

MULTIFAMILY PERFORMANCE PROGRAM

Technical Topic – Existing Buildings

Lighting Power Density

Summary

The features of lighting that are observable by building occupants are illumination level (foot candles), uniformity, layout, and aesthetic considerations such as color rendition. These design-related aspects of lighting are generally beyond the scope of most energy auditors. As a result, lighting improvement in existing buildings tend to consist of one-to-one replacement of existing bulbs and ballasts with more efficient bulbs and ballasts. The MPP goes beyond this basic step by requiring Partners to consider the lighting power density (LPD) of common areas.

Reduced lighting power density should be combined with other energy-saving improvements such as daylighting or occupancy sensors to achieve additional savings.

Lighting Power Density Defined

Lighting power density is a simple screening measure that indicates whether a space offers opportunities for energy savings. Lighting Power Density (LPD) is defined as watts of lighting per square foot of room floor area (W/sf).

Section 10.4 of the MPP Simulation Guidelines requires Partners to fill out the table provided in the “Lighting” tab of Simulation Guidelines Appendix. The spreadsheet can combine up to five different fixture types entered for a given space to calculate the overall space LPD. The LPD for all types of spaces in the project is calculated using inputs on Lighting tab and shown on “Lighting Summary” tab of the Simulation Guidelines Appendix. The comparison values in the table include International Energy Conservation Code (ECCC), ASHRAE 90.1-2004, and best practice targets for LPD in stairwells, corridors, lobbies, laundries, parking garages, storage rooms, and other common areas.

Using Lighting Power Density to Identify Energy Saving Opportunities

A 30 x 30 foot lobby with a 10’ ceiling has two kinds of lighting fixtures as described in the figure below, an edited screenshot of the Lighting table from the Simulation Guidelines Appendix.

Space			Existing						
Name	Type	Area	Fixture Description	Watts	Qty	Controls	Total Watts	Space Total W	LPD
Enter "S" for multiple fixture types in one space. Max of 5 fixture types per space.	Space Type (Note: If "S" is entered in column B this column must remain blank)	Area in sq ft.	Description of the Lighting Fixture	Watts per Fixture	Quantity	Timer, motion sensor, etc.	Total Fixture Wattage	Lighting Wattage Total for Space	Lighting Power Density (W/Sq Ft)
1 Lobby	Lobby	900	2F40T12	93	14		1302	1514	1.68
2			1F40T12	53	4		212		

The area of this lobby is 900 square feet. There are 1,514 watts of lighting, so the LPD is 1.68 W/sf.

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$$\text{LPD} = 1,514 \text{ Watts} / 900 \text{ square feet} = 1.68 \text{ W/sf}$$

Referring to the “Lighting Summary Tab” of the Simulation Guidelines Appendix, the maximum LPD for lobby areas under both the ECCC and ASHRAE 90.1-2004 is 1.3 W/sf, and the best practice target is 0.7 W/sf. This space offers an opportunity to lower LPD by reducing lighting wattage.

The most commonly-suggested energy conservation measure in this space would be Improvement #1:

Improvement #1

Make a one-to-one change to T8 bulbs and electronic ballasts. With 14 two-lamp and four one-lamp F32T8 fixtures, total installed watts are reduced to 940. The resulting LPD is 1.04 W/sf.

An LPD of 1.04 is below the ECCC/ASHRAE maximum, but higher than the best practice target.

Improvement #2:

Change fixtures to 18 one-lamp F32T8 fixtures with electronic ballast. There are 576 installed watts.

Improvement #2 reduces the LPD to 0.64 W/sf, lower than the best practice target. Both Improvements #1 and #2 can be accomplished without rewiring or changing the lighting layout.

The effects of Improvements #1, #2, and #3 are shown in the following edited screenshot of the Lighting worksheet:

Proposed							
	Fixture Description	Watts	Qty	Controls	Total Watts	Space Total W	LPD
	Description of the Lighting Fixture	Watts per Fixture	Quantity	timer, motion sensor, etc.	Total Fixture Wattage	Lighting Wattage Total for Space	Lighting Power Density in w/sqft (Cells highlighted red exceed code)
Improvement #1	2F32T8	58	14		812	940	1.04
	1F32T8	32	4		128		
Improvement #2	1F32T8	32	14		448	576	0.64
	1F32T8	32	4		128		
Improvement #3	1F32T8	32	5		160	288	0.32
	1F32T8	32	4		128		

Additional Considerations

In calculating LPD, it is not necessary to measure room areas with precision. Pacing or counting floor or ceiling tiles provides enough accuracy to identify spaces in which changes in LPD are warranted.

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Partners may be concerned that in meeting the best practice LPD they are reducing the illumination level too far. Visual and other lighting design software allows users to model the installed watts, LPD, and illumination levels produced by different fixtures and layouts. NYSERDA’s Commercial Lighting Program (CLP) provides guidance on the illumination levels required for different types of spaces (<http://www.nyserdera.org/sclp2/technicalGuide/design/targets.asp>).

For the same example lobby modeled above, Improvement #3 achieves even greater savings by reducing total installed watts by almost 80% compared to the baseline.

Improvement #3:

Eliminate seven of the 16 one-lamp fixtures described in Improvement #2, leaving nine one-lamp F32T8 fixtures. The LPD of this layout is 0.32 W/sf, with a total of 288 installed watts in the space.

Table 1 shows the annual energy usage and cost for the example lobby described in this tech tip.

Design	Fixture	# of Fixtures	New Bulbs & Ballasts?	New Fixtures?	New Wiring?	Total Watts	Annual kWh	Annual Operating Cost
Baseline	two-lamp F40T12	16	--	--	--	1,312	11,493	\$1,724
Improvement #1	two-lamp F32T8	16	Yes	No	No	928	8,129	\$1,219
Improvement #2	one-lamp F32T8	16	Yes	Yes	No	512	4,485	\$673
Improvement #3	one-lamp F32T8	9	Yes	Yes	Yes	288	2,523	\$378

Table 1. Lighting Improvements for an Example Lobby

Note: Electricity is assumed to cost \$0.15/kWh. Lights are assumed to be on 24 hours per day

According to our Visual model, Improvement #3 provides 12 fc of illumination, higher than the 10 fc target illumination level recommended by CLP for lobbies, as shown in Table 2 below.

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Space Type	Illumination Level (fc)
Corridor	5 ¹
Stairwell	5 ¹
Public Toilets	15 ³
Lobby	10 ¹
Laundry	30 ³
Parking Garage	1 fc on horizontal surfaces, 0.5 fc on vertical surfaces ²
Office	30- 50 ¹
Storage (active)	10 ¹
Storage (inactive)	10 ¹
Kitchen	50 ¹

Table 2. Suggested Illumination Levels for Common Areas

¹ from NYSERDA Commercial Lighting Program

<http://www.nysERDA.org/scfp2/technicalGuide/design/targets.asp>

50 fc is recommended for private offices, 30 fc for open offices

² from MPP EB Tech Tip –Parking Garage Lighting, September 2008 (minimum fc recommended by the Illuminating Engineering Society of North America (IESNA))

³ from Grainger catalog, attributed to IESNA