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# Vermont 2020 Commercial Building Energy Standards

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# Agenda

Administration & New Definitions

Envelope Requirements

Mechanical Systems

Service Water Heating

Lighting Systems

Additional Efficiency Packages

Existing Buildings



# Chapter 1

## Scope & Administration

# Code Effective Date

The effective date for both RBES and CBES updates is September 1, 2020

- Residential New Construction projects with “Construction Start” after September 1, 2020 must comply with 2020 RBES.
  - Construction Start is when site work began, when the ground was first dug to prepare for a below grade foundation or slab on grade, etc.”
- For Commercial/Industrial projects, the following rules apply
  1. Projects that have applied for or obtained a permit before 9/1/2020 can still follow 2015 CBES
  2. Projects that have not obtained or applied for a permit prior to 9/1/2020 must comply with 2020 CBES
  3. A permit in this context is limited to a building permit or an Act 250 permit

# Mixed Use Occupancy Buildings

## 3 Stories or Less in Height

- **Residential building requirements (RBES)**
  - Living spaces
  - Hallways, Laundry, Community Rooms, Storage Rooms, Foyers
- **Commercial building requirements (CBES)**
  - Areas served by BOTH Residential and Commercial uses

## 4 Stories or MORE in Height

- **CBES applied to all areas**

# Exempt Buildings

Yurt & Tent Buildings- **NEW**

Exempt only if:

- No mechanical cooling
- Heated with biomass or on-site renewable energy

# Chapter 2

# Definitions

# Code Official

Role: administration & enforcement of CBES

- This is not described in further detail

No current code enforcement:

- VT Dep of Public Service (DPS) does not enforce
- Efficiency Vermont does not enforce

*\*Potential refined definition in final code language*



# Cold-Climate Heat Pump

- Air-source
- Variable capacity compressor
  - Inverter driven
- Full heat capacity at 5 degrees F outdoor temperature
  - Minimum of 1.75 COP at that OAT
- Matched Indoor unit
  - AHRI Rated

# High Efficacy Lamps & Fixtures

## Lamps

- 65 lumens/watt or more
  - CFLs
  - LEDs
  - T-8
  - Other Fluorescent

## Fixtures

- 55 lumens/watt or more

# Multifamily Dwelling

Building with 3 or more dwelling units

- Permanent occupants
- Vertical or horizontal orientation

If side-by-side, at least one of these must be true:

1. No wall extending from ground to roof
2. Share a heating system
3. Shared water supply or sewage

# Occupancy Classifications

- **Group A: Assembly**
  - A-1: Performing arts, movie theaters
  - A-2: Casinos, nightclubs, restaurants, cafeterias, bars
  - A-3: Courtrooms, gyms, community hall
  - A-4: Indoor sporting with spectators
  - A-5: Outdoor viewing activities
- **Group B: Business**
  - Offices
- **Group E: Educational**
  - Through 12<sup>th</sup> grade

# Occupancy Classifications (part 2)

- Group F: Factory
- Group H: High Hazard
- Group I: Institutional
- Group M: Mercantile
- Group S: Storage
  - Non-hazardous

# Occupancy Classifications (part 3)

- **Group R: Residential**
  - R-1: Transient residents
    - Hotels and motels
  - R-2: Permanent residents
    - Apartments, dormitories, Fraternities & Sororities
  - R-3: Permanent residents
    - Not listed in R-1, R-2 or R-4
  - R-4: Supervised residential care
    - Nursing homes

# On-Site Renewable Energy

## Energy Generation Located ON the Project Site

- Solar radiation
- Wind
- Waved
- Tides
- Landfill gas
- Biogas
- Biomass
- Internal heat of the earth

# Semi-Conditioned Space

Space that is directly or indirectly heated or cooled and:

- Heating output  $\leq 14$  Btu/h\*SqFt of floor area
- Cooling sensible output  $< 3.4$  Btu/h\*SqFt of floor area



# Chapter 3

## General Requirements

# Climate Design Parameters

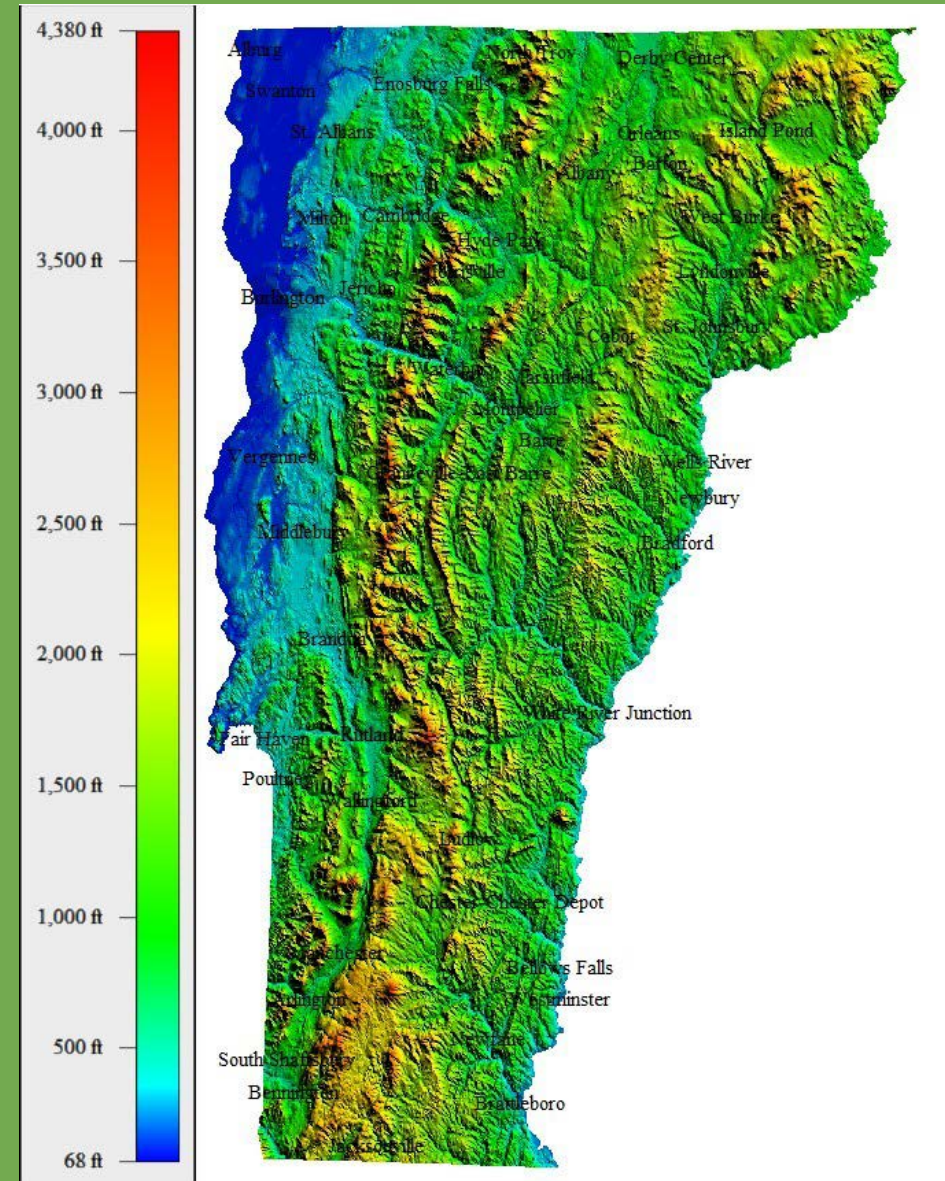
Vermont is in Climate Zone 6A

Updated Design Conditions:

- Heating:  $-9^{\circ}\text{F}$
- Cooling:  $84^{\circ}\text{F}$  db,  $69^{\circ}\text{F}$  wb
- HDD and CDD slightly lower

Indoor Design Temps- **No Change**

- Heating:  $72^{\circ}\text{F}$  max
- Cooling:  $75^{\circ}\text{F}$  min



# Chapter 4

## Commercial Energy Efficiency

# Section C401 General Requirements

# Compliance Paths

## 1. 2020 CBES Requirements

- Sections C402 through C407

## 2. ASHRAE 90.1-2016

Plus applicable provisions in C401.2.1

- Section C406 in 2020 CBES

## Same options as 2015 CBES

- Except ASHRAE 90.1-2013

# Section C402

## Building Envelope Requirements

# Overview of Changes

- **New Definitions:**
  - Multifamily and Semi-conditioned space
- **Updated U-factor & R-value tables**
- **New Assembly U-factor tables**
  - Wood framed attics, metal and wood framed walls
- **Fenestration Req's**
- **Air leakage Req's**
  - Increased performance
  - Air barrier commissioning
  - Tests in dwelling units
- **Vestibules**

# Roofs- 2020 Requirements

- U-factors a closer match for all framing types

Component	U-FACTOR		Example Assembly R-VALUES	
	Conditioned	Semi-Conditioned	Conditioned	Semi-Conditioned
Insulation Above Deck	U-0.025	U-0.039	R-40ci	R-25ci
Metal Building	U-0.026	U-0.037	R-25 + R-11* + R-11 LS	R-19 + R-11 LS or R-25 + R-8 LS
Attic	U-0.021	U-0.034	R-49	R-30

ci = Continuous Insulation

LS = Liner System



# Roofs- Comparison of Example Assemblies

- Above Deck & Metal Roofs Increased
- No Change for Attics

Component	2015	2020	
	Conditioned	Conditioned	Semi-Conditioned
Insulation Above Deck	R-30ci	R-40ci	R-25ci
Metal Building	R-25 + R-11 LS	R-25 + R-11 + R-11 LS	R-19 + R-11 LS or R-25 + R-8 LS
Attic	R-49	R-49	R-30

ci = Continuous Insulation  
 LS = Liner System

# Assembly U-Factors for Metal Building Roofs

INSULATION SYSTEM	RATED R-VALUE OF INSULATION	OVERALL U-FACTOR FOR ENTIRE BASE ROOF ASSEMBLY	OVERALL U-FACTOR FOR ASSEMBLY OF BASE ROOF PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)					
			Rated R-Value of Continuous Insulation					
Standing Seam Roofs with Thermal Spacer Blocks <sup>a</sup>			R-15.8	R-19	R-22.1	R-25	R-32	R-38
Single layer <sup>b</sup>	None	1.280					0.031	0.026
	R-10	0.115		0.036	0.032	0.030	0.025	0.021
	R-11	0.107		0.035	0.032	0.029	0.024	0.021
	R-13	0.101		0.035	0.031	0.029	0.024	0.021
	R-16	0.096		0.034	0.031	0.028	0.024	0.021
	R-19	0.082	0.036	0.032	0.029	0.027	0.023	0.020
Double layer <sup>b</sup>	R-10 + R-10	0.088	0.037	0.033	0.030	0.028	0.023	0.020
	R-10 + R-11	0.086	0.036	0.033	0.030	0.027	0.023	0.020
	R-11 + R-11	0.085	0.036	0.033	0.030	0.027	0.023	0.020
	R-10 + R-13	0.084	0.036	0.032	0.029	0.027	0.023	0.020
	R-11 + R-13	0.082	0.036	0.032	0.029	0.027	0.023	0.020
	R-13 + R-13	0.075	0.034	0.031	0.028	0.026	0.022	0.019
	R-10 + R-19	0.074	0.034	0.031	0.028	0.026	0.022	0.019
	R-11 + R-19	0.072	0.034	0.030	0.028	0.026	0.022	0.019
	R-13 + R-19	0.068	0.033	0.030	0.027	0.025	0.021	0.019
	R-16 + R-19	0.065	0.032	0.029	0.027	0.025	0.021	0.019
R-19 + R-19	0.060	0.031	0.028	0.026	0.024	0.021	0.018	
Liner system <sup>c</sup>	R-25+R-11+R-11 LS	0.026						
Filled cavity <sup>c</sup>	R-10 + R-19 Fc	0.041	0.025	0.023	0.022	0.020	0.018	0.016
<b>Thru-fastened Roofs without Thermal Spacer Blocks</b>								
	R-10	0.184			0.036	0.033	0.027	0.023
	R-11	0.182			0.036	0.033	0.027	0.023
	R-13	0.174			0.036	0.033	0.026	0.023
	R-16	0.157			0.035	0.032	0.026	0.023
	R-19	0.151			0.035	0.032	0.026	0.022
(Multiple R-values are listed in order from inside to outside) Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.								

# Assembly U-Factor for Attic Roofs w/Wood Joists- **NEW**

RATED R-VALUE OF INSULATION ALONE	OVERALL U-FACTOR FOR ENTIRE ROOF ASSEMBLY <sup>a</sup>
<b>Wood-Framed Attic, Standard Framing</b>	
R-30	U-0.034
R-38	U-0.027
R-49	U-0.021
R-60	U-0.017
R-71	U-0.015
R-82	U-0.013
R-93	U-0.011
R-104	U-0.010
R-115	U-0.009
R-126	U-0.008
<b>Wood-Framed Attic, Advanced Framing</b>	
R-30	U-0.032
R-38	U-0.026
R-49	U-0.020
R-60	U-0.016
R-71	U-0.014
R-82	U-0.012
R-93	U-0.011
R-104	U-0.010
R-115	U-0.009
R-126	U-0.008
<b>Wood Joists, Single-Rafter Roof<sup>b</sup></b>	
R-30	U-0.036
R-38	U-0.029
R-38 + R-15ci	U-0.020
<p>a. Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.</p> <p>b. The first R-value is the cavity insulation, while the second value is the continuous insulation uninterrupted by framing.</p>	

# Roof Assembly

## Continuous Insulation

- At least 2 layers w/ staggered edges
- Min of R-12 over entire deck
- Area-weighted average R-Value is = to Table C402.1

## Tapered Insulation & Roof Drains

Minimum of 60% of R-value from Table C402.1(1) maintained

## Mechanical Curbs

R-12 Insulation

## Skylight Curbs

Insulate to lesser of:

- Roofs above-deck insulation level
- R-10

# Walls Above Grade- 2020 Requirements

- U-factors a closer match for all framing types
- Lower U-values throughout

Component	U-FACTOR		Example Assembly R-VALUES	
	Conditioned	Semi-Conditioned	Conditioned	Semi-Conditioned
Mass	U-0.048	U-0.104	R-19ci	R-9.5ci
Metal Building	U-0.044	U-0.060	R-13 + R-17ci or R-22ci	R-15.8ci
Metal framed	U-0.044	U-0.064	R-13 + R-15ci or R-19 + R-8ci or R-20ci	R-13 + R-7.5ci
Wood-Framed & Other	U-0.042	U-0.064	R-13 + R-12ci or R-19 + R-8ci or R-20ci	R-13 + R-3.8ci

ci = Continuous Insulation

# Walls Above Grade- Comparison of Example Assemblies

Higher insulation values for all above-grade walls

Component	2015	2020	
	Conditioned	Conditioned	Semi-Conditioned
Mass	R-13.3ci	R-19ci	R-9.5ci
Metal Building	R-13 + R-13ci or R-19.5ci	R-13 + R-17ci or R-22ci	R-15.8ci
Metal framed	R-13 + R-7.5ci or R-13ci	R-13 + R-15ci or R-19 + R-8ci or R-20ci	R-13 + R-7.5ci
Wood-Framed & Other	R-13 + R-7.5ci or R-20 + R-3.8ci or R-23 or R-15ci	R-13 + R-12ci or R-19 + R-8ci or R-20ci	R-13 + R-3.8ci

ci = Continuous Insulation

# Assembly U-Factors for Metal Building Walls

RATED R-VALUE OF INSULATION	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL U-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-6.5	R-9.8	R-13	R-15.8	R-19	R-22.1	R-25	R-32	R-38
<b>Continuous Insulation Only</b>										
R-0	1.180				0.060	0.050	0.044	0.039	0.030	0.026
<b>Single Compressed Layer</b>										
R-10	0.186			0.054	0.047	0.041	0.036	0.033	0.027	0.023
R-11	0.185			0.054	0.047	0.041	0.036	0.033	0.027	0.023
R-13	0.162			0.052	0.046	0.040	0.035	0.032	0.026	0.023
R-16	0.155			0.051	0.045	0.039	0.035	0.032	0.026	0.022
R-19	0.147		0.060	0.050	0.044	0.039	0.035	0.031	0.026	0.022
<b>Single Layer in Cavity</b>										
R-25 <sup>a</sup>	0.059	0.044	0.039	0.035	0.032	0.029	0.027	0.025	0.021	0.019
R-30 <sup>b</sup>	0.052	0.042	0.037	0.033	0.031	0.028	0.026	0.024	0.021	0.019
<b>Double Layer</b>										
R-25 + R-10	0.047									
R-25 + R-16	0.042									
R-25 + R-10 <sup>c</sup>	0.039									
R-30 + R-16	0.039									

Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.

# Assembly U-Factors for Metal-Framed Walls- **NEW**

RATED R-VALUE OF CAVITY INSULATION (EFFECTIVE INSTALLED)	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL U-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-12	R-13	R-14	R-15	R-20	R-25	R-30	R-35	R-40
<b>Steel Framing at 16 in. on Center and 3.5 in. Depth</b>										
R-0 (0.0)	0.352		0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
R-11 (5.5)	0.132	0.051	0.049	0.046	0.044	0.036	0.031	0.027	0.024	0.021
R-13 (6.0)	0.124	0.050	0.048	0.045	0.043	0.036	0.030	0.026	0.023	0.021
R-15 (6.4)	0.118	0.049	0.047	0.045	0.043	0.035	0.030	0.026	0.023	0.021
<b>Steel Framing at 16 in. on Center and 6.0 in. Depth</b>										
R-19 (7.1)	0.109	0.047	0.045	0.043	0.041	0.034	0.029	0.026	0.023	0.020
R-21 (7.4)	0.106	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.022	0.020
<b>Steel Framing at 24 in. on Center and 3.5 in. Depth</b>										
R-0 (0.0)	0.338		0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
R-11 (6.6)	0.116	0.048	0.046	0.044	0.042	0.035	0.030	0.026	0.023	0.021
R-13 (7.2)	0.108	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.023	0.020
R-15 (7.8)	0.102	0.046	0.044	0.042	0.040	0.034	0.029	0.025	0.022	0.020
<b>Steel Framing at 24 in. on Center and 6.0 in. Depth</b>										
R-19 (8.6)	0.094	0.044	0.042	0.041	0.039	0.033	0.028	0.025	0.022	0.020
R-21 (9.0)	0.090	0.043	0.042	0.040	0.038	0.032	0.028	0.024	0.022	0.020

Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.



# Assembly U-Factors for Wood-Framed Walls- **NEW**

RATED R-VALUE OF CAVITY INSULATION (EFFECTIVE INSTALLED)	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL U-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-6	R-9	R-12	R-15	R-20	R-25	R-30	R-35	R-40
<b>Wood Studs at 16 in. on Center and 3.5 in. Depth</b>										
R-0 (0.0)	0.292			0.064	0.053	0.042	0.035	0.030	0.026	0.023
R-11 (11.0)	0.096	0.059	0.050	0.044	0.038	0.032	0.028	0.024	0.022	0.020
R-13 (13.0)	0.089	0.056	0.047	0.041	0.037	0.031	0.027	0.024	0.021	0.019
R-15 (15.0)	0.083	0.053	0.045	0.039	0.035	0.030	0.026	0.023	0.020	0.019
<b>Wood Studs at 16 in. on Center and 5.5 in. Depth</b>										
R-19 (18.0)	0.067	0.046	0.040	0.036	0.032	0.027	0.024	0.021	0.019	0.018
R-21 (21.0)	0.063	0.043	0.038	0.034	0.030	0.026	0.023	0.021	0.019	0.017
<b>Wood Studs at 16 in. on Center and R-10 Headers</b>										
R-19 (18.0)	0.063	0.045	0.039	0.035	0.031	0.027	0.024	0.021	0.019	0.017
R-21 (21.0)	0.059	0.042	0.037	0.033	0.030	0.026	0.023	0.020	0.018	0.017
<b>Wood Studs at 24 in. on Center and 3.5 in. Depth</b>										
R-0 (0.0)	0.298			0.064	0.054	0.042	0.035	0.030	0.026	0.023
R-11 (11.0)	0.094	0.059	0.050	0.043	0.038	0.032	0.027	0.024	0.022	0.019
R-13 (13.0)	0.086	0.055	0.047	0.041	0.036	0.031	0.026	0.023	0.021	0.019
R-15 (15.0)	0.080	0.052	0.044	0.039	0.035	0.029	0.026	0.023	0.020	0.018
<b>Wood Studs at 24 in. on Center and 5.5 in. Depth</b>										
R-19 (18.0)	0.065	0.045	0.039	0.035	0.032	0.027	0.024	0.021	0.019	0.018
R-21 (21.0)	0.060	0.042	0.037	0.033	0.030	0.026	0.023	0.020	0.018	0.017
<b>Wood Studs at 24 in. on Center and R-10 Headers</b>										
R-19 (18.0)	0.062	0.044	0.039	0.034	0.031	0.027	0.024	0.021	0.019	0.017
R-21 (21.0)	0.057	0.041	0.036	0.032	0.029	0.025	0.023	0.020	0.018	0.017

Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.

# Below-Grade Walls

New 2020 Requirements

- Semi-conditioned is 1/2 standard

Component	C-FACTOR		Example Assembly R-VALUES	
	Conditioned	Semi-Conditioned	Conditioned	Semi-Conditioned
Bellow-Grade Wall	C-0.063	C-0.119	R-15ci	R-7.5ci

ci = Continuous Insulation

# Below-Grade Walls

## Comparison of Example Assemblies

Component	2015	2020	
	Conditioned	Conditioned	Semi-Conditioned
Bellow-Grade Wall	R-10ci	R-15ci	R-7.5ci

ci = Continuous Insulation

# Floors

## New 2020 Requirements

Component	U or F-FACTOR		Example Assembly R-VALUES	
	Conditioned	Semi-Conditioned	Conditioned	Semi-Conditioned
Mass	U-0.051	U-0.087	R-16.7ci	R-8.3ci
Joist/Framing-Metal	U-0.032	U-0.052	R-38	R-19
Joins/Framing-Wood & Other	U-0.033	U-0.051	R-30	R-19
Unheated Slabs	F-0.36	F-0.54	R-10 entire slab & around perimeter	R-10 for 24"
Heated Slabs	F-0.373	F-0.55	R-20 entire slab & around perimeter	R-10 entire slab & around perimeter

ci = Continuous Insulation

# Floors

## Comparison of Example Assemblies

Component	2015	2020	
	Conditioned	Conditioned	Semi-Conditioned
Mass	R-12.5ci	R-16.7ci	R-8.3ci
Joist/Framing-Metal	R-38	R-38	R-19
Joins/Framing-Wood & Other	R-30	R-30	R-19
Unheated Slabs	R-10 for 48"	R-10 entire slab & around perimeter	R-10 for 24"
Heated Slabs	R-10 for entire slab	R-20 entire slab & around perimeter	R-10 entire slab & around perimeter

ci = Continuous Insulation

# Fenestration (Windows & Skylights)

- U-Factors Decreased
- No Change in Window SHGC's
  - Semi-conditioned spaces Exempt from requirements

Component	2015	2020
U-Factor		
Fixed Window	0.36	0.29
Operable Window	0.43	0.37
Entrance Doors	0.77	0.68
Skylights		
U-Factor	0.50	0.48
SHGC	0.40	0.38

# Air Barriers

**Blower door testing is required on ALL new buildings/additions**

Comply with Either:

1. **Testing Performance**
  - Hit a Specific Number
2. **Air Barrier Commissioning**
  - No value to pass, but many steps to follow

# Air Barrier Performance Testing

- **Meet or exceed 0.30 CFM75/SqFt**
  - Previous was 0.50 cfm50/SqFt
- **Six-Sided envelope**
  - Slab and Below-grade walls now included
- **75 Pa testing pressure**
  - Previous was 50 Pa

## Exceptions:

1. **50,000 SqFt buildings**

Can test portion (top level, entrance & loading dock levels, 25 % wall area)
2. **If test is > 0.3 CFM75/SqFt but < 0.4 CFM75/SqFt**
  - Find leaks while pressurized and sealed w/o deconstruction.
  - Document corrective actions in report, send to owner.



# Continuous Air Barrier Commissioning

Cx Report must include:

1. Field inspection checklist during installation
2. Report of construction
  1. Material handling/storage
  2. Approved materials
  3. Proper surface prep
  4. Air-barrier continuity at penetrations

# Envelope Commissioning Checklist

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Foundations subsoil drainage system	<u>Verify compliance with approved plans, specifications and construction documents.</u>
Foundation damp-proofing and waterproofing	
Flashing at: exterior doors, skylights, wall flashing and drainage systems	
Exterior wall coverings	
Moisture envelopes	Where applicable meet owner's project requirements (OPR), Basis of Design (BOD), Cx Specifications.
Exterior below-grade walls	Check for proper drainage system at exterior wall perimeter to keep water from entering building.
External floor and soffits, slab-on grade	Check for thermal resistance or insulation when required. Slabs: Check drainage for moisture penetration.
Exterior walls	Check drawings for wall assembly requirements.
Exterior glazed window fenestration: windows, glazed doors and skylights	Drawing reviews and contractor submittal reviews: <ul style="list-style-type: none"> <li>• Check that fenestration products are labeled with a U-factor (see NFRC 100) and a solar heat gain coefficient (SHGC) (see NFRC 200), and certification for the air infiltration requirement.</li> <li>• Check for proper flashing and caulking at walls and roof assemblies.</li> </ul> Glazed doors: <ul style="list-style-type: none"> <li>• Check for proper flashing, and seals and gaskets; and proper pull force, if provided with a closer.</li> <li>• Check for proper door swing.</li> </ul>
Site-built fenestration: curtain walls and store-front systems, and atrium roof systems	Check for a label certificate issued by the National Fenestration Rating Council (NFRC) or a label certificate issued by the glazing fabricator that meets the default U-factor and SHGC; or an NFRC component modeling approach (CMA) label certificate or another approved standard. <ul style="list-style-type: none"> <li>• Check for proper door swing.</li> </ul>
Field-fabricated fenestrations: fenestration made at the site, not preformed or cut	Check for compliance with the default U-factor and the default SHGC.

Exterior doors	Check for proper flashing installation at header, walls and floor. <ul style="list-style-type: none"> <li>• Check for U-factor requirements for swinging and nonswinging doors.</li> <li>• Check for appropriate manufacturer's referenced standard [American Architectural Manufacturer's Association (AAMA); Canadian Standards Association (CSA); and Window and Door Manufacturer's Association (WDMA) or other approved standard] product data sheets.</li> </ul>
Sealants, control joints and flashing (stationary and moveable)	Check for proper installation in accordance with the manufacturer's written instructions
Shading devices	Check for proper anchoring to building with proper flashing at wall connections.
Structural systems	Check for proper anchoring in accordance with construction documents, including metal connectors and beam supports.

# Dwelling Unit Air Infiltration

A random sampling of units shall be tested

- 10% of units in each building
- One corner unit
- One unit on each floor
- Equal # units per floor

Meet 0.35 cfm75/SqFt

- 75 Pa pressure
- Six-sided surface area

# Dwelling Unit Air Infiltration

Each unit must be tested and pass

- If a failure occurs:
  - Cause must be diagnosed and corrected
  - Unit re-tested until unit passes

Construction contractor will not choose units to be tested

HVAC systems will be shut off

- Dampers for exhaust, intake, makeup air will not be sealed with wrap

# Vestibules

- 7 feet between inside and outside doors
- Heat to max of 55 degrees F
- If unconditioned
  - Bring either interior or exterior walls up to conditioned envelope requirements

## New Exceptions

- Doors to Semi-conditioned space
- Elevator doors in parking garages, must have enclosed lobby at each level
- Vehicle doors

# Section C403

## Building Mechanical Systems

# Overview of Changes

- Electric Resistance Backup Heating
  - With Cold Climate Heat Pumps
- Equipment Performance Increases
- Energy Recovery Systems
- Economizers
- Parking Garage Ventilation
- VFDs on Fans Systems
  
- Refrigeration systems
  - Compressor Controls

# Ventilation

Follow Requirements in ASHRAE Standard 62.1-2016

*Ventilation for Acceptable Indoor Air Quality*

- *2015 CBES used 2013 version*

Mechanical Ventilation is required on new buildings

- Natural ventilation is no longer allowed



# Electric Resistance Heating Allowance

Electric resistance heating is still prohibited

## New Exceptions

### 1. Multifamily buildings: Meeting Heat load requirements\*

- 6.0 Btu/Hr/SqFt or less at Design Temperature

### 2. Cold Climate Heat Pumps\*

- Full heating load met with HP at 5 Degrees F
- Air Tested envelope to 0.20 CFM75/SqFt
  - 75 Pa and 6-sided

*\*Burlington projects need added BED approval*

# Commissioning & Equipment Sizing

Mechanical Systems must be commissioned in accordance with Section C407

- Cx Plan
- Systems Adjusting & Balancing
- Functional Performance Testing
- Commissioning Report
- Documentation

Equipment Sizing

- Up to 10% oversizing allowed

# HVAC Equipment Performance

## Few Changes from 2015 CBES

- **AC & Condensing Units**
  - No change from 2015 CBES
- **Heat Pumps**
  - Small increase in HSPF in smallest HPs
- **Water Chilling Packages**
  - No Change from 2015 CBES
- **VRF**
  - Air-Cooled: Heating & Cooling slightly higher
  - Water Source: IEER Added
  - Ground water & Ground-source: same as 2015

# Part-Load Controls

Hydronic Systems greater than 300,000 Btu/h shall include:

- **Supply water Temp adjustment**
  - Heating & Cooling
  - 25% reset at least
- **Vary pump flow**
  - 2 HP or larger pumps
  - 50% flow reduction
    - *2015 CBES was 5 HP*

*2015 CBES size limit was 500,000 Btu/h*

# “Fan System” Definition

## What is a Fan System? *Not in the CBES*

- Group of equipment & components
- Heating and Cooling Source

Examples:

- **Single-Zone**
  - VRF, WSHP, FCU, Small RTU
- **Multi-Zone**
  - Large RTU, Air handler

Why does it matter? Determines requirements for:

- Economizer, Energy Recovery, etc

# Economizers

## Required on:

- **Chilled water systems with capacity (less economizer capacity) > than**
  - Water-cooled system: 1,320,000 Btu/h
  - Air-cooled or District system: 1,720,000 Btu/h
- **Fan systems with cooling capacity > or = to 54,000Btu/h**
  - Other than Group R occupancy
  - Group R Occupancy needs > 270,000 Btu/h

## Number of exceptions has been reduced:

- Spaces humidified above 35F dewpoint
- Systems operating less than 20 hours a week
- Systems including heat recovery

# Economizer Controls

Partial economizing with integrated mechanical cooling

- OA Damper 100% open till 45 degrees F

DX units required to have:

- 3-stages of cooling if  $> 75,000$  Btu/h
- 4-stages of cooling if  $> 240,000$  Btu/h
  - Unless a Variable displacement compressor used with a constant compressor

High-limit shutoff

- Decreased from 75 to 70 Degrees F

Fault Detection Diagnostics

# Demand Control Ventilation

CO2-based DCV required for:

- Areas larger than 500 SqFt ...*and...*
- 25 people per 1,000 SqFt ...*and...*
- One of following:
  - 1) Air-side economizer
  - 2) Auto Modulation of OA Damper
  - 3) 3,000 cfm OA Design flow

## Exceptions

- If Energy Recovery included
- No DDC Controls
- Supply air (-) Makeup air < 1,200 cfm
- Process Only Ventilation



# Parking Garage Ventilation

## Enclosed Parking Garages

- (0-40% permanent openings)

## Follow VT Fire & Building Safety Code Ventilation rates

- Continuous ventilation: 0.05 cfm per square foot
- Design ventilation rate: 0.75 cfm per square foot
- Stage or modulate airflow rates based on CO levels

Sensor Failure results in 100% exhaust flow

# Energy Recovery Systems

Language changed from "Fan Systems" to "Air Systems"

Same Effectiveness: 50%

Same Exceptions:

- Spaces heated to < 60 Degrees F
- Systems operating < 20 hours a week
- Exhausting toxic, flammable fumes/dust
- Kitchen hoods for removing grease

**New Exception**

- 60% outdoor heating energy provided from site-recovered energy

# Energy Recovery Systems

Required for Air Systems operating 3,000 hours or more per year

PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
≥ 10% and < 20%	≥ 20% and < 30%	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
DESIGN SUPPLY FAN AIRFLOW RATE (cfm)							
≥ 10,500	≥ 6,500	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 120

Example: RTU with 10,000 CFM Supply Air. Operating 4,000 hours

- OA is 3,000 CFM
- %OA is 30%

ERV REQUIRED since its > 5,500 CFM Supply

# Kitchen Exhaust DCV

Same requirements as 2015 CBES

- For 5,000 cfm or greater systems

Do One of Following:

- 1) 50% of replacement air must be transfer air (would otherwise be exhausted)
- 2) DCV system
  - DCV on 75% of exhaust air
  - 50% reduction in air flow
- 3) UL Listed Energy Recovery systems
  - 40% effectiveness on 50% of exhaust air

# Fan Airflow Control

When do airflows need to be varied?

- Cooling system size reduced from 5.4 tons to 2 tons

For DX and Chilled water units:

- 2-stages of fan control
- Low speed =  $\frac{2}{3}$  max speed
  - 40% power draw

Non-Dx/Chilled water:

- 50% speed reduction
  - 30% power draw

# Fan Speed Control

Fan systems 2 hp or more need VFDs

- Old limit was 7.5 hp

Heat rejection devices need to reduce to:

- 50% of design airflow
- or
- 30% design of fan wattage

# Walk-in Cooler & Freezers & Warehouses

Same insulation values as 2015

## **New Requirements**

LED lighting Required:

- 90 lumens/watt or greater

Controls required on LEDs

- Turn off after 15-minute unoccupancy

# Refrigeration Efficiency Tables

Not yet available...

Waiting for Published CBES language



# Compressor Systems- **NEW**

1) Floating suction pressure control required

Exceptions:

- Single compressors with no variable capacity
- Suction groups with
  - 1) Design Temp of 30F or more
  - 2) Cascade system
  - 3) Serve chillers for secondary cooling fluids

2) Liquid Subcooling on 100,000 Btu/Hr systems

3) Crankcase heaters on compressors must cycle off during operation

# Duct & Piping Insulation

## Duct Insulation

- Same levels as 2015

## Pipe Insulation

- Required for all fluid temps other than 60F to 85F
  - Old upper limit was 115F

# Snow & Ice-Melt Controls

No manual control allowed

- Only automatic

Shut off at:

- 40 Degrees F OAT or
- 50 Degrees F 2" below slab surface

# Section C404 Service Water Heating

# Electric Water Heaters

## Max Size Increased to 7.5 kW

- Up from 5 kW

## Exceptions

### 1. Instant electric water heaters

- Serving emergency shower & eye-wash stations

### 2. Hybrid Heat Pumps, no kW limit if meets all:

- At least 60% hot water demand from HP alone
- Shower heads < 2.0 GPM
- Dishwashing equipment all Energy Star rated

# Hot Water Equipment Performance

## New equipment added:

1. Tabletop- 3ft cabinet sized
2. Grid-Enabled Heaters
  - 75 gallon storage tank
  - Manufactured after April 16, 2015

## Heat Pump Performance added

## Slight increases in efficiency for:

- Gas & Oil Storage Heaters
- Instant Gas Heaters

# High Input Water Heating Systems

## Gas-fired Equipment

- Individual equipment must meet 92% Et
  - Old efficiency was 90% Et
- Multiple equipment: weighted-average must be 92% Et

## Exceptions:

- At least 25% annual hot water from on-site renewables
- Individual Dwelling Unit Heaters and Heaters < 100,000 Btu/h in size
  - Not included in total input rating for building

*Et = Thermal Efficiency*

# Circulation Pumps

## Requirements:

1. Time-Switch to turn pumps off when no hot water required

*Or*

2. Modulating pump, set to min hot water temp
  - Control is Aquastat on pump return

## Exception

- Healthcare in accordance with ASHRAE Standard 188- Legionellosis



# Max Allowable Pipe Length

These sections were REMOVED:

1. Max Allowable Pipe Length
2. Max Allowable Pipe Volume
3. Water Volume Determination

Caused too much confusion in the 2015 CBES

# Commissioning

These water-heating systems need to follow Section C407.2

- Domestic Hot Water
- Swimming pool heating
- Spa heating
- Controls for systems listed above

# Section C405 Electrical Power and Lighting Systems

# New Lighting Definitions

## Luminaire-Level Lighting Controls (LLC)

- Lighting system with embedded lighting control logic including:
  - Occupancy sensors
  - Ambient light sensors
  - Wireless networking
  - Local override switching

# Dwelling & Sleep Unit Lighting

90% of lamps & fixtures shall be High Efficacy

## High Efficacy Means:

- Lamps: 65 lumens/watt or >
- Fixtures: 55 lumens/watt or >

# Lighting Controls

Comply with one of following:

1. Standard lighting control sections
2. LLC (luminaire-level lighting) controls
  - Increase/decrease light output based on occupant activity & daylight

Exceptions:

- Exit and emergency lighting
- Dwelling & Sleeping units
- Industrial and manufacturing process areas
  - With production or safety concerns

# Egress Lighting- Occupancy Controls

Egress lighting: Lighting that is continuously on

Egress lighting requirement:

- 50% power reduction after 15 minutes unoccupied
  - New for 2020 CBES

Exceptions:

1. Egress areas at 50% or less of LPD allowance
2. Egress illumination  $< 0.02$  watts per SqFt of total building area
3. Required by National Fire Protection Association (NFPA 1 or 101)

# Time Switch Controls

Same requirements as 2015 CBES

- 7-Day & Holiday schedules
- Backup programming
- Manual Override
  - 2 hours max
  - 5,000 SqFt max per switch

## Updated Exceptions

- Malls concourses
- Auditoriums
- Sales areas
- Manufacturing facilities
- Sports arenas



# Light-Reduction Controls

Same requirements as 2015 CBES

- Manual control for occupants
  - 50% lighting reduction or more

## Exceptions

- Daylight zones (following code req's)
- Spaces with only 1 fixture < 50 watts
- Spaces using < 0.3 Watts/SqFt
- Corridors, equipment rooms, lobbies, electrical & mechanical rooms

# Daylight Controls

Spaces with > 150 watts in daylight zones (top or sidelight)

Exceptions:

1. Health Care facilities w/ patient care
2. First floor of Group A-2 (restaurants) or M (shopping) occupancies
3. If LPD is < 35% Max allowed Watts/SqFt
4. If total connected lighting power (TCLP) is < adjusted interior lighting power allowance (LPA)
  - Equation 4-8

# Equation 4-8 Adjusted Lighting Power Allowance

$$LPA_{adj} = [LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)] \quad \text{(Equation 4-8)}$$

where:

- $LPA_{adj}$  = Adjusted building interior lighting power allowance in watts.
- $LPA_{norm}$  = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where reduced lighting power is used to comply with the requirements of Section C406.
- $UDZFA$  = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.3.2 and C405.2.3.3, that do not have daylight responsive controls.
- $TBFA$  = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

# Daylight Control Function

1. Side and Toplight zones controlled separately
2. Calibration from within space (facilities staff only)
3. Dimming to 15% output power in:
  - Offices, Classrooms, Labs, Libraries
4. Complete shutoff
5. Independent orientation (N, S, E, W)
6. 3-minute time delay
  - Prevent cycling
7. 2,500 SqFt max controlled by each sensor
8. Manual override
  - Reduction of light levels ONLY

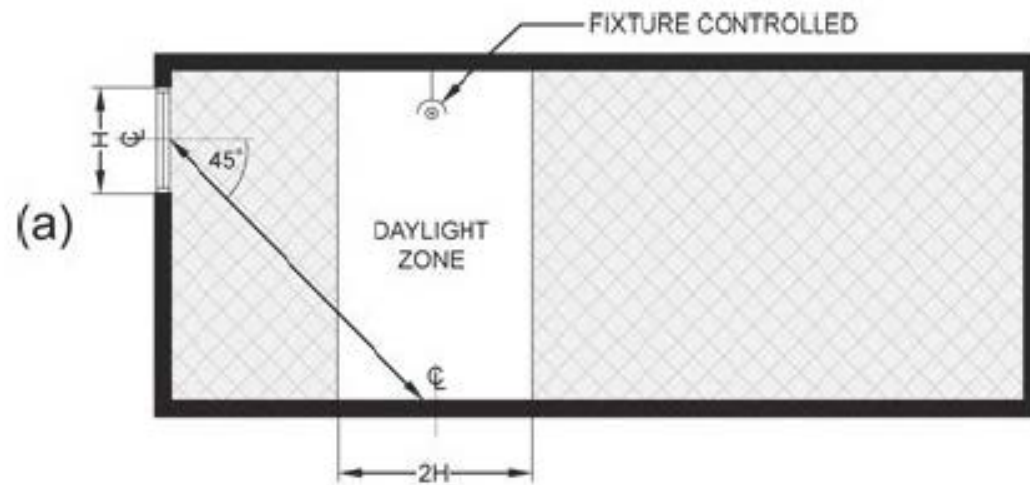
# Daylight Dimming Control

- Automatic dimming
- Maintain uniform illumination throughout space

Either Method:

1. Continuous dimming down to < 15% rated max power
2. Stepped dimming between 0 and 100% power
  1. At least 2-steps
  2. In equal increments (rounded to nearest 10%)
  3. Not allowed in offices, classrooms, labs, and library reading rooms
    - Continuous needed

# Clerestory Daylight Zones- NEW



(a) Section view

(b) Section view with obstruction

## A Sidelight Zone

### How to Measure This Daylight Zone?

- **Lateral projection:**
  - 2X the clerestory DEPTH
  - 45-degree angle from center of clerestory window
- **Longitudinal width:**
  - Same as normal window
  - 2 feet on each side

# Other Daylighting Changes

## Parking Garages Daylighting zone

- 20 ft from wall
  - Walls with 40% or > opening

## Small Windows not included in daylighting zones

- Window area < 10% area of calculated daylight zone (for that window)
  - Does not qualify as a daylight zone

# Toplight Zone Changes

## Rooftop monitor moved from sidelight section

- **Daylight zone calculated the same way**
  - Laterally: 1.0 times the height of monitor
  - Horizontally: 0.25 times height of monitor
    - Height measured from floor to bottom of monitor
- **Daylight zone stops at obstacle**
  - If obstacle is 0.7 times height of monitor



# Interior Lighting Power Requirements

## Dwelling & Sleeping Units

- **EXEMPT from LPD Requirements**
- Remove floor area from LPD Calculation

## Total Connected Interior Lighting Power

- New equation: 4-9
  - Updated default values

# Equation 4-9 Total Connected Interior Lighting Power

$$TCLP = [SL + LVL + BLL + LED + TRK + \text{Other}] \quad \text{(Equation 4-9)}$$

where:

*TCLP* = Total connected lighting power (watts).  
*SL* = Labeled wattage of luminaires for screw-in lamps.  
*LVL* = For luminaires with lamps connected directly to building power, such as line voltage lamps, the rated wattage of the lamp.  
*BLL* = For luminaires incorporating a ballast or transformer, the rated input wattage of the

*LED* = ballast or transformer when operating that lamp. For light-emitting diode luminaires with either integral or remote drivers, the rated wattage of the luminaire.

*TRK* = For lighting track, cable conductor, rail conductor, and plug-in busway systems that allow the addition and relocation of luminaires without rewiring, the wattage shall be one of the following:

1. The specified wattage of the luminaires, but not less than 8 W per linear foot (25 W/lin m).
2. The wattage limit of the permanent current-limiting devices protecting the system.
3. The wattage limit of the transformer supplying the system.

Other = The wattage of all other luminaires and lighting sources not covered previously and associated with interior lighting verified by data supplied by the manufacturer or other *approved* sources.

# Summary: Total Connected Interior Lighting Power

What to input into LPD Calculation?

## Track Lighting

1. The higher value of:
  - Wattage of fixture/lamp ...*or...*
  - 8 watts per linear foot of track length  
Old value was 30 watts/lin. Ft
2. Current Limiting Device

## Areas NOT included in LPD Calculation

- Task lighting for Plant growth/maintenance- **NEW**
  - Limited to 75 W per SqFt
  - Canopy Area, excluding hard surfaces

# Interior LPD Allowances

## Building Area Method

- 25% reduction from 2015 CBES

Building Type	2015 CBES	2020 CBES	% Reduction
Office	0.82	0.64	22%
Retail	1.26	0.92	27%
Warehouse	0.6	0.43	28%
Hotel/Motel	0.87	0.65	25%
Health care clinic	0.9	0.69	23%
Dining: bar lounge/leisure	1.01	0.76	25%
Manufacturing facility	1.17	0.82	30%

# Interior LPD Allowances

## Space-By-Space Method

- 25% reduction from 2015

Space Type	2015 CBES	2020 CBES	% Reduction
Office: Open	0.98	0.71	28%
Office: Enclosed	1.11	0.81	27%
Warehouse: Large Items	0.58	0.35	40%
Conference/ Multipurpose room	1.23	0.92	25%
Corridor	0.66	0.66	0%
Electrical/mechanical room	0.95	0.43	55%
Manufacturing: High-Bay	1.23	0.75	39%
Restroom	0.98	0.73	26%
Lobby	0.9	0.76	16%

# Additional Interior Lighting Power

## Retail Area additions:

- Existed in 2015 CBES
  - *Equation 4-10*
- 250 Watts allowance
  - Down from 500 Watts
- Retail Areas 1-4 Watt/SqFt
  - Reduced 65-70%

$$250 \text{ W} + (\text{Retail Area 1} \times 0.20 \text{ W/ft}^2) + (\text{Retail Area 2} \times 0.20 \text{ W/ft}^2) + (\text{Retail Area 3} \times 0.50 \text{ W/ft}^2) + (\text{Retail Area 4} \times 0.90 \text{ W/ft}^2)$$

where:

- Retail Area 1* = The floor area for all products not listed in Retail Area 2, 3 or 4.
- Retail Area 2* = The floor area used for the sale of vehicles, sporting goods and small electronics.
- Retail Area 3* = The floor area used for the sale of furniture, clothing, cosmetics and artwork.
- Retail Area 4* = The floor area used for the sale of jewelry, crystal and china.

# Exterior Lighting Zones

## Zone 4 was Removed

- No Metropolitan areas in VT

## Zone 3 = Our VT Downtowns

## Zone 2 = Most Common

- Mixed residential & light commercial

## Zone 1 = Rural & State Forests

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 or 2

# Exterior LPD Allowances

## Base site allowance

- Watts per Zone
- Reduced 50%

## Other Areas

- W/SqFt or W/Lin Ft
- Reduced 50%

## New Areas

- Dining
- Landscape
- Loading Docks

	LIGHTING ZONES		
	Zone 1	Zone 2	Zone 3
Base Site Allowance	250 W	300 W	375 W
<b>Uncovered Parking Areas</b>			
Parking areas and drives	0.02 W/ft2	0.03 W/ft2	0.05 W/ft2
<b>Building Grounds</b>			
Walkways less than 10 feet wide	0.35 W/linear foot	0.35 W/linear foot	0.40 W/linear foot
Walkways 10 feet wide or greater, plaza areas special feature areas	0.07 W/ft2	0.07 W/ft2	0.08 W/ft2
Dining areas	0.50 W/ft2	0.50 W/ft2	0.60 W/ft2
Stairways	0.40 W/ft2	0.50 W/ft2	0.50 W/ft2
Pedestrian tunnels	0.08 W/ft2	0.08 W/ft2	0.10 W/ft2
Landscaping	0.02 W/ft2	0.03 W/ft2	0.03 W/ft2
<b>Building Entrances and Exits</b>			
Pedestrian and vehicular entrances and exits	10 W/linear foot of door width	10 W/linear foot of door width	15 W/linear foot of door width
Entry canopies	0.10 W/ft2	0.12 W/ft2	0.20 W/ft2
Loading Docks	0.25 W/ft2	0.25 W/ft2	0.25 W/ft2



# Exterior LPD Allowances (continued)

	LIGHTING ZONES		
	Zone 1	Zone 2	Zone 3
<b>Sales Canopies</b>			
Free-standing and attached	0.30 W/ft <sup>2</sup>	0.30 W/ft <sup>2</sup>	0.40 W/ft <sup>2</sup>
<b>Outdoor Sales</b>			
Open areas (including vehicle sales lots)	0.15 W/ft <sup>2</sup>	0.15 W/ft <sup>2</sup>	0.25 W/ft <sup>2</sup>
Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	5 W/linear foot	5 W/linear foot
Building facades	No allowance	0.075 W/ft <sup>2</sup> of gross above-grade wall area	0.113 W/ft <sup>2</sup> 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	135 W per location plus 45 W per additional ATM per location	135 W per location plus 45 W per additional ATM per location
Entrances and gatehouse inspection stations at guarded facilities	0.5 W/ft <sup>2</sup> of covered and uncovered area	0.5 W/ft <sup>2</sup> of covered and uncovered area	0.5 W/ft <sup>2</sup> of covered and uncovered area
Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft <sup>2</sup> of covered and uncovered area	0.35 W/ft <sup>2</sup> of covered and uncovered area	0.35 W/ft <sup>2</sup> of covered and uncovered area

# Electric Vehicle Charging Stations- **NEW**

*EVSE = Electric Vehicle Supply Equipment*

Install EVSE in 50% of required spaces

- Round up to whole #
- Pre-wire remaining spaces

Label parking spots as

- “EV Use Only”

Level 1, 2 and DC Fast Charge Requirements

- If only installing Level 2 and/or DC Fast chargers
  - Combine Level 1 and Level 2 req's

# Electric Vehicle Charging Stations- **NEW**

Commercial Building Occupancy <sup>a</sup>	Minimum Number of EVSE and EVSE-ready Parking Spaces <sup>b</sup> Whole numbers represent actual number of required spaces. Fractional percentages shall be rounded up to nearest whole number.					
	<25 Parking Spaces in Lot		≥25 Parking Spaces in Lot Option A		≥25 Parking Spaces in Lot Option B	
	Level 1	Level 2 or DC Fast Charge	Level 1	Level 2 or DC Fast Charge	Level 1	Level 2 or DC Fast Charge
Groups A & M <sup>c</sup>	0	0	0%	4%	0%	10
Groups B, E, F, & H	1	1	3%	3%	2%	5
Groups I-1, I-2, I-3, & R-4	1	1	2%	4%	1%	10
Group R-1	0	1	0%	2%	1%	10
Group R-2	1	0	8%	0%	3%	5

Example: Hotel (group R-1) with 100 parking spaces

- Option A: 2% Level 2 = 2 parking spots
  - Install 1 at construction. Pre-wire other 1
- Option B: 1% Level 1 (1 parking spot) + 10 Level 2 parking spots
  - Install 1 Level 1 and 5 Level 2. Pre-wire remaining 5 spots

# Section C406

## Additional Efficiency Package Options

# Additional Energy Efficiency Credits

## 6 Credits required for each new building

- Existing Buildings exempt
- **Tenant Spaces**
  - Only 3 Credits Required

## Available credits vary for each building occupancy type

- **Use “All Other Groups” unless 65% is one of listed types:**
  - R-1: Hotels & Motels
  - R-2: Apartments & Dormitories
  - B: Business & Offices
  - E: Education, through 12<sup>th</sup> grade
  - M: Merchandise

# Credit 1: More Efficient HVAC Performance

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
2	2	5	2	6	3

- **15% more efficient HVAC**
  - 12 Performance Tables
  - 90% of Equipment must be listed in Tables
- **Stand-alone supply, return & exhaust fans > 1 hp**
  - Need FEG of 71
    - Baseline is 70

# Credit 2: Reduced Lighting Power

## Option 1

- 10% Reduction in LPD Values

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
1	1	3	3	3	2

## Option 2

- 20% Reduction in LPD Values

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
2	2	5	5	5	4

## Dwelling Units

- 95% lamps & fixtures High Efficacy

# Credit 3: Enhanced Lighting Controls

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
N/A	N/A	2	1	2	1

90% of Fixtures must have:

1. Continuous dimming
2. Individually addressable
3. Daylight sensor controlling 8 fixtures max
4. Digital Control system that:
  - Reconfigure light levels
    - Individual & Group of lights
  - Load Sheds
  - Individual occupant control in open offices
  - Occ/Daylight sensor reconfiguration
5. Sequence of Operations
  - Outline controls function in construction Doc's



# Credit 4: On-Site Renewable Energy

System size based on conditioned floor area

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
3	2	2	3	3	3

Energy sources include:

- Solar Radiation
- Wind, Waves or Tides
- Landfill Gas or Biogas
- Biomass (Wood)
- Geothermal Heat

ON-SITE RENEWABLE ENERGY SYSTEM RATING (PER SQUARE FOOT) Building Area Type	kBTU per year	kWh per year
Assembly	1.8	0.53
Dining	10.7	3.14
Hospital	3.6	1.06
Hotel/Motel	2.0	0.59
Multi-family residential	0.50	0.15
Office	0.82	0.24
Other	2.02	0.59
Retail	1.31	0.38
School/University	1.17	0.34
Supermarket	5.0	1.47
Warehouse	0.43	0.13

# Credit 5: Dedicated Outdoor Air System

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
3	1	2	3	4	3

## 100% Outdoor Air System

- Serving 90% of conditioned floor area
- Follow ASHRAE 62.1
- Supply-air temperature reset
  - Building loads or OAT

# Credit 6: High Efficiency Service Water Heating

## Option 1: Load Fraction

- 60% hot water provided by:
  - Waste heat recovery
  - Renewable energy heating system

## Option 2: High Performance Equipment

- 95% Efficiency for all

## Option 3: Heat Pump Equipment

- 3.0 COP
- Cannot draw conditioned indoor air

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	*GROUP I ONLY
Additional Efficiency Credits					
5	6	N/A	N/A	N/A	3

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	*GROUP I ONLY
Additional Efficiency Credits					
3	3	N/A	N/A	N/A	2

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	*GROUP I ONLY
Additional Efficiency Credits					
5	5	N/A	N/A	N/A	2

# Credit 7: Enhanced Envelope Performance

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
3	4	2	2	2	3

## Option 1: UA Method

- 15% better than Code

## Option 2: Above-Grade Perf Alternative

- $UA_{Total} / Area \leq 0.030$

# Credit 8: Reduced Air Infiltration

Max air leakage of:

- 0.25 CFM75/SqFt
  - 6-sided
  - 75 pascals

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
3	5	2	3	4	3

# Credit 9: Efficient Kitchen Appliances

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	*A-2 ONLY
Additional Efficiency Credits					
5	5	5	5	5	5

## Commercial Kitchens

- Serving at least 5 meals a week
- **Energy Star Rated Equipment**
  - Fryers
  - Hot food holding cabinets
  - Steam Cookers
  - Dishwashers
  - Griddles
  - Ovens

# Credit 10: Controlled Receptacles

50% of receptacles controlled in:

- Offices, Conference, Classrooms, Print/Copy Rooms
- Layout options:
  1. Split receptacles (top plug controlled)
  2. Or full controlled receptacles
    - 12 inch separation of uncontrolled & controlled
    - Visibly different

Control Types:

1. Occupancy (20 minute max)
2. Time of Day

Commercial Building Occupancy Group					
R-1	R-2	B	E	M	All Other
Additional Efficiency Credits					
N/A	N/A	6	2	N/A	N/A

Exceptions:

Equipment that needs to operate 24/7

# Section C407 Maintenance Information and System Commissioning



# Cx Authority Qualifications

## Experience with 3 previous projects

- Each at least 20,000 SqFt

## Third-Party Entity

- **Not an employee of:**
  - Design team
  - Construction team
  - Owner
  - Developer

# What Buildings to Commission?

No longer a SqFt requirement for Commissioning

- 2015 CBES was 50,000 SqFt or larger

**NEW**-System Size Requirements for 2020

Mechanical and Service Water Systems Cx Req's:

- **Cooling:**
  - 480,000 Btu/h (*140.7 kW*) or >
- **Space Heating and Service Water (combined):**
  - 600,000 Btu/h (175.8 kW) or >

# Requirements for Commissioning

- Cx Plan
- Systems Adjusting & Balancing
  - Air & Hydronic Systems
- Functional Performance Testing
  - HVAC equipment, controls & economizers
  - Lighting fixtures & controls
- Commissioning Report
- Documentation
  - Balancing report
  - Construction drawings
  - O&M Report

# Chapter 5

## Existing Buildings

# General Section

## No Major Changes

- Reorganized Language

## Historic Buildings

- Exempt from repair, alteration and change of occupancy code sections
  - If a "Historic Building Exemption Report" is sent and approved by State Historic Preservation Office
  - Same as 2015 CBES

# Additions

## Windows & Skylight Areas:

1. Additions need to meet fenestration area req's
2. Addition resulting in total building fenestration area > code levels must:
  - Comply with Component Performance Alternative
  - Weighted-average UA value of all envelope components

# Alterations

Existing building cannot be LESS conforming to code after alteration

Alterations NOT needing to bring up to code:

1. Storm Windows
2. Single-pane window film (reducing SHGC)
3. Exposed cavities (ceiling, wall, floor)
  - If filled with insulation
4. Existing cavity that's not exposed
5. Replacement of existing electric resistance unit- **NEW**
6. Roof recover
7. Air Barrier for roof recover/replacement
  - If remainder of envelope not touched

# Repairs

These repairs DO NOT need to meet code:

1. **Glass-only replacement**
  - Existing frame remains
2. **Roof Repair**
3. **Air Barrier for roof repair**
  - If remainder of envelope not touched
4. **Vestibule on existing door**
  - Don't remove an existing vestibule if present
5. **Bulb & ballast replacements**
  - If No increase in LPD



# Change of Occupancy or Use

If change results in increased demand (fuel and/or electric)

- Must meet CBES

Lighting: LPD shall match new occupancy type

Change is in building already exceeding fenestration area requirements:

- No need to meet fenestration area req's
  - If no additional increase in fenestration area
- If component performance alternative used
  - UA no greater than 110% of target UA

# Questions?

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