Lighting within Limits

Tightening energy codes and standards, along with new technology, present design teams with opportunities and challenges. By Joann Gonchar, AIA

LIGHTING DESIGNERS can help assure that a project is adequately illuminated, set the tone of a space or a room, or emphasize architectural form. But their role is growing increasingly complex, in part because lighting-related technology is evolving at a breakneck pace, but also because energy codes are becoming progressively more stringent.

One illustration is the standard developed jointly by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the Illuminating Engineering Society (IES): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings. The document, updated every three years, is often referred to in shorthand simply as "90.1." Most state energy codes are based on 90.1 or the International Energy Conservation Code (IECC), published by the International Code Council.

The latest version of 90.1, released in November 2010, is much more rigorous than its predecessor, says the U.S. Department of Energy (DOE). When comparing 90.1-2004 to 90.1-2007, DOE found an impressive 18.5 percent savings of site energy and 10 percent savings of energy consumed by a building as reflected in utility bills. In contrast, buildings that comply with 90.1-2007 are expected to save about 4.5 percent of site energy when compared to those designed to the 2004 version.

The savings achieved by the latest iteration of the standard can be attributed to several factors, including requirements for more efficient mechanical systems and for better-performing envelopes. However, tougher standards for energy consumption associated with lighting are also a major contributor.

THE QUALITY ISSUE

The 90.1 sets new limits on the amount of lighting that can be installed in buildings. For example, the whole building lighting power density (LPD) allowance for a library in 90.1-2010 is 1.85 watts per square foot, down from 2.5 in 2007, and from 3.51 in 2004. For an office, the limit in the most recent standard is 0.61 square foot, reduced from 0.6 in 2007, and from 0.8 in 2004. With these guidelines in mind, many prescient lighting-design and daylight consultants aim for the lowest numbers possible.

For instance, Washington, D.C.-based MCLA needed 90.1-2007 to plan the illumination system for the city's Walter T. Daniel - Shaw Neighborhood Library (see page 96). But the building is below the LPD set by the 2010 standard. And for the research areas of Princeton's Frick Chemistry Laboratory, lighting designers from Arup devised a scheme with densities well under code limits (see sidebar, this page).

Even so, many sources worry that this downward trend will be difficult to sustain should it continue in future releases of 90.1. "Lighting power densities can't go much lower without affecting quality," says Robert Horner, director of public policy at IES. "People need enough light to read, work, and feel right," he adds.

The LPD limits in the standard aren't arrived at arbitrarily, says Eric Kim, senior research engineer at the Pacific Northwest National Laboratory in Richland, Washington, and chair of the 90.1 development team's lighting and electrical subcommittee. The LPD numbers are a product of a host of factors, he explains, including the efficiency of readily available luminaires and lamps, good design practice, and industry light-level recommendations. However, he does concede that there is little room for further downward adjustment.

"There is no more square foot left," he says. Some sources, like Barbara Horton, president of HLW Lighting, New York City, point to developments with the voluntary standard LEED as an important catalyst, prompting designers to carefully consider how they are complying with LPD limits. LEED has recently introduced a new LEED Credit 21, "Interior Lighting - Quality." Its goal is to "ensure that energy efficiency isn't achieved at the expense of occupant comfort," explains Jayden McKay, a colleague of Horton's and HLW principal.

According to McKay, HLW plans to seek the credit on a 50,000-square-foot corporate interior project targeting LEED Gold certification. If the credit works as intended and is officially incorporated into the rating system, it will encourage the selection of fixtures that do not create glare and of lamps that render color well and are long-lasting. It should also encourage designers to rely on reflective light and increase its effectiveness by specifying materials

Frick Chemistry Laboratory
Princeton, New Jersey

At Princeton University's new Frick Chemistry Laboratory, designed by看一下原始图片。
LIGHTING AND ENERGY EFFICIENCY

LIGHTING WITHIN LIMITS

Energy codes and standards, along with technology, present design teams with opportunities and challenges. By Joann Gonchar, AIA

DESIGNERS can help assure that adequately illuminated, the space or a room, or even a building, is not a waste. But their role is growing ever more complex, in part because lighting technology is evolving at a breakneck pace. So too because energy codes are progressively more stringent.

The standard developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is the most recognizable, but the lighting standards established by the Lighting Research Center at Rensselaer Polytechnic Institute are also important.

These standards are continually updated and revised, and the latest version of ASHRAE Standard 90.1 is 80 percent more stringent than its predecessor, ASHRAE Standard 90.1-2010. The most recent version of ASHRAE Standard 90.1-2016 is a concerted effort by nearly every major energy code organization in the United States and Canada.

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OFFICE LIGHTING

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with above-minimum reflectance values for ceilings, walls, doors, and work surfaces.

“These are all good practice recommendations, but many design professionals don’t know how to apply them,” says McKay.

**CONTROLS IN CONTEXT**

Instead of reductions in LFDs, Richman anticipates that future iterations of 90.1 will emphasize the use of lighting control systems as a means of achieving energy savings. He also points to extensive new requirements for such systems in the 2009 version of the standard. Example, although previous versions required occupancy sensors in certain types of spaces, the latest version includes an expanded list of mandatory applications. For spaces with manual controls, multi-level lighting lighting configurations to provide intermediary illumination levels between off and full lighting power control is required. In addition, there are new stipulations for daylight harvesting controls. The standard offers incentives to designers for going beyond the minimum controls requirements, offering lighting power adjustments for projects that deploy advanced strategies.

The expanded reliance on controls in 90.1 essentially mandates what had been optional features. “Previously we would sell controls on the basis of their aggressive energy savings, but now their use is mandatory,” says Gary Meshberg, president of the Lighting Controls Association, an industry trade group.

The new version of 90.1 acknowledges what lighting designers with expertise in energy conserving design have known for some time: A low LFD isn’t always the most effective measure of efficiency. Especially “with the advent of advanced lighting controls and growing use of daylighting, this metric becomes less relevant,” explains George Lois, principal of Lois+Labs/LOBiode, in Alameda, California-based architecture, sustainability, and lighting consulting. Among his recent projects is a largely daylight exhibition space whose sole power supply for plug loads and sensor-controlled lighting is a 4,440-W photovoltaic array (see page 54). Although the 1,500-square-foot pavilion has a relatively high LFD of 1.83, the lights are on for only short periods of time and typically not at full power, he says.

Scott Garanith, a senior lighting designer at MCLA, Washington, D.C., points out that projects that deploy aggressive daylight harvesting strategies “need to be designed for the worst-case scenarios, which is night.” With the Boston office of Behnisch Architekten, Gaertner’s firm is working on a 194,000-square-foot law school facility for the University of Baltimore. The building, due for completion early in 2013, consists of several interlocking volumes housing.

**YOTEL NEW YORK CITY**

Last June, Yotel—a UK-based hotel chain inspired by Japanese capsule hotels and luxury airline lounges—opened a location on the far west side of Manhattan. It is just one component within a vast, $500 million, mixed-use complex designed by Arquitectonica. But the hotel, with a facade, public spaces, and 699 rooms by Rockwell Group and lighting firm Focus, possesses its own distinct character. It has a "2001: A Space Odyssey feel," says Michael Cummings, focus design director.

The hotel’s public spaces are illuminated almost exclusively with LEDs. The brightness of the source worked well with the sleek, predominantly white and gray interiors, explains Cummings. The choice also helped the project achieve a 78,000 square foot lighting power density, part of the larger building’s energy-conservation goals and its bid for LEED Silver certification.

On the exterior, where precast-concrete panels wrap the middle floors of a four-story podium, Focus installed linear RGB (red-green-blue) LED strips. The light is aimed from above and below to highlight the relief patterns in the cladding with the hotel’s signature color purple. At street level, a frosted glass portal, backlit with bright white LEDs, defines the entrance. But inside, along the lobby’s elevator bank wall, the effect is reversed. Here soft purple LEDs illuminate elevator door surrounds and white LEDs wash a textured ceramic tile wall.

For general lobby downlighting, the designers chose low-voltage recessed ceiling fixtures housing retrofit LED lamps. They decided against LED integral fixtures because they felt the retrofit option would better allow the client to take advantage of future improvements in lamp technology, explains Cummings.

In the compact rooms, the project team opted for linear fluorescent lamps as the most cost-effective primary light source option. Two are hidden behind a wall-mounted television and storage unit. One, which is illuminated when guests first arrive, is covered in a colored gel sleeve to wash the walls in purple. Guests have the option of turning this light off, and relying on a second, bare lamp for general illumination.

The project’s biggest challenges were finding LEDs that offered the desired dimming range, light output, and color rendition, and ensuring that the all-important purple was consistent from application to application and source to source. The selection process involved extensive vetting and testing, conducted mostly in Focus’ Upper Manhattan offices. But the lighting designers, along with the architects, also took advantage of a full-scale room mockup that the general contractor erected in Westchester County, New York, for the study of finishes and furnishings, as well as lamps and fixtures. Although such a mockup is often part of the hotel design and construction process, says Cummings, in this case, its proximity to Focus’ offices allowed frequent trips for tweaking. J.G.
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TRISKELION
SAN FRANCISCO

LOW ENERGY USE was a particular priority for the Triskelion, a 1,300-square-foot moveable pavilion commissioned by the nonprofit arts organization FOR-SITE. Designed by Oydzlak/Pfieffer Architects, San Francisco, the building consists of three shipping containers arranged at 120-degree angles to define a central skylit atrium. Since May 2000 it has been installed at the Presidio, where it was part of the yearlong Presidio habitat—a exhibition of artists' created animal habitats distributed around one corner of the national park. The pavilion served as a spa for the display of sketches and models.

Because Presidio officials required that the building be easily demountable and leave no trace of its existence once removed, the Triskelion could not tie into nearby utilities. It needed to be completely "unmetered" from the site, says architect Jake Oydzlak.

To meet the requirement, the project team devised an off-the-grid lighting scheme largely dependent on daylight penetrating the central skylight, windows at the ends of each container, and side openings. But for those times when daylight is insufficient, the power generated by a rooftop 4,440 W photovoltaic array illuminates photo-sensor-controlled 15 lamps inserted within fabric-covered covers. The light evenly washes the walls, creating an effect different from that found in most gallery settings, where individual pieces of art are typically highlighted against a dark background, explains George Loios, principal of Bay Area-based Loios + UBEolearch, the project's lighting and daylighting consultant. The more usual approach would have required track lights, but the containers had insufficient headroom, he says. The chosen strategy also offered the advantage of keeping the ceiling clear of fixtures, making the skylight opening seem like an abstract cut in the drywall plane, points out Oydzlak.

One challenge was positioning the dimming sensors, since daylight enters the building from multiple directions. To identify the best spots, Loios's team moved the sensors within a virtual model and then simulated the response of the electric lights. The Triskelion will remain at the Presidio through October and will host workshops associated with the 75th anniversary of the Golden Gate Bridge. FOR-SITE is considering options for the pavilion once the workshops end, including erecting it elsewhere in the city for use in its own offices.

TESTING AND TWEAKING

In 1984, HOK, this pre-occupancy adjustment and inspection step is now a requirement. And to ensure that the systems continue to work as intended, the standard also requires that documents such as a controls narrative and a schedule for recalibration are provided to the owner. However, there is no mechanism for making sure these materials are put to use. "An infrastructure for verification doesn't exist," says Richman. "The code official doesn't return to the building after it is occupied," he adds.

In addition to the mounting sophistication of control systems and tougher code requirements, lighting design professionals need to stay on top of the seemingly constant introduction of new lamps, luminaires, and associated equipment. This hardware is changing at such a rapid pace that almost every project offers opportunities to deploy new products that prolong lamp life, improve color rendition, and extended dimming capabilities. Designers like New York City-based Focus Lighting perform their own testing before specifying new products. They also include a standard notation on contract documents. The note requires that suppliers inform the project team if the most current version of a product is not the one specified to it can be thoroughly vetted before installation. Among Focus's recent projects is Totel, a hotel in New York City with public spaces illuminated almost exclusively with LEDs (see page 92).

The rapid rate of product development, the growing capabilities of control systems, and the increasing stringency of energy codes are all conspiring to make a carefully considered illumination strategy more critical to the success of an architecture project than ever before. As Horton points out, her discipline "is no longer just about painting with light." (Continued on page 96)
WATHA T. DANIEL - SHAW NEIGHBORHOOD LIBRARY
WASHINGTON, D.C.

LIKE A BEACON, the dynamic glow of the illuminated corner building on Rhode Island Avenue points to a bright future for area residents. The Wattha T. Daniel - Shaw Neighborhood Library (Shaw) was one of the first projects in an ongoing D.C. Public Library initiative to build new facilities with community-friendly spaces and state-of-the-art information technologies. The mandate also stipulates that the buildings meet or exceed LEED Silver certification.

According to Peter Cook, Davis Brody Bond principal in charge of the Shaw Library project, light — in particular daylight boosted by electric light and controls — was a significant part of their energy-saving design strategy. The architects took advantage of the unobstructed triangular site's potential for daylight by developing a three-story, 22,000-square-foot steel-frame structure with a 30-foot-deep overhang and perforated aluminum screen to shield the glazed, double-height reading room on its north side. Clerestory windows and translucent, insulated fiberglass panels on the north facade ample illumination from the sun on all sides, minimizing the need for electric light in the main reading room by day.

“The screen satisfies an important need to control the glare,” says project manager Christiane de Jonge. “Lighting a reading space with mostly daylight is somewhat unusual. The architects collaborated with the D.C.-based lighting design firm MCLA to validate what might be perceived as excessive light levels in the large open rooms through a detailed analysis. Once the lighting designers determined there was no cause for concern, they developed an electric lighting system based primarily on the TS linear fluorescent with a 3000-K Kelvin color temperature — the light preferred by the client for energy and maintenance efficiency. "The advantage of the TS is, because it is narrower in diameter than a T12, you can build a smaller reflector around it, which allows you to do smaller fixtures," says MCLA senior designer Frank Feint. So, using TSs, they cantilevered special fixtures from the tall stacks for vertical illumination on the books, and suspended luminaries over reading tables and workstations. Then they installed slim TS fixtures on top of exposed girders and the canopies under the clerestory windows for ambient uplighting that provides a luminous lantern effect and also reduces excess excite lighting.

The D.C. Public Library is now specifying translucent structures for future projects, notes de Jonge—a clear indication that the Shaw measures up. Linda C. Lent.