MULTIFAMILY PERFORMANCE PROGRAM

Technical Topic – Existing Buildings

Savings Opportunity - Corridor Lighting

Summary:

Corridor lighting offers possibilities for significant energy savings. Many corridors have more illumination than is required for safety. This Tech Tip discusses the concept of lighting power density as a means of evaluating potential savings and suggests potential design approaches for energy-saving corridor lighting.

The Problem

Corridor lighting can consume as much as 10% or more of a multifamily building's electricity usage. 24/7 operation and frequent over-lighting both contribute to this significant energy consumption.

Consider Corridor Lighting Type A, typical of many existing buildings: two-lamp 4' T12 fluorescent fixtures with magnetic ballast, spaced every 8 feet along the length of a 4-foot wide corridor. Assuming each fixture uses 72 watts, the lighting power density is 72/(8x4) = 2.25 watts per square foot (w/sf), which is extremely high. It turns out the average light level for this design is almost 50 footcandles, five times higher than necessary.

The Potential

Now consider Corridor Lighting Type B: single-lamp 4' T8 fixtures with electronic ballast, spaced every 20 feet. The light level meets the recommended 10 footcandles, and the lighting power density is now 30/(20x4), or 0.4 watts per square foot. Relative to the 2-lamp T12 fixtures, savings of over 80% are possible.

How much money could be saved by converting from Corridor Lighting Type A to Type B? Assume that the corridor is 96 feet long, with lights on 24/7, and the cost of electricity is $0.15/kilowatt-hour. For the purpose of this exercise, we won't separate out demand charges or worry about the need for additional heating fuel to balance the reduced heat from lower lighting watts.

Using the lighting power densities and utility costs provided above:

The annual cost of lighting with design Type A is $1182.
The annual cost of lighting with design Type B is $210.
The first year savings for this conversion is $972.

If bi-level lighting is added, turning off fixtures with occupancy sensors when the corridors are unoccupied, the effective lighting power density can drop further, providing additional savings.

Lighting Power Density Requirements

The New York State Energy Conservation Code requires a maximum of 0.9 w/sf in corridors.

This information is provided as a summary to the Technical Topics discussion in December 2008

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ANSI/ASHRAE/IESNA Standard 90 has a requirement of 0.5 w/sf, which indicates the direction that corridor lighting is going and the potential for savings.

Uniformity Ratio

Attention must be paid to the uniformity ratio, which is the ratio between the highest and lowest footcandle levels measured in the corridor. As light levels are reduced, this aspect of good lighting design becomes increasingly important. As a reference, for emergency lighting, a uniformity ratio of less than 40 is required.

The uniformity ratio of the two-lamp T12 lighting example above (Type A), spaced at 8', is approximately 1.5 (maximum 51 FC right under the light fixtures, divided by the minimum 35 FC between the fixtures). However, if the 2-lamp T12 is spaced to provide the correct 10 FC, at approximately 32' apart, the uniformity ratio rises above 20 (maximum 37 FC, minimum 1.5 FC).

The uniformity ratio of the suggested 1-lamp T8 lighting (Type B), spaced at 20', is approximately 4 (maximum 16 FC, minimum 4 FC). Therefore the uniformity ratio of the more energy efficient 1-lamp option, which meets the correct light level for corridors, is far better than for the 2-lamp option when correctly spaced.

Light Level Requirements - Occupied

Light levels in an occupied corridor should be 10 footcandles (FC) on average measured at 30" above the floor, per the IESNA Handbook (also consistent with the NYC City Code). This can be met with the 1-lamp 4' T8 ceiling fixture in the example above, with a lighting power density of 0.4 w/sf. Other options for energy-efficient lighting include appropriately spaced fluorescent downlights, or wall sconces. For example, 19-watt downlight fixtures, spaced at 8 feet in a 4-foot wide corridor, will provide an average of 10 FC with a lighting power density of approximately 0.6 w/sf.

Light Level Requirements - Unoccupied

If building owners insist on maintaining higher FC levels than required by code in corridors and/or stairwells, occupancy sensors or bi-level fixtures that turn fixtures down or off when these areas are unoccupied will help to mitigate the energy penalty of overlighting when they are occupied.

There appears to be some ambiguity about light level requirements for unoccupied corridors. Several codes (Fire Code, Life Safety Code) allow the use of occupancy sensors to turn off even low-level (1 FC) emergency lighting in means of egress, such as corridors. This would imply that no lighting is required when a corridor is unoccupied. However, the Property Maintenance Code requires corridors to be "lighted at all times with at least a 60-watt standard incandescent light bulb for each 200 square feet of floor area or equivalent illumination, provided that the spacing between lights shall not be greater than 30 feet."

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If turning off all lights (with occupancy sensors when corridors are unoccupied) is deemed not acceptable, a reasonable alternative is to turn off or dim some fixtures, but leave sufficient lighting to maintain 1 FC average and 0.1 FC minimum at floor level, which are common requirements for emergency lighting (Fire Code of NYS, Life Safety Code) or 2FC average and 0.2 FC (NYC City Code). Using the T8 lighting example above, four out of five lights could be turned off in a 100' corridor and the light level would still be above 2 FC average, above 0.2 FC minimum, and would maintain the recommended uniformity ratio of less than 40.

Deciding What to Evaluate

The easiest way to assess potential for savings is to calculate corridor lighting density. If existing lighting is more than 0.8 w/sf, significant savings (over 50%) are possible and action is strongly recommended (both lower lighting levels and occupancy sensors). If the existing lighting is between 0.4 and 0.8 w/sf, reasonable savings are still possible, and options should at least be evaluated in an energy audit. If existing lighting power densities are already below 0.4 w/sf, only occupancy sensors (bi-level lighting) need be evaluated.

Additional Considerations

If existing light fixtures are much higher above the floor than 8'-- for example, in high-ceilinged corridors of old schools that have been converted into apartment buildings -- pendant fixtures can be used to lower the light fixtures. This will increase FC at floor level, opening the possibility of further action to reduce lighting power densities.

The reflectance of walls, ceilings, and floors affect light levels and required lighting. More reflective surfaces (typically lighter colors) will lower the required lighting power densities in order to deliver target light levels.

Creative solutions can be developed for specific corridors using photometric software, like Visual (http://www.visuallightingsoftware.com/) or Lightolier's online calculator (www.lightolier.com). These software packages are easy to use and are free.