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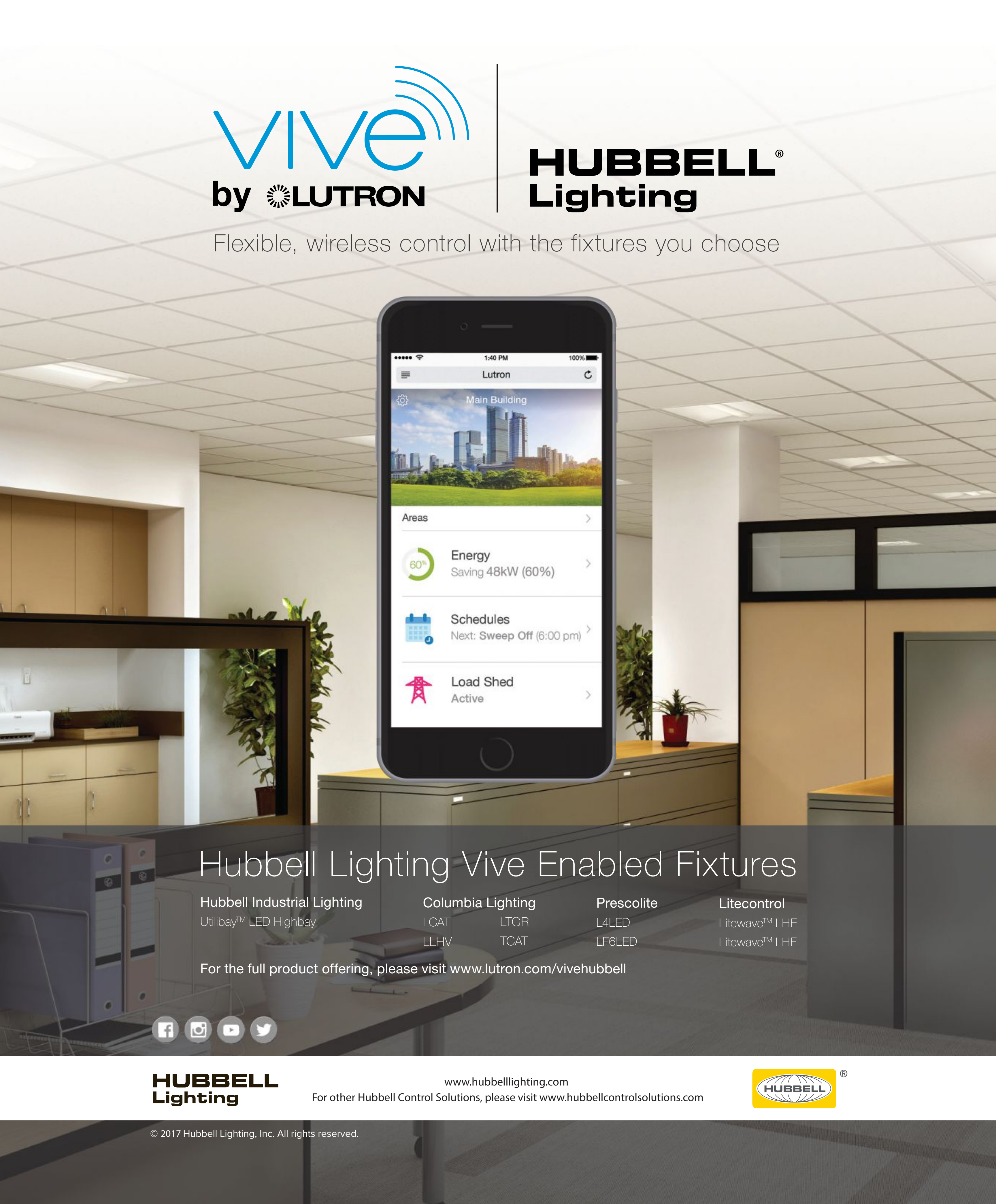
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WET

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ONLINE

A view of the light frieze at the Kunstmuseum in Basel, Switzerland.

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FEATURE

DEPARTMENTS

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As always, check out our website for expanded article coverage, videos, and news. Also, subscribe to our email newsletter, AL Notes, and find a link to ARCHITECTURAL LIGHTING's digital edition.

On the cover: William Rawn Associates, Architects' renovation of the Boston Public Library's Johnson Building: Photograph by Robert Benson Photography

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ARCHITECTURAL LIGHTING'S NEXT CHAPTER

Stephen Voss

The Editor's Comment is one of the most challenging articles to write. Deciding what to say, or not say, is something I take very seriously. This is the 78th time during my tenure with ARCHITECTURAL LIGHTING that I have the privilege of addressing you, the lighting community.

Over the years, I have used this page, hopefully with objectivity, to initiate debate, ask critical questions about the future of architectural lighting design, and address the pressing issues facing the lighting community. I've also encouraged the community to think about its role in the overall design process and its relationship to architecture. My motivation has been for the lighting community to see itself on equal terms with architecture, design, and engineering. In raising issues, I have always tried to offer a way forward. Lighting's greatest ongoing challenge is how it communicates its importance to the architectural arts, for it is one of the most important elements in a building, and it can make or break the success of any project.

This editorial approach has resonated with readers in print and online, and many have told me that AL—and this page in particular—has served as their guide in evaluating the industry's important issues. But it's not just during my tenure—14 years and 3 months, including 11 years as chief editor—that AL has led the way. AL has always played a unique role as the profession's independent voice.

Over the course of the publication's 31-year history, it has been at the leading edge of the lighting conversation. Never has that been more true than today, as we create more content than ever, across multiple platforms. From print to web to social media, AL engages with a worldwide audience of lighting designers, manufacturers, architects, emerging professionals, and students who are all working to shape the built environment. In each medium, AL has always maintained a strict commitment to editorial integrity and quality. Our imperative as a media brand has always been to inform, educate, and inspire as we serve as the eyes, ears, and voice of the lighting industry.

That is why it is particularly bittersweet to tell you that, starting in 2018, AL will become a digital-only entity—at *archlighting.com* and in our twice-monthly email newsletter AL Notes. This print issue you hold in your hands is the last of its kind. The print-to-digital transformation is something that all media brands, no matter the subject matter or audience, have had to face over the past decade. I had hoped we would be able to maintain our full portfolio longer, but business conditions for both publishing and lighting point in a different direction.

Additionally, Dec. 8 will be my last day as editor-in-chief, although I will help guide AL through its next chapter in an editor-at-large capacity. I'm particularly proud of the way we weave together the worlds of architecture and lighting design. When asked how I see AL, I've always said it is a lighting publication about architecture and an architecture publication about lighting. All the hard work is worth it, because it allows me to connect with all of you, and it gives AL an impact beyond lighting.

Over the years, we've received a number of prestigious journalism awards. In 2017, AL was a Top Ten Finalist for Magazine of the Year in the American Society of Business Publication Editors' Azbee Awards. In 2016, this column was recognized with a Jesse H. Neal Award in the category of Best Commentary/Blog. And in 2015, AL received another Neal Award for Best Media Brand (Overall Editorial Excellence), about which the jury said, "ARCHITECTURAL LIGHTING offers consistent quality of content and presentation across every platform, creating a brand presence and image of superiority, taste, and intellect."

AL doesn't just raise the bar in lighting journalism, it sets the bar. It has been my distinct honor and privilege to serve as its steward. I look forward to AL's next chapter; I'll see you online.

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"THE LITTLE DETECTIVE: SEARCH FOR THE BOOK"

For companies that produce products for architecture and lighting, design and business often come together in unique ways. For the past 26 years, the Zumtobel Group—parent company of six international lighting brands including Zumtobel, acdc, and Thorn—has partnered with architects and designers in the creation of its yearly business communiqué. For its 2016/17 Annual Report, the company selected Yung Ho Chang, an American-Chinese architect and professor at the Massachusetts Institute of Technology, who has developed a character called "The Little Detective," based on a story told to him as a child by his father. Using drawings, paintings, and photographs he produced between 1998 and 2016, Chang tells a tale of the Little Detective searching for a lost book and encountering "the opposing forces of light and darkness." —Elizabeth Donoff • *Read more at archlighting.com*


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GATES OF LIGHT

To protect itself from flooding, the Netherlands is guarded by a 32-kilometer-long (19.8-mile-long) dike called the Afsluitdijk. Completed in 1932, it is one of the country's engineering feats. Now, the government, at both national and local levels, has united in "an ambitious programme to protect and safeguard" its future. To celebrate the unique infrastructure, Rotterdam-based Studio Roosegaarde has designed a trio of interactive lighting installations. Titled Icoon Afsluitdijk, the series is comprised of Gates of Light, Windvogel, and Glowing Nature. Gates of Light (shown) is inspired by the reflective qualities of a butterfly's wings. Each of the dike's fully restored 60 floodgates has been treated with a reflective layer that illuminates when activated by a passing car's headlamps. All three installations can be viewed Nov. 17 to Jan. 21, 2018, at sunset. —**E.D.** • *Read more at archlighting.com*

Studio Roosegaarde

©Erwin Redl

WHITE LIGHT

Artist Erwin Redl's installation "Whiteout" will be on view from Nov. 16 through March 25, 2018, on the central Oval Lawn in Madison Square Park in New York City. The artwork is the 35th outdoor exhibition sponsored by the Madison Square Park Conservancy, which has been showcasing the work of living artists in the park since 2004. The piece, which measures 110 feet wide by 180 feet long by 12 feet tall, incorporates 900 transparent white spheres suspended via cabling from a grid of steel poles. A white LED is embedded in each orb, and each orb floats 2 feet above the ground plane of the lawn. The artist's computer-generated wave pattern sequences across the spheres from north to south and south to north creating "a luminous white carpet of LED lights" and a source of public illumination during the short, dark days of winter. —E.D. • *Read more at archlighting.com*


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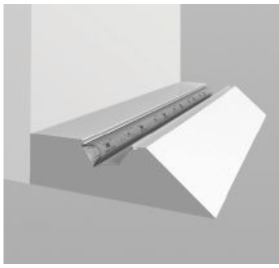
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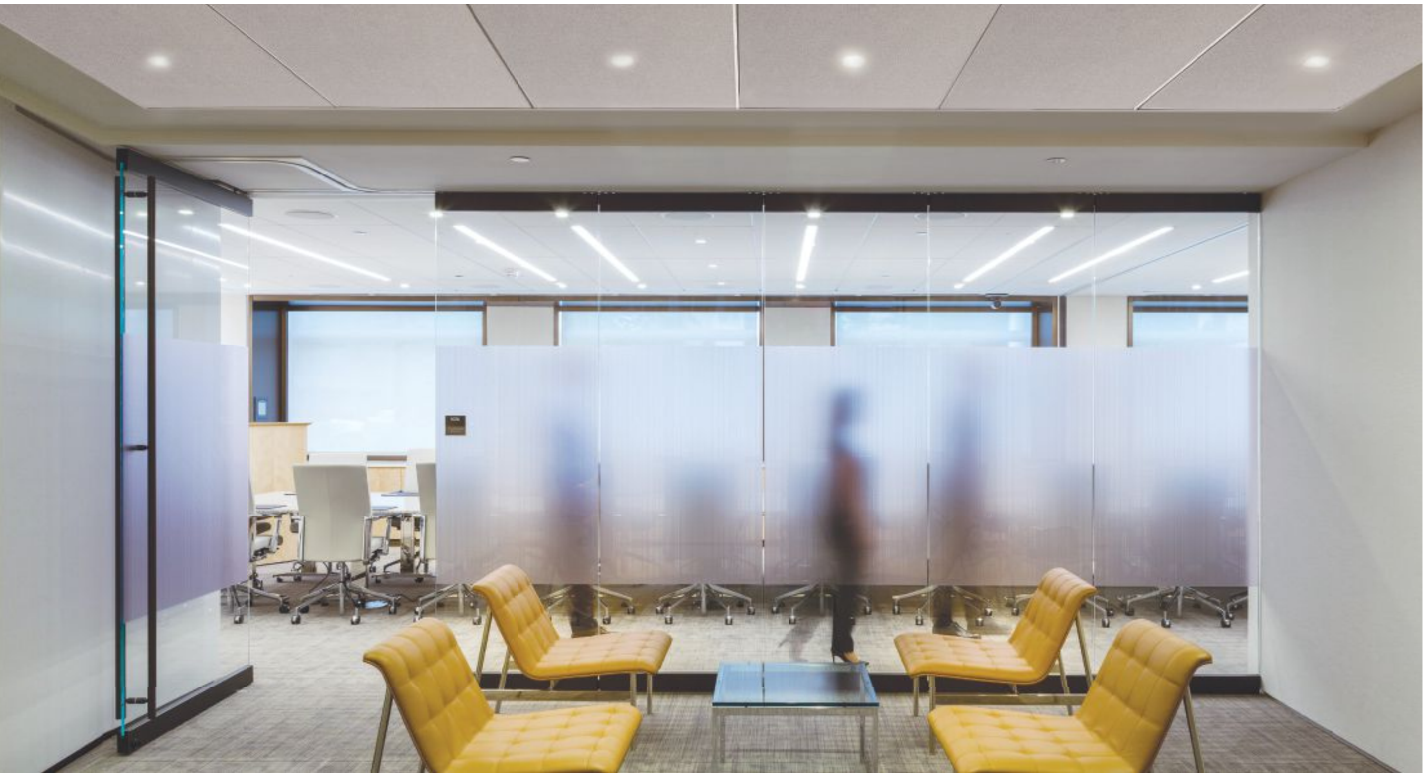


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ALIVE AND WELL

The WELL Building Standard is making inroads in the AE industry, but what impact will it have on the design community and the design process itself?

text by Katharine Keane

In June 2013, *New York Times* journalist Robin Finn previewed a residential trend then emerging in New York City: "Coming soon to a neighborhood near you: an empathic multimillion-dollar home that passively treats the occupant's body like a temple," she wrote in her article "Health-Centric Homes, for a Price." "The second coming of sustainable real estate, it will fuse green technology with nourishing all-about-me amenities and direct them indoors."

The article goes on to examine the then relatively new company Delos, branded as a "wellness real estate" enterprise founded by former Goldman Sachs executive Paul Scialla. Just a few months following *The New York Times* article, Delos

The American Society of Interior Designers office attained WELL-Platinum certification in June 2017.

Courtesy of Wild Factory

launched a subsidiary company, the International WELL Building Institute (IWBI) which unveiled the WELL Building Standard (WELL) in October 2014—a program six years in the making.

In the three years since the program's debut, more than 120 million square feet of real estate across 31 countries has been registered or certified by WELL standards. Yet, most design practitioners do not understand what WELL is or how it will impact design and construction.

WHAT IS WELL?

According to Delos, WELL is "the world's first building standard focused exclusively on human health and wellness." The program positions itself as a new standard in responsible construction, with benchmarks and guidelines for the design of buildings that promote the physical, emotional, and mental health of the inhabitants.

Scialla's interest in developing such a standard came about when he noticed a gap in the certification market when his employer—Goldman Sachs—was seeking Leadership in Energy and Environmental Design (LEED) certification for its office building. IWBI chief product officer Rachel Gutter recounts, "When he encountered that certification for the first time in the new space, he thought, 'This is really great, but where are the people in all of this?'"

Coupling this interest with his research on healthy buildings, Scialla opted to retire early from Goldman Sachs to focus on the creation of the New York–based Delos. The main goal of the wellness consultancy and real estate development company is "exploring the intersection between people and the built environment." The company's mission statement proclaims: "We see the built environment as an asset to maximize human potential, and we envision environments that enhance us—that are both proactive and reactive—to live better by cultivating healthy lifestyle choices and helping prevent health problems before they begin."

With the IWBI in place to implement these initiatives, the WELL team set out to create the standard, primarily through "extensive literature review of the existing research," Gutter says. "The version that's currently being utilized by the market went through a three-phase peer review process [by] design practitioners, medical practitioners, and scientists."

One of these peer reviewers was Chad Groshart, lighting design practice leader of global environmental design consultancy Atelier Ten. "I was motivated by this idea that someone was trying to build a standard that incentivized good lighting for humans and laid out a framework for how to create a better visual environment for people," Groshart says.

The current iteration of the standard, WELL – version 1, prioritizes seven key features: Air, Water, Nourishment, Light, Fitness, Comfort, and Mind. Each of these categories is organized into subcategories—air, for example, is subdivided into 29 "features" including air filtration, microbe and mold control, and cleaning protocol. (See sidebar at left.)

While the current WELL standards are still considered part of version 1, peer reviewers have made recommendations based on individual expertise, some of which have been translated into amendments. Version 2 will hit the market sometime in 2018. "The standard is a living, breathing thing," Gutter says. "It undergoes changes on a quarterly basis."

THE CERTIFICATION PROCESS

Like other non-code (meaning not required) certification standards, WELL necessitates multiple steps to attain certification at one of three levels—Silver, Gold, or Platinum. Applicants must first register their project (for a fee) and submit documentation including design drawings, operations schedules, and other project narratives and materials, as well as letters of assurance from architects, contractors, engineers, and owners to confirm that WELL feature requirements have been met. (Based on

WELL'S LIGHT CATEGORY FEATURES

According to WELL, the program's lighting guidelines are intended to "minimize disruption to the body's circadian system, enhance productivity, support good sleep quality, and provide appropriate visual acuity."

Breakdown by Feature

Feature 53: Visual Lighting Design
Feature 54: Circadian Lighting Design
Feature 55: Electric Light Glare Control
Feature 56: Solar Glare Control
Feature 57: Low-Glare Workstation Design
Feature 58: Color Quality
Feature 59: Surface Design
Feature 60: Automated Shading and Dimming Controls
Feature 61: Right to Light
Feature 62: Daylight Modeling
Feature 63: Daylighting Fenestration
Feature P2: Light at Night
Feature P3: Circadian Emulation

WELL's online pricing calculator, the registration fee for a hypothetical 100,000-square-foot new building would be $6,500 and the program and support fees would be $47,500 including an 18 percent early adopter discount, bringing the cost-per-square-foot to 54 cents.)

Once a WELL Assessor—third-party certifiers from Green Business Certification Inc. (GBCI)—reviews and approves the documentation, applicants schedule an on-site performance verification, but not before meeting certain occupancy requirements, which

Arup's Boston office achieved WELL-Gold certification in July 2017.

vary based on building type. Only then can a WELL Assessor visit the project for on-site measurements and inspections.

Once all these steps have been completed, WELL creates a feature-by-feature assessment report—scoring each of the seven categories individually. If the pursuant team accepts the report findings, certification is complete.

Projects must seek re-certification after three years under the initial standard, but must make applicable changes at the six-year mark to comply with the most current version of WELL. "They don't go through a full certification effort," Gutter says. "They've got to attest to anything that's changed in the project, and also demonstrate that they're able to meet our performance measures." Given the costs associated with attaining and retaining WELL certification, as well as the goal of "driving the market toward a state of continuous monitoring," the IWBI is considering a subscription-based payment model for future versions—but no plans have been confirmed at press time.

THE BENEFITS

In addition to incentivising design that promotes human health, upon closer examination the practical outcomes of WELL divulge another benefit—in the current real estate market, WELL-certified buildings might be worth more. "The value of [a] brick-and-mortar [building] will always be measured against market comps," says Tom Paladino, CEO and founder of Seattle-based green building consultancy Paladino and Co. "If buildings surrounding your property are selling at $500 per foot, everyone is going to expect your building to cost $500 per foot—unless it's special. And one way it could be special is to be WELL certified."

WELL-certified buildings can also be used by corporate tenants as a marketing tool to attract top talent. "The Fortune 500 companies think, 'We've gone to great lengths to recruit, we want to engage and retain these people,'" Paladino says. "So it makes sense that if you're going have a facility that you own and operate, it really has to be above average."

According to Gutter, the current interest in WELL supports this fact. "Several dozen multinational corporations, including [a] substantial number of Fortune 500 companies, are really interested in exploring participation in the portfolio offering," she says.

WHAT ABOUT LEED?

Since the IWBI's inception, there has been a great deal of cross-pollination between the LEED and WELL programs. In fact, IWBI CEO and chairman Rick Fedrizzi served as CEO and founding chair of the U.S. Green Building Council (USGBC)—LEED's creator and administrator—for 15 years prior to joining the IWBI in 2016. (Rachel Gutter also served as the senior vice president of knowledge at the USGBC before joining the IWBI team.) Even though both programs use the same independent credentialing company—GBCI—the IWBI maintains that, although the entities are complementary and they plan to collaborate going forward, their ultimate goals vary. "The true north of LEED is about conservation of resources for the good of the planet," Gutter says. "The north star of WELL is about enhancing human health and wellness."

According to Gutter, at present there is a 25-percent overlap between the two standards,

Darrin Hunter, courtesy Dyer Brown

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Saks Fifth Avenue, Brickell City Center Miami, FL • Lighting Design: Oculus Light Studio and the organizations are advocating for dual certification. "Buildings that pursue both LEED and WELL certification are socially responsible and encourage the best health, productivity, and longevity of the biggest investment made in the building over its lifetime—its people," said Megan Sparks, USGBC program manager and GBCI director of integration strategy in a statement to ARCHITECTURAL LIGHTING. A dual certification process could make an already involved and often complicated process that much easier for both clients and designers.

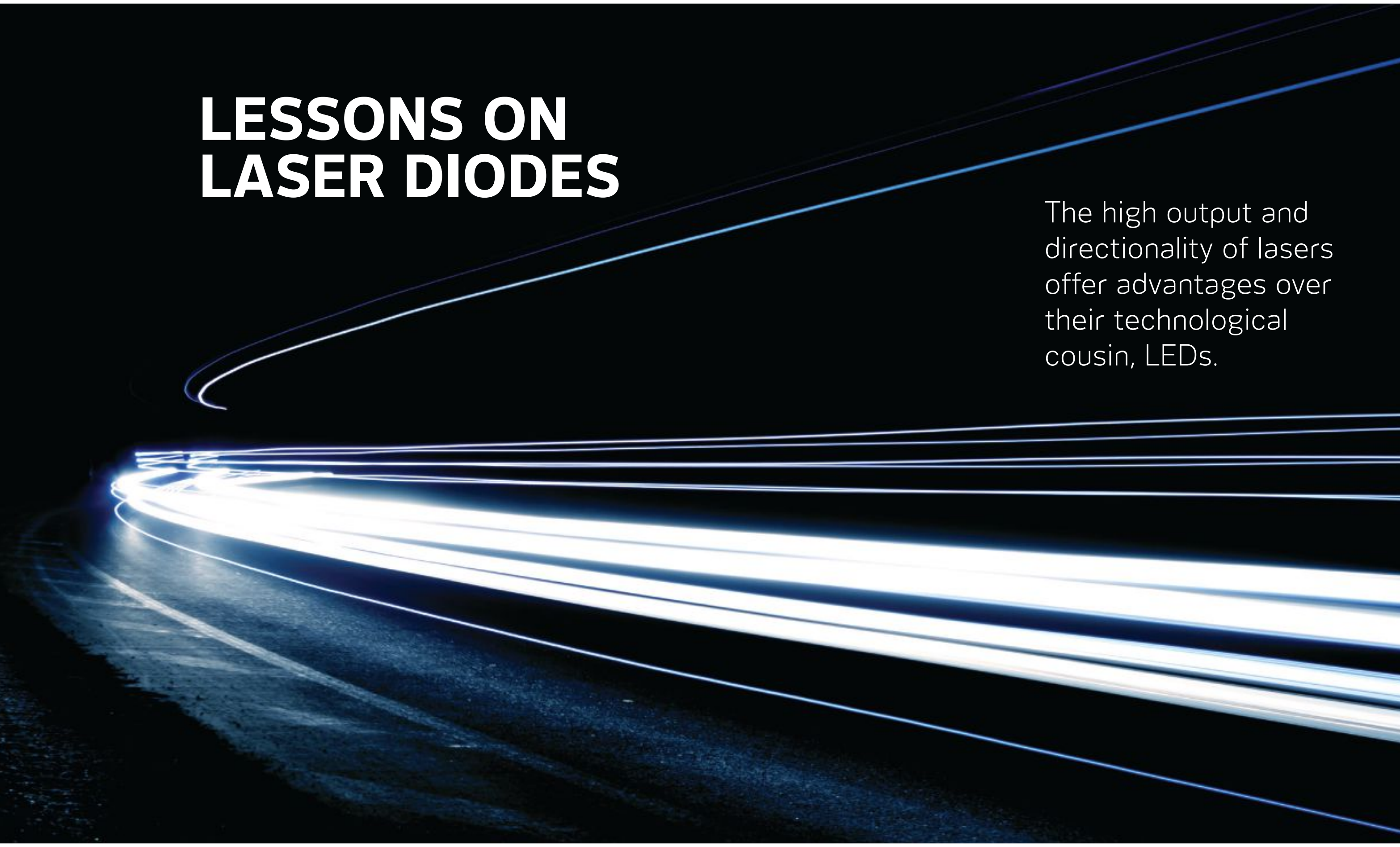
WELL'S LIGHTING IMPACT

One of the greatest challenges in establishing new standards across industries is accurately conveying best practices for both the novice and the experienced practitioner. IWBI director of standard development Gayathri Unnikrishnan, trained in lighting design, is spearheading the effort to create well-informed protocols for the lighting category. "We have a practice of reaching out to our friends in the lighting industry," she says. "In fact, we are building an educational resource for lighting designers to explain how they can implement the current WELL Building Standard and talk about the synergy that we have with LEED. A working group from the International Association of Lighting Designers was involved with that."

Though some of the IWBI's initial recommendations did not match current industry lighting standards, Groshart says, "once [the IWBI] got some feedback on how the design process works, they were able to make some changes and make it a little more user-friendly."

Ultimately, it may be too soon to tell what kind of impact WELL will have on the design community. Given the current pricing configurations, the certification begs the question, is healthy design only attainable for the "one percent" of buildings? Regardless of the program's ultimate goal of creating healthy environments for inhabitants—that, in some ways, should already be the result architects and lighting designers strive for—it is unclear if WELL will be accessible enough to influence the AE industry at multiple levels.

"The WELL building certification process is quite extensive, and there are some requirements that not everybody sees the value in," Groshart says. "But there's no reason that we shouldn't start designing buildings with better visual environments today. We can take some of the good advice in the standard and apply it to our projects just because it's better for humans, not because we're chasing points." •



LESSONS ON LASER DIODES

The high output and directionality of lasers offer advantages over their technological cousin, LEDs.

text by Jeff Hecht

For decades, vibrant laser lights have dazzled concertgoers, sports fans, and others. But behind the spectacle were technological limitations. A laser beam could illuminate only one spot at a time and never in white. Further, illuminated patterns created using lasers were rife with the ever-shifting and somewhat eerie phenomenon of speckle. However, recent advancements in solid-state lighting have informed the use of lasers in a wider range of lighting applications, from the precise short-throw illumination of building façades to long-range automobile headlights.

LASER DIODES VERSUS LEDS

Laser diodes are close technological cousins to light-emitting diodes, or LEDs. The diodes, or chips, both comprise two-terminal semiconductor devices that convert the flow of electrical energy into light of a specific wavelength, or color, which is dependent on the semiconductor blend used. Manufacturers create white LEDs by directing light from blue chips onto phosphors—chemical compounds that emit yellow

light when illuminated by blue light. The emission from this yellow phosphor and the blue LED combine to produce light that appears white to the human eye.

Laser diodes have two mirrors on the opposite ends of the semiconductor chip, one of which is partially transparent, like a two-way mirror. At low power levels, a laser diode works essentially like an inefficient LED. However, once the electrical power reaches a threshold density of around 4 kilowatts per square centimeter, the semiconductor emits enough light for a portion of the wavelengths reflecting between the mirrors to stimulate the semiconductor to emit more light, surpassing an LED's output. Furthermore, the light reflecting between the mirrors emerges through the semi-transparent mirror to create a narrow blue beam that can be directed onto a phosphor to generate yellow light.

Blue LEDs have a high luminous efficacy, converting up to 70 percent of the electrical power passing through them into light at a power density of 3 watts per square centimeter. That's considerably more efficient than blue laser diodes, whose power conversion peaks at around 30 percent when electrical power density tops 10 kilowatts per square centimeter, according to "Comparison Between Blue Lasers and Light-Emitting Diodes for Future Solid-State Lighting," a 2013 paper published in *Laser & Photonics Review* by Jonathan Wierer Jr., an associate professor of electrical and computer engineering at Lehigh University. However, LEDs can only achieve that high efficacy at low-current levels, which would require large areas of expensive semiconductors.

Pumping more current through LEDs can make them painfully bright—an outcome easily illustrated by removing the diffuser from an overhead LED fixture. While increasing the current reduces LEDs' efficacy sharply, a phenomenon known as "droop," the efficacy of laser diodes appears unaffected. So at electrical power densities of about 5 kilowatts per square centimeter, LEDs become less efficient than diode lasers, and that performance difference increases with the power level.

The output of a laser beam is only 1 to 2 degrees as compared to the 90-plus-degree light emission cone of LEDs. And, notably, the wavelengths of laser light fall within one nanometer, as compared to a few tens of nanometers for LED light. These differences make lasers valuable in some applications where LEDs fall short.

Within a diode, the laser can be focused onto a tiny spot on a phosphor to produce a narrow, intense beam with a luminance as much as 20 times greater than that of an LED. "We can generate 500 lumens from a focal spot of only a few hundred micrometers,"

SAFETY AND SPECKLE IN LASERS

One thing that should remain unseen in laser lighting is the laser light. Like the sun, looking directly into a laser beam can burn the retina. In products that incorporate lasers, such as Blu-Ray disc drives, the highly concentrated laser beam stays inside the box. "We ensure there is no blue [laser] light coming out directly from the laser," says SoraaLaser co-founder Paul Rudy. "The only blue light coming out is either down-converted to yellow or scattered for use as part of the white light."

A direct reflection, from a mirror for example, can be dangerous, but a diffused reflection, off a wall finished in flat paint, scatters the beam and does not pose a hazard. Strategic optical design decisions, such as avoiding transmissive phosphors, also reduce the risk.

Speckle, an undesirable artifact of laser illumination, describes the grainy composition that appears to twinkle with the slightest of air fluctuations. Harmless but annoying, it can be prevented by diffusing laser light with ground glass or white glass.

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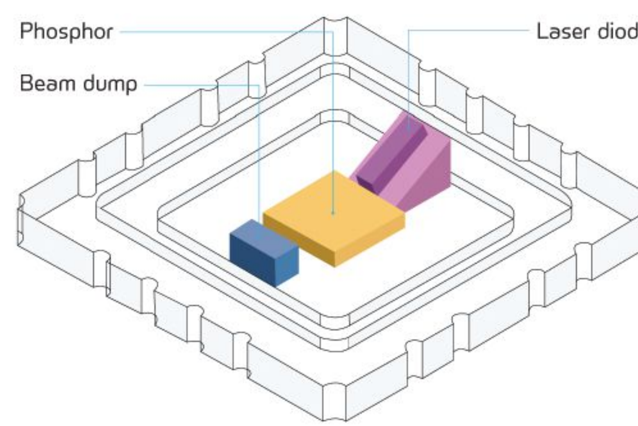
BLADE
WALL SCONCE

says Paul Rudy, co-founder and senior vice president of business development at the Fremont, Calif., office of SoraaLaser, which produces blue laser diodes. (SoraaLaser, a spinoff of lighting manufacturer Soraa, is one of the few companies beginning to explore laser lighting applications for an architectural lighting audience.) "With lasers and 1-inch optics, we get a spotlight beam of around 1 degree," he adds. "That's revolutionary. You can think of kilometer flashlights and long-range headlights."

Automobile manufacturer BMW, which has deployed laser lights in some of its models, reported in 2015 that a blue laser emitted from a 30-micrometer by 4-micrometer surface emitted as much optical power as LEDs covering an 800-micrometer square. To reach the maximum high-beam range allowed in the European Union, BMW designed a headlight that combined a wide angle, LED-illuminated phosphor unit with a narrow angle, long-range, laser-illuminated phosphor that could deliver an illuminance of 1 lux at 600 meters (1,968 feet). After being modified to meet U.S. headlight standards, a version of the headlights is now available domestically.

WHITE LIGHT LASER SURFACE-MOUNT DEVICE PACKAGE



SoraaLaser uses semi-polar gallium-nitride laser technology to produce a white light laser surface-mount device. This 7-millimeter-square package comprises a blue laser diode, a 1-millimeter-square phosphor, and a beam dump that blocks the blue laser beam from directly illuminating anything.

DESIGN CONSIDERATIONS FOR LASER FIXTURES

Fixtures utilizing laser sources will inherently have different design considerations from those for LED fixtures, says Faiz Rahman, an optoelectronics expert and visiting Stocker professor at Ohio University's Russ College School of Electrical Engineering and Computer Science. A laser diode and a phosphor must be separated by enough space for the laser beam to focus and to keep the phosphor from overheating; conversely, phosphors can be adjacent to or coated directly on LEDs. Software, Rahman says, can help designers model the optics in laser luminaires.

SoraaLaser's current laser lighting products utilize blue lasers emitting near 450 nanometers, the standard wavelength output for white LEDs. Thus, they can use the same yellow phosphors used on LEDs to create white light. However, the blue laser light must be scattered or diffused by materials, such as frosted glass, to blend properly with the phosphor emission.

Laser lighting also can leverage the mature technology of 405-nanometer violet lasers, developed for Blu-Ray optical discs, Rahman says. Producing white light requires adding phosphors to convert the violet light into blue light at 450 to 460 nanometers to complement the yellow phosphors. This conversion costs energy, Wierer says, but violet laser diodes' increased efficacy over blue lasers could make up the difference.

THE QUEST FOR MONOLITHIC WHITE LIGHT LASERS

Phosphor-based white LEDs dominate the solid-state lighting market because of their simplicity. Combining light from red, green, and blue LEDs to produce white light is another option, with the added ability to modulate color, as exemplified by several LED lamps on the market that have color-changing functionality.

In principle, RGB lasers can also be combined to produce white light, but the technology is still in research and development. One problem is the need to control or diffuse laser light for safety reasons and to prevent artifacts from laser illumination (see "Safety and Speckle in Lasers," page 28). Another is the challenge of finding suitable RGB laser sources.

Philips, for example, uses separate LEDs as RGB sources in its Hue lamp, with a higher proportion of green diodes because they are less efficient and emit less optical power than red or blue LEDs. The performance difference becomes larger for semiconductor lasers, with blue being the most powerful color, red less powerful, and green the weakest and shortest-lived. (Green laser pointers can be dangerously bright, but this light comes from crystalline lasers, not semiconductors.) To complicate matters, semiconductor lasers emitting each of the three wavelengths cannot be integrated on the same chip—desirable for mass production and quality control—because they are made from different semiconductor compounds that are deposited in different ways.

"It has been very difficult to have a monolithic piece of material that can make all the colors," says Cun-Zheng Ning, a professor at Arizona State University's School of Electrical, Computer and Energy Engineering. His group succeeded in integrating different colored laser diodes by eschewing the standard compounds—gallium, indium, nitrogen, and arsenic—used in semiconductor laser diodes in favor of a family of semiconductors composed of cadmium, zinc, sulfur, and selenium. By depositing different mixtures of those elements in thin layers, his team made a monolithic device that combines disparate diodes emitting blue, green, light red, and deep red light to produce white light. However, the technology is still solidly experimental.

At Aston University's Institute of Photonic Technologies, in Birmingham, England, professor Edik Rafailov's group has taken a different approach to producing white or color-tunable light from lasers. "We decided to use a broadly tunable infrared laser and convert it to a broadly tunable visible laser," says Rafailov. Infrared light can be shifted into the visible spectrum by combining two infrared beams in a thin, microstructured material—potassium titanyl phosphate—with a high nonlinear effect that adds their frequencies together. Mixing the laser outputs together produces red, green, and blue wavelengths.

ARCHITECTURAL APPLICATIONS FOR LASER SOURCES

The high intensity of lasers works well for spotlights and other lighting applications requiring narrow beams. Lasers with tiny optics can also illuminate precise areas with a large-angle, ultrashort throw, Rudy says. "You can project a 100- to 200-inch image even though you're only a couple of inches from the wall." Laser excitation of phosphors can produce very high contrast between bright and dark areas, with light gradients more than 10 times sharper than with LED-based sources. For example, a laser light source can uniformly illuminate a five-story building exterior from a single fixture near the ground floor. SoraaLaser's first-generation outdoor laser lighting systems have a nominal color temperature of 5700K and color-rendering indexes of 70 to 80.

Laser light can also be concentrated and directed into optical fibers or waveguides for transport, a difficult task with large-area LED sources. SoraaLaser is developing a fiber system to transport blue laser light to phosphors located in a remote luminaire so lighting designers and architects can specify fixtures for locations in which heat or electricity is undesirable.

The next big thing for SoraaLaser is spatially dynamic lighting, which Rudy calls "the convergence of display and lighting." Light from a static source is passed through a light-processing chip to create changing patterns, such as the shape of a spotlight, a company name, or dynamic imagery.

SoraaLaser expects the first wave of commercial, static lighting products to be available by 2019, with dynamic lighting to follow. Outstanding refinements include improvements to color rendering, energy efficiency, and performance for specific applications such as steerable spotlights, which will enable lasers to go where LEDs have yet not prevailed. •

Jeff Hecht writes about lasers and optics. His books include Understanding Lasers: An Entry-Level Guide, 3rd ed. *(Wiley-IEEE Press, 2008),* Understanding Fiber Optics, 5th ed. *(Prentice Hall, 2005), and* Beam: The Race to Make the Laser *(Oxford University Press, 2005). He is a Fellow of the Optical Society.*

SELECT RESOURCES

"Comparison Between Blue Lasers and Light-Emitting Diodes for Future Solid-State Lighting," by Jonathan Wierer Jr., et al., *Laser & Photonics Reviews*, 2013. Available at: bit.ly/2hwBsBp.

"Lasers Light the Road Ahead," by Abdelmalek Hanafi and Helmut Erdl, *Compound Semiconductor*, 2015. Available at: bit.ly/2mo0J2s.

"A Monolithic White Laser," by Fan Fan, et al., *Nature Nanotechnology*, 2015. Available at: go.nature.com/2AGx1J2.

ILLUMINATING THE OUTDOORS

These new luminaires can blend in or stand out in public spaces.

1

2

3

4

text by Selin Ashaboglu

1 **Calypso Compact, Targetti** • Calypso is an in-ground luminaire suitable for low-profile installations. Available in 4W or 8W at 3000K with a CRI of 84, the compact fixture measures 4.9" in diameter and has two lens options: a 15-LED diffused wide flood (4W version) and a seven-LED 10-degree clear spot (8W version). Lens selection determines lumen output, which is either 93 or 383 lumens. IP67-rated, the luminaire is drive-over-rated for vehicles weighing up to 20 kiloNewtons (one kiloNewton is approximately 225 pounds). • *targettiusa.net*

2 **Tex, Alva** • This large-scale, outdoor wall sconce designed by Culver City, Calif.–based Brilliant Lighting Studio for Alva is designed for doorways, lobby entrances, or placing between windows. The direct/indirect luminaire is Title 24–compliant, IP66-rated, and capable of withstanding high-pressure washing of exterior surfaces. It measures 12" wide and is offered in three lengths: 30", 45", and 60"; three wattages: 23W, 29W, or 37W (3500K with a CRI of 90); and delivers up to 3,700 lumens depending on the wattage. Tex can be installed vertically or horizontally using a steel mounting system. The luminaire is zero-to-10V dimmable. • *alvalight.com*

3 **Scoop, WAC Landscape Lighting** • Part of WAC Lighting's new family of landscape lighting offerings, this IP66-rated LED bollard is suitable for illuminating outdoor spaces such as walkways and parking areas. Available in wattage options of 5.7W, 10.5W, or 12.5W in either 2700K or 3000K with a CRI of 90, Scoop delivers up to 350 lumens depending on wattage selected. The fixture measures 30" tall by 5" in diameter, and operates with 12V, 120V, and 277V systems. Dimming options include TRIAC, ELV, and MLV, depending on voltage. • *waclandscapelighting.com*

4 **Matrix, Beacon Products, Hubbell Lighting** • This series of high-mount area and floodlight luminaires, suitable for illuminating large public spaces, can replace up to 1,000W high intensity discharge systems. Matrix is available in 3000K, 4000K, and 5000K with a CRI of 70, and delivers a range of 33,000 to 60,000 lumens depending on wattage. Four mounting applications are offered: upswept arm, knuckle, mast arm, and post top. The 29.7"-long by 25"-wide fixture head has five optics types. Energy savings control options include SiteSync, Energeni, and occupancy sensors. Available in eight finishes. • *hubbelloutdoor.com*

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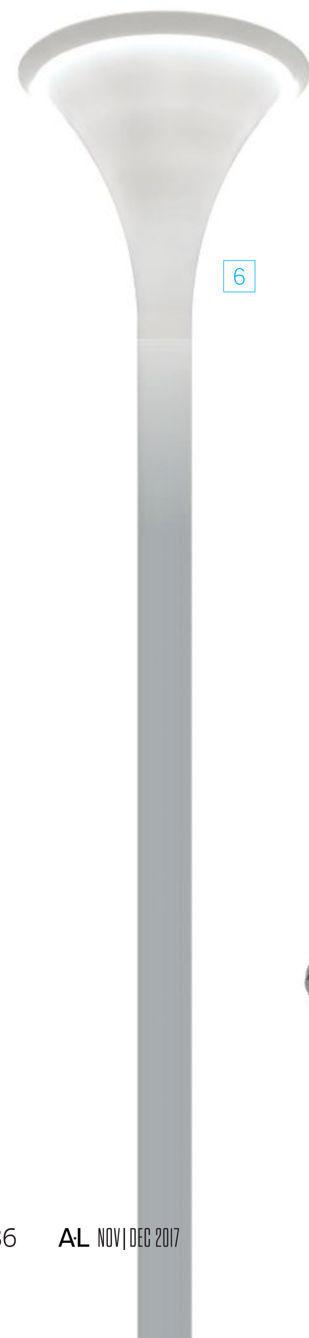
5

6



7

8

5 **GWC Galleon Wall LED, McGraw-Edison, Eaton** • This wall-mounted luminaire is suitable for outdoor area and site illumination. Fitted with a choice of 13 patented AccuLED Optics, the 15.7"-wide by 12"-deep fixture is available in 4000K with a minimum CRI of 70 as a standard option, as well as custom color temperature options of 3000K, 5000K, and 6000K. Eight lumen packages, ranging from 3,700 to 14,400 lumens, are offered depending on wattage and color temperature. The fixture is installed using a steel attachment that fits directly to a J-box or wall via the Galleon Wall "Hook-N-Lock" mechanism. • *cooperindustries.com*

6 **Lunetta 28" Pedestrian and Area Luminaire, Amerlux** • Suitable for outdoor commercial use and public spaces, this luminaire has a flared pole-top fitted with recessed LEDs around the perimeter. The 60W fixture is available in 3000K, 3500K, and 4000K and delivers 4,620 lumens. The fixture head is made of spun-aluminum and measures 28" in diameter by 26" deep, and the maximum length of the 5"-diameter pole can be 16'. Available in three thermoset polyester powdercoat finishes, Lunetta is zero-to-10V dimmable, ETL listed, and suitable for wet locations. • *amerlux.com*

7 **rNook-16, Holm, Hunter Industries** • Designed to illuminate commercial outdoor spaces, this recessed luminaire uses an integrated Xicato LED module and Holm's Next Generation Corrected Cold Phosphor Technology to maintain light quality and uniform color. The 11.2"-square fixture is available in 2700K, 3000K, 3500K, and 4000K with a minimum CRI of 81, and delivers a range of 629 to 1,856 lumens. The rNook-16 has three beam spread options and also uses Holm's ProAim technology for precise fixture-locking adjustments to prevent theft or tampering. IP65-rated, the die-cast aluminum fixture operates on 110V to 277V and is phase or zero-to-10V dimmable. • *holmlighting.com*

8 **Kazu, Schréder Group** • This pole-mount luminaire utilizes the company's LensoFlex2 and ThermiX technologies—the former is a photometric engine for even light distribution, the latter for thermal management. The 20.6"-diameter by 6.3"-deep fixture head features curved cooling fins to protect from dirt and is pre-wired for installation. Available in two fixture head styles: a flat, polycarbonate protector or a symmetrical dome-like protector, Kazu can be specified in 23W or 80W in either 3000K or 4000K, and delivers between 2,000 to 7,000 lumens, depending on the wattage. Optional control solutions include photocell or Owlet. • *schreder.com*

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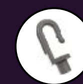
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BACK FROM BRUTAL

After decades of decline, the Boston Public Library's bright and renovated Johnson Building lets the light in.

Robert Benson Photography

Boylston Hall, the library's new two-story multifunctional space, opens the building to the street and features a wooden vaulted ceiling, mobile carts, and welcoming general light.

text by Mimi Zeiger

Brutalism can be tough to love. Characterized by their critics as hulking concrete edifices that turned weather-streaked and brooding over the decades, this most loathed of architectural styles has sparked new interest in recent years. While detractors bemoan the aesthetics, fans—architects, historians, preservationists—remind us that these structures from the 1950s, 1960s, and 1970s once spoke of a bright future for the city and represented dedicated investment in the civic realm.

Still for many, Philip Johnson's 1972 addition to the Boston Public Library's historic Back Bay location was one of the worst offenders—blighted when compared to its connecting neighbor, McKim, Mead & White's Renaissance Revival and Beaux-Arts masterpiece built in 1895. Johnson's design combined Brutalism with a historicist bent and mirrored the former scheme of an arcade courtyard surrounded by stacks and reading rooms with a nine-square structural grid and a central three-story atrium. For the addition's façade, he translated the original's stately pattern of arches into three large vaults on each side of the building.

The public was unimpressed. Large granite plinths on the exterior blocked natural light; tinted glazing left the interior dark and murky. It didn't help that over the years attendance dropped and the structure suffered from inattention. But that changed when Boston architecture firm William Rawn Associates, Architects (WRA) and Cambridge, Mass.–based lighting designers Lam Partners finished a two-part renovation in 2016.

"The Johnson Building was the second most hated building in Boston; the first is City Hall," says Lam Partners principal Paul Zaferiou, referring to the Kallmann McKinnell & Knowles building, also in the Brutalist style and completed in 1968. "It was hated because it was neglected. Lights were burning out, there were hideous rows of fluorescent lighting, and no pleasant place to sit and read."

According to Zaferiou, when the design team embarked on the architectural makeover, then Boston Mayor Thomas Menino laid out an ambitious mission: The library must become a lively cultural center for the city.

Although the exterior of the building is protected by the Boston Landmarks Commission and was required to remain untouched, the dank interior of the foyer was stripped back to its

structure. The plinth planters that blocked light into the ground floor were removed and new clear windows were installed, a radical move that took careful negotiation with preservationists. "Libraries have changed fundamentally in the last 50 years; this library needed to be connected to the city, to be welcoming, not a bunker," says architect and WRA principal Clifford Gayley. "But opening up the ground floor of the building flew in the face of the landmark status."

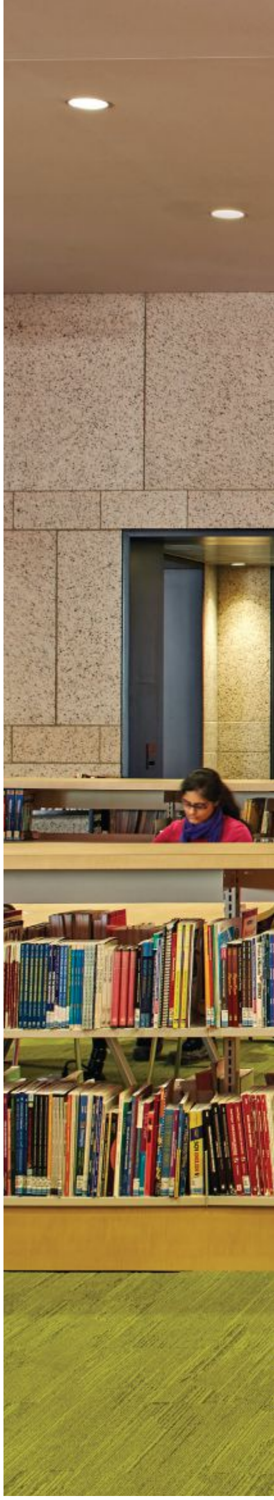
Before the team started work, Gayley and the other designers undertook extensive research into Johnson's built work and writings. This allowed them to be more sensitive to both his original vision and his shortcomings, such as with the library's entry. WRA met regularly with the staff of the Boston Landmark Commission and together they moved forward a scheme that would ensure that the library would thrive.

True to Lam Partners' philosophy to understand the spirit of the building and fold light into what the architects were trying to achieve, the lighting firm's integrated illumination scheme supports the overall vision for the newly light-filled entry spaces along Boylston Street and act as a "living room" for the city. Named Boylston Hall, this two-story multifunctional space includes the main lobby, a café, a studio for WGBH radio, and an enlarged and refreshed connection to the McKim Library. "The whole feeling of the lobby is one of community," says Zaferiou.

Here, the WRA team created a series of long wooden vaults that are suspended from the existing concrete ceiling. Each one has a small cove at its bottommost edge that conceals a 13W-per-linear-foot 3500K LED strip with a wide beam to create an ambient glow. Recessed 6-inch-diameter 57W 3500K LED downlights are positioned between slats to wash the floor with light. Zaferiou explains that the team wanted to create a welcoming general light, but that it was also important to keep the lighting flexible. And because the lobby is intended to serve so many functions, the architects created a series of sculptural book carts that can be moved and reconfigured depending on the activity. Lam Partners integrated surface-mounted 3W-per-linear-foot 3000K LED tapelight—in an extruded aluminum channel with a snap-in lens—into the mobile structures and equipped each one with a power source to plug into the floor.

The existing atrium was one of the most challenging spaces to relight because the three-story space was so tall and there was no way to conceal the fixtures. Lam Partners retrofitted the existing perimeter ceiling slot, swapping out energy-hogging high-powered 1,000W halogen floodlights for adjustable 50W 3000K LED spots. The new low-maintenance fixtures were zoned on a lighting control system to create different scenes, and use a fraction of the wattage in order to meet the City of Boston's energy efficiency goals for public buildings.

After decades of dreary utility, the Johnson Building's interiors are now bright, colorful spaces that welcome the public. "There's amazing transparency," Zaferiou exclaims. "It's a great metaphor for a modern library: Information is transparent and easily accessible." •



Opposite: Bruce T. Martin;
Above: Robert Benson Photography

The distinct architectural styles of the two buildings' façades on Boylston Street (opposite).

The stacks are lit with staggered and suspended T5HO 3500K linear direct fixtures (this image).

DETAILS

Project: Boston Public Library Central Branch Johnson Building Improvements, Boston • **Client:** City of Boston • **Architect:** William Rawn Associates, Architects, Boston • **Lighting Designer:** Lam Partners, Cambridge, Mass. • **Structural Engineer:** LeMessurier, Boston • **M/E/P Engineer:** Cosentini, Boston • **Project Size:** 156,000 square feet • **Project Cost:** $78 million • **Lighting Cost:** $1.3 million • **Watts per Square Foot:** 0.72 • **Code Compliance:** Massachusetts State Building Code (IEBC-2009 with 780 CMR)

MANUFACTURERS

Acolyte • ALM • Beta-Calco • Bega • Birchwood • Belfer • B-K Lighting • Edison Price • Eureka • i2Systems • Inter-lux • Limburg/Bega • Philips Color Kinetics • Philips Lightolier • Pinnacle Architectural Lighting • PMC Lighting • Schmitz • Scott Architectural Lighting

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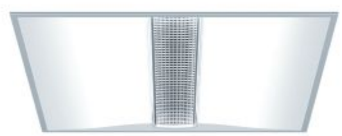

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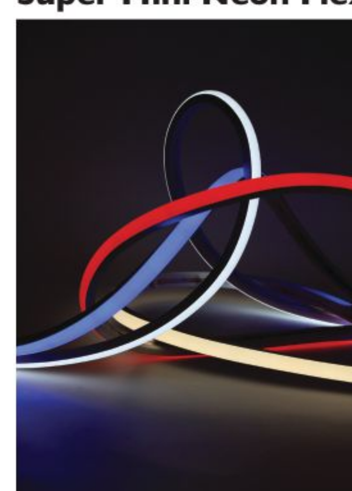

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ROBERT SHOOK

"Your ability to communicate lighting intent is a key factor in your success at being a lighting designer. You have to know who you are talking to."

Robert (Bob) Shook has successfully navigated a 40-plus-year career in theatrical and architectural lighting. Enamored with theater during high school in Louisville, Ky., he went on to earn degrees in theatrical lighting and production design. Working in Chicago in the 1970s and early 1980s, he crossed paths with fellow lighting designer Duane Schuler, whose practice was also growing beyond the theater. In 1986, the two formed Schuler Shook. From the beginning, the firm developed a unique dual practice to handle the nuances of both theater consulting and architectural lighting projects, and has since grown substantially beyond its initial Chicago and Minneapolis locations.

What drew you from theatrical lighting to architectural lighting design?
In theater, you create a piece of art and six weeks later it's gone. I wanted to design something that had more permanence.

How would you describe what a lighting designer does?
We determine the quality and quantity of light for all living spaces. Well-designed lighting enhances the architecture and the environment.

What is an ongoing challenge in the practice of lighting design?
We need better visualization tools. Some newer graphics applications make it a bit easier, but it's still very time consuming to try to graphically communicate lighting accurately to architects and clients.

What are you most excited about in terms of how lighting technology has evolved?
For decades, we've been wanting to get a lot of light out of a little bitty thing. That's why MR16s became so popular; they could produce a good quality beam out of a small aperture. Now we can do that so easily, and in so many form factors: holes, squares, lines, edges, and corners.

How do you view your role as a lighting designer on the project team?
We react to the other members of the design team and come up with a scheme. I want them to own the lighting as well.

What advice would you give a young lighting designer?
To best understand how light behaves, be a constant observer of light and shadow. •

interview by Elizabeth Donoff
photo by Joshua Albanese

Moorish Clock Tower
Guayaquil, Ecuador
Photo:
Miguel Salamon

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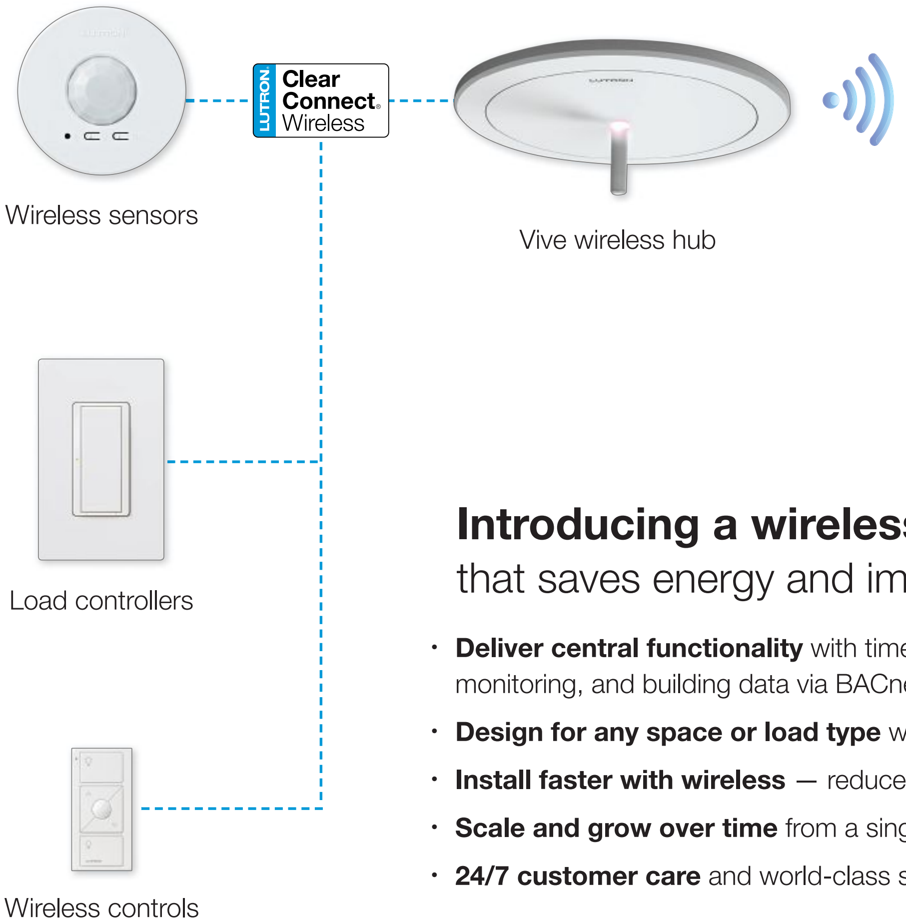

Introducing a wireless lighting control system

that saves energy and improves occupant comfort

- **Deliver central functionality** with time clock, demand response, energy monitoring, and building data via BACnet
- **Design for any space or load type** with a full suite of wireless controls
- **Install faster with wireless** — reduce labor time by up to 70%
- **Scale and grow over time** from a single room to a whole building
- **24/7 customer care** and world-class support allow you to specify with confidence

Need help specifying Vive on your commercial project?
Please visit **lutron.com/specifyvive**.

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