Commercial Lighting Requirements

Background

Lighting can account for 30% of the energy used in commercial buildings, and lighting provisions form a substantial part of the energy requirements in the Massachusetts Commercial Energy Code. The code improves lighting performance in two ways: through requirements for improved lighting efficacy and requirements for lighting controls.

Lighting efficiency is a measure of light output versus power input. The energy code has two different metrics that it uses for lighting efficiency improvements: lamp efficacy and lighting power density. Lamp efficacy is a ratio of the lumens (units of light) output of a lamp per Watt of electricity consumed. This metric is primarily used in the residential code, but it is an option for meeting the code's lighting efficiency requirements in dwelling and sleeping units. It is also used in the commercial code for lamps used for exterior lighting. The other metric used by the code is lighting power density, measured in Watts per square foot of area (W/sf). The metric is used with maximum Lighting Power Allowance requirements. Light power density incorporates the impact that ballasts and drivers have on system efficacy, and indirectly accounts for the impact of luminaire design, lighting layout, space design and even surface reflectances.

The control requirements in code involve controlling the lights based on occupancy or available daylight. Active occupancy controls use various technologies to detect when an occupant is in a space. Daylight controls detect the amount of available daylight and are configured to turn the electric lighting down or off when the daylight is sufficient for the purposes in the space. In some circumstances, the code allows simpler time clock controls programmed to anticipate when occupants will be in the space or when sufficient daylight will be available. For example, the code allows timer controls configured to turn site lighting off from dawn to dusk.

2015 IECC and the associated MA Amendments include changes for both lighting efficiency and lighting controls. Additionally, the lighting section has received widespread editorial and structural changes. So, while many of the requirements remain unchanged, they may have been relocated or are now worded differently. There are also more options for meeting Section 406 requirements with lighting, and the new existing buildings chapter (Chapter 5) includes changes for alterations that include luminaire replacements.

Lighting Efficiency

Lamp Efficacy

Under the previous version of the code, dwelling units were exempted from the lighting requirements of the code provided they met a certain lamp efficacy in 75% of the lighting fixtures. The conditions for the exception have been replaced with a reference to the lighting requirements in the residential code. The residential code has the same requirements the commercial code had, so the requirements have not changed even though the language has. However, a similar change for sleeping units does result in a change in requirements. Previously, sleeping units in commercial buildings were exempted from the lighting power allowance requirements of the code. Now, that exception is conditioned upon meeting the lamp efficacy requirements in the residential code. This mostly impacts hotels, motels and care facilities (R1, R3 and R4). However, the increase in federal minimum requirements for light bulbs mitigates the practical impact of this change since many of the light bulbs this would prohibit are already prohibited by the federal regulations.

The lamp efficacy for exterior lighting has been removed as it has been made redundant by federal lamp efficacy requirements.

Lighting Power Density and Allowances

The lighting power allowances in the code are developed based on widely available and cost effective lighting technologies. Lighting power allowances are calculated for different space and building types by combining these technologies with typical lighting designs for typical spaces. Those allowances are currently based generally on fluorescent lighting technologies. However, not all fluorescent technologies are created equal, so the lighting power allowances for both the building area and space-by-space methods have been updated to reflect the penetration of the market by more efficient fluorescent lighting technologies like "Super T8" lamps. Not all space types are seeing the same amount of change (lighting power allowances have increased in two building types - manufacturing facilities and warehouses) but the changes are an 18% improvement on average. LED lighting technologies make it easy to far exceed the efficiency required by the code, and LED products have come down considerably in cost.

Building Area Type	2012 LPD (w/ft2)	2015 LPD (w/ft2)	Difference
Automotive facility	0.9	0.80	-11%
Hospital	1.2	1.05	-13%
Library	1.3	1.19	-8%
Multifamily	0.7	0.51	-27%
Office	0.9	0.82	-9%
Religious building	1.3	1.00	-23%
Retail	1.4	1.26	-10%
Warehouse	0.6	0.66	10%

The individual lighting power allowances for building exteriors has received some minor changes, though not nearly as much as their interior lighting counterparts.

Lighting Controls

Occupancy Controls

The list of spaces subject to occupancy controls has been expanded. Classrooms were already required to have occupancy sensors, and now lecture and training rooms are also included. Likewise, multipurpose rooms have been included with conference/meeting rooms. Copy/print rooms, lounges, locker rooms and warehouses have also been added to the spaces in which occupancy controls are required. The addition of warehouses is accompanied by a section dedicated to the function of those occupancy controls. These occupancy controls are only required to reduce power by 50% instead of on/off, and they are required to control on an aisle-by-aisle basis.

The general functionality requirements for occupancy controls have been moved to their own section but are the same, with the exception that occupancy controls must now incorporate manual off functionality. This change won't have much practical effect for wall switch type occupancy controls as they typically already include this functionality, but it may have an impact on the design of some overhead occupancy controls in larger spaces.

The requirements for time-switch controls have also been updated. The code now requires more functionality from the controls, including 7-day scheduling, "holiday" shutoff, and backup program capabilities.

MASSACHUSETTS

Energy Code Technical Support

The requirements for controls in hotel and motel sleeping units have been updated to represent changing technology. Previously, these spaces were required to simply have a master control device that could turn off all lights and switched outlets in the entire hotel or motel room. Now, that control must be automatic and capable of turning off those lights 20 minutes after all the occupants have left the room. Lighting and switched receptacles that are controlled by a captive key system are exempted from this requirement as these systems provide the same basic functionality.

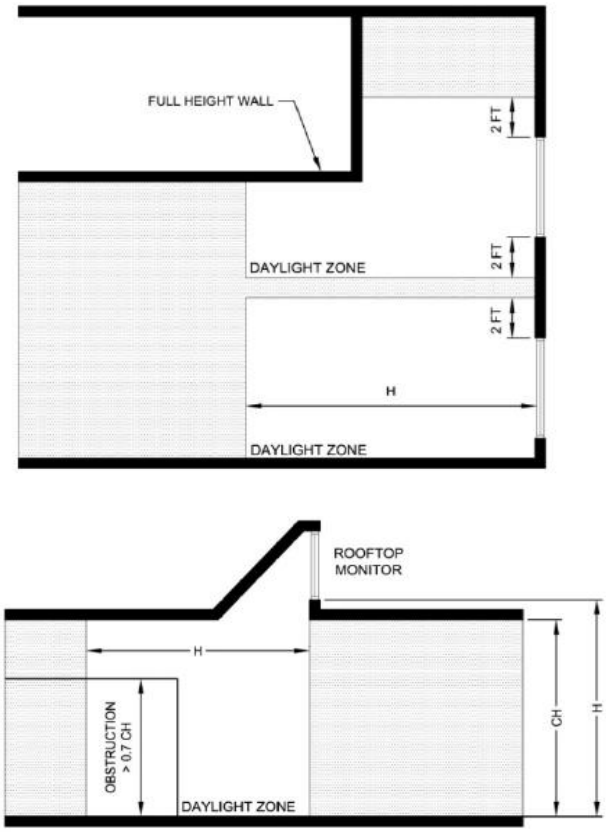
Daylighting Controls

The descriptions of areas that qualify as part of the daylight zone have been moved from the Definitions chapter to Section 405. Toplight daylight zones have been redefined to include roof monitors and not just skylights. Several diagrams have also been added to the code to help define daylight zones more clearly. Finally, changes in Chapter 1 require that the daylight zones be included in the plan set.

The requirements for daylighting controls have also been modified. The biggest change is that manual daylighting controls can no longer be used to meet the daylighting controls requirement. All daylighting controls, when required, must be automatic. Additionally, stepped dimming (where light output is reduced in at least two steps) can no longer be used to meet the daylighting controls requirements in some spaces. Continuously dimming controls are now required in offices, classrooms, laboratories and library reading rooms and must be able to dim to at least 15% of full light output.

There are also changes to the requirements for the daylighting controls themselves. Previously, the calibration mechanism only had to be readily accessible, now they need to be readily accessible to the occupants. They must also be located either within line of sight of the lights they control or they must be provided with some means of identifying the status of the lights. These changes may impact the placement for some projects.

Diagrams illustrating the daylight zone under a roof monitor. Both roof monitors and the diagrams are new in the latest edition of the code.



(a) Section view and
(b) Plan view of daylight zone under a rooftop monitor

Section 406

Section 406 (Additional Efficiency Package Options) sets out a list of efficiency measures from which the user must choose in addition to all the other code requirements and regardless of which compliance path they select. There are six options listed, and users must elect at least two of them. Option number 2 addresses lighting power density, and option number 3 covers enhanced lighting controls. The reduced LPD option has been modified so that it is a straight 10% reduction from the base code requirements instead of an independent table. This effectively reduces the LPDs below the levels in the option in the previous code. The enhanced digital lighting controls option allows for a high level of control and programmability for lighting systems and includes functionality and configuration requirements. The MA amendments to section 406 contains two important Exceptions. First, buildings in municipalities not served by a participating Mass Save investor-owned gas or electric utility provider must comply with only one (vs two) of the six options. The second Exception says that if a user takes the ASHRAE 90.1-2013 compliance path that option 2 (reduced LPDs) must be among the two options selected.

Existing Buildings

The new existing buildings chapter has one significant change for lighting. In the previous edition of the code, the full lighting requirements of Section 405 were only triggered if more than 50% of the luminaires were replaced. Under the revised code requirement, full compliance with Section 405 is triggered if only 10% of the luminaires are replaced.