Let There Be LIGHT

BY VERONICA GARRETON, ASSOC. AIA; CHIP ISRAEL AND SANDRA NOVALES

The design began with a dark, windowless warehouse originally used for cosmetics manufacturing. However, employees expressed concerns about their new windowless workplace.

LDA’s previous building had multiple windows in every office, but employees kept their blinds closed. The owner assumed that daylight wasn’t important to employees, so he bought a windowless building with two common walls. He found that his assumption was wrong.

Lighting Solutions
To address employee concerns, designers focused on providing a glare-free daylit space.

All lighting teaching tools and techniques are integrated into the project as a permanent art installation. Custom patented hybrid electrical/daylight systems introduce sunlight into the interior of all spaces during daylight hours, while the integrated electric lights slowly energize as light is needed in the evenings. By combining daylighting and electric lighting into one unit, visual clutter is eliminated within the ceiling.

Designed to meet LEED Platinum requirements, fully connected lighting loads are 0.6 watts/ft². Further reduction through daylight harvesting and dynamic dimming results in the actual average documented lighting load of 0.07 watts/ft² compared to California’s strict Title 24 energy code that allows 1.1 watts/ft².

All electric lighting loads are monitored through a green screen energy monitoring system, which calculates energy savings from the lighting dimming system. Savings are displayed on a monitor in the building lobby for building guests to see daily, weekly, monthly and yearly monitoring. To explore other sustainable technologies in a real-world application, 10 kW of photovoltaic panels are mounted to the sloped roof of the west façade and the flat roof above the open office space and warehouse.

The photovoltaic panels can easily offset remaining lighting demands.

An entry with soaring 22 ft ceilings was added to the building’s front to increase the scale and make it a more inviting space. Translucent glass at the reception area reduces glare and heat gain, while transom windows and light shelves bounce natural daylight deep into the interior. The transom windows are electrically operated and automated, as are the rear clerestory windows.

Preventing Heat Gain
The building is naturally ventilated most of the year by cool ocean breezes. Custom vertical translucent luminous louvers block the western sun on the front façade and provide some privacy in the front offices without sacrificing views and daylight. The panels are vertically oriented to allow for unobstructed views during most of the day. In the afternoon, the automated louvers shift to redirect the natural light without blocking views while the translucent

Nearly every type of lighting technology available on the market today is demonstrated in Lighting Design Alliance’s (LDA) new studio in Long Beach, Calif. From the color-changing LED skylight to the solar-fed fiber-optic accent lights, it’s clear that light is the most important design element. The key was to integrate all of the “teaching” features cleanly and seamlessly. A studio that showcases lighting might not seem to be an obvious choice for a high performance facility, but careful planning and robust controls have resulted in one of the most efficient buildings in California.

LIGHTING DESIGN ALLIANCE

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Building at a Glance

Name: Lighting Design Alliance
Location: Long Beach, Calif.
When Built: 1980
Major Renovation: 2007–08
Principal Use: Corporate office and design studio
Includes: lighting technology showcase, open offices, conference rooms, kitchen, gym, volleyball court and warehouse

Employees/Occupants: 20
Gross Square Footage: 22,000
Conditioned Space: 16,000
Total Renovation Cost: $1,600,000
Cost Per Square Foot: $73
Renovation Scope: Lighting, electrical distribution and HVAC replaced, restrooms renovated, accessible restrooms added

Occupancy: 50%

Distinctions/Awards: 2008 GE Edison Awards: Award of Excellence in Environmental Design, Award of Merit
panels glow softly. This minimizes the typical extreme brightness ratios that cause visual glare. The alternate systems considered for blocking the setting sun used horizontal louvers, but these had to be completely closed. The problem with vertical static louvers is that from the interior they seem like security bars.

Left: Vertical translucent louvers allow daylight without glare. Photovoltaic panels are installed on the sloped roof of the west façade and on the flat roof above the open office space and warehouse.

Below: The mezzanine was purchased in Mexico, dismantled, transported and reconstructed.

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All office spaces are 100% daylit, with no electric lights used during working hours. A total of 52 skylights are incorporated into the lighting design. Long Beach, Calif., experienced record rainfall in 2009–10, and the skylights did not leak. By using triple-layer heat stopping acrylic or double-pane low-e glass, the amount of daylight used was maximized while minimizing the amount of heat gain. Even on cloudy days, the space appears friendly and inviting while promoting worker productivity. The firm plans to track health issues, missed work, and productivity. The monitors at Lighting Design Alliance were designed to provide a maximum of more than 400 foot-candles of glare-free natural daylight (under full daylighting conditions at midday).

Maximizing Daylighting

In an office, typical lighting guidelines recommend between 25 and 50 footcandles. High daylight levels coincide with circadian rhythm requirements making open offices places where people want to work. The monitors at Lighting Design Alliance were designed to provide a maximum of more than 400 foot-candles of glare-free natural daylight (under full daylighting conditions at midday).

The space appears friendly and inviting while promoting worker productivity. The firm plans to track health issues, missed work, and overall office productivity as part of an in-house circadian rhythm study. A frosted acrylic ceiling system illuminated by a clear continuous skylight above spans the entire length of the building from the lobby to the rear exit, forming a bright central corridor. The ceiling provides 100% of the required light for this transition space, even on cloudy days.

Color-changing LEDs between the acrylic and the skylight come on after sunset to provide a variety of slowly changing light shows during evening events. The corridor also allows for natural convection to cool the building if the front and back doors are open. The visual terminus of the corridor has a light art sculpture by Stephen Knapp that only consumes 50 watts of power, but creatively lights most of the wall surface using dichroic glass. The lounge at the end of the corridor provides a maximum of more than 400 foot-candles of glare-free natural daylight (under full daylighting conditions at midday).

EIGHT FOOT BY EIGHT FOOT CLERESTORY MONITORS WRAPPED WITH SPECIAL UV/HEAT REJECTION FILM REFRACT LOW ANGLE DAYLIGHT WHILE REJECTING HEAT. NORTH-FACING, CLEAR WINDOWS ELECTRICALLY OPEN FOR VENTILATION AND ALLOW OCCUPANTS DIRECT VIEW OF THE SKY.
Controls

All lamp sources throughout the building were selected for long lamp life and high efficiency for reduced maintenance and wattage. Photocells, occupancy sensors, an astronomical time clock, and local controls at each workstation provide full building control to suit the needs of each employee. Every applicable light source was dimmed to allow for minimal energy use while still providing necessary illumination for visual tasks.

How occupants control their environment is sometimes more critical than what that environment actually is. LDA’s office uses 12 distinct HVAC zones. This allows the north side of the building to be treated separately from the south side of the building, and allows the HVAC to be used only in occupied spaces. To meet LEED Platinum requirements, all of the units are designed to be CFC-free.

Automated shading devices, automatic operable ventilation systems, a smart building computer, and local touch screen system create a space that can be customized for anyone in the office. The automated system combined with an external thermostat actually allows for the building to be automatically precooled. Insulation values exceed R-38, more than double what was required by code, and

A daylight transfer fiber-optic system lights the chandelier during the day. Metal halide lights spotlight it and the lobby atrium at night. The corridor (rear of room) is lit at night by color-changing LEDs integrated into the 60 ft skylight. The LEDs also avoid the “black hole” effect that skylights usually create at night.

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a high albedo (solar reflectance) roof helps minimize heat gain.

The building’s nonlighting load includes computers, HVAC, two refrigerators, plotters and printers and miscellaneous plug loads. In addition to lighting efficiencies, the building’s reduced electricity use from the grid is attributed to the occupancy sensors under each desk, the office’s 50% occupancy rate and the electricity produced by its photovoltaic panels.

Conserving Water, Materials
As the Los Angeles basin enters its ninth year of drought, water is a critical resource. The small area of landscaping is drought tolerant, native to the region, and can be hand watered, if necessary. Artificial turf installed in the planters looks like a lush grass.

Lighting equipment, like electric lighting equipment, is always evolving. The solar tubes are now larger and more efficient. New optical prisms have been added to maximize illumination in early morning and late afternoon, but they also reduce midday illumination levels. Solar tubes that extend above the roof are available to help eliminate shadowing from architectural elements or mechanical equipment. Automated daylighting systems are becoming more robust and reliable.

The fine-tuning of occupancy sensors and daylight tuning was time consuming. The designers wanted to ensure the lighting did not stay on too long after an employee left her office or lights turned on when an occupant walked by an office door. Likewise, the designers wanted to ensure the daylighting prompted the lights to dim as soon as possible and turn off completely to recover maximum savings. The designers recommend a second commissioning after the building has been occupied for some time to fine-tune it for maximum savings and employee comfort.

Commissioning is an evolving need. The control system is being updated and modified regularly to maximize lighting efficiency and increase the level of savings. Lamps, ballasts, occupancy/vacancy sensors and daylight sensors are regularly tested, which pinpoints the curiosity of employees and guests.

Fiber-optic daylight transfer systems, such as the one that lights the lobby chandelier, are expensive for their level of illumination, and have quite a few limitations, including distance to the source, low light levels on anything except the brightest days—or none in the case of a cloudy passing over—and relative difficulty of installation for proper function.

Sometimes the best solution doesn’t exist yet. That does not mean it should not be explored. LDA president and coauthor Chip Israel designed hybrid solar/electric systems using different manufacturers’ standard products. The hybrid systems keep the ceilings looking clean aesthetically and help LDA designers maintain constant light levels at their desks and conserve energy. The hybrid system was not much more expensive than having the two systems side by side, as would be done traditionally, because it was a single installation. Learning from its experience, LDA is now looking at modifying this concept for an upscale 2 by 4 system for spaces such as schools, which have many of the same lighting needs as commercial spaces.

Being sustainable is about long-term goals and daily maintenance. Building infrastructure for goals such as rainwater collection and piping for a future shower (installed February 2010), allows LDA to keep striving for LEED Platinum without great cost or inconvenience. Daily sustainable initiatives such as recycling and carpooling remind and educate employees of the company’s dedication to sustainability. Having a LEED-certified building is about creating a responsible culture, not about a checklist of construction requirements.

The most important lesson was that the needs of the users, as described by them, and not just as assumed by the design team, should be the defining factors from the beginning of design. The assumption that no one cared about having windows, and the subsequent discussion with LDA’s designers regarding daylight and glare, created an opportunity to develop and learn about many options for daylight in the everyday office environment and resulted in this energy-efficient innovative space.

Under construction, water seeped up through the foundation. Rather than deal with future mold issues, the owners had a portion of the floor removed. French drains and lateral drain pipes were added. At the same time, the large roof drains were rerouted to the rear of the property to facilitate future rainwater harvesting.

Most of the finishing touches in the building are either recycled materials or reused. All furniture was bought used, and a mezzanine brought from a demolished building in Mexico created the upper level for future expansion. A wall covering made from recycled blue jeans, seaweed and sawdust particle board creates a bold statement in
Stringent documentation from the beginning of construction did not exist, so the building is registered for LEED Existing Buildings and plans to become certified within one year. LEED-EB encapsulates not only the building shell, but the day-to-day operation of the building, which is perhaps more enduring.

Design Resolution

The designers of Lighting Design Alliance were a little apprehensive when they saw that their future office was a windowless warehouse with 8 ft ceilings, but no one feels that way now. The design studios and also acts as soundproofing for the open office space. A bridge between the in-house gym and the storage room reuses glue-laminated beams from a local high school basketball court that was being replaced.

A recycling program includes plastic, paper, cardboard, aluminum and glass. Each desk has a trash can and a recycling bin nearby. Larger recycling containers for full size architectural drawings are distributed throughout the building. A soda gun was even installed in the kitchen to eliminate the consumption of soda in aluminum cans. Additionally, computers that are being phased out are donated through an employee’s family to a school in South America.

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Above: Occupancy and HVAC controls reduce energy use when the conference room is vacant. Low-volatile organic compound paint promotes good air quality.

Right: Automated shades reduce glare. Variable light settings, zones and dimming allow for the correct lighting scenario for each use of the conference room.

About the Authors

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