

International Energy Conservation Code

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Hawaii State Energy Office



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Online
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Learning Objectives

Determine applicability and requirements for the Tropical-Zone compliance option for low-rise dwellings.

Identify complying residential envelope constructions.

Evaluate design options with the residential points option.

Determine commercial building envelope compliance.

Determine allowed interior and exterior lighting power

Use residential and commercial checklists to identify relevant requirements.

Sponsors



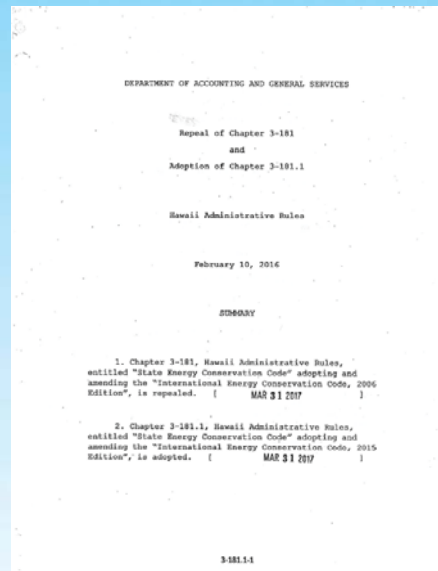
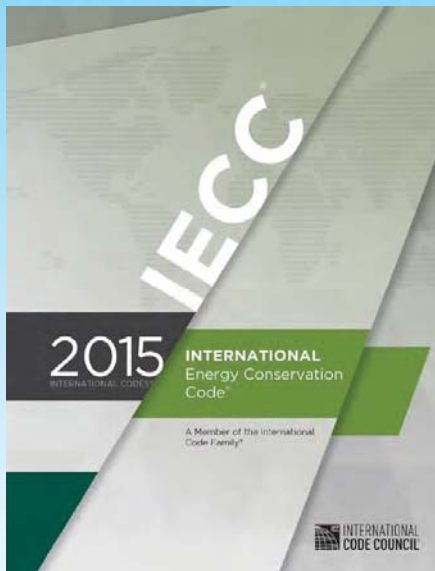
Agenda

8:00	Introduction
8:15	Residential – Tropical Zone option
8:45	Residential – Envelope
9:15	Residential – Systems
9:30	Residential – Additions & alterations
9:45	BREAK
10:00	Commercial – Envelope
10:30	Commercial – Systems
10:50	Commercial – Electrical & lighting
11:30	Adjourn

Section 1

Introduction

What is it?



County Adoption Status



2015 IECC Structure

Table of Contents

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

* See also Hawai'i State Energy Conservation Code amendments

Who needs to comply?

Residential Requirements

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



Commercial Requirements

- All other buildings
 - Including R-1 (hotels)



Who needs to comply?

- New construction
- Additions
- Alterations
 - Several exceptions
- Change of occupancy
 - When change results in increase in energy
 - Conversions to dwellings

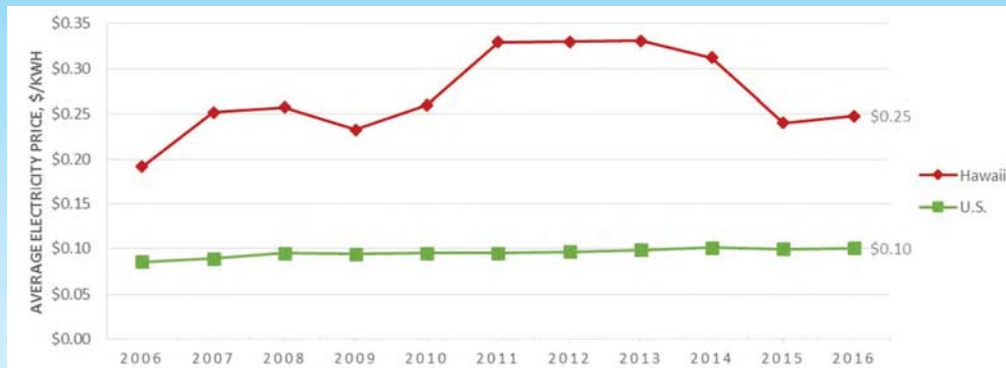
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Why should I care?

- Energy savings
 - Lower utility bills
 - Reduced oil imports
 - Lower emissions
- Value
- Comfort
- Already required for State buildings

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Why should I care?

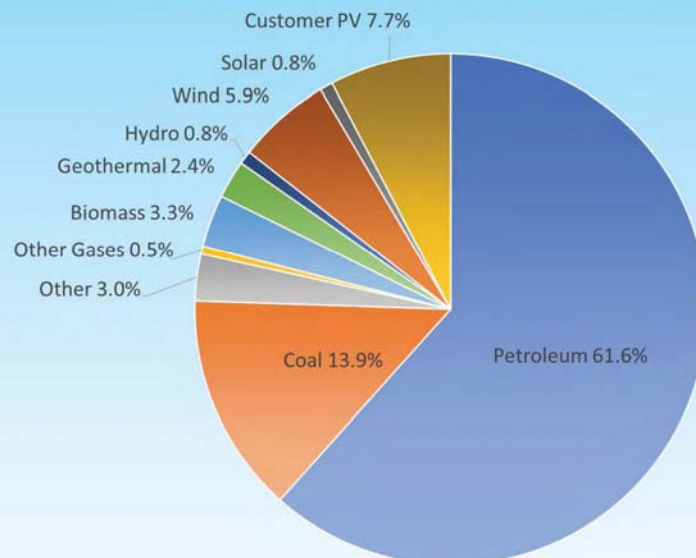


https://energy.hawaii.gov/wp-content/uploads/2011/10/HSEOFactsFigures_May2017_2.pdf

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Why should I care?

Hawaii Electricity Production by Source (2016)



Source: Eugene Tian, DBEDT

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How do I comply?

- Review checklist for relevant requirements
- **Include required design information on plans** (e.g. R-value)
- Include signed compliance certification on plans

Component/Detail	Requirement	Code Section	Plan Review Notes	Info on Plans
Certification	Responsible design professional certification on plans	R103.1*		<input type="checkbox"/> Signed statement on plans
Construction Documents	Includes: <ul style="list-style-type: none"> • Insulation locations • Fenestration U-factors and solar heat gain coefficients (SHGCs) 	R103.2		
Roof - wood frame	<input type="checkbox"/> R-19 or R-30, or <input type="checkbox"/> Total U-factor alternative, or <input type="checkbox"/> Energy rating	R103.2.1, R103.2.2, R103.2.3, R103.2.4	Table R-3.1 (optional): • glass, half insulation • 2 to 3 in. spray foam	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Roof - metal frame	<input type="checkbox"/> R-19 or R-30, or <input type="checkbox"/> Total U-factor alternative, or <input type="checkbox"/> Energy rating	R103.2.1, R103.2.2, R103.2.3, R103.2.4	Metal frame creates a thermal bridge, and more insulation is required. "R" and U-factor for 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-19 or R-30, or <input type="checkbox"/> Total U-factor alternative, or <input type="checkbox"/> Energy rating	R103.2.1, R103.2.2, R103.2.3, R103.2.4		<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Wall - wood frame	<input type="checkbox"/> R-13 or R-19, or <input type="checkbox"/> Total U-factor alternative, or <input type="checkbox"/> Energy rating	R103.2.1, R103.2.2, R103.2.3, R103.2.4	Table R-3.1 (optional): • 2 to 3 in. spray foam	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Wall - metal frame	<input type="checkbox"/> R-13 or R-19, or <input type="checkbox"/> Total U-factor alternative, or <input type="checkbox"/> Energy rating	R103.2.1, R103.2.2, R103.2.3, R103.2.4	Requires insulation in framing cavity plus a layer of continuous insulation (typically foam board).	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Roof - metal (other or untested)	<input type="checkbox"/> R-19 exterior, R-8 interior or U-0.09 <input type="checkbox"/> Total U-factor alternative, or <input type="checkbox"/> Energy rating	R103.2.1	Requires either exterior or interior insulation, typically foam board. RMC integral insulation does not comply.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans

RESIDENTIAL: pg. 4 of 11 April 2018

COUNTY OF
[COUNTY'S ENERGY CODE NAME]

To the best of my knowledge, this project's design substantially conforms to the [CODE NAME] (2015 IECC, as amended) for building envelope components.

COMPLIANCE METHOD

☐ Tropical Zone, R401.2.1
☐ Prescriptive, R402
☐ Points Option, R407
☐ Simulated Performance, R405
☐ Energy Rating Index, R406

INFORMATION IN CONSTRUCTION DOCUMENTS

☐ Roof insulation R-value
☐ Roof insulation type and location
☐ Roof membrane solar reflectance (if applicable)
☐ Wall insulation R-value
☐ Wall insulation type and location
☐ Window SHGC
☐ Air leakage testing requirement

NOTES

SIGNATURE: _____ DATE: _____

NAME: _____

TITLE: _____

LICENSE NO.: _____

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How do I comply?

Information required on construction documents (See checklist)

Section C103.2

1. Insulation materials and their R-values.
2. Fenestration U-factors and solar heat gain coefficients (SHGCs).
3. Area-weighted U-factor and solar heat gain coefficient (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water heating system and equipment types, sizes and efficiencies.
6. Economizer description.
7. Equipment and system controls.
8. Fan motor horsepower (hp) and controls.
9. Duct sealing, duct and pipe insulation and location.
10. Lighting fixture schedule with wattage and control narrative.
11. Location of daylight zones on floor plans.
12. Air sealing details.

Section R103.2

1. Insulation materials and their R-values.
2. Fenestration U-factors and solar heat gain coefficients (SHGC).
3. Area-weighted U-factor and solar heat gain coefficients (SHGC) calculations.
4. Mechanical system design criteria.
5. Mechanical and service water-heating system and equipment types, sizes and efficiencies.
6. Equipment and system controls.
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8. Air sealing details.

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Where do I get more info?

- 2015 IECC
 - <https://codes.iccsafe.org>
- Hawaii amendments & support info
 - <http://energy.hawaii.gov/hawaii-energy-building-code/2015-iecc-update>
- Email contact
 - Howard Wiig, howard.c.wiig@hawaii.gov



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Section 2

Residential - Overview

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Compliance Options - Residential

1. Tropical Zone

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



2. Prescriptive

Wall and roof options:

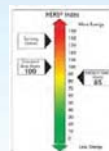
1. Prescriptive
2. Total UA
3. Points option

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glassed Fenestration SHGC	Ceiling R-Value	Wood Frame Wall R-Value	Matt. Wall R-Value	Floor R-Value	Basement or 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

3. Simulated performance alternative



4. Energy rating index (ERI)



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Highlights - Residential

- New Tropical Zone option
- New points option for walls and roof
- Air leakage testing – blower door
- Window SHGC
- Duct leakage testing
- High efficacy lighting

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Checklists - Residential

- Tropical Zone
- Prescriptive requirements
- Additions and alterations
- Points option tables

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
Scope of new construction	<ul style="list-style-type: none"> • > 50% of occupied space has AC • Insulation R-values • Fenestration U-factors • Glazing = 2,400 ft² 	RATS 2.1*	Overhangs that do not meet all their criteria must use another compliance option.	<input type="checkbox"/> AC space clearly indicated (if applicable)
Certification	Responsible design professional certification on plans	RATS 2.1*		<input type="checkbox"/> Signed statement on plans
Construction documents	<ul style="list-style-type: none"> • Insulation R-values • Fenestration U-factors and solar heat gain coefficients (SHGC) • Solar heat and air conditioning source • Insulation R-values • Fenestration U-factors and solar heat gain coefficients (SHGC) 	RATS 2.1*	Water for instant on water heater permitted.	<input type="checkbox"/> Solar water heating system specs on plans
Windows - solar heat gain coefficient (SHGC)	<ul style="list-style-type: none"> • SHGC = proportion factor x 0.80 • SHGC = 0.40 if proportion factor < 0.50 • SHGC = 0.50 if proportion factor > 0.50 • SHGC = 0.40 if proportion factor > 0.50 • SHGC = 0.50 if proportion factor > 0.50 	RATS 2.1*	Low SHGC typically requires dual pane glazing with a low-emittance coating that is designed to reduce solar heat gain.	<input type="checkbox"/> SHGC indicated on plans
Overhangs	<ul style="list-style-type: none"> • 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 3 ft in the center with a depth of 2 ft. • Overhang must have dual-pane glazing. 	RATS 2.1*		<input type="checkbox"/> Overhang dimensions on plans, if applicable
Daylighting - U-factor	U-factor	RATS 2.1*		<input type="checkbox"/> Daylighting U-factor on plans
Lighting	<ul style="list-style-type: none"> • > 70% of lamps or fixtures are high efficacy • High efficacy lamps are defined as: <ul style="list-style-type: none"> • T8 or smaller diameter fluorescent • Compact fluorescent • LED luminaire/fixture of < 20W and < 40W • LED luminaire/fixture of < 20W • Note: Not all LED lamps will qualify. Apply to permanently installed fixtures. Consider lighting in general. 	RATS 2.1*		<input type="checkbox"/> Lighting fixture locations on plans

Section 3

Residential – Tropical Zone



R401.2.1 Tropical Zone Hawaii Version

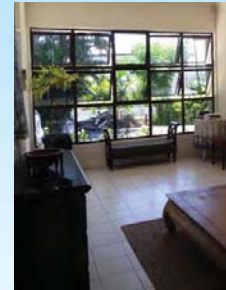


Can use this path if:

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

Requirements cover:

- Water heating
- Glazing
- Lighting
- Roof
- Natural ventilation
- Jalousie air leakage
- Envelope air leakage for AC areas



R401.2.1 Tropical Zone Hawaii 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 R402.2.1.

Table R402.2.1. Window SHGC Requirements

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

^bException: 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 R402.1.2.
6. Permanently installed lighting is in accordance with Section R404.
7. The roof/ceiling complies with one of the following options:

1. Comply with one of the roof surface options in Table C402.3 and install R-13 insulation or greater.
2. Install R-19 insulation or greater.

If present, attics above the insulation are vented and attics below the insulation are unvented.

Exception: The roof/ceiling assembly are permitted to comply with Section R407.

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. Jalousie windows shall have an air infiltration rate of no more than 1.2 cfm per square foot (6.1 L/s/m²).
14. 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. [Eff 5/24/10; am and comp MAR 31 2017] (Auth: HRS §107-29) (Imp: HRS §§107-24, 107-25)

R401.2.1 Tropical Zone Water Heating



Solar, wind or other renewable > 90%



Waiver for instant-on water heater permitted

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R401.2.1 Tropical Zone Windows



Maximum solar heat gain coefficient (SHGC)

Overhang
Projection Factor

No requirement	0.40	0.25
Large overhang 	Medium overhang 	Small overhang
≥ 0.5	$0.30 \leq PF < 0.50$	< 0.30

North windows: no requirement if $PF > 0.20$

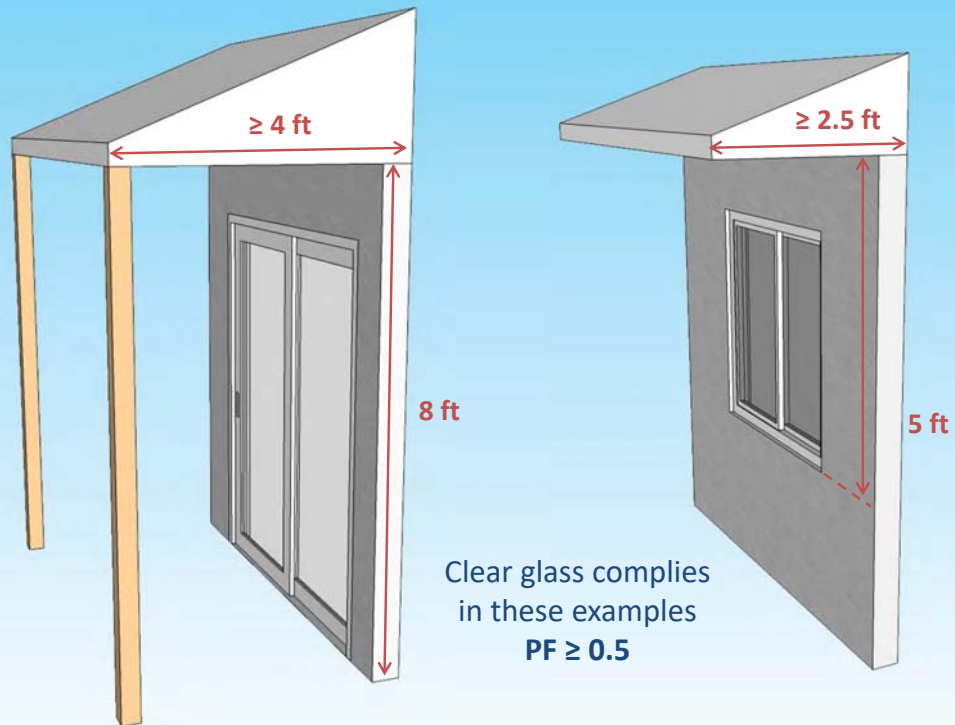
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Overhang size that allows clear glass to comply?



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Window examples

Dual-pane, low-e, solar control

Double Glazed	Visible Light			UV Trans %	SHGC	U-Factor	
	Trans %	Reflect Out %	Reflect In %			1/2" Gap Argon	Air
ClimaGuard 80/70 (#3)	81	13	13	41	0.702	0.271	0.315
HiLightR 802 (80/70 + IS-20)	79	14	14	40	0.678	0.222	0.254
ClimaGuard 72/57 (#3)	71	13	14	27	0.575	0.251	0.298
ClimaGuard 72/57	71	14	13	27	0.468	0.251	0.298
ClimaGuard 70/36	70	11	13	25	0.383	0.248	0.294
ClimaGuard 62/27	62	11	12	8	0.278	0.245	0.292
ClimaGuard 55/27	56	17	19	21	0.277	0.246	0.293
ClimaGuard 53/23	53	13	12	11	0.233	0.243	0.290

Source: www.guardian.com



Low UV transmission is an extra benefit

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National Fenestration Rating Council (NFRC) Label

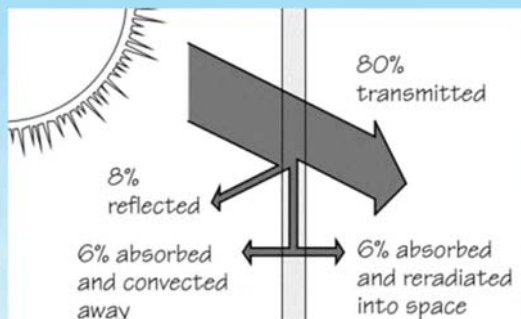


 National Fenestration Rating Council CERTIFIED	World's Best Window Co. Millennium 2000 [†] Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./I-P) 0.35	Solar Heat Gain Coefficient 0.25
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance 0.51	Air Leakage (U.S./I-P) 0.2
<small>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 </small>	

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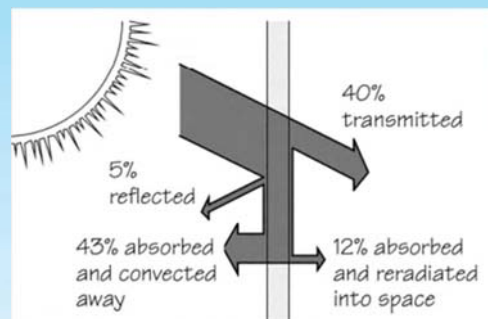
Solar Heat Gain Coefficient (SHGC)

Clear glass



$$\text{SHGC} = 80\% + 6\% = 86\%$$

Tinted glass
(heat-absorbing)



$$\text{SHGC} = 40\% + 12\% = 52\%$$

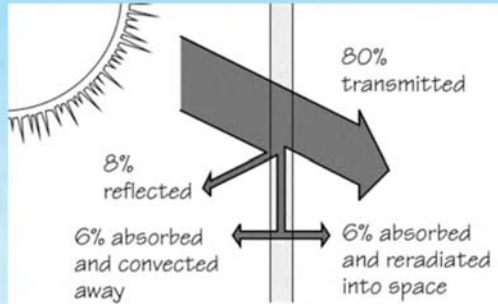
(An example. A range of performance is available)

<http://windows.lbl.gov/software/NFRC/SimMan/NFRCsim6.3-2013-07-Manual.pdf>

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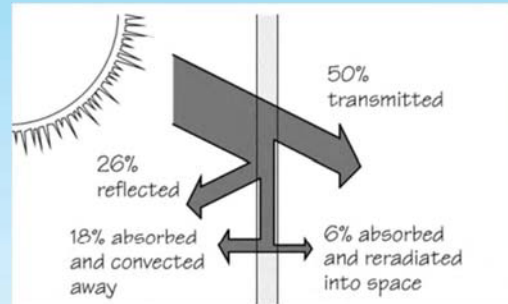
Solar Heat Gain Coefficient (SHGC)

Clear glass



$$\text{SHGC} = 80\% + 6\% = 86\%$$

Reflective glass coating

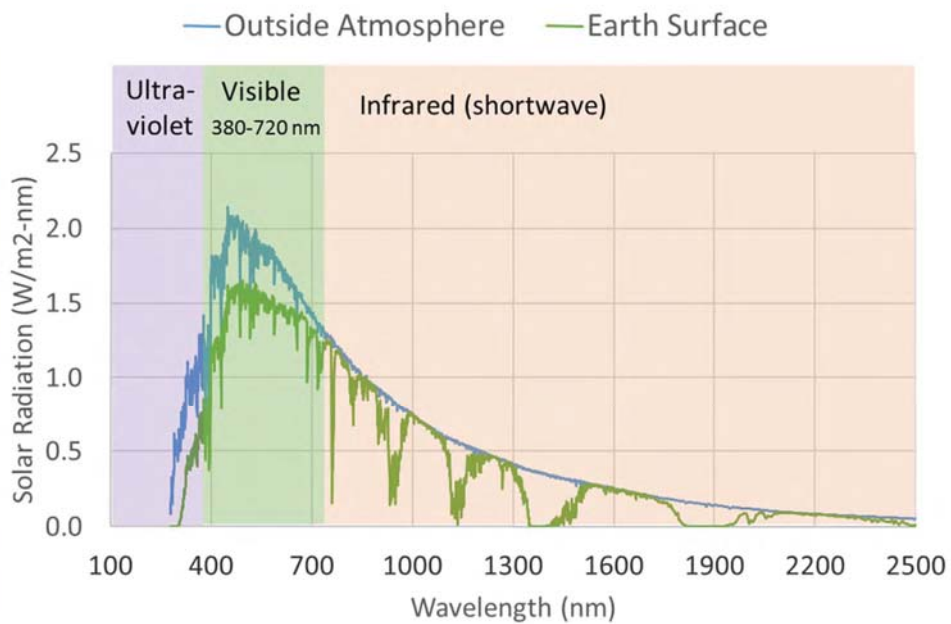


$$\text{SHGC} = 50\% + 6\% = 56\%$$

(An example. A range of performance is available)

<http://windows.lbl.gov/software/NFRC/SimMan/NFRCsim6.3-2013-07-Manual.pdf>

Solar Spectrum

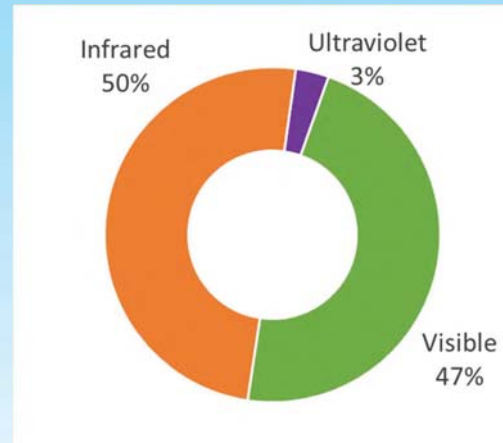


Data source: <http://rredc.nrel.gov/solar/spectra/>

Solar Radiation Power

At Earth Surface

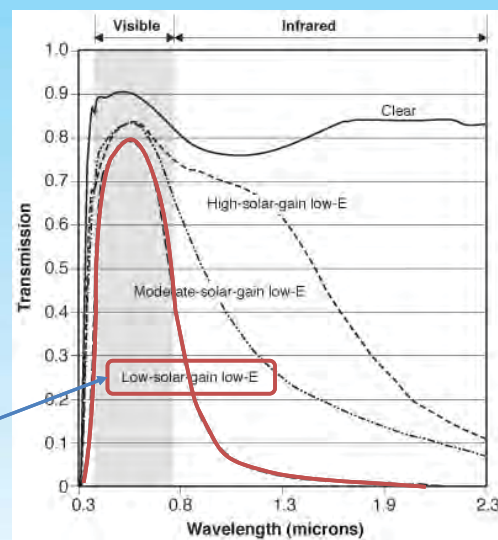
Ultraviolet	10 Btu/hr-ft ²
Visible	149 Btu/hr-ft ²
Infrared	158 Btu/hr-ft ²
Total	317 Btu/hr-ft²



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Low-e Glazing Spectral Transmittance

Spectrally selective



<http://www.commercialwindows.umn.edu>

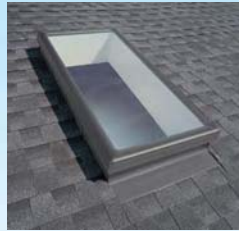
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R401.2.1 Tropical Zone Skylights



U-factor ≤ 0.75

Requires double-pane skylights



www.veluxusa.com

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R401.2.1 Tropical Zone Lighting (R404.1)



High efficacy
 $\geq 75\%$ of lamps

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

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High efficacy examples



**Compact
fluorescent**



Source: DOE/NREL PIX17458

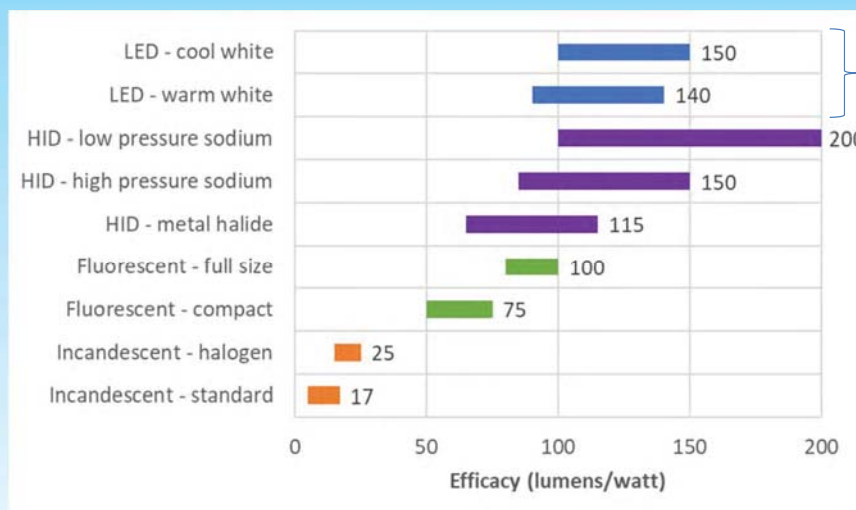
**Full-size
fluorescent**



Source: DOE/NREL PIX20307

LED

Future target
~250 lm/W



R401.2.1 Tropical Zone Roof



1. R-19 insulation
2. Cool roof + R-13 insulation
3. Points option (R407)

Cool roof



<http://coolroofhawaii.com>



<http://www.whirlwindsteel.com>

If there is an attic

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

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R401.2.1 Tropical Zone Natural Ventilation



- Operable windows
 - Area $\geq 14\%$ of floor area
- Bedrooms
 - Interior doors can be secured open
 - Openings on two different sides if exterior walls face two different directions
- Ceiling fans
 - Bedrooms
 - Largest space that is not a bedroom
- Jalousie windows
 - Air infiltration rate ≤ 1.2 cfm/ft²



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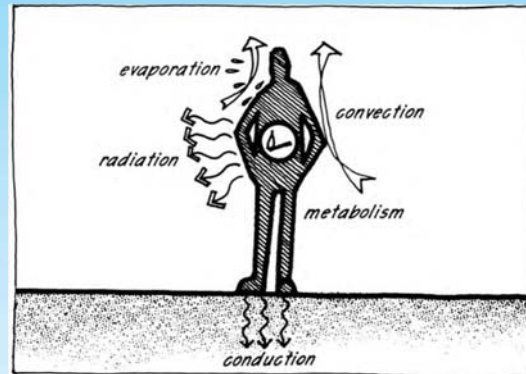
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R401.2.1 Tropical Zone Summary



- Efficiency
 - Little or no AC
 - Water heating
 - Lighting
- Comfort
 - Window solar gain
 - Roof heat gain
 - Natural ventilation



Heat generated within body \approx Heat loss from body

↓ Air temperature
↓ Ceiling temperature
↑ Air movement

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A 1920's Tropical Home



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A Brand New Tropical Home



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Kaupuni Village



Waianae Valley, Oahu
19 affordable homes
\$303,000 average construction cost
Built in 2011

<https://www.nrel.gov/docs/fy12osti/53401.pdf>
<https://www.nrel.gov/docs/fy13osti/58000.pdf>



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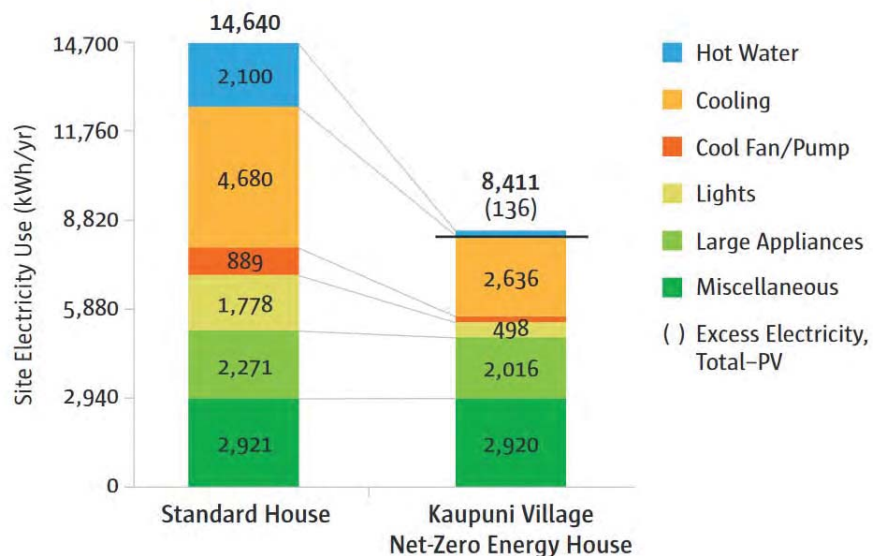
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Kaupuni Village



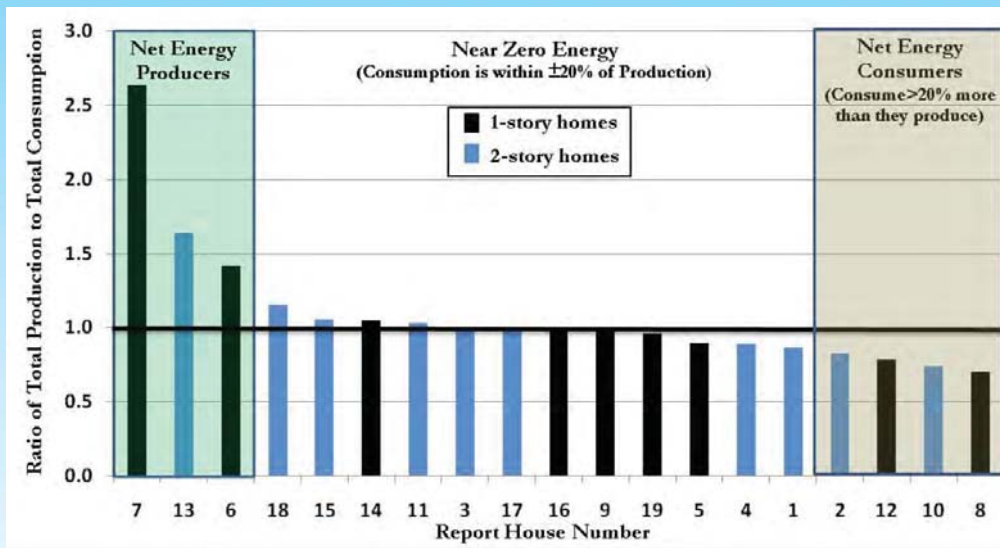
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Kaupuni Village



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Kaupuni Village



Tropical Zone Quiz

- What are the wall insulation requirements?
- Does single-wall construction comply?
- Which is not allowed under the Tropical Zone path?
 - Ductless mini-split air conditioner
 - Heat pump water heater
 - Dark roof
 - Unventilated attic
 - Jalousie windows
- Design professional certification not required
 - True
 - False

Section 4

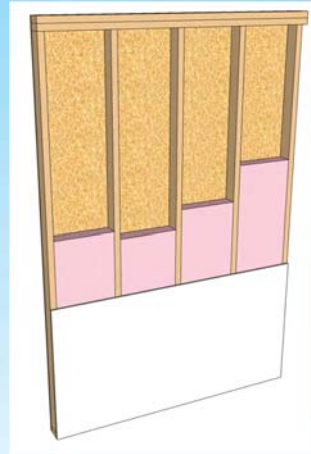
Residential – Envelope Prescriptive Option

Residential Envelope

- Wall and roof, three options
 1. Table R402.1.2
 2. Total UA
 3. Points option
- Windows & skylights
 - Table R402.1.2
- Air leakage
 - Installation
 - Testing

Table R402.1.2 Opaque Envelope - Prescriptive

	R-value (hr-ft ² -°F/Btu)	U-factor (Btu/hr-ft ² -°F)
Ceiling	R-30	0.035
Wood frame wall	R-13	0.084
Mass wall	R-3 – exterior R-4 – interior	0.197
Floor	R-13	0.064
Basement wall	0	0.360
Slab on grade	0	NA
Crawl space wall	0	0.477



¹Proposed County Amendment

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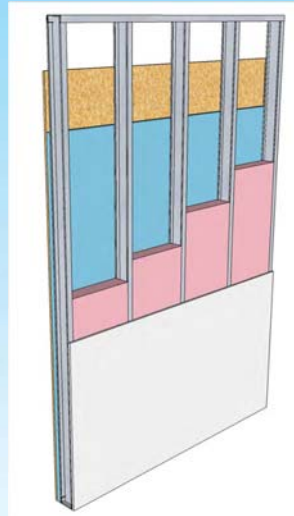


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Table R402.1.2 Opaque Envelope - Prescriptive

	Insulation R-value (hr-ft ² -°F/Btu)	
Steel frame wall, 16 in. o.c.	R-0 + 9.3 R-13 + 4.2 R-15 + 3.8	R-19 + 2.1 R-21 + 2.8
Steel frame wall, 24 in. o.c.	R-0 + 9.3 R-13 + 3.0 R-15 + 2.4	
Steel truss ceiling	R-38 R-30 + 3 R-26 + 5	
Steel joist ceiling	R-38 R-49 if framing > 2x8	



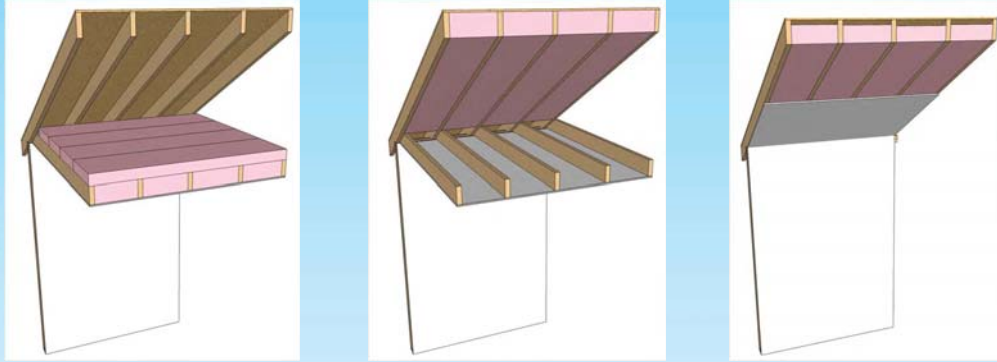
54



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Ceilings

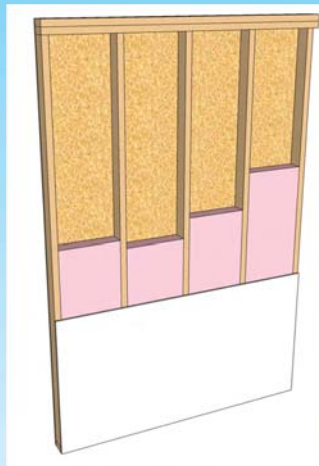


Some R-30 insulation options

- 10 in. batt
- ~10 in. blown-in
- ~8 in. open-cell spray foam
- ~5 in. closed-cell spray foam

Or use the points option
for compliance

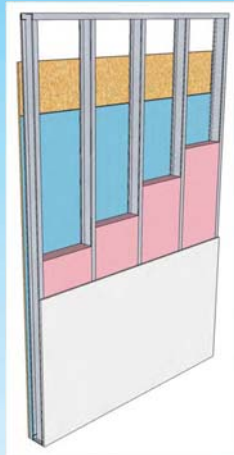
Wood Walls



Some R-13 insulation options

- 3.5 in. batt
- 3.5 in. blown-in
- 3.5 in. open-cell spray foam
- ~2 in. closed-cell spray foam

Metal Walls



Framing 16 in. o.c.

R-0 + 9.3
R-13 + 4.2
R-15 + 3.8

Framing 24 in. o.c.

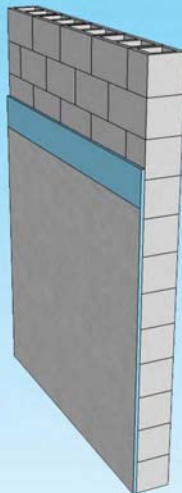
R-0 + 9.3
R-13 + 3.0
R-15 + 2.4

Rigid foam board thickness

R-value	Extruded Polystyrene (R-5/in.)	Polyisocyanurate (R-6/in.)
2.4	≥ 0.48 in.	≥ 0.40 in.
3.0	≥ 0.60 in.	≥ 0.50 in.
3.8	≥ 0.76 in.	≥ 0.63 in.
4.2	≥ 0.84 in.	≥ 0.70 in.
9.3	≥ 1.86 in.	≥ 1.55 in.

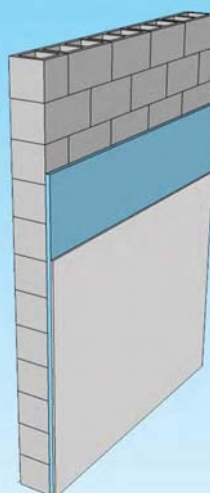
Or use the points option for compliance

Mass Walls



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

R402.1.5

Opaque Envelope – Total UA Option

- Calculate total U-factor x Area for walls and roof
- Typically use REScheck software
 - Desktop or Web version
 - <https://energycode.pnl.gov/REScheckWeb>



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A screenshot of the REScheck-Web application interface in a web browser. The browser address bar shows the URL "https://energycode.pnl.gov/REScheckWeb/#/new-project/". The page has a header with the REScheck-Web logo and a user profile for "erik@kolderupconsulting.com". Below the header, there are tabs for "Project", "Envelope", and "Compliance". The "Project" tab is active, showing a form for "Project Info" and "Building Characteristics". The "Project Info" section includes fields for "Project Title" (Tropical house), "Energy Code" (2015 IECC), "Location" (Honolulu County, Hawaii), and "Project Type" (New Construction, Addition, Alteration). The "Building Characteristics" section includes "Construction Type" (1- and 2-Family, Detached), "Conditioned Floor Area" (1500 ft²), "Orientation - Front Faces" (Enable:), and "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). A green arrow points to the "UA Trade-Off" option under the "Compliance Method" section.

Project Info:

Project Title: Tropical house

Energy Code: 2015 IECC

Location: Honolulu County, Hawaii

Project Type: ☒ New Construction ☐ Addition ☐ Alteration

Compliance Method: ☒ UA Trade-Off ☐ Performance Alternative

Building Characteristics:

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

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REScheckWeb - New Project

Secure | https://energycode.pnl.gov/REScheckWeb/#/new-project/

erik@kolderupconsulting.com | Help | Sign off |

Home » New Project

Project Envelope Compliance (15%) ✓ Cancel Save Report Compliance Check

Show all Glazing requirements

Ceilings / Skylights (1 assembly)

Add

Ceilings	Assembly	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
Ceiling	Flat Ceiling or Scissor Truss	1500	38	0	0.03

Walls / Windows / Doors (1 assembly)

Add

Walls	Assembly	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
Wall	Steel Frame, 16" o.c.	1600	19	5	0.101

Foundations

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Generated by REScheck-Web Software

Compliance Certificate

Project Tropical house

Energy Code: 2015 IECC
Location: Honolulu, Hawaii
Construction Type: Single-family
Project Type: New Construction
Conditioned Floor Area: 1,500 ft²
Climate Zone: 1 (0 HDD)
Permit Number:

Construction Site: Owner/Agent: Designer/Contractor:

Compliance: Passes using UA trade-off

Compliance: 15.0% Better Than Code Maximum UA: 187 Your UA: 159 Maximum SHGC: 0.25 Your SHGC: 0.00

The % Better or Worse Than Code index reflects how close to compliance the house is based on code trade-off rules. It DOES NOT provide an estimate of energy use or cost relative to a minimum code home.

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	U-Factor	UA
Ceiling: Flat Ceiling or Scissor Truss	1,500	38.0	0.0	0.030	45
Wall: Steel Frame, 16" o.c.	1,600	19.0	5.0	0.071	114

Compliance Statement: The proposed building design described here is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2015 IECC requirements in REScheck Version : REScheck-Web and to comply with the mandatory requirements listed in the REScheck Inspection Checklist.

Name - Title Signature Date

Project Title: Tropical house Report date: 04/08/18
Data filename: Page 1 of 1

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Section R407 Hawaii Specific Opaque Envelope – Points Option

- 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

Measure	Standard Home Points	Tropical Home 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 $\leq 1,000$ 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

Reasons to use the Points Option

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

Points Option - Wood Framed Walls

Measure	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 $\leq 1,000$ 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

Points Option - Metal Framed Walls

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

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Points Option - Footnotes

POINTS OPTION	
R-13 wall insulation	0
R-13 wall insulation + R-3 wall insulation	-1
R-13 wall insulation + high reflectance walls	0
R-13 wall + 90% high efficacy lighting and Energy Star appliances	1
R-13 wall insulation + exterior shading wpf=0.3	0
R-30 roof insulation	0
R-19 roof insulation	-1
R-19 + cool roof membrane or radiant barrier	0
R-19 roof insulation + attic venting	0
Ductless air conditioner	1
1.071 X Federal minimum SEER for air conditioner	1
1.142 X Federal minimum SEER for air conditioner	2
No air conditioning installed	NA
House floor area ≤ 1,000 ft²	1
House floor area ≥ 2,500 ft²	-1
Energy Star Fans	1
Install 1 kW or greater of solar electric	1

¹ Cool roof with three-year aged solar reflectance of 0.55 and 3-year aged thermal emittance of 0.75 or 3-year aged solar reflectance index of 64.

² One cfm/ft² attic venting.

³ Radiant barrier shall have an emissivity of no greater than 0.05 as tested in accordance with ASTM E-408. The radiant barrier shall be installed in accordance with the manufacturer's installation instructions.

⁴ Walls with covering with a reflectance of ≥ 0.64.

⁵ Energy Star rated appliances include refrigerators, dishwashers, and clothes washers and must be installed for the Certificate of Occupancy

⁶ The wall projection factor is equal to the horizontal distance from the surface of the wall to the farthest most point of the overhang divided by the vertical distance from the first floor level to the bottom most point of the overhang.

⁷ All air conditioning systems in the house must be ductless to qualify for this credit.

⁸ Install ceiling fans in all bedrooms and the largest space that is not used as a bedroom.

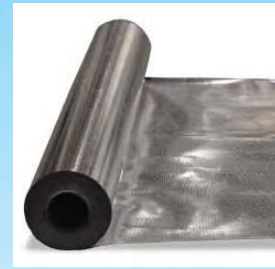
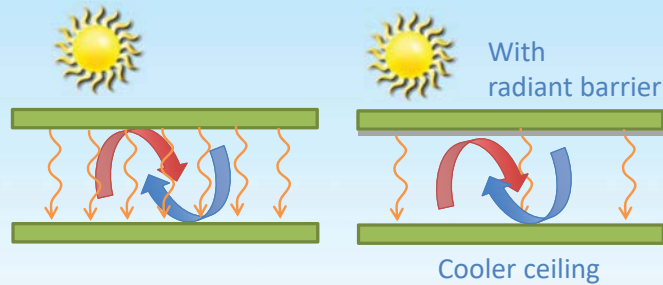
66



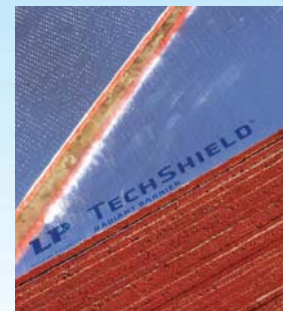
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Radiant Barriers

- Thermal emittance < 0.05 ("low-e")
- Low-e (shiny) surface facing air gap
- Cuts radiant heat transfer
 - Reduce cooling load through roof
 - Cuts radiant heat load on ducts from hot roof deck



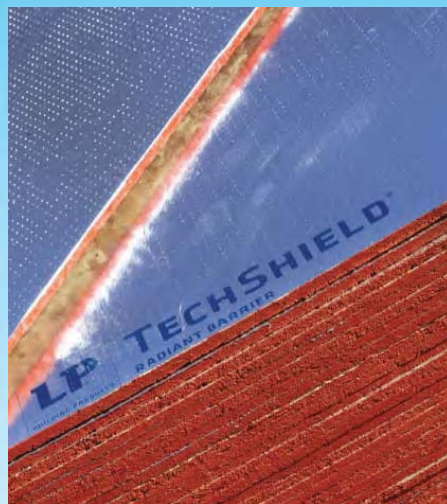
Source: www.radiantbarrier.com



Source: www.lpcorp.com

POINTS	OPTION	Points
1	1.00	1
2	2.00	2
3	3.00	3
4	4.00	4
5	5.00	5
6	6.00	6
7	7.00	7
8	8.00	8
9	9.00	9
10	10.00	10
11	11.00	11
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100	100.00	100

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POINTS	OPTION	Points
1	1.00	1
2	2.00	2
3	3.00	3
4	4.00	4
5	5.00	5
6	6.00	6
7	7.00	7
8	8.00	8
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68





Source: www.radiantbarrierguru.com

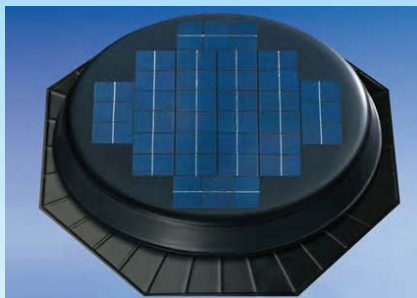


Source: www.radiantbarrier.com

POINTS	OPTION
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7	7.0
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94	94.0
95	95.0
96	96.0
97	97.0
98	98.0
99	99.0
100	100.0

Attic Venting

≥ 1 cfm/ft² for credit



Source: www.solatube.com

POINTS	OPTION
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0
6	6.0
7	7.0
8	8.0
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96	96.0
97	97.0
98	98.0
99	99.0
100	100.0

OK, LRV 78

OK, LRV 69

Not complying, LRV 57

Source: www.sherwin-williams.com

POINTS OPTION

0.12 units/wall insulation	0	1
0.10 roof insulation	0	1
0.10 wall insulation + cavity insulation or radiant barrier*	0	1
0.10 roof insulation + eave soffit*	0	1
0.10 roof insulation	0	1
0.12 wall insulation + high reflectance soffit*	0	1
0.10 wall + 50% high-efficiency lighting and energy star appliances*	2	2
0.12 wall insulation + exterior shading wall/0.2*	0	1
Insulation air sealant†	0	1
1.0/1.1 R-value windows 20% or less over-insulation	2	0
1.0/1.1 R-value windows 20% or less over-insulation	2	0
No air conditioning equipment	N/A	2
House floor area <1,000 ft ²	0	0
House floor area >1,000 ft ²	0	0
Energy Star New†	0	0

* If not available

† If not available

POINTS OPTION

POINTS OPTION

6.12 (c) (i) wall insulation	0	1
6.12 (c) (ii) insulation	0	2
6.12 (c) (iii) insulation + cavity wall insulation (or radiant barrier)	0	3
6.12 (c) (iv) insulation + attic ceiling	0	4
6.12 (c) (v) insulation	0	5
6.12 (c) (vi) insulation + high reflectance walls	0	6
6.12 (c) (vii) + 90% high efficiency lighting and Energy Star appliances	0	7
6.12 (c) (viii) insulation + exterior shading w/60°F	0	8
6.12 (c) (ix) air conditioning	0	9
1.073.1 Federal tax credits (2009) for air conditioning	0	10
1.073.1 Federal tax credits (2009) for air conditioning	0	11
No air conditioning installed	NA	2
House Size area 4,100-507	0	1
House Size area 3,100-407	0	2
House Size area 2,100-307	0	3
House Size area 1,100-207	0	4
House Size area 0,100-107	0	5
House Size area 0,000-097	0	6

POINTS OPTION

- 1 point: high reflectance walls
- 1 point: 90% HE lighting + ES appliances
- 1 point: wall shading
- 1 point: ductless AC
- 1 point: 13.9 SEER
- 2 points: 14.8 SEER
- 1 point: ES ceiling fans
- 1 point: ≥ 1 kW solar electric

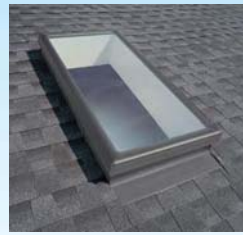
Table R402.1.2 & R402.3 Fenestration - Prescriptive

Solar heat gain coefficient (SHGC) ≤ 0.25

- Windows and skylights
- Area weighted average allowed

Exceptions

- Up to 15 ft² exempt
- Skylights can have SHGC ≤ 0.30

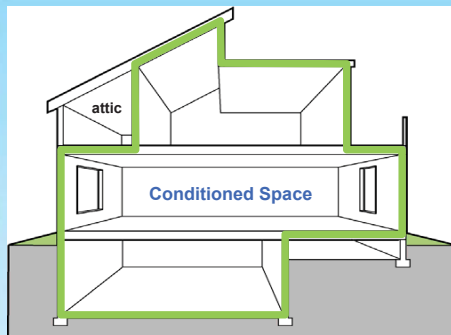


www.veluxusa.com

 World's Best Window Co. Millennium 2000® Vinyl-Clad Thermal Frame Double Glazing - Argon Fill - Low-E Product Type: Vertical Slider	
ENERGY PERFORMANCE RATINGS	
U-Factor (U.S./h·ft²·°F)	Solar Heat Gain Coefficient
0.35	0.25
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./h·ft³)
0.51	0.2
<small> Measurements include the heat transfer coefficient to determine the resistance to heat transfer under standard conditions. U-Factor ratings are determined for a fixed set of environmental conditions and a specific product type. Thermal transmittance is a measure of the overall performance of the window. </small>	

75

R402.4 Air Leakage - Installation



Details in Table R402.4.1.1

- Continuous air barrier
- Breaks or joints are sealed
- Recessed lighting
- Fenestration air leakage



76

R402.4.1.2 Air Leakage - Testing

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



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Prescriptive Envelope Summary

- Wall and roof, three options
 1. Table R402.1.2
 2. Total UA
 3. Points option
- Windows & skylights
 - Table R402.1.2
- Air leakage
 - Installation
 - Testing

Or Tropical Zone option



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Section 5

Residential – Systems

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R403

AC System Requirements

Programmable thermostat



Duct sealing



Source: www.energycodes.gov

Duct insulation



Duct testing

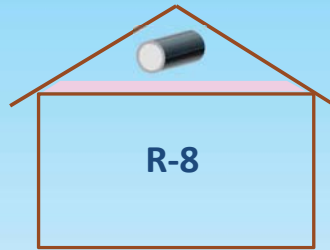


Source: DOE/NREL PIX04869

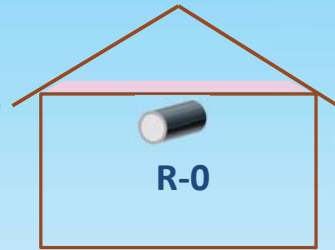
80

R403.3.1 Duct Insulation

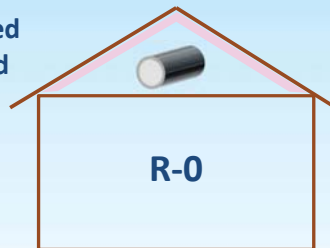
In attic



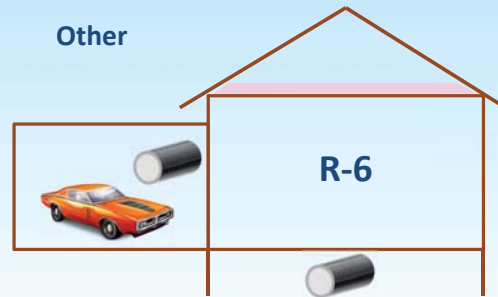
Within thermal envelope



In insulated and sealed attic



Other



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DUCT INSULATION EXAMPLES



R-6
(~1.75" thick)



R-8
(~2.5" thick)

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DUCT WITHIN THERMAL ENVELOPE EXAMPLES



Source: DOE/NREL PIX03067



Source: DOE/NREL PIX10076

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R403.2.2 Duct Sealing

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: www.energycodes.gov

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R403.2.2 Duct Sealing

IRC M1601.4.1 Joints, seams and connections
Ducts **mechanically fastened** and **sealed**

Mechanical fastening options

Flex duct

Mechanical fasteners with
UL mark "181 B-C"



Metallic duct

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

85

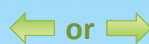
R403.3.3 & R403.3.4 Duct Testing

Rough-in test

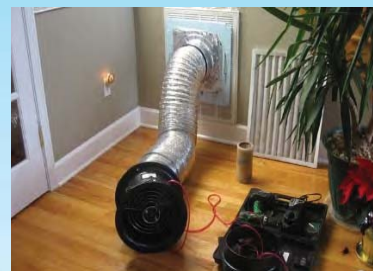


Leakage ≤ 4 cfm/100 ft²

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 conditioned space

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R403.5.4 Hawaii Specific Solar Water Heating

Section R403.5.5 Solar water heating.

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



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R 403.10 Pool and Spas

- On/off switch
- Time switch
- Cover for heated pool
 - Unless 70% solar or site recovered heat



Source: www.energycodes.gov

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Section 6

Residential – Electrical & Lighting

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R404.1 Lighting

High efficacy
≥ 75% of lamps

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

90

R404.2 Hawaii Specific Ceiling Fans

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



R404.2 Hawaii Specific Ceiling Fans/Whole-House Fan



R404.2 Hawaii Specific Ceiling Fans/Whole-House Fan



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Section 7

Residential – Additions & Alterations

94

- Additions
 1. New construction requirements for addition alone, or
 2. Simulated Performance Alternative for existing + addition
- Alterations
 - New construction requirements for altered components
 - Several exceptions (partial list)
 - Roof recover
 - Wall cavity is not exposed
 - Wall or roof cavity already filled with insulation
 - Glazing-only replacement
 - Roof replacement
 - Potential code amendment.** Choose two:
 1. Energy Star compliant roof covering
 2. Radiant barrier
 3. Attic ventilation via solar attic fans or ridge vent or gable vent
 4. Shaded roof (C402.3)

Compliance Certification

Residential – Wrap Up

1. Tropical Zone
 - ≤50% air conditioned,
 - not heated, and
 - elevation < 2,400 feet



2. Prescriptive
 - Wall and roof options:

1. Prescriptive
2. Total UA
3. Points option

Windows & skylights

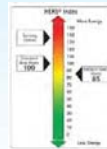
AC systems

Water heating

3. Simulated performance alternative

4. Energy rating index (ERI)

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



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KIUC Incentives

- Commercial incentives
 - 50%
 - High efficiency equipment retrofit
 - 80%
 - Incremental cost for high efficiency vs. standard efficiency
 - New construction
 - "end-of-life" equipment replacement
 - VFD installation (1st time)
 - 100% (G & J rates)
 - Energy efficient lamps

Projects must be submitted for consideration and eligibility testing prior to KIUC issuing an incentive agreement.

Visit www.kiuc.coop or call 246-4300 & ask for Energy Services



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KIUC Incentives

- Residential incentives
 - Refrigerator, Washer, Freezer, Energy Star Window A/C (CEER >11.0)
= \$50 Rebate
 - Energy Star Ceiling Fan
= \$25 Rebate
 - Heat Pump Water Heater Installation
= \$300 Rebate
 - Solar Water Heater Installation
= \$1,000 Rebate or Zero Interest Loan

Visit www.kiuc.coop or call 246-4300 & ask for Energy Services



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BREAK

Part two will start at 10:00 am



100

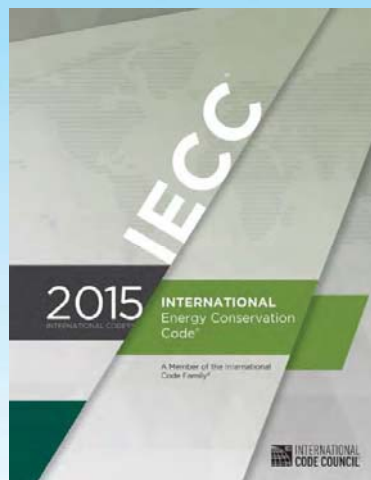
Section 7

Commercial – Overview

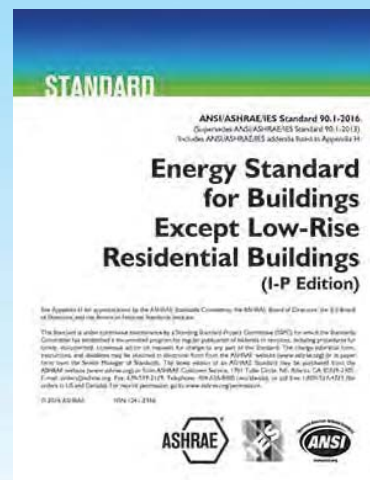
101

Options

2015 IECC



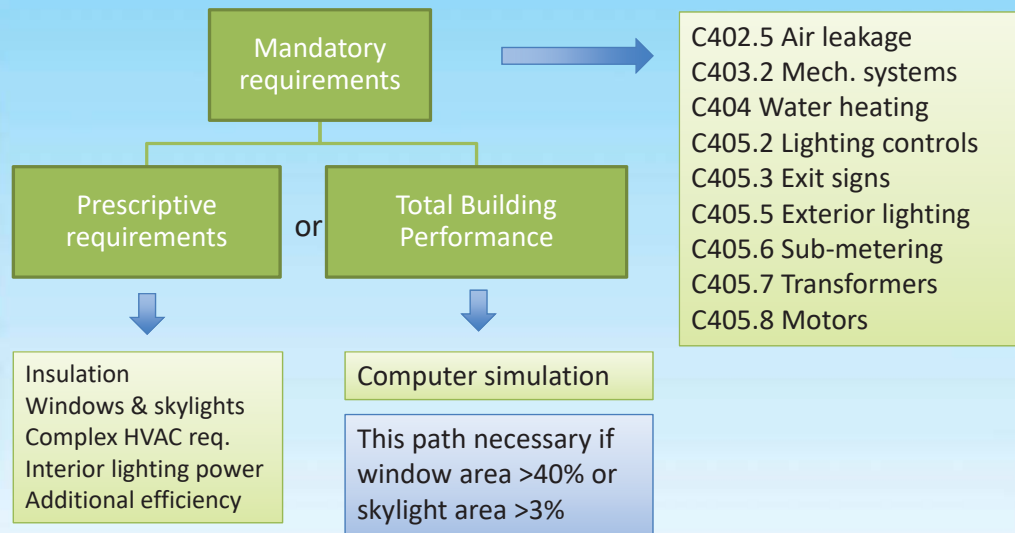
ASHRAE Standard 90.1-2013



or

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Compliance Options



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C406.1 Additional Efficiency Package Options

Buildings must comply with at least one additional efficiency feature:

1. More efficient HVAC
2. Reduced lighting power density
3. Enhanced lighting controls
4. On-site renewable energy
5. Dedicated outdoor air system
6. High-efficiency SWH



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Checklists - Commercial

- Envelope
- Mechanical system
- Service water heating
- Lighting and electrical
- Additional efficiency
- Additions
- Alterations

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
ENVELOPE REQUIREMENTS				
Certification	Responsible design professional certification on plans	CS10.1*		(1) Signed statement on plans
Calculation documents	Includes: • Insulation R values • Penetration U factors and solar heat gain coefficients (SHGCs)	CS10.2		
Roof - insulation above deck	(1) R-25 or U-0.039 (group R) (2) R-20 or U-0.068 (others)	CA10.1, CA10.2	Typically foam board on the roof deck. If tapered, R-value in some areas can be lower than the requirement if designer shows that weighted average is factor is applied.	(1) Insulation location on plans (2) Insulation R value on plans
Roof - metal building	R-15 + R-11 or U-0.046 (with thermal break and liner system)	CA10.1, CA10.2	Typically two layers of batt insulation. One parallel to and between purlins supported by fabric liner. The second draped over purlins and compressed when roof deck is installed. Also with R-11 foam block between purlins and metal roof deck.	(1) Insulation R value on plans (2) Thermal break indicated on plans
Roof - attic or other	R-30 or U-0.027	CA10.1, CA10.2	The category includes attic, cathedral ceilings, and insulation installed under the roof deck. Insulation on top of suspended ceiling is not allowed for compliance.	(1) Insulation location on plans (2) Insulation R value on plans
Wall - mass (CMU or concrete)	R-9.7 or U-0.331	CA10.1, CA10.2	Requires either exterior or interior insulation. CMU integral insulation does not comply.	(1) Insulation location on plans (2) Insulation R value on plans
Wall - metal building	R-13 + R6.5 or U-0.079	CA10.1, CA10.2	Typically two layers of batt insulation. One installed horizontally between girts. The second layer draped vertically the girts and compressed as the wall panel is installed.	(1) Insulation location on plans (2) Insulation R value on plans
Wall - metal frame	R-13 + R-5 or U-0.077 (R-5 is not required with reflectance > 0.80 or shading FF=0.81)	CA10.1, CA10.2*	Requires insulation in framing cavity plus a type of continuous insulation (typically foam board). cavity insulation complies on its own with shading or high-reflectance.	(1) Insulation location on plans (2) Insulation R value on plans (3) Shading or wall reflectance (shown if exception is applied)

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Highlights

- Increased roof insulation
- Cool roof for low-slope
- Increased wall insulation
- Mass-wall insulation
- Window U-factor requirement
- Window area limit
- Skylights required for some spaces
- HVAC energy recovery
- HVAC system commissioning
- Refrigeration systems
- Lower lighting power allowance
- Lighting system functional testing
- "Additional Efficiency" requirements

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Section 8

Commercial – Envelope

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Table C402.1.3 Roof and Wall Insulation

	Type	Min. Insulation	
		Group R	Other
Roof	Insulation entirely above deck	R-25ci	R-20ci
	Metal building	R-19 + R-11 LS	R-19 + R-11 LS
	Attic and other	R-38	R-38
Walls	Mass	R-5.7ci	R-5.7ci
	Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci
	Metal framed	R-13+ R-5ci *	R-13+ R-5ci *
	Wood framed and other	R-13+ R-5ci * R-20	R-13+ R-5ci * R-20

No requirement:

- Below grade wall
- Floors
- Slab-on-grade floors

ci = continuous insulation

LS = layer system

* See Hawaii exceptions

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Roof Insulation Entirely Above Deck

R-25 for group R buildings
R-20 for other buildings



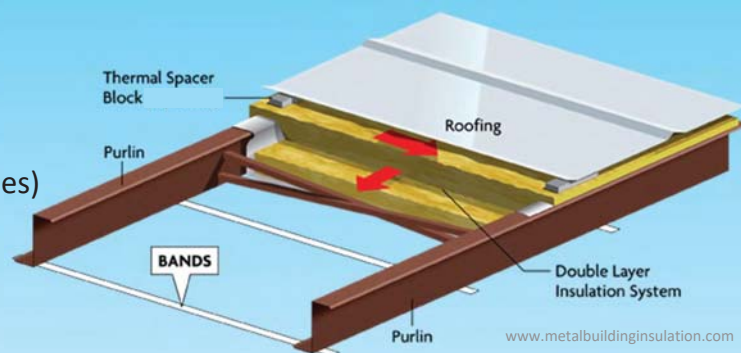
Polyisocyanurate R-6/inch
Extruded polystyrene R-5/inch



Photos courtesy of PIMA (Polyisocyanurate Insulation Manufacturers Association), via www.energycodes.gov

Roof Insulation Metal Building

R-19 + R-11 LS
& thermal block
(6 inches + 3.5 inches)



www.metalbuildinginsulation.com



Source: <http://armstrongsteel.com>

Roof Insulation Below Deck "Attic and Other"



R-38 for all buildings
(12 inch thickness)

Or U-factor ≤ 0.027



Source: www.energycodes.gov

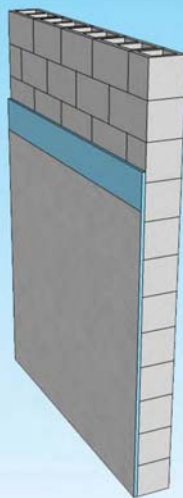
111



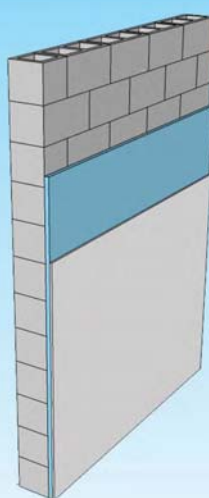
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Mass Wall Options



exterior



interior

R-5.7 insulation
(1 in. polyisocyanurate or
1.25 in. polystyrene)



U-factor ≤ 0.151
Interior furring
R-6 in wood or R-13 in metal

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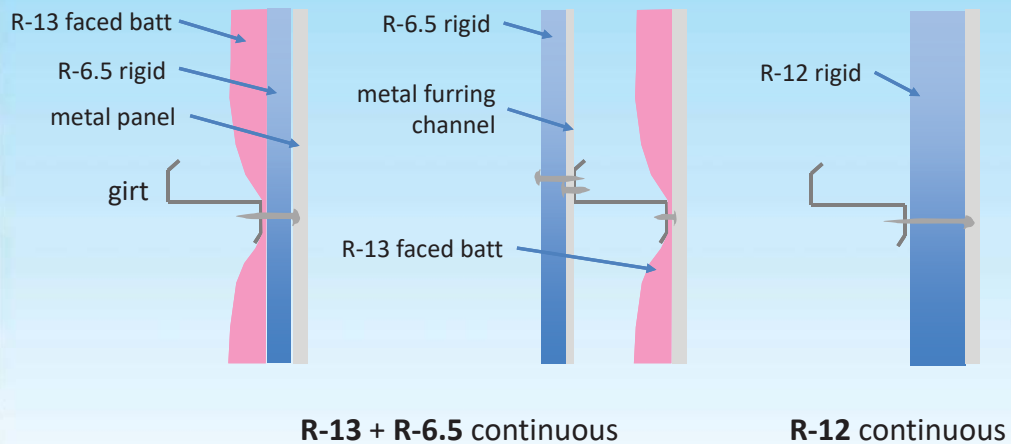
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Metal-building Wall Options



Source: <http://armstrongsteel.com>



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C402.2.3 Hawaii Specific Exception for continuous wall insulation

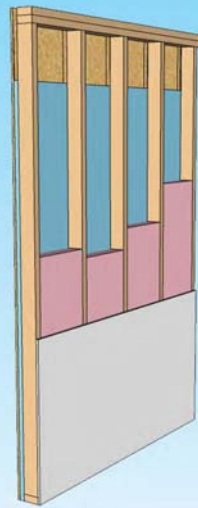
Continuous insulation for framed walls not required if:

1. Walls reflectance ≥ 0.64 , or
2. Walls overhang projection factor ≥ 0.3

R-13 cavity insulation complies

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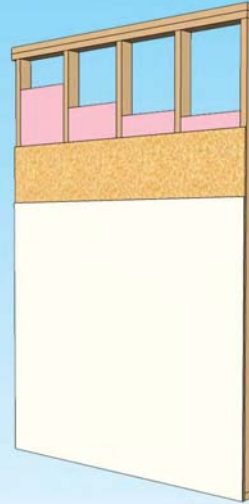
Wood-framed Wall Options



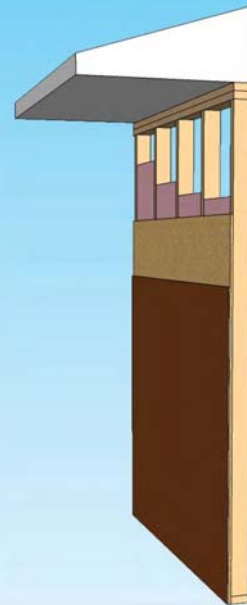
**R-13 +
R-3.8 continuous**



R-20



**R-13 +
Reflectance
 ≥ 0.64**



**R-13 +
Overhang
PF ≥ 0.3**

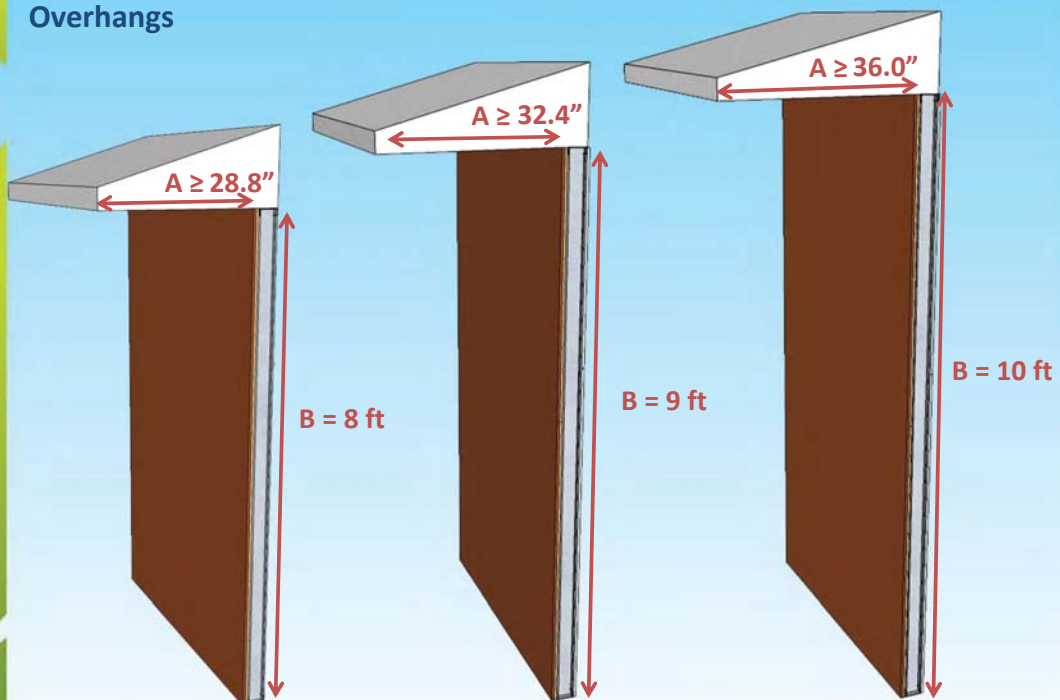
115



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Qualifying Wall Overhangs



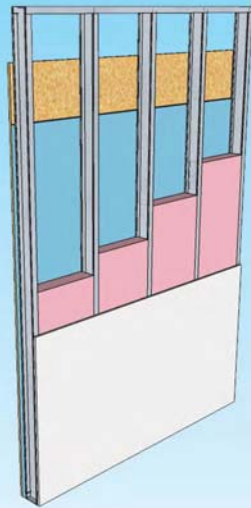
116



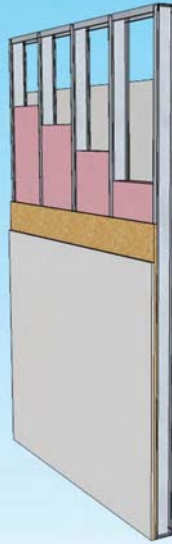
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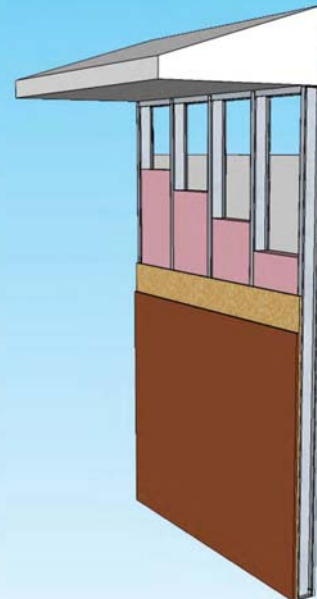
Metal-framed Wall Options



R-13+
R-5 continuous



R-13+
Reflectance ≥ 0.64



R-13 +
Overhang
PF ≥ 0.3

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C402.3 Low-sloped Roofs

Cool roof required

1. solar reflectance ≥ 0.55
+ thermal emittance ≥ 0.75 , or
2. solar reflectance index ≥ 64

3-year aged values

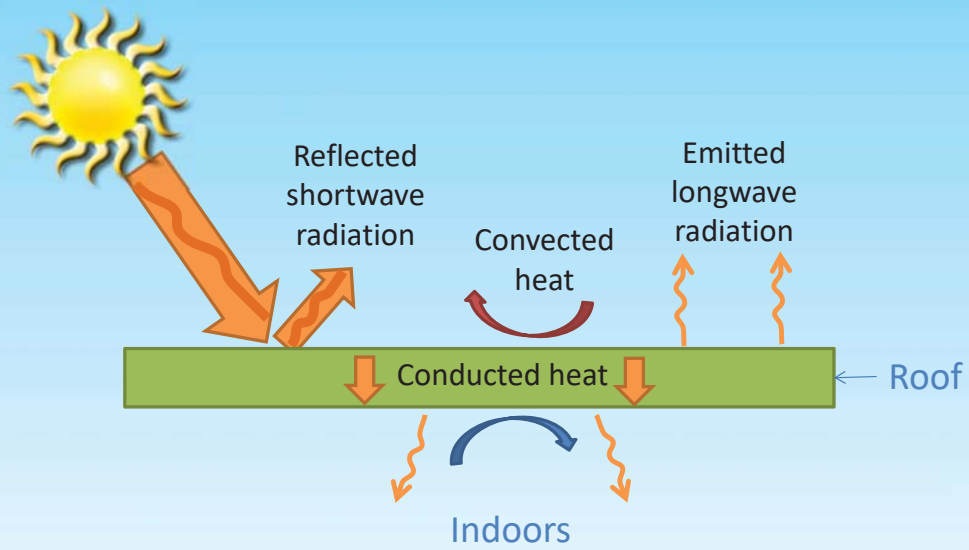
Typical products

- Single-ply membrane
- Liquid applied



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Roof Heat Transfer



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Roof Temperature Examples

Sacramento, CA
89°F ambient

EPDM
single-ply
173°F



Built up roof
with aggregate
159°F



Built up roof
with capsheet
158°F



Courtesy Dan Varvais, Applied Polymer Systems


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3 > 8 >

CRRC PROD. ID	MANUFACTURER: BRAND MODEL	PRODUCT TYPE	COLOR	SOLAR REFLECTANCE		THERMAL EMITTANCE		SRI		MORE INFO
				Initial	3 year	Initial	3 year	Initial	3 year	
0808-0001	Burkline Roofing: M-358 CSPE White	Membrane: Single Ply Thermoplastic and Thermoset Roofing	Bright White	0.83	0.71	0.88	0.87	104	87	+
0628-0011	Carlisle Construction Materials Incorporated: Spectro-Weld TPO White	Membrane: Single Ply Thermoplastic and Thermoset Roofing	Bright White	0.88	0.75	0.89	0.90	111	93	+
0628-0017	Carlisle Construction Materials Incorporated: Sure-Flex KEE HP Gray	Membrane: Single Ply Thermoplastic and Thermoset Roofing	Grey	0.57	0.50	0.88	0.85	67	57	+
0628-0016	Carlisle Construction Materials Incorporated: Sure-Flex KEE HP Tan	Membrane: Single Ply Thermoplastic and Thermoset Roofing	Tan	0.74	0.63	0.88	0.84	91	75	+
0628-0015	Carlisle Construction Materials Incorporated: Sure-Flex KEE HP White	Membrane: Single Ply Thermoplastic and Thermoset Roofing	Bright White	0.82	0.71	0.89	0.84	103	86	+

<http://www.coolroofs.org/products/search.php>

CRRC Product Label Example

	<u>Initial</u>	<u>Weathered</u>	
	Solar Reflectance	0.88	0.68 3 year aged
	Thermal Emittance	0.87	0.89 3 year aged
Rated Product ID Number	0001		
Licensed Seller ID Number	0896		
Classification	Production Line		
<p>Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.</p>			
<p>Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</p>			

C402.4 Fenestration

Windows and skylights

1. Maximum area
2. Maximum U-factor
3. Maximum solar heat gain coefficient (SHGC)



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C402.4 Fenestration – Area



Window area \leq **30%** of gross wall area

Up to 40% with daylighting controls

Skylight area \leq **3%** of gross roof area

Up to 5% with daylighting controls

Otherwise, use
Total Building Performance
compliance option



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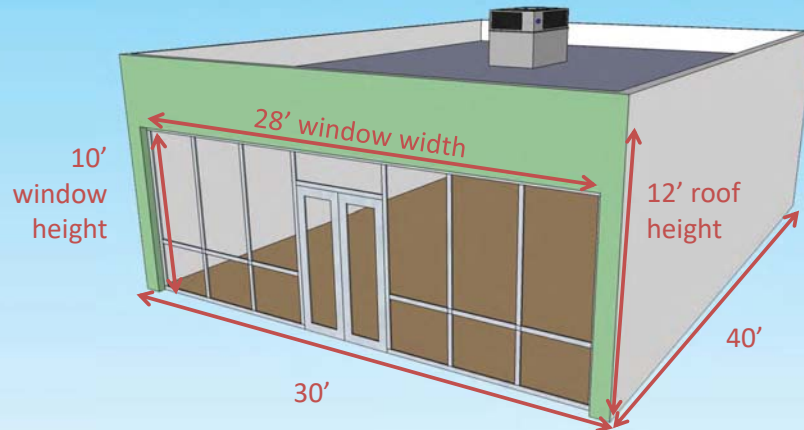


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Window area limit example

Is window area $\leq 30\%$ gross wall area?



Window area = 280 ft^2

Gross wall area = $(30 + 40 + 30 + 40) \times 12 = 1,680 \text{ ft}^2$

% Window area = $280/1,680 = 17\%$ OK

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C402.4 Window - SHGC



Window solar heat gain coefficient (SHGC)

<p>Overhang Projection Factor</p>	≤ 0.40	≤ 0.30	≤ 0.25
	Large overhang	Medium overhang	Small overhang
	<p>≥ 0.5</p>	<p>$0.20 \leq PF < 0.50$</p>	<p>< 0.20</p>

Area-weighted average SHGC allowed by Hawaii amendment

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C402.4 Windows – U-factor



Maximum U-factor

- U-0.50 fixed
 - U-0.65 operable
 - U-1.10 doors
- Dual-pane, low-e typical
- Single-pane complies

Area-weighted average U-factor allowed

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C402.4 Skylight – Minimum Area

Spaces

- Under roof
- Area > 2,500 ft²
- Ceiling height > 15 ft

Several exceptions apply

Minimum skylight area

1. 3% of roof, or
2. 1% effective aperture

- office
- lobby
- atrium
- concourse
- corridor
- storage space
- gymnasium/exercise center
- convention center
- automotive service area
- manufacturing
- nonrefrigerated warehouse
- retail store
- distribution/sorting area
- transportation depot
- workshop

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C402.4 Skylight Performance

SHGC ≤ 0.35

(or ≤ 0.60 with daylighting controls)

U-factor ≤ 0.75

(or U-0.90 with daylighting controls)

C402.5 Envelope Air Leakage

- Continuous air barrier
- Fenestration air leakage
- Openings to shafts, chutes, stairways and elevator lobbies
- Air intakes, exhaust openings, stairways, and shafts.
- Loading-dock weatherseals
- Recessed lighting in the thermal envelope

Compliance Certification

COUNTY OF [COUNTY'S ENERGY CODE NAME]

To the best of my knowledge, this project's design substantially conforms to the [CODE NAME] (2015 IECC as amended) for **building envelope components** (Section C402).

COMPLIANCE METHOD

- ☐ 2015 IECC as amended. Mandatory & Prescriptive
- ☐ 2015 IECC as amended. Mandatory & Total Building Performance
- ☐ ASHRAE Standard 90.1-2013. Mandatory & Prescriptive
- ☐ ASHRAE Standard 90.1-2013. Mandatory & Energy Cost Budget Method

INFORMATION IN CONSTRUCTION DOCUMENTS

	Yes	N/A
Roof insulation R-value	<input type="checkbox"/>	<input type="checkbox"/>
Roof insulation type and location	<input type="checkbox"/>	<input type="checkbox"/>
Roof membrane solar reflectance and thermal emittance	<input type="checkbox"/>	<input type="checkbox"/>
Wall insulation R-value	<input type="checkbox"/>	<input type="checkbox"/>
Wall insulation type and location	<input type="checkbox"/>	<input type="checkbox"/>
Window SHGC	<input type="checkbox"/>	<input type="checkbox"/>
Window U-factor	<input type="checkbox"/>	<input type="checkbox"/>
Skylight SHGC	<input type="checkbox"/>	<input type="checkbox"/>
Skylight U-factor	<input type="checkbox"/>	<input type="checkbox"/>

NOTES

SIGNATURE:

DATE:

NAME:

TITLE:

LICENSE NO.:

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Section 9

Commercial – Systems

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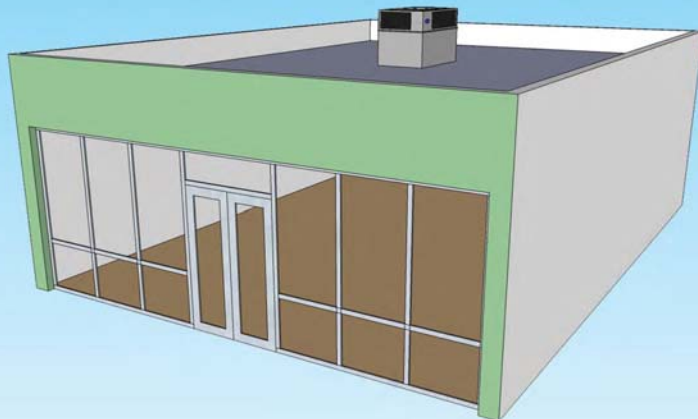
Mechanical System Requirements

- Cooling load calculations
- Cooling and heating equipment efficiency
- Controls
- Ventilation
- Energy recovery
- Kitchen exhaust
- Duct insulation
- Pipe insulation
- Commissioning
- Fans
- Refrigeration equipment efficiency
- Walk-in coolers and freezers
- Refrigerated warehouses
- Refrigerated display cases
- Heat recovery for water heating

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Small Commercial Example

1,200 ft² floor area
4-ton rooftop unit



C403.2.3 Efficiency
C403.2.4 Controls
C403.2.6 Ventilation
C403.2.9 Duct insulation and sealing

Maybe:
C403.2.8 Kitchen exhaust
C403.2.14 Refrig. equipment
C403.2.17 Refrig. display cases

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Small Commercial Example

C403.2.3 Efficiency

1,200 ft² floor area

4-ton rooftop unit

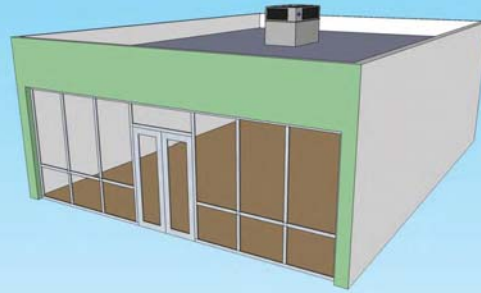


Table C403.2.3

Depends on equipment type & size

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	
				Before 1/1/2016	As of 1/1/2016
Air conditioners, air cooled	< 65,000 Btu/h ^b	All	Split System	13.0 SEER	13.0 SEER
			Single Package	13.0 SEER	14.0 SEER ^c

Small Commercial Example

C403.2.4 Controls

1,200 ft² floor area

4-ton rooftop unit



Programmable thermostat

- Off-hour setback

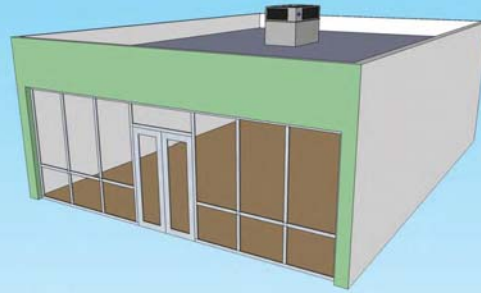


Small Commercial Example

C403.2.6 Ventilation

1,200 ft² floor area

4-ton rooftop unit



Outdoor air ventilation

- Per International Mechanical Code
- Equal to ASHRAE Standard 62.1
 - For example:
0.06 cfm/ft² + 5 cfm/person for office space

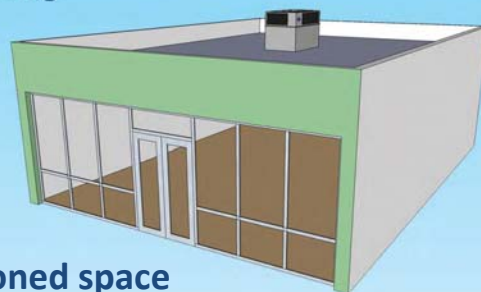
137

Small Commercial Example

C403.2.9 Duct insulation and sealing

1,200 ft² floor area

4-ton rooftop unit



Minimum insulation:

R-8 for ducts outdoors

R-6 for ducts in unconditioned space



**For both supply
and return ducts**

Source: www.energycodes.gov

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A few more mechanical requirements

- Guest room door switches
- Demand control ventilation
- Parking garage exhaust
- Energy recovery
- Commissioning

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C403.2.4.2.4 Hawaii Specific Door Switches

Space types

- Hotel and motel sleeping units
- Guest suites
- Time-share condominiums

Control operation

- Disable cooling or reset to $\geq 90^{\circ}\text{F}$
- < 5 minutes of opening



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C403.2.6.1 Demand Controlled Ventilation

Required for spaces

- > 500 ft², and
- ≥ **25 people**/1000 ft² of floor area

If HVAC system has

- Automatic outdoor air damper modulating control, or
- > 3,000 cfm outdoor airflow

Theater, auditorium, ballroom,
conference room, etc.



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C403.2.6.2 Enclosed Parking Garages

Automatic variable-speed exhaust fan control

- Contaminant sensors
- Reduce flow to <50%

Exceptions:

- < 22,500 cfm
- > 1,125 cfm/hp




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Table C403.2.7 Energy Recovery Ventilation

Energy recovery effectiveness $\geq 50\%$

If design supply air flow exceeds this limit



Design outdoor airflow	Fan Operates < 8,000 hrs/yr	Fan Operates $\geq 8,000$ hrs/yr
$\geq 10\%$ and $< 20\%$	$\geq 26,000$ cfm	$\geq 2,500$ cfm
$\geq 20\%$ and $< 30\%$	$\geq 16,000$ cfm	$\geq 2,000$ cfm
$\geq 30\%$ and $< 40\%$	$\geq 5,500$ cfm	$\geq 1,000$ cfm
$\geq 40\%$ and $< 50\%$	$\geq 4,500$ cfm	≥ 500 cfm
$\geq 50\%$ and $< 60\%$	$\geq 3,500$ cfm	> 0 cfm
$\geq 60\%$ and $< 70\%$	$\geq 2,000$ cfm	> 0 cfm
$\geq 70\%$ and $< 80\%$	$\geq 1,000$ cfm	> 0 cfm
$\geq 80\%$	> 0 cfm	> 0 cfm

C403.2.11 & C408.2 Mechanical Systems Commissioning

HVAC Commissioning

- Required when
 - $\geq 480,000$ Btu/h cooling capacity, or
 - $\geq 600,000$ Btu/h heating capacity
- Requires:
 - **Notes on construction documents**
 - Commissioning plan
 - Systems adjusting and balancing
 - Functional performance testing
 - Equipment
 - Controls
- Preliminary commissioning report
- Final commissioning report
- Construction documents and O&M Manuals

Typically $\geq 20,000$ ft²

Prior to final mechanical and plumbing inspections

Registered design engineer or approved agency

Compliance Certification

COUNTY OF _____
[COUNTY'S ENERGY CODE NAME]

To the best of my knowledge, this project's design substantially conforms to the [CODE NAME] (2015 IECC as amended) for **mechanical systems** (Sections C403, C404 and C408).

COMPLIANCE METHOD

☐ 2015 IECC as amended: Mandatory & Prescriptive
☐ 2015 IECC as amended: Mandatory & Total Building Performance
☐ ASHRAE Standard 90.1-2013: Mandatory & Prescriptive
☐ ASHRAE Standard 90.1-2013: Mandatory & Energy Cost Budget

INFORMATION IN CONSTRUCTION DOCUMENTS

	Yes	N/A
HVAC Systems		
Equipment capacity and efficiency: C403.2.3	<input type="checkbox"/>	<input type="checkbox"/>
Thermostatic controls: C403.2.4	<input type="checkbox"/>	<input type="checkbox"/>
Guest room door switches: C403.2.4.2.4	<input type="checkbox"/>	<input type="checkbox"/>
Ventilation rate: C403.2.6	<input type="checkbox"/>	<input type="checkbox"/>
Demand control ventilation controls: C403.2.6.1	<input type="checkbox"/>	<input type="checkbox"/>
Enclosed parking garage ventilation control: C403.2.6.2	<input type="checkbox"/>	<input type="checkbox"/>
Energy recovery ventilation system: C403.2.7	<input type="checkbox"/>	<input type="checkbox"/>
Kitchen exhaust systems: C403.2.8	<input type="checkbox"/>	<input type="checkbox"/>
Duct and plenum insulation thickness/R-value: C403.2.9	<input type="checkbox"/>	<input type="checkbox"/>
Duct and plenum sealing requirements: C403.2.9	<input type="checkbox"/>	<input type="checkbox"/>
Pipe insulation thickness/R-value: C403.2.10	<input type="checkbox"/>	<input type="checkbox"/>
Fan motor horsepower: C403.2.12	<input type="checkbox"/>	<input type="checkbox"/>
Fan efficiency: C403.2.12	<input type="checkbox"/>	<input type="checkbox"/>
Fan motor efficiency: C405.8	<input type="checkbox"/>	<input type="checkbox"/>
Pump motor efficiency: C405.8	<input type="checkbox"/>	<input type="checkbox"/>
Variable-flow fan control: C403.4.1	<input type="checkbox"/>	<input type="checkbox"/>
Static pressure sensor location: C403.4.1.2	<input type="checkbox"/>	<input type="checkbox"/>
Static pressure reset control: C403.4.1.3	<input type="checkbox"/>	<input type="checkbox"/>
Chilled water variable flow control: C403.4.2.4	<input type="checkbox"/>	<input type="checkbox"/>
Chiller isolation: C403.4.2.6	<input type="checkbox"/>	<input type="checkbox"/>
Cooling tower fan control: C403.4.3	<input type="checkbox"/>	<input type="checkbox"/>
Terminal unit minimum and maximum airflow: C403.4.4	<input type="checkbox"/>	<input type="checkbox"/>
Commissioning requirements: C408.2	<input type="checkbox"/>	<input type="checkbox"/>
Refrigeration		
Refrigeration equipment efficiency: C403.2.14	<input type="checkbox"/>	<input type="checkbox"/>
Walk-in coolers and freezers: C403.2.15, C403.2.16 & C403.5	<input type="checkbox"/>	<input type="checkbox"/>
Refrigerated warehouses: C403.2.15 & C403.5	<input type="checkbox"/>	<input type="checkbox"/>
Refrigerated display cases: C403.2.17 & C403.5	<input type="checkbox"/>	<input type="checkbox"/>
Service Water Heating		
Heat recovery for service water heating: C403.4.5	<input type="checkbox"/>	<input type="checkbox"/>
Equipment capacity and efficiency: C404.2	<input type="checkbox"/>	<input type="checkbox"/>
Pipe insulation: C404.4	<input type="checkbox"/>	<input type="checkbox"/>
Hot water pipe length/volume: C404.5	<input type="checkbox"/>	<input type="checkbox"/>
Hot water circulation controls: C404.6	<input type="checkbox"/>	<input type="checkbox"/>
Heated pool and spa covers: C404.9.3	<input type="checkbox"/>	<input type="checkbox"/>
Commissioning requirements: C408.2	<input type="checkbox"/>	<input type="checkbox"/>

NOTES

SIGNATURE: _____
DATE: _____
NAME: _____
TITLE: _____
LICENSE NO.: _____

Section 10

Commercial – Elec. & Lighting

Electrical Power & Lighting

- Dwelling unit lighting
- **Lighting controls**
- Exit signs
- **Interior lighting power**
- **Exterior lighting**
- **Sub-metering**
- Transformers
- Motors
- Elevators and escalators

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C405.2.1 Occupant Sensor Controls

- Occupant sensors required
 - Classrooms/lecture/training rooms
 - Conference/meeting/multipurpose
 - Copy/print rooms
 - Lounges
 - Employee lunch and break rooms
 - Private offices
 - Restrooms
 - Storage rooms
 - Janitorial closets
 - Locker rooms
 - **Other spaces ≤ 300 ft² with floor-to-ceiling partitions**
 - Warehouses



Exceptions

- Security or emergency areas
- Exit stairways, ramps and passageways

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C405.2.2 Time-Switch Controls

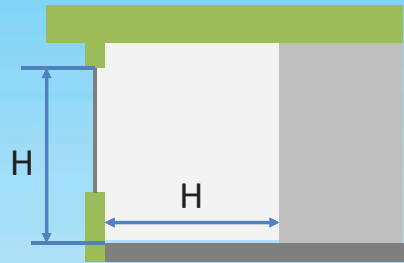
- Time-switch controls for each area without occupant sensor
 - Exceptions
 - Sleeping areas
 - Patient care
 - Safety or security
 - Lighting for continuous operation
 - Shop and laboratory classrooms
- Must have light reduction controls

C405.2.3 Daylight-responsive controls

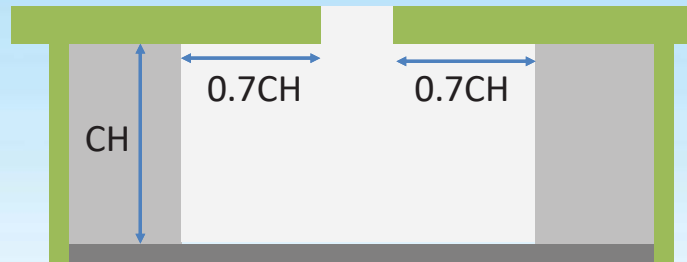
- Required in spaces with >150W of general lighting in:
 - Sidelight daylight zones
 - Toplight daylight zones
- Exceptions
 - Patient care
 - Dwelling units
 - Display and accent lighting
 - Display case lighting
 - First floor sidelight zone in A-2 and M occupancies



Sidelight
daylight
zone



Toplight
daylight
zone



More details in the code

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DBEDT
STATE OF HAWAII

HAWAII STATE
Energy Office

C405.2.4 Guest Room Master Control

- Applies to
 - Guest rooms and suites
 - Timeshare condos
- Auto shut off
 - Installed lights
 - Switched receptacles
 - < 20 minutes after guest leaves
- Key card system complies



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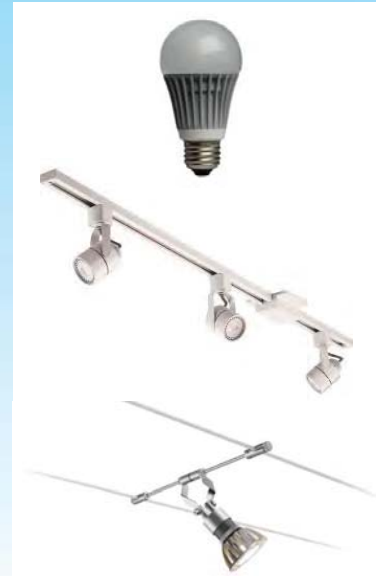


DBEDT
STATE OF HAWAII

HAWAII STATE
Energy Office

C405.4.1 Connected Lighting Power

- Includes
 - Screw-in lamps
 - Labeled max. luminaire power
 - Low-voltage lighting
 - Transformer rated power
 - Line-voltage tracks
 - $\geq 30\text{W/linear ft}$, or
 - Current-limiting device rating
 - Input power for all other luminaires



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Table C405.4.2(1) Interior Lighting Power Allowance

Building Area Method

TABLE C405.4.2(1)
INTERIOR LIGHTING POWER ALLOWANCES:
BUILDING AREA METHOD

BUILDING AREA TYPE	LPD (w/ft ²)		
Automotive facility	0.80	Motion picture theater	0.76
Convention center	1.01	Multifamily	0.51
Courthouse	1.01	Museum	1.02
Dining: bar lounge/leisure	1.01	Office	0.82
Dining: cafeteria/fast food	0.9	Parking garage	0.21
Dining: family	0.95	Penitentiary	0.81
Dormitory	0.57	Performing arts theater	1.39
Exercise center	0.84	Police station	0.87
Fire station	0.67	Post office	0.87
Gymnasium	0.94	Religious building	1.0
Health care clinic	0.90	Retail	1.26
Hospital	1.05	School/university	0.87
Hotel/Motel	0.87	Sports arena	0.91
Library	1.19	Town hall	0.89
Manufacturing facility	1.17	Transportation	0.70
		Warehouse	0.66
		Workshop	1.19

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Table C405.4.2(2)

Interior Lighting Power Allowance

Space-by-Space Method (partial)

TABLE C405.4.2(2)
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 per foot in total height
Greater than 40 feet in height	0.40 + 0.02 per foot in total height
Audience seating area	
In an auditorium	0.63
In a convention center	0.82
In a gymnasium	0.65
In a motion picture theater	1.14
In a penitentiary	0.28
In a performing arts theater	2.43
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	1.01
Breakroom (See Lounge/Breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	1.24

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HAWAII STATE
Energy Office

TABLE C405.4.2(2)
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Atrium	
Less than 40 feet in height	0.03 per foot in total height
Greater than 40 feet in height	0.40 + 0.02 per foot in total height
Audience seating area	
In an auditorium	0.63
In a convention center	0.82
In a gymnasium	0.65
In a motion picture theater	1.14
In a penitentiary	0.28
In a performing arts theater	2.43
In a religious building	1.53
In a sports arena	0.43
Otherwise	0.43
Banking activity area	1.01
Breakroom (See Lounge/Breakroom)	
Classroom/lecture hall/training room	
In a penitentiary	1.34
Otherwise	1.24
Conference/meeting/multipurpose room	1.23
Copy/print room	0.72
Corridor	
In a facility for the visually impaired (and not used primarily by the staff) ^b	0.92
In a hospital	0.79
In a manufacturing facility	0.41
Otherwise	0.66
Courtroom	1.72
Computer room	1.71
Dining area	
In a penitentiary	0.96
In a facility for the visually impaired (and not used primarily by the staff) ^b	1.9
In bar/lounge or leisure dining	1.07
In cafeteria or fast food dining	0.65
In family dining	0.89
Otherwise	0.65
Electrical/mechanical room	0.95
Emergency vehicle garage	0.56

TABLE C405.4.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES:
SPACE-BY-SPACE METHOD

COMMON SPACE TYPES ^a	LPD (watts/sq.ft)
Food preparation area	1.21
Guest room	0.47
Laboratory	
In or as a classroom	1.43
Otherwise	1.81
Laundry/washing area	0.6
Loading dock, interior	0.47
Lobby	
In a facility for the visually impaired (and not used primarily by the staff) ^b	1.8
For an elevator	0.64
In a hotel	1.06
In a motion picture theater	0.59
In a performing arts theater	2.0
Otherwise	0.9
Locker room	0.75
Lounge/breakroom	
In a healthcare facility	0.92
Otherwise	0.73
Office	
Enclosed	1.11
Open plan	0.98
Parking area, interior	0.19
Pharmacy area	1.68
Restroom	
In a facility for the visually impaired (and not used primarily by the staff) ^b	1.21
Otherwise	0.98
Sales area	1.59
Seating area, general	0.54
Stairway (See space containing stairway)	
Stairwell	0.69
Storage room	0.63
Vehicular maintenance area	0.67
Workshop	1.59
BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
Facility for the visually impaired ^b	
In a chapel (and not used primarily by the staff)	2.21
In a recreation room (and not used primarily by the staff)	2.41
Automotive (See Vehicular Maintenance Area above)	
Convention Center—exhibit space	1.45
Dormitory—living quarters	0.38
Fire Station—sleeping quarters	0.22
Gymnasium/fitness center	
In an exercise area	0.72
In a playing area	1.2

BUILDING TYPE SPECIFIC SPACE TYPES ^a	LPD (watts/sq.ft)
healthcare facility	
In an exam/treatment room	1.66
In an imaging room	1.51
In a medical supply room	0.74
In a nursery	0.88
In a nurse's station	0.71
In an operating room	2.48
In a patient room	0.62
In a physical therapy room	0.91
In a recovery room	1.15
Library	
In a reading area	1.06
In the stacks	1.71
Manufacturing facility	
In a detailed manufacturing area	1.29
In an equipment room	0.74
In an extra high bay area (greater than 50' floor-to-ceiling height)	1.05
In a high bay area (25-50' floor-to-ceiling height)	1.23
In a low bay area (less than 25' floor-to-ceiling height)	1.19
Museum	
In a general exhibition area	1.05
In a restoration room	1.02
Performing arts theater—dressing room	0.61
Post Office—Sorting Area	0.94
Religious buildings	
In a fellowship hall	0.64
In a worship/pulpit/choir area	1.53
Retail facilities	
In a dressing/fitting room	0.71
In a mall concourse	1.1
Sports arena—playing area	
For a Class I facility	3.68
For a Class II facility	2.4
For a Class III facility	1.8
For a Class IV facility	1.2
Transportation facility	
In a baggage/carousel area	0.53
In an airport concourse	0.36
At a terminal ticket counter	0.8
Warehouse—storage area	
For medium to bulky, palletized items	0.58
For smaller, hand-carried items	0.95

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply.

b. A "Facility for the Visually Impaired" is a facility that is licensed or will be licensed by local or state authorities for senior long-term care, adult daycare, senior support or people with special visual needs.

Small Commercial Example

Floor area 1,200 ft²
Office occupancy

What is the allowed
interior lighting power?

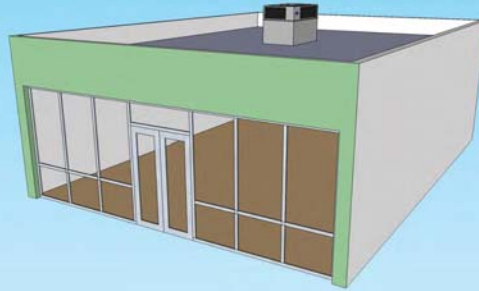
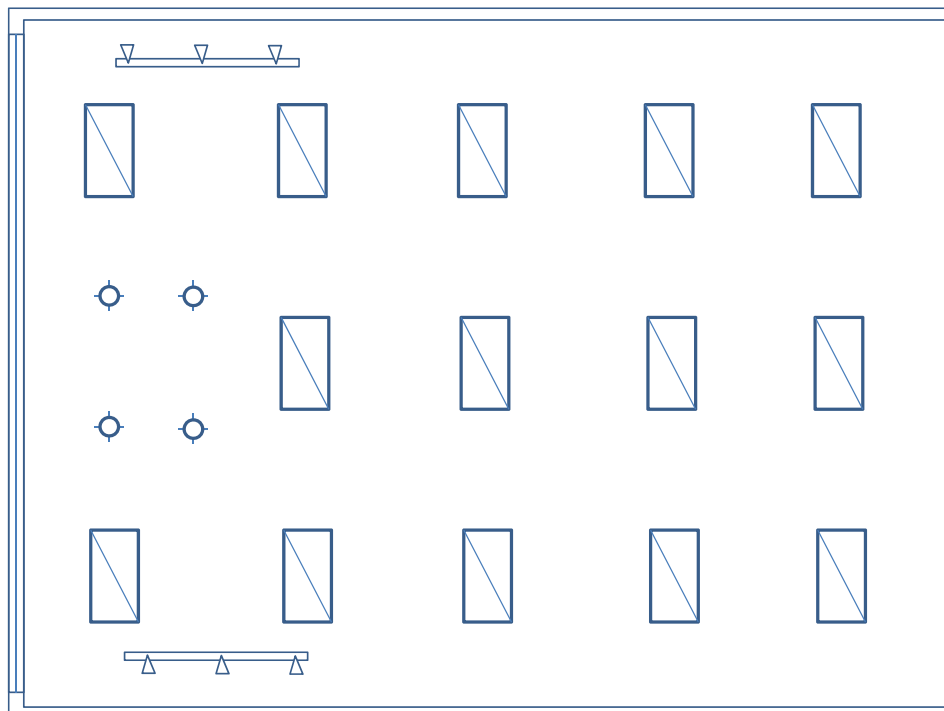


Table C405.4.2 Building Area Method Allowance
Office = 0.82 W/ft²

$$0.82 \text{ W/ft}^2 \times 1,200 \text{ ft}^2 = \mathbf{984 \text{ watts allowed}}$$

Small Commercial Example




What is the installed lighting power?



Small Commercial Example

What is the installed lighting power?

LUMINAIRE SCHEDULE

Symbol	Description	Input Power	Qty	Total Power
	2'x4', recessed LED troffer, 120V	45W	14	630W
	8-ft track, three 15W LED lamps, 120V	45W	2	90W
	LED downlight, 120V	26W	4	104W
Total				824W

Vs. 984 watts allowed

Complies?




C405.4.1 says, line voltage track lighting power counts for at least 30 W/ft

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Small Commercial Example

What is the installed lighting power?

LUMINAIRE SCHEDULE

Symbol	Description	Input Power	Qty	Total Power
	2'x4', recessed LED troffer, 120V	45W	14	630W
	8-ft track, three 15W LED lamps, 120V	45W 240W	2	90W 480W
	LED downlight, 120V	26W	4	104W
Total				824W 1214W

Vs. 984 watts allowed

Complies?

C405.4.1 says, line voltage track lighting power counts for at least 30 W/ft

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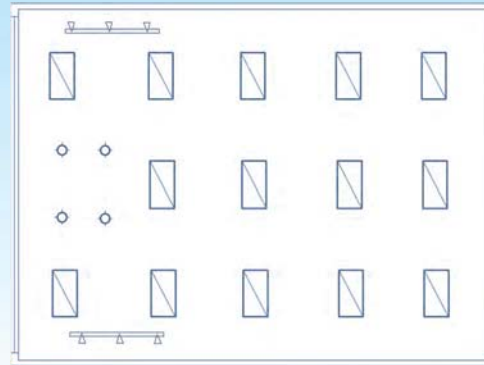
Small Commercial Example

Floor area 1,200 ft²
Office occupancy

What are the lighting
control requirements?



Occupancy sensors?
Time-switch?
Light-reduction?
Daylight responsive?
Display and accent?



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Small Commercial Example

Floor area 1,200 ft²
Office occupancy

What are the lighting
control requirements?

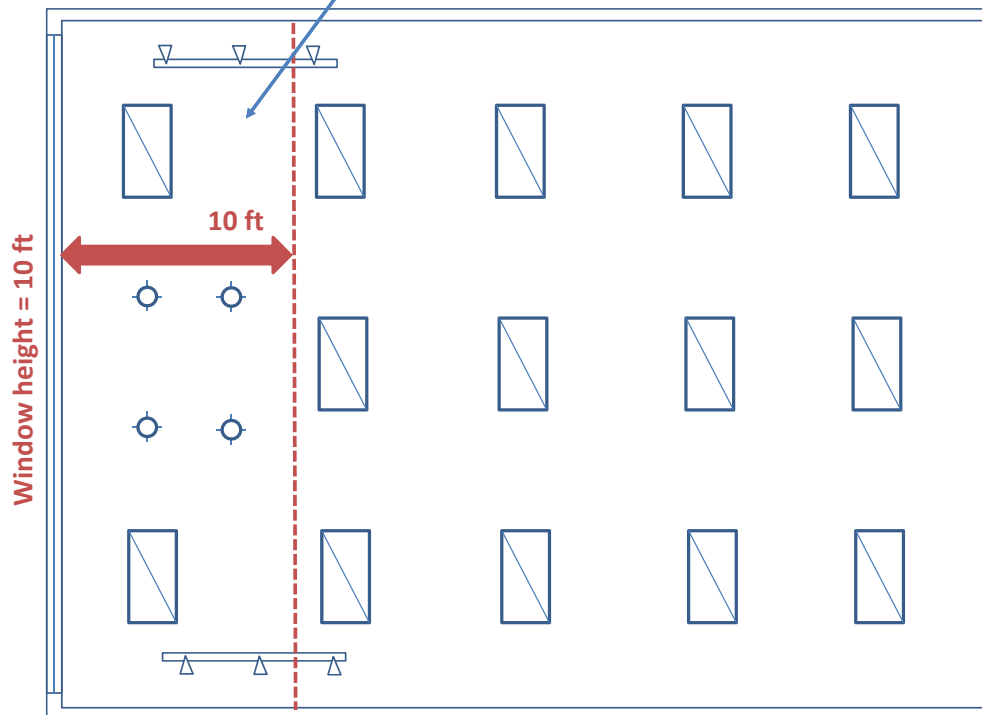


Occupancy sensors?	Not for this space type.
Time-switch?	Yes, but can use occupant sensor.
Light-reduction?	Not for this space type.
Daylight responsive?	Yes, >150W in sidelight zone.
Display and accent?	Yes, for track lighting.

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Small Commercial Example

Daylight responsive controls required
(exception for A-2 and M occupancy)



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C405.5 Exterior Lighting

Exterior lighting zones

1. Base site allowance
 2. Tradable surfaces
Sum allowance for all surfaces
 3. Nontradable surfaces
Each surface comply separately
- Some exceptions

TABLE C405.5.2(1)
EXTERIOR LIGHTING ZONES

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed-use areas
3	All other areas not classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

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C405.5

Exterior Lighting

1. Base site allowance

Zone 1	500 W
Zone 2	600 W
Zone 3	750 W
Zone 4	1300 W

2. Tradable surfaces

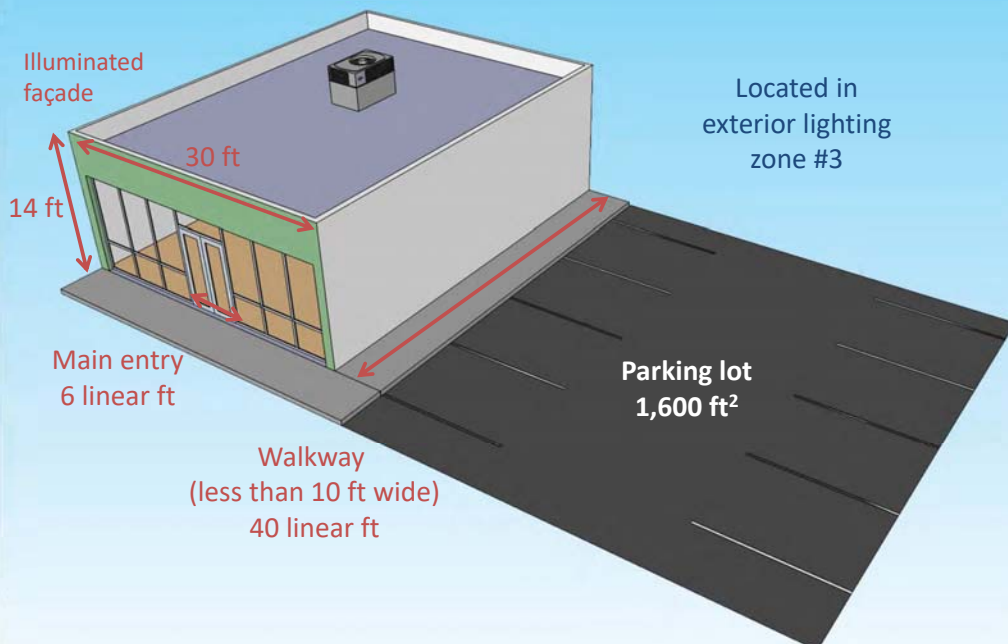
		LIGHTING ZONES			
		Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance (Base allowance is usable in tradable or nontradable surfaces.)		500 W	600 W	750 W	1300 W
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	Uncovered Parking Areas				
	Parking areas and drives	0.04 W/ft ²	0.06 W/ft ²	0.10 W/ft ²	0.13 W/ft ²
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater, plaza areas special feature areas	0.14 W/ft ²	0.14 W/ft ²	0.16 W/ft ²	0.2 W/ft ²
	Stairways	0.75 W/ft ²	1.0 W/ft ²	1.0 W/ft ²	1.0 W/ft ²
	Pedestrian tunnels	0.15 W/ft ²	0.15 W/ft ²	0.2 W/ft ²	0.3 W/ft ²
	Building Entrances and Exits				
	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width
	Entry canopies	0.25 W/ft ²	0.25 W/ft ²	0.4 W/ft ²	0.4 W/ft ²
	Sales Canopies				
	Free-standing and attached	0.6 W/ft ²	0.6 W/ft ²	0.8 W/ft ²	1.0 W/ft ²
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.25 W/ft ²	0.25 W/ft ²	0.5 W/ft ²	0.7 W/ft ²
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 W/linear foot	10 W/linear foot	30 W/linear foot

3. Nontradable surfaces

		LIGHTING ZONES			
		Zone 1	Zone 2	Zone 3	Zone 4
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	Building facades	No allowance	0.075 W/ft ² of gross above-grade wall area	0.113 W/ft ² of gross above-grade wall area	0.15 W/ft ² of gross above-grade wall area
	Automated teller machines (ATM) and night depositories	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	0.75 W/ft ² of covered and uncovered area	0.75 W/ft ² of covered and uncovered area	0.75 W/ft ² of covered and uncovered area	0.75 W/ft ² of covered and uncovered area
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area	0.5 W/ft ² of covered and uncovered area
	Drive-up windows/doors	400 W per drive-through	400 W per drive-through	400 W per drive-through	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry	800 W per main entry	800 W per main entry	800 W per main entry

Small Commercial Example

What is allowed exterior lighting power?



Small Commercial Example

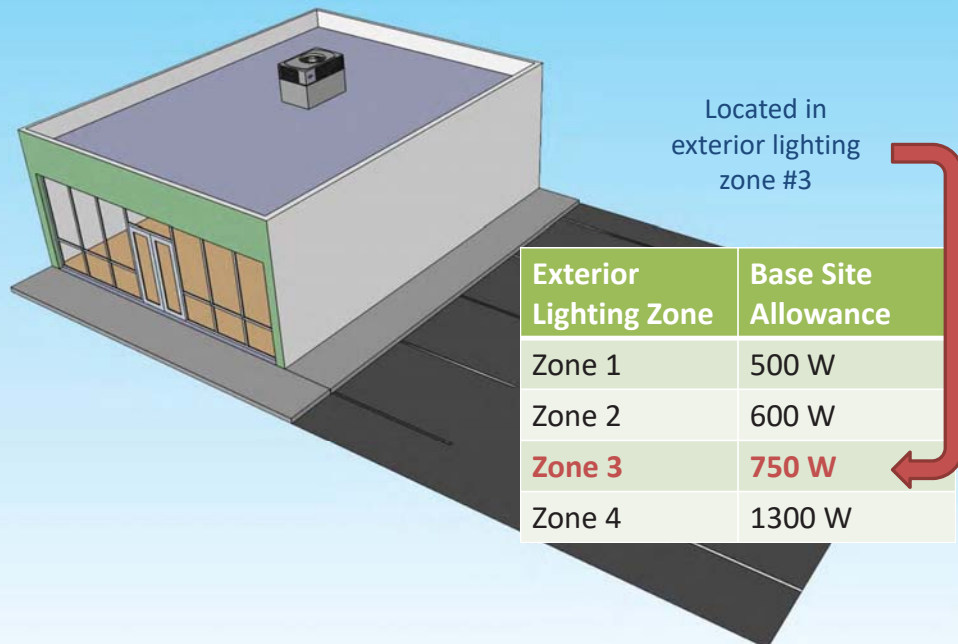
What is allowed exterior lighting power?



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Small Commercial Example

What is allowed exterior lighting power?



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Small Commercial Example

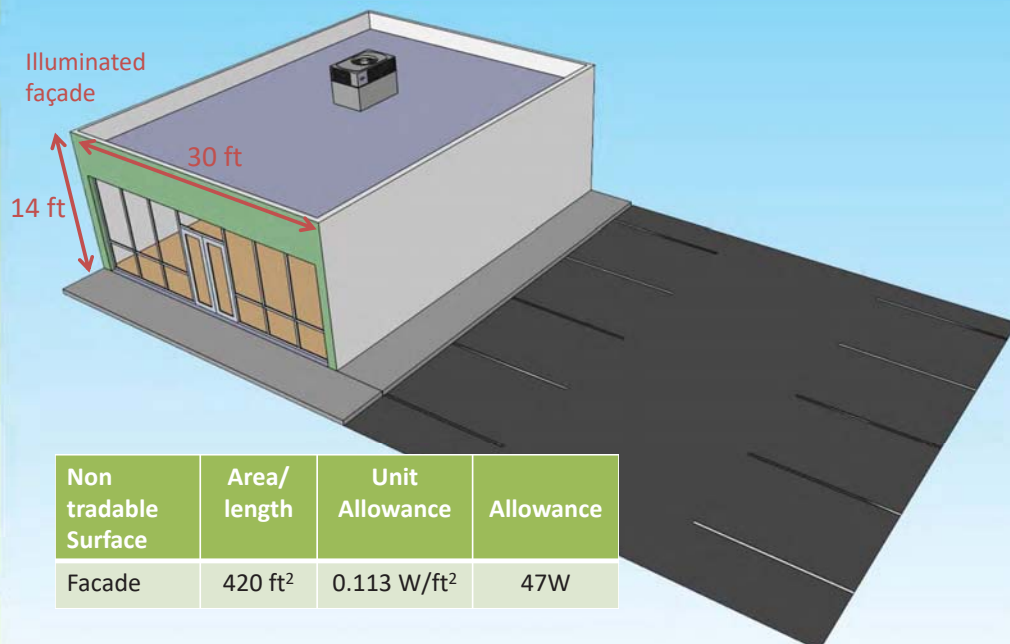
What is allowed exterior lighting power?



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Small Commercial Example

What is allowed exterior lighting power?



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C408.3

Lighting System Functional Testing

- Applies to:
 - Occupancy sensor controls
 - Time-switch controls
 - Daylight responsive controls
- Calibrated, adjusted, programmed and in proper working condition per the design and manufacturer's instructions
 - Prior to passing final inspection
 - Registered design professional provides evidence

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C405.10 Hawaii Specific

Sub-Metering

Metering for new buildings with tenants

1. Entire building, and
2. Each tenant occupying $\geq 1,000$ ft²

Tenants shall have access to data collected for their space



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Compliance Certification

COUNTY OF []		
[COUNTY'S ENERGY CODE NAME]		
To the best of my knowledge, this project's design substantially conforms to the [CODE NAME] (2015 IECC as amended) for electrical and lighting systems (Section C405 and C408).		
COMPLIANCE METHOD		
<input type="checkbox"/> 2015 IECC as amended. Mandatory & Prescriptive <input type="checkbox"/> 2015 IECC as amended. Mandatory & Total Building Performance <input type="checkbox"/> ASHRAE Standard 90.1-2013. Mandatory & Prescriptive <input type="checkbox"/> ASHRAE Standard 90.1-2013. Mandatory & Energy Cost Budget		
INFORMATION IN CONSTRUCTION DOCUMENTS	Yes	N/A
Interior Lighting		
Occupant sensor controls. C405.2.1	<input type="checkbox"/>	<input type="checkbox"/>
Time switch controls. C405.2.2	<input type="checkbox"/>	<input type="checkbox"/>
Daylight responsive controls. C405.2.3	<input type="checkbox"/>	<input type="checkbox"/>
Daylight zones on plans. C405.2.3.2 & C405.2.3.3	<input type="checkbox"/>	<input type="checkbox"/>
Guest room controls. C405.2.4	<input type="checkbox"/>	<input type="checkbox"/>
Interior lighting fixture schedule	<input type="checkbox"/>	<input type="checkbox"/>
Input power for interior lighting fixtures. C405.4.1	<input type="checkbox"/>	<input type="checkbox"/>
Interior lighting fixture locations	<input type="checkbox"/>	<input type="checkbox"/>
Lighting control functional performance testing requirement. C408.3	<input type="checkbox"/>	<input type="checkbox"/>
Exterior Lighting		
Exterior lighting controls. C405.2.5	<input type="checkbox"/>	<input type="checkbox"/>
Exterior lighting fixture schedule	<input type="checkbox"/>	<input type="checkbox"/>
Input power for exterior lighting fixtures	<input type="checkbox"/>	<input type="checkbox"/>
Exterior lighting fixture locations	<input type="checkbox"/>	<input type="checkbox"/>
Electrical		
Electrical transformer efficiency. C405.7	<input type="checkbox"/>	<input type="checkbox"/>
Tenant submetering. C405.10	<input type="checkbox"/>	<input type="checkbox"/>
NOTES		
SIGNATURE:		
DATE:		
NAME:		
TITLE:		
LICENSE NO.:		

KIUC Incentives

- Commercial incentives
 - 50%
 - High efficiency equipment retrofit
 - 80%
 - Incremental cost for high efficiency vs. standard efficiency
 - New construction
 - "end-of-life" equipment replacement
 - VFD installation (1st time)
 - 100% (G & J rates)
 - Energy efficient lamps

Projects must be submitted for consideration and eligibility testing prior to KIUC issuing an incentive agreement.

Visit www.kiuc.coop or call 246-4300 & ask for Energy Services

KIUC Incentives

- Residential incentives
 - Refrigerator, Washer, Freezer, Energy Star Window A/C (CEER >11.0)
= \$50 Rebate
 - Energy Star Ceiling Fan
= \$25 Rebate
 - Heat Pump Water Heater Installation
= \$300 Rebate
 - Solar Water Heater Installation
= \$1,000 Rebate or Zero Interest Loan

Visit www.kiuc.coop or call 246-4300 & ask for Energy Services



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Please fill out the evaluation forms

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For more information

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2015 IECC available:

- <http://iccsafe.org/publications>

State Energy Code Website:

- <http://energy.hawaii.gov/hawaii-energy-building-code/2015-iecc-update>

