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ARCHITECTURAL LIGHTING

INSIDE: MICHAEL KORS SHANGHAI STORE FAÇADE • LED HEAT SINKS • YALE LIBRARY RESTORATION • STAPLETON LIBRARY ADDITION • ONE-ON-ONE: NATHALIE ROZOT

SEPT/OCT 2015

hw

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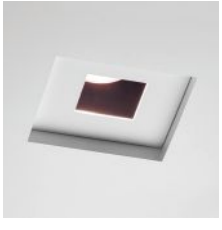

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RICHARD LANDRY
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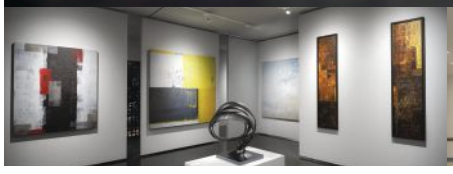

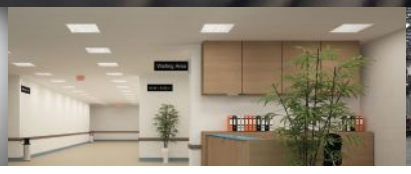

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FEATURES

The community room at the Stapleton Library

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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: Yale's Sterling Memorial Library nave restoration. Photo by Brian Rose.

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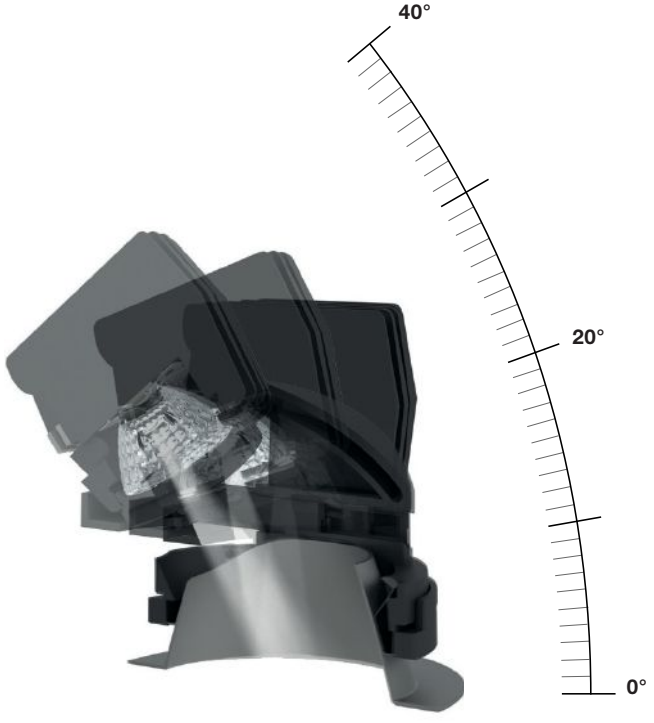
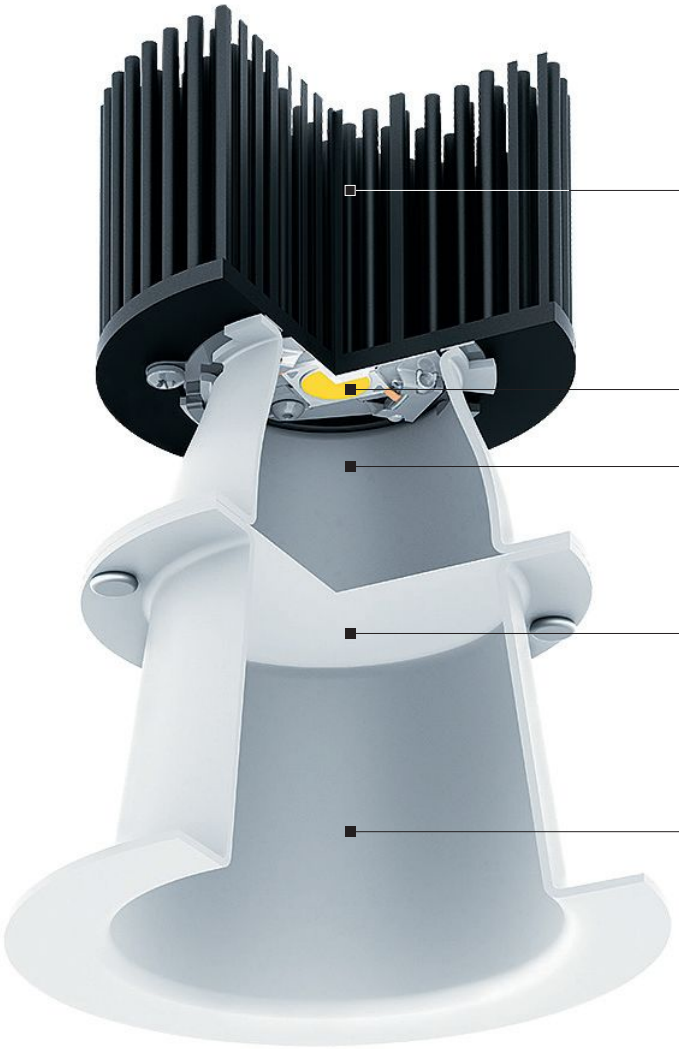
BASYS LED II

BASYS LED II is the next generation of the Zumtobel downlight and wallwasher series. Available with a broad range of options in 2.75", 4" and 6" apertures to meet the versatility and the demands of architectural lighting environments. Consisting of square and round recessed downlights and wallwashers, the product family provides efficient, flexible and precise illumination. One of the groundbreaking highlights in the BASYS LED II range is the adjustable version with the patented tiltShift technology.



Adjustable with patented tiltShift technology

While the luminaire can be tilted between 0° to 40°, it simultaneously shifts dependent on the angle so that the beam remains in the center of the aperture and will not be cut off by the reflector. Even if the angle of the beam changes, the luminous flux and the light quality, as well as appearance, remains constant. Additionally, BASYS LED II with tiltShift technology allows for rotation up to 360°. The combination of these features enhances the light quality and provides superior adaptability in the build environment.



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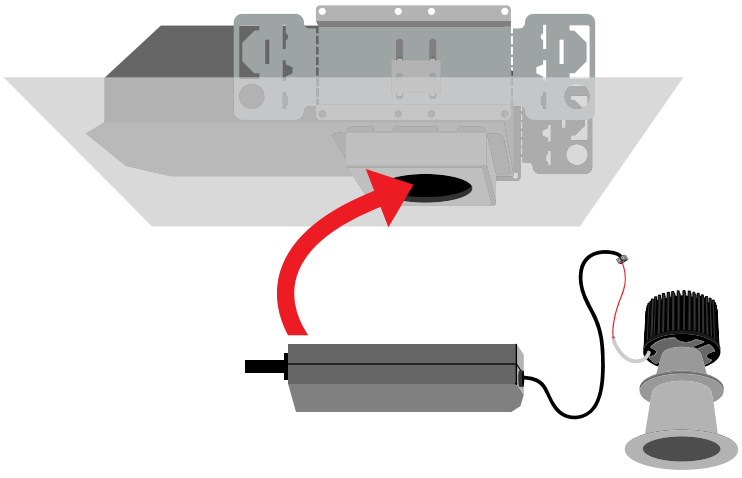
Zumtobel advancedOptics
diffuser technology that supports the intended light distribution and reduces glare

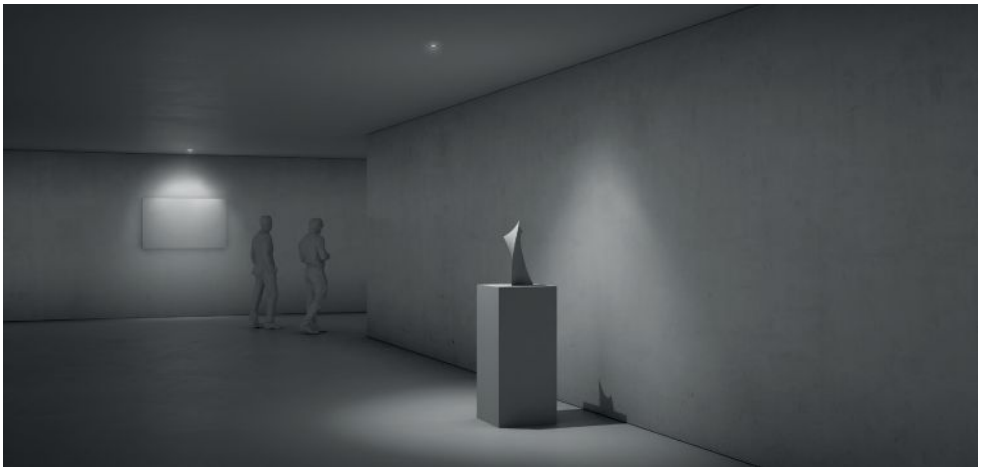
Zumtobel advancedReflector
technology with a unique 45° and 55° cut-off to either create less glare or improve efficacy



UL-certified driver housing design

Adding to the overall efficiency, the new dedicated driver housing design allows an option to ship the housing prior to the luminaire and driver. The capability to install the housing and complete the electrical wiring initially prevents damage or the loss of the reflector, luminaire and driver on the job site. The luminaire and driver are simply passed through the housing aperture and connected to the electric supply via a quick-connect mechanism. This unique feature leads to efficient installation and convenient maintenance. The luminaire and driver can be quickly removed for easy maintenance outside of the housing, which is especially helpful in inaccessible ceiling situations.

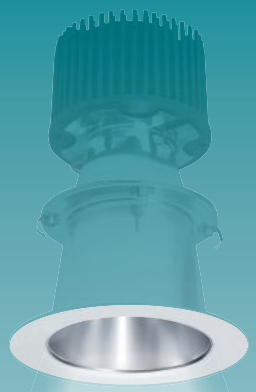
BASYS
Light Distribution



Zumtobel BASYS LED II 2.75" adjustable with tiltShift technology (from left: 40° tilted and 20° tilted)

Zumtobel BASYS LED II 2.75" Wallwashers and Downlights (from left: 55° and 45° cut-off)

DOWNLIGHT



Round | Square
Flanged | Flangeless
45° Cutoff | 55° Cutoff

2.75"	4"	6"
Color Temperature 2700 K 3000 K 3500 K 4000 K	**Color Temperature** 2700 K 3000 K 3500 K 4000 K	**Color Temperature** 2700 K 3000 K 3500 K 4000 K
Luminous Flux 600 lm – 1200 lm	**Luminous Flux** 1000 lm – 2100 lm	**Luminous Flux** 1400 lm – 3200 lm
80 or 90 CRI	85 CRI	85 CRI
Damp Location	Wet Location	Wet Location
Energy Star Rated Chicago Plenum TechZone 6" option	Energy Star Rated Chicago Plenum TechZone 6" option	Energy Star Rated Chicago Plenum

WALLWASHER

Round | Square
Flanged | Flangeless
45° Cutoff | 55° Cutoff

2.75"	4"	6"
Color Temperature 2700 K 3000 K 3500 K 4000 K	**Color Temperature** 2700 K 3000 K 3500 K	**Color Temperature** 2700 K 3000 K 3500 K
Luminous Flux 500 lm – 1000 lm	**Luminous Flux** 1000 lm – 2100 lm	**Luminous Flux** 1400 lm – 3200 lm
80 or 90 CRI	85 CRI	85 CRI
Damp Location	Wet Location	Wet Location
Energy Star Rated Chicago Plenum TechZone 6" option	Energy Star Rated Chicago Plenum TechZone 6" option	Energy Star Rated Chicago Plenum

ADJUSTABLE

Patented
tiltShift technology
Tilt 0–40°
360° Rotation
Constant uncut beam

Round | Square
Flanged | Flangeless

Beam Angles
10° 24° 38° 60°

2.75"

Color Temperature
2700 K
3000 K
3500 K
4000 K

Luminous Flux
850 lm – 1700 lm

80 or 90 CRI

Damp Location

Energy Star Rated
Chicago Plenum
TechZone 6" option

ZUMTOBEL

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Manufactured in USA.

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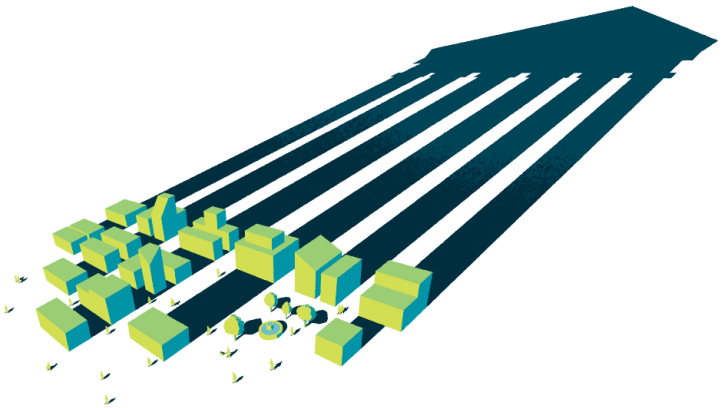

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NEW TIMES, NEW METRICS

Anyone now entering lighting design might mistakenly think that change is a steady constant of the industry, as evidenced by the number of new LED products and technological developments that are continually coming to market nowadays. But anyone who has been in practice for more than a decade or so knows that change in the lighting industry, especially when it comes to metrics and standards, is a long, involved process often riddled with committee meetings and public comment periods. It's like trying to turn a battleship 180 degrees. You wouldn't think it would take such a long time, but it does.

Another battleship is starting to turn. Over the past few months, there has been a discussion about adopting a new color metric as outlined in, *TM-30-15, IES Method for Evaluating Light Source Color Rendition*. Borne out of the need for a better standard that would address the specific color issues associated with LEDs, the proposed metric's most significant feature is the introduction of 99 color-evaluation samples, as opposed to the 14 (eight pastels and six additional hues) currently used for the industry's present guide, the Color Rendering Index (CRI).

Color is a core issue, and has always been an important topic of industry discussion. With the launch of our new website in June, ARCHITECTURAL LIGHTING has assembled a page entitled "Light and Color 101"—*archlighting.com/tag/color*—that serves as a directory of our articles on the subject. ARCHITECTURAL LIGHTING's most recent color discussion was in the last issue: "The Evolution of White Light," *bit.ly/AL_WhiteLight*.

There are many different aspects of color relevant to the discussion, such as consistency, temperature, rendering, difference, appearance, shift/stability, colorfulness, and matching. It's a complex topic, and the introduction of solid-state lighting (SSL) hasn't simplified matters. But what SSL has done that is of great benefit to lighting as a whole is that it is forcing designers and manufacturers to re-examine important technical issues like this one.

And that is what the introduction of *TM-30* late this summer has provided. Everyone is talking about it. The U.S. Department of Energy offered two webinars in September that are now available on their website: *energy.gov/eere/ssl/solid-state-lighting-webcasts*. Randy Burkett, Kevin Houser, and Michael Royer presented "Quantifying Color Rendition: A Path Forward" at the IALD's Annual Enlighten Americas conference in Baltimore on Oct. 8–10. Upcoming lighting trade shows in Europe, such as LuxLive in London, are also set to hold seminars on the subject.

There is still debate about whether the new metric addresses the shortcomings that have plagued CRI, a system that goes all the way back to the Commission Internationale de l'Eclairage chromaticity diagrams of 1931 and 1964. But what is sufficiently important is that the underlying research projects, and discussions at the committee level, have progressed to a stage where the information can be disseminated publicly: The Illuminating Engineering Society has released the new metric as an official technical memorandum.

The introduction of *TM-30* is important for the industry as whole. It reflects advancements that have far-reaching implications for research and product development. This much we know for certain. But the real question now is how will the discussion progress? Will there be more research and testing? How will the design community react and participate? How will manufacturers incorporate this data in their technical product sheets? Will *TM-30* lead the way to a completely new, industry-accepted standard, or will it simply become a marketing tool?

I hope the industry will give *TM-30* a fair shot and allow all parties involved to continue their meaningful and informative discussions. Too much work has already gone into the metric to let it flounder on the shelf.

Elizabeth Donoff
Editor-in-Chief
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Stephen Voss

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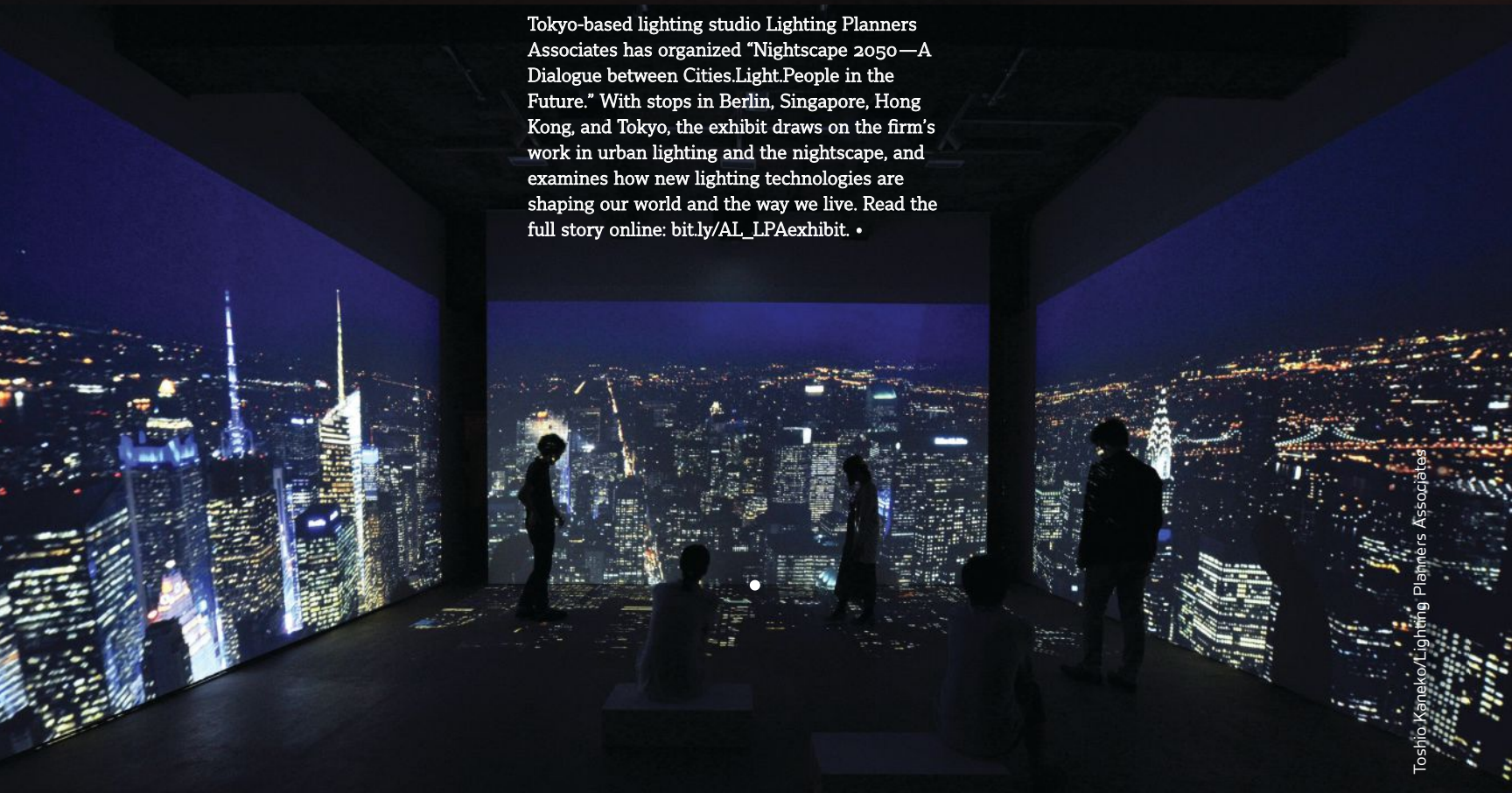
NIGHTSCAPE 2050

Tokyo-based lighting studio Lighting Planners Associates has organized "Nightscape 2050—A Dialogue between Cities.Light.People in the Future." With stops in Berlin, Singapore, Hong Kong, and Tokyo, the exhibit draws on the firm's work in urban lighting and the nightscape, and examines how new lighting technologies are shaping our world and the way we live. Read the full story online: bit.ly/AL_LPAexhibit. •



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"With this book, I aim to, in my own way, pass on the teachings of light that I once dedicated myself to and have used throughout the years," writes lighting designer Svante Pettersson in *See the Light*, a 310-page book published earlier this year by Arvinius+Orfeus. Part personal essay, part technical guide, Pettersson describes his philosophy of light, which has been shaped by his Nordic upbringing and surroundings in Sweden. Through the book's 14 chapters, he maps out the ways in which light shapes our senses and visual perception. bit.ly/AL_SeeLight. •

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ZUMTOBEL LIGHTING RENEWS ITS FOCUS ON THE AMERICAS

Zumtobel Lighting has been busy. Under the guidance of Kevin Maddy, who joined the company in April 2014 as CEO of the Americas Region, the lighting manufacturer has taken several steps to restructure and solidify its presence in North and South America. This includes a $10 million investment to expand operations, upgrades to the Highland, N.Y., facility (above), and opening an office in Santiago, Chile. Read our complete interview with Maddy at bit.ly/AL_ZumtobelAmericas. •

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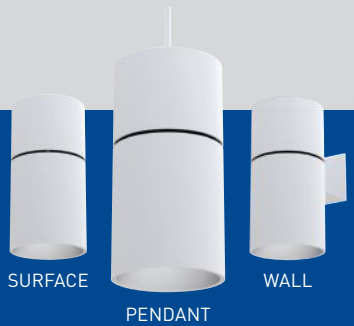

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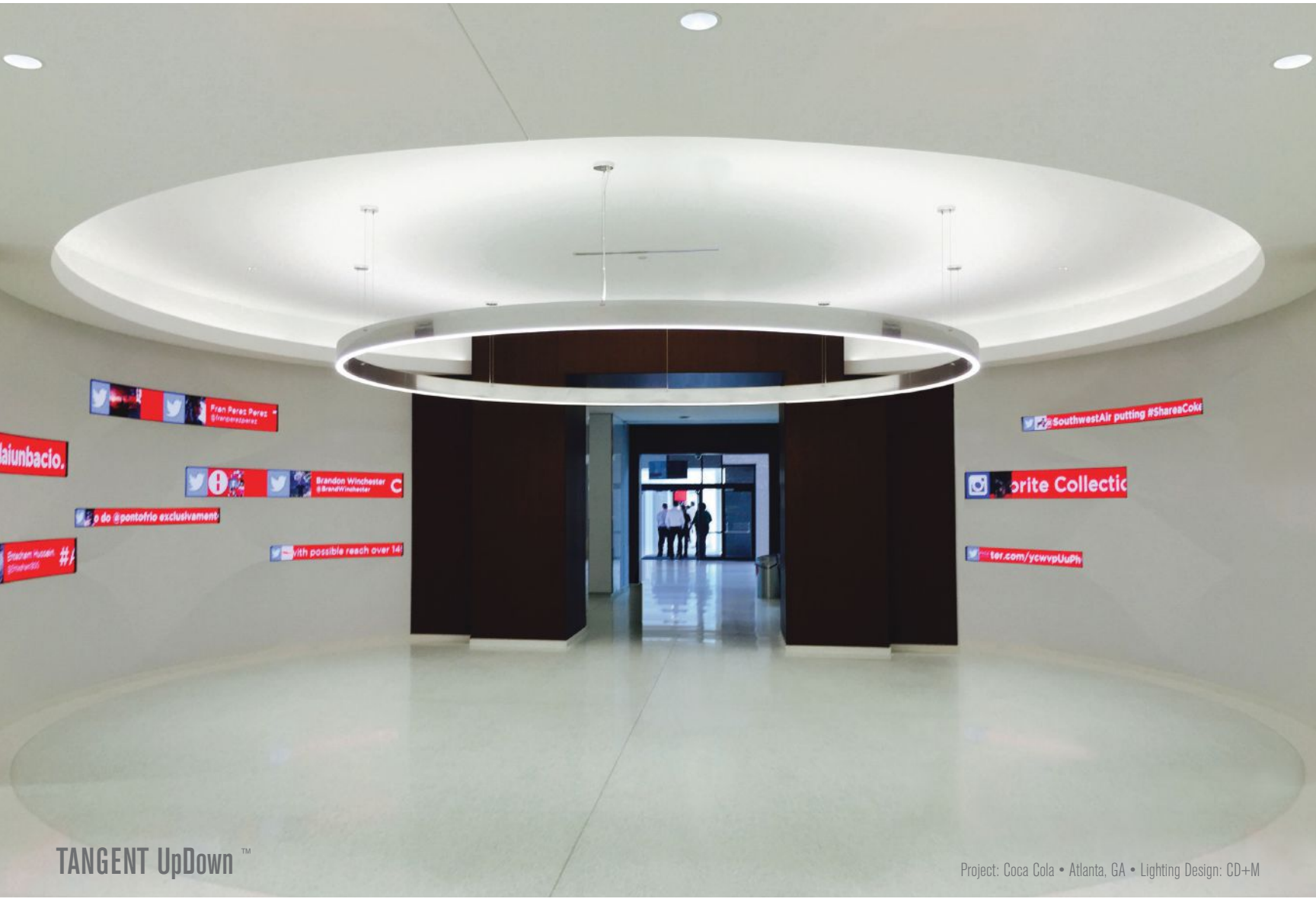

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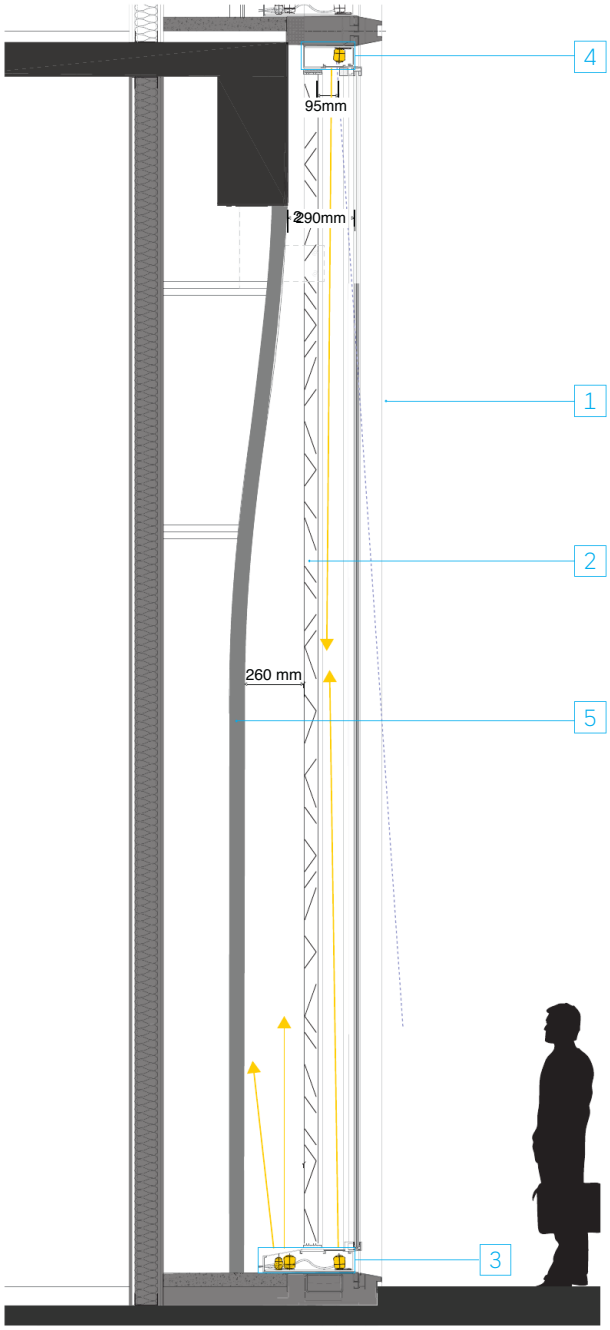
MICHAEL KORS SHANGHAI FLAGSHIP STORE FAÇADE

text by Elizabeth Donoff

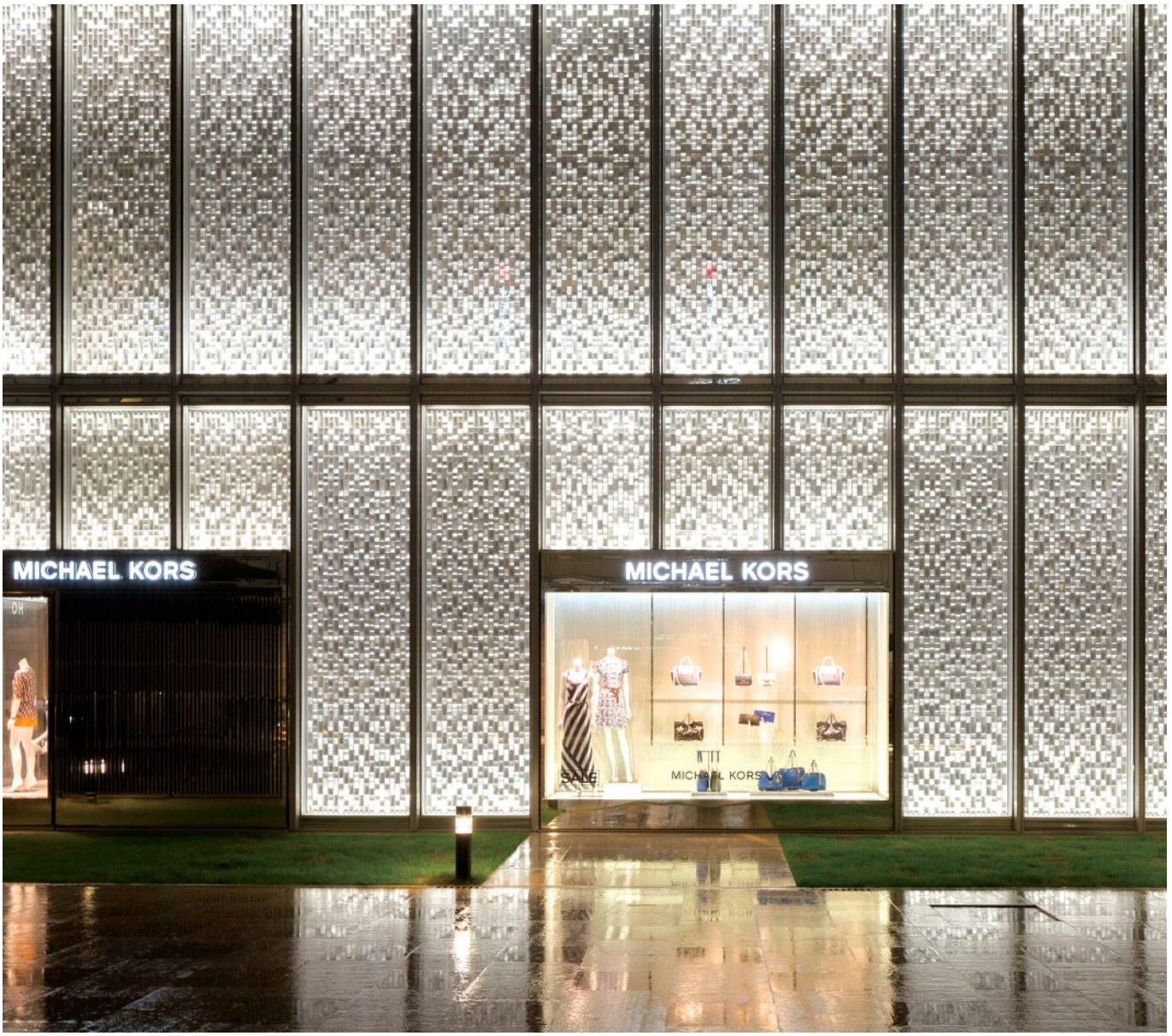
In an upscale Shanghai retail and hotel development called Jing An Kerry Centre sits Michael Kors' new flagship store. To distinguish the street-front boutique from its neighbors in this shopping district, the design team—architect Kohn Pedersen Fox and lighting designer Tillotson Design Associates (TDA)—developed a unique façade that showcases the identity of the Michael Kors brand, while giving it a timeless and universal appeal. "Light was always the main focus for this façade concept," says Thomas Bergeron, senior associate at TDA. The dynamic composition, which makes the façade look like a luminous fabric, is created by the use of hundreds of thousands of individual, hand-cut, angled, aluminum reflectors.



Tillotson Design Associates

Section Through Lower Portion of Curtainwall

1. Curtainwall
2. Angled, textured aluminum reflectors
3. Linear LED wall grazers in pull-out tray: white light fixture in front; RGB color-changing fixture behind
4. Linear LED white light wall grazer
5. Sloped back wall



Narrow optic wall grazers are located at the top and bottom of each panel and are coordinated with the reflector angles to create a sense of depth using a pattern of light and shadows across the façade. The fixtures at the bottom of the wall assembly sit in a pull-out tray for accessibility.

The design team narrowed 35 concepts down to one, and the designers worked principally in model, at multiple scales, so that they could study the play of light and reflection in the various configurations of the panels. The main challenge was how to create a sense of brightness and sparkle that would read both up close and from a distance without the disturbance of a lot of glare. The façade needs to work both during the day in natural lighting conditions and at night when the panels are illuminated by two different grazing fixtures located at the top and bottom of the entire assembly. The first fixture types are 10-degree 4000K LED grazers that illuminate the top front, the bottom front, and the bottom back of the panels with white light. The second are RGB LED luminaires with a medium beam distribution that create color-changing effects, and which sit behind the bottom grazing fixture. Like a cascade of paillettes on a garment, lighting transforms the façade from an ordinary curtainwall into a luminescent feature. •

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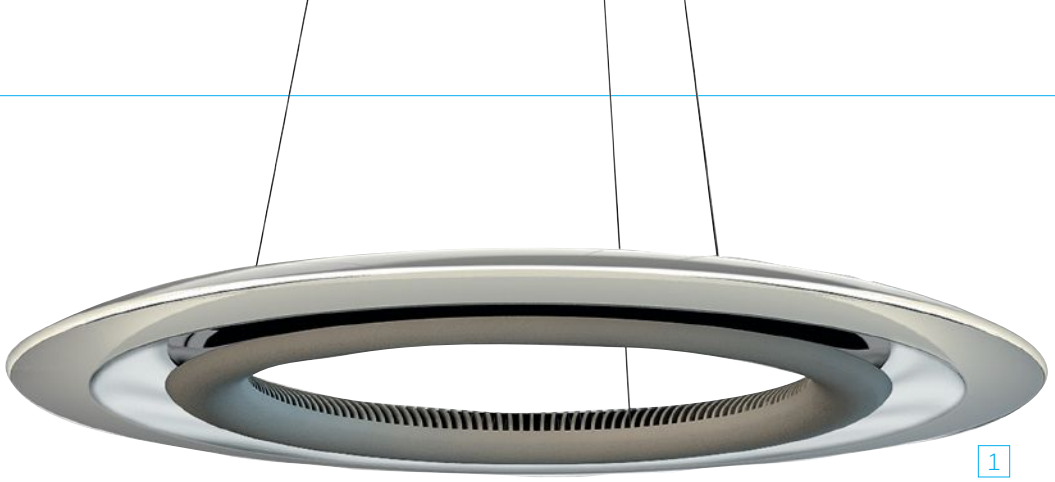
The peened aluminum reflectors used for the façade are individually positioned to specific angles to maximize the grazing effect and reflective quality of the light.

DETAILS

Project: Michael Kors Shanghai Flagship Store Façade, Jing An Kerry Centre, Shanghai • **Client:** Michael Kors Store Design Team, New York • **Architect:** Kohn Pedersen Fox, New York • **Lighting Designer:** Tillotson Design Associates, New York • **Façade Dimensions:** 5,000 square feet • **Project and Lighting Costs:** Withheld (per client's request) • **Code Compliance and Watts per Square Foot:** Not applicable

MANUFACTURERS

EcoSense Lighting: 10-degree-beam 4000K grazer for white lighting effect at façade top front, bottom front, and bottom back • **Philips Color Kinetics:** eW Fuse Powercore, RGB LED, with 30-degree by 60-degree optic for rear silhouette dynamic color-changing effects • **Alanod:** Textured mirror-finish aluminum reflectors



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LED SPOTLIGHT

text by Hallie Busta

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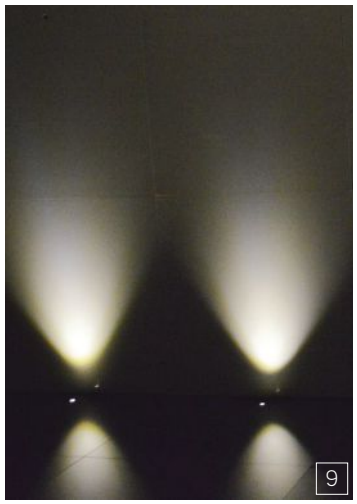

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1 F+P 550, Louis Poulsen • In 2009, London-based architecture firm Foster + Partners worked with Louis Poulsen to design the F+P 550 LED pendant for corporate interiors. The manufacturer recently updated the fixture, making it available in 3000K at 49 lumens per watt. The fixture has a mouth-blown opal glass shade with a matte anodized aluminum reflector, a metalized polycarbonate light conductor, and a heat sink, all suspended via PVC cords from a decorative ceiling canopy. • *louispoulsen.com*

2 Luxeon CoB Core Range (Gen 2) LEDs, Lumileds • Lumileds has updated its Luxeon chip-on-board (CoB) LEDs. The additions come in 2200K, 2700K, 3000K, 3500K, 4000K, 5000K, and 5700K at CRIs of 70, 80, and 90. They offer color rendering within a three-step MacAdam ellipse, and a lumen output 10% higher at the same drive currents as the company's existing CoB LED series. • *lumileds.com*

3 Ultra Glass PAR LED Lamps, Sylvania • The company's new lamps replace their halogen counterparts in PAR20, PAR30LN, and PAR38 models with a glass body and a full optic. They come in 2700K, 3000K, and 5000K at CRIs of 81 and 82, depending on the model, and with 15-, 25-, and 40-degree beam angles. The lamp family is UL wet-listed. • *sylvania.com*

4 1×4 LED Retrofit Kits, Litetronics • Litetronics is adding a 1x4 option to its interior LED retrofit kit line for converting existing T8 and T12 linear fluorescent troffers, striplights, and wraps for use with LED tubes. The one-piece housing consumes 32W and holds two 4'-long LED tubes on a 4"-wide metal platform. They can be placed end-to-end, strung individually, or used as a standalone fixture. For use with 120V to 277V systems, the 32W kit comes in 3500K, 4000K, and 5000K. • *litetronics.com*

5 L100-G3, Electrix • This 1"-square linear LED luminaire is designed for architectural cove and pocket applications. Available in 3000K, 3500K, and 4000K with a CRI of 85, the fixture delivers up to 354 lumens per foot. In 12" to 96" lengths, it can be wired in a series up to 12' long. Its extruded-aluminum housing has a satin anodized finish. • *electrix.com*

6 LSL Series, LaMar Lighting • The LSL Series recessed LED lensed luminaire is designed for use in offices, hospitals, and schools with grid ceilings. The fixture is available in 3500K and 4000K at a CRI of 84-plus. Fitted with field-replaceable LED modules, the luminaire comes in a 2x2 and a 2x4 format with either a prismatic haze or a frosted acrylic lens. Zero-to-10V dimmable, the fixture is compatible with 120V to 277V systems. • *lamarlighting.com*

7 24,000 and 48,000 DLE Intelligent High Bay, Digital Lumens • This high-bay LED fixture combines direct and indirect light sources via four independently aimable light bars, and features version 2.11 of the company's LightRules energy management software. Available in 4000K and 5000K with a minimum CRI of 70, the energy tool is offered in the 24,000- and 48,000-lumen versions of the fixture. It has efficacies of up to 106 lumens per watt and is IP52-rated. • *digitallumens.com*

8 FGP Path Light, Landscape Forms • Designer Francisco Gomez Paz crafted this geometric, surface-mounted pathlight for Landscape Forms with three stems that rise from its base to create triangular openings through which light from an LED array housed in its curved top is cast. Available in 3000K, 3500K, and 4000K, the IP66-rated fixture accepts a 100V to 277V power supply. It measures $38^{1}/_{4}$" tall by up to $8^{3}/_{4}$" wide. • *landscapeforms.com*

9 Quantum LP, Minimis • Austin, Texas–based Minimis is growing its line of high-end, miniature architectural luminaires for installation in panels of up to 1" thick with the 19mm-square Quantum LP. Available in 2800K to 3200K and in 5800K to 6300K, it has a 58-degree beam-angle cutoff reflector. Suited for recessed installation in materials including drywall, wood, steel, tile, and granite, the fixture has a milled-titanium housing. • *minim.is*

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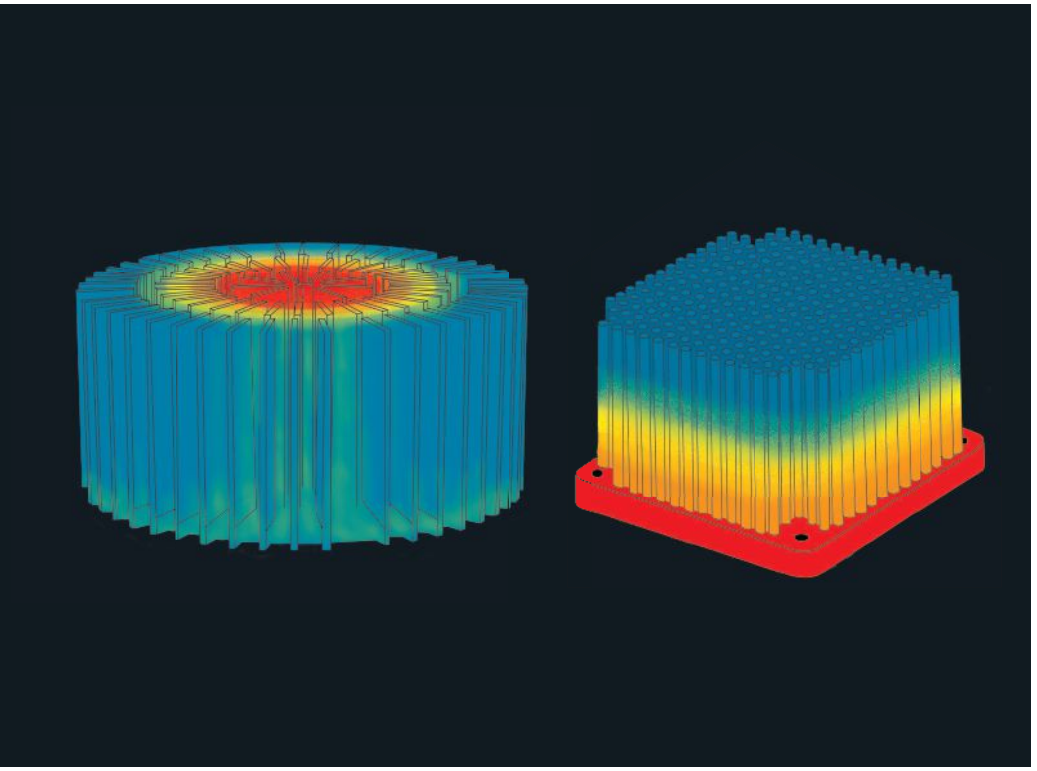
KEEPING IT COOL

Advancements in thermal management promise the most efficient generation of LEDs yet.

text by Timothy A. Schuler



Many LED fixtures use heat sinks with fins in a radial pattern (left) or in a grid layout (right), which is also called a pin fin design. The additional surface area of the fins helps dissipate heat from the LEDs.

From the tiny electronics in smart watches to the massive server racks in data centers, today's state-of-the-art technologies would fail if they couldn't manage one thing: heat. Solid-state lighting is no exception.

"Heat affects every aspect of an LED," says Chris Reed, director of product for San Antonio, Texas–based Lucifer Lighting, "and each element is affected differently." High heat loads can reduce the efficiency of an LED's phosphors (which convert blue and violet light to white light), degrade the color of optical-grade silicone, and shorten the life span of the diodes. "If you don't manage heat," Reed says, "not only do you get lumen depreciation over lifetime, but you also get color change."

The first generation of LEDs used for lighting, which emerged around the early 2000s, did not manage their heat and essentially "flopped," says Justin Wang, founder and CEO of AXP Lighting in San Francisco. "Some of them worked just three days and [then] went dead."

Over the next decade, original equipment manufacturers (OEMs) quickly learned to introduce heat sinks into their products. As a thermal management technique, these heat sinks worked—the LEDs performed better immediately—but they were heavy, accounting at times for more than 50 percent of a fixture's overall weight. This resulted in increased material consumption, higher shipping costs, and bulkier designs that interfered with lumen output, says Tim Rider, a senior global portfolio manager at Philips.

Today, the options for thermal management are far more numerous and sophisticated. The result is a wave of lighter and sleeker fixtures, and, in some cases, completely new form factors.

MATERIAL REVIEW

In 2008, the U.S. Department of Energy announced the L Prize, a technology competition that included a $10 million cash prize for the company that could develop a 60W replacement A-lamp with a life span of 25,000 hours. Philips won with a then-new type of aluminum heat sink that had fins to increase surface area and heat dissipation, and set a precedent for new lamp form-factors and heat-sink architecture.

Many heat sinks continue to utilize fins, often in a radial pattern or in a grid layout, the latter of which is known as a pin fin design. Aluminum also remains popular for its conductivity, light weight, and low cost relative to other metals, such as copper. More recently, manufacturers have employed high-quality alloys, such as forged aluminum, to create heat sinks with more complex shapes.

Companies are also experimenting with ceramics, thermally

conductive plastics, and graphite. Ceramics—inorganic, nonmetallic, and noncorrosive materials—are already used in many LEDs because they conduct heat but not electricity. In a typical diode stack, a minimum of three layers separate the chip and the heat sink: a printed circuit board (PCB), a conductor, and an adhesive layer. "[C]eramics eliminate all these layers so there is a significantly reduced potential for delamination," says Robert Christensen, the North American business development manager for the German company CeramTec, which manufactures heat sinks.

At the opposite end of the heat-sink performance spectrum are thermally conductive plastics, or thermoplastics, which are loaded with a conductive material such as aluminum nitride. Unlike aluminum, they are naturally noncorrosive, which makes them ideal for outdoor applications, where lumen demand is low and weight is a concern. According to Taiwan-based manufacturer Nytex Composite, thermoplastics are also 20 to 30 percent less expensive than aluminum, in part because they are simpler to make.

"With outdoor lighting, a heat sink becomes a sculptural element because it is the housing."

—Gary Trott, vice president of product strategy, Cree

Other companies are using longstanding materials in new ways. Copper, one of the best conductors of heat, is typically too expensive for LED applications, but Reggiani Lighting, based outside of Milan, has combined copper and extruded aluminum to reap the best of both metals. Marketing communication manager Filippo Devoti says the company redesigned its heat sink geometry to have a greater number of thinner fins and thus more dissipating surface.

THE OVERLOOKED TIMS

One oft-forgotten aspect of an LED's thermal management system is the thermal interface material (TIM), a hyperthin substance applied between the conductive layer and the heat sink to facilitate heat transfer. Depending on its makeup, this sole layer can cause substantial variance in the heat sink's effectiveness, Lucifer's Reed says.

TIMs can come in the form of adhesives, greases, gels, pads, or solder alloys. Greases, which are often silicone based, can degrade over time—as can many of the aforementioned substances. One alternative is Thermal Clad, an insulated metal substrate by German company Henkel. The material is reportedly more resilient and adheres to a heat sink with a pre-applied conductive adhesive tape.

Another option is Hitherm, a super-lightweight flexible material made from graphite. Graphite is the next best thing to diamond, Reed says,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because carbon is an excellent conductor of heat. Made by GrafTech, headquartered in Independence, Ohio, Hitherm comes in sheets that are die-cut and then applied to the LED "almost like a sticker," Reed says.

Because of graphite's superior conductivity, Reggiani Lighting has started to use the material for the heat sink of some of its fixtures. Devoti says these heat sinks are traditional in shape but perform better than aluminum, which make them worth their higher cost.

FORGO THE HEAT SINK?

More recently, some LEDs have been marketed as having no heat sink at all. In reality, the heat sink exists but is integrated into the design of the luminaire. For example, the die-cast aluminum body of Lucifer's CY3-AD downlight serves as its heat sink, while Philips' 60W replacement SlimStyle A19 uses the LEDs' circuit board to draw the heat away from the chips. The lamp features 26 LEDs—13 on each side of the circuit board—with generous spacing, which drives its flat form.

The 60W replacement SlimStyle A19 by Philips features 26 diodes generously spaced around the LEDs' circuit board to draw heat away.

Philips

Manufacturers have also turned to convection. Vents cut in the top and bottom of Cree's 4Flow A19 lamp create cross-flow ventilation that whisks heat away from LEDs. Cree uses the same philosophy for its OSQ Series LED outdoor area light. "With outdoor lighting, a heat sink becomes a sculptural element because it is the housing," says Cree vice president of product strategy Gary Trott, who is based in Atlanta. "So we [develop] something that is both functional and attractive, and something that integrates with various architectural sites."

Hong Kong–based Cledos uses both strategic LED placement and convection to control heat in its AirLED lamps, which "are comprised of multiple low-powered chips dispersed and wired in a proprietary process, using air circulation for thermal management," says COO Eric Steinmeyer. "The resulting physical design uses less raw material and is sleeker, lighter, and more streamlined."

AXP Lighting's Filament LED takes an aesthetic approach to thermal management. The 60W replacement lamp features Edison-style lamp filaments made up of 28 individual LED chips mounted to a transparent sapphire substrate. AXP's sealed lamp is filled with helium, which has a higher conductivity than oxygen and dissipates heat more efficiently.

Importantly, the lamp only generates a small amount of heat in the first place because AXP underdrives its chips by design, running them at about 20 percent of capacity. This means fewer lumens per LED, but AXP makes up for this with a greater number of diodes. "Sometimes people use only one chip and overdrive it at 120 or even 200 percent," AXP CEO Wang says. "If a chip can produce 80 lumens per watt, we only demand about 15 lumens per watt."

ACTIVE COOLING

For some lamps, passive cooling—through conduction with a heat sink or convection—still may not suffice. When a manufacturer needs to pack a lot of lumens into a small form factor, it can make up the difference with an active cooling strategy, such as using a fan. Some in the industry are skeptical, however, about the reliability of fans and the potential noise they create. Reed says that a fan can reduce the size of the heat sink by up to 90 percent, but if it stops working, "your heat sink is grossly undersized."

However, Reed continues, these are the failings of individual brands, not active cooling as a whole. "A lot of manufacturers went out and didn't do their homework," he says. Lucifer uses German manufacturer Ebm-Papst's high-performance fans, which run at 7 decibels—"about the same noise level of someone sleeping in an ultraquiet room," he says.

U.K.-based LED Eco Lights recently released a replacement for a high-pressure sodium lamp with a fan that generates less than 0.5 decibels—reportedly the quietest on the market. Using magnetic levitation technology, the fan uses no bearings, which are often the point of failure.

LOOKING FORWARD

The progress made in thermal management technologies, including the introduction of new materials and form factors, are happening alongside developments in nearly every other aspect of an LED's performance. "These improvements will lead to things that have never before been possible," Philips' Rider says.

As thermal management devices become smaller, more efficient, and better integrated into a fixture design, the burden OEMs previously faced of designing around a heat sink may soon become a thing of the past. The possibility, Rider says, of "[creating] the same light effect and the same experience, but with a much smaller form factor or with a completely new design is exciting." •

RESOURCES

"Understanding Heat Transfer Mechanisms in Recessed LED Luminaires," by Tianming Dong and Nadarajah Narendran, *Ninth International Conference on Solid State Lighting, Proceedings of the SPIE*, 2009. Available at: bit.ly/1LgVwzz.

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"Voids in Thermal Interface Material Layers and Their Effect on Thermal Performance," by Arun Gowda, *Proceedings of the Sixth Electronics Packaging Technology Conference*, 2004. Available at: bit.ly/1Vm80oO.

"Is the Thermal Resistance Coefficient of High-Power LEDs Constant?" by Lalith Jayasinghe, Tianming Dong, and Nadarajah Narendran, *Seventh International Conference on Solid State Lighting, Proceedings of the SPIE*, 2007. Available at: bit.ly/1jqlKTO.

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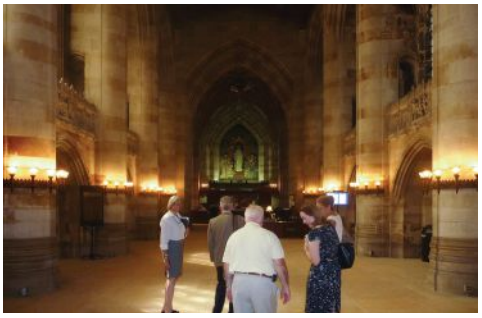
ILLUMINATING A CATHEDRAL OF LEARNING

An $18 million restoration to the nave of Yale's Sterling Memorial Library brings James Gamble Rogers' Gothic Revival masterpiece back to life.

text by Elizabeth Evitts Dickinson
photographs by Brian Rose



The nave, prior to restoration. It had not been cleaned in 80 years and the walls were blackened with soot and dust (left). The 17W PAR38 LEDs, positioned behind columns and screen walls, highlight the Alma Mater mural and the ceiling (previous spread).

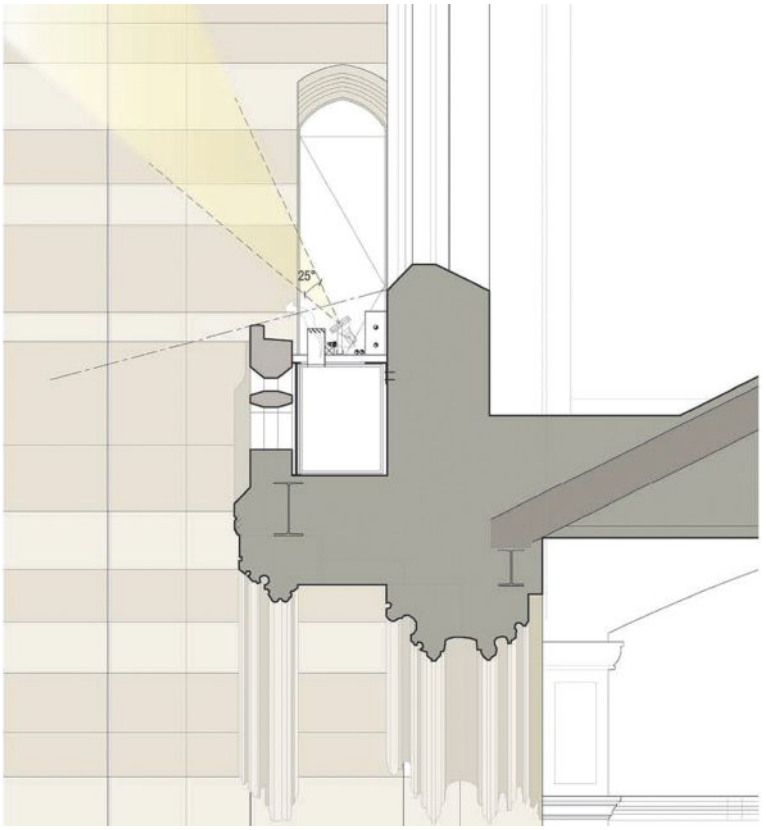
In 1928, architect James Gamble Rogers described his aesthetic intent for a new library at Yale University. Sited on the university's central quadrangle, the building was not only meant to house the school's extensive manuscript collection but to make a grand statement, and Rogers, a graduate of the class of 1889, endeavored to achieve that by designing "as near to modern Gothic as we dared." In doing so, he hoped to give the library "an enduring style" that would stand the test of time.

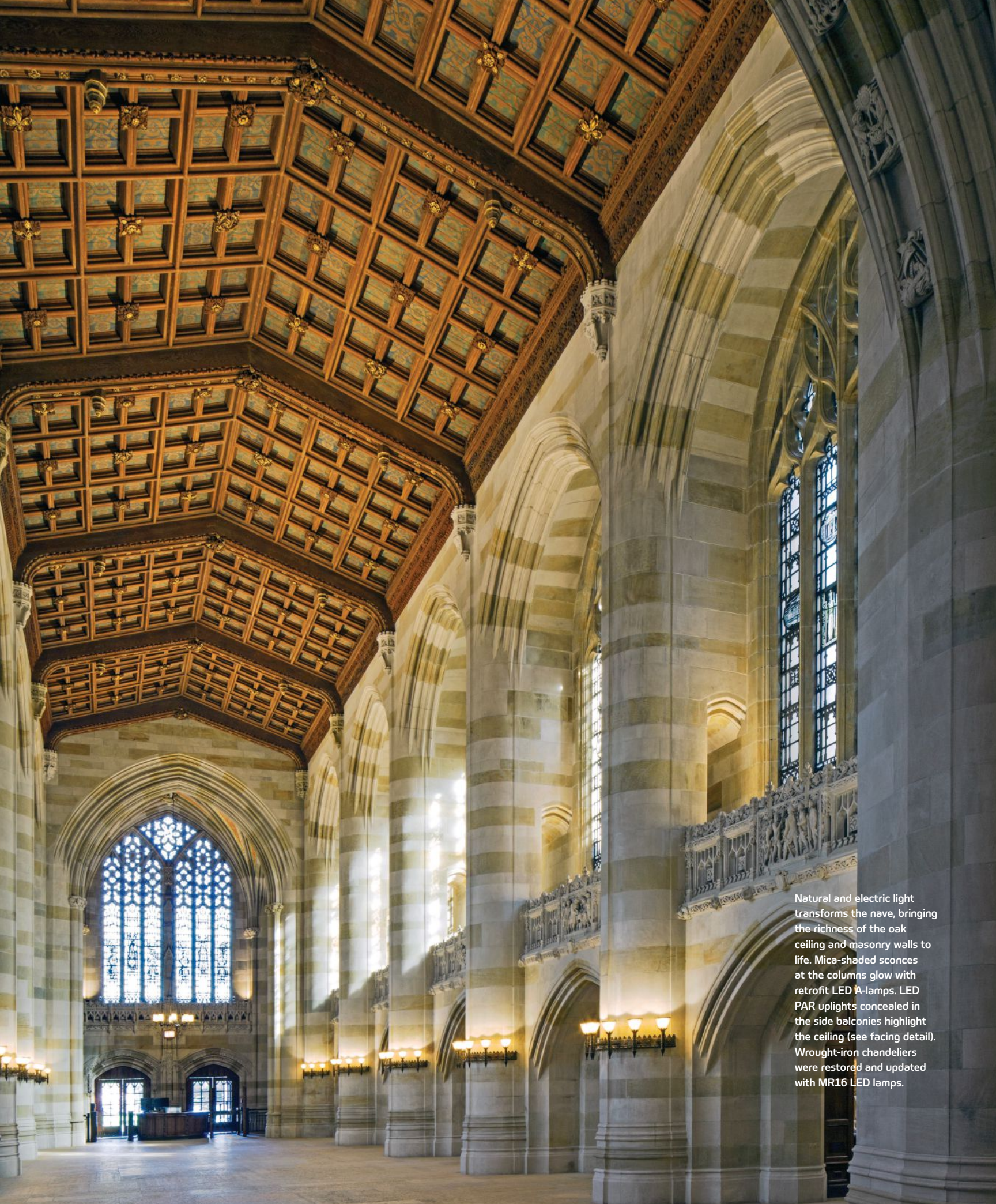
The Sterling Memorial Library, completed in 1930, has indeed endured. Eighty-three years after its opening, Jerry Kugler, principal of New York–based Kugler Ning Lighting Design, stood in the entry hall marveling at its construction and artistry. Rogers had made the entry a nave, mimicking the traditional architecture of a church. Built of load-bearing limestone and sandstone blocks, and with 45-foot-high ceilings, the 150-foot-long space contains hundreds of panes of stained glass created by artist G. Owen Bonawit, ornate metal lighting fixtures by master blacksmith Samuel Yellin, and an elaborately gilded coffered oak ceiling. At the Western terminus, a chancel became home not to clergy, but to the circulation desk. A striking, two-story fresco of a saintly woman surrounded by books and beatific figures, titled Alma Mater, graces the west wall.

But time has not been kind to the library's interior. "It hadn't been cleaned in 80 years and the ceiling was barely visible," Kugler says of the pre-renovation space. "It was so cavernous, so dark, that this grand space felt a bit eerie."

Today, the 16,000-square-foot nave again shines, after an $18 million renovation led by the New York firm Helpern Architects. Helpern was tasked with cleaning all of the architectural surfaces, repairing architectural details, and overhauling the lighting and building systems. The renovation also reconfigured circulation and

NAVE LIGHTING SECTION DETAIL





Natural and electric light transforms the nave, bringing the richness of the oak ceiling and masonry walls to life. Mica-shaded sconces at the columns glow with retrofit LED A-lamps. LED PAR uplights concealed in the side balconies highlight the ceiling (see facing detail). Wrought-iron chandeliers were restored and updated with MR16 LED lamps.

services to bring the library into the 21st century. And yet, most of the interventions by Helpern and the lighting design team from Kugler Ning remain hidden from the naked eye. The mantra for restoring this cathedral of learning, both in terms of the architecture and the lighting, was "WWRD"—What Would Rogers Do? "We always said to ourselves, if James Gamble Rogers had been brought back, how would he have done this?" says Helpern Architects founder David Helpern. "Lighting was critical. You don't readily see the new lighting. Rather you see the old lighting renewed. And that old lighting is supplemented to make a space that now quite literally glows."

Achieving that luminescence required an incredible mix of interventions, all of which needed to remain unobtrusive. The aim was to give the space the sense that it was radiating with daylight. "One of the things that we always wanted to do was to make sure that natural light from the windows and skylights, the new LED uplighting and fixtures, and all of the existing lights blended together to supplement the notion of daylight," Kugler says.

To achieve this, Kugler Ning gave the fixtures a dual purpose. For example, in the nave, new custom picture lights illuminate four paintings using 10W-per-linear-foot 2700K LED lamps while also concealing MR16 2700K LED uplights that brighten the ribbed ceiling. Two original Yellin-designed wrought-iron chandeliers with natural mica shades were not only restored, but they were also outfitted to hold—in a concealed fashion—an additional eight MR16 uplights, and one chandelier was added. "It looks like the chandeliers are doing all of the work, but it's really those uplights," Kugler says.

The restoration to the original Yellin fixtures, including the chandeliers and a series of sconces, also succeeded in emphasizing the material beauty of the mica shades. Some were damaged, and great pains were made to find comparable mica. Retrofitting the shades with LED A-lamps made them glow too hot and lose their lustrous beauty, so Kugler Ning added diffusion gel behind the mica to create a diaphanous quality. And because they had achieved enough electric light through new, hidden fixtures, they were able to significantly reduce the lumen output of the light inside the mica shade. "We made them glow like a lantern again, and now you see the materiality that had been previously lost," says Burr Rutledge, a senior associate with Kugler Ning.

The university's programmatic requirements for the nave were extensive and that included being able to use it as an event space in the evenings. "There are new lighting controls and presets so at night it becomes a softly lit space," says Kugler Ning principal Jackson Ning.

Adding supplemental light also required a clever appropriation of previously unused spaces. Running power sources and concealing fixtures in the nave proved a particular challenge, since the structure was built as a 16th century church would have been—with load-bearing masonry walls. Kugler Ning tucked 17W 2700K PAR38 LED uplights in two vacant upper balconies. They cross-aimed the lamps to illuminate the coffered ceiling for the first time. The balconies also house other new infrastructure such as HVAC, so it was a tight squeeze. "We had to modify the track heads to make them fit," Rutledge says.

In the south aisle study area, Kugler Ning designed new table lamps to complement the restored original pendants designed by Samuel Yellin. A 2700K cove fixture is installed in the skylight cavity.

PLAN

1 Entrance
2 Security desk
3 Nave
4 North aisle study area
5 South aisle study area
6 Information desk
7 Crossing
8 Alma Mater
9 Circulation desk

To further reveal the details and the different textures of Alma Mater, the existing fluorescent fixtures, which raked the mural from below in a greenish hue, were removed and replaced with integrated 17W 2700K PAR38 LEDs positioned behind columns and screen walls to highlight the art from three different positions. "There's a lot of layers of light going on, but they are hidden from view and not intended to be part of the public realm," Rutledge says.

In the north aisle, which is now used as a study area, the lighting team removed metal pendant fixtures, which had been added to the space over time but that were not original, and in their place designed a series of new custom pendants. These luminaires were hand-fabricated using the same materials and methods as Yellin's original fixtures. "Those take their cue from the Yellin chandeliers," Kugler says. "And we also have uplighting in those to make the glass and the ceiling both glow."

They also designed task lamps in a bronze finish with opaque shades that house 9.5W 2700K A19 LED lamps. "It's a modification to a classic library design with diffusion on the top, so it disperses light softly," Kugler says.

Across the way, in the south aisle, now also a study area, original pendant fixtures were restored, and additional task lamps were added. The card catalogs that once were the space's main feature were removed—except for one, a built-in furniture-like piece that was left for ambiance and as a nod to tradition. "It's evocative of the past generations that used it and it talks about the history of the library while creating a wonderful warm texture," Helpern says. That warmth is amplified by a subtle wash from the 10W-per-linear-foot 2700K LED picture lights.

Taken as a whole, the vaulted nave shines with a seemingly singular hue. "A great deal of effort went into color matching the LED light so that it blends well and looks incandescent," Kugler says.

The effect is a bit of a trompe-l'œil in that the nave appears to be flooded with natural light. "You get a great reaction when you turn things on and off," Kugler says. "Right before the opening, we did a walk through with folks and when we turned the electric lights off there was a big 'Oh!' because they didn't realize all of that light was coming from electric light."

Helpern believes the result is one the original architect would appreciate. "The combination of electric and natural light reveals the beauty that you would not see otherwise," he says. "It gives you an experience of the space that James Gamble Rogers would truly have welcomed." •

Details

Project: Restoration of the nave of the Sterling Memorial Library, Yale University, New Haven, Conn. • **Client:** Yale University Office of Facilities, Planning, and Project Management, New Haven • **Architect for the Restoration:** Helpern Architects, New York • **Original Architect:** James Gamble Rogers • **Lighting Designer:** Kugler Ning Lighting Design, New York • **Structural Engineer:** Robert Silman Associates, New York • **M/E/P, FP, IT, and Security Controls Engineer:** AKF Group, Stamford, Conn. • **Acoustics and A/V Consultant:** Jaffe Holden, Norwalk, Conn. • **Materials Conservator:** Jablonski Building Conservation, New York • **Project Size:** 16,000 square feet (gross) • **Project Cost:** $18 million • **Lighting Costs:** Withheld (per client's request) • **Code Compliance:** The connected lighting load is 64 percent below ASHRAE • **Watts per Square Foot:** 0.58 (combined ambient and decorative lighting)

Lighting Manufacturers

Acuity Brands/Winona Lighting: 17W 2700K LED PAR38 adjustable floodlights to illuminate Alma Mater • **Aurora Lampworks:** All custom fixtures—restorations and re-creations—throughout project • **Axis Lighting:** 21W/28W 3000K T5 recessed-mounted linear slot fixtures at offices • **B-K Lighting:** Custom canopy-mounted 8W 2700K LED adjustable accent light for dedication plaque • **Cree:** 9.5W 2700K A19 lamps for historic pendants and sconces with mica shades • **Eaton:** LED exit signs • **Edison Price Lighting:** 17W 2700K PAR38 LED track for uplighting hidden in nave balconies • **Electrix:** 10W-per-linear-foot 2700K LED accent light for card catalog luminaires restored by Aurora Lampworks • **Kenall Manufacturing:** 28W 3000K T5 surface-mounted lensed strip for back of house areas • **Manning Lighting:** LED exit signs • **Philips Color Kinetics:** 6W-per-linear-foot 2700K cove fixtures installed in south aisle skylight cavity • **Philips Day-Brite:** 32W 3000K sliding, hanger-mounted two-lamp T8 fixtures at back of house spaces • **Philips:** 10W 2700K MR16 LED lamps • **Starfire Lighting:** 10W 2700K MR16 LED surface-mounted adjustable socket strip at cross-aisle wood screen walls to highlight Alma Mater and uplight ceiling • **TCP:** 5W 2700K G16 LED lamps for smaller historic fixtures with mica shades • **USAI Lighting:** 20W 2700K recessed-mounted downlights at security office

SECOND EDITION

A new addition to Staten Island's Stapleton Library creates a 21st-century gathering place while reinvigorating the local community.


NEW YORK PUBLIC LIBRARY
STAPLETON BRANCH

text by Elizabeth Donoff
photos by Naho Kubota

Public libraries have always played an important civic role, serving both as communal gathering spaces and as vehicles for providing free access to information for all. That dual service, and the responsibility that comes with it, has never been more important as society fully transitions to the digital age. Libraries around the United States need to continue to be that place where anyone can go to check out the latest book, use reference materials, and take his or her kids to story hour. But today's libraries also have to provide computer stations that have Internet access and all types of media in digital formats.

The village of Stapleton on the south shore of the New York City borough of Staten Island is one community that understands the importance of having a library as a public amenity—and what it means when that resource is in jeopardy.

The library, a branch of the New York Public Library (NYPL) system, overlooks Tappen Park, the village's town square. The original building, a one-room structure, was designed by Carrère & Hastings in 1907, the same architectural duo of John Merven Carrère and Thomas Hastings responsible for the NYPL's Beaux-Arts main branch on Fifth Avenue and 42nd Street in Manhattan. Back on Staten Island, a school and an athletic field were later built behind the library. Like many communities, Stapleton has seen its share of hard times, succumbing to the population shifts and economic challenges that affected most American urban metropolitan areas during the 20th century. The school became run down and then was demolished, with the athletic field turning into a vacant lot. The library, once again, was left on its own.

Fast-forward to 2009. As part of New York City's Department of Design + Construction's Design + Construction Excellence program, which pairs architects with public building projects, local firm Andrew Berman Architect was tasked with the renovation and expansion of the Stapleton branch library. "We got to look at this project as both a library restoration and as a civic statement," says principal Andrew Berman.

When Berman and his team first visited the site they found a heavily used space—by both children and adults—with everything packed into the one 1,800-square-foot room. The building also suffered from what Berman refers to as "clumsy modernization efforts," but luckily those interventions were only cosmetic and the bones of the original structure and architectural details were still intact. One of the principal features of Carrère & Hastings classical architectural vocabulary were the $7\,1/2$-foot-tall oak bookcases lining the walls. It was this detail and material selection, with its quality and craftsmanship, that inspired Berman in his design of the new addition.

The new 12,000-square-foot building is a luminous rectangular box that flows easily from the existing structure and is flooded with natural light thanks to the front curtainwall and double-height windows on the rear elevation. Like one big study hall, the main reading room—whose ceiling slopes up from 18 feet 5 inches high nearest to the existing building to 25 feet $6\,3/4$ inches high farthest away, mimicking the grade of the site—is lined with new $7\,1/2$-foot-tall bookshelves (a nod to the library's originals) and the space is broken down into different work areas. The main circulation desk, which faces the new entry, serves as the visual hinge between the two buildings.

During meetings with the client, the NYPL insisted that spaces be clearly zoned for security purposes: the children, teen, and adult areas

The duo of natural and electric light create an open, airy feeling in the main reading room. The uplight portion of the linear pendant fixture highlights the texture and tone of the Douglas fir ceiling and its $11\,3/8$-inch-deep beams (facing page). Stack lights at the perimeter shelves highlight the stars of the library: the books.


MANGA

Details

Project: Stapleton Library, Staten Island, New York • **Client:** The New York Public Library, New York • **Architect:** Andrew Berman Architect, New York • **Structural Engineer:** Gilsanz Murray Steficek, New York • **M/E/P Engineer:** IP Group Consulting Engineers, New York • **Lighting Designer:** Cline Bettridge Bernstein Lighting Design, New York • **Landscape Architect:** Wallace Roberts & Todd, New York • **Geotechnical Consultant:** Langan Engineering & Environmental Services, New York office • **Project Size:** 12,000 square feet • **Project and Lighting Costs:** Withheld (per client's request) • **Code Compliance:** Complies with local New York City codes • **Watts per Square Foot:** 0.97

Lighting Manufacturers

Bartco Lighting: 21W and 28W 3000K T5 fluorescent bracket-arm-mounted luminaire for library stacks • **Cole Lighting:** 3000K LED illuminated handrail at entrance • **Kurt Versen Lighting/Hubbell Lighting:** Recessed 32W CFL double wallwasher with 6" aperture at main entry vestibule • **Louis Poulsen:** Decorative globe pendant in the children's room • **Philips Omega Lighting:** Recessed 3000K LED downlight with 4" aperture at entrance canopy • **Pinnacle Lighting:** 28W 3000K T5 fluorescent linear direct/indirect pendant luminaire throughout the project (main reading room, lounge, computer area, and community room)

A view from the children's room through to the new library wing. A decorative pendant was chosen by architect Andrew Berman to tie into the architectural details in the original building designed by Carrère & Hastings.

LONGITUDINAL SECTION

all had to be separate. The children's room is now the sole occupant of the original Carrère & Hastings building, and the teen and adult areas are in the new wing. Long tables, some with computer terminals and some without, provide more-formal workspaces, while lounges with oversized bean bag chairs create informal spots for reading, listening to music, and browsing. The center bay houses staff offices and a multipurpose community room.

The addition and its architectural features—the Douglas fir ceiling and beams, polished concrete floor, skylights, and expanse of glazing—all take their cues from the existing building, but in Berman's hands, these elements take on a contemporary feel that creates a warm, inviting, and intimate place despite its scale. And while Berman wanted library visitors and staff to have the sense that the building was predominantly day-lit, electric lighting was a necessity, and so he called on Stephen Bernstein, principal of Cline Bettridge Bernstein Lighting Design (CBBLD), who first worked with Berman in 2002–03 on AIA New York's Center for Architecture.

CBBLD's lighting scheme captures the essence of the architecture both in its form and in its material sensibility. CBBLD challenged themselves to see if they could find a single lamp type that could meet the needs of the entire project. "We went around the building looking at what needed to be lit and where we could put the light," Bernstein says. The CBBLD team decided on a 4-foot T5 linear fluorescent. (Since the project started in 2009, LED technology wasn't yet at the forefront of luminaire offerings as it is today.) In the main reading room and community room, the decision translates into a 28W 3000K T5 linear fluorescent direct/indirect pendant that provides 25 footcandles. These luminaires are suspended from aircraft cable and align with the horizontal mullions of the windows and the vertical wood columns of the front curtainwall. The rectangular form of the fixtures complements the shape of the Douglas fir ceiling beams and the fixture's datum of light becomes another architectural feature. "There isn't much reliance on over-decoration," Bernstein says. "The decoration is the palette of materials that were being used. Our lighting had to respond to that, and in its own way had to be an architectural element within the space."

At the library stacks, which employ a stainless-steel shelving system, bracket arm-mounted fixtures are used with 3000K 21W and 28W T5 linear fluorescents. Here, the goal is to brightly highlight the books.

At the entry, the lighting team departed from the linear fluorescent lamp typology, opting instead for a 3000K LED illuminated handrail, 3000K 4-inch recessed downlights at the canopy, and 6-inch recessed 32W CFL wallwashers in the vestibule. A decorative globe-shaped pendant was selected by the architect for the children's room and is meant to act as a design departure from the linear aesthetic of the new building.

Everyone is thrilled with the new library. This year it was one of five recipients of the second annual NYC Neighborhood Library Awards supported by the Stavros Niarchos Foundation and the Charles H. Revson Foundation. It has even drawn the attention of library professionals who have visited from other towns and states."We wanted this to be a great public library, not an architectural monument," Berman says. "The comments from the community are the best I could hope for." •

PRODUCT GALLERY

PRODUCT GALLERY

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NATHALIE ROZOT

For Nathalie Rozot, intellectual curiosity is a constant. With degrees in science and design, she has forged a multidisciplinary career. The director of New York–based L’Observatoire International from 2000 to 2005, she opened her own lighting design and research practice in 2006. She has taught landscape lighting workshops in France at the École National Supérieure de Paysage de Versailles and is the primary thesis faculty in the MFA lighting program in the School of Constructed Environments at New York’s Parsons the New School for Design where she has taught for the past 15 years and has served as thesis adviser since 2007. In 2011, she founded PhoScope, a “think tank on light” to establish “a new platform to facilitate change in the practice, education, and critical study of lighting.”

Do you see architecture and lighting as distinct or parts of the same whole of design?
Architecture and lighting decisions are related because space, materials, and light are connected. However, constructed environments need distinct areas of expertise that are complementary. Design needs to be served with cross-disciplinary knowledge and processes.

Does there need to be more critical dialogue and discussion in architectural lighting?
Yes. Our generation is too focused on practice and our intellectual legacy will be dire. We need a body of theoretical work and study to advance practice. I’m a strong advocate for a larger critical and research culture about lighting.

What do you see as the greatest challenge facing lighting education today?
We’re in a 21st century context where higher education, design education, and pedagogy have evolved. Lighting design education should evolve as well. We’re still teaching lighting design in an architecture-centric framework but we need to move beyond self-justification for our field. We should promote a wider literacy about light across all disciplines so that we can focus on the lighting design practices that are relevant today.

Why did you establish PhoScope?
The idea was to create a shift and to position critical research culture from a photo-centric viewpoint, as opposed to situating it within architecture and theory.

How would you describe what a lighting designer does?
I say that I am phototect and that I phosform public space in the photopolis. •

interview by Elizabeth Donoff
photo by Karsen Moran

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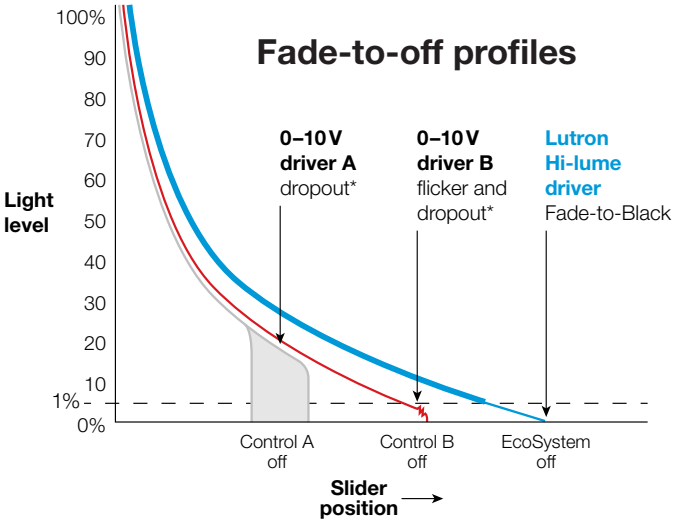

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