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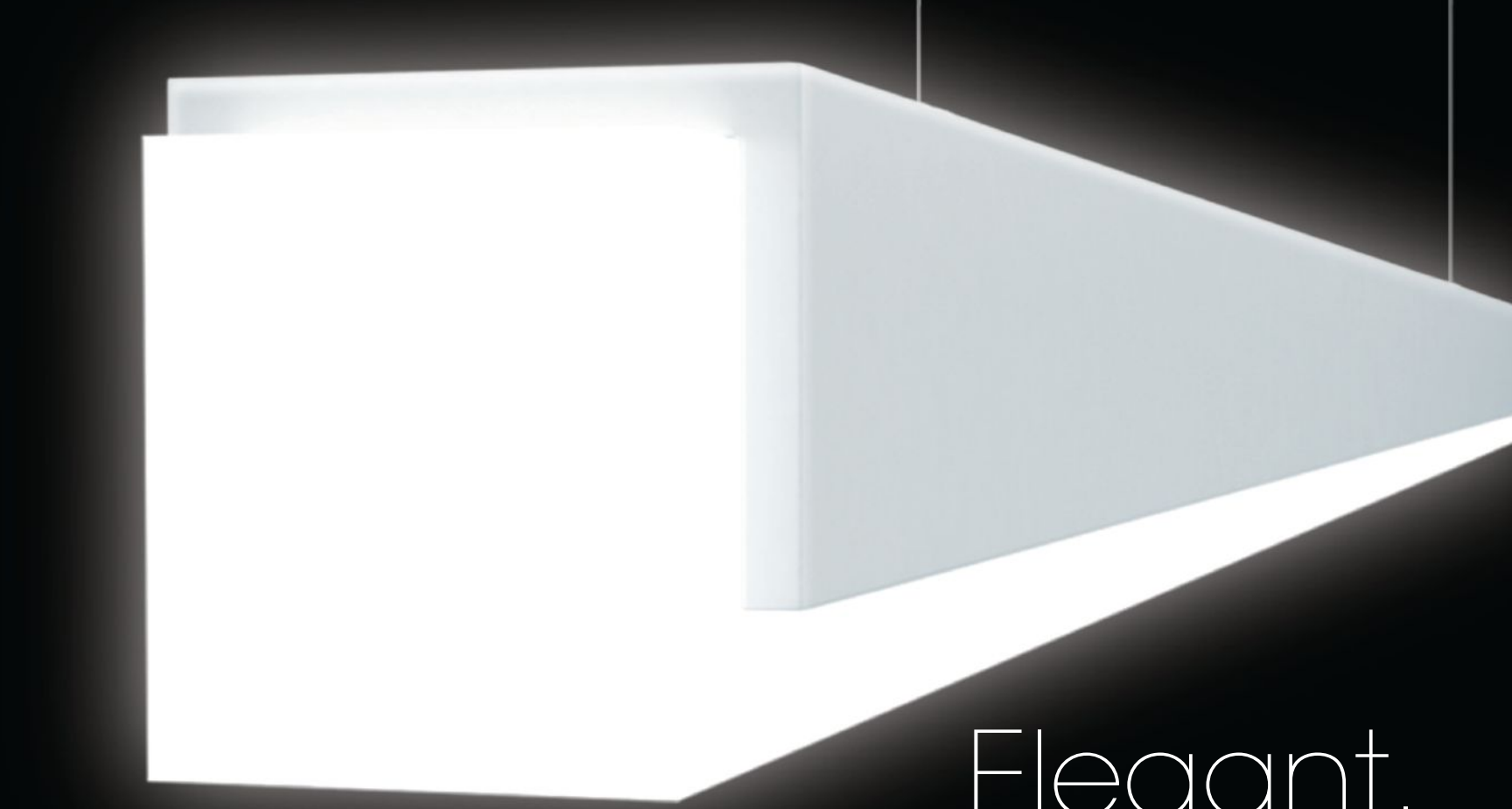

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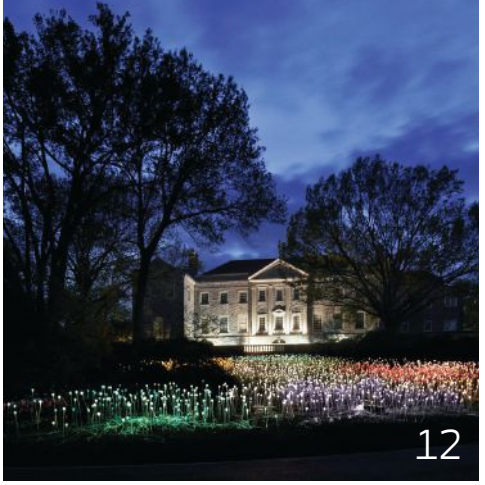

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Cover:
Lakewood Cemetery Garden Mausoleum
Photo by Paul Crosby

Left: Eduard Hueber/ArchPhoto; Top Right: Courtesy Cheekwood; Bottom Right: Orlin Culture Shop

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"It does take extra time to check and verify manufacturer information, but it's a critical part of the process—both on the editorial side as well as in the specification for a design. It's in all our interest for clarity of information and purpose to make sure we are using the same 'specification' vocabulary."

SPECIFICATION INTEGRITY

Clear communication and the relaying of information is one of the most important aspects of the design process. One area this takes on particular relevance is with product specifications. A critical piece in the overall project documentation process, the specification helps to ensure that the correct products are acquired for the job. This in turn makes sure that the designer's intent is seen through. In the case of lighting, it can be the difference between whether or not the lighting design is realized as intended or if it will be compromised.
The International Association of Lighting Designers, in conjunction with the Lighting Industry Resource Council's *Guidelines for Specification Integrity*, outlines the importance of the specification process and walks designers through the components that contribute to a successful specification.

Yet despite all the effort to produce specification documents that withstand the ebbs and flows of the project cycle, one area lags behind: proper citation of manufacturer names. The significant number of mergers and acquisitions that the lighting industry has seen over the past several years hasn't made this job any easier.

Proper citation is significant for many reasons. First, it stands as a kind of testimonial to the status of the lighting industry, a reference guide that reflects the lighting business landscape and its various changes.

Second, it shows that the lighting specifier, whether that person is a lighting designer or an architect, is aware of the organizational makeup of the industry and has some sense of the industry's supply chain.

Third, it allows a general contractor and the related subcontractors to bid and price a project accurately. It also helps to order and produce the correct product quantities.

In addition to the importance of accuracy when specifying products for projects, proper manufacturer citation is important when projects are submitted for publication or entered into award programs. Magazines such as ours include the manufacturers speced on a project in the project information section that accompanies articles. We rely on the supplied lists as the base from which we fact-check the manufacturer information.

Given the ever-changing landscape of the lighting industry, the issue of proper citation is something that we at ARCHITECTURAL LIGHTING have been sorting through for the past several years. You might have noticed how company references in our pages have changed and evolved. Many independent companies have become brands within larger conglomerates. In some cases, companies no longer exist.

Some have taken different approaches to their nomenclature. From the outset, Philips has followed a system where the brand follows the parent company name: Color Kinetics became Philips Color Kinetics, Lightolier became Philips Lightolier, and so on. Acuity Brands initially took the opposite approach, preferring the individual brand to be recognized before the parent—Peerless an Acuity Brands Company, for example. In the past year, however, Acuity has switched to citing the conglomerate first and then the brand—Acuity Brands/Peerless. Another of the major conglomerates, Cooper Lighting, was following a similar referencing system—parent company followed by the brand. Since their recent acquisition by Eaton, however, they are now using the style of Eaton's Cooper Lighting Business/Shaper.

Yes, it does take extra time to check and verify manufacturer information, but it's a critical part of the process—both on the editorial side as well as the specification for a design. It's in all our interest for clarity of information and purpose to make sure we are using the same "specification" vocabulary.

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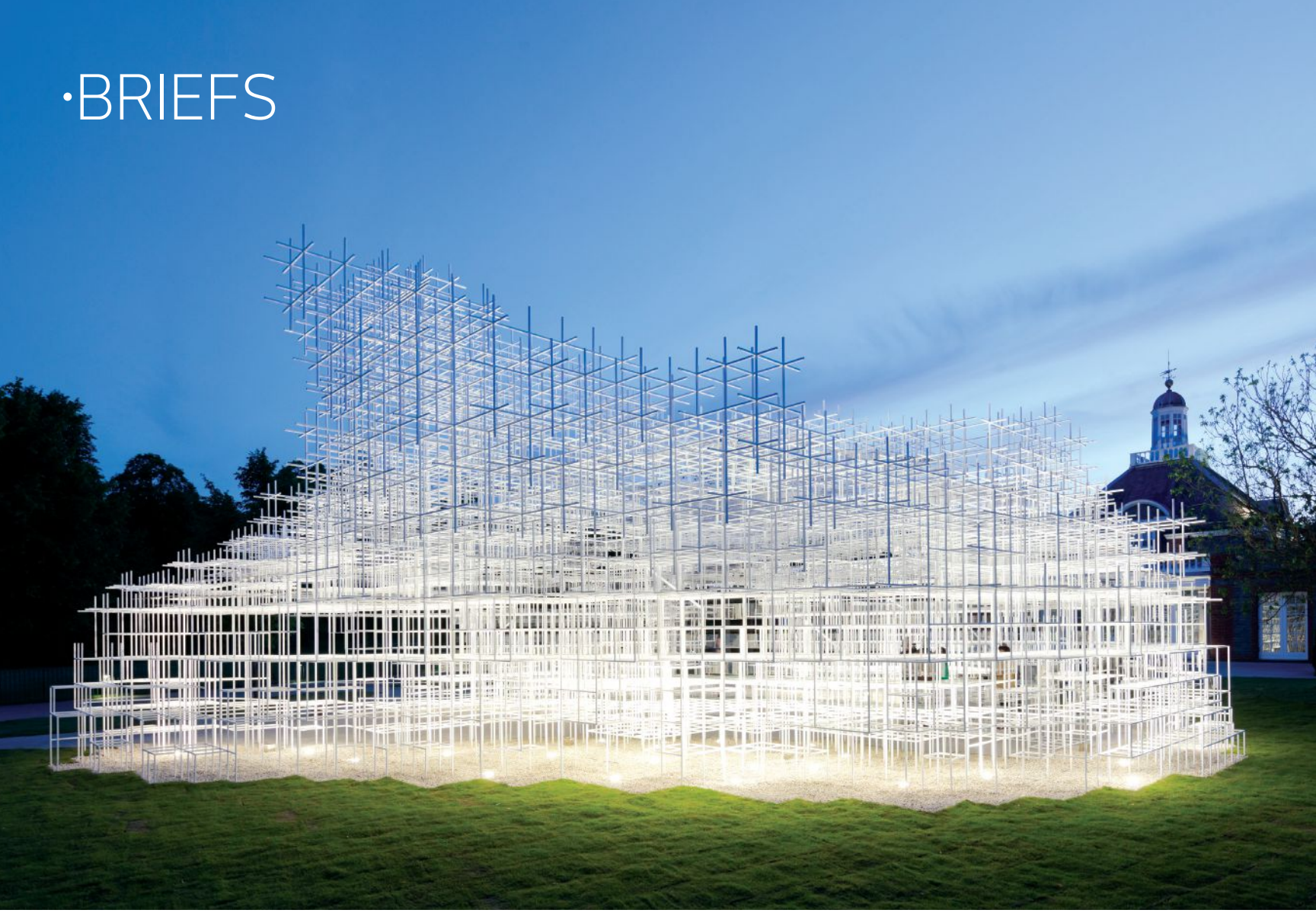

2013 SERPENTINE GALLERY PAVILION

Designed by Sou Fujimoto, the lattice structure is subtly illuminated with inground luminaires provided by Viabizzuno.

text by Elizabeth Donoff

On display through Oct. 20, this year's Serpentine Gallery Pavilion was designed by Japanese architect Sou Fujimoto. This marks the 13th occurrence of the prestigious architectural commission to design a temporary structure on the grounds of the Serpentine Gallery in Kensington Gardens in London. In addition, at 41, Fujimoto is the youngest architect to accept the challenge.

Fujimoto's pavilion is a lattice-like structure of 20mm (0.78-inch) steel poles that sit on 357 square meters (just over 1,100 square feet) on the gallery's front lawn. The lightweight and semitransparent appearance of the pavilion has an ephemeral quality as it blends against the backdrop of the sky. The installation is intended as a multipurpose social space that includes a café where visitors can relax and take in the surroundings. Said Fujimoto in a press statement: "A new form of environment has been created, where the natural and the man-made merge; not solely architectural or solely natural, but a unique meeting of the two."

During the day, natural light interacts with the structure to create a play of light and shadow that provides another layer of architectural space. At night, and to stay in tune with the pavilion's delicate look, the electric lighting is just as soft. Two fixtures—metal halide and LED inground uplights, both provided by Viabizzuno—are positioned in the gravel bed that serves as the pavilion's "floor." Aimed at the structure, the play of patterns is interpreted in this nighttime illumination. •

For more information about the Serpentine Gallery and the pavilion go to serpentinegallery.org.

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GREENBUILD LIGHTING PREVIEW

Greenbuild takes place in Philadelphia on Nov. 20–22 and three presentations on the seminar docket provide an overview of lighting issues in a green context.

text by Elizabeth Donoff

THE LIGHTING INSIDER'S LOOK AT LEED V4

Session Date and Time: Nov. 20, 2:00 p.m.
Speakers: Chad Groshart, Atelier Ten; Dane Sanders, Clanton & Associates; Glenn Heinmiller, Lam Partners; Lee Brandt, Horton Lees Brogden Lighting Design
Session Description: This presentation will identify the challenges and misunderstandings regarding lighting credits and provide tips for successful credit achievement. The significant changes and improvements made to lighting credits in LEED v4 will be explained.

Four leading lighting designers with extensive LEED project experience, and who have all participated in the LEED v4 credit-writing process, will cover each of the lighting-related categories: Light Pollution, Energy, Daylighting, and Lighting Quality. Presenters will use LEED submittal documentation and photographs of built projects to demonstrate solutions to credit challenges.

THE LIGHT STUFF: ENERGY-EFFICIENT LIGHTING FOR A HEALING ENVIRONMENT

Session Date and Time: Nov. 21, 8:00 a.m.
Speakers: Shanna Olson, KJWW Engineering Consultants; Coty Sandberg, SmithGroupJJR
Session Description: The most successful healthcare environments emerge when the architect and lighting designer work as a team to attain the energy and aesthetic goals of the client. Together they can address several different concepts, which contribute to a successful marriage of lighting and architectural design.

This presentation will feature an overview of advanced lighting and architectural design techniques as well as new technologies which, when combined, create healthy and energy-efficient lighting design. To illustrate this integrated approach, the presenters will draw on past and current LEED projects, particularly their work together on Advocate Health Care's $45 million Illinois Masonic Medical Center for Advanced Care in Chicago.

LET THERE BE DAYLIGHT: DEPLOYING ADVANCED DAYLIGHT CONTROLS

Session Date and Time: Nov. 22, 8:00 a.m.
Speakers: Adam Hinge, Sustainable Energy Partnerships; Stephen Selkowitz, Lawrence Berkeley National Laboratory; Richard Yancey, Green Light New York
Session Description: A presentation of two recent reports on advanced daylighting systems in commercial office buildings.

First, "Let There Be Daylight," published by Green Light New York in 2012, examines the potential for retrofitting NYC office space with advanced daylighting controls. The report finds that the area of NYC office space that can accommodate these controls is greater than the entire central business district of Chicago and their deployment would result in electric peak demand reduction of 160 megawatts, and more than $70 million of savings annually.

Second, "Daylighting The New York Times Building," a 2013 post-occupancy performance evaluation by Lawrence Berkeley National Laboratory assessing one of the most advanced automated daylighting systems in the country. The study finds a 24 percent reduction in annual electricity use, a 51 percent reduction in heating energy use, and a 25 percent reduction in peak-electric demand—while a significant majority of occupants indicated a high level of satisfaction with their workplace. The Times' investment in advanced energy-efficiency technologies is estimated to yield a 12 percent rate of return.

"Lighting is very important to green building design because it affects so many areas, not just the obvious—that lighting is a significant energy user—but also indoor environmental quality and light pollution on the site. Lighting involves both daylighting and electric lighting but lighting-related credits are scattered across three credit areas in the LEED rating system. Because lighting doesn't have its own 'home' in the LEED system, it doesn't get the attention it deserves."
—Glenn Heinmiller, principal, Lam Partners

Note: Seminars' schedules are subject to change. Please check onsite at Greenbuild for room locations and other scheduling updates.

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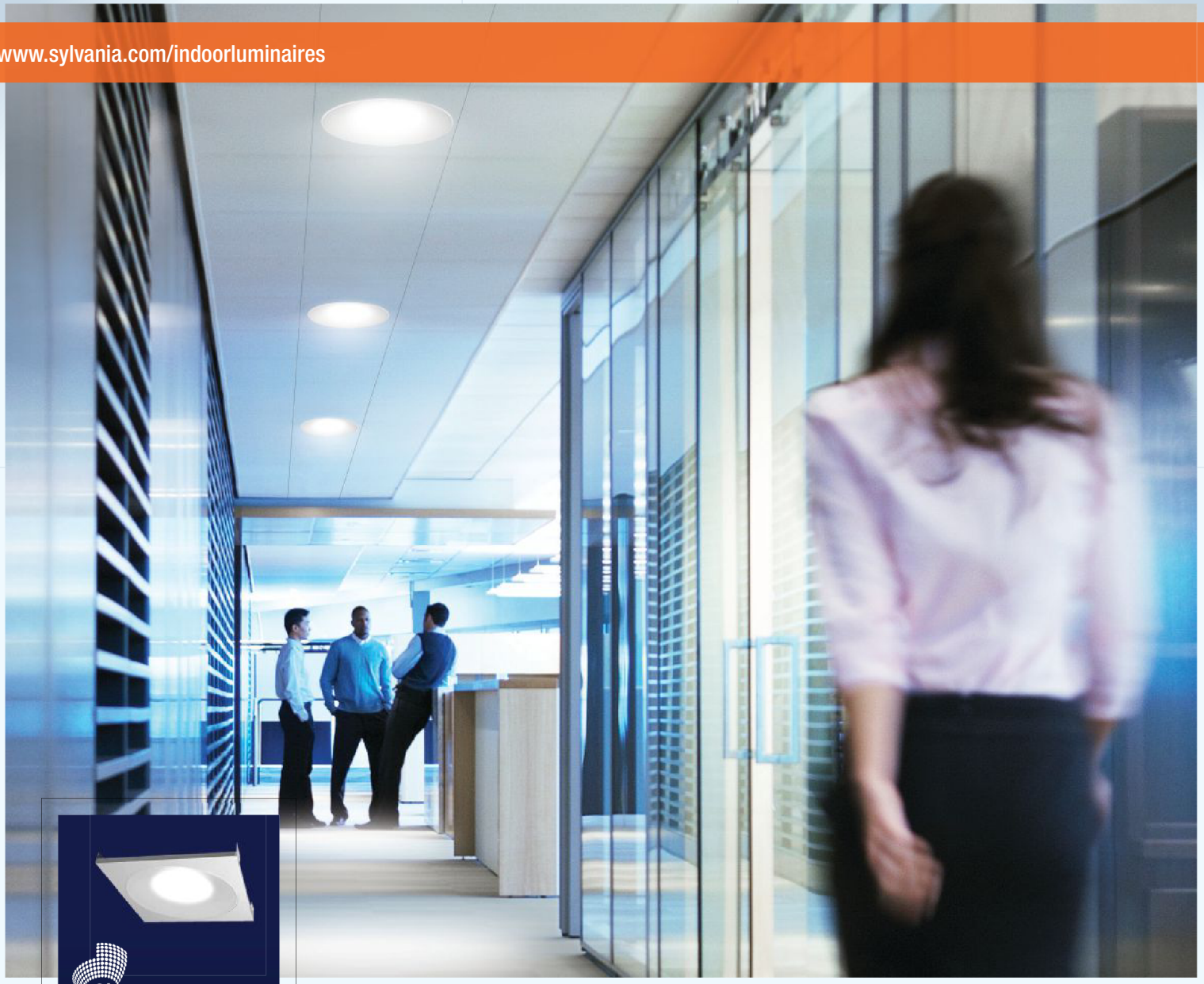

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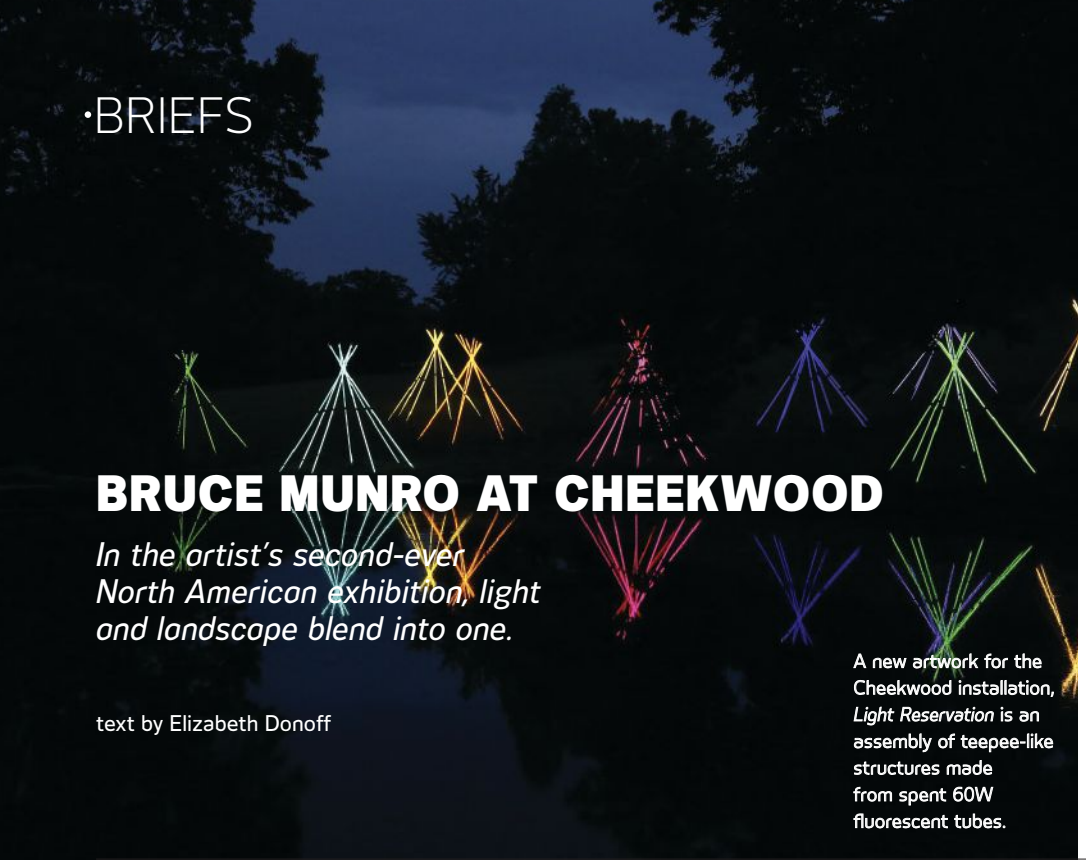

BRUCE MUNRO AT CHEEKWOOD

In the artist's second-ever North American exhibition, light and landscape blend into one.

text by Elizabeth Donoff

A new artwork for the Cheekwood installation, *Light Reservation* is an assembly of teepee-like structures made from spent 60W fluorescent tubes.

Following the success of 2012's *Light* at Longwood Gardens in Kennett Square, Pa., artist Bruce Munro has created a new work at Cheekwood Botanical Gardens & Museum of Art in Nashville, Tenn. On view through Nov. 10, the installation features four new artworks—*Light Reservation*, *Fagin's Urchins*, *Candelight*, and *Bell Chandelier*, all of which complement pieces that were part of the previous Longwood Gardens display. And those works, such as *Field of Light* and *Water Towers*, take on new life in the different setting of Cheekwood's 55 acres.

Using his signature palette of frosted glass spheres, acrylic rods, and optical fiber, along with LEDs and metal halides, Munro and his team of 10 designers, technicians, and studio staff spent 6,500 hours on the exhibit, and another 2,000 hours installing the work onsite.

"Cheekwood is the most perfect place to exhibit because it provides a variety of opportunities to respond to—each space varies in scale and topographical character," said Munro in a statement. •

For more, go to cheekwood.org.

IALD FELLOWS ANNOUNCED

Three prominent lighting designers—Katherine C. Abernathy, Janet Lennox Moyer, and Robert Shook—have been elevated to Fellowship status.

text by Elizabeth Donoff

The International Association of Lighting Designers (IALD) has announced that three of its members have achieved the designation of Fellow. They are Katherine C. Abernathy, Janet Lennox Moyer, and Robert Shook. The trio joins 33 of their fellow lighting colleagues.

The IALD Fellow designation is given to those members who have offered "valuable contribution to the art and science of lighting design, and for their continued service to the IALD." Fellows are also professional members of the association and need to have a minimum of 10 years work experience. The three recipients will be formally inducted during the organization's annual conference—IALD Enlighten Americas—in Montreal on Oct. 3–5.

"The criteria for being a Fellow is: a Professional member of the IALD and an outstanding member of the profession. Those seem to be big shoes to fill and I am honored to even have been considered. I have been very lucky to have served the IALD the past 10-plus years. It's a real honor to join all those that have taught me."
—Katherine C. Abernathy

"In all my endeavors, I always think about how I can connect with the IALD. This organization continues to represent us, and with my colleagues raising me to the membership level of Fellow, I feel continued responsibility to our young designers. I am honored and touched to join this esteemed group."
—Janet Lennox Moyer

"I find it very rewarding to change things. Too many people accept—or complain about—the status quo. Why not get involved in the solutions instead? Whenever I have been able to help a lighting designer or the field of lighting take a step forward, that's when I've felt I've accomplished something really valuable."
—Robert Shook

Top: Courtesy Cheekwood

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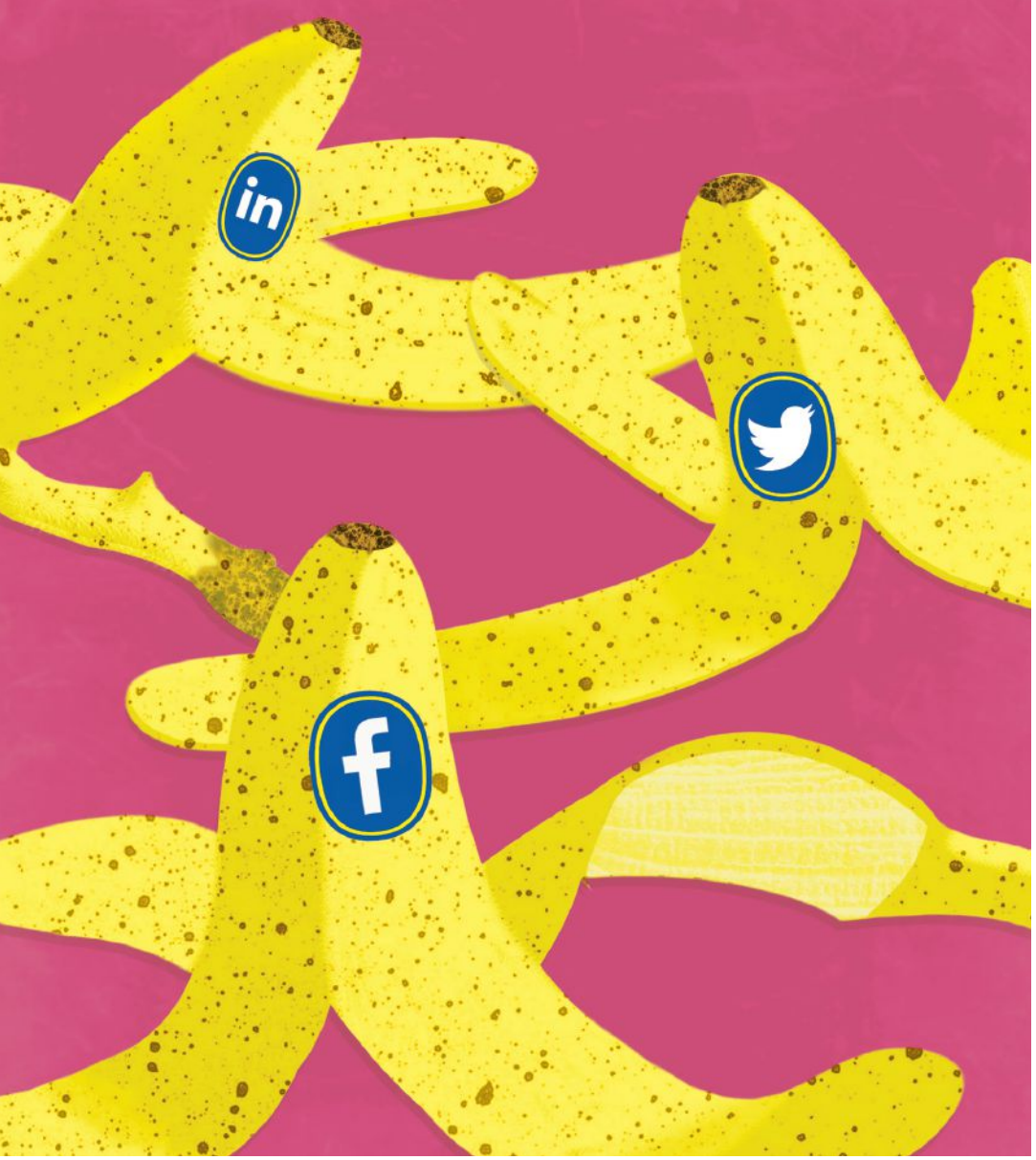

PROFESSIONAL PRACTICE

THE SOCIAL MEDIA REVOLUTION

How this ubiquitous new form of communication is changing business.

text by Peter J. Lamont
illustration by Thomas James

Peter J. Lamont is a business and commercial litigation attorney nationally recognized in a wide variety of highly specialized areas within the kitchen, bath, lighting, construction, and design industries. He routinely represents various national and international companies within the design sector, and has achieved the highest rating in both legal ability and ethical standards as awarded by AVVO (avvo.com).

What started off as a digital means of staying in touch with friends has grown into a mainstream and effective method of developing and maintaining business relationships. Today, most businesses and business people are connected through social media in some way. The proper use of social media can provide unlimited opportunities for architects, lighting designers, and design firms to generate exposure, find new leads and potential clients, and connect with existing customers.

But despite the vast opportunities that social media provides for making connections and promoting your work, it is not without its own set of challenges. The prolific use of social media in business has spawned an entirely new category of legal risks, and we'll cover some of the most prevalent ones here. The laws are developing very rapidly, and you're going to need to review them regularly.

WHAT IS SOCIAL MEDIA?

In short, the term "social media" describes any digital tool that creates and fosters interaction and discussion between people and businesses. You're well familiar with some of the most common social media forums, such as Facebook, Twitter, YouTube, LinkedIn, Google+, and Tumblr. The beauty of this form of communication is that you can reach large numbers of people immediately and inexpensively. For example, when a designer tweets about a new project, the message is immediately distributed, at no cost, to all of the businesses and individuals who follow him.

And it doesn't matter how big your company is, or where you're located. From sole practitioners to global firms, design businesses have embraced social media as a way of promoting their work, their employees, and their activities. The medium is quickly replacing traditional forms of advertising as the preferred means of attracting new business. Instead of spending thousands of dollars on producing a television commercial and paying for time to air it on a cable or satellite station, business owners are creating their own videos and publishing them for free on sites like YouTube or directly on their company's website.

But the very reasons that everyone loves social media are also the reasons that they dislike it. For one thing, social media is immediate, meaning that what you send out reaches everyone who follows you instantly. Once it's out, there is no way to really take it back, even if you delete the post in the first few seconds after launch. There have been a number of instances where companies and organizations have to engage in damage control after an employee makes an inappropriate post. One of the better known

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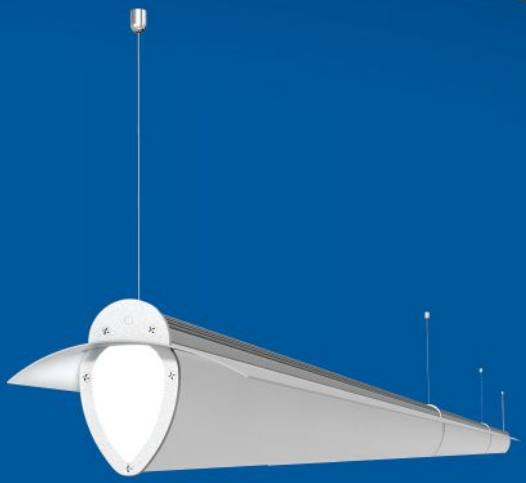

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Digital Citizenship

The immediacy of information that now exists presents a great stumbling block if not used appropriately. Etiquette and professionalism are still relevant online, but the informality of these exchanges often lead people to forget that the same rules of courtesy apply. Correct online behavior is an issue that schools are addressing through a concept called Digital Citizenship. While this is meant as a guide for students, as well as parents and teachers—particularly of elementary school children who are coming of age—the nine themes of digital citizenship below that make up "the norms of appropriate, responsible technology use" are something that all of us stand to benefit from:

1. Digital Access: Full electronic participation in society
2. Digital Commerce: Electronic buying and selling of goods
3. Digital Communication: Electronic exchange of information
4. Digital Literacy: Process of teaching, teaching about technology, and the use of technology
5. Digital Etiquette: Electronic standards of conduct or procedure
6. Digital Law: Electronic responsibility for actions and deeds
7. Digital Rights and Responsibilities: Those freedoms extended to everyone in a digital world
8. Digital Health and Wellness: Physical and psychological well-being in a digital technology world
9. Digital Security (Self-Protection): Electronic precautions to guarantee safety.

For more on Digital Citizenship go to digitalcitizenship.net.

examples was in 2011, when an American Red Cross staff member posted a tweet suggesting that they were drinking while on the job. The organization quickly posted a humorous tweet and the individual tweeted their regret, but this example does demonstrate the importance of maintaining separation between corporate and personal social media accounts. Additionally, it points out the importance of maintaining a professional voice, even if a corporate account is managed by more than one individual. Failure to properly maintain the privacy of a corporate social media account can have devastating effects on your business.

Another example of the dangers of improper use of social media was American Apparel's social media marketing campaign during Hurricane Sandy. The company offered coupons for online shopping "in case you're bored during the storm." It should go without saying that social media campaigns that are poorly worded and come across as insensitive or in poor taste can do more harm than good.

SOCIAL MEDIA AND EMPLOYEE SCREENING

As of today a number of states—including New Jersey, California, Illinois, Maryland, Michigan, and Delaware—have enacted laws that make it illegal for an employer or a hiring agent to request a job applicant's social media login information. While it may seem like common sense, prior to the enactment of these laws, some employers in these states were making the production of login information mandatory. Many states will likely pass similar laws over the next 12 months.

An employer can learn a great deal about a potential employee from their online Facebook or Twitter presence than they might during a traditional face-to-face interview. So is it illegal for an employer to Google an applicant or search Facebook for an employee? No. While it is illegal in some states and frowned upon in others to require login information, it is not illegal to conduct a regular Internet search for applicants or employees. Often, people fail to maintain adequate privacy settings and so a "snooping" employer may find photos or posts that provide greater insight into a person's character and lifestyle. But it is not illegal to look at public information.

It is illegal, however, to refuse to hire or to terminate an employee for any discriminatory reason. So, if an employer were to learn through public social media posts that an employee is pregnant or is a recovering alcoholic, it would be illegal for that employer to refuse to hire or to terminate the employment of that person.

Keep this in mind: Traditional labor laws apply to employee and applicants despite rapidly developing technologies and changes in communication formats. Social media background checks, like traditional checks, are subject to the Fair Credit Reporting Act, a federal law that protects the privacy of a consumer's credit report.

ONLINE ENDORSEMENTS AND TESTIMONIALS

These days, clients are spending more of their time looking for design resources online, so quality client testimonials can be the deciding factor in the decision to hire one designer over another. Online endorsements can also have the added benefit of improving your search rankings, which in turn should lead to more Web traffic. Nevertheless, you need to be mindful of who and what you endorse and who endorses you.

Don't be tempted to fudge a fake testimonial, no matter how difficult you may find it to ask a client for a written testimonial. The Federal Trade Commission (FTC) has written a guide concerning the use of testimonials in advertising. According to the FTC, all endorsements must be truthful and not misleading; there must be a disclaimer concerning generally expected results from using their products or services; and disclosure of any connection between the endorser and the business displaying the testimonial is required. These guidelines cover any advertising messages on any social media site. And the FTC regularly investigates claims of false testimonials and

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endorsements and is quick to assess penalties and fines. In 2011, a Tennessee company called Legacy Learning Systems and its owner were each fined $250,000 for paying people to provide online reviews and endorsements.

CONTESTS AND SWEEPSTAKES

Online contests, sweepstakes, and other offerings can be a great way to drive traffic to your website and expand your client base. Due to the potential liabilities associated with such promotions, however, designers should consult an attorney before launching any promotion.

As one example of the pitfalls with running a competition, offering a chance to win a free prize in exchange for liking your Facebook page could be considered an illegal lottery under certain state laws. This may sound outlandish, but it is a serious matter requiring legal guidance—or at least a good understanding of your state's contest laws.

Designers running online promotions have to be aware that their campaign is not only subject to the laws of each of the 50 states but also to the laws of every country in which their website appears. Therefore, it is important that any online promotion is limited in scope to a particular jurisdiction. For example, you should include a statement that your promotion is limited to your particular location, state, or country. Promotions are a very complicated legal field: There are many legal and quasi-legal areas that a designer can handle on his or her own, such as setting up a corporation

or LLC, but it is never a good idea to launch a promotional online marketing offering without first consulting with an attorney.

SOCIAL MEDIA POLICIES

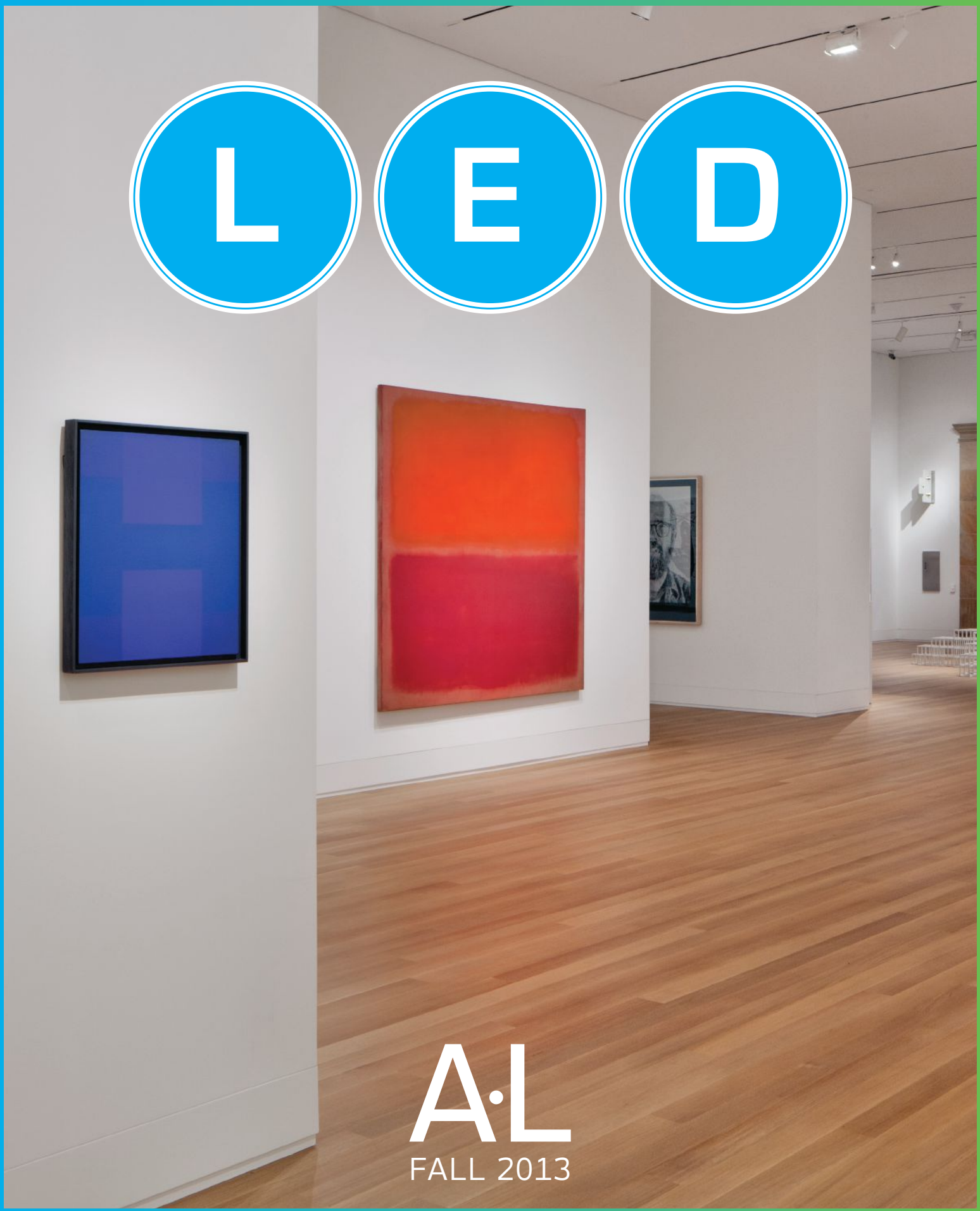
Finally, it is important for design firms and designers who have anyone working with them to have a social media policy, as it can help protect a designer's reputation and business. In addition to minimizing your liability, the policy can serve as a guideline for proper internal promotion, and it can help your employees to better understand how to promote the company online.

This policy does not need to be extensive. The key is to clearly state the prohibited activities and suggestions for the proper use of social sites. It is also important to understand state and federal laws when drafting it. For example, all social media policies should include a statement that the company does not prohibit employees from discussing the terms and conditions of their employment, including any criticism, so long as the online comments discuss the terms and conditions instead of just disparaging comments. Such a statement is important because the National Labor Relations Board has ruled numerous times in the past year that it is unlawful for an employer to terminate an employee for criticizing their working conditions on Facebook or elsewhere.

Another issue to address in your policy is the disclosure of confidential information. Recently, a design firm was bidding on a massive international construction project. The firm sent one of its top designers to Boston for a confidential meeting. Prior to the meeting, the company that was requesting the bids had made each bidder sign a strict confidentiality and nondisclosure agreement. On the train up to Boston, the designer tweeted that he was on his way to pitch his office to a large pharmaceutical company looking for lighting designers. The organization learned of the tweet prior to the designer's arrival, and they told him and his firm that they were no longer interested in entertaining bids from them.

If this firm had had a social media policy in place, the designer might have realized that confidential information should never be referenced in social media posts, regardless of how harmless it might seem. Such a policy might have prevented the loss of a major project and the business associated with it.

The integration of business and social media is here to stay. From issues surrounding privacy and security of information to etiquette and professionalism, designers must learn to manage it properly. Social media platforms can be a tremendous benefit when used correctly and a devastating and costly loss when not. •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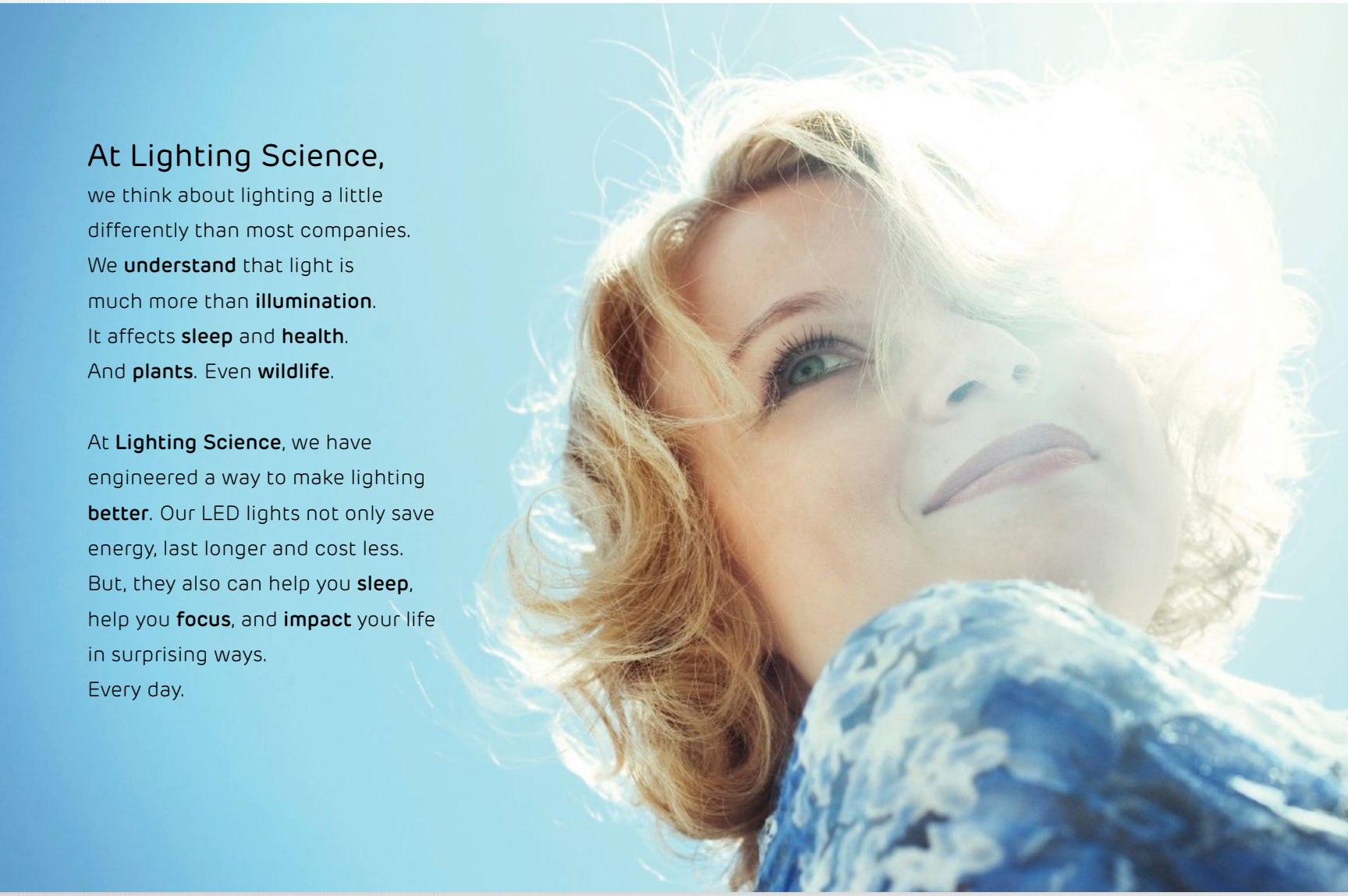
FALL 2013

WHAT'S THE MOST OUTDATED TECHNOLOGY YOU USE EVERY DAY?

Answer: Thomas Edison's light bulb – the technological innovation of the 1880s.



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LED Status Report

THE DEPARTMENT OF ENERGY'S SOLID-STATE LIGHTING PROGRAMS CONTINUE TO DRIVE PRODUCT MARKET ADAPTATION ALONG WITH SOURCE INFORMATION AND TESTING METRICS.

TEXT BY ELIZABETH DONOFF

28

The number of completed Gateway demonstration projects as part of the Department of Energy's SSL Program

20

The number of completed CALiPER rounds of LED product testing as part of the Department of Energy's SSL Program

199

The number of LED-focused R+D projects funded by the Department of Energy since 2003 as part of its SSL Program

L Prize Lumen Maintenance Testing Update

Since winning the 60W lamp category of the L Prize in August 2011, the Philips-submitted entry has been undergoing continued lumen maintenance testing. In July, the Department of Energy (DOE) issued the latest report for the lamp, which surpassed the 25,000-hour mark in April. Two hundred lamps samples are operated continuously in an environment of 45 C and tested for relative lumen and chromaticity maintenance on a lumen maintenance test apparatus.

According to the DOE's press statement, the light output of the winning entry has not altered significantly during the testing period, and the samples are operating at "greater than 100 percent of average initial output." The competition only required a minimum of 70 percent lumen maintenance at the 25,000 hour benchmark.

Another important finding during testing has been that the color remains stable. Measured against the International Commission on Illumination (CIE) 1976 color diagram, chromaticity change was less than 0.002 after 25,000 hours. This is well within the competition's stated tolerance of 0.004 at 7,000 hours of operation.

The latest report is one of the first "opportunities to confirm actual performance of a high-quality LED product at 25,000 hours." For more details about the L Prize testing process, go to lightingprize.org.

DOE Fact Sheets

As LEDs and solid-state lighting systems continue to migrate into lighting and luminaire development, questions have arisen regarding the safety of LED lighting in relation to the human eye. To respond to these queries, the DOE has issued a SSL Technology fact sheet titled *Optical Safety of LEDs*.

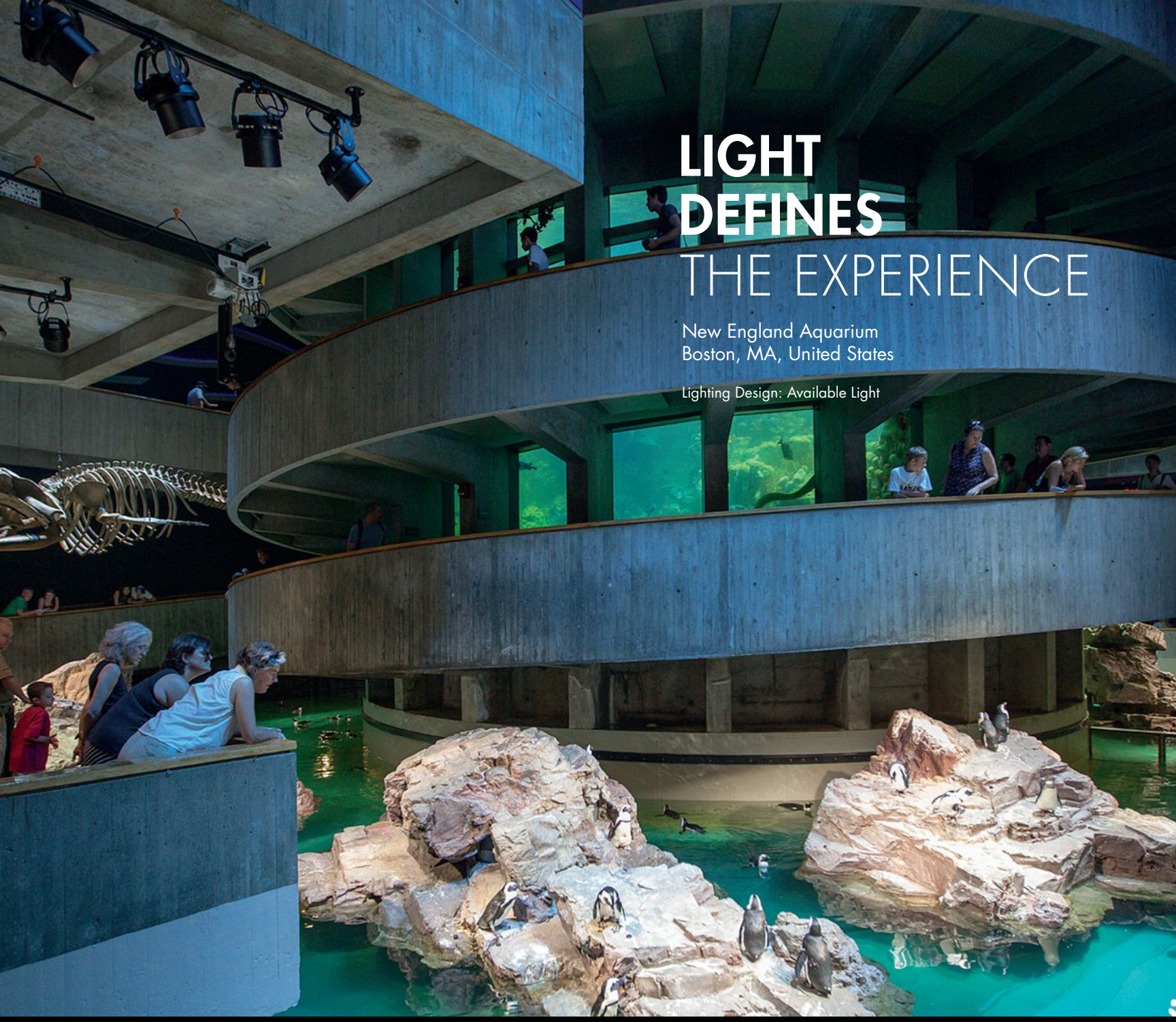
The principal optical safety concern in association with LEDs has to do with what is referred to as the "blue light hazard." Too much exposure to light in the violet and blue ranges of the light spectrum can result in photochemical damage to the eye's retina. The new fact sheet indicates that white light LEDs do not pose "any more of a blue light hazard than other types of general-purpose light sources at the same color temperature." The fact sheet along with others on LED basics, applications, and performance characteristics, can be referenced for free at ssl.energy.gov/factsheets.html.

DOE SSL Outdoor and Roadway Lighting Focus

One area in which solid-state lighting has made great strides is in the realm of outdoor and roadway lighting. High light-output along with maintenance and cost savings are some of the contributing factors that have made outdoor and roadway lighting such an appealing application-base for LEDs. To that end, the DOE has completed several case studies through its Gateway program and product testing through the CALiPER program for this lighting category.

Kansas City, Mo., and Washington, D.C., served as the two locations for the DOE's most recent Gateway reports. The Kansas City project tested nine different LED luminaires that were first installed in February 2011 as part of a replacement program for existing high-pressure sodium (HPS) fixtures. The Washington, D.C., project looked at parking garage lighting and used a parking facility at the U.S. Department of Labor headquarters as the test location. Existing HPS luminaires were replaced with LED fixtures. Gateway reports can be found at ssl.energy.gov/gatewaydemos_results.html.

The DOE's Municipal Solid-State Street Lighting Consortium (ssl.energy.gov/consortium.html) has released Version 1.0 of its Model Specification for Adaptive Control and Remote Monitoring of LED Roadway Luminaires. This document has been created to aid cities and utilities in their switch to LED streetlight systems to reduce energy and maintenance costs. An "estimated 26.5 million streetlights in the U.S. consume as much electricity each year as 1.9 million households, and generate greenhouse gas emissions equal to that produced by 2.6 million cars," said the report. The model specification, which has already been subject to a public review process, will be revised in future to reflect market changes. To download the model specification, visit ssl.energy.gov/control-specification.html. •



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DOE Revises L Prize PAR38 Competition Requirements

TEXT BY ELIZABETH DONOFF

After temporarily suspending the PAR38 reflector lamp category of the L Prize competition in January 2011, the U.S. Department of Energy (DOE) has reopened the competition and updated the requirements to be more in tune with current market conditions. The revisions incorporate feedback from lighting industry members as well as data analysis from the DOE's LED Lighting Facts program. The three main changes to the criteria in which PAR38 replacements lamps will be evaluated are:

1. A broader beam angle of up to 15 degrees will be allowed. Previously, the allowable beam angle spread was between 9 to 12 degrees.
2. The requirement for the first year's production quantity to be a minimum of 250,000 units has been omitted.
3. The requirement that the LED chips be U.S.-produced has been omitted, but final assembly of the lamp must still take place in the United States. According to the DOE, "This change reflects currently viable domestic manufacturing options and removes barriers for more U.S. companies to enter, while continuing to promote technology innovation."

The L Prize competition was established by Congress as outlined in the Energy Independence and Security Act of 2007. It officially launched in 2008 as a means of encouraging companies in their research, development, and market deliverability of high-performance, high-efficiency solid-state lighting alternatives for two of the most commonly used types of lamps: the 60W incandescent and the PAR38 halogen. The 60W category closed in August 2011—with the first L Prize going to Philips. (See "L Prize Winner Announced," AL LED Fall 2011, bit.ly/1fDD1VF.)

For full details on how to enter the L Prize PAR38 replacement lamp competition go to lightingprize.org. •

LED Lamp Recalls

LAMP RECALLS IN THE LIGHTING INDUSTRY ARE NOTHING NEW. AS TWO RECENT LED LAMP RECALLS SHOW, TECHNOLOGY HICCUPS ARE TO BE EXPECTED AND MANUFACTURERS ARE TAKING THE RESPONSIBLE STEPS TO ADDRESS THE ISSUE.

TEXT BY ELIZABETH DONOFF

In August, Philips issued a voluntary recall of certain of its Endura 12W A19 and Ambient 12.5W A19 LED dimmable lamps. The lamps in question were isolated to a global batch of 99,000 that were produced in November 2012. The company took the steps after two European customers experienced shocks during installation due to a possible improperly fit lead wire in the lamp's housing.

Philips has three A19-style LED replacement lamps on the market. The lamps in question have a yellow cap and have since been replaced with a white-capped version as the company moves away from remote phosphor technology. Full details for this recall can be found on the U.S. Consumer Product Safety Commission's website (cpsc.gov/en/Recalls/2013/Philips-Lighting-Recalls-Endura-and-Ambient-LED-Bulbs/) as well as Philips' website (publish-prod.webcms.philips.com/content/us/US-Recall/www/en/US-recall-LED-lamp.html).

Lamp recalls are nothing new. In March, Lighting Science Group issued a recall of 554,000 6W, 8W, and 9W A19, G25, and R20/PAR20 lamps that had been sold under the brand names Definity (Lighting Science Group brand), EcoSmart (Home Depot brand), Sylvania, and Westinghouse, the hazard being possible overheating leading to fire.

Full details for this recall can be found on the U.S. Consumer Product Safety Commission's website (cpsc.gov/en/Recalls/2013/LED-Light-Bulbs-Recalled-by-Lighting-Science-Group/). In both instances, the manufacturers have taken the necessary steps to address and correct the situation. •

TOP: Philips' first generation A19 LED replacement lamp
ABOVE: Philips' second generation A19 replacement lamp

Wintrust Bank, Rosemont, Illinois

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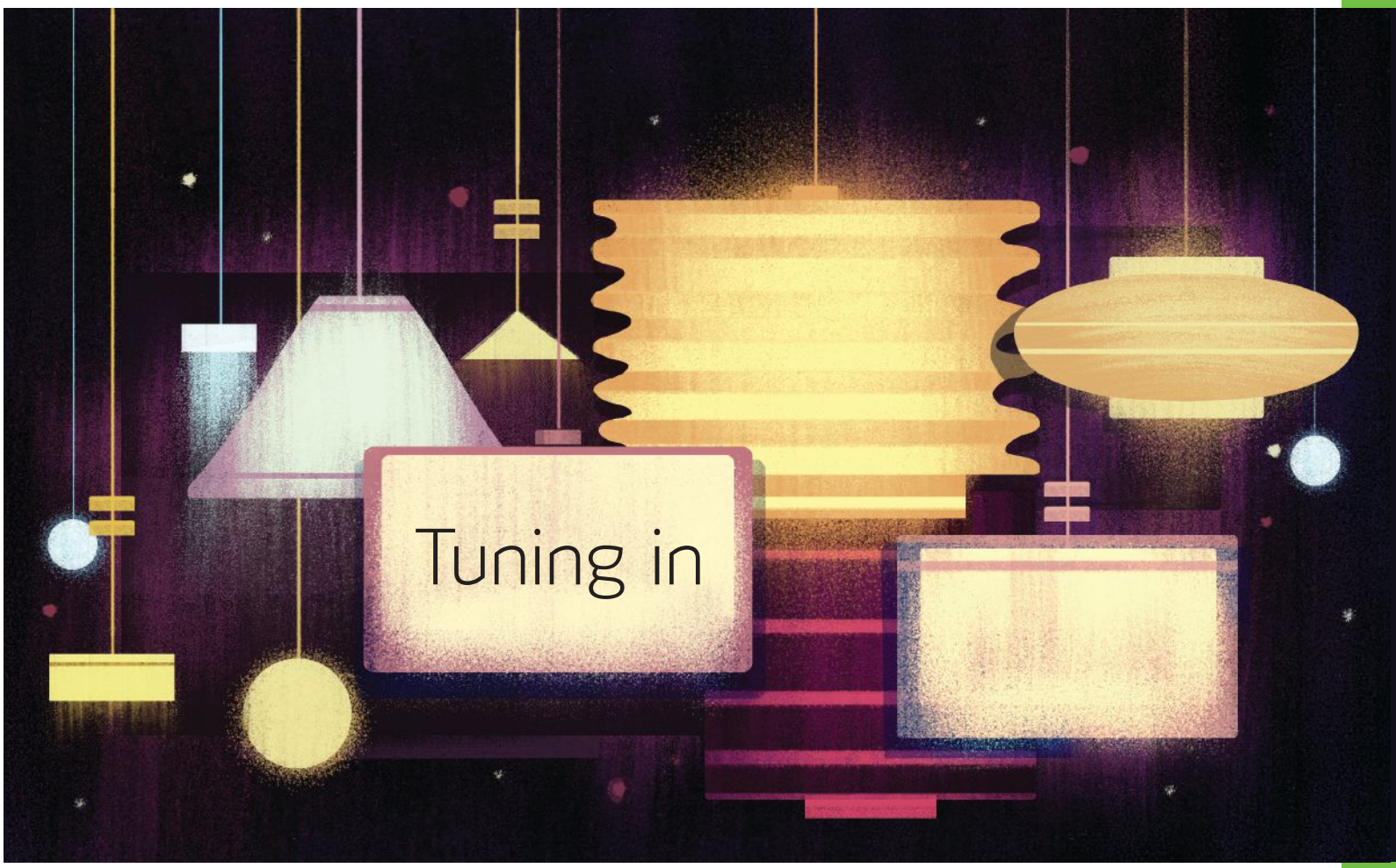

Tuning in

TECHNOLOGY • SOLID-STATE LIGHTING HAS GIVEN DESIGNERS A TECHNOLOGY THAT CAN PERFECT AN ARCHITECTURAL SPACE: TUNABLE WHITE LIGHT.

TEXT BY
BLAINE BROWNELL
ILLUSTRATION BY
ORLIN CULTURE SHOP

Experimenting with color photography in the early to mid-19th century, artist Paul Outerbridge valued the role of light in color perception. "What is color?" he asked. "No object of itself alone has color. We know that even the most brightly colored object, if taken into total darkness, loses its color. Therefore, if an object is dependent upon light for color, color must be a property of light."

This fundamental relationship between light and color is particularly relevant today given the technological advances that have enabled the unprecedented control of color temperature in solid-state lighting. Although early LED technology offered color-tuning capabilities, its color rendering index (CRI) was quite low—so LEDs were typically used for color washing or signaling purposes. Over the past several years, however, the technology has advanced significantly. In lighting applications, in particular, manufacturers are achieving acceptable white light configurations with solid-state lighting (SSL). As a result, LED applications now offer a high-quality tunable white light with precise controllability.

Early white LED light was underwhelming due to limited combinations of blue LEDs and yellow phosphors. Today, new phosphor compounds and remote phosphors yield higher CRI. Color consistency among different manufacturers' products, and even within each manufacturer's own bin groups, has been a challenge. This has necessitated the development of advanced drivers that offer firmware compensation—the ability to compensate for individual color temperature variations—due to binning discrepancies. Real-time feedback systems installed in lamps have also helped to minimize color shifting in LEDs when they are dimmed. Although new materials, drivers, and hardware enable unprecedented consistency in color temperature and intensity, lighting manufacturers must also ensure that the associated

software and hardware continue to perform over the life of the LED system and within the desired range of output.

Tunable white light is a technology that enables users to adjust the color temperature of a lamp in real time. For LEDs, users modify the correlated color temperature (CCT) and intensity of the source with an input, such as a slider control or intelligent lighting management system. The range of attainable color temperatures varies by product: a typical range may lie somewhere between 1600K and 6500K. Nevertheless, most recent manufacturer offerings provide a tunable spectrum with an effective range that covers both warm and cool temperatures.

Although tunable white light may seem a logical—perhaps even expected—capability of lamps and fixtures, it is worth taking a brief visit back through the history of lighting to comprehend how remarkable it is. Initially, the principles of white light and its relationship to color were not well understood. Isaac Newton's prism experiments, conducted from 1666 to 1672, revealed that light alone is responsible for color. Until that point, however, white light was a complete mystery.

The invention of electric light in the early 1800s led to the desire to deliver it at precise color temperatures. The scientists, engineers, and researchers who developed incandescent lighting recognized that different filament materials produced different temperatures of light. And by the mid-20th century, CRI became a metric for measuring how well a light source shows color naturally—with incandescent lamps approaching blackbodies at the top of the scale, high pressure sodium lamps at the bottom, and fluorescent lamps in between.

SSL offers a level of control that allows users a higher degree of finesse when it comes to light output. The realization of tunable white light requires the capability to tune a source's color temperature in real-time and with satisfying CRI results. Achieving this meant that SSL manufacturers had to develop both mixable LED modules and sophisticated software in order to maintain a balanced output relative to the blackbody locus, or the tunability within a perceptibly uniform color space.

A tunable white light LED system comprises the general components: a rectifier to convert AC voltage to DC, a master controller to regulate the system, LED fixtures that serve as "slaves," and communication interfaces—commonly DMX or DALI—that deliver the instructions. The master controller either requests the desired luminous output from each fixture or it must calculate and communicate the expected CCT to each LED driver independently. The master controller also runs the firmware that governs color-mixing algorithms, which compensate for color temperature and binning irregularities. The fixtures typically possess different channels of cool, neutral, and warm white diodes that are mixed within each integrated device to achieve the desired CCT.

In tunable white LED light, a user's desire for a warmer or cooler color temperature means that the lighting software has to adjust the drive current for each channel, which in turn changes the intensity of each LED within a module. This adjustment is made in a way that warm-white and cool-white LEDs are mixed in a perceptually smooth manner, according to the blackbody locus. Although this may seem simple, it does require lighting manufacturers to overcome many technical challenges.

To look at one example of this, USAI Lighting president Bonnie Littman says that her company selects the LEDs and bin mix, as well as reviews thermal management and drive-current considerations, for its tunable white LEDs. "To achieve fixture-to-fixture consistency in our tunable white Color Select product," she says, "the LEDs we select and mix must maintain stable color when dimmed at all color temperature and brightness levels and combinations." USAI requires its LED products to maintain a minimum of a two-step MacAdam ellipse—a region in the chromaticity diagram in which colors' differences are imperceptible. As a result, color consistency between diodes falls within two steps, plus or minus 50K. (For more insight from Littman, read our interview with her on page 88.)

In addition to the technology, the user interface is also critical. In developing its control interfaces, Littman says, USAI Lighting had to design "both simple user interfaces that are familiar and comfortable, such as simple room-side dimming switches, and [interfaces that are] compatible with more complex and fully automated dimming systems." In order to attain such functionality, USAI Lighting and other manufacturers have developed their own proprietary and patented algorithms and circuitry to enable consistent control over complex color changes that are user friendly.

Tunable white light also offers enormous benefits for both users and the design team, says Jeff Spencer, director of commercial product management and market development for Juno Lighting Group. "One challenge that almost all specifiers have encountered is completing a project and then having the end user say it 'feels too cool' or 'feels too warm' due to the color temperature of the light," he says. "This is a judgment that can't be made properly until the fixtures have been installed—and at that point, it is usually too late to change anything."

This is particularly important for project designs in which getting the desired color temperature is critical—such as retail settings, museums, and certain kinds of healthcare environments. A warm or cool CCT can enhance or mute particular colors of merchandise, such as supermarket produce (making it appear fresh or stale) or jewelry (by illuminating their sparkle). "Diamonds look best under cooler color temperatures, but jewelers now have a choice to set their lighting to warmer color temperatures to show certain metals or colored stones," Littman says. The design intent of a space also plays a large part, says Brian Stacy, Arup's lighting leader for the Americas. Tunable white light allows lighting consultants to "adjust the white light in an all-white surface treatment application for a truly minimalist piece of architecture," he says.

Tunable white light also guards lighting designers against unforeseen circumstances in the design and construction process. A common problem is the disconnect between the planned and executed luminous program—such as when an interior designer tells the lighting designer that they want a particular material and color palette, but later changes it to one that is no longer compatible with the specified lamp and color temperature. "A cool color temperature may be specified for a black granite boardroom table," Spencer says, "but if the interior designer changes his or her mind and goes with a dark wood, a warm color temperature may have been the more appropriate choice." In

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"THIS TUNABLE WHITE FEATURE TAKES THE RISK OUT OF NOT BEING ABLE TO COLOR MATCH THE LIGHT."

—BRIAN STACY, LIGHTING LEADER FOR THE AMERICAS, ARUP

either case, "a fixture with color tuning allows specifiers to change and adapt the delivered light color to enhance or complement the end result."

This technology can enhance a long-term maintenance strategy for LEDs. "In a period of time when a few LED downlights need to be changed because of some failures, this tunable white feature takes the risk out of not being able to color match the light," Stacy says.

Perhaps the most important advantage of tunable white light is its ability to enhance the level of human experience. For one thing, when programmed to emulate the changing colors and intensities of the natural daylighting cycle, tunable white LEDs can improve occupant mental health and productivity. "We know that students test best at 5000K but require cooler color temperatures of 6000K and higher when arriving at school to start their day," Littman says. In healthcare spaces, a tunable LED fixture could provide cool light for medical examinations and a more comfortable, warm light for the patient environment.

Examples like this hint at the broad significance that tunable white LEDs could have on the built environment, particularly as the technology evolves. Meanwhile, researchers, after many decades of study, now have enough information to make a legitimate scientific case about the influence of color temperature on human health and the effects of light on circadian rhythms. "As our understanding of color temperature and its impact on our actions, moods, and performance expands, lighting will become personalized," Littman says. "People's environments will tie into how they feel or want to feel … and the specific tasks they are performing, ultimately impacting the way people live, work, and play." •

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TEXT BY JENNIFER BICKFORD

Calculite White LED Downlight, Philips Lightolier • Calculite is an Energy Star–rated family of white LED luminaires. It represents the company's latest evolution from remote phosphor technology to white LEDs. It is available in five lumen outputs ranging from 500 to 3,500 lumens, and four color temperatures—2700K, 3000K, 3500K, and 4000K—all with a CRI of 82. Both round and square aperture sizes are available from 4" to 8" in medium- and wide-beam distributions. A 50-degree cut-off reflector reduces aperture brightness. Several reflector finishes are available as well as three flange finishes—white, flush-mount, and polished—to match the aperture. • *lightolier.com*

Vero Series LED Arrays, Bridgelux • Available in four different light-emitting surface configurations, these chip-on-board LED modules have outputs ranging from 275 to 16,400 lumens, using 9W to 81W, and an efficacy of 120 lm/W. The radial die pattern provides lumen density and beam control. Using 2SDCM and 3SDCM (Standard Color Deviation Match) MacAdam binning, the standard color temperatures include 2700K, 3000K, 3500K, 4000K, and 5000K. CRI options include 70, 80, 90, and 97, typical for the company's Décor Array Series of LEDs. A solderless connector port enables plug-and-play connectivity and field upgrades. • *bridgelux.com*

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Graft High Bay, Zumtobel • Featuring a rectangular die-cast aluminum housing, this LED High Bay has a square light distribution for more uniform illumination. Available in up to 28,000 lumens at 4000K with a CRI of 80, or at 6500K with a CRI of 70, the chromaticity tolerance between multiple luminaires is up to four MacAdam ellipse steps. Cooling fins provide thermal management and reduce dust accumulation. Both narrow-beam and wide-beam optics are offered. The fixture is sealed to meet IP65 requirements and has a white powdercoat finish. • *www.zumtobel.com*

3 Series Downlight Family, Lucifer Lighting • The 3 Series is a 3.5" die-cast LED downlight family of luminaires that includes fixed downlights, lensed wallwashers, and dual-axis, hot-aimable adjustable accents that are lockable from below. Beam optic systems are proprietary in 25, 40, or 60 degrees and are field changeable. Remote phosphor LED color temperatures include 2700K, 3000K, 3500K, and 4000K in 80-plus or 95-plus CRI. Each fixture can accommodate two additional effects devices. Available trim options include a 5.13" or a 5.56" flange overlay or zero-sightline for interior or IP64 exterior locations. Finishes include granulated powdercoat, treated metals, and plated. • *luciferlighting.com*

Quattro LED Task Desk Lamp, Sonneman • The Quattro LED desk lamp features a 6W 3000K flat-panel LED source with a CRI of 85. The task lamp has three brightness levels—100%, 60%, and 20%—all controlled by a touchless optical sensor on the fixture head. The thin, square head rotates on two axes and is attached to an articulated rectangular arm that pivots 90 degrees from the square base. Available finishes include bright satin aluminum, gloss white, black, or combo red/yellow/black. • *sonnemanawayoflight.com*

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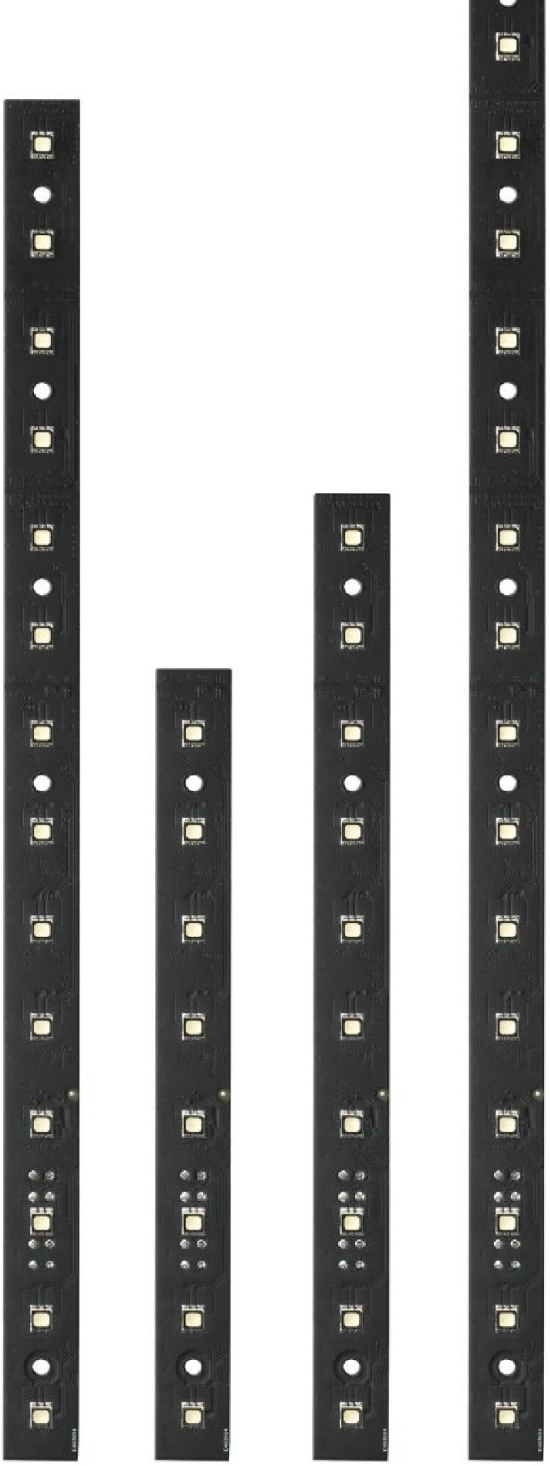
M-Modular LED Series, Selux • The M-Modular LED Series luminaires include recessed, surface, and pendant versions in three profile widths: 36mm, 60mm, or 100mm (1.41", 2.36", or 3.93", respectively). An LED gear tray system allows for easy installation, maintenance, and replacement of the LED arrays, which are offered in three color temperatures (3000K, 3500K, and 4000K) and come with either zero-to-10V or DALI dimming control. Multiple optic and lensing systems are available including a symmetrical lens, an asymmetric 20-degree wallwash lens, a microprism inlay, and an opal diffuse lens. Fixtures are specified as a linear or an L module in incremental lengths of 1.55". Finish options are white or silver and the fixture has a five-year warranty • *selux.us*

XSM Vibrant Series LED Module, Xicato • Designed specifically for use in retail and hospitality applications, the Vibrant series of LED modules is a Corrected Cold Phosphor LED module engineered to make colors and textures appear richer and more vivid. Using the XSM module form-factor, this new 45W LED delivers 3,000 lumens with an efficacy of 67 lm/W, and a lumen maintenance of 50,000 hours when driven at 1,050mA. The module is available in 3000K with a CRI greater than 80 and an R9 value of 16. • *xicato.com*

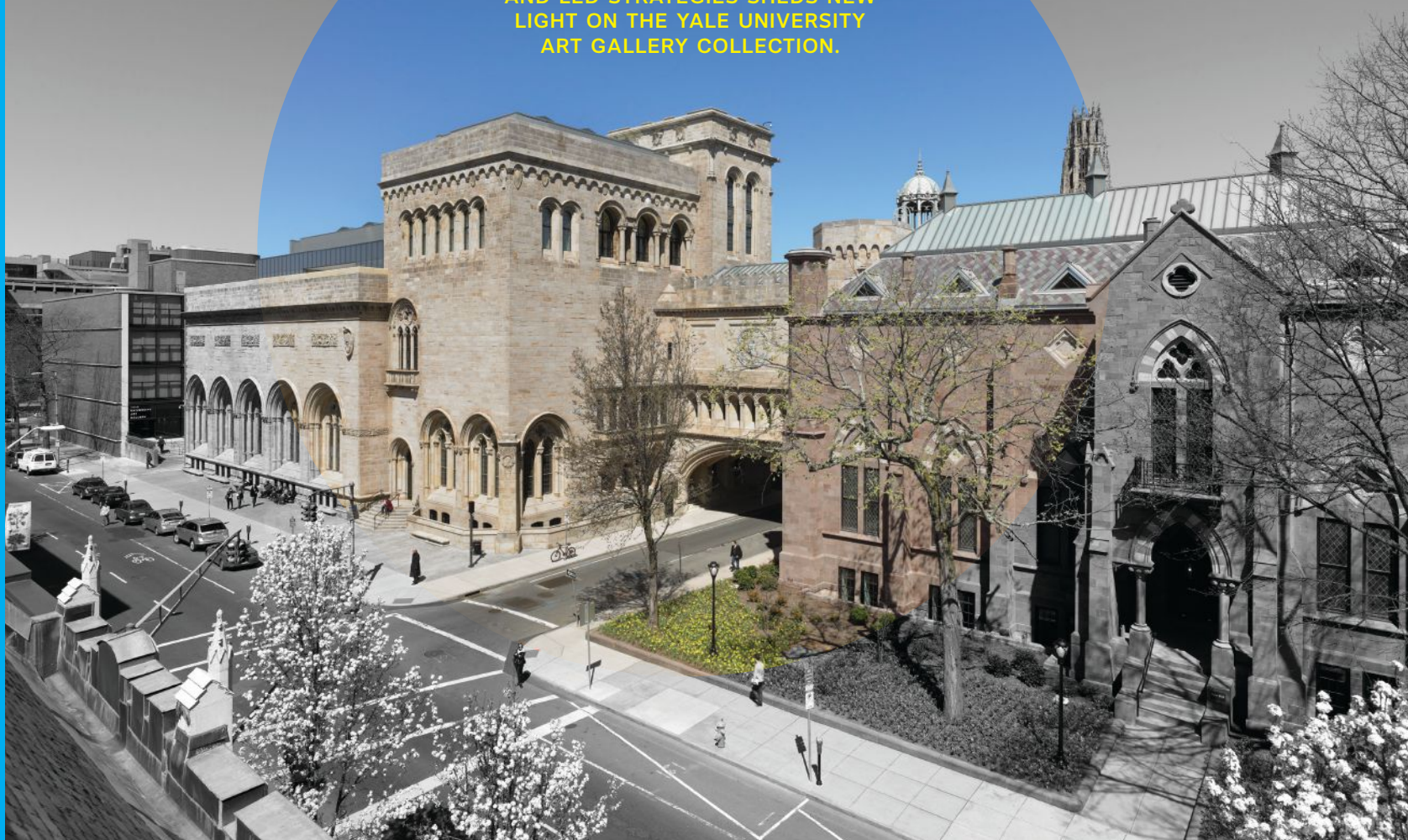
LED XSPR Streetlight, Cree • The XSP series is a family of streetlights in seven configurations that address a variety of conditions and is a replacement for low-wattage (70W) to high-wattage (400W) high pressure sodium fixtures. The XSPR (shown) is intended for residential neighborhoods and is available in 2,722 lumens at 25W or 4,109 lumens at 42W. Color temperatures include 4000K and 5700K, both with a CRI of 70. Diffuse NanoOptic Precision Delivery Grid optics are available in three distributions. The luminaire can be mounted on a 1.25" or 2" horizontal tenon and is adjustable 5 degrees. • *cree.com*



VC-Strips, Martin by Harman • VC-Strips are 0.8"-wide LED video strips designed for the integration of video using 16-bit-per-color image processing technology. Nominal 8'- or 16'-long strips come with either eight or 16 individually controllable pixels and can be cut to length onsite. Calibrated for pixel-level brightness and color, the strips are available in RGB or 2700K, 4000K, or 6500K white LEDs. Powered using Martin's P3 System Controller, or via DMX, the combined power/data allows for daisy-chaining up to 45 strips. Custom configurations are available on request. • *martin.com*

Night and Day at the Museum

A COMPLEX RESTORATION COMBINING DAYLIGHT, HALOGEN, AND LED STRATEGIES SHEDS NEW LIGHT ON THE YALE UNIVERSITY ART GALLERY COLLECTION.



TEXT BY
ELIZABETH EVITTS
DICKINSON
PHOTOS BY
ELIZABETH FELICELLA

With more than 200,000 objects in its care, the Yale University Art Gallery houses a vast permanent collection with works ranging in date from ancient times to present day. The collection has grown significantly since being founded in 1832. And today, after a $135 million renovation, the gallery finally has a structure worthy of its holdings. Or, rather, it has three structures. In December of last year, the Yale Gallery opened to the public after a massive overhaul led by New York–based Ennead Architects, which united three disparate buildings—a 1953 modernist structure by Louis Kahn; the 1928 Old Yale Art Gallery by Egerton Swartwout; and Street Hall, designed in 1866 by Peter Bonnett White—into one seamless museum. This project also marries a complex array of natural and electric lighting strategies, including a significant number of LEDs, to create a vibrant experience for visitors.

Figuring out how best to light almost 70,000 square feet of gallery space over three buildings, plus safely illuminate the more than 4,000 works that would be on display in the galleries, was the job of Steven Hefferan of Boulder, Colo.–based Hefferan Partnership Lighting Design. "It was one of the more complicated and rewarding projects I've ever worked on," Hefferan says.

The first consideration was daylight. The architectural team, led by Ennead's management partner Duncan Hazard and design partner Richard Olcott, hoped to expose some of the windows that had been covered throughout the years, to bring in light as well as views of the Yale campus. "Light was one of the motifs for the whole project," says Hazard. "These are beautiful buildings and they have beautiful windows with views, but a lot of them had been obscured by storage rooms or offices. We were determined, to the maximum extent possible, to bring those back."

This led to a healthy debate within the museum, according to Jeffrey Yoshimine, Yale's director of exhibitions. "There were those focused on audience who wanted to allow a lot of vistas and provide inviting, bright, naturally lit galleries," Yoshimine says. "On the other end of the spectrum were the conservators who wanted to preserve objects. We had to find a happy medium."

In some galleries, Hefferan says, scrims were added to knock down light levels but still allow obscured views. In other exhibit areas, it was simply about a strategic placement of artwork. "It's no coincidence that the south-facing window[ed] rooms get the Greek and Roman sculpture," Hefferan says.

Because there is a science to how much light an art object can be exposed to over the course of a year to minimize damage, Hefferan helped the staff develop an annual light exposure budget for the different gallery spaces where sensitive artworks could be exposed to light readings above conservation standards for short durations, but then black-out shades and other similar devices are employed to minimize exposure when the galleries are closed. "If the illuminance criteria is defined on an annual basis then you can allow naturally higher summer daylight light levels to balance with lower winter daylight exposure and allow for a more dynamic viewing experience that changes with weather and seasons," Hefferan says. "This is critical to allow daylit

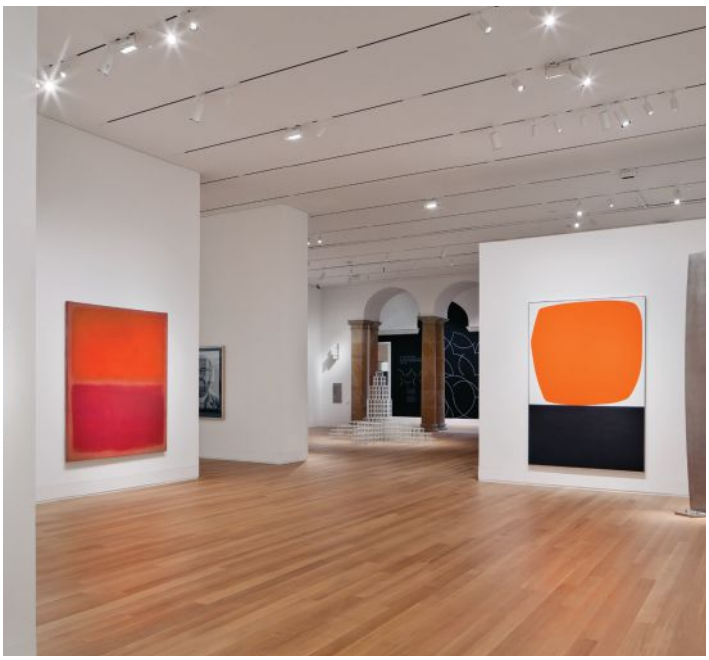
spaces to have more life and give patrons more of a connection to the outside world."

Hefferan had a myriad of electric lighting needs to tackle as well. Some of the galleries required contemporary updates to historical fixtures, while others necessitated that 21st-century lighting systems be installed in 19th-century spaces. But the biggest challenge was determining the type of light source, says Hefferan: "Do we want LED or do we want halogen? There is pressure to move to LED—it's fashionable for its efficiency and energy cost savings—but in the museum world there is hesitancy. The museum staff has been looking at these objects under halogen their entire life and LED just looks different."

Hefferan began by educating the curators, conservators, and staff from Yale's 11 different collecting departments on the nuances of LEDs, including the specifics of color temperature and color rendering. When the buildings were handed over to the museum at the beginning of 2012, they had almost a year to install the galleries and select luminaires before the grand opening. Hefferan says that the project greatly benefited from not having to specify exact track-mounted fixtures before construction, which meant that he could choose from the latest in LED technology. "Every three months, I'm amazed by what becomes possible in the LED world," he says.

Mock-ups proved a useful communication tool in working with the curatorial and conservation teams, something that Hefferan learned during his days working at the Metropolitan Museum of Art in New York. Curators like to see the art in situ with the paint color on the wall and the placards in place. The Gallery hung and displayed art in different gallery settings and let the staff experience the varying LED lamp types firsthand. Yoshimine says it changed the way the curators felt about LEDs. "The eye has been trained for so many years to accept the warm, almost yellowish characteristic of incandescent light as being the standard," he says. "What Steve was able to do was demonstrate how LED lighting showed reds to be truly red, blues to be true blue.

OPENING SPREAD: Exterior of the Yale University Art Gallery.
ABOVE: American paintings and sculpture galleries.
FACING PAGE, TOP: Ancient art sculpture hall.
FACING PAGE, BOTTOM LEFT: European art galleries.
FACING PAGE, BOTTOM RIGHT: Modern and contemporary art galleries.



He demonstrated that across the curatorial departments so that he got [a] nearly unanimous buy-in for going in the direction of LED." In the end, "the curators chose the 3000K color temperature," Hefferan says.

LEDs were also used in many of the exhibition cases and in special installations, such as for backlighting a 16-foot-tall stained glass window—*The Good Knight*—by John La Farge. Hefferan worked with the gallery's carpenters to customize a removable curtain of 54 4200K white LED light panels to go behind the window. "That would not have been possible any other way without making it either incredibly difficult to maintain or without having to provide accommodations for heat buildup," Yoshimine says.

The architects added a suite of special exhibition galleries atop the Swartwout building and the largest gallery includes an undulating ceiling made of a resin material with a large skylight. "It's great to have a skylight, but this is a special exhibition gallery, so the demands can go from 100 percent light to zero percent light depending on the show," Hazard says.

To address this, the architects added operable louvers to the skylight to darken the space. However, Hefferan says, "the curators also didn't want that ceiling to be dead in a blackout situation, so we developed an LED uplighting system to illuminate the louvers when they are closed creating a false sky effect."

Since color temperature preferences vary depending on the show, Hefferan designed a system where each curator gets to mix the color to his or her preference via an easy-to-control dimmer system in a nearby closet. The question then became: Could the entire project be outfitted in LED alone?

Hefferan had some concerns. In a gallery setting, the illumination restrictions are low, and at Yale it's just 5 to 15 footcandles for most of the objects displayed.

The trick is creating a situation where visitors can adjust to the interior light levels quickly and stay there, or else you can create what Hefferan calls the "matinee effect," where a user becomes blinded by the bright light. "A stray window or a high-glare track fixture immediately jumps you into a high [visual] adaptation [level] and then the place can look gloomy," he says. Ultimately, Hefferan and the museum staff opted for a blended approach, with a combination of 20W MR16 halogen accent lights used to highlight the art with a 25W LED source for general ambient illumination and wallwashing.

Hefferan says he can see a day when a museum could be outfitted in all LEDs, but that the industry still has some work to do. "When I give a presentation on LED lighting used in museums, my subtitle is 'A Cautionary Tale' because of the potential for glare," he says. "From my perspective, we're going to get there, but it's OK to move forward in small incremental steps." •

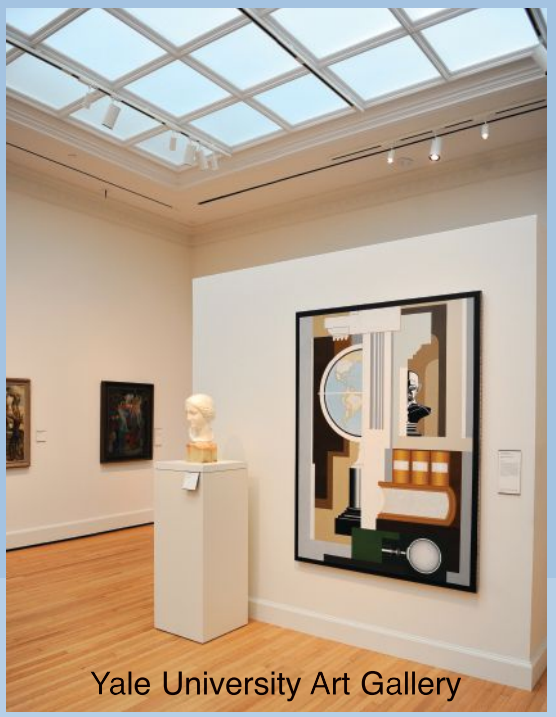
TOP LEFT: Indo-Pacific art galleries.
TOP RIGHT: Special-exhibition galleries in the Old Yale Art Gallery.

THIS PAGE:
Street Hall elevator and stair.

DETAILS

Project: Yale University Art Gallery Renovation and Expansion, New Haven, Conn. • **Client:** Yale University Art Gallery, New Haven, Conn. • **Architect:** Ennead Architects, New York • **Lighting Designer:** Hefferan Partnership Lighting Design, Boulder, Co. • **Structural Engineer:** Robert Silman Associates, New York • **M/E/P/FP Engineer:** Altieri Sebor Wieber, Norwalk, Conn. • **Civil Engineer:** BVH Integrated Services, Bloomfield, Conn. • **Preservation Consultant:** Building Conservation Associates, New York • **Landscape Architect:** Towers | Golde Landscape Architects, New Haven, Conn. • **Exterior Envelope:** Simpson Gumpertz & Heger, New York • **Construction Manager:** Dimeo Construction, New Haven, Conn. • **Project Size:** 159,000 square feet (Kahn building: 62,000 gross square feet; Old Yale Art Gallery and Street Hall: 97,000 gross square feet) • **Project Cost:** $135 million (Kahn building construction and reinstallation: $44 million; Old Yale Art Gallery and Street Hall construction and reinstallation: $91 million) • **Lighting Cost:** Not available • **Code Compliance:** IECC 2003 and 90.1-2001 • **Watts per Square Foot:** Most of the gallery space has a lighting power density (LPD) that varies with the collections displayed. On average though, the exhibit lighting in the galleries—a combination of LED wallwashers and halogen accent lighting—came in at 1.1W for the initial installation. • **Manufacturers/Applications:** **Bega** (18W CFL steplight at main staircase); **B-K Lighting** (20W MR16 halogen adjustable burial accent lighting at sculpture terrace); **Eaton's Cooper Lighting Business/Iο Lighting** (3000K high-output LED wall grazer at main staircase); **Focal Point** (recessed adjustable accent light and wallwashers in elevator vestibules and gallery-adjacent corridors; 4' T5HO linear fluorescent slots in restrooms; and 4' T5HO fluorescent wallwashers in administrative offices); **Lighting Services Inc** (museum-grade tracklighting systems—surface, pendant, and flangeless profiles—with 2044 series LED—25W, 3000K—and CX16 series 20W MR16 halogen trackheads in the galleries); **Nulux** (recessed multilamp adjustable accent 20W MR16 luminaires in period rooms); **Philips Color Kinetics** (alternating rows of 2700K and 4000K white LED striplights—QLX Series—above translucent ceiling in special exhibition gallery); **Rambusch Lighting** (restoration and replication of historic decorative fixtures throughout the project using LED retrofit and CFL lamps); **Xicato** (Artists Series LED modules for gallery tracklighting); **Zumtobel** (recessed 4' T8 fluorescent fixtures—ML Series—in offices)

clean impact



Yale University Art Gallery

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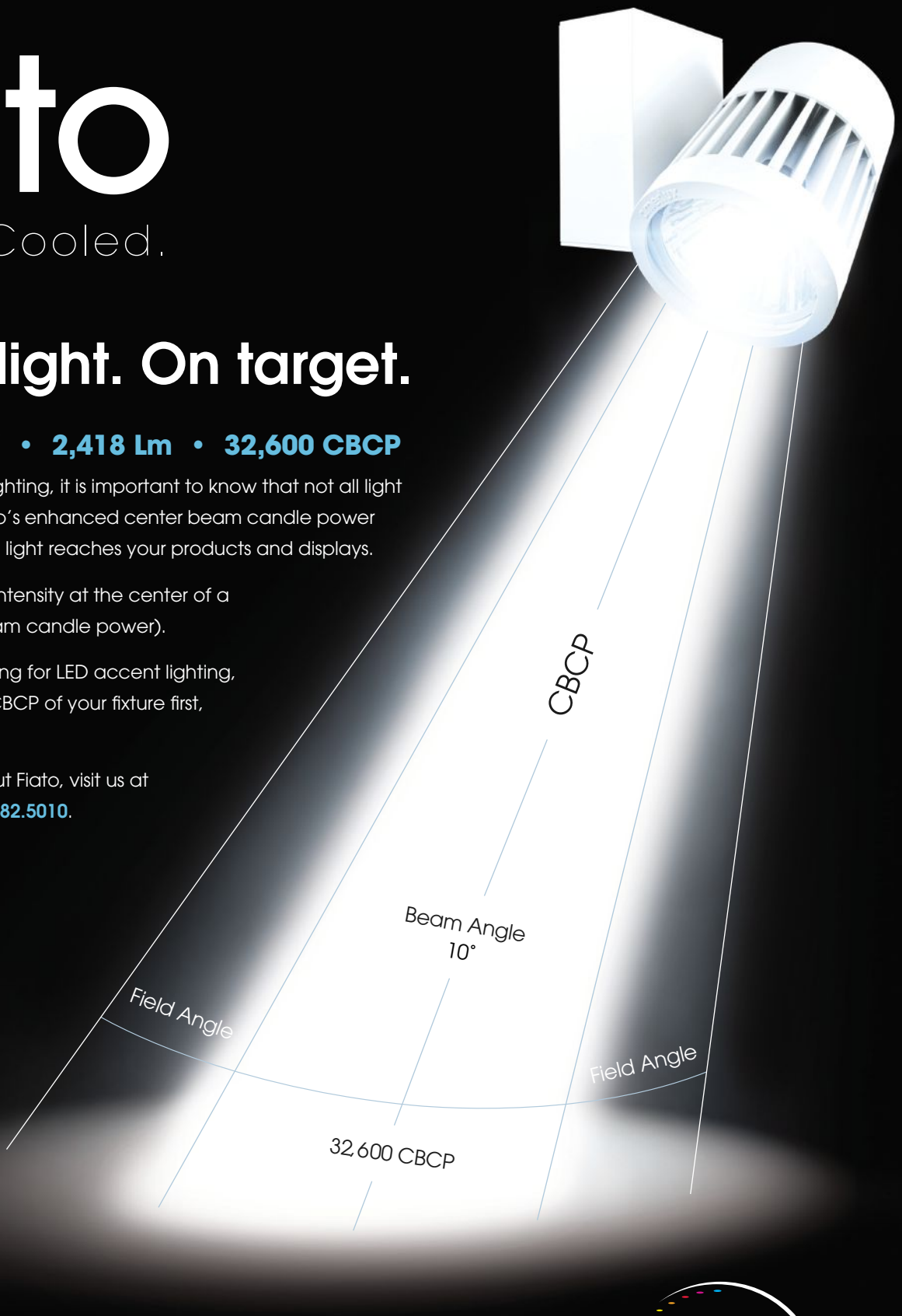

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Gerard Harbers

INTERVIEW BY ELIZABETH DONOFF
PHOTO BY MATHEW SCOTT

Like many in the lighting industry, Gerard Harbers didn't intentionally pursue a career in lighting. It found him. Trained as an optical engineer in the Netherlands, Harbers was working in the field of optical testing and recording for CDs. In 1996, an opportunity to join Philips Lighting presented itself as the company was getting into solid-state lighting. In 2000, he joined Philips Lumileds, and that move eventually brought him to the United States. Frustrated by the color quality of LEDs he was seeing, he co-founded Xicato with Menko Deroos and Mark Pugh in 2007. In turn, the company has created what many in the industry consider the "gold standard" for LED color.

What fascinates you about light?
Light is all about the lit effect and how that affects people, how you can enjoy a space.

Is there a text that has had an impact on your thinking about light and lighting technologies?
Geoffrey Moore's *Crossing the Chasm* (HarperBusiness, 2006). There's a huge paradigm shift right now from analog to digital lighting and that's exactly what this book discusses—how to deal with these disruptive technologies in the market.

What makes a great luminaire?
It goes back to the lit effect. It needs to be able to provide great color, have good beam control, so there is uniformity and contrast of surface textures without creating glare. It also has to look good, be reliable, and be easy to install.

What makes one product successful in the marketplace and not others?
It's something Moore speaks about in his book. There are two types of customers: early adopters and those who are a bit more conservative. At some point you have to make the switch from selling a specific technology to selling the quality and value of a product. It's about having the consumer be excited about the product and serving as your "sales force."

How do you define innovation?
Creating something new with a clear purpose.

What are some untapped areas in which lighting still has room to grow?
Understanding the human visual system and lighting control systems.

How does Xicato build on its success as it continues to evolve as a company?
It's all about having a great team. Our goal is to serve the industry with reliable products that provide good color. •

"There is the semiconductor industry and there is the lighting industry. The semiconductor industry is really focused on components and optimizing their efficacy and power consumption. But that shouldn't be a lighting designer's focus. They should be looking at the overall luminaire and what that equipment will allow them to do in terms of creating effects."

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- Integral Electronic Driver
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- 50,000 Hour Life
- Integral Electronic Driver
- Dimmable

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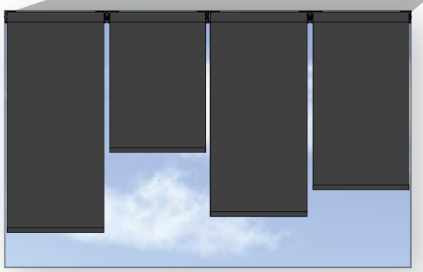
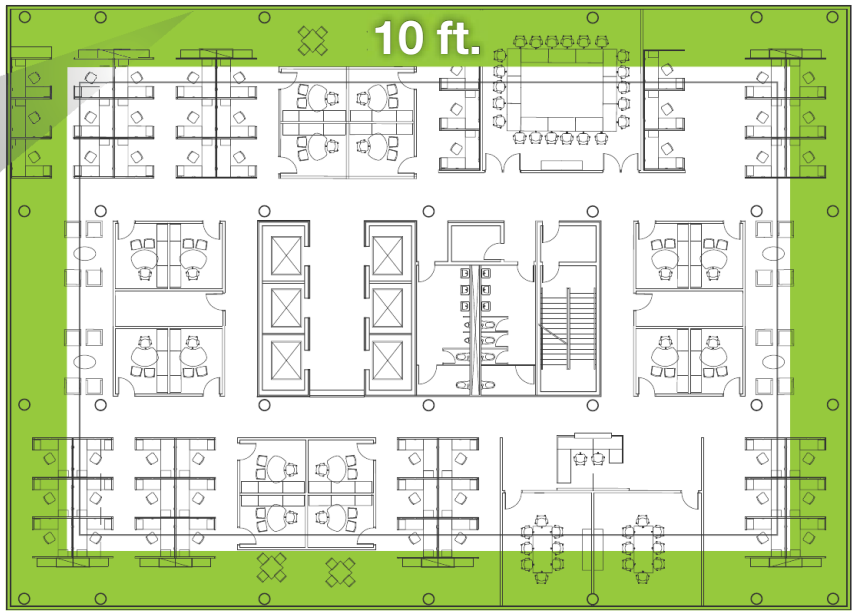
Manual shades provide a useful daylight zone up to only **10 ft.**



Manual shades are rarely adjusted and usually misaligned.



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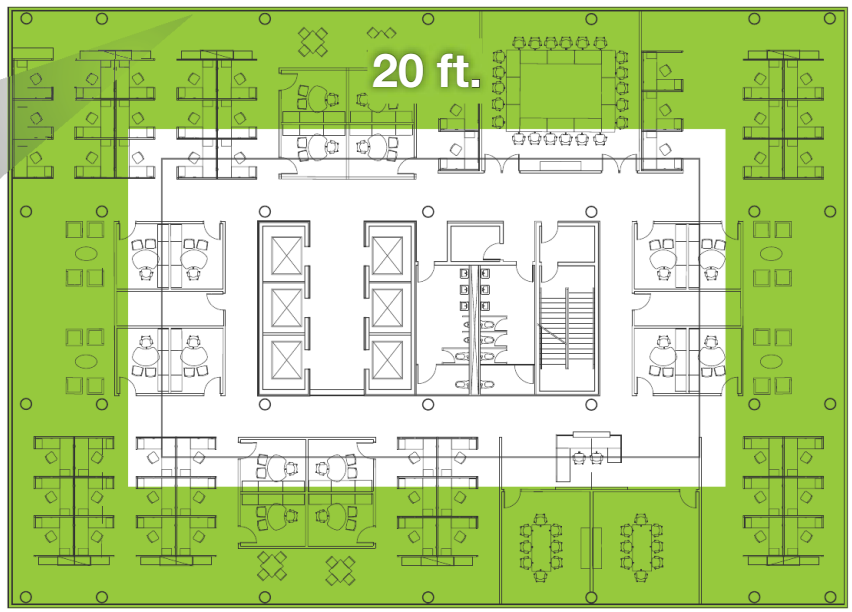

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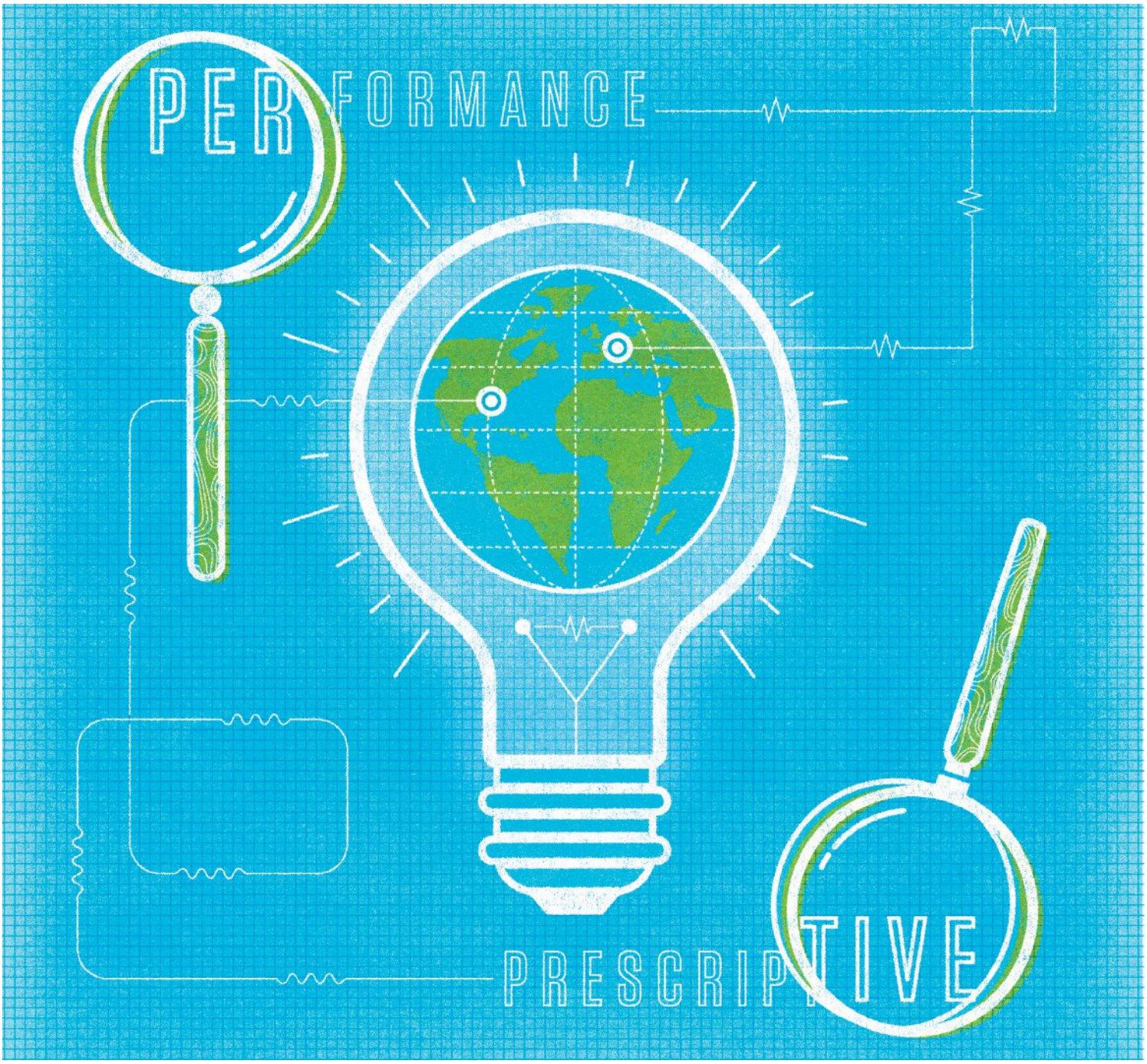
* Lutron Electronics Co., Inc. worked with Purdue University to analyze the benefits and savings potential of Lutron's Hyperion automated shading systems. The results showed the impact of how automated shades significantly reduce annual lighting energy usage. Savings are based on energy simulation of a perimeter private office with a lighting power density of 0.9 W/ft², a standard clear double pane glass, and a shade fabric with 5% transmittance and a 76% reflectance. Manual shades were simulated by closed shades. Values shown are the average of three window to wall ratios: 20%, 40%, and 60%. Daylight harvesting system required.



REPORT

THE ATLANTIC DIVIDE

When it comes to energy codes in the U.S., jurisdictions prescribe specific design and construction practices. Europeans tend to set broad benchmarks, implement post-occupancy enforcement, and let technical advances flourish.

text by Bill Millard
illustration by Headcase

Although architects who have practiced in both the United States and overseas often delegate compliance with energy codes to engineers, lighting designers, and other specialists, these regulations can be major determinants of design. Professionals familiar with the various code systems find that they differ enough, both over time and among legal jurisdictions, that it behooves all members of a design and construction team to become familiar with applicable codes, overcome compartmentalization, and coordinate

compliance. Despite lax or uneven enforcement in some places, energy codes are the indispensable stick accompanying efficiency-incentive carrots, and they have been evolving toward ever-greater stringency.

Energy codes all share the goal of improving performance in lighting, mechanical systems, and other building components. They came about during the 1970s and 1980s after the Organization of the Petroleum Exporting Countries (OPEC) convulsed energy prices worldwide, a series of events that coincided with increased environmental awareness in the industrialized West. Variation in public-sector priorities and in attitudes toward regulation means that different standards have taken on the force of law in different locations. The multiplicity of applicable codes, administered at the state or local level in the U.S. and the national level in Europe (under European Commission oversight), can be confusing even for seasoned firms.

While all energy codes have grown tougher in recent years, what they emphasize and how they are implemented differ on the two sides of the Atlantic. "American codes are typically developed for, and enforced by, building code officials," says Jack Bailey, partner at One Lux Studio in New York, "and building code officials have a longstanding tradition of not interfering with operations after the certificate of occupancy is issued. So in America, our codes tend to be focused almost exclusively on design and construction of buildings, and then take a very hands-off approach for how the building's going to be operated." (New York City's Department of Buildings, he notes, is a rare exception in this regard—with its regular inspections, audits, and retro-commissioning; application of Greener, Greater Buildings Plan standards to existing structures; and public reporting of large buildings' Energy Star scores.)

The European approach—which Bailey and others see as more progressive and effective, though more difficult to comply with—focuses on measured building performance. (This system is also used by Australia.) In Europe, buildings are assigned an overall annual allotment of energy use, but officials are agnostic about how the efficient use of energy is achieved, and tradeoffs among different components are common. Post-occupancy enforcement mechanisms also hold facility managers accountable.

Some European nations, influenced in part by wartime experiences, instituted energy codes well ahead of the OPEC crisis: Denmark, for example, first incorporated energy-consumption limits into building codes in 1961. In addition, the term "energy codes" carries a broader meaning in Europe, says code-compliance specialist Ryan Meres of the Institute for Market Transformation, including policies on energy rating and disclosure as well as specific building regulations.

Other countries, Bailey says, copy either the American or the European system—more often the former, since post-occupancy enforcement requires "a much more evolved legal tradition" that is not always available worldwide in some cases even for life safety, let alone energy. Having worked on buildings in the Middle East, Southeast Asia, Europe, and the U.S., and having helped to devise the daylighting component of the new International Green Construction Code (IgCC), Bailey recognizes that post-occupancy evaluation "comes with monstrous complexities for everybody involved," but regards it as the most responsible approach when feasible.

Lighting power density limits have "come down, down, down" over the past decade, Glenn Heinmiller says, while mandates for occupancy sensors and daylight-response controls have increased.

U.S. CODES: OVERLAPS, RESISTANCE, AND LEAPFROGGING

The older of the two main code systems in use in the U.S. was developed by ASHRAE, formerly known as the American Society of Heating, Refrigeration, and Air-Conditioning Engineers, in conjunction with the Illuminating Engineering Society of North America (IES), and published originally in 1975. The updated American National Standards Institute (ANSI)/ASHRAE/IES Standard 90.1, started in 2001 and updated every three years since then, addresses specific performance metrics in three main areas: building envelope, mechanical systems, and lighting. But those sectors don't really "talk" to each other that much says Glenn Heinmiller, principal at Cambridge, Mass.–based Lam Partners and chair of the Energy and Sustainability Committee of the International Association of Lighting Designers (IALD).

Expert committees base the standards on models of energy use by minimally code-compliant buildings prototyped at Pacific Northwest National Laboratory, determining ways to increase efficiencies in each area. Lighting standards are based on lighting power density, a budget for wattage per square foot based on building type, with additional requirements for automatic controls such as occupancy sensors for certain uses. The lighting power density limits have "come down, down, down" over the past decade, Heinmiller says, while mandates for occupancy sensors and daylight-response controls have increased.

The 2009 version of the International Energy Conservation Code (IECC) is the most commonly adopted system in the U.S. and covers about 80 percent of the nation's population. Modified continuously on three-year cycles, similar to the ANSI/ASHRAE/IES standard 90.1, the IECC is a relative newcomer. It is regarded as easier to apply, and

interchangeable with 90.1 if a building team considers the more complex code appropriate. (Since IECC 2009, however, this option must be implemented across an entire building's systems, not mixed system-by-system if lighting designers and mechanical engineers disagree.) Meres says that IECC 2009 was a major milestone in several regards: It was the first iteration to address residential lighting (requiring 50 percent of lamps in permanent fixtures to meet high-efficiency specifications) and it has been a strong driver of lighting upgrades in retrofits, assisted by American Recovery and Reinvestment Act funding for improvements to government buildings.

Because codes are implemented at the state level or, in home-rule states, at the local level, the legal conditions applicable to any new building can be complex. Municipalities are often allowed to develop their own code or to add specific requirements that are more stringent than the state's adopted code. Heinmiller emphasizes the distinction between national standards (including voluntary programs like LEED and Energy Star) and local codes; knowing which code is in effect in a project's jurisdiction is essential, he says. "A lot of times people hear, 'Oh, 90.1-2010 came out, so that's the new energy code.' Well, it's the new model, but it isn't code until somebody adopts it."

As updated in September on the U.S. Department of Energy (DOE) online map (energycodes.gov/adoption/states), commercial construction codes in 34 states and territories use the 2007 version of 90.1 or IECC 2009, both of which were regarded as game-changers. A few states adhere to different-generation codes, older or newer. "Some states have no statewide energy code at all," Heinmiller adds, "even though technically the federal law requires [them] to adopt an energy code of a certain stringency. There's no enforcement mechanism for [the] DOE to make the states do that, so some states just don't." For commercial buildings, these states are Alaska, Arizona, Wyoming, South Dakota, Kansas, Missouri, and Maine, as well as the U.S. territory of American Samoa, with Mississippi added to the list for residential buildings. Jurisdictions that are without codes tend to be those where most of the construction is smaller single-family residential, or where little construction occurs.

California, where per capita energy use has remained flat for a decade, has long regarded prevailing nationwide norms as inadequate. The state has its own code, the influential Title 24, along with the nation's highest-developed industry of energy modelers and other compliance professionals. Massachusetts offers an optional "stretch code," which is a municipal overlay of higher efficiency standards (about 20 percent better than the IECC 2009) covering new residential buildings and many new commercial ones in about 185 of the commonwealth's 300-odd towns and cities. Firms working in Massachusetts need to know whether a project is sited in a stretch-code town.

Replacing this patchwork with a uniform national code would simplify matters greatly, but Heinmiller regards this as a political impossibility, given the philosophical contrasts between environmentally progressive leadership in some areas and "don't tread on me" attitudes toward regulation in others. "If you overlaid the red state/blue state map on top" of the DOE's map of state code adoption, One Lux Studio's Jack Bailey says, "there's probably a pretty high correlation."

This situation may change as new standards emerge, if some states leapfrog from older versions (or none) to newer ones. Where municipal codes are more advanced, state-level adoption of a new version would render them moot. This may happen to New York City's code, Bailey says, after New York State updates its code at the end of this year (it is projected to adopt IECC 2012), unless the city upgrades its code again after the mayoral turnover.

The prescriptive nature of U.S. codes, Meres says, is both a strength and a limitation. In locations where most construction is residential or small-scale commercial and architects are often not even involved, "a general contractor can very easily read the code, understand the prescriptive provision, install what it tells you to install, and be in compliance," Meres says. "There is an argument for the simplicity on the prescriptive path, but I think that simplicity can deter innovation"—though codes, too, sometimes restrict use of new technologies. Manufacturers may improve products' performance for the sake of above-code options such as LEED, Energy Star, or the Home Energy Rating System (HERS), but those programs' relatively small market share means that the mass market has little incentive to go beyond requirements. "On the residential side, I've heard that about 40 percent of new homes get a HERS rating," Meres says; the proportion of commercial construction meeting LEED standards is lower.

The periodic IECC revisions, Meres adds, are "quite frankly a crapshoot," since they attract immense lobbying by commercial interest groups, which "can tweak those numbers to what they think is right, whether they've done the analysis or not. … With the prescriptive requirement, they can predict what products they need to make and what they're going to sell, based on the states that adopt it. When you

Because codes are implemented at the state level or, in home-rule states, at the local level, the legal conditions applicable to any new building can be complex. Municipalities are often allowed to develop their own code or to add specific requirements more stringent than the state's adopted code.

"If you look at the London market for office space [and at] rental values, it's only the office space that meets the German rules that attracts the premium rent," Peter Raynham says. "You can't see a law firm wanting to let their senior lawyer be more than 15 meters from a window."

have a building-level requirement that sets an EUI [energy use intensity] or some other energy target, they have no idea; they just need to make a good product, and hope that builders are going to buy it and architects are going to specify it."

His European colleagues find the IECC system puzzling, and Meres describes it diplomatically as "uniquely American."

EUROPEAN CODES: PERFORMANCE-BASED AND STANDARDIZED, YET FLEXIBLE

In the European Union, which is a free-trade zone as much as it is a political entity, the regulatory approach leans more toward consistency, says Peter Raynham, senior lecturer at the Bartlett School of Graduate Studies, University College London. "National standards which don't follow the European standards are regarded as non-tariff barriers to trade," Raynham says, "so they start to get removed." The European Commission's 2010 Energy Performance of Buildings directive requires each member nation to have a national method for calculating a building's energy performance, such as Part L of the Building Regulations for England and Wales and equivalents in other areas, and each nation has to upgrade this method every five years.

"The very lazy nations," Raynham says, adopt the continent-wide calculation format of the European Committee for Standardization (or CEN, which is short for Comité Européen de Normalisation). Lighting is covered in CEN EN 12464-1. "What they do in the U.K. and a lot of other places," he says, "is, you assess the energy that's going to be used in your building, and then you rerun the calculation inside the calculation model, using a notional building," which the real building must outperform.

The approach is more *dirigiste*, but commentators note that by focusing on building-level metrics and refraining from prescriptive norms on specific components, it also allows a designer flexibility in meeting the energy threshold. As long as a building's overall EUI per unit area is within the limits for the building type, regulators are largely indifferent about how it gets there. Raynham does note that the U.K.'s energy-certificate system has "backstop values for each subsystem" and A-through-F letter grades for both subsystems and the building as a whole. A building with a need for high light levels can compensate by having a higher-performing building shell or HVAC system. "Overall, in the EU, energy efficiency is more culturally expected," Meres says. "It's very much dictated from the top down, and I think some of their lighting innovations have come about just because it's more culturally accepted, and others because they're not held strictly to a lumens-per-watt [standard] or lighting power density, like we are under the U.S. prescriptive codes."

The Simplified Building Energy Model (SBEM), which is a software tool developed by the Building Research Establishment in the U.K., calculates CO_2 emission equivalents for new buildings and it assists in compliance with Part L. Other nations are implementing their own version or equivalent. "If you get a bunch of building engineers together," Raynham says, "the one thing they're going to complain most about is SBEM and how it's useless." Nevertheless, software-based performance analysis is advancing on both sides of the Atlantic. Meres has heard from code officials in California and Florida that 90 to 95 percent of new buildings in those two states are being built according to a European-style performance path, in part because user-friendly performance software has become available.

Germany's legal requirements for office workers' access to daylight have had an influence extending beyond their legal reach, affecting the wider design realm. Building envelopes meeting these standards tend to have ample fenestration, limited depth, and very large floor-to-ceiling heights—typically 4 meters (13.1 feet), compared with the 2.7-meter (8.85-foot) norm in the U.K. and comparable heights in the U.S. "If you look at the London market for office space [and at] rental values, it's only the office space that meets the German rules that attracts the premium rent," Raynham says. "You can't see a law firm wanting to let their senior lawyer be more than 15 meters from a window. So they're not as daft as they say." (Bailey says that different nations have approached daylight regulations as a matter of protecting workers' rights, as in Germany and other continental nations, or of property owners' rights, as in the U.K. or Japan.)

Raynham, appointed by the British Standards Institution, currently leads a CEN working group (composed of lighting designers, engineers, academics, public officials, industry representatives, and trade-association representatives, with active members from 13 nations, who are developing a European standard for daylight performance that will define good working conditions, including certain amounts of daylight, views, and freedom from glare. These regulations are being written to be informative rather than normative, he says, to avoid contradicting multiple national laws until an EU directive can cover the subject. Local architectural traditions in northern and southern Europe, he notes, have long accounted for different levels of daylight, "so you have to write the standard in a way that promotes the use of daylight everywhere, but allows for the fact [that] the south wants to exclude it more than the north. It's a nightmare for standard makers, but we try to be fair, and so you can't destroy vernacular architectural styles with a standard like that."

Another performance-oriented German innovation, the Passivhaus system, is attracting attention in both European and American markets, though it serves a niche market and is probably too rigorous for general use. Its lighting component emphasizes daylighting through building orientation and appropriate fenestration. Raynham notes that the impressive energy savings of Passivhaus can involve tradeoffs that lower overall sustainability. "It makes you do some strange things to buildings to make it work, and they're not always that carbon-efficient": e.g., specifying electric cooking rather than gas, so that air-exchange rates are lower. That's "fair enough," Raynham says, "but [as for] the carbon footprint of the electric cooking: Because the carbon's outside the building, it doesn't count." As in so many aspects of environmental performance, there is no free lunch.

YESTERDAY'S OPTIONS, TOMORROW'S MANDATES

Codes and the LEED system (or their equivalents, such as the U.K.'s BREEAM or

the United Arab Emirates' Estidama) are converging, particularly in lighting. Still, the U.S. Green Building Council is a private organization, and its point system does not have the force of law. With the 2013 version of the ANSI/ASHRAE/IES standard 90.1 nearing completion and IECC 2015 on the horizon (the final action hearings take place in Atlantic City, N.J., this October), Bailey says that LEED-point options five or six years ago may attain mandatory status in next-generation codes. Lighting power densities dropped significantly in the 2007 version of 90.1 and in the 2009 version of IECC but have not undergone such sharp reductions since, except for particular spaces such as lobbies. Instead, requirements for controls are accelerating. Within five years, Bailey predicts, codes will require daylight-responsive controls or occupancy sensors in most spaces. IECC 2015, he adds, should also benefit from unprecedented involvement by IALD members.

Adopted at statewide levels by five states as of July (Florida, Maryland, North Carolina, Oregon, and Rhode Island) and various municipalities, the IgCC may represent the future of codes, codifying principles that were previously voluntary. Unfortunately, Bailey points out that its implementation has lagged because of timing: It was published during the global economic slump, when little was being built, permit fees were scarce, and enforcement departments were on tight budgets. It was "exactly the wrong time to be coming out with a green code," he says, "because people weren't forward-looking." He says the IgCC's requirements, which he helped develop, are the first step toward mandated daylighting of major building-use groups (businesses, schools, factories, retail, and others) in any U.S.-based code. "Worker productivity, enhanced learning, absenteeism—all those issues are possibly less important than the biological impacts of light, which is something that we know a little bit about, but which is still not really informing design practice at all." The IgCC also explicitly addresses a major limitation of LEED to date: the cost barriers to certification for smaller buildings.

The question of whether codes drive new technology or vice versa leads to chicken-or-egg speculation. For Heinmiller, codes have generally lagged behind technology. As an example, he points out that in the tungsten-lamp era, about 20 years ago, allowable lighting power densities were higher than they needed to be since more-efficient fluorescents were being released. Densities dropped with the 2004 iteration of 90.1, and they are likely to drop again in the next generation of both U.S. code systems as the transition to LEDs accelerates. The 2013 version of 90.1 reflects deliberations that began in 2011, Heinmiller says, when LED products had not gained significantly in efficiency; the reduction in lighting power densities may look alarming at first, but the LEDs that are likely to be in wide use in a few years will make them achievable.

Technological change and code revision "very much go hand in hand," Raynham says. "The cynic would say that the technological change drives the law, because the people who have the technology also have the budget to go political lobbying." In Europe, he observes, politicians "back away from it and push it out to the standards makers, [who] by and large are the experts" and are more insulated from commercial pressures.

He sees the integration of daylighting and electric lighting as a critical area for the new codes, raising certain challenging scenarios. "Technically, [when] lighting controls go into an installation, they've got to last 25 years. The problem is that, generally, you reconfigure your building every five years. The controls company that made it [the controls] goes broke in seven to 10 years, and that [means] the technology becomes unsupportable in that short period. So there are real nightmares in facilities management, and that's probably an issue that needs to be dealt with. I think you have the same problems in the U.S. I just don't think you're quite as far down that particular path yet."

The Achilles' heel for any code system is enforcement. "The numbers on compliance rates will go all across the board," says Meres, who describes his work with the Global Buildings Performance Network as "getting building departments to recognize that energy-code compliance is an issue and giving them the tools to do so." Compliance with 90 of 100 specific requirements implies nothing about a building's performance, because the noncompliant 10 percent may account for disproportionate effects. Across the U.S., he says, the best general compliance rates are found in the Pacific Northwest.

Colleagues in Paris have also told him that "they actually think compliance is a huge problem in Europe, but they're not sure how to tackle it yet." Post-occupancy evaluation and public disclosure of results, he says, are powerful tools, citing several salutary examples: EU-wide labeling requirements (despite varying implementation by member states); Washington, D.C.'s local requirement that Energy Star Target Finder scores be submitted with permit applications; and New York City's requirement that private buildings disclose their energy consumption. As the green-building sector matures, increasing public attention to metrics and accountability creates a demand for clear, substantive information about what it means for a building's components to be up to code •

Compliance with 90 of 100 specific requirements implies nothing about a building's performance, because the noncompliant 10 percent may account for disproportionate effects. Across the U.S., says Ryan Meres, the best general compliance rates are found in the Pacific Northwest.

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AN ERA OF ENLIGHTENMENT

In an industry focused on the latest lighting technologies, human factors play a critical role in determining the success of an environment.

text by Robert G. Davis
illustration by Tang Yau Hoong

The design community's interest in the role of human factors in lighting is growing. While technology may seem to drive our industry, designers are concerned with enhancing human experiences in the spaces they create—and with good reason. Lighting influences everything from human health, worker productivity, perception, safety, circadian rhythms, the aging eye, discomfort glare, and cognition.

It also affects how people experience architecture; lighting can help or hinder how

Lighting can help or hinder how people process the environments they encounter. Each time a person walks into a new setting, the brain is challenged with constructing a cognitive map of its surroundings to use as the basis for how to act.

they process the environments they encounter. Each time a person walks into a new setting, the brain is challenged with constructing a cognitive map—a mental representation of the key elements of the scene and their interrelationships—of its surroundings to use as the basis for how to act. Our sensory systems feed information derived from sights, sounds, and smells to the brain, which then compares the current cognitive map to scenes experienced in the past to see if any experiences stored in memory can help inform how to react and behave in this new setting.

To illustrate how environmental cues and attributes guide the construction of an internal cognitive map, which in turn guides how people interact with their surroundings, imagine standing at the entry to a new exhibition at your local museum. Directly ahead is the show's headliner, an artifact accented with tracklighting to distinguish it from the dim surrounds. But you still don't understand the layout of the exhibition. As you move farther inside, accent lighting draws your attention to a statue at the center of an open space to your right. You then notice that the room becomes a larger exhibition space, which extends deep into the building beyond the statue. Comfortable that you now understand the expected pathway through the exhibition, you return your attention to the entry display. And all of this happens in a matter of seconds.

Research into the cognitive map began decades ago, in fields such as environmental psychology, environmental behavior research, and man-environment research. Different researchers have addressed narrower aspects of the overall, broad topic. For example, John Brebner, a psychology professor at the University of Adelaide in South Australia, studied how people use information garnered from their past to extrapolate general principles embedded into their perceptions and how they apply those principles to new experiences in different settings.

Amos Rapoport, a retired architecture and urban planning professor at the University of Wisconsin-Milwaukee, has also written extensively about the cognitive goal of deriving meaning from environmental cues. People expect the environment to communicate meaning and rules, and to indicate appropriate behavior, Rapoport argues. Difficulty arises when the cues are either too subtle to be noticed, or when they are incomprehensible or contradictory to other indicators that are also present. Meanwhile, Boston College psychology professor James Russell proposes that the cerebral appraisal of environments occurs through the assessments of overall

pleasantness, arousal level, and dominance in terms of the level of control a person believes they have in the setting.

But the most thorough development of ideas from this field of research comes from Stephen and Rachel Kaplan, a husband-and-wife research duo at the University of Michigan. The Kaplans propose that people spend considerable mental energy throughout their lives on two fundamental purposes: making sense of the settings they encounter and assessing opportunities for participating in those environments.

The ability to understand one's conditions and the potential to become involved with the environs will influence an individual's personal preferences. Whether it is an outdoor park, museum, retail store, office, living room, or waiting room, how a person reacts to their surroundings is based in large part on whether they are able to make sense of and interact with their environment. Lighting, therefore, can be critical to helping people understand a space and can dictate how engaging the space turns out to be.

COHERENCE AND COMPLEXITY

Though their research focused on how people experience exterior settings, the Kaplans derived principles about personal engagement that designers and planners can use to enhance people's experiences in any setting. While the Kaplans reference these principles throughout their decades of research (to the present day), *Cognition and Environment* was their classic text that established the framework (see "People and Prose," on page 67).

Though many visual characteristics factor into defining an environment's setting and how people participate in it, the Kaplans identified two primary properties: coherence and complexity. As people construct their cognitive maps, they instinctively seek information on these important spatial qualities.

In a coherent scene, the boundaries of the spatial envelope are easily defined and connected, and surface intersections are clear. Any element highlighted through lighting should help the viewer establish this sense of coherence. When important spatial properties, objects, or surfaces are difficult to identify because of the lack of visual emphasis, coherence breaks down. It can also be hindered through careless design, such as an unintended scallop effect on a wall or column that is irrelevant to the architectural space and which can become a distraction.

At the other end of the spectrum, an oversimplified space with uniform light levels and no highlights or emphases can also lead to coherence. However, while this approach avoids the negative cues that break down coherence, it also results in a boring and insipid space. Simplicity may be safe, but to create engaging spaces, designers need to introduce adequate complexity and visual interest.

Complexity helps satisfy the basic human desire for stimulation and interaction with the environment. In architectural lighting, techniques such as accent lighting on artwork reinforce the idea of engaging people with their surrounds. In the earlier museum example, the added complexity of focused lighting on the statue invites the visitor to step closer for a more detailed look, thus strengthening the sense of involvement.

SEEING, HEARING, AND UNDERSTANDING

The principles of coherence and complexity are often synergistic. Architectural elements with integrated lighting, such as wall slots or coves, enhance coherence by defining spatial boundaries and injecting visual complexity. The practice of highlighting objects with accent lighting allows distant focal points to emerge and aids in wayfinding. Both techniques help a person understand a space while encouraging them to engage with their surrounds. For lighting designers, the challenge then is to find a balance between these principles. At some

point, adding elements of complexity can lead to visual clutter and hinder coherence.

Beyond visual perception, the principles of coherence and complexity apply to a large number of applications and human experiences. Music appreciation relies, in part, on a proper balance between these principles. Daniel Levitin, who heads the Laboratory for Music Perception, Cognition, and Expertise at McGill University in Montreal, describes this balance in his book, *This is Your Brain on Music*. When a musical piece is very simple, he writes, people tend not to like it. When a composition becomes more complex, people respond more favorably. But when a piece becomes too complex, it can become incoherent and evoke a negative response.

Although Levitin does not use the term "coherence" in his writing, the underlying principle is the same: Adding complexity to a cognitive stimulus can build interest and increases people's partiality to an extent. When complexity reaches the point of diminishing coherence, the partiality disappears.

THE FUTURE OF LIGHTING

As the lighting industry continues to focus on the proliferation of solid-state lighting, accompanied by ever-lower power allowances, nuanced discussions of human factors appear to have been lost in the shuffle. Overlooking these topics could have unintended consequences. Attempting to satisfy reduced power budgets using directional sources, such as LEDs, in systems designed only to satisfy task-plane illuminance levels could result in projects that fail to help the user understand the space or provide the complexity to make the setting pleasant. Also, the idea that eliminating accent lighting, wall-slot lighting, wall sconces, and covelighting might be the only way to meet future energy codes is a disturbing one, since these lighting strategies help designers create coherent spaces with suitable complexity. If small, bright, discrete light sources dominate the visual scenes of the future, designers will struggle to satisfy the design criteria without creating visual noise.

But what if luminaires, regardless of their source, were designed with human factors in mind? Technological developments have led to small-scale, highly efficient luminaires that can define spatial boundaries and highlight key objects at lower power levels. Several manufacturers have recently introduced new and smaller LED cove, wall slot, and wallgrazing products that add coherence and complexity at low wattages. LED and OLED sources also provide opportunities for innovative form factors. To date, those form factors are primarily used for decorative lighting, but perhaps they will inspire new ideas for architecturally integrating lighting equipment to boost coherence. Meanwhile, the combination of solid-state sources and controls opens doors for tunable systems that empower designers to create dynamic, visual, and engaging environments.

These new technologies are critical to the lighting industry's future. If applied thoughtfully, they can also empower manufacturers and designers to create lighting solutions that fully address topics of concern in human factors, such as those associated with circadian health, an aging population, glare control, workplace productivity, and the need to comprehend and enjoy the environs in which we live, work, shop, and play. One of the Kaplans' more recent books is titled *With People in Mind*. This simple phrase provides a concise call-to-action for the lighting industry as we move forward. •

Robert Davis is a senior staff lighting engineer at the Pacific Northwest National Laboratory (PNNL) and holds a M.S. degree in architectural engineering and a Ph.D. in cognitive psychology. This article expresses his personal views and not those of PNNL or the U.S. Department of Energy.

PEOPLE AND PROSE

Human factors are a complex area of research, and lighting is but one part of this very nuanced subject matter. Below is an introductory bibliography to the topic.

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SYSTEM CHECK

The latest in lighting controls product offerings are revolutionizing lighting integration at the individual fixture and building system level.

text by Jennifer Bickford

VerifEye Submetering Solutions, Leviton • For use in retrofits and new construction, this energy-tracking solution enables monitoring and verification of real-time energy usage, and provides precise data for billing and operational purposes. Submeters record data in real time and transmit output to the communications products. This data is sent on to the Energy Manager Data Center where it is stored, managed, and used for reporting. Reports can be generated via Leviton Energy manager or the PC-based Leviton BillSuite. Measuring kilowatt-hour consumption and demand, the single-phase Series 1000 and three-phase Series 2000 versions are available in both steel and NEMA 4X enclosures. The Series 3000 Smart Meters provide additional metrics of instantaneous power, voltage, amperage, wattage, volt-ampere reactive, and volt-ampere per phase. Mini Meter submeters offer a smaller, more cost-effective option for residential applications. VerifEye integrates with Building Management Systems platforms as well as third-party billing systems and utility companies. Wired, wireless, and IP versions are available and all versions are UL listed, and cULus and ANSI C12.1 certified. • *leviton.com*

infiNET EX Wireless IRCOM, Crestron • Designed for control and monitoring in retrofits of historic and existing buildings without running wires, the infiNET EX Wireless IRCOM is 2.5" square and can control most systems that use an IR remote. The device includes two IR ports and one bidirectional RS-232 port, and it communicates with a Crestron control system over the infiNET EX wireless network, with up to 100 infiNET EX devices. Wireless range is approximately 150' indoors and 250' outdoors (depending on site conditions). The IRCOM should be surface-mounted near the equipment it will be controlling or monitoring and is powered by an included outlet-mounted universal 100V-to-240V AC power pack. • *crestron.com*

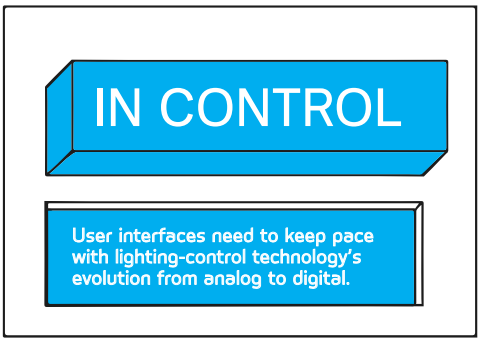
LMPC-100-5 Occupancy Sensor, WattStopper • The LMPC-100-5 is a low-profile, ceiling-mounted occupancy sensor that uses passive infrared technology and one of two 360-degree coverage patterns to detect occupancy in spaces with 20' to 40' ceiling heights. When mounted at 40', the sensor can detect walking motion within a 35' radius via a specialized 360-degree lens. Part of the Digital Lighting Management (DLM) integrated control system, the sensor plugs to a choice of DLM devices to control various load types based on occupancy. Features include an IR transceiver that allows for remote control and wireless configuration as well as a digital sensor with LCD display. Programmable pushbuttons are also available behind a snap-off cover. • *wattstopper.com*

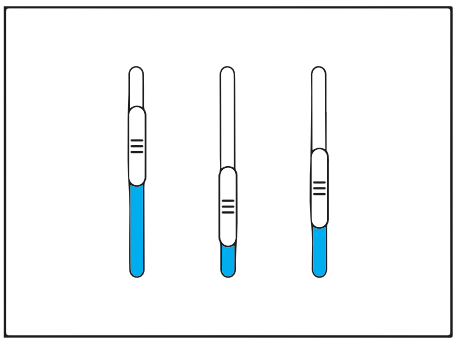
Architectural Dimming Systems, Schneider Electric • Schneider Electric's architectural dimming system is available in two styles: the Wall-Mounted Architectural Dimming Panel for small to mid-sized commercial spaces with up to 30 dimming channels, and a Rack-Mounted Dimming Panel for larger applications that allow for up to 120 dimming channels. Both the wall-mounted and rack-mounted system support inTouch Control Stations; only the wall-mounted version supports DMX512 digital controls. Both styles save energy by cutting power at the load level when engaged in power-off mode, rather than at the fixture level. The systems can interface with third-party control solutions such as daylight harvesting, relay panels, and occupancy sensors and also feature a magnetic circuit breaker for when current limits are exceeded. • *schneider-electric.com/us*

Room Controller, Cooper Controls • The Room Controller lighting control system is preconfigured to work out of the box when connected to RC devices—arriving with everything you need to install it—so no on-site programming is required. An Integral Demand Response input allows for four levels of preconfigured energy reduction and allows for daylighting controls, occupancy/vacancy sensors and manual switching for energy management. The system features a manual or automatic on, bi- or tri-level dimming control strategies, and includes three relays and up to three zero-to-10V DC dimming outputs to control compatible dimmable ballasts. Switching relays and zero-to-10V DC outputs are controlled separately. • *coopercontrol.com*

OEM LED Power and Dimming Controls, Phihong • These remote access tools for original engineering manufacturer (OEM) lighting applications include both touch and remote controls for residential and commercial lighting products. The handheld LED lighting remote control (left) enables users to dim and switch lights on and off. Powered by a 3V button-cell battery, the remote has a 7m (23') range when pointed directly at the IR receiver. Wall-mounted wireless touch-key controls (right) offer the same functionality as the remote and can be mounted up to 10m (33') away from the receiver. Both the remote and the wallstation are part of Phihong's custom LED Lighting solutions, which are only available to OEM customers. • *phihong.com*

Animeo IP, Somfy • Designed for commercial buildings, Animeo IP uses sun-tracking technology to automate motorized solar shading. A combined hardware–software device that uses Internet Protocol (IP) and the Somfy Digital Network, the system is scalable and allows for expansion, and the line includes building controllers, subcontrollers, and weather stations. Virtual keypads can be accessed by occupants for personal control over nearby shades. The sun-tracking feature uses real-time input from the system's sun and temperature sensors, and logs of past temperature and light readings can be generated. Programming can be done both remotely and on site. Animeo IP can also be integrated into third-party control systems. • *somfy.com*





text by Hallie Busta

The lighting world's lingua franca has shifted from hardware to software, requiring its controls to offer simpler interfaces that pare down the complex, cloud-based web of technology that keeps the lights on. Incentives for energy management and a user's willingness to adapt are driving innovation. As a result, individuals can personalize their environments while facility managers moderate a building's lighting activity, fixture by fixture.

"User interfaces are ways to say, 'That's usually what happens, but right now this situation is different,'" says Evan Ackmann, Crestron's technology manager for lighting control and energy management. "If I walk into a room that's scheduled for a video conference … but that changes at the last minute and no one's going to call in, I may hit a button on the wall that changes what happens in that space."

The same is true for residential projects. Vantage Controls' Equinox 4 LCD keypad lets a user control the lighting and eight other non-lighting scenes, such as the HVAC and home entertainment systems. Settings can be customized based on the preferences of different users or for a particular activity. Day-to-day functionality lives on a touchscreen dashboard, and users can navigate down one level to adjust the settings. "One of the advantages we have today is that people are used to using smartphone technology," says Andrew Wale, Vantage Controls' vice president of marketing. "It's not alien to them to press on an app and open it up, get inside it, get back to the settings, and customize things."

Eric Lind, vice president of global specifications at Lutron Electronics, says that product designers must consider three factors when developing the physical interface: aesthetics, ergonomics, and intuition. That is, the control interface must meld with a room's decor, its controls must be right-sized and tactile, and the functionality must make sense to newcomers. Whether users swipe, turn, flip, or press a button, switch, or dial to activate a command depends on the functions that the interface controls.

The desire to manage energy consumption in residential and commercial settings is driving the use of centralized systems that rely on conditional logic which change settings to produce efficient outcomes. Still, Lind says: "It doesn't buy you much if you build in too much complexity. … You want this kind of intelligence to happen behind the scenes so when you press the button that says 'on,' it doesn't matter what time of day it is: It's always going to come on to the right preset level."

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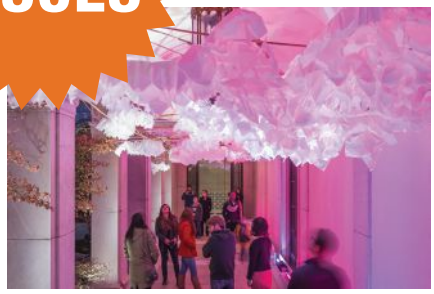

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LUMINOUS REPOSE

In the new Lakewood Cemetery Garden Mausoleum, daylighting is exquisitely balanced with electric light to create a luminous resting place for the dead and a place of respite for the living.

text by Camille LeFevre
photos by Paul Crosby

A view of the Lakewood Garden Mausoleum entry. The exterior materials include split-face gray granite. White mosaic tile surrounds the bronze entry doors.

When several business leaders, originally from New England, founded Lakewood Cemetery in Minneapolis in 1871, their models were the "rural" or "garden" cemeteries popular on the East Coast. Surrounded by a bustling residential area next to Minneapolis' popular Chain of Lakes, Lakewood's 250-acre, rolling landscape includes beautifully maintained gardens, statuesque mature trees, famous monuments and memorials, and iconic artworks and architecture. It's an oasis in the city for walks, picnics, historical tours and outdoor theater performances; a bucolic resting place for the dead and a bit of heaven for the living.

Like others of its building type, the modernist Memorial Mausoleum, constructed in 1965, sits heavily on the Lakewood Cemetery site, although not ornately. Following tradition, the building looks inward, rather than out, despite its 24 striking, 8-foot-high stained-glass windows. By 2003, Lakewood—non-sectarian and nonprofit—realized the building was running out of space, and commissioned a master plan with a new mausoleum for 10,000 of the departed. But only 25 acres were available for a new structure.

Joan Soranno and John Cook, of Minneapolis-based HGA Architects and Engineers and designers of numerous award-winning religious and cultural projects, decided that the new mausoleum shouldn't intrude on the cemetery's historic context and pastoral setting. So they buried three-quarters of the new Lakewood Cemetery Garden Mausoleum into a hill overlooking the extant mausoleum and sunken garden with an infinity pool.

"Historically, as a building type, mausoleums tend to be dark, introverted spaces," Soranno says. "With this project, we did the exact opposite. We needed the rooms, especially those underground, to feel open and airy, with views to the beautiful landscape. So light was the most considered, studied component of the design, along with materials."

The 24,500-square-foot mausoleum is clad in rough-textured, gray granite and white mosaic-marble. The dramatic contrast continues inside, with the juxtaposition of dark and light, rough and polished materials. Daylight floods the interiors through well-considered clerestories, floor-to-ceiling windows, glass doors, and skylights—all of which highlight the textures, colors, and finishes of the simple, yet rich palette.

The daylight also serves a spiritual purpose. "Light is crucially important in buildings with religious purposes, especially with regards to death and remembrance," Soranno says. "Spiritual light comes in two forms. One is daylight brought in by windows, which we positioned to frame beautiful views of the historic cemetery. The second is more indirect light, where you can't see the source, which we incorporated through methods like covelighting in selected areas of the building." Moreover, she says, "When you're designing for people who are grieving, you need to create warm, safe, comforting, and nurturing environments. Light is an effective way of evoking those feelings."

The architects used electric lighting judiciously throughout "to balance the daylight and supplement its warmth," says HGA in-house lighting designer Tao Ham. "Daylight is always the most beautiful source of light. It doesn't matter how lovely the electric lighting design might be; you can't compete with daylight. So except for spaces away from the windows, where there is supplemental lighting, the building is daylit."

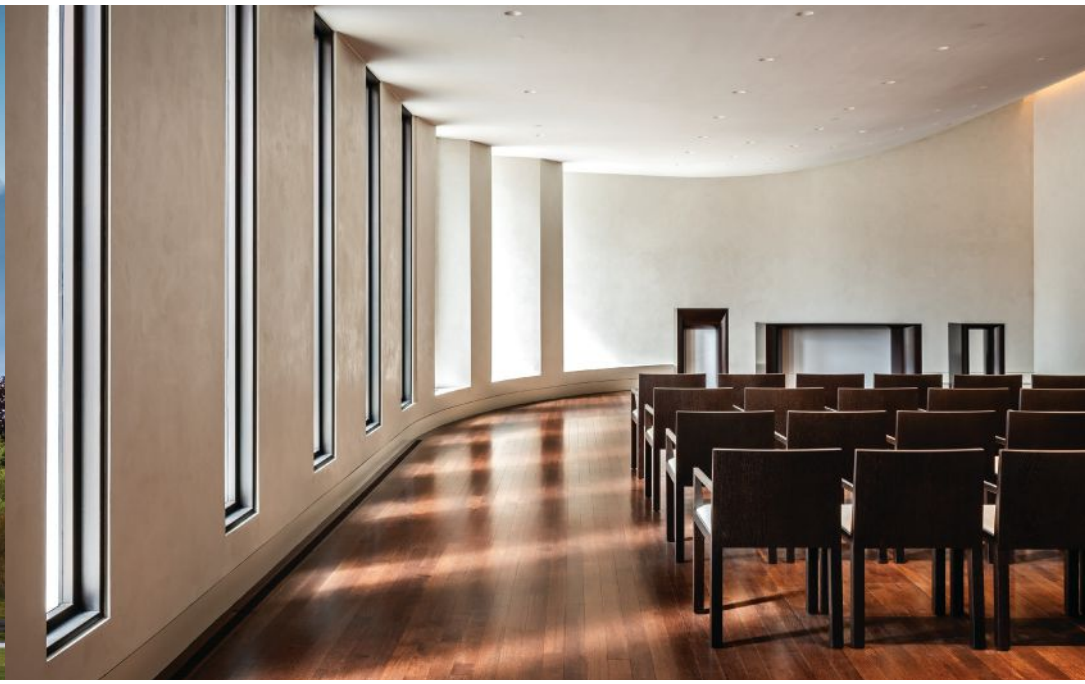
The two-level entry foyer, for instance, has a white marble floor, folded mahogany walls, and large window walls and clerestories. Daylight accentuates the curves and angles of the white, sculptural ceiling planes. Delicate cascades of 10W xenon crystal pendants drop from the ceiling and "add sparkle," Ham says.

The foyer leads to a reception area with window walls facing west. Embedded in the ceiling coffers, in star-like constellations that

Longitudinal Section

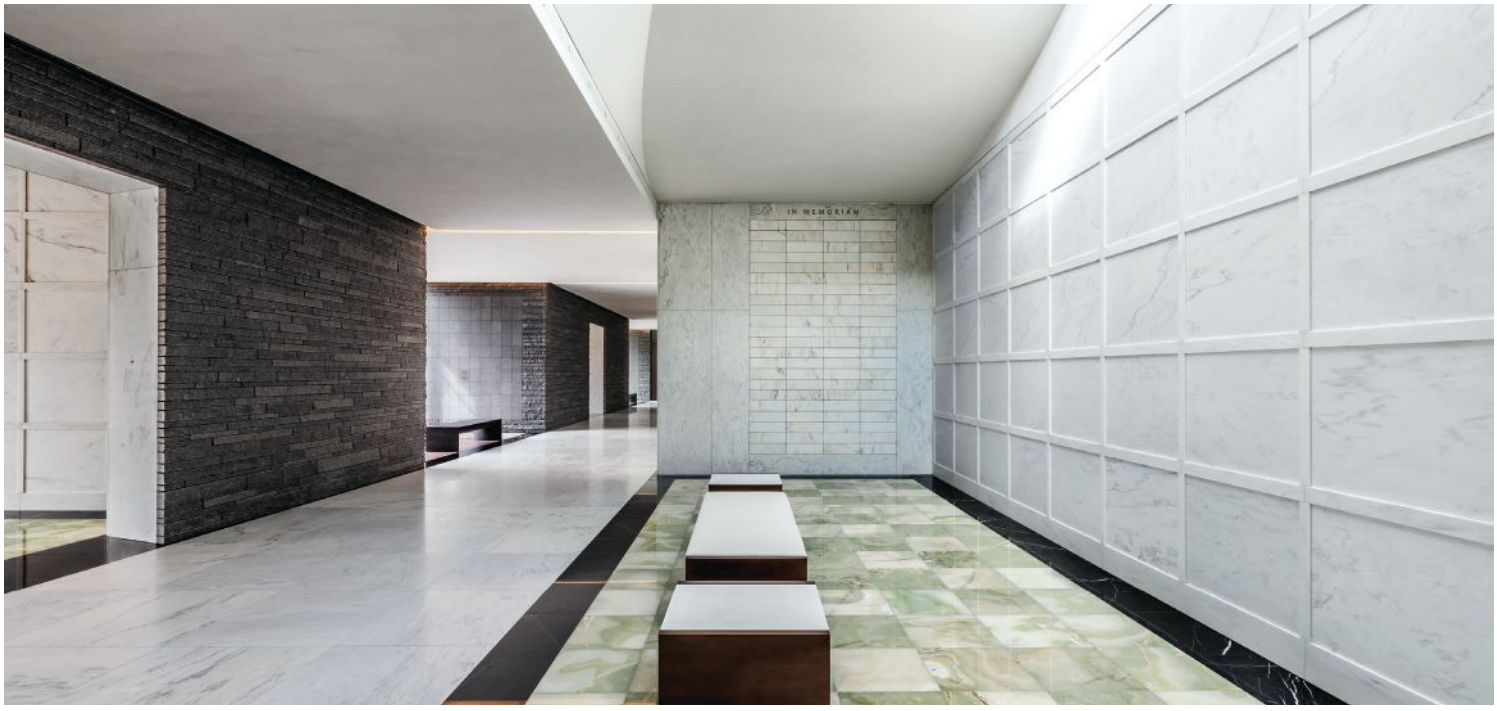
Transverse Section

1. Street Level Entry
2. Foyer
3. Multipurpose / Reception Room
4. Terrace
5. Lower Foyer
6. Committal Room
7. Garden Crypts
8. Columbarium
9. Crypt



The mausoleum is designed so that it blends with the surrounding landscape (above left). The material palette of stone, wood, and light creates a comforting and nurturing environment for visitors. Daylight floods the interiors through well-considered and intentionally positioned clerestories, glass doors, skylights, and floor-to-ceiling windows (as seen in the chapel, above). Decorative pendants provide an accent of light at the entry foyer (below).

Light slots, with LED sources every 20 feet, illuminate the corridor ceiling plane and provides a soft, reflected light on the marble floors and limestone walls (above). A 180-foot-long corridor at the garden-level lobby connects alternating bays of the columbaria and the crypts (below).



correspond with the ceiling's forms, are small-aperture 50W MR16 adjustable downlights. The modern furnishings include circular glass table lamps, each with three incandescent T10 lamps, that create small pools of light. The lighting control system's settings include dimmers, a spotlight for the podium, and lighting for slideshows or movies projected onto a drop-down screen.

Also in the entry foyer, a stairway with LED steplights leads visitors past the window wall, to a solid wall of layered limestone, and then down to the garden level below. On the west side of the garden-level lobby, a curved Venetian-plaster wall guides mourners to the chapel where committal ceremonies are held.

In the chapel, nine vertical windows, which widen as they progress toward the back wall, are deeply angled to diffuse the daylight and ensure the privacy of mourners. As families leave the chapel, "the windows provide views to the soothing landscape, which reconnects mourners with the outside world," Soranno says.

The architects juxtaposed the chapel's curved ceiling and angled wall to create slots from which a soft light emanates. The "covelight also accentuates the ceiling's curves while lending a sense of mystery to the room," Soranno says. The covelight's dimmable T6 fluorescents with a diffusing lens are integrated with the HVAC system. A grid of small aperture, MR16 adjustable downlights embedded in the ceiling "adds a jewel-like texture," Ham says.

Extending east from the garden-level lobby is a 180-foot-long corridor that connects alternating bays or pods of six columbaria (with niches for cremated remains) and six crypts (for caskets). Three family crypts are also located here. LED light slots, every 20 feet, illuminate the corridor's floating ceiling planes. The light slots also cast delicate sprays of warm light down the smooth, white marble walls to the north and accentuate the rough texture of the dark, limestone walls opposite.

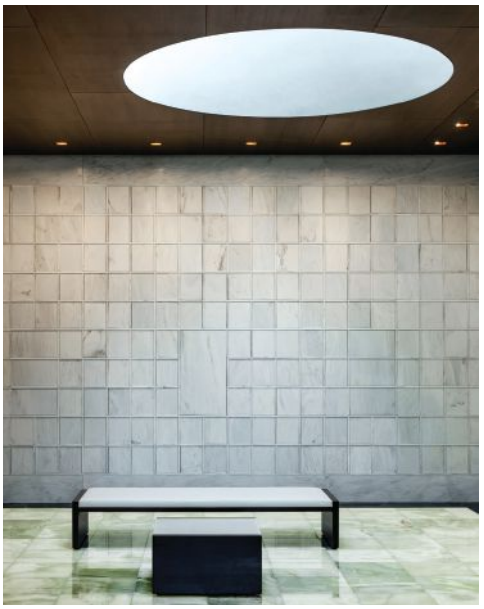
To the north, the chambers are inserted into the hillside. "A lot of people choose to be buried in a mausoleum because they don't want to be buried in the ground," Soranno says. "So when we decided to bury the crypts and columbaria into the earth, we had to make sure the rooms didn't feel subterranean. The primary tool to do that was light."

Each columbarium has an oculus, and daylight enters via the 6.5-foot-diameter window in the building's grass-covered roof, travels through a white-painted tapered cone, and then angles and expands through the 8-foot opening in the dark wood ceiling. To balance the diffused daylight, 22 MR16 wallwashers wrapped in custom wood recesses ring the ceiling and play across the marble niches embedded in the walls. Each of the crypts has a rectangular skylight positioned in the sculptural planes of the ceiling, with 6-foot-by-12-foot glass and a 3-foot-6-inch-by-9-foot opening. A row of 16 MR16 accentlights, recessed at the chamber headwall, balances daylight and illuminates the marble walls of each crypt.

The architects placed each oculus and skylight in a different position in each chamber. "Depending on the time of day, the light levels are different in each chamber," Soranno says. "There isn't uniformity from room to room." The light also helps soften the marble. "Mausoleums, including this one, are mostly stone, which is beautiful, but cold and hard," Soranno says. "So we countered that hardness and coldness with soft materials like rich, dark wood, with daylight, and with warm electric light."

The crypts and columbaria have windows overlooking, or glass doors opening onto, the cemetery's sunken garden with an infinity pool to the south. Also enhancing each chamber's distinctive feel are subtle material variations, including floors of yellow, green, or pink onyx. The entire building is equipped with dimmable light sources and time-based preset lighting controls that respond to daylight levels in order to save energy and extend lamp life.

Throughout the mausoleum, light is exquisitely balanced, seamlessly integrated with singular architectural forms, and deployed to enhance the materials' simple elegance. Open from dawn to dusk, the building is primarily daylit, but with small sources of electric light that emanate a warm glow as the daylight fades away. In designing a mausoleum that invites, shares, and transmits light, HGA has created a luminous resting place for the dead—and for the living. •



A contemplative but soothing atmosphere is created by the abundance of natural light that permeates the interiors. Each room has a slightly different feel due to the variations in shape and position of the skylights. In one north-facing columbarium, accented with green onyx flooring (above), an oculus functions as the primary luminaire, while MR16 wallwashers provide the balance of electric light.

Details

Project: Lakewood Cemetery Garden Mausoleum, Minneapolis • **Client:** Lakewood Cemetery Association, Minneapolis • **Architect and Lighting Designer:** HGA Architects and Engineers, Minneapolis • **Project Size:** 24,500 square feet • **Project Cost:** $25.5 million (including landscape for the 4-acre site) • **Lighting Costs:** Withheld • **Code Compliance:** ASHRAE 90.1-2007—1.3W per square foot • **Watts per Square Foot:** 1.12 • **Manufacturers/Applications:** **Acuity Brands/Hydrel** (exterior LED inground luminaire) • **Acuity Brands/Winona Lighting** (exterior/interior LED steplights) • **Bega** (exterior LED inground luminaire) • **Bocci** (cascade pendants with 10W xenon lamps in the foyer) • **Flos** (25W G9 halogen sconces in the restrooms) • **FontanaArte** (spun-glass table lamps in reception and garden-level corridor) • **Nippo Electric** (25W T6 linear fluorescent wall slot in architectural detail in the chapel) • **Nulux** (50W MR16 recessed linear adjustable accent lights at the vertical headwall of the crypts) • **Philips Color Kinetics** (linear LED light slots in garden-level corridor) • **Specialty Lighting Industries** (50W MR16 recessed downlights and wallwashers throughout the building) • **Williams** (T6 linear fluorescent lamps throughout the project)


JOHN JAY
COLLEGE OF CRIMINAL JUSTICE
CUNY

URBAN INTERVENTION

Drawing inspiration from Manhattan's street grid, the new John Jay College of Criminal Justice weaves itself into the city's fabric using light as its thread.

text by Aaron Seward
photos by Eduard Hueber/ArchPhoto Inc.

The John Jay College of Criminal Justice is the only higher education liberal arts institution in the United States with a focus on criminal justice and forensics. As such, it experienced a phenomenal rate of growth on the heels of September 11, 2001, when the terrorist attacks of that day spurred not only a great wave of interest in the field, but also turned law enforcement into a growth industry. To handle this influx of students, the college hired Skidmore, Owings & Merrill (SOM) to design a new facility that would integrate with its existing buildings—including the C.B.J. Snyder–designed 1903 Haaren Hall—and fill out the entire city block between 10th and 11th avenues and 58th and 59th streets in Manhattan. In addition to creating more programmatic spaces—classrooms, lecture halls, dining areas, and mock courtrooms—the school wanted a facility that would act as an urban campus, providing community and informal gathering spaces for its student body.

SOM responded with a glass-clad building composed of two distinct volumetric elements: a long, low podium that connects to the existing buildings along 10th Avenue, and a 14-story tower that anchors the college on 11th Avenue. Within these volumes, the architects inserted a central circulation spine that also acts as a commons. "We call it the cascade," says Mustafa Abadan, SOM's partner in charge of the project. "It's about the width of a New York City street." Just as Broadway steps to the west as it works its way north through Manhattan, this commons steps up in section as it works its way toward the tower, culminating in a light and airy atrium space. The architects also gave the podium an accessible green roof, known as the Jay Walk, which gave the college its first and only campus quad.

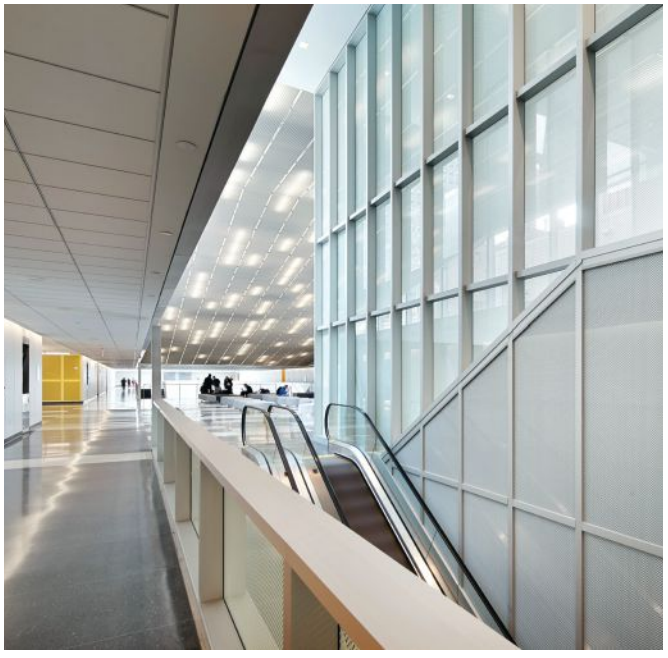
The lighting designer, New York City–based SBLD Studio, devised a simple, elegant scheme for the project that relies on the ample daylight provided by the glass architecture while unobtrusively deploying electric fixtures that are easy to maintain. "The lighting was [designed] completely in response to the architecture," says

SBLD principal Susan Brady. "It's as integrated as possible, so that you don't see a lot of fixtures"

Another of SOM's architectural moves that aids in creating a sense of campus for the school despite its city setting was to locate John Jay's main entrance at the middle of the block along 59th Street, away from the hustle and bustle of the avenues. Students enter into an airy lobby topped by a sloped skylight that floods the space with natural light. A matrix of long, vertical pendants—the project's most outgoing luminaires—hang from the steel armature of the skylight. "They create a sense of place and really emphasizes the verticality of that space," Brady says. The pendants are of two types: one with a luminous shaft outfitted with two 3-foot T5s and a 35W PAR30 metal halide downlight, and the second with an opaque shaft and a 35W PAR30 metal halide downlight.

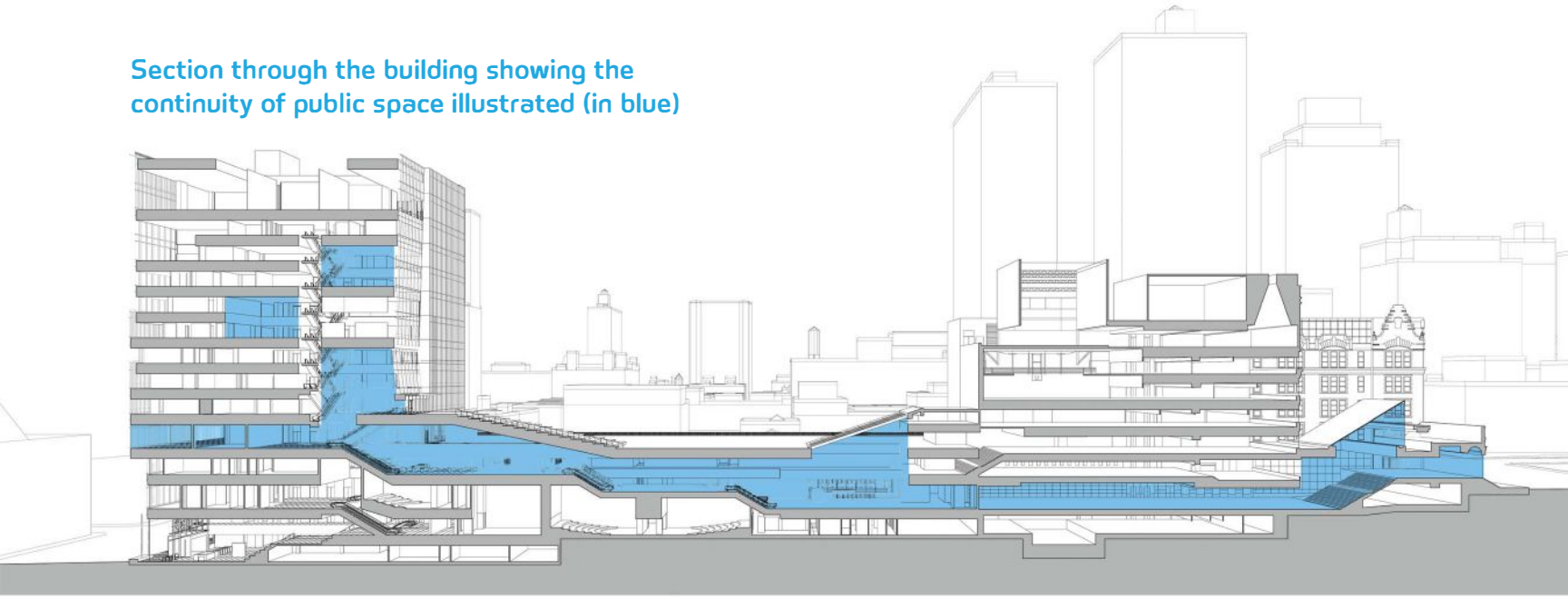
From the entrance lobby, students can turn left into the older buildings or turn right into the new facility and the series of spaces that make up the commons. Initially, SOM wanted the interior street of this space to be capped by a traditional luminous ceiling, a goal that was retooled when new safety codes required a more robust smoke-exhaust system. Instead, the architects specified a cellular aluminum ceiling panel capable of accommodating the ventilation equipment. SBLD developed a random pattern of T5 fluorescent strip fixtures in varying lengths, which are also concealed by the ceiling panels. This erratic, staggered array of fixtures provides a variable amount of footcandles while using much less energy than a traditional luminous ceiling. It is also very forgiving from a maintenance point of view, since a burned out T5 is not nearly as noticeable in a random arrangement as it is in a standard grid formation. SBLD zoned these fixtures in three different groups that can be switched on or off individually, in pairs, or all together, depending on how much illumination is needed at any given time.

SOM created a hierarchy of space throughout the commons. One way the firm did this was by calling out certain elements with primary colors. For example, coffee bars, information centers, and other locales of import were given a dark blue wrapper, whereas cross corridors that feed perpendicularly off the commons have bright yellow walls. To return to the Manhattan street grid metaphor, the blue areas are the major cross streets—such as 14th, 23rd, or 34th—whereas the yellow hallways are the smaller in-between streets. The lighting scheme follows suit. For example, the blue panels stand out from the rest of the wall and there are coves at top and bottom outfitted with long 28W CFLs. The fixtures are overlapped so as not to show the socket shadow that typically appears when fluorescents are arranged linearly. Exposed 28W T5 fixtures run



SOM's design for the John Jay College of Criminal Justice's new facility is much more than just a single building. The new facility integrates itself with the college's existing structures to create an urban campus that fills out an entire city block between 10th and 11th avenues on Manhattan's west side. The main feature of the new campus is a series of light-filled public spaces called the cascade (above and left), which provide areas for formal and informal gathering.

Section through the building showing the continuity of public space illustrated (in blue)



Details

Project: John Jay College of Criminal Justice, New York • **Client:** City University of New York, John Jay College of Criminal Justice, and Dormitory Authority of the State of New York, New York • **Architect:** Skidmore, Owings & Merrill, New York • **Lighting Designer:** SBLD Studio, New York • **Structural Engineer:** Leslie E. Robertson Associates, New York • **M/E/P Engineer and Vertical Transportation:** Jaros Baum & Bolles, New York • **Laboratories Planning:** GPR Planners Collaborative, Purchase, New York • **Higher Education Programming:** Scott Blackwell Page Architect, New York • **Civil/Geotechnical/Environmental Consultant:** Langan Engineering & Environmental Services, Elmwood Park, New Jersey • **Owner's Representative/Construction Manager:** Turner Construction, New York • **Project Size:** 625,000 square feet • **Project Cost:** $410 million • **Lighting Costs:** $9.50/square foot for fixtures; $13.50/square foot installed • **Energy Code Compliance:** Completed prior to current energy code compliance requirements • **Watts per Square Foot:** 1 • **Manufacturers/Applications:** **Bega** (13W PL-C exterior steplights) • **Crenshaw Lighting** (two custom pendants—3-foot T5s and a 35W PAR30 metal halide for downlight component—at entry lobby) • **Eaton's Cooper Lighting Business/io Lighting** (illuminated handrail system at Jay Walk) • **Hess America** (pole luminaire at Jay Walk with 28W biax CFL lamps and inground LED pavers) • **Legion Lighting** (54W T5HOs in luminous ceiling in cafeteria; 28W biax uplight and covelighting at Blue Boxes) • **Linear Lighting** (28W T5 staggered linear fluorescents in east–west secondary corridors; 28W T5 recessed linear fixtures in classrooms) • **Philips Lightolier** (T5 fixtures at the cascade—primary public circulation and gathering areas; 28W T5s at yellow cross corridors) • **Sylvania** (lamps throughout the project) • **USAI Lighting** (35W MR16 dimmable downlights in cafeteria and throughout project)

down the center of the ceiling and distinguish the yellow corridors. Other secondary corridors that run east to west along the commons are topped by wallwashing coves equipped with staggered 28W T5s.

The commons culminates in an airy atrium that climbs its way into the tower and faces onto the Jay Walk. The space's primary architectural element is a switchback staircase with blue paneling, which forms a visual backdrop that can be seen from the green roof at night. The undersides of the stair flights are equipped with recessed 28W T5s. The lighting in the atrium itself fulfills a supplementary role to the ample daylight that floods the big room. Wedge-shaped uplights outfitted with 42W CFLs two-thirds of the way up the wall combine with recessed 35W metal halide downlights in the ceiling. Throughout the project, downlights are either 26W, 32W, or 42W CFLs or 35W metal halide, depending on the ceiling height. Metal halide lamps were used for the taller ceilings. "If we were designing this today," says Brady, "we would use LEDs." (The project was initially designed in 2003 and then put on hold before completed in 2011.)

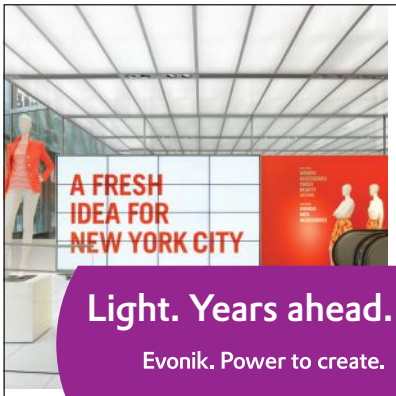
John Jay's typical classrooms are light and airy with relatively high ceilings, all of which allowed the lighting designers to use direct/indirect pendants outfitted with 28W T5s. Some classrooms with lower ceilings feature recessed T5s. The direct/indirect lamps in the pendant fixtures can be switched on or off separately to tailor the light level for the prevailing daylight conditions. Fixtures adjacent to the perimeter glass wall have daylight sensors that will turn the indirect lamps on or off automatically.

The building also features a multipurpose seminar room. SOM distinguished this space with a wooden interior that wraps up the walls and across the ceiling. Infrastructure bands cut across the wood paneling, equipped with ventilation and audio equipment as well as 54W T5HOs and 35W MR16s. In this room, the lighting is programmed with different presets calculated for the many uses that the room is meant to serve, such as video presentations, lectures, or cocktail receptions.

The project also features some dedicated exterior lighting. For example, the canopy at the main entrance is outfitted with recessed CFLs that supplement the light that pours out from the interior. But it is the Jay Walk that was given the most robust treatment. Here, steps that descend from the tower are set aglow with 13W PL-C CFLs and light poles, equipped with 28W long biax CFLs, that create a stately progression along the walkways, whose pavers feature integrated LEDs. An amphitheater that descends from the tower radiates with recessed 13W PL-C CFLs arranged in a similar randomized pattern found in the ceiling of the cascade.

The scattered points of light continue across the campus green, again 13W PL-C CFLs recessed within the grass. "They're like stars, points of light, that kind of randomness is projected to the grass surface," says Abadan. "From upper levels of the tower you look down onto this space and it's quite attractive at night." And the building's glass envelope—alternately transparent and fritted with an orange color meant to blend with the prevailing brick character of the neighborhood—provides the most splash. It allows the variety of interior lighting scenes to peek through the walls and animate the building at night. •

Lighting design firm SBLD Studio developed a lighting scheme that capitalizes on ample daylight while unobtrusively deploying electric lighting and luminaires that are easy to maintain. A random pattern of T5 fluorescent strip fixtures in varying lengths (opposite) provide a whimsical yet practical amount of light. To create a hierarchy of space in the cascade, the architects developed a color-coding system; blue denotes coffee bars, information centers, and other locales of import (this page).



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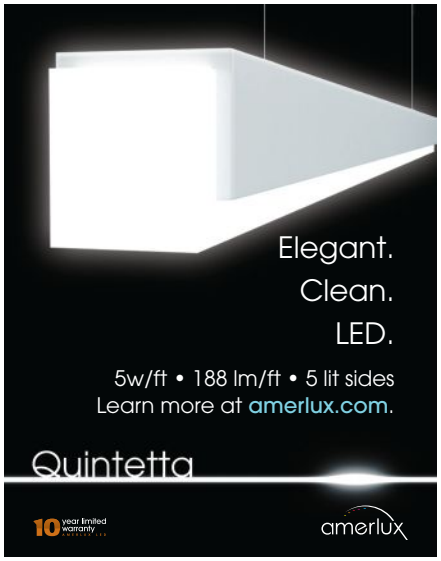

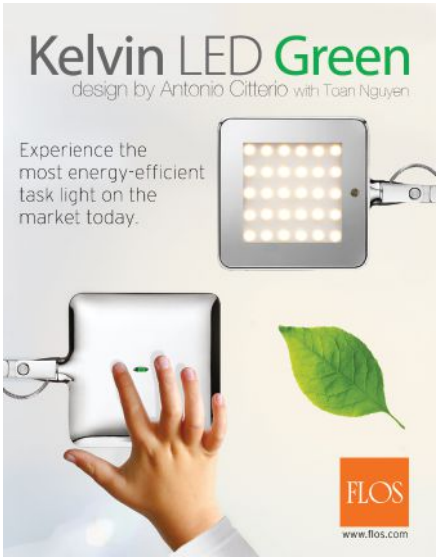

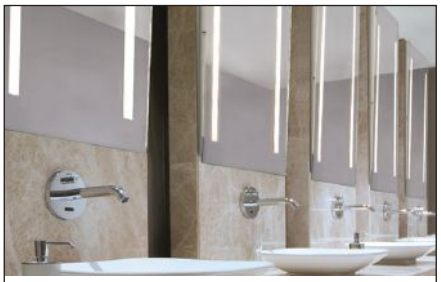

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BONNIE LITTMAN

interview by Elizabeth Donoff
photo by Peter Ross

"The leading edge of technology will always allow for innovators to continue to push a technology beyond the applications that are known and expected today."

Lighting is a family affair for Bonnie Littman. The third generation of her family to work in the industry, Littman can trace her lighting roots back to her grandfather, William Littman, who, in the 1930s, built fluorescent fixtures that GE introduced to the public at the 1939 World's Fair. Her father Eugene, who passed away in July, joined the family business, growing it into the company known as Lightron. But he never assumed that his children would follow in his footsteps. (Littman's brother and sister also run their own lighting companies.) "I don't think my dad was looking for any of us to be in lighting," Littman says. "Its just something that we were always fascinated by as kids and really fell in love with." It's this legacy and spirit of innovation that drives her today as she steers USAI Lighting into the 21st century.

Do you have a lighting philosophy?
Regardless of the time of day, your location, or the activity you are engaged in—working, learning, healing, etc.—you should be able to maximize your performance in those tasks. Light should make life easier and better.

Is there a text that has had an impact on your thinking about light?
Chronotherapy: Resetting Your Inner Clock to Boost Mood, Alertness, and Quality Sleep by Dr. Michael Terman (Avery, 2012). Several chapters focused on color temperature and intensity as it impacts human performance.

What makes a great piece of lighting equipment?
A great fixture is one that offers everything a user needs with no compromise. We take a systems approach to the design and development of everything that we make. We start from the inside and work our way out. It is time consuming and costly.

In this economy, how do you make that happen successfully?
The people who specify and buy these products know that there's no compromise. When you make products that people can rely on, then they want to buy from you and you are rewarded for technical risk-taking.

What are the most exciting technical developments you are seeing in lighting?
LEDs have evolved from a one-dimensional source that were based on energy efficiency to a multidimensional design tool that redefines how we think about illuminating a space. But the most important innovation is really how color is delivered. The pursuit of personalized lighting and color flexibility is going to be the big story for many years to come. •

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For end-to-end seamless illumination, Alinea® offers a complete system of beautiful linear illumination ideal for kitchen and bathroom accent lighting. Available in both T5 fluorescent and LED, Alinea® features a modern design in a variety of color temperatures to radiate a soft warm light. Mount in continuous rows for seamless illumination, individually, or select our 360° model that lets you aim the light to increase or decrease the direction of the beam pattern.

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ALINEA® LED

ALINEA® 360

ALINEA® 9200

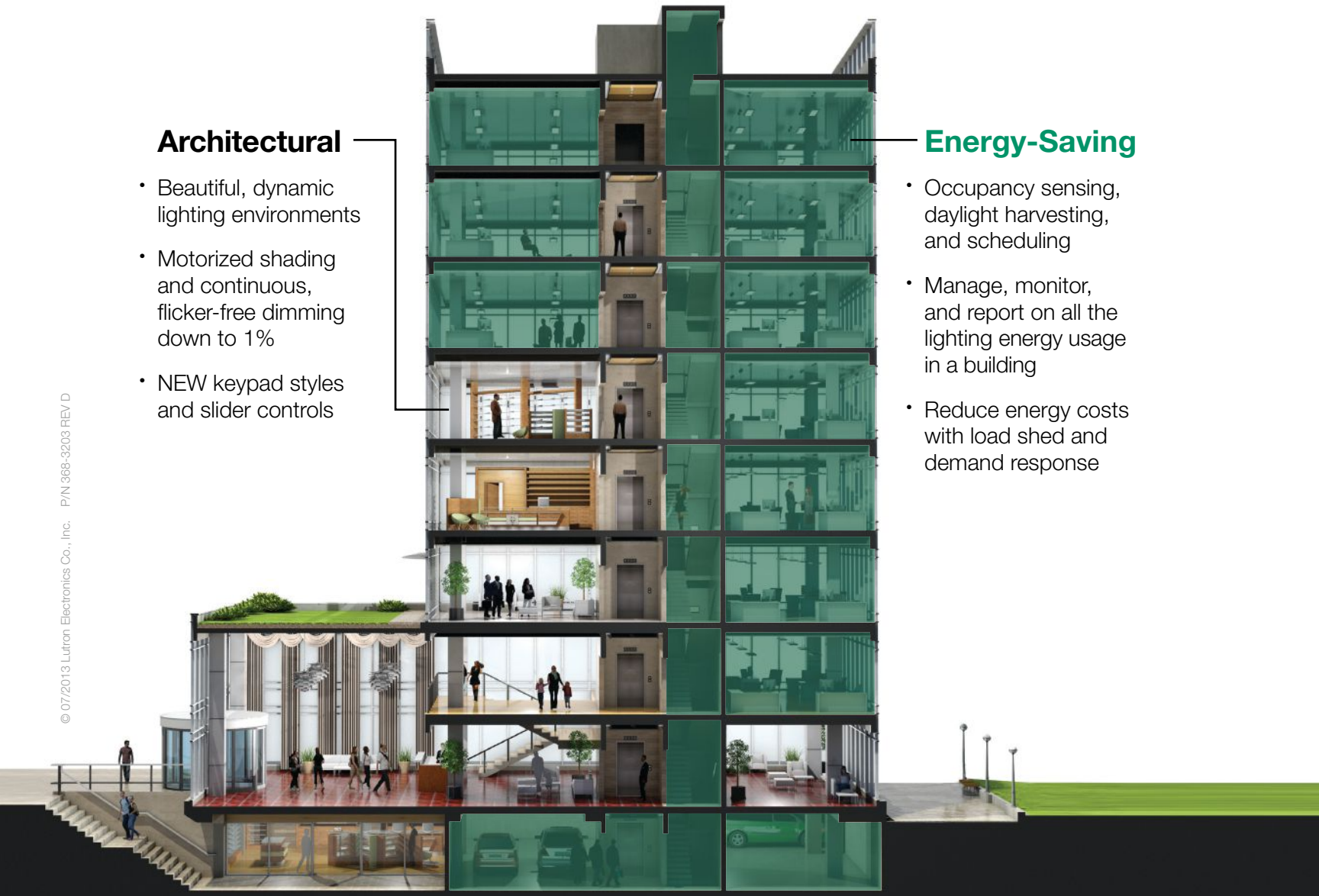
Quantum®:

The best of both worlds

Different spaces in your building have different needs.
Quantum Total Light Management™ handles them all.

Architectural

- Beautiful, dynamic lighting environments
- Motorized shading and continuous, flicker-free dimming down to 1%
- NEW keypad styles and slider controls



Energy-Saving

- Occupancy sensing, daylight harvesting, and scheduling
- Manage, monitor, and report on all the lighting energy usage in a building
- Reduce energy costs with load shed and demand response

Contact your local Lutron sales representative to find out how you can enjoy the best of both worlds by including Quantum on your next project.

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