Environmental Responsibility Through the Layering and Control of Light

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From ASHRAE and LEED to ENERGY STAR, the growing list of environmental lighting guidelines can be at times overwhelming for today's design professional.

When you add the need to meet environmental and industry guidelines to creating a sophisticated, unique and aesthetically appealing lighted space, design professionals are facing a dilemma – how to effectively layer light in a way that does not sacrifice style for sustainability or vice versa.

Balancing Efficiency with Aesthetics

While a standard and simple practice for most, the layering of light can become quite challenging for even the most seasoned of professionals when environmental regulations need to be met. With today's push toward being more energy efficient and meeting more stringent energy codes, there can be a tendency for architects and designers alike to start subtracting too much from a space to meet the bare minimum level of illumination required when layering light.

Under pressure to follow not only environmental guidelines, but also their clients' direction, design professionals often encounter pitfalls as a result. An example of such is when a specifier focuses too much on fixture reduction as the primary avenue for cutting back on overall energy consumption, resulting in the elimination of one or more "layers" of light. While this design direction could produce a space that meets the latest energy codes, it has the potential to be poorly lit and thus less functional from the use of low light levels – ultimately creating an unappealing environment for those who inhabit it.

Specifiers should always first consider the complete spectrum of light sources that can be used. Selecting the proper light source for a given application will allow them to more easily incorporate the various layers of light as well as meet environmental guidelines. Sources that should be considered include:

- LED (Solid State): Possessing a good CRI of more than 80 (with some products reaching color rendering indexes (CRIs) of more than 90) this high-efficacy source for general and task applications can also be ideal for adjustable accent applications when trying to meet even the most stringent of energy criteria
- Ceramic Metal Halide: With an exceptional CRI of more than 90 this is also a high-efficacy source appropriate for high ceilings, general and accent applications
- Compact Fluorescent: Featuring a good CRI of more than 80 this efficient source is designed for general, task and wall wash applications
- Low Voltage Halogen: Having the highest CRI of 100, the punch and sparkle of this source's faceted reflectors enhance perceived brightness within a space and when incorporated with an architectural dimming system, there are numerous lighting possibilities available in the same space with minimal energy consumption

To ensure that all of the above are performing at an optimal energy level, they should be utilized in conjunction with a lighting controls system. Sensors and dimming systems also multiply the energy effects of deploying the above sources.

Making Sense of Sensors

Savings achieved by the utilization of more energy-efficient lighting fixtures are significantly enhanced when combined with lighting control solutions. In fact, average savings of 25 to 30 percent with more efficient lighting fixtures can be increased to as much as 75 to 80 percent savings during peak power usage depending on the control solution deployed and the application at hand. The options that can be considered for maximizing energy efficiency include sensors, daylight harvesting systems, networked lighting and wireless controls systems. Primary sensor types that can be leveraged are:

- Occupancy sensors – turns lights on in a vacant space when an individual enters
- Vacancy sensors – turns lights off when an individual leaves a space

Both occupancy and vacancy sensors are available with different types of sensing technology. Infrared sensors work based off of motion in a space – for use in areas where ambient noise is prevalent. Ultrasonic sound waves bounce off surfaces in a space – where line of sight is not always available. Multi-technology sensors employ a combination of infrared and ultrasonic technology for optimal sensing capability.

Another control technology to consider when wanting to increase energy efficiency within a space is a daylight harvesting system. This sustainable solution utilizes photocell technology to sense a presence of ambient daylight and can be tuned to detect desired levels of daylight in terms of foot-candles (fc). This option has two types of controls associated with it:

- Switched – turns some or all of the system light sources on/off
- Dimmed – lights levels to corresponding pre-set light levels based on level of ambient light it detects

A networked lighting controls system is also another alternative to evaluate as this programmable lighting control system can integrate all of a building's various lighting controls into one single network. For example, it can link sensors with daylight harvesting with more "static" fixtures. In fact, when used properly, these systems can turn whole sections of a building's lighting systems off automatically during non-usages times. Sensors deployed in individual offices, conference rooms, hallways, etc., can turn lights on and off again in spaces that are occupied during these programmed "off" periods. As a general rule, it is important to ensure light is only on when needed.

A final system to consider is a wireless control system. This is especially easier to install in retrofit applications because of a lesser need to run wiring from lighting control stations to desired fixtures.

Peeling Back the Layers

To effectively layer light, it is essential to incorporate three types of lighting: general/ambient, task and accent. General/ambient lighting is the base level of lighting and the primary focus of energy reduction efforts. Much of that focus is directed at lighting the horizontal surfaces of a space. By making sure that the vertical surfaces are also properly illuminated, via sconces or wall washers, one can lower the required light level contribution from other fixtures and subsequently enhance the energy savings within the overall space.

Task lighting is the functional level of lighting used to accommodate tasks that require higher levels of concentration. Task lighting is typically three times general lighting levels and is not usually impacted by a project's energy reduction efforts for the following reasons:

- Too necessary to the function of the space;
- May utilize more energy-efficient sources, but fixture reductions are not likely because the number of "tasks" to be performed in a space are static; Often accomplished by portable lamps/fixtures that are introduced into the space after the project is complete; and
- Accomplished via undercabinet task lights that are installed in workspace furnishings.

Accent lighting is the layer most impacted, and often even eliminated because general lighting reductions become such a focus that accenting is downplayed or overlooked altogether. But it shouldn't be forgotten. It is essential to remember the importance of accent lighting in creating drama within the space. This emotional layer of lighting complements general and task lighting layers for a complete lighting application, and should as a general rule be a minimum of four to five times the general lighting level to provide the appropriate contrast.

By broadening one's understanding of the energy-efficient light sources that are now available and their range of function, proper layering of light provides even more flexibility in meeting lighting requirements for today's energy codes.

Several green building studies have shown that workforce productivity gains of as much as 7 percent are possible with properly designed lighting for a space, specifically those spaces where occupants feel like there is good lighting. That is approximately equal to an additional 35 minutes per working day or five minutes per day for every 1 percent improvement in productivity. Improper light levels can have an equal, but opposite effect. The better a space feels and the more subsequent productivity gains are realized, studies have shown stress levels are typically reduced, thus resulting in better health of workers and longer life-spans for multi-disciplinary work teams.

In summary, it is important to remember to deploy a lean approach to lighting for energy efficiency because the fundamentals of layering lighting will remain the same. With the advent of new lighting and controls technology, new sources are now part of the design equation and previously discounted sources are now viable options to consider when planning a space's lighting design. As there is no one source that can do it all, focus on eliminating waste, not fixtures. If you can accomplish the same lighting application with 20 watts versus 50 watts with no loss of light output or effect, why wouldn't you? The very point of being lean and efficient is to perform the same task with less energy expended; not to perform a lesser task with less energy expended.

Al Near is senior vice president of USAI where he effectively translates the architecture and design industry's lighting needs into smart and sustainable offerings. A lighting industry leader, USAI (USA Illumination) is helping to shine an entirely new light on the way commercial and residential properties address lighting design solutions.