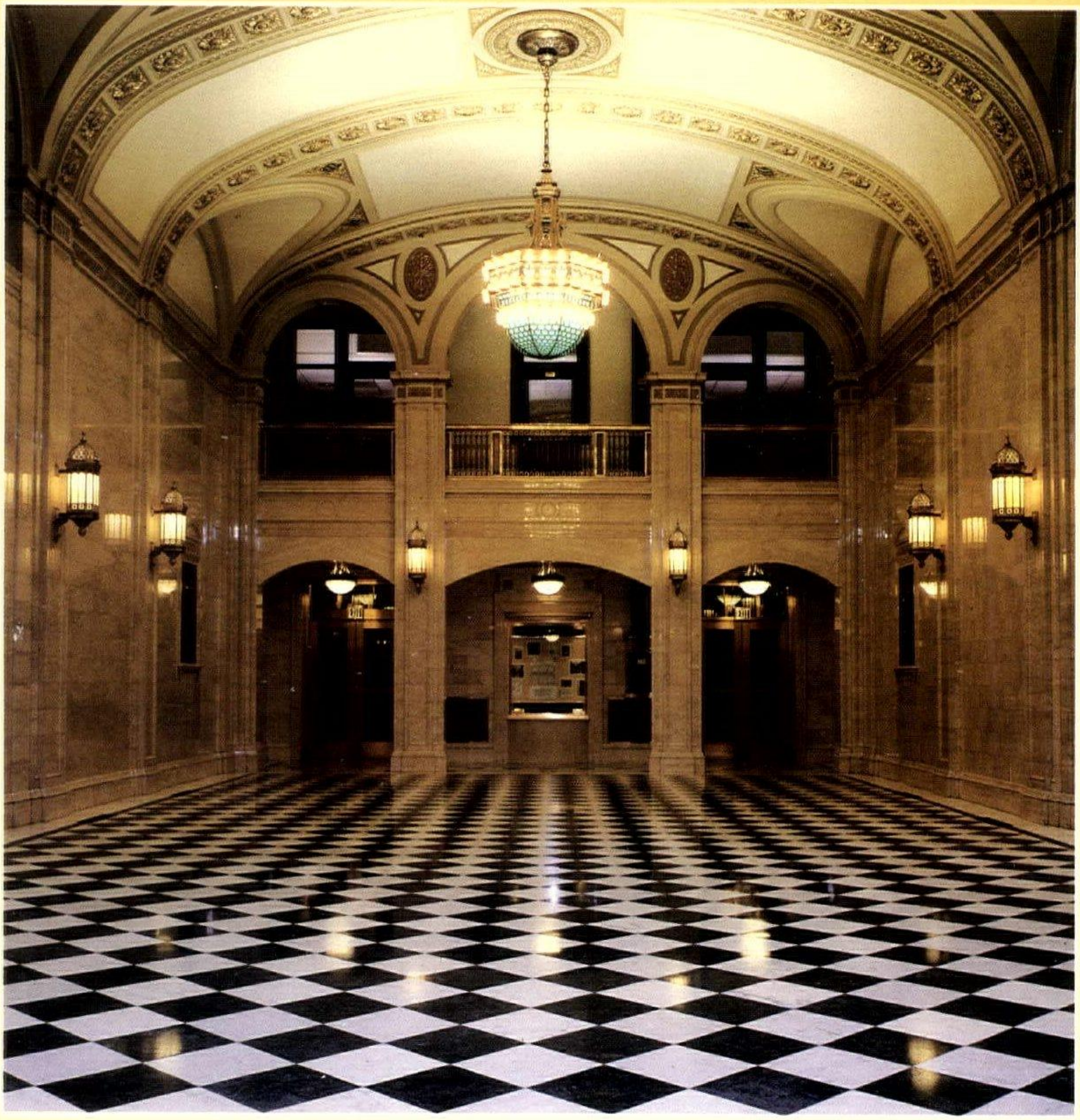
ARCHITECTURAL LIGHTING



March 1987
Five Dollars

Lighting the Corridor

It's time to rethink.

New lighting technology makes the old answers obsolete.

Your first true impression of a building's interior comes when you leave the lobby and enter the corridors.

The picture below demonstrates the kind of impression a corridor can make. When you walk into this corridor, every part of it seems washed in a soft, even glow. An effect like this requires exceptionally consistent, comfortable illumination at a high enough level to make the corridor clearly "well lighted."

Contrast this image with the dozens of unfortunate corridors you've encountered over the years: the gloomy hotel corridor, the glaring hospital corridor, the bland office corridor. In each case, the blame falls on an outdated lighting system.

High illumination: up instead of down

Almost every corridor in America with a high illumination level uses a down light. If the floor is reflective, as in the hospital corridor, you find yourself staring into what amounts to a second set of light fixtures on the floor, throwing uncomfortable light over every surface.

If the floor has a medium to dark carpet, downlights won't reflect light back into the ceiling. The fixtures stand out as glaring spots on a dark surface. You end up with a half-lit space: well-lit floor and lower walls, under-lit ceiling and upper walls.

The corridor in the picture demonstrates a lighting concept developed in the early 1980s and now beginning to gain broad acceptance. A lensed indirect fixture with an unusually wide distribution turns the whole ceiling into a single light source, creating smoother, more pleasing illumination.

The secret to the distribution lies in the Peerless Softshine Optical System. The strip of visible lens at the sides of the fixture has a pleasant, low-brightness glow from a normal viewing angle. But from just above viewing angle, it throws great amounts of light out to the upper walls.

It also makes you feel the corridor is better lit. In a comparison study, Penn State University discovered that a visible lens like the one in the photo raises perceived light levels about 20%.

A corridor light for the 1990s: glare-free illumination plus the sparkle of a low-brightness lens.

No other fixture in the world can deliver smooth illumination over vertical and horizontal surfaces so efficiently. As a result, no other fixture can light a corridor so successfully.

Peerless invented and patented it. And only Peerless makes it.

It's the lighting of the future. If you'd like to see what else the future holds, just call.

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The inviting corridor: much of its personality comes from the soft, cheerful lighting. Note the absence of deep shadows and harsh highlights. The specialized Softshine Optical System of the lensed indirect fixture has an exceptional ability to fill a wide area with pleasant light.

ARCHITECTURAL
LIGHTING

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Editorial Advisory Board

Architectural Lighting's Editorial Advisory Board represents various facets of the lighting professions, and members were chosen for their expertise. EAB members may suggest article subjects, review manuscripts or projects, and answer questions as they arise.
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A new EAB member

Architectural Lighting *is proud to introduce a new member of the Editorial Advisory Board. Members represent various facets of the lighting professions and were chosen for their expertise. EAB members suggest article subjects, review manuscripts or projects, and answer questions as they arise.*

■ Fran Kellogg Smith, ASID, CSI, MIES, IDEC, EDRA

Fran Kellogg Smith is the founder of Luminae Lighting Consultants Inc., San Francisco, California, and an instructor in the interior design certification program at UCLA. She received a bachelor's degree in politics from Pomona College, Claremont, California, and a bachelor's degree in interior design from Woodbury University in Los Angeles. She has accumulated almost 300 hours of graduate credit in lighting design at the Lighting Institute at Nela Park, Immaculate Heart's special-effects lighting program, and the Universities of Wisconsin, Pennsylvania, and California.

Smith began her career in lighting design as a partner with Omnia, Los Angeles. She then joined the staff of Black, Swarens, and Okada in that city. In 1973 she founded Luminae, which expanded in 1976 to include offices in San Francisco as well as Los Angeles. She left Luminae in 1984 to concentrate on writing and teaching.

Smith is the author of numerous articles and coauthor of *Bringing Interiors to Light* (Whitney Library of Design, 1986). She has presented guest lectures at institutions throughout the country. She is a member of IES, ASID, the Construction Specifications Institute, the Interior Design Educators Council, and Environmental Design and Research Associates, and she serves on several national committees. ■

Keep in touch

We want *Architectural Lighting* to be your forum for lighting issues of all kinds and invite your letters on subjects of interest to our readers.

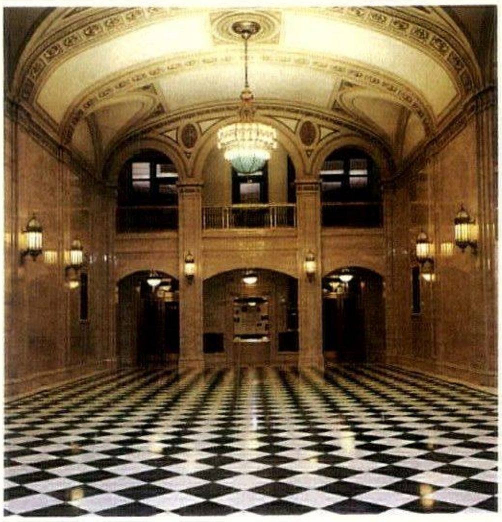
Address your letters to Charles Linn, Editor, *Architectural Lighting*, P.O. Box 10460, Eugene, OR 97440-1046.

Credit where credit is due

Photo credits were inadvertently omitted from two black-and-white photographs of the Johnson Wax Administration Building on page 49 of the February 1987 issue of *Architectural Lighting*. Photo credit for both should have been given to Ezra Stoller/ESTO.

ARCHITECTURAL LIGHTING

March 1987
Volume 1, Number 3



Cover Story

Articles

Statements

Columns

Departments

From the Editor

Nothing breaks this editor's heart like having another magazine publish a story his magazine is working on — Jimmy Olsen of the *Daily Planet* used to call it "getting scooped." The consolation prize is getting the chance to see what the other guy did and trying to do it better — if the magazine hasn't already gone to press. Trying to be first is part of the job, but if one isn't careful it can become a paranoid, fanatical obsession.

That's probably why I broke out into a cold sweat last month when I spotted a cover blurb on the latest *National Enquirer:* "Lighting Affects You in Ways You Never Knew." Insult compounded injury when a quick perusal of the tabloid article in question (I wouldn't actually buy a copy) revealed that an author I've been courting for an article on lighting and behavior was cited as an expert consultant for their article. Horrors!

Usually when the competition scoops my magazine, I feel disappointed, but at least I know I'm on the right track. After all, *Time* and *Newsweek* cover a lot of the same stories every week, and occasionally even have the same folks on their covers at the same time. But this was different. Suddenly, *Architectural Lighting* was going head-to-head with the rag that has the "largest circulation of any paper in America."

My fingers trembled as I dialed the expert consultant. What about credibility? Would my readers feel I had let them down?

"Not to worry," said he. "It wasn't the practical sort of information that goes into *Architectural Lighting* anyway. I don't think very many designers will be able to make design decisions based on that information — at least I hope they don't." At once I felt redeemed. We could still do a better job of publishing his article on light and behavior. And maybe some of my readers didn't catch all the coverage in the *Enquirer.* Maybe only a few of them did. Maybe I'm the only one who did.

As I write this editorial, I still feel confident that we're on the right track. After all, the *National Enquirer* is a fairly accurate barometer of what people care about. The adjacent blurb on the very same cover read, "Expert Reveals Six Ways to Help You Get a Raise." Maybe I should have bought a copy after all. But no — I'd have to have real practical information about that!

Charles Linn, AIA

Letters to the Editor

Inconsistent labels

For the second time your magazine has hit the mark and filled a need. Congratulations on another superb issue!

Found one error; on page 56 [January 1987] in the text under the photograph of the F40T12CW/RS fluorescent lamp. The text states "40 is the nominal length in inches" of the lamp. The lamp shown has a nominal length (including lampholders) of 48 inches. The 40 in this case represents the wattage of the lamp. In some cases, such as a slimline lamp, the designation does indicate the length — F48T12/CW — a 39-watt single-pin lamp, which is not a bipin lamp as shown in the illustration. Such is the inconsistency of man-made designations!

Again thanks for filling a need.

Robert R. Wylie, PE, FIES
Illumination Consultant
Danvers, Massachusetts

Informative, but confusing

I enjoyed reading the informative article, "The Parts Department," by Sidney M. Pankin [January 1987] concerning fluorescent lamp sources; however, without writing a major dissertation, I would like to point out to your readers an error (or erroneous assumption).

It concerns the lamp recognition symbols detailed under the photo on page 56. The lamp shown is an F40T12CW/RS, which is a rapid start (preheat) type of lamp, and in the case of all preheat type lamps, the "40" denotes nominal *watts*, not nominal length. Please don't confuse the nomenclature of rapid start lamp sources with that of slimline.

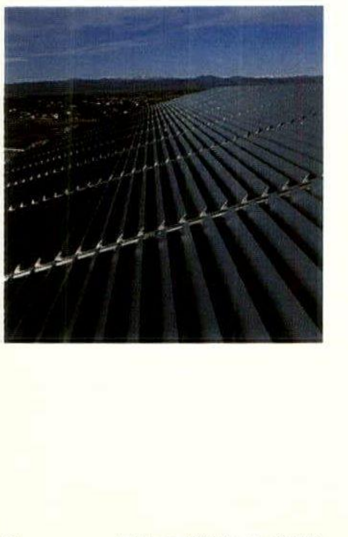
Keep the informative articles coming. They are interesting.

Gordon Smart
Engineered Lighting Specialties
Little Rock, Arkansas

These writers are absolutely right. We should have used a picture of a slimline (one-pin) type lamp. Although the *40* designation indicates nominal length for slimline lamps, it indicates nominal *watts* for rapid start lamps. Interestingly, lamp manufacturers continue to use the F40 designation for energy-saving lamps that consume only 32 or 38 watts. So, 40 stands for watts sometimes — and sometimes not. Still, without exception, F40 rapid starts will fit into 4-foot fixtures. The same is true for F30s; they will fit into 3-foot fixtures. If you're looking for 4-foot *slimlines*, however, look for an F48. We apologize for the confusion.

The Editor

The great open spaces, where light is managed by louvers



Project: Solarium, Great West Life Building
Location: Greenwood Village, Colorado
Architects: WZMH Group, Inc.
Interior Photo: Bill Lemke
Exterior Photo: Laman & Assoc.

Installing a 40-foot by 225-foot north-south single-slope skylight in the center of a Denver-area office building sounds like an HVAC headache. Nevertheless, Super Sky Products engineers were not worried about connecting two office wings of the Great West Life Building with a skylight to form a solarium. All that would be required, they reasoned, was an adjustable fenestration system.

But therein lay the rub. Traditional approaches to fenestration — sun shelves and baffles, for example — seek to optimize the use of shading devices that are calibrated to some point in the sun's seasonal cycle. Thus, a shade might be set for optimum use on June 21. The sun, however, does not stay put. The sun's altitude and azimuth angles are constantly changing but are the same, for example, in June and September — seasons with drastically different HVAC loads.

Variable fenestration controls were the solution, and this was where an automated daylighting system came into play.

A series of louvers on the skylights turn in response to lighting conditions: the sun's position, sensor readings inside and outside the building, and thermostat readings. The control console, in turn, is integrated into the building's energy management computer permitting selection of a variety of operating options.

These options include automated shade tracking, whereby the louvers block out direct sunlight but allow cool, reflected light to enter the solarium. Automated light intensity is achieved as the interior light level is repeatedly compared to an adjustable set point, and the louver blades move to maintain the desired level. In this mode, when daylight falls below the determined level, the system can automatically switch on as many as three lighting circuits. When direct sunlight is desired, the louvers track the sun with their blades pointed edge-on so that all the sunlight can enter the building — for example, when heat gain is needed.

Two additional features of the louver system make it particularly applicable for the solarium. The louvers can be closed at night, their edges overlapping to form a continuous surface. The closed louvers form, in effect, a thermal blanket that reflects heat back into the building.

A second advantage for the solarium is the louvers' snow-dumping capability. When snow reaches a predetermined level on the closed louvers, they open and close rapidly, dumping the snow on the warm skylight and promoting melting. The louvers themselves can bear quite a bit of weight.

Less easy to quantify but no less an asset is the aesthetic value of the variable fenestration system. Because the angle of the blades is never the same from one hour to the next, the system takes on the appearance of a living skin over the building. The value of the fenestration is that it can change, and the user can control it. ■

For product information, see the Manufacturer Credits section on page 70.

THE BRIGHT IDEA IS AN IDEA THAT WORKS

It is officially called the Specular Silver Optical Reflector (SSOR). By installing the high performance retrofit reflectors in your buildings fluorescent light fixtures, the fixtures can be de-lamped by 50% without significant reduction in light levels. As a result, **The Bright Idea** *provides important* **benefits** *for your buildings needs.*

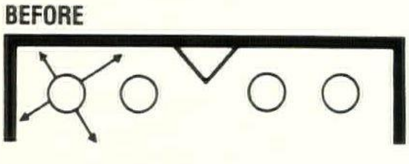
- *40 to 50 percent reduction in lighting energy bills*
- *Lighting maintenance cost reduction (50 percent fewer lamps and ballast to replace)*
- *No significant reduction of light levels*
- *Fixture illumination uniformity*
- *Glare control and reduction*
- *Improve color rendition*
- *Building cooling system load reduction*
- *Longer light fixture component life (lower fixture operating temperatures)*
- *Assured reflector reliability and longevity*

THE BRIGHT IDEA IS SIMPLE

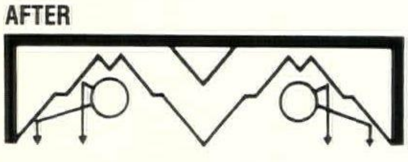
Maximum Technology has engineered the highest performance reflector. The specular silver optical reflector consists of a space age silver film that is bonded to .025" aluminum material creating a highly reflective mirror. Unlike polished metals; the silver film demonstrates superiority in reflectivity because it reflects 96% of incident light.

When The Bright Idea is installed in a fluorescent light fixture, the light is precisely reflected back into the work area rather than being scattered by the aluminum or white metal surfaces found inside most fixtures.

BEFORE



AFTER



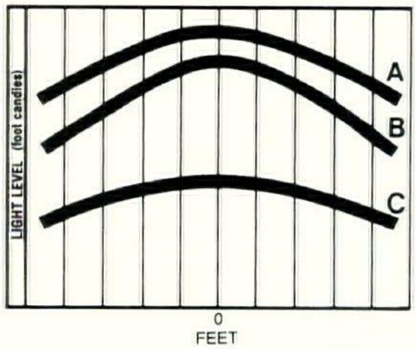
THE BRIGHT IDEA IMPROVES LIGHTING EFFICIENCY

Maximum Technology manufactures **The Bright Idea** *for almost all types of fluorescent luminaires, new fixtures as well as existing fixtures. Over 1,000 custom designs have been produced for a wide range of customer applications. However, the most common fixture is the standard 2×4 foot luminaire. Let's examine how* **The Bright Idea** *improves efficiency, through wattage reduction.*

2×4 Fixture Components	Before Retrofit	After Retrofit
#lamps/watts	(4) F40W/160W	(2) F40W/80W
#ballast/watts	(2) Ballast/30W	(1) Ballast/15W
Total watts	190W	95W
Total watts saved	95W	

By installing **The Bright Idea** *50% of the lamps and ballasts are removed from the 2×4 luminaire, thus improving efficiency of the fixture. Available photometric testing demonstrates the improved efficiency as well as the impressive light level performance.*

FIXTURE



A *Standard 2×4 foot fixture with 4 lamps*

B *Standard 2×4 foot fixture with 2 lamps removed and* **The Bright Idea**

C *Standard 2×4 foot fixture with 2 lamps removed*

THE BRIGHT IDEA IS A QUALITY DESIGN

Maximum Technology utilizes computer aided design (CAD) techniques to engineer the highest performance reflective design for your fixtures. Once the design is determined, the reflectors are manufactured in Maximum Technology's 25,000 square foot modern production facility.

Sophisticated computer controlled fabrication equipment insures the accuracy and quality of the reflectors. The quality control department demands ±½° angular accuracy and ±.005" dimensional accuracy, because the slightest variations in angle or dimensions can change reflector performance.

Maximum Technology maintains a large inventory of raw materials as well as 15 computer controlled machines to produce up to 100,000 reflectors a week.

THE BRIGHT IDEA IS GUARANTEED

Your building, like your business, is different from any other. To accommodate these differences, a comprehensive **Lighting Application Analysis** *is recommended to determine the value you will receive from installing* **The Bright Idea.**

A no-charge walk-through evaluation of your facility is the first step. You will receive a written quotation, financial proposal and energy audit. Upon your acceptance, an evaluation test area within your building is designated. This will allow your personnel to experience the benefits of the system to be expected throughout your facility.

A design team determines the exact specifications required for each fixture to produce the best results. Once installed, either by Maximum Technology or by your crew, the system requires no special maintenance or cleaning. Maximum Technology **unconditionally guarantees** *the product and installation* **in writing.**

Most installations are completed during off-hours, so there is no intrusion during normal business hours.

THE BRIGHT IDEA PAYS FOR ITSELF

The installation of **The Bright Idea** *provides dramatic energy savings such that the investment ususally pays for itself in less than 2 years. In addition, energy credits, tax incentives, local utility rebate programs and other incentives may provide additional savings.*

Maximum Technology Financial Corp. offers an exciting financing program. Based on documented energy savings, **The Bright Idea** *can be installed in your building* **without a down payment or cash outlay.** *The fixed monthly payments can be funded comfortably from energy savings.*

THE BRIGHT IDEA HAS BEEN APPROVED

This is a patented system that is U.L. listed (for safety), and approved by Lighting Sciences, Inc. (for improved lighting of various fluorescent fixtures, improved vision, operational characteristics, and photometrics).

Over 100 major facilities have been successfully retrofitted with **The Bright Idea.** *Customers include: manufacturing facilities, offices, banks, institutions, stores, assembly plants—in large, medium and small buildings. Complete case histories and documented test results are available for your review. Call today and get* **The Bright Idea!**

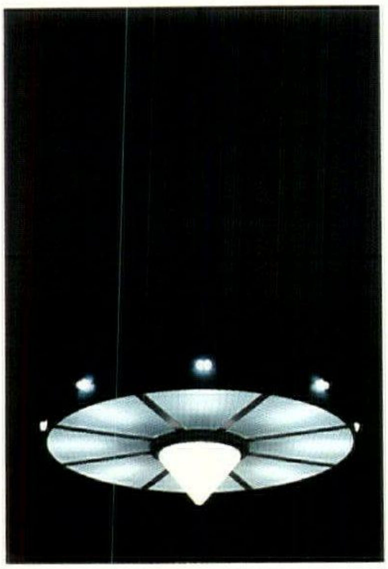
MAXIMUM TECHNOLOGY

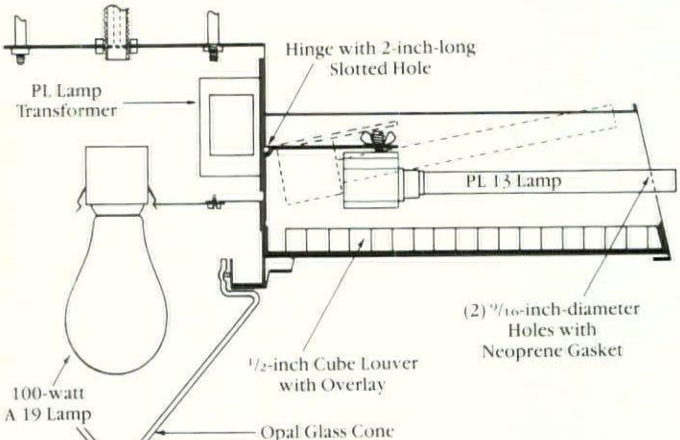
60 Industrial Way
Brisbane, CA 94005
(415) 468-2560

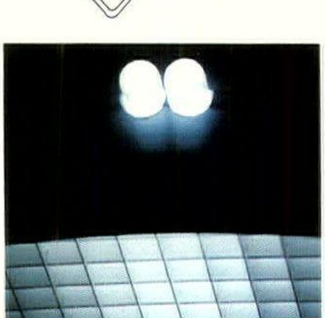
U.S. Patent 4336576 Other patent pending products.

Circle 10

Compact fluorescent lamps stand in for jewels around chandelier rim







Project: Offices of Griffin Bacal
Location: New York, New York
Lighting Consultant: Jerry Kugler Associates
Architect: Paul Segal Associates

"The architect came to us and said, 'We don't have a whole lot of money to spend on this space, but we want to make a big impression with the lighting,' " recalls lighting consultant Jerry Kugler. Paul Segal Associates was renovating tenant office space in a Manhattan building occupied by Griffin Bacal, an advertising agency with accounts in the toy business.

"These were a group of creative people with a sense of humor," Kugler says. Segal asked Kugler's firm to design energy-efficient, relatively inexpensive custom lighting to complement the architecture and please the client.

The renovated building had 12- and 25-foot ceilings — enough room, Kugler decided, to hang a thin-profile chandelier. He liked the idea of a narrow layer of lamps sandwiched between two flat disks — a design he'd seen in magazine and book illustrations from the 1930s and 1940s — but he wanted to replace the traditional incandescent lamps with compact fluorescents.

"I noticed that in the history of chandelier making, one idea was the notion of jewels in the side, faceted like cut crystal. We weren't going to do anything literal like that, we had a budget of just under $500 each for the chandeliers," Kugler says. "So I began to do a wagon wheel of PL lamps and then thought, well, the ends of the PL lamps could be the jewels if I can only find a way to poke them through the rim. Finally, it came down to a simple hinge and wing nut — you slide the lamp back and swing it up for relamping."

Kugler specified two lay-in pieces of perforated steel to form the upper surface of the chandelier. The white-painted steel reflects most of the light downward and allows some through — just enough to reveal the ornamental stem mechanism and to create a soft glow on the ceiling.

On the bottom, Kugler wanted a disk of relatively low brightness to contrast with the points of light around the rim. To achieve the right balance, he decided to experiment with a prototype. "We actually designed into our drawings the idea that there would be a mock-up in which louver material with an overlay would be replaced with different types of textured glass," Kugler says. As it happened, the original louver design worked best.

The final element Kugler chose was the opal glass cone that recalls the brightness of the lamp tips. Because custom glass would be too expensive for a project of this size, Kugler searched through catalogs for a standard piece that would match the shape he had in mind. He found what he wanted in a catalog of finished luminaires; the manufacturer was willing to sell the glass cone as a component.

A custom manufacturer fabricated the spun-steel rim and central housing, built the mock-up model, and produced the entire set of chandeliers when the mock-up was approved. ■

For product information, see the Manufacturer Credits section on page 70.

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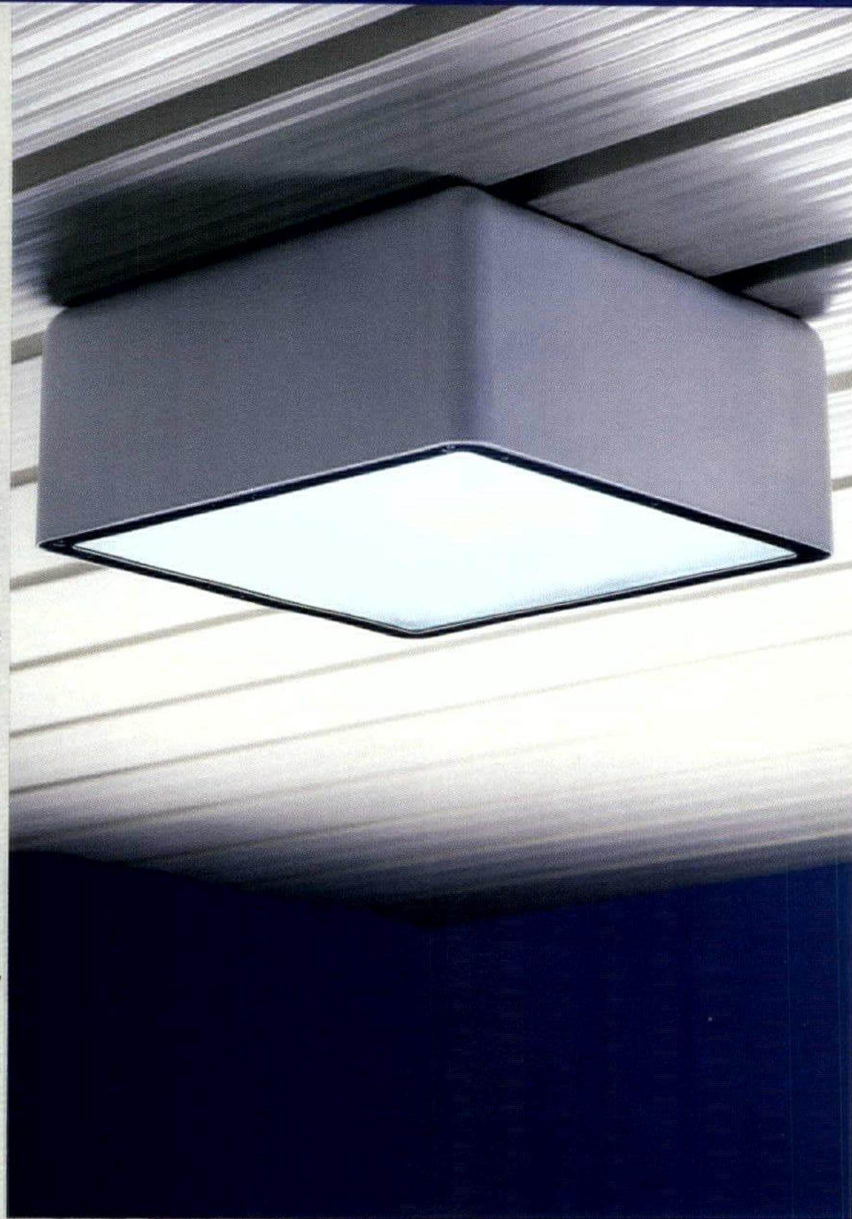
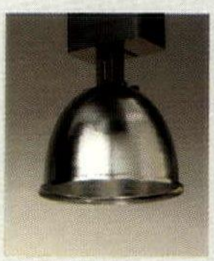


Canopy Lights



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Circle 11

7002

Block diagrams — making an atrium into a showcase

Project: Besser World Headquarters
Location: Alpena, Michigan
Project Manager and Designer: Bruce E. Johnson, AIA, Innovative Design, Inc.
Photos: Bruce E. Johnson

The Besser World Headquarters building in Alpena, Michigan, houses the world's largest manufacturer of machines for making concrete block. The company quite naturally wanted to incorporate concrete block into the design of its headquarters. The climate of Alpena, however, precluded extensive exterior displays — few clients want to take outdoor tours when the temperature drops below freezing.

The obvious solution was to take the concrete block indoors. Architect Bruce E. Johnson, AIA, went one step further and created a showcase atrium. It incorporates a gardenlike setting, ample opportunities for using borrowed light, and a fenestration system that supplies abundant light for plant growth and energy efficiency.

A key design element was the use of a barrel-vaulted, insulated, translucent fiber glass panel system for skylighting. The panel system was used in the south wall of the atrium in combination with a series of windows glazed with low-emissivity glass. Johnson wanted as much beam sunlight as thermally possible for visual contrast in the more evenly lit work areas and to create shadows that highlight the texture of the concrete masonry.

In addition, the atrium is the central area for all horizontal and vertical traffic, so enhancing the area with daylight helps promote employee interactions in the atrium, Johnson points out. "In that severe winter climate, the atrium is very important to give the company's employees not only a source of light but also a source of relief from the winter climate," Johnson says.

An ancillary benefit is that offices adjacent to the atrium are able to borrow light from windows and glass doors. Johnson explains, "The standard office width is only 32 feet and, in some cases, that's from the outside wall to the atrium, so workers get plenty of light into the middle of the building."

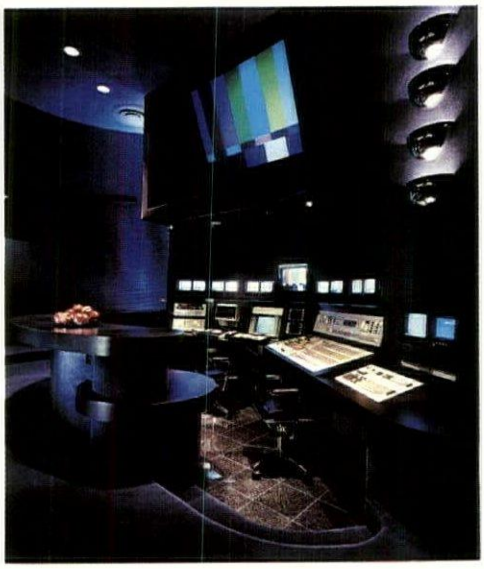
Abundant light in the atrium also gave Johnson an opportunity for creative design in the firm's conference room, a second-floor area that presents a curved, glass block surface to the atrium.

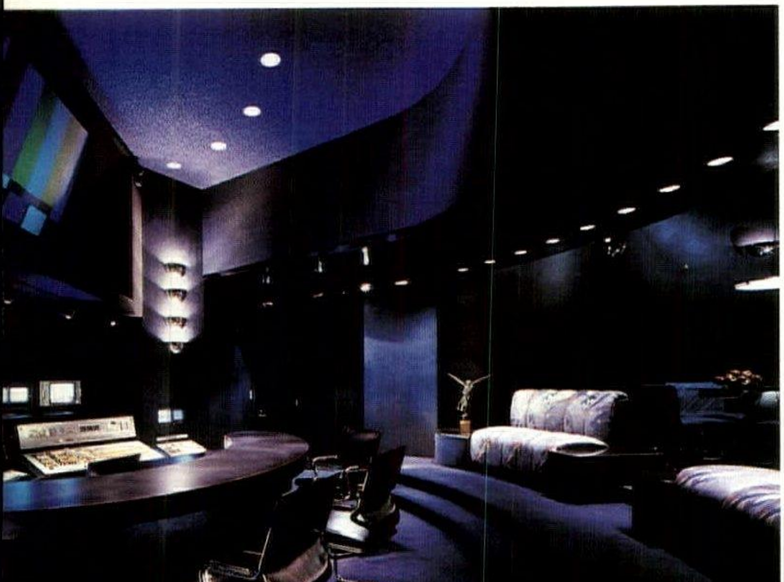
Paths in the atrium are lighted by a series of bollards that are activated by the same sensors that control the exterior lights. The bollards come on when the exterior lights do, but they operate at low levels of intensity to define the walking areas and accent the water. The design effect is to ensure adequate ambient lighting without distracting from the interplay of concrete masonry, colors, tones, and textures in the foliage, an application for which bollards are well suited.

The gardenlike atmosphere of the atrium and the abundant daylight it provides also have a psychological advantage: "Especially in the Alpena climate," Johnson says, "they have a lot of days that are dark when workers arrive at their offices and are dark when they leave. At least with the atrium, workers have a sense of the passing day." ■

For product information, see the Manufacturer Credits section on page 70.

TVC, where Madison Ave. goes to watch more than TV





Project: TVC Video
Location: New York City
Lighting Designers: Ralph Potente and Tom Koszalka, Ralph Potente, Ltd.
Photos: Mark Ross Photography

When you're paying $500 an hour to watch TV, the last thing you want is distracting glare. And that can be a problem when a Madison Avenue office sends an account exec to the TVC postproduction videotape editing room to oversee the dubbing of special effects for one of the agency's television commercials.

It's a competitive world in postproduction, according to Ralph Potente, partly because any video artist can buy the equipment to do top-notch work. Glare on the screen, however, can cost an entire project. Providing the amenities can mean the difference between gaining and losing a client, as the owners of TVC know very well. That helps explain why Potente and his colleague, Tom Koszalka, lavished so much care on lighting the TVC studio.

Glare is most noticeable on monitors, so the designers specified flexible low-voltage track lights with MR 16 lamps. The track lights are fitted with baffles and focused directly on the editing consoles where editors need task lighting to operate controls.

Next, areas such as the counter, where directors must read scripts, and the seating in the back of the room were lighted with deeply recessed high-hat downlights. Their multigroove baffles have a black matte finish, again to reduce glare while providing adequate task lighting.

Finally, the designers arranged two vertical rows of chrome sconces for additional ambient light. Because the finish is highly reflective and intense reflections of the lower lamps could appear in the upper sconces, the designers covered the top of each sconce with frosted glass to eliminate reflections and soften the light.

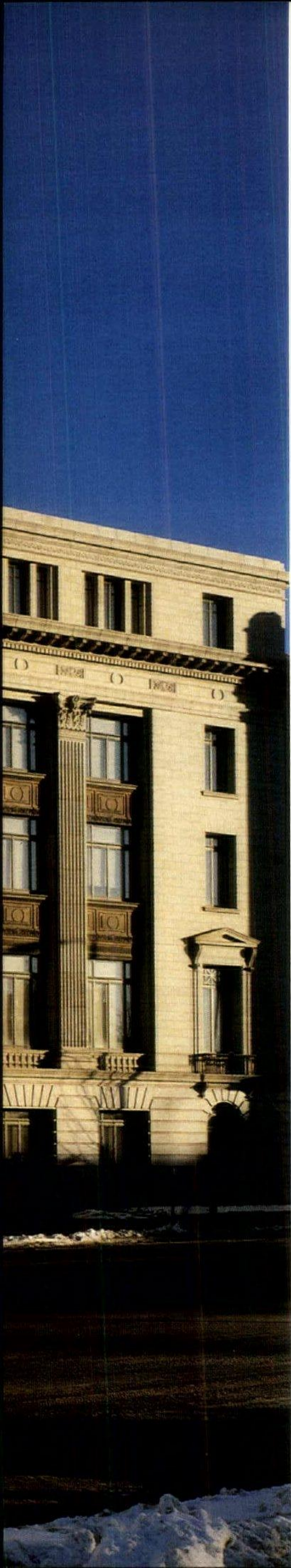
Potente points out that a relatively large number of light sources are in a small space. To ensure that each component of the lighting system is used to maximum advantage, the design team installed a six-zone dimming control system in the studio. Four preset lighting arrangements and manual override capability give users flexibility and efficiency in the editing room, which is used by both large and small groups.

The first preset lighting mode accommodates small groups sitting at the counter and paying attention to several small monitors while the large monitor is off; in this mode, the back of the room is darkened. In a second working mode, ambient light is brought up slightly, but the lighting helps highlight both the large and the small monitors. Darkening the back of the room and turning off the smaller monitors helps focus attention on the large rear-projection video screen only. In a final mode, the lights are on full for routine tasks such as maintenance.

At the TVC studio there is no catch light on the monitors, and even though the room is expansive, there is ample task lighting without glare. Potente admits that the job was expensive, but the owners of the TVC studio also believe that it was worth every penny. ■

For product information, see the Manufacturer Credits section on page 70.

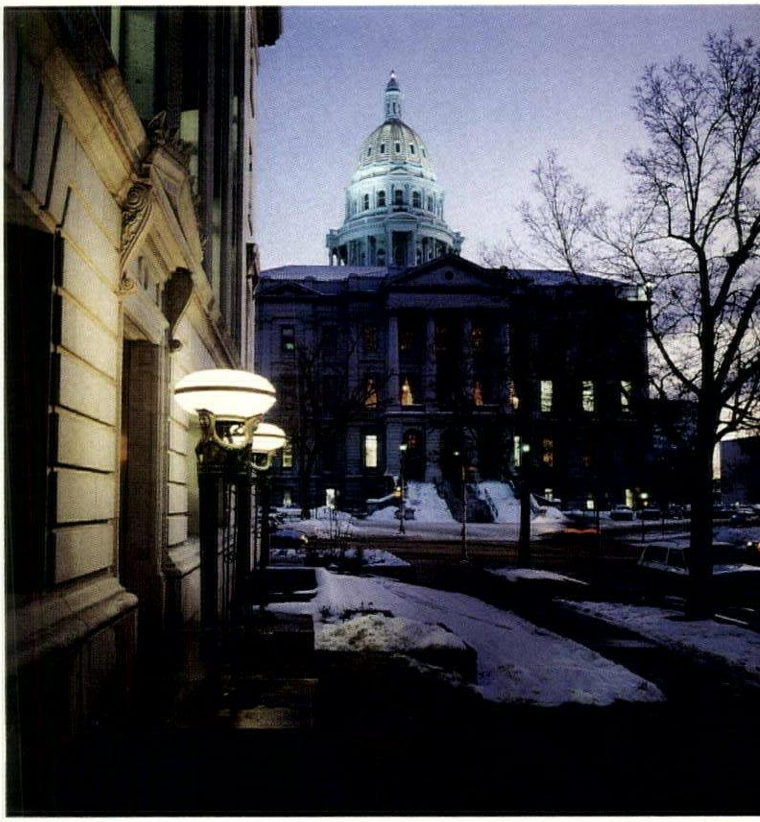

STATE OFFICE BUILDING



The best of both worlds: Historic luminaires and modern illumination

ARTICLE BY
CHARLES LINN, AIA

PHOTOGRAPHS BY
DAVID ROSENBERG



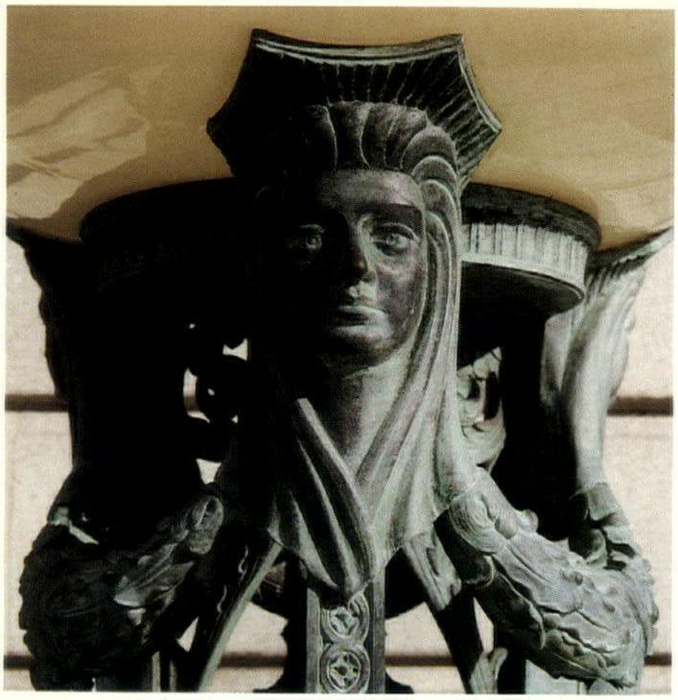
It took more than Brasso and new bulbs to rehabilitate the lighting of the 1920 Colorado State Office Building. From Day One, electrical engineer Les Yingling found himself involved with the Colorado State Historical Society. The historians stressed visual unity as a major design objective in the rehabilitation of the 75,000-square-foot structure, which had been closed several years earlier because of fire code violations.

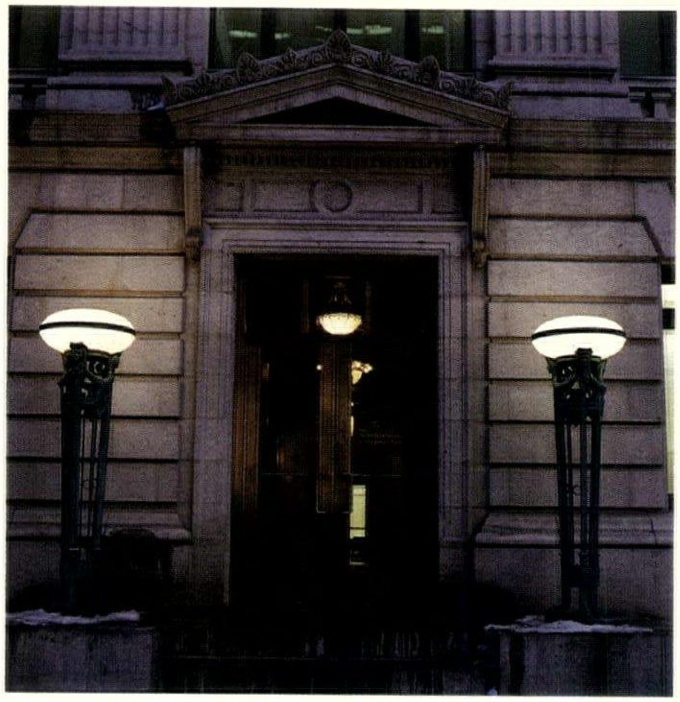
"They didn't want the public to perceive the place as a 1920s structure that had been gutted and turned into a 1986 office building. Because the lighting was a major element of the building's historical context, it was extremely critical to handle the rehabilitation with sensitivity," says Yingling.

But, attempting to combine sensitivity with practicality can be a tricky bit of business. Many of the luminaires on this project had been replaced, but not for failure to recognize their architectural value. They were traded for fluorescent strips because, as the building's use evolved over time, more light was needed to accomplish the tasks at hand.

To ensure that the project would succeed, Yingling *rehabilitated* the luminaires by repairing and altering them in a way that preserved original features, yet made them suitable for efficient contemporary use. He made certain that the new lamp sources would have greater efficacy and lamp life than the original incandescent sources without straying too far from their color temperature. He also sought artisans willing to work with him to clean and rebuild existing

Project: Colorado State Office Building
Location: Denver, Colorado
Architects: Urban Design Group
Electrical Engineer: Les Yingling, Torgerson•Yingling Associates, Inc.

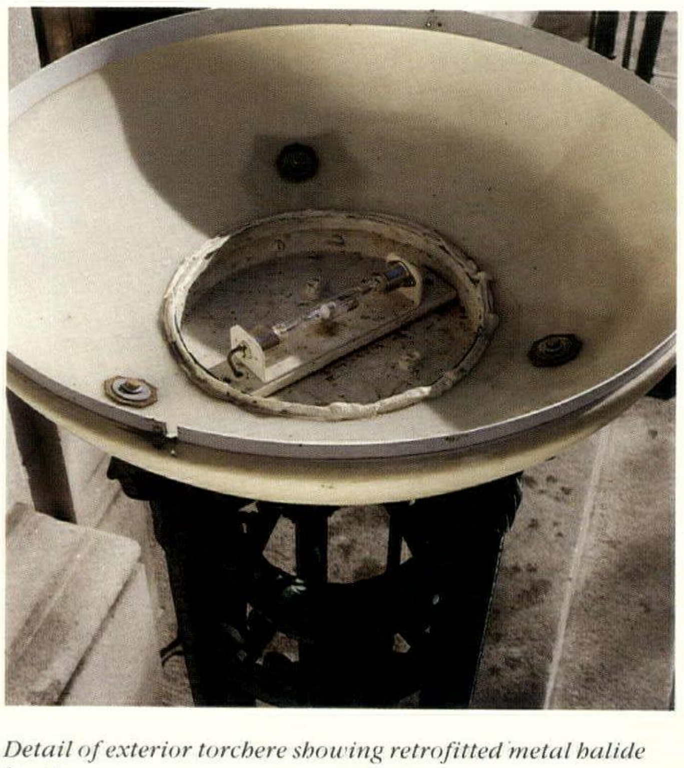




luminaires, to re-create from scratch either whole luminaires or missing components, and to repair broken stained glass.

The luminaires were a bit of Colorado history, having been custom manufactured for the job in Denver by the Sechrist Manufacturing Company. As was true of other Sechrist products, the luminaires were fabricated of extremely high quality materials, which added to the rehabilitation challenge. "You have to be as faithful to the original as possible. In most cases where there was bronze, for example, we used bronze," Yingling says.

"Then, we had to find the drawings and see what the originals really looked like, and whether they had been changed over the years. We were pretty lucky on this job, as we were able to locate either the original architect's drawings or else we still had one of the originals around to work from."



Detail of exterior torchere showing retrofitted metal halide lamp.

Exterior Lighting

For this rehabilitation, all of the existing wall bracket luminaires were removed and cleaned; broken stained glass insert panels were matched and replaced. The incandescent sources were replaced with 70-watt metal halide.

Rehabilitating a set of twin plinth-mounted exterior torcheres was more complicated. The original luminaires were fitted with elliptical globes of alabaster glass joined by tooled bronze bands at the horizontal half-point. At some point the globes were replaced with large vacuuformed plastic spheres. The bronze standards had been coated with flat black enamel to keep bronze patina from staining the stonework. The incandescent lamps needed constant replacement.

The torcheres were shipped to a New York firm that specializes in custom rehabilitation and restoration work. There, they were stripped of paint and cleaned and the bronze finish restored to a light patina. New elliptical globes were formed of polished, vandal-resistant white acrylic. The globes were formed in halves and joined with a hand-tooled bronze band, as the original had been.

The torcheres also received new sources: "We chose metal halide for three reasons: color, size, and lamp life. These new 70-watt lamps have a very low color temperature, about 3000 degrees Kelvin. So they're almost as warm as incandescent. The lamps are quite small, and so is the ballasting hardware. We concealed the ballast right beneath the globe, so it can't be seen. Based on a 10-hour burn cycle, these lamps give about 5000 hours instead of the 750 from one of the 150-watt A lamps they used to have in these fixtures."

Lobby Lighting

The two-story lobby with an arched plaster ceiling is illuminated by a pair of rehabilitated chandeliers, fitted with new lamp sources, and a large stained glass skylight. The original chandeliers were filthy, and much of the cut stained glass around the lower half of the fixtures was broken or missing. In New York, artisans carefully matched the glass, cut and beveled the prisms, and set each into place.

"We used what might seem like an odd combination of lamps," says Yingling. "The glass in the lower portion has a greenish-yellow tint to it, and we really wanted to bring that

Restored skylight in center of lobby.

Interior of light box showing indirect 500-watt quartz luminaires.

out and to emphasize the contrasting color of the bronze. We tried incandescent lamps in this section, but the color was too yellowish, and it didn't bring out the bronze at all," he adds.

"We wound up using a 250-watt color-corrected deluxe mercury vapor lamp in the lower section. At 3300 degrees Kelvin, it does a good job of bringing out the green — although it isn't nearly as green as it would appear in a photograph. This lamp has the added advantage of long life, which is important when you consider that these chandeliers are extremely heavy and usually get broken when someone tries to change a lamp. We should get about 24,000 hours of lamp life out of the mercury vapor."

Around the tops of the chandeliers, clear, pear-shaped 11-watt sign lights were installed, replacing the A-type lamps used before the fixture rehabilitation. "They're smaller than the A lamps and make the bronze sparkle in a way that wouldn't be possible with a higher wattage frosted lamp — and without the glare. Because these 130-volt lamps are run on 120 volts, their lamp life is lengthened considerably." Four 300-watt indirect quartz lamps are concealed in the top of each chandelier to wash the ceiling with light and create shadows on the ornate plaster ceiling details.

Yingling's second challenge in restoring the lobby to its original grandeur was the 8-foot by 10-foot stained glass skylight in the center of the lobby. The skylight is at the bottom of what originally was a three-story air shaft covered by a clear glass skylight.

Neglect had taken its toll on the stained glass panels; many of the glass lights were broken, and the skylight was so dirty that little light could penetrate the years of accumulated grime. A further complication was the fact that meeting egress and square footage requirements dictated closing the air shaft above the skylight. Plans also called for installing a new concrete floor at the fourth-floor level of the shaft; that would effectively prevent daylight from reaching the skylight through this shaft as it once had.

The skylight was dismantled, marked piece by piece, and trucked to New York to be rebuilt. There it was cleaned, and new matching stained glass was installed along with new lead came and angle iron braces. Unfortunately, when Yingling went to inspect the work he learned that no one had mentioned to the workers that the skylight had to fit in a curved ceiling. The rehabilitation team then had to substantially rebuild what already had been reconstructed once.

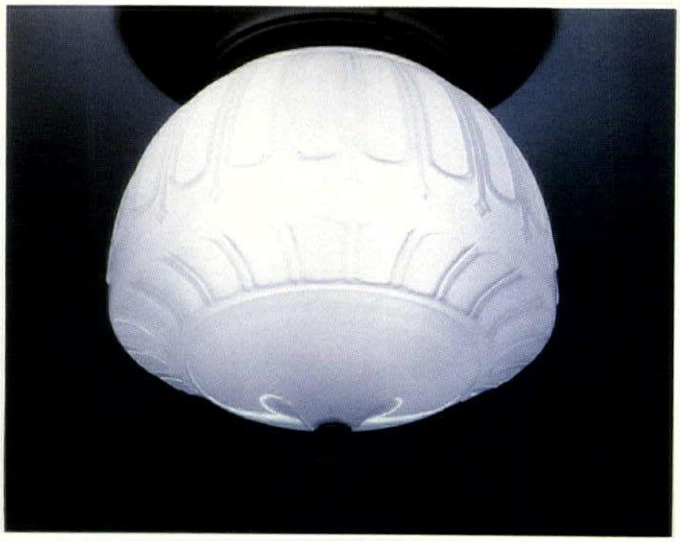
In the meantime, workers in Denver built a light box above the opening where the skylight originally was installed. Essentially a small fire-rated room constructed of gypsum board and metal studs, this light box has a 4-foot-high ceiling; its interior walls and ceiling are painted white. Eight 500-watt quartz incandescent luminaires, placed around the light box perimeter, illuminate the skylight indirectly by bouncing light up, off the ceiling, and down through the stained glass. Four access doors, one for every two luminaires, facilitate lamp servicing.

"You couldn't get daylight down into that skylight any more," Yingling says. "To try to maintain what the skylight did originally, we decided we could still let the daylight determine how bright the stained glass illumination would be. We ran a photocell to the outside of the building and use it to drive a dimming system that controls the brightness of the incandescent lights inside the light box. Now, if the sun goes under a cloud, the skylight illumination dims as it would if it were still daylit."

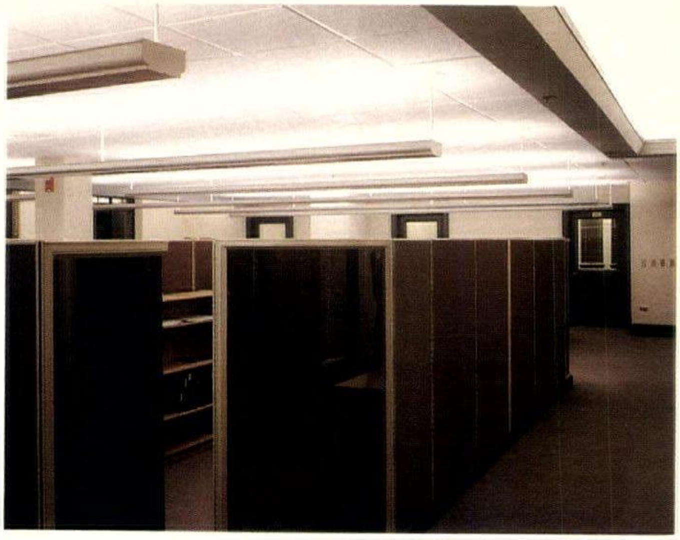
Smaller chandeliers illuminate the alcoves surrounding the lobby. One of these had been lost over the years and replaced with a 4-foot fluorescent strip. During the rehabilitation, an existing chandelier was dismantled and its bronze components used to make the patterns needed to cast a duplicate. The stained glass insert panels were matched and bent to match the originals. "The only way you could tell that the fixture was not an original," Yingling says, "would be to take it apart and put a micrometer on it. The duplicate is slightly smaller because of the recasting."

Egress Lighting

Corridor lighting throughout the building was originally accomplished with ceiling-mounted globe-type fixtures illuminated by standard A-type incandescent lamps. "The requirement was that these corridors be lit 24 hours a day for egress. The fixtures and the wiring were old, so the tendency was to replace just the fixtures that were causing trouble with fluorescent strips," said Yingling. "The average A lamp lasts about a month with that kind of use. We knew that we couldn't increase the wattage of the lamp source too much because the old black-pipe conduit cast into the concrete ceilings wouldn't hold any more wiring than it was already holding. Besides, we knew that if we put too bright a source in the globes,



Existing globe fixture retrofitted with compact fluorescent lamps.



Interior of renovated office space showing custom indirect fluorescent luminaires and built-in light cove.

you'd be able to see it through the glass, not to mention that there was limited room to conceal any kind of ballast. Basically any high intensity discharge lamp source was ruled out," he said.

"We started to look at compact fluorescent lamps as the solution. They could give us the lamp life we needed and could also provide us with the footcandles necessary for egress," Yingling says. "We mocked up single 7-watt lamps and single 13-watt lamps and finally settled on twin 9-watt lamps. We were able to mount them vertically to get good light distribution throughout the globes without the lamps being visible. The ballast hardware is quite compact; it fits into the recess created by the metal spinning that the globe fastens to — without creating any shadow. The color of the lamps is pretty close to incandescent — about 2700 degrees Kelvin. With the lights on in the corridors 24 hours a day, they can expect maximum lamp life — about 12,000 hours — from these compact fluorescent sources."

Office Lighting

The challenge of lighting the Colorado State Office Building did not end with rehabilitating the vintage interior and exterior lighting; lighting also had to be provided in office areas. The requirements for this part of the project involved more than simply cleaning and reconstructing existing bronze and stained glass. In the office areas, no fixtures set a precedent worthy of repeating; rather, there were so many different styles of pendant-mounted fluorescents that the sheer size of the collection might be worthy of recognition somewhere — but not here.

The historical society mandated a visually unified appearance of office lighting from street level outside of the building. The 10-foot-high ceiling is high enough to clear the windows; 5 feet into the rooms, however, the ceiling height drops to 8 feet, 6 inches to accommodate new HVAC equipment. Fluorescent lighting is concealed in a cove at the bottom of this vertical drop in the ceiling and washes upward. From outside the building, it appears to be a continuous white band running from one office to the next.

The central part of the offices needed indirect lighting for VDT use, even though the 8-foot, 6-inch ceilings are lower than is generally considered practical for indirect fluorescent luminaires. Yingling worked with a manufacturer to create a pendant-mounted fluorescent uplight that provides sufficient indirect illumination and also complements existing architectural details.

"We duplicated the existing metal base that originally ran around the outside edge of the rooms, turned it upside down, and made a metal extrusion that matched it," says Yingling. "These pendants allow you to spread the lamps out to keep them from spilling light into each other. Placing the ballasts in the middle and wrapping specular reflectors around the lower half of each tube gives a much wider distribution of the light directed upward. So the fixtures can be much closer to the ceiling; in most cases they're stemmed down only about 14 inches," he says.

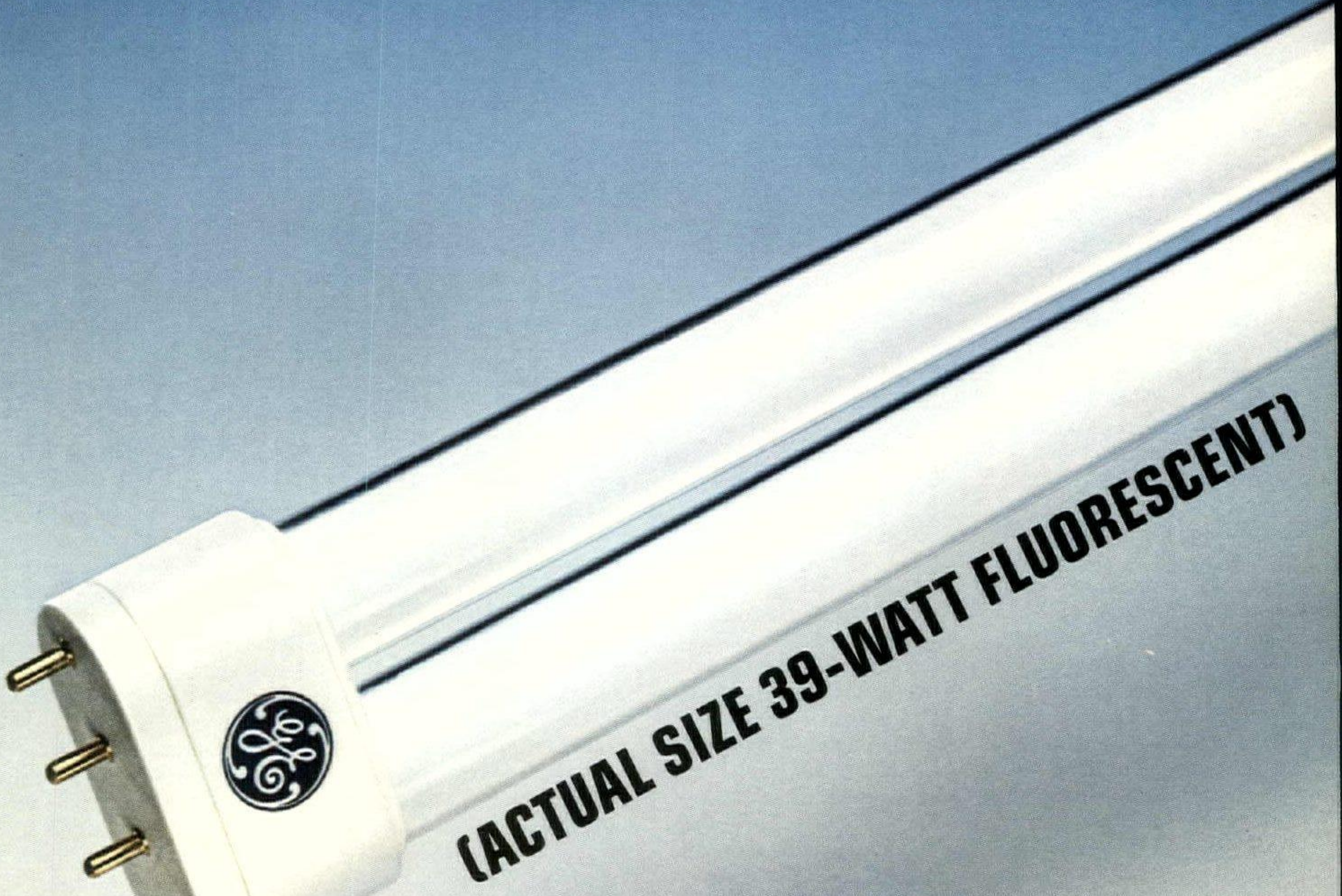
"The fixtures are only about 3 inches deep because we didn't want to create the illusion when people walk into the office space that these massive structures are hanging down at head level. The profile of these fluorescents is so thin it appears to be a series of thin lines, rather than a large group of massive hanging structures." These fixtures provide about 75 footcandles at task level.

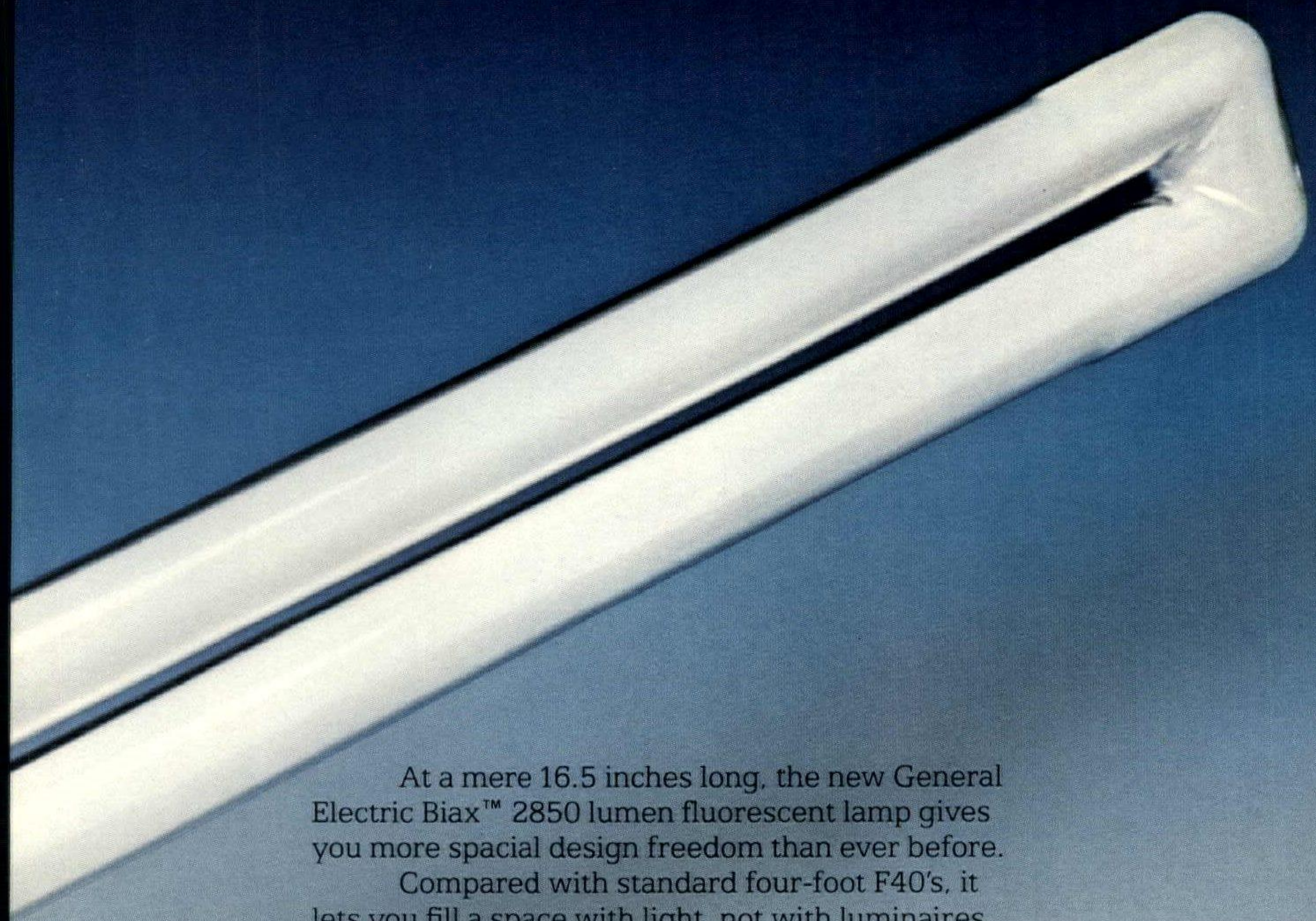
Yingling's lighting design for the Colorado State Office Building is successful not only because it successfully met the mandates of the state historical society, but also because of his thorough preparation. Yingling spent a tremendous amount of time on research before the rehabilitation and found artisans who were willing and able to do the work required.

Perhaps most important of all was the time Yingling spent investigating and experimenting with practical, modern lamp sources that interface with the historical fixtures. The new sources provide better efficacy and longer lamp life than the originals, but in every case, Yingling attempted to use a color-corrected source that would closely mimic incandescent light. Although some purists may argue that period luminaires should use period lamp sources, that can create problems. If the historic combination provides too little light for contemporary building occupants, eventually some well-meaning person will take the luminaires down again. The next step is installation of some modern fluorescent strips in their place. By ensuring that the historic luminaires provide the illumination that occupants need today, Yingling has guaranteed them a future in a place of history. ■

For product information, see the Manufacturer Credits section on page 70.

HOW TO MAKE A BRILLIANT REDUCTION.





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Circle 14

Testing and labeling custom fixtures — who, how, why

Peter Balint, PE

Peter Balint is West Coast Division manager for ETL Testing Laboratories, Inc., San Francisco, California.

The National Electrical Code requires — as every architect and designer knows — that electrical equipment installed in buildings be "approved." Despite various misconceptions to the contrary, the only one who can approve a product or an installation is the building or electrical inspector in the jurisdiction where it is installed.

The authorities in that jurisdiction can give inspectors the power to approve products based on their own inspection. For the most part, however, cities and states have decided they do not want that responsibility. Their desire to avoid liability suits — and large court judgments based on the "deep pockets" theory — has prompted increasing numbers of public officials to accept the approval labels of independent testing laboratories. In fact, many jurisdictions insist upon such labels as the sole determinant of a product's acceptability.

It has long been standard procedure, in specifications for standard light fixtures, to include a sentence stating that the equipment must bear the label of a recognized independent testing laboratory, such as Underwriters Laboratories (UL) or ETL Testing Laboratories (ETL). Lighting designers often need to ensure that custom fixtures will meet the same safety standards as labeled, off-the-shelf fixtures. It will be helpful, then, to understand just what the labels mean.

UL and ETL Labels

Many people think that UL and ETL labels are some sort of evidence of government approval or indicate that the product is of good quality. The labels really mean that the type of product to which they are attached has been evaluated and tested for conformity with the requirements of nationally recognized safety standards.

Safety standards documents are fairly complicated; different requirements interlock in a multitude of ways. So this article can give only a brief summary of some of the important points.

Components. Each standard includes a brief paragraph that requires all components to meet the requirements for that type of equipment. This means that wire, lamp holders, ballasts, and other components must meet appropriate safety standards. The cost and time involved in testing each component while testing a light fixture would be prohibitive. So, wise fixture designers use components that have already been investigated and "listed" or "recognized" by an approved testing laboratory.

Wire, lamp holders, ballasts, and other components must meet appropriate safety standards.

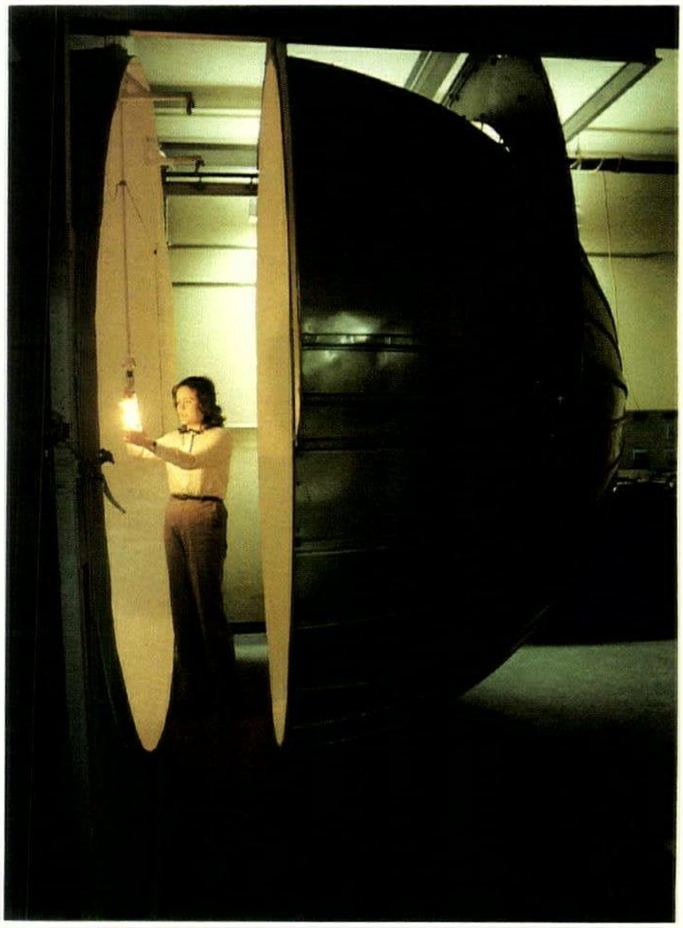
Cords. With some exceptions, wiring must be enclosed, usually in metal. The most common exception occurs when cords have appropriate jacket materials; they may then be unenclosed. Splices must be enclosed.

Metal. The structure of the fixture must be made of sheet metal of a minimum thickness or an equivalent material. The specifics depend upon fixture size, type of metal, and exact use. The absolute minimum thickness is 0.016 inch.

Glass. Where glass is used, the standards prescribe minimum thickness and maximum area; if glass is tempered, larger panes may be used.

Live parts. Terminals and other live parts must be inaccessible to users. This excludes the socket part of screw type Edison base lamp holders.

After a product has been shown to comply with the standards, the laboratory sets up a follow-up program with the manufacturer to ensure that all products of the same type will meet the same requirements. The testing lab checks manufacturers' quality control and manufacturing techniques to make sure they can reach the level of consistency required. Thereafter, the testing laboratory makes periodic unannounced visits to the factory to determine whether the products are being manufactured in the same way as the initially tested sample.



ETL technician Ann Hotchkin uses the 3-meter integrating sphere photometer, which measures the light output of all kinds of large lamps.

Choosing a Testing Laboratory

When choosing a testing lab, look for one with a full range of listing programs for all types of equipment — not only for lighting fixtures, but also for air conditioning and other types of electrical and electronic equipment. Manufacturers need verification that their equipment meets appropriate standards, preferably with a minimum of hassles and red tape. It is, of course, essential that technical requirements associated with the safety standards be rigorously met. There are, however, ways to speed up the necessary paper work that goes with this evaluation and testing.

How to label custom equipment of any type, including light fixtures, is a special problem. The time involved in investigating equipment from "scratch" could make it impossible to meet a specific project deadline. Also, the cost of investigating a piece of equipment is usually spread over a manufacturer's entire production of that equipment — whether that involves hundreds or millions of pieces. Thus the cost per unit is relatively low compared to the unit sale price. It is economically prohibitive for a small number of custom fixtures to bear the entire cost of such an investigation.

A testing lab can provide the custom fixture manufacturer with a special procedural guide outlining the conditions under which to manufacture the product. Some factors the laboratory may consider include test results of past designs and the lab's familiarity with a given manufacturer's capabilities in design, manufacturing, and quality control. When certain basic criteria are met, the testing procedure may be less time-consuming and costly than it could be for a totally new product. A manufacturer can then provide a labeled custom fixture.

Today's highly competitive design scene requires more than simply picking a light fixture out of a catalog. To emphasize the uniqueness of a space, architects and lighting designers increasingly use custom-designed fixtures — wall lights, chandeliers, and any number of other possible configurations.

Balancing Beauty and Safety

In the excitement of finding the right design, it is also important to attend to such mundane considerations as safety. Faulty wiring in light fixtures is a major cause of fires, and the liability involved can be staggering. In a study of 375 store fires with damage exceeding $500,000 — and in which the cause of the fires could be determined — 36 percent were caused by electrical equipment arcing overloaded due to mechanical failure or malfunction. In this category, 32 percent of the causes were fixed wiring in the buildings, and 26 percent were light fixtures. That is, 9.4 percent of the fires were caused by arcing in light fixtures. The designer who wants to avoid taking unnecessary risks in the product liability area should well consider the requirements of product safety.

Safety considerations need never stifle creative design. Such design, however, cannot ignore safety. If a fixture is already designed before someone knowledgeable about safety criteria becomes involved with it, redesign can be a very frustrating experience. Manufacturers involved with a safety listing program usually have the expertise necessary to give designers helpful guidance in the early design stages. Thus, safety can be incorporated into the design without compromising its creative aspects. ■

UL standards may be obtained (for a fee) from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062, (312) 272-8800. The standards are frequently revised, so the company offers a subscription service that keeps subscribers up to date on all revisions.

Lights, camera, magic make architectural photography

Lighting solutions in the environment are in three-dimensional spaces. Publications devoted to lighting issues — electrical or daylighting — try to bring those spaces to life in two-dimensional approximations of reality. They are, however, at the mercy of photographers who are, in turn, at the mercy of film and camera limitations. Lighting and design professionals who understand the limitations of photographers' and magazines' presentations are better able to evaluate the accuracy of photographic renditions.

Michael Urbanek

Mike Urbanek is an architectural photographer based in Ojai, California.

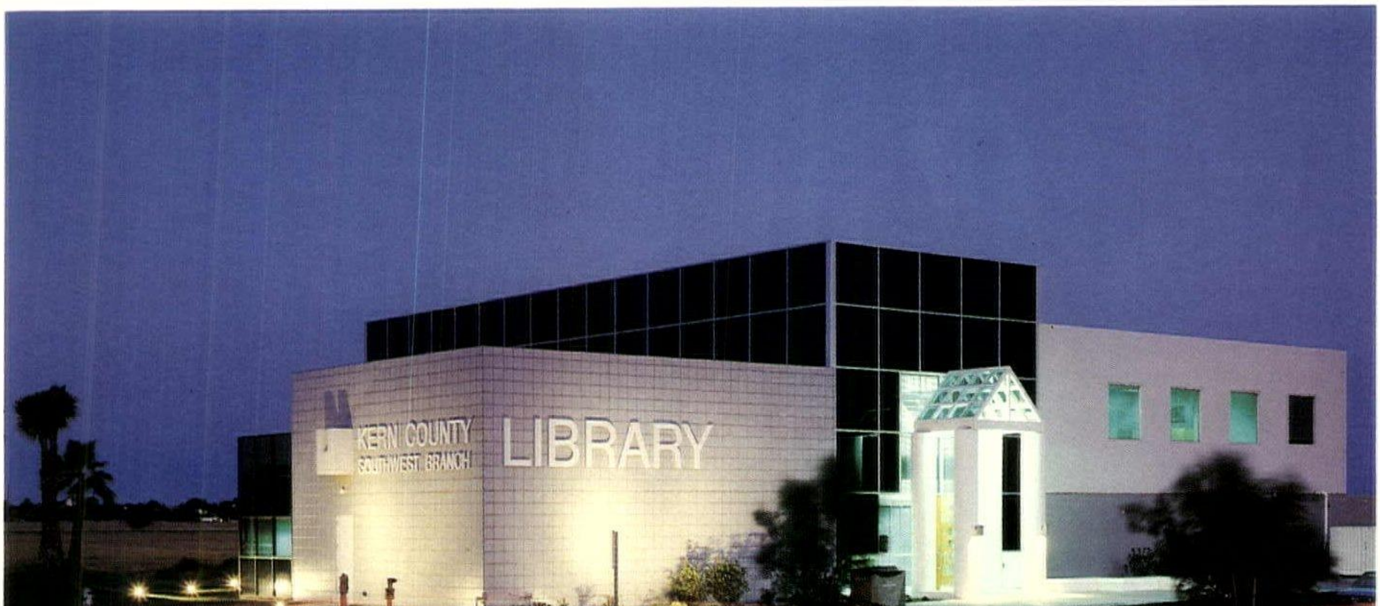
Photos: Michael Urbanek

The relationship between photographers and architecture and interior design involves a serious obligation. The photographer is responsible for the way people — perhaps thousands of people — view an environment. The spaces are more than buildings and rooms; they are functioning works of art.

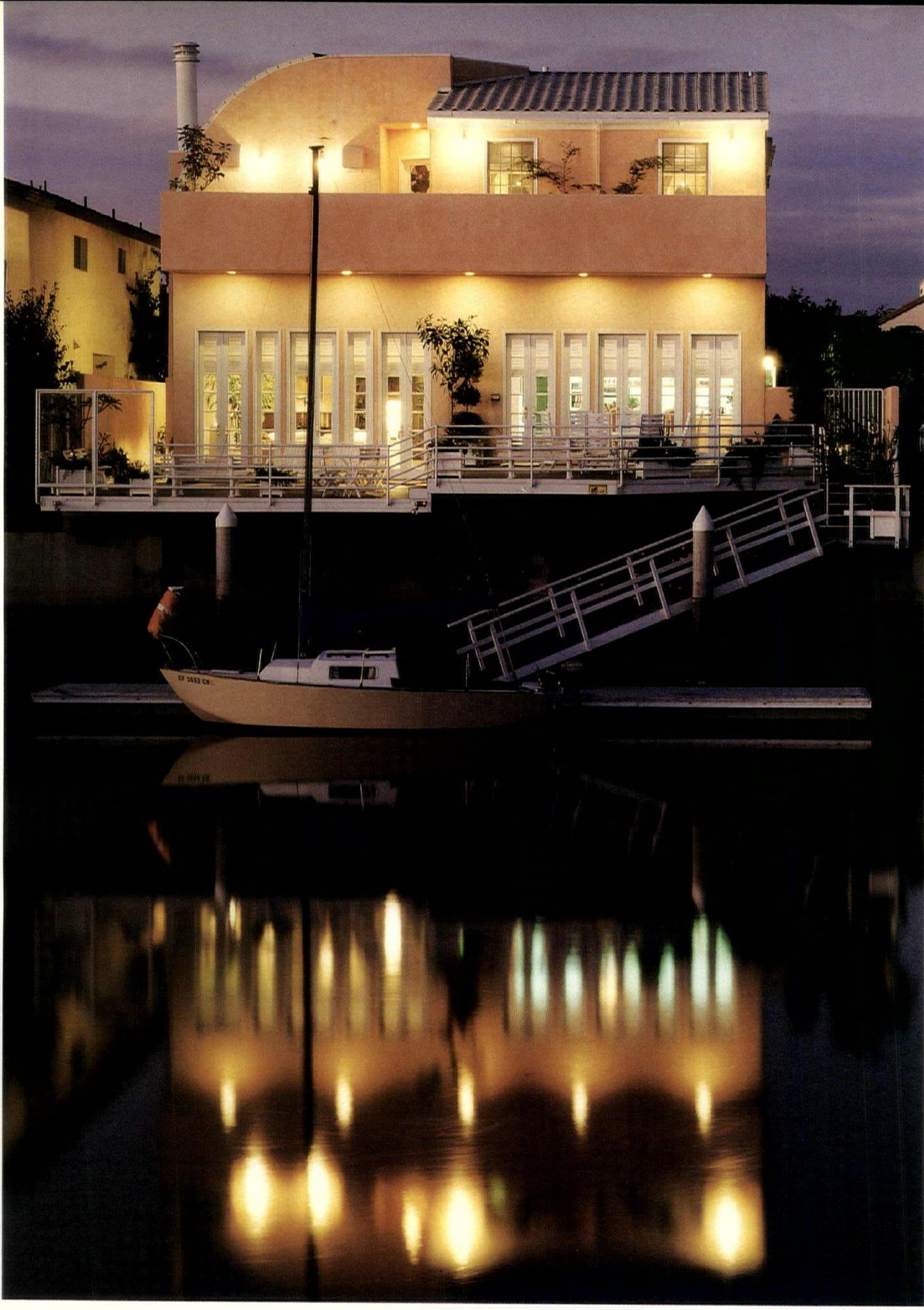
The images born of the relationship between architecture and film are important. They often contain technology and design that others can adapt and expand upon, furthering the art of environmental design and thus the quality of life.

These images are crafted with photographic tools that are at once magical and frail. The pictures are not literal. The final print or transparency is a two-dimensional analogue that can approximate reality, enhance it, or expose and magnify its blemishes.

That film works at all is magic. The important thing to remember is this: because of the frailties of film and the limitations of the printing process, it is often necessary for the photographer to *manipulate* reality in order to *approx-*

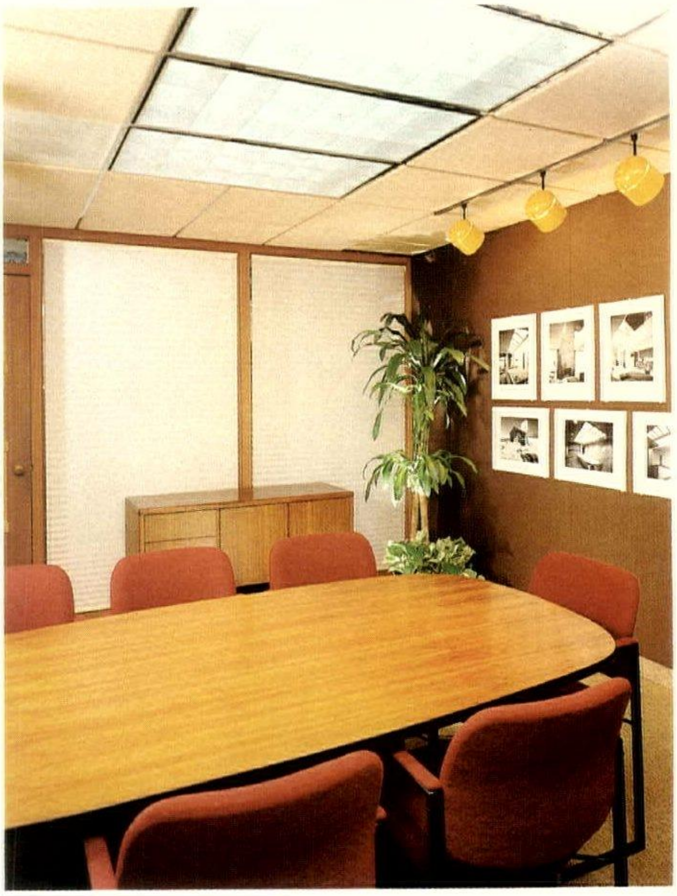


The lighting for this photo is both dramatic and real. The streaking taillights are real, just not the way the eye sees them. Because the stucco part of the building (on the right side of the photo) required additional lighting for this picture, the photographer used a hand-held quartz spotlight. Note the green hue from interior fluorescents showing through the windows and door. Architect: David Milazzo, AIA.



Daylight film recorded this subject — lit mostly with tungsten lights — at just the right moment. Note the kitchen windows on the lower level, right side. The draperies mask the many cool white fluorescent tubes, preventing the film from "seeing" them. The water, however, sees the tubes and transmits the green color in its reflection. Building designer: David Huffman. Interior designer: Katherine Jones Griffith, ASID.

A compromise exposure; no additional lighting was used. The clerestory is a little too "hot," and the carpet is a little too dark. Architect: Scott Ellinwood: AIA.



The incandescent track lights are the best lights in this scene, but turning off the fluorescents would record a "dead" luminaire. Although these tubes were covered with filtration material, they still have a green cast in the photo. Architect: John Kulwiec, AIA.

imate reality.

The camera itself is a facility that joins the two operative entities in photography, lens and film. Each entity is limited in its own way.

Optics can expand or compress a scene. A familiar comment is, "Gee, the room looks so much bigger in the photograph." This rarely results from a photographer's intent to deceive. Generally, the lens chosen is dictated by the subject and the location available in which to place the camera.

Light and Film

Light is what the film sees. And film has a severely limited ability to translate contrast as seen by the human eye. The eye and brain adjust in microseconds to evaluate detail in highlights and shadows. Film, however, handles only a fraction of the highlight-to-shadow ratio that eyes are capable of seeing.

Light streaming through a clerestory 20 feet above the floor is inoffensive. In fact, if it faces north, it is a beautiful light, the preferred light of artists for centuries. During the course of a day it will provide sufficient illumination for a passage or general work area. The design functions adequately for the eye, but not for film.

Photographers have two choices: add supplemental lighting to the scene to bring shadow detail to the threshold of the film's lower range (relative to highlights), or choose a time of day when the discrepancy is minimized. The first alters the scene, but is often necessary because of budgets and schedules. Available light may seem "more honest" than using supplemental lighting, but it also involves a kind of benign manipulation: the photographer uses the minutes or hours that daylight is sufficient to portray a design that, for the human eye, works all day.

The range of colors of the materials in the scene is vital, as is the amount of square footage covered. For example, the carpet color in the compromise exposure scene is pleasing in person, but some colors soak up light like a sponge and resist all of a photographer's efforts to wring it out. Dark greens are one of the worst.

Adjoining rolls or squares of carpet can appear to be two entirely different shades if the direction of the nap varies. At the scene, the human mind adjusts automatically; in a picture, it simply seems to look peculiar — particularly in a somewhat expansive view.

Daylight is the primary source for this photo, which also used unobtrusive electronic strobe fill light. Building designer: David Huffman. Interior designer: Katherine Jones Griffith, ASID.

This nighttime interior scene was lit with tungsten lights except for the fluorescent soffit lighting; the two kinds of lighting were wired on the same switch. All 14 fluorescent tubes around the room's perimeter were covered with filtration material to approximate the light tungsten-balanced film needs. Still, in this instance, the fluorescent lighting records cooler than the other lighting in the room. The photographer used supplementary uplighting behind the chair and table on the right to add depth to the scene. The client for this photo was the window treatment manufacturer. Interior designer: Kerry Roscoe.

It was necessary to overcome many lighting difficulties to get this photograph. Details outside the windows were needed, and there was insufficient time to remove the egg-crate ceiling and filter the fluorescent tubes. Separate filtered exposures for each light source were impossible because the same switch controlled both fluorescent and incandescent lights. The solution was to expose for the daylight and strobe, then, in a subsequent exposure, to turn on the lamps very briefly. This technique "heated up" the areas just enough to tell that the lights were on while minimizing their improper color. Architect: Zelma Wilson, FAIA.

Tungsten film at dusk. Interior designer: Katherine Jones Griffith, ASID.

Some of the carpet may seem too dark, some too light, and some just right. So it's obvious that contrast is a problem.

Film also has a strong preference for light from a single type of source. It sees each source as a distinctly different color. Fluorescent, sunlight, open shade, high and low pressure sodium, incandescent, metal halide, and mercury vapor each look different to film, which isn't the least bit "happy" about the situation.

Through filtration, film will accept any light source and reproduce remarkably faithful color — but only one source at a time. With few exceptions, film in confusion is not a pretty sight. One exception is the incredible mood of a dusk interior with a view to the outside; tungsten-balanced film exaggerates the bluish outside light and creates an indigo sky.

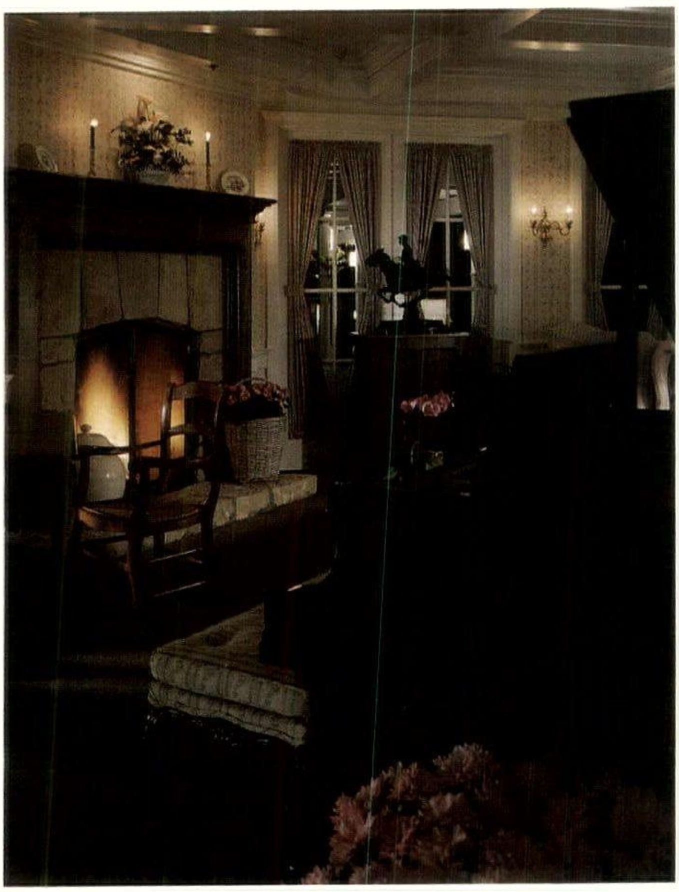
A photo of a daytime interior containing a lighted fireplace or a table lamp may have a pleasing warmth when recorded on film balanced only for daylight or strobe. Both of the above situations are enhancements that sometimes are acceptable, sometimes are not. Their acceptability depends on whether the application is to be one of mood depiction or literal accuracy.

Getting Technical

The fluorescent luminaires most people work under have four — or two or eight — tubes in the ceiling. Each tube probably is emitting a slightly different Kelvin temperature. As they age, the lamp temperatures change at varying rates. To film, Kelvin temperature is everything. Without going into a technical description of Kelvin temperature, suffice it to say that any large discrepancy in Kelvin degrees within a single picture can ensure that some editor's Fahrenheit temperature will rise. Geometrically.

As is apparent in all fine design magazines, photographers don't let these complications stop them. The photographic industry provides photographers with the materials to filter photo fill lights, light sources, lenses, and win-

Daylight film was used for this photograph, which was partially lit with electronic strobe flash. Note the warm effect from the lamps and fireplace. Interior designer: Barbara Swartz, ASID.



The tungsten-balanced film used to make this photo recorded the flame in the fireplace and the candles somewhat less warmly than the daylight film used in the preceding illustration. Architects: Ketzel & Goodman. Interior designer: Mabel Shults Associates.

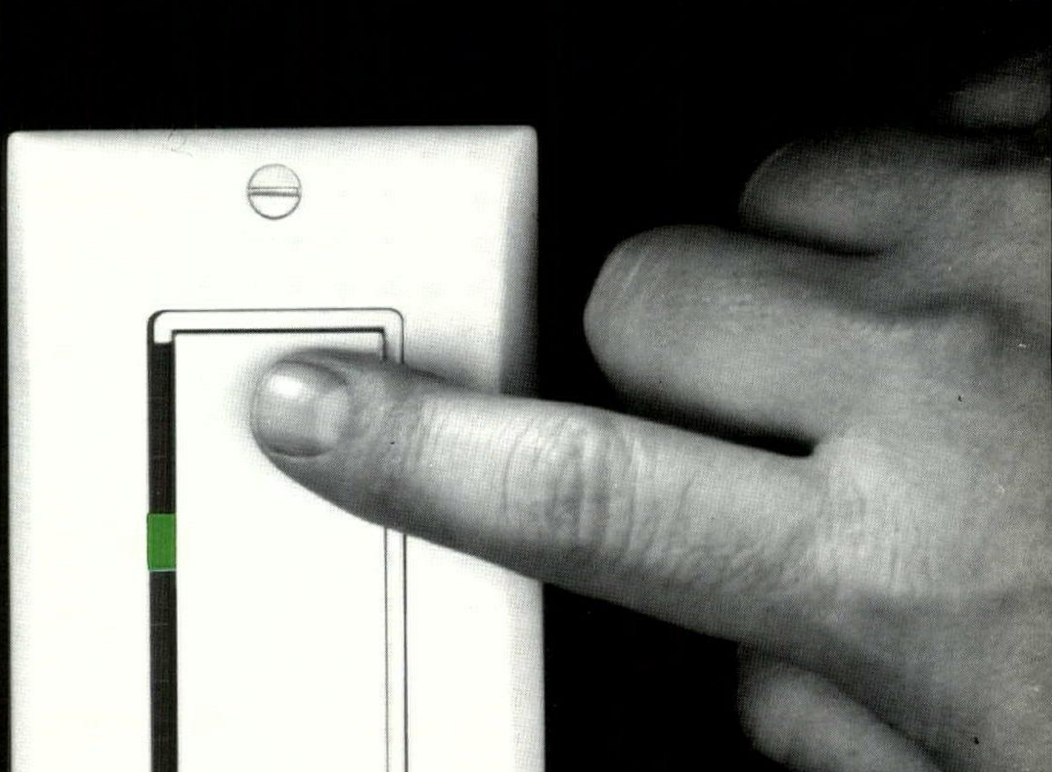
dows. This is often done by making multiple exposures on the same piece of film, which requires calculations that make the theory of relativity look like child's play — well, almost. At least Einstein never had to please an interior designer.

Pleasing a designer, however, is only one important issue. Producing a reasonable facsimile of the scene is the goal. Photographers must reconcile the contrast and balance the color because nobody wants to look at a bad photograph — even if it is "honest." For that reason, good photographers err on the side of good composition, proper color balance, and pleasing contrast. This usually requires some manipulation — either active or benign.

As you scan the pages of architectural magazines and books, keep in mind that the photographer is just a technician. Or, at best, a translator. The art is the subject, the artist the designer. Perhaps some cautious manipulation occurs. But it must be working because lighting and design professionals keep improving the environments in which people live and work. ■

For product information, see the Manufacturer Credits section on page 70.

THE FIRST DIMMER THAT REMEMBERS HOW TO TURN ON THE LIGHTS.



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To find landscape lighting solutions, define the problem

Chip Israel

Chip Israel is an associate with Grenald Associates Ltd., a firm of architectural lighting consultants with offices in Los Angeles, Philadelphia, and New York.

Lighting design for exterior areas is similar to that for interior areas. To develop a lighting solution, designers must first accurately define the problem. Once that has been done, they must determine where light is required and the nature of its quality.

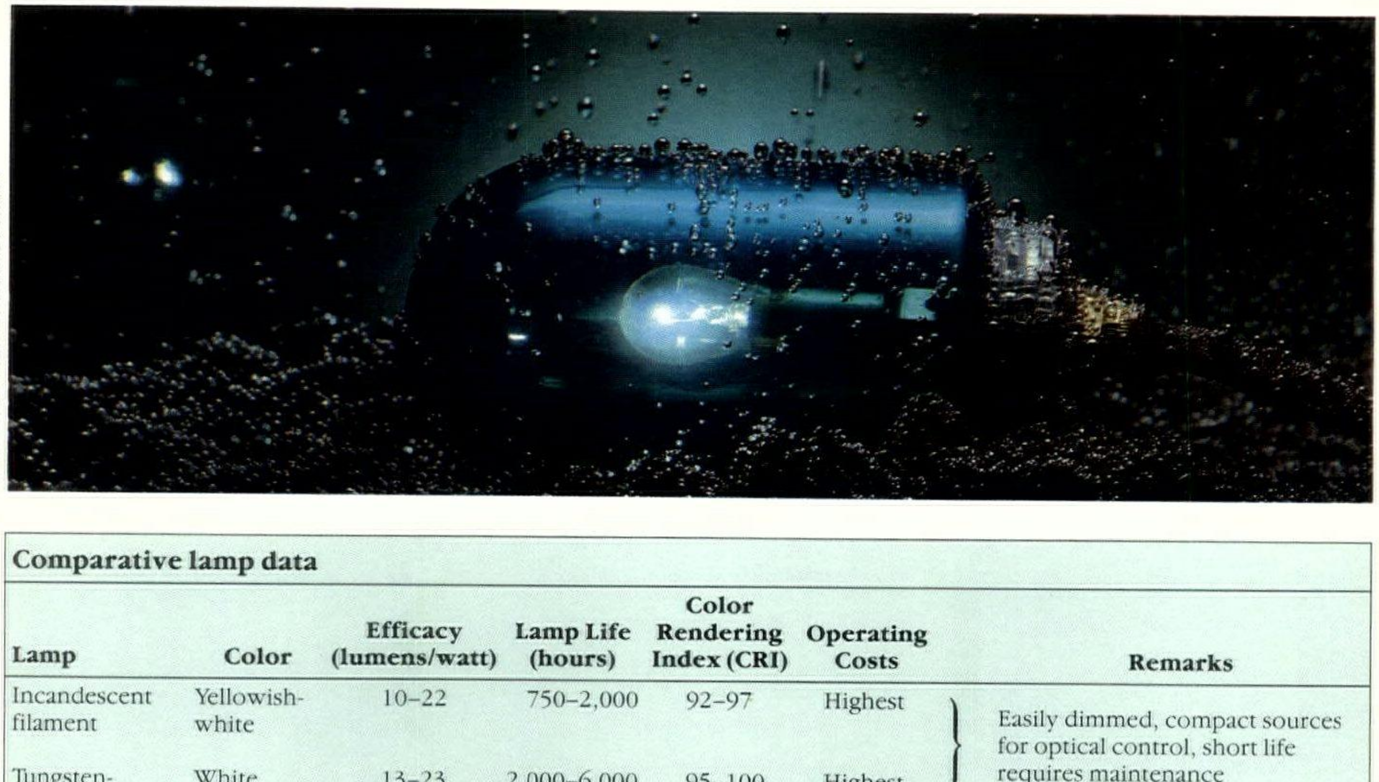
The final step may be the easiest: how to achieve the desired effect technically. This involves selecting appropriate fixtures, knowing where to mount them, and knowing which lamps to use in them. Even though they are separate tasks, those three selections are best done simultaneously.

As for any type of design, a variety of external factors must be considered. The most important is safety. Exterior fixtures not only should be tested and approved, but also should be properly installed.

Although the initial price of a lighting system may be important, its overall life cycle cost also should be considered. The cost of maintaining an exterior lighting system may be several times the initial investment — and quite often it is. Consider factors such as non-electrical operating costs, like lamp replacement and fixture maintenance.

Special Outdoor Factors

Exterior fixtures are exposed to corrosive elements in the air as well as in the soil. Although water is not a typical problem, it's possible for pressurized



COURTESY OF NIGHTSCAPING BY LORAN

Comparative lamp data

Lamp	Color	Efficacy (lumens/watt)	Lamp Life (hours)	Color Rendering Index (CRI)	Operating Costs	Remarks
Incandescent filament	Yellowish-white	10–22	750–2,000	92–97	Highest	Easily dimmed, compact sources for optical control, short life requires maintenance
Tungsten-halogen	White	13–23	2,000–6,000	95–100	Highest	
Fluorescent	Cool to warm white	40–93	12,000–30,000	52–93	Medium	Wide variety of colors and CRIs, some temperature restrictions
Mercury vapor	Greenish-blue white	22–60	16,000–24,000	15–50	Medium	Simulates moonlight, self-ballasted models available
Metal halide	Blue white	60–100	10,000–20,000	60–88	Medium	Cool natural light with good CRI
High pressure sodium	Golden yellow	58–140	20,000–24,000	20–65	Low	High efficiency, limited use in landscape lighting
Low pressure sodium	Yellow	130–180	10,000–18,000	–40	Lowest	Monochromatic, usually not acceptable

Specific values vary with manufacturer, wattage, ballast, and climate.

sprinklers to damage fixtures. Expensive fixtures may rust or pit away in a few short years.

Another external hazard is insects; lights can attract them and, if the fixtures are not correctly detailed, also collect them. Dirt on the lens of a PAR lamp can ruin its performance as fast as a pile of leaves can. It is also important to remember that exterior lighting, especially landscape lighting, requires some flexibility because the plants and trees are always growing and changing.

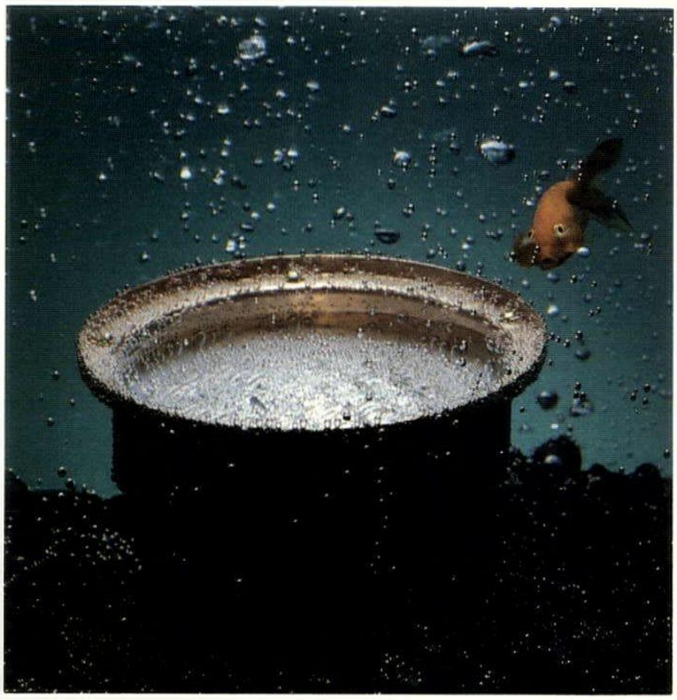
Luminaire Choices

Luminaires are available in a wide variety of shapes and sizes. The basic fixture is a lamp holder. Its name describes its function: it holds a lamp, usually incandescent, and provides electrical connections. Lamp holders may also include a junction box or an area where additional electrical connections can be made. Lamp holders are inexpensive, but they offer no protection for the lamp or against its glare.

Bullets. A bullet fixture is an upgraded lamp holder; its housing protects the lamp from accidental breakage and may provide a shield to reduce unwanted glare. Depending on the degree of flexibility the job requires, a bullet fixture may be mounted directly on a junction box or on a stake with a cord. It can be used with incandescent or HID lamps, usually in a PAR configuration.

Lenses can be added to protect lamps or to change the color or distribution of the light. With all directional fixtures and lamps, it is important to check with the manufacturer to determine that the fixture is approved for aiming above the horizontal.

Recessed luminaires. Well lights and direct burial lights are two fixture types that can be recessed into the ground or paving. Well lights require drainage "to be provided by others." Careful detailing and supervision is required to ensure a satisfactory installation. Direct burial fixtures can be placed in direct contact with the soil because they require no additional drainage. To minimize the chemical reaction possible with some types of soils, burial fixtures are being offered in weatherproof plastic versions as well as the familiar metal ones.



COURTESY OF NIGHTSCAPING BY LORAN

COURTESY OF BEGA/FS

Low-level lighting. Path lights or low-level lights have been available for many years. The low-level lights are usually 3 feet in height and use louvers to direct the light downward. Fixtures of this type are suited for highlighting low plantings and gardens or providing additional safety lighting along dark paths. An early fixture design, the pagoda light, is now available for use with energy-efficient compact fluorescent lamps. Several manufacturers offer low voltage pagoda lights or spotlights that are inexpensive and easy to install. Mushroom and tulip-type fixtures also are available in many styles.

Louvered step lights can be recessed into various forms and surfaces to provide glare-free lighting. Energy efficient, low-wattage bollards can also provide excellent low-level lighting.

Underwater lighting. Specifying underwater fixtures requires extreme care. The two basic types of underwater fixtures are dry niche and wet niche. Dry niche fixtures are serviced from behind the pool or fountain wall. These luminaires are fairly expensive and use high-wattage incandescent lamps that require constant maintenance. Wet niche fixtures must be removed from the water to change lamps. Some low-voltage fixtures may be comparatively inexpensive, but they may not be approved for swimming pools.

Architectural and decorative fixtures. Luminaires are available to use every light source. They can be mounted on walls, posts, or piers, placed in a bollard, or be suspended. If incandescent fixtures are to be purely decorative, a dimmer can reduce glare while increasing lamp life. Energy-efficient high intensity discharge (HID) lamps may have reflectors or refractors to direct the light where it is needed. When considering any exterior fixture, consider vandalism when making a selection.

Area fixtures. Streets and parking lots are typically illuminated by either of two types of area fixtures: refractor and cutoff luminaires. The majority of streetlights have refractor or "cobra head" fixtures, which use HID lamps because of their energy efficiency and long life. A dropped lens provides some glare control, but the amount may be insufficient. Cutoff luminaires provide excellent optical control through the use of internal reflectors. Glare control may be a critical issue in areas where municipal ordinances forbid the use of exterior luminaires that fail to reflect glare toward the ground; these are known as "dark sky ordinances."

Specialty lighting. The final category for exterior fixtures encompasses specialty lights, which include twinkle lights for trees, border lights to outline structures, decorative marquee lights, neon, lasers, candles, and even Tiki torches. For every exterior design, there is usually a standard or custom fixture available.

Selecting Sources

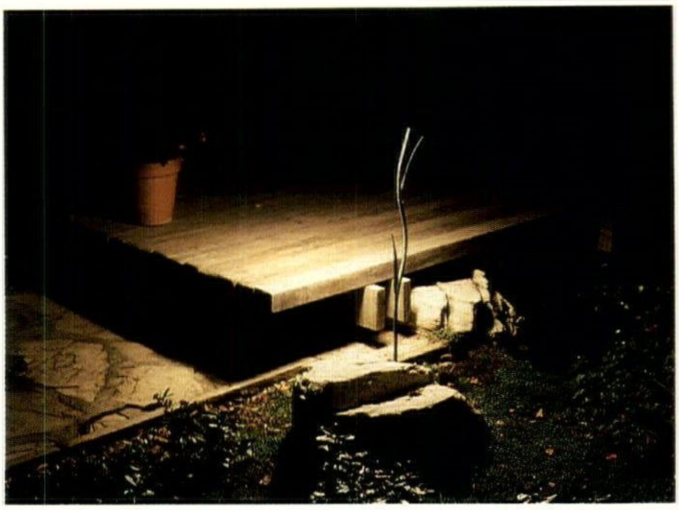
While determining the style or type of fixture to use, designers must also select the lamp source and intensity. The type of lamp to use depends largely on the effect desired.

Color temperature. The color spectrum of the lamp should be balanced to the plantings or objects to be illuminated. The color rendering index (CRI) is important if objects are to look natural. Lamps of different color temperatures can also be used to define or expand a space. Cooler colors tend to recede into the distance, for example, and warmer colors tend to advance.

Lamps provide three basic light sources. These are incandescent, fluorescent, and HID.

Incandescent lamps. The typical incandescent A lamp may be used outdoors, but it needs some protection from the elements if it is over 40 watts. PAR lamps, on the other hand, are typically used because they are prefocused and virtually weatherproof. PAR lamps and R lamps are also available in a blue-white color that is excellent for lighting most varieties of landscaping.

COURTESY OF KIM LIGHTING



COURTESY OF KIM LIGHTING

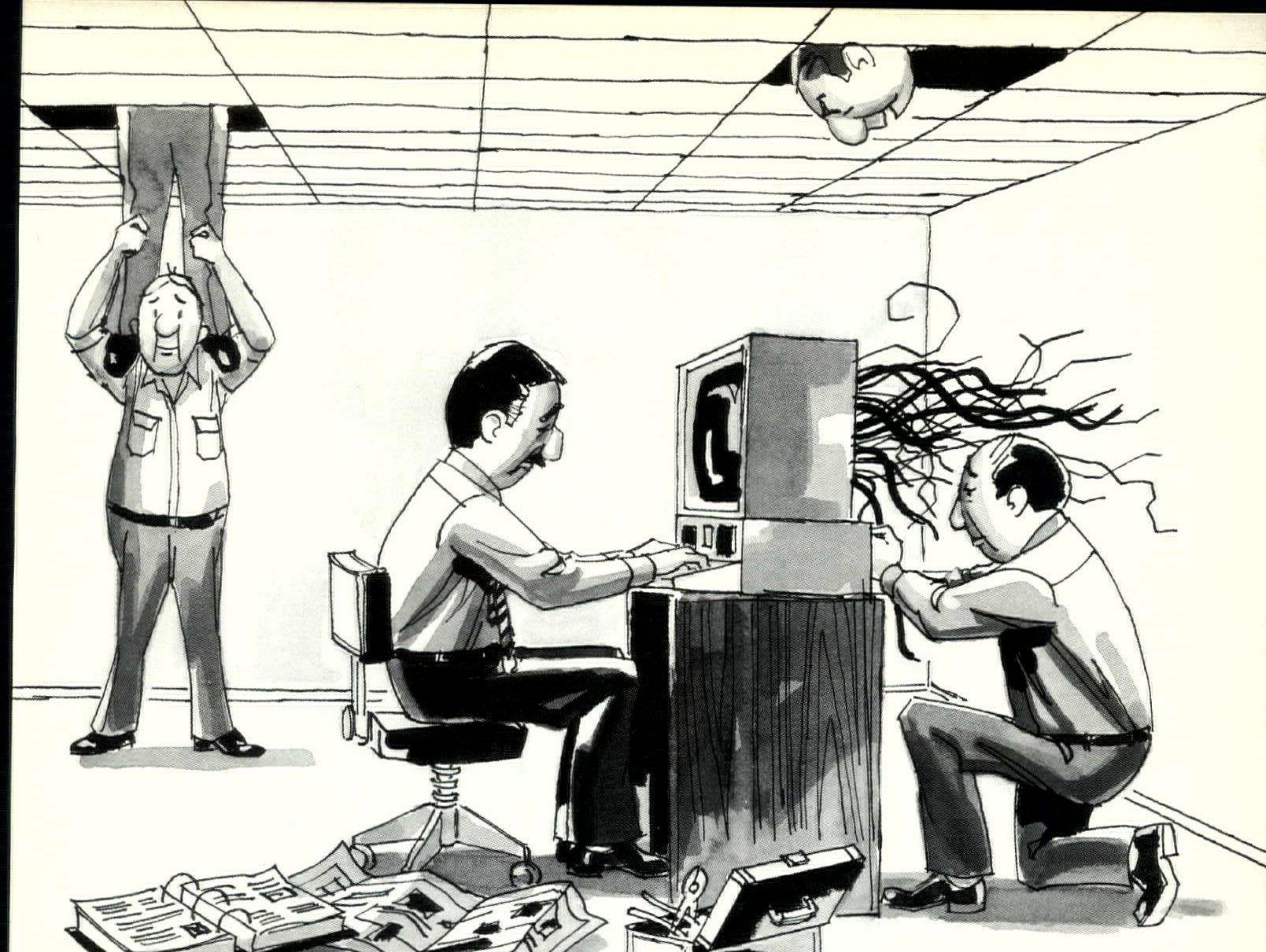
The greatest drawback to the use of incandescent lamps is their relatively short life and their energy inefficiency. Low-voltage lamps are becoming increasingly popular. Low-wattage lamps can provide precise beams of light for accenting tall trees or exterior sculptures. One manufacturer has devised a simple snap-together connection for attaching low-voltage fixtures to the main power feed. This connection can also be incorporated into the first true exterior track system.

Fluorescent lamps. Fluorescent lamps come in a variety of sizes and colors; the high color rendering types are a great improvement over the typical cool-white lamps. The development of compact fluorescent lamps has had a great impact on exterior lighting; like other fluorescent lamps, the compacts are efficient and have a long life. They may, however, operate only under limited climate conditions. Check with the manufacturer.

Many fixtures have been developed to use compact fluorescent lamps as mini-floods. For landscape lighting, the new 4100 degree Kelvin lamp is superior to the original, warmer 3000 degree Kelvin lamp. To reduce energy or maintenance costs, the compact fluorescent lamps can replace incandescent lamps with the use of a simple ballast adapter.

HID lamps. The family of high intensity discharge (HID) lamps includes mercury vapor, metal halide, high pressure sodium, and low pressure sodium. The accompanying table describes the main operating characteristics of these and other lamps. A new 70-watt metal halide lamp offers a high color rendering index and energy efficiency in a new low-wattage package.

With information at hand about available sources and luminaires, exterior lighting design should be fairly straightforward. Local manufacturers' representatives can provide current information about their products and helpful installation tips. ■



Revamping downtown: Lighting the law offices

Stephen P. Schuber

The author is contributing editor of Architectural Lighting.

South-facing roof monitors present daylighting designers with a trade-off situation. They provide abundant natural light; their generous use can provide light deep into the interior of a building sited on a long narrow lot — such as William Morgan's Waynesville, Missouri, law office. South-facing monitors can also be a source of blinding glare and become a heat gain-heat loss energy use liability.

Avoiding such problems presented Tim Montgomery — a passive solar design specialist in nearby Rolla, Missouri — with one part of his dual challenge. He also was to fulfill Morgan's desire for a building on Waynesville's town square that would be both an example of the latest in energy-efficient architecture and an anchor for the square's redevelopment. Morgan wanted a 4000-square-foot building, half to use for his law firm, the other half to house an abstract and title company. He envisioned a structure that would spark interest in the town square.

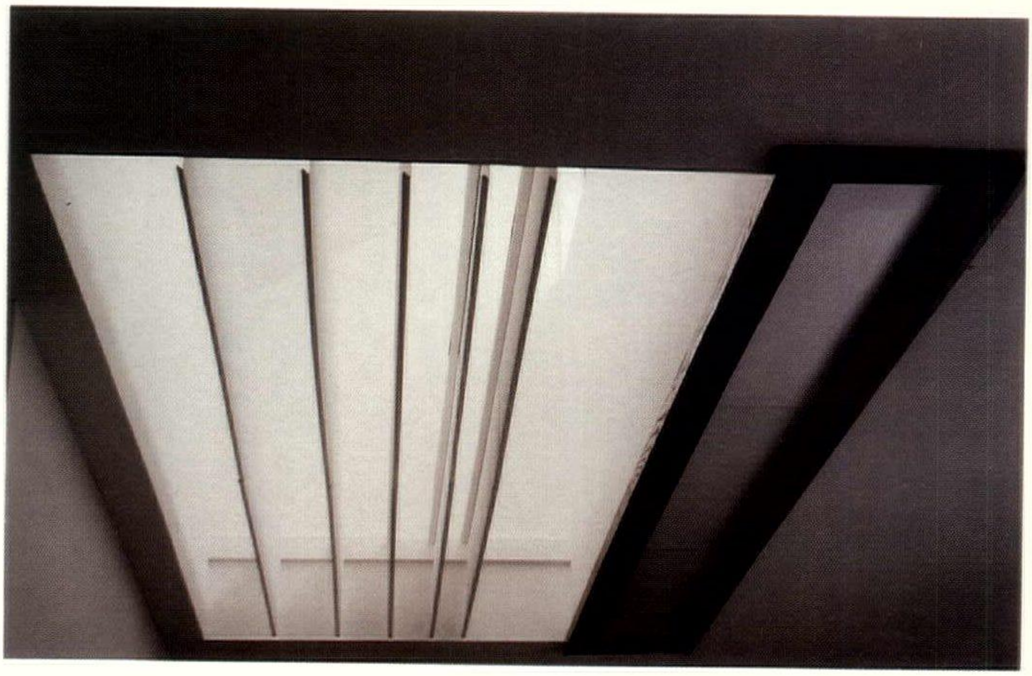
Abstract and title companies — and more than a few lawyers' offices — are notorious for mediocre design and poor lighting in areas where the very nature of the business is paper work. Abundant daylight was simple enough to obtain. Montgomery had several options —

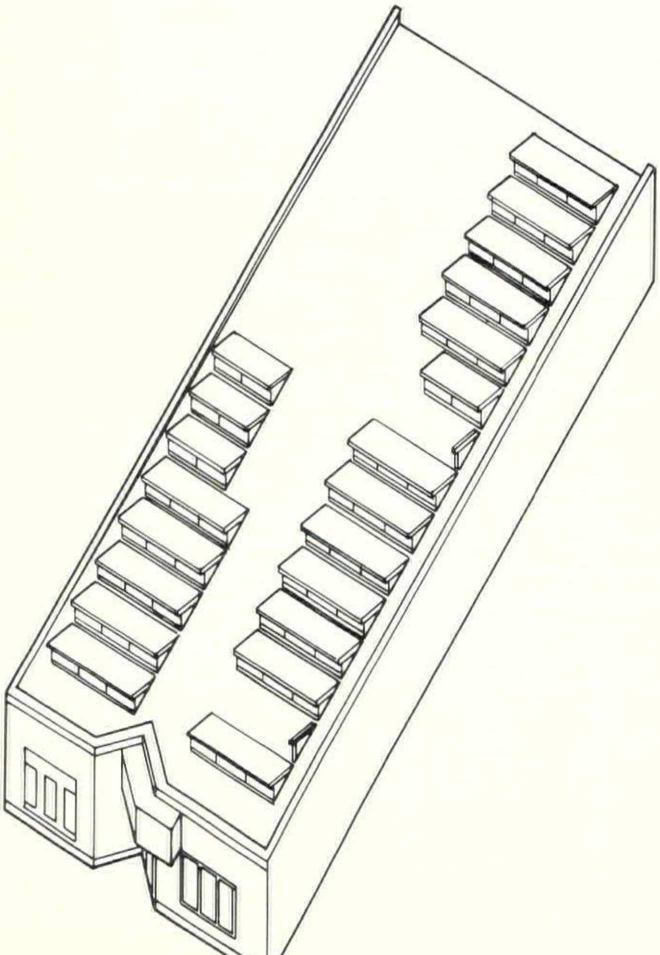
Project: William Morgan Law Office
Location: Waynesville, Missouri
Design Team: Tim Montgomery and Michael Kern, Solstice
Interior Designer: Lori Wiles
Photos: Joel Goodridge

including sawtooth clerestories, skylights, and light shelves. But Morgan also wanted greater use of emerging, energy-efficient technologies to maximize passive solar daylighting.

Montgomery's solution was to install a series of south-facing sawtooth clerestories to bring daylight into parts of the interior distant from the wall-mounted windows. At ceiling level in each clerestory roof opening is a group of louvers or baffles that diffuse the light and eliminate glare.

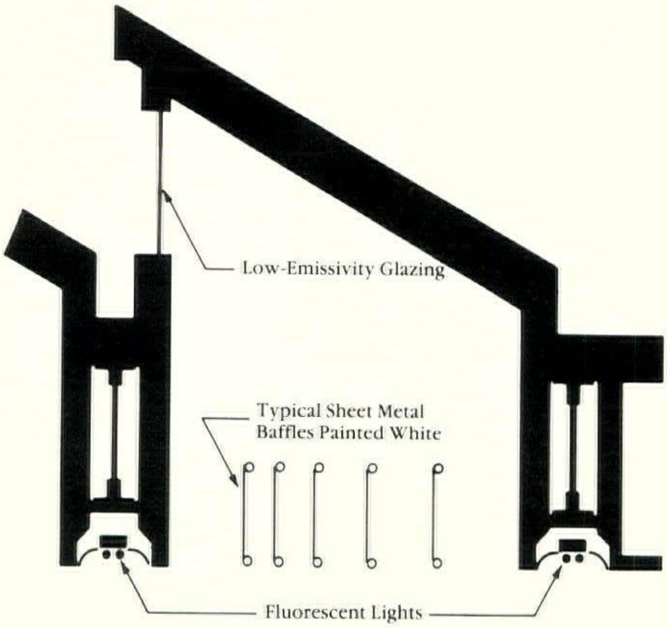
Executing this design required several steps. The roof's slope complicated the clerestory overhang and ceiling level, for example; and it was necessary to calculate optimum placement for each louver. To perform the complex series of



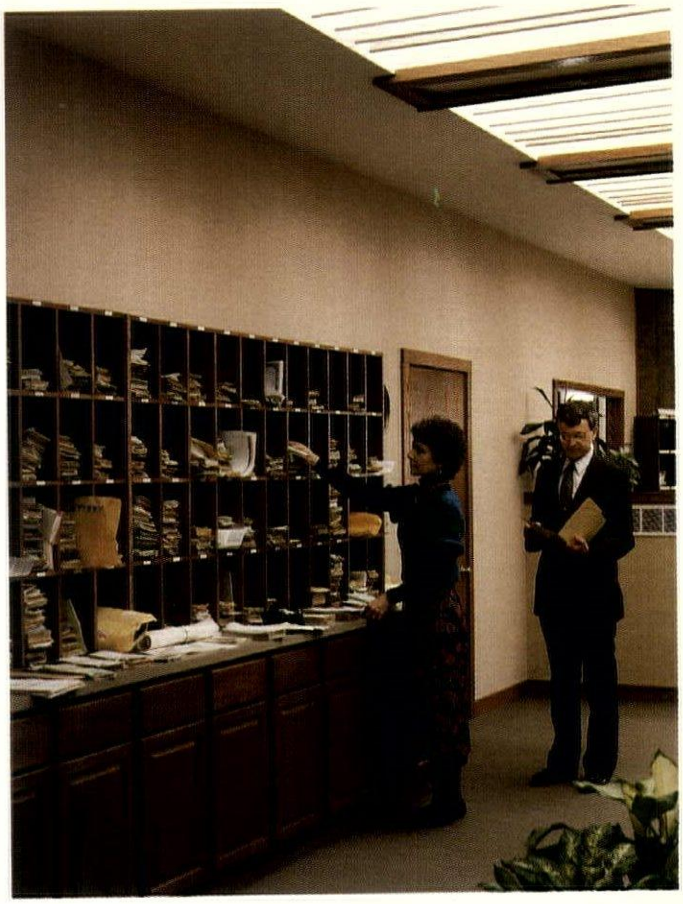


equations, Montgomery used a light-modeling program.

Montgomery explains, "The computer program creates isolux diagrams in both two and three dimensions, and I used these to complete the daylighting analysis to avoid glare." In addition, the clerestories are grouped to keep out most direct summer sunlight. The back of each monitor bounces light through the aperture of the one behind it. The entire roof surface, including the backs of the clerestories, is covered with a white, polyester-reinforced roofing



Section through typical roof monitor.



membrane. The white color, of course, results in less heat gain during the summer and promotes better light capture yearround. Added advantages, Montgomery says, are the fact that most roof sections were factory welded, which permitted faster installation.

The baffles were custom-made from galvanized steel bent and then painted white. During cloudy periods and at night, a series of sensors activates two-tube, 4-foot-long fluorescents placed between the monitors. Building users comment that they hate to see the fluorescents turn on during Missouri's unpredictably cloudy weather, but they also note that even minimal sunlight gives the fluorescent light a warmer color.

The clerestories have functions beyond daylighting — they are an integral component of the energy strategy. Montgomery points out that the most important cooling strategy has nothing to do with air conditioning; it has to do with eliminating electric lighting. "High daylighting levels are achieved throughout the building; during the heating season, daylighting components do double duty by providing direct-gain solar heat," he says. In addition, operable windows and a centrally located attic fan permit occasional daytime ventilation, particularly in the spring and fall. Thick masonry walls with a center dead-air space and light-colored exteriors help reduce temperature fluctuations.

Lawyer Morgan and his colleagues did not occupy their offices until late September 1986, and comparisons with conventional buildings are difficult. Nevertheless, the occupants are satisfied, on the basis of their current heating and lighting bills, that Montgomery's strategies are paying off. Montgomery's own in-house computer analysis, which was corroborated by Bion Howard of the National Concrete Masonry Association, predicts that the building will consume only 24.5 percent of the energy required for a well-insulated energy-efficient structure of the same size.

Because of the building's design and its efficient HVAC system, the structure is expected to save 152.2 million BTU of heating energy per year. Those savings translate roughly into $1500 per year. Daylighting is projected to save an additional $1000 per year on lighting. Amortizing the added cost of the clerestories and the roof structure over that of a conventional flat roof, the system is expected to pay for itself within seven years.

Both the architect and the client are pleased with the office, and the people of Waynesville have taken a big step toward revitalizing the town square. Since work began on Morgan's office, workers have begun to remodel a nearby building. ■

For product information, see the Manufacturer Credits section on page 70.

The Design Department

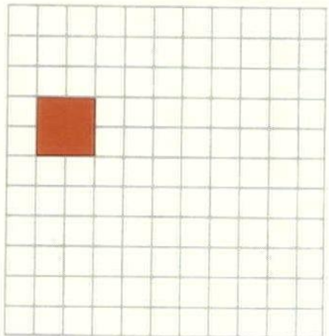
Brightness contrast helps to establish the relative strength of visual symbols. As designers change the patterns of light, shade, and color in a room, the inhabitants, in turn, receive altered subjective impressions. The organization of brightness patterns, therefore, is a fundamental consideration in defining visual space.

Individuals define an environment through a process of additive perception. They gather information by scanning the boundaries of a space, thereby forming a concept of direction and limits. A lighting system should be designed to establish the physical boundaries of a space and to enhance meaningful symbols. Such a system helps people maintain a sense of direction and basic spatial form with a minimum of visual distraction from the environment.

Lighting should help to define and separate the major surfaces of a space.

Lighting should help to define and separate the major surfaces of a space. The shape of the light distribution — such as a *cone* of light — should relate to the form of the surface. A wall or ceiling, for example, should be lighted with a linear *wash* of light that approximates as closely as possible the form and dimension of that surface. *Scallop* patterns and similar aberrations should usually be minimized. Except where special effects are intended, a lighted surface should be perceived as a unified form, not as a surface intersected by patterns of light.

This is not to say that an irregular pattern of light is always undesirable. A shaft of sunlight may have intrinsic value of its own, as may some



Gary Gordon, IES, IALD

The author is principal of Gary Gordon Architectural Lighting Design, New York, a firm that designs lighting systems for commercial and institutional settings. He also teaches advanced courses in architectural lighting design practice and techniques at the Parsons School of Design Lighting Institute.

manufactured lighting patterns that have no relationship to the physical form of a space. But the real value of irregular patterns of light is that they often serve as a temporary spatial stimulant. Otherwise, irregular light patterns should relate to an appealing characteristic of the physical space, such as a picture, sculpture, plant, or architectural detail.

Vertical surfaces, in particular, require special attention; these are the surfaces first seen upon entering a space. They define the space. They are often used for displaying works of art or communicating a message; to a great extent they set the mood and create an atmosphere. To an even greater extent, the visual impression made by vertical surfaces determines the overall effectiveness of a design.

Lighting that emphasizes vertical surfaces, rather than horizontal surfaces, reinforces the viewer's subjective impressions of spaciousness, visual clarity, relaxation, intimacy, or pleasantness. John Flynn's studies at the Pennsylvania State University in the early 1970s demonstrated that wall lighting creates favorable attitudes about interior space.

Flynn's research compared overhead and peripheral wall lighting systems in the same room; only the distribution of light was varied. He found that changes in wall lighting induce consistent and predictable perceptions of the space. Uniform wall lighting, for example, strengthens feelings of spaciousness and visual clarity. Nonuniform peripheral wall lighting, particularly when it is provided by warm-toned sources, reinforces feelings of relaxation, intimacy, and pleasantness.

Many designers who rely upon formulas to provide a certain quantity of footcandles on a horizontal plane disregard the lighting of vertical surfaces. Consequently, the fixtures used for general illumination are likely to cast unanticipated or undesired light patterns on the vertical surfaces or leave them in relative darkness. The result can be monotonous and uninteresting. Sophisticated lighting equipment is available and it warrants corresponding sophistication in applications by designers.

Vertical surfaces require special attention; they are the first seen upon entering a space.

Traditionally, architects manipulate surface finishes and colors to establish contrast, variation, and visual interest in a space, regardless of the lighting condition. Surface brightness can also be manipulated by altering the amount of incident light on a specific surface. Carefully selecting and positioning lighting fixtures with suitable light distribution characteristics can make even a dark-colored, low reflectance surface the brightest area in a visual field.

Any object or surface that reflects or transmits light becomes a secondary light source. What viewers perceive as "brightness" is not the incident light on a surface; it is the light that is *reflected* from that surface toward our eyes. There is an inherent relationship between the distribution of light from a fixture and the way architectural surfaces redirect that light.

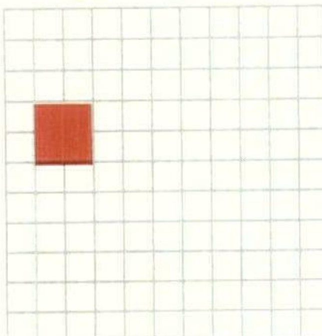
Architects manipulate surface finishes and colors to establish contrast, variation, and visual interest.

Whether it is high or low in intensity, some amount of incident light from fixtures or from interreflection falls on all room surfaces. The relative area of these surfaces and the intensity of light reflected from them determine their visual prominence in an architectural composition. Reflected light is generally diffuse or multidirectional, causing interreflection between all surfaces and objects. This interreflection tends to fill in shadows, reduce contrast, and produce more uniform brightness.

Brightness depends in part upon the intensity of the light that initially strikes a surface. Yet it is also a function of the reflectance or transmittance properties of that surface. Low-reflectance finishes absorb much of the light that strikes

Continued on page 53

The Daylighting Department



Norbert M. Lechner

Norbert Lechner is an associate professor in Auburn University's School of Architecture, Auburn, Alabama. The daylighting column is adapted from his book Heating, Cooling, and Lighting: The Architectural Approach, *which will be published by John Wiley & Sons.*

Daylight that enters a window can come from several sources: direct sunlight, clear (blue) sky, clouds, and reflections from the ground and nearby buildings. The light from each source varies not only in quantity but also in such qualities as color, diffuseness, and efficacy.

Although sky conditions can be infinitely variable, it is useful to understand the daylight from two specific conditions, overcast sky and clear sky with sunlight. A daylighting design that works under both of those conditions will also work under most other sky conditions.

The brightness of an overcast sky is typically three times greater at the zenith than at the horizon. Although the illumination from an overcast day is quite low — 500 to 2000 footcandles — it is still 10 to 50 times greater than is needed indoors.

On a clear day, the brightest part of the sky is around the sun and is about 10 times brighter than the darkest part of the sky, which is at 90 degrees to the sun. Under such a sky the illumination is quite high — 6000 to 10,000 footcandles, a level more than 100 times that required for good indoor illumination. Under such conditions, windows and skylights can be quite small. The main difficulty with the clear sky is the challenge of the direct sunlight; it is not only extremely bright but also is constantly changing direction. Consequently, to understand clear day illumination, it is also necessary to understand the daily and seasonal movements of the sun.

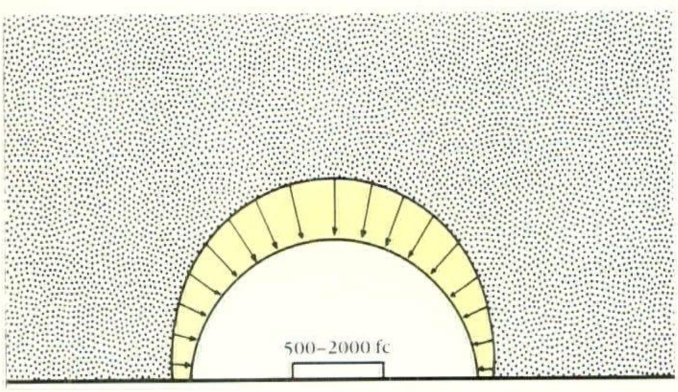
Light Quantity and Quality

Most climates have enough overcast and clear days to make it necessary to design for both conditions. The main exceptions are parts of the Northeast and the Pacific Northwest, where overcast skies predominate, and the Southwest, where clear skies predominate. In these areas, designers should focus upon the predominant condition. Under overcast skies, the designer's main challenge is quantity; for clear sky conditions, the challenge is quality.

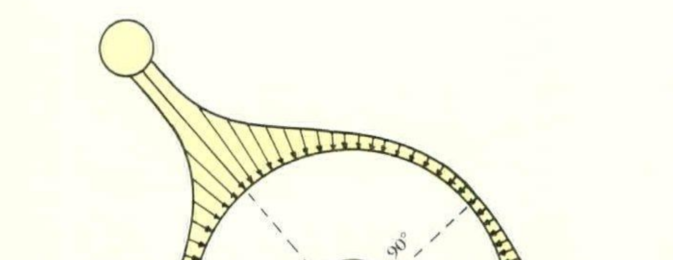
Most climates have enough overcast and clear days to make it necessary to design for both conditions.

The daylight from clear skies consists of two components, skylight and direct sunlight. Light from blue sky is diffuse and of low brightness; direct sunlight is directional and extremely bright. Because of direct sunlight's potential for glare, excessive brightness ratios, and overheating, designers sometimes assume it should be excluded from a building.

Often, in fact, people erroneously believe that direct sunshine is appropriate only for solar heating. Although direct beam sunlight has a



The brightness distribution on an overcast day is typically about three times greater at the zenith than at the horizon.



The brightness distribution on a clear day is typically about 10 times greater near the sun than at the darkest part of the sky, which is 90 degrees from the direction of the sun.

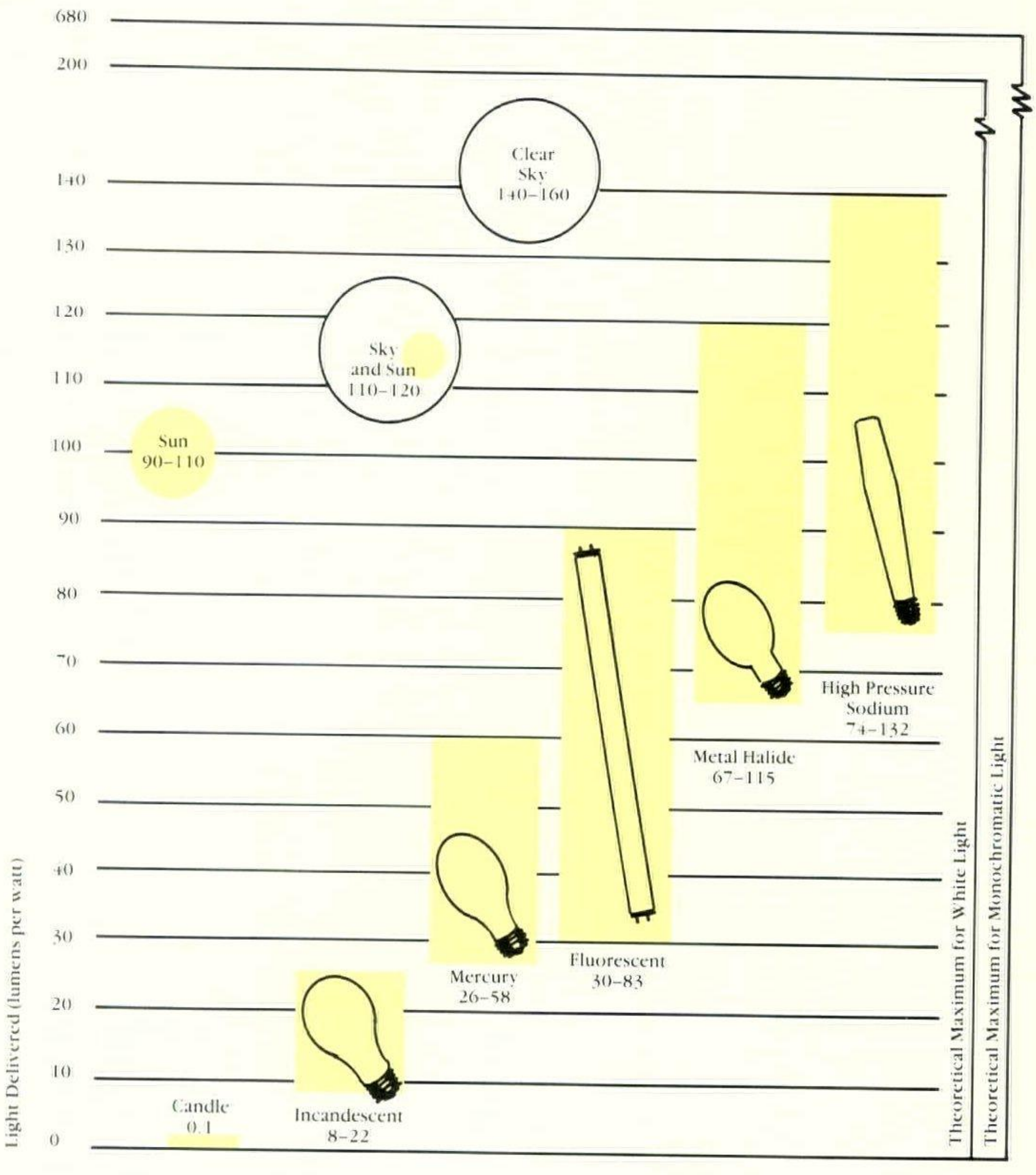
Typical reflectances

Material	**Reflectance (in percentages)**
Aluminum, polished	70–85
Asphalt	10
Brick, red	25–45
Concrete	30–50
Glass, clear or tinted	7
reflective	20–40
Grass, dark green	10
dry	35
Mirror (glass)	80–90
Paint, white	70–90
black	4
Porcelain enamel, white	60–90
Snow	60–75
Stone	5–50
Vegetation, average	25
Wood	5–40

lower efficacy (lumens per watt) than skylight, its efficacy is comparable to and its color rendering quality is superior to the best electric sources. Therefore, it is not a good policy to exclude direct sunlight because, with the proper design, it can supply both high quality and high quantity daylight.

The light from clear skies, especially the light from the northern sky, is rich in the blue end of the spectrum. The color rendering quality of such light is excellent, but it is slightly on the cool side.

Reflected light from the ground and neighboring structures can be a significant source of daylight. Reflected light may even be the major source of daylight; the reflectance factor of the reflecting surface is critical in this regard. A white painted building frequently reflects about 80 percent of the incident light; lush green grass reflects only about 10 percent, and mostly green light at that. The reflectances for some common surfaces are shown on the accompanying table.



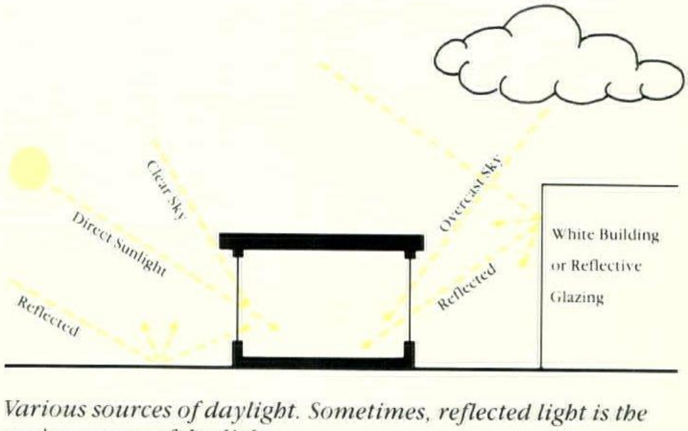
Conceptual Model

Direct beam light can be nicely modeled with arrows, but a diffuse source cannot. To understand and to predict the effect of a diffuse light source requires a different kind of visual model.

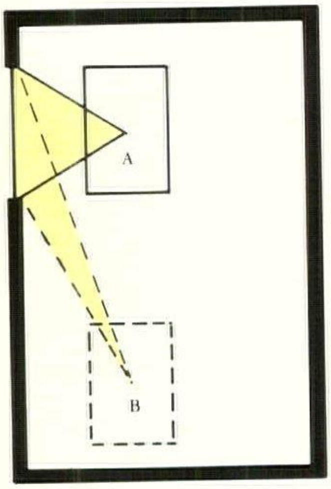
The illuminating effect of a diffuse source on a point is a function of both the brightness and the apparent size of the source.

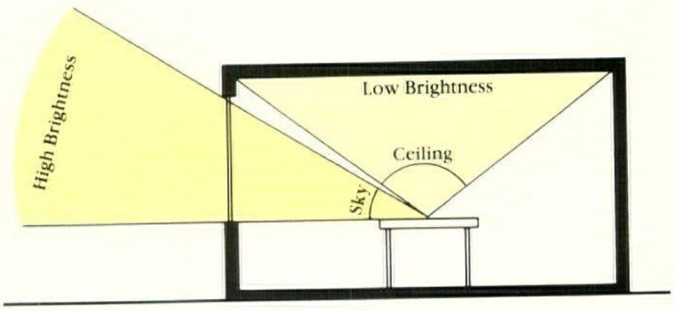
The illuminating effect of a diffuse source on a point is a function of both the brightness and the apparent size of the source. Apparent size is a consequence of actual size, proximity, and tilt. For example, the *apparent* size of a source decreases if the *actual* size of that source decreases or if the source is moved further away or if the source is tilted. If a flat source is tilted 90 degrees, its apparent size is zero.

This model can be used to visualize the way a table in a room will be illuminated by a window. Moving the table from a position near a window to one farther away decreases the illumination for two reasons: it changes the proximity



Various sources of daylight. Sometimes, reflected light is the major source of daylight.





The relative contributions of two sources of daylight, sky and ceiling, are demonstrated in this model.

Average illumination from overcast skies

North latitude	Illumination
46°	700 fc
42°	750 fc
38°	800 fc
34°	850 fc
30°	900 fc

Values above are typical for overcast sky conditions from 8 a.m. to 4 p.m. Adapted from Egan's Concepts in Architectural Lighting, *McGraw-Hill.*

and tilt of the window in relation to a point on the table. Everything else remains constant.

A section of that room with the table shows the relative contributions of two main sources of daylight — the sky and the ceiling — for a point on the table. Some of the daylight entering the window is reflected off the ceiling, which then becomes a low brightness light source for the table. Even though its brightness is low, the illumination from the ceiling is significant because of its large apparent size. The combination of brightness and apparent size determines the contribution. The sky is the major source of light despite its smaller apparent size, because it is much brighter than the ceiling. If the walls are a light color, they will also reflect some light on the table; but for simplicity, the walls' contribution is omitted from the accompanying drawing.

Typical minimum daylight factors

Type of space	Daylight factor
Art studio	4.0–6.0%
Factory, laboratory	3.0
Office, classroom, gymnasium	2.0
Lobby, lounge, living room	1.0
Corridor, bedroom	0.5

This general guide for checking the adequacy of illumination supplied by windows is adapted from M. David Egan's Concepts in Architectural Lighting *with permission from McGraw-Hill.*

The Daylight Factor

One of the best ways for an architect to determine the quantity and the quality of daylighting is to use physical models. Although most daylighting model tests are conducted under the real sky, the usefulness of actual measured illumination data is limited. Unless a model can be tested under the worst daylight conditions, illumination measured inside it cannot indicate the lowest expected illumination level.

Fortunately, there is a solution to this problem — the daylight factor, which is the ratio of the illumination indoors to that outdoors. The daylight factor describes how effectively a design takes daylight indoors. It is not necessary, then, to test the model under the worst conditions to determine the daylight factor. Although winter overcast skies are usually the worst design condition, the model can be tested under an overcast sky at any time of year or day.

If the measured daylight factor is greater than the typical minimum for that kind of space shown on the accompanying table, then there will be more than enough daylight for most of the year. Multiplying the daylight factor by the average minimum daylight shown in the average illumination table lets a designer determine the average minimum indoor illumination.

Remember that absolute illumination is a poor indicator of visibility because the human eye has a great ability to adapt. Relative brightness between the interior and the window, however, is a critical consideration in daylight design, and the daylight factor is a good indicator of this relationship. The higher the factor the less extreme are the brightness differences.

If a design excludes direct sunlight, then clear days behave similarly to the overcast conditions explained above. If direct sunlight is included, as it generally should be, then the model has to be tested with a sun machine to simulate the various sun angles throughout the year. Model testing will be explained in a later column.

During the design process, several alternative schemes usually must be compared. Because actual outdoor lighting varies greatly from hour to hour and day to day, footcandle measurements cannot be compared; but the daylight factor can. As the outdoor illumination changes, the indoor illumination changes proportionately and the daylight factor remains constant for any particular design. ■

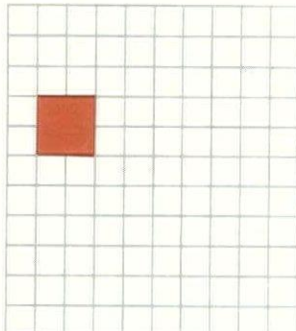
The Parts Department

The most beautiful, sophisticated lighting system a designer can devise cannot perform as intended if postoccupancy maintenance is poor. Designers can ensure the upkeep of their designs by considering what happens to lamps and luminaires as they age and by recommending to new building owners various options for lamp and luminaire maintenance.

Lighting systems of today are sophisticated, but their performance is still affected by deterioration of components. The accumulation of dirt, lumen depreciation, and discoloration of lenses can decrease illumination and the overall effectiveness of a lighting system. Planned maintenance is the only way to ensure the effectiveness of lighting systems. It is important, therefore, to recognize the factors that contribute to overall loss of illumination.

Lamp burnout. Lamp burnout is the most obvious contributor to loss of illumination from a lighting system. The *average rated life* that a manufacturer publishes for a lamp is, by definition, that point in time of operation at which approximately 50 percent of the lamps in a large group have burned out. As lamps burn out, illumination levels decrease proportionately. In the case of a rapid-start fluorescent system, when one lamp goes out in a two- or four-lamp fixture, the companion lamp operating on the ballast also goes out.

Lumen depreciation. The light output from a lamp de-



R. Arnold Tucker

R. Arnold Tucker is manager of technical programs at GTE Electrical Products, U.S. Lighting Division, Danvers, Massachusetts.

creases as it ages. This light loss is caused by internal deposits from vaporized filaments, cathodes, or electrodes. This *lamp lumen depreciation* is an inherent characteristic of all lamps.

Luminaire dirt depreciation. The light loss caused by deposits of dust or dirt on the exterior of the light source, the fixture reflector, or the lens is referred to as *luminaire dirt depreciation.* This factor leads to a significant loss of light, especially in some manufacturing plant environments. Dirt accumulation on the surfaces can be reduced if the reflector surface is sealed from the air, as in a dust-tight fixture. Ventilated lighting units tend to collect less dirt than fixtures with closed tops.

Fixture selection and accessibility. Designers should consider whether the luminaire they choose for a specific location will facilitate or hinder lamp replacement. Some lamps, for example, must be ordered from a specific supplier; others are readily available at local electrical distributors. Some fixtures are difficult to disassemble for lamp replacement or are accessible only by unusual means, such as scaffolding. Such problems may discourage maintenance workers from making prompt replacements of burned-out lamps.

Other considerations. Other factors can also affect illumination levels. Materials used in luminaire construction differ in their resistance to dirt accumulation, discoloration, and deterioration. Dirt accumulation on room surfaces tends to reduce the amount of reflected light in the area. Voltage variation, particularly for incandescent lamps, and ambient temperature in the case of fluorescent lamps can cause variations in light output from day to day.

Poor lighting maintenance habits can significantly affect illumination levels in the workplace. Typical light losses due to poor maintenance for various light source types can range from 15 to 40 percent, as the accompanying table shows.

An effective lighting maintenance program must meet both short-term and long-term needs as well as budget requirements. For example, it is not practical to institute a planned lighting maintenance program that replaces every component of the system (lamps, sockets, ballasts, wiring, reflectors, and so forth) before it malfunctions or burns out. Neither is it practical or economical to totally neglect the routine maintenance of the lighting system until burnouts or breakdowns occur.

Typical light loss (percent reduction) due to poor lighting maintenance

	Old lamps, dirty lamps	Dirty fixtures	Combined effect
Incandescent	15	15	28
Fluorescent	15	30	40
High intensity discharge	20	15	32

Designer's Maintenance Manual

Designers should prepare a maintenance manual for any complicated lighting system. Such a manual includes a set of electrical plans, manufacturers' information on each type of luminaire used on the project, and relamping information. If special lamps — very narrow spot 3200-degree-Kelvin PAR 38s, for example — have been used in a specific location for a specific purpose, a good maintenance manual notes the locations, the types of lamps used, and supplier information.

Whenever possible, the designer of the lighting system should meet with maintenance personnel to acquaint them with the intricacies of the system. Many maintenance people are proud of their buildings and, given the necessary information, will maintain them properly.

Designers' recommendations can influence management's choice of a lighting maintenance plan. With a knowledge of the factors involved, designers also can plan installations with an awareness of potential maintenance costs.

Few Advantages to Spot Relamping

Spot relamping has a few perceived advantages. No planning is required, no cost is obvious, and no coordination of time or personnel is necessary. These advantages, however, are outweighed by many disadvantages. In the long run, spot relamping is expensive. Light levels can fluctuate significantly, the benefits of cleaning are not realized, and unit cost to replace one lamp at a time is high. Spot maintenance can disturb building users. Safety hazards and electrical problems can go undetected, and the aesthetics of an area can be affected. Color consistency may not be maintained because lamps of different colors may be used. Ballast life can be shortened by burned-out or flickering lamps. Finally, spot replacements interrupt maintenance personnel or take them away from other duties.

Evaluations usually indicate that a program incorporating planned maintenance concepts is best. An analysis of the lighting installation will help in determining the most economical method based on replacement costs, desired illumination level, and method of replacement of burnouts that occur before a scheduled relamping.

Three equations provided by the Illuminating Engineering Society can be used to calculate replacement cost per fixture per year. The equations, shown here in a table, yield cost estimates for spot replacement, group replacement, and group replacement with spot relamping of early burnouts. They account for relamping costs only; cleaning costs are not included.

Equations used to calculate lamp replacement cost per fixture per year

$$\text{Spot replacement cost} = \frac{BX}{R}(c + i)$$

$$\text{Group replacement cost} = \frac{BX}{A}(L + g)$$

$$\text{Group and early burnout replacement cost} = \frac{BX}{A}(L + g + Kc + Ki)$$

where
- X = lamps per fixture
- B = operating hours per year
- R = average rated lamp life, in hours
- A = operating time between group replacements, in hours (percent of rated life × rated life)
- c = net price of lamps for spot replacement, in dollars
- L = net price of lamps for group replacement, in dollars
- i = labor cost per lamp for spot replacement, in dollars
- g = labor cost per lamp for group replacement, in dollars
- K = proportion of lamps failing before group replacement (from lamp mortality curve)

Consider the Cost

Consider the example of an office building lighted by four-lamp, four-foot fluorescent recessed troffers equipped with standard lamps. The space is relatively clean and the lights are being used approximately 12 hours per day, five days per week, 52 weeks per year for an estimated total of 3000 operating hours annually. Each lamp's average rated life is 20,000 hours. An accompanying table summarizes the following cost comparison.

For this example, assume a user net price of \$2.19 per lamp. Experience in the lighting maintenance area suggests that \$7.50 per hour for labor cost and 20 minutes per lamp to spot relamp are fairly typical. Group relamping will take 5 minutes per lamp on the average. According to the first equation in the table, spot replacement will cost \$2.814 per fixture per year under these conditions.

To determine the costs associated with group relamping, select the operating time between replacements; the illumination levels to be maintained usually determine this interval. If early burnouts are to be replaced, group replacement can be delayed until spot replacement becomes burdensome or uneconomical.

In the example that follows, 10 percent lamp failure was determined to be acceptable with no relamping before group replacement is performed. According to the lamp mortality curve, this failure rate occurs at approximately 70 percent of average rated life (20,000 hours), so the selected operating time is 14,000 hours between group replacements. The resulting calculations, using the second equation in the table, show that group replacement with no spot replacement will cost \$2.413 per fixture per year.

If the program includes replacing early burnouts before the next group replacement,

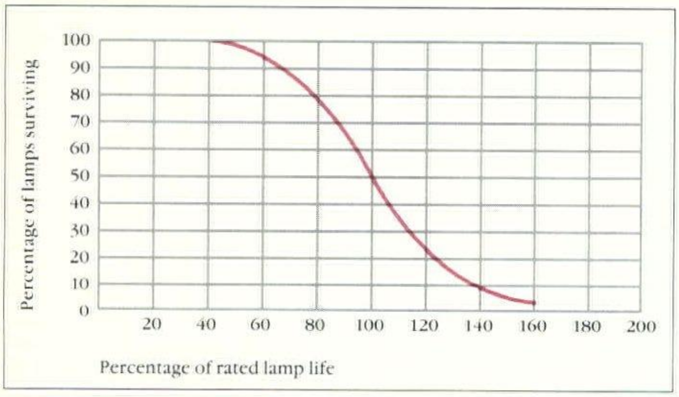
Example comparison of replacement method costs

Lamps per fixture = 4
Operating hours per year = 3000
Average rated lamp life (hours) = 20,000
Net price of lamps:
  new = \$2.19
  used = 0
Time required to replace one lamp (minutes):
  spot replacement = 20
  group replacement = 5
Labor cost:
  per hour = \$7.50
  per spot relamping = \$2.50
  per group relamping = \$0.625

Spot replacement only
Replacement cost per fixture per year = **\$2.814**

Group replacement only
Lamp failure rate before group replacement = 10%
Percent of rated life used before replacement = 70%
Operating hours between replacements = 14,000
Replacement cost per fixture per year = **\$2.413**

Group replacement with spot replacement of early burnouts
Lamp failure rate before group replacement = 25%
Percent of rated life used before replacement = 85%
Operating hours between replacements = 17,000
Replacement cost per fixture per year = **\$2.428**



Mortality curve showing typical life expectancy for fluorescent lamps.

the decision on when to group relamp typically allows up to 25 percent lamp failure. The lamp mortality curve indicates that this will increase the time between group relampings to 85 percent of rated life — approximately 17,000 hours.

Either new lamps or working lamps from the previous relamping can be used to replace burnouts. The spot replacement lamp cost for early burnouts, *c*, can therefore run from the cost of a new lamp, *L*, to zero. Typically, spot replacement is done with used lamps and the cost is nothing. If early burnouts are replaced with used lamps in the example, group replacement with spot relamping of burnouts will cost $2.428 per fixture per year, according to the third equation.

In this hypothetical analysis, group relamping with no early burnout replacement is the most economical method, but only by a small margin. If it is important for aesthetic reasons to maintain uniform lighting between group relampings (in retail store operations, for example), the above calculations indicate a minimal cost requirement — an additional penny and a half per fixture per year.

In general, building management should consider group replacement when the labor cost per lamp for group relamping is significantly less than the labor cost per lamp for spot relamping. Records or work studies on lamp replacement may help management to determine the time and labor cost involved in either spot or group replacement. Computer programs are available that can determine the most economical relamping schedule by considering lamp and labor costs for a specific installation.

Building management and maintenance staff will ultimately determine lighting maintenance choices. Designers who understand their perspectives can create lighting systems that are more likely to be well maintained. ■

Continued from page 47

them and reflect very little toward the eye. This produces low surface brightness and yields an impression of a dark space. High reflectance finishes, on the other hand, reflect more of the incident light, producing a brighter interior with a more general diffusion of light.

The relationship between the initial distribution of light by the luminaires and the distribution of reflected light from room surfaces is critical to the creation of a desired environment. Depending upon whether the light illuminates or subordinates these surfaces, the initial light distribution will reinforce a viewer's impression of high or low general brightness. The overall brightness also depends upon the distribution of reflected light, which in turn depends upon the reflectance characteristics of surfaces in the space. For example, if all the room surfaces are light colored, interreflections will fill in shadows and reduce contrast. Dark finishes have the opposite effect. This action is independent of both concentrated and diffuse light distributions.

The choice of surface finishes may reinforce or nullify the initial distribution of light from luminaires.

The choice of surface finishes, then, may reinforce or nullify the initial distribution of light from luminaires. The finishes not only affect the brightness of visual elements that define a space, but also determine their significance as secondary light sources.

The moon is a perfect example of a surface functioning as a secondary light source. At night, the initial distribution of light from the primary source, the sun, is not apparent to us. The moon becomes the lighting element that illuminates the earth by reflection.

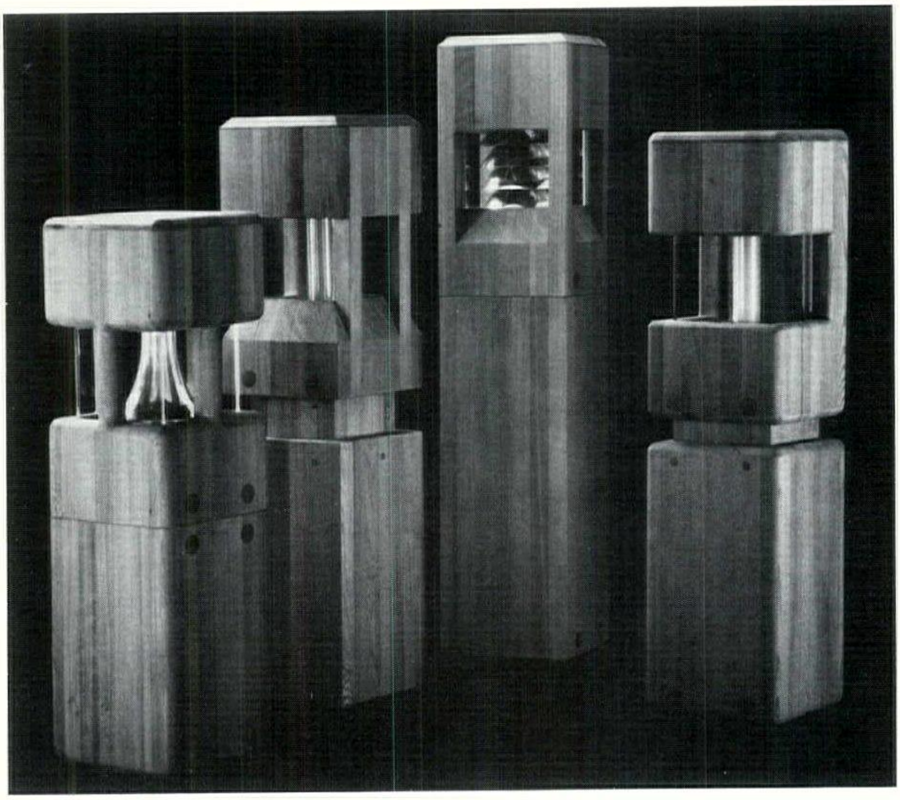
Similarly, a wall can become the light source that illuminates a room. The distribution of light in the room is dependent upon the reflected distribution from the wall surface, rather than upon the initial light distribution of the lighting equipment.

Impressions of relaxation and intimacy can be elicited when secondary sources are the major source of illumination. Quite different are the feelings of tension and depersonalization evoked when the lighting condition results from the primary distribution of the lighting elements. It is very difficult to create the romance of a moonlit evening with direct light from a primary source.

The visual perception of space is a function of both surface character and incident light. In appraising the architectural function of a lighting system, then, designers must recognize the influence of reflected light.

A designer's control over the luminous environment includes the ability to intelligently specify the relationship between lighting fixtures and room surfaces. Manipulating brightness and contrast through precise light control, along with the control of surface and form, is an important technique for establishing variation and visual interest. ■

Product Showcase

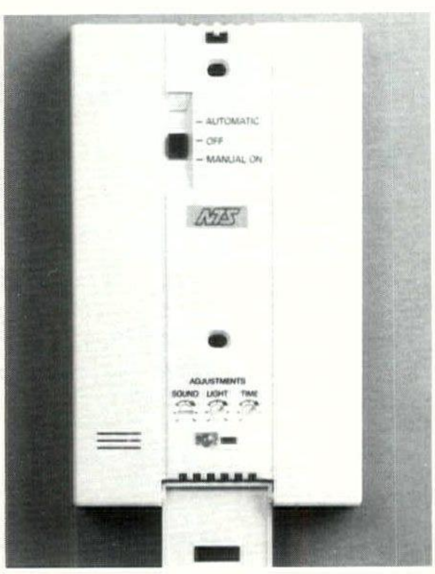


Redwood bollards

The bollards shown here belong to Wood-Form's Group 4000 series of contemporary outdoor lighting products. High intensity discharge lamps illuminate the handcrafted redwood luminaires in the series. The units incorporate a concealed reflector assembly to maximize light distribution.

Cylindrical, conical, and parabolic options are available. Lamp choices include high pressure sodium, mercury vapor, and metal halide. All units are UL approved. WoodForm, Inc., Portland, OR.

Circle 55



Occupancy sensor

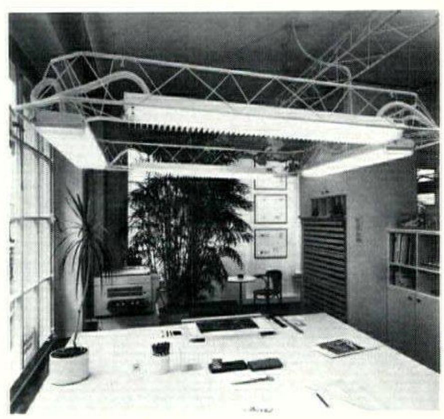
NTS Products Group has introduced a 600-watt sound-activated lighting control unit that can sense occupants within a 10,000-square-foot area. The unit is designed to replace a standard switch and fits in a standard switch receptacle. It features a built-in sensor, a manual off switch, and an adjustable daylight sensor that overrides the sound activation circuit when ambient light is sufficient. Common applications for the unit, which can handle both incandescent and fluorescent loads, include restrooms, storage closets, conference rooms, and garages. NTS Products Group, Chatsworth, CA.

Circle 56

Art deco fixture

Classic Illumination offers an art deco fixture that can be paired with a variety of shades. The model 1920-1 is made of solid brass; it uses incandescent lamps, but can be modified to accept compact fluorescent or halogen lamps instead. The fixture, which accommodates lamps up to 450 watts, is shown here with the model 16FD etched-glass dish shade. Other shade styles are available. Classic Illumination Inc., Berkeley, CA.

Circle 57



Space-frame system

The new Structura space-frame system from Lightolier provides a versatile frame-work for display lighting. The modular triangular frames of the system fit together to partition areas, carry loads, localize lighting, or simply to decorate. The system is specifically designed to carry the firm's display lighting and track lighting equipment.

Structura components include curves, corners, and spans in four lengths. Black, white, and custom colors are offered. Accessories include fluorescent lighting and dimming systems. A detailed catalog and a template are available to assist designers with layouts, the manufacturer reports. Lightolier, Secaucus, NJ.

Circle 58

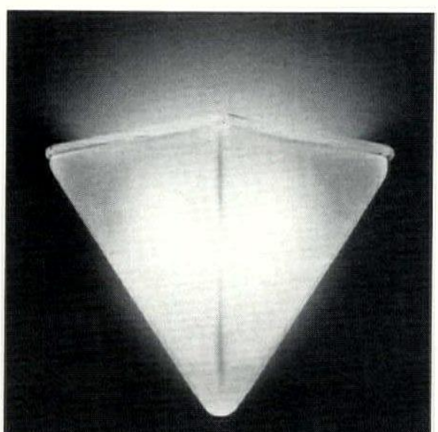
■ Corrosion-resistant luminaires

QL's stainless steel garage luminaires are built to withstand environmental and accidental abuse and vandalism. A high intensity discharge lamp is enclosed in a one-piece welded housing of 304 stainless steel for normal applications, 316 stainless steel for corrosive areas, and AL6XN stainless steel for marine locations. A shatterproof lens and tamperproof screws also protect the luminaire.

The luminaire features sharp cutoff lighting and three choices of reflectors for symmetrical, asymmetrical, and forward-throw light distribution. Both the heavy extruded aluminum lens frame and the spun-aluminum reflector are hinged for ease of service. A gasketing system filters out moisture and debris but permits air to circulate through the unit and cool electrical parts. This reduces operating and maintenance costs, according to the manufacturer. Side knockouts allow for through wiring within the fixture, and top knockouts allow for ceiling or junction box mounting. QL, Inc., Northbrook, IL.

Circle 59

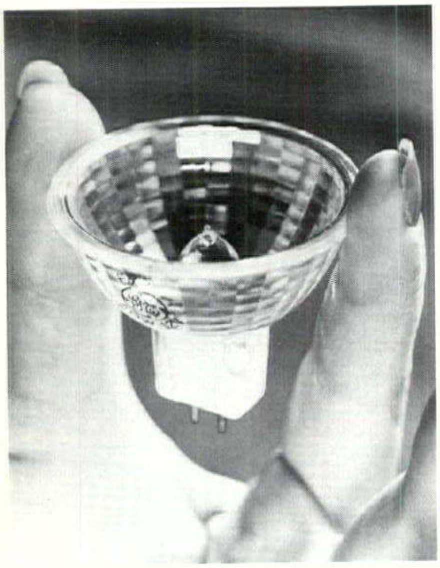
Circle 19



■ Sconce

The Volo wall sconce was designed by Robert Pamio for Leucos and is distributed in the United States by Innovative Products for Interiors (IPI). The V-shaped incandescent wall sconce provides uplighting and diffused light through its white, hand-molded Murano glass diffuser. The sconce is UL listed. Innovative Products for Interiors, Inc., Long Island City, NY.

Circle 60

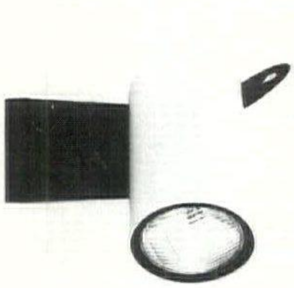


■ 12-volt lamp

General Electric Lighting Business Group offers the Precise line of 12-volt multi-faceted reflector lamps. Only 2 inches in diameter, the lamps produce highly controlled beams by focusing the light emission of miniature quartz-halogen filament tubes. A dichroic reflector coating reduces beam heat through rear lamp emission of infrared rays.

The lamps are recommended for decorative and display lighting, especially the illumination of perishables and objects with colors that may fade under high heat. General Electric Lighting Business Group, Cleveland, OH.

Circle 61

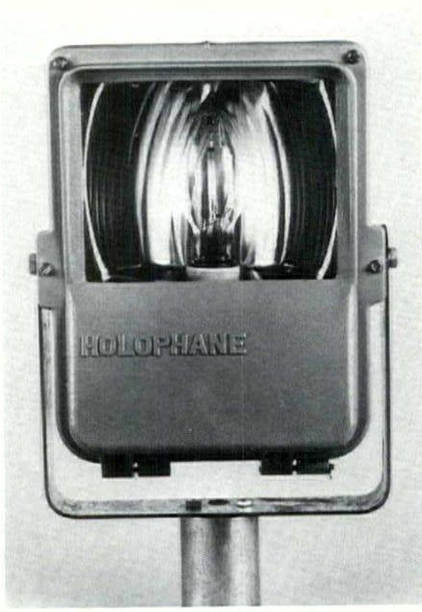


■ Emergency lighting cylinders

Redesigned Z and ZV decorative lighting cylinders from Lightalarms offer an alternative to conventional emergency lighting units. The self-contained units provide fully automatic operation and are available in single- and double-cylinder models. They incorporate maintenance-free 6-volt sealed lead or nickel-cadmium batteries.

The ZV models can be used as master battery stations to power three remote fixtures or exit signs each. All models are equipped with automatic solid state charger, low-voltage disconnect to prevent overdischarge of battery, dust-tight instantaneous transfer relay, charge monitor LED indicator, and momentary test switch. Lightalarms Electronics Corporation, Baldwin, NY.

Circle 62



■ Industrial floodlight

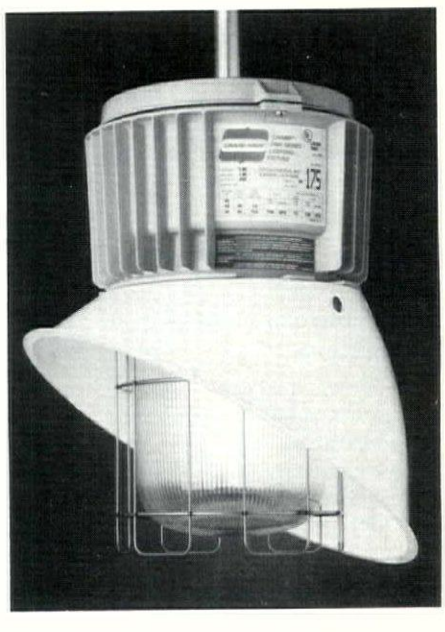
Holophane's Predator industrial floodlight provides a broad horizontal and narrow vertical beam with minimum glare. The reflector design eliminates bright streaks, even when the unit is placed close to the lighted surface, affording more uniform surface brightness for better viewing comfort.

All exposed metal parts are constructed of stainless steel except the housing, which is made of die-cast aluminum. The housing is finished with electrostatically deposited, thermoset powdered polyester paint. An epoxy coating with an acrylic overcoat is also available.

The Predator can be rotated 360 degrees on its yoke for bottom, back, top, or intermediate mounting position. The yoke can be removed and the fixture mounted directly to wall or column with a 15-degree downward tilt. A slip-fit adapter is available as an accessory for tenon mounting.

All electrical components, including the socket, are mounted on the door with a quick disconnect. Maintenance personnel can remove the door for bench testing and repair, or replace it to change wattage or high intensity discharge source. Holophane, Newark, OH.

Circle 63



■ Hazardous-area lighting

A line of high intensity discharge fixtures for use in Class II hazardous areas has been introduced by Crouse-Hinds Electrical Construction Materials. The new DMV Series Class II Champ fixtures provide effective light distribution at normal and high ambient temperatures. They are suitable for use in areas made hazardous by the presence of flammable gas or combustible dust.

Mounting modules include fixed and offset pendant, straight and angle stanchion, ceiling mount, and wall mount. Low-glare globes are fluted internally, so the smooth exterior surface sheds dust, according to the manufacturer.

No tools are needed to install the optional fiber glass–reinforced polyester twist-on reflectors or the stainless steel snap-in guards. Guards feature an open bottom design for easy relamping. All fixtures are finished with a corrosion-resistant epoxy powder coat. Crouse-Hinds Electrical Construction Materials, Syracuse, NY.

Circle 64

■ Electronic ballasts

Electronic ballasts from Fyrnetics draw 30 percent less wattage than conventional electromagnetic ballasts while providing full light output. The ballasts meet the light-output standard set by the Council of Ballast Manufacturers (CBM), which specifies that operating lamps produce 95 percent of rated lumen output.

Because the ballasts require less current than conventional ballasts, more units can be connected per circuit, saving on new building construction cost. They use the same wiring connections as conventional ballasts and can be retrofitted without modifying any wiring in existing fixtures. Eight configurations accommodate one to three 40-watt lamps or two 96-watt lamps with 120-volt or 277-volt input voltages.

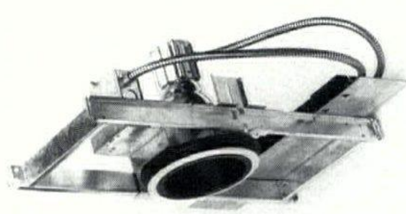
The ballasts carry a three-year warranty that covers both ballast and labor replacement cost. They are approved by the California Energy Commission, listed by Underwriters Laboratories, and Class P thermally protected. Fyrnetics, Inc., Elgin, IL.

Circle 65

■ Exit lights

Devine Lighting has introduced its NFDVG80 series emergency exit lights. The UL-listed lights fully comply with the new UL924 requirements for luminance and contrast in standard and 90-minute emergency modes, the manufacturer reports. The units are constructed of die-cast aluminum and are available with a variety of mountings and finishes. Devine Lighting, Kansas City, MO.

Circle 66



■ Baffled downlight

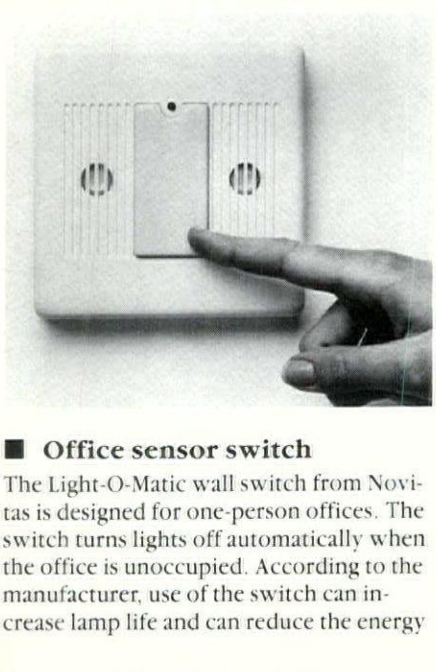
Indy Lighting has introduced a new addition to its series of baffled luminaires. The downlight, listed as models 8032MB and 6032MB, features the new 32-watt medium-base metal halide lamp from General Electric. The lamp's color temperature of 3500 degrees Kelvin and color rendering index of 65 suit it for indoor commercial use. The downlight's Tru-Lock bar hanger simplifies installation. Indy Lighting, Indianapolis, IN.

Circle 67

■ Mexican chandelier

Arte de Mexico offers a chandelier that features handcrafted wrought iron and a hand-turned wooden center post. The chandelier's body is made in Mexico; electrical wiring is added in the United States to conform to UL standards. Silk and linen shades are available. The chandelier measures 48 inches high and 54 inches in diameter. Arte de Mexico, North Hollywood, CA.

Circle 68

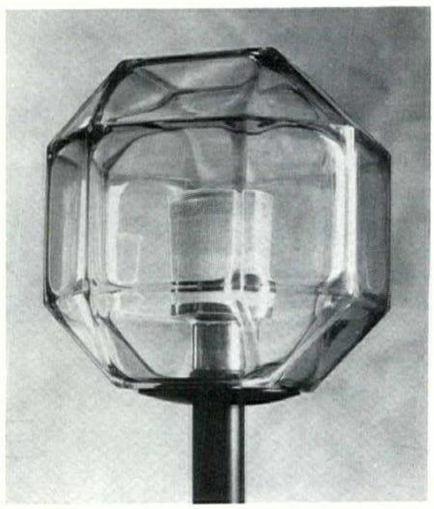


■ Office sensor switch

The Light-O-Matic wall switch from Novitas is designed for one-person offices. The switch turns lights off automatically when the office is unoccupied. According to the manufacturer, use of the switch can increase lamp life and can reduce the energy cost of office lighting by 45 to 50 percent.

The Light-O-Matic is a one-piece unit that replaces a standard wall switch. It operates on 120-volt or 277-volt circuits and is covered by a three-year warranty. Novitas, Inc., Santa Monica, CA.

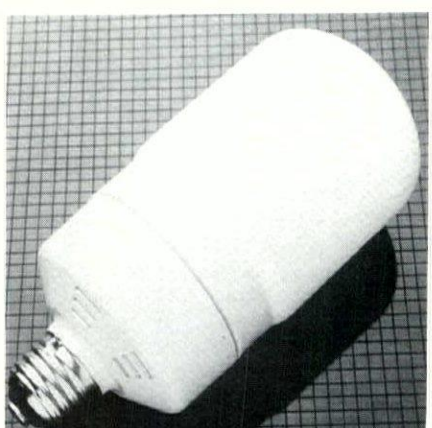
Circle 69



■ Multifaceted enclosure

TrimbleHouse's Geodesic Sphere is a polycarbonate enclosure that accommodates incandescent or high intensity discharge light sources. The unit is 18 inches in diameter and is available in clear and colored versions. TrimbleHouse Corporation, Norcross, GA.

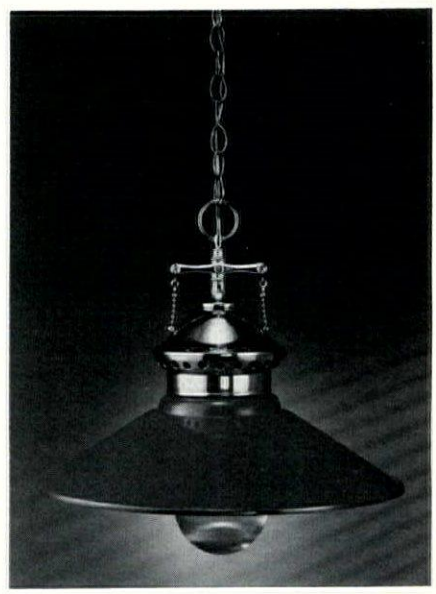
Circle 70



■ Screw-in fluorescent

The Marathon fluorescent lamp from Mitsubishi is approximately 75 percent more energy efficient than a standard incandescent lamp with comparable light output. Discharge gas circulates through both the inner light-emitting tube and the outer globe, making the outer globe a light-producing part of the lamp. The firm offers the screw-based lamp in spherical and cylindrical shapes, with clear and opaque glass, in 13-watt and 15-watt versions, and with color temperatures of 2800 and 5000 degrees Kelvin. Mitsubishi Electric Sales America, Inc., Cyprēss, CA.

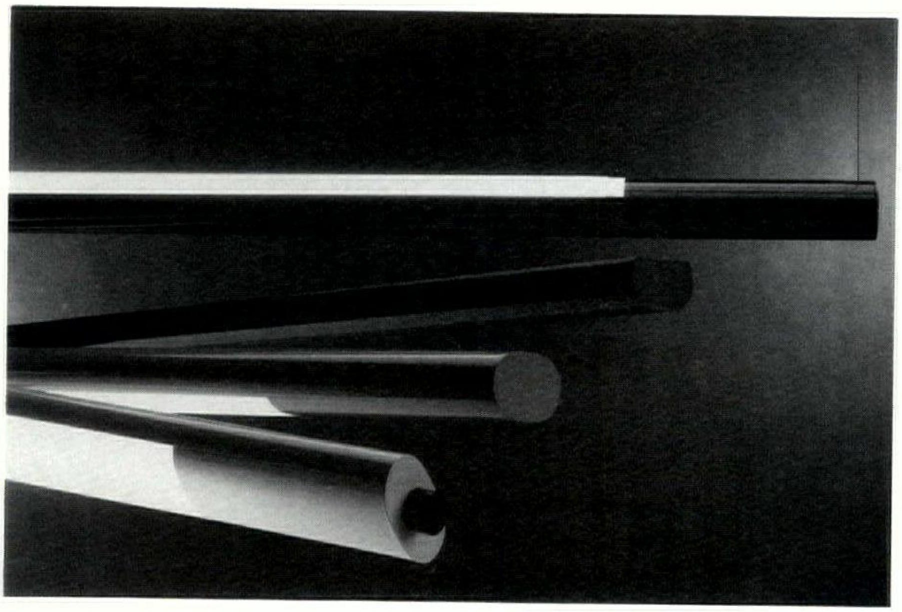
Circle 71



■ Pendant

The new Victoria Station pendant from Progress Lighting is patterned after the gas lamps that lighted railroad stations in the 1800s. Design details include a gas-flow regulator and ventilation holes. The polished brass crown holds a 17-inch-diameter red, green, chrome, or polished brass shade with a white reflective inner lining. A prismatic glass diffuser shelters a 100-watt incandescent lamp. Progress Lighting, Philadelphia, PA.

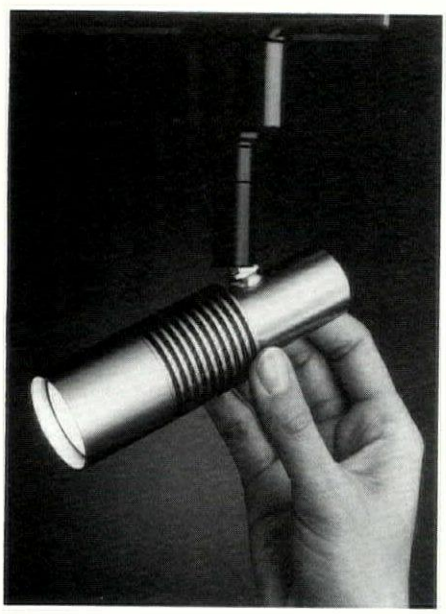
Circle 72



■ **Linear fluorescents**

Elan from Lam Lighting Systems is a linear fluorescent accent and ambient lighting system. The extruded aluminum housings of the system are elliptical in section. Elan is available in direct, indirect, and direct-able configurations that incorporate lenses and diffusers. The manufacturer furnishes the system in straight runs and patterns. Lam Lighting Systems, Wakefield, MA.

Circle 73



■ **Miniature accents**

Capri Lighting has introduced a series of miniature low-voltage accent lights. The luminaires use ultracompact MR 11 quartz halogen mirrored reflector lamps, which are only slightly larger in diameter than a 25-cent piece. The tiny 20-watt and 35-watt lamps provide excellent color rendition and beam control, the firm reports. The small size of the accent lights suits them for use in confined spaces, such as jewel cases, under shelves, and over counter tops. Capri Lighting, Los Angeles, CA.

Circle 74

■ **Troffers for CRT users**

Graybar's new Meter Miser troffers are designed specifically to eliminate glare on CRT screens. According to the manufacturer, tests by CRT users rated the visual comfort probability (VCP) of lighting with the troffers at 93 percent. The troffers feature a 3/4-inch parabolic cube louver with acrylic overlay that provides low brightness without producing reflections or stray light, the firm reports.

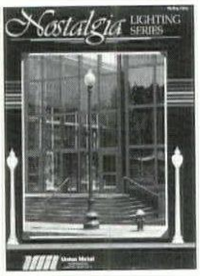
The troffers are prelamped and can be prewired to simplify installation. They are available in two versions, the Performer and the Saver. The Performer features high color rendering capability, lumen output, and visual comfort. The Saver offers greater energy savings with equal visual comfort. All troffers are equipped with energy-saving ballasts and General Electric SP35-Maxi Miser or Watt Miser II lamps.

Meter Miser troffers are recommended for offices, hospitals, schools, airports, and other locations where CRTs are used. Other applications include areas where paintings, photos, or exhibit cases require reduced glare. Graybar Electric Co., Inc., St. Louis, MO. ■

Circle 75

Product Literature

Historic lampposts



The base castings for Union Metal's Nostalgia series lampposts are made from original, handmade wood patterns. A brochure displays the posts and matching luminaires. Union Metal Corporation, Canton, OH.

Circle 100

Luminaires, systems

Swivelier's 92-page catalog covers the manufacturer's full range of indoor and outdoor luminaires and systems. Accent lights and track systems for merchandising applications are featured. Swivelier, Nanuet, NY.

Circle 101

Flat fluorescent

The Series 66 Flatlite from Neo-Ray encloses two T 8 lamps in a shallow aluminum housing. A small-cell parabolic louver mediates direct downlighting; a pendant model also provides uplighting. Neo-Ray Lighting, Brooklyn, NY.

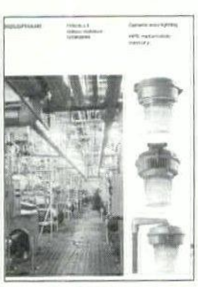
Circle 102

Cast lighting posts

Antique Street Lamps offers a wide selection of cast lighting posts and matching luminaires. A foldout brochure details the products, including posts of iron, iron and steel, fiber glass–reinforced polyester, aluminum, and polysteel. Antique Street Lamps, Inc., Austin, TX.

Circle 103

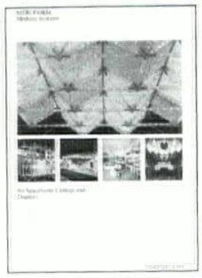
Area lighting



A 12-page brochure describes and illustrates how the reflectors and refractors of the Petrolux II deliver illumination to walkways, loading platforms, garages, and storage areas. Holophane, Newark, OH.

Circle 104

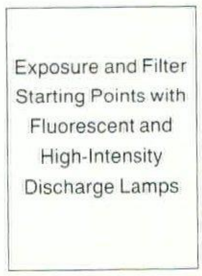
Modular system



Meroform structural assemblies combine two basic components — tubes and connecting nodes — in a versatile system for space-frame ceilings and displays. A brochure shows applications and lighting accessories. Mero Corporation, Hawthorne, NY.

Circle 105

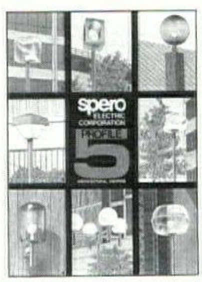
Exposure, filter guide



A data sheet from GE Lighting Business Group recommends photographic exposure and filter adjustments for Kodak color films. Twelve fluorescent and five high intensity discharge sources are included. GE Lighting Business Group, Cleveland, OH.

Circle 106

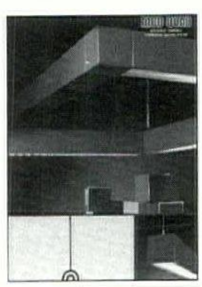
Post-mounted fixtures



Spero's Profile 5 series features several diffuser shapes for post-mounted outdoor fixtures. A brochure details the fixtures and matching wall-mounted styles. Spero Electric Corp., Cleveland, OH.

Circle 107

Fluorescent quadrille



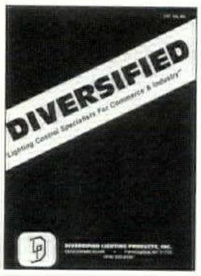
The Mod Quad is a modular fluorescent lighting system based on a quadrille pattern. The 6-inch-square modules accommodate a variety of optical assemblies, as shown in a brochure. Prudential Lighting, Los Angeles, CA.

Circle 108

Downlights

A pictorial data sheet diagrams the Rambusch Downlite. The cutaway view reveals the downlight's inner construction and its frosted tungsten-halogen lamp. Rambusch, New York, NY.

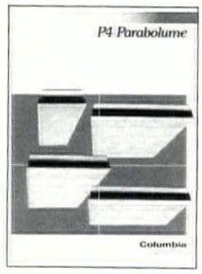
Circle 109



Louvers, lenses

Diversified Lighting Products manufactures a line of louvers, lenses, modular panels, globes, safety sleeves, pans, and diffusers. A brochure provides information about the products, including custom and retrofit items. Diversified Lighting Products, Farmingdale, NY.

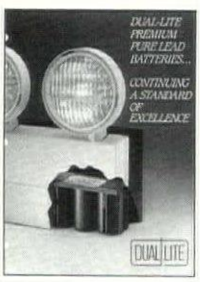
Circle 110



Recessed fluorescents

Columbia Lighting offers the P4 Parabolume series of recessed fluorescent luminaires. Data sheets present coefficients of utilization, visual comfort probabilities, and photometric, energy-distribution, and air-handling data. Columbia Lighting Inc., Spokane, WA.

Circle 112



Lead batteries

Dual-Lite now provides pure lead batteries as standard equipment with its emergency lighting products and exit signs. The firm offers an illustrated brochure that explains the features and benefits of the batteries. Dual-Lite Inc., Newtown, CT.

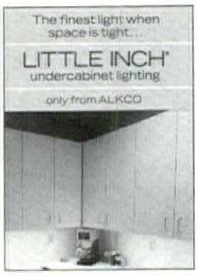
Circle 111

Ultrasonic cleaner

The Sonic Cleaner from Chicago Ultrasonics uses ultrasonic agitation of a water-based bath to clean overhead lenses, reflectors, and parabolic louvers. The portable unit can clean 50 louvers per hour, according to a brochure. Chicago Ultrasonics Corp., Marengo, IL.

Circle 113

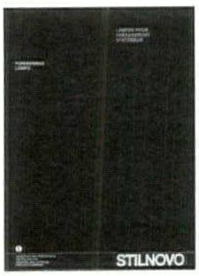
Circle 21



Undercabinet lighting

A miniature brochure features the Little Inch undercabinet light from Alkco. The firm recommends use of the fixtures in kitchens, study carrels, computer work stations, and workshops. Alkco, Franklin Park, IL.

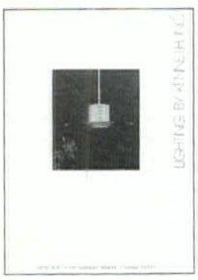
Circle 114



Indoor lighting

Stilnovo's catalog of indoor lamps portrays table, floor, suspension, and ceiling and wall lamps. Most designs are shown in full color. Stilnovo s.p.a., Milan, Italy.

Circle 115



Indoor luminaires

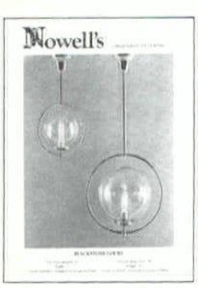
The Lighting by Kenneth catalog displays pendants, floor and table lamps, and wall fixtures, many using crystal glass. All are shown in full color. Lighting by Kenneth, Inc., Miami, FL.

Circle 116

Fluorescent lighting

A contractor's and user's guide from Mercury Lighting Products details the available options for the firm's fluorescent lighting products. Mercury Lighting Products Company, Inc., Passaic, NJ.

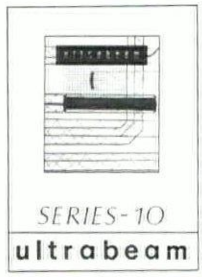
Circle 117



Brass pendant

A pictorial data sheet from Nowell's illustrates the Blackstone Court brass pendant. Available in 24- and 36-inch-high models, the pendant can be finished in polished, antiqued, or lacquered brass. Nowell's, Sausalito, CA.

Circle 118



Lighting supports

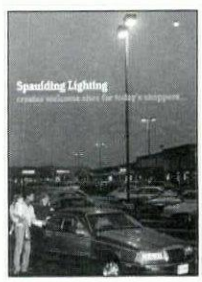
A brochure illustrates the Ultrabeam Series 10 display lighting supports and fluorescent fixtures. The manufacturer constructs the support sections from 0.5-inch steel tubing and 0.187-inch solid steel rods. Interstate Marketing Systems, San Francisco, CA.

Circle 119

Electrical lighting

Day-Brite's 122-page catalog details the firm's fluorescent and high intensity discharge luminaires and the Electro/Connect wiring system. An applications section provides technical information. Day-Brite Lighting Division, Emerson Electric Co., Tupelo, MS.

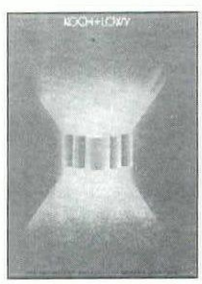
Circle 120



Retail lighting

A brochure from Spaulding Lighting shows how the firm's products illuminate retail areas such as outdoor parking lots, facades, landscaped areas, interiors, and garages. Layouts, footcandle plots, and a selection guide provide details. Spaulding Lighting, Inc., Cincinnati, OH.

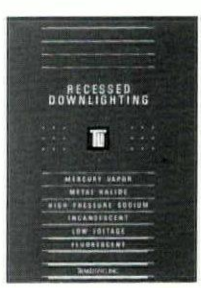
Circle 121



Lighting collection

Koch + Lowy's comprehensive catalog presents the firm's complete line of floor lamps, table lamps, pendants, and other luminaires. Illustrations fill most of the 82 pages. Koch + Lowy, Long Island City, NY.

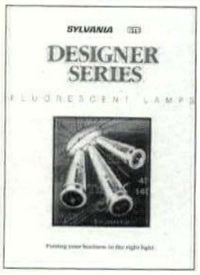
Circle 122



Recessed downlighting

A 34-page catalog from TrakLiting presents the firm's recessed downlighting fixtures. Lamp comparison charts and photometric data augment the presentation. TrakLiting, Inc., City of Industry, CA.

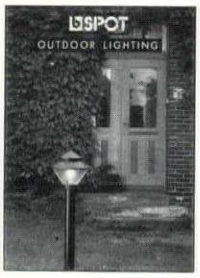
Circle 123



■ Fluorescent lamps

A foldout brochure from GTE/Sylvania presents the firm's Designer Series fluorescent lamps. The brochure explains the concepts of color temperature and color rendering. GTE/Sylvania Industrial/Commercial Lighting, Danvers, MA.

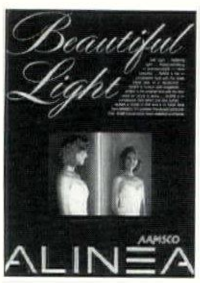
Circle 124



■ Outdoor lighting

Brilliant Lighting's outdoor lighting brochure presents 26 photographs of the firm's post-mounted and wall-mounted outdoor luminaires. Brilliant Lighting Inc., San Fernando, CA.

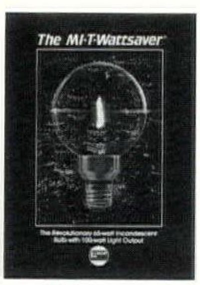
Circle 125



■ Tubular incandescents

Alinea tubular incandescent lamps and fixtures are manufactured by Aamsco. A brochure shows the lamp's five available colors and describes features and options. Aamsco Manufacturing Inc., Jersey City, NJ.

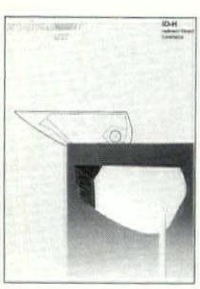
Circle 126



■ Energy-saving lamp

A data sheet announces the introduction of the Mi-T-Wattsaver, a 65-watt incandescent lamp that reportedly produces the same light output as a 100-watt standard incandescent. Luxor Lighting Products, Inc., subsidiary of Duro-Test Corp., Lyndhurst, NJ.

Circle 127



■ Task, ambient lighting

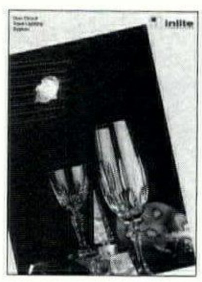
Zumtobel's ID-H luminaire provides both task and ambient lighting with a combination of direct and indirect illumination. A brochure details the unit's features and photometrics. Zumtobel Lighting Inc., Fairfield, NJ.

Circle 128

■ Air-handling luminaire

Globe Illumination has released a data sheet that summarizes the construction, applications, air-handling function, installation, and maintenance of the Tri-Par 9030 series parabolic fluorescent luminaire. Globe Illumination Co., Gardena, CA.

Circle 129



■ Double-circuit track

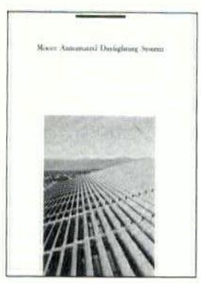
Inlite's double-circuit track lighting system offers flexibility to designers of merchandising displays. A 12-page brochure presents illustrations and technical data. Inlite Corporation, Berkeley, CA.

Circle 130

■ Dimming systems

Electronics Diversified illustrates applications of its architectural dimmers and controls in a foldout brochure. Pictured are a hotel, a church, and the products themselves. Electronics Diversified, Inc., Hillsboro, OR.

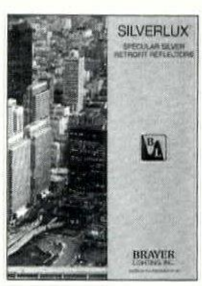
Circle 131



■ Daylighting system

A 16-page brochure provides in-depth information on the Moore Automated Daylighting System of electronically controlled louvers. The Moore Company, Marceline, MO.

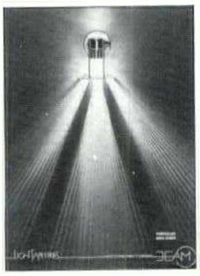
Circle 132



■ Retrofit reflectors

Literature from Brayer introduces the firm's specular silver retrofit reflectors, which are coated with Silverlux film from 3M. Brayer Lighting Inc., San Francisco, CA.

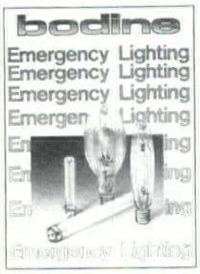
Circle 133



■ **Light conveyance system**

Light Tapestries from BeamO use glass lens plates to produce decorative sprays of light. The manufacturer recommends applications and modifications in a data sheet. BeamO, Charlestown, MA.

Circle 134



■ **Emergency lighting**

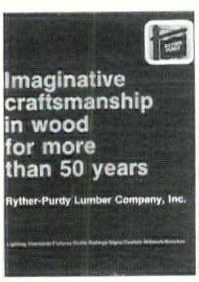
A brochure from Bodine outlines the company's emergency lighting products, including fluorescent emergency ballasts, central battery ballasts, DC inverter ballasts, and a high intensity discharge emergency system. The Bodine Company, Collierville, TN.

Circle 135

■ **Clean room lighting**

Guth's data sheets on high-tech and clean room lighting summarize features and specifications of the firm's specialized lighting equipment. Guth Lighting, St. Louis, MO.

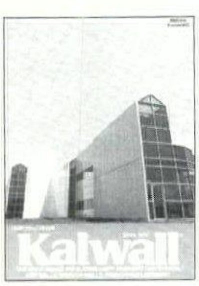
Circle 136



■ **Landscape lighting**

Ryther-Purdy Lumber offers a catalog of landscape lighting standards and fixtures. The firm's products are constructed primarily of western red cedar. Ryther-Purdy Lumber Company, Inc., Old Saybrook, CT.

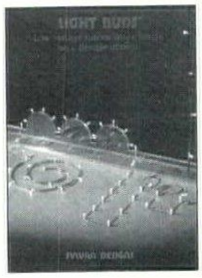
Circle 137



■ **Light-transmitting panels**

Kalwall offers a brochure that explains how its insulated light-transmitting panels can be used in translucent walls, window walls, and window replacement applications. Kalwall Corporation, Manchester, NH.

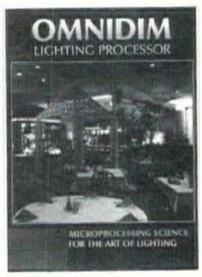
Circle 138



■ **Subminiature lamps**

Light Buds are 12- or 24-volt ribbons of subminiature lamps that can be installed indoors or outdoors. A brochure depicts typical applications and describes custom options. Sylvan Designs, Inc., Northridge, CA.

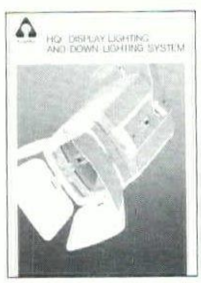
Circle 139



■ **Lighting processor**

A brochure outlines the features of the Omnidim lighting processor, which incorporates a microprocessor-based, 16-scene lighting control system. A 128-scene memory option is available. MasterDim, Dallas, TX.

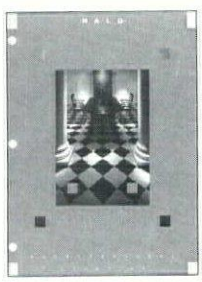
Circle 140



■ **Display lighting**

Amerlux's HQI display lighting system accommodates the Osram HQI compact metal halide lamp in a series of housings. The firm offers literature that details the system's components and performance. Amerlux, West Caldwell, NJ.

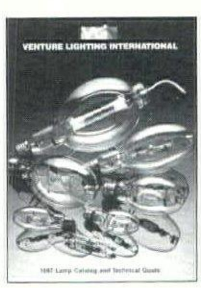
Circle 141



■ **Architectural lighting**

Halo's 80-page architectural lighting catalog encompasses incandescent, low-voltage, and high intensity discharge recessed and surface lighting. Reference guides supplement the product data. Halo Lighting, Elk Grove Village, IL.

Circle 142



■ **Lamps**

Venture Lighting International's 52-page 1987 lamp catalog and technical guide includes manufacturer and ANSI code cross-reference charts. Venture Lighting International, Cleveland, OH. ■

Circle 143

Calendar

March 9–13, 1987	**Fundamentals I, short course,** General Electric Lighting Institute, Cleveland. The course covers basic aspects of indoor commercial and industrial lighting. Repeats May 4–8, June 15–19, September 14–18, October 26–30, and November 30–December 4. Early registration is recommended. Contact: Janet Allen, Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.
March 23–25, 1987	**IES regional conference,** south central and southeastern regions, Asheville, NC. Contact: Bob Burns, 131 Winfield Road, Greenville, SC 29607, (803) 298-6966.
March 25–27, 1987	**IES regional conference,** Great Lakes region, Pittsburgh, PA. Contact: Harry J. McGovern, LaFace & McGovern Associates, 5330 Enterprise Blvd., Bethel Park, PA 15002, (412) 854-3200.
March 25–27, 1987	**Westweek '87,** Pacific Design Center, Los Angeles, CA. Contact: James Goodwin, (213) 657-0800.
March 30–31, 1987	**Indoor lighting design seminar,** Lighting Sciences Inc., Scottsdale, Arizona. Contact: Lighting Sciences Inc., 7830 East Evans Road, Scottsdale, AZ 85260, (602) 991-9260.
March 30–April 1, 1987	**Seminar on lighting for museums, art galleries, and displays,** General Electric Lighting Institute, Cleveland, Ohio. Contact: Janet Allen, Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.
April 1–3, 1987	**Outdoor lighting design seminar,** Lighting Sciences Inc., Scottsdale, Arizona. Contact: Lighting Sciences Inc., 7830 East Evans Road, Scottsdale, AZ 85260, (602) 991-9260.
April 9–11, 1987	**IES regional conference,** east central region, Roanoke, VA. Contact: Michael E. Siska, Hubbell Lighting, Inn Electric Way, Christiansburg, VA 24073, (703) 382-6111.
April 13–15, 1987	**Lighting conference for contract interior designers,** General Electric Lighting Institute, Cleveland. Repeats October 13–15. Contact: Janet Allen, Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.
April 14, 1987	**Custom lighting: From lemons to lumens,** Designers Lighting Forum seminar, Contract Center, San Francisco. Architect David Malman will discuss custom design. Contact: Paula Goodell, (415) 550-0333.
April 15, 1987	**Lighting controls: The frosting on the cake,** Designers Lighting Forum seminar, New York City. James Nuckolls will present the seminar. Contact: Louis Baldinger & Sons, Inc., 19-02 Steinway Street, Astoria, NY 11105, (718) 204-5700.
April 15, 1987	**What's new with ballasts,** discussion and exhibit, Boston. Contact: John C. Gates, IES New England Section, (617) 655-1180.
April 21–23, 1987	**Lighting conference for energy managers and consultants,** General Electric Lighting Institute, Cleveland. Contact: Janet Allen, Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.
April 22–24, 1987	**IES regional conference,** north central region, Milwaukee, WI. Contact: Peg Wallock, Enterprise Lighting, 7112 W. Fond du Lac Avenue, Milwaukee, WI 53218, (414) 462-5257.
April 30–May 2, 1987	**Light Works,** IES regional conference, southwestern region, Dallas. Contact: Ruth Maddox, 1506 Commerce, Dallas, TX 75201, (214) 698-7791.
May 11–13, 1987	**Lighting World International,** Jacob Javits Convention Center, New York City. The event is jointly sponsored by IALD and IES. Contact: Marion Greene, IALD, 18 East 16th Street, Suite 208, New York, NY 10003, (212) 206-1281. ■

Manufacturer Credits

The great open spaces, where light is managed by louvers (Solarium, Great West Life Building, Greenwood Village, Colorado). Skylights: **Super Sky Products, Inc.** Solar shades: **The Moore Company.** Space frame: **Louis Huffman Co.** Shade installation: **Columbine Building Specialties.**

Compact fluorescent lamps stand in for jewels around chandelier rim (Offices of Griffin Bacal, New York City). Compact fluorescent lamps: **North American Philips.** Custom manufacturing: **Bergen Art Metal Inc.** Opal glass cone: **Raak Lighting.**

Block diagrams — making an atrium into a showcase (Besser World Headquarters, Alpena, Michigan). Ambient and task lighting: **Steelcase.** Bollards: **EMCO.** Relays: **Square D.** Can lights: **Prescolite.** Recessed downlights: **Lightolier.** Translucent fiber glass panel system, with low-emissivity clear glass inserts: **Kalwall.**

TVC, where Madison Ave. goes to watch more than TV (TVC Video, New York City). Dimming system: **Lutron.** Track lighting: **Halo.** Recessed downlights, half-moon sconces: **Lightolier.** Incandescent lamps: **Chromalux.**

The best of both worlds: Historic luminaires and modern illumination (Colorado State Office Building, Denver). Custom luminaire rehabilitation and re-creation: **The Rambusch Company.** Restoration of stained glass skylight: **The Rambusch Company.** Indirect quartz incandescent luminaires: **The Rambusch Company.** 70-watt metal halide lamps: **Osram.** Pendant-mounted indirect fluorescent luminaires: **Peerless.**

Revamping downtown: Lighting the law offices (William Morgan Law Office, Waynesville, Missouri). Photocells: **Multipoint Control Company.** Fluorescent luminaires: **Lithonia L240.** Roofing material: **Duro-Last Roofing, Inc.** Computer-aided solar analysis: **Solarsoft, Inc.** ■

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