



California Energy Commission

2016 Building Energy Efficiency Standards

What's New for Residential

The most significant changes in the *2016 Building Energy Efficiency Standards* affecting residential buildings include the **new requirements for high-performance insulation within walls and attics**. Other changes include:

Mandatory Measures:

1. Insulation in roof/ceiling construction must be at least R-22 (maximum U-factor of 0.043) (§ 150.0(a)1).
2. New duct total leakage reduced to 5 percent or less (§ 150.0(m)11B1).
3. All installed air-conditioner and heat pump systems shall be equipped with liquid line filter driers as specified by manufacturer's instructions (§ 150.0(h)3B).
4. Storage hot water heaters no longer need to be externally wrapped (§ 150.0(j)1).
5. All luminaires must be "high-efficacy" (§ 150.0(k)1A).
6. Isolation valves must be installed on instantaneous water heaters that have a minimum input of 6.8 kBTU/hr (§ 110.3(c)7).

Prescriptive Compliance:

1. Increased flexibility for envelope compliance (§ 150.1(c)).
2. Increased roof assembly requirements to include insulation installed either above or below roof deck (§ 150.1(c)1A).
3. Requirements for water-heating systems in single-family and multifamily buildings have been updated and more options have been added (§ 150.1(c)8).
4. High-performance attics and ducts in conditioned spaces have been added as an option for a space-conditioning distribution system (§ 150.1(c)9).
5. If a whole house fan (WHF) is required, it must comply with a total air flow of at least 1.5 CFM/ft² and have 1 square foot of attic vent free area for each 750 CFM (§ 150.1(c)12).

Performance Compliance:

All compliance software programs that are approved by the Energy Commission must use a single interpretation of the performance compliance rules that the Energy Commission has integrated into the public domain software. More information is available in the *2016 Residential ACM Approval Manual* and the *2016 Residential ACM Reference Manual*.

Additions and Alterations:

1. Changes to the prescriptive requirements for the building envelope (specifically wall insulation) for additions (§ 150.2(a)1).
2. With alterations, the prescriptive requirements for mechanical cooling, water heating, and lighting have been revised (§ 150.2(b)).
3. More detailed information on additions and alterations in Chapter 9 of the *2016 Residential Compliance Manual*.

CALIFORNIA'S 2016 — RESIDENTIAL BUILDING ENERGY EFFICIENCY STANDARDS

CALIFORNIA ENERGY COMMISSION

The state's energy efficiency standards for new buildings and appliances have saved consumers billions in reduced electricity and natural gas bills. The building standards include better windows, insulation, lighting, air conditioning systems and other features that reduce energy consumption in homes and businesses. Since 1978 these standards have helped protect the environment by reducing more than 250 million metric tons of greenhouse gas emissions (or the equivalent of removing 37 million cars off California roads).

\$7,400 SAVINGS OVER A 30 YR. MORTGAGE | INITIAL COST \$2,700



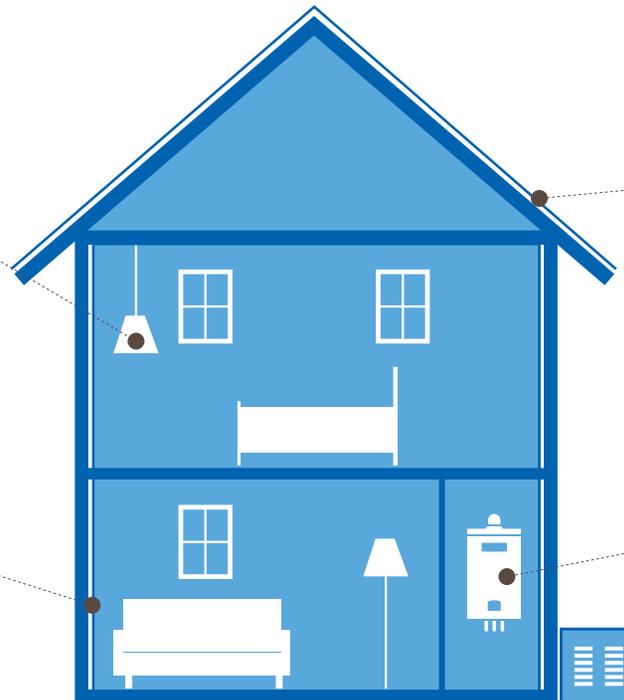
HIGH EFFICACY LIGHTING

All lighting in new homes must be efficient. Installation of high quality lighting with controls that nearly halve the energy required for lights in new homes.



HIGH PERFORMANCE WALLS

Increased wall insulation keeps the sun's heat out of your home during hot summer months and warm air in during winter months, improving comfort and reducing energy consumption.



HIGH PERFORMANCE ATTICS

Attics with additional insulation at the roof deck keep attic temperatures closer to ambient, improving the home's heating and cooling performance. Extra insulation at the roof deck, in addition to the ceiling insulation, will reduce the attic temperature by 35 degrees or more during hot summer days.



IMPROVED WATER HEATING SYSTEM EFFICIENCY

Installing tankless water heating technology and better distribution systems reduces the energy needed to provide hot water to the home by about 35 percent.

These are cost effective measures that home builders may consider to achieve new levels of efficiency. They can be traded for other efficient technologies such as higher efficiency HVAC units, higher efficiency water heaters, etc.

Figure 4-8: Ventilated Attic Prescriptive Compliance Choices

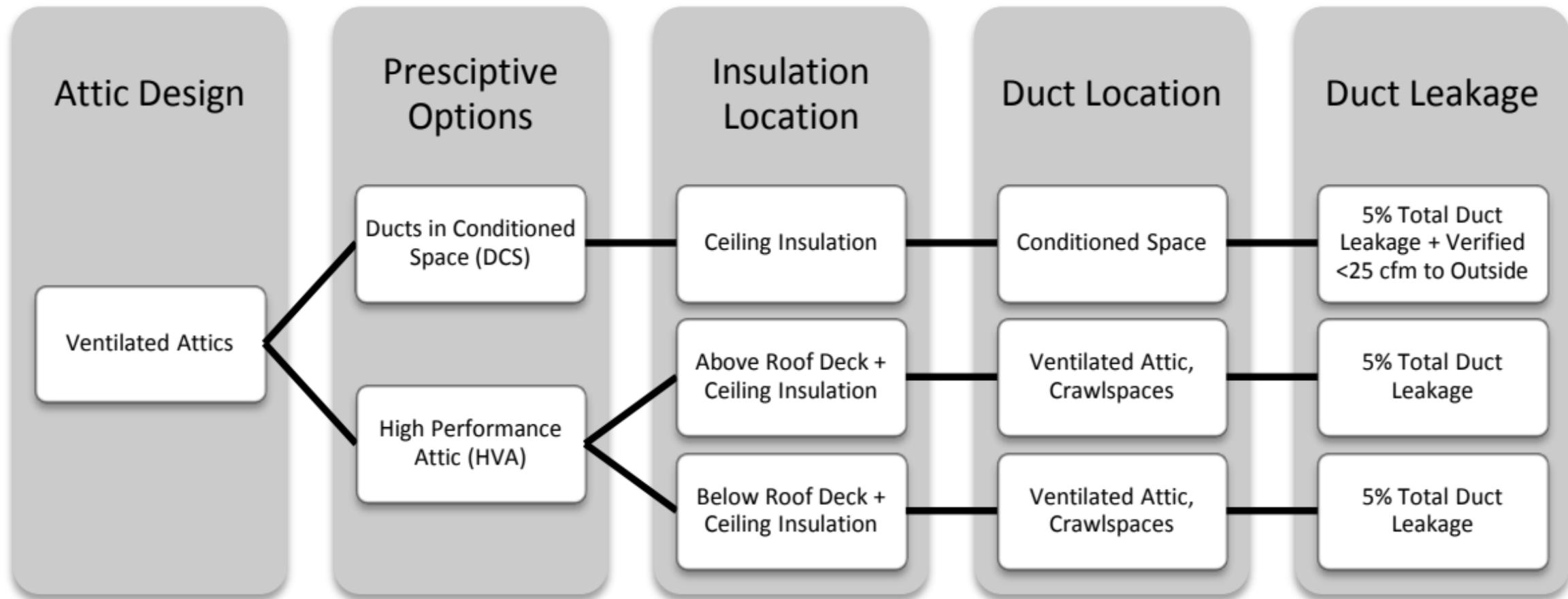


TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

				Climate Zone																		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
Building Envelope Insulation	Roofs/Ceilings	Option A (meets §150.1(c)9A)	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space ¹	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8		
				Roofing Type	With Air Space ²	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
			Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38										
			Radiant Barrier		NR	REQ	NR															
			Below Roof Deck Insulation ³	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18									
				Roofing Type	With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13									
		Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38											
		Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	NR											
		Option C (meets §150.1(c)9B)	Ceiling Insulation		R 38	R 30	R 38															
			Radiant Barrier		NR	REQ	NR															

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

		Climate Zone																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
Building Envelope Insulation	Roofs/Ceilings	Option A (meets §150.1(c)9A)	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space ¹	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8		
				Roofing Type	With Air Space ²	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
			Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 30	R 38								
		Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Option B (meets §150.1(c)9A)	Below Roof Deck Insulation ³	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18								
				Roofing Type	With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13								
	Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 30	R 38										
	Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	NR											
	Option C (meets §150.1(c)9B)	Ceiling Insulation		R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38							
		Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

		Climate Zone																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
Building Envelope Insulation	Roofs/Ceilings	Option A (meets §150.1(c)9A)	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space ¹	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8		
				Roofing Type	With Air Space ²	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
			Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 30	R 38								
		Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Option B (meets §150.1(c)9A)	Below Roof Deck Insulation ³	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18								
				Roofing Type	With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13								
	Ceiling Insulation		R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 30	R 38										
	Radiant Barrier		NR	REQ	REQ	NR	REQ	REQ	REQ	REQ	NR										
	Option C (meets §150.1(c)9B)	Ceiling Insulation		R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38							
		Radiant Barrier		NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

			Climate Zone																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Building Envelope Insulation	Walls	Above Grade	Framed ⁴	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051								
			Mass Wall Interior ⁵	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.059 R 17	
			Mass Wall Exterior ⁶	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.1025 R 8.0	U 0.125 R 8.0	U 0.070 R 13	
		Below Grade	Below Grade Interior ⁷	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.066 R 15	
			Below Grade Exterior ⁸	U-0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19	
	Floors	Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0	
		Raised	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	
		Concrete Raised	U 0.092 R 8.0	U 0.092 R 8.0	U 0.269 R 0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0									
	Building Envelope	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	0.63	NR	0.63	NR											
				Thermal Emittance	NR	0.75	NR	0.75												
Steep Sloped		Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR	
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR	
Building Envelope	Fenestration	Maximum U-factor	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32		
		Maximum SHGC	NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25		
		Maximum Total Area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
		Maximum West Facing Area	NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%		



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2016 Building Energy Efficiency Standards

What's New for Nonresidential

Changes include:

Envelope

1. Revisions to the mandatory requirements for metal framed and demising walls (§ 120.7(b)).
2. Changes to the prescriptive envelope requirements (§ 140.3(a)).
3. Revisions to the roof/ceiling insulation tradeoff for aged solar reflectance (TABLE 140.3 of the Energy Standards).
4. Significant changes to the total skylight area requirement (§ 140.3(c)4).
5. Revisions to the requirements for all fenestration alterations (§ 141.0(b)2A).

Lighting

1. Clarification and simplification of existing language; removing exceptions no longer relevant (§ 130.0 through § 130.5 and § 140.6 through § 140.8).
2. Reductions to lighting power density (LPD) values in TABLES 140.6-B, 140.6-C, and 140.6-G.
3. Removal/addition of power adjustment factors (PAFs) (§ 140.6(a)2).
4. Significant reductions in outdoor lighting power allowances (TABLE 140.7-A).
5. Clarification and streamlining of alteration requirements, including addition of a new compliance path that allows compliance by reducing the existing lighting power. For indoor lighting, this path foregoes bi-level control requirements but is otherwise identical to the 85 percent or less of lighting power allowance path.

Mechanical

1. Revision of the mandatory requirements for equipment efficiency in TABLES 110.2-A through 110.2-K of the Energy Standards.
2. Interlock controls requirements when operable wall or roof openings are present (§ 140.4(n)).
3. Revisions to fan control system requirements in TABLE 140.4-D of the Energy Standards.
4. Energy management control system (EMCS) to comply with the thermostatic control requirements (§ 120.2(a)).
5. Changes to the requirements for dampers installed on outdoor air supply and exhaust equipment (§ 120.2(f)).
6. New section specifying direct digital controls (DDC) applications and qualifications (§ 120.2(j)).
7. Revisions to the requirements for space conditioning systems with DDC to the zone level (§ 120.2(k)).
8. New general requirements for pipe insulation (§ 120.3(a)).

Electrical

1. New definitions of electrical metering, service equipment, plug load, and low voltage dry-type distribution transformer are added to § 100.1.
2. Revisions and clarifications of service electrical metering § 130.5(a), separation of electrical circuits in § 130.5(b), voltage drop in § 130.5(c), and circuit controls in § 130.5(d).

Covered Processes

New mandatory requirements for elevators, escalators and moving walkways (§ 120.6(f) and § 120.6(g)).

Commissioning

Revisions to language and content to make § 120.8 more clear.

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DOOR AND WINDOW INTERLOCKS

Sensors on doors and windows adjust the thermostat to turn off the heating or cooling if a door or window is left open for more than five minutes. This allows occupants to take advantage of outside temperatures and save on heating and cooling costs.



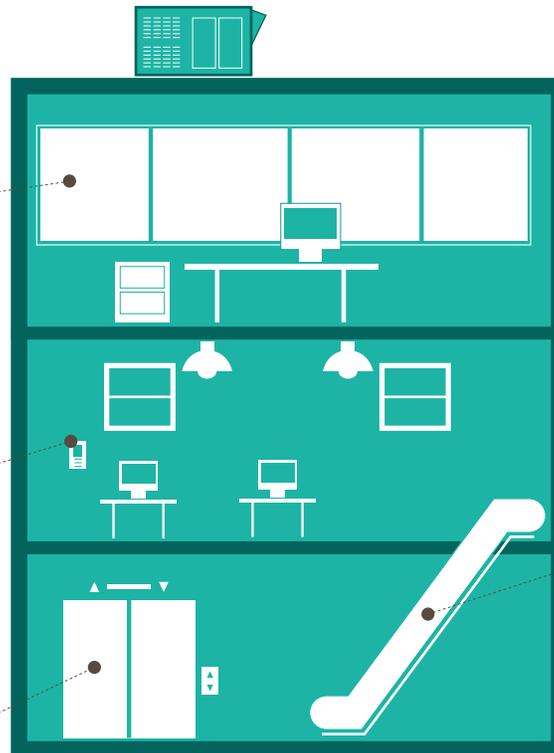
DIRECT DIGITAL CONTROLS

For larger heating, ventilation and air conditioning systems, installing digital controls enables communication with building energy management systems, allowing managers to tailor the building's heating and cooling demands and prevent waste.



ELEVATORS

Efficient ventilation fans and lighting sources installed within the elevator, along with controls that turn off the cab lighting and fans when the elevator is empty, save energy both when the elevator is in use and when empty.



OUTDOOR LIGHTING

The general power allowance for outdoor lighting has been lowered to include newer, more efficient luminaires which are widely available and commonly used for outdoor lighting applications.



ESCALATORS

Requires escalators and moving walkways in transit areas to run at a lower, less energy-consuming speed when not in use.

These are cost effective measures that builders may consider to achieve new levels of efficiency. They can be traded for other efficient technologies such as higher efficiency HVAC units, higher efficiency water heaters, etc.

TABLE 120.2-A DDC APPLICATIONS AND QUALIFICATIONS

BUILDING STATUS	APPLICATIONS	QUALIFICATIONS
Newly Constructed Buildings	Air handling system and all zones served by the system	Individual systems supplying more than three zones and with design heating or cooling capacity of 300 kBtu/h and larger
Newly Constructed Buildings	Chilled water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design cooling capacity of 300 kBtu/h (87.9 kW) and larger
Newly Constructed Buildings	Hot water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design heating capacity of 300 kBtu/h (87.9 kW) and larger
Additions or Alterations	Zone terminal unit such as VAV box	Where existing zones served by the same air handling, chilled water, or hot water systems that have DDC
Additions or Alterations	Air handling system or fan coil	Where existing air handling system(s) and fan coil(s) served by the same chilled or hot water plant have DDC
Additions or Alterations	New air handling system and all new zones served by the system	Individual systems with design heating or cooling capacity of 300 kBtu/h and larger and supplying more than three zones and more than 75 percent of zones are new
Additions or Alterations	New or upgraded chilled water plant	Where all chillers are new and plant design cooling capacity is 300 kBtu/h (87.9 kW) and larger
Additions or Alterations	New or upgraded hot water plant	Where all boilers are new and plant design heating capacity is 300 kBtu/h (87.9 kW) and larger

TABLE 140.6-A LIGHTING POWER ADJUSTMENT FACTORS (PAF)

TYPE OF CONTROL	TYPE OF AREA		FACTOR
<p>a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2</p> <p>b. Only one PAF may be used for each qualifying luminaire unless combined below.</p> <p>c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF</p>			
1. Daylight Dimming plus OFF Control	Luminaires in skylit daylit zone or primary sidelit daylit zone		0.10
2. Occupant Sensing Controls in Large Open Plan Offices	In open plan offices > 250 square feet: One sensor controlling an area that is:	No larger than 125 square feet	0.40
		From 126 to 250 square feet	0.30
		From 251 to 500 square feet	0.20
3. Institutional Tuning	Luminaires in non-daylit areas: Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.10
	Luminaires in daylit areas: Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.		0.05
4. Demand Responsive Control	All building types less than 10,000 square feet. Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF		0.05