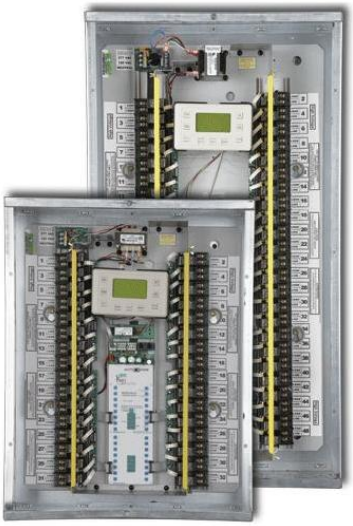
Energy Efficiency in Lighting Design

The ongoing pursuit by municipalities, utility companies and developers to create greener commercial facilities is a worthy cause for many reasons. But the recent conversations seem to focus on either replacing incandescent bulbs with fluorescent bulbs or designing finishes with renewable materials.

Before continuing it is important to define what is meant by "energy efficient." The less wattage that is consumed by an electrical device (light, appliance, workstation, etc) on a relative basis, the more energy efficient that it is. For example, a 14watt compact fluorescent (CFL) bulb produces the same light output as a 60watt incandescent bulb so the CFL is more energy efficient because it consumes less wattage. And the less wattage that is used, the lower the electric bill will be.

The reality is there are several ways of achieving higher energy efficiency in commercial buildings during the lighting design phase. In fact, a lot of the design features I discuss in this article are also ways of achieving points toward LEED Certification. The obvious drawback to most of the items below is that they involve an increase in the construction cost. But if developers can be convinced of the cost savings over the life of the building, then they will achieve a return on investment that is guaranteed due to the cost savings of energy efficiency.

Lighting Control Relay Panels



Lighting Control & Design GR 2400 Control Panel

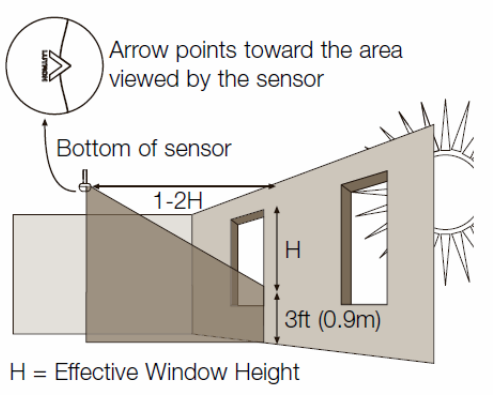
Lighting Control Relay Panels have the capability to control all lighting fixtures in a commercial building. It is for this reason they are good for creating energy efficiency. By having central control of the light fixtures, they can be programmed to turn on and off ant a preset time. This reduces the potential for lights to be left on all night or all weekend and it increases lamp life.

Not to mention, having central control of the lights allows the building management to reduce the price of the power bill by limiting the duration that lights are on. And in some cases, the lighting control panel can be programmed to have zones of lights that are only on for short durations, such as public areas where there are 8 hours of sunlight.

Most relay panels allow for future upgrades in case there is an expansion planned. And most have internal diagnostics which can monitor energy usage and transmit to the building management system the energy trouble spots.

by Matthew R. Buecker

Daylighting Controls



Daylighting is a term used to describe the reduction of lighting fixture light output (and thus load reduction) due to the increase of natural light into a space through storefront windows, doors and/or skylights. It works by having a sensor mounted in the ceiling, within 5'-10' of the glazing that detects the natural light's footcandle level. The sensor then relays the footcandle level to and dims the lighting fixture accordingly, which reduces the energy consumed by the light fixture. In essence, the more natural light in the room, the more energy efficient the light fixture becomes.

As with other methods of energy efficiency, this one also requires an investment upfront. The costs associated with this method are the sensor, the dimmable ballast for the light fixture and all associated wiring.

The major challenge to daylighting is that there is an inconsistent projection of cost savings. Suppose there are months where most days are overcast and daylighting is rarely used. How then can a developer expect to see a return on the investment of the daylighting devices if the lights are not dimmed? This is something to seriously consider during the planning phase.

Occupancy Sensors

Occupancy sensors are a very common method of limiting energy usage. Like a standard toggle light switch, they simply act to turn lights on and off. But unlike standard switches, they have a sensor that detects either sound movement (ultrasonic) or body-warmth (passive infrared) in a room or open area. And most occupancy sensors are available for both 120v and 277v lighting.

Ceiling mounted Wattstopper DT355 dual technology occupancy sensor

There are two primary forms of occupancy sensors. One is a sensor mounted high on a wall or mounted in the ceiling. Sensors such as the Wattstopper DT355 are dual technology so they detect both heat and movement. By spacing these 30'-40' on center, there is enough coverage to ensure lights are controlled properly over all floor space. And in most cases a light switch is located somewhere in the office area to manually override the occupancy sensor control.

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Wall mounted switch with integral occupancy sensor

The second form of occupancy sensor is one that is integrally located in a wall light swtich. These integral occupancy sensor switches are great for enclosed offices because they allow individual control of the lights while also ensuring the lights are switched off when no one is in the room.

One important thing to note about occupancy sensors is this: Some are directly connected to line voltage while others are connected via low voltage to a power pack which is connected to the line voltage. From my experience, it is best to avoid those connected to the power packs because they limit circuit connectivity of light fixtures and it is in extra (and unnecessary) component to purchase and install.

Better Selection of Lighting Fixtures

During the design phase is the best time to decide the energy efficiency of the lighting fixtures. It is usually the electrical engineer that specifies the light fixtures so they have the decision on the product they want to specify. Obviously, there are budget constraints and aesthetics to be concerned with but with the owner's approval, the design engineer can recommend the following lighting fixture features:

LED as the lamp source

Light Emitting Diodes or LED's are the most energy efficient light source as they use a fraction of the load that fluorescent and incandescent use. But they are still the most costly. If you can convince the owner to make the extra investment upfront, than the lighting will consume far less energy than if fluorescent bulbs were used. As a result, the power bill will be comparatively low for the life of the project meaning there will ultimately be a significant return on investment.

New retrofit LED bulb for fluorescent light fixture

Lithonia RT5 indirect fluorescent with two T5 lamps

Utilizing 2x4 Indirect Fluorescents

Indirect fluorescent 2’x4’ "Basket" fixtures are designed to evenly distribute the light in such a way that they use less bulbs than conventional 2'x4' parabolic fixtures. Parabolics are designed to shine light directly down while the indirect 2x4 evenly spreads light out from the fixture. The result of this is that a 2-lamp indirect fixture can provide the same light, but less power consumption, than a 3-lamp parabolic.

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Use T5 lamping instead of T8

This is a more economical way of providing energy efficiency. T5 fluorescent bulbs are newer technology than T8 bulbs so the T5 lamps and ballasts do cost more. But the standard 4'-0" T8 bulb is 32 watts while the standard 4'-0" T5 bulb is 28w. When you consider how many light fixtures are in a typical office building, 4 watts can go a long way to save on power consumption.

Avoid Incandescent lighting

Incandescent lighting consumes far more power than Fluorescent and LED lighting. But they have been popular in the past because of the "warm" light they admit and the fixture could be more decorative. Things have changed -- for the better! In 2010, most manufacturers of decorative lighting fixtures allow fluorescent and LED lamping capabilities. Gone are the days when only PAR socket connections are allowed.

In addition, most types of fluorescent bulbs are now available in lower Kelvin temperatures which mean warmer light output. Fluorescent lighting has long been known
for the unattractive light it produces. the newer warm bulbs mean that it can produce a higher quality light while consuming less energy.

Conclusion

When an electrical design engineer begins designing the lighting for a commercial building, it is typically based on a design criteria set forth by either the architect, developer or owner. Armed with knowledge in this article, the engineer can make a solid case about how best to make a building energy efficient. With a bigger investment at the start of the project, the building can be very energy efficient during the life of that building.

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