ARCHITECTURAL LIGHTING

November 1987
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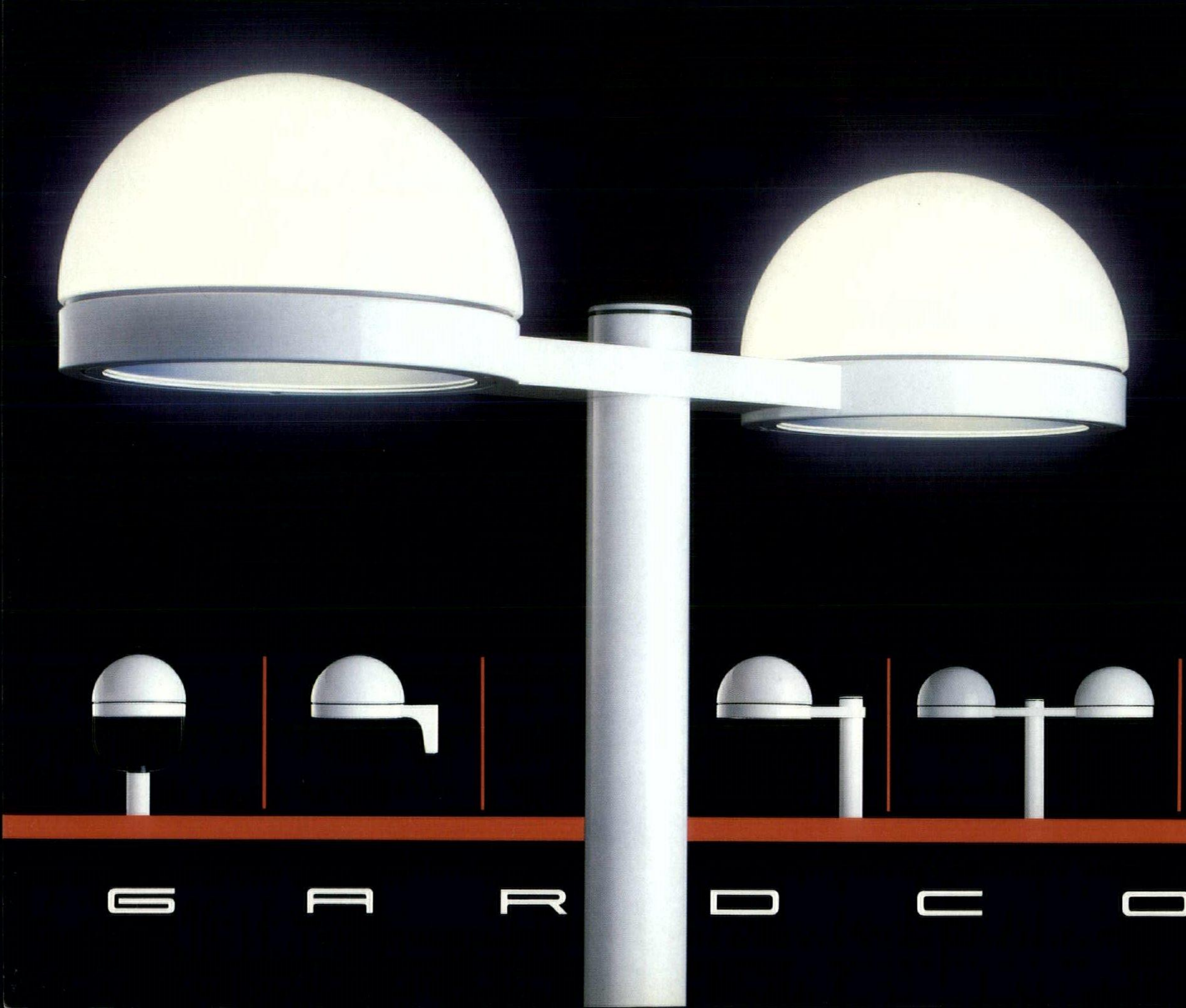
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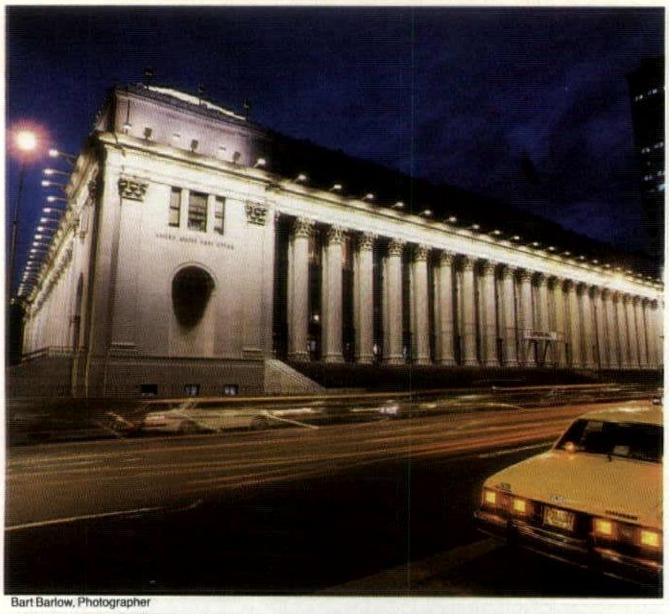

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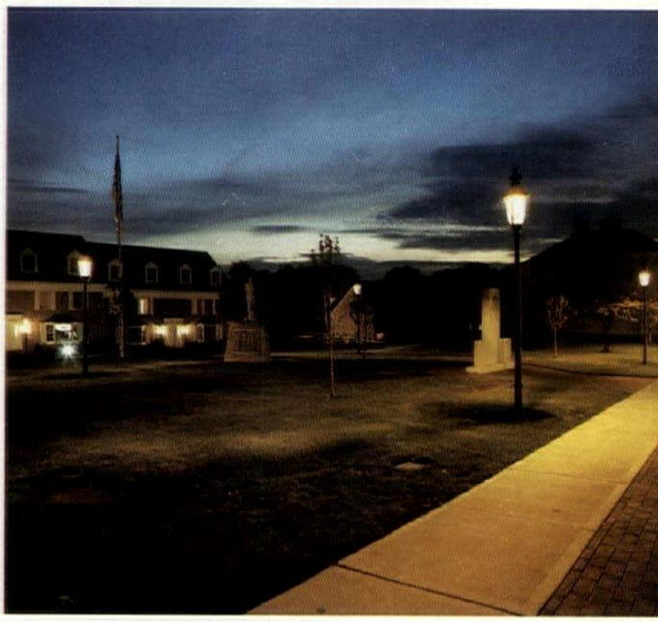

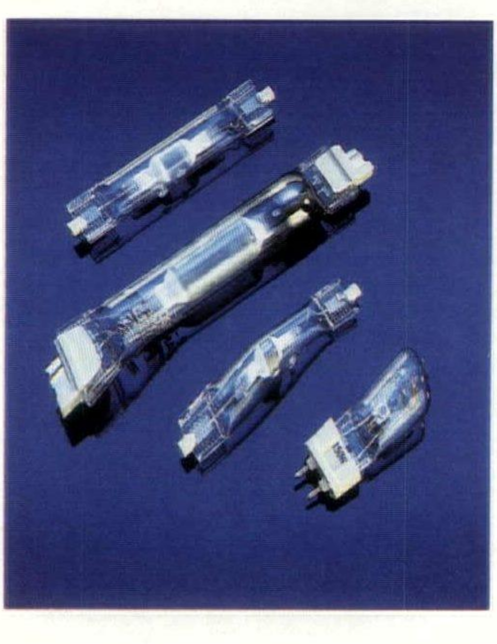

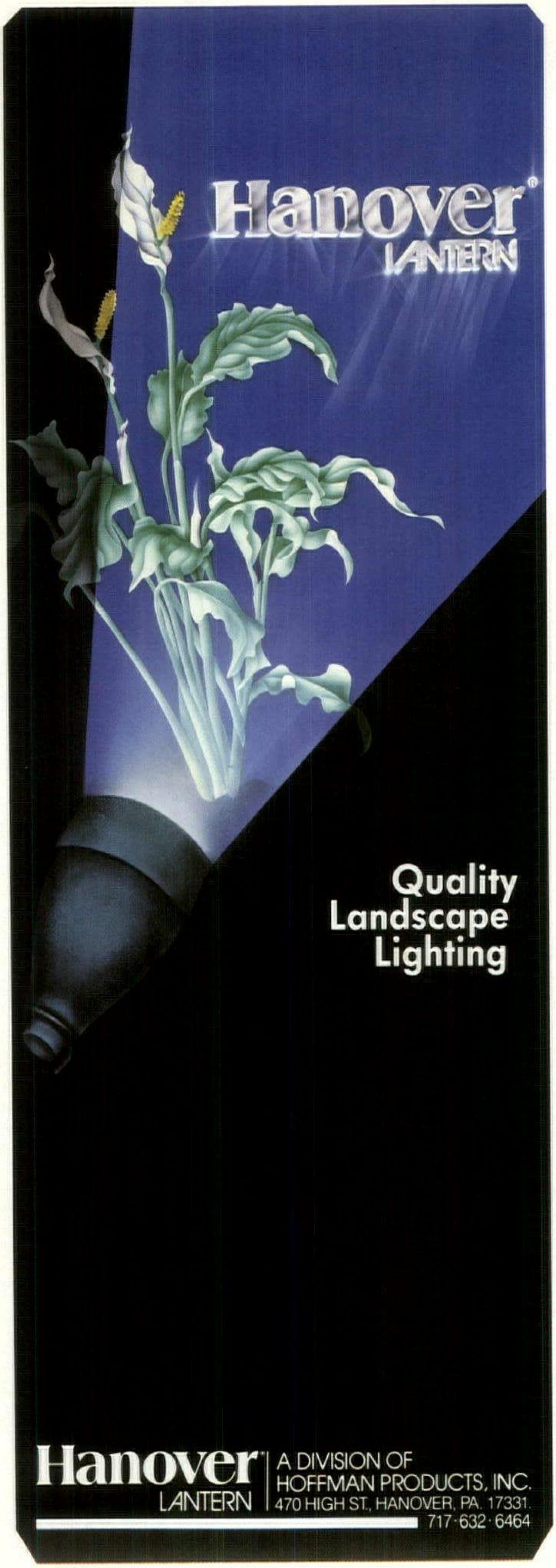

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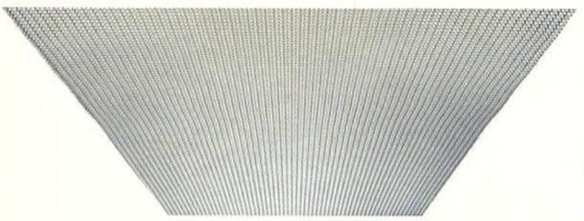

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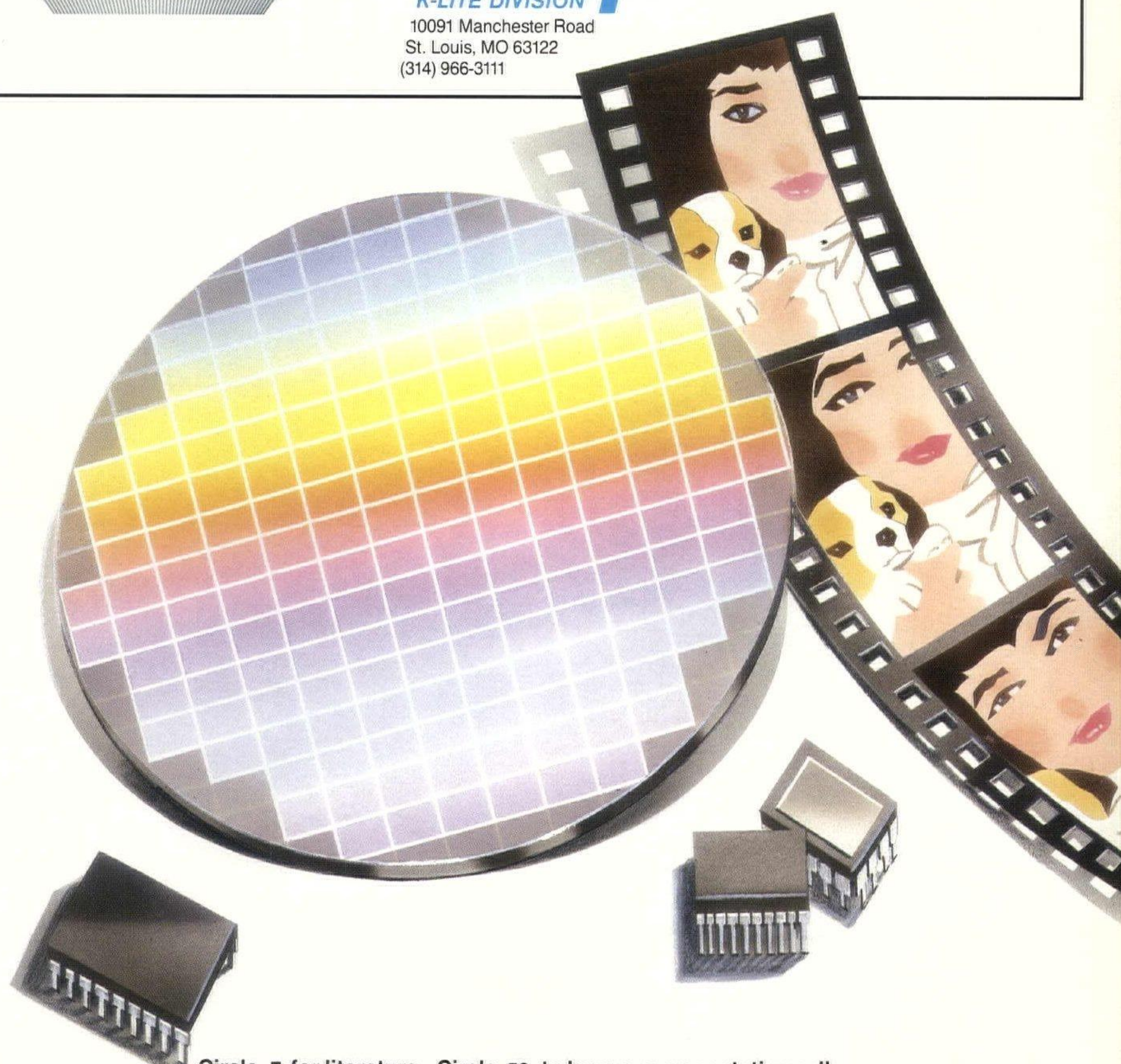

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ARCHITECTURAL LIGHTING

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Volume 1, Number 10

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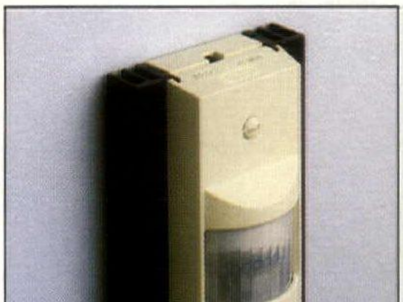

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From the Editor

This month's cover story about the new Museum of Flight brings up an important point about having an expert energy consultant on a building's design team: the consultant's work may be the key to determining whether a conceptual building design can be made energy-efficient enough to receive a building permit.

In this case, the nearly all-glass building that architect Ibsen Nelsen wanted to design was a radical departure from any prescriptive building design package permitted by the local energy code. The design team had to prove the building was equal to or better than one of those prescriptive packages in order to get the permit — a tall order considering that Nelsen's design relied heavily on daylighting and upon lighting control and glazing technologies that were not considered by the code.

Enter energy consultant Vladimir Bazjanac. He used an extremely complicated computer program to predict the energy performance of Nelsen's proposed design. In the process, Bazjanac simulated many different glazing materials and lighting systems to determine which combination of these would perform optimally — information critical to the final design of the building. Data from the energy performance simulations helped convince building department officials to establish an energy budget specifically for the museum, and ultimately, a permit was issued for construction.

King County, Washington, isn't the only locale with an energy code. California has its Title 24, other states have their codes, and surely many more such codes will emerge. The lesson to be learned is that prescriptive building design packages need not limit building design. Designers can get around their restrictions.

But, when a building is as complicated as the museum, in all likelihood it will require the services of an energy consultant to demonstrate that an alternate building design will perform better than or equal to one of those prescriptive packages, a consultant who can execute analyses far more complicated than most of us can do ourselves. Designers should not hesitate to hire such a consultant — designing the right building for the job may depend upon it.

Charles Linn, AIA

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Letters

Handrails and handicap codes

Sam Mills's Lighting Graphics column on handrail lighting [September 1987] was very complete. I am glad to see that the CRIs of lamps were also discussed.

Your readers might want to know some additional information about handrails. Some handicap codes mandate the maximum diameter of a handrail. This means the luminaire must fit into a 2-inch-diameter handrail. Therefore, alternate methods must be considered.

Raymond Grenald, FAIA, IALD
President
Grenald Associates Ltd.
Los Angeles, California

Reflective coating characteristics

Sid Pankin's October Parts Department column on retrofit reflectors was interesting and painstakingly detailed. There are just two areas that I find particularly controversial. Under the heading "Anodic aluminums," he states, "The West German Brite sheet has a 2-micron-thick anodized coating, and the American product has a heavier oxide coating created by the Alzak process of anodizing." That is true, but not true.

Let me explain. Typically, the Alanod product has an anodic thickness of between 2 and 3 microns, which is a standard in the retrofit industry worldwide. No manufacturer that I am aware of can guarantee to hold a single anodic thickness consistently across the width of the material. Materials produced by American manufacturers *do not* have a heavier coating. They have an average coating of 5 milligrams per square inch, which, roughly translated, is about 2.7 microns. Therefore, we [at Alanod] are basically offering the same anodic thickness. We just express it in a slightly different way.

Furthermore, the domestic product known as Everbrite has only ½ micron of anodizing. It is, in fact, below Alcoa's own standard laid down for anodizing and is better known as flash-anodizing. This is published in manufacturers' data and you can verify it by looking at their literature.

Under the heading "Enhanced aluminum," the columnist states, "Because the anodic aluminums absorb light, the blue-gray color of the aluminum will affect lamp color." This is a totally erroneous statement. Anodic aluminums *do not* absorb light other than a very small percentage (less than 1 percent) of light energy that is converted to heat. The spectral distributions of the incident light and the reflected light are the same; aluminum surfaces *do not* change the color rendition of any lamp. Exhaustive tests have been carried out worldwide on this and there is no change in the lamp color.

Andrew M. Riga
Alanod U.S.A. Inc.
Dallas, Texas

Clearer than words

As an architect, my own definition of *architecture* begins with "The choreography of space and light." Your magazine is read with the keenest interest. It was truly welcome to see a publication that deals with the qualitative aspects of light, rather than reading like outtakes from the IES handbook.

The articles on the McCarran Airport and the Orange County Performing Arts Center [September 1987] were interesting, albeit lacking in documentation. A few well-executed drawings would have explained the projects in a more useful and concise fashion.

It seems to me that a drawing of the airport's conceptual lighting plan would have served better to describe the use of light to define functional and spatial areas, delineate circulation, and so forth, rather than have the text as the primary agent of information. In reference to the Orange County facility, it is difficult to determine the relationship of the Fire Bird to the lobby and exterior plaza, and how the overlapping tasks of providing both ambient and focal lighting are accomplished simultaneously.

As architects, the medium of our communication is not the written word, but the drawing in its many faces. I think it would strengthen future articles to put a greater emphasis on graphic presentation, with less on verbiage. Having taught lighting design, and having an abiding belief in light as the primary component of the architectural design vocabulary, I realize that creating a graphic visual instrument to explicate light is a difficult proposition at best, but should not this exploration be part of our ongoing discourse?

Thomas Whitlock, AIA
Director of Design
Eagle Group
Culver City, California

This is your forum

Architectural Lighting is your forum for lighting issues. We invite your letters on subjects of interest to our readers.

Address your letters to:
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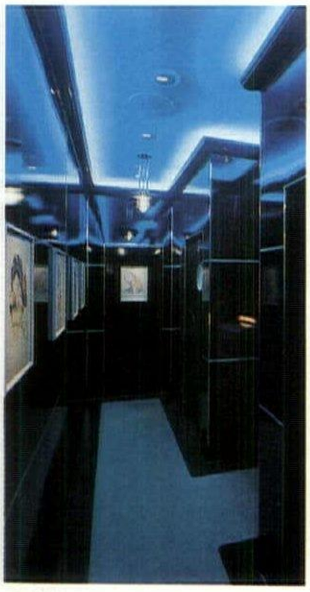
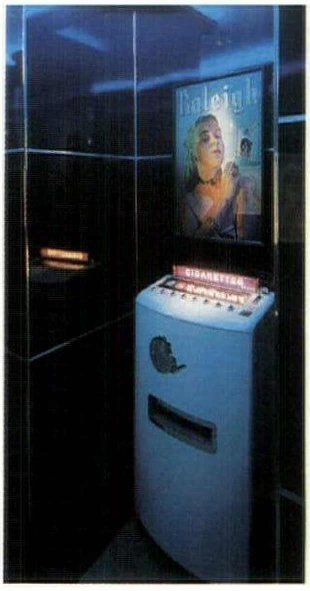
Simple elements create sophisticated atmosphere





Flamboyant colored lighting is nothing new to electrical engineer Cliff Ishii and architect Larry Frapwell, who have worked together on several casinos. The designers were right at home when lighting the Bubbles restaurant and nightclub. "The client and the architect wanted to set a flamingo theme, recalling when Miami was influenced by art deco," says Ishii. "Right away, that said we were going to have neon."

Concealed neon suffuses the restaurant's dining and bar areas with red light. Sconces punctuate the dining room walls, creating a sense of the space's depth and dimension. Low-voltage PARs in adjustable recessed downlights provide the task lighting, each aimed at the surface of a dining table. Ishii chose the lamps because they can be precisely aimed and because the built-in glare shield makes the source less conspicuous. The spotlighting effect is more subtle for diners than it appears in photographs, which emphasize contrast, Ishii says.

The dining room features a unique bubble maker — a transparent water-filled glass column that reaches up through the skylight and is open to the outside. A ¼-horsepower pump creates a continuously rising veil of bubbles that float up and out of sight. Simple incandescent lighting around the bottom of the column dramatizes the bubbling novelty.

Glowing blue neon creates a different mood in a corridor leading to the restrooms. "We wanted it more subdued, as if you were going into the back room," Ishii says. "There's plenty of light for circulation, but it's a low-key area."

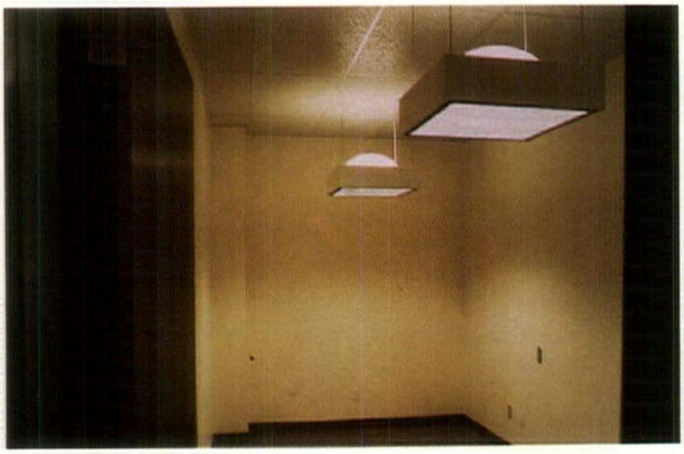
Near the end of the corridor, a replica of a 1950s-era cigarette machine emerges from the semidarkness. "It's not intended to be a profit maker — people are smoking less these days," Ishii explains. "It's part of the era we were trying to recreate. At that time, the machine would not have been highlighted, but here we treated it as a museum piece. We wanted to bring some visual attention to it without destroying the subdued mood." The technology that brings the concept to life, a single low-voltage PAR downlight, could hardly be more simple.

"The whole point of this project is to use generic, inexpensive lighting to give a high-end look. We took very simple things and ended up with a project that looks sophisticated, classy, and expensive," Ishii says. "This nightclub cost no more than any other. It came in at the same budget as one with ordinary features."■

Project: Bubbles restaurant
Client: Bubble's Balboa Club
Location: Newport Beach, California
Architect: Larry Frapwell, The Hill Partnership, Inc.
Lighting Designer: Cliff Ishii, Cliff Ishii & Associates
Electrical Engineer: William R. Ishii & Associates
Photos: Ronald Moore

For product information, see the Manufacturer Credits section on page 78.

Luminaire combats small office banality



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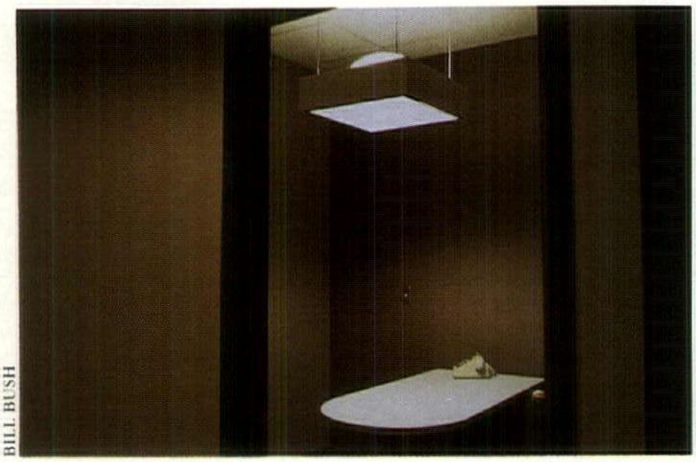

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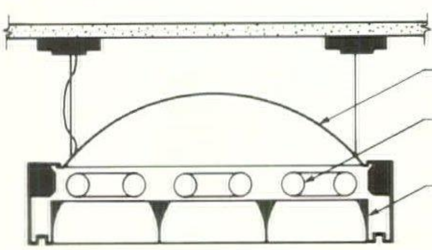

Project: Steuben County Office Building
Location: Bath, New York
Architect: Jim McKinney, Einhorn Yaffee Prescott
Lighting Designer: Paul Brasile, Einhorn Yaffee Prescott

Small offices pose problems in orienting lighting to tasks. Although it is best to orient one-by-four and two-by-four fluorescent luminaires with the long axis of the lamp normal to the long axis of the desk, usually designers can only guess where a desk will be placed in the room. In addition, if room surfaces are not broadly illuminated, an already small space will appear dull and confining.

"I've never felt comfortable with the average solution for a small office," says lighting designer Paul Brasile of Einhorn Yaffee Prescott. "Some of the more expensive solutions are nice, but we don't have a lot of opportunity to use them in government work" — such as the new Steuben County Office Building in Bath, New York, which has 43 one-occupant offices, each smaller than 100 square feet.

Like many other government jobs, the design had to be executed on a limited budget. Brasile and architectural designer Jim McKinney pursued an innovative, economical solution that would reduce the need for stringent furniture location requirements. At the same time, it would provide high-quality illumination to make the space appear more open.

The designers began with a standard two-by-two, surface-mount fluorescent luminaire body. Inside, they placed three F40 U lamps with a 3⁵/₈-inch leg spacing. Each lamp aligns over a row of cells in a standard nine-cell, 3-inch-deep, semispecular parabolic aluminum louver. The fixture is pendant mounted with the bottom 6 feet, 10 inches above the finished floor and 2 feet, 8 inches below the ceiling.

To illuminate the ceiling and the high side walls, the designers inserted an opal acrylic dome in a circular hole cut in the top of the steel housing. The dome provides top and side illumination with light emission characteristics approaching those of a perfectly diffuse emitter. It also provides a soft visual element when the luminaire is viewed in elevation. An indirect component reaching the task areas raises the quality of illumination.

Brasile and McKinney named the design Spheralume and refined it with paper studies using lumen calculations and summary graphic simulations. Coincidentally, a student at the Pennsylvania State University analyzed one of the fixtures for his senior thesis; in exchange, the fixture was photometered in the Penn State lab. The designers used the resulting candlepower summary with computer software to generate photometric data and perspective views of the luminaire in various office configurations. The client liked the straightforward approach of the design, which provides functional versatility and visual interest where banality is more often the rule. ■

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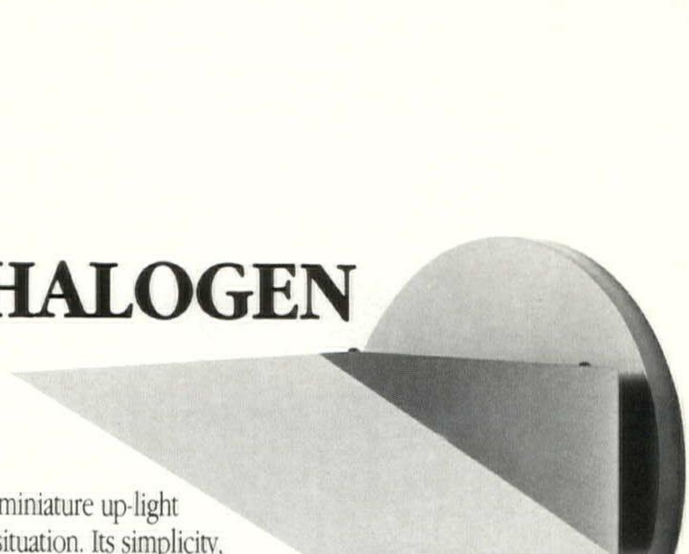

A versatile low profile, wall mounted miniature up-light suitable for any general area lighting situation. Its simplicity, size and wide light distribution pattern enable the designer to provide high lighting levels from a very small luminaire. This general purpose, wide angle, open reflector type floodlight is suitable for a 150w quartz halogen lamp. The one-piece body and back plate are formed from cast aluminum. The inner specular anodized reflector effectively controls intense light output and provides a well balanced spread of upward light.

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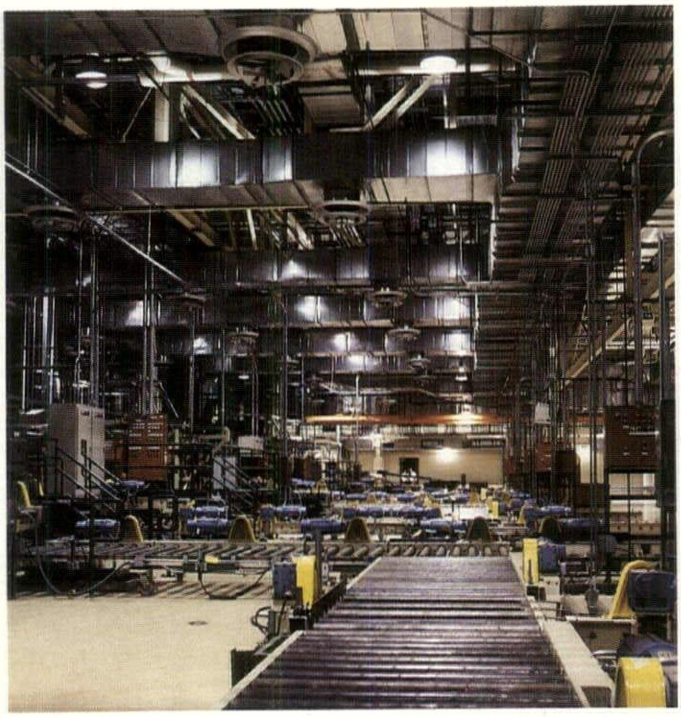
Engineers test factory fixtures with hammers



Project: Tobaccoville cigarette manufacturing complex
Location: Winston-Salem, North Carolina
Client: R.J. Reynolds Tobacco USA
Architectural Design Engineers: Rust Engineering
Photos: Walt Urbina

Designing a lighting system for the world's largest cigarette factory demanded a well-planned approach. The Tobaccoville cigarette manufacturing complex includes a production building with a perimeter of 1.2 miles and about 2 million square feet of finished floor space. As principal engineer for R.J. Reynolds Tobacco USA, Wally Warren extensively tested fixtures for the project.

Warren and his staff first prepared a comprehensive schedule of footcandle levels for each area of the plant. The most difficult area to light was the largest — the 1.5 million square foot processing area. A maze of air ducts, pipes, electrical raceways, and processing equipment was to be installed in the area, directly adjacent to lighting fixtures.

To ensure adequate illumination around the equipment, it was necessary to analyze the photometrics of fixtures for these complex areas. To accommodate equipment relocations, fixtures had to be easily movable. Other performance criteria were safety, durability, ease of maintenance, noise level, power factor, lumen maintenance, and lamp life.

Most of the Reynolds Tobacco cigarette factories use glass-lined metal halide fixtures in processing areas; Warren was interested in using the more economical high pressure sodium fixtures. He obtained samples and, to test them for photometrics and durability, installed them in an environment similar to that of the new plant.

"We put the fixtures through some pretty rugged tests to see how they would react," explains Rick L. King, engineering investigations section manager for Reynolds Tobacco. "We used steel wool to see how the reflective surfaces would hold up under abrasive applications of cleansers. We gave them the the old hammer test, too. We actually beat on the fixtures with a hammer to test their durability."

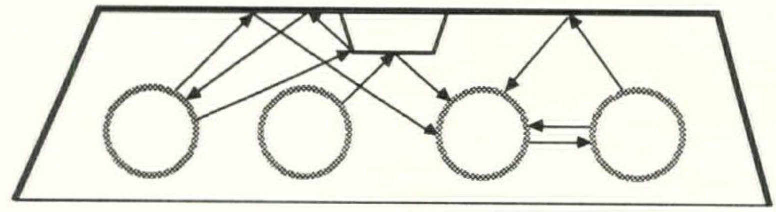
After further investigation and analysis, Warren selected high pressure sodium fixtures that made the grade. Operating and maintenance expenses, as well as the initial purchase price, were predicted to be much lower than those for the glass-lined metal halide fixtures.

Reynolds Tobacco engineers used 5000 fixtures and 43,000 feet of strut to build a track lighting system that delivers average levels of 40 to 50 footcandles at floor level. The fixtures are hung with a universal hook and ¾-inch coupling. Each is terminated to separate tap and fixture boxes, allowing staff to move any fixture without rerouting power. After nearly two years of experience with the system, Reynolds Tobacco engineers are completely satisfied with its performance. ■

For product information, see the Manufacturer Credits section on page 78.

The Problem

Conventional lighting systems are inefficient and costly—40 to 60 percent of the light from fluorescent lamps can be trapped inside your fixture.



The Solution

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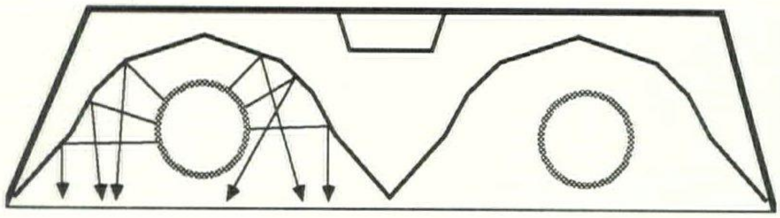

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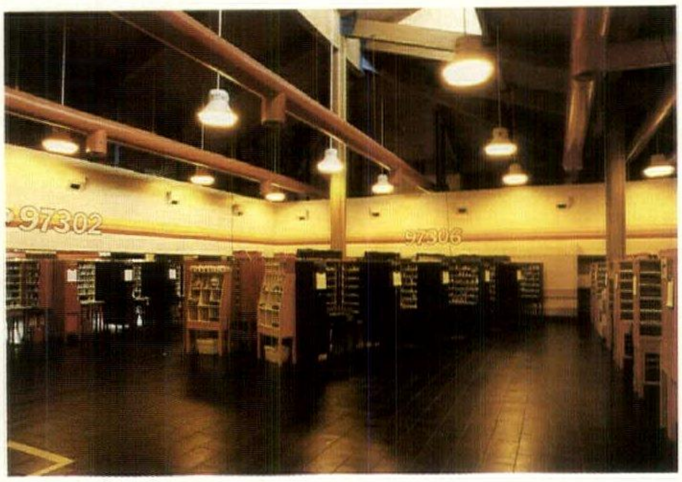
Daylight turns austerity into a winner



Project: Vista Station Post Office
Location: Salem, Oregon
Architect: Wilson Bryant Gunderson Seider
Landscape Architect: Lacoss & Associates
Electrical Engineer: Warner Engineering
Photos: Photographer Vittoria

The United States Postal Service relies on well-established operating guidelines to regulate and control its costs. So when Wilson Bryant Gunderson Seider designed the lighting for the 9340-square-foot workroom at the new Vista Station Post Office in Salem, Oregon, part of their job had already been done; the post office specified high pressure sodium lighting to provide 50 footcandles throughout the workroom.

Warner Engineering used standard lumen method calculations to determine the number and location of the high pressure sodium fixtures. Thirty-four 250-watt lamps were suspended 16 feet apart and 15 feet above the floor. Injection-molded acrylic refractors were used to distribute the light evenly.

To improve the station's ability to conserve energy, Warner designed the system in eight zones, any of which can be shut off when not in use. The station was designed to accommodate 10 years of growth and contains extra work areas for future use. Zone switching ensures that energy is used only where and when it is needed.

To ameliorate the poor color rendering qualities of high pressure sodium light, WBGS included in the design a north-facing clerestory. Daylight helps balance the golden cast of the electric light while bolstering the 50-footcandle minimum.

In addition to improving color balance, the clerestory represents the design's second energy-saving feature. When the room is not in full use, lights can be turned off without completely darkening the room. The option allows lighting (and energy) use to be adapted to circumstances.

Some work areas are in the daylight's shadow. The high pressure sodium lamps also create shadows that, together with the light's color qualities, make paperwork difficult. To solve these problems, fluorescent task lighting was attached to each mail carrier's work station. These luminaires provide superior light for paperwork and, because they are not needed for general lighting purposes, are turned off when not in use.

Vista Station manager Joy Brown, who believes in the importance of color in the work environment, carefully selected colors for work stations that were appealing under the colored light. Green was quickly discarded in favor of two hues each of orange and blue, and touches of yellow. The high pressure sodium light strengthens these colors, she says.

The lighting design works, according to rave reviews from postal service employees and administrators. WBGS is working on four new post office buildings in Oregon that have been modeled on the Vista Station, where clerestory daylight and sensitivity to color environment helped turn stark austerity into an attractive workplace. "It's beautiful," says Joy Brown. ■

For product information, see the Manufacturer Credits section on page 78.

FLIGHT
TAKES
OFF

Museum of Flight: A flight into light

ARTICLE BY
CHARLES LINN, AIA
INTERIOR PHOTOGRAPHY BY
CHRIS EDEN, EDEN ARTS
EXTERIOR PHOTOGRAPHY BY
ROBERT PISANO

When an architect undertakes the design of a museum, the lighting must achieve several purposes. The objects displayed must be lit to their best advantage, so that the viewer has the best possible visual experience. Equally important is that the lighting be designed to *conserve* the objects on display, that is, to protect them against damage from too much exposure to both the visible spectrum and ultraviolet radiation inherent in all lighting.

Architect Ibsen Nelsen's recently completed Museum of Flight provides a unique solution to the sometimes conflicting needs of the viewer and the objects on display — in this case, the museum's vast collection of aircraft. Nelsen worked closely with the museum's planning committee, toured many museums throughout the country, and talked to many experts before deciding on the concept of a building whose semitransparent walls and roof would essentially *be* the lighting design during the daylight hours. His concept was that a gallery for airplanes ought to be as free of obstructions and as light-filled as the air in which they once flew.

Energy Studies

Nelsen's next challenge, after coming up with a building concept, was getting that conceptual design through the local energy code. The King County (Washington) energy code allows buildings to be designed in two ways: prescriptively or by performance. If a prescriptive design is chosen, the design must conform to a standard set of building envelope characteristics, which are defined by the code for a particular building type. If designers choose to design a building with envelope characteristics that do not conform to the code — such

Project: Museum of Flight
Location: Seattle, Washington
Architect: Ibsen Nelsen and Associates
Mechanical Engineers: Miskimen/Associates
Electrical Engineers: Travis, Fitzmaurice & Associates
Energy Consultant: Vladimir Bazjanac, PhD
Exhibit Lighting Designer: Frank A. Florentine, National Air and Space Museum

as the all-glass roof of the great gallery — they must demonstrate that the design's predicted energy performance is equal to or better than a standard building that would meet the code on a prescriptive basis. No building permit can be issued until the design meets these requirements.

"The critical event in the design of this particular building was getting it through the energy code," says Vladimir Bazjanac, energy consultant for the building. "King County didn't have energy budgets for museums or any building type for which this would qualify. So we had to demonstrate that the performance of this building would be equal to or better than a building of essentially the same configuration that would meet the code. We ran into a significant problem there, because the code allows no credit for the energy use reductions we could gain through proper daylighting design. There was no way to demonstrate that this was an energy-efficient building that should meet the code. After a lot of negotiation, and some political intervention, they finally defined an energy budget specifically for this building, which was 60,000 BTU per square foot per year."

In order to demonstrate that the building would meet this energy budget, Bazjanac used DOE2.1C, a building energy simulation program, to conduct extensive computer modeling studies (see *Architectural Lighting* articles in January and June 1987). These studies showed how energy consumption would be affected by different glazing material and mechanical-electrical system design options. This simulation program not only allowed the design team to demonstrate that the building would meet the energy budget, but also allowed them to determine which combinations of materials and systems would be most practical, cost-effective, and energy-efficient before they began work on the construction drawings.

Glazing Options

Critical to the energy performance of the building was the selection of proper glazing materials. Reflective glass was not considered appropriate for the walls of the museum, so this left only conventional double-glazed tinted glass and double-glazed low-emissivity — or low-e — glass (see *Architectural Lighting,* June 1987). Nelsen did not want the appearance of the walls to be monochromatic, so the simulations were conducted with three shades of glass, the darkest at the top of the walls and the lightest near the bottom.

Although conventional tinted glazing can have the advantage of allowing higher daylighting levels than low-e glazing, it also has higher solar transmittance and thermal conductivity. This glazing caused the building to have the highest heating and cooling loads of all the glazing types simulated, but caused a 47 percent reduction in lighting load.

Several of the low-e glazings simulated were of the Heat Mirror variety. They are double glazed, but have a thin coating of metal oxides applied to a polyester membrane that is suspended between the two panes, creating two air spaces — in effect, a triple-glazed assembly. These were simulated

in a variety of visible and solar transmittances. Several generic low-e glazings were also simulated. They also are double glazed but have their coating of metal oxides applied to one of the panes inside the air space.

Generic low-e glass performed slightly better than Heat Mirror glazing in terms of annual energy consumption, according to Bazjanac, but the Heat Mirror provided a better shield against ultraviolet radiation damage — critical in the conservation of the aircraft — which made it the best choice for use in the walls. The Heat Mirror chosen admitted daylight sufficient to permit a 46 percent reduction in the lighting load for the building. Although that reduction is 1 percent lower than the tinted glazing, the thermal performance is significantly better.

Roof Glazing

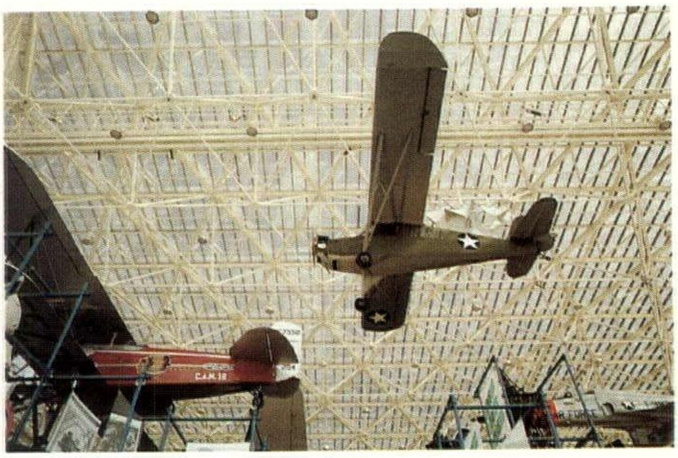
Nelsen's concept required a glass roof. Bazjanac's simulations considered a triple-glazed opaque glass, a low-e Heat Mirror glazing, and a triple-glazed reflective glass. Although it allows a glass appearance on the exterior of the building, the opaque glass offers no view of the sky from inside the building; it also would have increased the electric lighting load by a whopping 32 percent.

The triple-glazed reflective roof caused the highest heating and the lowest cooling loads; the Heat Mirror caused the opposite effect and admitted only a small amount of additional daylight. The triple-glazed reflective glass was eventually selected for use on the roof because the glazing would be installed in a nearly horizontal position. This would have caused stresses in the metal oxide–coated membrane of the Heat Mirror, and its long-term performance could not be guaranteed.

Based on the materials and systems selected, Bazjanac's simulations predict total annual site energy consumption of only 38,500 BTU per square foot per year — 65 percent of the energy budget suggested by King County. The actual energy consumption will be monitored for a period of 18 months to see how it compares to the simulation.

The Completed Gallery

The completed six-story great gallery has a floor area of 50,672 square feet, with over 50,500 square feet of the Heat Mirror low-e glazing used in the exterior walls. These walls are shaded by canopies, each made of a group of parallel steel pipes mounted horizontally in the exterior wall frames. Other energy-efficiency features incorporated in the mechanical



and electrical systems made it possible to meet the projected budget. For example, fans and vents that open automatically draw in cool fresh air for first stage cooling without the use of air conditioning.

Photocontrols light the great gallery at night by turning on 400-watt metal halide lamps. The gallery is divided into four zones, and each zone is controlled by two systems. The metal halide lamps in each zone are circuited so that when daylight decreases to a specified level, a low-voltage photocontrol sends a pulse to one-third of the fixtures, which turn on and warm up at full brightness for 15 minutes. Then, the fixtures dim to a preset footcandle level controlled by the second photocontrol system.

As daylight continues to fade, the second third of the fixtures in the zone are switched on by the low-voltage control system, warm up, and are dimmed, and finally the last third are switched on and dimmed. Each third of the total number of fixtures in each zone is spread throughout the overall zone, so that when they switch on, uniform illumination is maintained throughout the exhibit area. Each third of the fixtures also switches off automatically whenever light in each zone exceeds the preset footcandle level. One advantage to continuously dimming the metal halide lamps is that this system automatically compensates for lumen depreciation due to lamp aging and dust accumulation on the fixtures.

Exhibit Lighting

At night, a series of ellipsoidal reflector fixtures give the aircraft additional lighting. These are mounted on rails next to a catwalk mounted within the space frame that supports the roof of the great gallery. Additional fixtures are hung from a track located elsewhere in the gallery. None of these fixtures are connected to a dimming board, but each has a series of built-in shutters that can be adjusted to control the beam spread and has hard- and soft-focus settings to control the edge of the light beam. These are set as required to achieve the lighting desired.

Circuiting run through the floor of the gallery powers the low-voltage track lighting used to illuminate the interpretive displays. The undersides of the aircraft are washed by light from a recently developed low-voltage fixture that contains nine MR-16 lamps wired in series. The lamps are mounted in a three-by-three grid. Each vertical row of three lamps is independently adjustable, and the entire unit can be pivoted up or down.

Conservation Issues

The Museum of Flight's deputy director, Ralph Johnston, says of the museum lighting, "We provide two completely different visitor experiences, the daytime and the nighttime. In the daytime we've

At night, photocontrolled 400-watt metal halide luminaires (top left) and ellipsoidal reflector fixtures (top right) wash the aircraft with light. Low-voltage track lighting (bottom left) illuminates interpretive displays.

got a huge volume of light, which, of course, floods the aircraft in the gallery and is impossible to redirect. At night, the incandescent lighting lights the airplanes selectively and gives them a completely different look — with a careful and sensitive lighting design, the depth and the contours of the airplanes come out more effectively than they do in the daytime."

Some conservators have said, however, that exhibits may receive too much exposure to light, even though the museum's glazing effectively filters out most of the ultraviolet radiation during the daylight hours. Johnston goes on to say in response, "Airplanes are fairly durable objects as compared to other objects that museums deal with. The architect and the museum's planning committee really did their homework in that regard. We recognize that, because there are high levels of light in the building, we have to be careful about exhibiting certain types of objects. The lighting environment is one of the many exhibit design considerations that we deal with when we decide what we're going to exhibit and how we're going to put it in the gallery.

"The advantage of the daytime situation is that you can see what's going on outside, and you can relate these airplanes to what's going on right outside at Boeing Field. You can look up through the ceiling and see real airplanes going overhead. You can look up at our airplanes with the sky as a backdrop, and you can get a closer approximation to what their natural habitat is. I think there are pluses and minuses to both of the scenes that we offer, but there's no question about it, it's two totally different experiences for the visitor. I think that's a beautiful advantage."■

For product information, see the Manufacturer Credits section on page 78.

Cinema lighting brings back movie magic

Susan Degen

Susan Degen is assistant editor of Architectural Lighting.

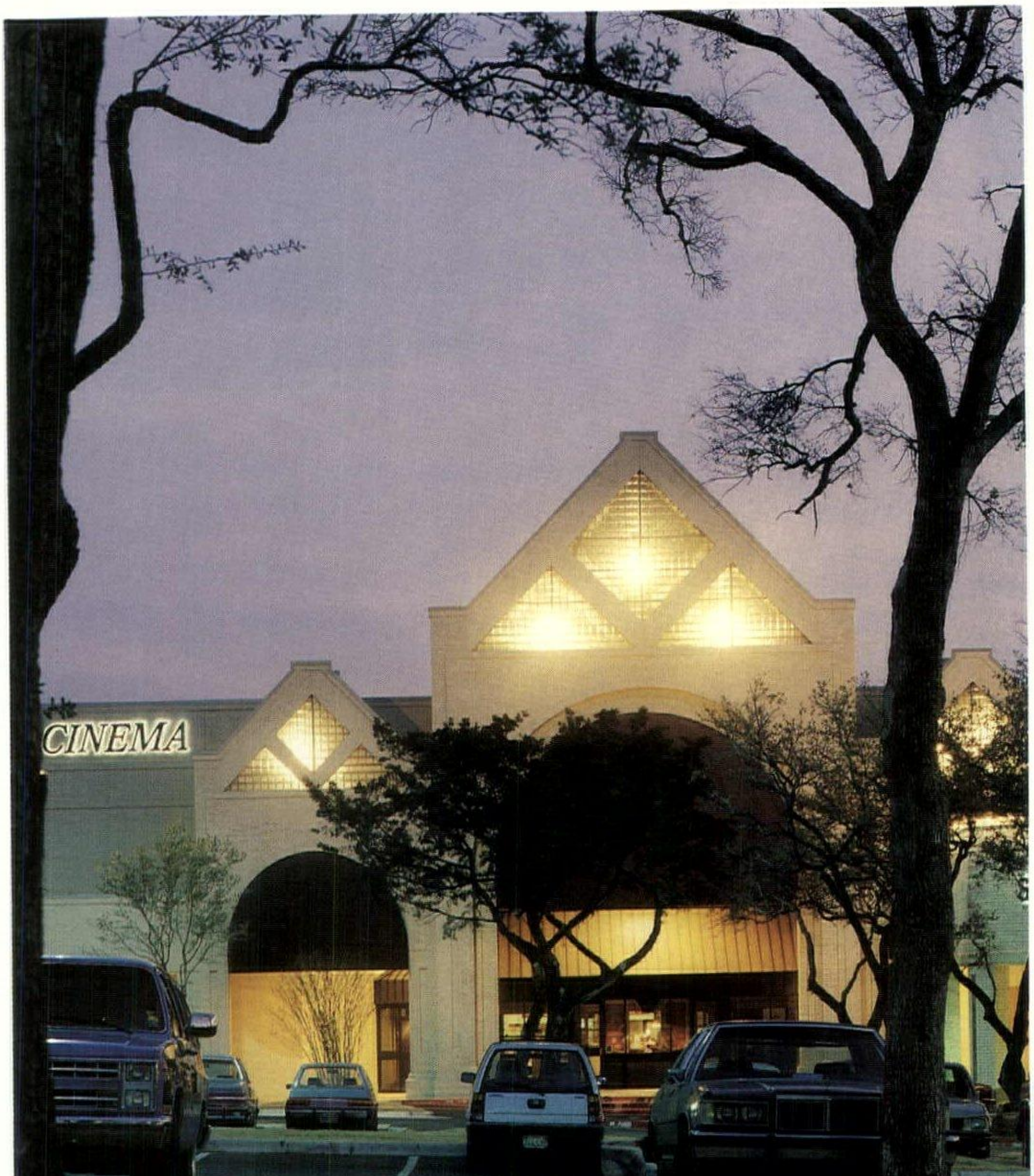
Presidio Enterprises' marketing strategy is based on the belief that movie patrons need a compelling reason to leave their VCRs at home and go out to see a movie. The company wanted its new complex to be a special place, a place where moviegoers know they will be entertained from the moment they walk through the front door. That was the challenge facing Kinney Kaler Sanders & Crews as the firm began planning the design for a multiplex cinema.

"Our client is in show business," says Jeff Jack, project architect for the job, "so we decided to create a stage setting atmosphere based on the idea of an exterior courtyard space, with a European flavor, done as if it was night."

The cinema is open both day and night, however, so the designers had to determine how to control the light inside the lobby to maintain a constant nighttime ambience. For the project to be economically practical, the client needed four auditoriums on the lot, which dictated a relatively small theater lobby for the Arbor Cinema Four.

To compensate for the small lobby space, the designers made it two stories high. "The night scene concept allowed us to visually expand the space upward. And the addition of exterior architectural elements, exterior lighting fixtures, and strategically placed mirrors allowed us to create the illusion of a much wider space, thus further dispelling the feeling of

Project: Arbor Cinema Four
Location: Austin, Texas
Client: Presidio Enterprises, Inc.
Architects: Kinney Kaler Sanders & Crews
Project Principal: Girard Kinney
Project Architect: J. Jeff Jack
MEP Engineers: Hendrix & Myers Consulting Engineers
Wall murals and cloud design: Jim Carroccio
Photos: R. Greg Hursley, Inc.



Nighttime view of the cinema showing ticket vestibule and deep arcades covered with canopies, designed to prevent direct light from hitting the cinema's exterior glass wall.

The concession stand is the lobby's central focus. Strip lights outline its canopy covering and the pathway into the lobby. Fabric clouds and star light panels suggest a cloudy night sky. Mirrors on the clock tower make the starry sky appear continuous.

a small lobby," says Jack.

The client wanted the ticketing area to be visible from the parking lot. This meant that the cinema's exterior wall had to have glass. At the same time, the designers had to prevent as much light as possible from penetrating into the lobby's nightscape. Jack solved this problem by designing a deep arcade with large canopies to prevent direct light from hitting the dark gray exterior glass.

To further reduce the amount of light entering the lobby, Jack located the ticket area in a vestibule, which is separated from the lobby by an additional set of interior doors. These doors have small vision lights that look like part of the courtyard scene from the inside. What little daylight penetrates into the lobby looks like dim nighttime illumination.

Wall-hung and post-mounted ornamental exterior lighting fixtures provide about 80 percent of the illumination for the lobby's courtyard scene. "After the installation was completed," says Jack, "we experimented with the overall effect by playing with the dimmers until we found the right combination of settings." He chose incandescent lamps for all the exposed fixtures to maintain a traditional-looking night atmosphere. Black polycarbonate ceiling panels studded with miniature lamps create the effect of a starry night sky.

One of the lobby's major features is a clock tower that projects into the lobby to conceal a stairway and elevator to the second floor. To enhance the illusion of a night sky, Jack placed mirrors at the top of the tower. He ran the star panels up to the mirrors so that the ceiling looks like a continuous expanse of starry sky.

Clouds mask the edges of the star panels. "The clouds were made with a primary form of chicken wire stretched over a metal pipe armature," says Jack. "The form was covered with treated fire-retardant heavy cotton gauze. Then a fire-retardant stretch fabric was pulled, tucked, and tied over the whole form in the shape of clouds and spray painted." A local theater scene and set designer, Jim Carrocio, worked with the architects during the design; he built the clouds and painted the courtyard murals.

The concession counter is the lobby's visual focus. The designers used indirect lighting to attract customers without overwhelming the nightscape in the rest of the lobby. Fluorescent fixtures provide soft, diffuse area lighting from the cavity of an opaque canvas awning above the concession counter. The awning keeps light from escaping up into the nightscape. It has a soffit of translucent white fabric that prevents direct light from spilling down. Springs hold the fabric in place for easy maintenance and relamping.

Miniature strip lights outline the awning over the concession stand. Others mounted in the floor define the paved path leading from the ticket area to the concession stand and separate it from the carpeted area beyond. An added touch of sparkle at the concession counter comes from miniature strip lights hidden at the front edge of the counter's casing.

The only other illumination in the lobby comes from specialty fixtures, such as those that illuminate the pediment, the star panels on the ceiling, two microspots, and strobe lights. The strobe lights enhance the theatrical effect of the nightscape — their flashes synchronized with a prerecorded tape of thunder to suggest an approaching storm.

The pediment and individual minimarquees above the auditorium entries also provide small amounts of light. Two 4-foot fluorescent lamps are

An illuminated pediment marks the entryway to individual auditoriums. A minispot accents the company's logo mounted above the pediment. Exterior ornamental fixtures provide most of the lobby illumination.

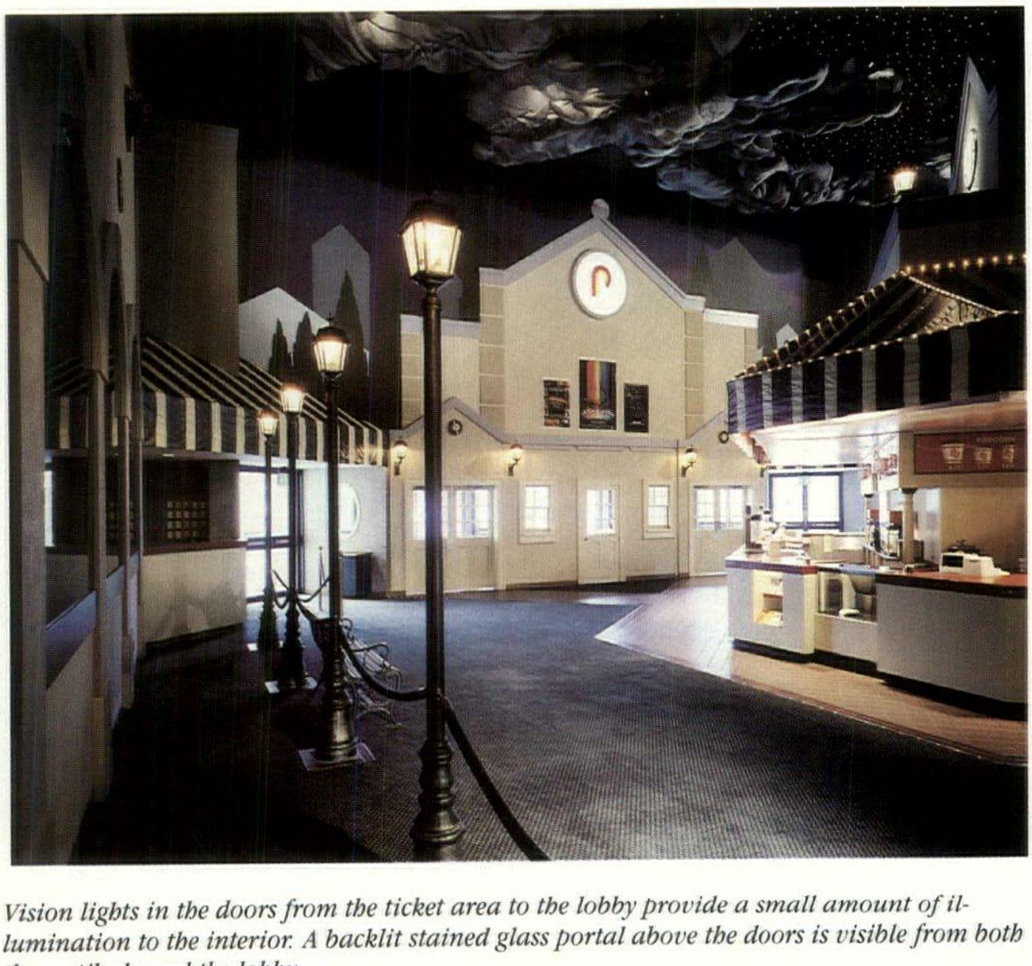
mounted in a trough at the base of the pediment that marks the entryway to the auditoriums. A purple acrylic lens covers the lamps to suggest an evening glow. For added interest, miniature strip lights outline the cutout pattern in the pediment.

The minimarquees directly over individual theater doorways are "simply sheet metal boxes with fluorescent fixtures covered by translucent acrylic sheets," says Jack. "So this lighting would not be overpowering, we added an extra sheet of beige acrylic to soften the light."

Two microspots complete the lobby light sources. One is aimed at Presidio's stainless steel logo, which is mounted in the pediment above the entrances to the two larger theaters. The other is aimed at the clock in the tower above the concession stand. The company's logo is also prominent in a two-sided stained glass portal mounted in the wall above the ticket vestibule door. The portal is backlit so it can be seen from the lobby as well as from the theater's entrance.

The designers of the Arbor Cinema Four have restored some of the old magic of the movies by creating a dramatically lit theatrical setting that entertains while it lures customers to the concession stand. Perhaps this signals a trend away from the mundane, cramped lobbies of modern multiplex cinemas and a return to a more exotic theater architecture, as in the days when cinemas were designed to engage the imagination and suggest the flight into fantasy to come. The lure of the exotic seems to work in Austin, where the Arbor Cinema Four has become one of the most profitable cinemas in the country. ■

For product information, see the Manufacturer Credits section on page 78.



Vision lights in the doors from the ticket area to the lobby provide a small amount of illumination to the interior. A backlit stained glass portal above the doors is visible from both the vestibule and the lobby.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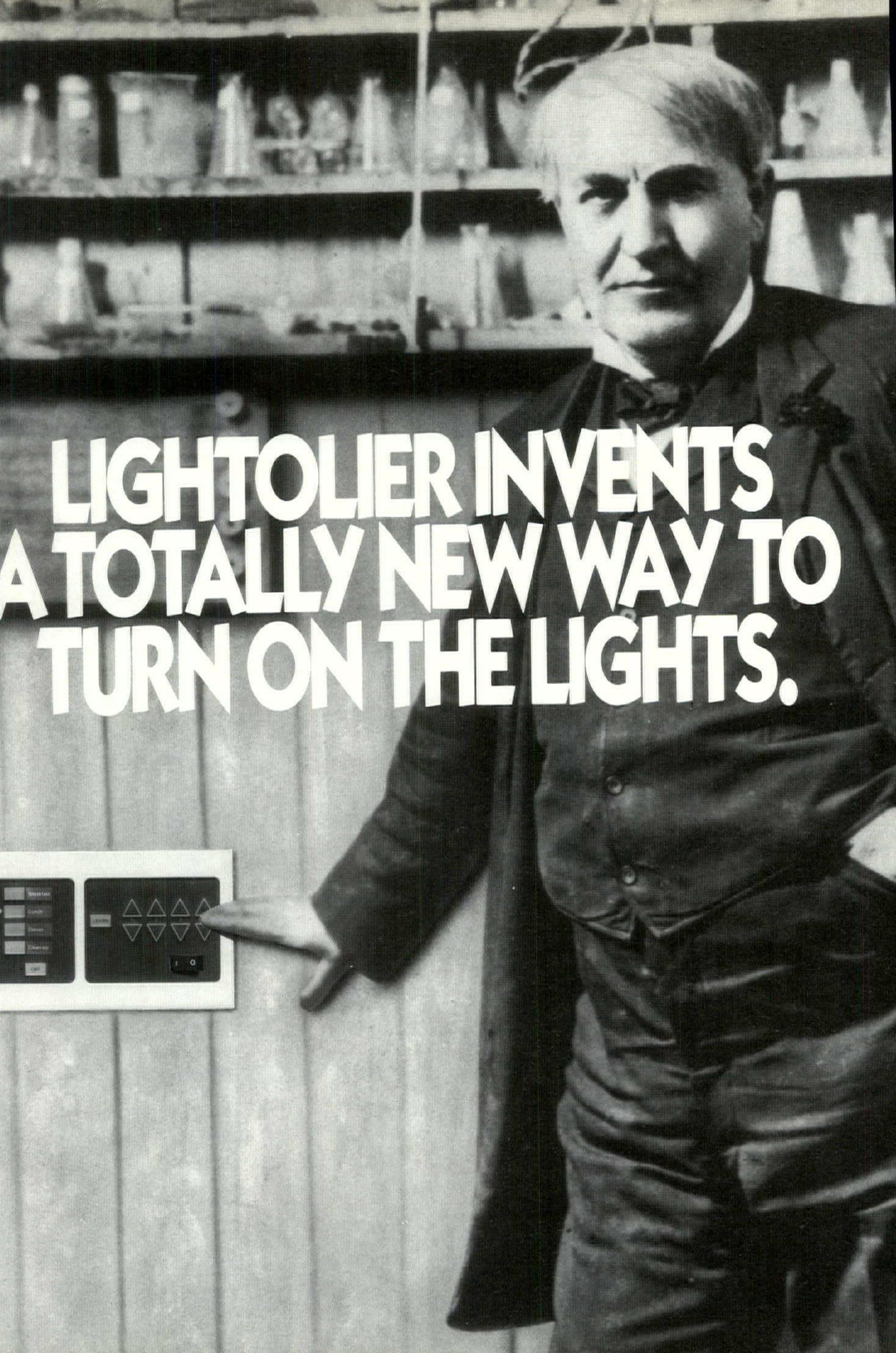
LIGHTOLIER INVENTS
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Designing for people: Applying psychology of light research

Craig A. Bernecker

Craig Bernecker is director of illumination studies in the department of architectural engineering at The Pennsylvania State University, University Park.

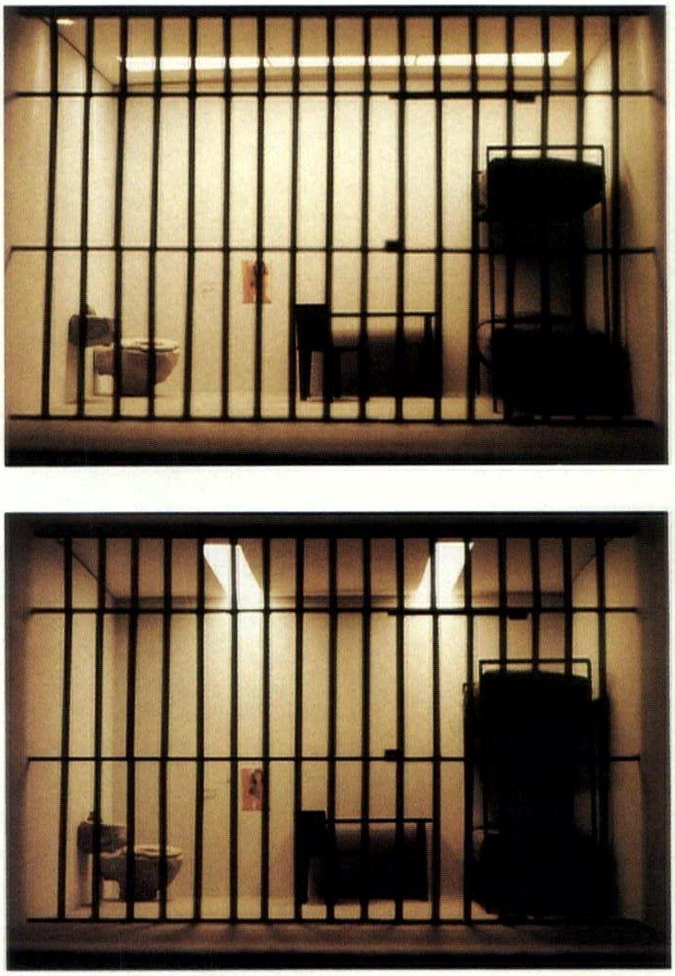
Many lighting professionals consider John E. Flynn's work a landmark approach to lighting design. His research on the psychology of light has been available for more than 10 years. Yet, despite the respect his work has earned during the past decade, it seems it is seldom used in actual design practice.

Several reasons may explain why this work seems to be absent from lighting design. Perhaps some designers question its validity; others may believe they use — and have used — the results intuitively. I suspect, however, that two other reasons bear more of the responsibility.

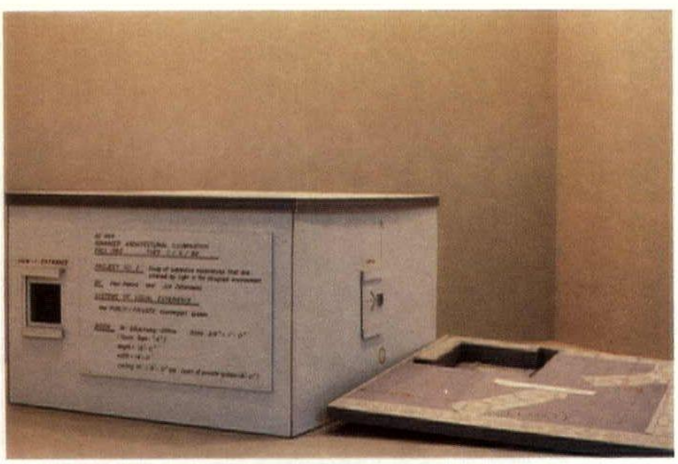
First, many designers may remain unaware of the work; second, those who are aware of it may simply be unsure about how to use it — that is, they may not know how to apply the results of Flynn's work in their design practice. This article intends to help designers overcome both problems by further exposing Flynn's work and, perhaps more importantly, by suggesting some methods by which it might be applied.

Both Flynn and I have used this technique with students at Penn State. Essentially, the task has been to build a scale model of a single room or circulation space and, by manipulating lighting modes, to generate both extremes of a particular impression — for example, spaciousness and confinement. All other characteristics of the model are held constant; the change in impression is generated solely by changing the pattern, location, and intensity of light.

In practice, this exercise generally means building two ceilings for the model, as shown in the photograph of an exterior of a student's model.



Light structures model representing spaciousness and confinement impressions. The prison setting is the work of one of the author's former students, Leslie McIlvried.

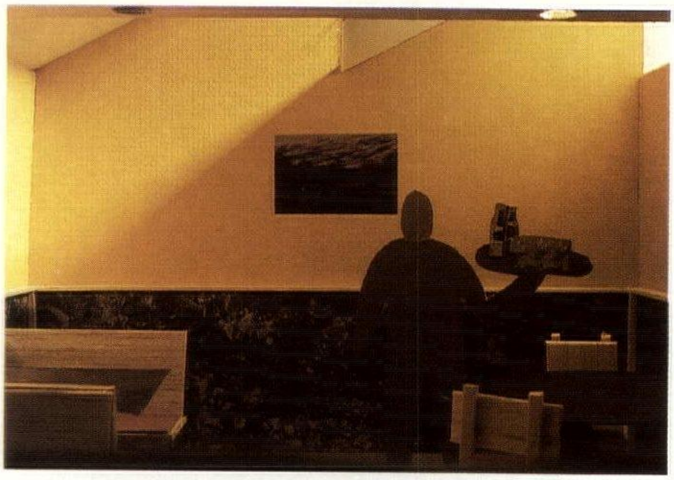


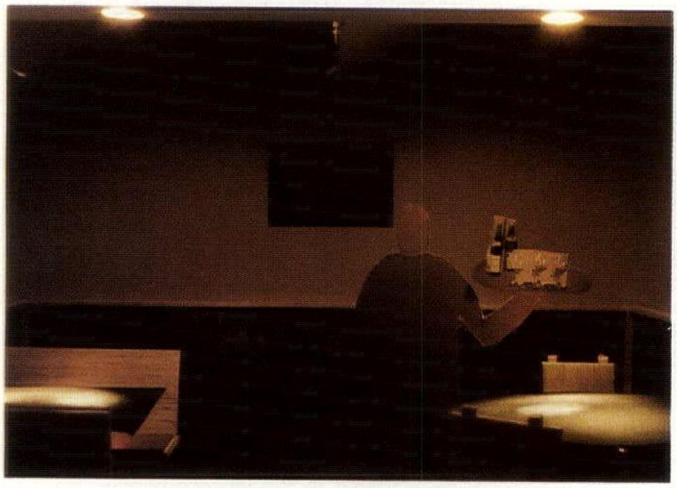
Exterior of light structures model.

Punching holes, cutting slots, and adding tracing paper or some other diffusing media produces adequate lighting systems. Spotlamps and diffuse lamps are mounted outside the model to project light through these apertures. Actual photometric measures are not essential here because the issues are the relative intensities and patterns of light.

Other photographs show examples of student models attempting to illustrate several Flynn-identified impressions. One set represents the spaciousness-confinement continuum in a unique application — a prison cell. The spaciousness setting uses uniform wall lighting (uniform and peripheral modes) and a high level of illuminance (bright mode); the confinement setting uses an overhead, somewhat nonuniform, and dimmer lighting system. A designer who is trying to enhance the quality of life in and counteract the overcrowded feeling of a prison might find quite useful a lighting system that generates an impression of spaciousness.

A pair of photos illustrates the public-private impression continuum in a restaurant. Daylight coming through saw-





Model representing public and private impressions. The restaurant setting is the work of one of the author's former students, Michael Chicoine.

toothed clerestories generates the kind of relatively uniform, high illumination (the uniform and bright modes) that might be desirable in a high activity public setting — a fast food restaurant, for example. The nonuniform, lower intensity system might be appropriate for a private setting, such as an intimate dining atmosphere. There is a problem with this example, however; looking carefully at the private setting reveals downlights directly over the place where some of the occupants would sit.

The lighting reinforcement table indicates that, for a private setting, light intensities should be low in the immediate locale of the user. No pool of light belongs where people are sitting. Thus, although this atmosphere may look private to those looking from the outside in, the space may seem exactly the opposite to someone actually using it. It may seem almost as though a spotlight is on them!

Understanding the Psychology of Light

To explain ways of applying the Flynn work, it is first necessary to provide a base level of understanding of the work. Essentially, he was studying subjective human reactions to lighting systems. Understanding the psychology of light research can help designers understand how they might influence a person's reaction to or impression of an environment simply by changing the lighting system. In fact, Flynn identified several *consistent categories of impression* that can be influenced by lighting systems.

Each impression covers a range with opposite meanings at two extremes — for example, relaxed versus tense. Flynn grouped these impressions into categories that refer to the way people see the environment, what they expect to do in it, and, finally, how they feel about it.

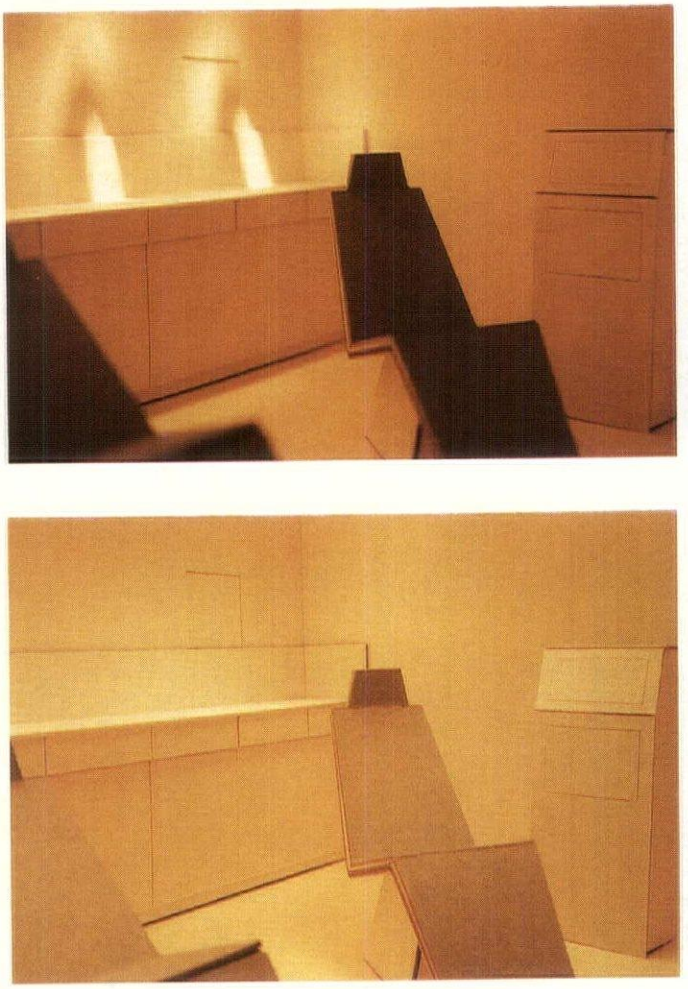
Flynn used a combination of techniques to gather and analyze impressions that people reported and to determine how those impressions were influenced by various lighting systems. He used semantic differential ratings, factor analysis, and multidimensional scaling. An accompanying table lists and categorizes some impressions that Flynn identified.

Another table identifies the characteristics of lighting systems that can be manipulated to influence people's impressions. Flynn referred to these characteristics as *lighting modes,* light cues that communicate subjective associations or impressions. As with the categories of impression, each lighting mode is a range with opposites at either end of a particular dimension.

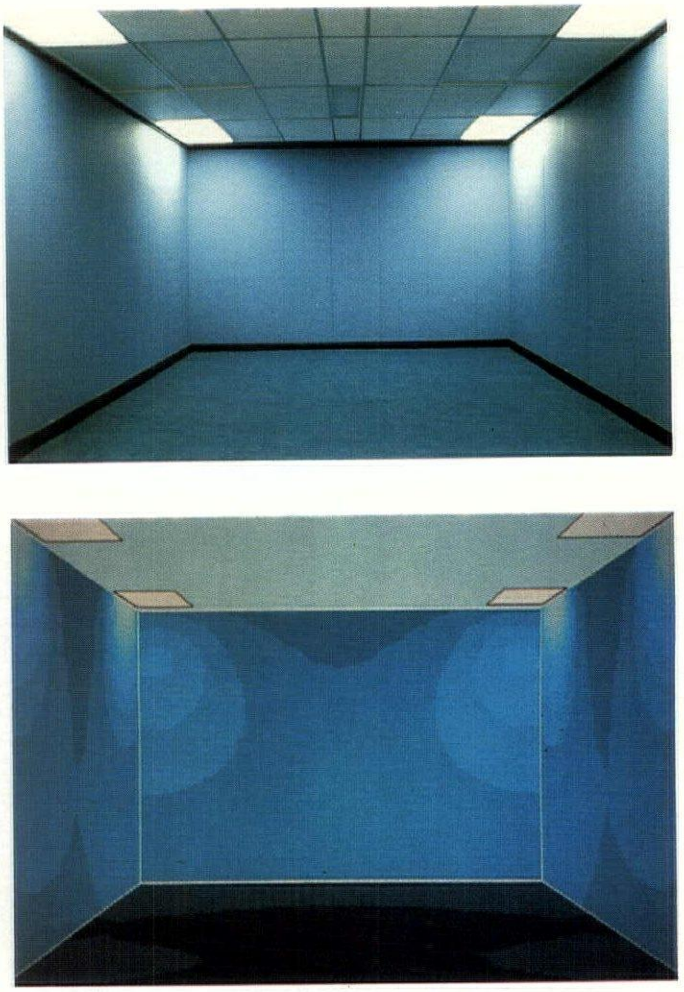
A third table indicates some of the ways that specific sets of lighting modes can influence or reinforce particular impressions. For instance, an impression of spaciousness can be generated by using the

Categories of impression
Perceptual impressions
Visual clarity
Spaciousness
Spatial complexity
Color tone
Glare
Behavior setting
Public versus private space
Relaxing versus tense space
Overall impressions
Preference (like versus dislike)
Pleasantness
Identified by Flynn (1977)

Lighting modes
Overhead-peripheral Lighting emphasis on vertical surfaces rather than lighting central horizontal surfaces with overhead luminaires
Uniform-nonuniform Articulation or modeling of the room and/or articulation of forms and objects in the room. This mode may actually have two dimensions, a basic uniform-nonuniform dimension related to the appearance of the room or major surfaces in the room and an independent but sometimes related specular-nonspecular dimension that relates to the appearance of objects and artifacts within the room.
Bright-dim Perceived intensity of light on the horizontal activity plane
Visually warm–visually cool Perceived color tone of the light in the room (Kelvin)
Identified by Flynn (1977)



Light structures model representing relaxation and tension impressions. The dentist office setting is the work of one of the author's former students, Lynn Mastandrea.



Lab mock-up and computer graphic of a lighting system used in the author's research at Penn State.

uniform and peripheral modes and, to some degree, the bright mode. Conversely, an impression of confinement can be generated by an overhead, nonuniform lighting system, and low brightness can be a reinforcing factor.

This is the essence of the Flynn work, although certainly not a complete description. A list of references at the end of this article is a guide to more detailed information.

Light Structures Models

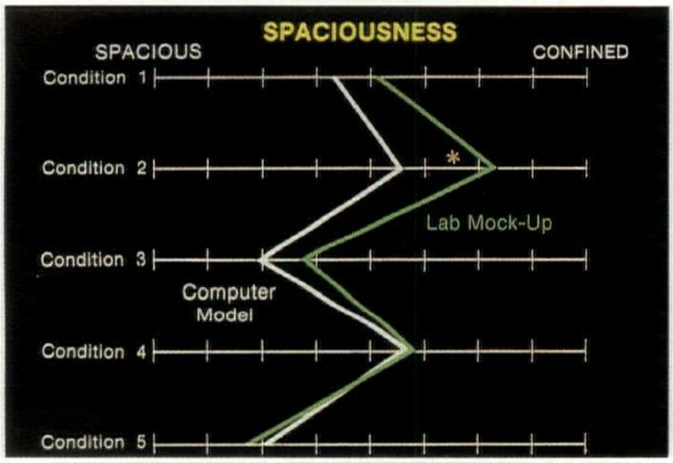
One of the phrases Flynn often used to describe his work was *light structures.* He preferred this phrase because it implies that light is being used to "structure" or build one's understanding of an environment and its intended use. This concept of building an understanding carries over into one of the methods for applying the Flynn work: building a light structures model to study the impressions desired for a space being designed.

A final set of photo examples demonstrates the relaxation-tension continuum. In another unique application, a dentist's office, uniform and overhead lighting of a fairly high level is used to generate a feeling of tension; nonuniform, peripheral, lower level lighting is used to generate an impression of relaxation. It is easy to guess which environment patients would prefer when facing the dentist's drill — ignoring, for the moment, the task lighting required for drilling.

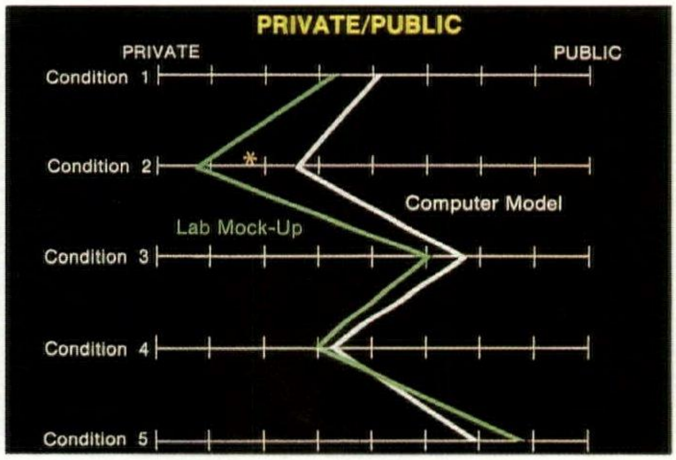
This technique can easily be extended from the classroom to the design office. In fact, this is how and why it is taught along with many other lighting design techniques. It's not possible to quantify these impressions in the way other design criteria are determined, but — as for other qualitative characteristics of environments — these impressions can be studied systematically through simulation. Thus, an informed decision can be made about the appropriate lighting system to use in an application, just as that decision might be made following any sort of quantitative analysis.

Computer Graphics

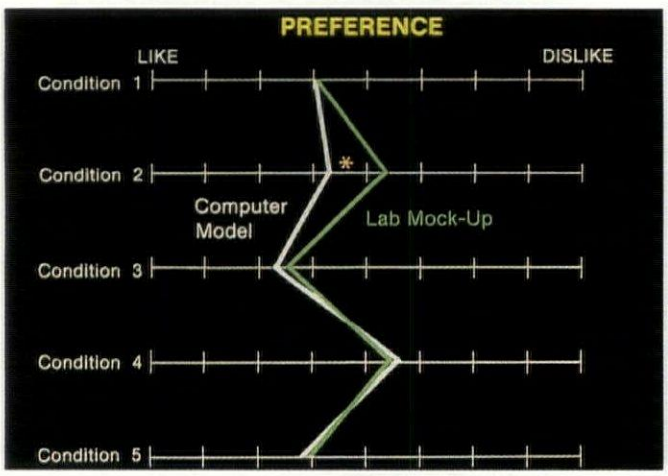
My colleagues and I at Penn State have studied another potential method for applying the Flynn work. Penn State has been involved with computer



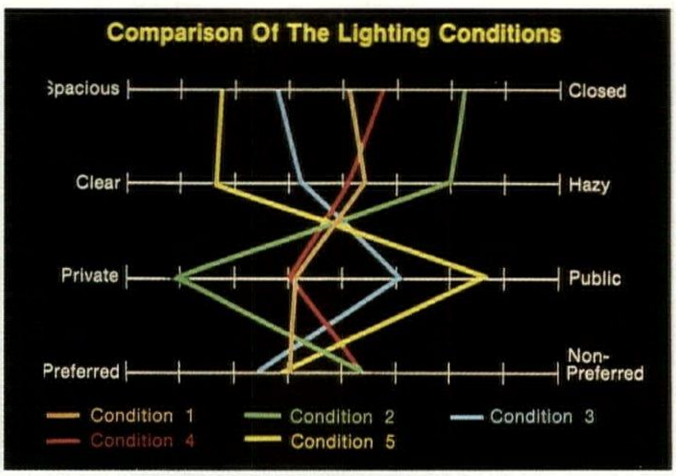
Comparison of computer model and lab mock-up ratings of spaciousness impressions.



Comparison of computer model and lab mock-up ratings of public and private impressions.



Comparison of computer model and lab mock-up preference ratings.



Comparison of ratings among lighting conditions.

graphics in lighting since the mid-1970s. Our emphasis has been not only on good graphics, but also on their reliability, validity, and applicability as a design tool. A recent study involved comparing the subjective impressions generated by a computer graphic with those generated by a real space; the purpose was to validate computer graphics as a design tool and to determine how well they can communicate impressions like those determined by Flynn.

In the study, several lighting systems were mocked up in a full-scale room and also graphically created on Penn State's computer graphic system. Photographs show both the real room and a computer graphic for one of the lighting systems. We used techniques similar to those used by Flynn to evaluate both the graphic room and the real one relative to several of Flynn's categories of impression. The accompanying graphs show the results of these evaluations for the five lighting systems used in the study.

Comparing the lines for the computer model and for the lab mock-up reveals that the computer model was a good representation of the real room. In other words, the computer graphic was virtually as good as the real room in communicating the impressions influenced by the lighting systems. This was especially evident in the case of preference; on that graph, the lines virtually match for every lighting condition except the second one. It should also be noted that impressions changed enough across conditions to indicate that the same thing was being measured each time.

Although this is certainly not a conclusive study, and the need for additional testing should not be minimized, the implication is clear. It appears that computer graphics such as those shown here can be a valuable tool for predicting subjective impressions of lighted environments. It appears that people are likely to get the same impression from a computer picture as they would get from a real room.

Lighting reinforcement of subjective effects	
Subjective impression	**Reinforcing lighting modes**
Visual clarity	Bright, uniform lighting mode Some peripheral emphasis, such as high-reflectance walls or wall lighting
Spaciousness	Uniform, peripheral (wall) lighting Brightness is a reinforcing factor, but not a decisive one
Relaxation	Nonuniform lighting mode Peripheral (wall) emphasis, rather than overhead lighting
Privacy, intimacy	Nonuniform lighting mode Tendency toward low light intensities in the immediate locale of the user, with higher brightnesses remote from the user Peripheral (wall) emphasis is a reinforcing factor, but not a decisive one
Pleasantness, preference	Nonuniform lighting mode Peripheral (wall) emphasis
Flynn (1977)	

Thus, in much the same way as light structures models — though perhaps even more easily manipulated — computers can be used in a design office for the systematic study of different lighting systems and their subjective effects.

There is more to the Flynn work than is presented here; his testing involved multiple room types, several light sources, and a range of subjects. He used several conference rooms, an auditorium, and a classroom; he used incandescent, fluorescent, mercury vapor, and high pressure sodium sources. Yet he himself admonished other researchers that the testing was incomplete; it will take a great deal more work before we understand light's influence on people and the ways that people respond to their surroundings.

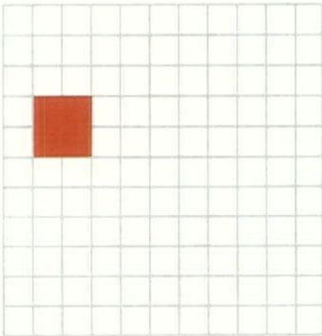
Even in its present incomplete form, however, the information is useful. Given the right tools, such as those described here, our current understanding of the psychology of light can help to enhance the quality of our lighted environments. Some of the information we need is available today. We need not wait for tomorrow's final answers to improve lighting design in many environments. As is true of most design tools, this one can be and will be improved. Yet, as it exists, it can be useful when properly applied. ■

The author wishes to acknowledge the major contribution of Bob Davis in the computer graphics study.

For further information about the psychology of light, the author recommends the following:

Bernecker, Craig A. The potential for design applications of luminance data. Journal of the Illuminating Engineering Society, *10:3:8–16, October 1980.*
Davis, Robert G. & Craig A. Bernecker. An evaluation of computer graphics of the lighted environment. Journal of the Illuminating Engineering Society, *14:1:493–514, October 1984.*
Flynn, J.E. A study of subjective responses to low energy and nonuniform lighting systems. Lighting Design + Application, *7:2:6–15, February 1977.*
Flynn, J.E. & T.J. Spencer. The effects of light source color on user impression and satisfaction. Journal of the Illuminating Engineering Society, *6:3:167–179, April 1977.*
Flynn, J.E. The psychology of light. Electrical Consultant *(series of eight articles), 88:12 through 89:7, 1972–73.*
Flynn, J.E., C. Hendrick, T. Spencer, & O. Martynick. A guide to methodology procedures for measuring subjective impressions in lighting. Journal of the Illuminating Engineering Society, *8:2:95–110, January 1979.*

Lighting Graphics



Sam Mills, AIA, IES

Sam Mills is an architect and lighting consultant with his own firm in Oklahoma City. In this column, he draws on 25 years of experience in lighting and architecture to offer design ideas, technical data, and graphic details that can be used to design coordinated lighting and architecture.

Electric light sources contain different amounts of energy in wavelengths that make up the visible light spectrum from violet through red. This variation affects the appearance of the light in terms of its relative warmness or coolness — with white light a mixture of all colors in approximately equal amounts.

Spectral energy distribution curves for typical white light sources graphically show this variation in energy at different wavelengths (as discussed in last month's Lighting Graphics column). The spectral distribution diagram shows the energy distribution for full-spectrum noon sunlight and for blue and pink fluorescent lamps. A pink lamp has most of its energy in the red range, and the blue lamp peaks in the blue-green range. With very little energy present at other wavelengths, these lamps are true color sources, producing no white light. Mixing the light from the two lamps, however, creates a spectrum that is almost continuous, producing white light weak in yellow.

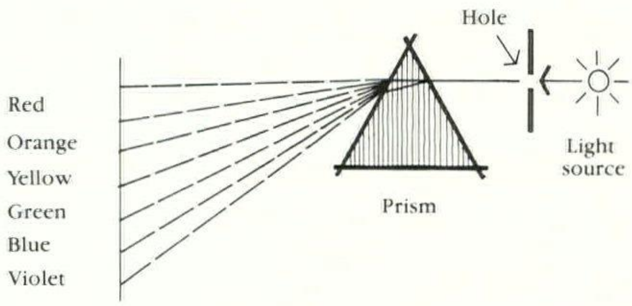
Color temperature (Kelvins) measures the relative warmness or coolness of a light source.

Because white light sources contain this variation of visible wavelengths, it is difficult to specify or measure the relative warmness or coolness in terms of the dominant wavelengths, measured in nanometers. To help identify subtle color variations, a method has been developed that compares the color of light with the appearance of a laboratory blackbody radiator. All objects emit light when heated to high temperatures and, as the temperature is raised, the color changes. This variation in appearance is identified by different *color temperatures.*

A blackbody is primarily a laboratory phenomenon; it is an object that theoretically absorbs all radiation falling on it, with no reflection or transmission. Because it absorbs all radiant energy, it is also said to be a perfect radiator, emitting maximum thermal energy from its surface. This effect was studied in the early 1900s and is the basis for the law of blackbody radiators, which predicts the spectral distribution of thermal radiation as a function of temperature.

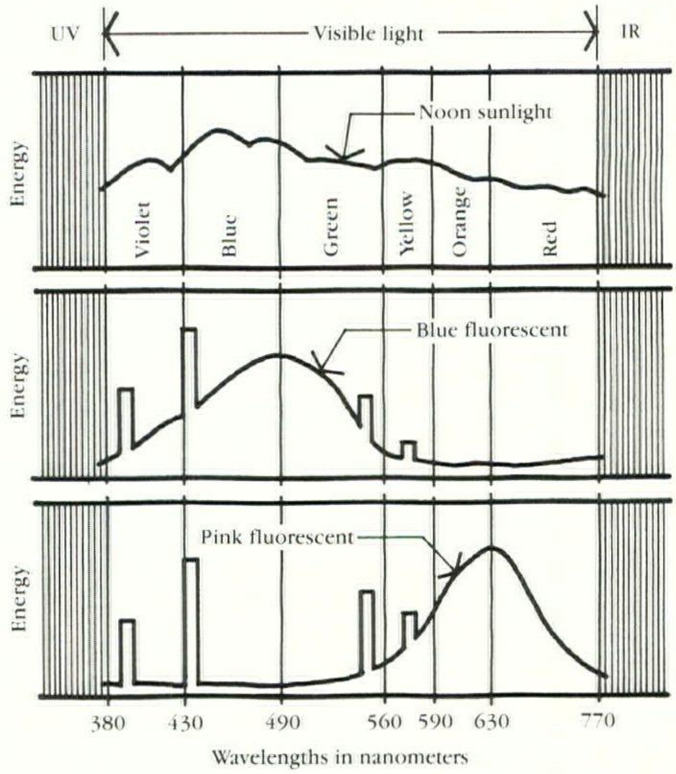
Heating a blackbody increases the internal agitation of its molecules and atoms. An ideal blackbody produces no visible radiation when heated to room temperature, but radiates from a red glow through blue-white at higher temperatures. The effect can be compared to that achieved when a blacksmith heats an iron bar.

Iron will glow if heated to sufficiently high temperatures — as will a blackbody — and appears dull red at first, then orange, yellow, white, and, finally, blue-white. Although no radiator of practical materials is truly a blackbody, laboratory examples use exotic metals and materials heated in special containers, which are viewed through blackbody-simulating sight tubes.



The color of white light

A narrow beam of light passing through a glass prism is refracted to show all the colors of the visible light spectrum.



Spectral distribution

The relative energy per lumen emitted at each wavelength of the visible light spectrum is shown above for a pink and a blue fluorescent lamp and for natural noon sunlight.

Color Temperature

Because the apparent color of a blackbody depends upon its temperature, the idea evolved of using *color temperature* to describe the color of light sources. Color temperature refers to the absolute temperature of the laboratory blackbody when its visible radiation closely matches the color of the light source. That is, it is an approximate way of identifying the source as appearing warm or cool.

The *Kelvin* scale is used to identify the temperature with a zero point at absolute zero (minus 459 degrees Fahrenheit) and intervals similar to those of the Celsius scale — with the freezing and boiling points of water 100 degrees apart — at 273K and 373K. A theoretical blackbody becomes red at 3000K, white at 5000K, blue-white at 8000K, and brilliant blue at 60,000K.

Because the light source color may not exactly match that of a blackbody, the term *correlated color temperature* (CCT) is used and expressed in Kelvins (K). Technically, the color temperature designation should apply only to sources with a continuous spectrum, such as incandescent lamps and natural light. It is, however, often used empirically to describe the degree of whiteness for other lamps, such as fluorescent, mercury, metal halide, and high pressure sodium, where the spectral distribution is predominantly made up of peaks of energy rather than a continuous range. An accompanying diagram gives the correlated color temperatures for some of the more commonly used light sources, along with some comparative natural sunlight and skylight values.

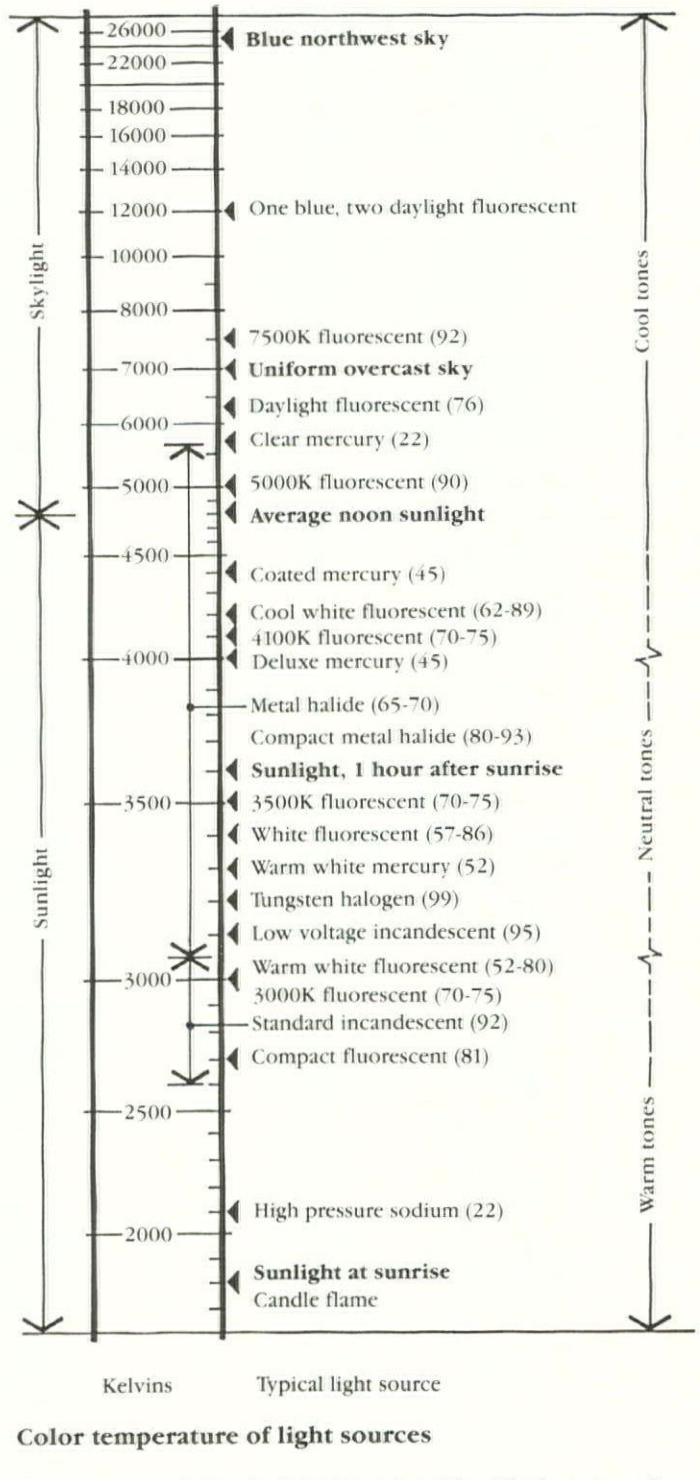
Color Rendering

Further characterization of electric light sources is sometimes referred to as the *quality* of light, or the color rendering capabilities of the source. The *color rendering index* (CRI) is expressed in numerical values based on comparing the spectral energy content of a light source with that of a full-spectrum reference source. Based on a maximum value of 100 for full-spectrum natural light — and values very close to 100 for incandescent lamps — the index numbers are always less than 100. They typically range between 20 and 80 for most common light sources. CRI values appear in parentheses on the color temperature chart.

The development of CRI values is a complicated process and far from perfect. We are cautioned as designers that these values are intended only as a guide and that certain restrictions must be observed for optimum accuracy.

The most important limitation is said to be that color rendering values should be used only to compare light sources with similar color temperatures (6000K daylight fluorescent and clear mercury, for example). Common sense tells us, however, that a 5000K fluorescent lamp with a CRI of 90 will render colors better than a 2100K high pressure sodium lamp with a CRI of 22. Experience also tells us that 3000K and 4100K fluorescent lamps, with identical CRIs of 70 to 75, will make colors appear somewhat different — even though both lamps will elicit a similar perceived level of quality or lack of color distortion.

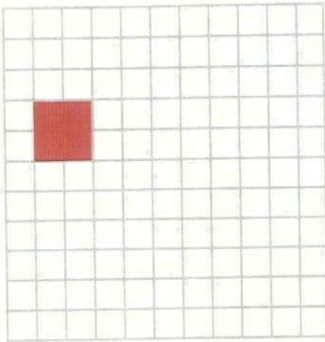
Also, most observers can distinguish the difference between a tungsten halogen incandescent lamp with a color temperature of 3400K and a CRI of 99 and an ordinary incandescent lamp with a color temperature of 2800K and a CRI of 92. The tungsten halogen light will be whiter and render colors slightly more



Color temperature of light sources

The Kelvin scale (at the left) is used to identify the color of light. It is the closely matching temperature and corresponding color of a laboratory blackbody heated through the various stages of incandescence from red to blue-white and referred to as the correlated color temperature (CCT). The color rendering index (CRI) for each source is shown in parentheses at the right.

The Daylighting Department



Choosing the right glazing material is critical to successful daylighting design. The first choice a designer must make is between diffusing and transparent materials.

Transparent glazing comes in a variety of types: clear, tinted, heat-absorbing, reflective, and selectively reflective. The tinted and heat-absorbing types are rarely appropriate for daylighting purposes because they reduce light transmission and distort the color of the view.

Clear glazing is often the best choice because it allows both a clear view and a maximum of daylight to enter. It does not solve the problem of glare, which is caused by the excessive brightness ratio of the view and the interior surface brightnesses. No other glazing can solve the problem any better than clear glazing, however, because other glazing materials reduce the interior brightness as much as they reduce the brightness of the view. The ratio remains the same and so does the glare.

Choosing the right glazing material is critical to successful daylighting design.

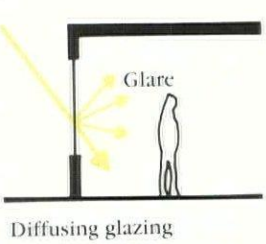
Tinted or reflective glazing can reduce window glare only if the interior is illuminated primarily by other sources — such as electric lights, skylights, or clerestory lights — and not by the view windows. In such cases, reducing the transmission of the view glazing improves the glare problem because the reduced brightness of the view window is then closer to the interior brightness.

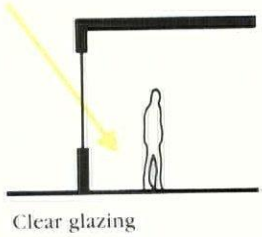
Because reflective glazing reflects light along with solar infrared radiation, it should not be used in windows that are designed to collect daylight. A new selectively reflecting glazing is available, however; it reflects more of the shortwave infrared than visible light. Reflective glazing is more often used when solar heat gain must be reduced rather than when daylighting is desired. Neither the normal reflecting nor the new selectively reflecting glazings are appropriate in buildings where solar heating is desirable in the winter.

One type of glass block is especially good for daylighting design. It is called *light directing* because its built-in prisms refract the light. These blocks are usually used to

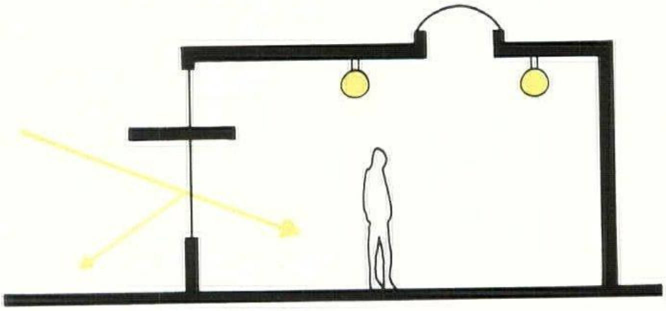
Norbert M. Lechner

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

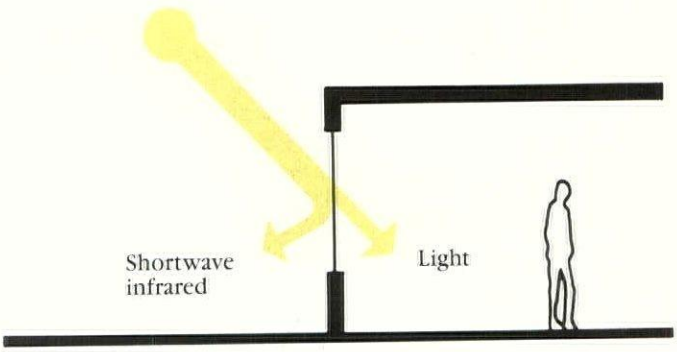




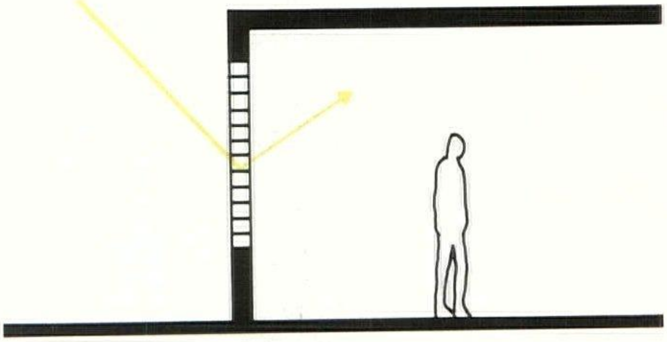
Diffusing glazing with high light transmission values can be a major source of glare because some of the sunlight is directed into the eyes of the observer.



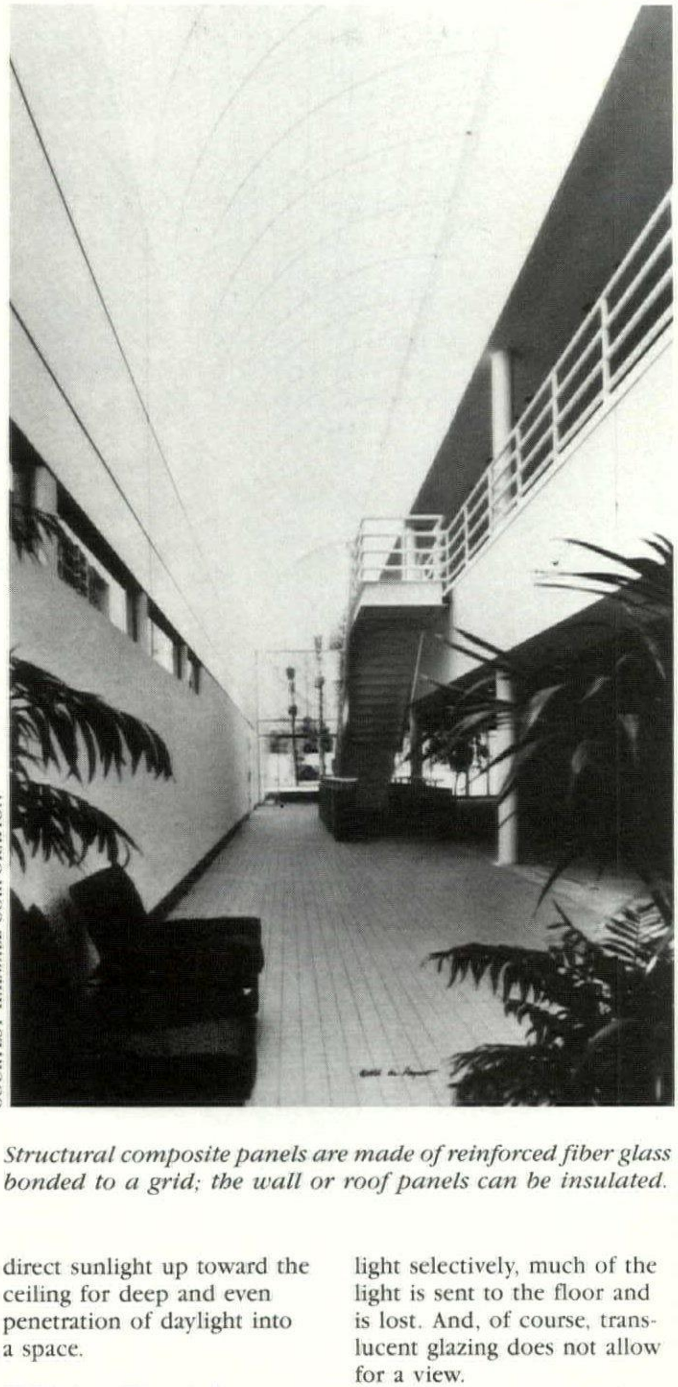
Tinted or reflective window glazing will reduce glare only if the space is lighted by other sources, such as electric lights or skylights.



The ideal selectively transmitting glazing would reflect all of the sun's infrared radiation and would allow the visible light to pass through.



Light-directing glass blocks have built-in prisms that can be used to refract light toward the ceiling.



COURTESY KALWALL CORPORATION

Structural composite panels are made of reinforced fiber glass bonded to a grid; the wall or roof panels can be insulated.

direct sunlight up toward the ceiling for deep and even penetration of daylight into a space.

Diffusing Materials

Diffusing glazing material with very high light transmission is not usually appropriate for window glazing for several reasons. It becomes an excessively bright source when sunlight falls on it. Because it does not diffuse light selectively, much of the light is sent to the floor and is lost. And, of course, translucent glazing does not allow for a view.

On the other hand, diffusing glazing materials of relatively low light transmittance can be used successfully for daylighting if the window glazing area is quite large. A large area of low transmittance glazing will create a large low-brightness source that will contribute a significant amount of light without glare.

Translucent membrane roofs. A translucent membrane may be used as a very diffused low-glare light source. Unfortunately, none of the available translucent membrane materials have very good insulating value. Consequently, except in special cases, the thermal penalties often outweigh the lighting benefits. A translucent membrane would be appropriate, however, for buildings that are not air conditioned and for buildings in very mild climates.

Many stadiums, tennis courts, and other such facilities are now covered with these translucent membranes — usually made of a Teflon- or silicone-coated fiber glass fabric. Even though the light transmission of those fabrics is often less than 10 percent, abundant high-quality light is available inside because of the very large area covered by the translucent material.

Sometimes double membranes are used to increase the insulating value of the skin to a point at which heating or air conditioning becomes feasible. The stadium and sporting facilities of the University of Florida at Gainesville are covered by a combination of pneumatic and arch-supported fabric membranes.

Structural composite panels. Where a translucent wall or roof is desirable on a smaller scale, a structural composite panel system may offer the best alternative. These panels are fabricated by bonding reinforced fiber glass face sheets to a grid of extruded structural aluminum I-beams. They are available in a wide variety of colors and thicknesses. The panels may be installed in roofs or walls, or can be assembled into domes or arches.

The panels may be insulated by translucent fiber glass insulation inserted in the panels at the factory as specified by the designer. The amount of insulation and the panel color chosen by the designer have a direct effect on the amount of light transmitted: the more insulation specified and the darker the face sheets, the less light is transmitted.

For example, a panel with white face sheets on each side insulated to a U factor of 0.4 has a light transmission of 30 percent. A panel specified with identical face sheets insulated to a U factor of 0.15 has a light transmission of 6 percent. Light transmission values as high as 60 percent and as low as 2 percent are available. These specification options allow designers to choose appropriate light transmission and insulating values according to the climatic and programming requirements of their individual projects. ■

TEMPO II

Unequaled Efficiencies

TEMPO II offers a wide assortment of lighting distributions and efficiencies that range from 72% to an unequaled 94%.

Certified test reports are available upon request.

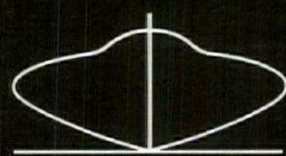
Balanced Color Mix

TEMPO II vertically mounted lamps combined with the TEMPO II patented optical system produces a symmetrical color mix and a color temperature range from 2450 K. to 2950 K.

Unequaled Distribution

TEMPO II offers a wide angle distribution - with maximum candlepower between the 105° and 120° zones.

TEMPO II can be mounted as close as 18 inches from the ceiling.



Wide Range of Lamp/Wattage Combinations and Shapes

Recommended combinations:
100W H.P.S./175W M.H.
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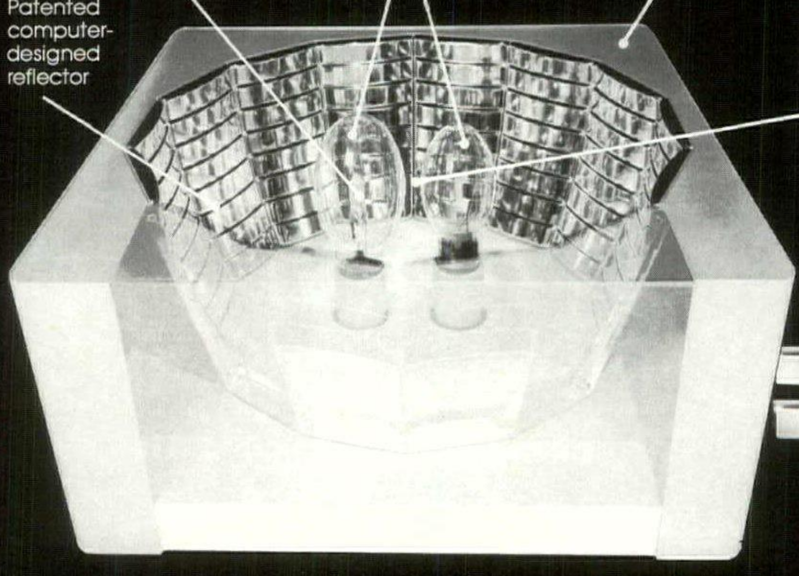


= 94% efficiency

Patent NO. 4,293,900

Circle 26

The Parts Department

Sidney M. Pankin

Sid Pankin, the principal of Pankin & Associates, Inc., is a lighting applications engineer who specializes in lighting design, energy conservation, and the design and fabrication of lighting retrofit components.

Low-voltage lamps have existed for years but have only recently been used in architectural lighting. The original low-voltage PAR lamps were developed as headlamps for tractors, cars, and other vehicles that lacked a 120-volt power supply. The predecessor of the MR (multifaceted reflector) lamp was invented as a low-heat light source for audiovisual equipment, such as slide projectors. Lighting designers later discovered the advantages of low-voltage lighting's precise optical control. Low-voltage PAR and MR lamps suitable for architectural applications were introduced in the 1970s.

The PAR 36 was the first entry in the field, and it looks like a small version of a standard round automobile headlamp. It has a filament mounted between a mirrored parabolic reflector and a clear glass lens. The filament, which provides relatively high beam control and candlepower, is shielded internally to reduce glare. Wattages available range from 25 to 75 watts; beam spreads range from wide floods to very narrow pin spots.

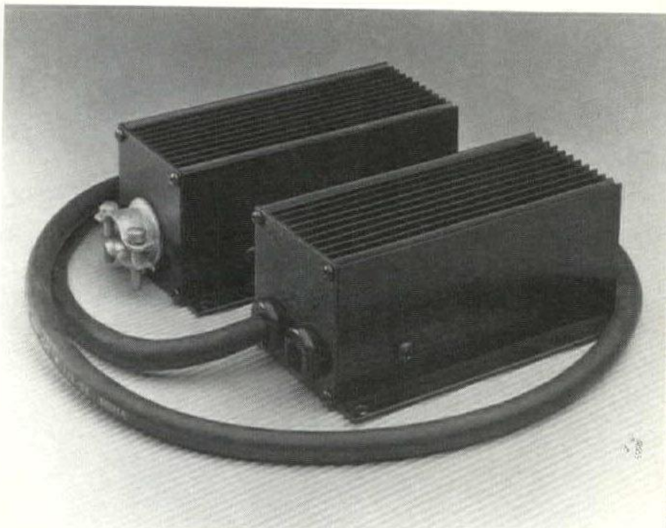
Low-voltage lamps offer precise optical control.

MR16 lamps have a tiny tungsten halogen lamp sealed into a glass multifaceted reflector. Variations in the facet configurations of the reflector and the positioning of the halogen lamp make possible the wide range of beam spreads available. Wattages available range from 20 to 75. Tight beam control combined with high color rendering qualities makes the MR16 a very effective accent lighting lamp in a small package.

A tungsten halogen lamp, often called simply a halogen lamp, is basically an incandescent lamp, but it also has halogen gases in an envelope that surrounds the filament. Some characteristics of halogen lamps are superior to those of conventional incandescent lamps.

In the *halogen regenerative cycle,* tungsten evaporated from the hot filament combines with iodine vapor to form tungsten iodide. The compound is carried back to the filament, where very high temperature separates the elements. The tungsten is deposited onto the wire filament, and the iodine is released to repeat the cycle.

Because the filament operates at much higher temperatures than conventional incandescent filaments, halogen lamps generate more light at a slightly higher color temperature: 2925 to 3075 degrees Kelvin compared with 2800 to 2900 degrees Kelvin for standard incandescent. When halogen lamps are operated at normal voltages, the regenerative cycle maintains nearly constant light output through the life of the lamp, generally 2000 to 3000 hours.



Dimmable electronic transformers.

COURTESY LUMINANCE, INC.

The glass reflector of an MR lamp has a *dichroic filter* built of layered thin films that transmit infrared and ultraviolet rays through the back and reflect visible light into the room. The filter reduces the heat of the beam, which reduces the risk of damaging heat-sensitive objects or fading colors because of UV exposure. Lamps with silver and gold anodized reflectors are also available for use in applications where it is more critical to protect the fixture from heat than to protect the object it is lighting.

Halogen lamps burn brighter and last longer than standard incandescents.

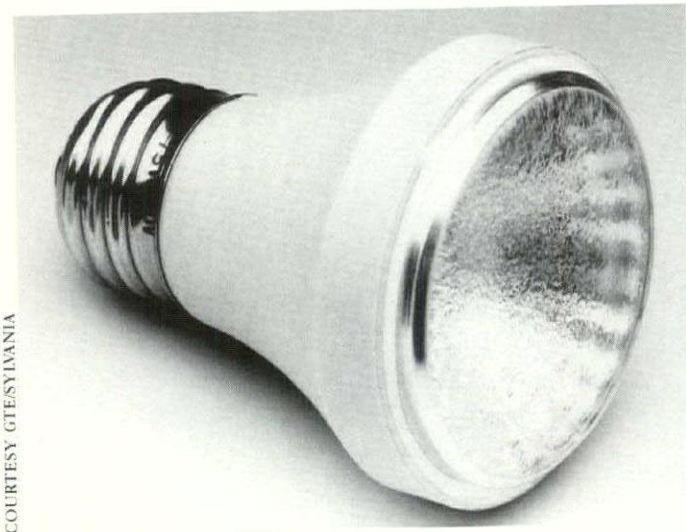
Some halogen lamps, including the MR16, are sometimes called *quartz lamps* because they use a quartz envelope that withstands high operating temperatures. The exposed envelope on the MR16 is extremely sensitive to handling. A touch of the fingers can deposit skin oils that react with the quartz, causing discoloration, lumen loss, and possibly lamp failure, so one should always handle the lamp by holding its reflector.

System Applications

Low-voltage lighting offers exciting possibilities for lighting designers. It is available in all of the standard fixture applications — recessed, track, and individual point source — with a wide array of wattage and beam spread combinations. But, always remember that low-voltage lighting is a system, not a panacea, and is effective only with proper application.

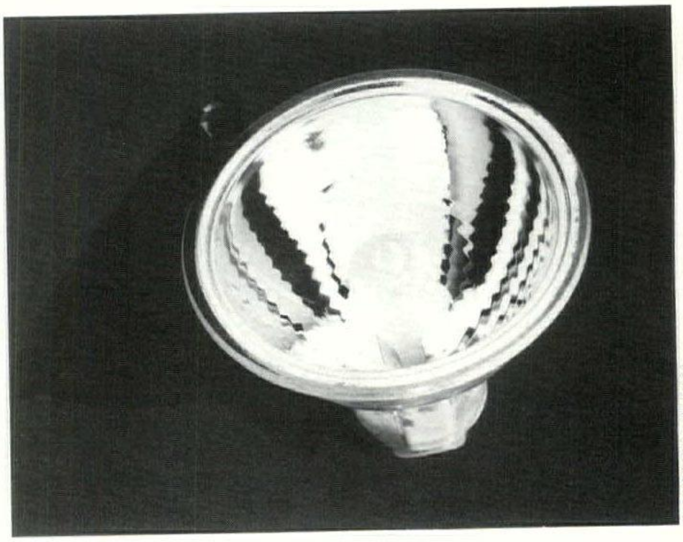
The approach has its pitfalls. First and foremost, low-voltage lighting should not be considered a substitute for a good ambient source of light. It can be excellent when used for accent and task lighting, but its value can be minimized by using the wrong beam spreads or placing the fixture too close or too far away from the lighted object.

Effectiveness depends on beam spread and distance, so it is important to use manufac-



COURTESY GTE/SYLVANIA

Tungsten halogen lamp.



COURTESY OSRAM

MR16 lamp.

turer beam spread charts. When using an MR16 system, it is a good idea to buy a variety of beam spread configurations. This enables end users to adjust their lighting to changing requirements, such as the relocation of displays or art objects.

Transformers and Dimmers

Low-voltage lighting requires an AC step-down transformer that lowers line voltage, usually to 12 volts. The most popular approach uses lamp holders with integral magnetic transformers. Because of the light weight and compact size of magnetic transformers and new solid-state transformers, lamp holders are smaller and lighter, making them easier to handle and use.

Fixtures used with remote transformer systems have particularly compact designs. In these systems, transformers are concealed in an accessible location relatively close to the fixtures to minimize voltage drop.

Dimming can be part of a low-voltage lighting system and can help extend lamp life, as described later in this article. Dimmers for use with magnetic transformers must be designed specifically for use with low-voltage components. Standard dimmers will operate solid-state transformers if each dimmer is limited to 600 watts. Dimmers must be wired on the primary side of the step-down transformer (between the outlet and the transformer), never between the transformer and the lamp.

Dimming low-voltage lamps more than 15 percent may cause more rapid lumen depreciation than operating lamps at full voltage because the halogen regenerative cycle does not operate at the lowered voltage levels. To avoid this problem, operate the lamps with dimmers turned up to full power a few hours per week to allow the regenerative cycle to function properly.

Reducing Voltage for Longer Life

Reducing voltage to either standard or low-voltage incandescent lamps results in longer lamp life. Light output and lamp life are interdependent. Voltage is the force that pushes the energy through the filament. The greater the force, the greater the resistance. The greater the resistance, the more light and heat developed, and the shorter the lamp life. Lowering the line voltage into a lamp reduces resistance in the filament, which in turn reduces lamp heat and increases lamp life.

Effect of voltage control on incandescent lighting

Line voltage reduction	Light output reduction	Energy use reduction	Lamp life increase
5%	15%	7.5%	200%
10	30	15.0	400
15	42	22.0	800

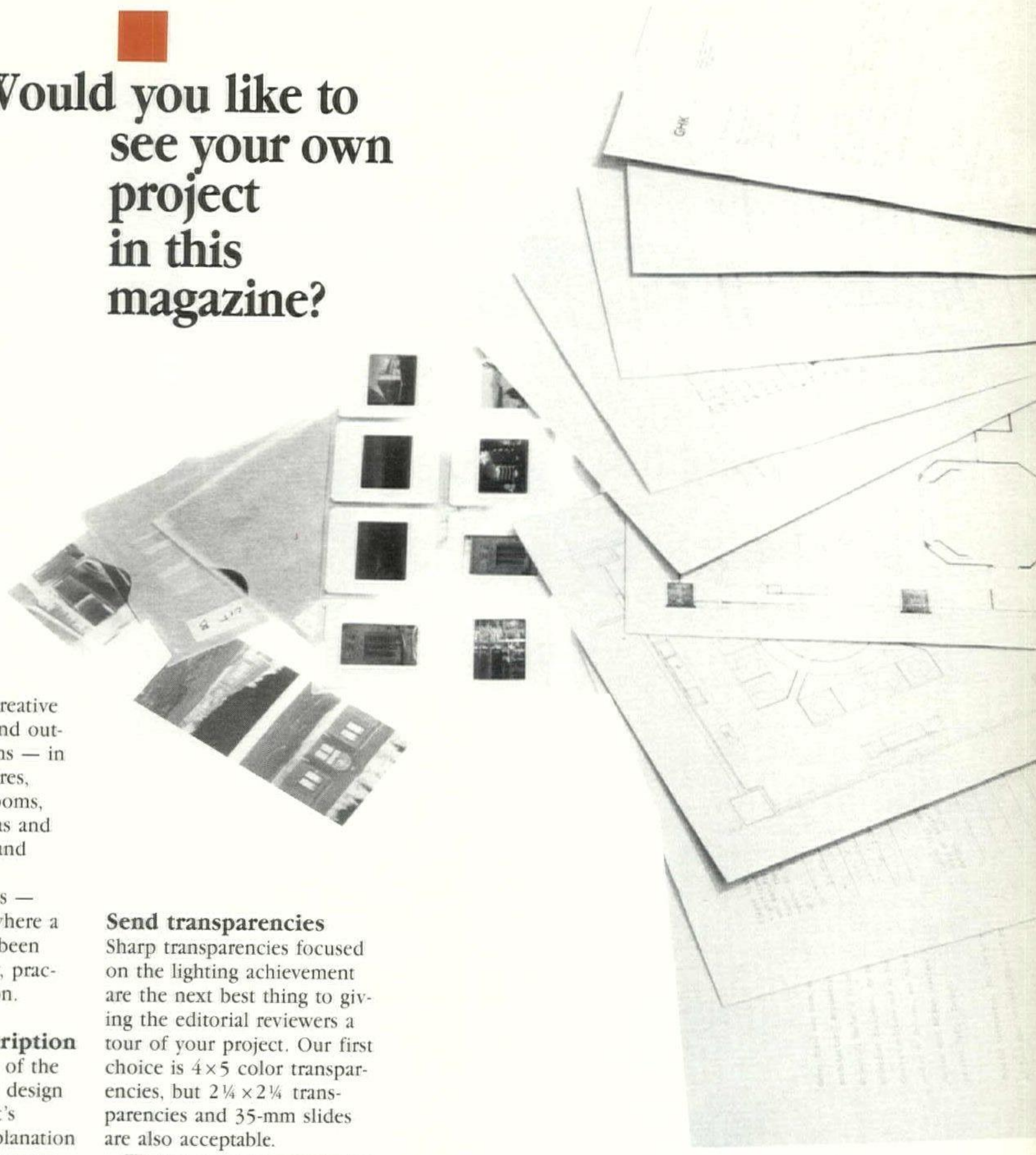
Changes in incandescent lamp operating characteristics caused by using a step-down transformer system for specific lighting circuits.

The voltage control principle can be applied to standard incandescent lamps where the cost and inconvenience of replacement is high. The cost of the retrofit must be justified by convenience and good maintenance practice rather than energy reductions.

Lowering voltage reduces the light output of the lamps significantly, but saves only a small amount of energy, as the accompanying table shows. Although lamp wattage could be increased to establish a higher light level, higher wattage lamps may completely cancel out any energy use reductions. Lamp application planning should take this factor into consideration. Color temperature is also lowered significantly, just as it is when a dimmer is used to reduce line voltage to a table lamp.

The mechanics of the system are simple. The specific lighting circuits to be controlled can be run through step-down transformers to achieve the desired line voltage to the lamps, or a prepackaged voltage control system can be purchased that incorporates other features, such as time control and the ability to vary line voltage. Large applications may justify the cost of a prepackaged system. Smaller projects can be handled at the breaker with the advice of an electrical engineer, electrical contractor, or both. ■

Would you like to see your own project in this magazine?



We want to publish creative solutions to indoor and outdoor lighting problems — in warehouses, retail stores, power plants, showrooms, factories, sports arenas and playing fields, parks and gardens, monuments, museums, parking lots — everywhere and anywhere a lighting problem has been solved with creativity, practicality, and innovation.

Send project description
Send us a description of the project, including the design objectives, the project's scope, and a brief explanation of any modeling, computer simulations, or other calculations used during planning and design.

A brief statement about the effect the designer was after and the extent of the spaces that were lit helps the editorial reviewers to evaluate whether and how well the objectives were fulfilled.

You don't have to be a writer, but you do need to send us enough information to let us "visit" the lighting project. Remember that *Architectural Lighting* focuses on the lighting rather than the space that was lit.

Send transparencies
Sharp transparencies focused on the lighting achievement are the next best thing to giving the editorial reviewers a tour of your project. Our first choice is 4×5 color transparencies, but 2¼×2¼ transparencies and 35-mm slides are also acceptable.

We give your transparencies and other art materials tender loving care and return them after the magazine is printed. Be sure to provide the photographer's name and phone number, even if you own the publication rights.

Selected projects
When a project is selected for publication, the contributor is asked to supply additional information about the "cast of characters" and light sources and luminaires. A member of our editorial staff may ask for drawings, sections, and other details about the project.

The details that explain how you achieved your lighting goals can help our readers determine new approaches to their own designs and projects.

To submit your project to *Architectural Lighting*, send transparencies and project description to:

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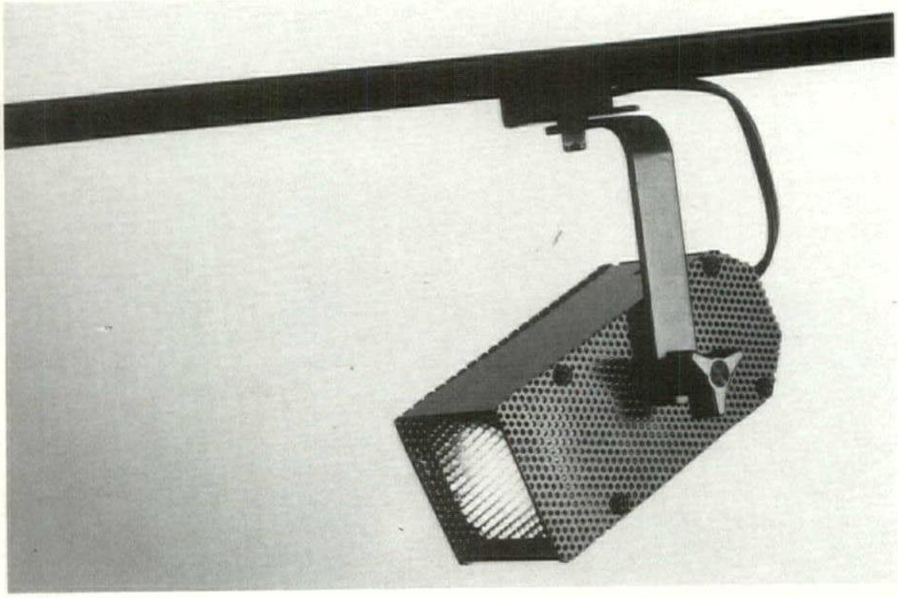
ARCHITECTURAL LIGHTING

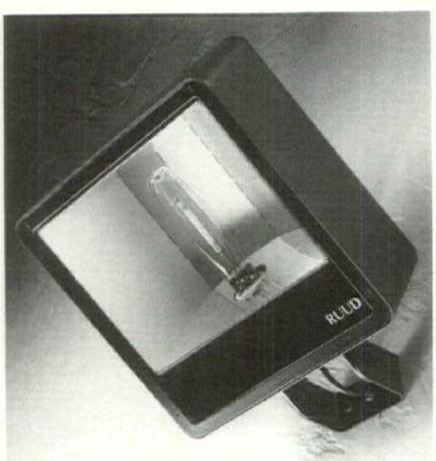
Product Showcase



MR16 track light

The Modena V MR16 track fixture from Luma Lighting features a ventilated housing of extruded, die-stamped aluminum, a heat-sink socket holder, and marine-grade stainless steel hardware. The fixture accommodates a 75-watt lamp and comes in a choice of a white or black powder coating. It operates at temperatures that allow adjustment after hours of operation. The fixture is compatible with the company's 500-watt-capacity miniature Starline track system, which has no straight or corner connectors and can run distances of up to 200 feet with nominal voltage drop. Luma Lighting Industries, Inc., Santa Ana, CA.

Circle 60



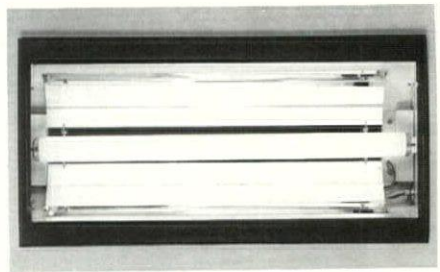
Yoke-mounted HID floodlights

Yoke-mounted high intensity discharge floodlights from Ruud Lighting deliver high illumination levels but reduce wind loading because of their compact size and soft-corner design, according to the manufacturer. Both the yoke brackets and the 16-inch-square, 6½-inch-deep housings are made of die-cast aluminum with a bronze powder coat finish. The bracket mount allows the fixture to tilt and lock at angles of 0, 20, 30, 60, or 90 degrees.

Gaskets and internal hinges hold a clear tempered glass lens in place. The luminaire comes with preinstalled high power factor multitap ballast, capacitor, and igniter. A 42-inch cord is included to allow for easy wiring. A variety of computer-designed optical systems are available.

The floodlights are suitable anywhere that tenons are impractical but adjustability is needed, such as mountings on the ground, on walls, or on square wood or steel poles. The floodlights are UL listed for wet locations and accommodate high pressure sodium or metal halide lamps up to 400 watts. Ruud Lighting, Inc., Racine, WI.

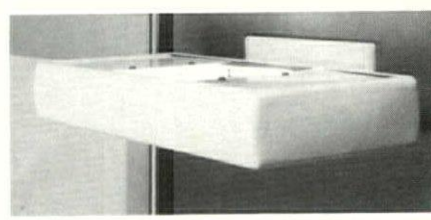
Circle 61



Optical reflector

Maximum Technology offers optical reflectors for fluorescent lighting fixtures. The reflector surface is covered with a 0.025-inch-thick layer of silver film that reflects 96 percent of incident light, according to the manufacturer. Installing optical reflectors enables users to reduce the number of lamps and ballasts in use, thereby cutting energy consumption for lighting by up to 50 percent. The reflectors are suitable for use in both new and retrofit applications. They are available for most types of fluorescent luminaires and can be ordered in custom sizes. Maximum Technology, Brisbane, CA.

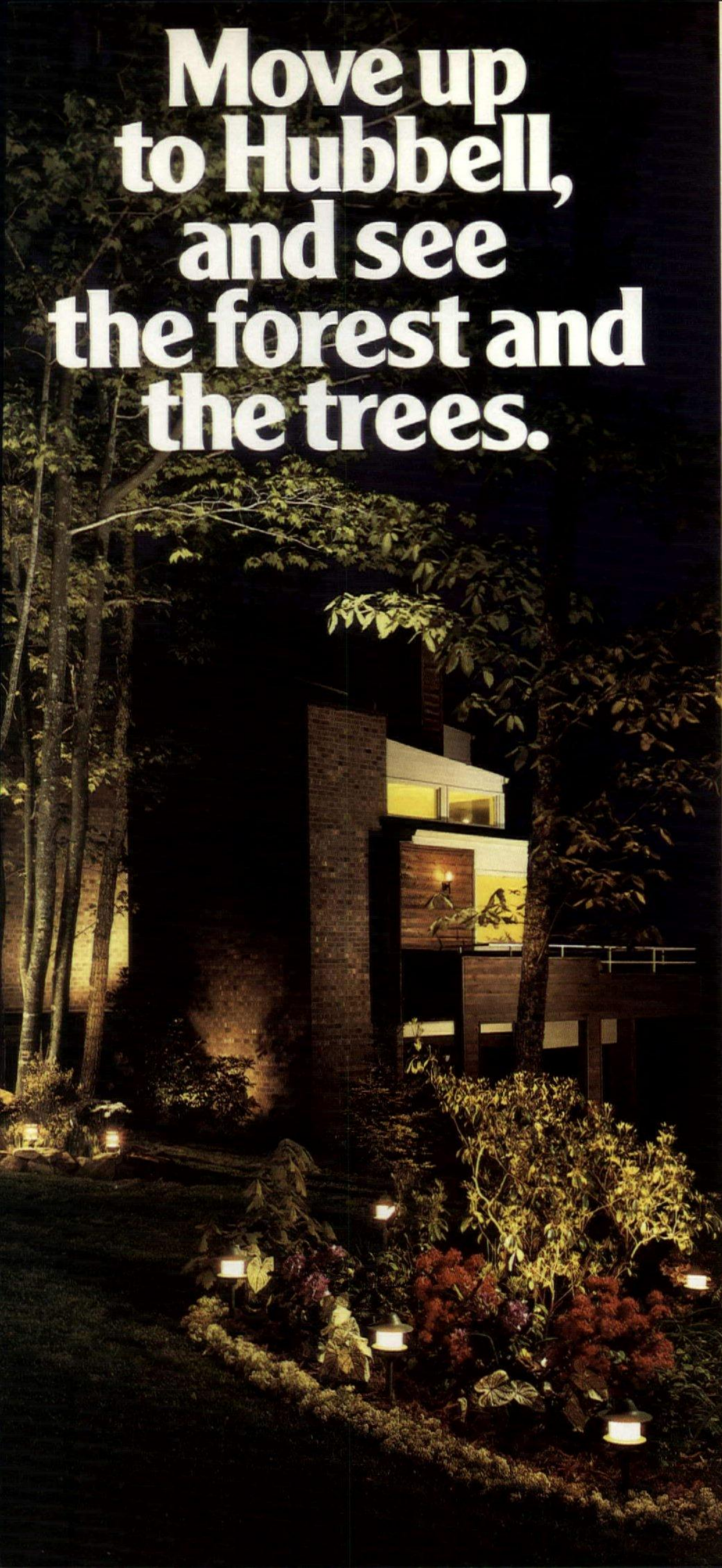
Circle 62



Indirect lighting

Guth Lighting's Spirit indirect lighting system features a symmetric reflector of textured specular aluminum that produces a wide distribution of shadow-free indirect illumination. The slim-profile luminaire is 2½ inches high and 7½ inches deep. It comes in lengths of 12, 18, 30, and 48 inches for single and dual lamp combinations for Osram's HQI compact metal halide lamps or biaxial lamps. Asymmetric reflectors are also available for directional control. The versatile system is available as a shelf unit or for partition, wall, or pendant mounting. Guth Lighting, St. Louis, MO.

Circle 63



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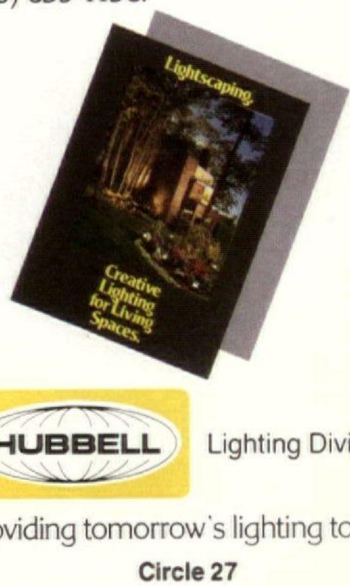

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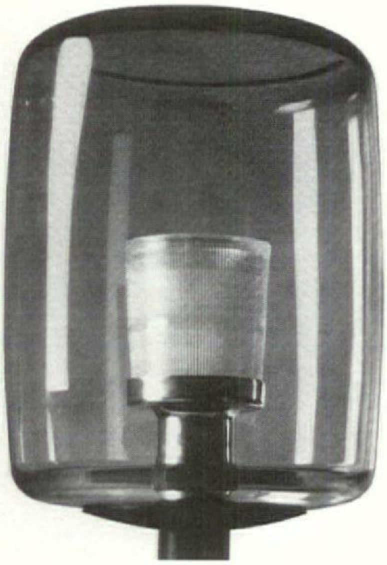
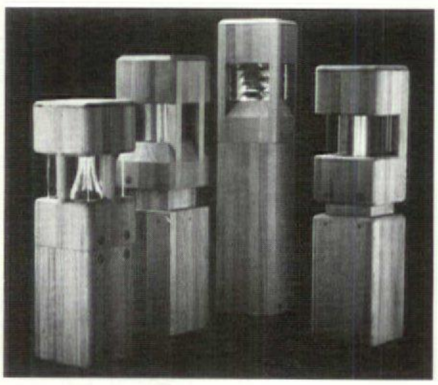
Circle 27



■ Outdoor globe

The THYB globe from TrimbleHouse has a heavy die-cast aluminum holder with a spring-loaded enclosure bracket. The vandalproof lens of one-piece seamless polycarbonate plastic is ultraviolet-stabilized for long life and color consistency. The globe is available in clear, amber, and smoke finishes and accommodates high pressure sodium lamps up to 250 watts. It is suitable for walkways, parks, and buildings. TrimbleHouse Corporation, Norcross, GA.

Circle 64

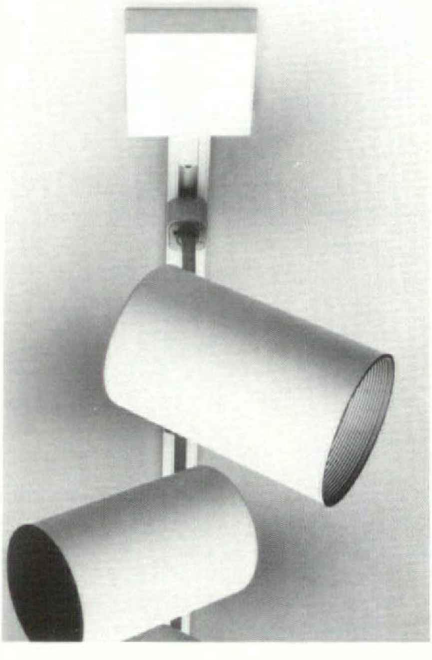


■ HID bollards

WoodForm's group 4000 bollards for high intensity discharge sources are made of kiln-dried, clear, all-heart California redwood for beauty and natural resistance to decay and insect attack. The 10½-inch-square bollards incorporate a concealed reflector assembly with a choice of cylindrical, conical, or parabolic glare-reducing optical systems.

The fixtures accommodate a variety of HID sources: 35-, 50-, 70-, or 100-watt high pressure sodium; 50-, 75-, or 100-watt mercury vapor; and 100-watt metal halide. They come with supply voltages of 120, 208, or 240. All models come in heights of 42, 48, 60, 72, and 84 inches; two 37-inch-high models are also available. Most designs can be special-ordered in Western red cedar, Alaskan yellow cedar, ash, oak, maple, or teak. WoodForm, Inc., Portland, OR.

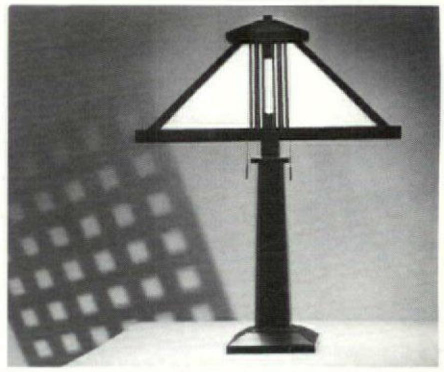
Circle 65



■ Track light controller

The Smart Start end connector from Capri Lighting allows users to control two sets of track lights from a standard wall switch without altering existing wiring. The device is mounted to an outlet box and attached to a new or existing two-circuit track from the company. When the wall switch is first turned on, all lamps light. Turning the switch off and on again activates fixtures installed on one circuit of the track. Turning the switch off and on a second time activates the other circuit. Capri Lighting, Los Angeles, CA.

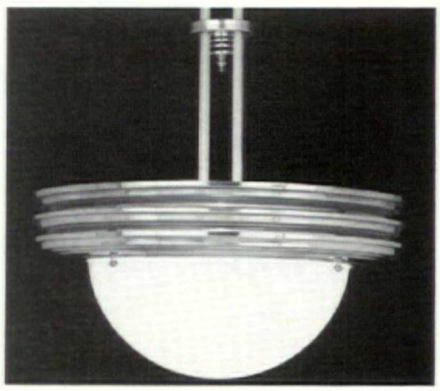
Circle 66



■ Table lamp

Jack Mitchell designed Boyd Lighting's Glasgow table lamp in a style reminiscent of the innovative turn-of-the-century designer Charles Rennie MacKintosh. The pyramid-shaped alder hardwood frame comes in two finishes — semigloss black lacquer or white limed natural satin. The translucent panels are of white flash glass or silver mica. The 26¼-inch-high, 20-inch-square lamp accommodates two 75-watt A19 lamps and has an on/off pull-chain switch. Boyd Lighting Company, San Francisco, CA.

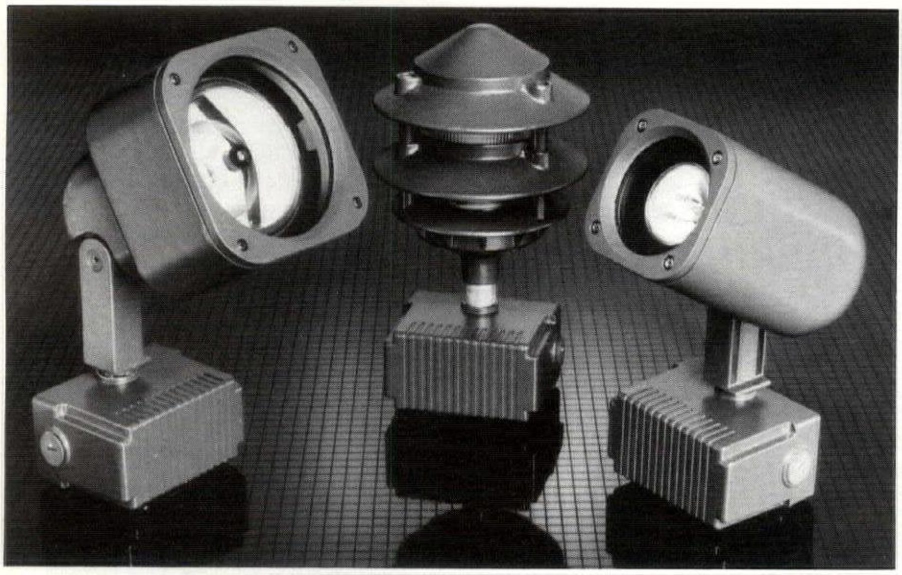
Circle 67



■ Hanging fixture

Art Directions offers authentic reproductions of period lighting fixtures, including this Art Deco style hanging luminaire from the Original Cast series. Three spun rims, two of brass and one of aluminum, encircle a wide luminous white acrylic dome. The 28-inch-diameter luminaire extends 42 inches from the ceiling and accommodates three 100-watt incandescent lamps. Art Directions, St. Louis, MO.

Circle 68

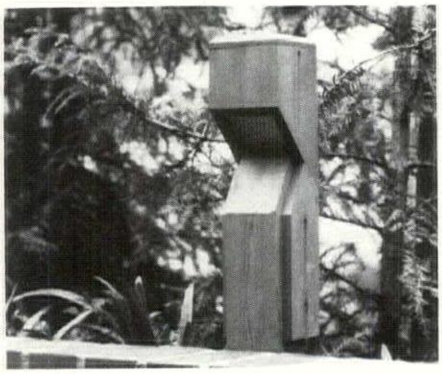


■ Landscape lighting

Imperial Bronzelite offers the LW Series low-wattage landscape lighting system, which includes three compact fixtures for miniature halogen and incandescent lamps in power distribution configurations for 12-volt to 12-volt, 120-volt to 12-volt, or 120-volt only.

The die-cast aluminum fixtures have heat-resistant lenses and full gasketing for durable, weatherproof operation. Transformers are included for the 12-volt to 12-volt and 120-volt to 12-volt systems. All fixtures have a weather-resistant, textured dark bronze powder finish that blends into the landscape. Accessories include photocell, cord and plug set, glare shield, connectors, and mounting brackets. Imperial Bronzelite, San Marcos, TX.

Circle 69

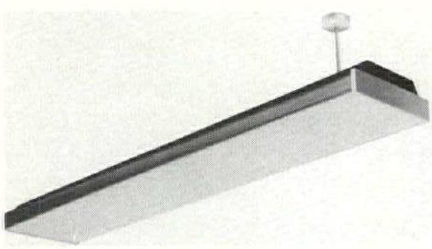


■ Walkway luminaire

The S-144BG is part of the Sylvan Lites line of walkway and landscape lights. The low-voltage walkway light is constructed of kiln-dried redwood for insect and decay resistance; the clear, vertical-grain wood provides extra strength and stability.

The luminaire measures $4\frac{7}{8}$ inches square and 18 inches high and is installed by direct burial. Relamping involves simply removing the top and replacing the 12-volt, 18-watt bayonet-base lamp. The walkway light comes in a standard natural, unstained redwood; it may also be treated with clear water seal, stained, or custom finished. Sylvan Designs, Inc., Northridge, CA.

Circle 70



■ Fluorescent wrap fixture

KLP's Aspen II fluorescent surface wrap fixtures deliver uniform low-brightness and high-efficiency illumination. A prismatic lens provides even, glare-free light distribution and is secured by opaque end caps to minimize the possibility of lens sag. The fixtures are available in two sizes: $10\frac{1}{4}$ by 49 inches and $10\frac{1}{4}$ by $97\frac{3}{4}$ inches. Both sizes are available for flush or suspended ceiling installation and may be used interchangeably with conventional fixtures. KLP, Wilmington, MA.

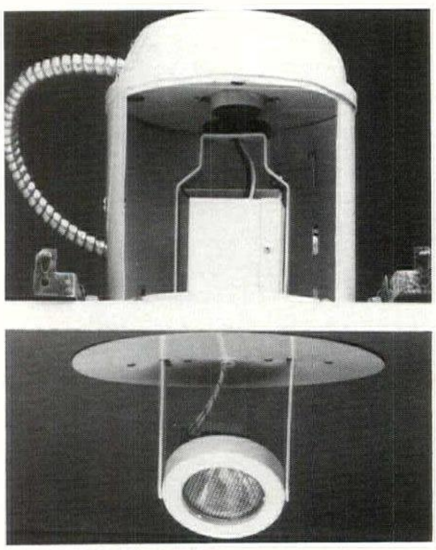
Circle 71

■ Outdoor ceiling luminaire

Jens Moller Jensen designed the Saturn ceiling luminaire from Poulsen Lighting, which has housing and components of heavy gauge galvanized steel. Four vertical struts join the luminaire's antiglare shield and the $10\frac{3}{5}$-inch-diameter reflecting ring, which simulates the rings of Saturn. A threaded glass envelope encloses the lamp compartment.

The luminaire is designed to be mounted over a standard recessed octagonal junction box and is UL listed for damp locations. The $8\frac{1}{2}$-inch-tall luminaire comes in gray, white, and natural galvanized finishes and accommodates a maximum 75-watt A19 clear lamp. Poulsen Lighting Inc., Miami, FL.

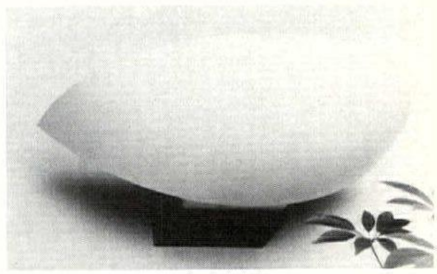
Circle 72



■ Retrofit fixtures

Low-profile retrofit fixtures from Roxter allow users to change from 110-volt systems to low-voltage systems without rewiring, according to the manufacturer. Pictured is a recessed high-hat fixture, model 9550, which accommodates a 50-watt MR16 lamp. Standard features for all models include a built-in transformer, a 360-degree ratchet socket, an adjustable flange cover, a universal swivel for unlimited lighting positions, and a white finish. Roxter Manufacturing Corp., Long Island City, NY.

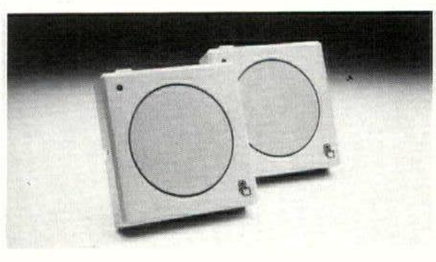
Circle 73



■ Metal halide uplight

Amerlux offers the UWM 100 wall-mounted uplight for double-ended metal halide lamps. The lamp's reflector system uses a controlled wide beam to produce an asymmetrical light pattern for glare-free ambient lighting. The white housing is available in round and square shapes, and the trim casting in white, red, or blue standard finishes. The uplight accommodates 70- and 150-watt double-ended metal halide lamps and is suitable for offices, corridors, entryways, lobbies, and large areas. Amerlux, Fairfield, NJ.

Circle 74

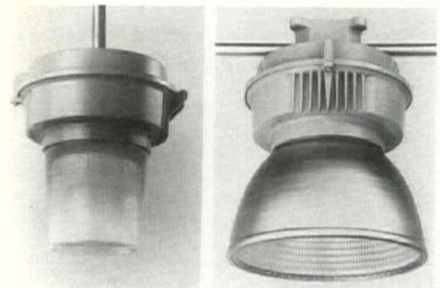


■ Automatic light switch

Watt Watcher's low-profile automatic light switches attach to normal switching boxes in less than 10 minutes without modification to walls or wiring, according to the manufacturer. Occupancy sensors monitor spaces up to 300 square feet, and the switches turn lights on when someone enters a room and off from 15 seconds to 10 minutes after it is vacated. An on-off switch and a logic bypass allow continued operation during a failure.

Models are available for both 120- and 277-volt systems: one for loads from 60 to 280 watts and another for loads from 250 to 800 watts. The UL-listed units have a three-year warranty. The Watt Watcher, Santa Clara, CA.

Circle 75



■ Hazardous location luminaire

Holophane's Petrolux II luminaire is designed to provide optimum light distribution, safe and reliable performance, and economical operation in indoor and outdoor hazardous environments. The luminaire is available in two enclosed, gasketed optical designs: a low-wattage refractor series with symmetrical or asymmetrical distributions and a reflector series for low and medium wattages with a prismatic borosilicate glass reflector and a spun-on aluminum cover.

The luminaire's hinged housing of heavy duty copper-free cast aluminum contains an integral ballast and has a polyester powder finish. It is UL listed for environments containing flammable gases and vapors, combustible dusts, or ignitable fibers and flyings, and is also suitable for wet locations.

The luminaire accommodates incandescent lamps of 200 watts, high pressure sodium lamps from 50 to 400 watts, mercury lamps from 100 to 400 watts, and metal halide lamps from 175 to 400 watts. Holophane, Newark, OH.

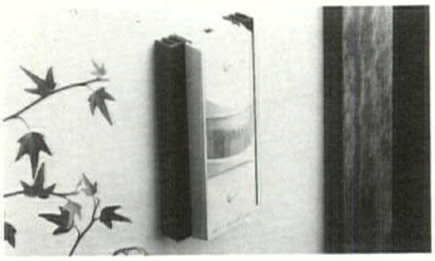
Circle 76

Circle 29

■ Software module

Lighting Technologies offers Lumen-Micro, a program for personal computers that allows designers to preview design solutions without expensive mock-ups or renderings. The program generates full color, perspective images that accurately and realistically illustrate the lighting effects of specified equipment in a space. Coupled with input from a video camera, these images can be used to show fully furnished spaces and can be stored on a VHS video tape for later presentations. Lighting Technologies, Boulder, CO.

Circle 77

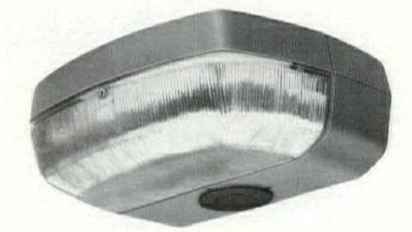


■ Lighting controller

Hubbell's H-Moss 500 wall switch sensor controls lights automatically when it senses whether the room it monitors is occupied or vacant. It turns off lights 12 minutes after the room is vacated.

The electronic, box-mounted, passive infrared sensor is designed for use in private offices of up to 500 square feet. Its field of view is 90 degrees by 25 feet deep. The sensor fits all standard one- and two-gang wall switch boxes. Users can adjust a built-in control switch for automatic or manual light control. Hubbell Incorporated, Wiring Device Division, Bridgeport, CT.

Circle 78

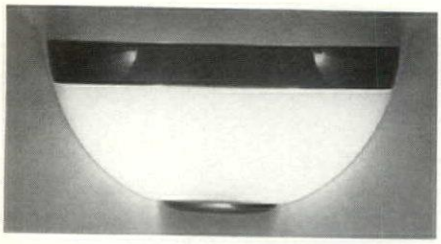


■ Outdoor light

McPhilben's Sitelite 2 outdoor luminaires have die-cast aluminum housings with impact-resistant polycarbonate prismatic diffusers. The wall-mounted model 2A (shown here) is available in black, gray, red, green, and dark bronze finishes. It accommodates a 50-watt mercury lamp, 35- and 50-watt high pressure sodium lamps, two 13-watt compact fluorescent lamps, or a 100-watt incandescent lamp. The luminaire comes with high power factor ballasts for the HID lamps or a normal power factor ballast for 13-watt compact fluorescent lamps.

Other models can be mounted on walls, poles, or ceilings; all are UL listed for wet locations. The luminaires are suitable for applications such as walkways, parking areas, swimming pools, and gardens. McPhilben Lighting Division, Emerson Electric Co., Melville, NY.

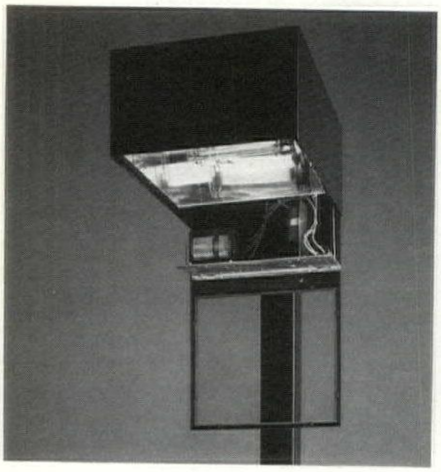
Circle 79



■ Wall sconce

DEC USA's Tilt wall sconce, designed by Federico de Majo and Ezio Rizzetto, features a 12-inch-diameter shade of hand-blown, double-cased Murano glass. The two-color shade has a frosted glass bowl with a rim of cobalt blue, clear, or frosted glass. The wall sconce accommodates two 60-watt incandescent lamps. It is part of a collection that includes a 14-inch-diameter sconce as well as pendant, table, and flush-mount lamps in the same design. DEC USA, Mount Vernon, NY.

Circle 80



■ HID luminaires

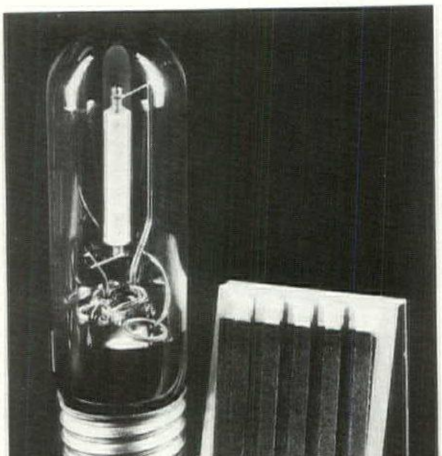
JW Lighting's JPL Series 20 high intensity discharge luminaires offer a broad range of distribution types. Their reduced weight and projected areas lessen pole loads, according to the manufacturer. The luminaires have ballast assemblies and doors that hinge toward the pole for easy installation and maintenance. They come in three basic sizes to accommodate high pressure sodium and metal halide lamps from 70 to 1000 watts. JW Lighting, Inc., Houston, TX.

Circle 81

■ Dimmers

The RT 81 dimmer has sliding controls for 300-watt floor or table lamps and is available in black and white. It is part of the Relco line of dimmers distributed in the United States by Lazin Lighting. The UL-listed dimmers are designed in Italy and manufactured to U.S. specifications. They are protected by a fuse and do not interfere with radio signals, according to the distributor. The line includes both in-line and built-in dimmers that can regulate incandescent and halogen sources from 150 to 500 watts. Lazin Lighting Inc., New York, NY.

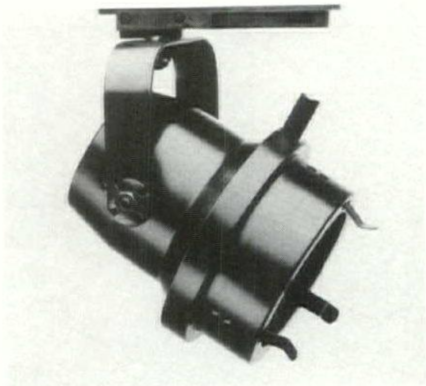
Circle 82



■ HPS lamp

C.E.W. Lighting offers Iwasaki's Daylux lamp, which resolves the coloring problems of high pressure sodium lamps for display and downlighting, according to the distributor. The low-wattage white lamp operates on a standard HPS ballast and has a color rendering index of 85, for light comparable to incandescent. The lamp is less than 4 inches high, making it suitable for indoor displays and general downlighting. It will operate in any burn position and has an average life of 12,000 hours. The lamp is available with a medium base in wattages of 50, 100, and 150. C.E.W. Lighting, Inc., Dallas, TX.

Circle 83



■ Spotlight

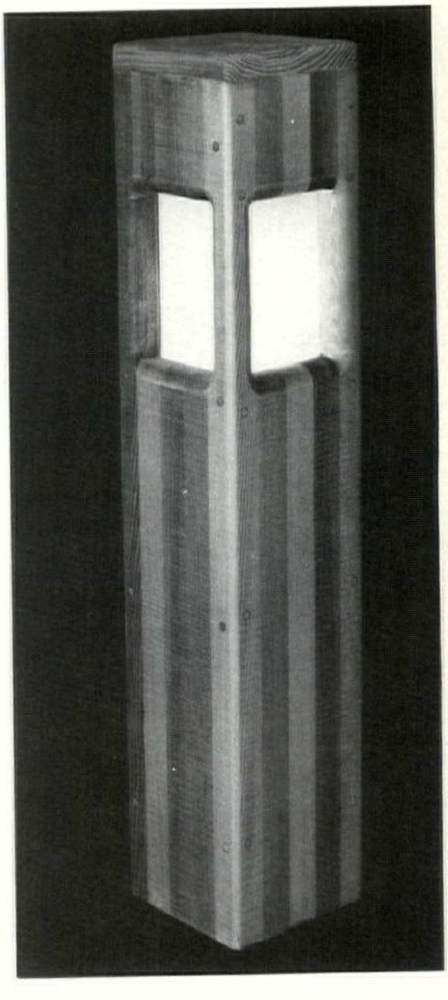
The 280 series spotlight from Lighting Services is a compact specification-grade fixture designed for 50- and 75-watt PAR 30 lamps. It also accommodates 100-watt MR16 medium screw base 120-volt lamps. The fixture accepts all the company's size A accessories, including glass color filters, louvers, hoods, light blocking screens, and spread lenses. All units are UL listed and are available with optional integral dimmers. Standard paint finishes are black, white, and silver aluminum. Lighting Services Inc., New York, NY.

Circle 84

■ Halogen wall sconce

The FP series wall sconce is one of four models in Elliptipar's Ensconce line that can accommodate halogen lamps from 150 to 350 watts. The sconce incorporates a variable cutoff shield and an adjustable asymmetric reflector that projects light evenly across surfaces. It is suitable for use in hallways, lobbies, stairways, theaters, offices, and similar applications. Elliptipar, West Haven, CT.

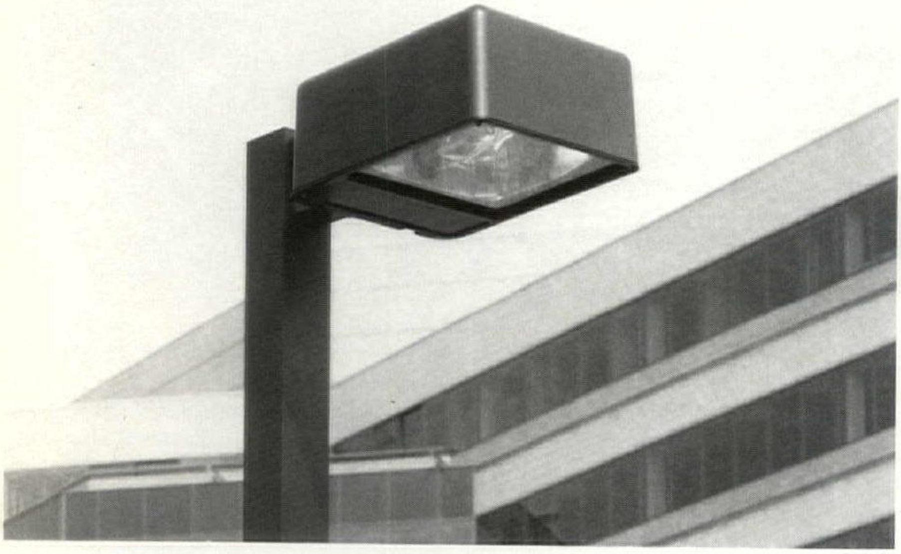
Circle 85



■ Wood bollards

Idaho Wood offers commercial-grade bollards of solid 1½-inch-thick glue-laminated cedar with acrylic diffusers. The 7½-inch-square luminaires are fastened with screws that are flush-plugged. They are wired complete to a concealed steel base that attaches to a concrete pad with four J bolts. Models for 100-watt incandescent lamps are available in heights of 18 and 36 inches. A 36-inch-high model accommodates 35-, 50-, and 70-watt high pressure sodium lamps. Idaho Wood Industries, Inc., Sandpoint, ID.

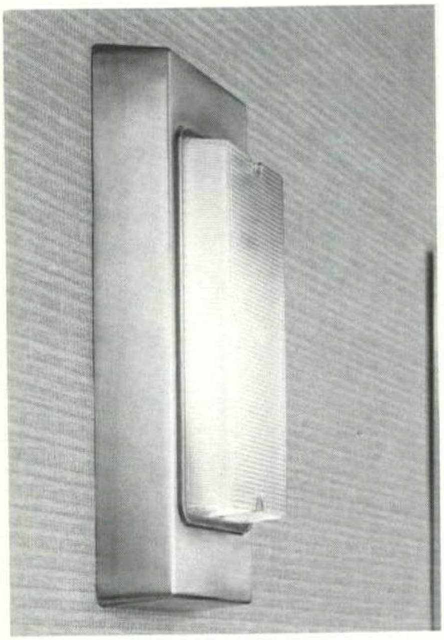
Circle 86



■ **Cutoff luminaire**

Hadco's new Performance Plus series luminaires provide uniform, glare-free Type III cutoff illumination for most outdoor lighting applications. The luminaires are available in a large size for pole heights from 12 to 35 feet and a small size for pole heights from 3 to 15 feet. The fixtures are constructed of precision die-cast aluminum for durability and are finished with a burnished bronze powder coat for lasting beauty. The small model accommodates a 150-watt high pressure sodium lamp or a 100-watt mercury lamp; the large model accommodates high pressure sodium and metal halide lamps up to 400 watts. The luminaires are backed by Hadco's three-year limited warranty. Hadco, Littlestown, PA.

Circle 87

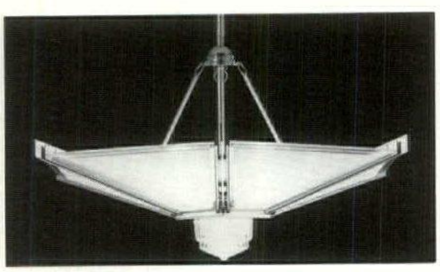


■ Security light

The model 3384 security light from Gim Metal Products has a rugged die-cast construction with separate lamp, ballast, and igniter compartments for extended lamp and ballast life. The unit features a vandal-resistant, injection-molded polycarbonate lens, is UL listed for wet locations, and may be mounted on walls or ceilings.

The luminaire is designed to accommodate a variety of lamps: one or two 13-watt twin-tube fluorescent, one 26-watt double twin-tube fluorescent, 35- and 50-watt high pressure sodium, or 10-watt low pressure sodium. The unassembled fixture components are available to OEM lighting manufacturers. Ballasts, lamps, sockets, and plastic lenses must be purchased separately. Gim Metal Products, Inc., Carle Place, NY.

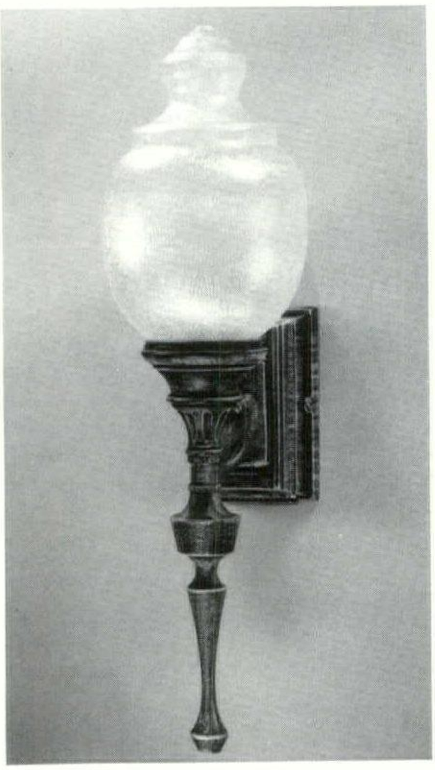
Circle 88



■ Pendant lamp

The L'Avenir 750 pendant lamp is part of a series created by the Sonneman Design Group and available from L'Image. The fixture's casing comes in chrome or polished brass. Its sandblasted, ribbed glass diffuser has a molded glass base. The stem-hung hexagonal fixture has a 12-inch and a 24-inch rod to allow overall hanging lengths of 29, 41, or 53 inches. The fixture itself measures 26½ inches in diameter and 14½ inches high. It accommodates four medium-base 100-watt A19 lamps. L'Image, St. Albans, VT.

Circle 89



■ Ornamental globe

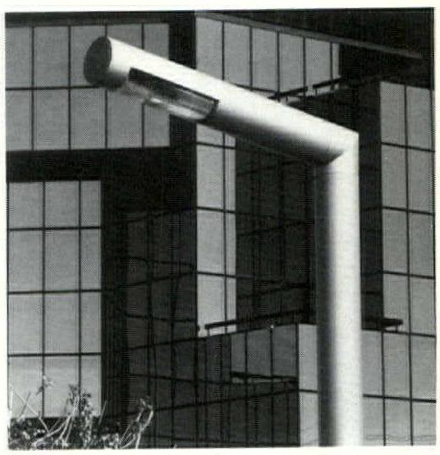
Sternberg has added a smaller model to its A850/A840 series of textured polycarbonate acorn-shaped globes. The 8-inch by 13-inch globe, model A830, can be used by itself on posts, piers, hanging units, or wall brackets or coordinated with larger models. It is designed for a 35- or 50-watt high pressure sodium or a 50-watt mercury lamp. The larger globes accommodate 250-watt mercury, 175-watt metal halide, or 150-watt high pressure sodium lamps. Sternberg Lanterns Inc., Chicago, IL.

Circle 90

■ Low-voltage outdoor lighting

The Footliter from Nightscaping produces a glare-free circle of low-level illumination 14 feet in diameter. The manufacturer notes that a unique electrostatic process for bonding a powder coating to the all-metal fixture increases its resistance to impact, weathering, and air pollutants and extends its life to 10 years. The spike-mounted luminaire is 10 inches high and comes with a 12-volt, 12.3-watt LL93 lamp. Nightscaping, division of Loran, Inc., Redlands, CA.

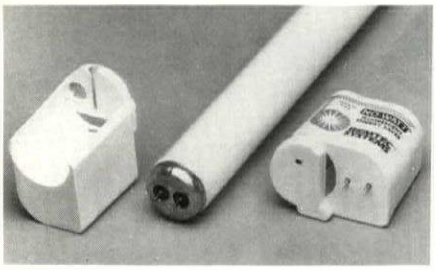
Circle 91



■ Exterior area lighting

Kim Lighting offers the OTS outdoor tube lighting system. The system is available in 6- and 8-inch-diameter tubes that range from 12 to 30 feet in height. Single, dual, or quad mounting configurations make the system suitable for a variety of applications, including parking lots, pathways, courtyards, and streets. The outdoor tube system accommodates high intensity discharge lamps from 70 to 400 watts. Kim Lighting, City of Industry, CA.

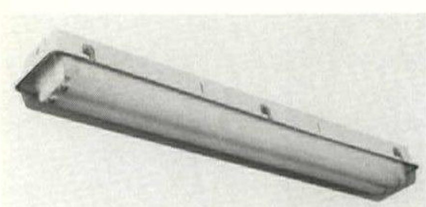
Circle 92



■ Fluorescent energy saver

Remtec Systems features the No-Watt snap-on energy saver for limiting the amount of electrical output a ballast sends to F30 and F40 rapid start lamps. Lamp circuit voltage remains constant while the decrease in current flow reduces wattage and the lamps' lumen output proportionally. The device is available in models for wattage reductions of 20, 30, or 50 percent. A self-tapping screw holds the device in place during lamp changes. It can be installed or removed easily in 2-foot by 4-foot fixtures, making it useful for business relocations and leased spaces. Remtec Systems, Duarte, CA.

Circle 93



■ Industrial luminaire

The Series 86 industrial luminaire from H.E. Williams is available in a UL-listed model that has factory-installed watertight fittings, making it suitable for wet locations. The unit's lamps are accessible without tools, and its acrylic lens attaches to the housing with tension clamp latches. The luminaire accommodates one or two fluorescent lamps. Options include rapid-start, slimline, and high-output models, a National Sanitation Foundation–listed enclosure, and tamper-resistant latches. H.E. Williams, Carthage, MO.

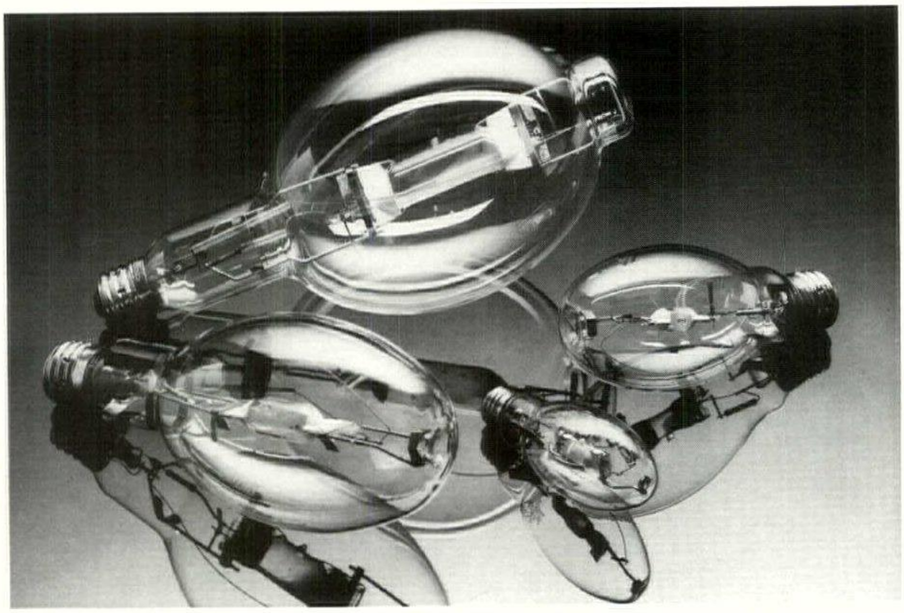
Circle 94

Circle 35

■ Outdoor luminaire

Brilliant Lighting offers wall-mounted Mars outdoor luminaires. The 8½-inch high luminaire extends 8¾ inches from the wall. It comes in a black or white finish and accommodates a maximum 100-watt E26 lamp. Post-top and ground-mounted models in the same style are also available. Brilliant Lighting Inc., San Fernando, CA.

Circle 95

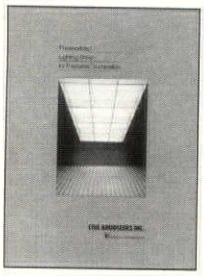


■ High-output metal halides

Venture Lighting International's horizontal operation Super Pro-Arc metal halide lamps come in wattages from 70 to 1650. They require the use of position-oriented sockets and can be operated as much as ±45 degrees off horizontal. These lamps provide 25 percent more light output in the horizontal burning position than do universal lamps burned in the same position, according to the manufacturer. All wattages come with a clear glass bulb; 175-, 250-, and 400-watt lamps are also available with phosphor-coated glass bulbs. Venture Lighting International, Cleveland, OH. ■

Circle 96

Product Literature



■ Anodized sheets

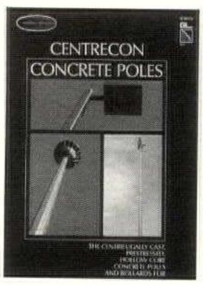
Coil Anodizers explains the advantages of its anodized aluminum sheets in a brochure that includes sheet sizes, specifications, and a graph showing the relative reflectivity of various surfaces. Coil Anodizers Inc., Muskegon, MI.

Circle 120

■ Outdoor luminaire

A brochure provides specifications, dimensions, and sketches of the Charles from Welsbach Lighting. The fixture, pole, bracket, and base are available as a complete unit or as retrofit components. RWL Corporation, New Haven, CT.

Circle 121



■ Concrete poles

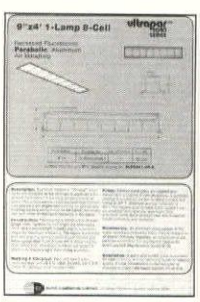
Centrifugally cast, prestressed, hollow-core concrete poles and bollards are described in a brochure that contains color photos of aggregate textures in two surface finishes and six colors. Centrecon Inc., Everett, WA.

Circle 122

■ Floor lamp

The Graal series, designed by Gabriella Montaguti, includes a floor lamp with a dimmer that accommodates a 300-watt halogen lamp. A data sheet gives details on dimensions and finishes. Thunder & Light Ltd., New York, NY.

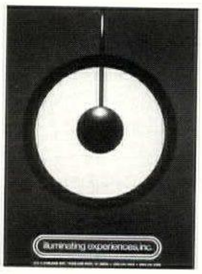
Circle 123



■ Parabolic luminaire

The Ultrapar 9040 series includes a 9-inch by 4-foot parabolic luminaire with eight cells that is compatible with most standard ceiling systems. A data sheet details important features. Globe Illumination Company, Gardena, CA.

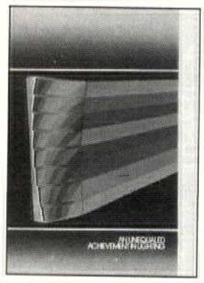
Circle 124



■ Lighting collection

A color brochure contains a selection of chandeliers, wall sconces, pendant lamps, wall- and ceiling-mounted fixtures, and floor and table lamps. Illuminating Experiences, Inc., Highland Park, NJ.

Circle 125



■ Indirect lighting

The Tempo II dual source indirect lighting system combines a metal halide lamp and a high pressure sodium lamp in a unit surrounded by a multifaceted specular reflector. A brochure describes features and components. Forum Inc., Pittsburgh, PA.

Circle 126

■ Lighting panels

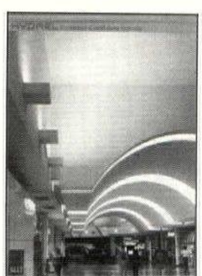
The KSH-24 acrylic prismatic lighting panels in gold or black combine three separate light control techniques. A brochure includes photometric data and general specifications. K-S-H Inc., St. Louis, MO.

Circle 127

■ Fluorescent floodlights

A data sheet on Omegalux 1200 series floodlights for compact fluorescent lamps lists models, specifications, options, and energy cost comparisons. Western Lighting Industries, Inc., North Hollywood, CA.

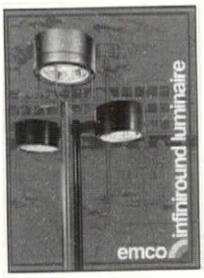
Circle 128



■ Area lighting

The Hypak system of high performance controlled cutoff luminaires for HID sources comes in two sizes. A 28-page color brochure illustrates a variety of applications and provides detailed technical information on all system components. Hydrel, Sylmar, CA.

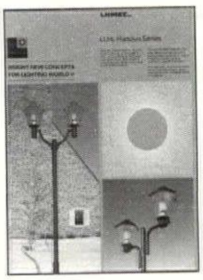
Circle 129



■ Round area lights

Infiniround luminaires are designed to match the performance of square fixtures. A brochure details five available optical systems, options for pole-side and pole-top mounting configurations, and general specifications. Emco Environmental Lighting, Milan, IL.

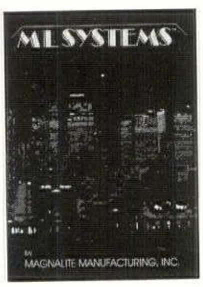
Circle 130



■ Pole-top luminaires

LLHL Histolux pole-top luminaires feature Rotomatic quarter-turn fasteners. A brochure details pole heights, mounting configurations, finishes, and lamp types and wattages. Lumec Inc., Boisbriand, Quebec, Canada.

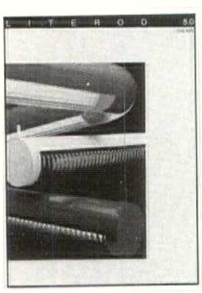
Circle 131



■ Specular reflectors

ML Systems specular reflectors are made of anodized, polished aluminum alloy. A brochure explains installation, fabrication, and cost and energy savings. Magnalite Manufacturing, Inc., Bridgewater, NJ.

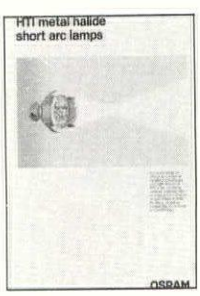
Circle 132



■ Linear lighting

Coast Light Systems offers an 8-foot version of the extruded aluminum Literod system for direct or indirect illumination. A leaflet details lengths, accessories, mountings, and finishes. Coast Light Systems, Los Angeles, CA.

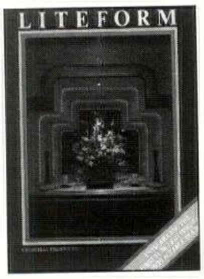
Circle 133



■ Short arc lamps

The HTI metal halide short arc lamps are designed for AC operation and come in models with and without reflectors. An illustrated brochure describes construction, photometrics, and operation. Osram, West Haven, CT.

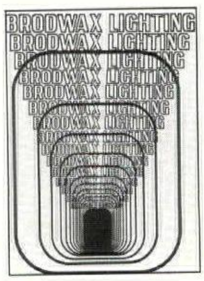
Circle 134



■ Replaceable tube lights

The Liteform low-voltage tube light system allows burned-out lamps to be replaced without removing fixtures or touching wires. A brochure describes replacement procedures and models for various mounting options. Celestial Products, North Hollywood, CA.

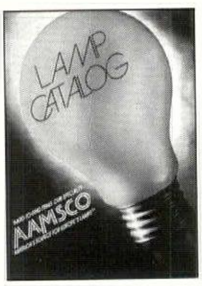
Circle 135



■ Fluorescent luminaires

Brodwax Lighting's color catalog shows a collection of luminaires for linear, circular, and U-shaped fluorescent lamps. The luminaires feature acrylic diffusers; many have oak or walnut frames. Brodwax Lighting Corp., Island Park, NY.

Circle 136



■ Specialty lamps

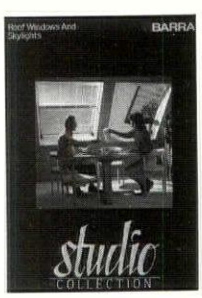
A catalog details a representative sampling of Aamsco's line of specialty and hard-to-find sources, including photo and studio lamps, miniature lamps, neon glow lamps, and incandescent tubular lamps. Aamsco, Jersey City, NJ.

Circle 137

■ Fiber glass poles

Highline's 100, 200, and 300 series direct burial lighting poles of nonconductive fiber glass resist combustion and corrosion. A data sheet lists features, options, and heights for each model. Highline Products Corporation, Old Saybrook, CT.

Circle 138



■ Skylights

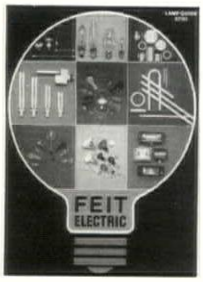
A brochure profiles the Studio collection of roof windows and skylights from Barra. It lists standard specifications, construction details, accessories, and options. Barra Corporation of America, West Caldwell, NJ.

Circle 139

■ Outdoor lighting

An 8-page color brochure illustrates a selection of nine of Hanover Lantern's commercial outdoor fixtures along with matching posts and accessories. Specifications, photometrics, and available finishes are included. Hanover Lantern, Hanover, PA.

Circle 140



■ Lamps

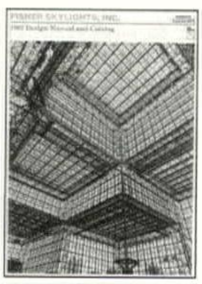
A 51-page lamp guide lists specifications and ordering information for the company's incandescent, fluorescent, halogen, HID, low pressure sodium, and specialty lamps. Feit Electric Company, Los Angeles, CA.

Circle 141

■ Outdoor luminaires

A brochure from Bega/FS profiles a variety of exterior lighting options, including wall and ceiling luminaires, floodlights, spherical globes and pole-tops, bollards, and garden luminaires. Bega/FS, Santa Barbara, CA.

Circle 142



■ Commercial skylights

A 27-page design manual and catalog contains sketches, specifications, and photos of applications for metal-framed, roll-away, and ventilating skylights in several designs. Fisher Skylights, Inc., West Nyack, NY.

Circle 143

■ Design software

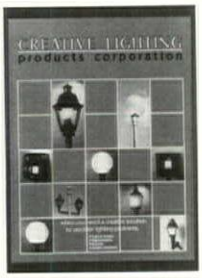
Micro-Site-Lite is a microcomputer version of a software package for outdoor lighting design and analysis; it includes applications for roadways, areas, sporting events, and floodlighting. Lighting Sciences Inc., Scottsdale, AZ.

Circle 144

■ Bollards

A brochure illustrates a collection of bollards in square, round, octagonal, and domed styles with a choice of five optical systems and several different light sources. U.S. Pole Company, Inc., Sun Valley, CA.

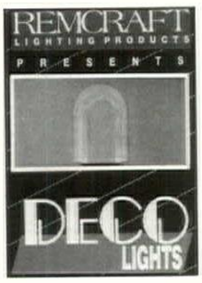
Circle 145



■ Outdoor luminaires

A brochure featuring Creative Lighting's outdoor products includes lamping requirements for 12 standard fixtures and examples of custom work. Creative Lighting Products Corporation, Allegan, MI.

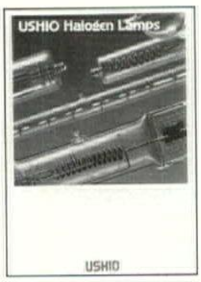
Circle 146



■ Wall sconces

A color brochure illustrates the Normandy model from the Deco Lights line of wall sconces, which comes in five colors and accommodates incandescent or compact fluorescent sources. Remcraft Lighting Products, Miami, FL.

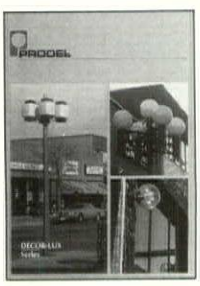
Circle 147



■ Halogen lamps

A 30-page catalog profiles Ushio's line of halogen lamps for a variety of applications, including floodlighting, studio lighting, shop lighting, and optical instruments. Ushio America, Inc., Torrance, CA.

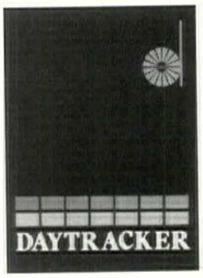
Circle 148



■ Pole-top luminaires

A brochure featuring the Decor-Lux series provides information on styles, optical systems, dimensions, voltages, light sources, and mounting configurations. Included are color photographs of each style. Prodel Inc., Beauport, Quebec, Canada.

Circle 149



■ Daylighting system

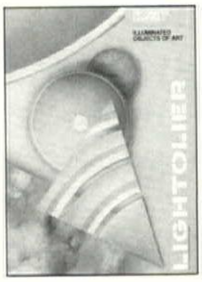
The Daytracker daylighting system provides uniform, high-quality natural illumination indoors. The interactive system has a sun-tracking mirror, a reflective light tunnel, and a diffusing lens. International Daytracking Systems, Inc., San Diego, CA.

Circle 150

■ Entertainment lighting

Ness Imports distributes Clay Paky novelty lighting products. A brochure contains color photos of projectors, adapters, special effects devices, and accessories. Ness Imports Inc., Hackensack, NJ.

Circle 151



■ Decorative fixtures

A brochure from Lightolier illustrates luminaires in faux stone, alabaster, and etched glass. Descriptions and color photos of each luminaire are included. Lightolier Incorporated, Secaucus, NJ.

Circle 152

■ Parking structure luminaire

The 410 Series parking structure luminaire from QL is made of stainless steel for maximum durability. A brochure discusses components, optics, mounting, layouts, and specifications. QL Inc., Northbrook, IL.

Circle 153

■ Occupancy sensors

A data sheet lists product specifications and describes advantages of retrofitting existing wall switches with two-wire passive infrared occupancy sensors to control lighting automatically. Sensor Switch, Inc., Branford, CT. ■

Circle 154

Calendar

November 10, 1987
HQI fixtures and lamps: How to specify, DLF panel discussion, San Francisco. Contact: Paula Goodell, Northern California Designers Lighting Forum, P.O. Box 1429, San Francisco, CA 94101, (415) 550-0333.

November 16–18, 1987
Lighting conference for plant engineers, short course on modern plant lighting and its contribution to productivity, GE Lighting Institute, Cleveland. Contact: Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

November 18, 1987
Office lighting, DLF event, New York. Contact: Sy Bollinger, Designers Lighting Forum of New York, (212) 255-8555.

November 18–19, 1987
Build Boston '87, convention and trade show, World Trade Center, Boston. Sponsored by the Boston Society of Architects and includes the National Architectural Research Conference. New services, products, and technologies and more than 70 workshops. Contact: Paula DiFoggio, Build Boston '87, BSA, 10 Midland Avenue, Newton, MA 02158, (617) 965-0055.

November 18–20, 1987
Lighting conference for utility marketing/sales representatives, General Electric Lighting Institute, Cleveland. For and limited to public and private utility people involved in promoting energy-efficient lighting to commercial, industrial, and institutional customers. Contact: Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

November 20, 1987
Sports lighting: An evening at the races, IES Golden Gate Section event, Bay Meadows Race Track, San Mateo, CA. Presentation by David Malman. Contact: Jamie Anderson, Lighting Studio, 1808 4th Street, Berkeley, CA 97410, (415) 843-3468.

November 30–December 4, 1987
Fundamentals I, short course, General Electric Lighting Institute, Cleveland. The course covers basic aspects of indoor commercial and industrial lighting. Early registration is recommended. Contact: Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

December 7–9, 1987
Electrical contractors lighting conference, GE Lighting Institute, Cleveland. Contact: Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

December 8, 1987
All-industry Christmas party, a benefit for the Marine Corps Toys for Tots program, Galleria Design Center, San Francisco. An event for the entire design community. Admission charge plus an unwrapped new toy. Contact: Ben Langwick, 25 Rhode Island, San Francisco, CA 94103, (415) 626-1005.

December 13, 1987
Lighting design workshop, Tallahassee, FL. Jane Grosslight will discuss the use of graphics to communicate lighting ideas, how to get more daylight into dim interiors, ways to design scenes for programmable dimmers, and lighting principles and applications. Contact: Amy Kemler, Center for Professional Development and Public Service, Florida State Conference Center, Florida State University, Tallahassee, FL 32306, (904) 644-3801.

December 14–16, 1987
Fundamentals II, short course in commercial and industrial lighting, General Electric Lighting Institute, Cleveland. Contact: Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

January 30, 1988
Entry deadline for the 1987 Edison Award. Competition open to lighting professionals who use a significant number of GE lamps in a lighting design project. Contact: Mr. F.F. LaGiusa, Chairman, Edison Award Competition, General Electric Company, Nela Park #4162, Cleveland, OH 44112. ■

Manufacturer Credits

Simple elements create sophisticated atmosphere (Bubbles Restaurant, Newport Beach, California). Standard generic low-voltage PAR fixtures, incandescent wall sconces, concealed neon.

Luminaire combats small office banality (Steuben County Office Building, Bath, New York). Luminaires: **Mark Lighting.** Lamps: **General Electric.** Lumen-Micro analysis software: **Lighting Technologies.**

Engineers test factory fixtures with hammers (Tobaccoville cigarette manufacturing complex, Winston-Salem, North Carolina). 150-, 250-, and 400-watt high pressure sodium fixtures: **Hubbell Lighting Division.**

Daylight turns austerity into a winner (Vista Station Post Office, Salem, Oregon). High pressure sodium fixtures: **Hubbell Lighting Division.** Controls: **Simplex.** Fluorescent fixtures: **Hun Industries** and **Sun-Light Manufacturing.**

Museum of Flight: A flight into light (Museum of Flight, Seattle, Washington). Heat mirror glazing: **Southwall Technologies.** Triple-glazed reflective glass: **Alpine Industries.** Low-voltage photoelectric controls: **Multipoint Controls.** Metal halide fixtures and photoelectric controls: **Wide-Lite Corporation.** Ellipsoidal reflector spotlights: **Strand Century.** Low-voltage track lighting: **Capri.** 9-lamp MR16 fixtures: **Lighting and Electronics.**

Cinema lighting brings back movie magic (Arbor Cinema Four, Austin, Texas). Exterior ornamental fixtures: **Sternberg Lanterns.** Light strips and ceiling skylight panels: **Tivoli Industries.** Concession counter hidden edge lights, logo backlight, minispots, and canopy downlights: **Lightolier.** Concession canopy top: **The Satrup Company.** Concession canopy bottom soffit: **J. Boyle & Company.** Exterior lobby glass: **PPG Industries.**

Advertiser Index