each efficiency measure beyond 2006 lowers the score. A passing score for Climate Zone 1 is 57.
See Tropical Zone Checklist below	See Prescriptive Checklist below. See Points Option tables below.	See code Section R405	See code Section R406

CHECKLIST CONTENTS

Sponsor: Hawaii State Energy Office

Acknowledgment: This material is based upon work supported by the Department of Energy under Award Number EE0006986

Resources

Checklist

PRESCRIPTIVE REQUIREMENTS CHECKLIST

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
Roof – wood frame	☐ **R-30**, ☐ **U-0.035**, ☐ Total UA alternative, or ☐ Points option	R402.1, R402.1.5, R407*	Some R-30 options: • 10 in. batt insulation	☐ Insulation location on plans ☐ Insulation R-value on plans
Roof – metal truss	☐ **R-38**, ☐ **U-0.035**, ☐ **R-30** + **R-3**, ☐ **R-26** + **R-5**, ☐ *Total UA alternative*, or ☐ *Points option*	R402.1, R402.2, R402.1.5, R407*	Metal frame creates a thermal bridge, and more insulation is required. "R-3" and R-5" refer to continuous insulation, typically foam board.	☐ Insulation location on plans ☐ Insulation R-value on plans
Roof – metal joist	☐ **R-38** in 2x4, 2x6 or 2x8 framing, ☐ **R-49** in any framing ☐ *Total UA alternative*, or ☐ *Points option*	R402.1, R402.2, R402.1.5, R407*		☐ Insulation location on plans ☐ Insulation R-value on plans
Wall – wood frame	☐ **R-13**, ☐ **U-0.084**, ☐ *Total UA alternative*, or ☐ *Points option*	R402.1, R402.1.5, R407*	Some R-13 options: • 3.5 in. batt insulation • 2 to 3.5 in. spray foam	☐ Insulation location on plans ☐ Insulation R-value on plans
Wall – metal frame	Framing 16 in. on center: ☐ **R-13** + **R-4.2** ☐ **R-21** + **R-2.8** Framing 24 in. on center: ☐ **R-13** + **R-3.0** ☐ **R-15** + **R-2.4** ☐ *Total UA alternative*, or ☐ *Points option*	R402.1, R402.2, R402.1.5, R407*	Requires insulation in framing cavity plus a layer of continuous insulation (typically foam board).	☐ Insulation location on plans ☐ Insulation R-value on plans
Wall – mass (CMU or concrete)	☐ **R-3** exterior, ☐ **R-4** interior, ☐ **U-0.197**, ☐ Exterior reflectance ≥**0.64**, ☐ Overhang projection factor ≥**0.3**, ☐ Mass wall thickness ≥ **6** inches, ☐ *Total UA alternative*, or ☐ *Points option*	R402.1*	Requires either exterior or interior insulation, typically foam board. CMU integral insulation does not comply. Hawaii amendments add several alternatives .	☐ Insulation location on plans ☐ Insulation R-value on plans

Asterisk = State amendment

Red text = change vs. 2015

RESIDENTIAL pg. 4 of 13 May 2021

Resources

Past training materials

Home » Hawaii Energy Building Code Training

HAWAII ENERGY BUILDING CODE TRAINING

The Hawaii State Energy Office and allied professional organizations sponsor free training sessions on energy building code requirements.

July 2020: Dueling UV Pulses: The Most Efficient Way of Zapping the COVID Virus?

June 2020. Honolulu Amendments to the 2015 International Energy Conservation Code

April 2020. Residential Requirements of the 2015 IECC with County Amendments

March 2020. Energy Modeling for 2015 IECC Compliance and Net Zero Design

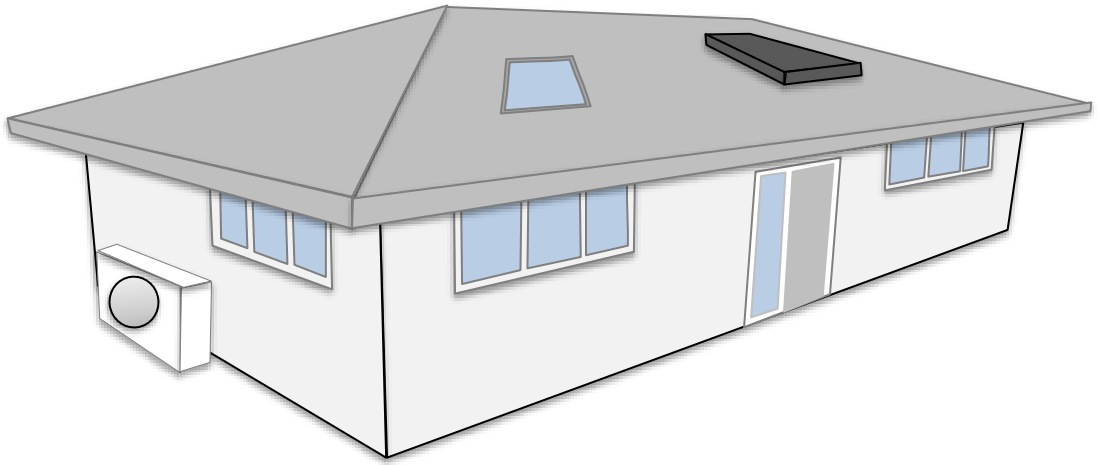
August 2019. Training of Hawaii's 2015 IECC County Amendments and Envelope Design

April 2018. International Energy Conservation Code Training

https://energy.hawaii.gov/building-code-training

Section 2

Overview & Definitions



What's covered

Envelope

Roof
Walls
Window & skylights
Air leakage

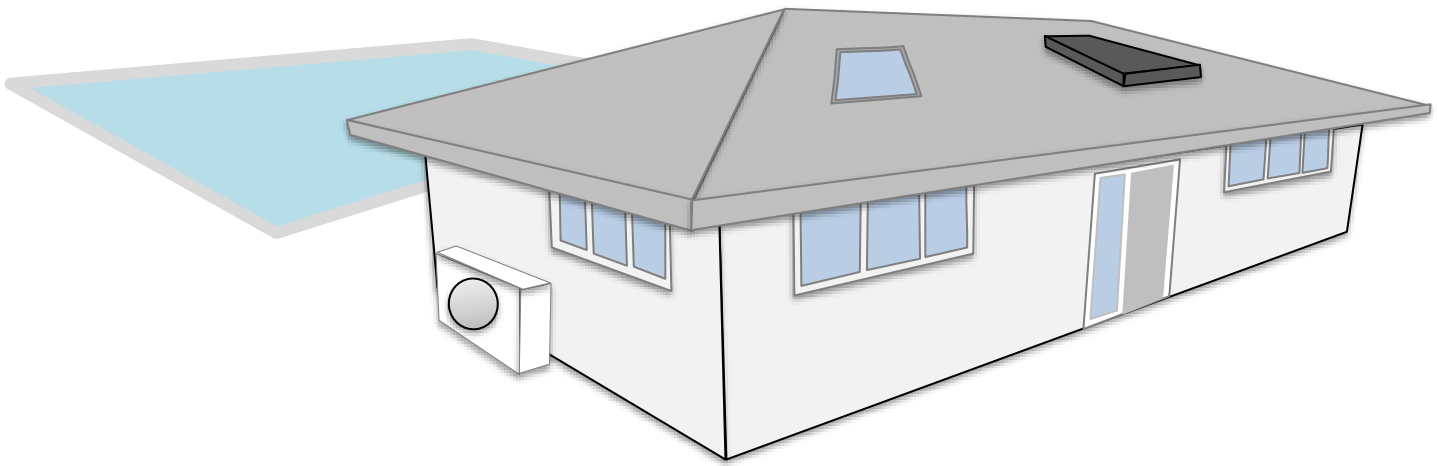
Systems

Air conditioning controls
Duct insulation
Duct leakage
Water heating
Swimming pool

Electrical

Permanently installed lighting
Ceiling fan
~~EV readiness~~
~~PV readiness~~

Up to counties for 2018



Not covered

AC efficiency
Water heater efficiency
Plug-in lighting
Appliances

Definitions

R-value

U-factor

Solar heat gain coefficient (SHGC)

Projection factor (PF)

Solar reflectance

Thermal emittance

Definitions

R-value ➡

U-factor

Solar heat gain coefficient (SHGC)

Projection factor (PF)

Solar reflectance

Thermal emittance

Thermal resistance
(Btu/hr-ft^2-F)

Definitions

R-value

U-factor ➡

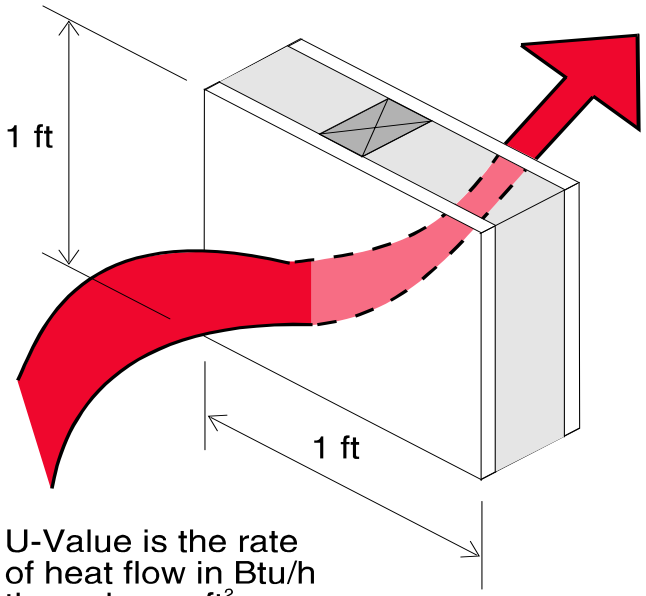
Solar heat gain coefficient (SHGC)

Projection factor (PF)

Solar reflectance

Thermal emittance

Thermal transmittance
(hr-ft^2-F/Btu)



U-Value is the rate of heat flow in Btu/h through one ft^2 area when one side is 1° F warmer

$$U = 1/R$$

$$Q = U \cdot A \cdot \Delta T$$

Heat flow (Btu/hr) = U-factor * area * (Outdoor temperature – Indoor Temperature)

Definitions

R-value

U-factor

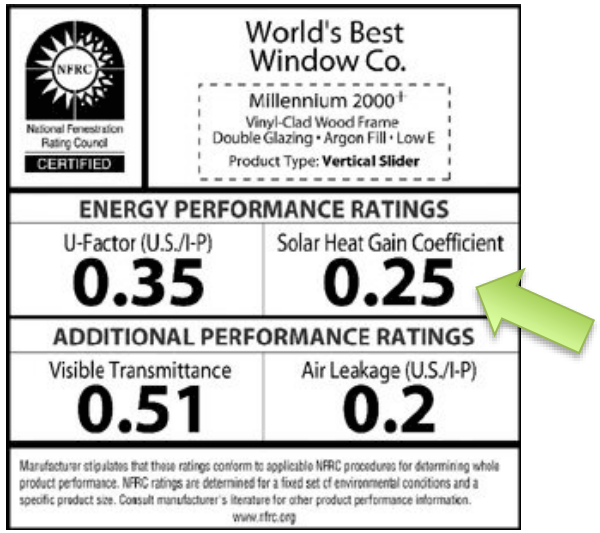
Solar heat gain coefficient (SHGC) ➡

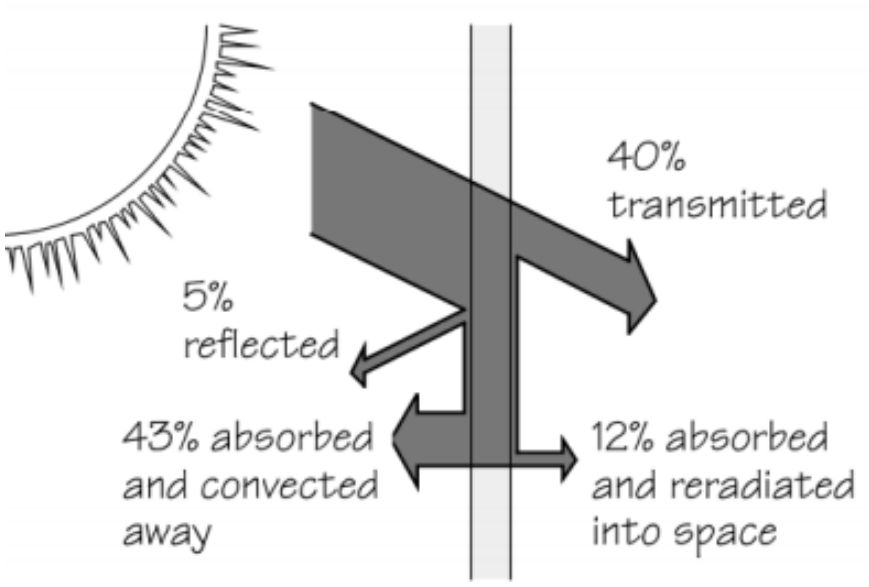
Projection factor (PF)

Solar reflectance

Thermal emittance

$$\text{SHGC} = \frac{\text{Solar heat gain entering the space}}{\text{Incident solar radiation energy}}$$





http://windows.lbl.gov/software/NFRC/SimMan/NFRCSim6.3-2013-07-Manual.pdf

Definitions

R-value

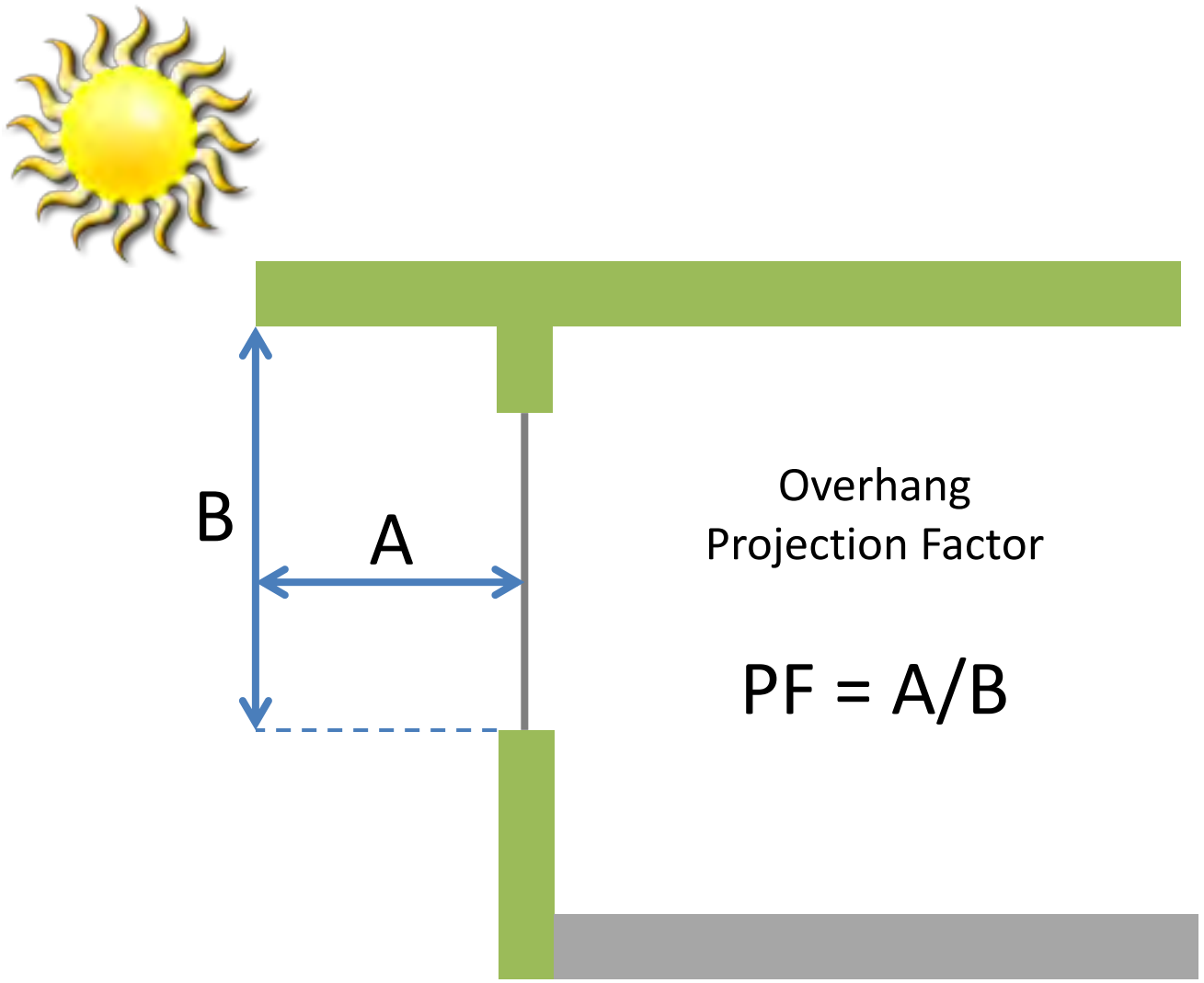
U-factor

Solar heat gain coefficient (SHGC)

Projection factor (PF) ➡

Solar reflectance

Thermal emittance



Definitions

R-value

U-factor

Solar heat gain coefficient (SHGC)

Projection factor (PF)

Solar reflectance ➡

Thermal emittance

Percentage of solar energy reflected by a surface

http://coolroofhawaii.com

Definitions

R-value

U-factor

Solar heat gain coefficient (SHGC)

Projection factor (PF)

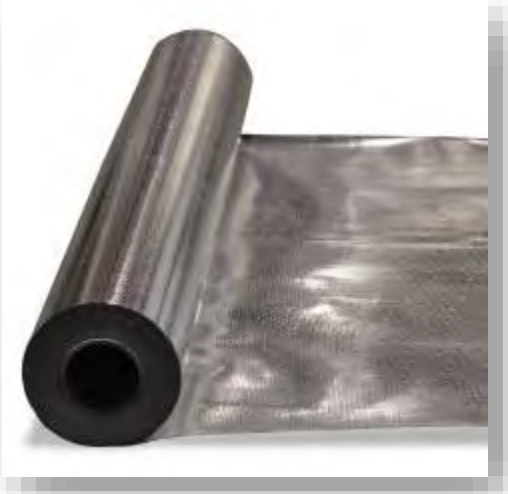
Solar reflectance

Thermal emittance ➡

$$\varepsilon = \frac{\text{Radiation emitted by a given material}}{\text{Radiation emitted by a black body at the same temperature}}$$

ε = 0.8 – 0.9 typical

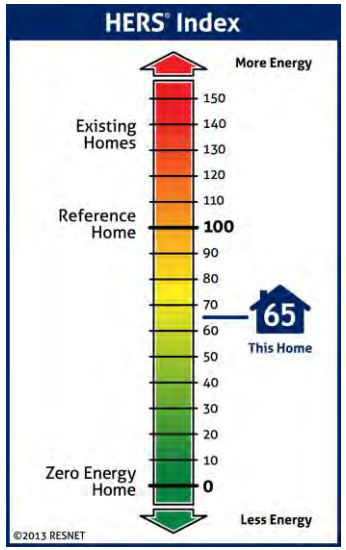
ε < 0.1 for “low-e” surfaces, polished metal



Compliance options - residential

1. Tropical Zone
   - ≤50% air conditioned
   - not heated
   - elevation < 2,400 feet
2. Prescriptive
   - Envelope (+ Points Option)
   - Systems
   - Electrical power and lighting systems
3. Simulated performance alternative
   - Proposed design energy cost ≤ standard reference design
4. Energy rating index (ERI)
   - ERI ≤ 57

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value	Floor R-Value	Basement R-Value	Slab R-Value	Crawl Space Wall R-Value
1	NR	0.75	0.25	30	13	3/4	NA[1]	0	0	0



Section 3

Tropical Zone Compliance Path

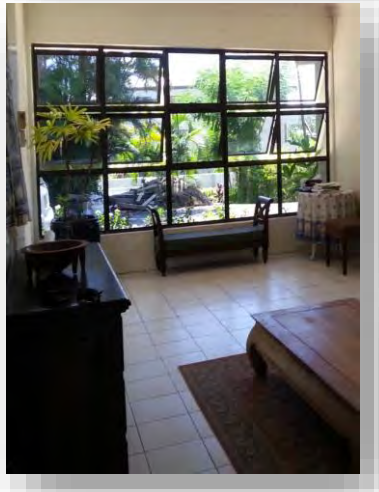
Tropical Zone Option (R401.2.1)

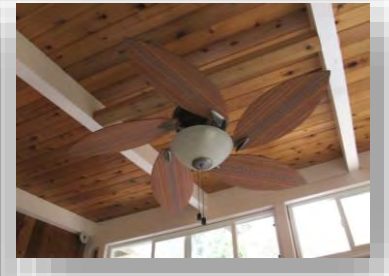
Can use this path if

- ≤50% air conditioned,
- not heated, and
- elevation < 2,400 feet

Requirements

- Roof insulation (credit for cool roof)
- Windows SHGC (overhang and jalousie exceptions)
- Skylight U-factor
- Natural ventilation window openings and interior door latches
- Ceiling fans or whole-house fan
- Solar water heating
- High efficacy lighting
- Envelope sealing for AC areas





Tropical Zone Option (R401.2.1)

State amended version

R401.2.1 Tropical zone. *Residential buildings* in the tropical zone at elevations below 2,400 feet (731.5 m) above sea level shall be deemed to comply with this chapter where the following conditions are met:

1. Not more than one-half of the dwelling unit is air conditioned
2. The *dwelling unit* is not heated.
3. Solar, wind or other renewable energy source supplies not less than 90 percent of the energy for service water heating.
4. Glazing in *dwelling units* shall have a maximum *solar heat gain coefficient* as specified in Table R402.1.2.

Change vs. 2015

Window SHGC Requirements

Projection Factor of overhang from base of average window sill	SHGC
< .30	.25
.30 - .50	.40
≥.50	N/A

Exception: North-facing windows with pf > .20 are exempt from the SHGC requirement. Overhangs shall extend 2 feet on each side of window or to nearest wall, whichever is less.

5. Skylights in dwelling units shall have a maximum U-factor as specified in Table R402.1.4.
6. Permanently installed lighting is in accordance with Section R404.
7. The roof/ceiling complies with one of the following options:
   a. Comply with one of the roof surface options in Table C402.3 and install R-13 insulation or greater.
   b. Install R-19 insulation or greater.
8. Roof surfaces have a minimum slope of ¼ inch per foot of run. The finished roof does not have water accumulation areas.
9. Operable fenestration provides ventilation area equal to not less than 14 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
10. Bedrooms with exterior walls facing two different direction have operable fenestration or exterior walls facing two different directions.
11. Interior doors to bedrooms are capable of being secured in the open position.
12. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as bedroom.
13. Walls, floors and ceilings separating air conditioned spaces from non-air conditioned spaces shall be constructed to limit air leakage in accordance with the requirements in Table R402.4.1.1.

Tropical Zone Option (R401.2.1)

Motivations behind the Tropical Zone Option

- Efficiency
  - Little or no AC
  - Solar water heating
  - High efficacy lighting
- Comfort (keep the sun out, let the breeze in)
  - Window & roof heat gain
  - Natural ventilation openings
  - Ceiling fans

→ Lower indoor air temperature
Lower ceiling temperature
Increased air movement

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

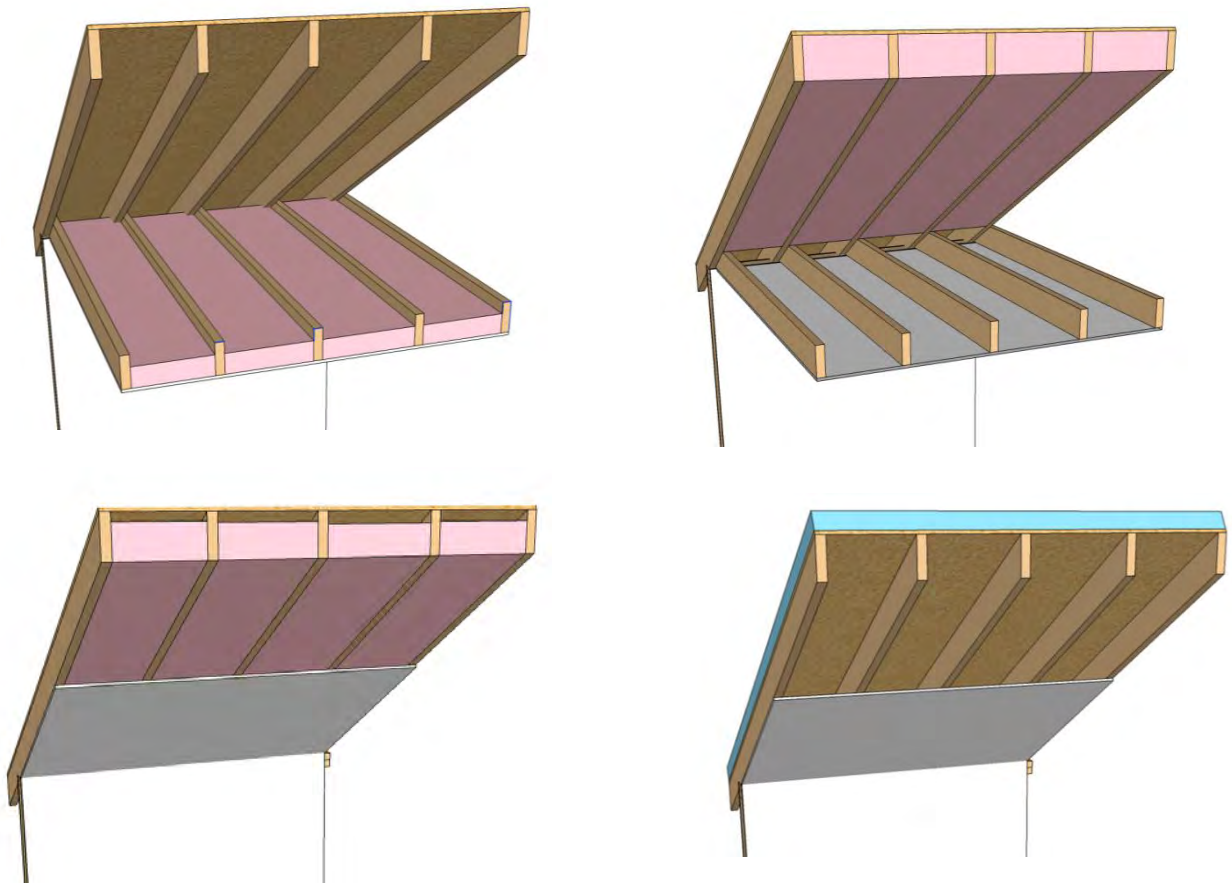
Ceiling fans

Solar water heating

Lighting

Envelope air sealing

1. R-19 insulation
2. Cool roof + R-13 insulation



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

1. R-19 insulation
2. Cool roof + R-13 insulation

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

1. R-19 insulation
2. Cool roof + R-13 insulation

Insulation type & thickness	R-13	R-19
Batt or blown-in	3.5”	6”
Open-cell spray foam	3-4”	5-6”
Closed-cell spray foam	2-3”	3-4”
Polystyrene board	2.75”	4”
Polyisocyanurate board	2”	3”

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

1. R-19 insulation
2. Cool roof + R-13 insulation

Cool roof definitions (C402.3)

1. Solar reflectance ≥ 0.55 & thermal emittance ≥ 0.75
2. Solar reflectance index ≥ 0.64
3. Shaded (see C402.3)

Architect: Daniel Sandomire, Armstrong Builders

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

1. R-19 insulation
2. Cool roof + R-13 insulation

Cool roof definitions (C402.3)

1. Solar reflectance ≥ 0.55 & thermal emittance ≥ 0.75
2. Solar reflectance index ≥ 0.64
3. Shaded (see C402.3)

www.hansonrooftile.com

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

1. R-19 insulation
2. Cool roof + R-13 insulation

Cool roof definitions (C402.3)

1. Solar reflectance ≥ 0.55 & thermal emittance ≥ 0.75
2. Solar reflectance index ≥ 0.64
3. Shaded (see C402.3)

http://coolroofhawaii.com

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

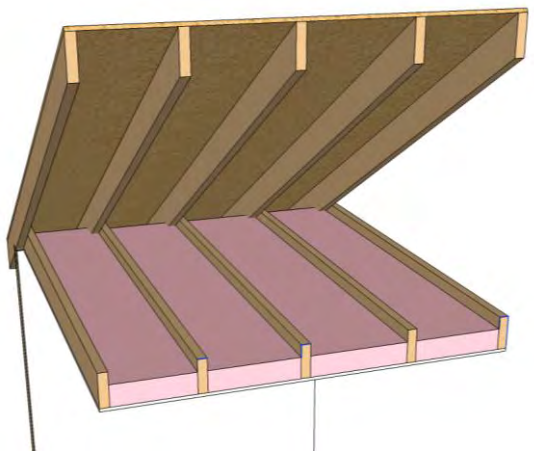
Solar water heating

Lighting

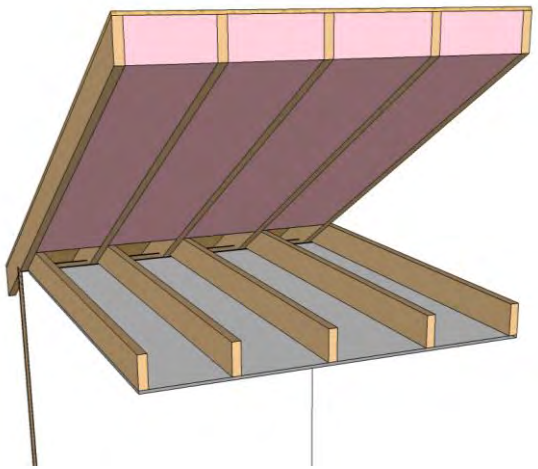
Envelope air sealing

If there is an attic

- Vented if attic above insulation
- Unvented if attic below insulation



Must be vented



Must be unvented

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

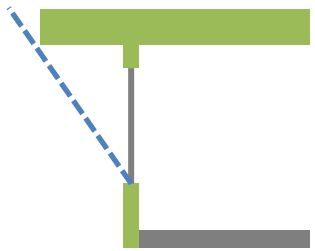
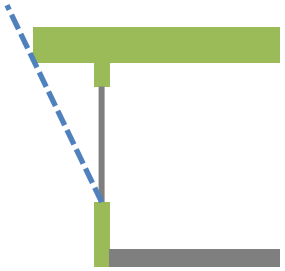
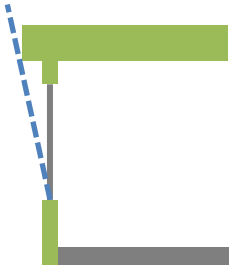
Envelope air sealing

No requirements!

Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Maximum solar heat gain coefficient (SHGC)

	No requirement	**0.40**	**0.25**
	Large overhang 	Medium overhang 	Small overhang 
Overhang Projection Factor	≥ 0.5	0.30 ≤ PF < 0.50	< 0.30

North windows: no requirement if PF > 0.20

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

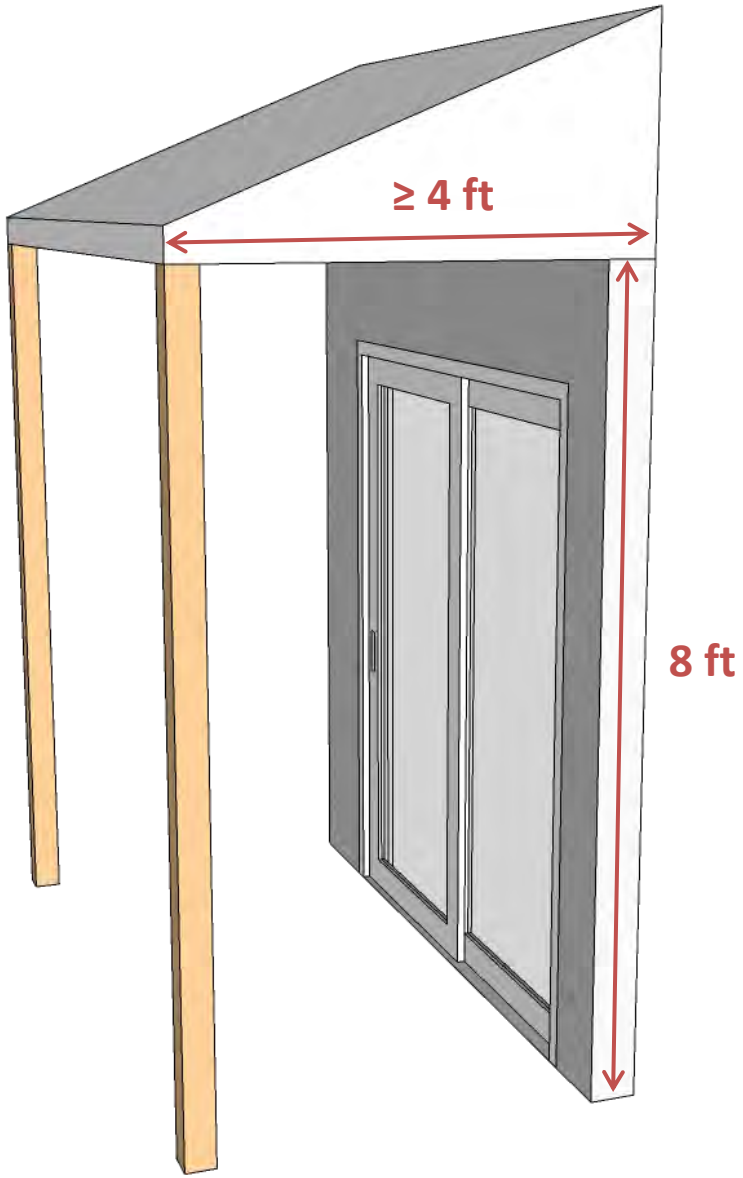
Solar water heating

Lighting

Envelope air sealing

Overhang size that allows clear glass to comply?

PF ≥ 0.5



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

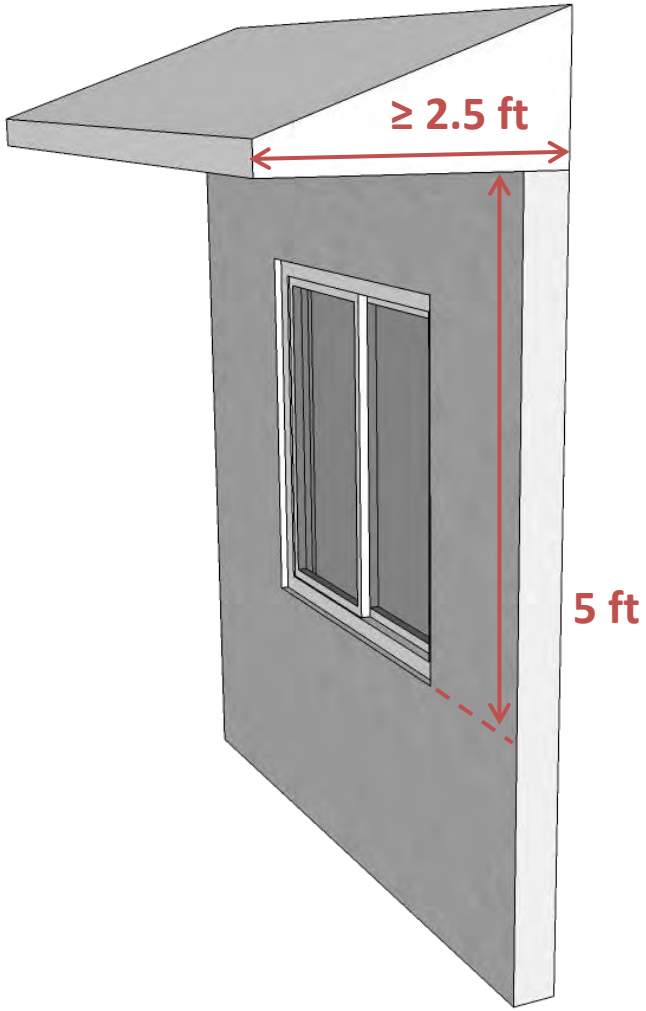
Solar water heating

Lighting

Envelope air sealing

Overhang size that allows clear glass to comply?

PF ≥ 0.5

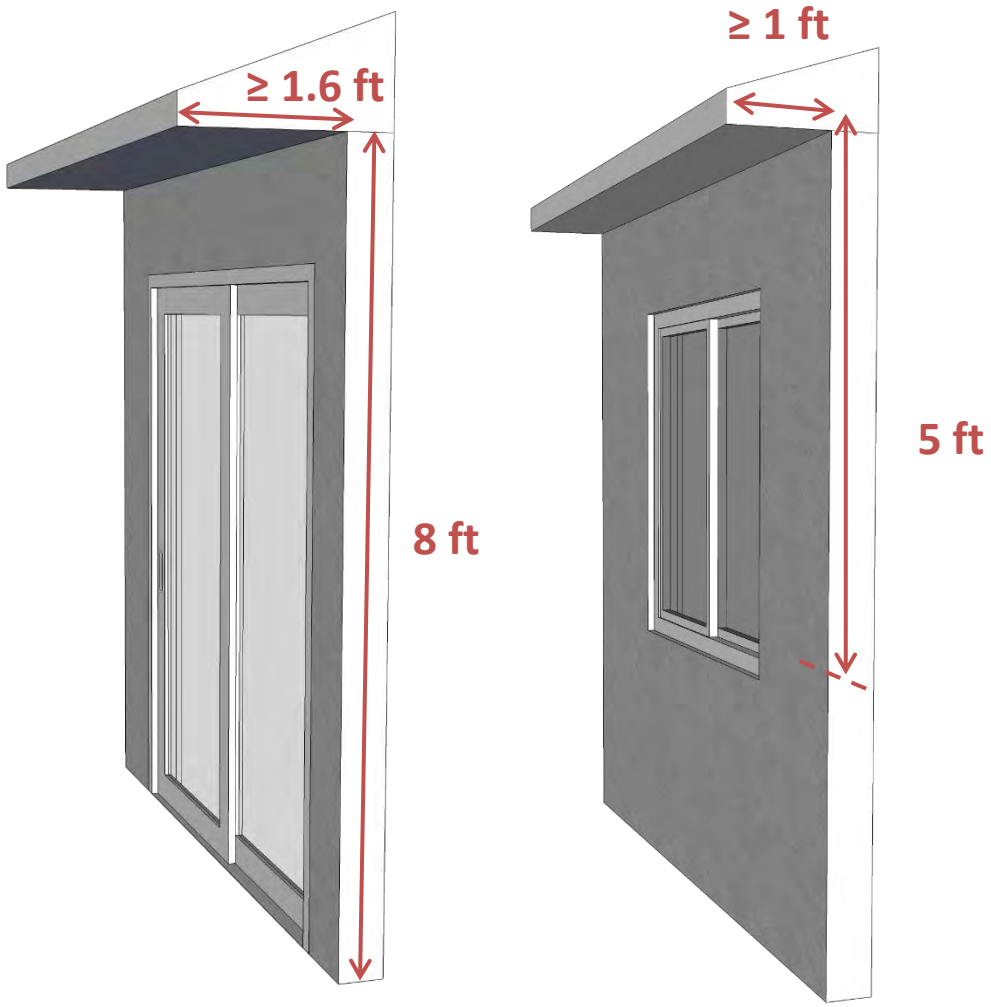


Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Overhang size that allows clear glass to comply?

North-facing windows
PF ≥ 0.2

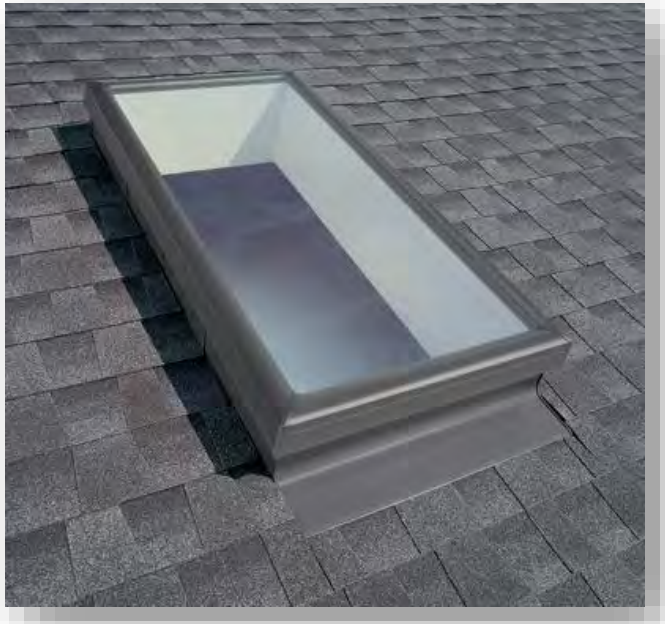


Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

U-factor ≤ 0.75

Requires double-pane skylights



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Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

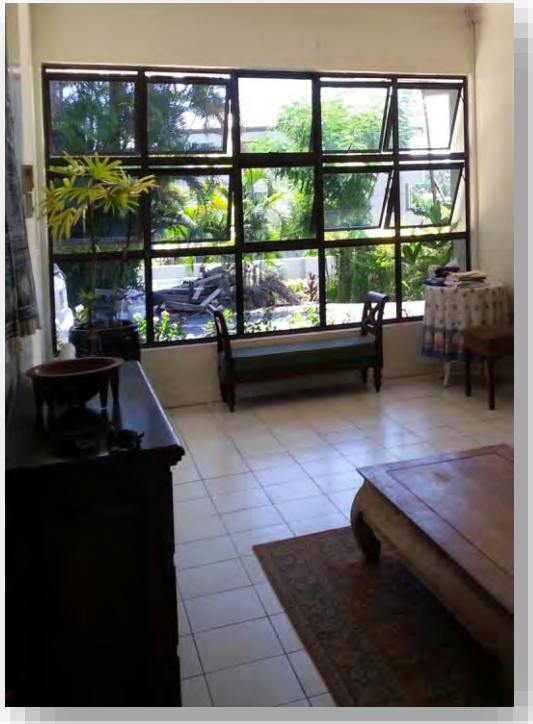
Operable windows

- Ventilation area ≥ 14% of floor area in each room
- Or equivalent fan

Bedroom interior doors can be secured open

Bedroom windows two different directions

- If there are two exterior walls

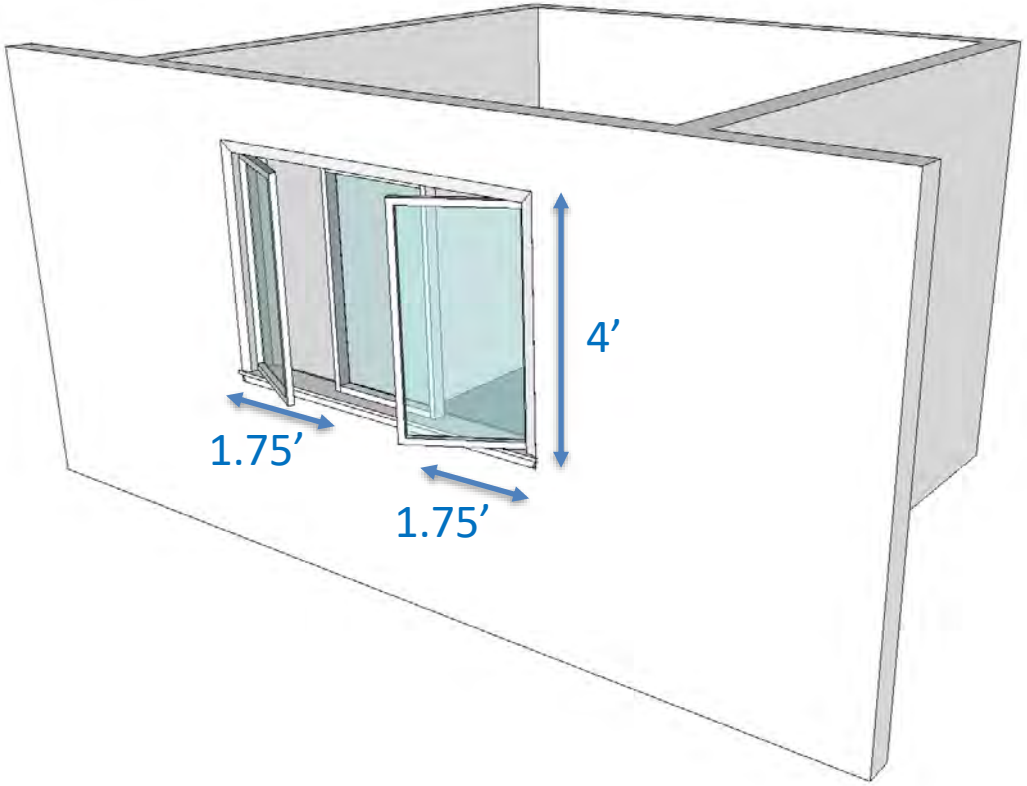


Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Ventilation area ≥ 14% of floor area

Example: 10’x10’ bedroom needs 14 ft^2 vent area

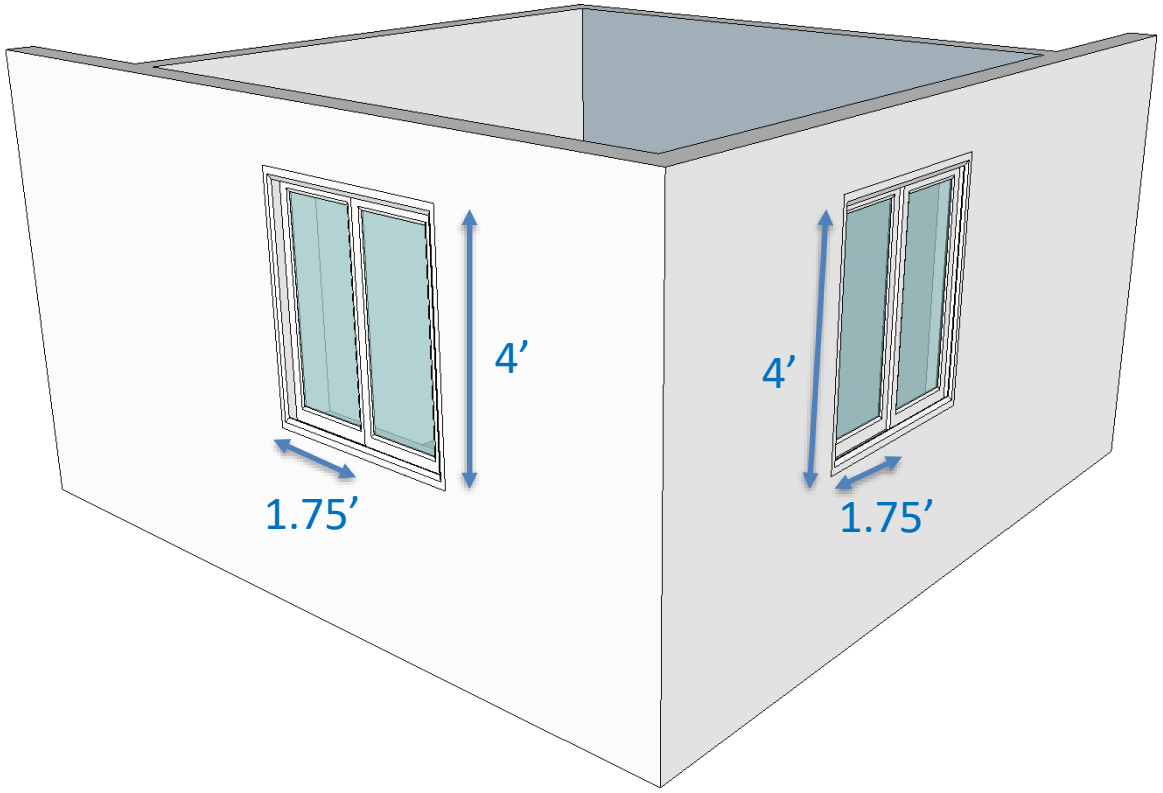


Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Ventilation area ≥ 14% of floor area

Example: 10’x10’ bedroom needs 14 ft^2 vent area

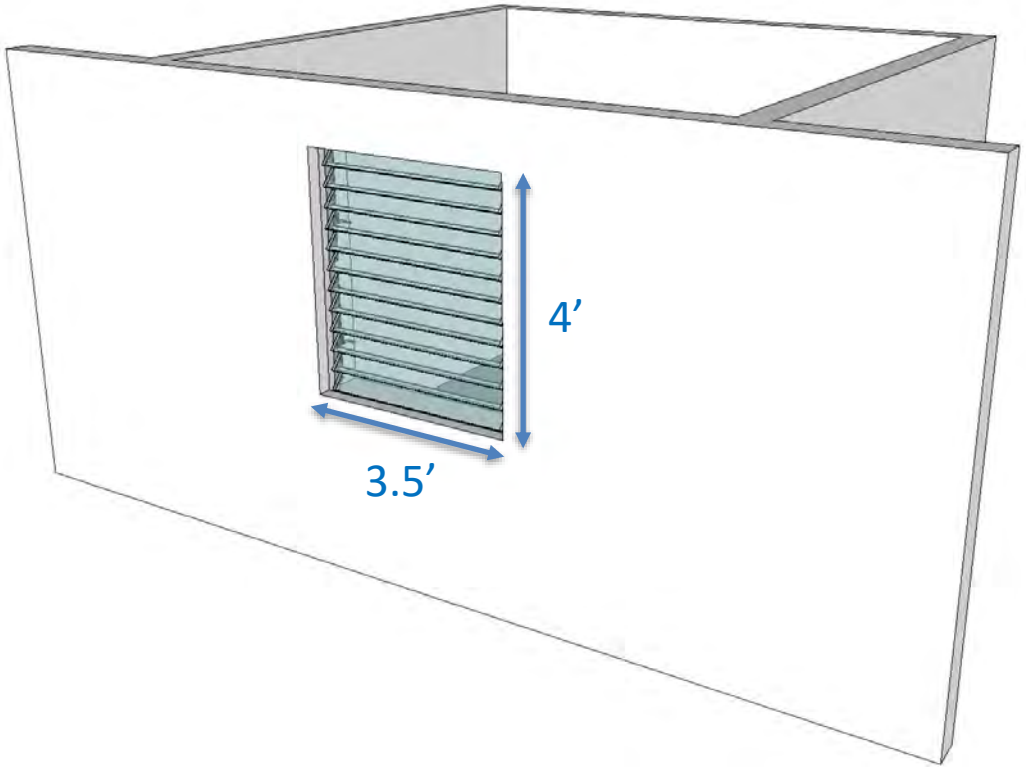


Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Ventilation area ≥ 14% of floor area

Example: 10’x10’ bedroom needs 14 ft^2 vent area

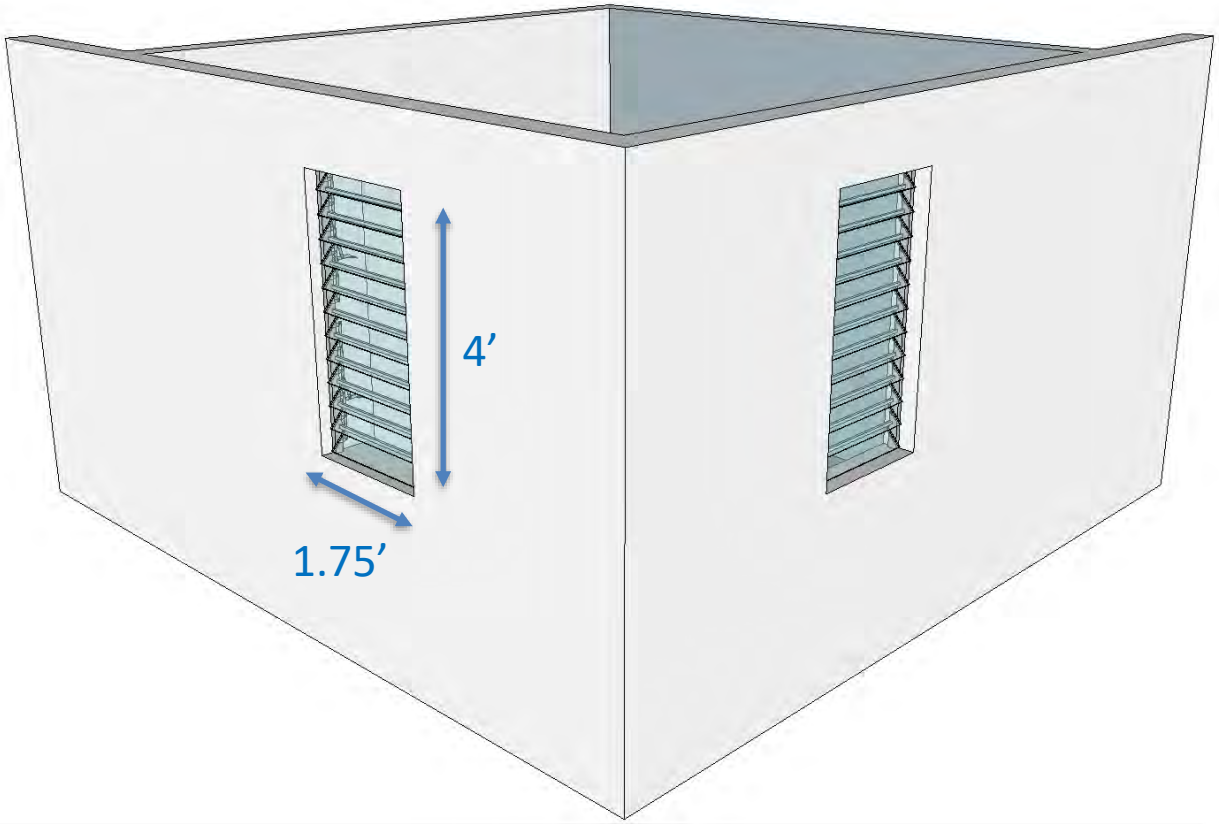


Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Ventilation area ≥ 14% of floor area

Example: 10’x10’ bedroom needs 14 ft^2 vent area



Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Ceiling fans or rough-ins

- Bedrooms + largest space

Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

Solar, wind or other renewable > 90%

Tropical Zone Option (R401.2.1)

Roof insulation
Wall
Windows
Skylights
Natural ventilation
Ceiling fans
Solar water heating
Lighting
Envelope air sealing

High efficacy ≥ 90% of permanently installed lamps

Lamp Wattage	Efficacy (lumens/watt)
> 40 watts	60
15-40 watts	50
< 15 watts	40

Source: DOE/NREL PIX20307

Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

Solar water heating

Lighting

Envelope air sealing

Walls, floor and ceilings that separate AC spaces and non-AC spaces use air-tight construction

Tropical Zone Option (R401.2.1)

TROPICAL ZONE REQUIREMENTS CHECKLIST

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
Tropical zone qualification	▪ ≤ 50% of the dwelling unit has AC ▪ No heating installed ▪ Elevation < 2,400 ft	R401.2.1*	Dwellings that do not meet all these criteria must use another compliance option.	☐ AC space clearly indicated (if applicable)
Water heating - solar	Solar, wind or other renewable source supplies ≥ 90% of energy for water heating	R401.2.1*	Waiver for instant-on water heater permitted. See also: https://energy.hawaii.gov/resources/solar-water-heater-variance.	☐ Water heating system specs on plans
Windows – solar heat gain coefficient (SHGC)	≤ **0.25** if projection factor < 0.30 ≤ **0.40** if projection factor 0.30-0.50 N/A: projection factor ≥ 0.5. N/A: north windows if PF > 0.20 Jalousie windows exempt.	R401.2.1*	SHGC = solar heat gain factor. Low SHGC typically requires dual-pane glazing with a low-emittance coating that is designed to reduce solar heat gain. Projection factor = horizontal projection of overhang ÷ vertical distance from overhang to bottom of window. Overhang must extend at least 2 ft on each side of the window or to the nearest wall, whichever is less.	☐ SHGC indicated on plans ☐ Overhang dimensions on plans, if applicable
Skylights – U-factor	≤ **0.75**	R401.2.1*	Skylights must have dual-pane glazing.	☐ Skylight U-factor on plans
Lighting	≥ 90% of lamps or fixtures are high efficacy	R404.1	High efficacy lamps are defined as: ▪ T-8 or smaller diameter fluorescent ▪ Compact fluorescent ▪ 60 lumens/watt if >40W ▪ 50 lumens/watt if >15W and ≤40W ▪ 40 lumens/watt if ≤15W Most, but not all, LED lamps will qualify. Applies to permanently-installed fixtures. Low-voltage lighting is exempt.	☐ Lighting fixture locations on plans ☐ Lighting fixture schedule includes input power and lumen output

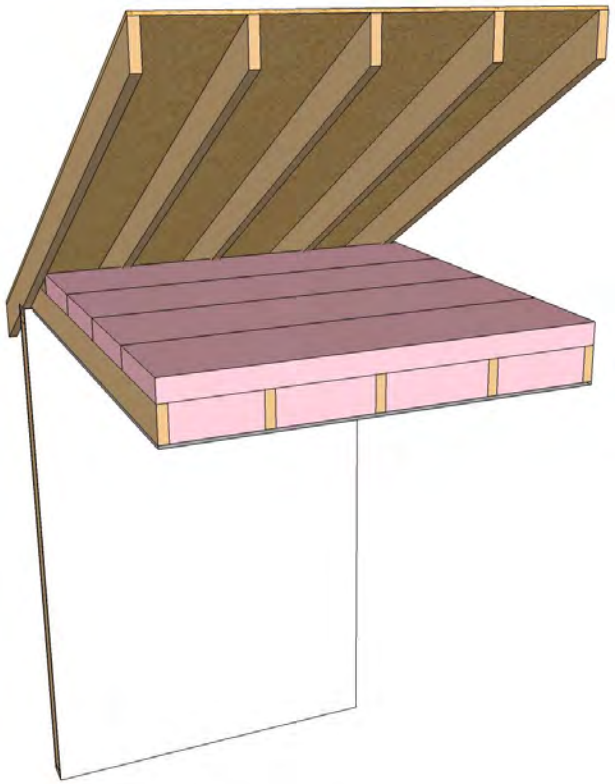
Tropical Zone Option (R401.2.1)

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
Roof – insulation and membrane	☐ **R-13** + cool roof, ☐ **R-19**, or ☐ *Points option (section R407)*	R401.2.1*	Qualifying cool roof membranes must meet one of the following (per Table C402.3): 1. Aged reflectance ≥ 0.55 & aged thermal emittance ≥ 0.75 2. Aged solar reflectance index (SRI) ≥ 0.64 Qualifying cool roofs will typically be white in color. Typical options include white painted metal, white tile, white liquid applied coating, and white single-ply membranes. If present, attics above insulation must be vented and attics below insulation must be unvented.	☐ Insulation location on plans ☐ Insulation R-value on plans ☐ Membrane specs on plans (if applicable
Roof – slope	≥ ¼ in. per foot	R401.2.1*	No water accumulation areas allowed.	☐ Roof slope indicated on plans
Walls and floor	No requirement			
Natural ventilation	▪ Opening area ≥ 14% of floor area in each room (or provide a ventilation fan) ▪ Bedrooms with exterior walls facing two different directions have operable fenestration facing two directions ▪ Interior doors to bedrooms capable of being secured open	R401.2.1*	Operable windows and/or skylights are required for natural ventilation. Ventilation fans can be provided as an alternative.	☐ Operable openings on plans ☐ Ventilation fans on plans (if applicable)
Ceiling fans	Ceiling fans or rough-ins required for: ▪ Each bedroom ▪ Largest space not used as a bedroom	R401.2.1*	A "rough-in" is an electrical junction box mounted in the ceiling that is rated for ceiling fan installation.	☐ Ceiling fan locations on plans
Air leakage	Walls, floor and ceilings that separate AC spaces and non-AC spaces use air-tight construction	R401.2.1*	For air conditioned spaces, see section R402.4: ▪ Continuous air barrier ▪ Breaks or joints are sealed ▪ Recessed lighting ▪ Fenestration air leakage	☐ Plan notes indicate installation requirements

* Code section added or modified by Hawaii amendment

Section 4

Envelope



Envelope - Prescriptive

- Windows
  - SHGC (Table R402.1.2)
- Skylights
  - SHGC & U-factor (Table R402.1.2)
  - Total UA (R402.1.5)
- Wall and roof – four options
  - Insulation R-value (Table R402.1.2)
  - Assembly U-factor (Table R402.1.4)
  - Total UA (R402.1.5)
  - Points option (R407)
- Air leakage
  - Air barrier, sealing
  - Testing

Envelope - Prescriptive

- Windows
  - SHGC (Table R402.1.2)
- Skylights
  - SHGC & U-factor (Table R402.1.2)
  - Total UA (R402.1.5)
- Wall and roof – four options
  - Insulation R-value (Table R402.1.2)
  - Assembly U-factor (Table R402.1.4)
  - Total UA (R402.1.5)
  - Points option (R407)
- Air leakage
  - Air barrier, sealing
  - Testing (optional Kauai, Maui, Hawaii County)

Minimum Insulation R-value

TABLE R402.1.2 INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.32	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.32	0.55	0.40	49	20 or 13+5[h]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.30	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.30	0.55	NR	49	20+5[h] or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.30	0.55	NR	49	20+5[h] or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

Envelope - Prescriptive

- Windows
  - SHGC (Table R402.1.2)
- Skylights
  - SHGC & U-factor (Table R402.1.2)
  - Total UA (R402.1.5)
- Wall and roof – four options
  - Insulation R-value (Table R402.1.2)
  - Assembly U-factor (Table R402.1.4)
  - Total UA (R402.1.5)
  - Points option (R407)
- Air leakage
  - Air barrier, sealing
  - Testing (optional Kauai, Maui, Hawaii County)

Maximum Assembly U-factor

TABLE R402.1.4 EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091[c]	0.136
4 except Marine	0.32	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

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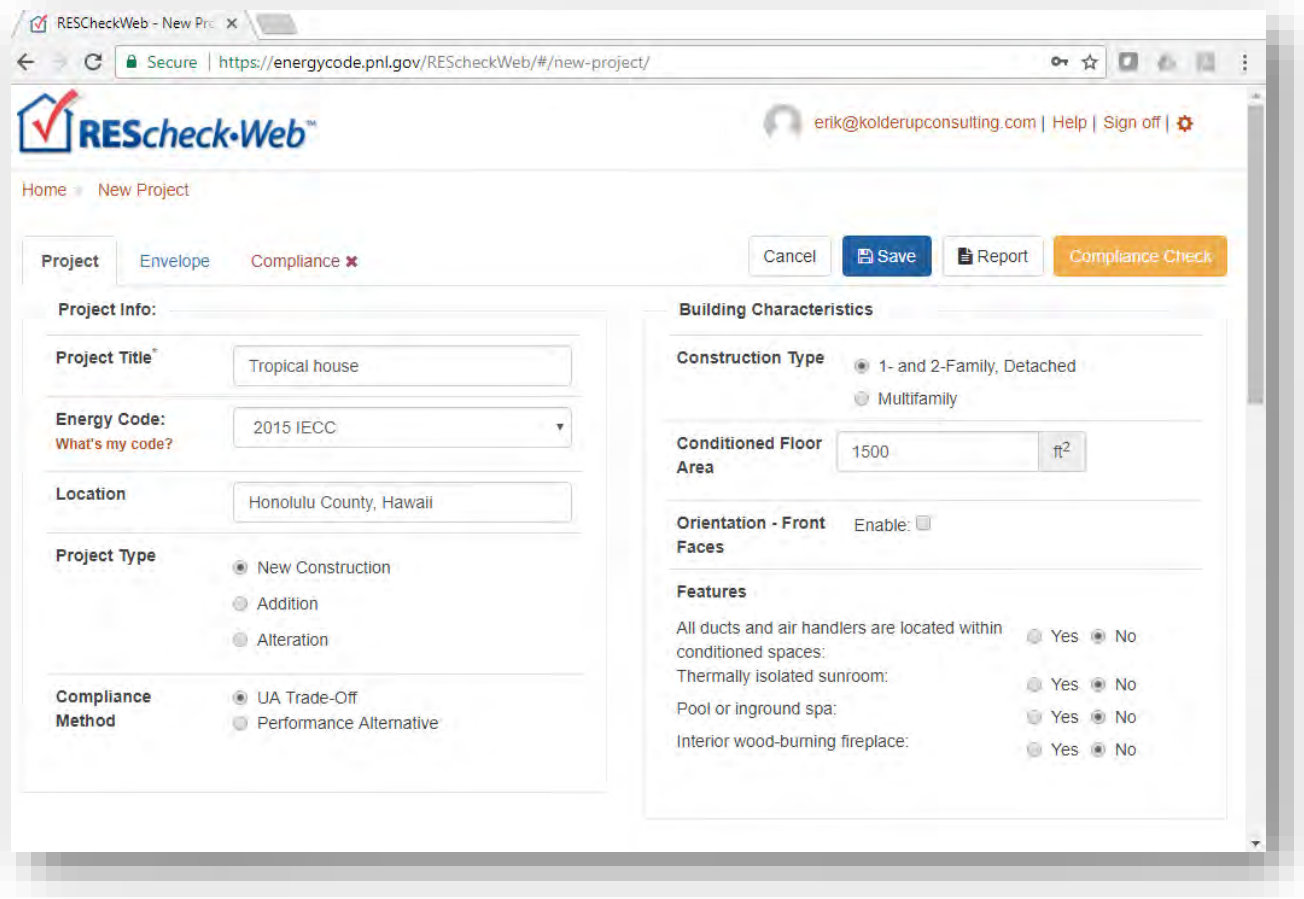
- Windows
  - SHGC (Table R402.1.2)
- Skylights
  - SHGC & U-factor (Table R402.1.2)
  - Total UA (R402.1.5)
- Wall and roof – four options
  - Insulation R-value (Table R402.1.2)
  - Assembly U-factor (Table R402.1.4)
  - Total UA (R402.1.5)
  - Points option (R407)
- Air leakage
  - Air barrier, sealing
  - Testing (optional Kauai, Maui, Hawaii County)



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- Windows
  - SHGC (Table R402.1.2)
- Skylights
  - SHGC & U-factor (Table R402.1.2)
  - Total UA (R402.1.5)
- Wall and roof – four options
  - Insulation R-value (Table R402.1.2)
  - Assembly U-factor (Table R402.1.4)
  - Total UA (R402.1.5)
  - Points option (R407)
- Air leakage
  - Air barrier, sealing
  - Testing (optional Kauai, Maui, Hawaii County)

Measure	Standard Home Points	Tropical Zone Points
R-13 + R-3 wall insulation	0	1
R-13 cavity wall insulation + R-0	-1	0
R-13 wall Insulation + high reflectance walls[4]	0	1
R-13 wall + 90% high efficacy lighting and Energy Star Appliances[5]	1	2
R-13 wall insulation + exterior shading wpf=0.3[6]	0	1
R-30 roof Insulation	0	1
R-19 roof Insulation	-1	0
R-19 + cool roof membrane[1] or radiant barrier[3]	0	1
R-19 roof Insulation + attic venting[2]	0	1
Ductless air conditioner[7]	1	1
1.071 X Federal minimum SEER for air conditioner	1	1
1.142 X Federal minimum SEER for air conditioner	2	2
No air conditioning installed	NA	2
House floor area ≤ 1,000 ft^2	1	1
House floor area ≥ 2,500 ft^2	-1	-1
Energy Star Fans[8]	1	1
Install 1 kW or greater of solar electric	1	1
Reduce fenestration from 14% to 10% (Hawaii County only)	NA	-1

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Windows

1. U-factor – no requirement
2. Solar heat gain coefficient (SHGC) ≤ 0.25

Exceptions

1. Up to 15 ft^2
2. Area-weighted average allowed
3. Jalousie windows exempt

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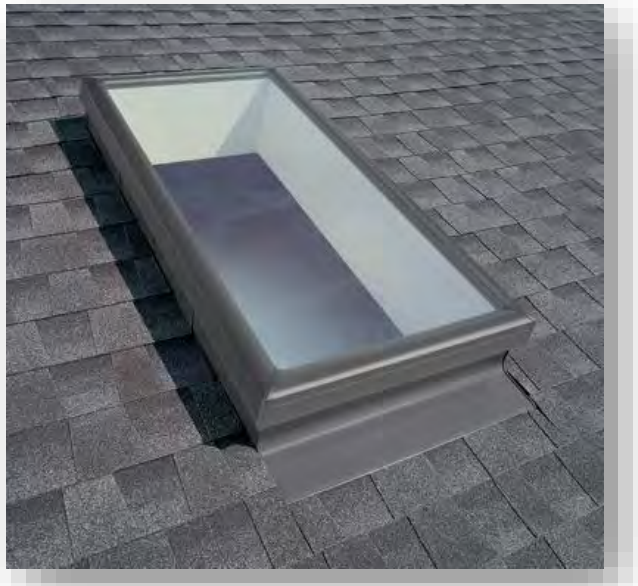
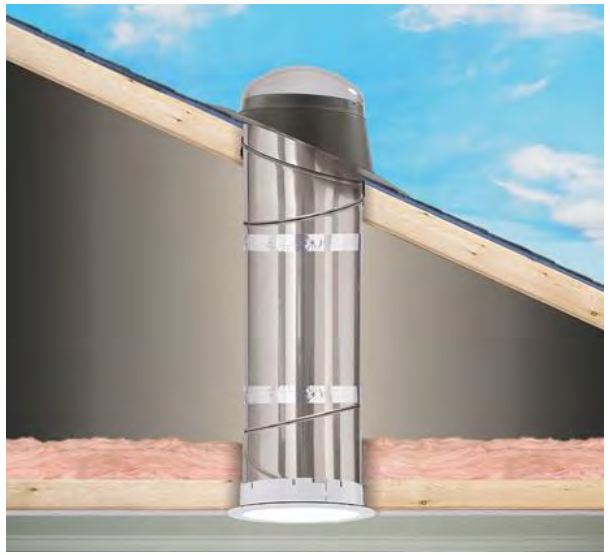
Skylights

1. U-factor ≤ 0.75
2. Solar heat gain coefficient (SHGC) ≤ 0.30

Exceptions

1. Up to 15 ft^2 (total for window + skylight)
2. Area-weighted average allowed





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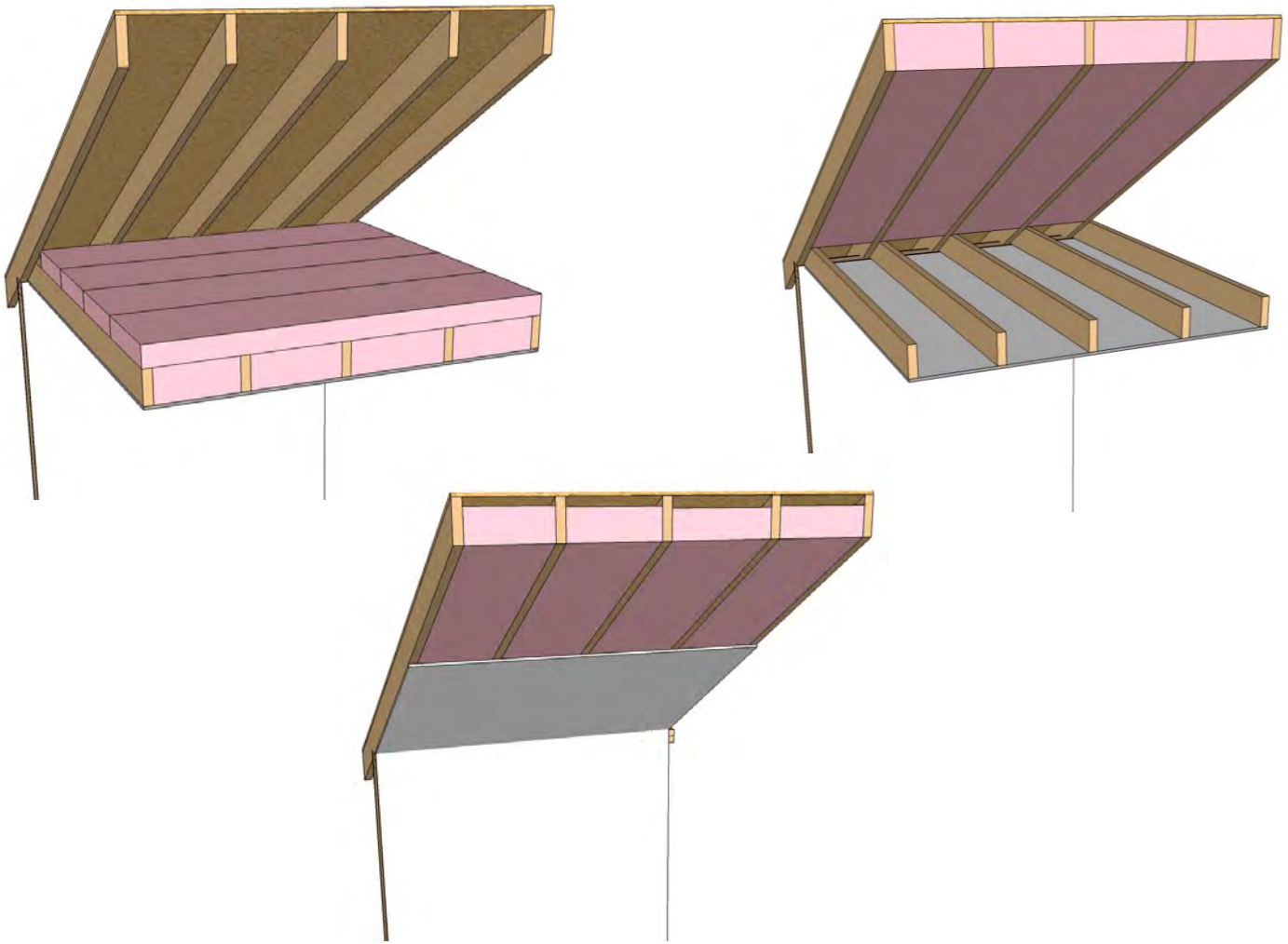
Ceiling – wood framed

1. R-30 insulation (Table R402.1.2)
2. U-0.035 (Table R402.1.4)

Insulation type & thickness	R-30
Batt	8-10”
Blown-in	12”
Open-cell spray foam	~8”
Closed-cell spray foam	~5”
Polystyrene board	6”
Polyisocyanurate board	5”

Or use the points option (R407)



Envelope - Prescriptive

Ceiling – steel truss

1. R-38 insulation
2. R-30 + 3
3. R-26 + 5

Ceiling – steel joist

1. R-38 insulation
2. R-49 in any framing >2x8

(Table R402.2.6)

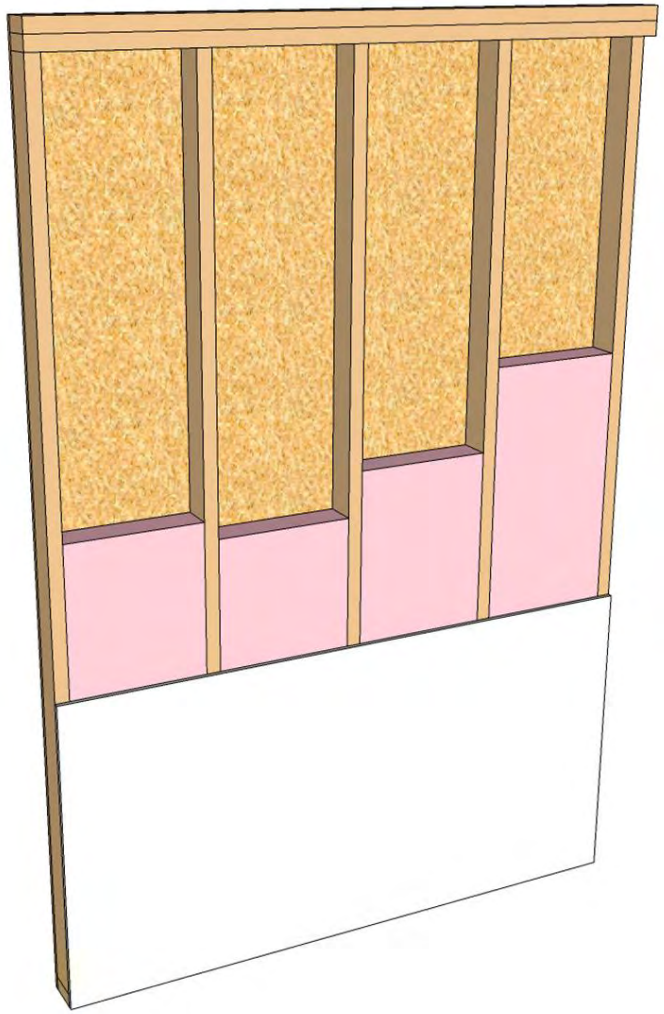
Insulation type & thickness	R-38	R-49
Batt	10-12”	15”
Blown-in	15”	19”
Open-cell spray foam	~10”	
Closed-cell spray foam	~6”	

Envelope - Prescriptive

Walls – wood frame

1. R-13 insulation (Table R402.1.2)
2. U-0.084 (Table R402.1.4)

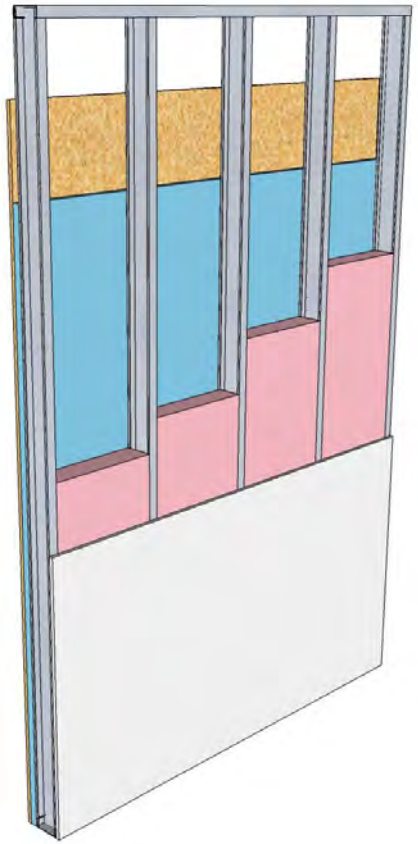
Insulation type & thickness	R-13
Batt or blown-in	3.5”
Open-cell spray foam	3-4”
Closed-cell spray foam	2-3”
Polystyrene board	2.75”
Polyisocyanurate board	2”



Envelope - Prescriptive

Walls – metal frame

1. Table R402.2.6
2. U-0.084 (Table R402.1.4)



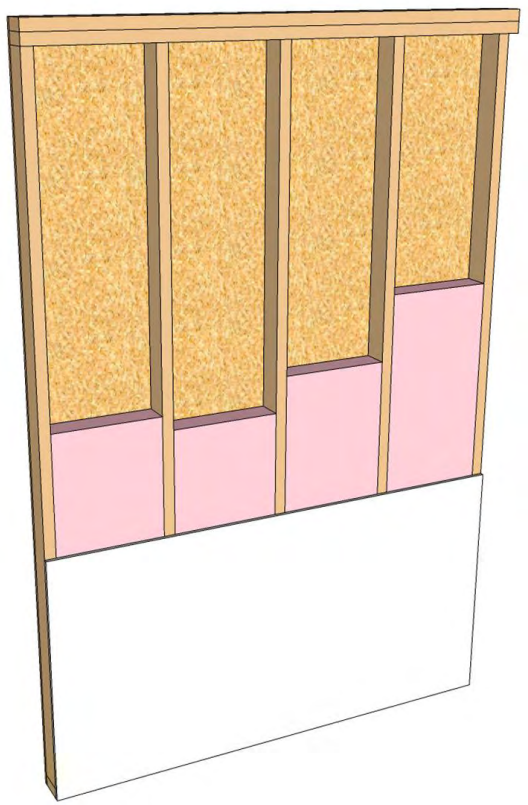
			Rigid foam board thickness	
Frame spacing	Cavity insulation R-value	Continuous insulation R-value	Extruded Polystyrene (R-5/in.)	Poly-isocyanurate (R-6/in.)
16 in. o.c.	R-0	R-9.3	≥ 1.86 in.	≥ 1.55 in.
	R-13	R-4.2	≥ 0.84 in.	≥ 0.70 in.
	R-15	R-3.8	≥ 0.76 in.	≥ 0.63 in.
24 in. o.c.	R-0	R-9.3	≥ 1.86 in.	≥ 1.55 in.
	R-13	R-3.0	≥ 0.60 in.	≥ 0.50 in.
	R-15	R-2.4	≥ 0.48 in.	≥ 0.40 in.

Or use the points option (R407)

Envelope - Prescriptive

Why is extra insulation is required with metal framing?

R-13 in wood frame

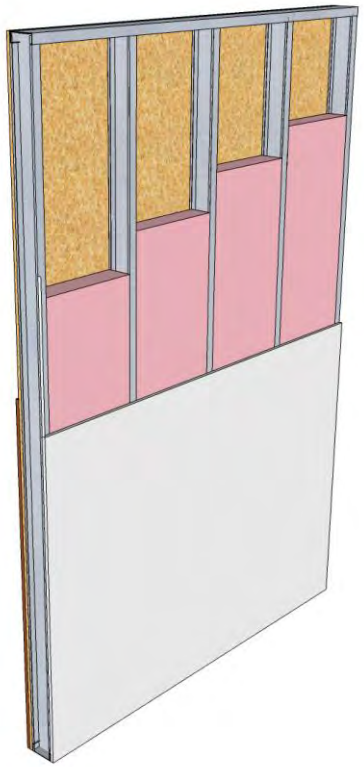


U-factor
0.089

R-13 in steel frame (effective R-6)

U-factor
0.124

39% higher heat transfer



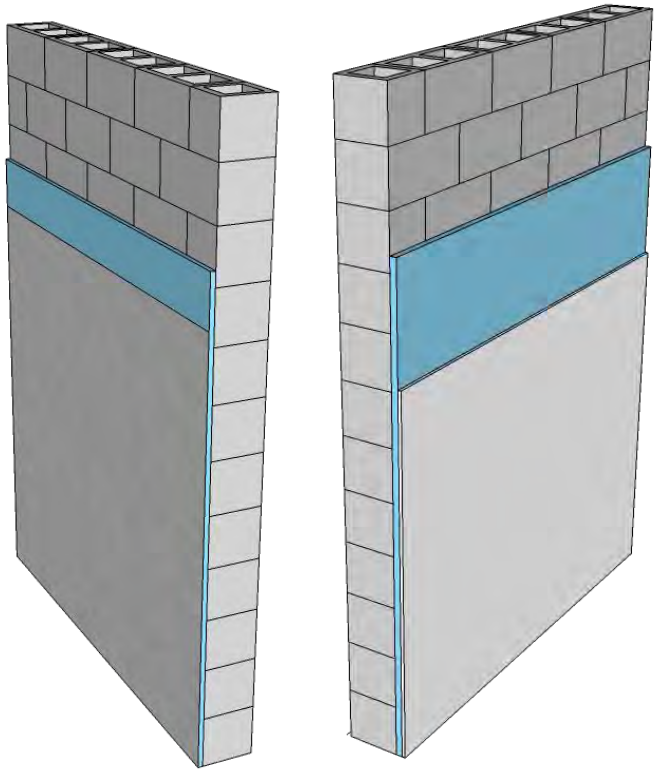
U-factor source: ASHRAE Standard 90.1-2019, Table A3.3.3.1 and Table A3.4.3.1

Envelope - Prescriptive

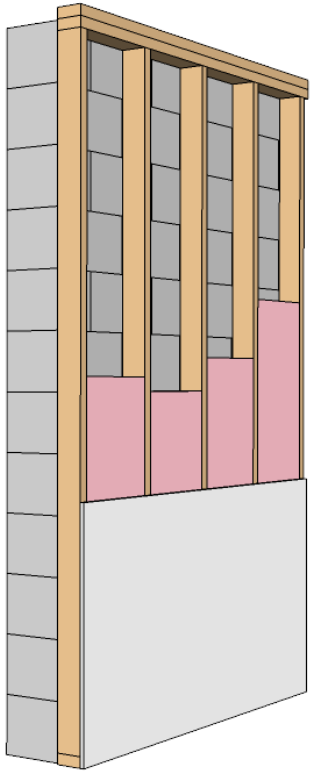
Walls – mass

1. R-3 exterior insulation (Table R402.1.2)
2. R-4 interior insulation (Table R402.1.2)
3. U-0.197 (Table R402.1.4)

R-3 exterior
≥ 0.50 in. polyisocyanurate
≥ 0.60 in. polystyrene



R-4 interior
≥ 0.67 in. polyisocyanurate
≥ 0.80 in. polystyrene



U-factor ≤ 0.197
≥ R-4 in wood furring
≥ R-11 in metal furring

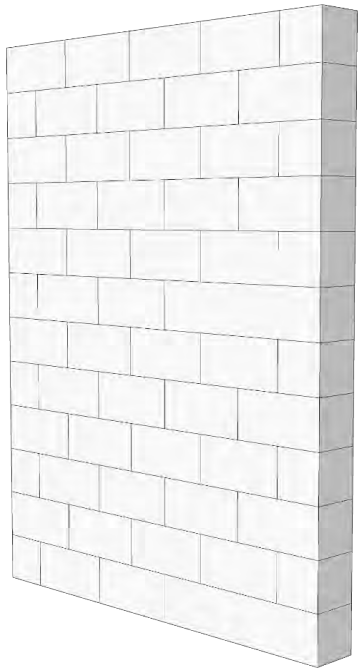
Envelope - Prescriptive

Walls – mass

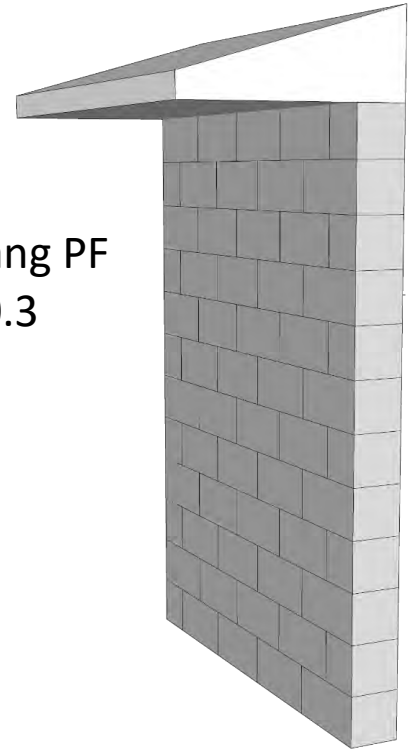
1. R-3 exterior insulation (Table R402.1.2)
2. R-4 interior insulation (Table R402.1.2)
3. U-0.197 (Table R402.1.4)

State Amendment

Exterior reflectance ≥ 0.64



Overhang PF ≥ 0.3



Thickness ≥ 6 inches

Envelope - Prescriptive

Floors

1. R-13 (Table R402.1.2)

Envelope – Points Option (R407)

Total points ≥ 0

- Roof and walls, or
- Roof alone and wall alone

Options for credit

- Insulation
- Cool roof
- Radiant barrier
- Wall reflectance
- More efficient lighting
- Efficient appliances
- Wall shading
- Ductless AC
- High efficiency AC
- No AC
- Small dwelling
- Energy Star fans
- Solar electric

Reasons to use it

1. Want <R-30 roof insulation
2. Have metal-framed walls and don't want to add foam board insulation

Envelope – Points Option (R407)

Total points ≥ 0
- Roof and walls, or
- Roof alone and wall alone

Options for credit
- Insulation
- Cool roof
- Radiant barrier
- Attic venting
- Wall reflectance
- More efficient lighting
- Efficient appliances
- Wall shading
- Ductless AC
- High efficiency AC
- No AC
- Small dwelling
- Energy Star fans
- Solar electric

Measure **Wood Framed Walls**	Standard Home Points	Tropical Zone Points
R-13 cavity wall insulation	0	1
R-19 roof insulation	-1	0
R-19 roof insulation + cool roof membrane[1] or radiant barrier[3]	0	1
R-19 roof insulation + attic venting[2]	0	1
R-30 roof insulation	0	1
R-13 wall insulation + high reflectance walls[4]	1	2
R-13 wall + 90% high efficacy lighting and Energy Star appliances[5]	1	2
R-13 wall insulation + exterior shading wpf=0.3[6]	1	2
Ductless air conditioner[7]	1	1
1.071 X Federal minimum SEER for air conditioner	1	1
1.142 X Federal minimum SEER for air conditioner	2	2
No air conditioning installed	NA	2
House floor area ≤ 1,000 ft^2	1	1
House floor area ≥ 2,500 ft^2	-1	-1
Energy Star fans[8]	1	1
Install 1 kW or greater of solar electric	1	1

See also checklist

Envelope – Points Option (R407)

Total points ≥ 0
- Roof and walls, or
- Roof alone and wall alone

Options for credit
- Insulation
- Cool roof
- Radiant barrier
- Attic venting
- Wall reflectance
- More efficient lighting
- Efficient appliances
- Wall shading
- Ductless AC
- High efficiency AC
- No AC
- Small dwelling
- Energy Star fans
- Solar electric

Measure **Metal Framed Walls**	Standard Home Points	Tropical Zone Points
R-13 + R-3 wall insulation	0	1
R-13 cavity wall insulation + R-0	-1	0
R-13 wall insulation + high reflectance walls[4]	0	1
R-13 wall + 90% high efficacy lighting and Energy Star Appliances[5]	1	2
R-13 wall insulation + exterior shading wpf=0.3[6]	0	1
R-30 roof insulation	0	1
R-19 roof insulation	-1	0
R-19 + cool roof membrane[1] or radiant barrier[3]	0	1
R-19 roof insulation + attic venting[2]	0	1
Ductless air conditioner[7]	1	1
1.071 X Federal minimum SEER for air conditioner	1	1
1.142 X Federal minimum SEER for air conditioner	2	2
No air conditioning installed	NA	2
House floor area ≤ 1,000 ft^2	1	1
House floor area ≥ 2,500 ft^2	-1	-1
Energy Star Fans[8]	1	1
Install 1 kW or greater of solar electric	1	1

See also checklist

Envelope – Points Option (R407)

Total points ≥ 0
- Roof and walls, or
- Roof alone and wall alone

Options for credit
- Insulation
- Cool roof
- Radiant barrier
- Attic venting
- Wall reflectance
- More efficient lighting
- Efficient appliances
- Wall shading
- Ductless AC
- High efficiency AC
- No AC
- Small dwelling
- Energy Star fans
- Solar electric

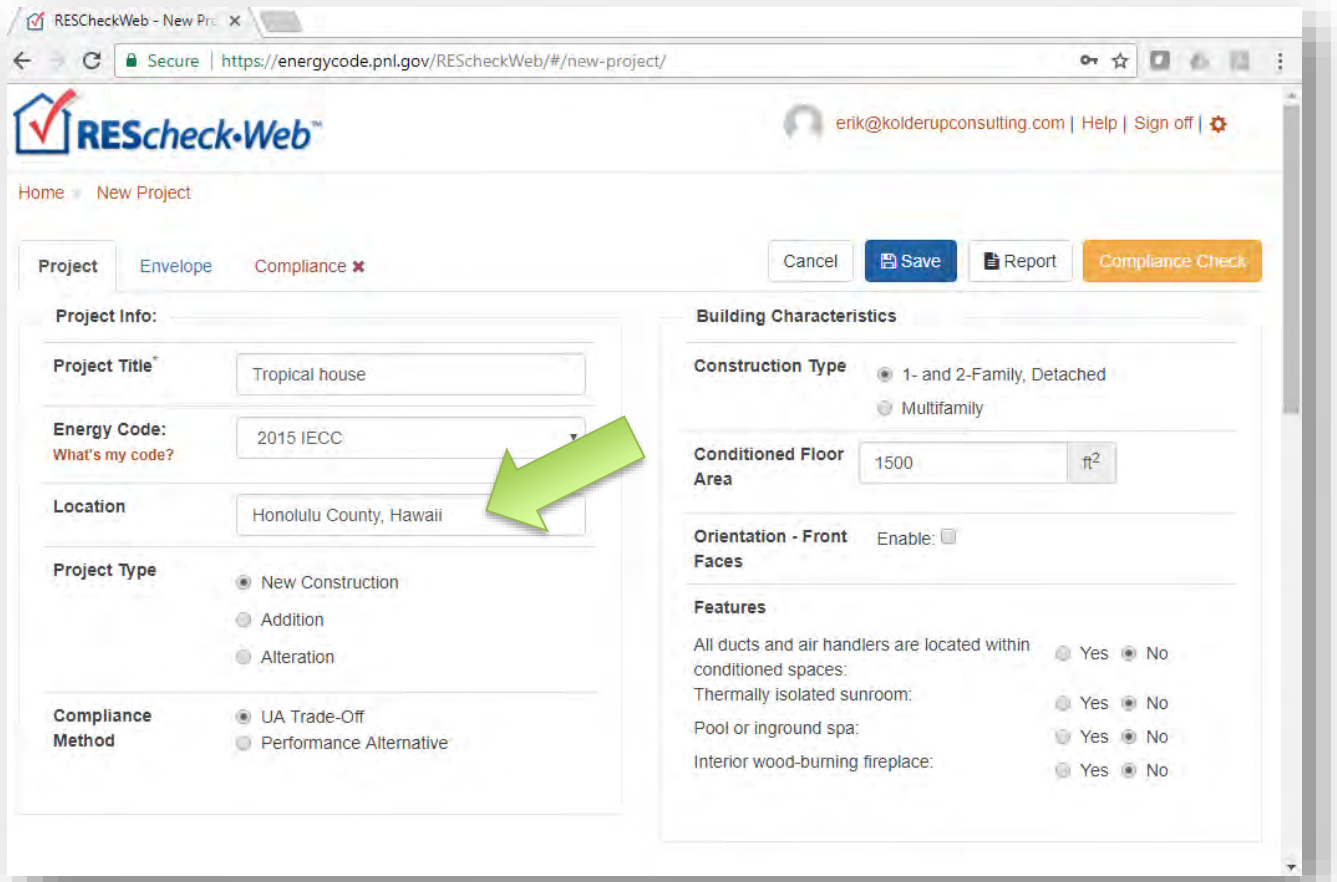
Measure **Mass Walls**	Standard Home Points	Tropical Home Points
R-3/4 Insulation	0	1
R-0 Wall insulation	-1	0
R-0 Wall Insulation + high reflectance walls[4]	0	1
R-0 Wall + 90% high efficacy lighting and Energy Star Appliances[5]	1	2
R-0 Wall Insulation + exterior shading wpf=0.3[6]	0	1
R-19 Roof/ceiling Insulation	-1	0
R-19 + Cool roof membrane[1] or Radiant Barrier[3]	0	1
R-19 Roof Insulation + Attic Venting[2]	0	1
R-30 Roof/ceiling Insulation	0	1
Ductless Air Conditioner[7]	1	1
1.071 X Federal Minimum SEER for Air Conditioner	1	1
1.142 X Federal Minimum SEER for Air Conditioner	2	2
No air conditioning installed	NA	2
House floor area ≤ 1,000 ft^2	1	1
House floor area ≥ 2,500 ft^2	-1	-1
Energy Star Fans[8]	1	1
Install 1 kW or greater of solar electric	1	1

See also checklist

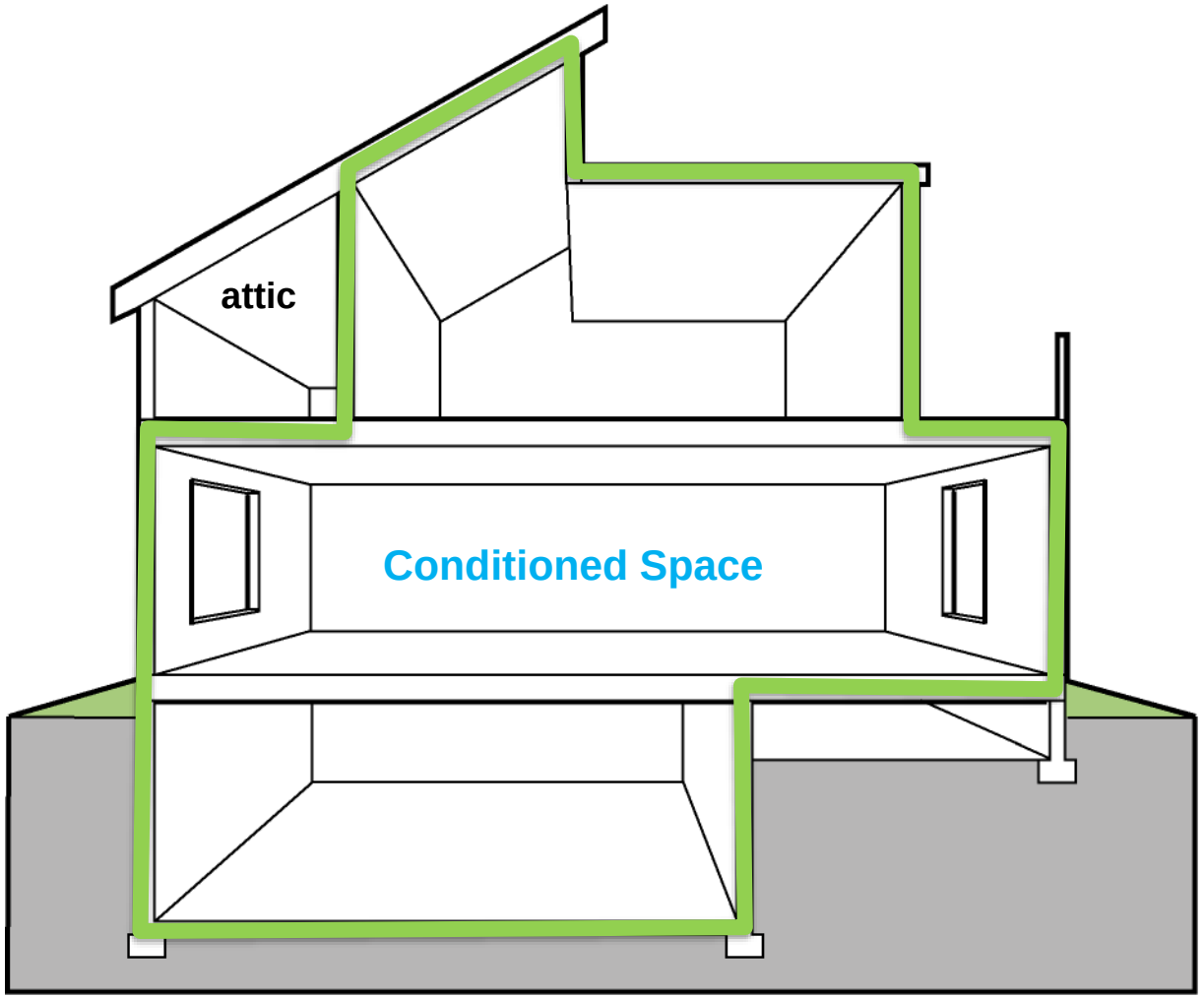
Envelope – Total UA (R402.1.4)

Alternative to prescriptive envelope

- Calculate total (U-factor x Area) for walls, roof and fenestration
- Typically use REScheck software
  - Desktop or Web version
  - Does not include Hawaii amendments
  - https://energycode.pnl.gov/REScheckWeb



Envelope – Air Leakage (R402.4)



Installation details in Table R402.4.1.1

- Continuous air barrier
- Breaks or joints are sealed
- Recessed lighting
- Around windows and skylights

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall b Knee walls s	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum.
Windows, skylights and doors	The space be and skylights	
Rim joists	Rim joists sh	
Floors (including above garage and cantilevered floors)	The air barri of insulation.	perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with overlapping	Where provided instead of floor insulation,
Shafts, penetrations	Duct shafts, opening to e sealed.	
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring		Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	

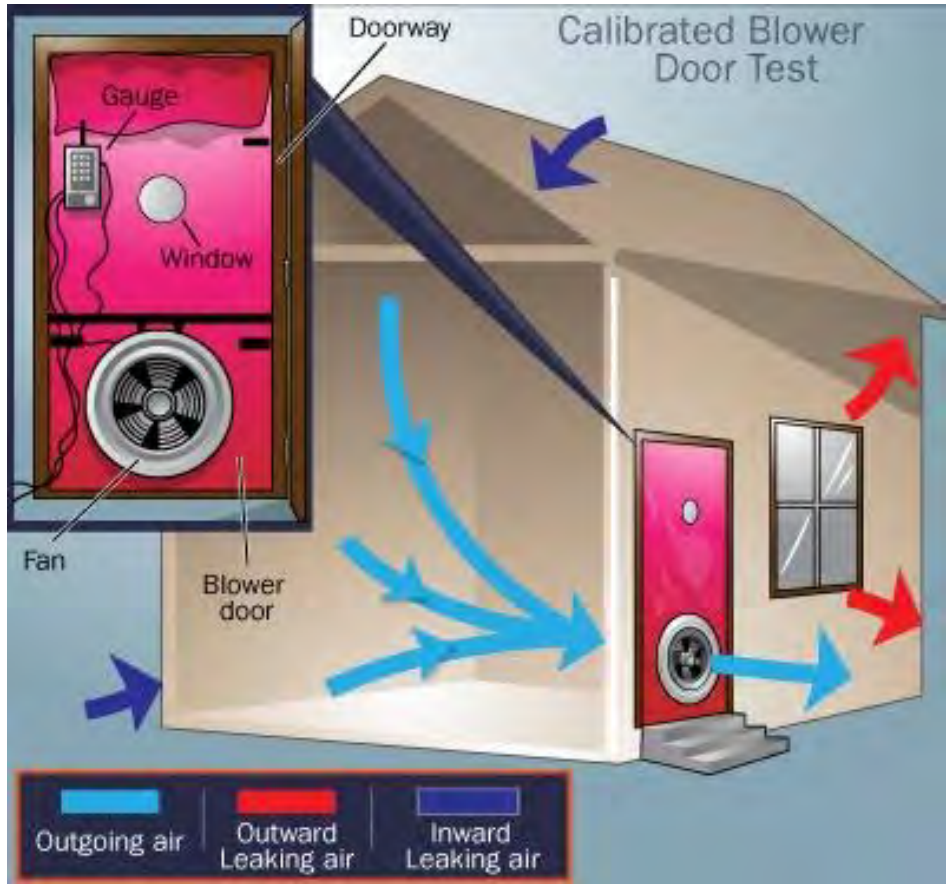
a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.

Envelope – Air Leakage (R402.4)

Testing

Leakage ≤ 5 air changes per hour at 0.2 in. w.c. pressure (50 Pa)



Envelope – Air Leakage (R402.4)

Fenestration air leakage

- ≤ 0.3 cfm/ft^2 for windows, skylights and sliding doors
- ≤ 0.5 cfm/ft^2 for swinging doors
- Exception for site-built
- Exception for jalousie windows

Recessed lighting in thermal envelope

- IC rated (insulation contact)
- Labeled ≤ 2 cfm at 75 Pa

Prescriptive Envelope Summary

- Windows
  - SHGC (Table R402.1.2)
- Skylights
  - SHGC & U-factor (Table R402.1.2)
  - Total UA (R402.1.5)
- Wall and roof – four options
  - Insulation R-value (Table R402.1.2)
  - Assembly U-factor (Table R402.1.4)
  - Total UA (R402.1.5)
  - Points option (R407)
- Air leakage
  - Air barrier, sealing
  - Testing

Or Tropical Zone option

Section 5

Ventilation

Ventilation – Hot/Humid climates

2018 IECC Code Review

Ventilation in hot humid climates

Efficacy vs. function and amounts

- 2018 IECC does require ventilation, but points to IRC or IMC
- Paragraph R403.6— How much and what type

R403.6 Mechanical ventilation (Mandatory).

The *building* shall be provided with ventilation that complies with the requirements of the *International Residential Code* or *International Mechanical Code*, as applicable, or with other *approved* means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Efficacy – IECC requirements:

R403.6.1 Whole-house mechanical ventilation system fan efficacy. P

Fans used to provide whole-house mechanical ventilation shall meet the efficacy requirements of Table R403.6.1.

Exception: Where an air handler that is integral to tested and *listed* HVAC equipment is used to provide whole-house mechanical ventilation, the air handler shall be powered by an electronically commutated motor.

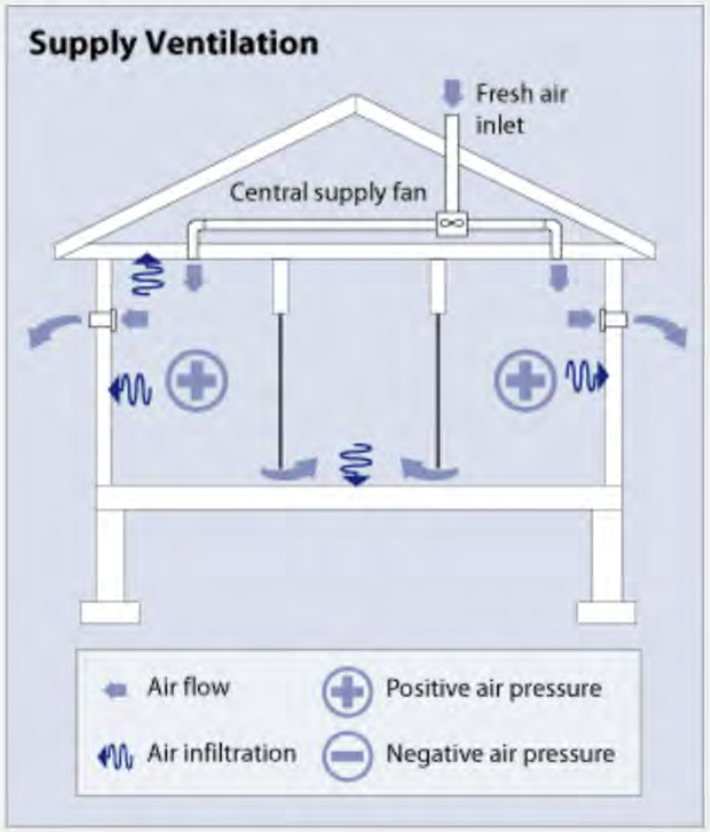
Vent. methods

(function – what kind)

Supply Only

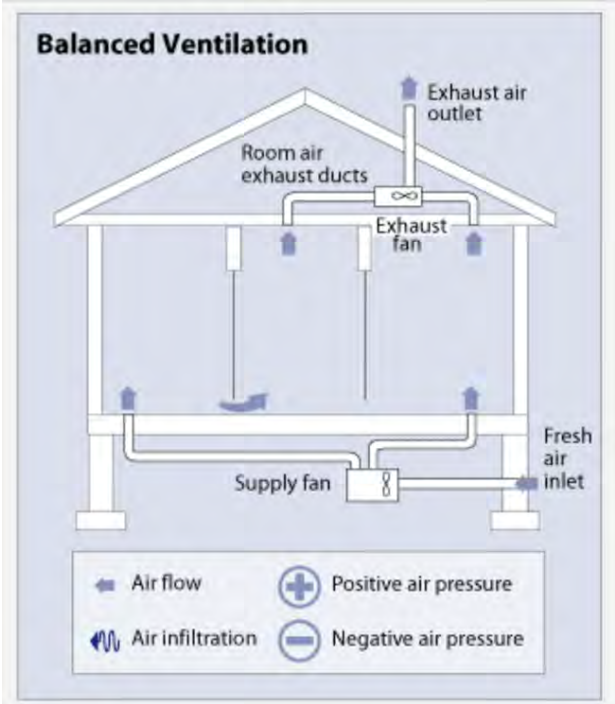
Exhaust Only

Balanced



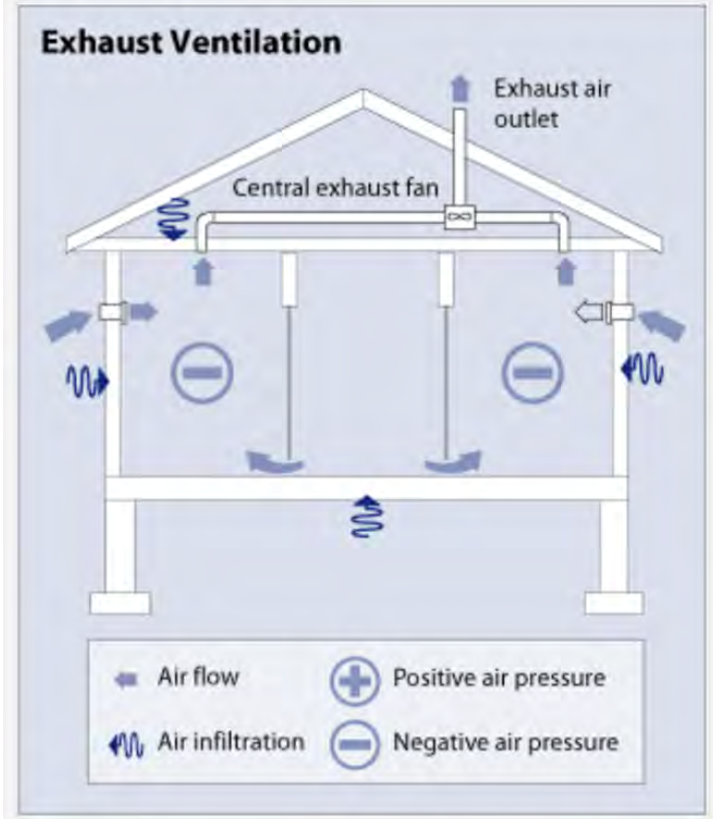
DOE

Supply Ventilation System



DOE

Balanced Ventilation System



DOE

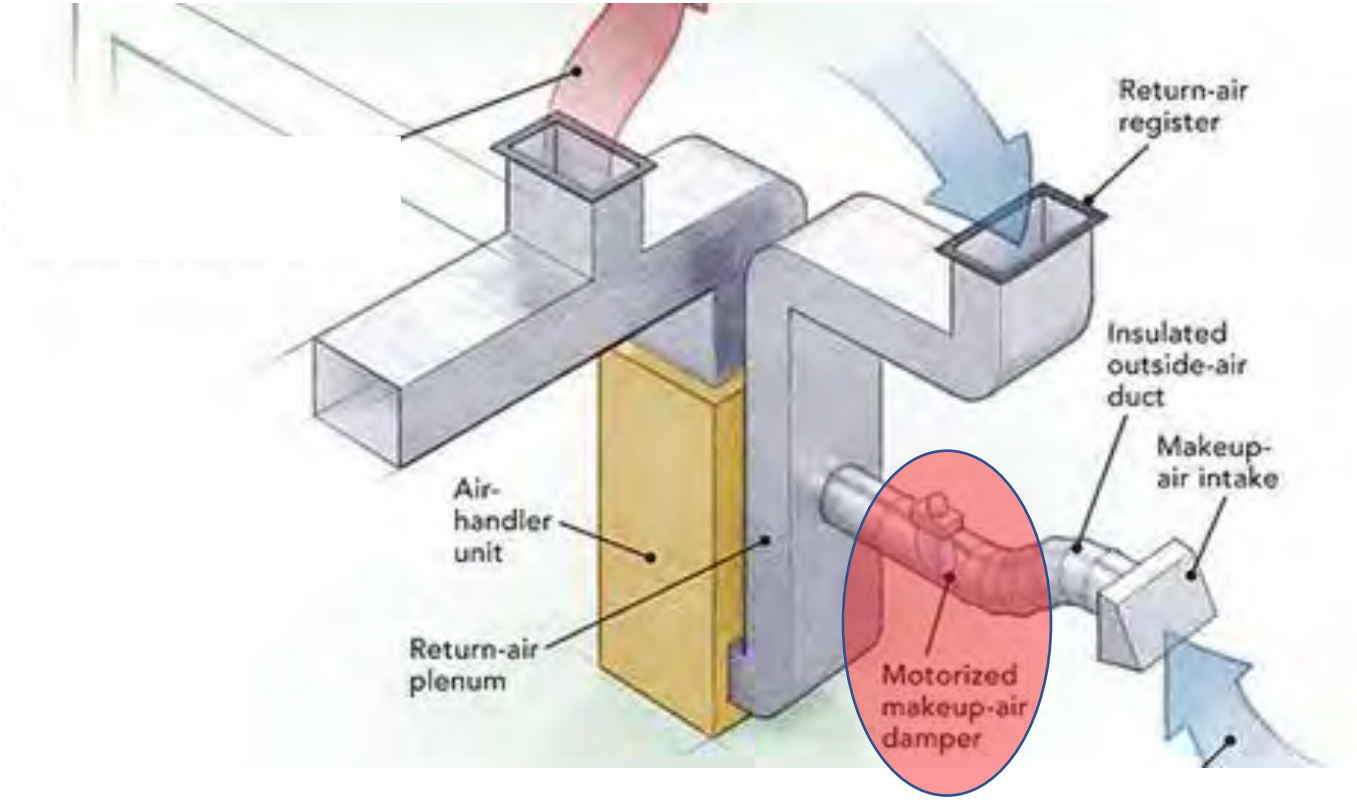
Exhaust Ventilation System

ASHRAE 62.2-2010 minimums

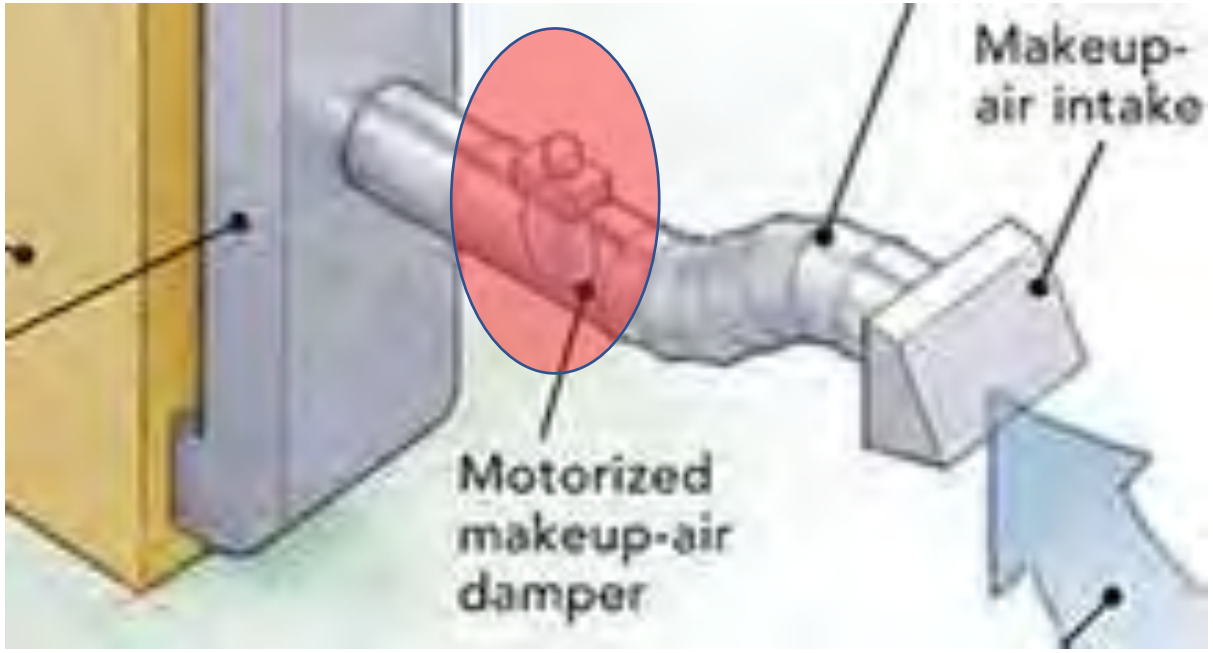
- CFM = .01 x floor area (SF) + 7.5 x (number of bedrooms + 1)

- 3500 SF 4 Bedroom Home
  - (3500 x .01) + 7.5 x (4+1)
  - 35 + 38 = 73 cfm continuous

Common ventilation method – ducted systems



Motorized, connected vs gravity damper



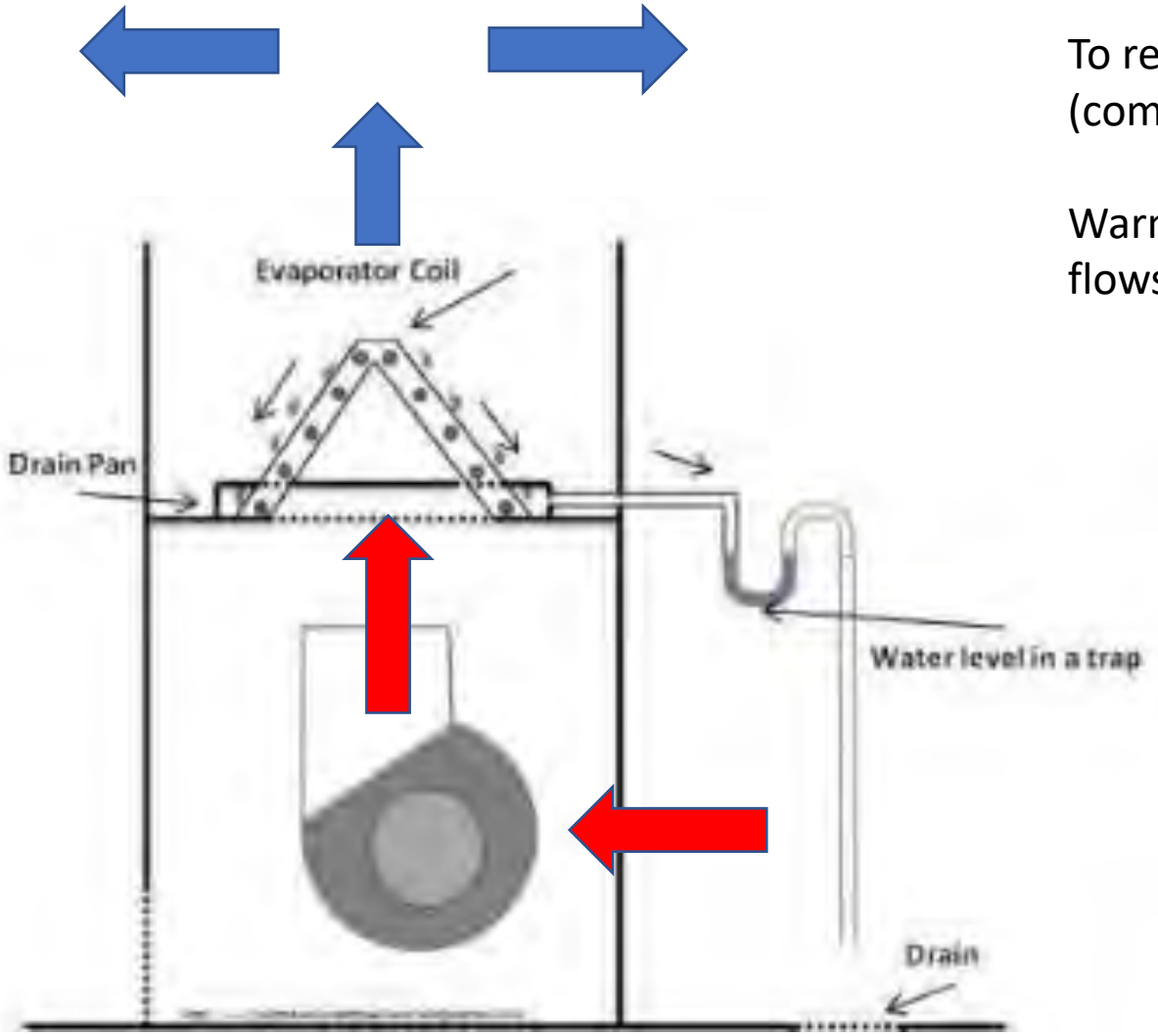
Gravity Damper

- ❑ Not allowed for Energy Star New Homes
- ❑ Only brings in outside air when cooling
- ❑ Unable to precisely control outside air amount

Mechanical ‘smart’ damper tied to FCU

- Required for Energy Star New Homes
- Runs FCU for specified amount of time regardless of cooling load (this is KEY!)
- Able to control outside air amount

Quick overview – how AC works



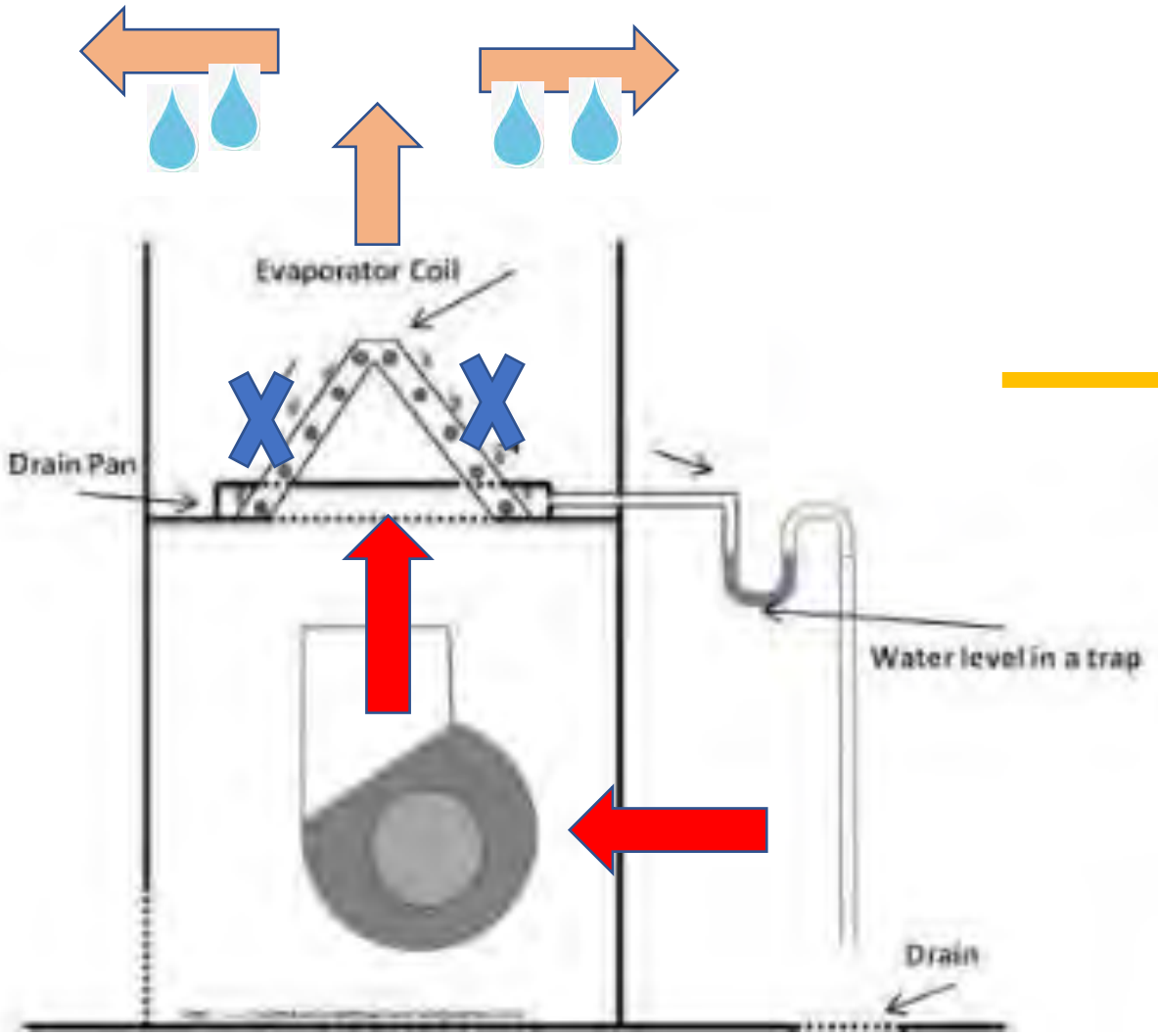
Primary function is dehumidification

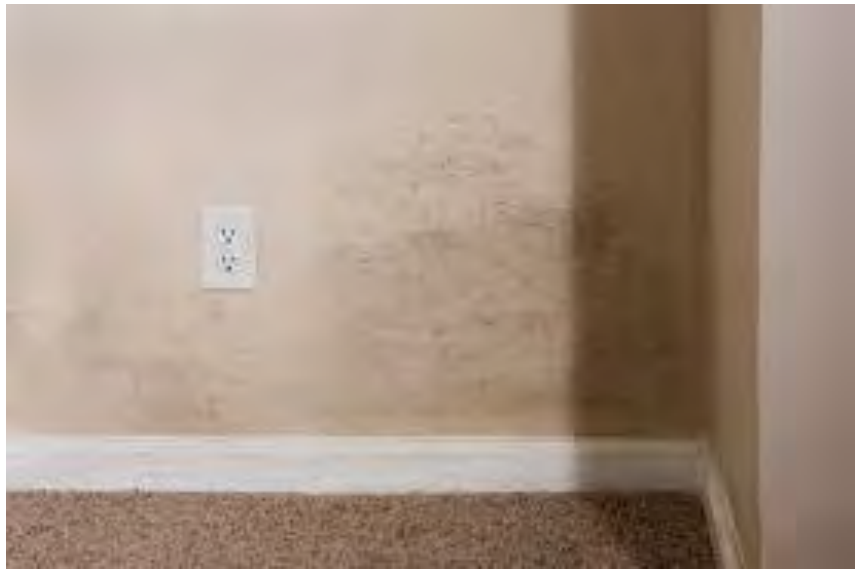
To remove moisture from air, coils must be cool (compressor on, refrigerant flowing)

Warm return air mixed with warm/humid outside air flows over cool coils, drops moisture as cools

Supply ventilation hot / humid climates

If FCU runs WITHOUT compressor, water is NOT removed from return/outside air. Plus more water on coils is picked up, then distributed throughout the duct system and house.





Warm moisture laden air hits cool wall surfaces and condenses leading to mold

Review:

Supply ventilation through ‘smart’ dampers – Not a bad idea in general, just not appropriate for hot/humid predominantly cooling climates.

Better ventilation options available

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Section 6

Systems

What's covered

Envelope

Roof
Walls
Window & skylights
Air leakage

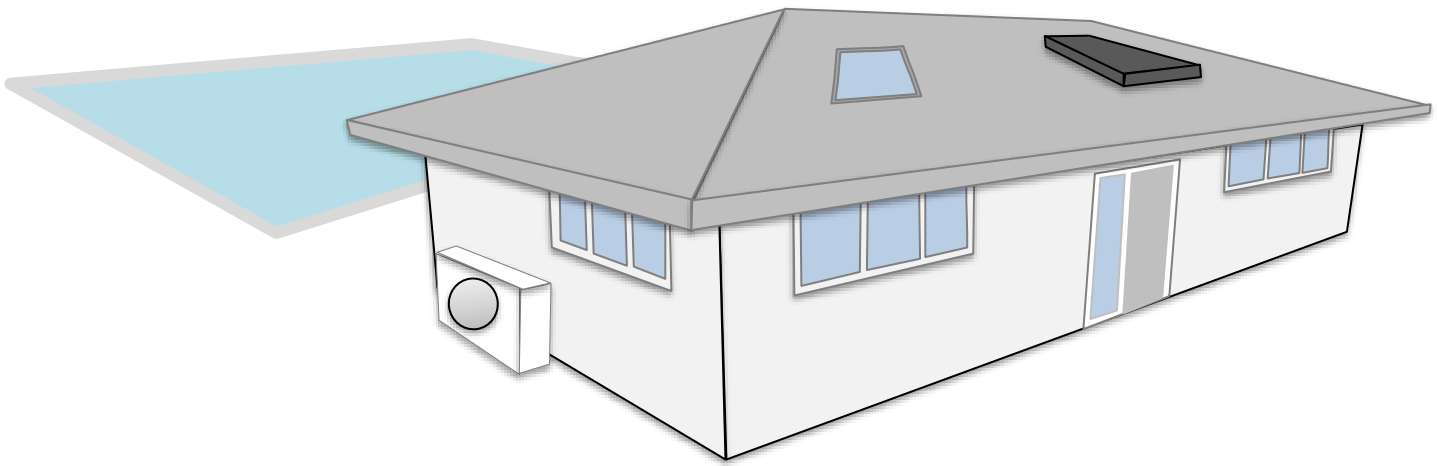
Systems

Air conditioning controls
Duct insulation
Duct leakage
Water heating
Swimming pool

Electrical

Permanently installed lighting
Ceiling fan
~~EV readiness~~
~~PV readiness~~

Up to counties for 2018



Not covered

AC efficiency
Water heater efficiency
Plug-in lighting
Appliances

Systems – AC Requirements

Programmable thermostat

Duct sealing & fastening

Source: www.energycodes.gov

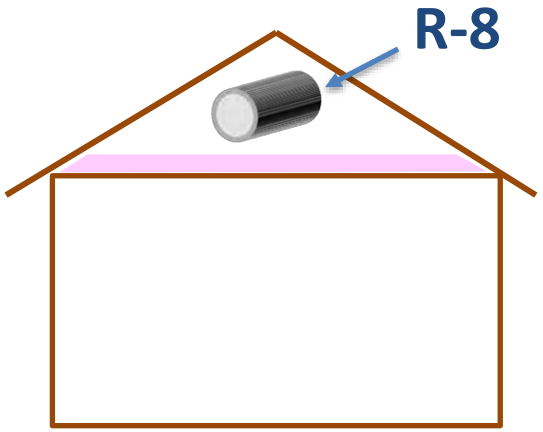
Duct insulation

Duct testing

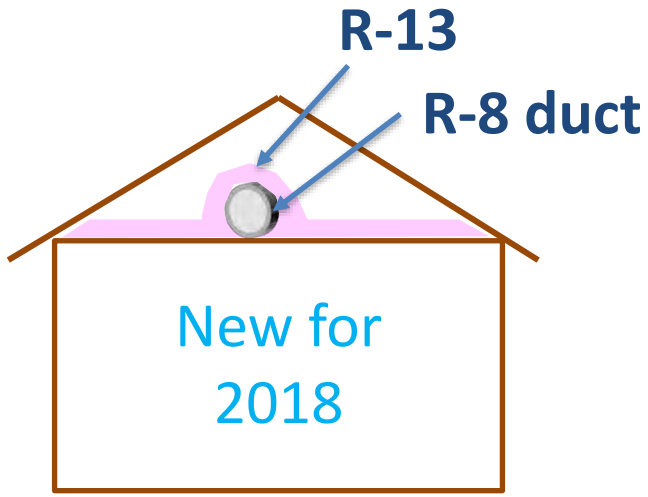
Source: DOE/NREL PIX04869

Systems – Duct Insulation

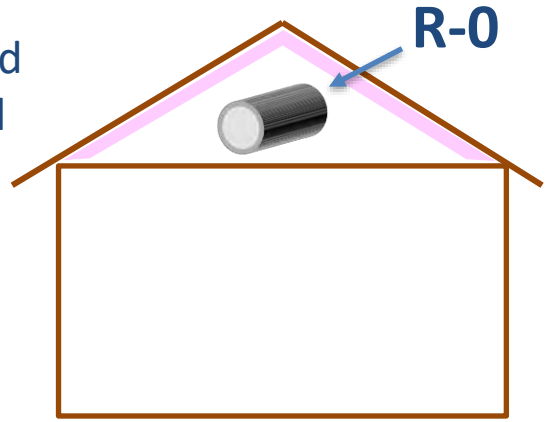
In attic



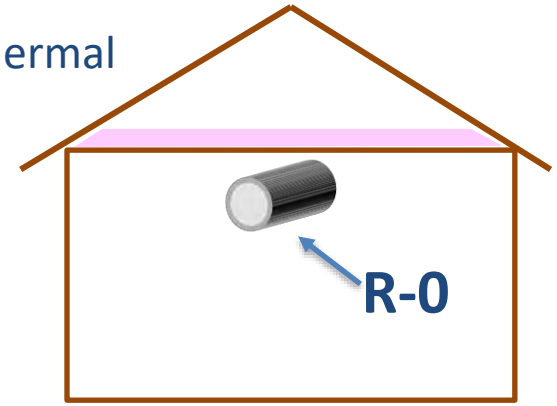
Buried in ceiling insulation



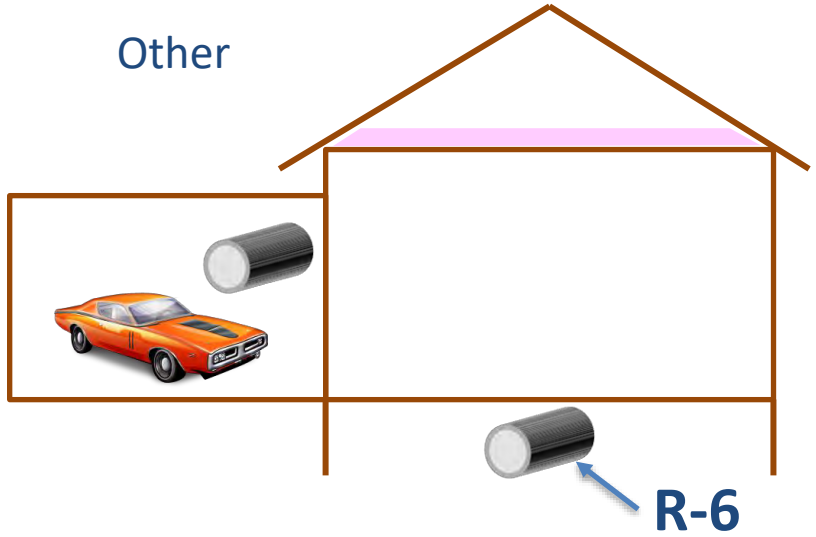
In insulated and sealed attic



Within thermal envelope



Other



Systems – Duct Insulation

Examples

R-6 (~1.75” thick)

R-8 (~2.5” thick)

Systems – Duct Insulation

DUCTS WITHIN THERMAL ENVELOPE EXAMPLES

Source: DOE/NREL PIX03067

Source: DOE/NREL PIX10076

Systems – Duct Sealing (R403.3.2)

IRC M1601.4.1 Joints, seams and connections

Ducts **mechanically fastened** <u>and</u> **sealed**

Sealing options

Tape with UL mark “181 B-FX”

Mastic with UL mark “181 B-M”

Source: DOE/NREL PIX04869

Systems – Duct Sealing (R403.3.2)

IRC M1601.4.1 Joints, seams and connections

Ducts **mechanically fastened** and **sealed**

Fastening options

Flex duct
Mechanical fasteners
with UL mark “181 B-C”

Metallic duct

- At least 1 inch overlap
- At least three screws/rivets

Systems – Duct Testing (R403.3.3 & R403.3.4)

Rough-in test

or

Postconstruction test

Leakage ≤ 4 cfm/100 ft^2

Leakage ≤ 3 cfm/100 ft^2
(without air handler)

Leakage ≤ 4 cfm/100 ft^2

Test **not** required if air handler and all ducts are within the thermal envelope

Systems – Solar Water Heating (R403.5.4)

Solar water heating systems are required for new single-family residential construction pursuant to HRS 196-6.5

More information

https://energy.hawaii.gov/resources/solar-water-heater-variance

https://www.capitol.hawaii.gov/hrscurrent/Vol03_Ch0121-0200D/HRS0196/HRS_0196-0006_0005.htm

Systems – Service Hot Water

Circulation systems (R403.5.1.1)

- Pump required
- Automatic temperature and demand controls required

Demand recirculation systems (R403.5.2)

- Control based on signal from user action
- Limit on hot water temperature entering cold water piping

Systems – Service Hot Water

Hot water pipe insulation (R403.5.3)

- ≥ ¾” diameter
- Serving more than one dwelling
- Outside conditioned space
- From water heater to manifold
- Under a slab
- Buried
- In recirculating systems

R-3 insulation (typically ½”)

Systems – Pools and Spas (R403.10)

On/off switch

Time switch

Cover for heated pool

- Unless >75% solar or heat pump

Courtesy Daniel Sandomire, Armstrong Builders

Section 7

Electrical & Lighting

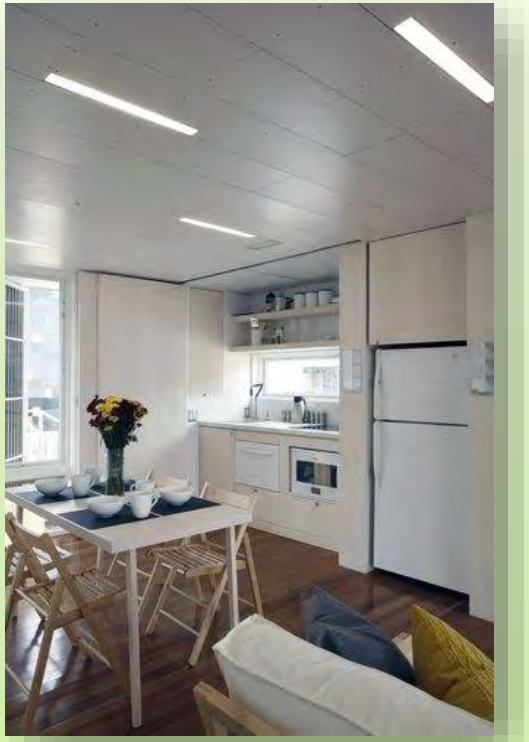
Lighting (R404.1)

High efficacy
≥ 90% of lamps

Lamp Wattage	Efficacy (lumens/watt)
> 40 watts	60
15-40 watts	50
< 15 watts	40

High efficacy examples

Compact fluorescent



Source: DOE/NREL PIX17458

Full-size fluorescent

Source: DOE/NREL PIX20307

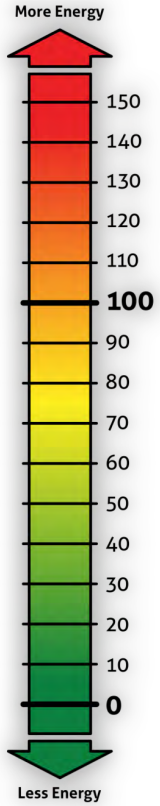
LED

Ceiling Fans (R404.2)

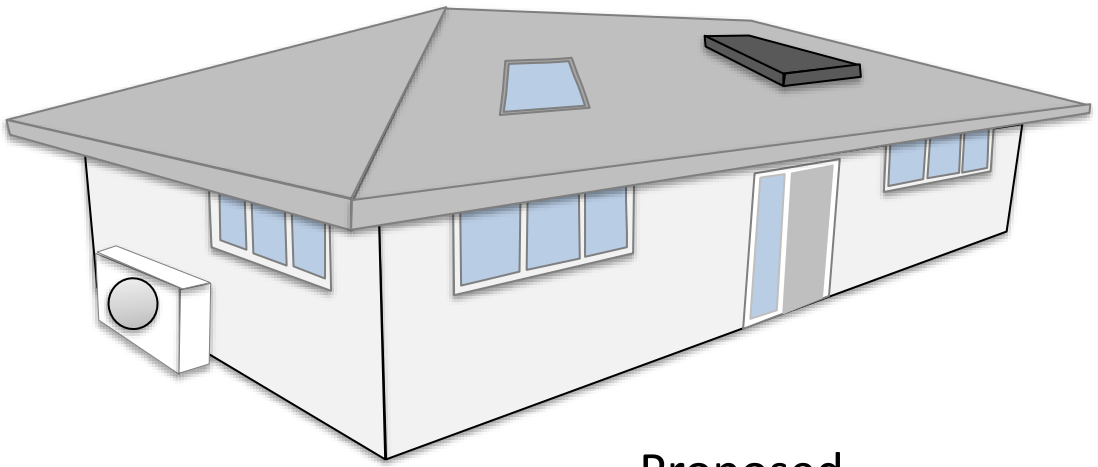
R404.2 Ceiling Fans (Mandatory). A ceiling fan, ceiling fan rough-in or whole house fan is provided for bedrooms and the largest space that is not used as bedroom.

Section 8

Performance Compliance Options



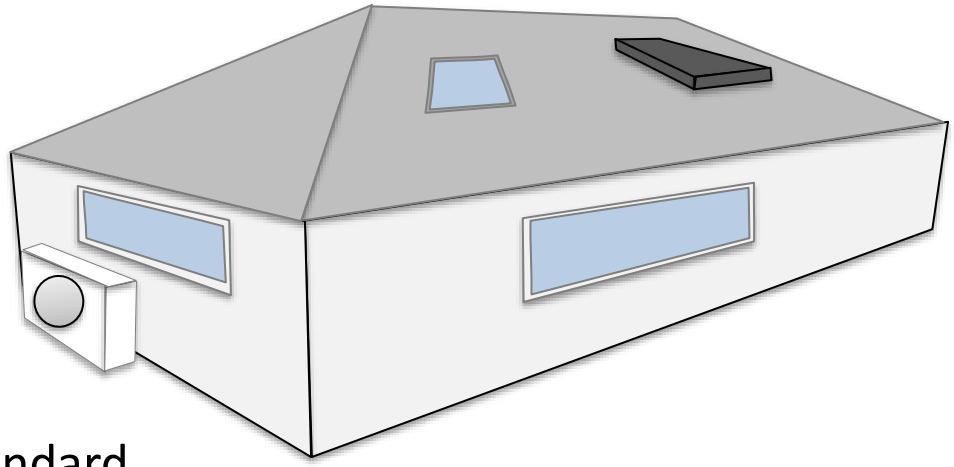
Simulated Performance Alternative (R405)



Proposed design $/year

≤

Standard reference design $/year



Common software

- REM/Rate and REM/Design
- Ekotrope
- EnergyGauge USA
- IC3 (Texas A&M)

Standard reference design

- Prescriptive envelope
- Window area ≤ 15% of floor area
- Windows equally distributed all sides
- No window shading
- Proposed cooling system
- Proposed water heating system

Energy Rating Index Compliance (R406)

Compliance

- Mandatory requirements
- Envelope performance ≥ 2009 IECC
- Energy Rating Index ≤ 57 (was 52)
- Verification by approved third party

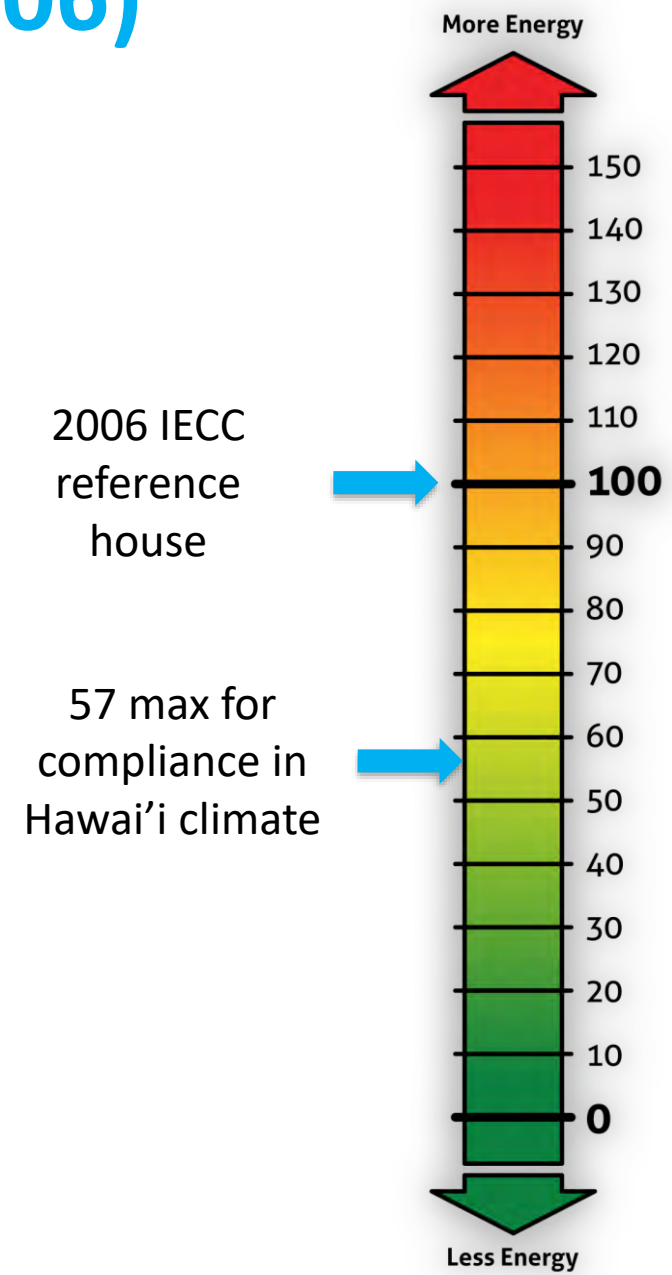
Accredited providers

https://www.resnet.us/providers/accredited-providers/accredited-rating-providers/

Accredited software tools (May 2021)

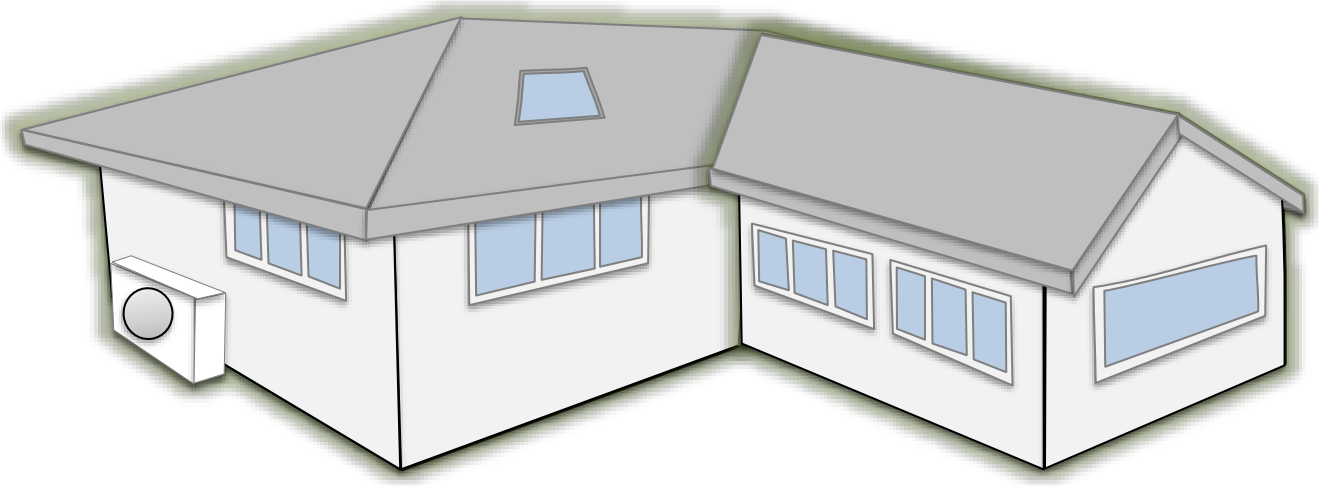
https://www.resnet.us/providers/accredited-providers/hers-software-tools/

- Ekotrope
- EnergyGauge USA
- REM/Rate



Section 9

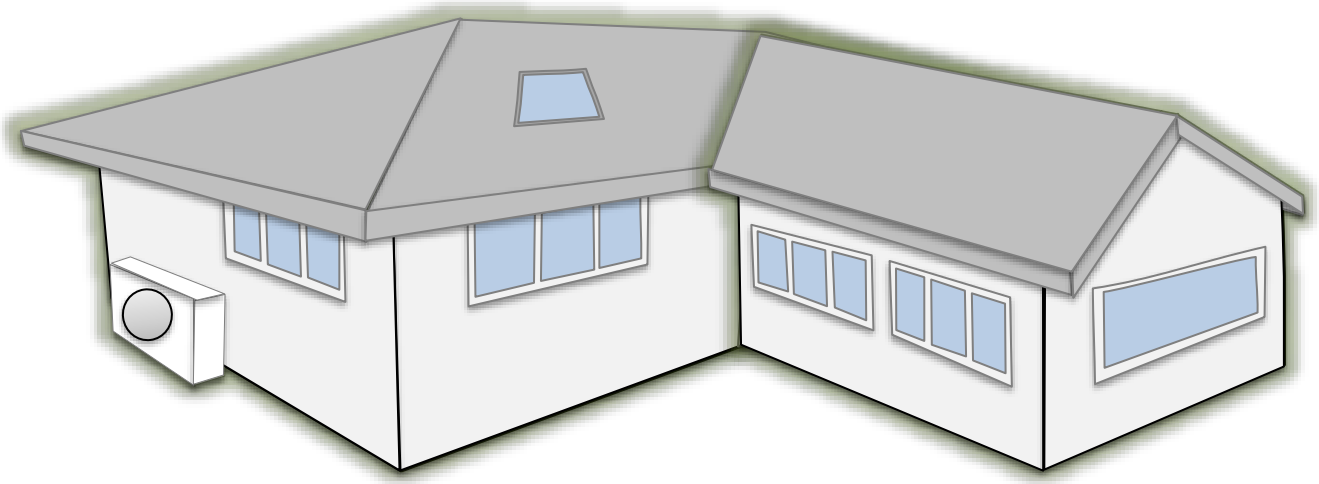
Existing Building Compliance



Additions (R502)

Three options

1. New construction requirements for addition alone
2. Performance method for existing + addition
3. Existing + addition no more energy than existing



Envelope	Systems
New roof	New AC
New walls	New duct
New windows & skylights	New water heating
Air leakage	New lighting

Alterations (R503)

General requirement for alterations

Altered components meet new construction requirements

Example alterations

- New windows in existing wall
- Replaced windows with sash and frame
- New AC system
- New water heating system
- New lighting systems
- Replace wall siding
- Roof replacement

Some exceptions

Alterations (R503)

Roof

Meet new construction insulation requirements

Exceptions

- Roof repair – no requirement
- Roof recover – no requirement
- Roof replacement - amendment

***ROOF REPLACEMENT**. The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.*

Roof replacement options

1. R-30 insulation or cool roof
2. R-19 or cool roof (Tropical Zone)
3. Choose two
   1. Energy Star roof covering
   2. Radiant barrier
   3. Attic ventilation
   4. Exceptions listed in C402.3
4. Shake on battens replaced with equal or better performance

1. Portions covered by:
   - Photovoltaic systems or components.
   - Solar air or water-heating systems or components.
   - Roof gardens or landscaped roofs.
   - Above-roof decks or walkways.
   - Skylights.
   - HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions shaded during summer solstice
3. Portions ballasted with stone 17 lb/sf

Alterations (R503)

Walls

R-value or U-factor for new construction

Exceptions

- Wall cavity is not exposed
- Wall cavity is filled with insulation

Alterations (R503)

Windows

0.25 SHGC for new windows and replacement windows or skylights

(Area weighted average allowed)

Skylights

U-factor ≤ 0.75

SHGC ≤ 0.30

(Area weighted average allowed)

Exception

- Glazing-only repairs of existing windows and skylights

Alterations (R503)

Air conditioning systems

New systems and components meet new construction requirements

Exceptions

- Duct extensions of less than 40 ft in unconditioned space

Water heating systems

New systems and components meet new construction requirements

Alterations (R503)

Lighting

High efficacy ≥ 90% of lamps

Exceptions

- Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

Section 10

Electric Vehicle and Solar Readiness

https://www.clippercreek.com/

Electric Vehicle and Solar Readiness

Left to the Counties

- Electric vehicle charging readiness
- Solar conduit and electric panel readiness

2018 IECC Appendix RA (Optional)

Solar-Ready Provisions – Detached One- and Two-Family Dwellings and Townhouses

- Solar ready zone area, free from obstructions
- Roof load documentation
- Interconnection pathway
- Electrical service reserved space
- Permanent certificate

Section 11

Wrap Up

Wrap Up – Compliance Alternatives

- Tropical Zone
  - ≤50% air conditioned
  - not heated
  - elevation < 2,400 feet
- Prescriptive
  - Envelope (+ Points Option)
  - Systems
  - Electrical power and lighting systems
- Simulated performance alternative

- Energy rating index (ERI)
  - ERI ≤ 57

Q&A

Erik Kolderup, PE, Kolderup Consulting

Howard Wiig, State Energy Office

Peter Stone, Energy Consultant

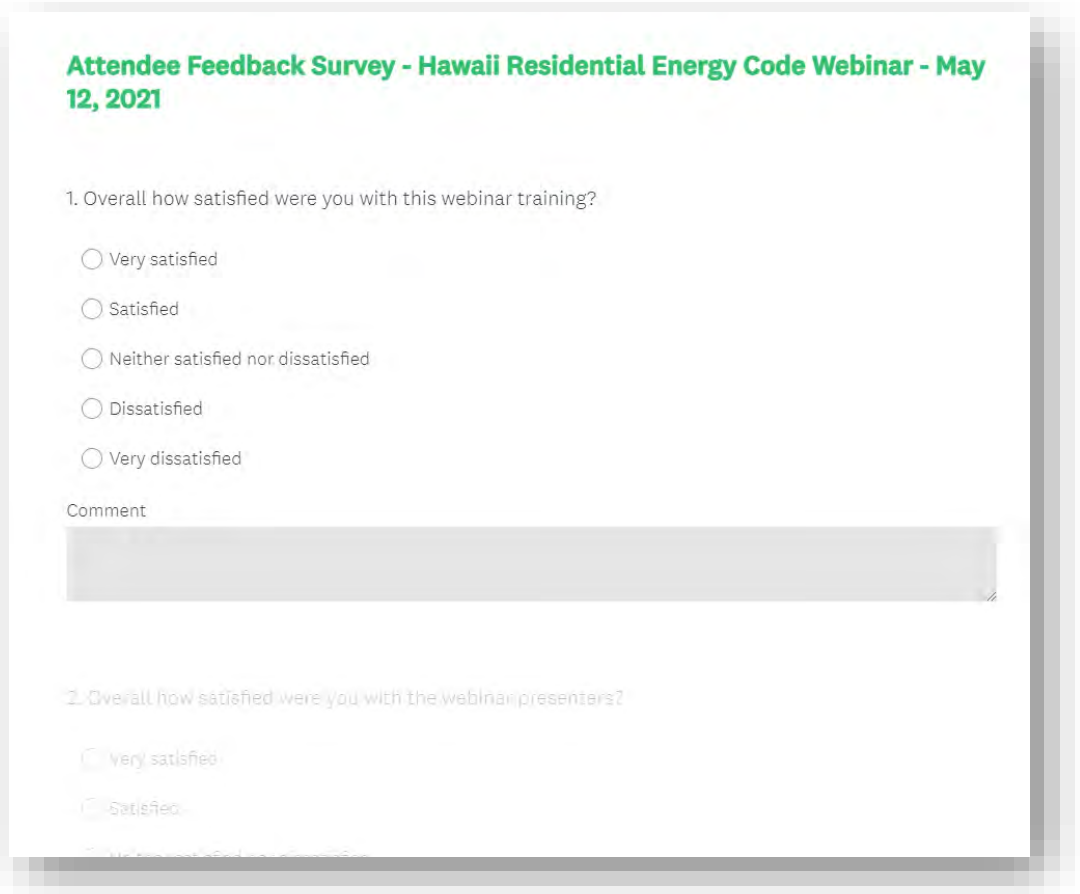
Next week!

2018 IECC with Hawaii Amendments Commercial Requirements

Webinar
Wednesday, May 19, 2021
12:00 – 1:30pm

Evaluation Survey

https://www.surveymonkey.com/r/NWPRKM7



Attendee Feedback Survey - Hawaii Residential Energy Code Webinar - May 12, 2021

1. Overall how satisfied were you with this webinar training?

- Very satisfied
- Satisfied
- Neither satisfied nor dissatisfied
- Dissatisfied
- Very dissatisfied

Comment

2. Overall how satisfied were you with the webinar presenters?

- Very satisfied
- Satisfied

For more energy code information

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2018 IECC available:

- http://iccsafe.org/publications
- https://codes.iccsafe.org/content/iecc2018

State Energy Code Website:

- http://energy.hawaii.gov/hawaii-energy-building-code

Hawaii Energy Code Website

- https://hawaiienergy.com/codes