research MATTERS

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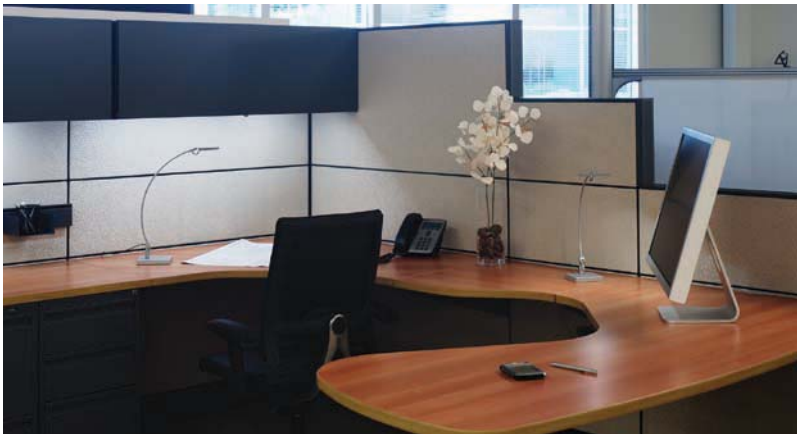
When it comes to task lighting in the workplace, the devil is in the details. Task lighting has long been known as a practical method to achieve adequate illumination levels for varied individual needs and preferences. However, traditional task lighting solutions have often failed to meet any design criteria beyond providing adequate illumination levels. Specifically, traditional task lighting is relatively energy intensive and typically provides more light than is needed, resulting in excessive luminance ratios between adjacent tasks, and lumen waste beyond the immediate task area.

In some applications, task lighting has been combined with reduced ambient lighting (known as task/ambient lighting design) to provide energy-efficiency and lighting-quality benefits. Lower ambient light levels reduce power density and often decrease glare. But task/ambient systems require task lights that provide an appropriate level of workplane illuminance while minimizing modulation. Up to this point, such task lights have been hard to find and/or comparatively expensive, making advances in integrating task lighting with low-level ambient design an unlikely reality.



Finelite's Personal Lighting System consists of a family of adjustable desk lamps and under-cabinet lights connected to a single power module controlled by an occupancy sensor.

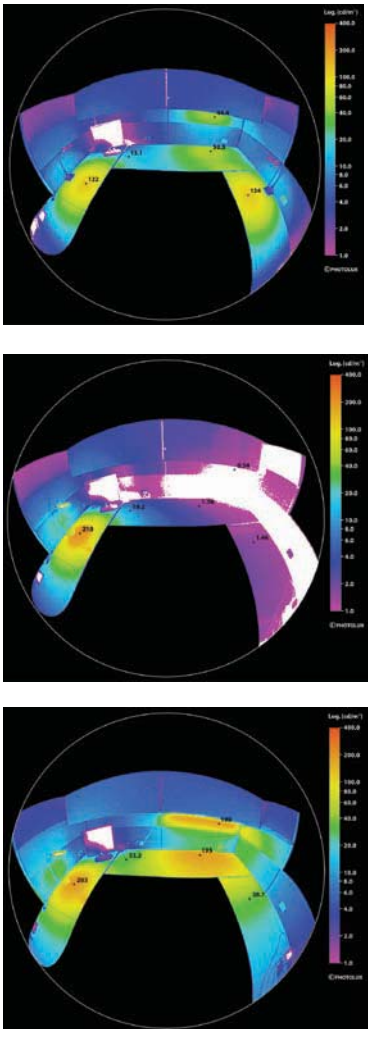
LEDs COME OF AGE

Enter LED task lights. LEDs seem to offer something for everyone: Designers see a small, efficient and controllable new light source; facility managers see the potential for low energy use and low maintenance; end users see a controllable and flexible light source available in many different configurations; environmentalists see a low-carbon solution with global implications; utilities think in terms of fewer coal-fired plants and a more stable power-grid.

The problem, however, is that once again the devil is in the details, and good LED luminaire design is not only rare, but requires a thorough understanding of the many challenges this fledgling technology still faces. The "million-dollar question" is: Will LED technology provide the missing piece to the task/ambient puzzle?

Imagine a typical setting: an 8-ft x 8-ft workstation, on average taking up 120 sq ft of floor area (when considering associated circulation spaces), with work surfaces along three sides of the cubicle. With binder bins along one panel, the under-cabinet lighting might be provided by one 4-ft-long single lamp T8 task light and perhaps a 13-W compact fluorescent desk lamp for a total of approximately 45 watts, or a lighting power density of almost 0.375 watts per sq ft. And this is just for the task lighting. If the same 8-ft x 8-ft workstation did not have binder bins, the task lighting might consist of simply the 13-W compact fluorescent desk lamp, or a lighting power density of 0.108 watts per sq ft. While this task lighting solution is low in lighting power density, the resulting illumination on adjacent tasks is very uneven. Moreover, these types of task lighting systems are usually not intelligently controlled, so they are often left on when the space is not occupied, even overnight in many situations.

Some of the most stringent energy standards acknowledge



These luminance maps compare an LED system (top, 18-W), a CFL task light (middle, 13-W) and a CFL task and fluorescent under-cabinet (bottom, 45-W). The LED system has reduced modulation, lower glare and wider brightness coverage across the workplane as compared to the fluorescent systems.

the current task lighting dilemma. For example, California's Title 24 currently allows a lighting power density of 1.2 watts per sq ft for office areas. At the same time, this standard requires that 0.2 watts per sq ft be counted as task lighting, effectively limiting the lighting power density of the ambient lighting system to 1.0 watt per sq ft. As pointed out in the previously described task lighting solutions, the lighting power density associated with the task lighting might very well exceed the 0.2 watts per sq ft assumed value, which means that the overall lighting power density in actual spaces might be higher than the 1.2 watts per sq ft allowance.

Now imagine the same 8-ft x 8-ft workstation, only this time with LED task lights instead of fluorescents (by the way, the system is occupancy controlled, but we won't count this energy savings here). There are 6 watts of LED under-cabinet lighting, and an additional 12 watts for two free-standing, moveable desk lamps. The total energy use is now 18 watts, for a power density of 0.150 watts per sq ft, but this time providing uniform lighting throughout the task area, as well as meeting the spirit of stringent energy standards that consider the lighting power density associated with task lighting.

The 'million-dollar question' is: Will LED technology provide the missing piece to the task/ambient puzzle?

PERSONALIZED SOLUTION

Today, LED technology has the capacity to achieve these levels of performance, but it's certainly not easy. LEDs must be thermally managed, the bins must be controlled to achieve proper color uniformity, and the overall design must compete with the cost for traditional task lighting. Even with these requirements, new LED task lights are starting to reach the market and many more will surely follow. These emerging systems open up new possibilities for office lighting that truly optimize both energy efficiency and user comfort.

One such system is the Personal Lighting System (PLS) developed by the California Lighting Technology Center (CLTC) and Finelite, Inc., with funding from the California Energy Commission's Public Interest Energy Research (PIER) program.

The PIER program encourages partnerships between research institutions and manufacturers. These partnerships have proven successful in leveraging the strengths of the research organizations with the manufacturing and production experience of manufacturers to produce high-quality, market-viable products. Researchers and engineers from both CLTC and Finelite worked over the course of a year-and-a-half developing the PLS LED task lighting system, starting with first principles and ending with a market-ready design. Key research and development issues included identifying the best available LED technology, designing and modeling fixture elements, looking at thermal and photometric performance and refining the designs for both consumer acceptance and manufacturability.

The PLS consists of a family of adjustable desk lamps and under-cabinet lights connected to a single power module controlled by an

occupancy sensor. Users can specify the appropriate number and size of desk lamps and/or under-cabinet lights for their specific office layout and the nature of their work. The desk lamps and under-cabinet lights are each available in 3-, 6- and 9-W versions, allowing the appropriate amount of light for the specific needs of the occupant. Moreover, the prospect of providing just the right amount of light in the right location at the right time for the majority of office tasks means that the ambient lighting system can be just that—ambient.

Finally, the energy savings potential of a broad application of task/low-ambient systems is staggering; in several test sites where the PLS was implemented, the total lighting power density (task and ambient) ranged between 0.5 and 0.7 watts per sq ft. Conservatively estimating energy savings in the U.S. as a whole, this level of lighting power density would mean saving, on average, 1.0 watt per sq ft in 10 billion sq ft of commercial office space, translating into an astounding 10,000 MW savings, or enough power for 4.7 million homes.

The system has been rolled out in at least one major application. Occupants of *The New York Times* headquarters building took delivery of their first systems in June of this year.

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