










<h2>Honolulu Energy Code</h2> <p>Low-rise Residential Requirements</p> <p>December 5, 2023</p> <p>HAWAII STATE ENERGY OFFICE</p> <p>Presentation Collaborators</p> <p>Hawaii Energy AIA Honolulu RENEW Hawaii Design</p>	<h2>Section 1</h2> <h3>Introduction & Scope</h3> 	<h2>Section 2</h2> <h3>Compliance</h3> 	<h2>Section 3</h2> <h3>Tropical Zone Compliance Path</h3> 	<h2>Section 4</h2> <h3>Prescriptive Compliance Option</h3>
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Honolulu Energy Code

Low-rise Residential Requirements

December 5, 2023



**HAWAI'I
STATE
ENERGY
OFFICE**

Presentation Collaborators



AIA
Honolulu





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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

Updates to Honolulu's building energy code take effect on November 23. Join this free hybrid session, either in-person or online, to learn how these changes will affect your projects. This session covers low-rise residential requirements, including new energy performance requirements for large single-family homes. This code update moves Honolulu from the 2015 to the 2018 International Energy Conservation Code, with updated County amendments.



LEARNING OBJECTIVES

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

1. Identify applicable new requirements in the 2018 IECC, including Honolulu 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
- Erik Kolderup, PE, Kolderup Consulting
- Ben Sullivan, City & County of Honolulu Office of Climate Change, Sustainability and Resiliency

Acknowledgments

- Karen Shishido, Hawaii Energy
- Gail Suzuki-Jones, State Energy Office

Topics

Hawaii Energy Programs

Introduction & Scope

Compliance

Tropical Zone Option

Prescriptive Option

- Envelope
- Systems
- Electrical & Lighting

EV and Solar Readiness

Large single-family home

Performance Compliance Options

Existing Building Compliance

- Additions
- Alterations

Q&A

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



Hawai'i Energy

[HawaiiEnergy.com](https://www.hawaiienergy.com)

RESIDENTIAL NEW CONSTRUCTION

PRESCRIPTIVE APPROACH

Minimum Requirements

LED Lighting – 85% for PY23
50% 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

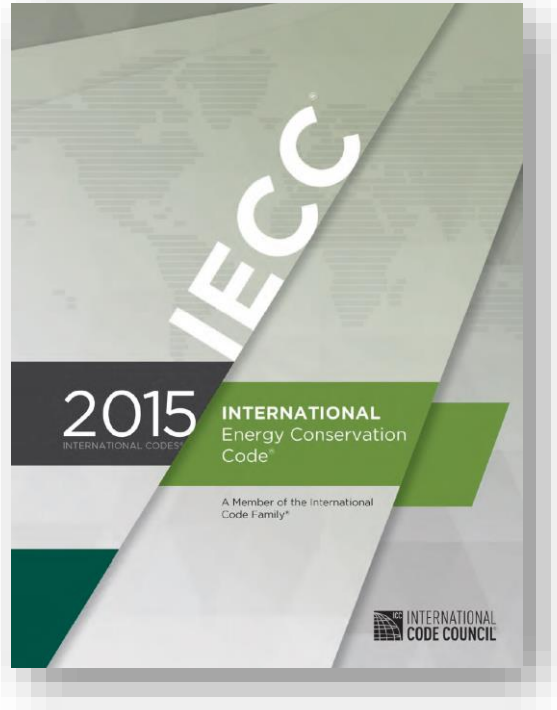
Additional Incentive Opportunities

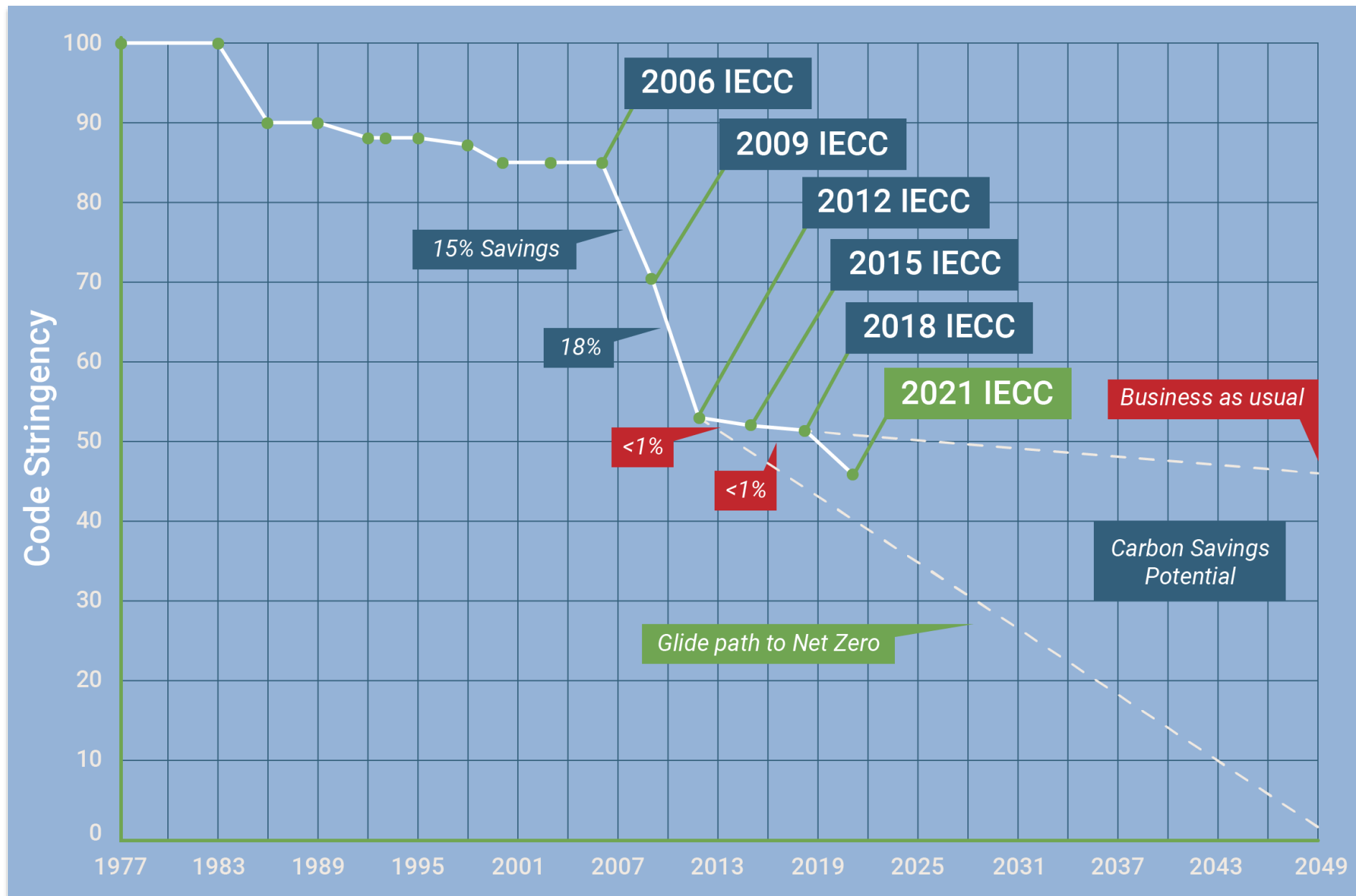
Multifamily sector - potential for enhanced incentives for affordable rental housing

All grid-tied measures installed above current code requirements considered for custom incentives. *e.g. solar water heating for multi-family projects*

Section 1

Introduction & Scope





Source: Energy Efficient Codes Coalition. <https://energyefficientcodes.org/iecc/>

Adoption

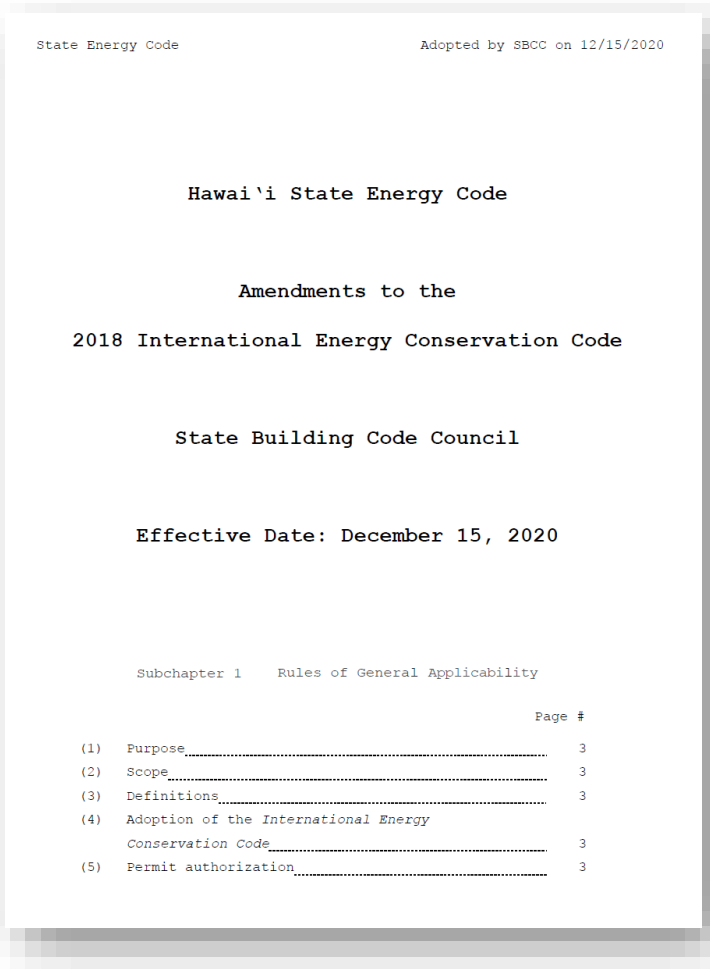
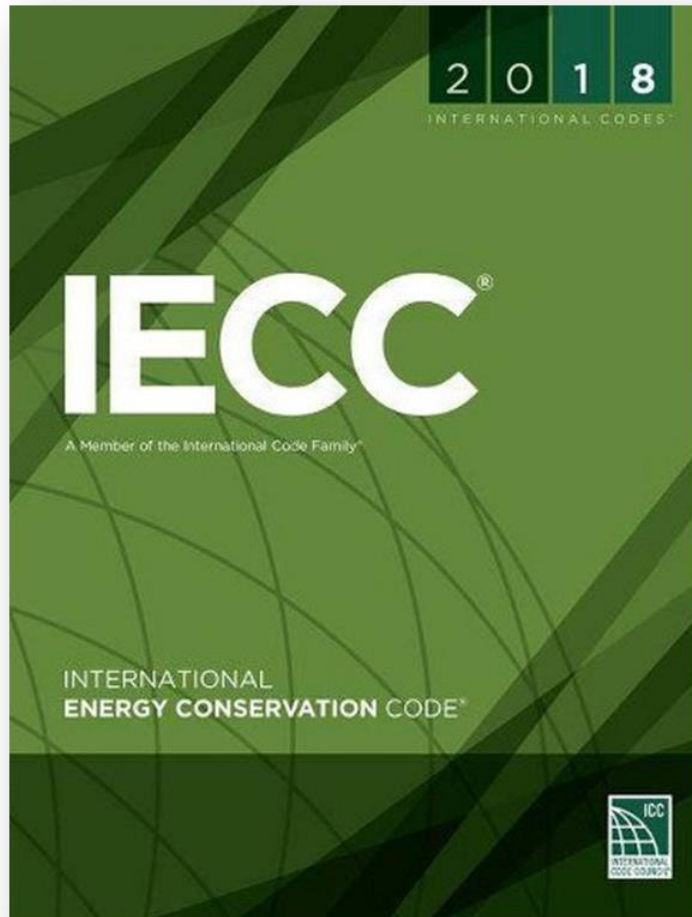


Dec. 15, 2020 – State adoption

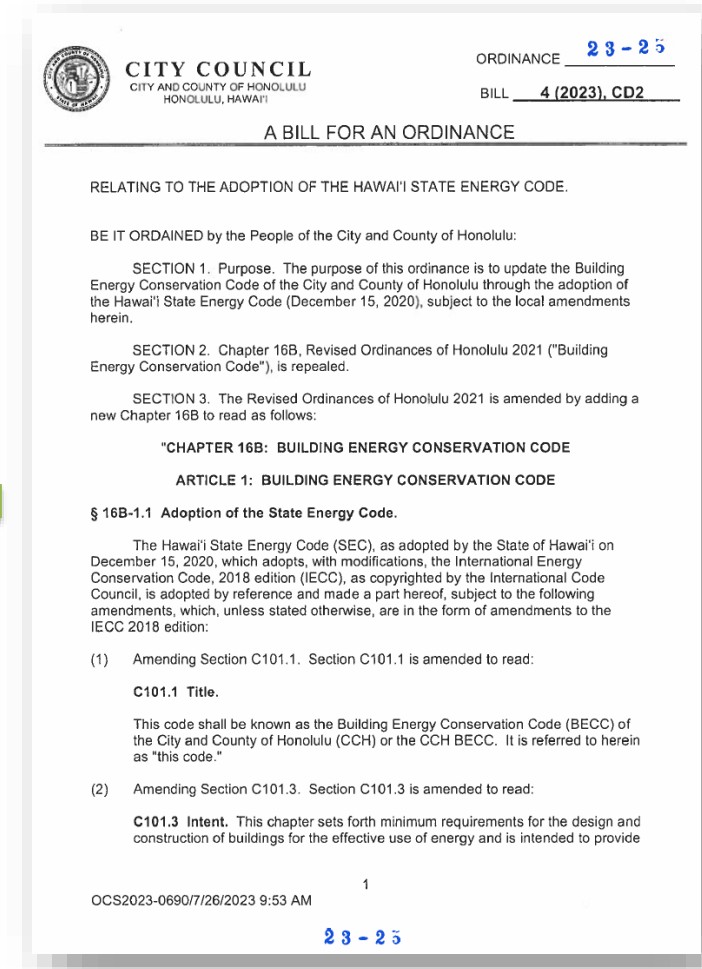
Aug. 23, 2023 – Honolulu adoption

Nov. 23, 2023 – Honolulu effective date

State amendments 12 pages



Honolulu amendments 38 pages



<https://codes.iccsafe.org/content/iecc2018>

<https://energy.hawaii.gov/what-we-do/energy-efficiency/hawaii-energy-building-code-iecc-updates>

<https://www.resilientoahu.org/energycode>

Scope

Today's topic

Residential

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



Courtesy Daniel Sandomire, Armstrong Builders

Commercial

- All other buildings
 - Including R-1 (hotels) and R-2 \geq 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>

What's covered

Envelope

Roof
Walls
Windows & skylights
Air leakage

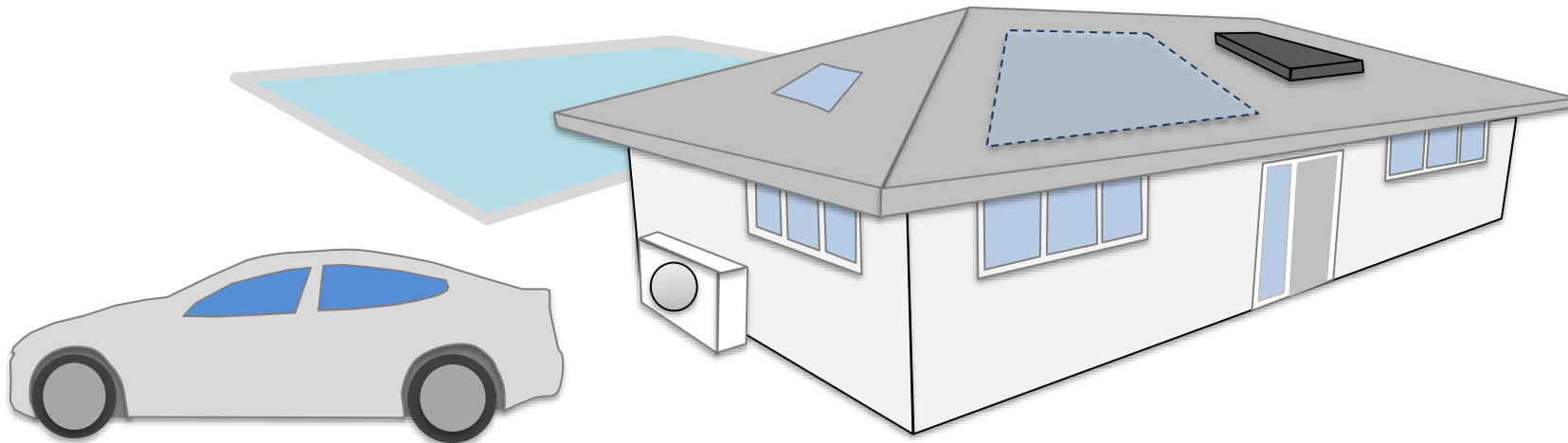
Systems

Air conditioning controls
Duct insulation
Duct leakage
Water heating
Swimming pool

Electrical

Permanently installed lighting
Ceiling fans
PV readiness
EV readiness

**Honolulu
Amendment**



Not covered

AC efficiency
Water heater efficiency
Plug-in lighting
Appliances

Resources

Checklist

RESIDENTIAL CHECKLIST IECC 2018 with Honolulu Amendments



This checklist covers requirements of the Honolulu Energy Conservation Code, approved August 2023 and effective November 23, 2023. This code is an amended version of the 2018 International Energy Conservation Code (IECC), with Honolulu amendments applied to the State amended version (December 15, 2020).

- State amendments: <https://energy.hawaii.gov/what-we-do/energy-efficiency/hawaii-energy-building-code-iecc-updates>
- Subsequent Honolulu amendments: <https://www.resilientoahu.org/energycode>
- View the 2018 IECC here: <https://codes.iccsafe.org/content/iecc2018>

Red text in this checklist indicates changes compared to the previous Honolulu energy code (2015 IECC with Honolulu 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	Large Single Family Homes
Allowed when: 1. ≤50% air conditioned, 2. not heated, and 3. elevation < 2,400 feet.	Include three options for walls and roof compliance: 1. Prescriptive 2. Total UA (typically with ResCheck software) 3. Points option (added by Hawaii amendment) Envelope requirements apply to unconditioned occupiable space (Honolulu amendments, R402.1)	Simulated energy performance analysis for heating, cooling and water heating. The analysis shall have an energy cost or reference design.	Third-party Home Energy Rating System (HERS) calculation. Allow 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.	Required if > 7,000 ft ² and ≥2,000 ft ² conditioned space Comply with: ▪ Simulated performance alternative, or ▪ Energy rating index alternative Meet additional efficiency requirements
See Tropical Zone Checklist below	See Prescriptive Checklist below. See Points Option tables below.	See code Section R405	See code Section R406	See Large Single Family Home checklist below
PV and EV ready				
Solar conduit and electrical panel readiness (R408.1) Electric vehicle readiness (R408.2)				

Red text = change vs. 2015

CHECKLIST CONTENTS

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Prescriptive checklist	5
Large single family home checklist	10
Additions and alterations checklist	12
Points option tables	14

Resources

Checklist

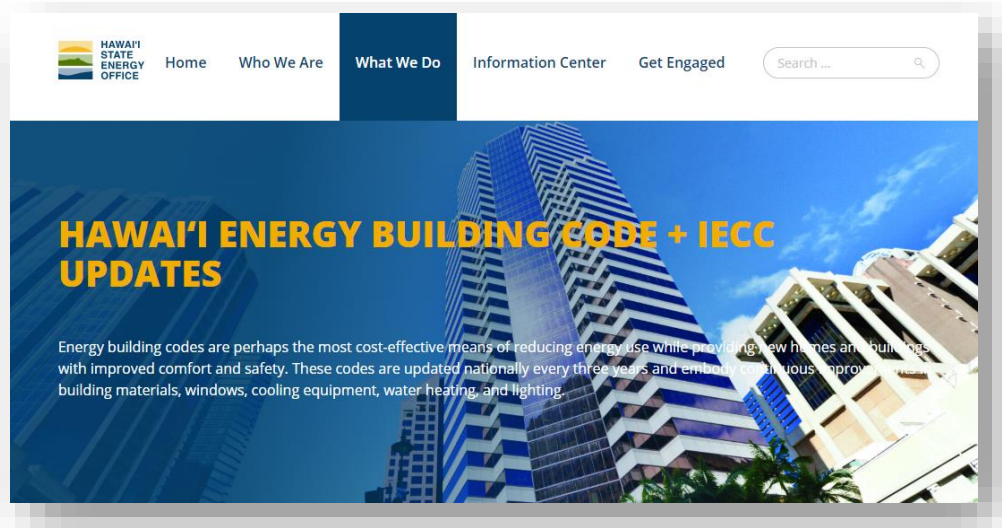
PRESCRIPTIVE REQUIREMENTS CHECKLIST

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
Design professional statement	Form included on plans with signature of design professional	R103.1 [†] R103.2 [†]	See the Honolulu amendments for required	<input type="checkbox"/> Signature block included
Certificate	Permanent certificate	R401.4 [†]	[†] = Honolulu amendment insulation R-values, window SHGC, results of duct and air leakage testing (if required), efficiency of air conditioning and water heating equipment, PV system information (if applicable), Energy Rating Index score (if applicable) Section is renumbered by Honolulu amendment.	
Roof – wood frame	<input type="checkbox"/> R-30, <input type="checkbox"/> U-0.035, <input type="checkbox"/> Total UA alternative, or <input type="checkbox"/> Points option	R402.1, R402.1.5, R407*	Some R-30 options: • 10 in. batt insulation * = State amendment	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Roof – metal truss	<input type="checkbox"/> R-38, <input type="checkbox"/> U-0.035, <input type="checkbox"/> R-30 + R-3, <input type="checkbox"/> R-26 + R-5, <input type="checkbox"/> Total UA alternative, or <input type="checkbox"/> 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.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Roof – metal joist	<input type="checkbox"/> R-38 in 2x4, 2x6 or 2x8 framing, <input type="checkbox"/> R-49 in any framing <input type="checkbox"/> Total UA alternative, or <input type="checkbox"/> Points option	R402.1, R402.2, R402.1.5, R407*		<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Wall – wood frame	<input type="checkbox"/> R-13, <input type="checkbox"/> U-0.084, <input type="checkbox"/> Total UA alternative, or <input type="checkbox"/> Points option	R402.1, R402.1.5, R407*	Some R-13 options: • 3.5 in. batt insulation • 2 to 3.5 in. spray foam	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Wall – metal frame	Framing 16 in. on center: <input type="checkbox"/> R-13 + R-4.2 <input type="checkbox"/> R-21 + R-2.8 Framing 24 in. on center: <input type="checkbox"/> R-13 + R-3.0 <input type="checkbox"/> R-15 + R-2.4 <input type="checkbox"/> Total UA alternative, or <input type="checkbox"/> Points option	R402.1, R402.2, R402.1.5, R402.2.6, R407*	Requires insulation in framing cavity plus a layer of continuous insulation (typically foam board). Other complying combinations of batt and board insulation are listed in Table R402.2.6 in the 2018 IECC	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans

Resources

HSEO Website

Past training materials



<https://energy.hawaii.gov/what-we-do/energy-efficiency/Hawaii-energy-building-code-iecc-updates/>

December 9, 2021 – Complying With the Energy Code – 2018 IECC with Hawai'i Amendments

A new energy code takes effect for Hawai'i State building projects on December 14, 2021, and for other projects no later than December 2022, depending on adoption by the Counties. This webinar provided guidance on the energy code compliance process and covered a range of project types, including new construction and alteration projects.

Presenters: Howard Wiig, Energy Analyst with the State Energy Office and Chair of the State Building Code Council, and Erik Kolderup, building energy consultant and energy code specialist.

- [Presentation: Complying With the Energy Code – 2018 IECC with Hawai'i Amendments](#)
- [Video: Energy Code Webinar](#)

May 12 & 19, 2021 – Energy Code Update – 2018 IECC with Hawai'i Amendments

Presenters: Howard Wiig, Energy Analyst with the State Energy Office and Chair of the State Building Code Council, and Erik Kolderup, building energy consultant and energy code specialist.

An update to the building energy code has been adopted by the State Building Code Council, moving Hawai'i from the 2015 IECC to the 2018 IECC. The webinars provided an overview of code requirements with emphasis on the Hawai'i amendments and updated requirements.

Commercial and High-Rise Residential Requirements Training Material

- [Presentation: 2018 IECC with Hawai'i Amendments Commercial and High-Rise Residential Requirements](#)
- [Checklist: Commercial Checklist 2018 IECC with State Amendments \(PDF\)](#)
- [Video: Hawai'i 2018 IECC commercial 2021 05 19](#)

Low-Rise Residential Requirements Training Material

- [Presentation: 2018 IECC with Hawai'i Amendments Low-Rise Residential Requirements \(PDF\)](#)
- [Checklist: Residential Checklist IECC 2018 with State Amendments \(PDF\)](#)
- [Video: Hawai'i 2018 IECC Residential Requirements 2021-05-12](#)

Section 2

Compliance

CITY AND COUNTY OF HONOLULU REVISED ORDINANCES OF HONOLULU 2021 CHAPTER 16B	
To the best of my knowledge, this project's design substantially conforms to the Building Energy Conservation Code for:	
_____	Building Component Systems
_____	Electrical Component Systems
_____	Mechanical Component Systems
Signature: _____ Date: _____	
Name: _____	
Title: _____	
License No.: _____	

Compliance options – low-rise residential

1. Tropical Zone
 - $\leq 50\%$ 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 \leq standard reference design
4. Energy rating index (ERI)
 - $ERI \leq 57$
5. Large homes
 - $> 7,000 \text{ ft}^2$

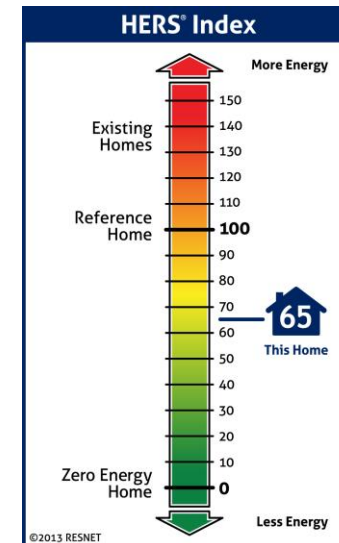
**State
Amendment**



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



**Honolulu
Amendment**



Design professional certification (R103.2)

CITY AND COUNTY OF HONOLULU
REVISED ORDINANCES OF HONOLULU 2021
CHAPTER 16B

To the best of my knowledge, this project's design substantially conforms to the Building Energy Conservation Code for:

_____ Building Component Systems
_____ Electrical Component Systems
_____ Mechanical Component Systems

Signature: _____ Date: _____

Name: _____

Title: _____

License No.: _____

**Honolulu
Amendment**

Certificate (R401.3)

- Permanent certificate
- Utility room or approved location
- Includes
 - R-values of insulation
 - U-factors and SHGC of fenestration
 - Air leakage test results (if applicable)
 - Equipment efficiencies

EXAMPLE

Energy Efficiency Certificate					
Insulation Rating		R-Value		R-Value	
Ceiling /Roof		R-		R-	
Walls	Frame	R-		Mass	R-
	Basement	R-		Crawl space	R-
Floors	Over unconditioned space	R-		Slab edge	R-
Ducts	Attic	R-		Other	R-
Air Leakage Test Results					
Blower door		ACH/50 Pa.	Duct testing		Cfm/100 ft²
Fenestration Rating		NFRC U-Factor		NFRC SHGC	
Window	U-				
Opaque door	U-				
Skylight	U-				
Equipment Performance		Type		Efficiency	
Heating system					AFUE
Cooling system					SEER
Water heater					EF
Indicate if the following have been installed (an efficiency shall not be listed)					
<input type="checkbox"/> electric furnace	<input type="checkbox"/> gas-fire unvented room heater	<input type="checkbox"/> baseboard electric heater			
Designer/builder					
Code edition		Date			

Section 3

Tropical Zone Compliance Path



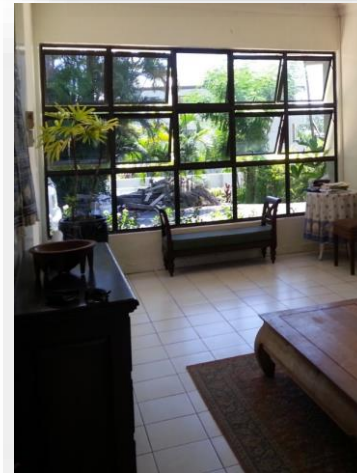
Tropical Zone Option (R401.2.1)

Can use this path if

- $\leq 50\%$ 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

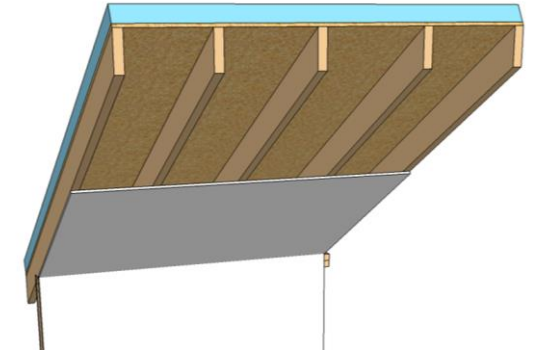
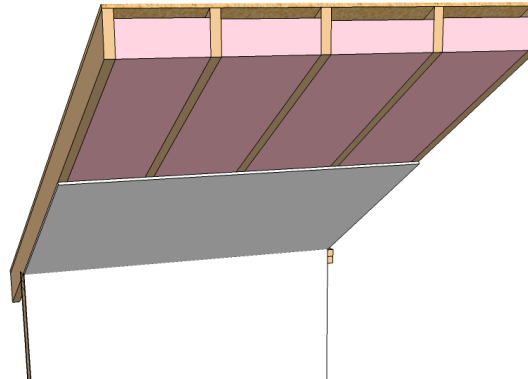
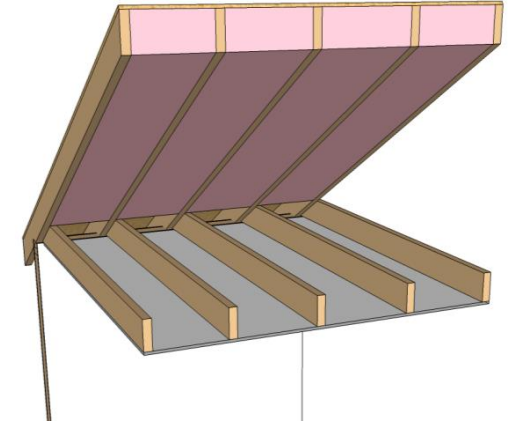
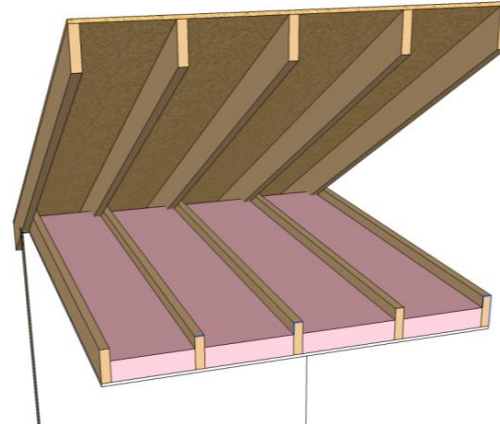
Ceiling fans

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



Courtesy of Peter Stone

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



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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

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)



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

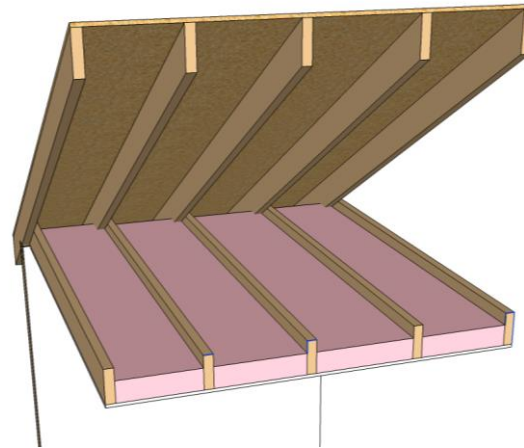
Solar water heating

Lighting

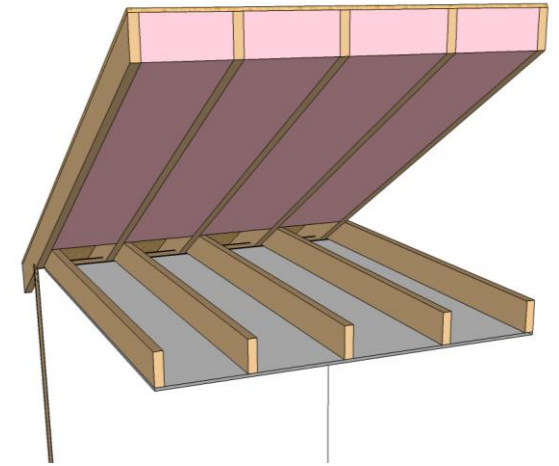
Envelope air sealing

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

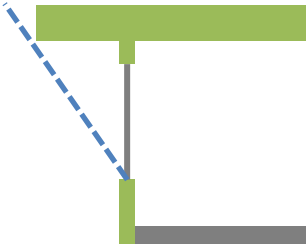
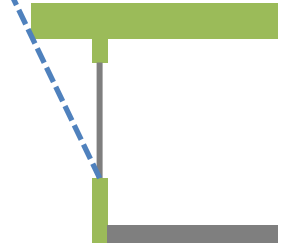
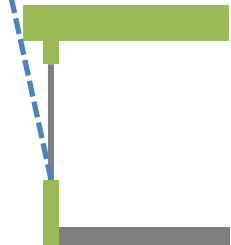
Solar water heating

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	$0.30 \leq PF < 0.50$	< 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

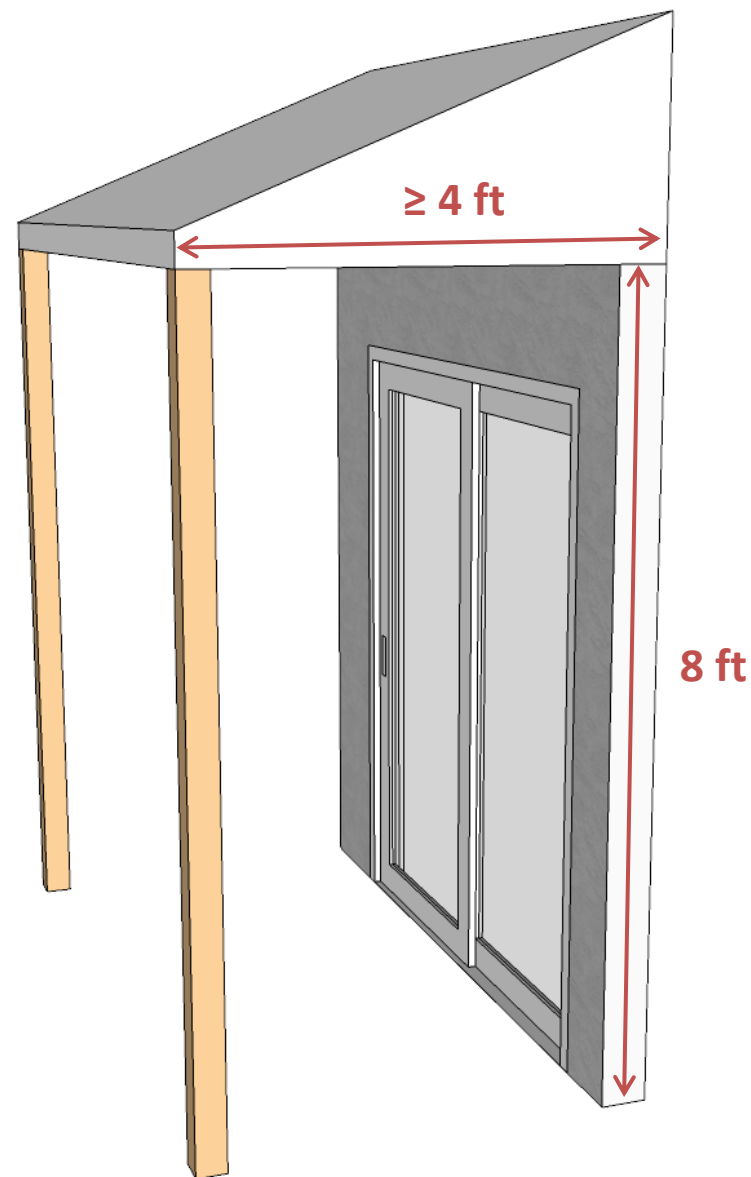
Solar water heating

Lighting

Envelope air sealing

Overhang size that
allows clear glass to
comply?

PF \geq 0.5



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

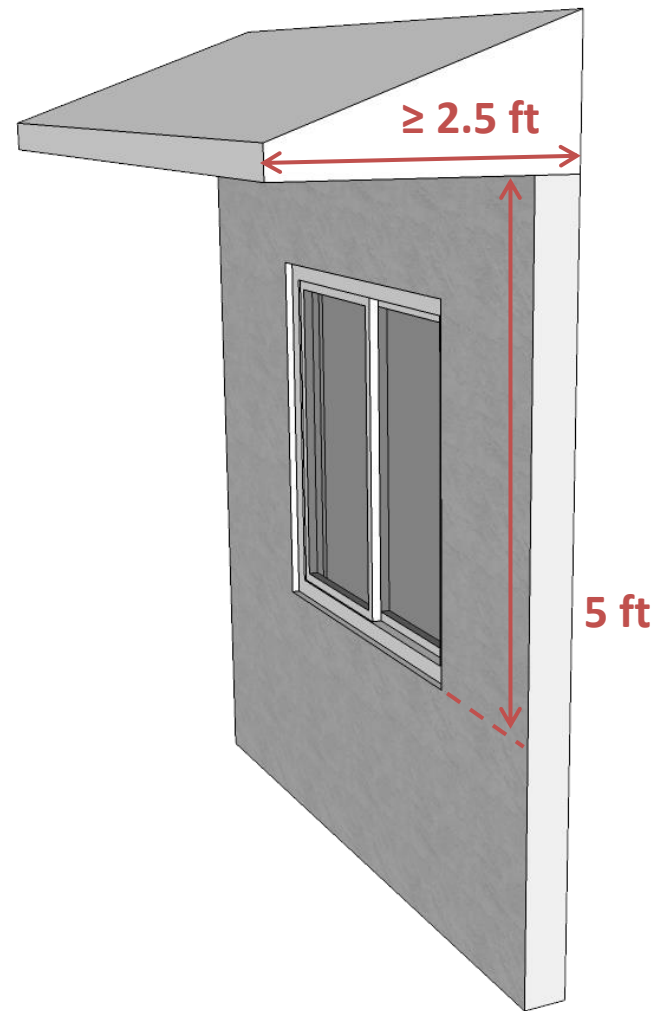
Solar water heating

Lighting

Envelope air sealing

Overhang size that
allows clear glass to
comply?

PF \geq 0.5



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

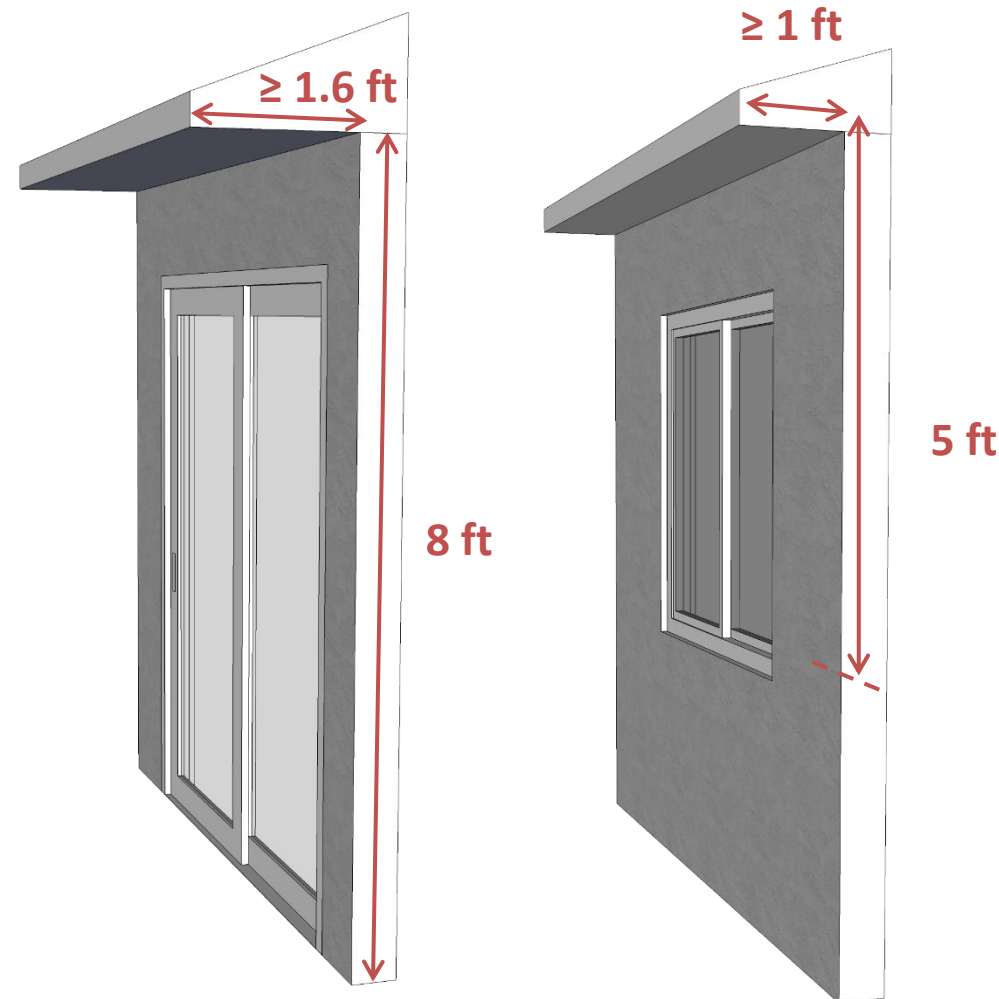
Solar water heating

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 $\geq 14\%$ 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

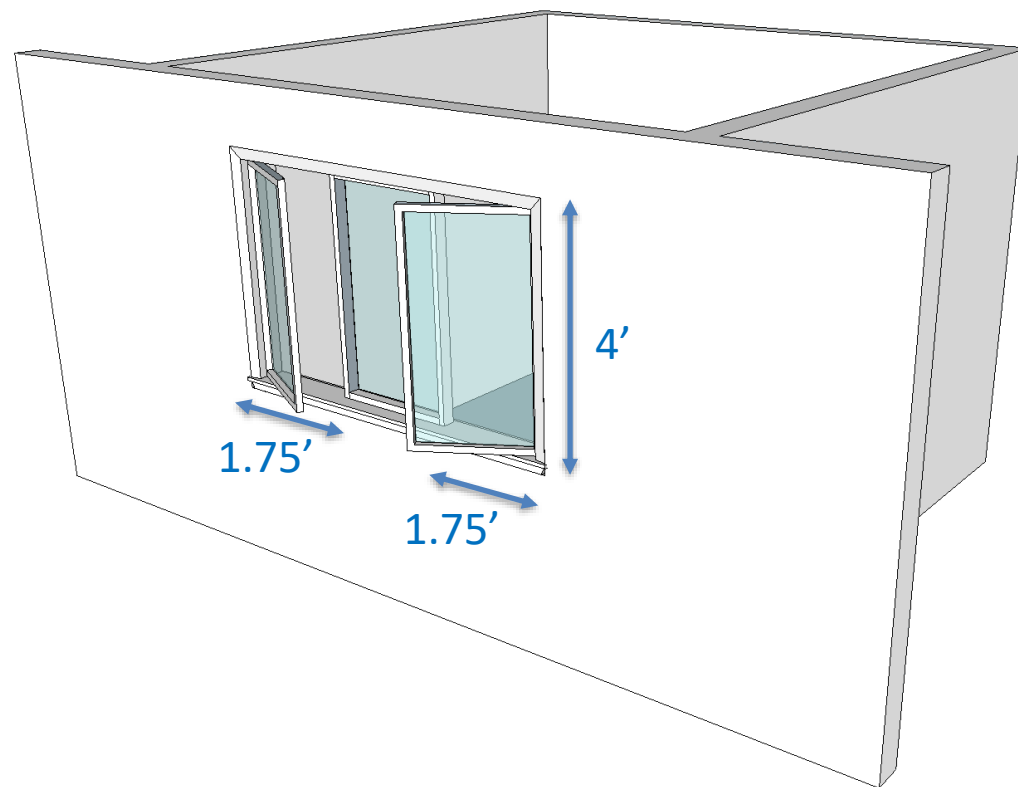
Solar water heating

Lighting

Envelope air sealing

Ventilation area $\geq 14\%$ of floor area

Example: 10'x10' bedroom needs 14 ft² vent area



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

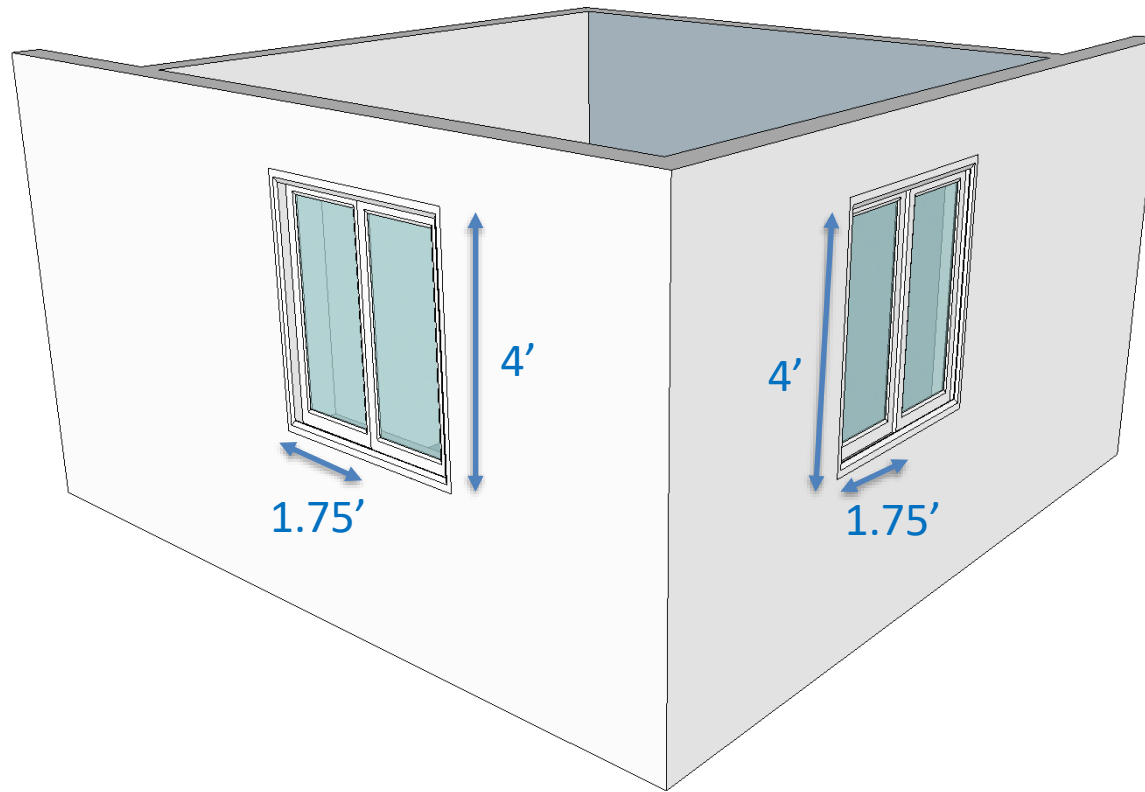
Solar water heating

Lighting

Envelope air sealing

Ventilation area $\geq 14\%$ of floor area

Example: 10'x10' bedroom needs 14 ft² vent area



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

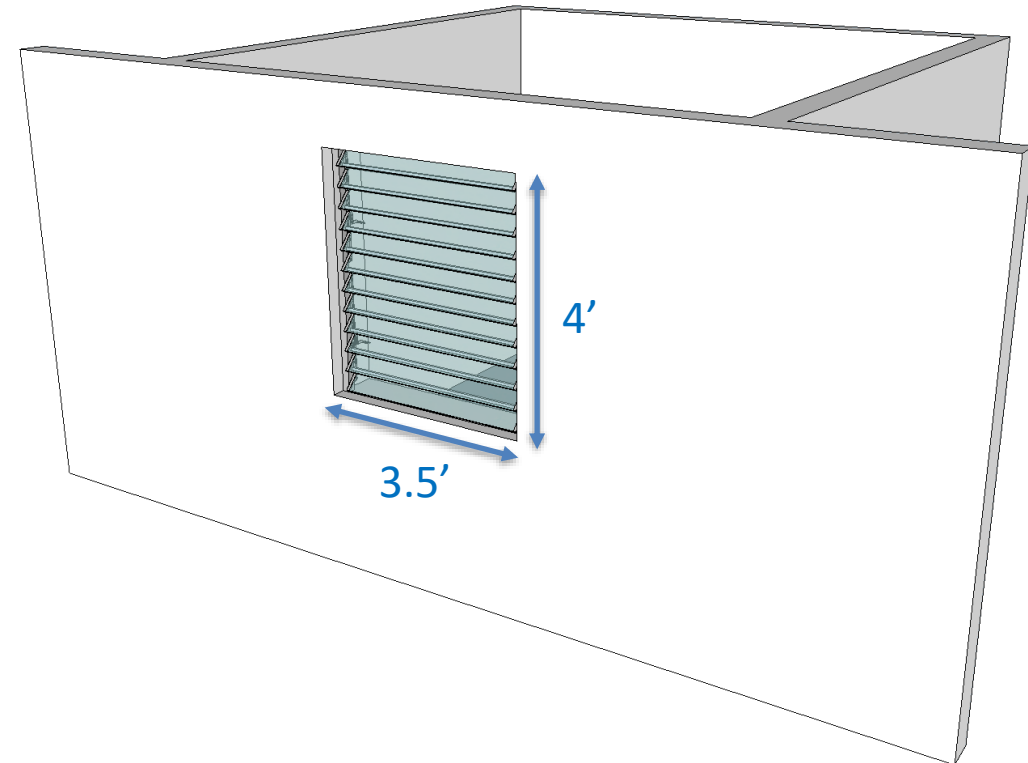
Solar water heating

Lighting

Envelope air sealing

Ventilation area $\geq 14\%$ of floor area

Example: 10'x10' bedroom needs 14 ft² vent area



Tropical Zone Option (R401.2.1)

Roof insulation

Wall

Windows

Skylights

Natural ventilation

Ceiling fans

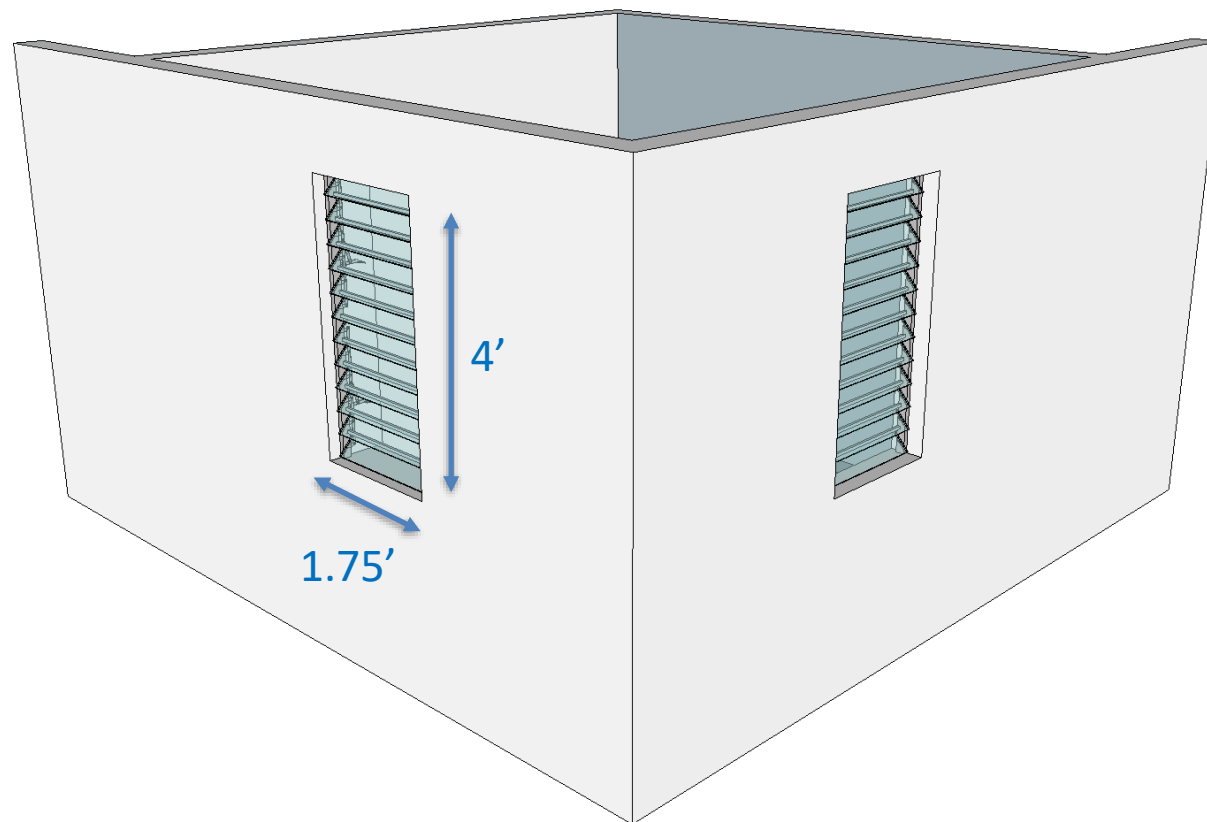
Solar water heating

Lighting

Envelope air sealing

Ventilation area $\geq 14\%$ of floor area

Example: 10'x10' bedroom needs 14 ft² 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

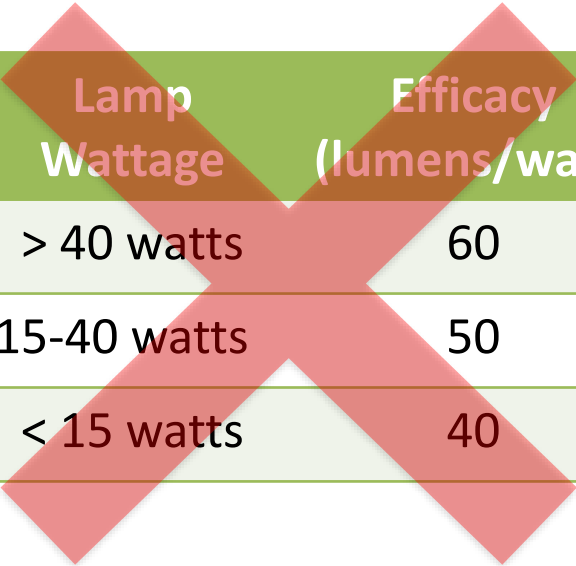
Solar, wind or other renewable > 90%



Tropical Zone Option (R401.2.1)

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

High efficacy $\geq 90\%$ of permanently installed lamps



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

HIGH-EFFICACY LIGHTING means an efficacy of not less than 70 lumens per watt for lamps and 55 lumens per watt for fixtures.

Honolulu
Amendment



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
Design professional statement	Form included on plans with signature of design professional	R103.1 [†] R103.2 [†]	See the Honolulu amendments for required format.	<input type="checkbox"/> Signature block included
Tropical zone qualification	<ul style="list-style-type: none"> ≤ 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.	<input type="checkbox"/> AC space clearly indicated (if applicable)
Certificate	Permanent certificate	R401.4 [†]	Posted on a wall in approved location. Includes insulation R-values, window SHGC, results of duct and air leakage testing (if required), efficiency of air conditioning and water heating equipment, PV system information (if applicable), Energy Rating Index score (if applicable) Section is renumbered by Honolulu amendment.	
Water heating - solar	Solar, wind or other renewable source supplies ≥ 90% of energy for water heating	R401.2.1*	HRS 196-6.5: https://www.capitol.hawaii.gov/hrscurrent/Vol03_Ch0121-0200D/HRS0196/HRS_0196-0006_0005.htm HSEO guidance: https://energy.hawaii.gov/what-we-do/energy-efficiency/solar-water-heat-variance	<input type="checkbox"/> 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 ≥ 0.50 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.	<input type="checkbox"/> SHGC indicated on plans <input type="checkbox"/> Overhang dimensions on plans, if applicable
Skylights – U-factor	≤ 0.75	R401.2.1*	Skylights must have dual-pane glazing.	<input type="checkbox"/> Skylight U-factor on plans
Lighting	≥ 90% of lamps or fixtures are high efficacy	R202 [†] R404.1*	The definition of high efficacy lamps is modified in Honolulu amendments: <i>"High-efficacy lighting means an efficacy of not less than 70 lumens per watt for lamps and 55 lumens per watt for fixtures."</i> Most, but not all, LED lamps will qualify. Applies to permanently-installed fixtures. Low-voltage lighting is exempt.	<input type="checkbox"/> Lighting fixture locations on plans <input type="checkbox"/> 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	<input type="checkbox"/> R-13 + cool roof, <input type="checkbox"/> R-19 , or <input type="checkbox"/> <i>Points option (section R407)</i>	R401.2.1*	<p>Qualifying cool roof membranes must meet one of the following (per Table C402.3):</p> <ol style="list-style-type: none"> 1. Aged reflectance ≥ 0.55 & aged thermal emittance ≥ 0.75 2. Aged solar reflectance index (SRI) ≥ 0.64 <p>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.</p> <p>If present, attics above insulation must be vented and attics below insulation must be unvented.</p>	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans <input type="checkbox"/> Membrane specs on plans (if applicable)
Roof – slope	$\geq \frac{1}{4}$ in. per foot	R401.2.1*	No water accumulation areas allowed.	<input type="checkbox"/> Roof slope indicated on plans
Walls and floor	No requirement			
Natural ventilation	<ul style="list-style-type: none"> Opening area $\geq 14\%$ 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*	<p>Operable windows and/or skylights are required for natural ventilation.</p> <p>Ventilation fans can be provided as an alternative.</p>	<input type="checkbox"/> Operable openings on plans <input type="checkbox"/> Ventilation fans on plans (if applicable)
Ceiling fans	Ceiling fans or rough-ins required for: <ul style="list-style-type: none"> 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.	<input type="checkbox"/> 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: <ul style="list-style-type: none"> Continuous air barrier Breaks or joints are sealed Recessed lighting Fenestration air leakage 	<input type="checkbox"/> Plan notes indicate installation requirements
Solar conduit and electrical panel readiness	See prescriptive checklist	R408†		
Electric vehicle readiness	See prescriptive checklist	R408†		

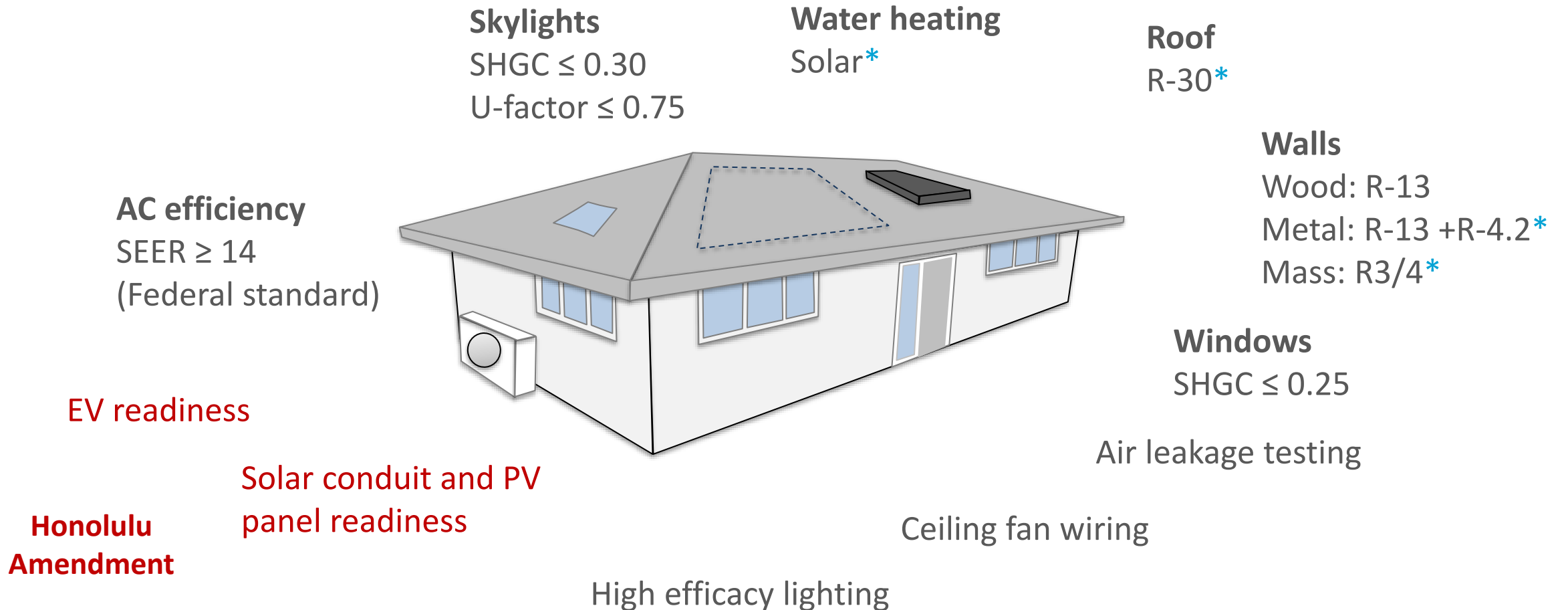
* Code section added or modified by State amendment

† Code section added or modified by Honolulu amendment

Section 4

Prescriptive Compliance Option

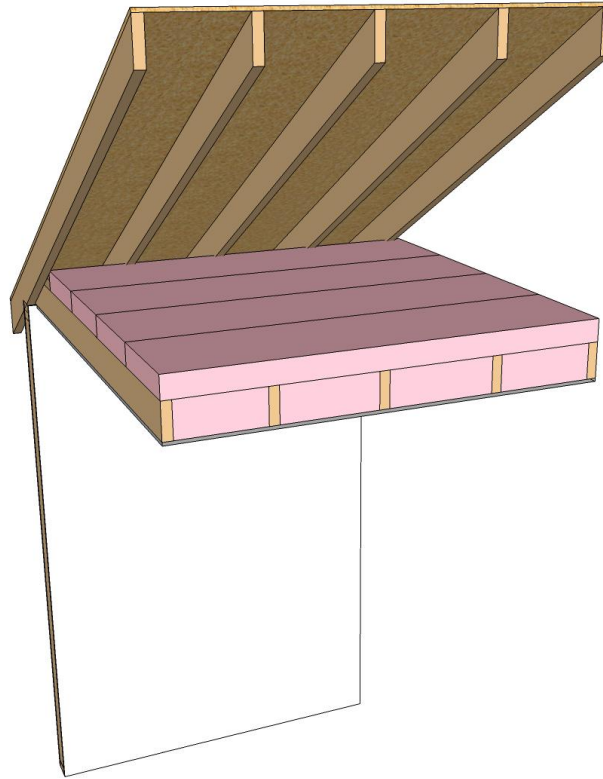
Prescriptive Requirements - Snapshot



* Some exceptions

Section 5

Prescriptive - 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

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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)

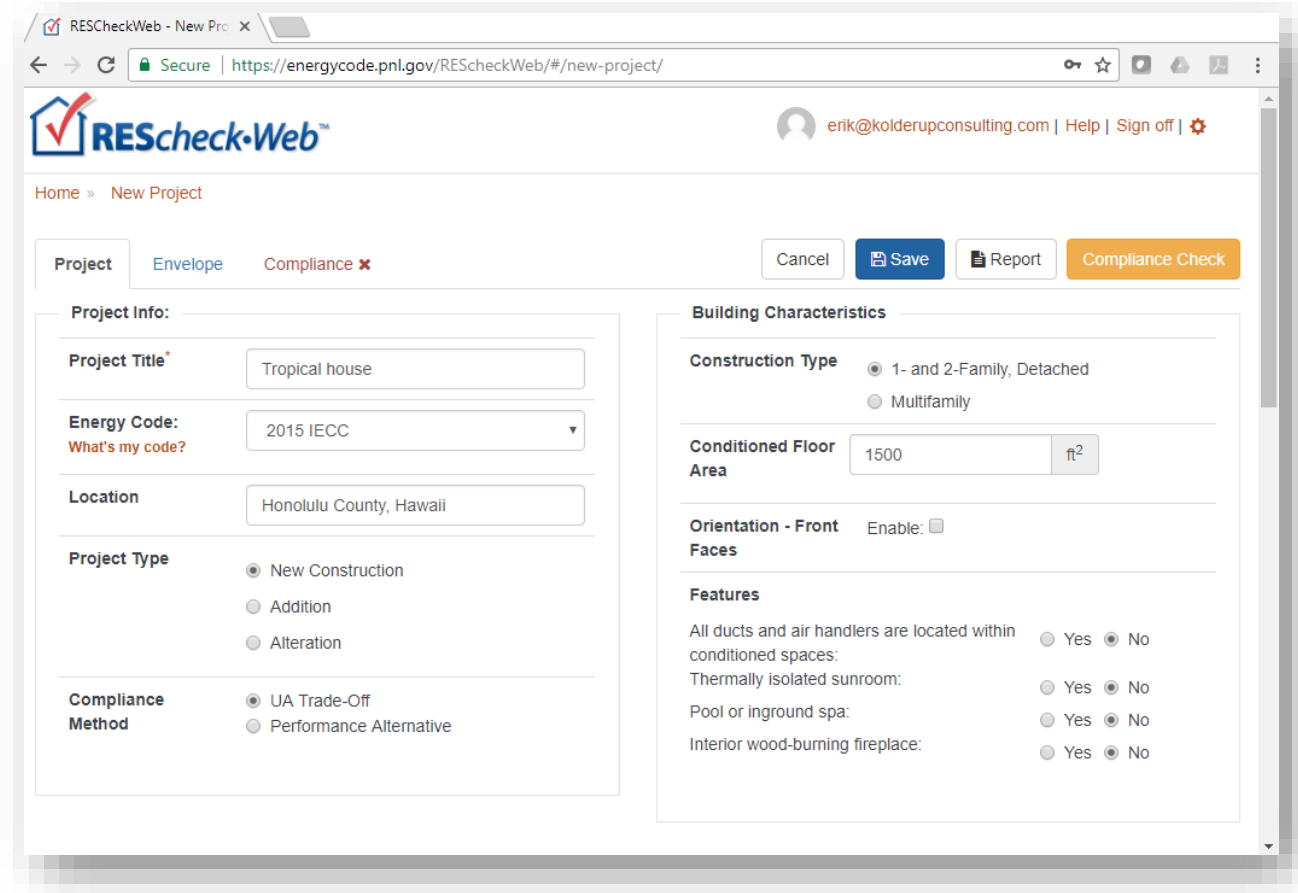
Maximum Assembly U-factor

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

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)



The screenshot displays the REScheck-Web application interface for a new project. The browser address bar shows the URL <https://energycode.pnl.gov/REScheckWeb/#/new-project/>. The application header includes the REScheck-Web logo and a user profile for erik@kolderupconsulting.com with links for Help, Sign off, and a settings icon.

The main navigation bar has three tabs: **Project**, **Envelope** (selected), and **Compliance** (marked with a red 'x'). Action buttons on the right include **Cancel**, **Save**, **Report**, and **Compliance Check**.


The **Project Info:** section contains the following fields:

- Project Title***: Tropical house
- Energy Code:** 2015 IECC (with a link "What's my code?")
- Location**: Honolulu County, Hawaii
- Project Type**: ☒ New Construction, ☐ Addition, ☐ Alteration
- Compliance Method**: ☒ UA Trade-Off, ☐ Performance Alternative

The **Building Characteristics** section includes:

- Construction Type**: ☒ 1- and 2-Family, Detached, ☐ Multifamily
- Conditioned Floor Area**: 1500 ft²
- Orientation - Front Faces**: Enable: ☐
- Features**:
 - All ducts and air handlers are located within conditioned spaces: ☐ Yes, ☒ No
 - Thermally isolated sunroom: ☐ Yes, ☒ No
 - Pool or inground spa: ☐ Yes, ☒ No
 - Interior wood-burning fireplace: ☐ Yes, ☒ No

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

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 ft²
2. Area-weighted average allowed
3. Jalousie windows exempt



 National Fenestration Rating Council CERTIFIED	World's Best Window Co. Millennium 2000 ¹ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider	
ENERGY PERFORMANCE RATINGS		
U-Factor (U.S./I-P) 0.35	Solar Heat Gain Coefficient 0.25	
ADDITIONAL PERFORMANCE RATINGS		
Visible Transmittance 0.51	Air Leakage (U.S./I-P) 0.2	
Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. Consult manufacturer's literature for other product performance information. www.nfrc.org		

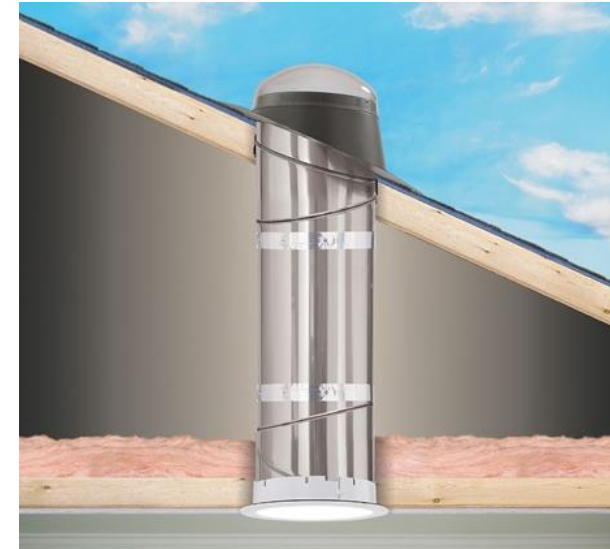
Envelope - Prescriptive

Skylights

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

Exceptions

1. Up to 15 ft² (total for window + skylight)
2. Area-weighted average allowed



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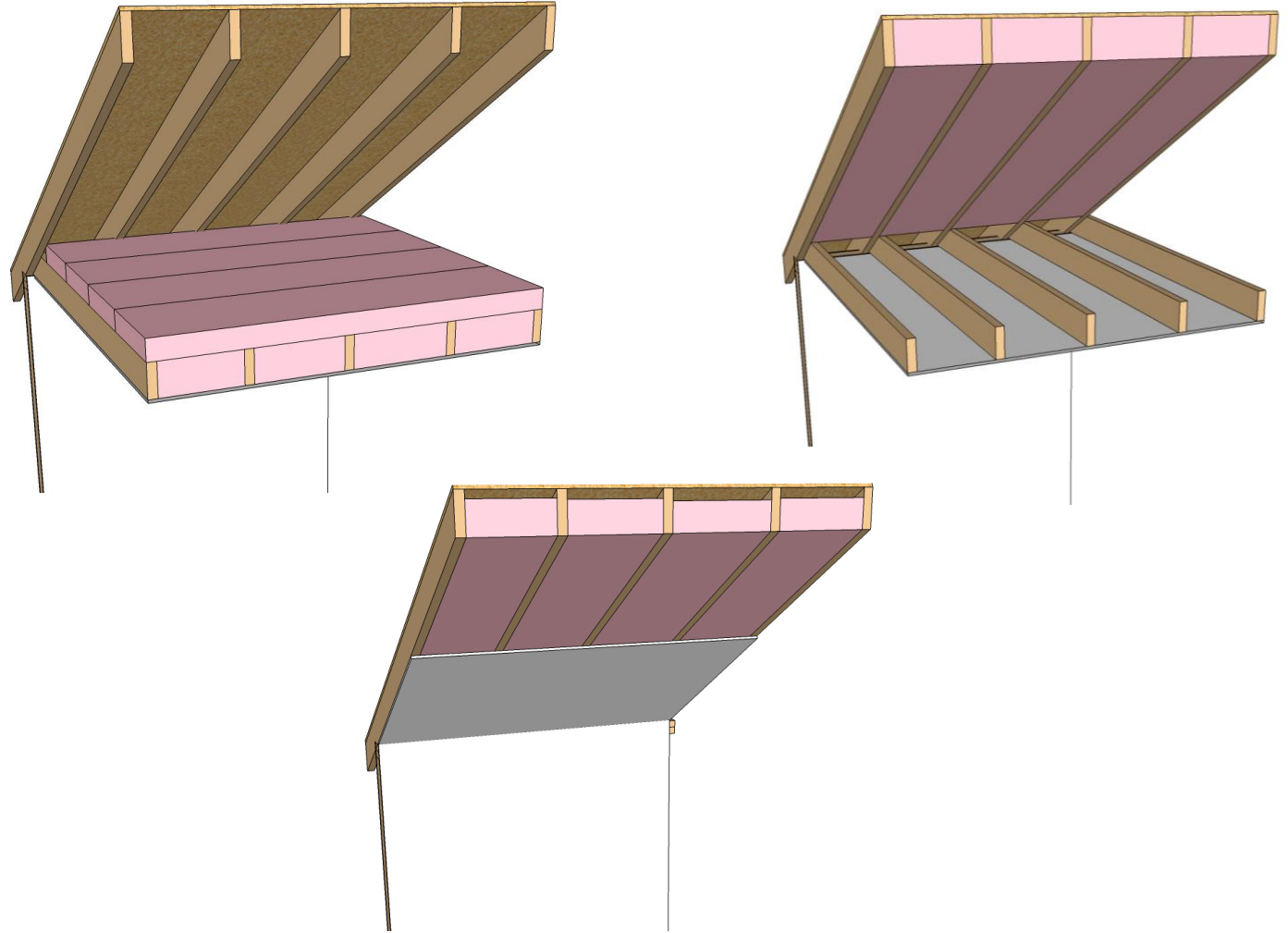
Envelope - Prescriptive

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)

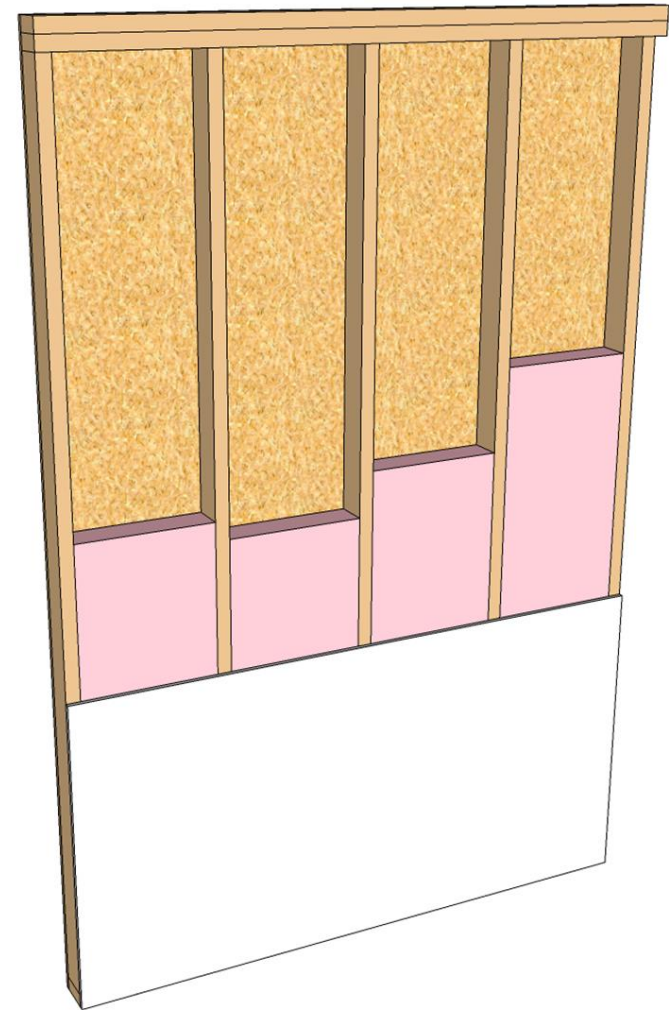
Insulation type & thickness	R-38	R-49
Batt	10-12"	15"
Blown-in	15"	19"
Open-cell spray foam	~10"	
Closed-cell spray foam	~6"	

Envelope - Prescriptive

Walls – wood frame


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

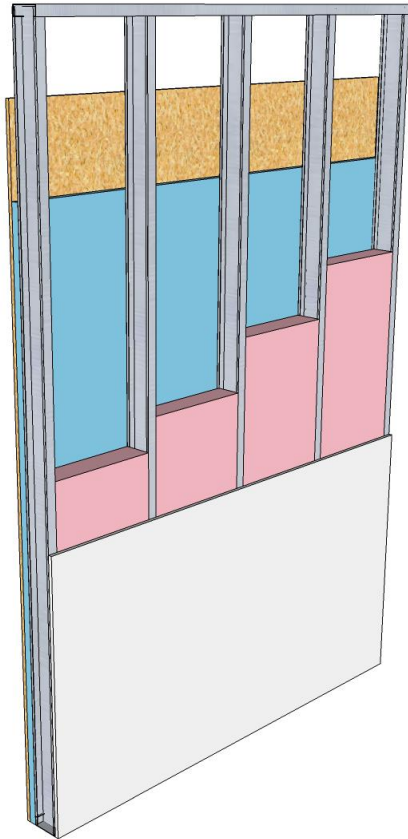
Insulation type & thickness	R-13
Batt or blown-in	3.5"
Open-cell spray foam	3-4"
Closed-cell spray foam	2-3"
Polystyrene board	2.75"
Polyisocyanurate board	2"



Envelope - Prescriptive

Walls – metal frame

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



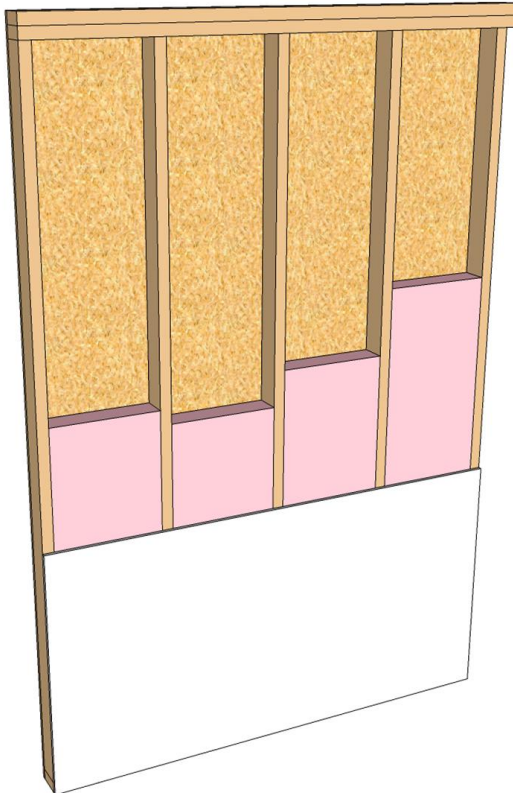
Frame spacing	Cavity insulation R-value	Continuous insulation R-value	Rigid foam board thickness	
			Extruded Polystyrene (R-5/in.)	Polyisocyanurate (R-6/in.)
16 in. o.c.	R-0	R-9.3	≥ 1.86 in.	≥ 1.55 in.
	R-13	R-4.2	≥ 0.84 in.	≥ 0.70 in.
	R-15	R-3.8	≥ 0.76 in.	≥ 0.63 in.
24 in. o.c.	R-0	R-9.3	≥ 1.86 in.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

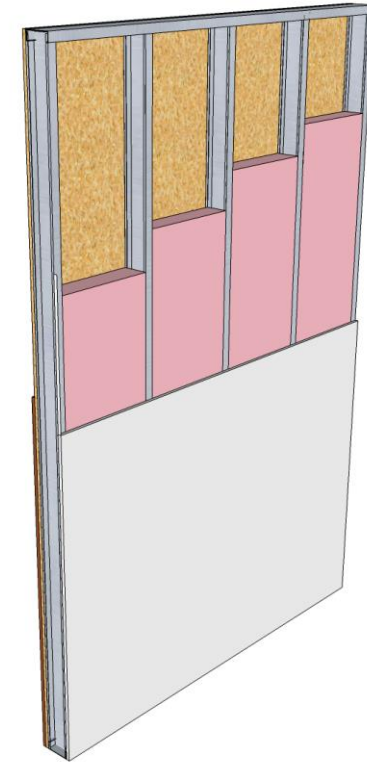
Why is extra insulation is required with metal framing?

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

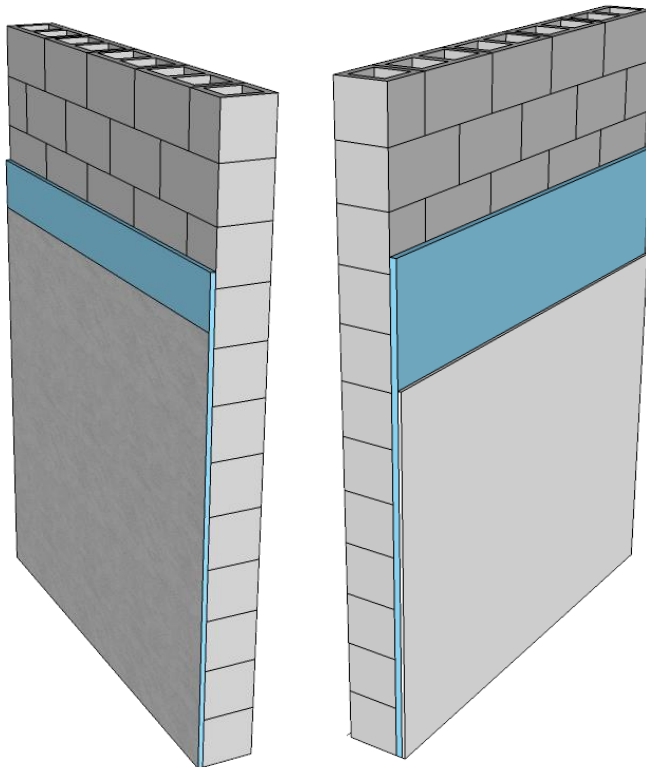
Envelope - Prescriptive

Walls – mass

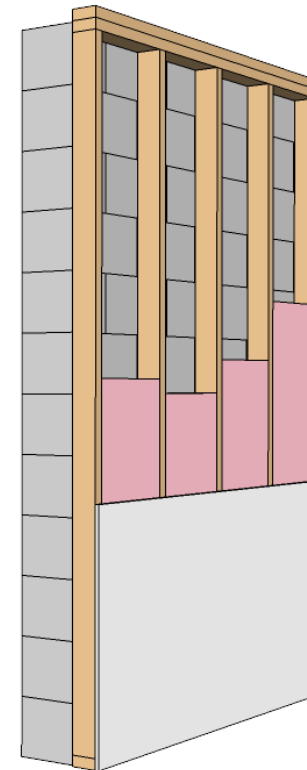
1. R-3 exterior insulation (Table R402.1.2)
2. R-4 interior insulation (Table R402.1.2)
3. U-0.197 (Table R402.1.4)

Or use the points option (R407)

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



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



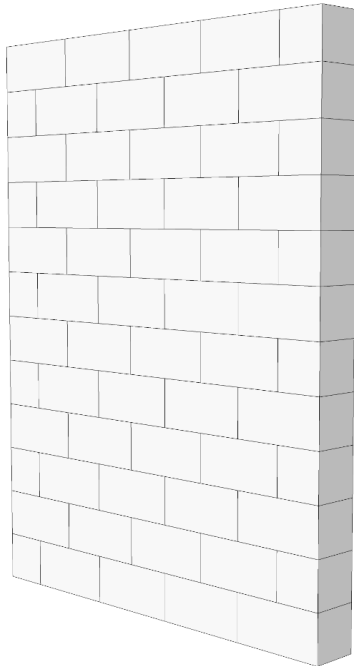
U-factor ≤ 0.197
≥ R-4 in wood furring
≥ R-11 in metal furring

Envelope - Prescriptive

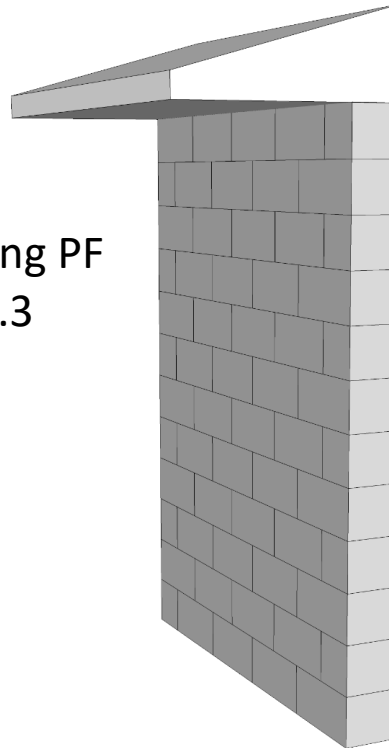
Walls – mass

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)

Exterior
light
reflectance
 ≥ 0.64



Overhang PF
 ≥ 0.3



Alternatives by State Amendment

Thickness
 ≥ 6 inches +
unpainted finish
with or without
clear sealer



Honolulu
Amendment



Envelope - Prescriptive

Floors

1. R-0 (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

State Amendment

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	Standard Home Points	Tropical Zone Points
<u>Wood</u> Framed Walls		
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 $\leq 1,000$ ft ²	1	1
House floor area $\geq 2,500$ 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	Standard Home Points	Tropical Zone Points
<u>Metal</u> Framed Walls		
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 $\leq 1,000$ ft ²	1	1
House floor area $\geq 2,500$ 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	Standard Home Points	Tropical Home Points
<u>Mass Walls</u>		
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 $\leq 1,000 \text{ ft}^2$	1	1
House floor area $\geq 2,500 \text{ ft}^2$	-1	-1
Energy Star Fans ⁸	1	1
Install 1 kW or greater of solar electric	1	1

See also checklist

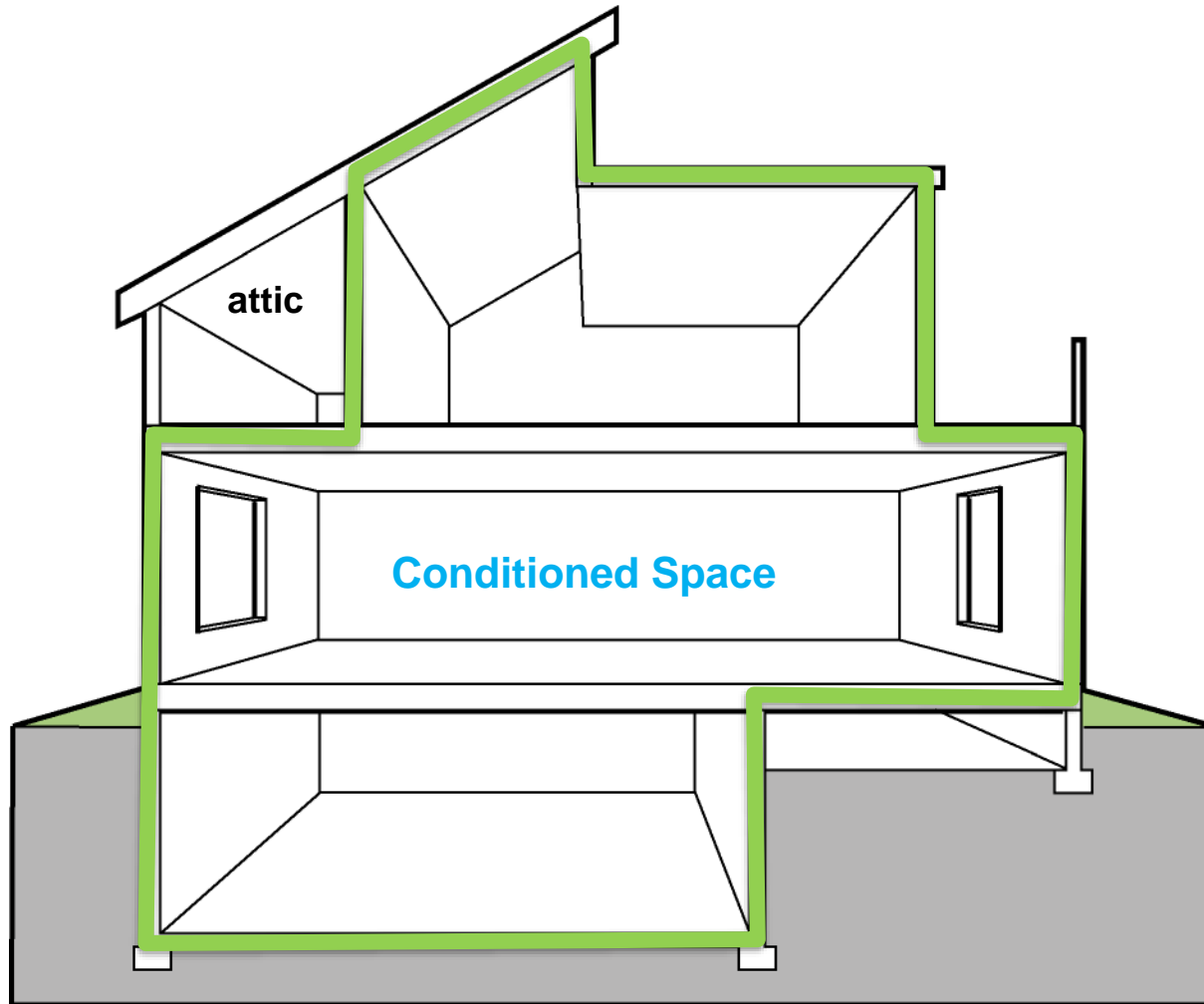
Envelope – Total UA (R402.1.4)

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>

A screenshot of the REScheck-Web software interface. The top navigation bar includes the REScheck-Web logo, a user profile icon, and a "Sign off" link. Below the navigation bar, there are tabs for "Project", "Envelope", and "Compliance", with "Envelope" currently selected. To the right of the tabs are buttons for "Check Compliance", "Save", "Report", and "Help". The main content area is divided into two columns. The left column, titled "Project Info:", contains fields for "Project Title" (Hawaii House), "Energy Code" (2018 IECC), "Location" (Honolulu, Hawaii), "Project Type" (New Construction), and "Compliance Method" (UA Trade-Off). The right column, titled "Building Characteristics", contains fields for "Construction Type" (1- and 2-Family, Detached), "Conditioned Floor Area" (1500 ft²), "Orientation - Front Faces", and a "Features" section with several Yes/No questions. Two green arrows point from the "Energy Code" and "Location" fields to the "Conditioned Floor Area" field.

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 be sealed. Knee walls shall be sealed.	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 between the window frame and the exterior wall shall be sealed.	
Rim joists	Rim joists shall be sealed.	
Floors (including above garage and cantilevered floors)	The air barrier shall be installed on the underside of the floor joists or on the perimeter floor framing members.	
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with overlapping vapor barrier.	Where provided instead of floor insulation.
Shafts, penetrations	Duct shafts, openings to exterior shall be sealed.	
Narrow cavities		Butts 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.

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)

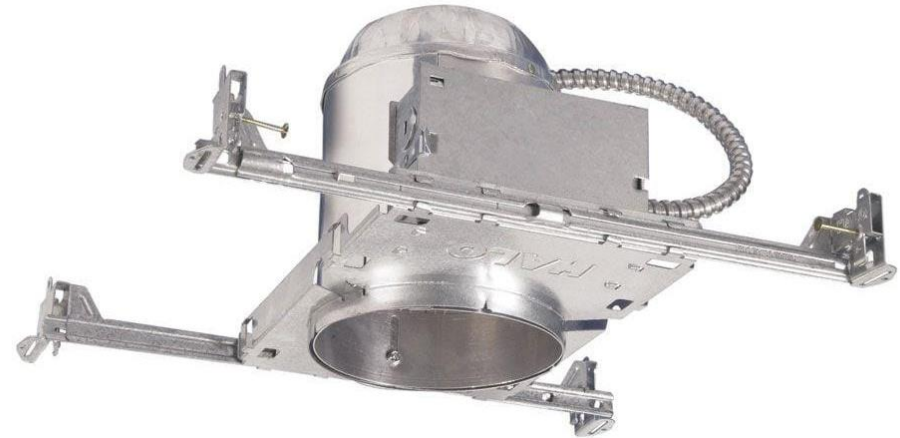
Fenestration air leakage

- ≤ 0.3 cfm/ft² for windows, skylights and sliding doors
- ≤ 0.5 cfm/ft² 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 6

Prescriptive - Systems



What's covered

Envelope

Roof
Walls
Windows & skylights
Air leakage

Systems

Air conditioning controls
Duct insulation
Duct leakage
Water heating
Swimming pool

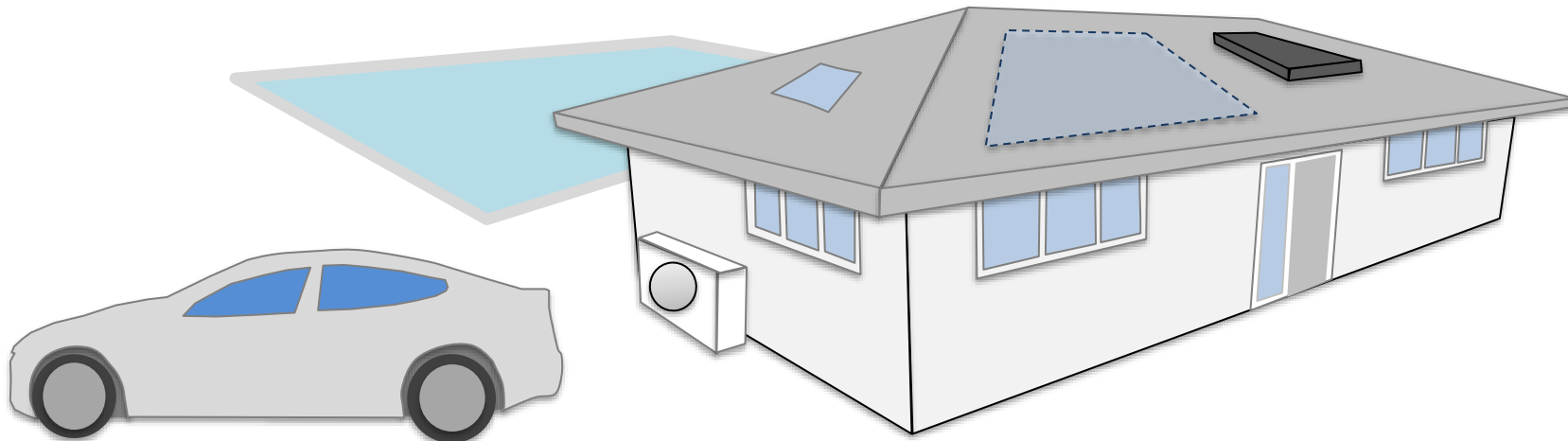
Electrical

Permanently installed lighting
Ceiling fans
PV readiness
EV readiness

**Honolulu
Amendment**

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

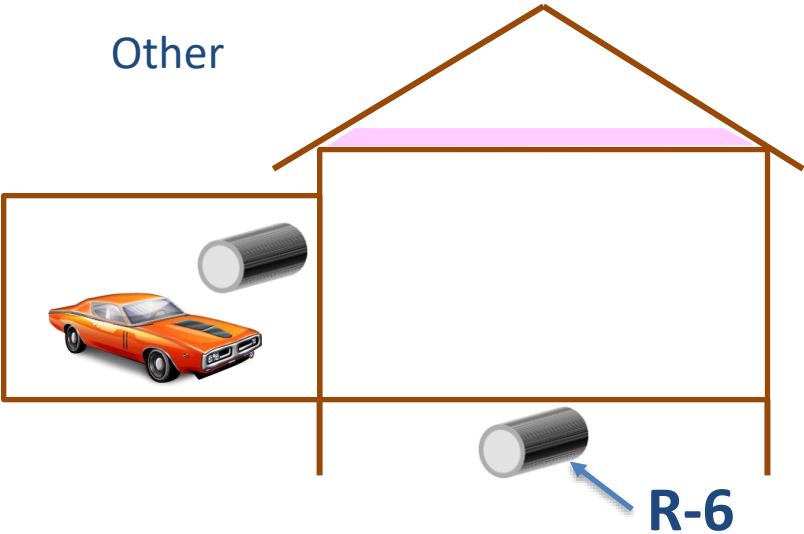
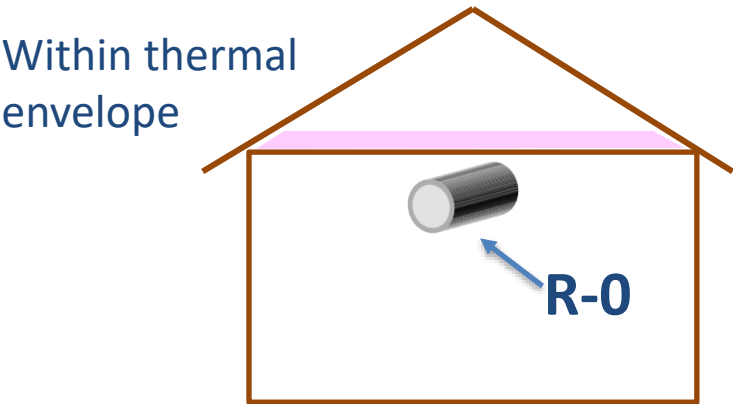
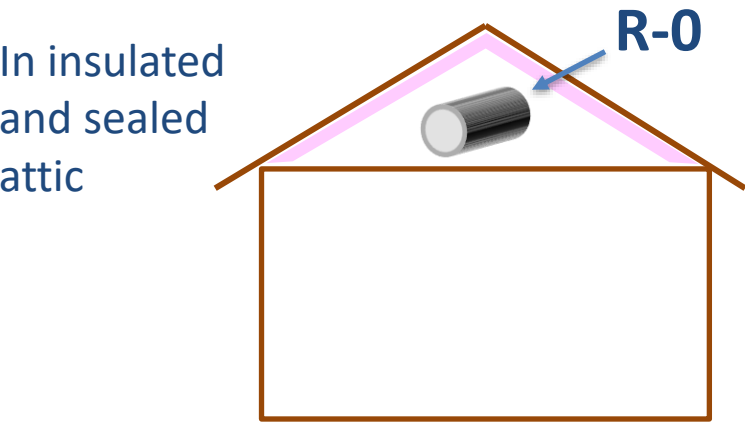
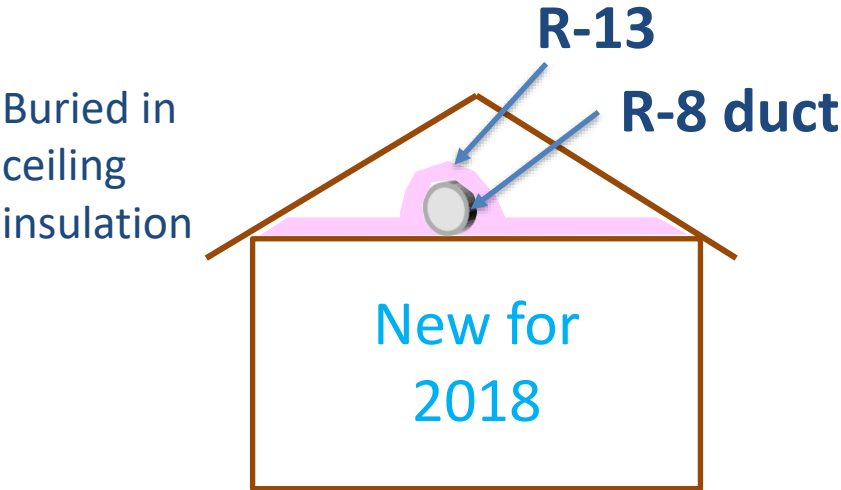
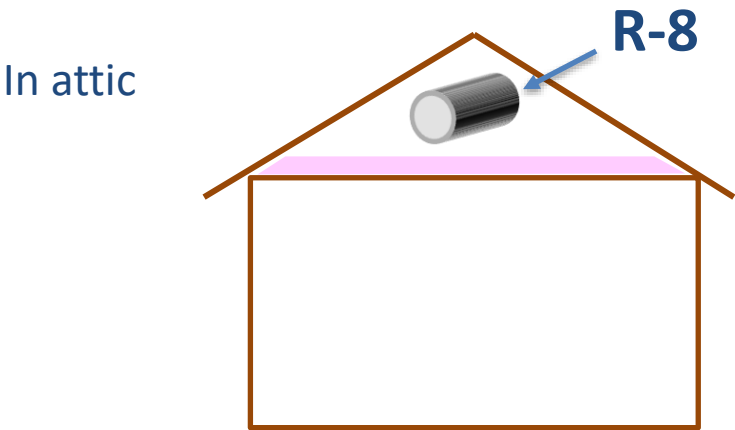


Duct testing



Source: DOE/NREL PIX04869

Systems – Duct Insulation



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** and 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



Leakage ≤ 4 cfm/100 ft²

Leakage ≤ 3 cfm/100 ft²
(without air handler)



Postconstruction test



Leakage ≤ 4 cfm/100 ft²

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)

- If a pump is installed, automatic temperature and demand controls required

Heat trace systems (R403.5.1.1)

- If a heat trace is installed, automatic temperature controls required

Demand recirculation systems (R403.5.2)

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



**Honolulu
Amendment**



Systems – Service Hot Water

R-3 hot water pipe insulation (R403.5.3)

Exceptions

- Piping under a slab
- Buried piping
- Piping serving only one dwelling unit

New

Honolulu
Amendment

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

Prescriptive - Electrical & Lighting



What's covered

Envelope

Roof
Walls
Windows & skylights
Air leakage

Systems

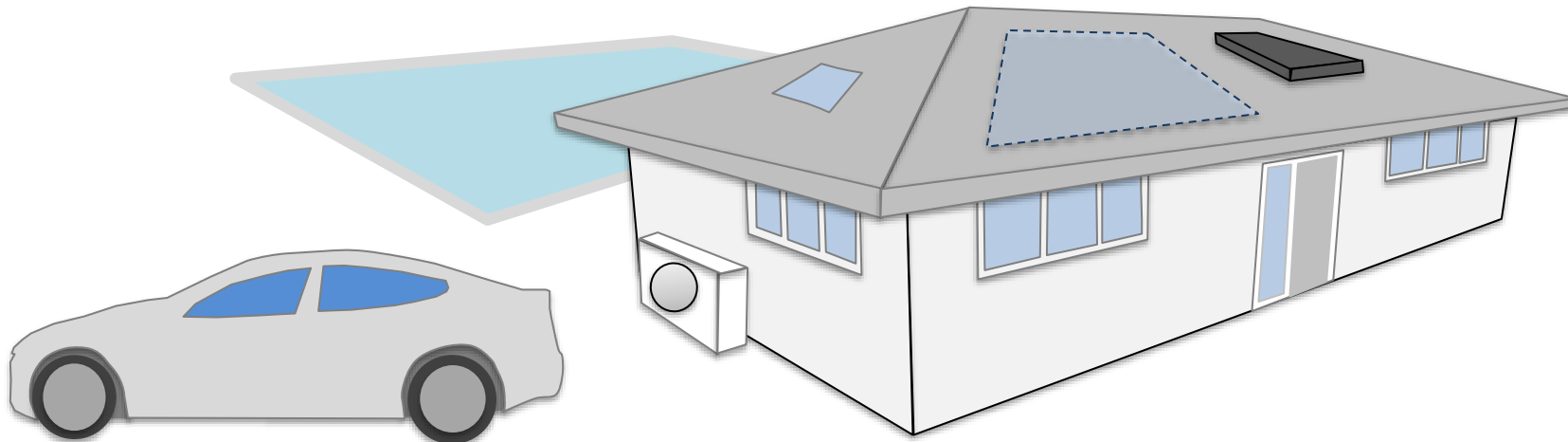
Air conditioning controls
Duct insulation
Duct leakage
Water heating
Swimming pool

Electrical

Permanently installed lighting
Ceiling fans

PV readiness
EV readiness

**Honolulu
Amendment**



Not covered

AC efficiency
Water heater efficiency
Plug-in lighting
Appliances

Lighting (R404.1)

High efficacy \geq 90% of lamps

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



Honolulu
Amendment

New

HIGH-EFFICACY LIGHTING means an efficacy of not less than 70 lumens per watt for lamps and 55 lumens per watt for fixtures.



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.



Exception: For production home building, ceiling fan junction boxes shall be provided for bedrooms and the largest interior space that is not used as a bedroom, and ceiling fan equipment shall be provided as a buyer's option.

Honolulu
Amendment

New



Section 8

Electric Vehicle and Solar Readiness



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



What's covered

Envelope

Roof
Walls
Windows & skylights
Air leakage

Systems

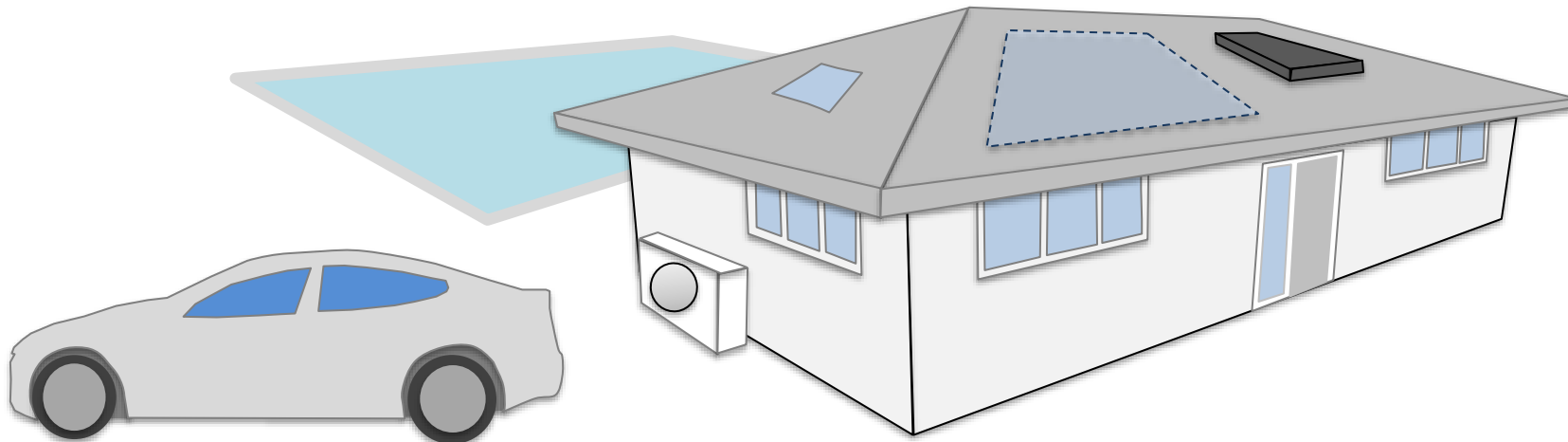
Air conditioning controls
Duct insulation
Duct leakage
Water heating
Swimming pool

Electrical

Permanently installed lighting
Ceiling fans

PV readiness
EV readiness

**Honolulu
Amendment**



Not covered

AC efficiency
Water heater efficiency
Plug-in lighting
Appliances

Solar Conduit and Electrical Panel Readiness (R408.1)

Requirements retained from previous code

- Plans show:
 - Solar equipment location
 - Pathway for conduit
- Electrical panel reserve capacity:
 - Single family/duplex: 5kW PV per unit
 - Multi-family: sized for common area load or roof space
- Conduit installed for new buildings
 - Electrical panel to inverter location
 - Inverter location to underside of roof

**Honolulu
Amendment**



Electric Vehicle Readiness (R408.2)

Requirements updated from previous code

- Dedicated receptable or junction box must be provided for each enclosed attached garage to support AC Level 2 charging
- AC Level 2 is defined as 208 to 240V AC, 1-phase, minimum 16A

Honolulu Amendment



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

Section 9

Large homes compliance

Large home compliance (R401.3)

All single-family homes $\geq 7000 \text{ ft}^2$

- Demand response controls
 - Electric water heaters
 - AC >2.5 tons
 - Pool and spa pumps
 - Electric pool and spa heaters
- Walls
 - R-13 minimum, or
 - Solar reflectance ≥ 0.30
- Roofs any two:
 - R30
 - Attic ventilation
 - Cool roof

$\geq 7000 \text{ ft}^2$ and $\geq 2000 \text{ ft}^2$ of A/C space

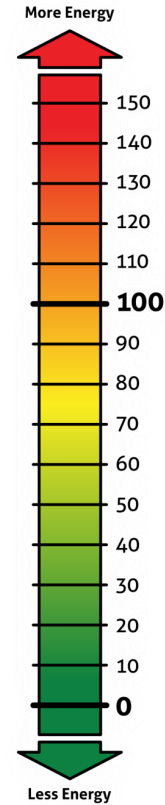
- Compliance alternative:
 - Simulated performance alternative, 10% better than reference design, or
 - Energy rating index alternative, $\text{ERI} < 52$
- HVAC must be multi-stage variable capacity
- Thermostats capable of demand response

**Honolulu
Amendment**

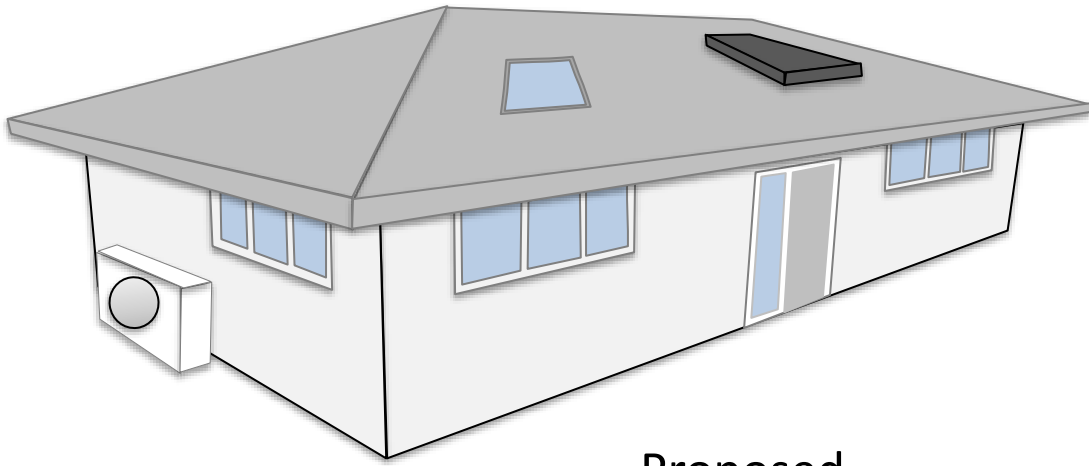
New

Section 10

Performance Compliance Options



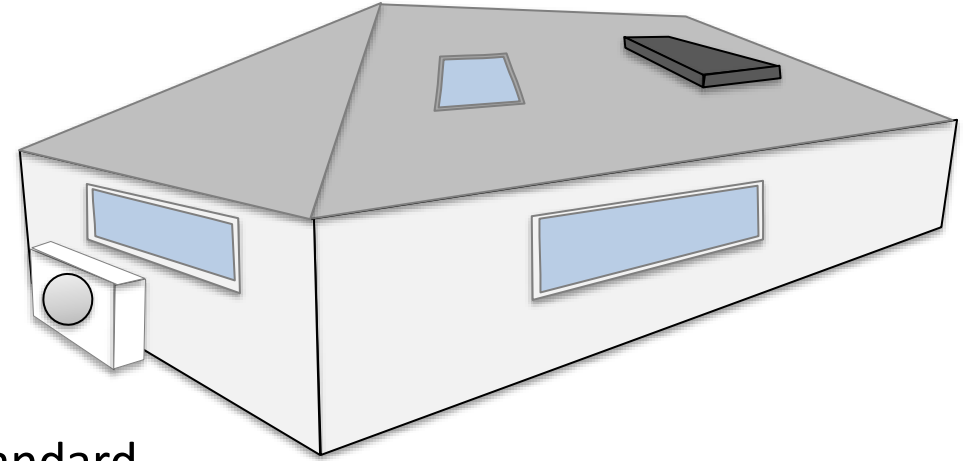
Simulated Performance Alternative (R405)



Proposed
design
\$/year

\leq

Standard
reference
design
\$/year



Standard reference design

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

Common software

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

Energy Rating Index Compliance (R406)

Compliance

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

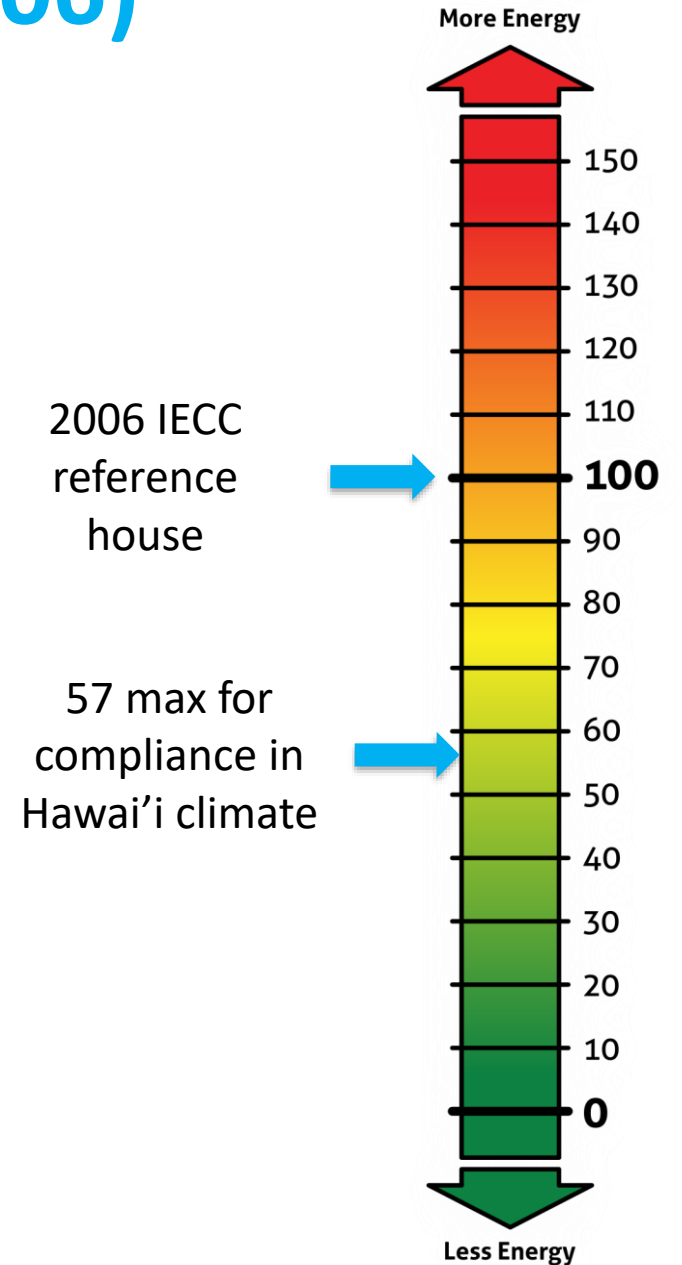
Accredited providers

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

Accredited software tools (Dec. 2023)

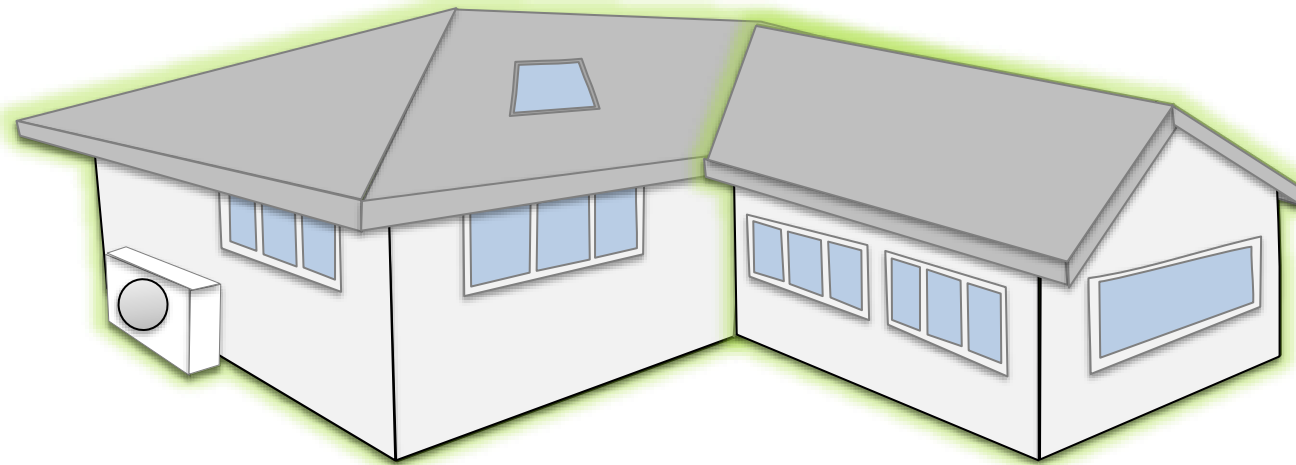
<https://www.resnet.us/providers/accredited-providers/hers-software-tools/>

- Ekotrope
- EnergyGauge USA
- REM/Rate



Section 11

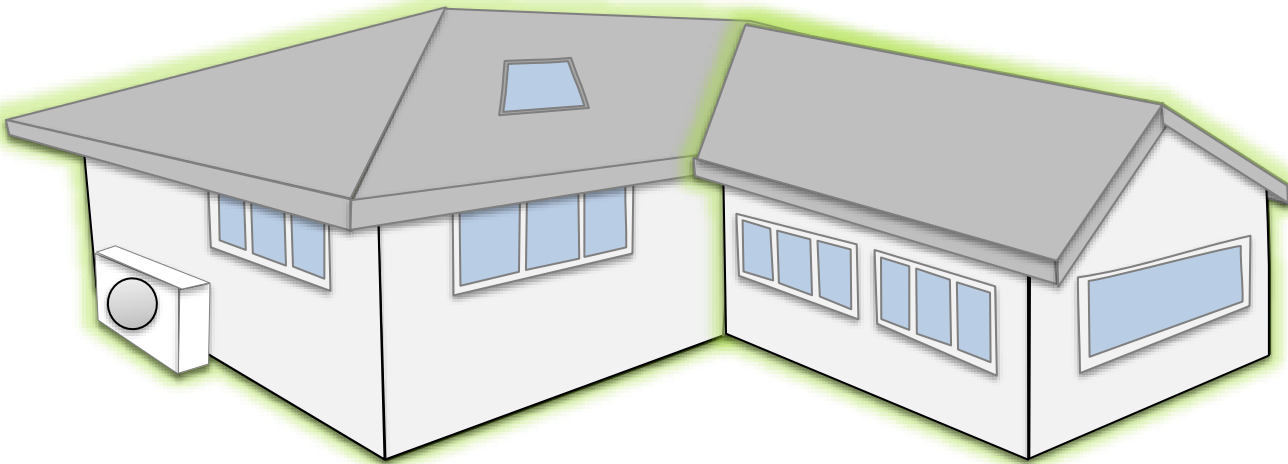
Existing Building Compliance



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

New roof
New walls
New windows & skylights
Air leakage

Systems

New AC
New duct
New water heating
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 – **State 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 \geq 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 12

Wrap Up

Wrap Up – Compliance Alternatives

1. Tropical Zone

- $\leq 50\%$ air conditioned
- not heated
- elevation $< 2,400$ feet

2. Prescriptive

- Envelope (+ Points Option)
- Systems
- Electrical power and lighting systems

Plus PV readiness
EV readiness

3. Simulated performance alternative

4. Energy rating index (ERI)

- $ERI \leq 57$

5. Large homes

- $> 7,000 \text{ ft}^2$

Q&A

Howard Wiig, State Energy Office

Erik Kolderup, PE, Kolderup Consulting

Ben Sullivan, City & County of Honolulu Office of Climate Change, Sustainability and Resiliency

Evaluation Survey

<https://www.surveymonkey.com/r/7ZFHR3J>

Honolulu Energy Code - Residential - Dec. 5, 2023

Your feedback will help improve future webinars.

1. My role

<input type="checkbox"/> Architect or designer	<input type="checkbox"/> Product vendor
<input type="checkbox"/> Engineer	<input type="checkbox"/> Building official
<input type="checkbox"/> Contractor	<input type="checkbox"/> Other government
<input type="checkbox"/> Developer	<input type="checkbox"/> Educator
<input type="checkbox"/> Real estate sales	<input type="checkbox"/> Student
<input type="checkbox"/> Other (please specify)	

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>

Honolulu Energy Code Website

- <https://www.resilientoahu.org/energycode>