BEST PRACTICES 2010

San Jose State University King Library Lighting Retrofit

Through the creative use of fixture prototyping, an extensive lighting retrofit at the Dr. Martin Luther King, Jr. Library reduced building energy use by 25 percent, bringing the total well below the initial design goal. New lamp and ballast combinations extend lamp life and reduce maintenance costs.

Award Category

Lighting Design/Retrofit

Green Features

Stack light retrofit with 5000K 21-watt T5 lamps and programmed-start ballasts

Basket troffer retrofit with 5000K 17-watt T8 lamps and high ballast-factor ballasts

Parabolic troffer retrofit with APL retrofit kits and 3 to 2 delamping

Prototyping of fixtures to test appearance and optimize controls

Size

475,000 ft^2

Cost

$1,360,800

Annual Energy and Cost Savings

1937 MWh

$310,000

Maintenance savings reduces payback period to approximately two years

Completion Date

Winter 2009/2010

The library, a signature building completed in 2003, is managed jointly by the City of San Jose and San Jose State University. Although the building was designed to LEED Silver with an energy target of 32 percent below Title 24, a 2006 study showed that the building was operating at only 24 percent below the benchmark. A comprehensive lighting retrofit was initiated in 2008 to aggressively improve energy performance.

Lighting retrofits must take into consideration numerous factors including aesthetics, security, and the visual comfort of building users. The lighting retrofit was led by SJSU staff under the management of a diverse committee that included campus and city librarians, facilities managers, and other city agencies. Although the original design included 50 different lighting types, a lighting audit identified three light fixtures that would provide the greatest benefit from a retrofit in terms of energy savings, financial payback, aesthetics, and decreased maintenance costs. The lights selected for the retrofit included stack lighting fixtures mounted on library shelving, “basket” troffer fixtures located throughout the library, and parabolic troffer fixtures located primarily in utilitarian areas.

Although there was concern about the cooler 5000K lamps, they are closer in color to daylight and turned out to be well received by library staff and users.

One of the major concerns with the retrofit plans was that proposed 5000K lamps would appear cold and unappealing in comparison to the warmer, existing 3000K lamps. There was also a concern that having more than one lamp temperature would create a clash of lighting colors. Library staff also had questions about the use of occupancy sensors in stack areas, as some feared that reduced light levels would provide a security risk, or that the switching would be distracting or difficult to control appropriately. To address these and other concerns, the design team installed prototypes for each fixture type, and allowed facility and library staff to evaluate the alternatives for several months.

Stack lighting after the retrofit. Image: Carol Bebee.

The retrofit of approximately five-thousand stack lights was one of the more complex aspects of the project. It was determined that incompatibility between the existing lamps and ballasts was resulting in the premature failure of both. In addition, lighting control problems led to entire floors of lights being left on overnight while custodial staff worked. With lamps being on close to 8000 hours per year, lamp life was greatly reduced.

A series of prototypes was installed on six aisles to test various ballast and lamp combinations, lamp colors, and occupancy control operation. The final stack light design included standard T5 lamps, program-start ballasts for longer lamp life, and ballasts located more conveniently above the stacks instead of above the fixture housings. The new configuration reduced energy use from 85 to 45 watts per fixture.

2010 BEST PRACTICES

Additional Awards

Savings by Design

Contacts

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Project Team

Project Management: SJSU Facilities Development and Operations

Architect: Carrier-Johnson

Lighting Design: Lighting Wizards

Design-build contractor: AECOM

Lighting sub-contractor: Enlight

More Information

www.fypower.org/inst/gov/project-detail.html?id=52

www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/rebatesincentives/eefficiency/inc/mlk.pdf

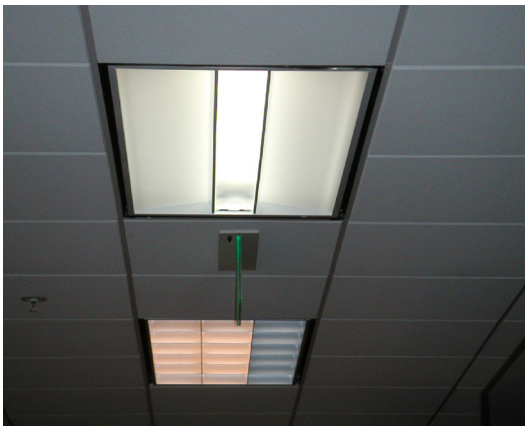
www.sjsu.edu/fdo/energy/sustainability/king_lib_leed/kingleed-6innovation/

The mockups were useful for demonstrating and fine tuning the occupancy control operation. It was determined that the best control strategy would be to have the fixtures on both ends of the aisles not be connected to the occupancy sensors, so that the main circulation areas would always be illuminated. To ensure that lights would not be triggered excessively by people walking past the ends of aisles, the contractor shielded the view of the occupancy sensors. The complete stack light installation has been in place since the end of 2009, and has been well accepted by library staff and users, and has led to significant energy savings.

By retrofitting existing lights, the amount of waste generated by the project was greatly reduced, adding to the project's LEED point count.

The "basket" troffer fixtures installed throughout the public areas of the library also presented good retrofit opportunities. The 2x2 fixtures had originally been installed with perforated metal diffusers, which provided a relatively glare-free light quality, but provided an efficiency of only 58 percent. The design team mocked-up 55 retrofitted fixtures in an open area, and two in an enclosed office. The prototypes replaced the 40-watt biax fluorescent lamps with 17-watt T8s, installed more efficient ballasts, and replaced the perforated metal baskets with frosted acrylic lenses. After the mockups were approved, a total of 1175 fixtures were retrofitted. The new design reduced lamp wattage by more than 50 percent, but maintained the previous light levels. In fact, some people found the retrofit to be too bright, however bi-level switching allows the lights to be switched off by 50 percent, reducing both illumination levels and energy use.

The third type of fixtures included in the lighting retrofit were parabolic troffers, which had been installed in many utilitarian areas of the library. The existing chrome egg-crate diffusers were replaced by off-the shelf retrofit kits from lighting manufacturer ALP. The retrofit included acrylic lenses and white reflectors, and reduced the number of lamps from three to two. The results were well received by staff due to the improved lighting quality. After the mockups were approved, over 600 lights were retrofit.



Parabolic fixture before (at rear) and after the retrofit (at front). Image: Carol Bebee.

LESSONS LEARNED

Adam Bayer, Director of Energy Utilities & Engineering at SJSU, notes that the use of mockups was essential for showing the appearance of the fixtures to library staff and users. He also notes that using LEED helped drive the decision to retrofit rather than replace fixtures entirely. "The volume of waste that would have been created from demolishing thousands of fixtures would have been immense. There is an industry surrounding lighting retrofits," he says, with many options for replacing diffusers and reflectors.

The lighting retrofit, in combination with HVAC commissioning, has led to significant energy reductions, and the library now operates at 57 percent below Title 24, well below the original goal of 32 percent below the benchmark.

Best Practices case studies are coordinated by the Green Building Research Center, at the University of California, Berkeley.

The Best Practices Competition showcases successful projects on UC and CSU campuses to assist campuses in achieving energy efficiency and sustainability goals. Funding for *Best Practices* is provided by the UC/CSU/IOU Energy Efficiency Partnership.