

# ARCHITECTURAL SSL

NUMBER 5 • MAY 2008 [www.architecturalsl.com](http://www.architecturalsl.com)



## HYBRID SYSTEM HAS POTENTIAL TO REVOLUTIONIZE OFFICE LIGHTING

California Lighting Technology Center,  
Davis, Calif.

By Craig DiLouie, contributing writer

At the California Lighting Technology Center on the campus of the University of California-Davis, the CLTC, in conjunction with Public Interest Energy Research (PIER) and Union City, Calif.-based manufacturer, Finelite, has constructed a mock-up demonstrating a new task/ambient system based on white LEDs. Previous research had shown that task/ambient lighting systems can improve lighting quality in office environments while reducing lighting energy costs by 20% to 33%. But CLTC set out to show this was only scratching the surface. New research at CLTC has shown the group's LED-based system can reduce lighting power density to as low as 0.5 to 0.7 watts/sq. ft., or energy savings as high as 40% to 50% compared to traditional lighting approaches.

Beyond incorporating white LED task lamps, which optimize flexibility and efficiency, the Personal Lighting System (PLS) includes an integral occupancy sensor for additional energy savings, it supports utility demand response strategies and improves lighting quality by eliminating shadows and glare. "It's the future of office lighting," says Michael Siminovitch, associate director for the Energy Efficiency Center and a professor at the University of California-Davis, and director of the CLTC.

The project began when the California Energy Commission and the state's largest utilities directed the CLTC through the PIER program to explore opportunities to reduce lighting energy use while maintaining or increasing lighting quality. Resulting opportunities would become likely targets for adop-

### THE PERSONAL LIGHTING SYSTEM

The Personal Lighting System consists of an individually configurable array of LED task lights. It works by placing horizontal light on the task area and undercabinet fixtures, and placing vertical light across the back wall.

Images: Finelite

## THE CHALLENGE:

Design integrated task/ambient office lighting systems where the general lighting will produce ambient light only, but incorporate efficient task lighting to provide sufficient illumination on task surfaces. The general lighting, therefore, would need to provide 25-30 fc of ambient light levels with the task lighting providing 50 fc on the task and 20-25 fc on the back wall. By reducing the light output of the general lighting system, it is speculated that lower-wattage designs can be achieved.

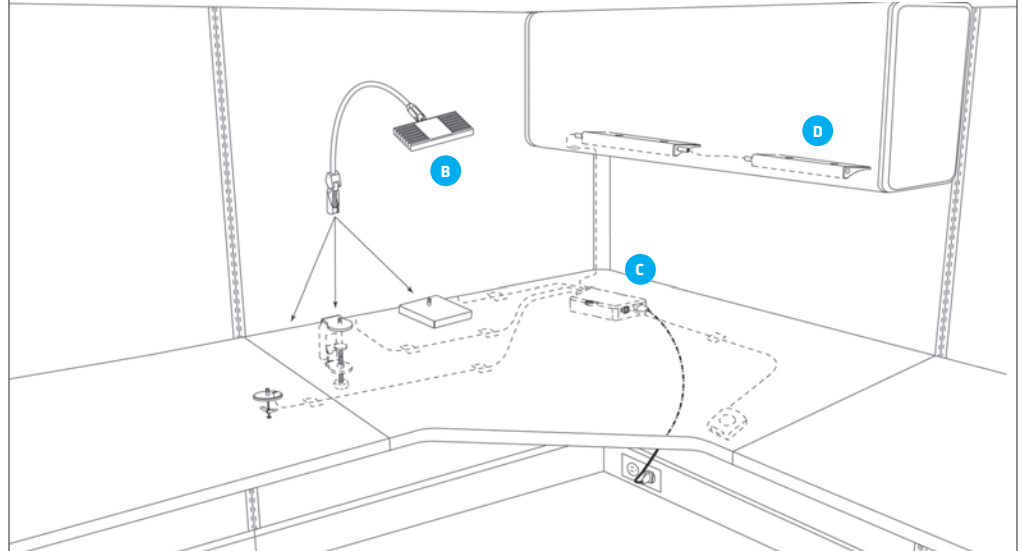
## THE SOLUTION:

In conjunction with a significantly reduced direct/indirect ambient system, the Personal Lighting System is made up of an array of freestanding white LED task lights that can be positioned by the occupant to provide a wide distribution on the task plane within a cubicle environment. The task lighting system also includes a series of LED undercabinet lights in different lengths/wattages to provide vertical illumination across the back wall.

Designed by CLTC, PIER and Finelite, these task lighting systems were created explicitly to reduce glare while producing sufficient light levels on the desktop and back wall. With plug-and-play connections, the lights can be installed and relocated easily, plugging into a single power supply; 3-, 6- and 9-watt units can be individually configured to produce a balanced luminous environment as long as the total connected load is not greater than 21 watts. The power supply also features an occupancy sensor for automatic shutoff, generating 20% to 30% energy savings compared to uncontrolled systems.

## LAB DETAIL:

An integrated system, the Personal Lighting System, or PLS, has actually been developed for commercial sale through Finelite. Key components include the actual LED task light (B); the power supply (C); and the undercabinet lighting (D).



tion in future versions of Title 24, the state's stringent energy code.

But lighting quality was an important concern. "One of the big drivers in this research project was to maintain or even increase the lighting quality within the near surround for a typical workstation while producing energy and potential peak power reductions that are so critically needed," Says Siminovitch.

## Portrait of a Typical Office

CLTC's research and development effort began with a survey of office buildings to create a portrait of the typical open office. CLTC found that the typical office contains a configuration of cubicle-type workstations including various furniture, undercabinet linear fluorescent task lighting (often) and integrated partitions (occasionally), with no occupancy-based automatic shutoff. The general lighting is typically a regular grid of lensed or parabolic troffers.

"Regular grids of recessed troffers inside an office environment can present a high level of reflected glare, particularly with VDT tasks," says Siminovitch. "Glare and shadowing are

often cited anecdotally as a major complaint."

Because general lighting can create significant shadowing on work surfaces, fluorescent undercabinet fixtures are often installed as supplementary light sources. These low-cost fixtures are typically installed directly in front of the occupant and blast out significant amounts of light—often 100-200 fc on the back wall partition and 90-120 fc on the desktop—producing overlighting and sources of glare. Current light level recommendations, in contrast, are 40-50 fc on desktops; for vertical partitions, a study of task lighting in offices conducted by National Research Council Canada suggests that 20 to 25 fc is a minimum preferred light level on workstation partition walls. Additionally, while higher-quality undercabinet fixtures with a batwing lens distribute light to the sides, many distribute it forward, which can produce a form of disability glare called a veiling reflection. CLTC estimated 80% of occupants turn off their undercabinet fixture, suggesting people would rather suffer the discomfort of shadows than suffer the irritation of glare.



**ABOVE:**  
The occupancy sensor provides automatic shutoff when the workstation is unoccupied, generating 20% to 30% energy savings compared to uncontrolled systems.

In addition, vertical light levels on the back wall partition are often highly compromised due to the furniture and storage cabinet configurations.

**The Integrated Task/Ambient Approach**

The idea behind the integrated task/ambient office lighting approach is to design the general lighting to produce ambient light only, while incorporating efficient task lighting to provide sufficient illumination on task surfaces. The general lighting, therefore, would provide 25-30 fc of ambient light levels and the task lighting would provide 50 fc on the task and 20-25 fc on the back wall. By reducing the light output of the general lighting system, lower-wattage designs can be achieved. The Inverse Square Law suggests that any time a light source is placed closer to the surface being lighted, an overall gain in efficiency will occur as long as the addition of the task lighting, coupled with the lower-wattage general lighting, does not exceed the wattage of the general lighting alternative. Prior to PLS, integrated task/ambient systems were reported to

produce 20% to 33% energy savings.

For general lighting, direct/indirect is recommended. Direct/indirect fixtures, be they linear suspended pendants or high-efficiency recessed baskets, combine the advantages of direct and indirect distribution while mitigating the disadvantages of each. The indirect component scatters light in many directions, diffusing light distribution, which can aid visual comfort and facial recognition, eliminate shadows, reduce glare on computer screens, and place light on walls and ceilings—making the space appear brighter and more spacious. However, as using indirect lighting alone can make a space appear flat and empty of highlights and shadows that provide spatial definition, the direct component of the fixture is needed to provide this definition.

**Optimizing Lighting Quality**

CLTC optimized the efficiency of the task/ambient approach by developing and demonstrating the PLS as the task component. Over the past year, CLTC conducted a series of beta site tests ranging from single offices up to large interior cubicle-type layouts.

“The system is made up of an array of freestanding LED task lights that can be positioned by the occupant to provide a wide distribution on the task plane within a cubicle environment,” Siminovitch explains. “The task

**PRODUCT DETAIL: A**  
**Occupancy Sensor.** Developed by Wattstopper for Finelite, the DIF-110 uses passive infrared (PIR) technology to detect occupancy. A user adjustable time delay of 30 seconds to 30 minutes can be accommodated.

**PRODUCT DETAIL: B**  
**PLS Desk Lamps** exhibit elegance. Interchangeable mountings let users quickly tailor illumination patterns and levels to specific tasks by simply adjusting the fixture’s head.

**PRODUCT DETAIL: C**  
**Power Supply.** Available in 21- or 60-watt options, the units are for use with any combination of PLS fixtures. Input voltage are supplied with 5-ft AC power cord.

**PRODUCT DETAIL: D**  
**PLS Undercabinet light.** At only 0.8 in. tall and 2.5 in. wide, the fixtures fit seamlessly under binder bins, overhead cabinets and shelving.

lighting system also includes a series of LED undercabinet lights in different lengths/watt-ages to provide vertical illumination across the back wall."

Designed by CLTC, PIER and Finelite, these task lighting systems were created explicitly to reduce glare while producing sufficient light levels on the desktop and back wall. With plug-and-play connections, the lights can be installed and relocated easily, plugging into a single power supply; 3-, 6- and 9-watt units can be individually configured to produce a balanced luminous environment as long as the total connected load is not greater than 21 watts. The power supply also features an occupancy sensor for automatic shutoff, generating 20% to 30% energy savings compared to uncontrolled systems.

"Overall, the acceptance of the system has been quite high," Siminovitch says. "Throughout the study, we found that 21 watts is more than enough to provide a high-quality light distribution typically with small to large cubicle configurations. People really appreciate the ability to configure the systems and move the task lights around to their particular location of choice."

In addition he says, the system presents a very low-glare office lighting approach.

A major research finding, he points out, is that the quality of task lighting directly affects the amount of ambient light that is needed to light offices.

By optimizing the overall efficiency of the task/ambient approach using a flexible LED-based task lighting design, the integrated task/ambient system demonstrated power densities as low as 0.5-0.7 w/sq. ft.—or 36% to 55% less than ASHRAE 90.1-2004/2007 and California's proposed 2008 Title 24 energy code—and energy savings as high as 40% to 50% compared to the typical California office. The use of the occupancy sensor, in turn, was found to reduce energy consumption by an additional 20% to 30%.

What's more, says Siminovitch, is the integrated task/ambient approach enables buildings to participate, in a relatively painless manner, in demand response programs. "The ability to achieve demand response without compromising lighting quality will be

a very significant capability coming down the road," says Siminovitch.

For example, he adds that with this PLS system, one can envision a demand response signal being sent to the building that would eliminate or greatly reduce all the ambient lighting, but the occupants would still have a very high-quality lighting system through the LED task lights.

### Implementation

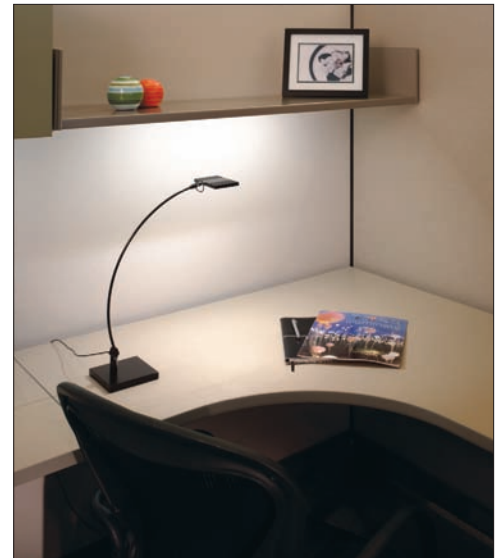
There are two markets for integrated task/ambient office lighting solutions, each with its own particular advantages and special challenges: new construction (and renovation) and retrofit.

In new construction, the general lighting should be specified as direct/indirect and the task lighting as PLS (or other system as other manufacturers may develop similar systems). The advantage of this approach in new construction is that the return on investment is based on the cost difference between task/ambient and its alternatives rather than all of the labor and materials required to install a new system in an existing building. The challenge with this approach is it involves coordination for both ambient and task lighting between the lighting designer, the design team, and the owner or developer. The major issue is integration, as it represents a fairly significant departure from typical practice and requires a level of sophistication that is beyond what is done today. Ceiling lighting systems are often completed well in advance of occupancy and associated furniture configurations.

In retrofit situations, however, the approach can be trickier and must be economically justified, which requires management interest in reducing operating costs via investment in energy savings. Assuming approval, the biggest challenge to implementation is dampening the output of the general lighting system—reducing light levels from about 50-75 fc to 25-30 fc, usually by delamping—but with sufficient caution to avoid damaging lighting quality and aesthetics.

Siminovitch says CLTC is working on templates targeted to both markets.

For more information, visit [cltc.ucdavis.edu/content/view/83/85](http://cltc.ucdavis.edu/content/view/83/85) or [www.finelite.com/products/pls-overview.html](http://www.finelite.com/products/pls-overview.html). ■



#### ABOVE:

Integrated/task ambient lighting featuring properly sized general lighting and the PLS improved the visual environment while reducing lighting power density to 0.5-0.7W/sq.ft



**FINELITE**  
*Better Lighting*