

2018 IECC with Hawaii Amendments
Commercial and High-rise Residential Requirements

Webinar
May 19, 2021

Presentation Collaborators

HAWAII STATE Energy Office **AIA Honolulu** **ASHRAE Hawaii Chapter**

Hawai'i Energy **HAWAII** **BOMA HAWAII**

Section 1 Introduction & Scope



Section 2 Compliance



Section 3 Envelope



Section 4 Mechanical Systems

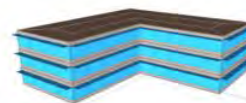


Section 5 Service Water Heating

Section 6 Electrical & Lighting



Section 7 Energy modeling for code compliance



Section 8 Existing Building Compliance

Section 9 Wrap Up

2018 IECC with Hawaii Amendments

Commercial and High-rise Residential Requirements

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AIA
Honolulu



HAWAII





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

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



COURSE DESCRIPTION

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



LEARNING OBJECTIVES

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

1. Identify applicable new requirements in the 2018 IECC, including Hawaii amendments
2. Determine commercial building envelope compliance.
3. Determine allowed interior and exterior lighting power
4. Use energy code checklists to review designs for compliance

Introductions

Presenters

- Howard Wiig, State Energy Office
- Ramsey Brown, Hawaii Energy
- Erik Kolderup, PE, Kolderup Consulting
- Austin Van Heusen, Green Building Hawaii

Acknowledgments

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

Topics

Hawaii Energy Programs

Introduction & Scope

Compliance

Envelope

Mechanical

Service Water Heating

Electrical & Lighting

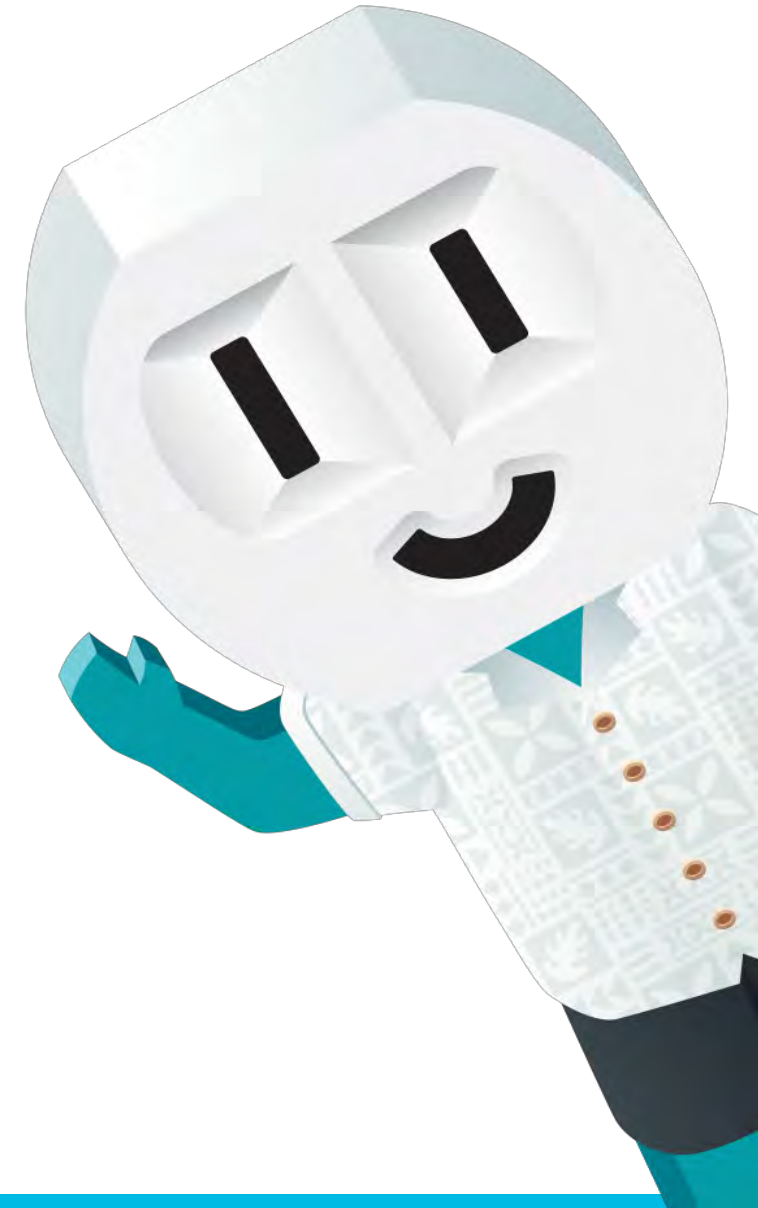
Energy Modeling for Code Compliance

Existing Building Compliance

Q&A

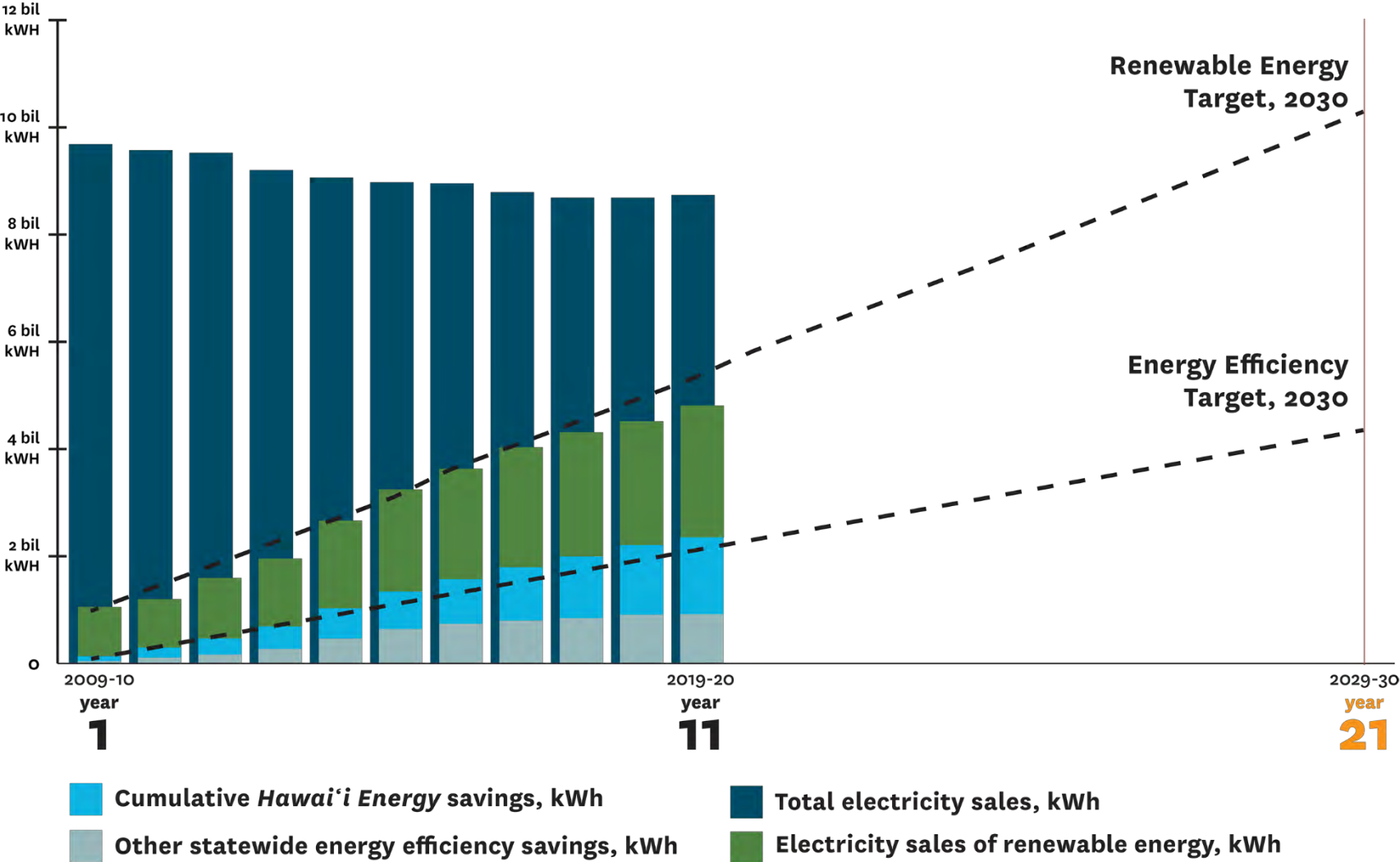
Hawaii Energy Incentives

NEW CONSTRUCTION & MAJOR RENOVATION



HAWAI'I CLEAN ENERGY INITIATIVE (HCEI)

Achieve 70% Clean Energy by 2030: 30% from Energy Efficiency, 40% from Renewable Energy
This 2030 goal is a milestone to achieving the 2045 HCEI target of 100% clean energy



New Construction & Major Renovation

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



Whether you're using energy modeling systems to plan energy-saving features during the conceptual stage or seeking support on specific products/equipment, Hawaii Energy is here to help guide you through creating a more sustainable and energy-efficient building.

For Questions

Contact our Energy Advisors:



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(808) 848-8521



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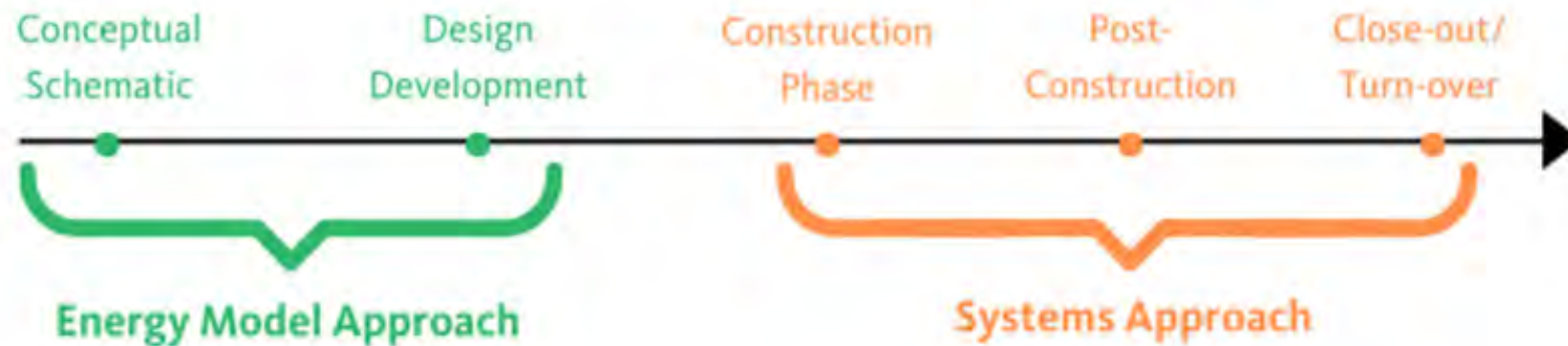


Graceson Ghen
Hawaii County
graceson.ghen@leidos.com
(808) 895-6713

<https://hawaiienergy.com/for-business/business-solutions/new-construction-major-renovation>



- ✦ Work with us as early as possible



Energy Model Approach (EMA) is an analysis during *the conceptual or schematic development stage* of the design.

Using this approach, our incentive is calculated and paid across three milestone stages: energy model, energy model report presentation, and post-construction.

Systems Approach (SA) is a method to identify and incorporate energy efficiency options during *the construction phase*.

Using this approach, Hawaii Energy will apply standard [prescriptive](#) and [custom rebates](#). Custom rebates are calculated at \$0.12/kWh based off energy savings and \$125/kW for demand reduction.

<https://hawaiienergy.com/for-businesses/business-solutions/new-construction-major-renovation>

Rebates

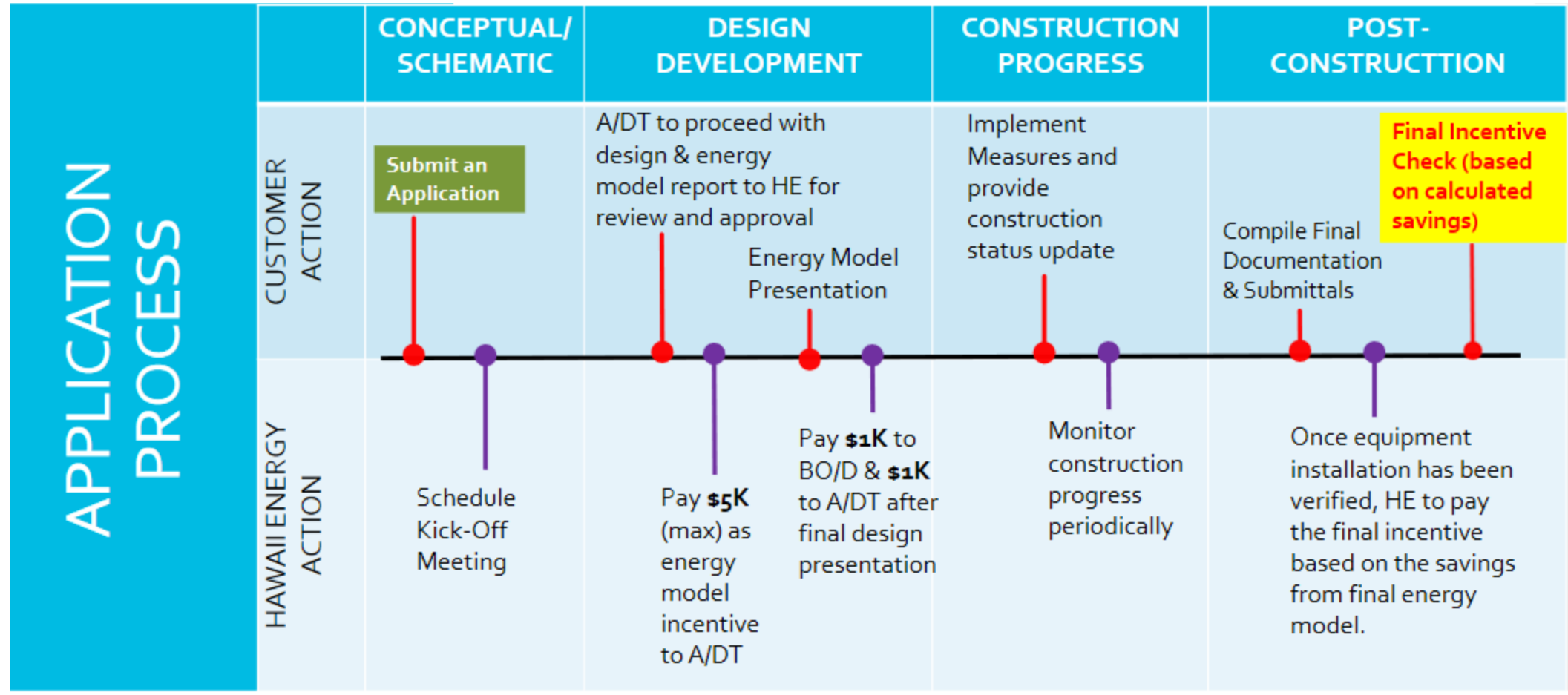
✦ Energy Model Approach

- Up to \$5,000 for energy model
- \$1,000 each for Owner and Design Team for presentation & collaboration on results
- Final incentive after completion based on updated model calculated savings

✦ Systems Approach

- Standard Hawai'i Energy prescriptive or custom rebates at time of application

Energy Model Approach (EMA)



INCENTIVES

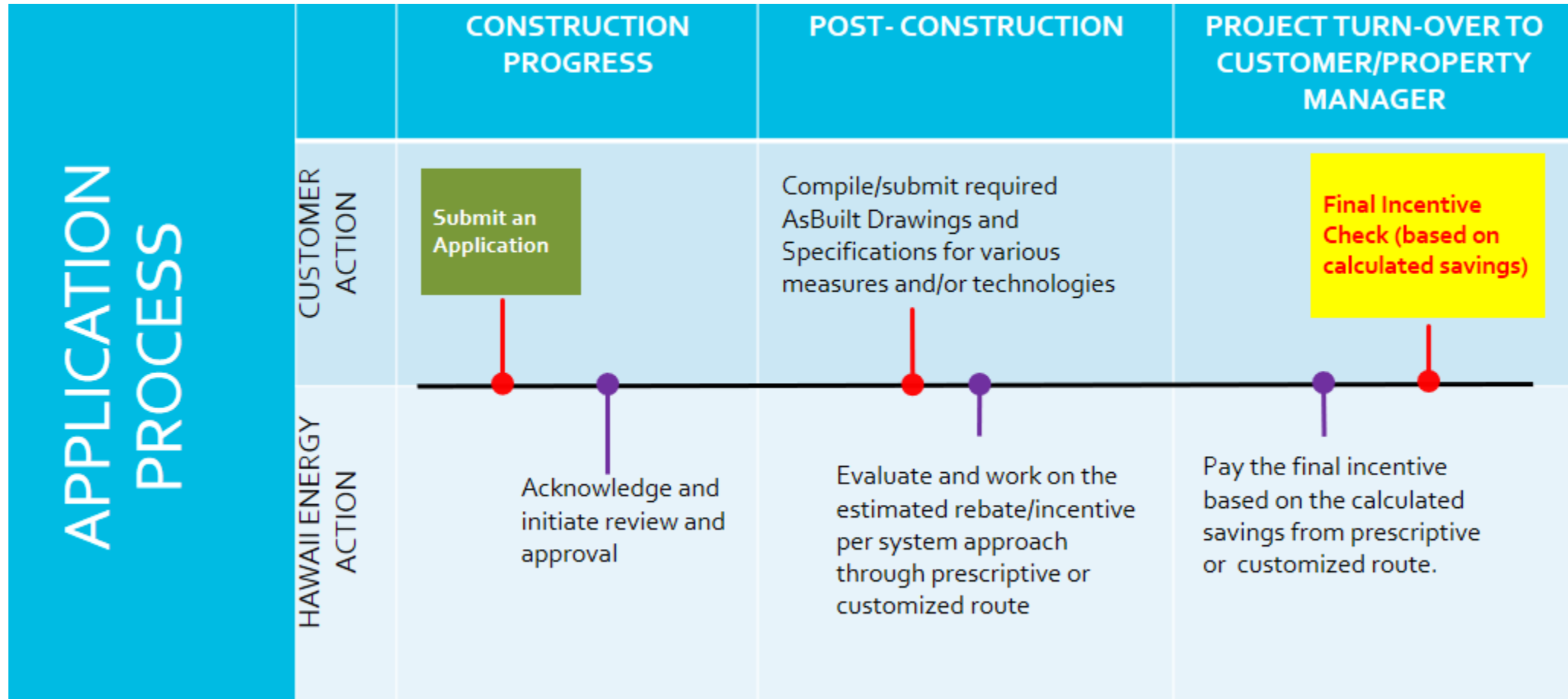


ENERGY MODEL APPROACH (EMA) INCENTIVES

Customer Incentive (BO/D) & (A/DT)	Energy Model Incentive Amount (\$)	Bonus Incentive Amount (\$)	Energy Savings Incentive Amount (\$)
Owners/ Developers (BO/D)		\$1,000 <i>for attending design team presentation</i>	\$0.12/kWh Maximum: \$150,000 <i>based off energy savings predicted by energy model</i>
Architects/ Design Team (A/DT)	Full cost of energy model <i>Up to \$5,000</i>	\$1,000 <i>for presenting energy model results to BO/D & Hawai'i Energy</i>	



Systems Approach (SA)



INCENTIVES

SYSTEMS APPROACH INCENTIVES

Customer Incentive (BO/D) & (A/DT)	Lighting Incentive Amount (\$)	HVAC Incentive Amount (\$)	Other Systems & Processes Incentive Amount (\$)
Either Owners/ Developers (BO/D) - or - Architects/ Design Team (A/DT)	Custom \$0.12/kWh based off lighting power density (LPD) difference between COMcheck® model and current allowable in energy code (2015 IECC)	Prescriptive straightforward calculated incentive or Custom \$0.12/kWh based off energy savings calculated in Hawai'i Energy's Commercial Custom worksheet	Custom \$0.12/kWh based off energy savings calculated in Hawai'i Energy's Commercial Custom worksheet





Mahalo!

Stay Connected

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

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

www.hawaiienergy.com



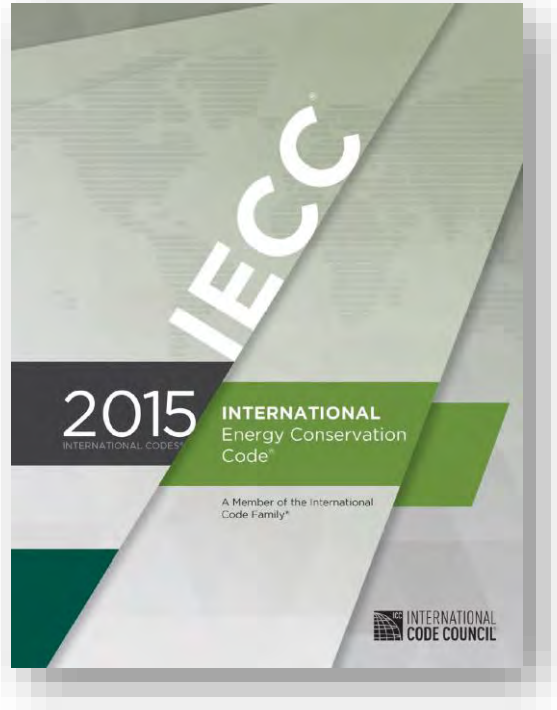
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Section 1

Introduction & Scope

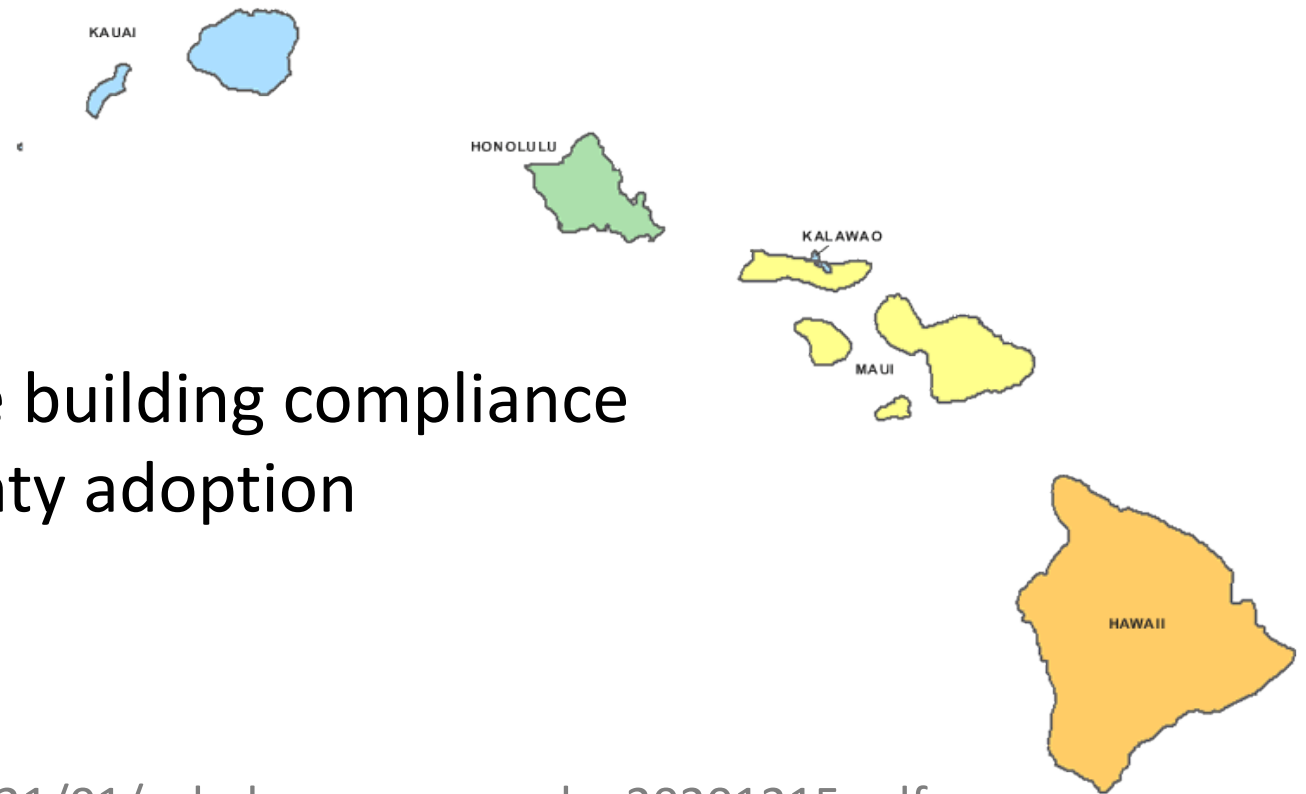


Adoption

Dec. 15, 2020 – State adoption

Dec. 15, 2021 – Deadline for State building compliance

Dec. 15, 2022 – Deadline for County adoption

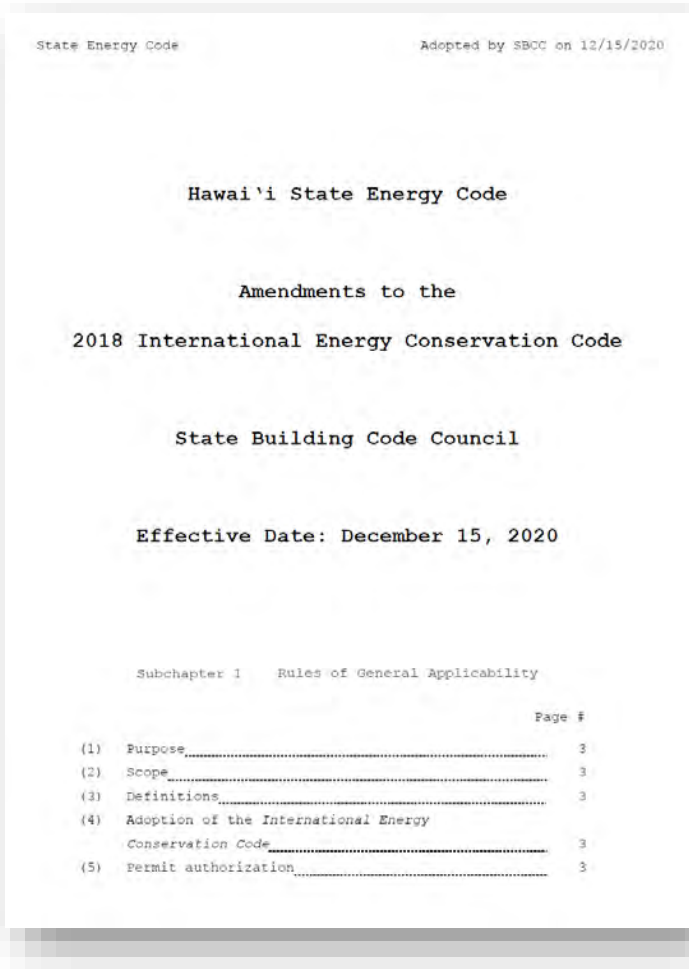
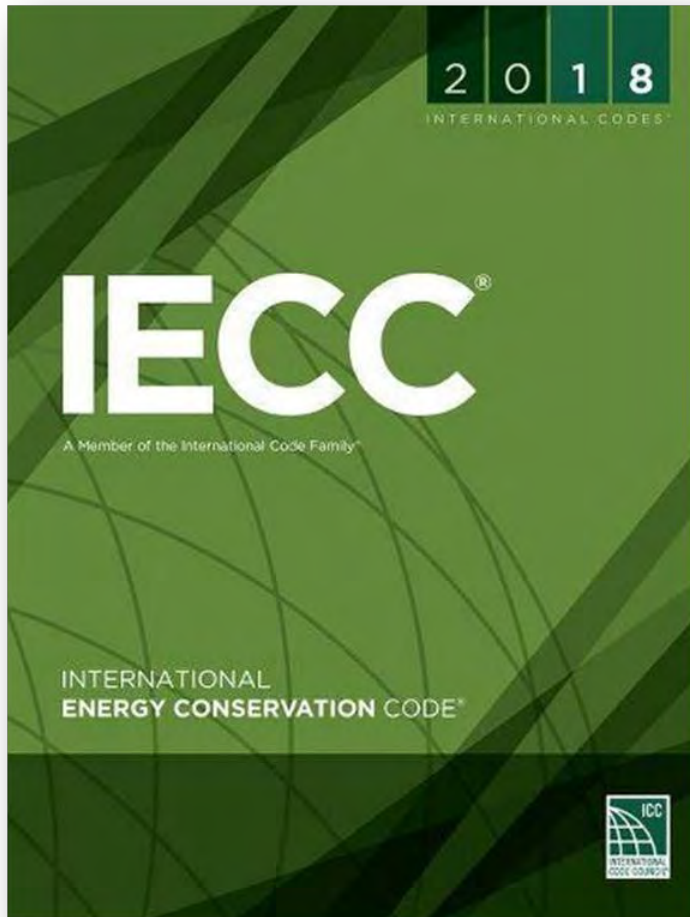


State amendments

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

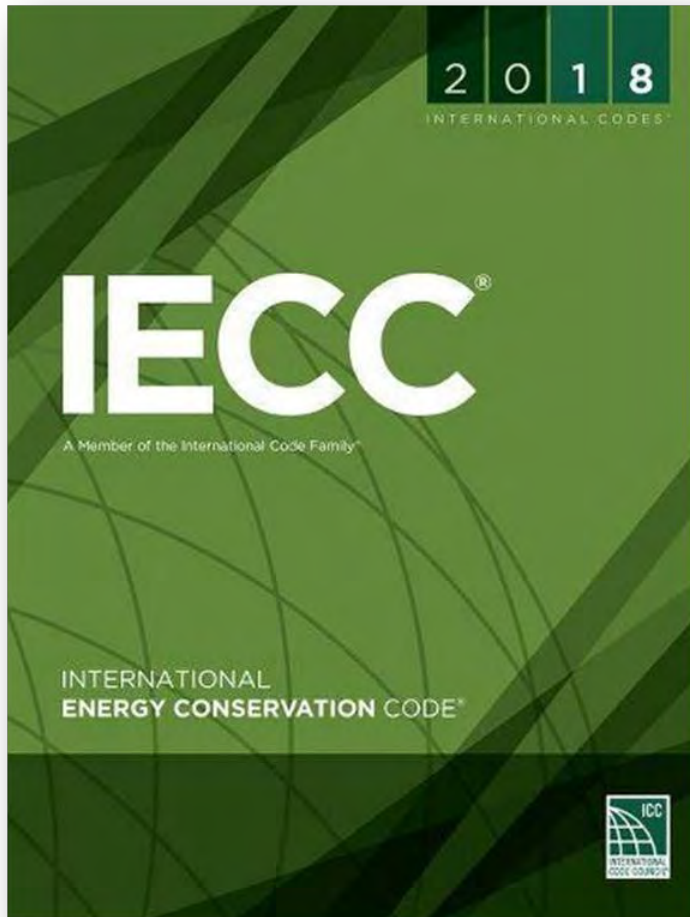
2018 IECC

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



State amendments
12 pages

County amendments



Commercial Provisions

Chapter 1 – Scope and Administration

Chapter 2 – Definitions

Chapter 3 – General Requirements

Chapter 4 – Commercial Energy Efficiency

Chapter 5 – Existing Buildings

Chapter 6 – References Standards

Residential Provisions

Chapter 1 – Scope and Administration

Chapter 2 – Definitions

Chapter 3 – General Requirements

Chapter 4 – Residential Energy Efficiency

Chapter 5 – Existing Buildings

Chapter 6 – References Standards

Scope

Residential

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



Courtesy Daniel Sandomire, Armstrong Builders

Commercial

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



Scope

Mixed use buildings

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



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

Scope

New construction ➡

Additions (C502)

Alterations (C503)

Change in space conditioning (C503.2)

Repairs (C504)

Change of occupancy (C505)

Applies to commercial buildings and the buildings' sites and associated systems and equipment.

Envelope

Mechanical systems

Service hot water

Electrical power and lighting systems

Scope

New construction

Additions (C502) ➡

Alterations (C503)

Change in space conditioning (C503.2)

Repairs (C504)

Change of occupancy (C505)

Options

1. New construction requirements for addition
2. Performance method for existing + addition

Vertical fenestration area

Skylight area

Building mechanical systems

Service water heating systems

Pools and inground permanently installed spas

Lighting power and systems

Scope

New construction

Additions (C502)

Alterations (C503) ➡

Change in space conditioning (C503.2)

Repairs (C504)

Change of occupancy (C505)

New construction requirements for altered portions

Several exceptions

Roof replacement (amendment)

1. New construction requirements
2. Initial solar reflectance $\geq 85\%$ + aged reflectance $\geq 63\%$
3. At least one of:
 1. EnergyStar compliant covering
 2. Radiant barrier
 3. Attic ventilation
 4. Exceptions in Section C402.3

Scope

New construction

Additions (C502)

Alterations (C503)

Change in space conditioning (C503.2) →

Repairs (C504)

Change of occupancy (C505)

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

Scope

New construction

Additions (C502)

Alterations (C503)

Change in space conditioning (C503.2)

Repairs (C504) ➡

Change of occupancy (C505)

Compliance not required

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

Scope

New construction

Additions (C502)

Alterations (C503)

Change in space conditioning (C503.2)

Repairs (C504)

Change of occupancy (C505) ➡

Compliance required

- When change in occupancy would result in an increase in demand for either fossil fuel or electrical energy
- Lighting power compliance where space type changes

What's changed vs. 2015?

2018 IECC vs. 2015 IECC

- Lower interior and exterior lighting power
- Dwelling unit lighting 90% high efficacy
- Garage doors with glazing U-factor requirement
- Max skylight area increased to 6% with daylighting controls
- Guestroom temperature and ventilation controls
- VAV box control
- Walk-in cooler and freezer efficiency requirements
- Water heater efficiencies
- Occupancy sensors for open office lighting
- Dwelling unit lighting control
- Voltage drop in feeders and branch circuits

- Performance method, solar energy credit limit
- Additional efficiency options added: increased envelope efficiency and reduced air leakage

Changes vs. 2015 State amendments

- Deleted from IECC (left to Counties)
 - Certification
 - Construction documents
- Envelope compliance for non-AC habitable spaces is dropped
- Mass wall insulation exceptions added
- Jalousie windows exempt
- Roof replacement alternatives updated

Resources

Checklists

Envelope

Mechanical

Service water heating

Lighting and electrical

Additional efficiency

Additions

Alterations

COMMERCIAL CHECKLIST 2018 IECC with State Amendments



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

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

SCOPE

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

COMMERCIAL COMPLIANCE OPTIONS

Prescriptive	Total Building Performance Alternative	ASHRAE Standard 90.1-2016
Separate requirements for envelope, mechanical systems, water heating systems, lighting and electrical systems. Also includes "additional efficiency" requirements.	Simulated energy performance analysis for heating, cooling, lighting and SHW. Proposed design must have annual energy cost less than or equal to energy cost of reference design.	Includes both prescriptive and performance compliance options.
See Prescriptive Checklist below	See code Section C407	See separate standard, available from www.ashrae.org

CHECKLIST CONTENTS

PAGE

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Mechanical system	5
Service water heating	9
Lighting and electrical	11
Additional efficiency	16
Additions	18
Alterations	20

Sponsor: State of Hawaii, Department of Business, Economic Development and Tourism

Acknowledgment: This material is based upon work supported by the Department of Energy under Award Number DE-EE0000811

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Resources

Checklists

Envelope

Mechanical

Service water heating

Lighting and electrical

Additional efficiency

Additions

Alterations

COMMERCIAL CHECKLIST 2018 IECC with State Amendments ENVELOPE REQUIREMENTS



Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
ENVELOPE REQUIREMENTS				
Roof – insulation above deck	<input type="checkbox"/> R-25 or U-0.039 (group R) <input type="checkbox"/> R-20 or U-0.048 (others) At least two insulation layers, with staggered edge joints	C402.1, C402.2.1	Typically foam board on the roof deck. If tapered, R-value in some areas can be lower than the requirement if designed to meet the weighted average U-factor.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Roof – metal building	R-19 + R-11 or U-0.044 (with thermal block and liner system)	C402.1, C402.2	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-5 foam block between purlins and metal roof deck.	<input type="checkbox"/> Insulation R-value on plans <input type="checkbox"/> Thermal block indicated on plans
Roof – attic or other	R-38 or U-0.027	C402.1, C402.2	This category includes attics, cathedral ceilings, and insulation installed under the roof deck. Insulation on top of suspended ceiling is not allowed for compliance.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Roof – skylight curbs	R-5 minimum	C402.2.1.1	Unit skylights with U-factor labeled per NFRC 100 do not need insulated curb	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Wall – mass (CMU or concrete)	R-5.7 or U-0.151 (Insulation not required with reflectance ≥ 0.64 , shading PF ≥ 0.3 or thickness ≥ 6 inches)*	C402.1, C402.2	Requires either exterior or interior insulation. CMU integral insulation does not comply. State amendment provides exceptions.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans
Wall – metal building	R-13 + R6.5 or U-0.079	C402.1, C402.2	Typically two layers of batt insulation. One installed horizontally between girts. The second layer draped outside the girts and compressed as the wall panel is installed.	<input type="checkbox"/> Insulation shown on plans <input type="checkbox"/> Insulation R-value on plans
Wall – metal frame	R-13 + R-5 or U-0.077 (R-5 not required with reflectance ≥ 0.64 or shading PF ≥ 0.3)*	C402.1, C402.2*	Insulation complies on its own with shading or high reflectance. State amendment provides exceptions.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans <input type="checkbox"/> Shading or wall reflectance shown (if exception is applied)
Wall – wood frame and other	R-13 + R3.8 or R-20 or U-0.064 (R-3.8 not required with reflectance ≥ 0.64 or shading PF ≥ 0.3)*	C402.1, C402.2*	2x4 requires cavity insulation plus continuous insulation (with exception for shading or high reflectance). 2x6 OK with R-20 cavity insulation. State amendment provides exceptions.	<input type="checkbox"/> Insulation location on plans <input type="checkbox"/> Insulation R-value on plans <input type="checkbox"/> Shading or wall reflectance shown (if exception is applied)

Red text = change vs. 2015

Asterisk = State amendment

Resources

Past training materials

[Home](#) » Hawaii Energy Building Code Training

HAWAII ENERGY BUILDING CODE TRAINING

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

[July 2020: Dueling UV Pulses: The Most Efficient Way of Zapping the COVID Virus?](#)

[June 2020. Honolulu Amendments to the 2015 International Energy Conservation Code](#)

[April 2020. Residential Requirements of the 2015 IECC with County Amendments](#)

[March 2020. Energy Modeling for 2015 IECC Compliance and Net Zero Design](#)

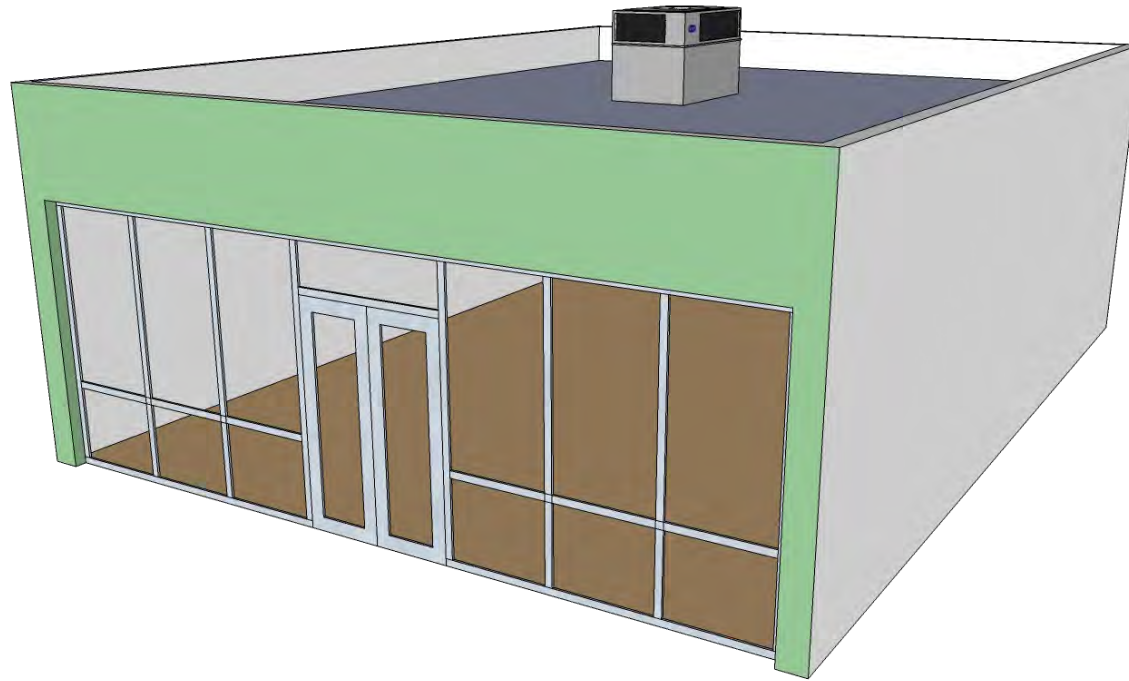
[August 2019. Training of Hawaii's 2015 IECC County Amendments and Envelope Design](#)

[April 2018. International Energy Conservation Code Training](#)

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

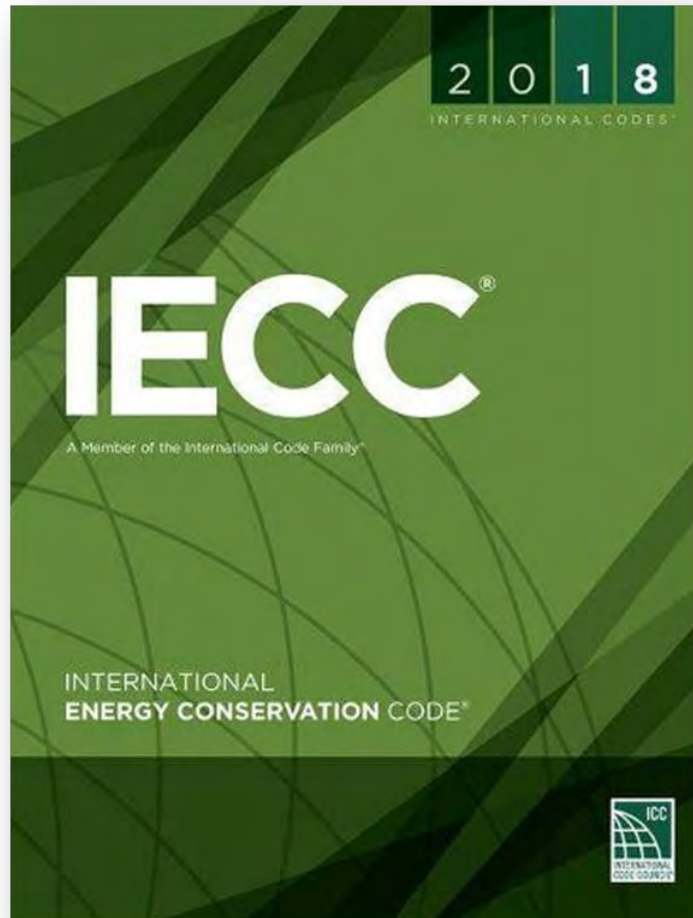
Section 2

Compliance



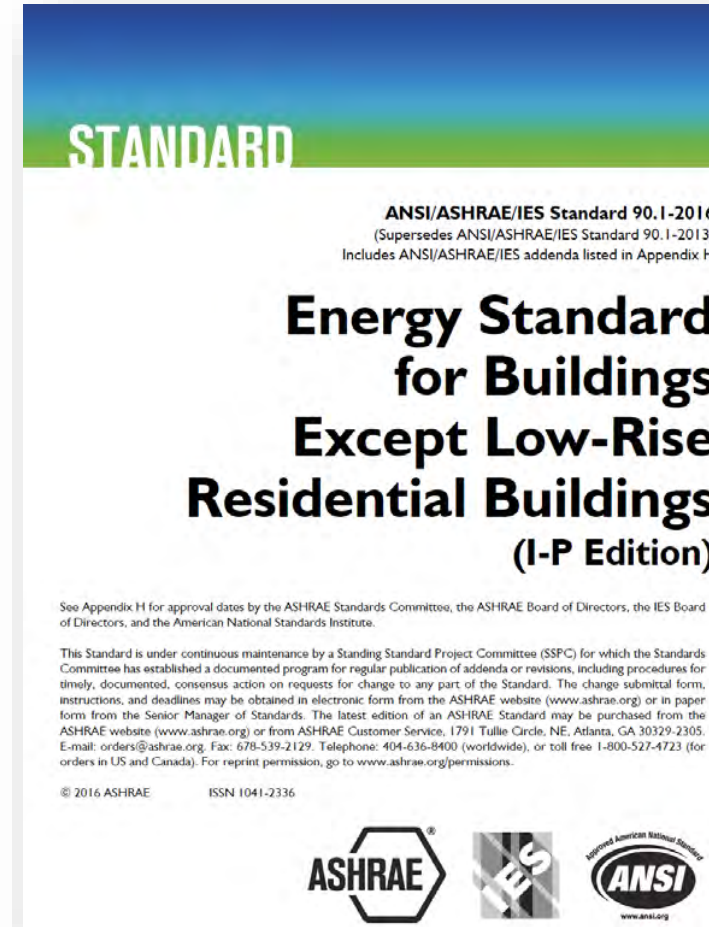
Commercial compliance

2018 IECC + amendments

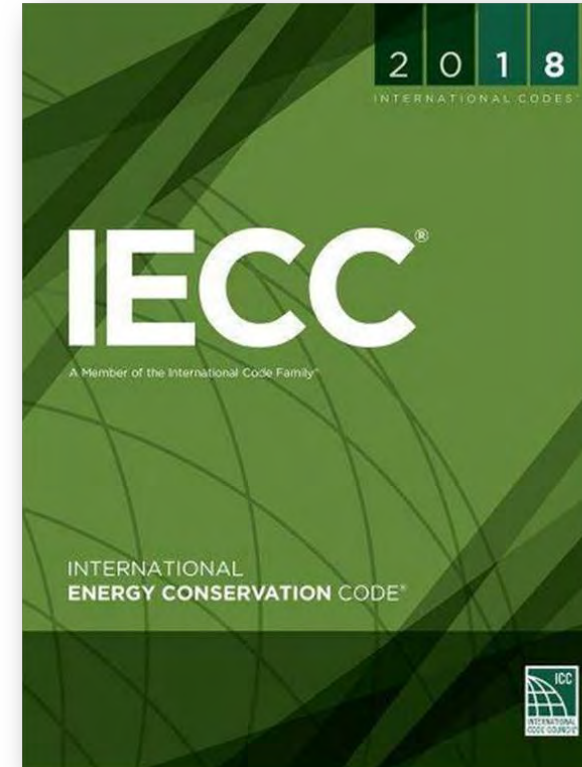
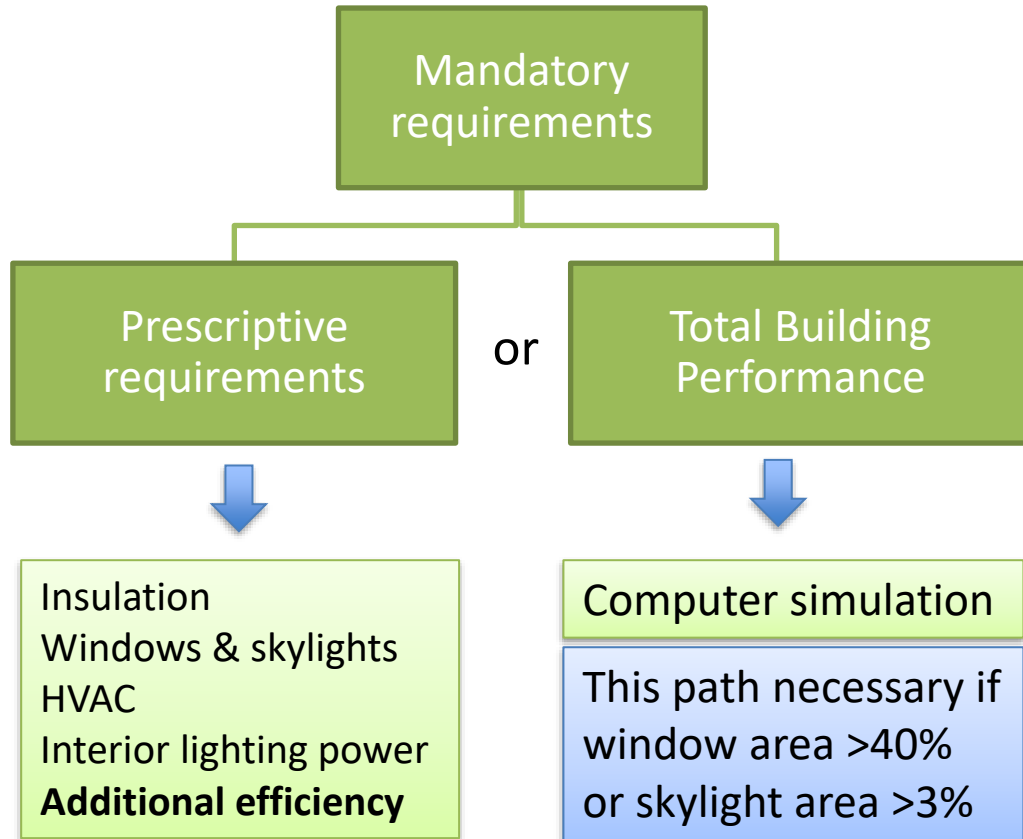


or

ASHRAE Standard 90.1-2016



Commercial compliance



Commercial compliance

Additional Efficiency Package Options (C406.1)

Buildings must comply with at least one additional efficiency feature:

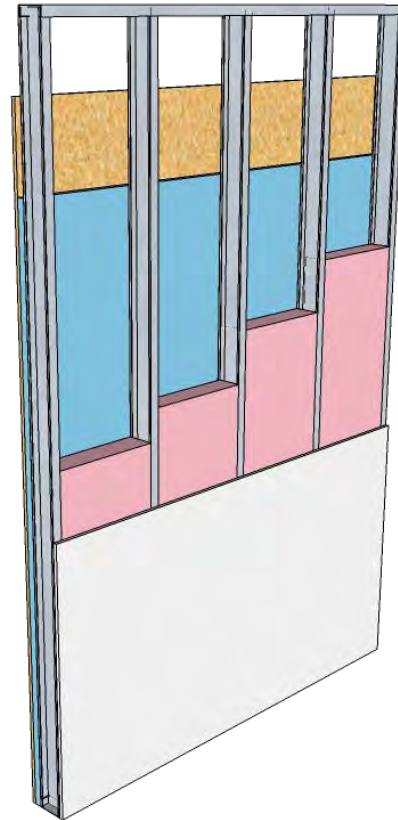
1. More efficient HVAC
2. Reduced lighting power density
3. Enhanced lighting controls
4. On-site renewable energy
5. Dedicated outdoor air system
6. High-efficiency SWH
7. Enhanced envelope performance
8. Reduced air infiltration

New in 2018



Section 3

Envelope



Envelope exemptions

C402.1.1 Low-energy buildings

Exempt from the envelope requirements (buildings or portions of buildings)

1. Peak design rate of energy usage $<3.4 \text{ Btu/hr-ft}^2$ for space conditioning
2. Those that do not include conditioned space
3. Greenhouses



2015 State amendments exempt unconditioned space only if it is not habitable space

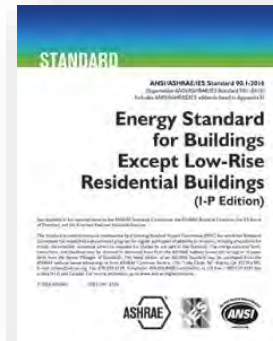
Envelope compliance options

1. Prescriptive requirements

- Roof and wall thermal performance
 - R-value, U-factor, or component performance alternative
- Roof solar reflectance and thermal emittance
- Windows and skylights
 - Maximum area
 - Maximum U-factor
 - Maximum solar heat gain coefficient (SHGC)
- Air leakage

2. Total Building Performance

3. ASHRAE Standard 90.1-2016



CLIMATE ZONE	1	
	All other	Group R
Insulation entirely above roof deck	R-20ci	R-25ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38
Mass ^g	R-5.7ci ^c	R-5.7ci ^c
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-3.8ci or R-20	R-13 + R-3.8ci or R-20
Below-grade wall ^d	NR	NR
Mass ^e	NR	NR
Joist/framing	NR	NR
Unheated slabs	NR	NR
Heated slabs ^h	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab
Nonswinging	R-4.75	R-4.75

Envelope prescriptive requirements

Roof insulation (Table C402.1.3)

	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

ci = continuous insulation
LS = layer system

Roof U-factor (Table C402.1.4)

	Type	Min. Insulation	
		Group R	Other
Roof	Insulation entirely above deck	U-0.039	U-0.048
	Metal building	U-0.035	U-0.035
	Attic and other	U-0.027	U-0.027



Envelope prescriptive requirements

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



New for 2018

At least two insulation layers,
with staggered edge joints
(C402.2.1)

Envelope prescriptive requirements

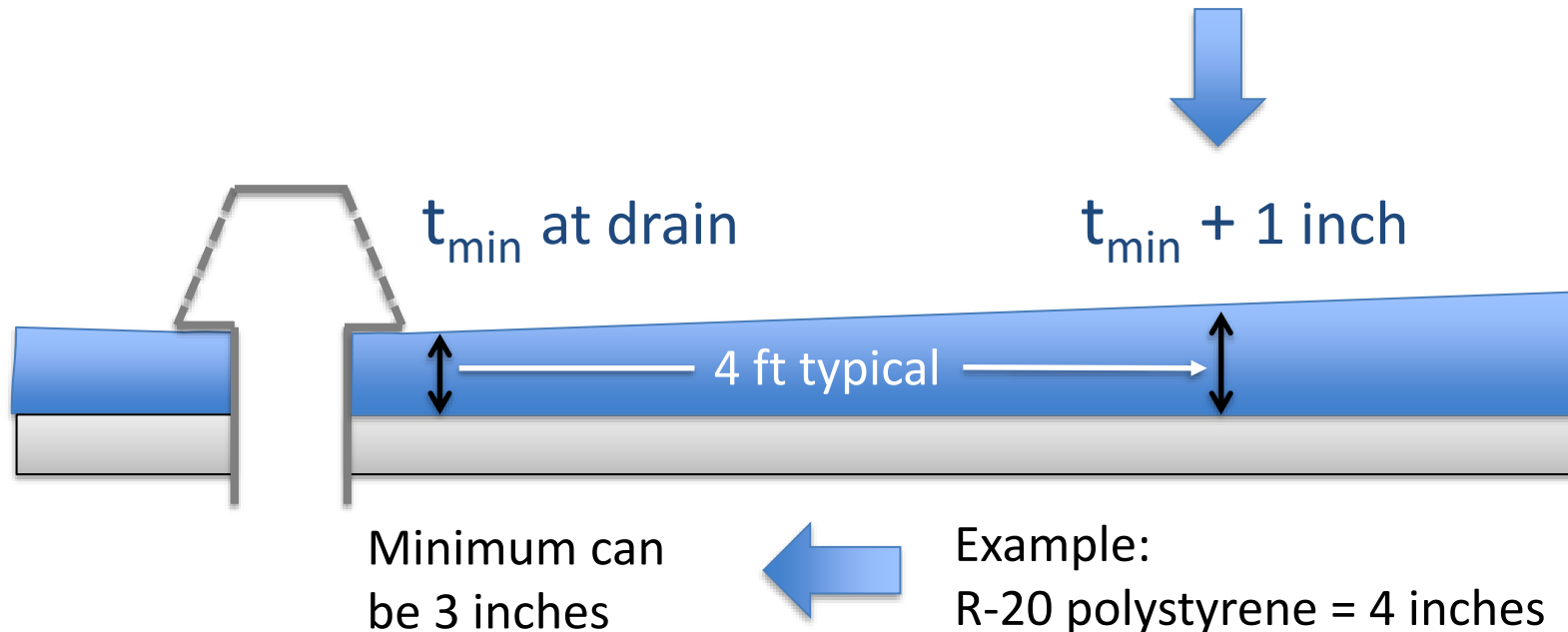
**Roof Insulation
Entirely Above Deck**

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

**Tapered insulation
exception
(C402.2.2)**

Meet minimum R-value here

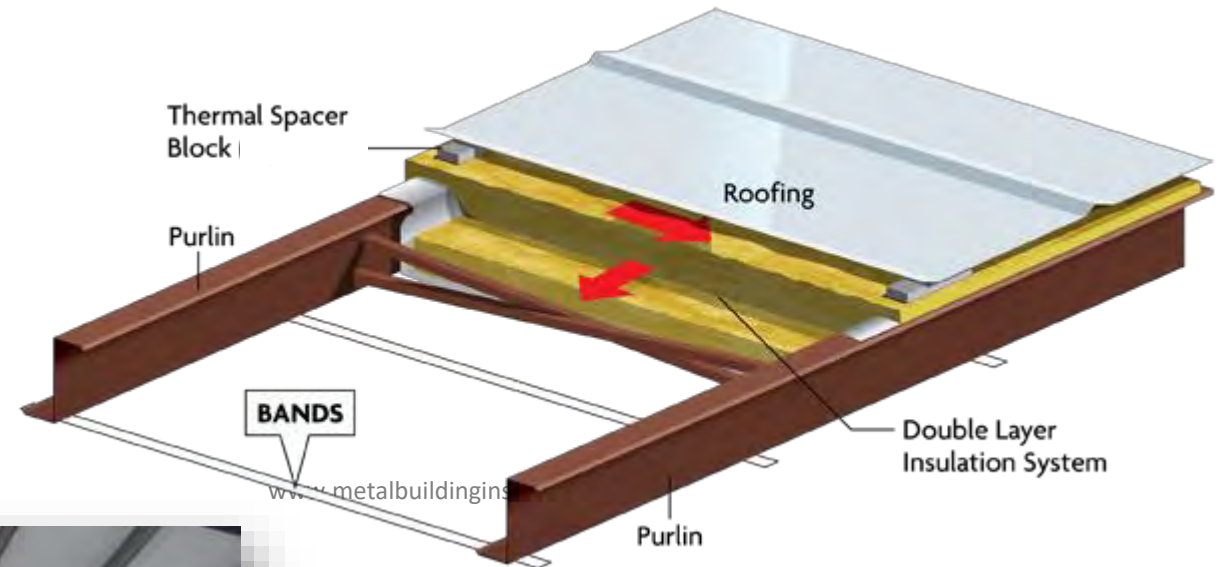
- R-25 for group R buildings
- R-20 for other buildings



Envelope prescriptive requirements

Roof Insulation Metal Building

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



Source: <http://armstrongsteel.com>

Envelope prescriptive requirements

Roof Insulation Below Deck “Attic and Other”

R-38 for all buildings
(12 inch thickness)

Or U-factor ≤ 0.027



Source: www.energycodes.gov



Envelope prescriptive requirements

Roof solar reflectance and thermal emittance (C402.3)

Cool roof required for low-slope roofs

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

Typical products

- Single-ply membrane
- Liquid applied

3-year aged values

Low slope < 2-in-12

Some exceptions



Envelope prescriptive requirements

Wall insulation (Table C402.1.3)

State amendment

	Type	Min. Insulation
Walls	Mass	R-5.7ci
	Metal building	R-13 + R-6.5ci
	Metal framed	R-13+ R-5ci
	Wood framed and other	R-13+ R-3.8ci R-20

R-0 alone with:

- Reflectance ≥ 0.64 , or
- Overhang PF ≥ 0.3
- Thickness ≥ 6 in.

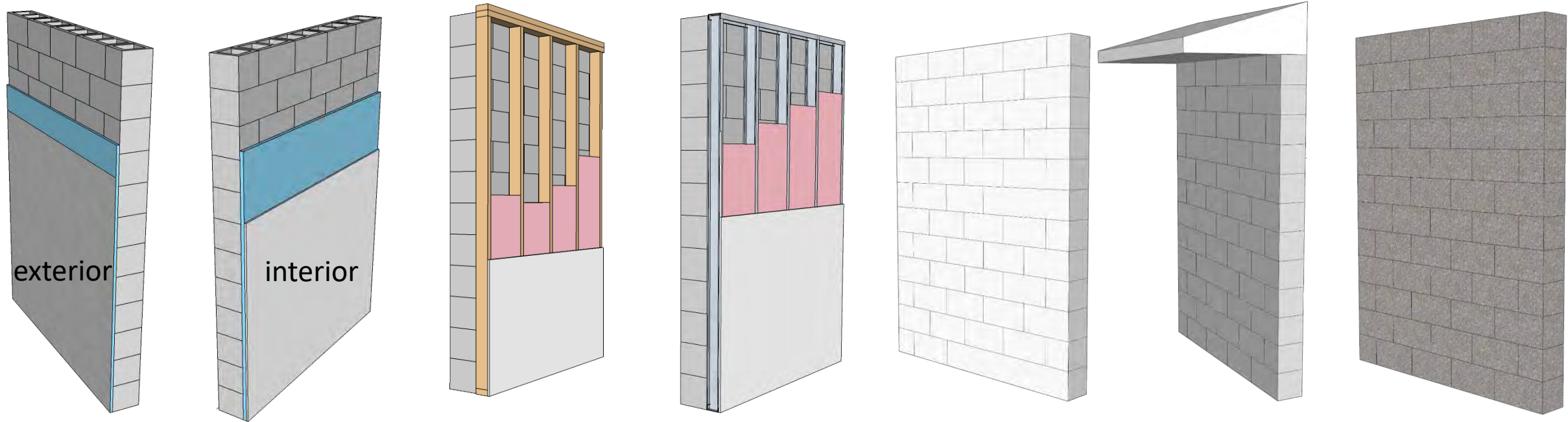
R-13 alone with:

- Reflectance ≥ 0.64 , or
- Overhang PF ≥ 0.3

ci = continuous insulation

Envelope prescriptive requirements

Commercial mass wall options



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

Reflectance
 ≥ 0.64

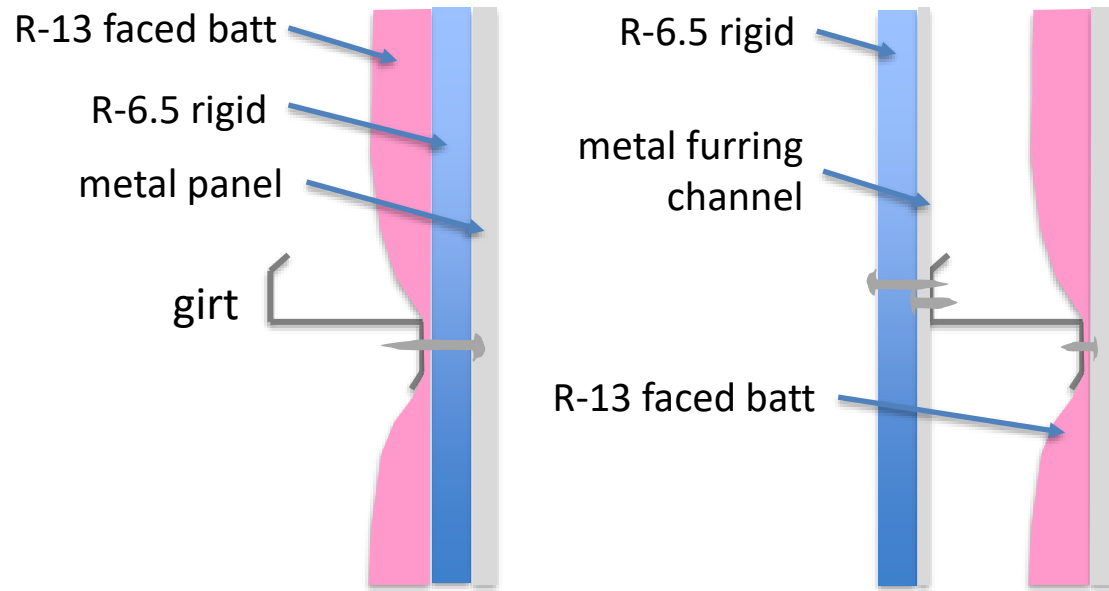
Overhang PF
 ≥ 0.3

Thickness
 ≥ 6 inches

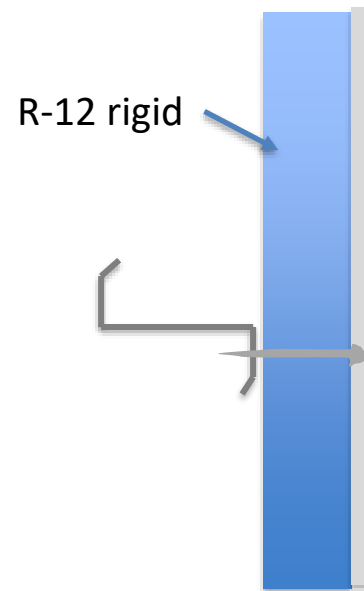
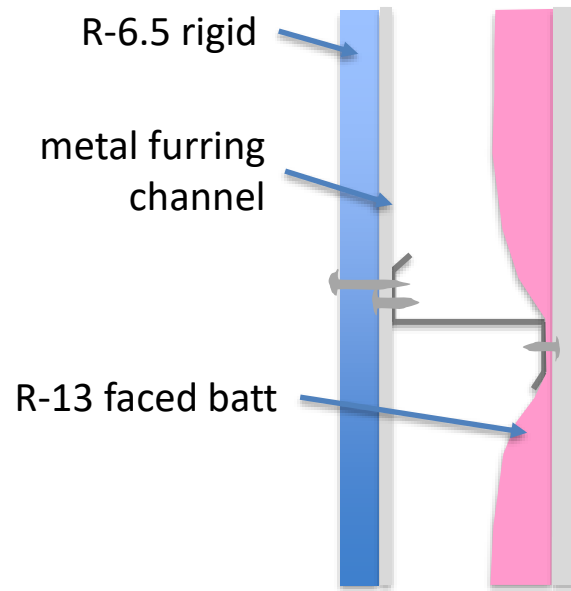
State amendment

Envelope prescriptive requirements

Commercial metal-building wall options



R-13 + R-6.5 continuous



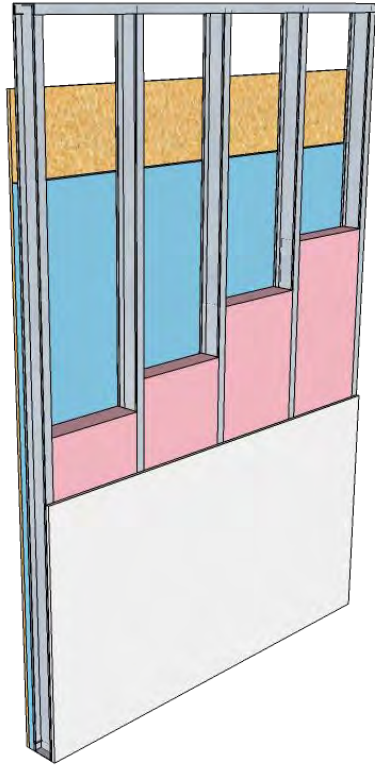
R-12 continuous



Source: <http://armstrongsteel.com>

Envelope prescriptive requirements

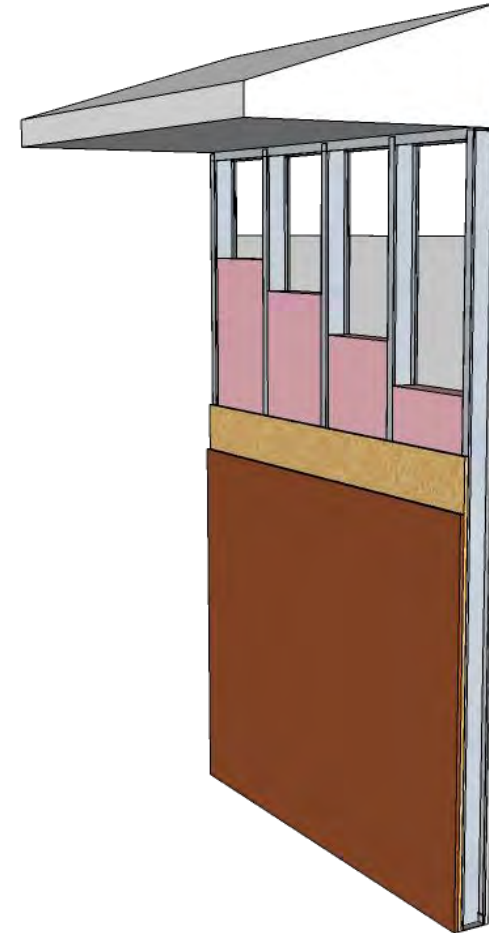
Commercial metal-framed wall options



R-13 + R-5 continuous



R-13+ Reflectance ≥ 0.64



R-13 + Overhang PF ≥ 0.3

State amendment

Impact of Steel Framing

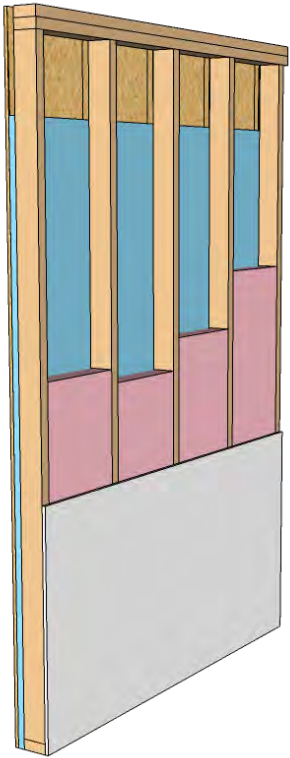
TABLE C402.1.4.1
EFFECTIVE R -VALUES FOR STEEL STUD WALL ASSEMBLIES

NOMINAL STUD DEPTH (inches)	SPACING OF FRAMING (inches)	CAVITY R -VALUE (insulation)	CORRECTION FACTOR (F_c)	EFFECTIVE R -VALUE (ER) (Cavity R -Value $\times F_c$)
3½	16	13	0.46	5.98
		15	0.43	6.45
3½	24	13	0.55	7.15
		15	0.52	7.80
6	16	19	0.37	7.03
		21	0.35	7.35
6	24	19	0.45	8.55
		21	0.43	9.03
8	16	25	0.31	7.75
	24	25	0.38	9.50

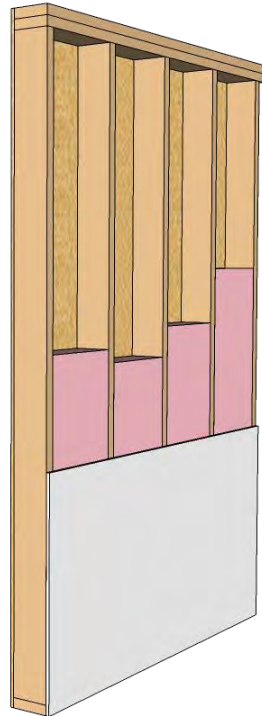
R-19 in 2x6
@ 16 in. o.c.
↓
Effective R-7.03

Envelope prescriptive requirements

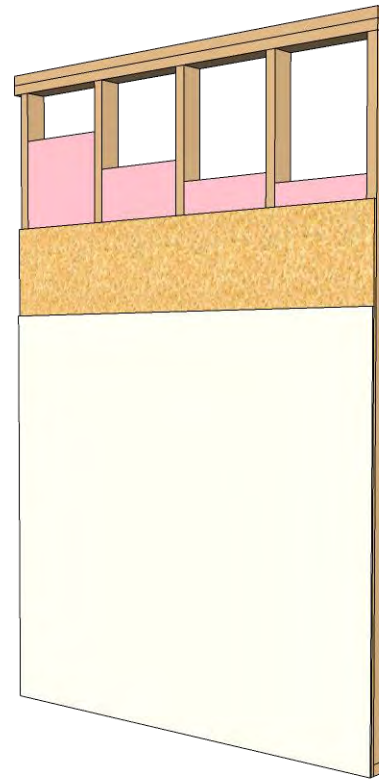
Commercial wood-framed wall options



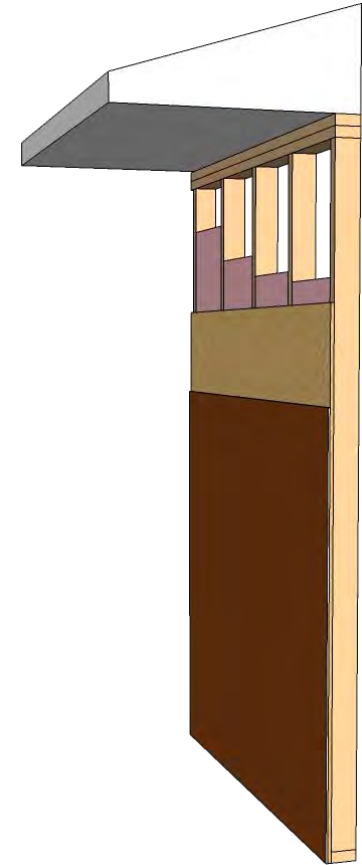
**R-13 +
R-3.8 continuous**



R-20



**R-13 +
Reflectance ≥ 0.64**



**R-13 +
Overhang PF ≥ 0.3**

State amendment

Envelope prescriptive requirements

Component performance alternative (C402.1.5)

- Tradeoff calculation for roof and walls
- Opaque envelope thermal performance

$$A + B + C + D + E \leq \text{Zero}$$

where:

A = Sum of the (UA Dif) values for each distinct assembly type of the building thermal envelope, other than slabs on grade and below-grade walls.

UA Dif = UA Proposed - UA Table.

UA Proposed = Proposed U-value \times Area.

UA Table = (U-factor from [Table C402.1.3](#), [C402.1.4](#) or [C402.4](#) \times Area).

B = Sum of the (FL Dif) values for each distinct slab-on-grade perimeter condition of the building thermal envelope.

FL Dif = FL Proposed - FL Table.

FL Proposed = Proposed F-value \times Perimeter length.

FL Table = (F-factor specified in [Table C402.1.4](#)) \times Perimeter length.

C = Sum of the (CA Dif) values for each distinct below-grade wall assembly type of the building thermal envelope.

CA Dif = CA Proposed - CA Table.

CA Proposed = Proposed C-value \times Area.

CA Table = (Maximum allowable C-factor specified in [Table C402.1.4](#)) \times Area.

Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by [Section C402.4.1](#), the value of D (Excess Vertical Glazing Value) shall be zero. Otherwise:

D = (DA \times UV) - (DA \times U Wall), but not less than zero.

DA = (Proposed Vertical Glazing Area) - (Vertical Glazing Area allowed by [Section C402.4.1](#)).

UA Wall = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.

U Wall = Area-weighted average U-value of all above-grade wall assemblies.

UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.

UV = UAV/total vertical glazing area.

Where the proposed skylight area is less than or equal to the skylight area allowed by [Section C402.4.1](#), the value of E (Excess Skylight Value) shall be zero. Otherwise:

E = (EA \times US) - (EA \times U Roof), but not less than zero.

EA = (Proposed Skylight Area) - (Allowable Skylight Area as specified in [Section C402.4.1](#)).

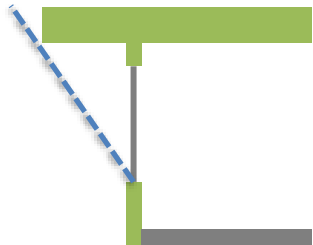
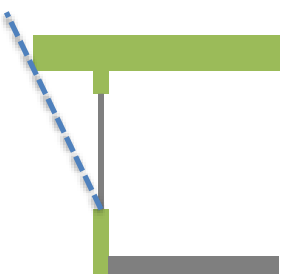
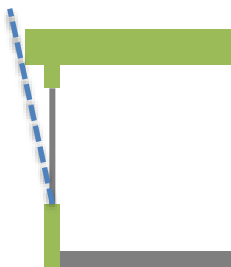
U Roof = Area-weighted average U-value of all roof assemblies.

UAS = Sum of the (UA Proposed) values for each skylight assembly.

US = UAS/total skylight area.

Envelope prescriptive requirements

Window maximum solar heat gain coefficient (SHGC) (C402.4)

	Large overhang 	Medium overhang 	Small overhang 
	$PF \geq 0.5$	$0.20 \leq PF < 0.50$	$PF < 0.20$
E/S/W	0.40	0.30	0.25
North	0.40	0.37	0.33

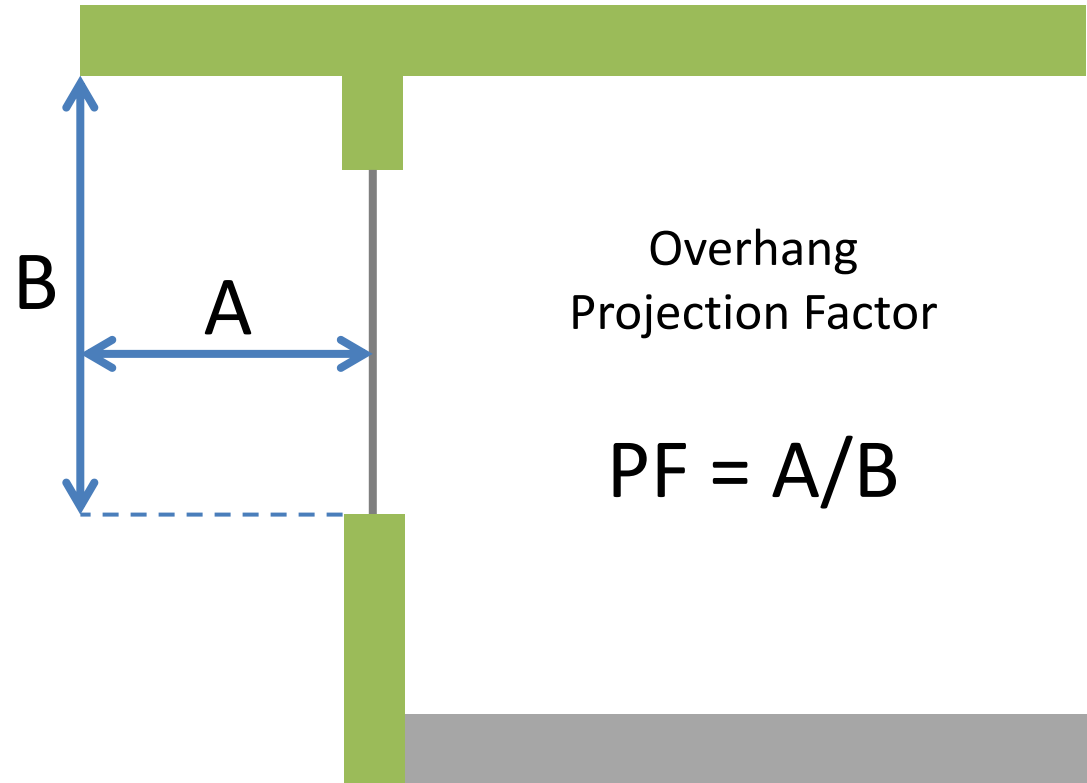
Area-weighted average SHGC allowed by Hawaii amendment

State amendment

Jalousie windows exempt



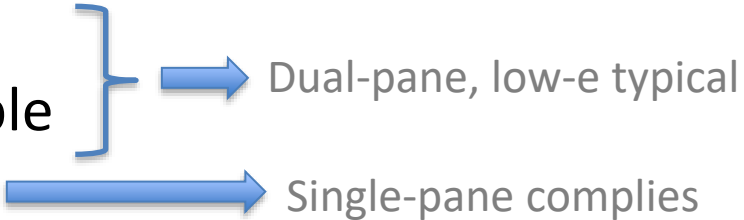
<https://breezway.com/>



Envelope prescriptive requirements

Window maximum U-factor (C402.4)

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

Envelope prescriptive requirements

Skylight SHGC & U-factor (C402.4)

SHGC \leq **0.35**

(or ≤ 0.60 with daylighting controls)

U-factor \leq **0.75**

(or U-0.90 with daylighting controls)

Envelope prescriptive requirements

Maximum fenestration area (C402.4)

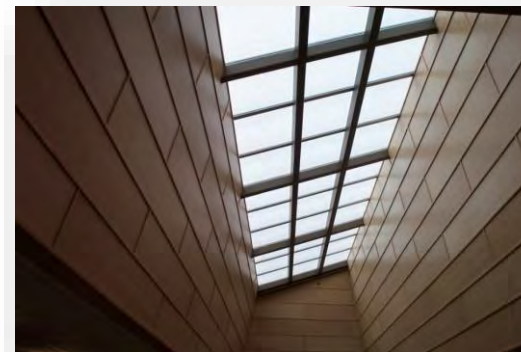
Window area \leq **30%** of gross wall area

Up to 40% with daylighting controls

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

Up to 6% with daylighting controls

Otherwise, use
Total Building Performance
compliance option

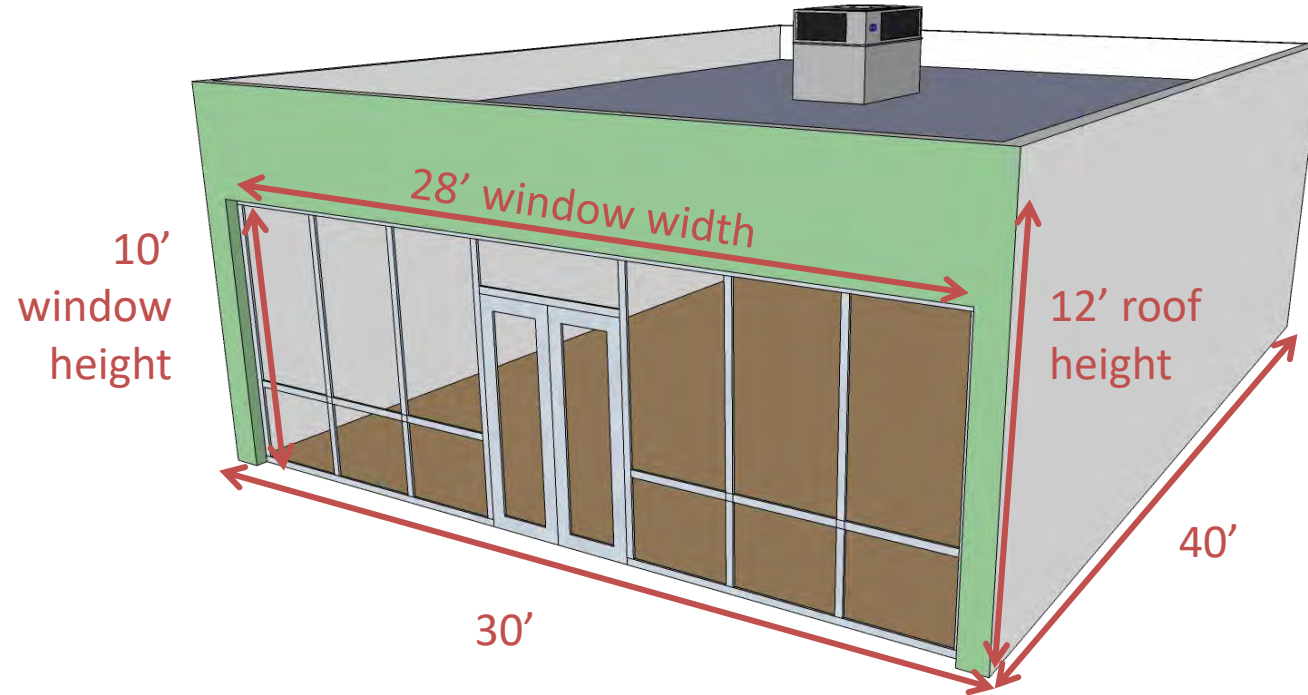


www.veluxusa.com

Envelope prescriptive requirements

Window area limit example

Is window area \leq 30% gross wall area?



Window area = 280 ft²

Gross wall area = $(30 + 40 + 30 + 40) \times 12 = 1,680$ ft²

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

Envelope prescriptive requirements

Skylight minimum area (C402.4)

For spaces under a roof where

- Floor area $> 2,500 \text{ ft}^2$ and
- Ceiling height $> 15 \text{ ft}$



Envelope prescriptive requirements

Skylight minimum area (C402.4)

For spaces under a roof where

- Floor area > 2,500 ft² and
- Ceiling height > 15 ft

≥50% of floor area must be daylighted by skylights

and

Minimum skylight area

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

Several exceptions apply, including
lighting power < 0.5 W/ft²

Space types

- 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

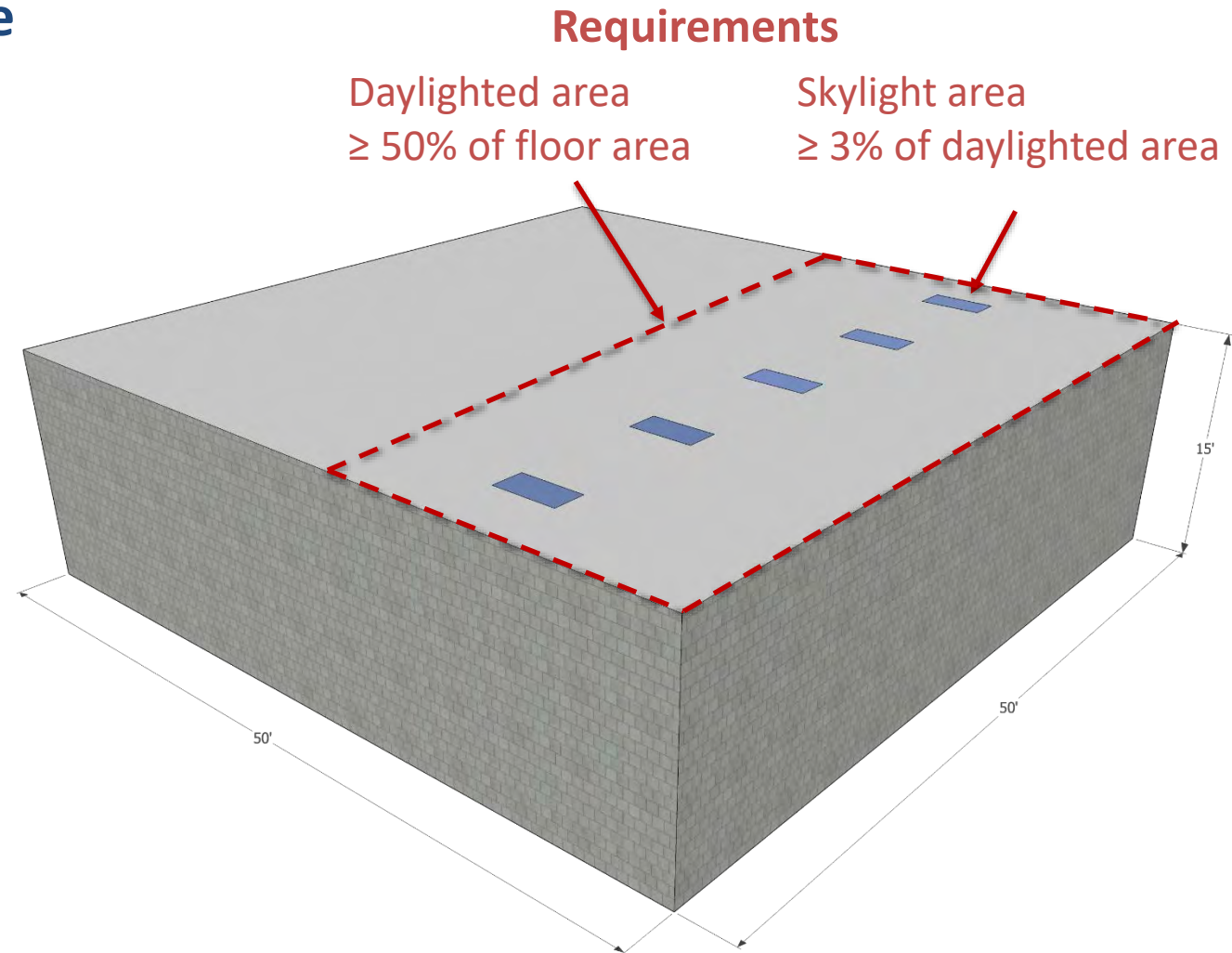


Envelope prescriptive requirements

Minimum skylight area example

When

1. Space floor area $> 2500 \text{ ft}^2$
2. Ceiling height $> 15 \text{ ft}$



Envelope prescriptive requirements

Envelope air leakage (C402.5)

- 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

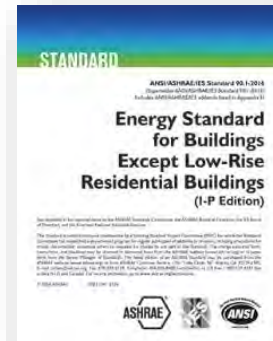
Envelope compliance options

1. Prescriptive requirements

- Roof and wall thermal performance
 - R-value, U-factor, or component performance alternative
- Roof solar reflectance and thermal emittance
- Windows and skylights
 - Maximum area
 - Maximum U-factor
 - Maximum solar heat gain coefficient (SHGC)
- Air leakage

2. Total Building Performance

3. ASHRAE Standard 90.1-2016



CLIMATE ZONE	1	
	All other	Group R
Insulation entirely above roof deck	R-20ci	R-25ci
Metal buildings ^b	R-19 + R-11 LS	R-19 + R-11 LS
Attic and other	R-38	R-38
Mass ^g	R-5.7ci ^c	R-5.7ci ^c
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-3.8ci or R-20	R-13 + R-3.8ci or R-20
Below-grade wall ^d	NR	NR
Mass ^e	NR	NR
Joist/framing	NR	NR
Unheated slabs	NR	NR
Heated slabs ^h	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab
Nonswinging	R-4.75	R-4.75

energycode.pnl.gov/COMcheckWeb/index.html

COMcheck-Web™

Hawaiian office

2015 IECC

Register | Forgotten Password?

Log In

New Project

PROJECT ENVELOPE INT. LIGHTING EXT. LIGHTING MECHANICAL REQUIREMENTS

Row: Edit Duplicate Move Up Move Down Delete

Add: Roof Skylight Ext. Wall Window Door Basement Floor

	Component	Assembly	Orientation	Building Area Type	Fenestration Details	Construction Details	Gross Area	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor
1	Roof	Attic Roof, Wood Joists		1 - Office (Nonresi...			5000 ft ²	38	0	0.027
2	Ext. Wall	Wood-Framed, 16in. o.c.	North	1 - Office (Nonresi...			1000 ft ²	20	0	0.064
3	Ext. Wall	Wood-Framed, 16in. o.c.	South	1 - Office (Nonresi...			1000 ft ²	20	0	0.064
4	Ext. Wall	Wood-Framed, 16in. o.c.	East	1 - Office (Nonresi...			500 ft ²	20	0	0.064
5	Window	Metal Frame: Fixed			Non-NFRC:...		300 ft ²			0.5
6	Ext. Wall	Wood-Framed, 16in. o.c.	West	1 - Office (Nonresi...			500 ft ²	20	0	0.064
7	Window	Metal Frame: Fixed			Non-NFRC:...		100 ft ²			0.5

☒ Envelope Passes +0%

☐ Interior Lighting TBD

☐ Exterior Lighting TBD

Does not include Hawai'i amendments

COMcheck Software Version COMcheckWeb Envelope Compliance Certificate

Project Information

Energy Code: 2015 IECC
Project Title: Hawaiian office
Location: Hilo, Hawaii
Climate Zone: 1a
Project Type: New Construction
Vertical Glazing / Wall Area: 13%

Construction Site: Owner/Agent: Designer/Contractor:

Additional Efficiency Package(s)

Reduced interior lighting power. Requirements are implicitly enforced within interior lighting allowance calculations.

Building Area	Floor Area
1-Office : Nonresidential	5000

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor _B
Roof: Attic Roof, Wood Joists, [Bldg. Use 1 - Office]	5000	38.0	0.0	0.027	0.027
NORTH					
Ext. Wall: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Office]	1000	20.0	0.0	0.064	0.064
EAST					
Ext. Wall: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Office]	500	20.0	0.0	0.064	0.064
Window: Metal Frame: Fixed, Perf. Specs.: Product ID 333333, SHGC 0.23, PF 0.30, [Bldg. Use 1 - Office] (b)	300	---	---	0.500	0.500
SOUTH					
Ext. Wall: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Office]	1000	20.0	0.0	0.064	0.064
WEST					
Ext. Wall: Wood-Framed, 16in. o.c., [Bldg. Use 1 - Office]	500	20.0	0.0	0.064	0.064
Window: Metal Frame: Fixed, Perf. Specs.: Product ID 33333333, SHGC 0.23, PF 0.30, [Bldg. Use 1 - Office] (b)	100	---	---	0.500	0.500

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
(b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.

Envelope PASSES: Design 0.0% better than code

Envelope Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed envelope systems have been designed to meet the 2015 IECC requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Project Title: Hawaiian office
Data filename:

Report date: 03/22/20
Page 1 of 11

Commercial Building Inspection Stories

Austin Van Heusen



**GREEN
BUILDING
HAWAII**
A division of energyLogic

Austin Van Heusen



Energy Efficiency Specialist

- Certified Energy Auditor (CEA)
- Certified Building Commissioning Professional (CBCP)
- HERS Rater
- LEED GA

Austin.VanHeusen@nrglogic.com

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**GREEN
BUILDING
HAWAII**
A division of EnergyLogic

Third Party Inspections

Why are these valuable?

- New construction
- Retrofit projects
- Quality assurance
- Properly installed materials
- Properly sized equipment
- Properly installed equipment



Section 4

Mechanical Systems



Mechanical System Requirements

Mandatory

- Cooling load calculations
- Zone isolation
- Ventilation
- Equipment efficiency
- Hot gas bypass limit
- Thermostatic and off-hour controls
- Demand control ventilation
- Parking garage ventilation
- Energy recovery ventilation
- Kitchen exhaust
- Guest room temperature and ventilation control
- Shutoff dampers
- Fan power and efficiency
- Walk-in coolers and freezers, refrigerated warehouses, refrigerated display cases
- Duct insulation and sealing
- Pipe insulation and protection
- Commissioning

Prescriptive

- Hydronic system controls
- Chiller isolation
- VAV for multiple zone systems & reheat limitations
- SAT reset controls
- Static pressure reset controls
- Two-speed or variable airflow control
- Cooling tower fan and cell control
- Heat recovery for water heating
- Refrigeration condenser and compressor systems

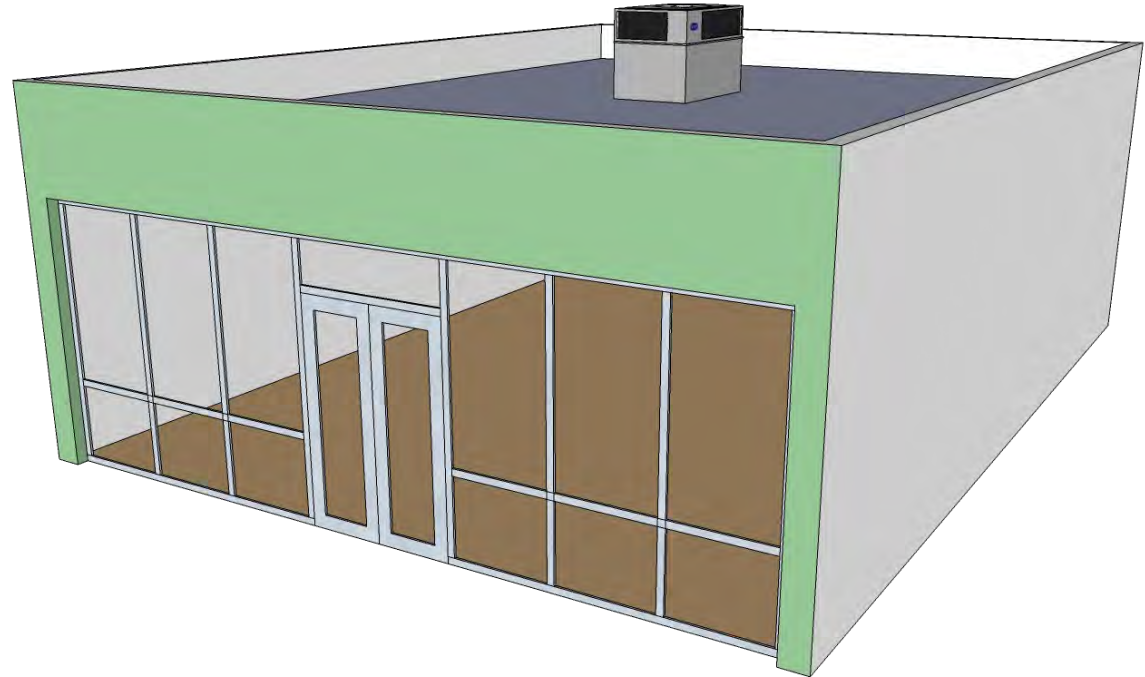
Small Commercial Example

- C403.1.1 Cooling load calcs
- C403.2.2 Ventilation
- C403.3.1 Equipment sizing
- C403.3.2 Equipment efficiency
- C403.4 Controls
- C403.11 Duct insulation and sealing

Maybe:

- C403.7.5 Kitchen exhaust
- C403.8.5 Fan airflow control, if >5 tons
- C403.10 Refrig. equipment
- C403.10.3 Refrig. display cases

1,200 ft² floor area
4-ton rooftop unit



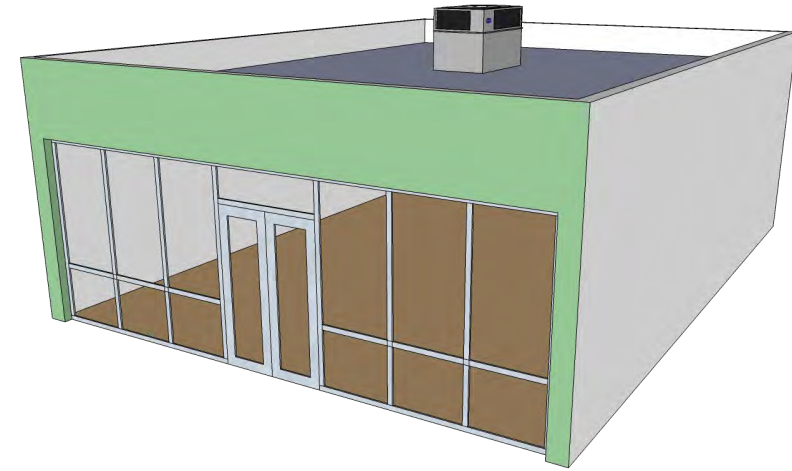
Small Commercial Example

1,200 ft² floor area
4-ton rooftop unit

C403.2.2 Ventilation

Outdoor air ventilation

- Per International Mechanical Code
- Equal to ASHRAE Standard 62.1
 - For example:
 $0.06 \text{ cfm/ft}^2 + 5 \text{ cfm/person}$ for office space



Small Commercial Example

C403.3.1 Efficiency
Depends on equipment type & size

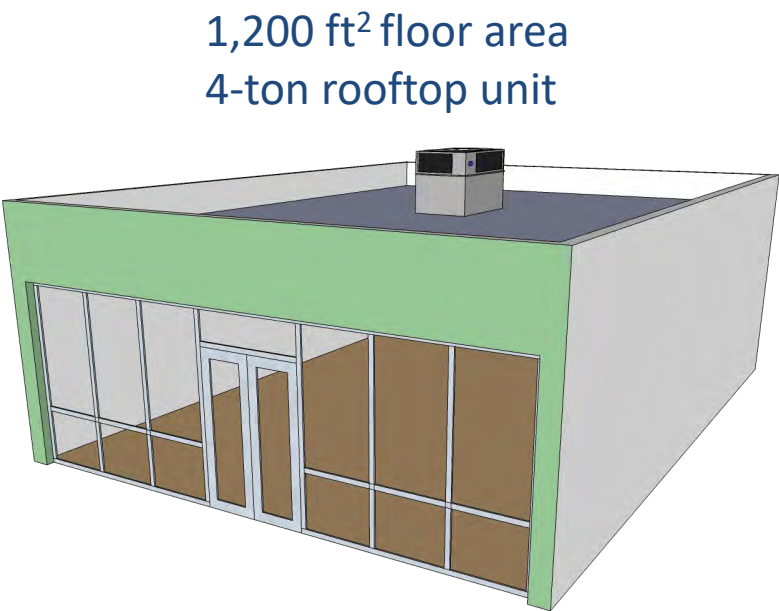


TABLE C403.3.2(1)
MINIMUM EFFICIENCY REQUIREMENTS: ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS

EQUIPMENT TYPE	SIZE CATEGORY	HEATING SECTION TYPE	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY	TEST PROCEDURE ^a
Air conditioners, air cooled	< 65,000 Btu/h ^b	All	Split System	13.0 SEER	
			Single Package	14.0 SEER	

Small Commercial Example

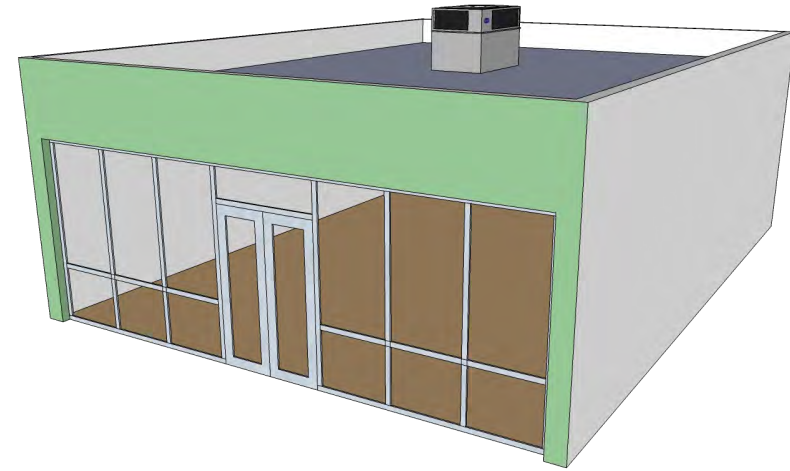
C403.4 Controls

Programmable thermostat

- Off-hour setback



1,200 ft² floor area
4-ton rooftop unit



Small Commercial Example

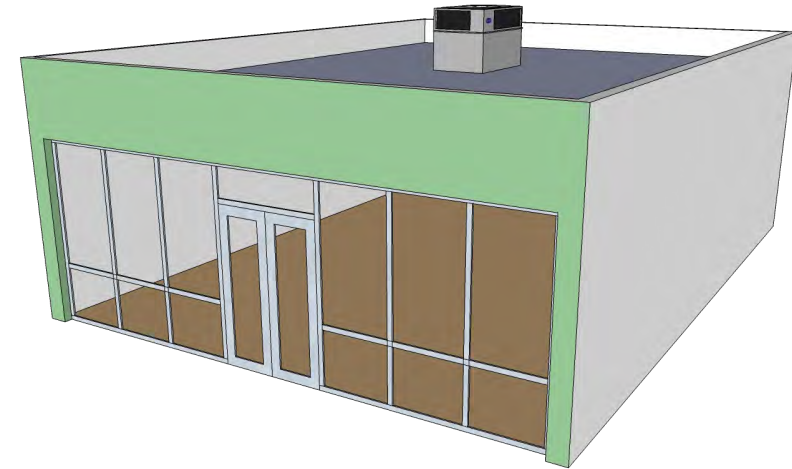
1,200 ft² floor area
4-ton rooftop unit

C403.11 Duct insulation and sealing

Minimum insulation:

R-8 for ducts outdoors

R-6 for ducts in unconditioned space



For both supply
and return ducts

R-6 (~1.75" thick)

R-8 (~2.5" thick)



Source: www.energycodes.gov

Mechanical systems

A few more requirements

- Guest room AC and ventilation controls
- Hydronic part-load controls
- VAV box control
- Demand control ventilation
- Parking garage exhaust
- Energy recovery
- Kitchen exhaust
- Fan power and efficiency
- Fan airflow control
- Heat recovery for water heating
- Refrigeration
- Commissioning

Mechanical systems

Door Switches (C403.2.3)

State amendment

- 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



Mechanical systems

Automatic control of HVAC serving guestrooms (C403.7.6)

If >50 guestrooms

New in 2018

1. Temperature setpoint controls

- Raise setpoint by 4F within 30 minutes
- Setpoint $\geq 80F$ when unrented or unoccupied >16 hours
- Some exceptions

2. Ventilation controls

- Turn off ventilation and exhaust within 30 minutes
- Automatic pre-occupancy purge allowed



Mechanical systems

Hydronic part-load controls (C403.4.4)

- ≥ 300 kBtu/hr capacity (25 tons)
- Chilled water or hot water

Requirements

- Temperature reset
- Variable flow, if pump ≥ 2 hp and ≥ 3 control valves
- Variable speed drive required in some cases

Some exceptions

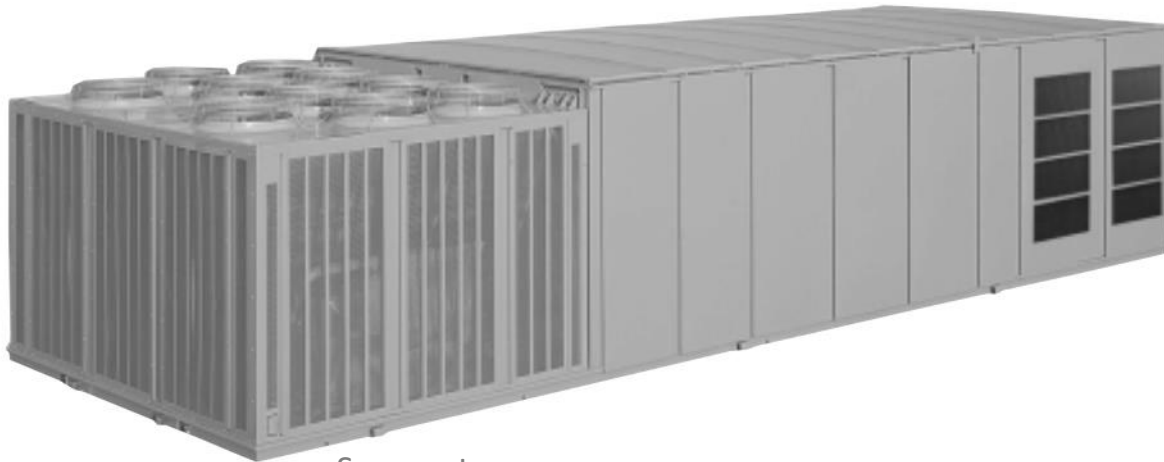


Mechanical systems

Mechanical systems serving multiple zones (C403.6)

- Variable air volume required (with some exceptions)
- Dual maximum VAV box control, 20% minimum flow (with exceptions) ←
- Supply-air temperature reset control
- Duct static pressure setpoint reset control

New in 2018



Source: trane.com



Mechanical systems

Demand control ventilation (C403.7.1)

Required for these spaces:

- $> 500 \text{ ft}^2$, and
- $\geq 25 \text{ people}/1000 \text{ ft}^2$ of floor area, and
- Served by systems with $> 3,000 \text{ cfm}$ outdoor airflow

Theater, auditorium, ballroom, conference room, etc.



Mechanical systems

Enclosed parking garage ventilation controls (C403.7.2)

Automatic exhaust fan control

- Contaminant sensors
- Automatically reduce flow
 1. Stage or modulate fans to 50% or less flow
 2. Operate intermittently for 20% or less of occupied time

Exceptions:

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



Mechanical systems

Energy recovery ventilation systems (C403.7.4)

- Energy recovery effectiveness $\geq 50\%$
- If design supply air flow exceeds limit →
(some exceptions)

Common options

- Air-to-air heat exchanger
- Heat pipe
- Heat wheel
- Run-around coils

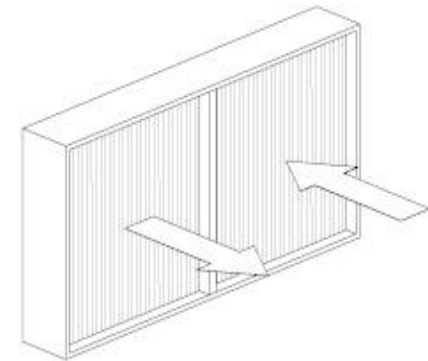
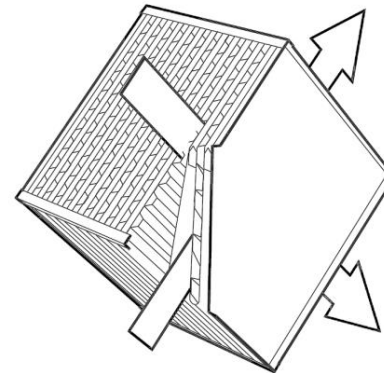
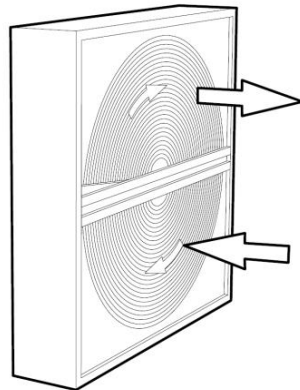


Table C403.7.4 (excerpt)

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	>140 cfm
$\geq 60\%$ and $< 70\%$	$\geq 2,000$ cfm	>120 cfm
$\geq 70\%$ and $< 80\%$	$\geq 1,000$ cfm	>100 cfm
$\geq 80\%$	>120 cfm	>80 cfm

Change for 2018

Mechanical systems

Kitchen exhaust systems (C403.7.5)

- $\leq 10\%$ replacement air directly into hood
- Limit on conditioned supply air

If total exhaust flow > 5,000 cfm

- Factory-built hoods, UL listed
- Max. cfm/linear ft (Table C403.7.5)
- One of the following
 - transfer air $\geq 50\%$
 - demand-control ventilation
 - energy recovery



TABLE C403.7.5
MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH

TYPE OF HOOD	LIGHT-DUTY EQUIPMENT	MEDIUM-DUTY EQUIPMENT	HEAVY-DUTY EQUIPMENT	EXTRA-HEAVY-DUTY EQUIPMENT
Wall-mounted canopy	140	210	280	385
Single island	280	350	420	490
Double island (per side)	175	210	280	385
Eyebrow	175	175	NA	NA
Backshelf/Pass-over	210	210	280	NA

For SI: 1 cfm = 0.4719 L/s; 1 foot = 305 mm.

NA = Not Allowed.

Mechanical systems

Fan power & efficiency (C403.8.1 - C403.8.4)

- When fan system power > 5 hp
 - Allowable fan horsepower limit
 - Motor nameplate HP limit
 - Fan efficiency requirement
- Fractional hp fan motors
 - Electronically commutated motors required for 1/12 hp – 1 hp
 - Some exceptions



Mechanical systems

Fan airflow control (C403.8.5.1)

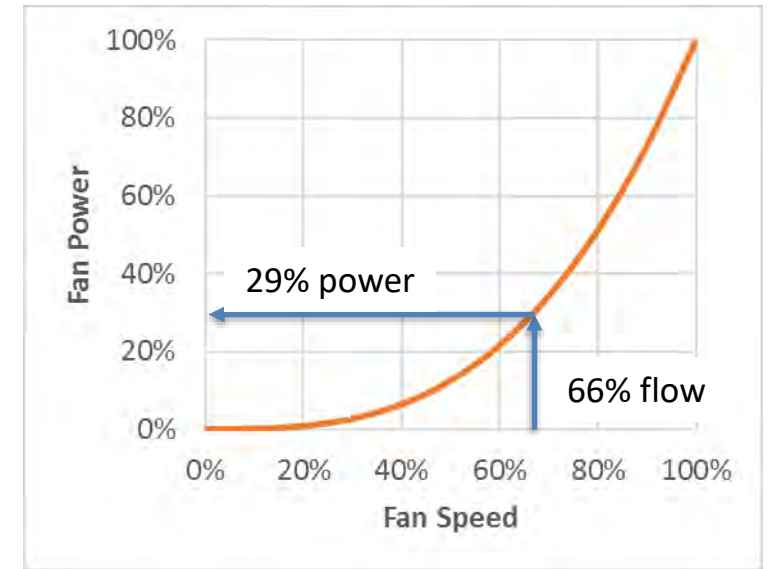
- DX systems with cooling capacity $\geq 65,000$ Btu/hr
- Chilled water systems with fan power ≥ 0.25 hp

Variable airflow required

- Systems that vary cooling capacity to control space temperature
 - At least two stages of fan control
 - Low speed $\leq 66\%$ flow and $\leq 40\%$ fan power
- Systems that vary airflow to control space temperature
 - Minimum speed $\leq 50\%$ and power $\leq 30\%$

Some exceptions

Fan Laws



Mechanical systems

Heat recovery for service water heating (C403.9.5)

For buildings with

- 24-hour operation
- $> 6,000,000$ Btu/hr (500 tons) heat rejection
- Water heating load $> 1,000,000$ Btu/hr

Requirement, the smaller of:

- Recover 60% of heat rejection
- Preheat water to 85F

Some exceptions



Mechanical systems

Refrigeration equipment performance (C403.10)

- Commercial refrigerators and freezers
- Maximum kWh/day ratings



Mechanical systems

C403.10.1

- Walk-in coolers
 - Walk-in freezers
 - Refrigerated warehouse coolers
 - Refrigerated warehouse freezers
- } Not site assembled



C403.10.2

- Walk-in coolers and walk-in freezers, site assembled

Requirements

- Door closers
- Infiltration limiting measures
- Insulation
- Fan motor type
- Antisweat heater limits
- Lighting efficiency



New efficiency requirements (C403.10.2.1)

- Display door
- Passage and freight doors
- Refrigeration system efficiency

Mechanical systems

Refrigerated display cases (C403.10.3)

Requirements

- Automatic lighting controls
- Defrost controls
- Antisweat heater controls





Mechanical systems

Mechanical systems commissioning and completion (C408.2)

Required when:

- $\geq 480,000$ Btu/h cooling capacity, or
 - $\geq 600,000$ Btu/h heating capacity
- } Typically $\geq 20,000$ ft²

Requirements

- Notes on construction documents
 - Commissioning plan 
 - Systems adjusting and balancing
 - Functional performance testing
 - Preliminary commissioning report 
 - Final commissioning report
- Developed by registered design professional or approved agency
- Certified by registered design professional or approved agency

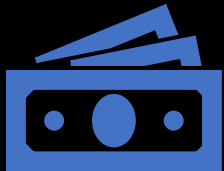
Project Information: _____ Project	
Name: _____	
Project Address: _____	
Commissioning Authority: _____	
Commissioning Plan (Section C408.2.1)	
<input type="checkbox"/>	Commissioning Plan was used during construction and includes all items required by Section C408.2.1
<input type="checkbox"/>	Systems Adjusting and Balancing has been completed.
<input type="checkbox"/>	HVAC Equipment Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
<input type="checkbox"/>	HVAC Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
<input type="checkbox"/>	Economizer Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
<input type="checkbox"/>	Lighting Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
<input type="checkbox"/>	Service Water Heating System Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on: _____
<input type="checkbox"/>	Manual, record documents and training have been completed or scheduled
<input type="checkbox"/>	Preliminary Commissioning Report submitted to owner and includes all items required by Section C408.2.4
I hereby certify that the commissioning provider has provided me with evidence of mechanical, service water heating and lighting systems commissioning in accordance with the 2018 IECC.	
Signature of Building Owner or Owner's Representative _____	
Date _____	

FIGURE C408.2.4 COMMISSIONING COMPLIANCE CHECKLIST

Air Conditioning Solutions



With energy modeling for new construction, it is possible to provide financial analysis for energy efficiency upgrades in order to maximize operating costs for new facilities.



Through energy audits, existing facilities can identify equipment upgrades that are fiscally responsible investments that will reduce operation costs and have reasonable returns on investments.

Energy Modeling for New Construction

Sample Energy Model Chart

- Six models of air conditioning system were modeled
- When compared to install cost a financial analysis can be provided
- Hawaii Energy rebates, increased efficiency consistently makes financial sense

Energy <u>saving</u> <u>strategy</u>	Saving MWh	Cost reduction [USD/year]
Generic VRF	70.87	\$ 19,843.83
LG Multi V 5	126.84	\$ 35,513.89
Daikin	89.12	\$ 24,952.63
York	85.77	\$ 24,014.35
AC CWL	83.58	\$ 23,403.30
PACU R	42.80	\$ 11,983.87

Proper Equipment Sizing

Oversized systems use more energy and can create humidity issues

- Energy models provide sizing based on heat loads
- Many contractors base sizing off of square footage
- Reduced equipment cost
- Reduced operational cost
- More comfortable spaces
- Avoid short-cycling



**GREEN
BUILDING
HAWAII**
A division of EnergyLogic

Section 5

Service Water Heating

Service water heating

- Water heating equipment efficiency (C404.3)
- Heat traps for storage water heaters (C404.3)
- Pipe insulation (C404.4)
- Heated water supply piping (C404.5)
 - Maximum allowable length
 - Maximum allowable volume
- Circulation and temperature maintenance systems (C404.6)
- Demand recirculation controls (C404.7)
- Pools and spas (C404.9)

Service water heating

Insulation of piping (C404.4)

- Insulation thickness (Table C403.11.3)
 - 1 inch for pipe <1.5 in. pipe size
 - 1.5 inch for 1.5 inch or larger pipe
- Location
 - All hot water pipe from water heater to termination of fixture supply pipe

Service water heating

Heated water supply piping (C404.5)

- Maximum allowable length, or
- Maximum allowable volume

Piping from source to fixture

- Water heater to fixture
- Circulation pipe to fixture

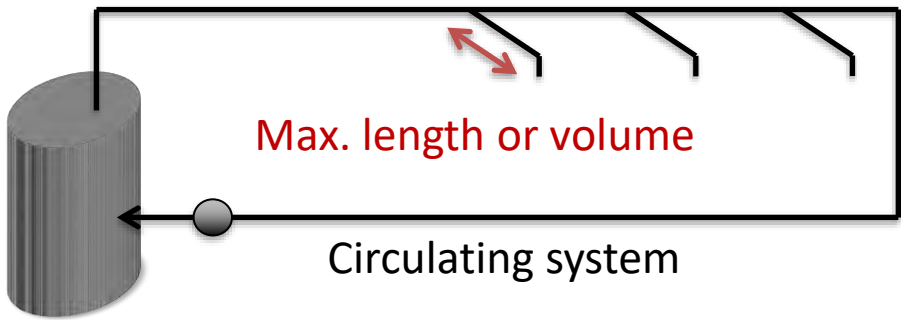
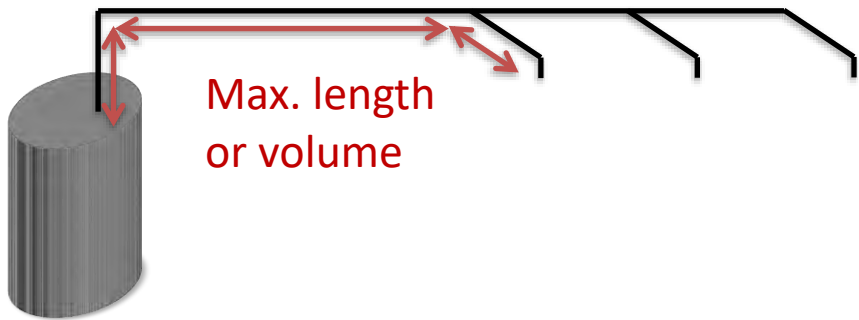


TABLE C404.5.1 PIPING VOLUME AND MAXIMUM PIPING LENGTHS

NOMINAL PIPE SIZE (inches)	VOLUME (liquid ounces per foot length)	MAXIMUM PIPING LENGTH (feet)	
		Public lavatory faucets	Other fixtures and appliances
1/4	0.33	6	50
5/16	0.5	4	50
3/8	0.75	3	50
1/2	1.5	2	43
5/8	2	1	32
3/4	3	0.5	21
7/8	4	0.5	16
1	5	0.5	13
1 1/4	8	0.5	8
1 1/2	11	0.5	6
2 or larger	18	0.5	4

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 liquid ounce = 0.030 L, 1 gallon = 128 ounces.

Section 6

Electrical & Lighting



Electrical Power & Lighting

- Dwelling unit lighting
- Lighting controls
- Interior lighting power
- Exterior lighting
- Transformers
- Motors
- Elevators and escalators
- Voltage drop New in 2018
- Sub-metering
- Solar ready zone (optional appendix) New in 2018
- Functional testing of lighting control

Interior lighting

Dwelling and sleeping unit compliance (C405.1)

	≥90% lamps high efficacy (R404.1)	Interior lighting power allowance (C405.3)	Controls (C405.2.4)	
1. Dwelling unit in multifamily building	Required	NA	NA	
2. Dwelling unit in other buildings	Choose		Occupancy sensor or multi-level control	New for 2018
3. Sleeping unit	Choose		Auto-off control for permanent lights and switched receptacles	

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

SLEEPING UNIT. A room or space in which people sleep, that can include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are part of a dwelling unit are not sleeping units.

Interior lighting

Dwelling and sleeping unit compliance (C405.1)

High efficacy lighting option (R404.1)

- $\geq 90\%$ lamps high efficacy

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



**Compact
fluorescent**



Source: DOE/NREL PIX17458

**Full-size
fluorescent**



Source: DOE/NREL PIX20307



LED

Interior lighting



Dwelling and sleeping unit compliance (C405.1)

Interior lighting power allowance option (C405.3)

Building Area Method

Building Area Type	Lighting Power Density (W/ft ²)	
	2015	2018
Dormitory	0.57	0.61 
Hotel/motel	0.87	0.75 

Space-by-space Method

Space Type	Lighting Power Density (W/ft ²)	
	2015	2018
Dormitory living quarters	0.38	0.54 
Guestroom	0.47	0.77 

Interior lighting

Occupant Sensor Controls (C405.2.1)

- Required space types
 - Classrooms/lecture/training rooms
 - Conference/meeting/multipurpose
 - Copy/print rooms
 - Lounges/break rooms
 - Enclosed offices
 - **Open plan office areas**
 - Restrooms
 - Storage rooms
 - Locker rooms
 - Other spaces ≤ 300 ft² with floor-to-ceiling partitions
 - Warehouse storage areas

New for 2018



Warehouse storage areas

- Each aisle separately
- Reduce to 50% or less

Open office areas

- Control zones ≤ 600 ft²
- Reduce to 80% or less

All other spaces

1. Manual on, or
2. Auto-on to $\leq 50\%$ power

Exceptions

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

Interior lighting

Required for each area without occupant sensor

Time-switch controls (C405.2.2)

- Exceptions
 - Patient care
 - Safety or security
 - Lighting for continuous operation
 - Shop and laboratory classrooms

Light reduction controls (C405.2.2.2)

- Manual control to 50% or less power
- Uniform illumination
- Exception
 - Daylight-responsive controls

Interior lighting

Daylight-responsive controls (C405.2.3)

- Required in spaces with >150W of general lighting in:
 - Sidelit daylight zones
 - Toplit daylight zones
- Exceptions
 - Patient care
 - Dwelling units & sleeping units
 - Display and accent lighting
 - Display case lighting
 - First floor sidelight zone in A-2 and M occupancies
 - **Total building lighting power $\leq LPD_{adj}$**

New for 2018

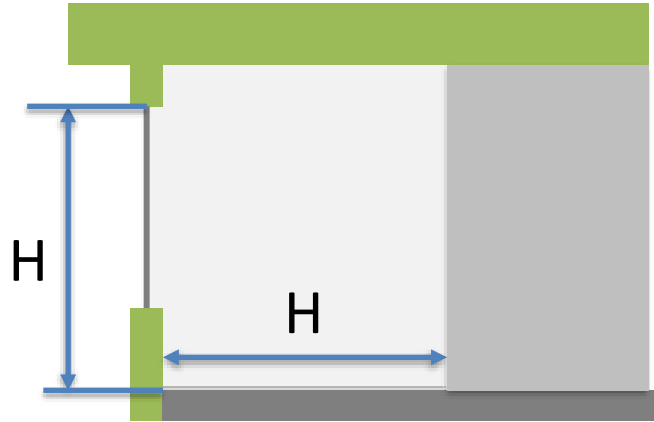


$$LPA_{adj} = LPA_{norm} \times \underbrace{\left(1 - \frac{0.4 \times \text{Uncontrolled daylight zone floor area}}{\text{Total floor area}} \right)}_{1.0 \text{ to } 0.6}$$

1.0 to 0.6

Interior lighting

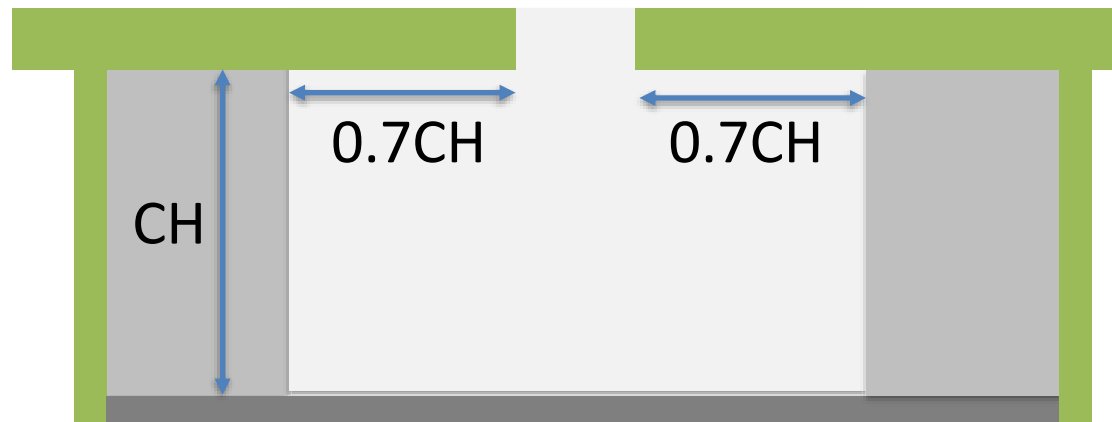
Sidelit
daylight
zone



Window area $\geq 24 \text{ ft}^2$

Glazing light transmission ≥ 0.20

Toplight
daylight
zone



More details in the code

Interior lighting

Specific application controls (C405.2.4)

Separate manual control + occupant sensor or time-switch control

- Display and accent lighting
- Lighting in display cases
- Supplemental task lighting
- Lighting equipment for sale or demonstration in lighting education

New for 2018

Sleeping unit (e.g. guestroom)

- Auto-off for permanently installed lights and switched receptacles

Dwelling unit (not in multi-family building)

- Occupant sensor or light reduction

New for 2018

Non-visual applications (e.g. plant growth or food warming)

- Time-switch control

New for 2018

Interior lighting

Connected lighting power (C405.3.1)

- Screw-in lamps
 - Rated lamp wattage
- Luminaires with ballast or transformer
 - Rated input wattage
- LED
 - Rated input wattage
- Track lighting options
 1. Luminaire wattage, not less than **8W/linear ft**
 2. Current-limiting device rating
 3. Transformer limit
- Manufacturer data for other luminaires



Interior lighting

Connected lighting power (C405.3.1)

Exceptions

1. Television broadcast lighting for playing areas in sports arenas.
2. Emergency lighting automatically off during normal building operation.
3. Occupants with special lighting needs, including those with visual impairment and other medical and age-related issues.
4. Casino gaming areas.
5. Mirror lighting in dressing rooms.
6. Task lighting for medical and dental purposes that is in addition to general lighting and controlled by an independent control device.
7. Display lighting for exhibits in galleries, museums and monuments that is in addition to general lighting and controlled by an independent control device.
8. Lighting for theatrical purposes, including performance, stage, film production and video production.
9. Lighting for photographic processes.
10. Lighting integral to equipment or instrumentation and installed by the manufacturer.
11. Task lighting for plant growth or maintenance.
12. Advertising signage or directional signage.
13. Lighting for food warming.
14. Lighting equipment that is for sale.
15. Lighting demonstration equipment in lighting education facilities.
16. Lighting approved because of safety considerations.
17. Lighting in retail display windows, provided that the display area is enclosed by ceiling-height partitions.
18. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff.
19. Exit signs.

Interior lighting

TABLE C405.3.2(1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA
METHOD

BUILDING AREA TYPE	LPD (w/ft ²)
Automotive facility	0.71
Convention center	0.76
Courthouse	0.90
Dining: bar lounge/leisure	0.90
Dining: cafeteria/fast food	0.79
Dining: family	0.78
Dormitory ^{a, b}	0.61
Exercise center	0.65
Fire station ^a	0.53
Gymnasium	0.68
Health care clinic	0.82
Hospital ^a	1.05
Hotel/Motel ^{a, b}	0.75
Library	0.78

Manufacturing facility	0.90
Motion picture theater	0.83
Multifamily ^c	0.68
Museum	1.06
Office	0.79
Parking garage	0.15
Penitentiary	0.75
Performing arts theater	1.18
Police station	0.80
Post office	0.67
Religious building	0.94
Retail	1.06
School/university	0.81
Sports arena	0.87
Town hall	0.80
Transportation	0.61
Warehouse	0.48
Workshop	0.90

2015
allowance
examples

Interior lighting

Partial table

TABLE C405.3.2(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	2.03
In a religious building	1.53
In a sports arena	0.43

Locker room	0.48
Lounge/breakroom	
In a healthcare facility	0.78
Otherwise	0.62
Office	
Enclosed	0.93
Open plan	0.81
Parking area, interior	0.14
Pharmacy area	1.34
Restroom	
In a facility for the visually impaired (and not used primarily by the staff ^b)	0.96
Otherwise	0.85
Sales area	1.22
Seating area, general	0.42
Stairway (see Space containing stairway)	
Stairwell	0.58
Storage room	0.46
Vehicular maintenance area	0.56
Workshop	1.14

1.11
0.98

2015
allowance
example

Extra allowances for

1. Sales areas
2. Decorative lighting or highlight art or exhibits

Interior lighting

Small Commercial Example

What is the allowed
interior lighting power?

Floor area 1,200 ft²
Office occupancy

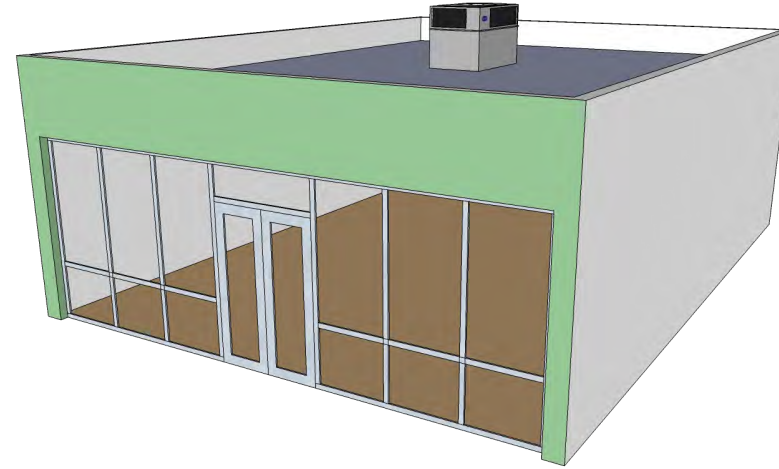


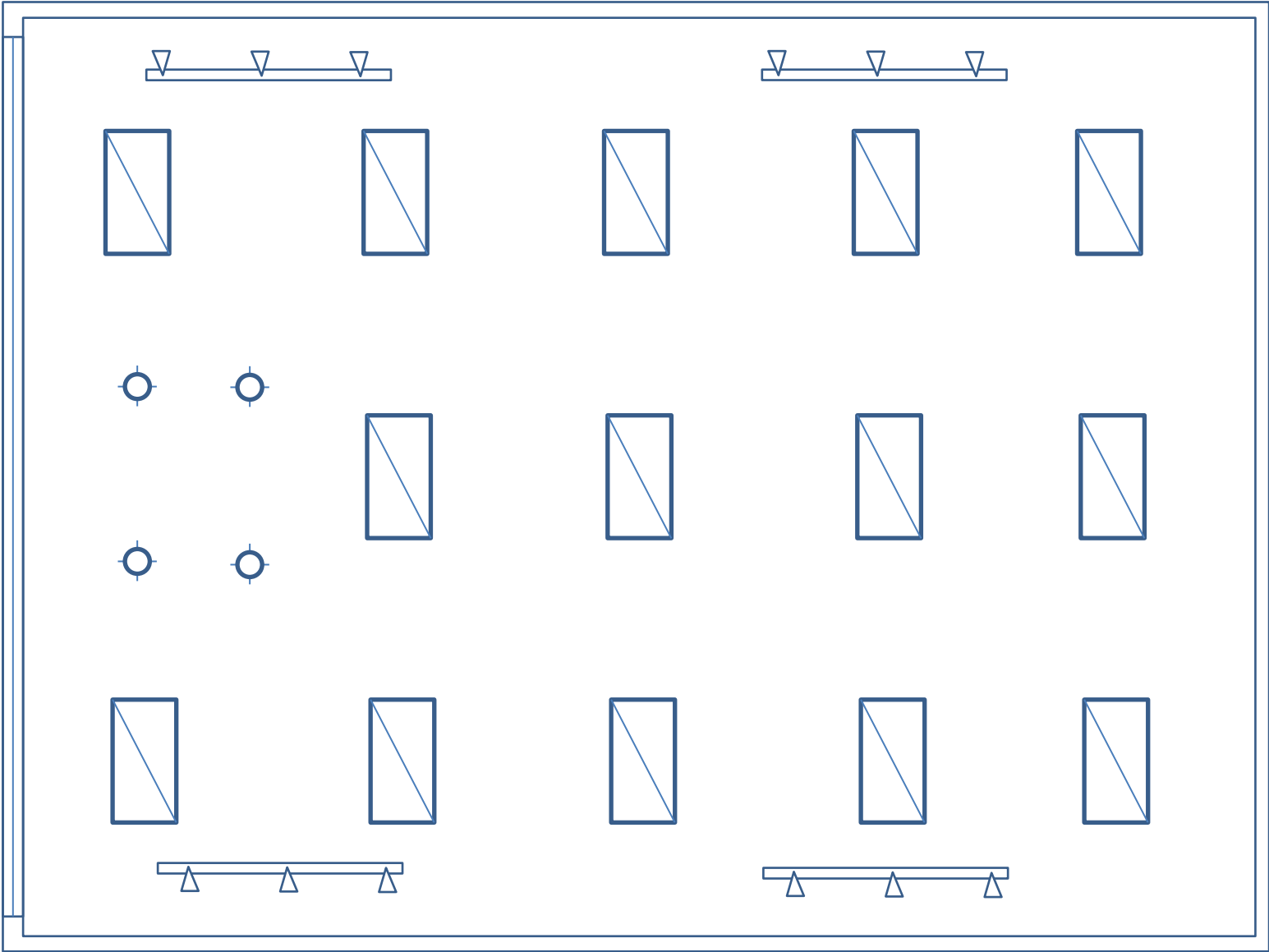
Table C405.4.2 Building Area Method Allowance

Office = 0.79 W/ft²

$$0.79 \text{ W/ft}^2 \times 1,200 \text{ ft}^2 = \mathbf{948 \text{ watts allowed}}$$




Small Commercial Example

What is the installed lighting power?



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	4	180W
	LED downlight, 120V	26W	4	104W
			Total	914W




Vs. 948 watts allowed

Complies?

C405.4.1 says, line voltage track lighting power counts for at least 8 W/ft

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 64W	4	180W 256W
	LED downlight, 120V	26W	4	104W
			Total	914W 990W

Vs. 984 watts allowed

Complies?

C405.4.1 says, line voltage track lighting power counts for at least 8 W/ft

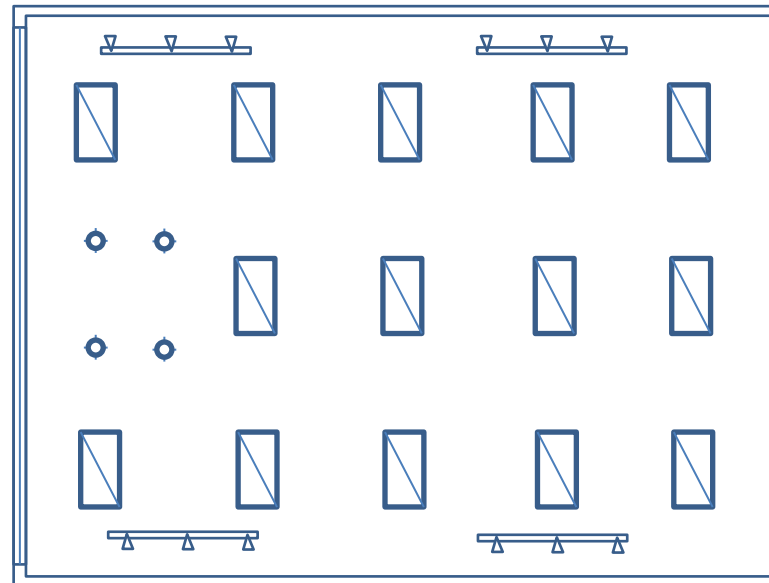
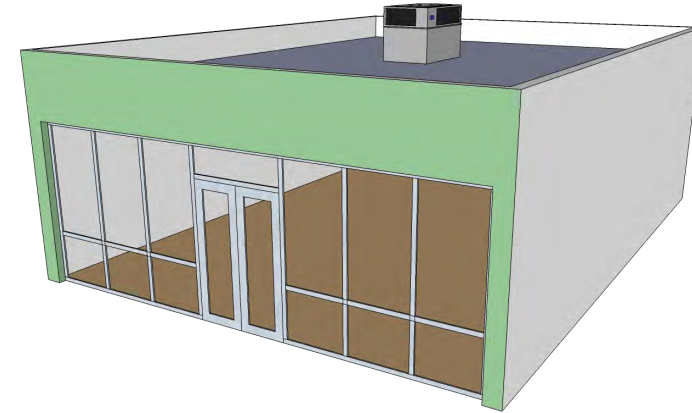
Interior lighting

Small Commercial Example

What are the lighting control requirements?

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

Floor area 1,200 ft²
Office occupancy

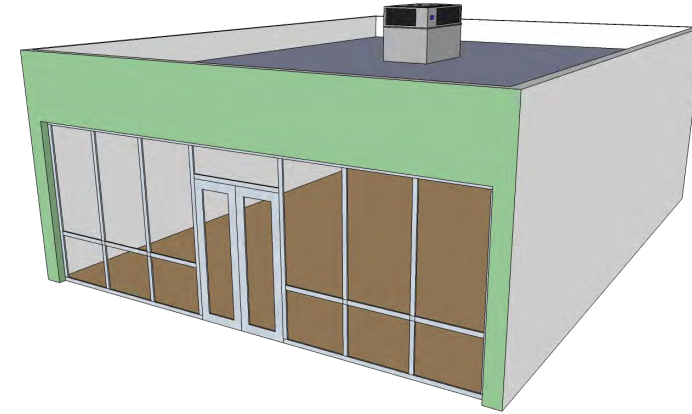


Interior lighting

Small Commercial Example

What are the lighting control requirements?

Floor area 1,200 ft²
Office occupancy



Occupancy sensors?

Yes (open office new for 2018).

Time-switch?

No

Light-reduction?

No

Daylight responsive?

Yes, >150W in sidelight zone.

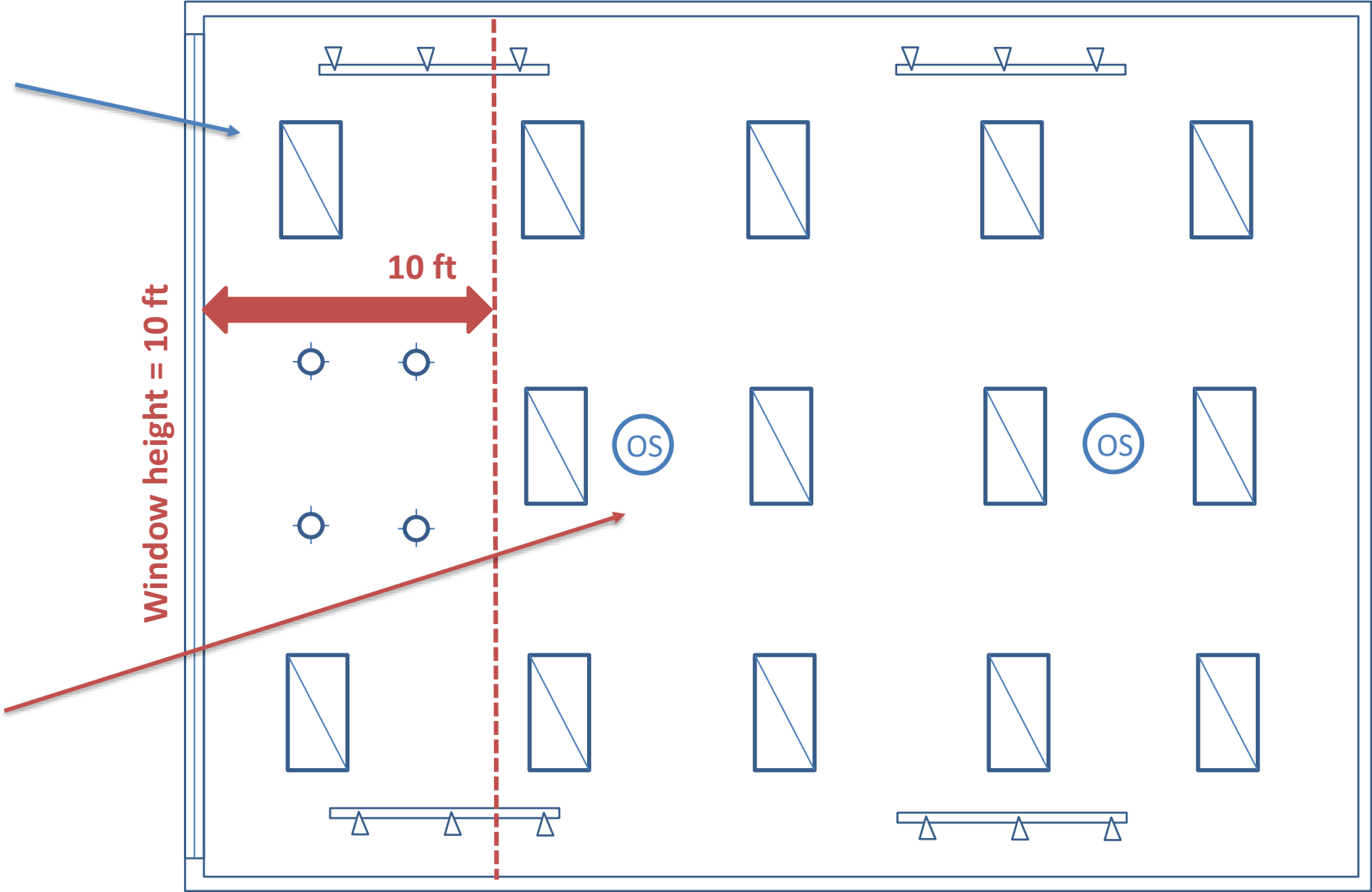
Display and accent?

Separate manual control + occupant sensor.

Small Commercial Example

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

2+ occupant sensor zones, $\leq 600 \text{ ft}^2$ for open office



Exterior lighting

Exterior lighting controls (C405.2.6)

- Daylight shutoff
- Façade and landscape decorative lighting
 - Off ≤ 1 hour after closing
 - On ≤ 1 hour before opening
- Setback for other lighting by $\geq 30\%$
 1. Midnight to 6am
 2. 1 hour after closing to 1 hour before opening
 3. When activity not detected for 15 minutes
- Time-switch function
 - 7-day program
 - Holidays
 - 10+ hours backup

New for 2018

Exterior lighting

Total connected exterior building lighting power (C405.4.1)

- Max. rated wattage of all lighting powered through the energy service for the building
- Exceptions
 - Lighting approved because of safety considerations.
 - Emergency lighting automatically off during normal business operation.
 - Exit signs.
 - Specialized signal, directional and marker lighting associated with transportation.
 - Advertising signage or directional signage.
 - Integral to equipment or instrumentation and installed by its manufacturer.
 - Theatrical purposes, including performance, stage, film production and video production.
 - Athletic playing areas.
 - Temporary lighting.
 - Industrial production, material handling, transportation sites and associated storage areas.
 - Theme elements in theme/amusement parks.
 - Used to highlight features of art, public monuments, and the national flag.
 - Lighting for water features and swimming pools.
 - Lighting controlled from within dwelling units, where the lighting complies with Section R404.1.

Exterior lighting

Exterior lighting power allowance (C405.4.2)

- 1. Base site allowance
- 2. Power allowances for building exteriors
- 3. Additional exterior lighting power
Limited to the fixtures serving specific applications

Varies by exterior lighting zone 

TABLE C405.4.2(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

Exterior Lighting

1. Base site allowance (Table C405.4.2(1))

	2015	2018
Zone 1	500 W	350 W
Zone 2	600 W	400 W
Zone 3	750 W	500 W
Zone 4	1300 W	900 W

TABLE C405.4.2(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

Exterior Lighting

2. Power allowances for building exteriors (Table C405.4.2(2))

	LIGHTING ZONES			
	Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance	350 W	400 W	500 W	900 W
Uncovered Parking Areas				
Parking areas and drives	0.03W/ft ²	0.04 W/ft ²	0.06 W/ft ²	0.08 W/ft ²
Building Grounds				
Walkways and ramps less than 10 feet wide	0.5 W/linear foot	0.5 W/linear foot	0.6 W/linear foot	0.7 W/linear foot
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 W/ft ²	0.10 W/ft ²	0.11 W/ft ²	0.14 W/ft ²
Dining areas	0.65 W/ft ²	0.65 W/ft ²	0.75 W/ft ²	0.95 W/ft ²
Stairways	0.6 W/ft ²	0.7 W/ft ²	0.7 W/ft ²	0.7 W/ft ²
Pedestrian tunnels	0.12 W/ft ²	0.12 W/ft ²	0.14 W/ft ²	0.21 W/ft ²
Landscaping	0.03 W/ft ²	0.04 W/ft ²	0.04 W/ft ²	0.04 W/ft ²
Building Entrances and Exits				
Pedestrian and vehicular entrances and exits	14 W/linear foot of opening	14 W/linear foot of opening	21 W/linear foot of opening	21 W/linear foot of opening
Entry canopies	0.20 W/ft ²	0.25 W/ft ²	0.4 W/ft ²	0.4 W/ft ²
Loading docks	0.35 W/ft ²	0.35 W/ft ²	0.35 W/ft ²	0.35 W/ft ²
Sales Canopies				
Free-standing and attached	0.40 W/ft ²	0.40 W/ft ²	0.6 W/ft ²	0.7 W/ft ²
Outdoor Sales				
Open areas (including vehicle sales lots)	0.20 W/ft ²	0.20 W/ft ²	0.35 W/ft ²	0.50 W/ft ²
Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	7 W/linear foot	7 W/linear foot	21 W/linear foot

Exterior Lighting

3. Additional exterior lighting power

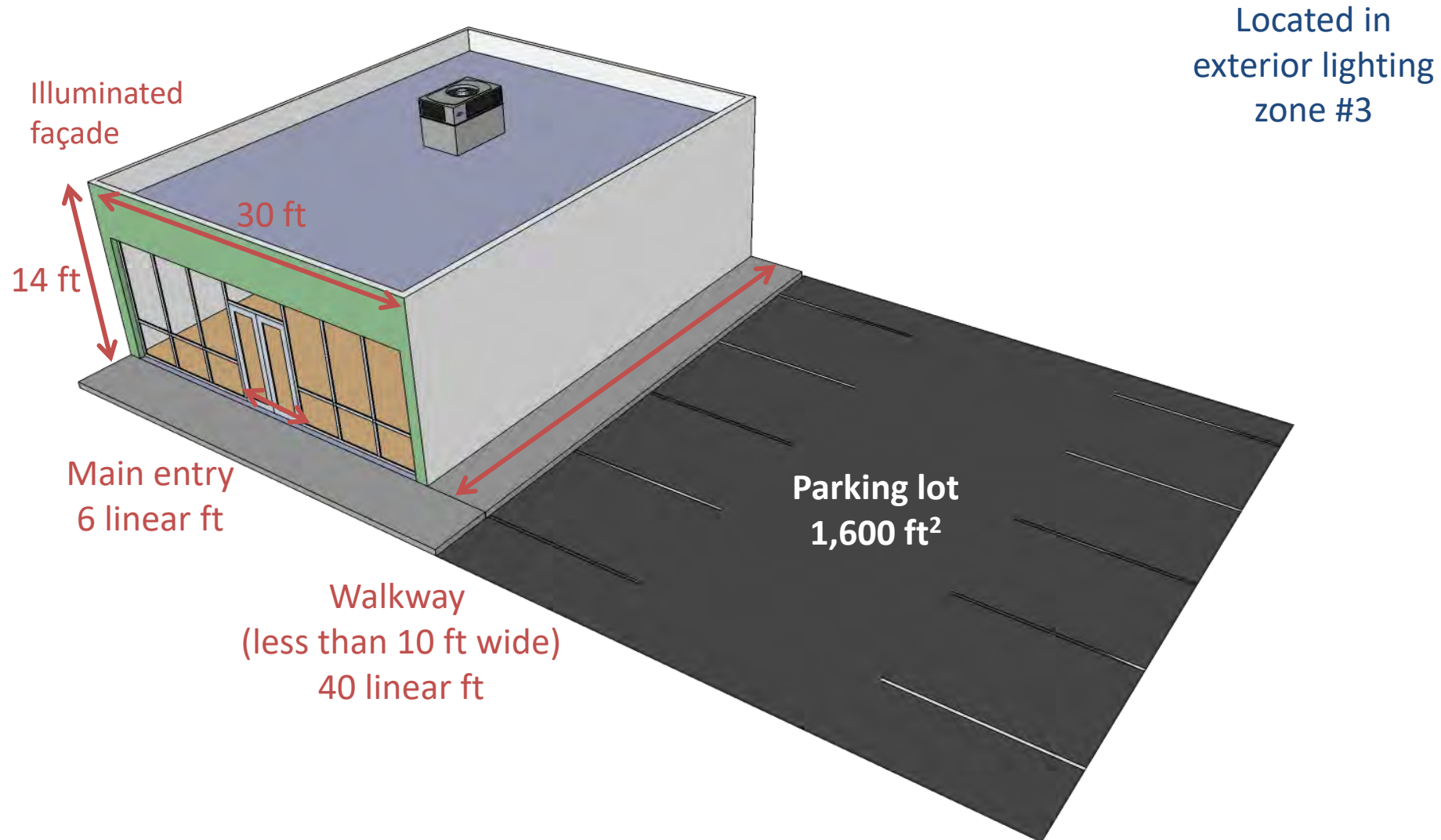
TABLE C405.4.2(3) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

LIGHTING ZONES				
	Zone 1	Zone 2	Zone 3	Zone 4
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	135 W per location plus 45 W per additional ATM per location			
Uncovered entrances and gatehouse inspection stations at guarded facilities	0.5 W/ft ² of area			
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft ² of area			
Drive-up windows and doors	200 W per drive through			
Parking near 24-hour retail entrances.	400 W per main entry			

The additional power shall be used only for the luminaires that are serving these applications and shall not be used for any other purpose

Small Commercial Example

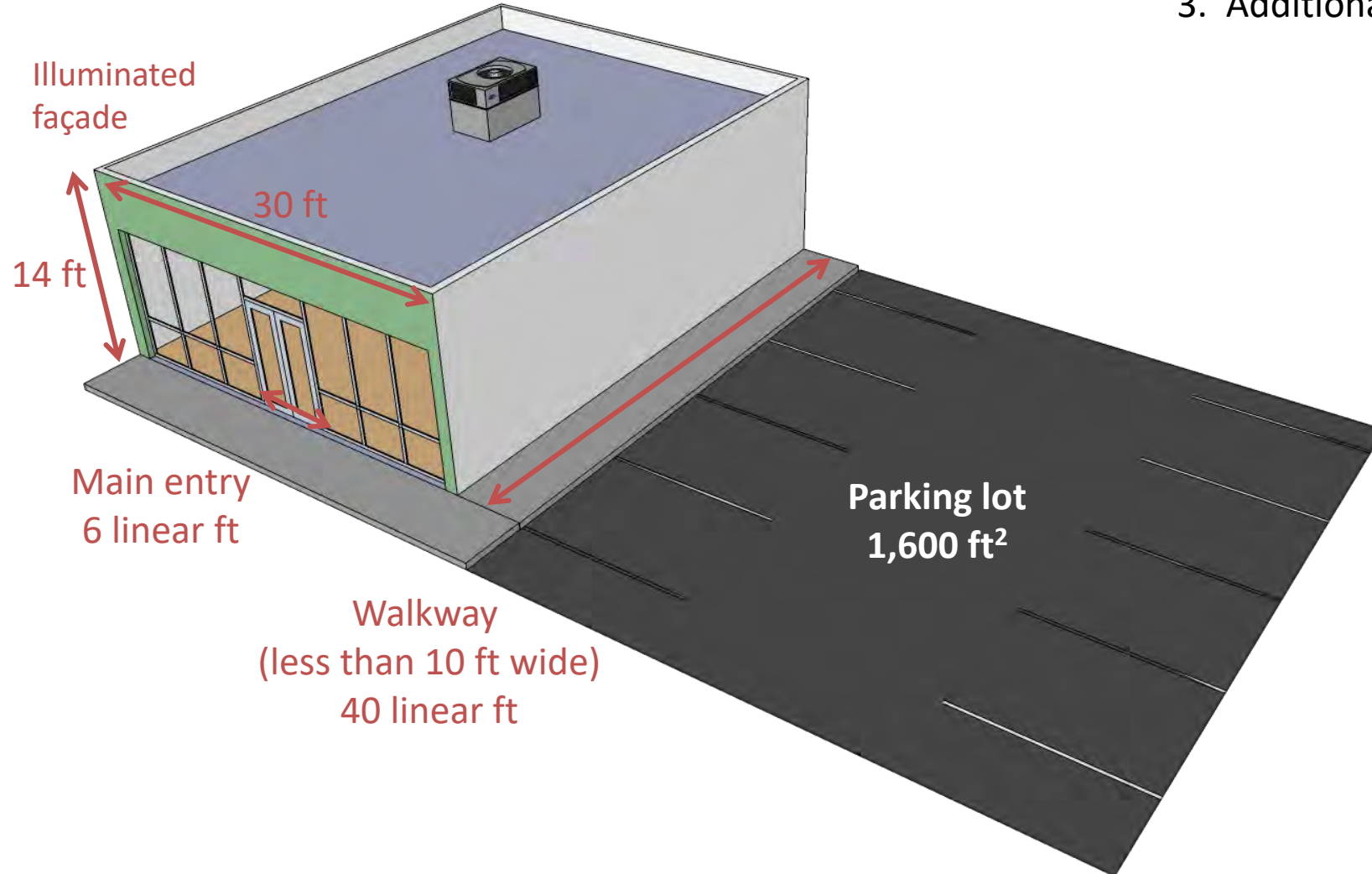
What is allowed exterior lighting power?



Small Commercial Example

What is allowed exterior lighting power?

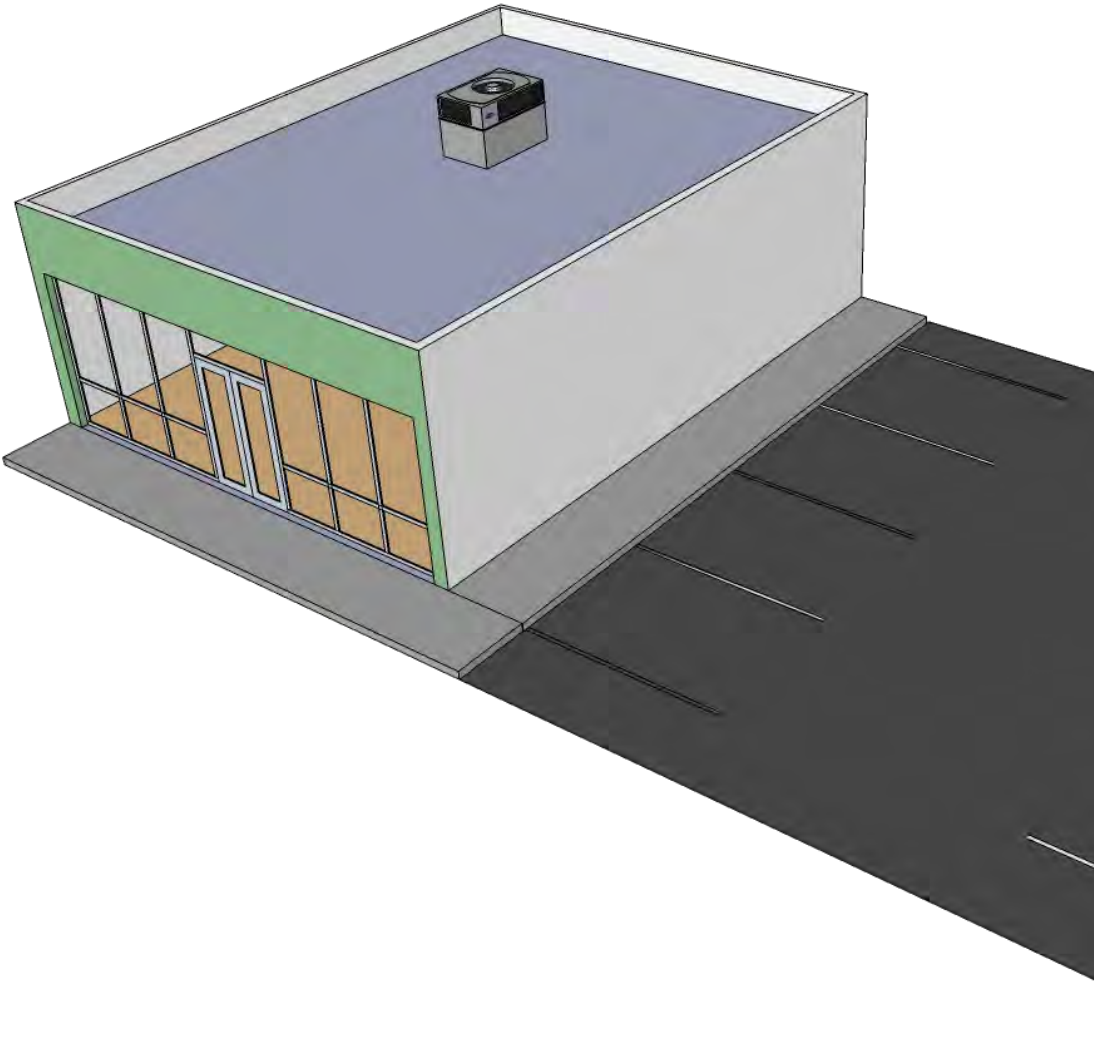
1. Base site allowance
2. Power allowances for building exteriors
3. Additional exterior lighting power



Small Commercial Example

What is allowed exterior lighting power?

1. Base site allowance



Located in
exterior lighting
zone #3

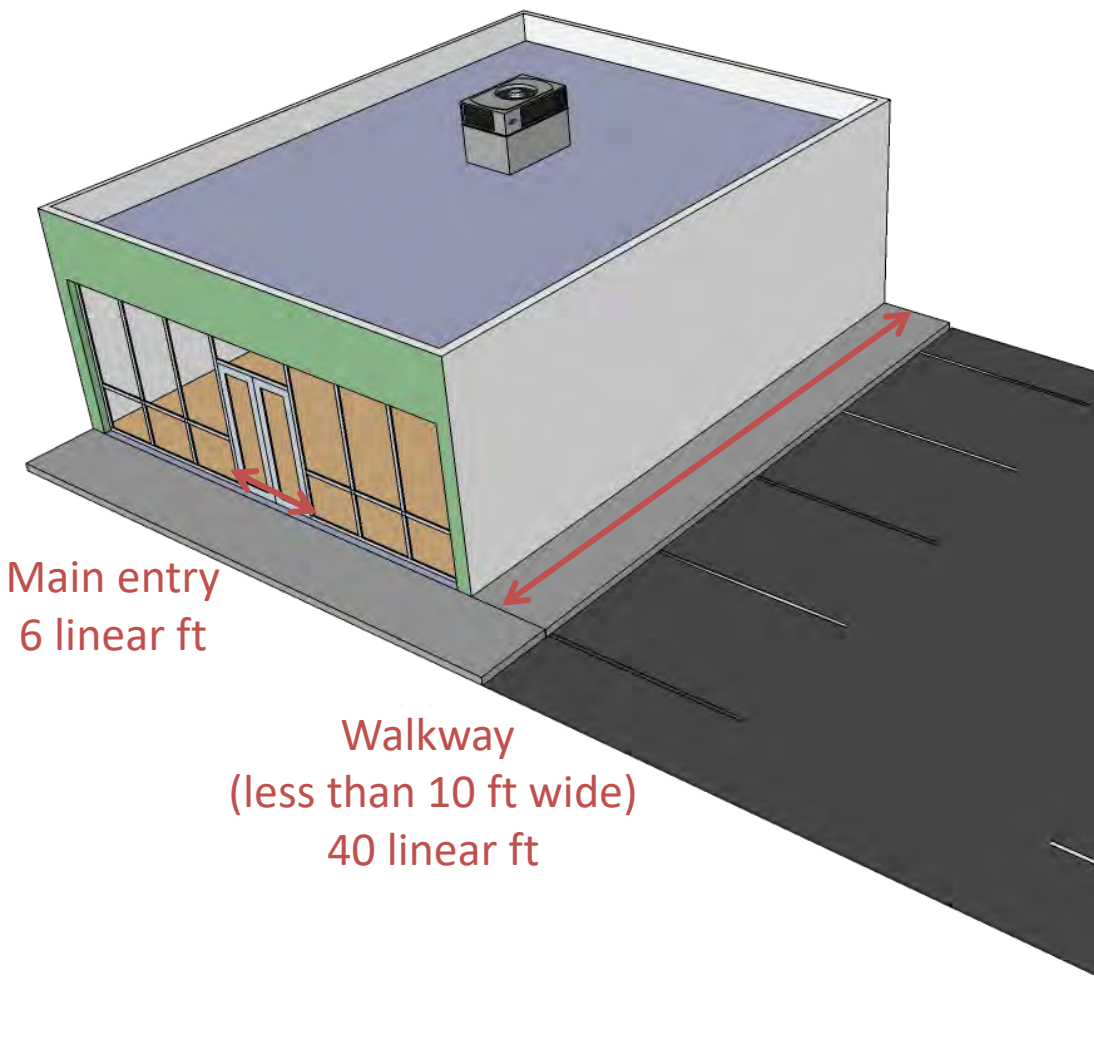
Exterior Lighting Zone	Base Site Allowance
Zone 1	350 W
Zone 2	400 W
Zone 3	500 W
Zone 4	900 W

Small Commercial Example

What is allowed exterior lighting power?

2. Power allowances for building exteriors

Located in
exterior lighting
zone #3

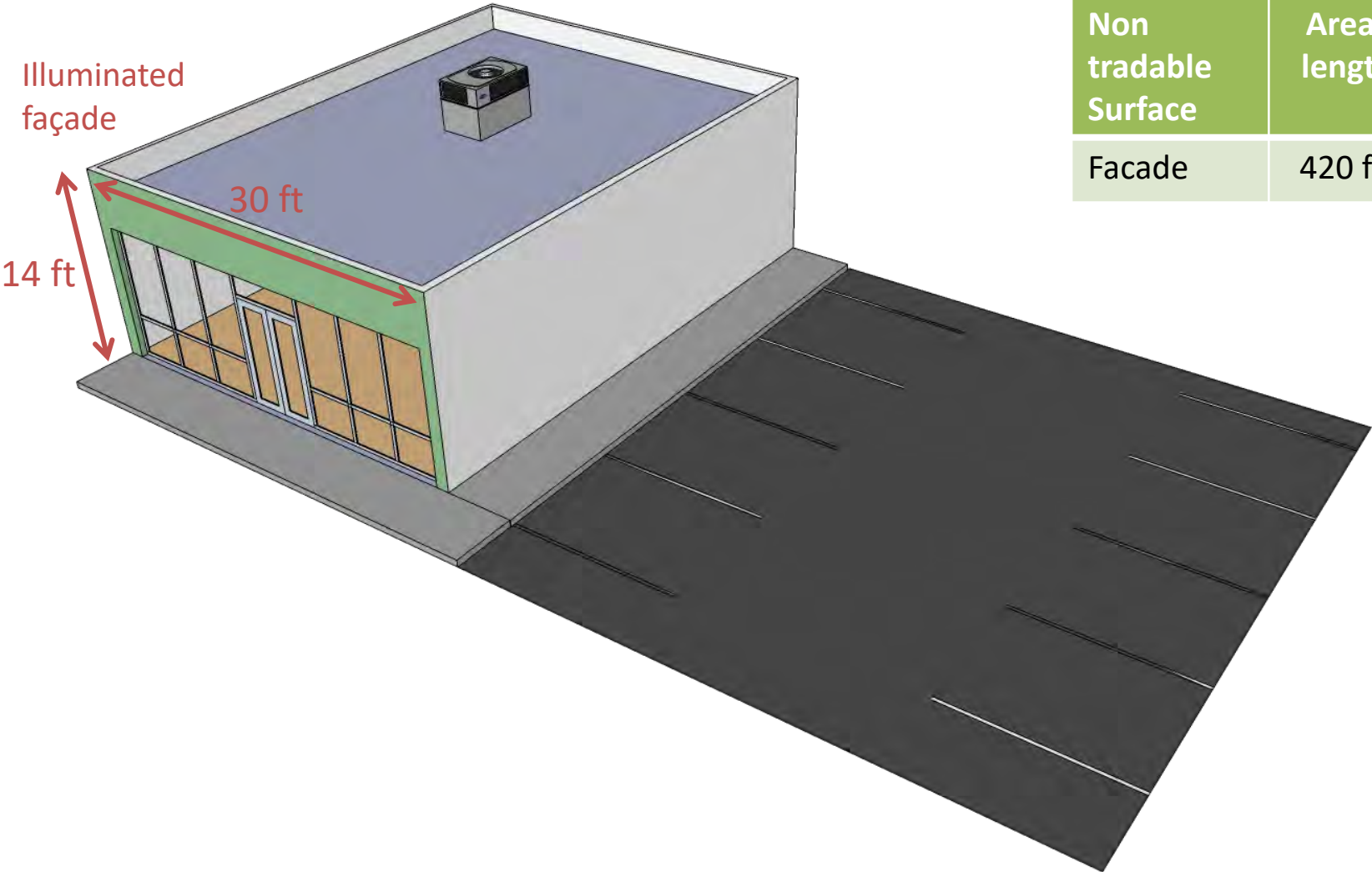


Tradable Surfaces	Area/length	Unit Allowance	Allowance
Parking lot	1,600 ft ²	0.06 W/ft ²	96W
Walkway	40 ft	0.6 W/ft	24W
Main entry	6 ft	21 W/ft	126W
Subtotal			246W
Base site allowance (previous slide)			500 W
Total			746 W

Small Commercial Example

What is allowed exterior lighting power?

3. Additional exterior lighting power



Non tradable Surface	Area/ length	Unit Allowance	Allowance
Facade	420 ft ²	0.113 W/ft ²	47W

Lighting Solutions



Green Building Hawaii offers solutions to new construction and existing building lighting retrofits



Lighting audits and lighting design plan reviews can ensure code compliance, maximize Hawaii Energy rebates as well as long term energy efficiency savings benefits

Lighting Retrofit Energy Savings

Lighting audits will provide financial analysis for project approval

Location	Estimated Total Gross Cost	Total Annual Cost Saved	Estimated Total Net Cost (after rebates)	Estimated Life Savings \$\$	Estimated Simple Payback after Rebates (in years)	Estimated ROI After Rebates
Recreation Center 7	\$37,584	\$14,436	\$31,426	\$246,918	2.2	46%



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Electrical transformers

Electrical transformers (C405.6)

TABLE C405.6
MINIMUM NOMINAL EFFICIENCY LEVELS FOR 10 CFR 431 LOW-VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMERS

SINGLE-PHASE TRANSFORMERS		THREE-PHASE TRANSFORMERS	
kVA ^a	Efficiency (%) ^b	kVA ^a	Efficiency (%) ^b
15	97.70	15	97.89
25	98.00	30	98.23
37.5	98.20	45	98.40
50	98.30	75	98.60
75	98.50	112.5	98.74
100	98.60	150	98.83
167	98.70	225	98.94
250	98.80	300	99.02
333	98.90	500	99.14
—	—	750	99.23
—	—	1000	99.28

a. kiloVolt-Amp rating.

b. Nominal efficiencies shall be established in accordance with the [DOE 10 CFR 431](#) test procedure for low-voltage dry-type transformers.



Electrical motors

Electrical motors (C405.7)

- Minimum efficiency tables
 - NEMA design A, NEMA design B, and IEC design N: 1 to 500 hp
 - NEMA design C and IEC design H: 1 to 200 hp
 - Polyphase small, 0.25 to 3 hp
 - Capacitor-start capacitor-run and capacitor-start induction run, 0.25 to 3 hp
 - Some exceptions



Vertical & horizontal transport

Elevator cabs (C405.8.1)

- Lighting ≥ 35 lumens/W
- Ventilation fans ≤ 0.33 watts/cfm
- Lights and fans auto off after 15 minutes



Vertical & horizontal transport

Escalators and moving walks (C405.8.2)

- Automatic speed controls
 - Or variable-voltage drive system
- Regenerative drive for down escalators and reversible escalators



Electrical distribution

Voltage drop in feeders and branch circuits (C405.9)

- The total voltage drop across the combination of feeders and branch circuits shall not exceed 5 percent

New for 2018

Sub-Metering

Sub metering (C405.10)

- Metering for new buildings with tenants
 1. Entire building, and
 2. Each tenant occupying $\geq 1,000 \text{ ft}^2$
- Tenants shall have access to data collected for their space

State amendment

C405.10 Sub-metering. In new buildings with tenants, metering shall be collected for the entire building and individually for each tenant occupying $1,000 \text{ ft}^2$ (total enclosed and unenclosed) (93 m^2) or more. Tenants shall have access to data collected for their space. A tenant is defined as "one who rents or leases from a landlord."



Electric Vehicle Infrastructure

No requirements in the State amendments

Solar ready zone - commercial

New for 2018

Appendix CA Solar Ready Zone (not mandatory)

- SOLAR-READY ZONE. A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Provisions

- Construction documents
- Solar-ready zone area
- Obstructions
- Roof loads and documentation
- Interconnection pathway
- Electrical service reserved space
- Certificate

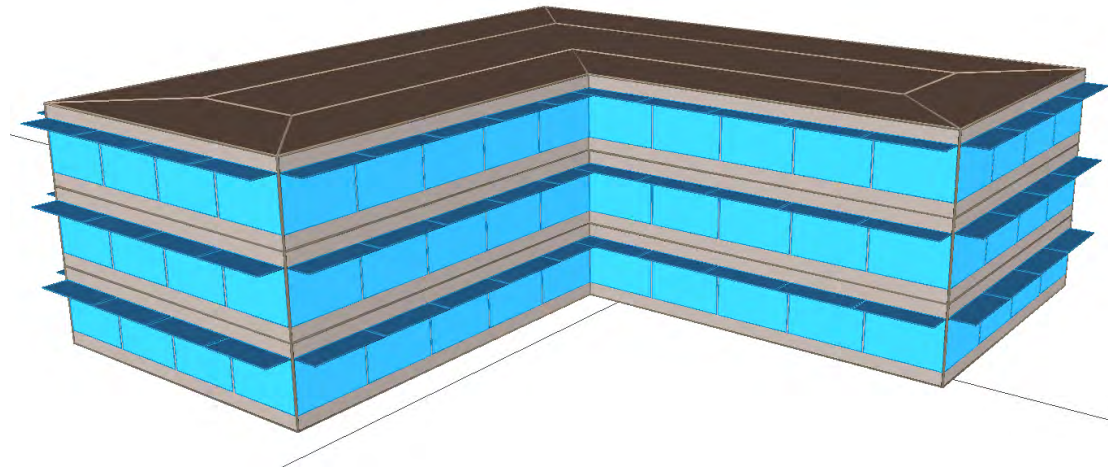
Functional testing of lighting controls

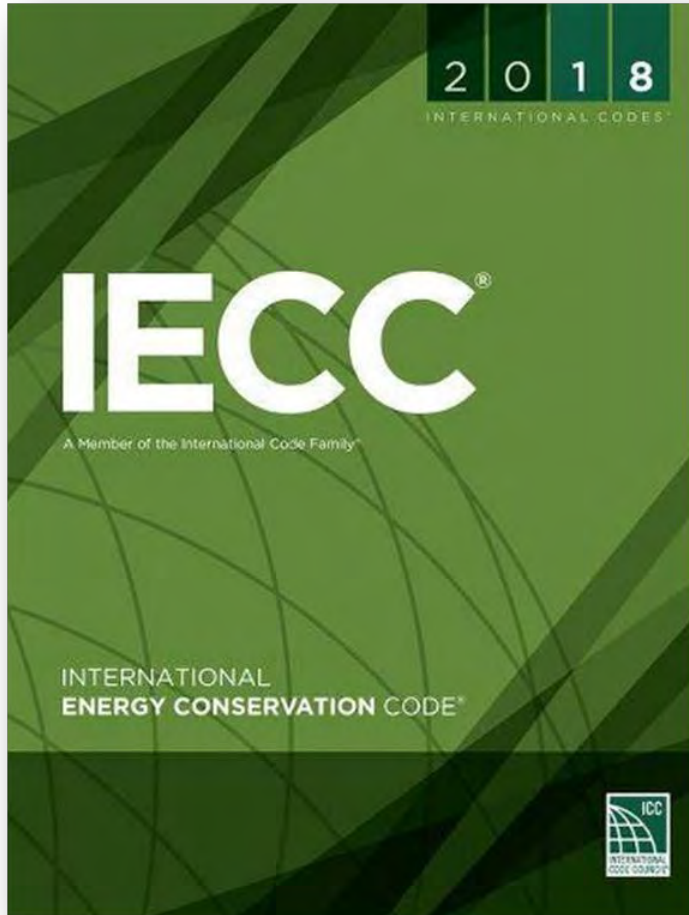
Functional testing of lighting controls (C408.3)

- 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
- Documentation
 - Equipment on drawings
 - O&M manuals provided
 - Report of test results provided

Section 7

Energy modeling for code compliance





C401.2 Application.

Commercial buildings shall comply with one of the following:

1. The requirements of ANSI/ASHRAE/IESNA 90.1.
2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Mandatory requirements

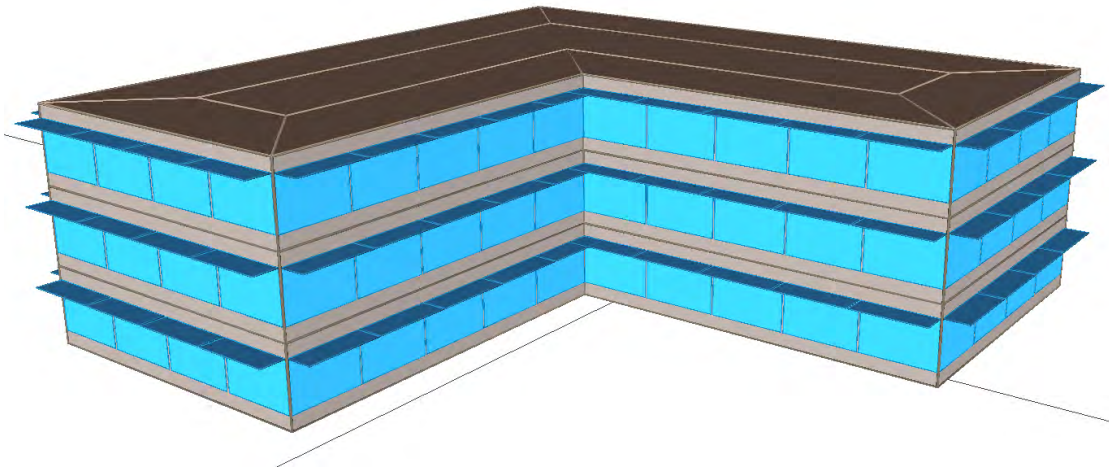
and

C407. Total Building Performance

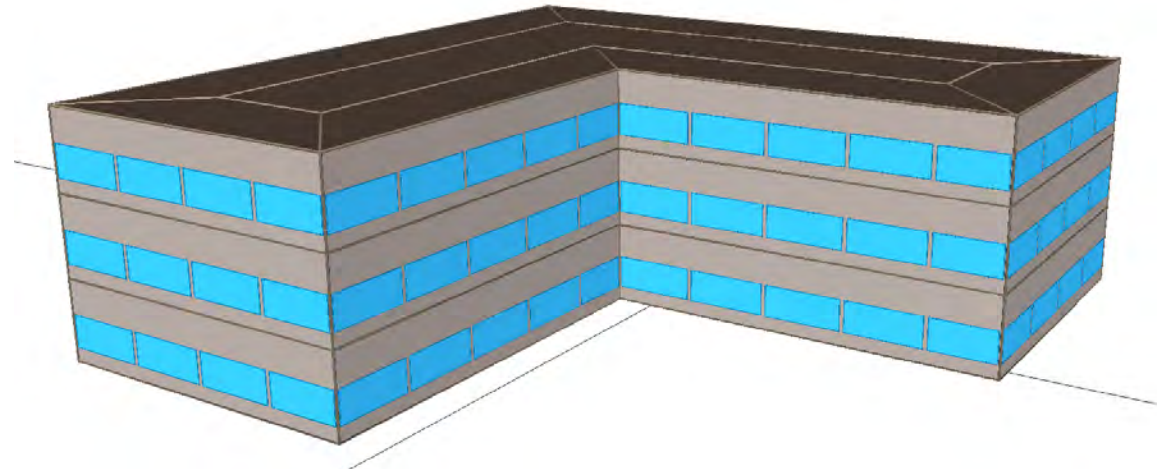
Energy modeling for code compliance

C407 Total Building Performance

Proposed design model



Standard reference design model



Proposed design
\$/year

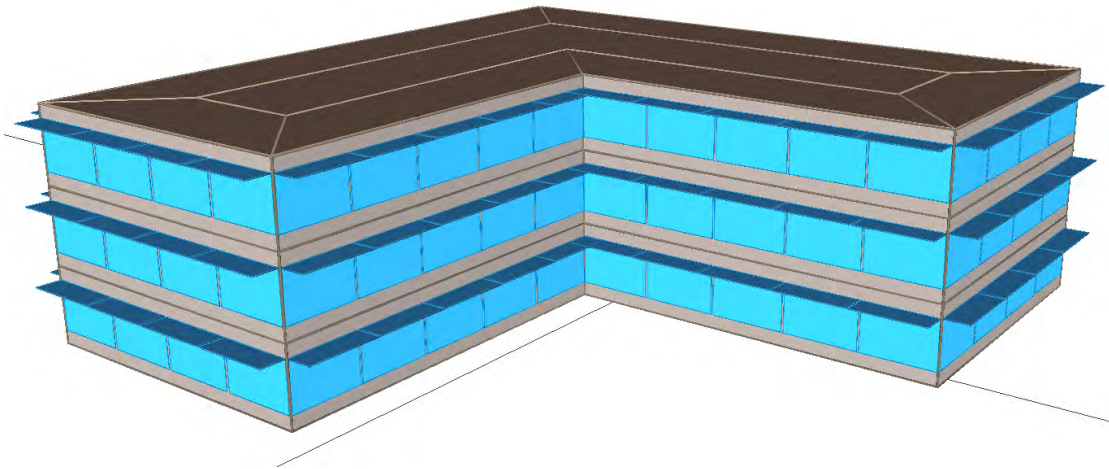
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Standard reference design
\$/year x 0.85

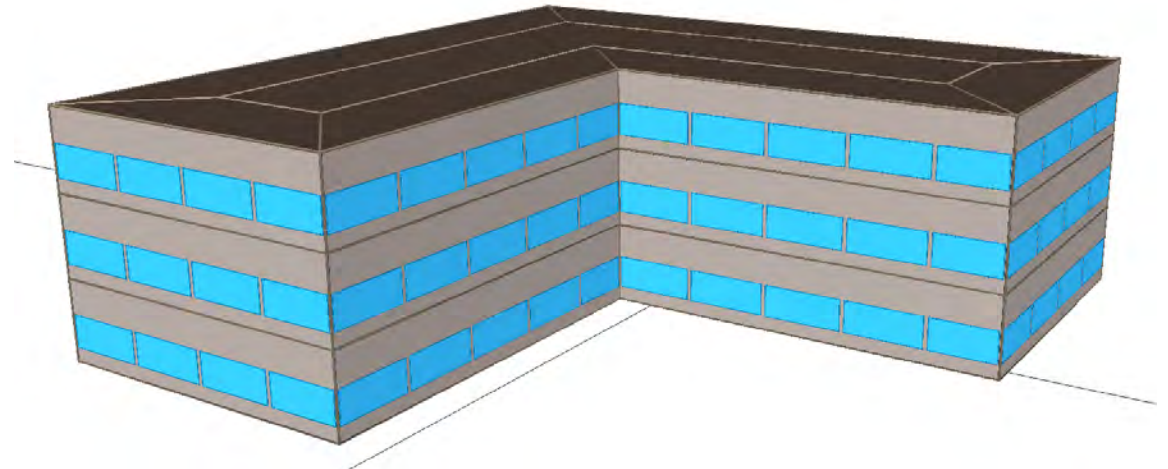
Energy modeling for code compliance

C407 Total Building Performance

Proposed design model



Standard reference design model



As designed

- Envelope
- HVAC
- Domestic hot water
- Interior lighting
- Exterior lighting
- Plug loads

Same for both models

- Floor area
- Building form
- Plug loads
- Occupancy schedule
- HVAC schedule
- Utility rates
- Weather data

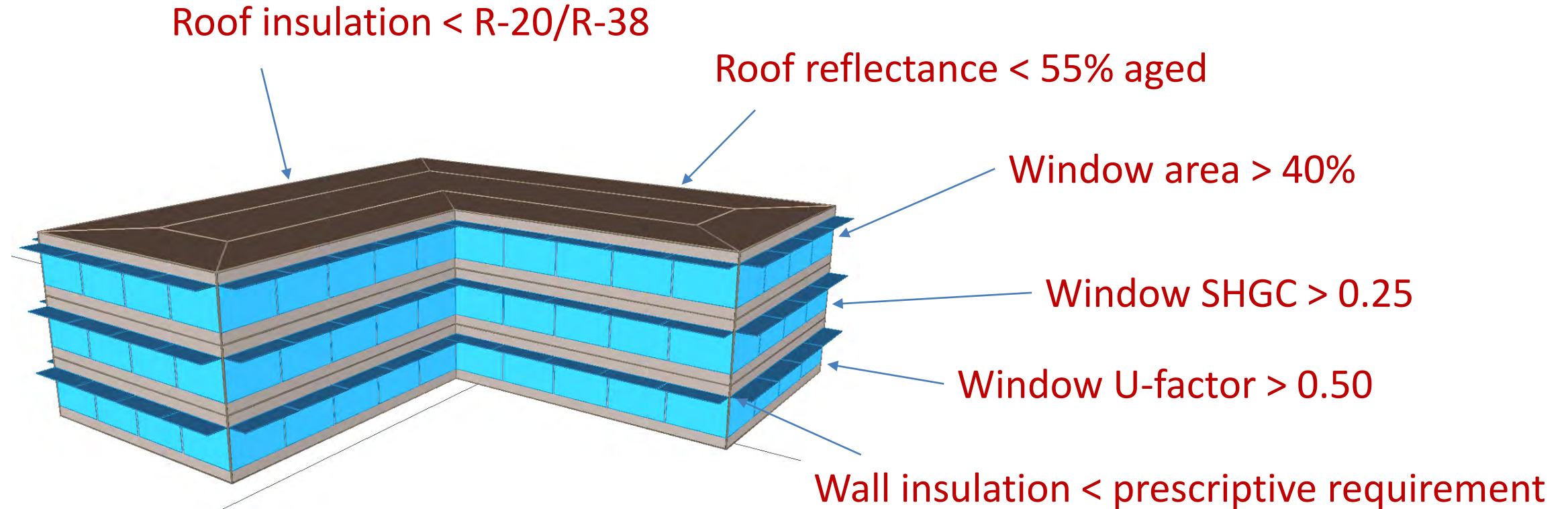
Per section C407

- Standard constructions and glazing
- Standard HVAC type & efficiency
- Standard DHW and lighting
- No exterior shading
- Window-wall ratio capped at 40%
- Skylight-roof ratio capped at 3%

Energy modeling for code compliance

C407 Total Building Performance

Why use it?

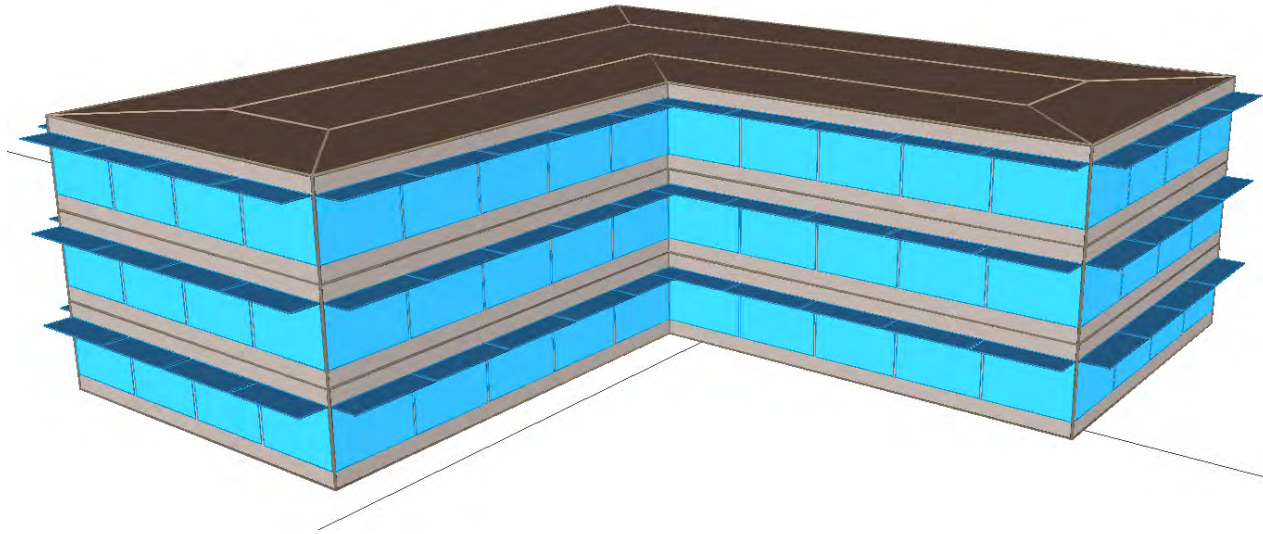


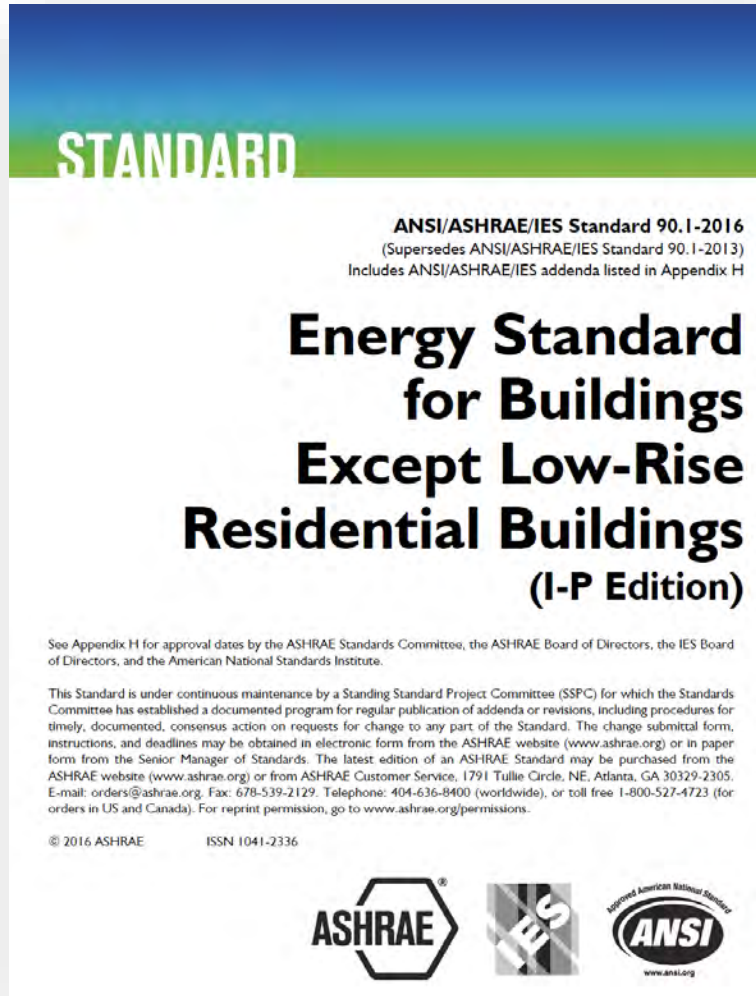
Energy modeling for code compliance

C407 Total Building Performance

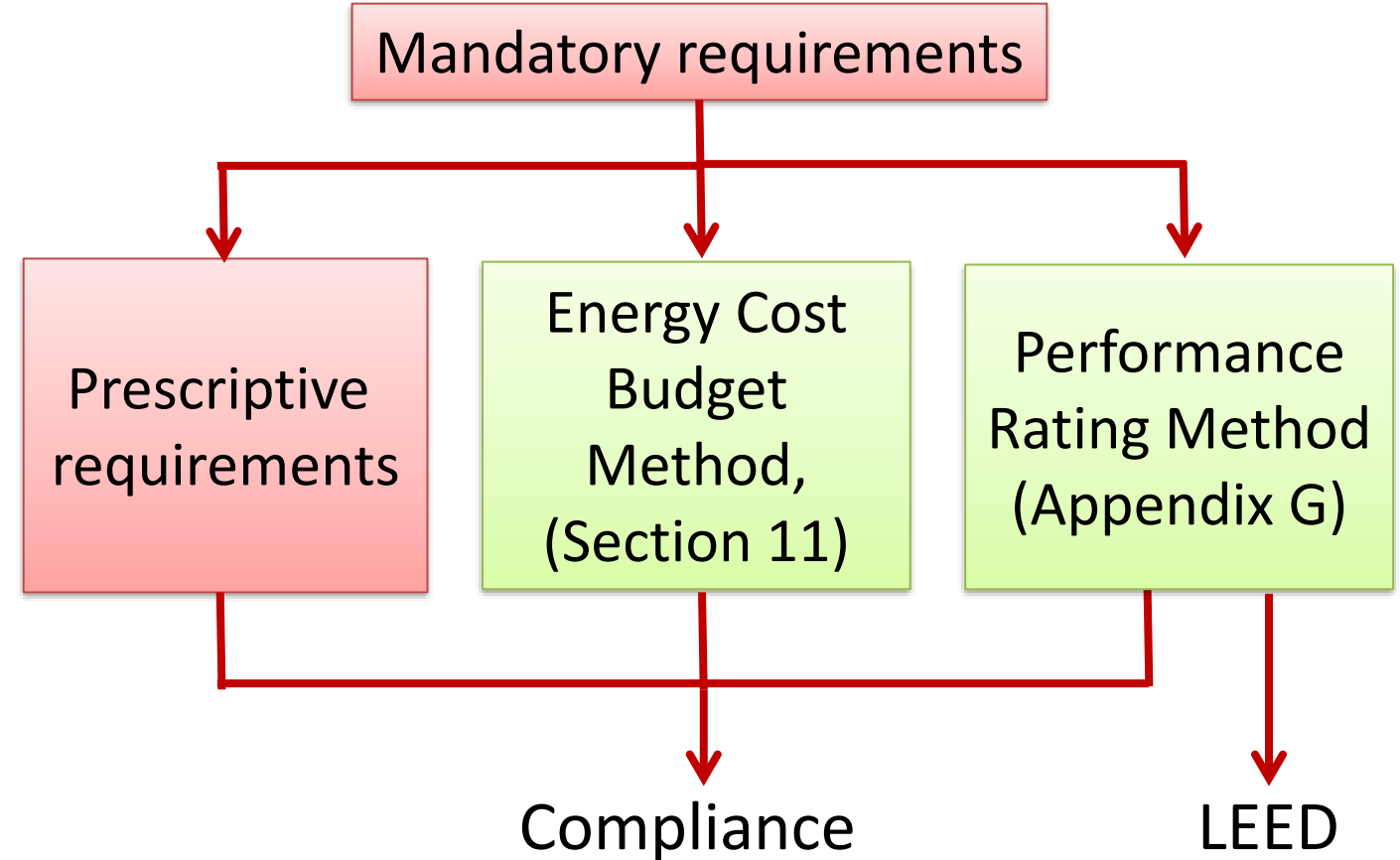
Typical measures that get credit

- Low lighting power
- Exterior window shading
- Envelope constructions that exceed prescriptive requirements
- Efficient HVAC equipment
- Efficient HVAC system type





ASHRAE Standard 90.1-2016 Compliance



Free online viewer

https://ashrae.iwrapper.com/ViewOnline/Standard_90.1-2013_I-P

Section 8

Existing Building Compliance

Additions (C502)

Two options

- Addition alone
- Addition + existing

New construction requirements apply

- Window & skylight area
- Window & skylight thermal performance
- Wall & roof thermal performance
- Mechanical systems
- Service water heating
- Pools and spas
- Interior lighting
- Exterior lighting

Alterations (C503)

Change in space conditioning (C503.2)


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

Alterations (C503)

Roof


Meet new construction insulation requirements

Exceptions

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

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

Options (Hawaii amendment)

1. New construction requirements
2. Initial solar reflectance $\geq 85\%$ and aged reflectance $\geq 63\%$
3. At least one of:
 1. EnergyStar compliant covering
 2. Radiant barrier
 3. Attic ventilation via solar fan(s), ridge ventilation or gable vents
 4. One or more exceptions in Section C402.3 
1. Portions covered by:
 - Photovoltaic systems or components.
 - Solar air or water-heating systems or components.
 - Roof gardens or landscaped roofs.
 - Above-roof decks or walkways.
 - Skylights.
 - HVAC systems and components, and other opaque objects mounted above the roof.
2. Portions shaded during summer solstice
3. Portions ballasted with stone 17 lb/sf

Alterations (C503)

Walls

R-value or U-factor for new construction

Exceptions

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

Alterations (C503)

Windows & skylights

- New construction performance for new windows and replacement windows or skylights
(Area weighted average allowed)
- Maximum area limit

Exception

- Glazing-only repairs of existing windows and skylights

Alterations (C503)

Heating and cooling systems (C503.4)

New systems and components meet new construction requirements

Service hot water systems (C503.5)

New systems and components meet new construction requirements

Lighting systems (C503.6)

New systems meet new construction requirements

Exception:

- <10% of luminaires in a space are replaced and lighting power does not increase

Section 9

Wrap Up

Q&A

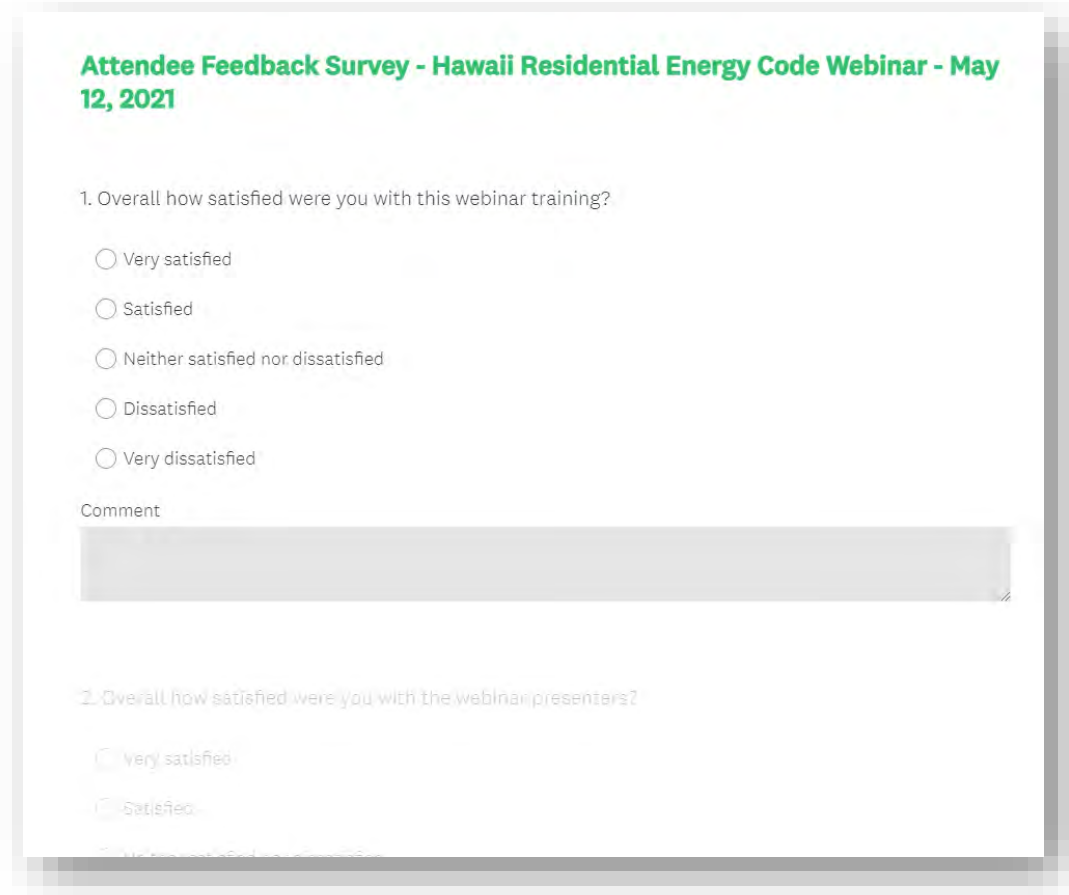
Howard Wiig, State Energy Office

Erik Kolderup, PE, Kolderup Consulting

Austin Van Heusen, Green Building Hawaii

Evaluation Survey

<https://www.surveymonkey.com/r/5KHT9FP>



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

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

☐ Very satisfied

☐ Satisfied

☐ Neither satisfied nor dissatisfied

☐ Dissatisfied

☐ Very dissatisfied

Comment

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

☐ Very satisfied

☐ Satisfied

☐ Neither satisfied nor dissatisfied

☐ Dissatisfied

☐ Very dissatisfied

For more energy code information

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2018 IECC available:

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

State Energy Code Website:

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

Hawaii Energy Code Website

- <https://hawaiienergy.com/codes>