Honolulu Energy Code

Commercial and High-rise Residential Requirements

December 6, 2023

HAWAI'I STATE ENERGY OFFICE

Presentation Collaborators

Hawaii Energy · AIA Honolulu · ASHRAE Hawaii Chapter

Hawaii Energy

An Overview of New Construction Efficiency Incentives

Section 1
Introduction & Scope

Section 2
Compliance

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Electric vehicle infrastructure

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Honolulu Energy Code

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AIA Honolulu

ASHRAE Hawaii Chapter

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

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

COURSE DESCRIPTION

Updates to Honolulu's building energy code take effect on November 23, 2023. Join this free hybrid session, either in-person or online, to learn how these changes will affect your projects. This session covers commercial and high-rise residential requirements, with highlights of changes to envelope, lighting and mechanical requirements. This code update moves Honolulu from the 2015 to the 2018 International Energy Conservation Code, with updated County amendments.

LEARNING OBJECTIVES

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

1. Identify applicable new requirements in the 2018 IECC
2. Determine applicable Honolulu amendments
3. Understand how to follow the Total Building Performance compliance path
4. Use energy code checklists to review designs for compliance

Introductions

Presenters

- Howard Wiig, State Energy Office
- Erik Kolderup, PE, Kolderup Consulting
- Ben Sullivan, City & County of Honolulu Office of Climate Change, Sustainability and Resiliency

Acknowledgments

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

Topics

Hawaii Energy Programs

Introduction & Scope

Compliance

Envelope

Mechanical

Service Water Heating

Electrical & Lighting

Energy Modeling for Code Compliance

Existing Building Compliance

Q&A

Hawai‘i Energy

An Overview of New Construction Efficiency Incentives

Incentives available for a wide range of high efficiency electric equipment

Appliances & Electronics

Audits & Retro-Commissioning

Building Envelope

Commercial Kitchen Equipment

Custom Projects

EV Charging Stations

HVAC

Industrial & Special Equipment

Lighting

New Construction

Pumps & Motors

Refrigeration

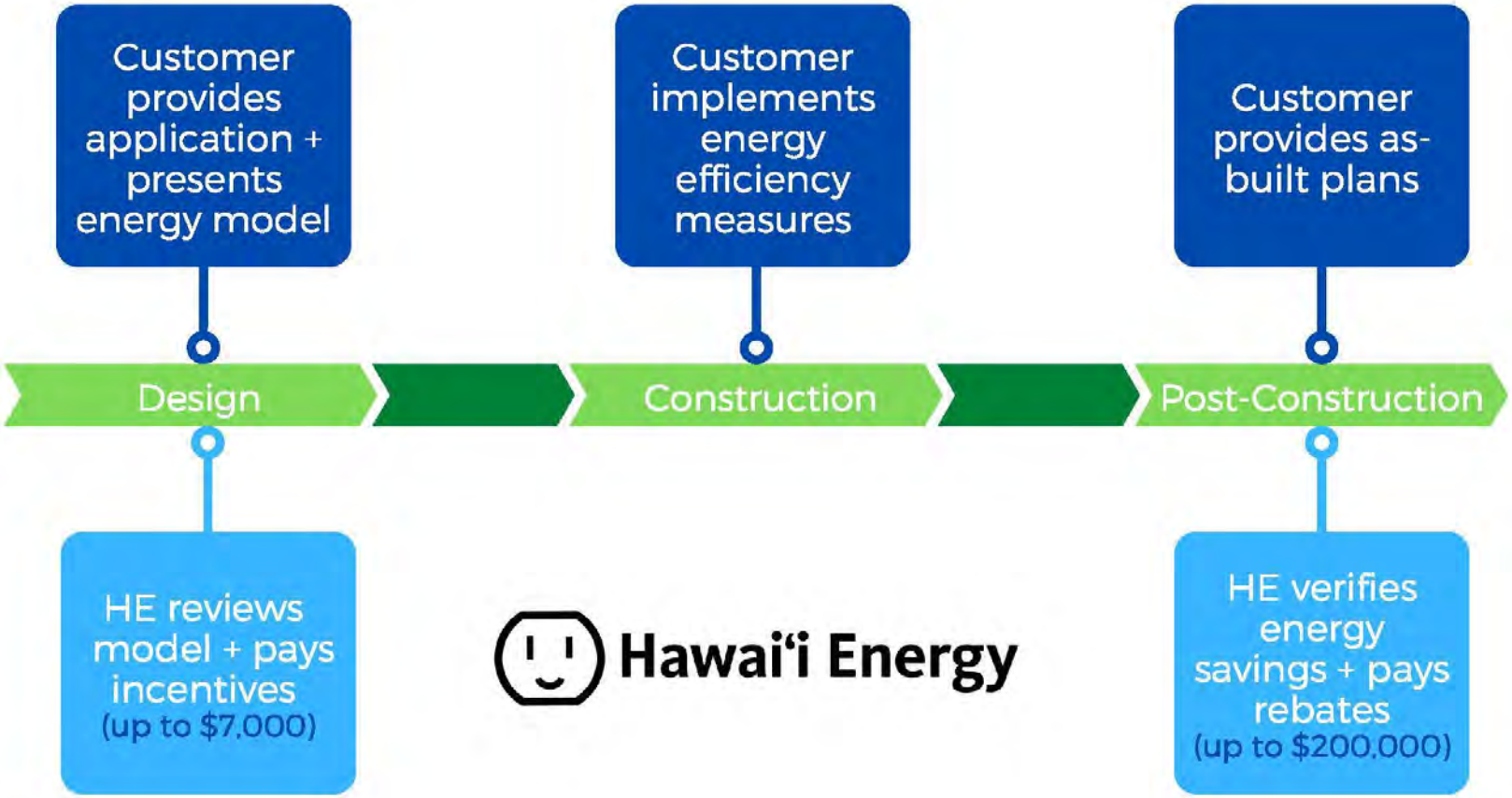
Smart Devices

Submetering

Water Heating

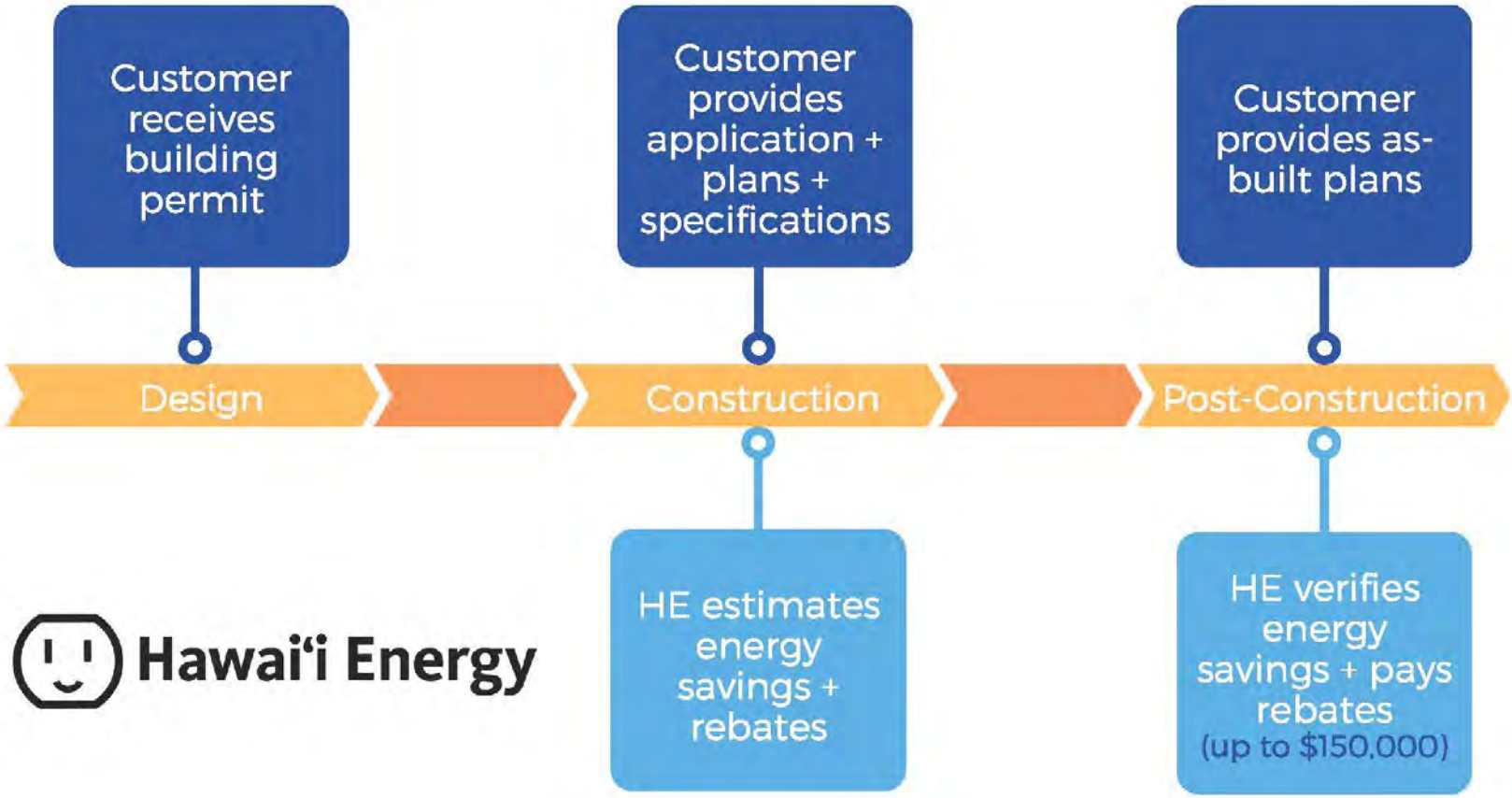
Two tracks for new construction incentives

Energy Model Approach



Two tracks for new construction incentives

Systems Approach



Hawai'i Energy

Mahalo!

Stay Connected

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

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

www.hawaiienergy.com

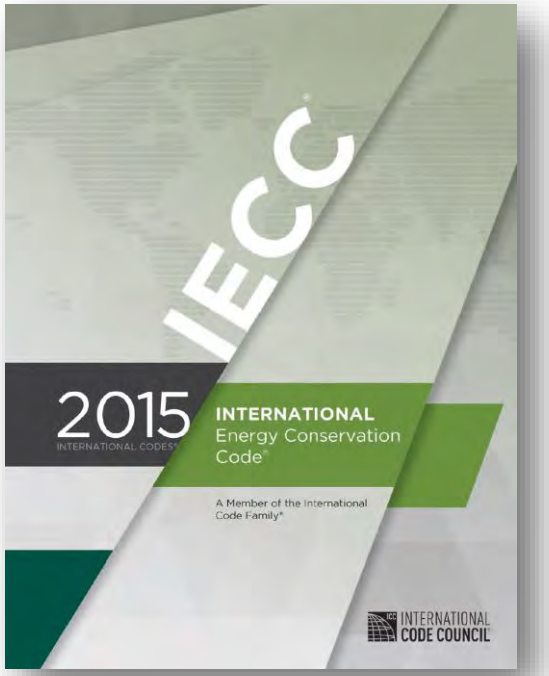
facebook.com/hawaiienergy @myhawaiienergy

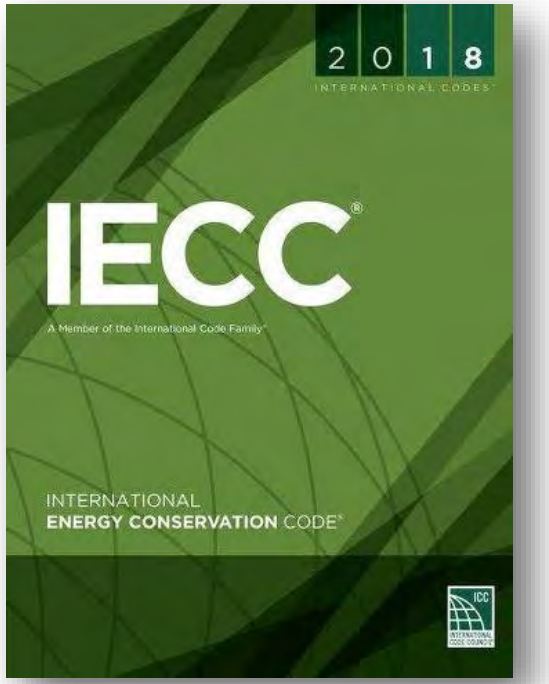
Eileen Stewart

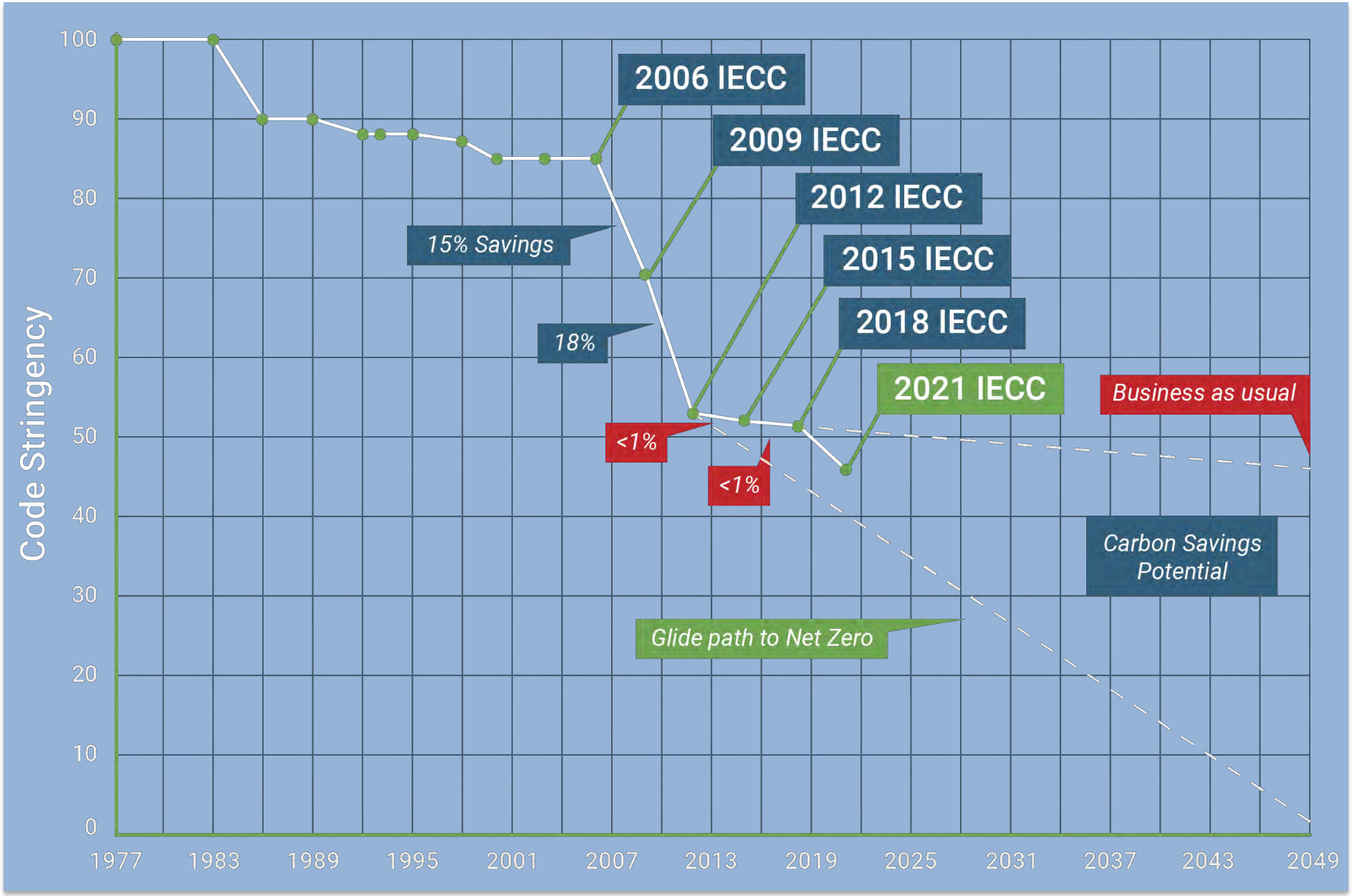
Business Solutions Manager

Section 1

Introduction & Scope

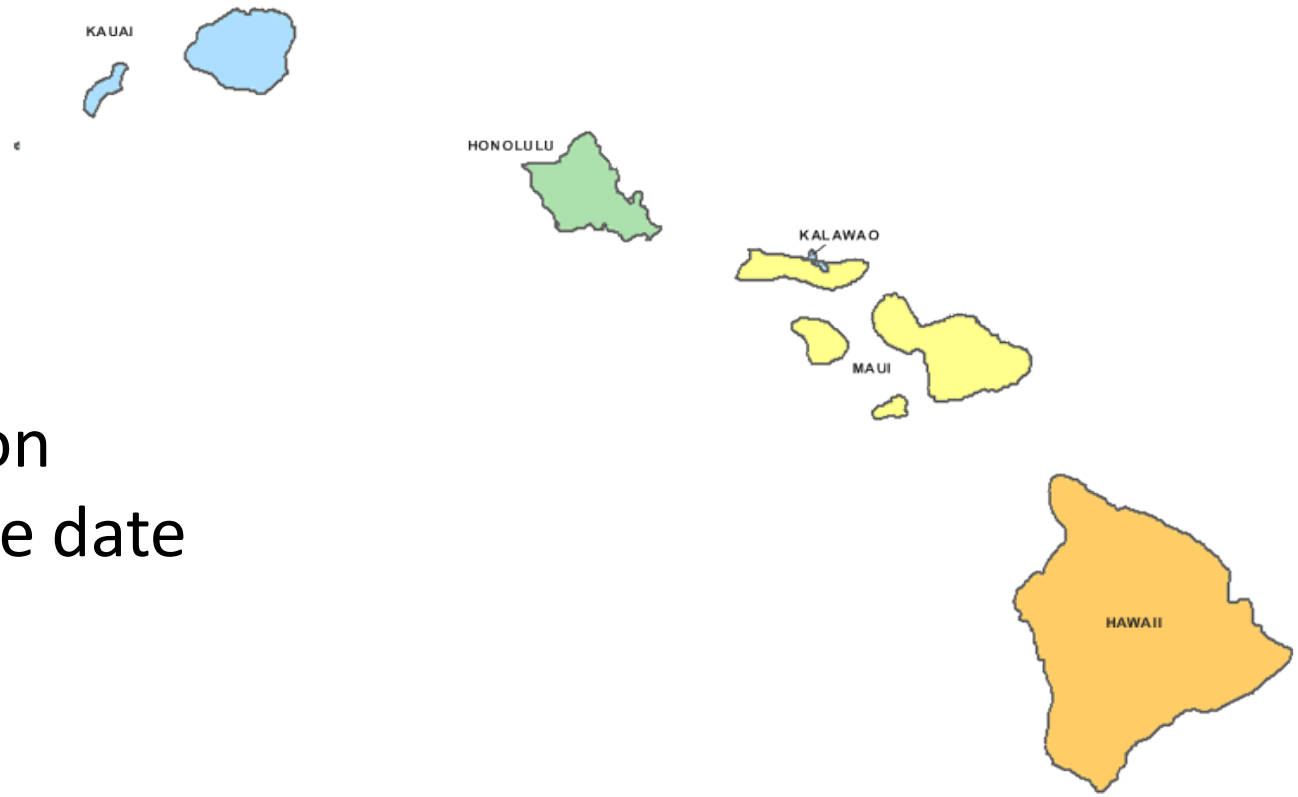






Source: Energy Efficient Codes Coalition. https://energyefficientcodes.org/iecc/

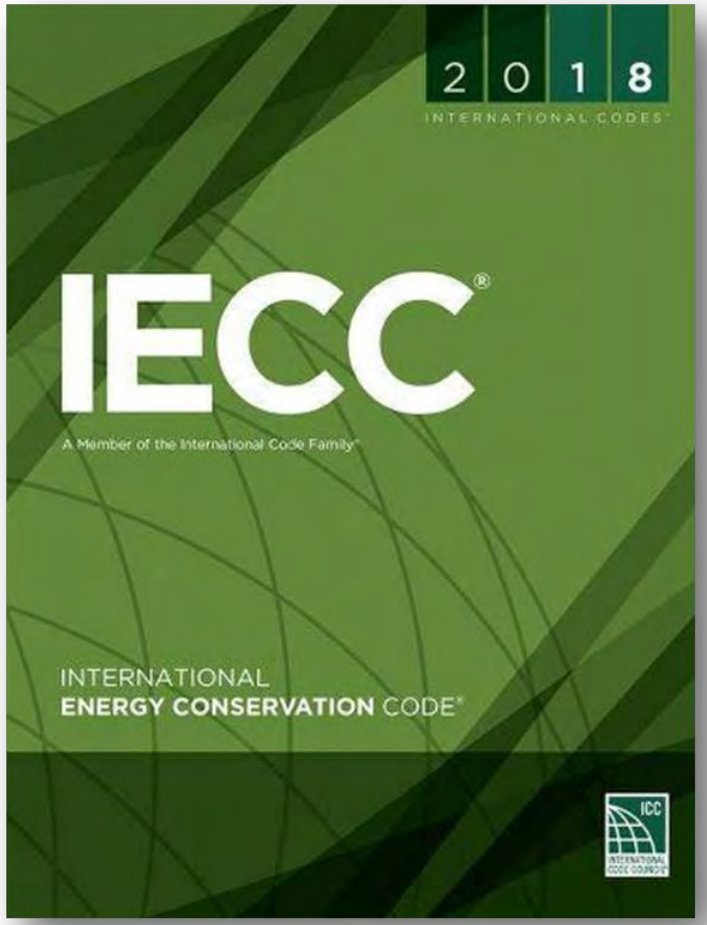
Adoption

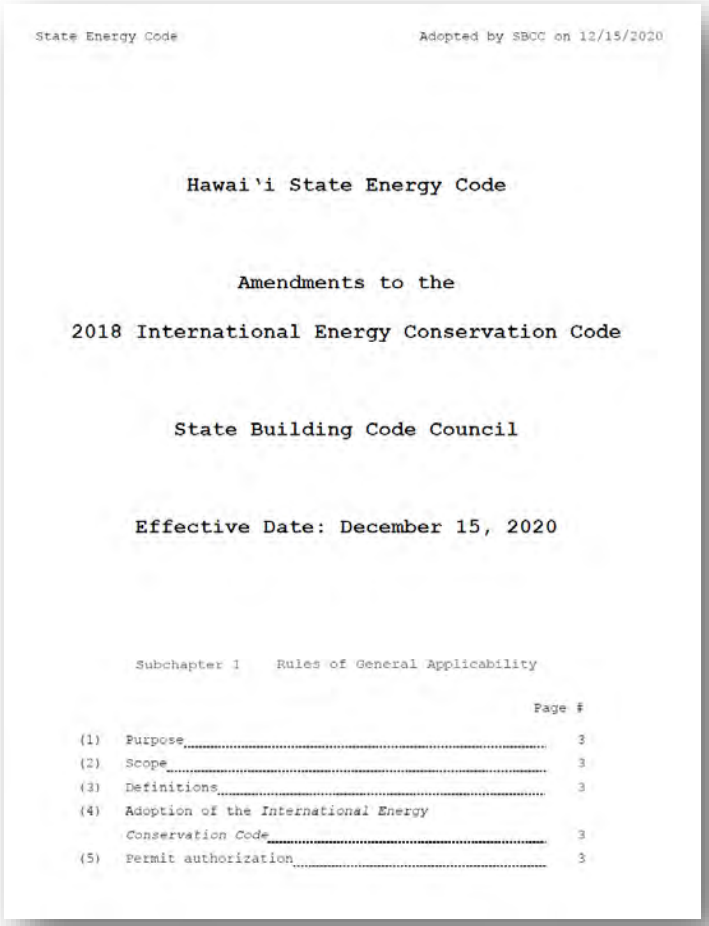


Dec. 15, 2020 – State adoption
Aug. 23, 2023 – Honolulu adoption
Nov. 23, 2023 – Honolulu effective date

State amendments
12 pages

Honolulu amendments
38 pages





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

Hawai'i State Energy Code

Amendments to the

2018 International Energy Conservation Code

State Building Code Council

Effective Date: December 15, 2020

Subchapter 1 Rules of General Applicability

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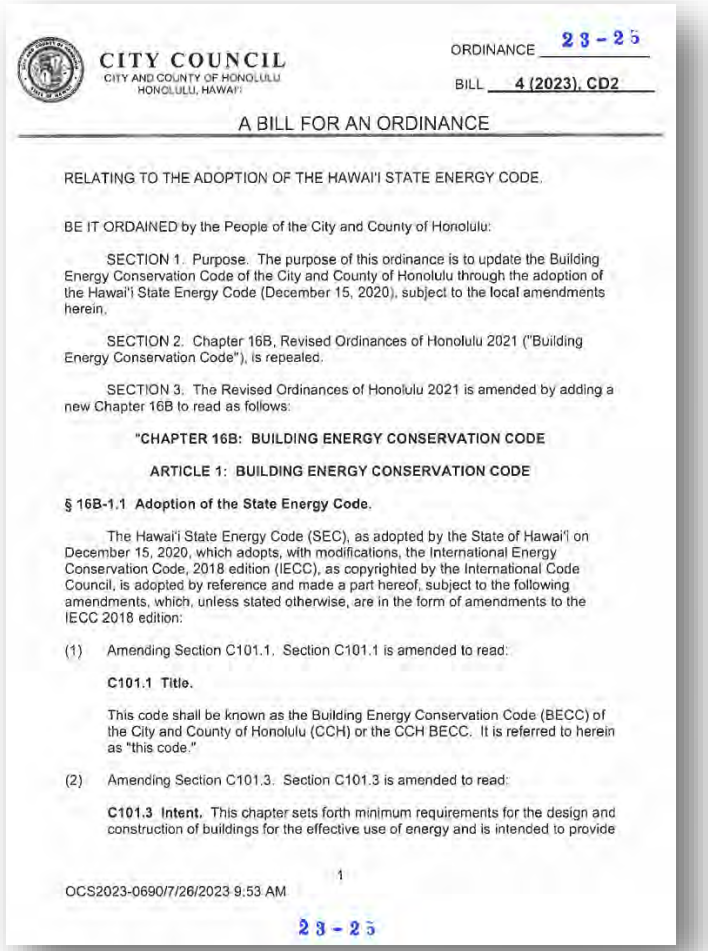
(1) Purpose 3
(2) Scope 3
(3) Definitions 3
(4) Adoption of the *International Energy Conservation Code* 3
(5) Permit authorization 3



CITY COUNCIL
CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAI'I

ORDINANCE 23-25

BILL 4 (2023), CD2

A BILL FOR AN ORDINANCE

RELATING TO THE ADOPTION OF THE HAWAI'I STATE ENERGY CODE.

BE IT ORDAINED by the People of the City and County of Honolulu:

SECTION 1. Purpose. The purpose of this ordinance is to update the Building Energy Conservation Code of the City and County of Honolulu through the adoption of the Hawai'i State Energy Code (December 15, 2020), subject to the local amendments herein.

SECTION 2. Chapter 16B, Revised Ordinances of Honolulu 2021 ("Building Energy Conservation Code"), is repealed.

SECTION 3. The Revised Ordinances of Honolulu 2021 is amended by adding a new Chapter 16B to read as follows:

"CHAPTER 16B: BUILDING ENERGY CONSERVATION CODE

ARTICLE 1: BUILDING ENERGY CONSERVATION CODE

§ 16B-1.1 Adoption of the State Energy Code.

The Hawai'i State Energy Code (SEC), as adopted by the State of Hawai'i on December 15, 2020, which adopts, with modifications, the International Energy Conservation Code, 2018 edition (IECC), as copyrighted by the International Code Council, is adopted by reference and made a part hereof, subject to the following amendments, which, unless stated otherwise, are in the form of amendments to the IECC 2018 edition:

(1) Amending Section C101.1. Section C101.1 is amended to read:

C101.1 Title.

This code shall be known as the Building Energy Conservation Code (BECC) of the City and County of Honolulu (CCH) or the CCH BECC. It is referred to herein as "this code."

(2) Amending Section C101.3. Section C101.3 is amended to read:

C101.3 Intent. This chapter sets forth minimum requirements for the design and construction of buildings for the effective use of energy and is intended to provide

1

OCS2023-0690/7/26/2023 9:53 AM

23-25

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

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

https://www.resilientoahu.org/energycode

Scope

Residential

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

Courtesy Daniel Sandomire, Armstrong Builders

Today's topic

Commercial

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

Scope

Mixed use buildings

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

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

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/Honolulu amendments

- Mass wall insulation exceptions updated
- Roof replacement alternatives updated
- Increased skylight area exception updated
- EV-ready affordable housing exception updated
- Voluntary stretch code added

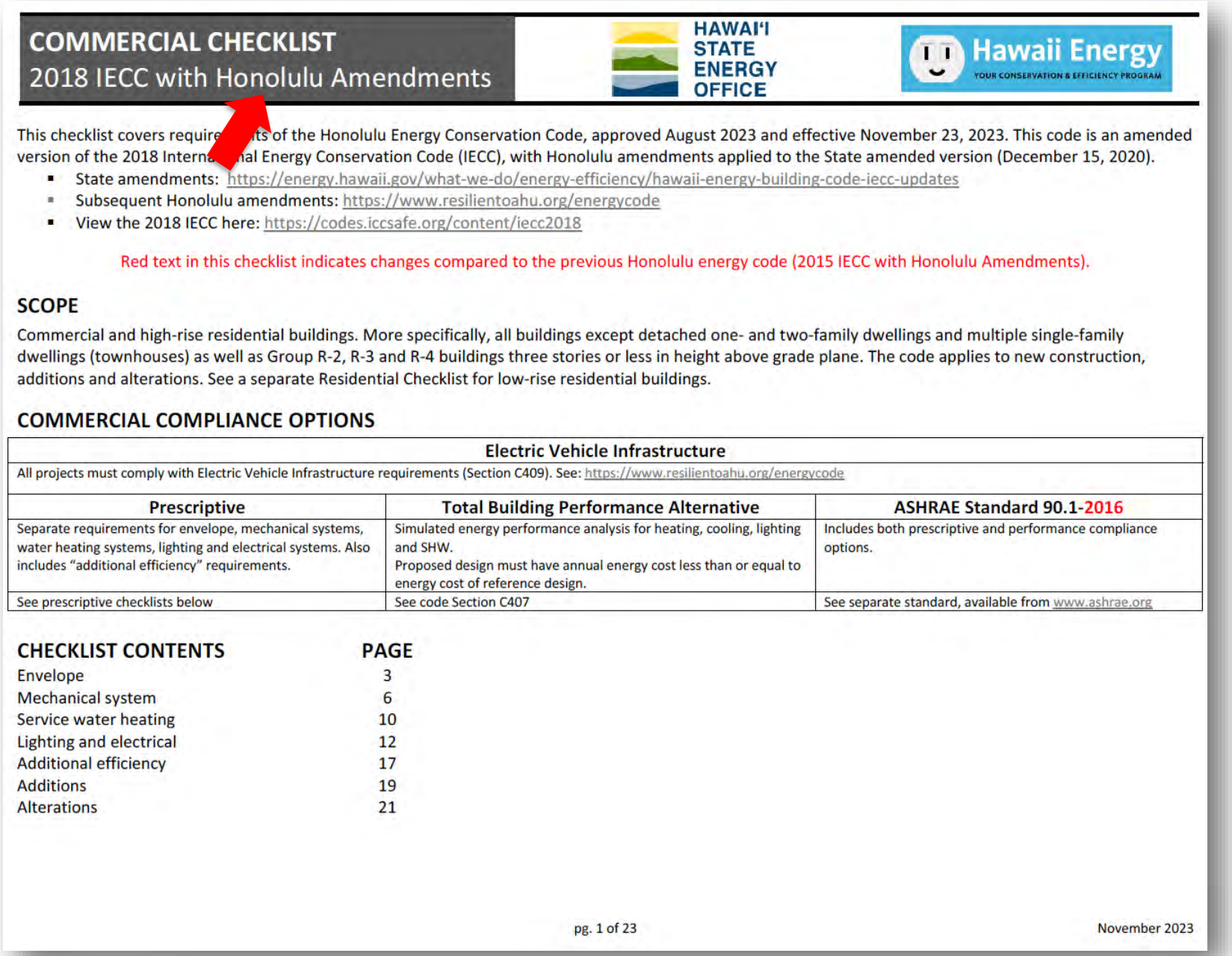
Amended IECC sections - commercial

IECC Section	Description	State or Honolulu Amendment
C103.1, C103.2	Designer certification	Honolulu
C402.1.1	Low-energy buildings (envelope scope)	Honolulu
C402.1, C402.2	Wall – mass (CMU or concrete)	Honolulu
C402.1, C402.2	Wall – metal frame	Honolulu
C402.1, C402.2	Wall – wood frame and other	Honolulu
C402.4.3	Windows – solar heat gain coefficient (SHGC)	State
C402.4.1.2	Skylights – maximum area	Honolulu
C403.2.2	Ventilation	Honolulu
C403.2.4.2.4	Door switches	State
C404.5.3	Hot water pipe insulation	Honolulu
C202	High efficacy lighting definition	Honolulu
C405.2.2	Controls - time-switch	Honolulu
C405.2.2.2	Controls – light reduction	Honolulu
C405.2.3	Controls - daylight-responsive	Honolulu
C405.2.4	Controls – guest rooms	State
C405.10	Electrical sub-metering	State
C406.3	Reduced lighting power density	Honolulu
C408.2	Mechanical system commissioning	Honolulu
C409	Electric vehicle infrastructure	Honolulu
C503.1, C503.3.1	Roof replacement	Honolulu

Resources

Checklists

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



COMMERCIAL CHECKLIST
2018 IECC with Honolulu Amendments

HAWAIʻI STATE ENERGY OFFICE

Hawaii Energy
YOUR CONSERVATION & EFFICIENCY PROGRAM

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

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

Red text in this checklist indicates changes compared to the previous Honolulu energy code (2015 IECC with Honolulu Amendments).

SCOPE

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

Electric Vehicle Infrastructure		
All projects must comply with Electric Vehicle Infrastructure requirements (Section C409). See: https://www.resilientoahu.org/energycode		
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 checklists below	See code Section C407	See separate standard, available from www.ashrae.org

CHECKLIST CONTENTS **PAGE**

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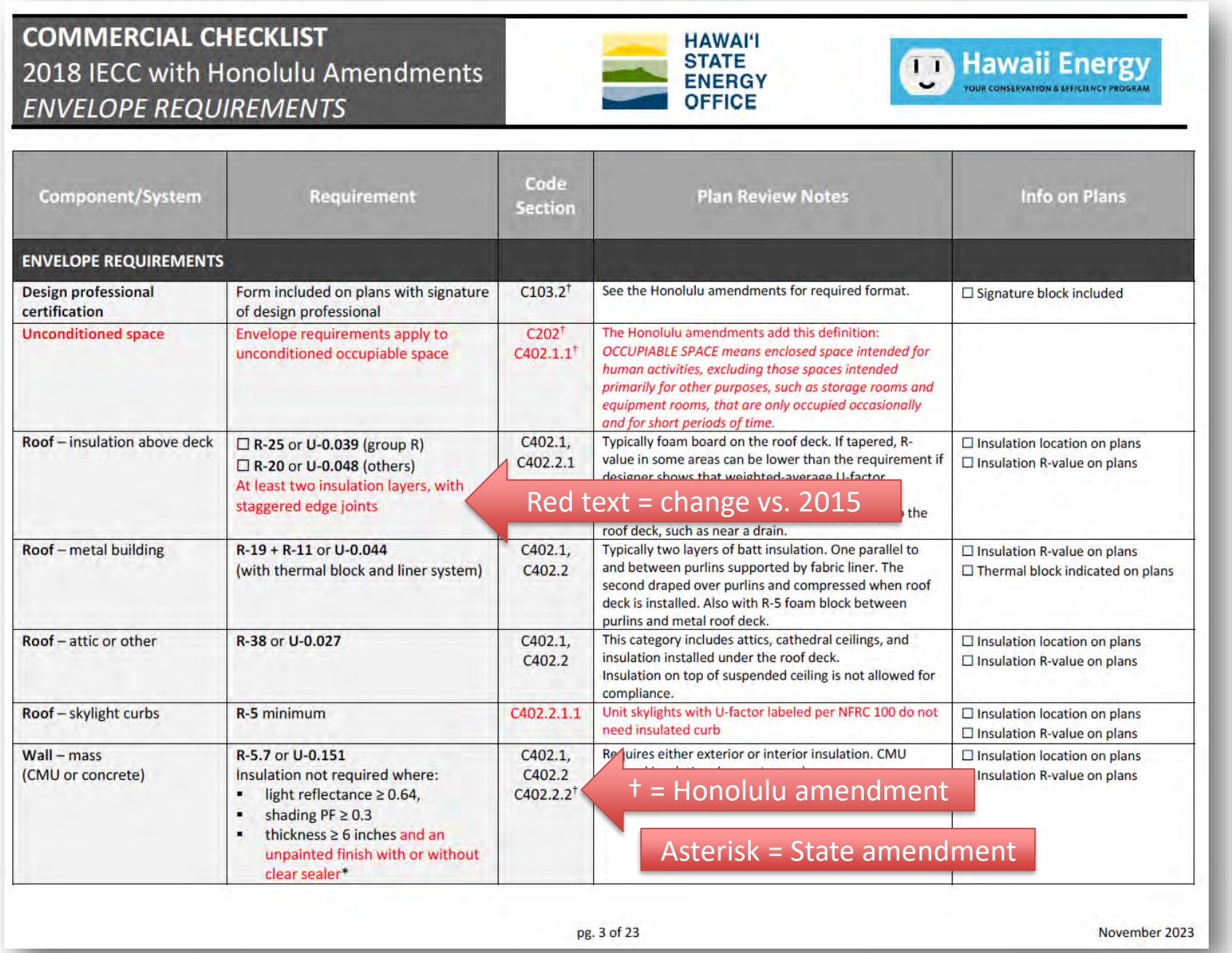
November 2023

Resources

Checklists

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



COMMERCIAL CHECKLIST
2018 IECC with Honolulu Amendments
ENVELOPE REQUIREMENTS

HAWAI'I STATE ENERGY OFFICE

Hawaii Energy
YOUR CONSERVATION & EFFICIENCY PROGRAM

Component/System	Requirement	Code Section	Plan Review Notes	Info on Plans
ENVELOPE REQUIREMENTS				
Design professional certification	Form included on plans with signature of design professional	C103.2†	See the Honolulu amendments for required format.	☐ Signature block included
Unconditioned space	Envelope requirements apply to unconditioned occupiable space	C202† C402.1.1†	The Honolulu amendments add this definition: *OCCUPIABLE SPACE means enclosed space intended for human activities, excluding those spaces intended primarily for other purposes, such as storage rooms and equipment rooms, that are only occupied occasionally and for short periods of time.*	
Roof – insulation above deck	☐ **R-25** or **U-0.039** (group R) ☐ **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 designer shows that weighted-average U-factor … the roof deck, such as near a drain.	☐ Insulation location on plans ☐ 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.	☐ Insulation R-value on plans ☐ 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.	☐ Insulation location on plans ☐ 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	☐ Insulation location on plans ☐ Insulation R-value on plans
Wall – mass (CMU or concrete)	**R-5.7** or **U-0.151** Insulation not required where: ▪ light reflectance ≥ 0.64, ▪ shading PF ≥ 0.3 ▪ thickness ≥ 6 inches and an unpainted finish with or without clear sealer*	C402.1, C402.2 C402.2.2†	Requires either exterior or interior insulation. CMU …	☐ Insulation location on plans ☐ Insulation R-value on plans

Red text = change vs. 2015

† = Honolulu amendment

Asterisk = State amendment

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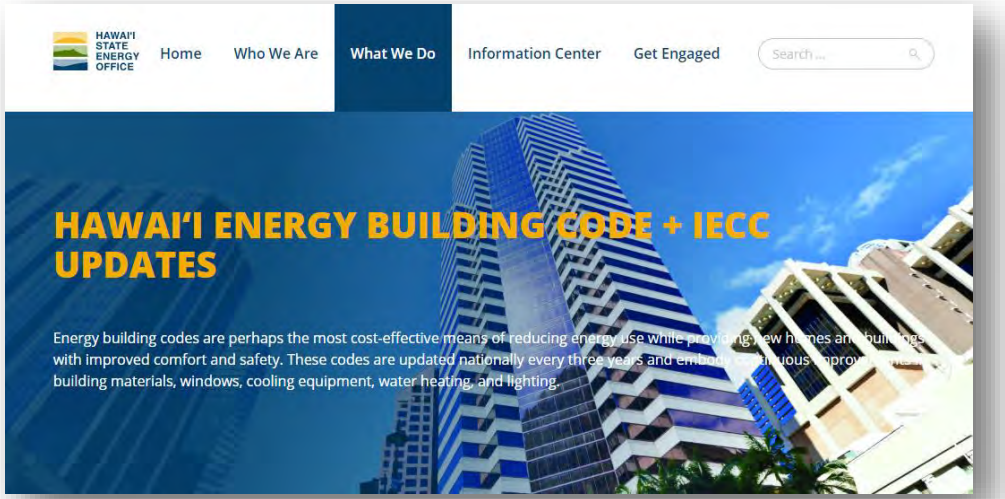
November 2023

Resources

HSEO Website

Past training materials



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

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

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

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

- Presentation: Complying With the Energy Code – 2018 IECC with Hawai'i Amendments
- Video: Energy Code Webinar

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

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

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

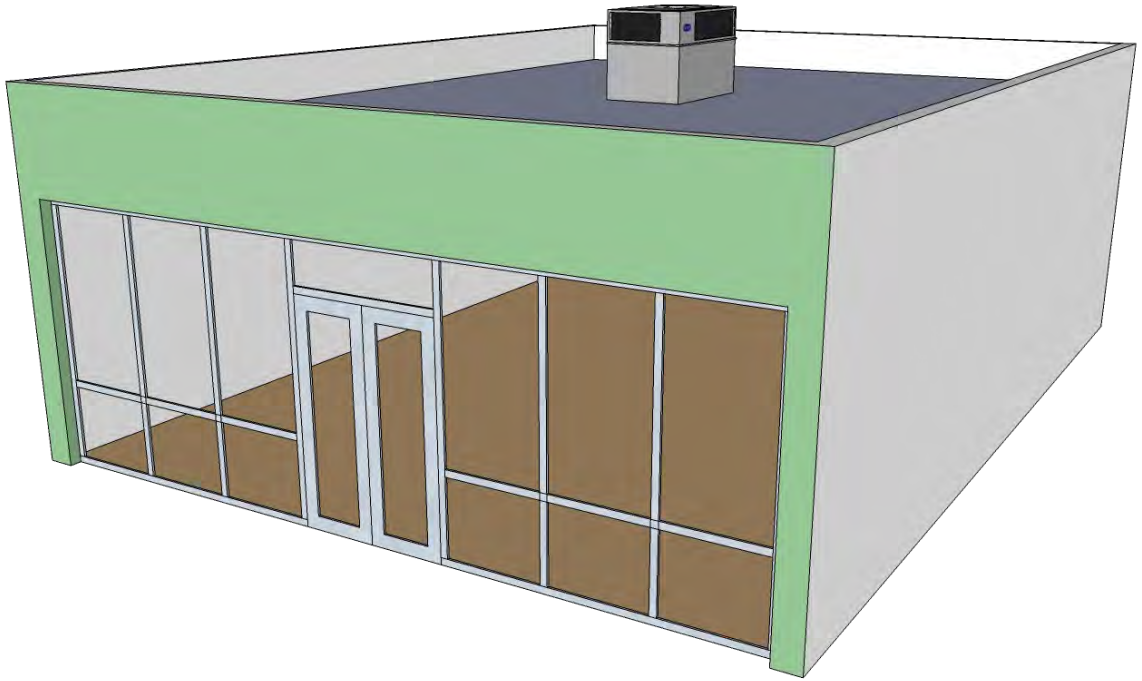
Commercial and High-Rise Residential Requirements Training Material

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

Low-Rise Residential Requirements Training Material

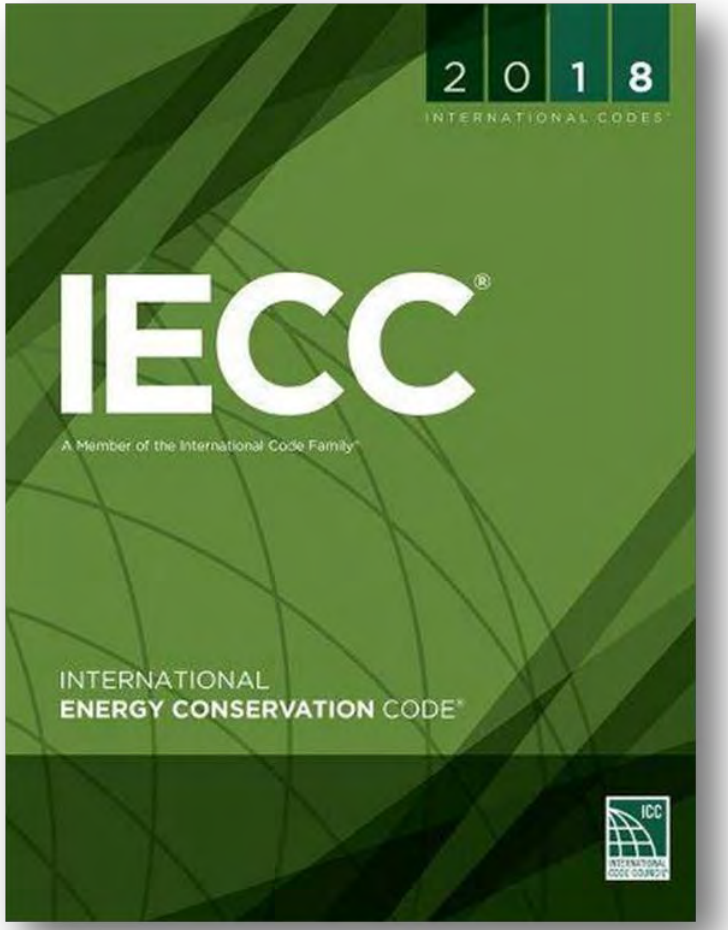
- Presentation: 2018 IECC with Hawai'i Amendments Low-Rise Residential Requirements (PDF)
- Checklist: Residential Checklist IECC 2018 with State Amendments (PDF)
- Video: Hawai'i 2018 IECC Residential Requirements 2021-05-12

Section 2
Compliance



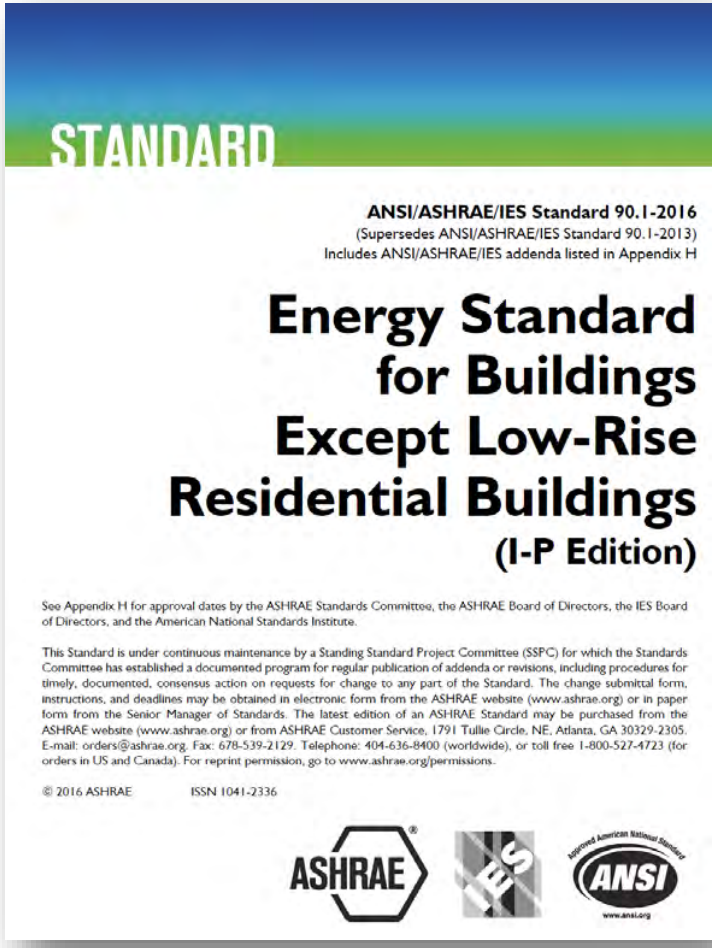
Commercial compliance

2018 IECC + amendments



or

ASHRAE Standard 90.1-2016
+ EV infrastructure



Commercial compliance

Mandatory requirements

Prescriptive requirements

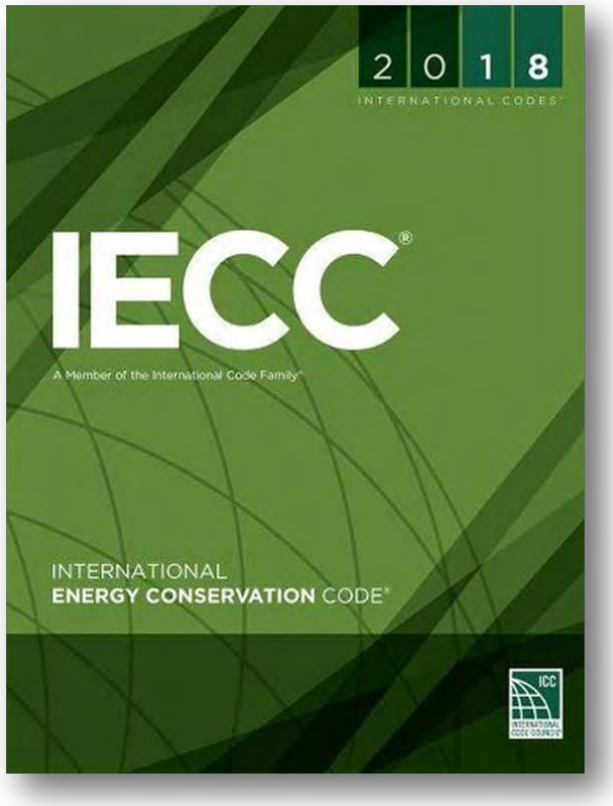
or

Total Building Performance

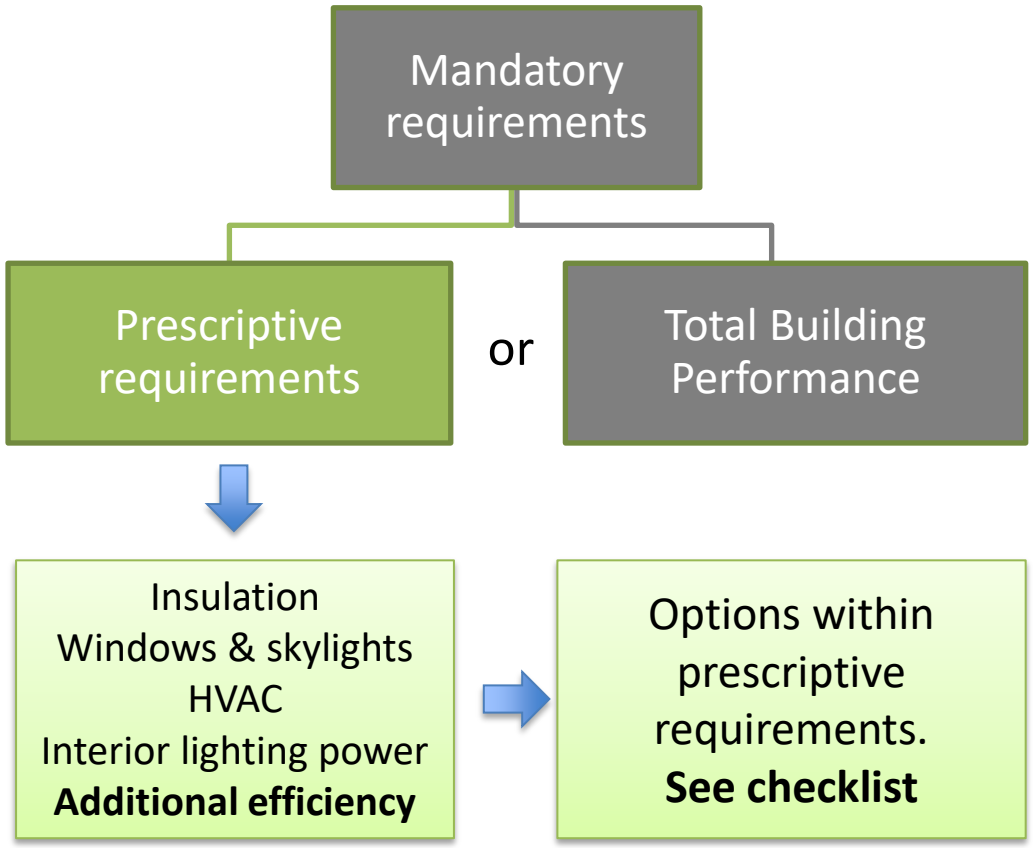
Insulation
Windows & skylights
HVAC
Interior lighting power
Additional efficiency

Computer simulation

This path necessary if window area >30/40% or skylight area >3/6%



Commercial compliance



Component/System	Requirement	Code Section
Wall – metal building	**R-13 + R6.5** or **U-0.079** (R-6.5 continuous insulation not required with light reflectance ≥0.64 or shading PF ≥ 0.3)*	C402.1, C402.2
Wall – metal frame	**R-13 + R-5** or **U-0.077** (R-5 continuous insulation not required with light reflectance ≥0.64 or shading PF ≥ 0.3)*	C402.1, C402.2*
Wall – wood frame and other	**R-13 + R3.8** or **R-20** or **U-0.064** (R-3.8 not required with light reflectance ≥0.64 or shading PF≥0.3)*	C402.1, C402.2*
Door - swinging	**U-0.61**	C402.1
Door – non-swinging	**R-4.75**	C402.1
Door – garage <14% glazing	**U-0.31**	C402.1
Low-slope roof membrane	**Aged solar reflectance ≥0.55 + aged emittance ≥0.75**, or **aged solar reflectance index ≥0.64** (exceptions available)	C402.3

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

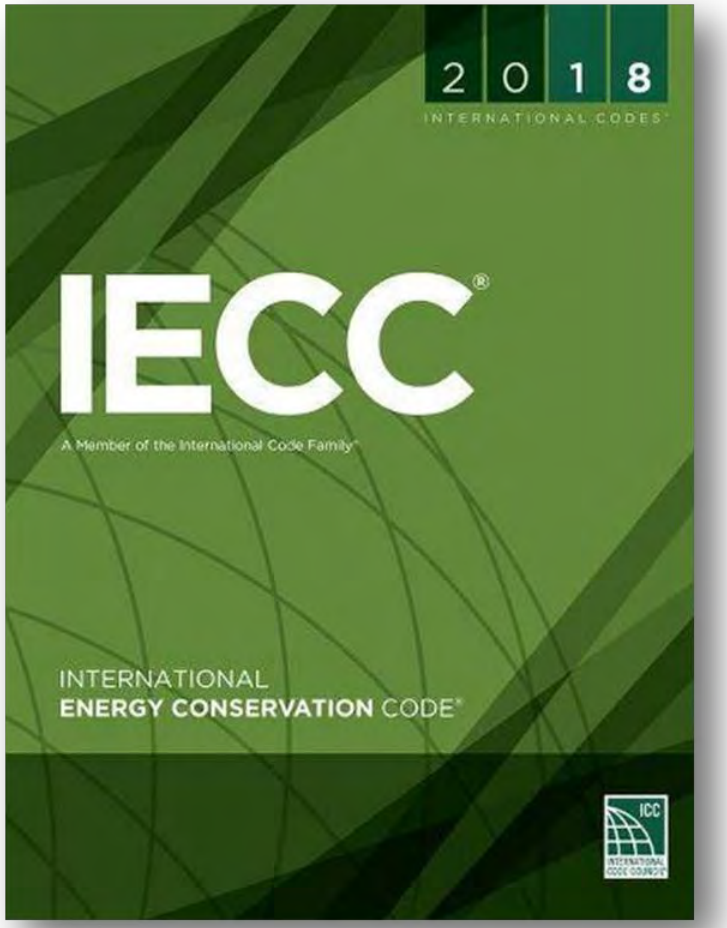

High Efficiency HVAC


On-Site Renewables

Total Building Performance (C407)

Honolulu Amendment

EV infrastructure



C401.2 Application. Section C409 and

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.

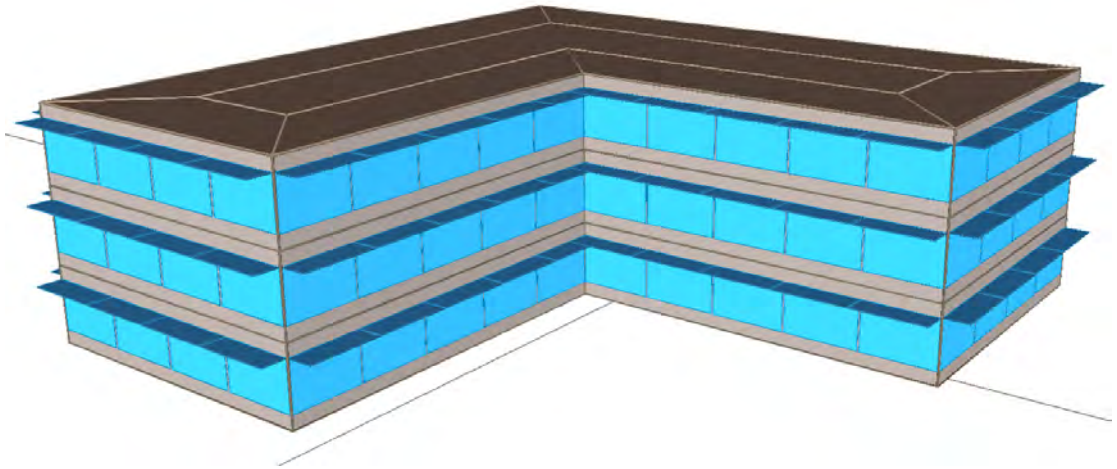
Mandatory requirements

and

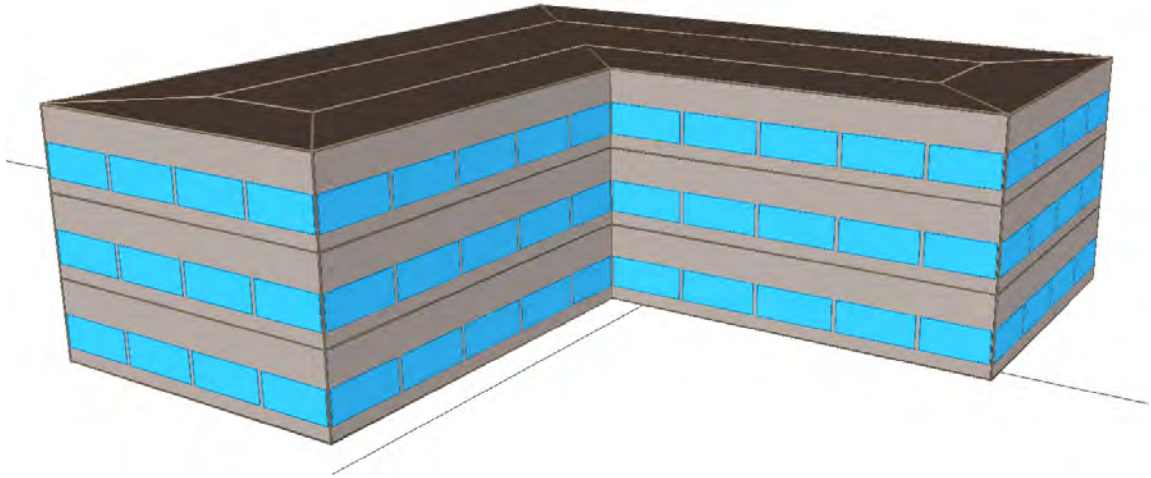
C407. Total Building Performance

Total Building Performance (C407)

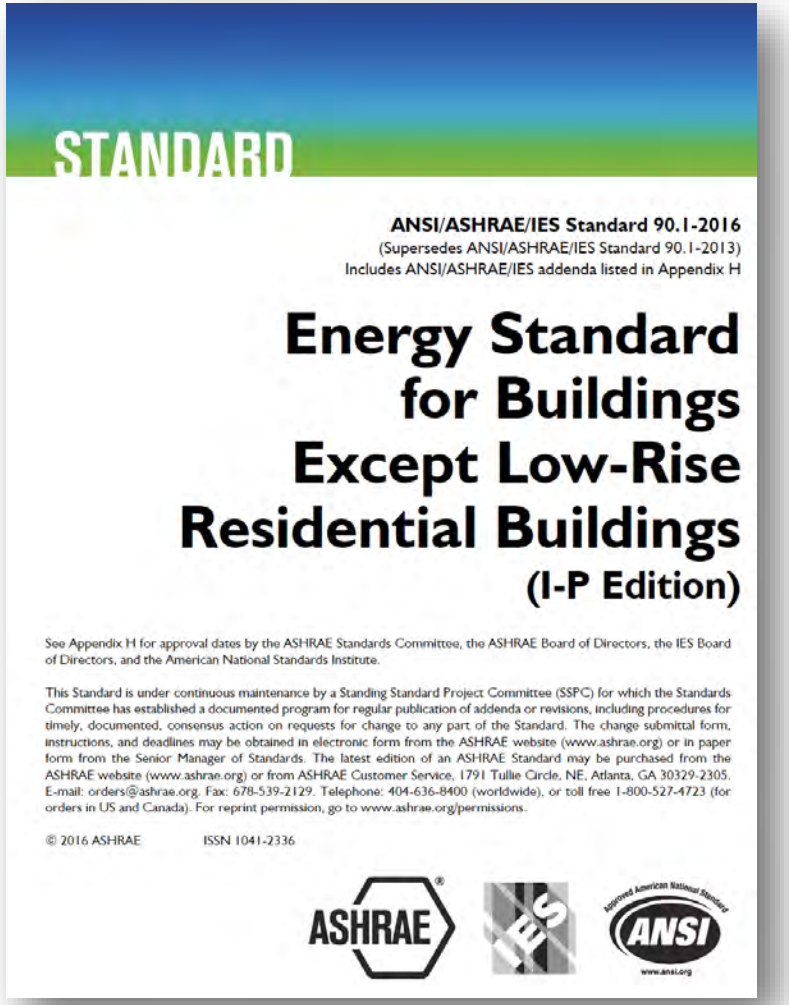
Proposed design model



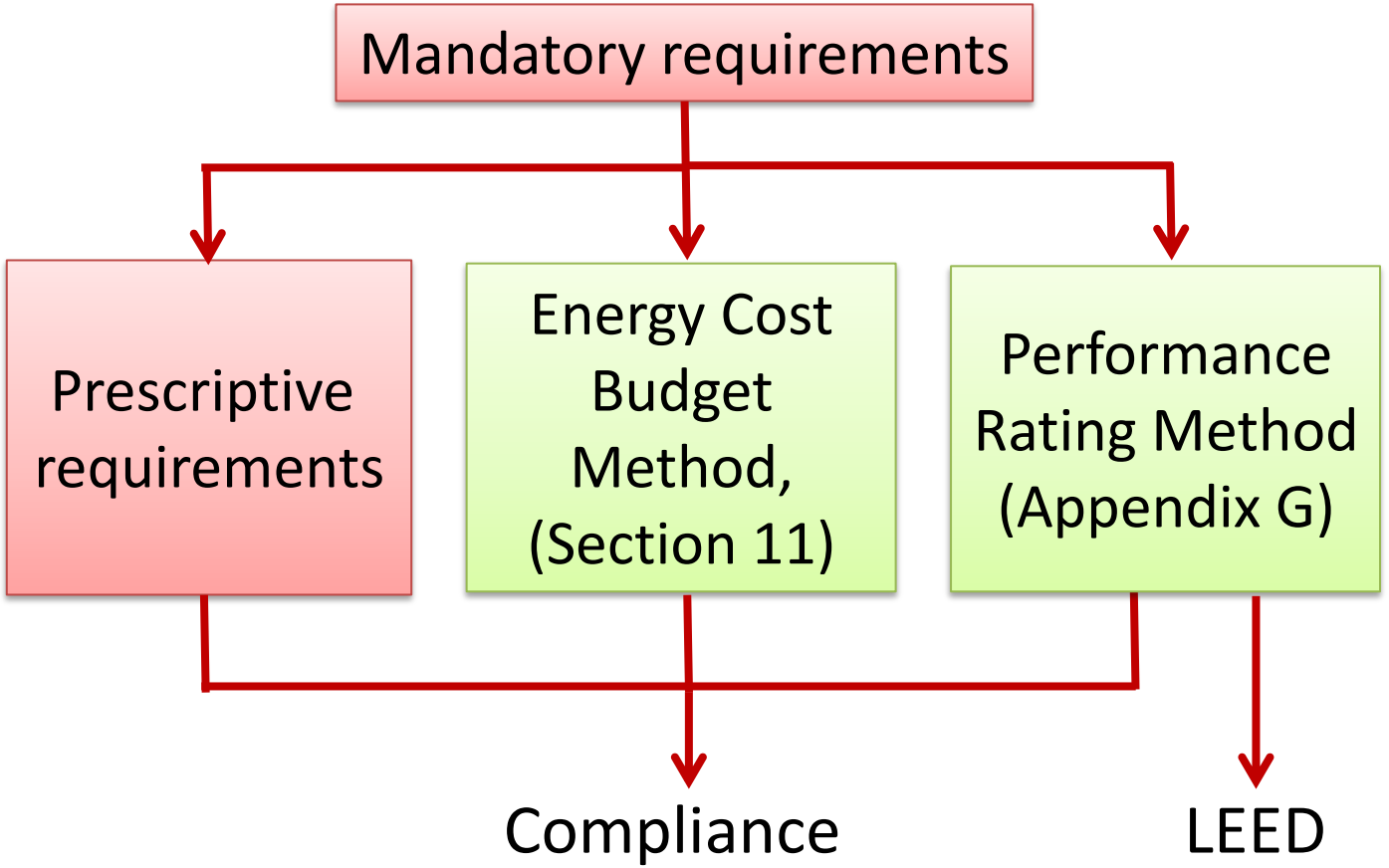
Standard reference design model



Proposed design $/year ≤ Standard reference design $/year x 0.85



ASHRAE Standard 90.1-2016 Compliance



Online preview

https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.1_2016_IP

Design professional certification (C103.2)

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

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

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

Signature: _____ Date: _____
Name: _____
Title: _____
License No.: _____

Include only those items that the signator is responsible for. This block shall be on the first sheet of the pertinent plan, e.g. architectural, electrical, and mechanical. The above may be submitted separately to the Code Official in a letter including the identification of the building.

Honolulu Amendment

Construction documents (C103.2)

2018 IECC Section C103.2

Information required in construction documents

Honolulu Amendment

2018 IECC Section C103.2

a) Insulation materials and their *R*-values.
b) Fenestration *U*-factors and solar heat gain coefficients (SHGCs).
c) Area-weighted *U*-factor and solar heat gain coefficient (SHGC) calculations.
d) Mechanical system design criteria.
e) Mechanical and service water heating systems and equipment types, sizes and efficiencies.
f) Economizer description.
g) Equipment and system controls.
h) Fan motor horsepower (hp) and controls.
i) Duct sealing, duct and pipe insulation and location.
j) Lighting fixture schedule with wattage and control narrative.
k) Location of *daylight* zones on floor plans.
l) Air sealing details.
m) Electric vehicle infrastructure
n) Solar ready infrastructure

Construction documents (C103.2)

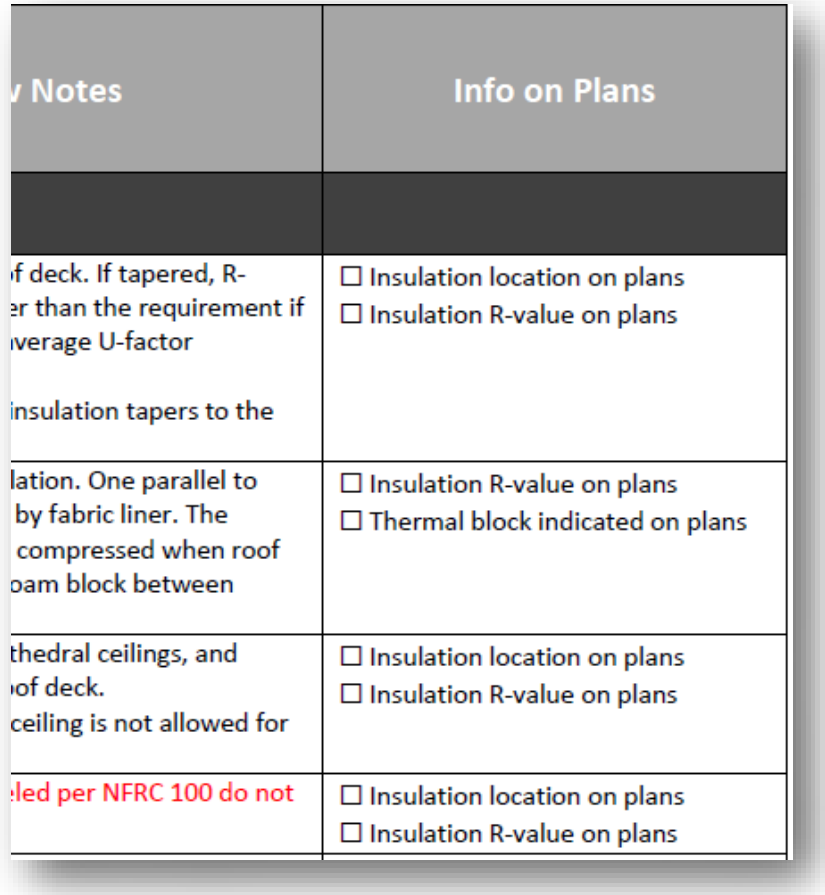
2018 IECC Section C103.2

- Information required on plans

Recommendations in energy code checklists →

Items often not on plans

- Insulation R-value
- Window SHGC
- Lighting fixture input power
- AC equipment efficiency and fan power



Notes	Info on Plans
f deck. If tapered, R- er than the requirement if verage U-factor insulation tapers to the	☐ Insulation location on plans ☐ Insulation R-value on plans
lation. One parallel to by fabric liner. The compressed when roof oam block between	☐ Insulation R-value on plans ☐ Thermal block indicated on plans
thedral ceilings, and of deck. ceiling is not allowed for	☐ Insulation location on plans ☐ Insulation R-value on plans
led per NFRC 100 do not	☐ Insulation location on plans ☐ Insulation R-value on plans

Section 3

Electric vehicle infrastructure

Electric vehicle infrastructure (C409)

Two options

Honolulu Amendment

1. Baseline percentage
   - Minimum number of new parking stalls that must be EV-charger-ready
   - Charge method: 208/240VAC/40-100A Minimum 32A

2. Points-based
   - Minimum number of points required
   - Points earned by charger capacity and type of parking stall

Electric vehicle infrastructure (C409)

Baseline Compliance Path

Charge method:

208/240VAC/40-100A Minimum 32A

Minimum number of EV-ready stalls:

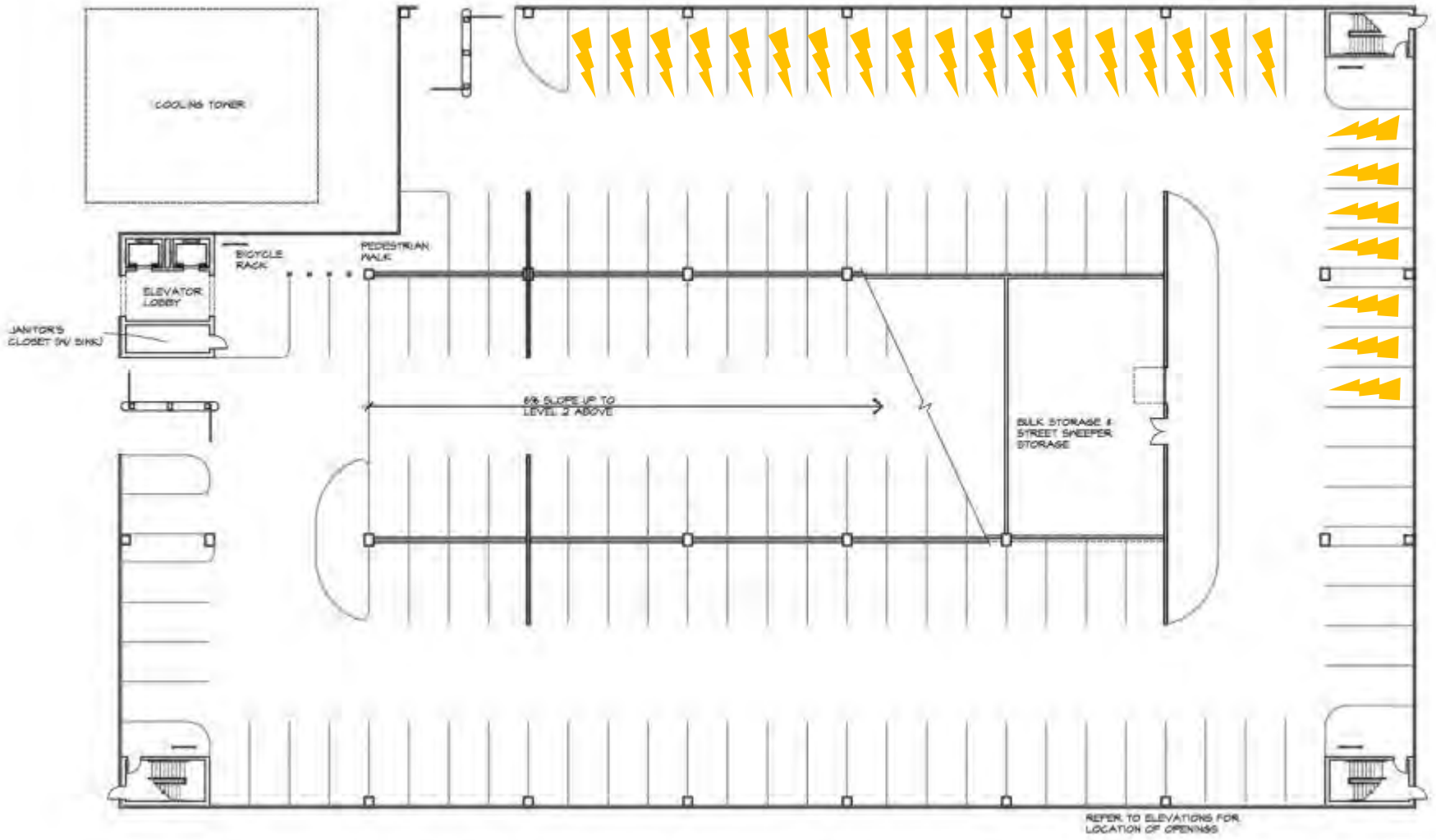
Building type	Number of new stalls	Minimum number of EV-ready stalls
Multi-unit residential	≥8	≥25%
Commercial	≥12	≥20%
Retail	≥8	≥25%
Affordable housing (for sale)	≥8	≥20%
Affordable housing (for rent)	NA	None

Electric vehicle infrastructure (C409)

Baseline Compliance Path Examples, 20 new parking stalls

Electric vehicle infrastructure (C409)

Baseline Compliance Path Examples, 100 new parking stalls with 25% charging



Electric vehicle infrastructure (C409)

Points-based electric vehicle readiness path

Minimum number of points required

Building type	Number of new stalls	Minimum number of points
Multi-unit residential	≥8	# of new stalls ÷ 4
Commercial	≥12	# of new stalls ÷ 4
Retail	≥8	# of new stalls ÷ 4) × 0.80
Affordable housing (for sale)	≥8	# of new stalls ÷ 4) × 0.80
Affordable housing (for rent)	NA	None

Electric vehicle infrastructure (C409)

Points-based electric vehicle readiness path

Points calculation

Charger type			Compliance points earned per stall		
Electric Vehicle Charger Capacity Level	Charging rate (kW)	Time to charge 50 kW battery (hrs)	Dedicated EV-Ready Stalls	Common Area EV-Ready Stalls	Common Area Stall with EV Charging Equipment Installed
Level 2, Minimum 16A	3.4	14.7	1 (enclosed garage)	NA	NA
Level 2, Minimum 32A	6.7	7.5	1	4	7
Level 2, 64A to 80A	13.3	3.8	1	7	14
DCFC 50 kW (480/277 Vac 3-phase)	50	1	1	25	50

Points may be aggregated over multiple projects, with some restrictions

Section 4

Voluntary stretch code

Voluntary stretch code (Appendix CB)

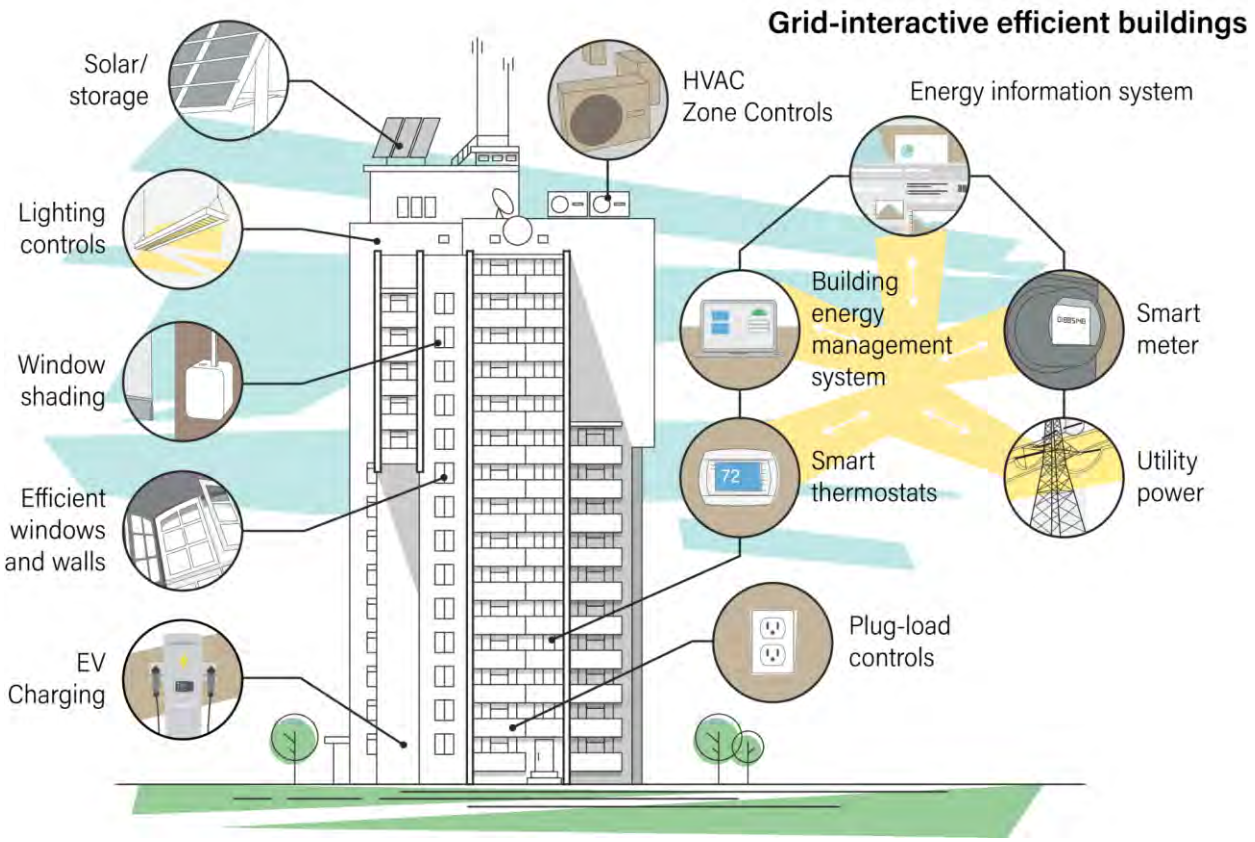
Focused on a building's ability to integrate to the electrical grid.

Defines performance in terms of three key functions:

1. Avoiding energy use during system peak
2. Dynamically shifting building load to support grid needs
3. Overall building energy efficiency

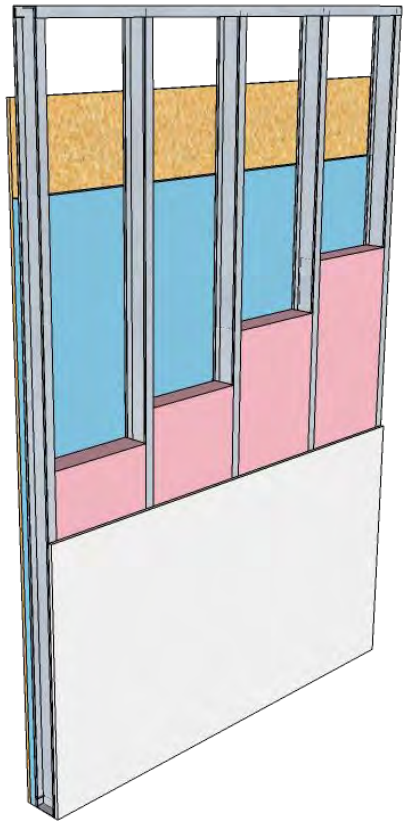
Honolulu Amendment

New



Section 5

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 Btu/hr-ft^2 for space conditioning
2. Unconditioned space that does not include occupiable space
3. Greenhouses

Honolulu Amendment

OCCUPIABLE SPACE means enclosed space intended for human activities, excluding those spaces intended primarily for other purposes, such as storage rooms and equipment rooms, that are only occupied occasionally and for short periods of time

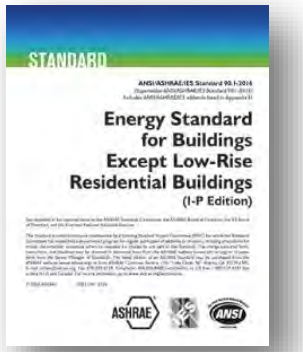
New

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 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

3-year aged values

Low slope < 2-in-12

Some exceptions

Typical products
- Single-ply membrane
- Liquid applied

Envelope prescriptive requirements

Wall insulation (Table C402.1.3)

Honolulu 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

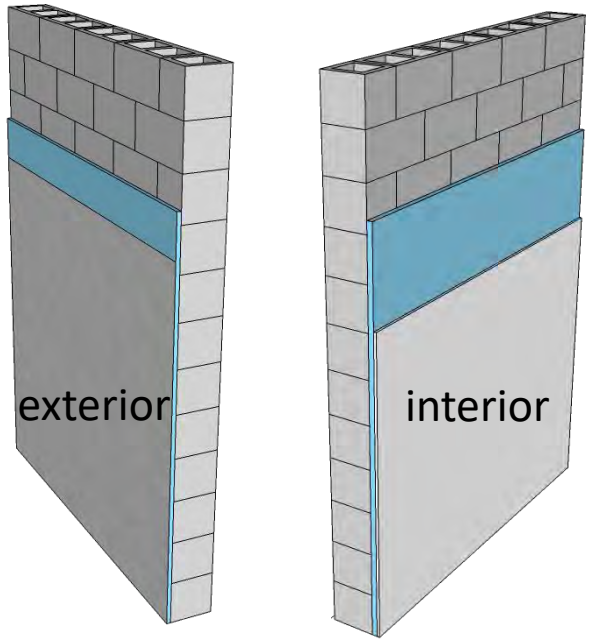
Exceptions allow R-0

Exceptions allow R-13 alone

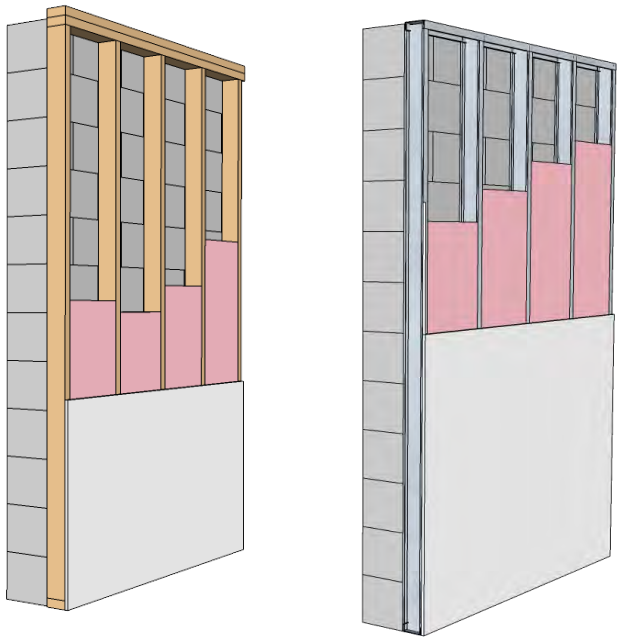
ci = continuous insulation

Envelope prescriptive requirements

Commercial mass wall options

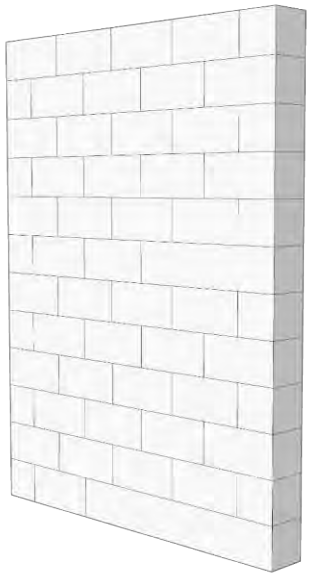


R-5.7 insulation
(1 in. polyisocyanurate or
1.25 in. polystyrene)

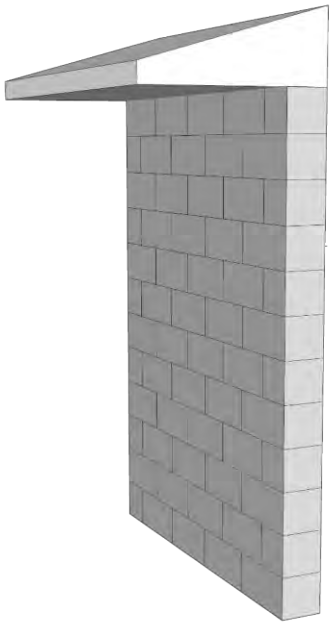


U-factor ≤ 0.151
Interior furring
R-6 in wood or **R-13** in metal

Honolulu Amendment



Reflectance
≥ 0.64



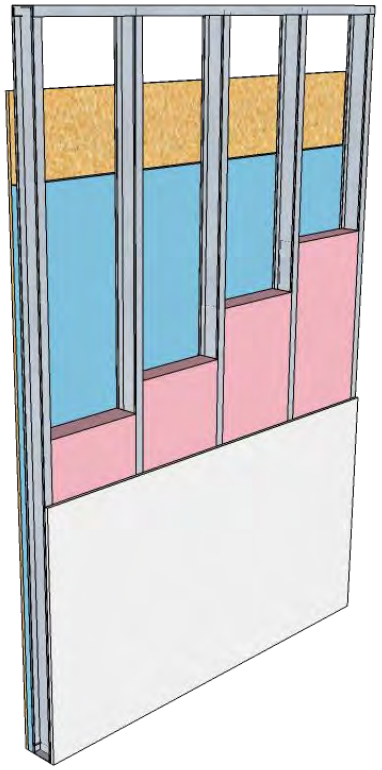
Overhang PF
≥ 0.3

New

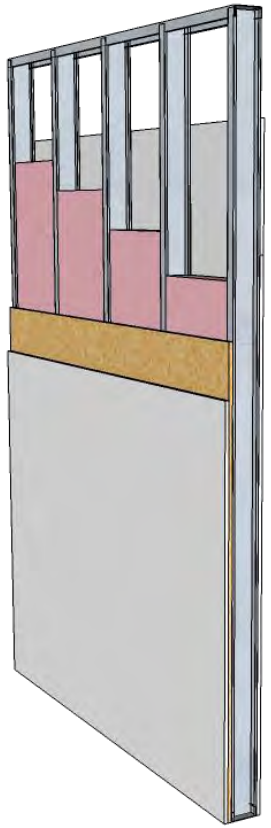
Thickness
≥ 6 inches +
unpainted
finish with or
without
clear sealer

Envelope prescriptive requirements

Commercial metal-framed wall options

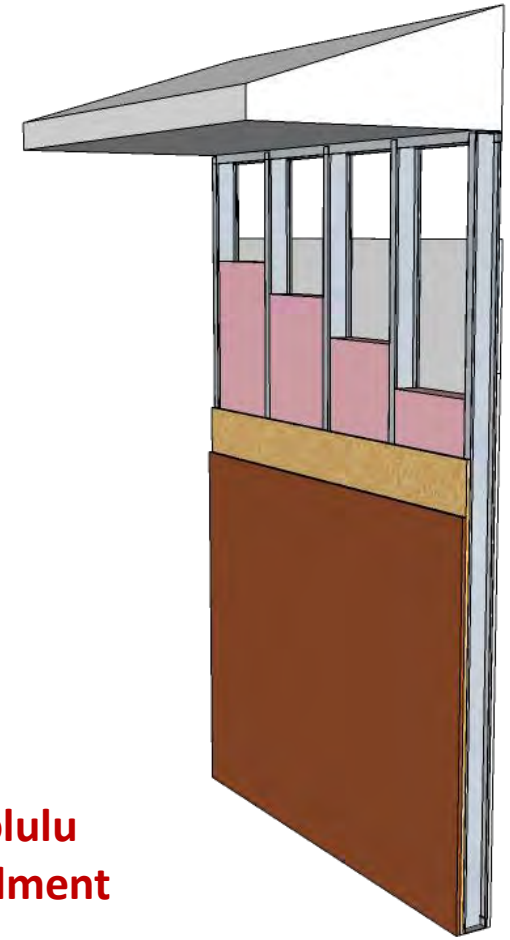


R-13 + **R-5** continuous



R-13+ Reflectance ≥ **0.64**

Honolulu Amendment

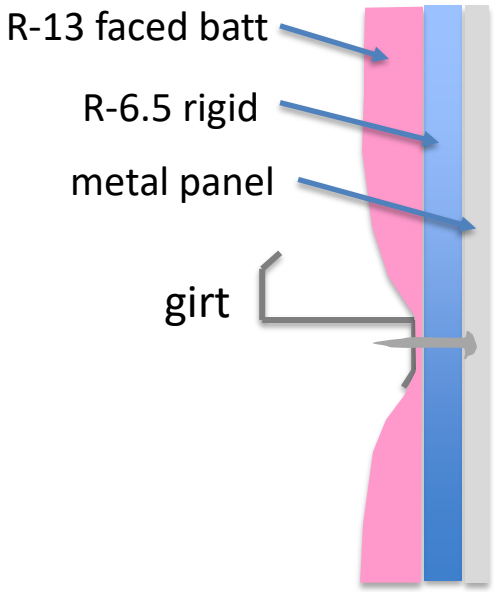


R-13 + Overhang **PF ≥ 0.3**

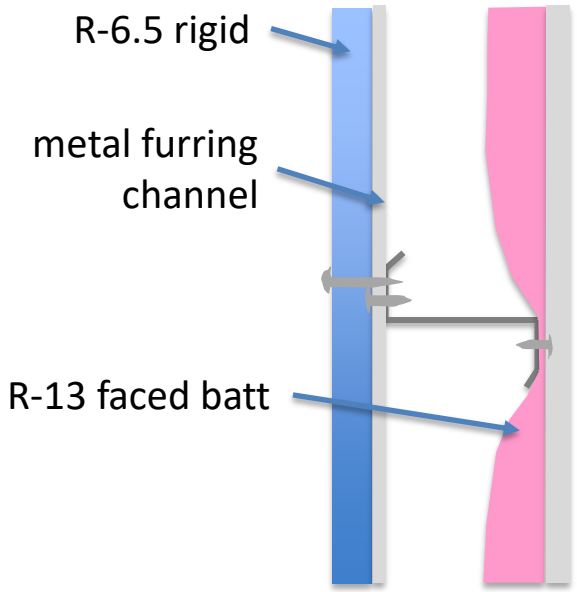
Envelope prescriptive requirements

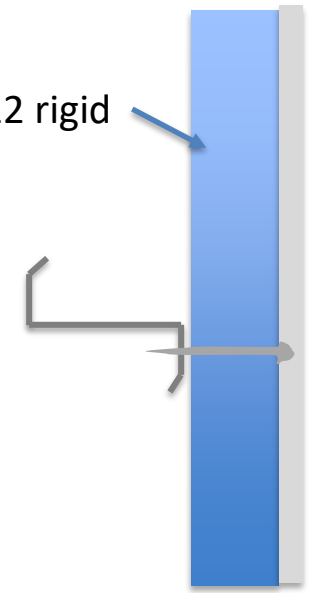
Commercial metal-building wall options

Source: http://armstrongsteel.com

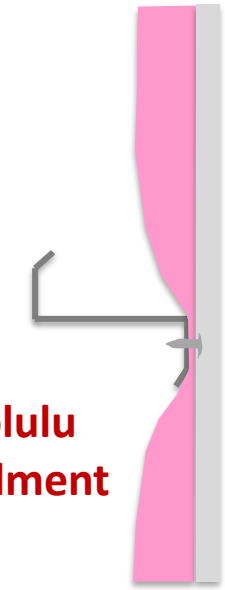


R-13 + **R-6.5** continuous





R-12 continuous

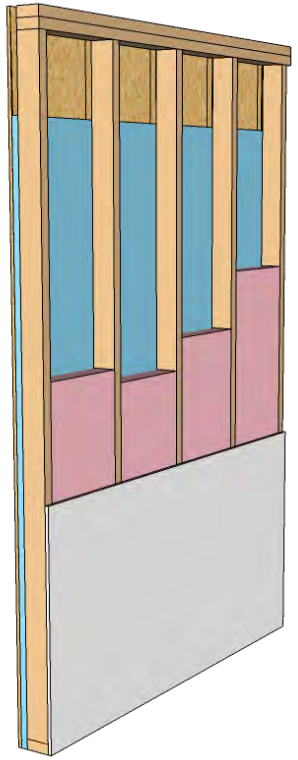


R-13
+ Reflectance ≥ **0.64**, or
+ Overhang **PF ≥ 0.3**

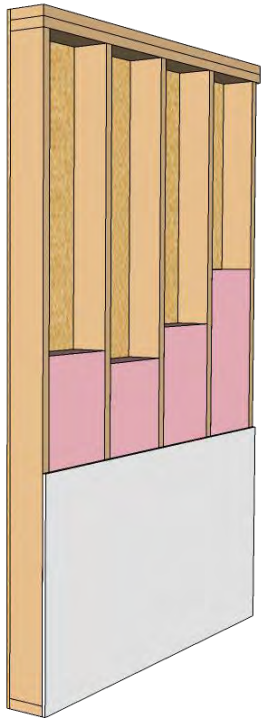
Honolulu Amendment

Envelope prescriptive requirements

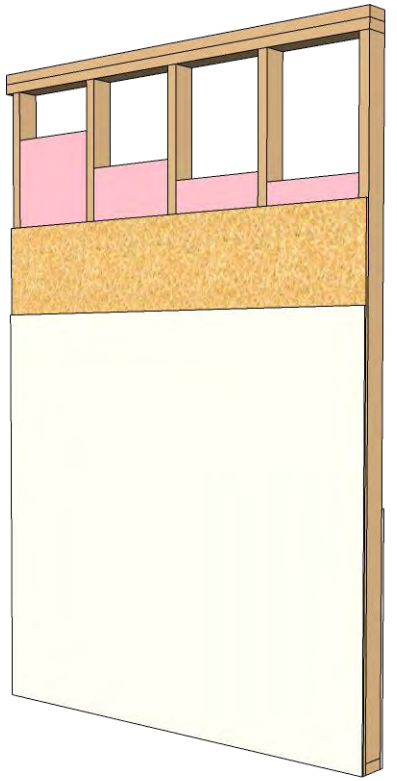
Commercial wood-framed wall options



R-13 +
R-3.8 continuous

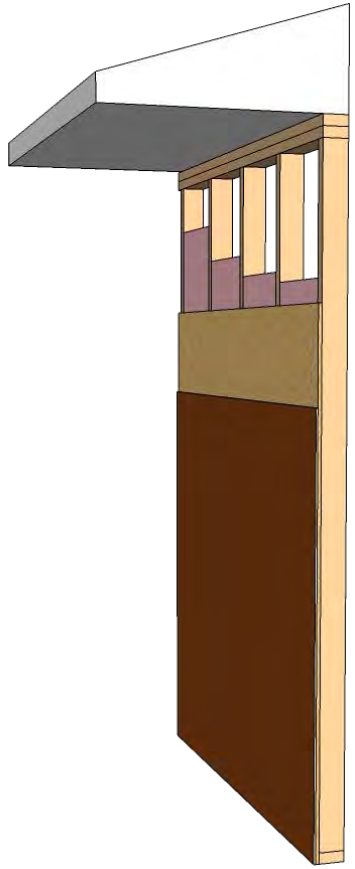


R-20



R-13 +
Reflectance ≥ **0.64**

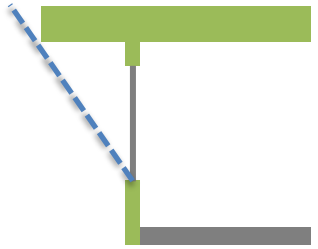
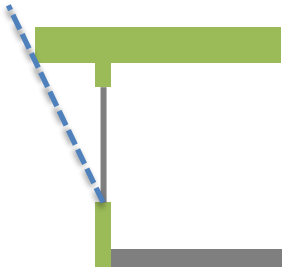
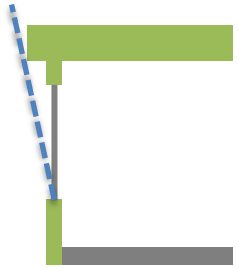
Honolulu Amendment



R-13 +
Overhang PF ≥ **0.3**

Envelope prescriptive requirements

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

	Large overhang	Medium overhang	Small overhang
			
	PF ≥ 0.5	0.20 ≤ 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

→ Dual-pane, low-e typical

- U-1.10 doors → Single-pane complies

Area-weighted average U-factor allowed

Envelope prescriptive requirements

Skylight SHGC & U-factor (C402.4)

SHGC **≤ 0.35**
(or ≤ 0.60 with daylighting controls)

U-factor **≤ 0.75**
(or U-0.90 with daylighting controls)

Envelope prescriptive requirements

Maximum fenestration area (C402.4)

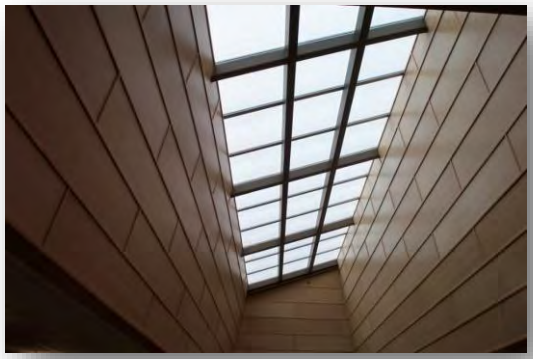
Window area **≤ 30%** of gross wall area

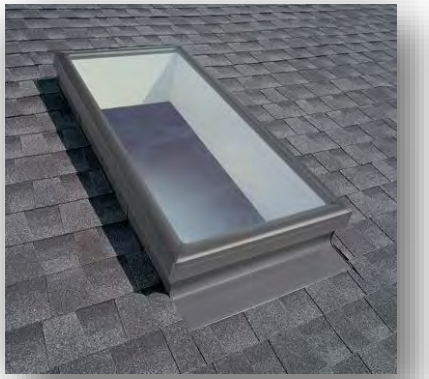
Up to 40% with daylighting controls

Skylight area **≤ 3%** of gross roof area

Up to 6% with daylighting controls
or reduced lighting power

Honolulu Amendment





www.veluxusa.com

Otherwise, use
Total Building Performance
compliance option

Envelope prescriptive requirements

Skylight <u>minimum</u> area (C402.4)

For spaces under a roof where

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

Envelope prescriptive requirements

Skylight <u>minimum</u> area (C402.4)

For spaces under a roof where
- Floor area > 2,500 ft^2 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/ft^2

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

Envelope air leakage (C402.5)

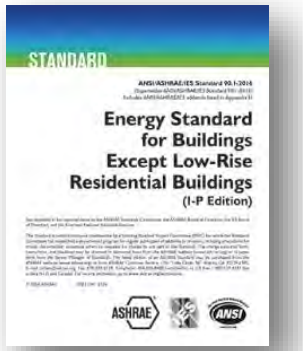
- Continuous air barrier
- Fenestration air leakage
- Openings to shafts, chutes, stairways and elevator lobbies
- Air intakes, exhaust openings, stairways, and shafts.
- Loading-dock weatherseals
- Recessed lighting in the thermal envelope

Envelope compliance option summary

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

Section 4
Mechanical Systems

Small Commercial Example

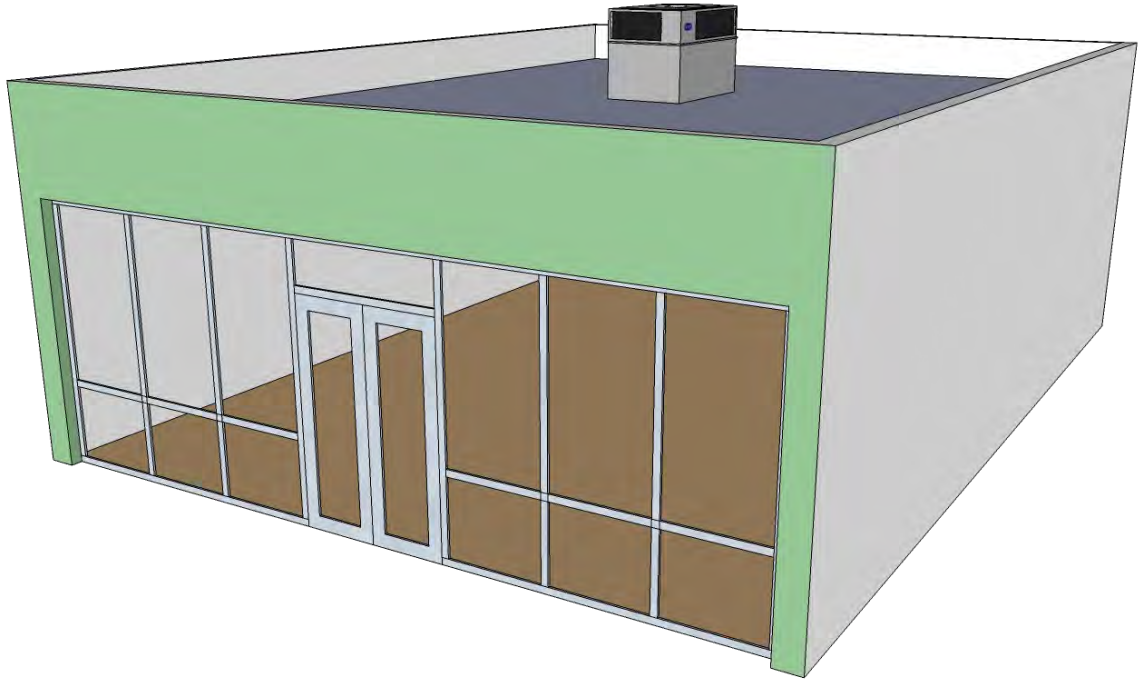
C403.1.1 **Cooling load calcs**
C403.3.1 **Equipment sizing**
C403.3.2 **Equipment efficiency**
- SEER 14

C403.4 **Controls**
- Programmable thermostat

C403.11 **Duct insulation and sealing**
- R-6 in unconditioned space

Maybe also:
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 ft^2 floor area
4-ton rooftop unit



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

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 ≥90°F
  - < 5 minutes of opening

Mechanical systems

Automatic control of HVAC serving guestrooms (C403.7.6)

If >50 guestrooms

New

1. Temperature setpoint controls
   - Raise setpoint by 4°F within 30 minutes
   - Setpoint ≥80°F 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

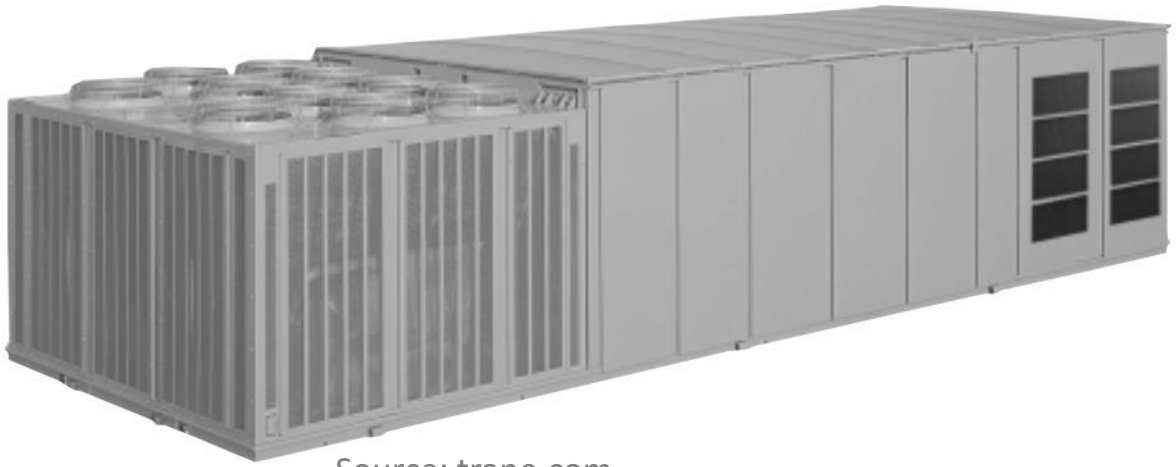
- Temperature reset
- Variable flow, if total pumps ≥ 2hp and ≥3 control valves
- Variable speed drive required for pumps ≥ 2hp

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) ← Changed in 2018
- Supply-air temperature reset control
- Duct static pressure setpoint reset control



Source: trane.com

Mechanical systems

Demand control ventilation (C403.7.1)

Required for these spaces:

- > 500 ft², and
- ≥ **25 people**/1000 ft² of floor area, and
- Served by systems with > 3,000 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 **≥ 50%**
- If design supply air flow exceeds limit (some exceptions)

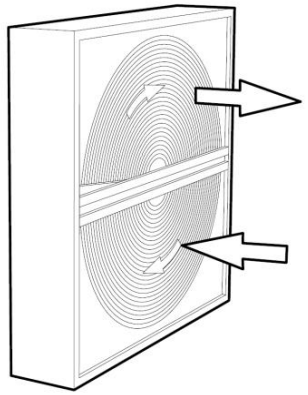
Table C403.7.4 (excerpt)

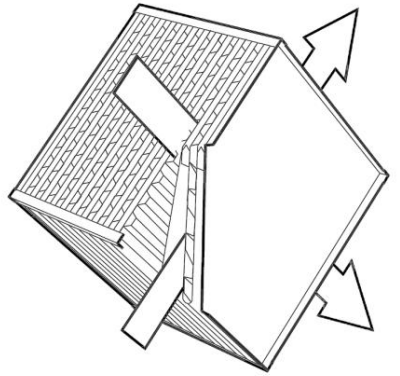
	Design supply air flow rate	
Design percent outdoor airflow rate	Fan Operates < 8,000 hrs/yr	Fan Operates ≥ 8,000 hrs/yr
≥ 10% and <20%	≥26,000 cfm	≥2,500 cfm
≥ 20% and <30%	≥16,000 cfm	≥2,000 cfm
≥ 30% and <40%	≥5,500 cfm	≥1,000 cfm
≥ 40% and <50%	≥4,500 cfm	≥500 cfm
≥ 50% and <60%	≥3,500 cfm	>140 cfm
≥ 60% and <70%	≥2,000 cfm	>120 cfm
≥ 70% and <80%	≥1,000 cfm	>100 cfm
≥ 80%	>120 cfm	>80 cfm

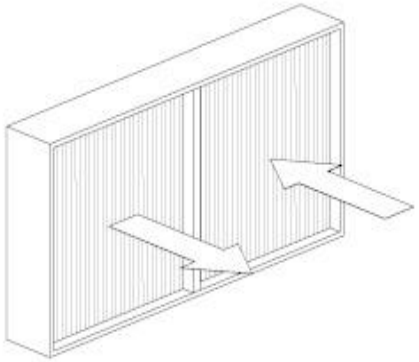
Change for 2018

Common options

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







Mechanical systems

Kitchen exhaust systems (C403.7.5)

- ≤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 ≥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

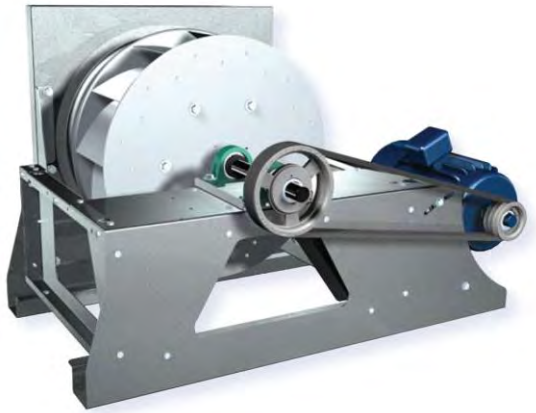
For SI: 1 cfm = 0.4719 L/s; 1 foot = 305 mm.

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)

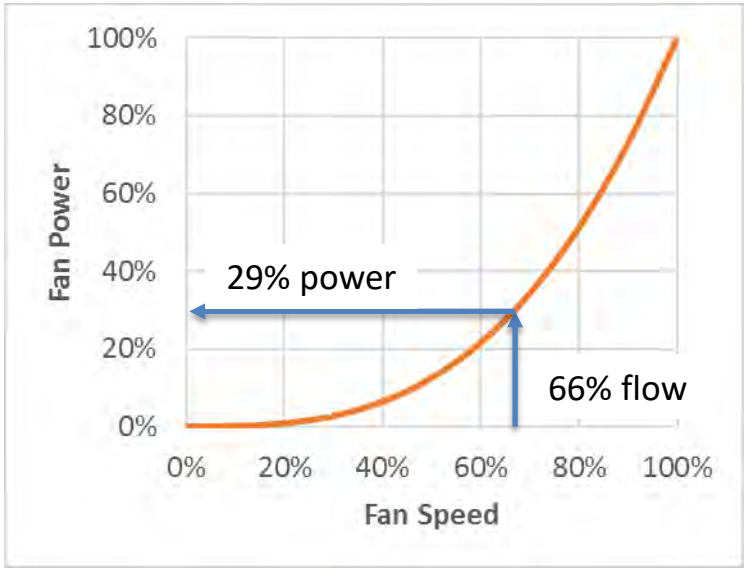
- DX systems with cooling capacity ≥65,000 Btu/hr
- Chilled water systems with fan power ≥0.25 hp

Variable airflow required

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

Some exceptions

Fan Laws



Mechanical systems

Heat rejection equipment (C403.9)

- Air-cooled condensers
- Dry coolers
- Open-circuit cooling towers
- Closed-circuit cooling towers
- Evaporative condensers

http://www.entechsales.com/services/engineering-construction/projects/cooling-towers/

Fan speed control

Change for 2018

Variable speed required where total fan power ≥ 5hp

Multiple-cell control

Operate maximum number of fans

Some exceptions

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)

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

C403.10.3

- Refrigerated display cases

C403.10.4

- Remote condensers & compressors

Mechanical systems

Mechanical systems commissioning and completion (C408.2)

Required when:

- ≥ 480,000 Btu/h cooling capacity, or
- ≥ 600,000 Btu/h heating capacity

} Typically ≥ 20,000 ft^2

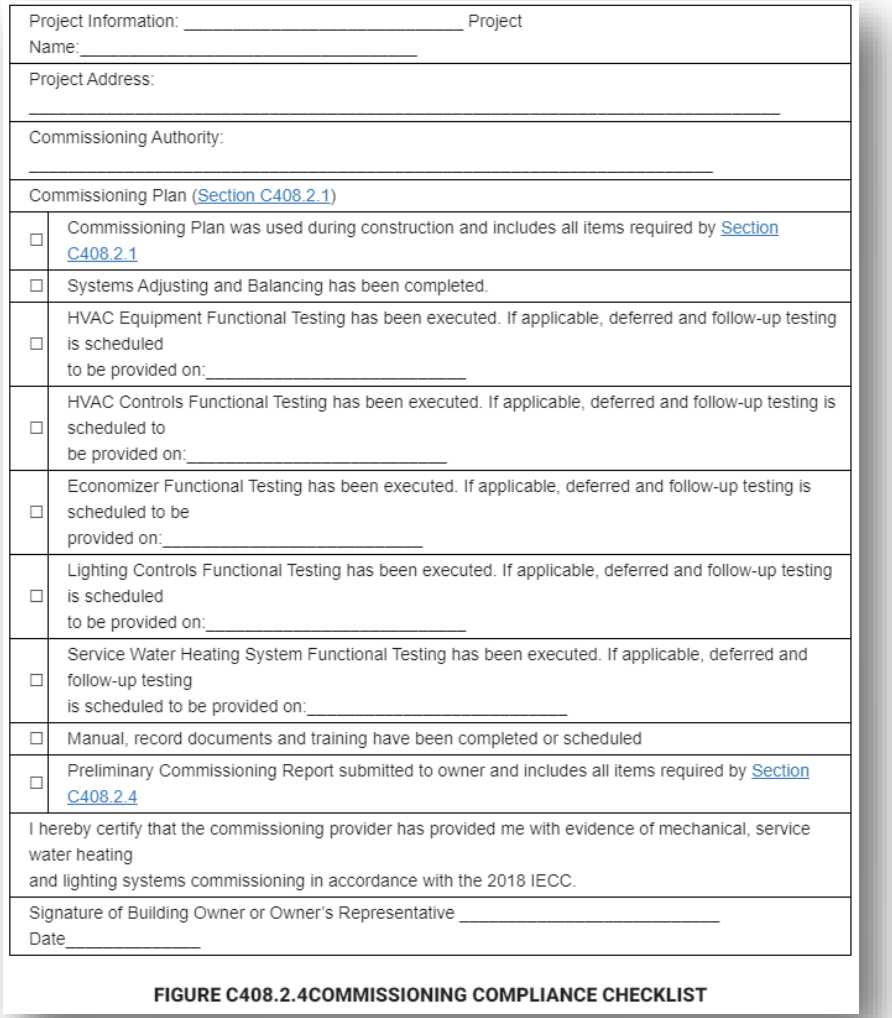
Requirements

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

↓

Letter from owner before certificate of occupancy

Honolulu Amendment



Project Information: _____ Project Name:_____
Project Address: _____
Commissioning Authority: _____
Commissioning Plan (Section C408.2.1)
☐ Commissioning Plan was used during construction and includes all items required by Section C408.2.1
☐ Systems Adjusting and Balancing has been completed.
☐ HVAC Equipment Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on:_____
☐ HVAC Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on:_____
☐ Economizer Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on:_____
☐ Lighting Controls Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on:_____
☐ Service Water Heating System Functional Testing has been executed. If applicable, deferred and follow-up testing is scheduled to be provided on:_____
☐ Manual, record documents and training have been completed or scheduled
☐ 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 C408.2.4COMMISSIONING COMPLIANCE CHECKLIST

Section 6
Service Water Heating

Service water heating

- Water heating equipment efficiency (C404.3) - some changes vs 2015
- Heat traps for storage water heaters (C404.3)
- Pipe insulation (C404.4)
- Heated water supply piping (C404.5)
  - Maximum allowable length
  - Maximum allowable volume
  - Or insulated pipe (Honolulu amendment)
- 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)

Piping from source to fixture

- Water heater to fixture
- Circulation pipe to fixture

Requirements

- Maximum allowable length,
- Maximum allowable volume, or
- Insulate per Table C403.11.3

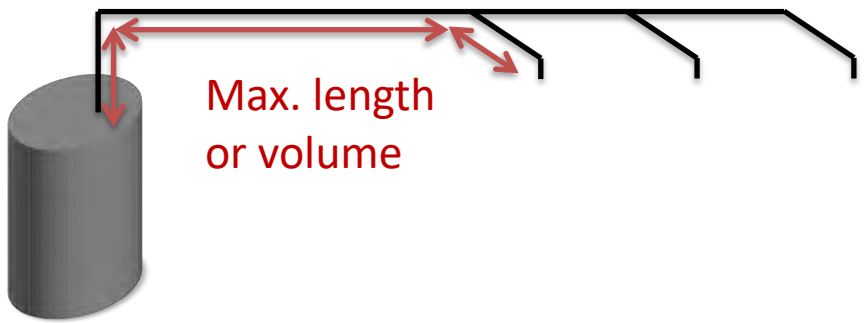
Honolulu Amendment

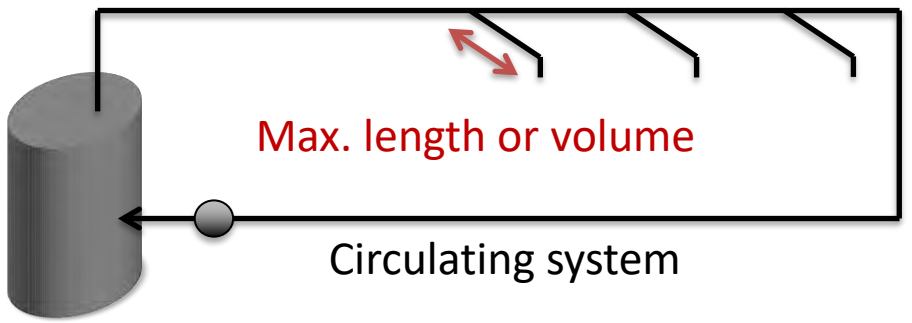
New

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 7

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
3. Sleeping unit	Choose		Auto-off control for permanent lights and switched receptacles

New for 2018

DWELLING UNIT means a building or portion thereof that contains living facilities, including permanent provisions for living, sleeping, eating, cooking and sanitation, as required by this code, for not more than one family, or a congregate residence for 16 or fewer persons.

Honolulu Amendment

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)

- ≥90% lamps high efficacy

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

Honolulu Amendment

New

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

Source: DOE/NREL PIX20307

LED

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

Lighting Controls (C405.2) (covered on following slides)

- Occupant sensor controls
- Time switch controls
- Light reduction controls
- Daylight-responsive controls
- Specific application controls

Exceptions

- Security or emergency areas
- Exit stairways, ramps and passageways
- Egress lighting that is normally off

Honolulu Amendment

Exception for corridors, passageways, lobbies and other circulation spaces within multi-family buildings that must remain lighted for egress.

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 — New for 2018
- Restrooms
- Storage rooms
- Locker rooms
- Other spaces ≤300 ft^2 with floor-to-ceiling partitions
- Warehouse storage areas

Warehouse storage areas
- Each aisle separately
- Reduce to 50% or less

Open office areas
- Control zones ≤600 ft^2
- Reduce to 80% or less

All other spaces
1. Manual on, or
2. Auto-on to ≤50% power

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
  - Spaces with lighting power ≤80% of allowance

Honolulu Amendment

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)

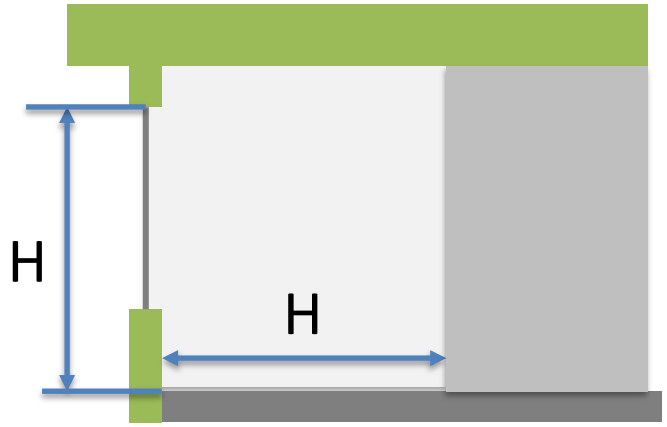
- Required in spaces with >150W of general lighting in:
  - Sidelit daylight zones
  - Toplit daylight zones
- Exceptions
  - Patient care
  - Dwelling units & sleeping units
  - Display and accent lighting
  - Display case lighting
  - First floor sidelight zone in A-2 and M occupancies
  - Spaces with lighting power ≤80% of allowance ← **Honolulu Amendment**
  - Total building lighting power ≤ LPD_{adj}

New for 2018

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

Interior lighting

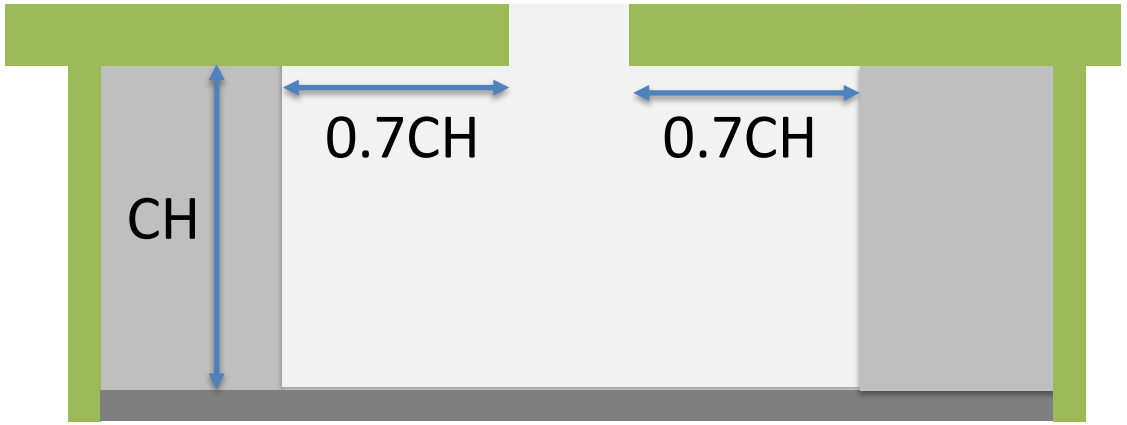
Sidelit daylight zone



Window area ≥24 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

New for 2018

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

Sleeping unit (e.g. guestroom)

- Auto-off for permanently installed lights and switched receptacles

Dwelling unit (not in multi-family building)

New for 2018

- Occupant sensor or light reduction

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

More stringent in most cases 2018 vs. 2015

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

0.82

1.26

0.66

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

2015 allowance examples

1.11

0.98

Extra allowances for

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

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

New for 2018

- Setback for other lighting by ≥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

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

More stringent in most cases 2018 vs. 2015

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

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

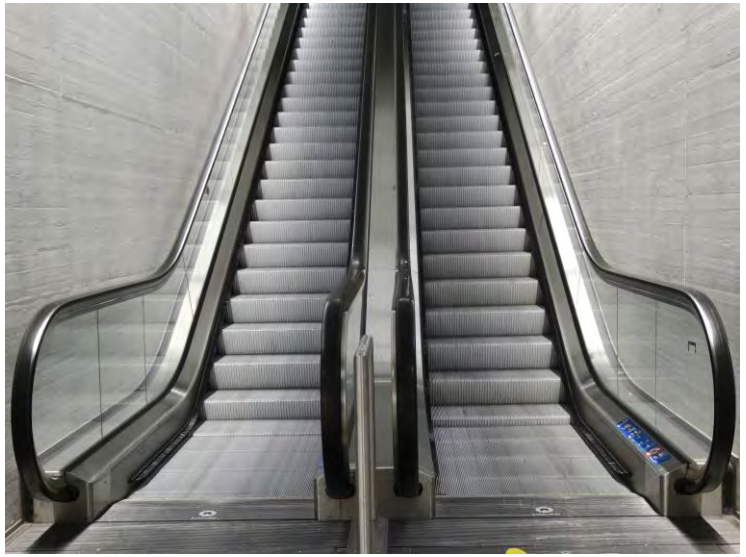
Vertical & horizontal transport

Elevator cabs (C405.8.1)

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

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 ≥1,000 ft²
- 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 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."

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 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 (State amendment)

1. New construction requirements
2. Initial solar reflectance ≥85% and aged reflectance ≥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

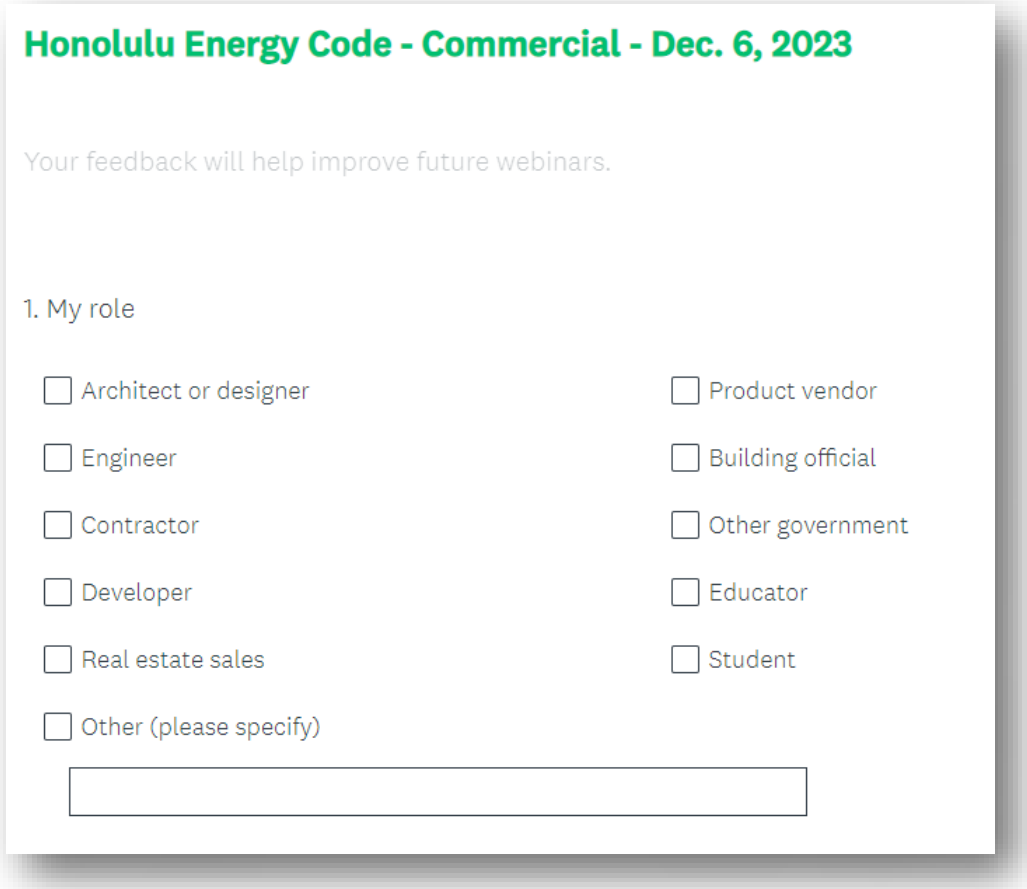
Howard Wiig, State Energy Office

Erik Kolderup, PE, Kolderup Consulting

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

Evaluation Survey

https://www.surveymonkey.com/r/756DYWS



For more energy code information

Howard C. Wiig

Energy Analyst, Hawaii State Energy Office

Office (808) 590-9555

Howard.c.wiig@Hawaii.gov

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