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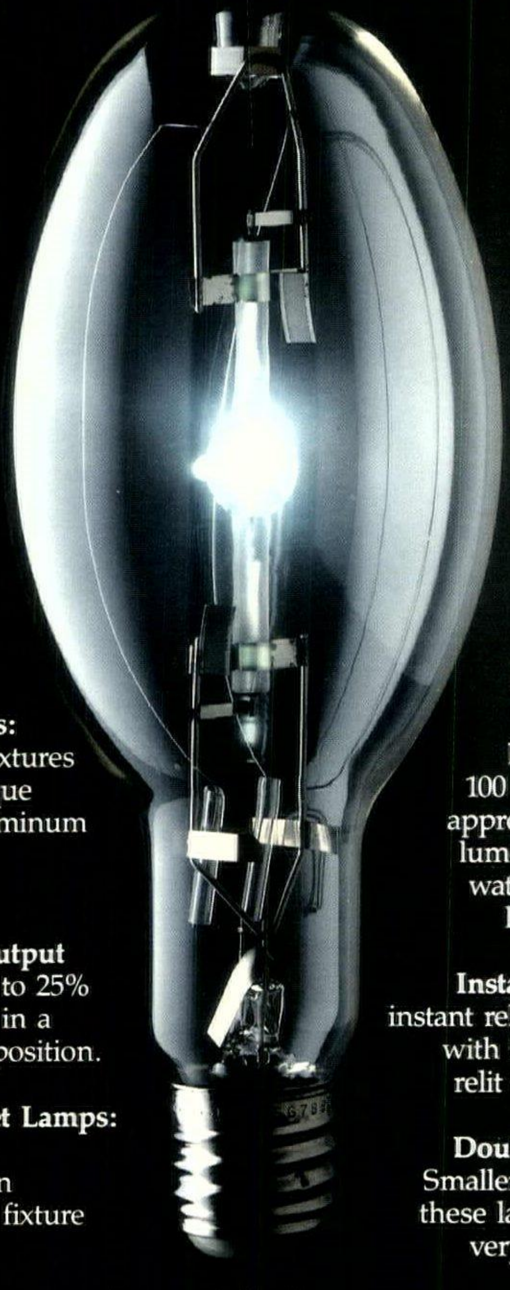

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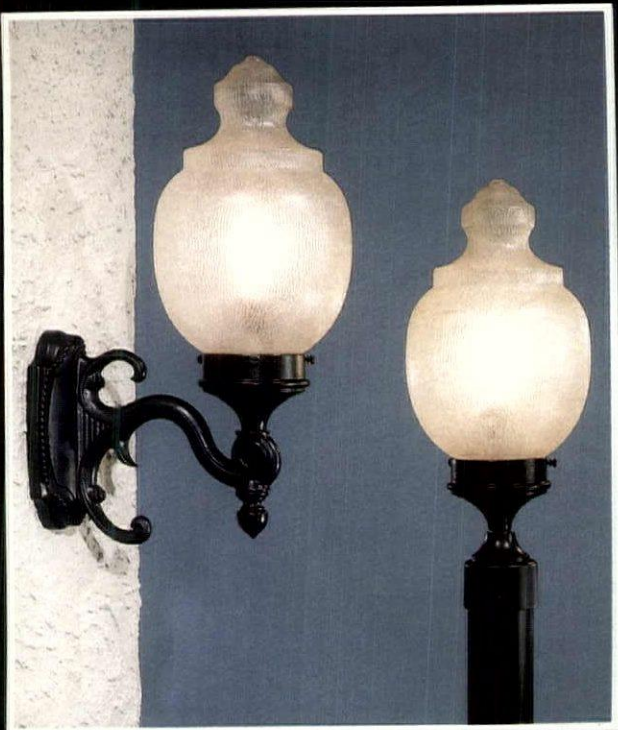

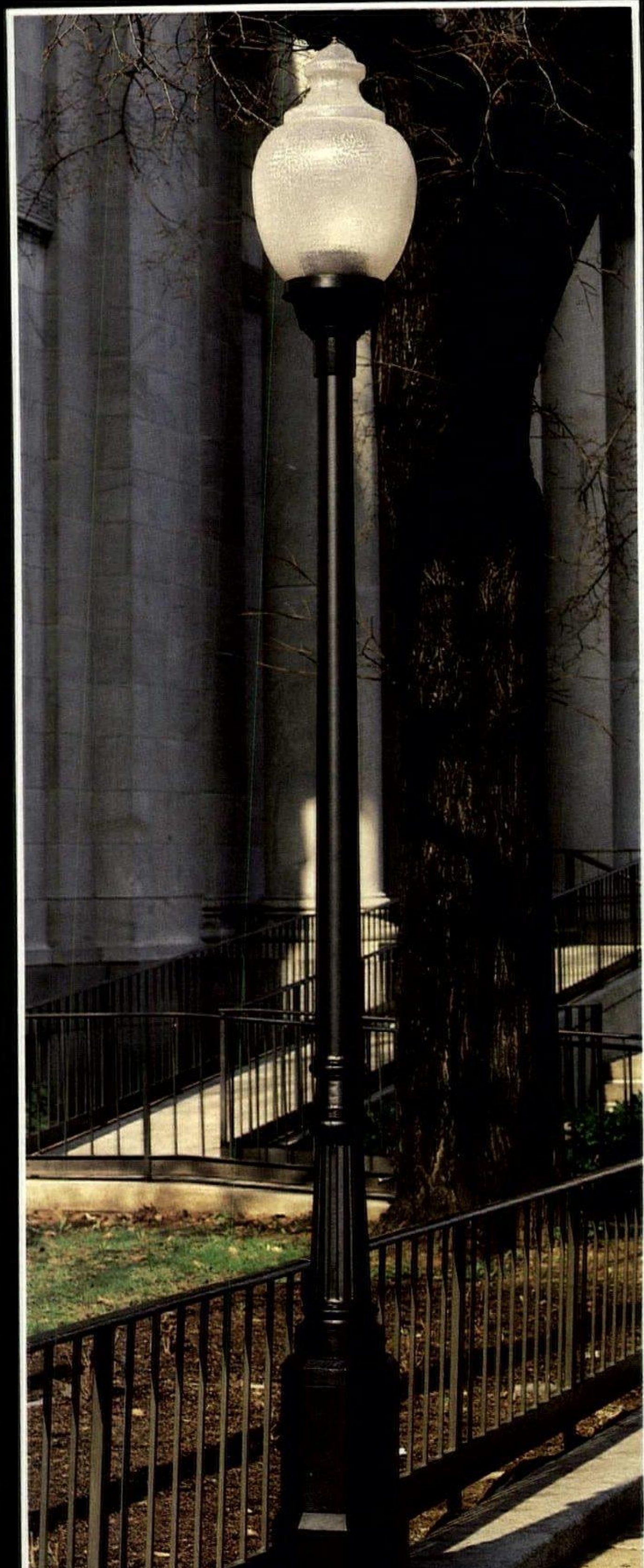

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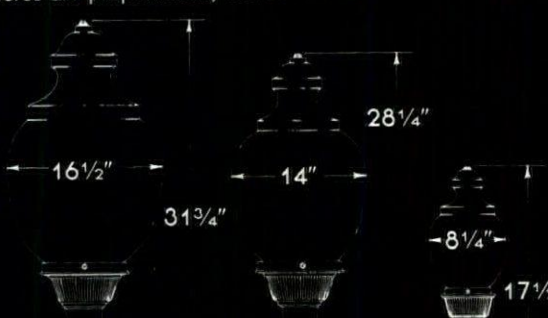

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ARCHITECTURAL LIGHTING

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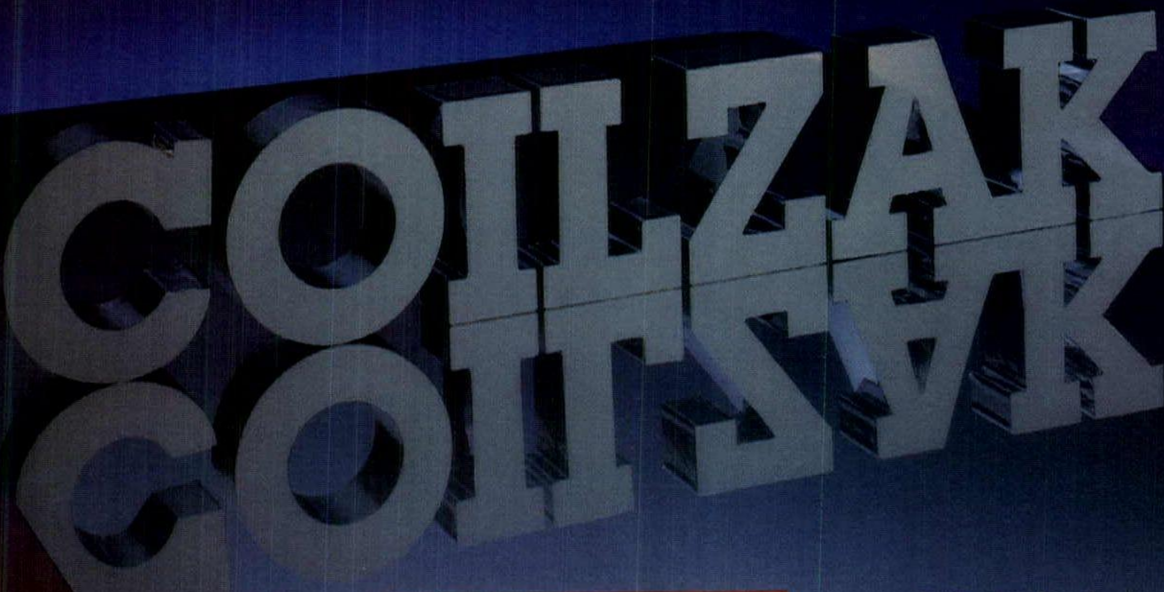

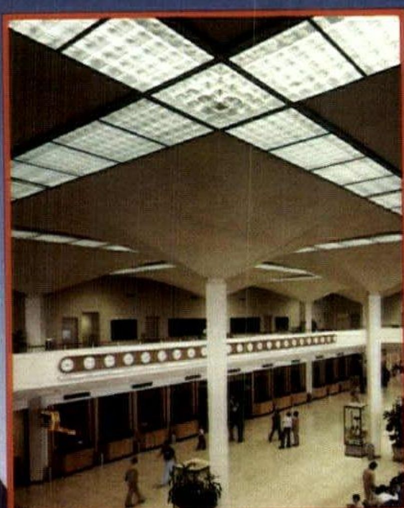

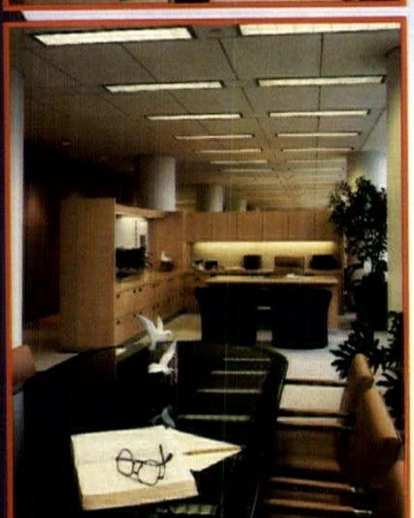

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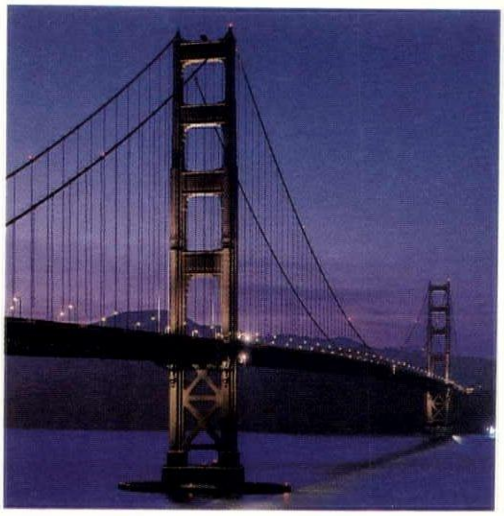


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Concept

From the Editor

When the Golden Gate Bridge opened in 1937, the roadway lighting was the only part of bridge architect Irving F. Morrow's illumination plan to make it off the drawing board. Ironically, the graceful fixture standards Morrow designed for compatibility with the bridge architecture almost weren't around to see Morrow's tower lighting scheme completed.

Morrow used common H-beams — painted in the familiar red, bent 90 degrees at the top, and split — to hold a glass flask. The flask held a revolutionary new lamp, low pressure sodium, and an exposed batwing optical reflector to bounce the light onto the roadway surface. The lamps were extremely efficient for that time and gave off a golden glow, which became familiar to an admiring public.

The fixtures, however, were annoyingly difficult to maintain in the corrosive San Francisco Bay atmosphere. Each required an overhaul and cleaning every six months. The ensuing decades heralded the birth of an even better source and fixture — the high pressure sodium cobra head. In the late 1960s, a movement was afoot to replace the fixtures by bolting cobra heads to Morrow's standards or to replace the whole lot, standards and all, with cobra heads and poles.

A local fixture designer, John Brass, took an existing box-type roadway fixture and modified it for installation on the original standards. He used a special reflector and a yellow acrylic lens with a high pressure sodium lamp to mimic the golden glow of the original source. "It really doesn't look like the original glass flask," says Brass, "but you have to remember it was a compromise. This was a time when saving bits of history like the fixture standards was less important than it is today. We either had to find a luminaire that could be maintained and looked somewhat like it belonged there or live with the cobra heads."

With the support of community members and bridge engineers Bob Shields and Ed Anderson, Brass's fixtures were ultimately approved and installed. Now, most people don't realize they aren't looking at the original fixtures. It may seem like a small thing, but it proves preservation begins with details. If the replacement of Morrow's fixture standards had been permitted 15 years ago, it might have been much harder for others to preserve the integrity of Morrow's lighting design for the towers today.

Charles Linn, AIA

Letters

Bright isn't always right

Without a doubt, color rendition and lamp choice is the most abused, least understood, and all too often ignored, important aspect of lighting.

Perhaps after we get color rendition understood, the next step will be to reduce the overkill prevalent in wall washing and downlighting. All too often we are subjected to indiscriminate usage of incandescent R and PAR lamps of high wattages under the mistaken approach that "bright is right."

Too often designers forget that heat is both objectionable and destructive. Bright is fine, provided that the object of focus is well defined. Bright is not right when glare or reflection obscures the shape, texture, or color, or the heat causes fading of color or deterioration of the materials.

Keep up the excellent work; the magazine is informative and enjoyable.

Robert L. Wand, MIES
Vice President
Barry Engineering, Inc.
San Antonio, Texas

Design resource

Your November 1986 issue sits by my desk as a resource for a retail project we are in the process of designing.

Over a year ago, a client and a friend approached me to help with the rehabilitation of a historic 100-year-old church building that had fallen on hard times and misuse. Our design intent was to return it to a recognizable likeness of its former self and to showcase antiques in a dignified setting. The shop has done well, and my client is in the process of moving the operation to a larger historic house up the street from the current location.

Your article on the Loyd-Paxton Galleries [November 1986] has proved invaluable in presenting to the client the direction we should investigate.

I personally have enjoyed the articles featured and consider your magazine a resource and continuing valuable tool for myself and staff.

Wayne H. Camas, AIA
Camas Associates
Charlotte, North Carolina

Applause for lighting societies

The May 1987 issue gave a fantastic presentation on lighting organizations. I'm familiar with IALD and am celebrating my Golden with IES. The DLF is an old-timer for me, as I was a member of the first one started in New York City in the 1930s when it was known as the Residential Lighting Forum. It's a pity that DLF isn't represented in every major city in the country. Where it does exist, all interior designers should be members.

The society I'm least familiar with is DNNA. It should attract the interest of all professionals interested in lighting in general. Daylighting is gaining ground for interior lighting and offers a great future in this field.

The Illuminating Engineering Society will hold its annual technical conference on August 2–6, 1987, in Scottsdale, Arizona. I'm honorary chairman of the Local Activities Committee for this conference, and we have a lot to offer in technical, practical, and educational sessions as well as a most attractive series of social events. It would be a pleasure to personally greet a large attendance of subscribers and readers of *Architectural Lighting.*

George J. Taylor
Illuminating Engineering Society of North America
Green Valley, Arizona

Pan Pacific Lighting Exposition

The third annual Pan Pacific Lighting Exposition, this year at San Francisco's Concourse Exposition Center, takes place September 20–22. The conference program will highlight the design process, custom and commercial products, and applications. The exposition features fixtures, ballasts, bollards, canopies, chandeliers, controls, hardware, lenses, and louvers; it also features medical, sign, shelf, sports, step, theater, exterior, industrial, utility, emergency and exit, and other types of lighting along with HID, fluorescent, incandescent, halogen, low pressure sodium, and other sources.

The conference program is sponsored by the California Council, American Institute of Architects, the Golden Gate section of the Illuminating Engineering Society, the North Pacific Region of the American Society of Interior Designers, and the Northern California chapter of the Institute of Business Designers. The Calendar section in this issue has an address and phone number for more information.

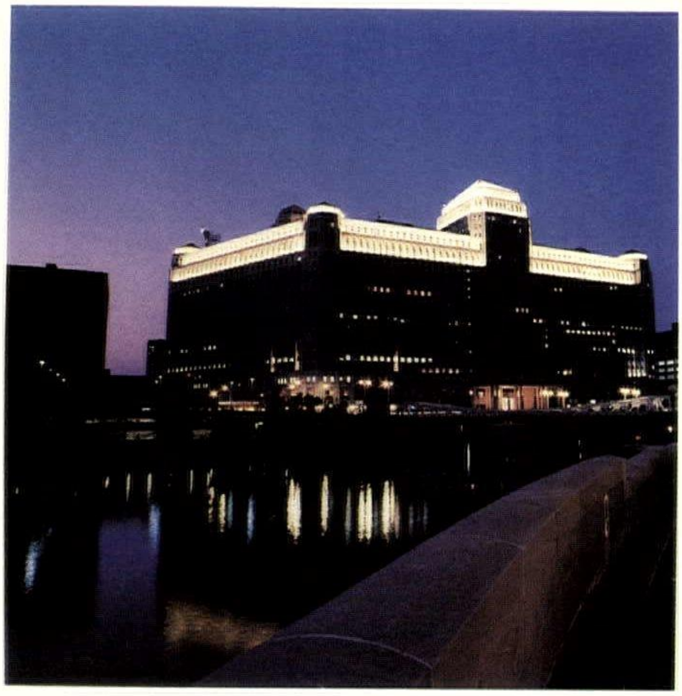
The Editors

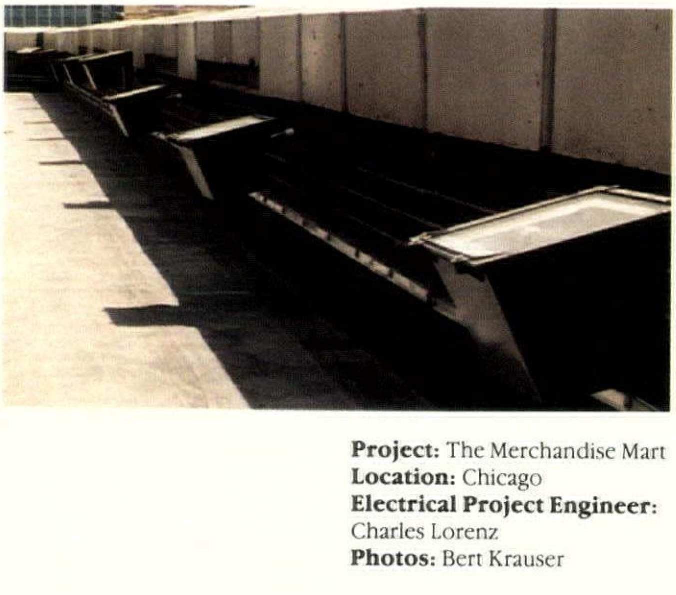
Keep in touch

We invite your letters on subjects of interest to our readers.

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

New lighting showcases Merchandise Mart





Project: The Merchandise Mart
Location: Chicago
Electrical Project Engineer: Charles Lorenz
Photos: Bert Krauser

Chicago's Merchandise Mart had a new look for Neocon 19, the furniture exposition held June 9 through 12 this year. The Mart's copper roofs now appear to catch the light of sunset long after nightfall.

For years after the building was occupied in 1930, the Indiana limestone setbacks, corner pylons, and central tower were illuminated at night. The lights went out when the OPEC oil embargo hit in 1973. The building remained dark for 11 years until management decided to restore electrical power to the existing system in time for Neocon 16 in 1984.

Charles Lorenz, electrical project engineer at the Mart, explains that the 678 incandescent PAR 38 fixtures were a maintenance nightmare. "Between the old fixtures and the lamps themselves being subject to the outdoors, the average life of the PARs fell short of their 2000-hour rating," he says. "When you're dealing with that many fixtures, it's nothing to find several out in a week, and when each one is doing a specific task, it really shows up. So it needed attention on a weekly basis."

As part of an overall rehabilitation program, management asked Lorenz to specify new exterior lighting that would cut energy use, increase lumen output, and improve maintenance. Lorenz found a fixture that could do all this and more.

He chose a 150-watt high intensity discharge floodlight that unexpectedly saved installation costs because it mounted directly on the existing conduit system. The rigid galvanized steel conduit, which Lorenz estimates is at least 40 years old, was still in fine shape. A contractor rewired the entire system, removed all of the old fixtures, and installed 426 floodlights.

The new lighting definitely satisfies the energy efficiency, lumen output, and maintenance goals. The replacement cut energy usage by 38.3 kilowatts. Total initial lumen output is now 6,848,000 compared with the previous 1,335,600. And the new lamps have an average rated life of more than 24,000 hours. "I would recommend that we group relamp after 5 years or so," says Lorenz, "depending on operating hours. In the past, that's been 2000 to 2500 hours per year."

The floodlights' type 7 distribution provides a wide flood of light, allowing 10-foot spacing while reducing the hot spotting that was a problem with the PARs. At close range, the floodlights distribute light as much as 24 feet above their locations.

In preliminary testing, Lorenz demonstrated high pressure sodium and metal halide lamps in the new fixtures side by side. Management took a look and chose the sodium. Lorenz explains that the light source's low color rendering index was not a problem. "The apparent color is not objectionable because it looks golden; they liked that," he says. The project is an outstanding example of the way new lamp technology can help lower the cost of operating and maintaining an exterior lighting system while at the same time improving building appearance. ■

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

Low-brightness lighting — the sweet taste of excellence

Project: World's Finest Chocolate, Inc., national headquarters
Location: Chicago
Architect: Nagle, Hartray & Associates Ltd.
Lighting Designer: Melvin Cohen and Associates, Inc.
Photos: Jon Miller, Hedrich Blessing

When World's Finest Chocolate asked Melvin Cohen, PE, to light its national headquarters, it asked for a special sense of excellence. The headquarters would be both a busy office and a showroom for visitors and prospective buyers from around the world. The company wanted its architectural surroundings to live up to the "World's Finest" name — giving VIPs no clue that they were walking through a former warehouse.

The architectural firm of Nagle, Hartray & Associates created impressive vaulted ceilings in some areas. In others, Cohen had a flat ceiling to work with, but low ceiling heights and shallow plenums restricted the use of recessed fixtures.

All this, and the showplace was still a work space. How could he light the secretarial areas, where workers would be at their desks all day? Cohen sums up his solution in two words: shadowless lighting. He created an unusually effective low-brightness lighting, free of glare and easy on the eyes.

Cove lighting was a natural for the executive secretary area, a 100-foot-long, 14-foot-wide room with a vaulted ceiling that arches up to a 15-foot height at its center point. Cohen specified single-lamp, high-output fluorescent fixtures with parabolic aluminum reflectors that spread the light out on the ceiling. The even wash provides a comfortable low-brightness environment, yielding a maximum of 100 footcandles on desktops.

The 150-foot-long general office area has a comparatively generous 45-foot width and a flat ceiling, two factors that inspired a different lighting solution. The partitions here have enough room to hold custom-made wood enclosures for 250-watt metal halide uplights. Unlike pendants or stem-mounted fixtures, these indirect luminaires fade into the woodwork. "You can't tell where the light is coming from," Cohen remarks.

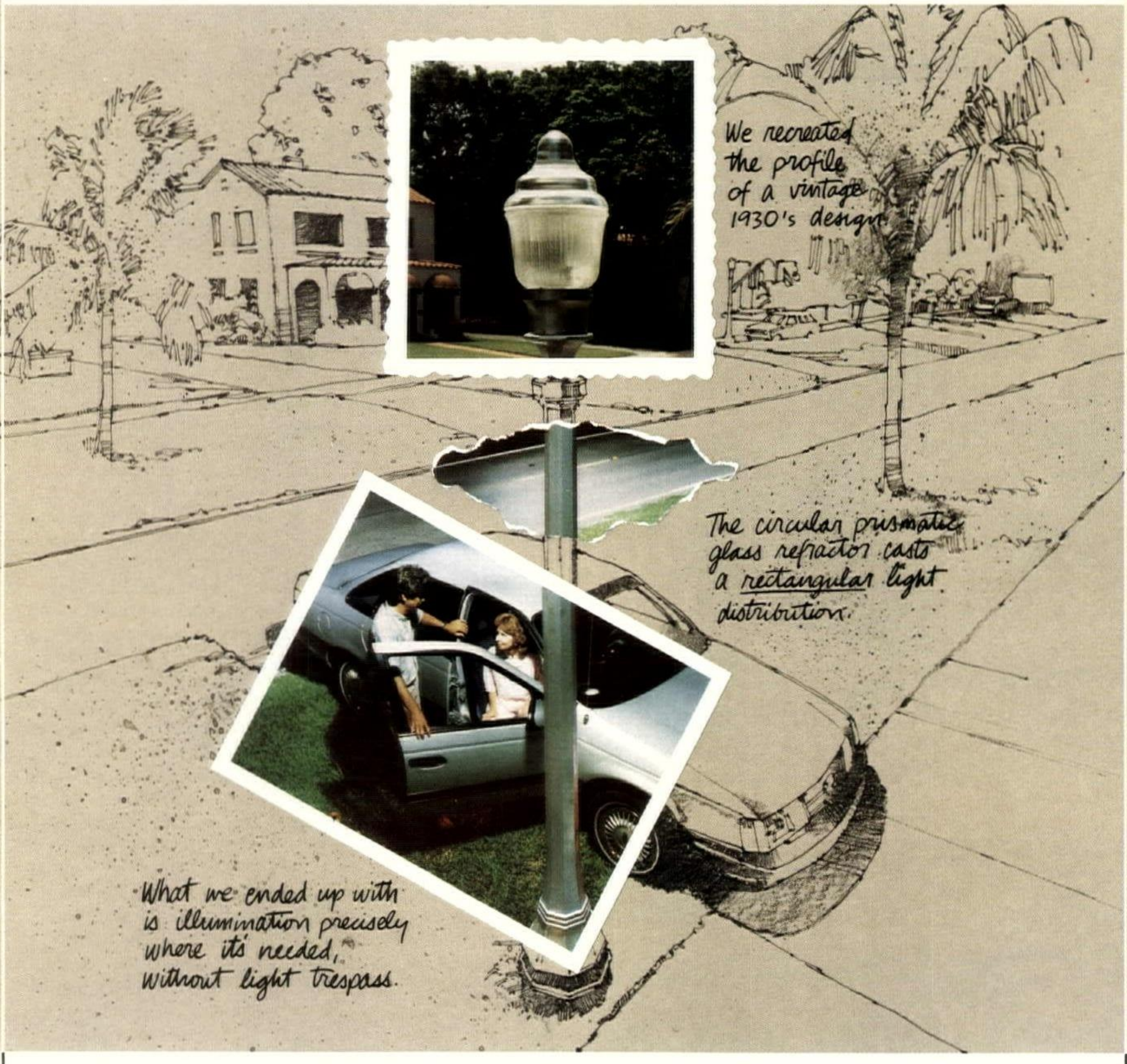
Tubular fluorescent task lights are built into the work units in the general office area. The combination of fluorescent and metal halide provides 120 footcandles on the desktop consuming only 2.1 watts of energy per square foot, according to Cohen's calculations.

Cohen specified remote dimming for each indirect lighting system. As lamps age and dirt accumulates, the dimmers can be manually adjusted to maintain a constant illumination level. "You can group replace the lamps and dim the system down, then bring it up as the lamps age," Cohen explains.

The complexities of this project might have pushed a lighting designer into solutions that were obviously second best. Instead, Cohen's unique approach created an environment that is both showy and humane — a result he calls "the sweet taste of lighting excellence." ■

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

IN DAYLIGHT YOU'D SWEAR IT'S 50 YEARS OLD. BY NIGHTFALL YOU'LL KNOW IT'S NOT.



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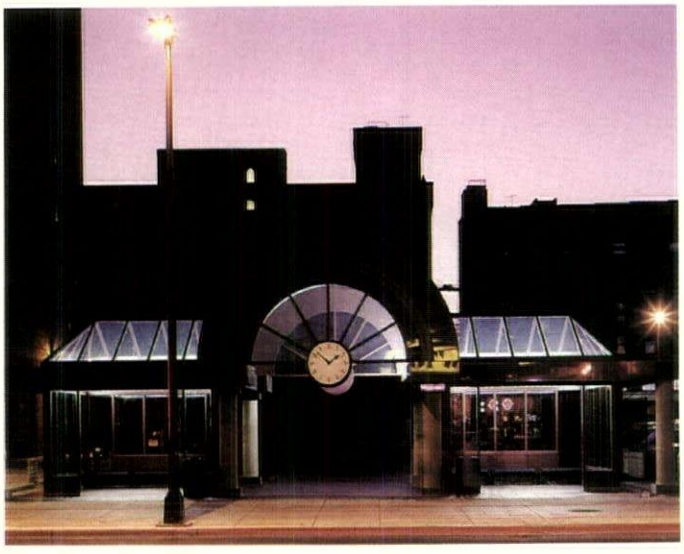
Simplicity key to lighting transit stop and miniature park



Project: Sixth Street Transit Station
Location: Minneapolis, Minnesota
Client: City of Minneapolis, Department of Public Works
Architects: BRW, Inc.
Electrical Engineer: Cain Ouse & Associates
Photos: George Heinrich

Once known as Minneapolis's Great White Way and heart of the city's entertainment district, Hennepin Avenue is now more notable for an abundance of surface parking lots. As part of planned improvements to the district, the city asked BRW, Inc., to design a transit station and miniature urban park.

BRW planners sited the station, the first of four, at one of the busiest stops and transfer points in the city's bus system. The parklike plaza offers a lunch spot for downtown employees and a site for events sponsored by the Hennepin Center for the Arts, a performing arts center located in the adjacent Masonic temple building.

During the day, the skylights and glass walls of the shelter's main waiting areas provide daylight. The distinctive barrel vault creates a cooler, darker space below. Passing through this darker area into the daylight beyond provides a simple transition for pedestrians entering the plaza, which is screened from urban surroundings by a fence and linden trees.

At night, fluorescent uplighting maintains the vault's presence on the street, symbolically inviting passersby to take shelter inside. High light levels in the waiting areas are designed to discourage vandalism and create an oasis of security for bus patrons, says Craig Amundsen, principal in charge. Simple, sturdy fluorescent strips with white acrylic diffusing lenses and photosensors do the job.

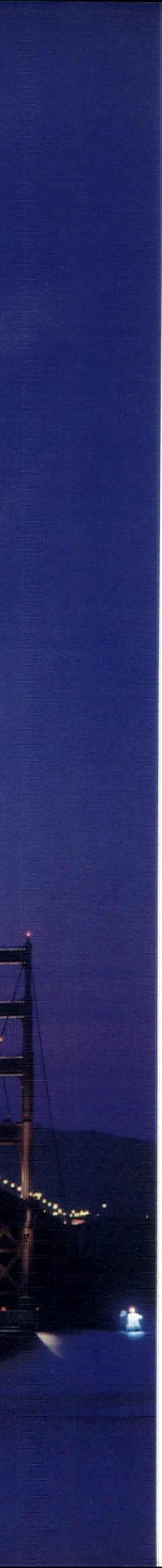
"We didn't want to get elaborate," says project architect Koshrow Rezai. Vandalism and maintenance were major concerns. "I don't think we could prevent vandalism, no matter what we could have done — unless we put up an iron cage," Rezai says. Therefore, the architects specified vandal-resistant components that could be easily replaced if damaged. Off-the-shelf components also simplify regular maintenance by the city's public works department.

To the rear and side of the station, pole- and bracket-mounted high pressure sodium luminaires flood the turnaround where parents drop off and pick up children at the performing arts center. The architects used double the normal illumination levels here — 1 footcandle instead of 1/2 footcandle — for extra security.

Reproductions of antique pole lights to illuminate and define the plaza are also part of the design. They were not, however, in place in time for the accompanying photographs.

The design of the station illustrates a successful integration of daylighting and economical electric lighting in an urban building type that is too often dreary. The result is public architecture that, through its lighting, provides a secure, inviting atmosphere and discourages vandalism. ■

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



Golden anniversary brings new light to Golden Gate Bridge

ARTICLE BY
CHARLES LINN, AIA

PHOTOGRAPHY BY
GREG WEST, WESTSHOTS

Perhaps the happiest consequence of the 50th anniversary of the Golden Gate Bridge opening is the illumination of the bridge towers, an important part of an illumination scheme originally proposed in 1935 by bridge architect Irving F. Morrow.

Morrow's concept for lighting the bridge was a considerable departure from the original 1930 proposal by chief engineer Joseph B. Strauss. Strauss was a convincing promoter and skilled politician — he had to be to convince a community about to be hurled into the heart of the Depression that they should fund the structure. Emotions ran high about whether the project was environmentally desirable, whether it would ever be needed, and whether it was even feasible to construct it. Still, he advocated brilliant floodlighting of the bridge's approaches, plazas, towers, and pylons complete with a typical "string of pearls" treatment of the suspension cables.

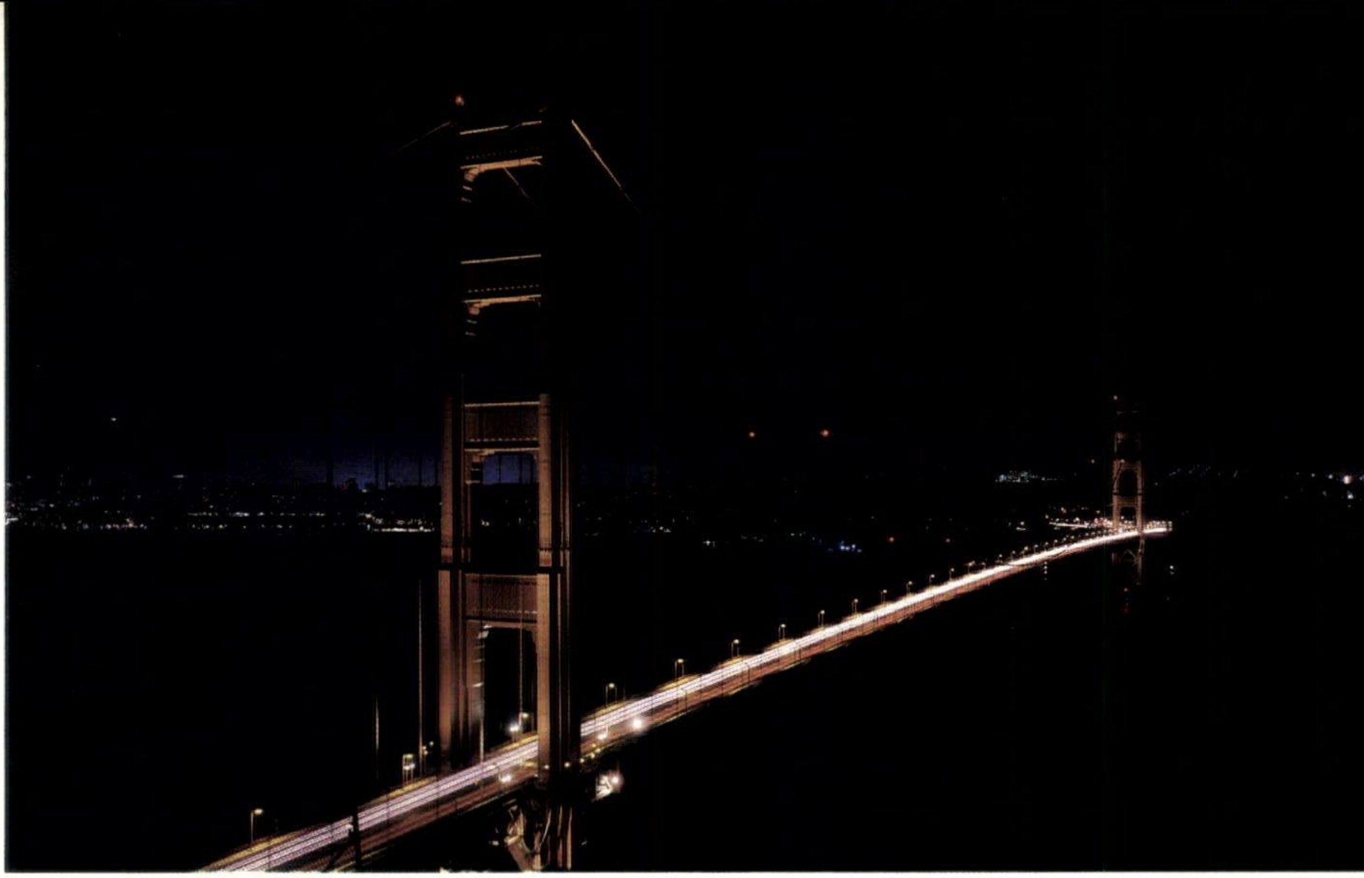
Morrow, along with engineer Charles Ellis, is credited with making Strauss's bulky preliminary design into the art deco masterpiece we know today. When he wrote his report on color and lighting for the bridge five years later, the north tower was complete and the south tower under construction. Morrow had a deep appreciation for the immense scale of the project and the importance of appropriately influencing how the bridge would ultimately be perceived by the public in daylight and at night.

Which Color?

Today, it is unthinkable that the bridge be painted any color other than the deep red the world has come to know and love. But, at the time, other color choices received considerable discussion, including black, battleship gray, brown, yellow, and aluminum.

Morrow's report was comprehensive, discussing the issue of color selection from every conceivable point of view, including site, scale, composi-

Project: Golden Gate Bridge tower illumination
Client: Golden Gate Bridge, Highway and Transportation District; Daniel Mohn, PE, District Engineer; Duncan Patterson, PE, Senior Engineer; Robert Thiel, EE, Electrical Superintendent
Architect: Bolles Associates, Peter Bolles, AIA, Principal; Richard Rutter, AIA, Project Manager
Electrical Engineers: Charles H. Krieger & Associates, Charles H. Krieger, PE, Principal-in-Charge; Paul S. Walker, Lighting Designer
Structural Engineers: Preece/Goudie & Associates
Electrical Contractor: Abbett Electric, Greg Abbett, Project Manager



tion, luminosity, cost, publicity and public opinion, maintenance, and the effects of the color on the modeling of the structure both during the day and at night.

Morrow noted that the design of the bridge "was generally recognized as being exceptionally expressive and imposing" and that "color will be an integral factor in the final effect." He believed a dark color would essentially negate the form of the bridge itself and reduce the perceived size of the structure. He feared that the contrast between light and shadow would be lost against a dark or dull paint and that the effect of the modeling of the structure would be lost, that the bridge would appear as a silhouette. More than this, however, he feared the color chosen would be ordinary.

Morrow asked in his report, "Is it desired to emphasize the bridge as an important feature of the landscape or to make it as inconspicuous as possible?" Answering his own query, he advanced the philosophy that "the bridge should be made to count to the fullest possible degree."

He based his opinion on the fact that it would certainly be impossible to conceal a structure of this magnitude, stating, "It may as well be recognized from the start that the bridge is certain to be prominent and accept this as the basis of treatment without effort at self-deception." He noted that its position at the entrance to the harbor, as well as its size, provided "an unparalleled opportunity to derive legitimate community publicity from the bridge." He added, "Its unprecedented size and scale, along with its grace of form and independence of conception, call for unique and unconventional treatment from every point of view. What has thus been played up in form should not be let down in color."

Morrow suggested that, because San Francisco is covered by fog and gray skies a considerable portion of the year and its atmospheric colors are predominately cool, the structure of the bridge should be a contrasting warm color. He noted that architecture of the region had "remained on the whole timidly colorless, hence without the accent and warmth which conditions called for."

Finally recommending a color, Morrow wrote, "Fortunately, it is not necessary to make a decision based on theoretical considerations alone, for there have already been two practical demonstrations of the ideal color. During the erection of the north tower and again at the present moment with the south tower assuming form, observers from all walks of life have been universally impressed by the beauty of the structures in the shop red lead coat. This color is luminous, undergoes atmospheric changes with great beauty, is prominent without insistence, enhances the architectural scale to the utmost, and gives weight and substance at the same time that it is light enough properly to register variations of shade and shadow. In short, it is the ideal color from every point of view, and hereby recommended and urged as the most appropriate and satisfactory color for the finished bridge."

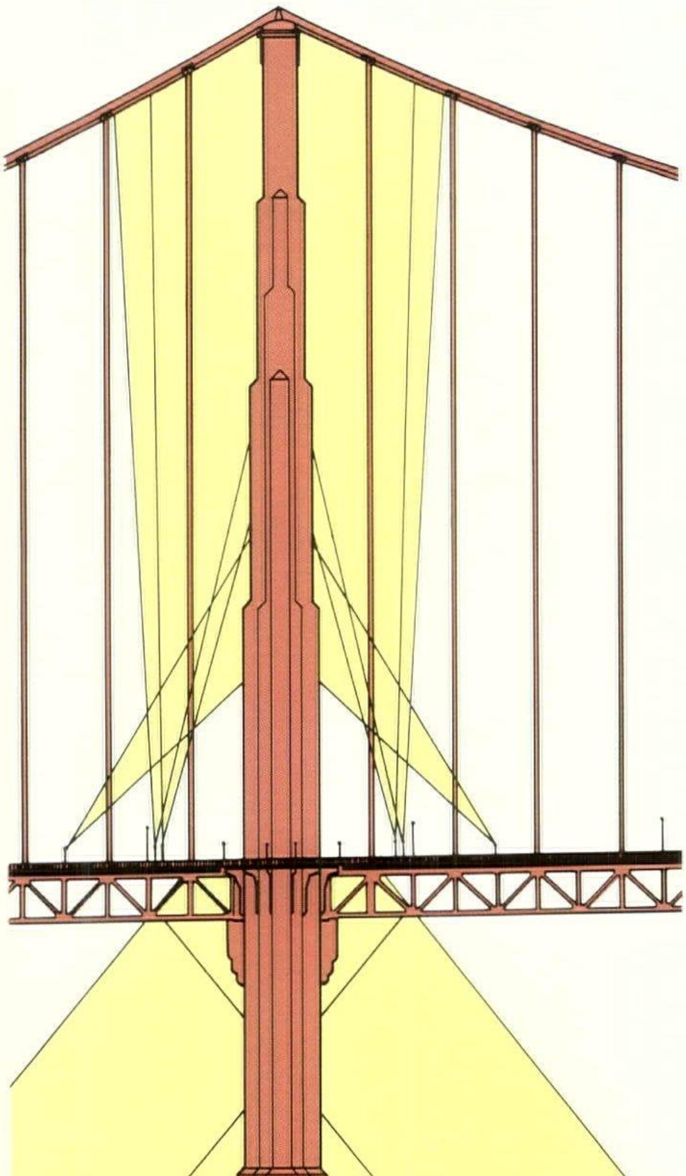
Morrow remarked that "there will always be opportunities to paint bridges any of the alternative colors which can be suggested. An opportunity such as is offered here does not occur once in a generation."

It is also quite clear that when Morrow advocated leaving the bridge red, he was already thinking about how the color chosen would integrate with his lighting design concept. He argued against the notion that aluminum or gray paint was more reflective and would therefore require less electricity to illuminate than would the red lead paint. He went so far as to suggest that "the color of the bridge is unhesitatingly put forth as of more importance than the illumination. If this possible economy in current consumption is a controlling consideration, then the recommendation is to abandon decorative illumination and preserve the right color."

Morrow's Lighting Design

The second part of Morrow's report detailed his position on the way the bridge should be illuminated. He wrote that unless a certain minimum standard of lighting could be achieved the lighting scheme should be abandoned entirely.

His primary concern was that the illumination be as dignified as the structure itself. He adamantly opposed lighting the bridge uniformly, noting, "uniform distribution over a distance of a mile and a half would seem too artificial for belief, and would hence compromise the effect of size. Similarly with the height of the towers. With tops illuminated as brilliantly as the bases, they would appear to fall within the range of ordinary elevations; if the tops practically disappear into the night, they will seem to soar beyond the range of illumination . . . in this case we are seeking relatively low intensities and constant gradation of light . . . the object is to reveal aspects of a great monument which are unsuspected under the conditions of natural or day light."



Positioning of the spotlights above and below the bridge roadway relative to the towers; 12 fixtures are required for each face of each tower, 6 above the roadway, and 6 below. In all, 48 fixtures are used to illuminate the towers.

Morrow was also opposed to attaching lights to the suspension cables, and wrote that the bridge required, "the greatest simplicity and sobriety of means. Tricky, flashy or spectacular effects would be unworthy of the dignity and permanence of the bridge, and put it into the class of temporary expositions, or worse yet, of frivolous amusement parks."

Morrow explained that his strategy for achieving such a lighting design required "stressing the significant points and allowing the imagination to supply the minor ones." He suggested the subtle lighting of the towers, the pylons and arch of the south approach to the bridge at Fort Winfield Scott, and the San Francisco and Marin anchorages and approach viaducts. All of this was to be tied together with the continuous punctuation of the roadway lighting.

The lighting of the north and south towers of the bridge was central to Morrow's scheme; he noted that both towers had to be illuminated identically. Because there was no area off the bridge to place fixtures, they would have to be located close to the towers on the bridge itself. This necessitated locating fixtures above the bridge deck to uplight the towers and below the deck to downlight the portion of the towers from the deck to the water.

Morrow decided upon an average of 5 footcandles of illumination on the face of the towers, but he ruled out the use of low pressure sodium lamps — which had been selected for the roadway lighting — because its color rendering was inadequate. He estimated that each tower would require 40 1000-watt incandescent floodlights above the deck and 30 1000-watt incandescent floodlights below. He pointed out, however, that the calculation methods then available did not permit predeterming the numbers and positions of lights needed or predicting how the lit towers would look. He suggested trying a full-scale mockup of the system.

Only part of his plan was to be. Although Morrow ultimately succeeded in retaining the lead red shop coat color for the bridge, the price tag for illuminating the bridge was too high: Morrow's 1935 estimate was $89,000. Only the roadway lights, airway beacons, and marine obstruction lights were installed.

False Start

More than 30 years passed before Morrow's scheme was again actively pursued. In 1969, the Golden Gate Bridge, Highway and Transportation

District asked San Francisco architect John S. Bolles to study illumination of the bridge towers. Bolles travelled throughout the country studying monumental lighting, looking at bridges in particular. Early in 1970, after executing a number of graphical studies based on Morrow's tower lighting concept, Bolles and a team of experts from General Electric finally did the full-scale illumination mock-up originally suggested in Morrow's report. They used the north face of the north tower to avoid attracting public attention; the mock-up was deemed a success. But again the project was scrapped when the cost of energy began to rise in the early 1970s.

In 1985, the Golden Gate Bridge district again contacted Bolles Associates, now headed by the late John Bolles's son, Peter. The district asked the firm to examine the studies and documents prepared during the 1970s and to come up with a plan to implement Morrow's concept for the towers. Bolles Associates again sought the help of General Electric and consulted with Charles H. Krieger and Associates, electrical engineers.

"We looked at my father's original studies," Bolles says, "and then we did a number of additional mock-ups, scale model studies, and computer simulations with different fixtures and lamps — metal halide, high pressure sodium, and other kinds of quartz lamps. We wanted to come up with a solution that would be something like the one Morrow described in his 1935 narrative. We had to keep in mind that the bridge had been placed on the National Register — which it hadn't been in 1970. If we were going to light it at all, we had to do it in terms of a historical perspective."

Some 70 combinations of fixtures, locations, and aiming angles were simulated by computer. Of these, they selected three for the actual on-site testing in February 1986. The fixtures that made it to this stage were already known to be acceptable on the basis of accessibility, economy of maintenance, corrosion resistance, and future availability for replacement. High pressure sodium lamps were chosen instead of metal halide because of their warmer color rendering, better aging characteristics, lamp life, and energy efficiency.

On-Site Testing

All that remained to be determined was the best location. For the full-scale on-site testing, the design team electrified fixtures above the roadway with temporary wiring and mounted the fixtures on movable stands. On each side of the roadway, they used two 400-watt high pressure sodium fixtures — one with a beam spread of about 10 degrees and one with a beam spread of about 18 degrees. The narrower spot was aimed toward the cable saddles at the top of the tower, and the wider one toward the lower portion of the tower.

Members of the design team working on the bridge moved the illuminated fixtures through a predetermined sequence of horizontal and vertical positions. Other members were posted at vantage points away from the bridge, where they could observe the effect of the various lighting positions. The groups used walkie-talkies to communicate — those at the distant vantage points directing those on the bridge to help them eliminate hot spots and to evaluate which positions met Morrow's criteria for "subtlety and variety of treatment."

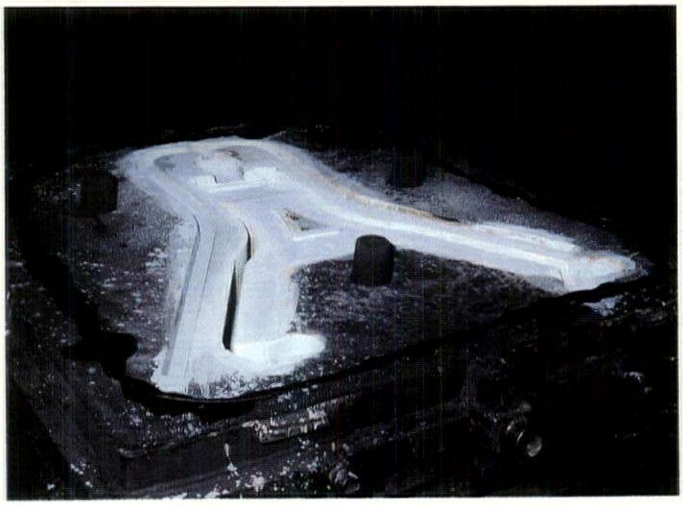
Below the roadway, they illuminated the bottom portion of the tower with high pressure sodium fixtures bolted to the bottom of a permanent under-roadway painter's scaffold. On each side of the scaffold, they aimed one 400-watt fixture with a beam spread of 80 degrees vertically toward the water and one 175-watt spotlight fixture horizontally toward the top of this lower portion of the tower. Design team observers again directed the fine tuning of fixture location and aiming. They carefully documented all the position and aiming angles for later use, when the permanent fixtures would be manufactured and installed.

Environmental Impact Considerations

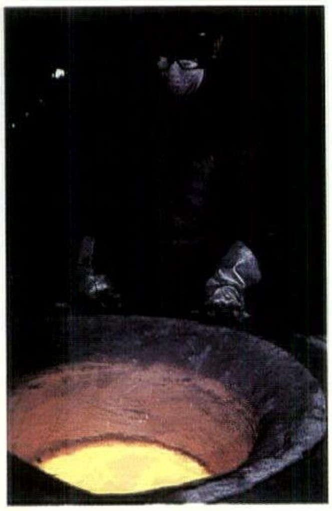
The responsibilities of the bridge district and Bolles Associates included more than studying ways to illuminate the towers. They also were to study whether the project would adversely affect automobile, marine, or aviation traffic and the wildlife population.

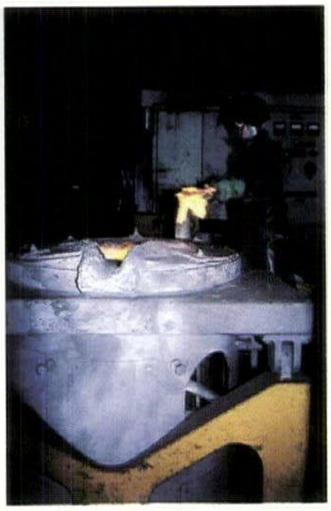
The impact on automobiles going over the bridge was determined to be negligible. Footcandle levels on the towers during the test were equal to or below those on the roadway, so their illumination was not deemed to be a source of glare or distraction to traffic. During the test, after the fixture locations and aiming had been set, the south tower was illuminated for an entire month, and automobiles appeared to move over the bridge at a normal rate.

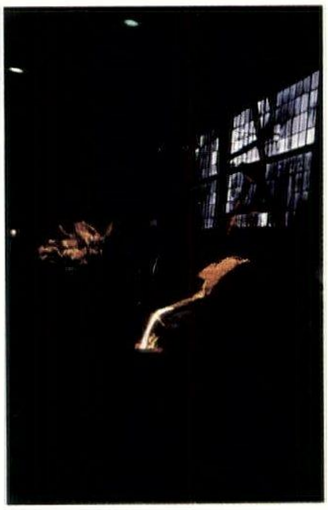
For marine traffic, the primary consideration was whether the fixtures mounted below the roadway would cause either direct or reflected

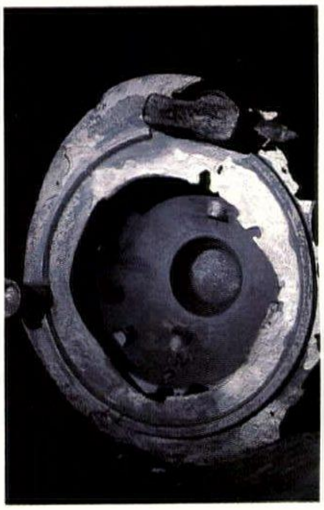


A wooden pattern of half the yoke assembly is pressed into a sand-filled flask, leaving an impression that is later filled with molten metal (left). With one half of the mold readied for casting, the other half, face down, is lowered into place with a hoist (right).

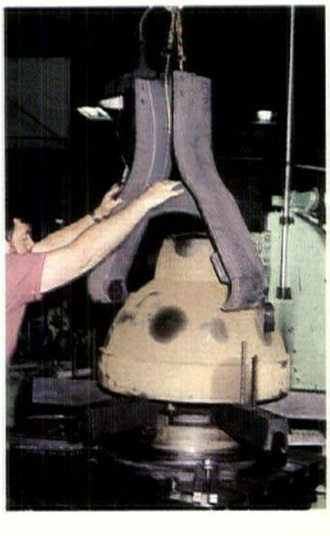






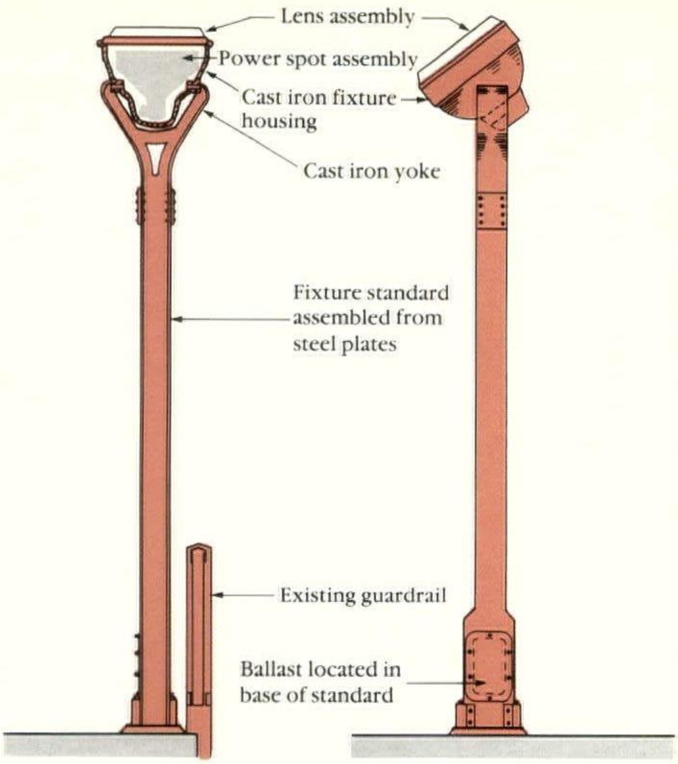


A ductile, corrosion-resistant alloy of four parts iron and one part nickel for the yoke and fixture housing castings is melted in an electric furnace (left). Before pouring (center left), a worker skims impurities, called slag, off the top of the molten metal. The crucible is lifted by a hoist and the molten metal is poured into the molds (center right). Rough fixture housing castings, fresh from the sand molds (far right), have surplus metal that will be removed at the machine shop.



At the machine shop (left), milling machines flatten rough surfaces where metal parts must fit together or where rubber gaskets will be installed. Drilling and threading for pins and connectors is completed. A machinist test fits a yoke casting to one of the fixture housings (center left). After being sandblasted, degreased, hot-dip galvanized, and painted, these fixture housings (right) will be installed at the bridge.

Luminaire elevation



The art-deco, searchlight-inspired electroliers installed on the bridge at the roadway level house high pressure sodium lamps and stock spotlight fixtures that illuminate the faces of the bridge towers.

glare at night or whether their brightness would obscure navigational beacons mounted in the concrete fender that surrounds the south tower at sea level. The design considered these factors. Glare was controlled by using fixtures with narrow beams and good cutoff characteristics. The relatively low light level — approximately 4 footcandles at sea level — was insufficient to interfere with the beacons. The U.S. Coast Guard published a request for feedback on the effect of the lighting on marine traffic in advance of the testing. No negative comments resulted.

Both the Federal Aviation Administration and the U.S. Coast Guard noted that ship pilots use the airway beacons atop the towers for navigation more often than airplane pilots do. As was true for the beacons at sea level, the light level at the top of the towers — 0.8 footcandles — was insufficient to interfere with the airway beacons.

Finally, Bolles Associates and the bridge district considered the effect of the lighting scheme on the sea and shore bird populations — and the possible effects of birds on the lighting fixtures. They determined that fowl activity on the roadway level is limited because of high winds and vehicular noise. Birds were therefore unlikely to find the fixtures acceptable roosting points. Below the roadway, the fixtures were to be pointed down; their effectiveness would not be compromised by roosting or droppings.

Finally, the Light

In March of this year, Abbett Electric of San Francisco was awarded a contract to proceed with fabricating and installing the bridge illumination based on the Bolles Associates plan.

Illumination for the north and south towers is a combination of 150-, 250-, and 400-watt high pressure sodium lamps and standard off-the-shelf power-spot fixtures. For each face of each tower the electrical contractor used 12 fixtures, 6 above the roadway and 6 below, a total of 48 fixtures. Only 16 kilowatts are required to operate the lamps; the 140-fixture solution that Morrow originally proposed in 1935 required 140 kilowatts of incandescent to achieve similar light levels.

All of the fixtures installed at the roadway level are mounted inside cast housings, supported by a pole-mounted cast yoke arm assembly. These housings protect the fixtures from the wind, moisture, and corrosive atmosphere on the bridge and provide them an appearance that integrates with the bridge architecturally. These electrolier assemblies are a streamlined version of art-deco–style searchlights that were in place atop the towers during the era of the China Clipper flying boats, which at one time flew over the bridge en route to the Orient. The searchlights were removed during World War II.

Below the bridge, fixtures are bolted to the bridge structure next to new catwalks to allow servicing. The completely prefabricated catwalks were prepainted and lowered over the side of the bridge by jib cranes temporarily mounted atop the fixture standards that will eventually support the tower uplighting.

Fixtures pointed down into the water are inside housings similar to those used above the roadway, but mounted on a short pivoting arm that cantilevers out over the water. The arm is counterweighted to allow workers to swing up the 800-pound assembly for relamping. With the 28,000-hour lamp life of high pressure sodium lamps, this operation might only occur once every 5 to 7 years.

At the time of the celebration, the permanent fixture housings were not complete, but the permanent standards were in place. The fixtures to be mounted inside the housings were temporarily installed and turned on, giving the world a look at Morrow's vision for the first time. The final lighting design is understated — but the vocabulary of the bridge's architecture still remains fluent — which is the way Morrow would have wanted it.

"The thrill for me and perhaps for everybody who worked on the project," says Peter Bolles, "was the unstated notion that we were working on a one-of-a-kind adventure. The bridge is San Francisco's genuine architectural treasure. It's the one thing here that really respects the majesty of the area's geography, yet still stands alone as a successful architectural and engineering statement. I think Morrow's concept of understating the lighting and our attempts to fulfill that statement really come down to having a deep respect for this environment, but desiring to maintain at night the bridge's rightful place within it." ■

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

B O Y D

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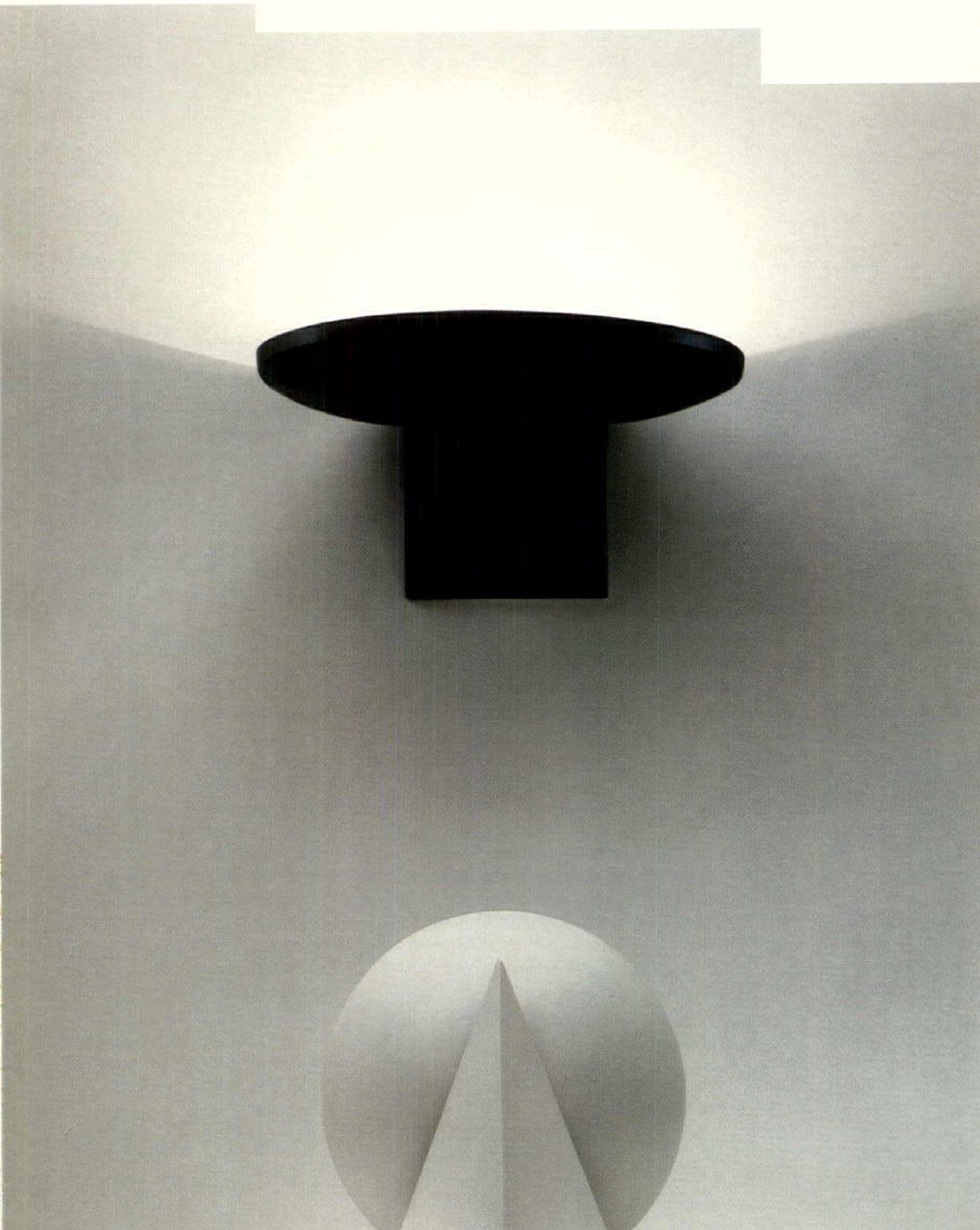


RESOURCES COUNCIL ROSCOE AWARD 1986

Some viewpoints on office and task lighting: A recent seminar

This four-part article focuses on different elements of task-ambient office lighting. The historical overview outlines the high expectations this kind of system originally inspired and how slowly the expectations are being met. The following section examines what its author calls the revolution in task lighting. The last two parts of the article, which are scheduled to appear in the September issue, look at ceiling lighting — louvered and indirect. The authors were participants in a recent seminar on task-ambient lighting held in Philadelphia.

■Historical overview

Victor Antes, RA

Vic Antes is a principal of Interspace Incorporated, Philadelphia.

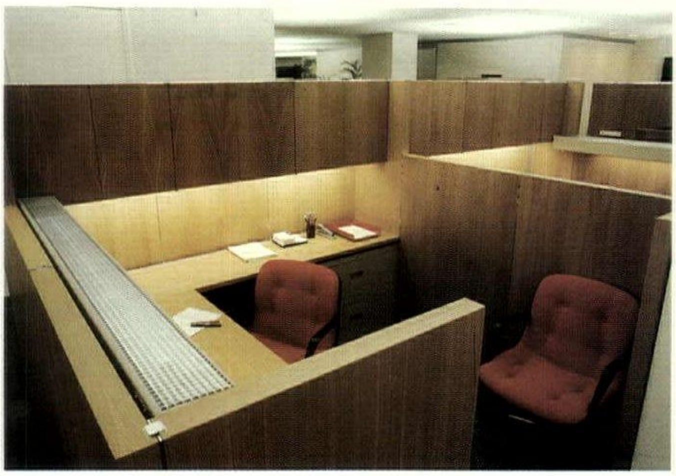
In 1975, the Atlantic Richfield Company offices in Philadelphia incorporated lighting into mass-produced, open plan system furniture. Design critics at the time called it "revolutionary" and "one of the most significant design projects of the past 50 years."

The new lighting was integrated into low partition work stations — indirect uplighting for general illumination and direct downlighting for work activities. Cynics were quick to ask what was revolutionary about the concept. Indirect lighting, they pointed out, had been around since the 1930s, and a combination of up- and downlights had been used in hospitals, hotels, and architect drafting rooms since the mid-1960s. They also indicated that combining up- and downlights in work stations simply recognized the age-old table lamp as a more pleasant source of illumination than any unidirectional lighting system.

The significance of the new work station lighting, however, was its concentration on people and their activities. The key to the interest it generated was the increasing popularity of open plan systems furniture, which was changing the character of the corporate work environment.

A 1975 *Interiors* magazine article said, "This lighting literally illuminates a new humanism by providing specific light for individuals and their specific mobile activities." It was to be the lighting system for offices of the future.

The apparent advantages of the task-ambient system were — and still are — extremely impressive. The new up- and downlighting eliminated the glare and veiling reflections produced by too-bright and too-exposed ceiling fixtures, increasing workers' ability to see small details.



ROBERT HARRIS PHOTOGRAPHY

In 1975, office lighting was integrated into work stations with low partitions at the Philadelphia offices of the Atlantic Richfield Company — an innovation called "revolutionary" at that time.

ROBERT HARRIS PHOTOGRAPHY

Five years later, office automation and use of CRTs and VDTs had increased. Eliminating ceiling fixtures became more important as a way to eliminate the direct glare and reflection from ceiling lights in screens and monitors. Without ceiling fixtures, there would be no further need for the 6-inch plenum space for light fixtures in the ceiling. Duct and sprinkler runs could be simplified because there would no longer be potential conflicts with light fixtures. Without ceiling fixtures, increased numbers of ceiling tiles create better acoustic absorption. Designers and architects were delighted with the system because it allowed the possibility of "clean ceilings" — ceilings free of busy lighting fixture grids.

Task-ambient lighting helped designers accept the fact that less than half the area in a typical office needs a high level of illumination for task work and that only low levels of general illumination are required to give definition to space and minimize shadows. The system heralded the end of the requirement for 100 maintained footcandles or more in the office environment.

The spin-off benefit of this was particularly attractive during the energy crisis and recession of the 1970s: task-ambient lighting reduced the energy needed to illuminate work areas by about 50 percent. Less lighting also means less heat, so the system was thought to result in an estimated 25 percent reduction in energy costs.

Fewer fixtures to buy meant lower maintenance costs for replacing lamps. It also meant lower construction costs because the lighting was included in the furniture budget. If a company relocated, it could take the lighting along.

Until changes in federal tax laws, a task-ambient lighting system even had tax advantages — which are now less certain. It allowed a faster tax write-off because the light fixtures were part of the furnishings rather than the building.

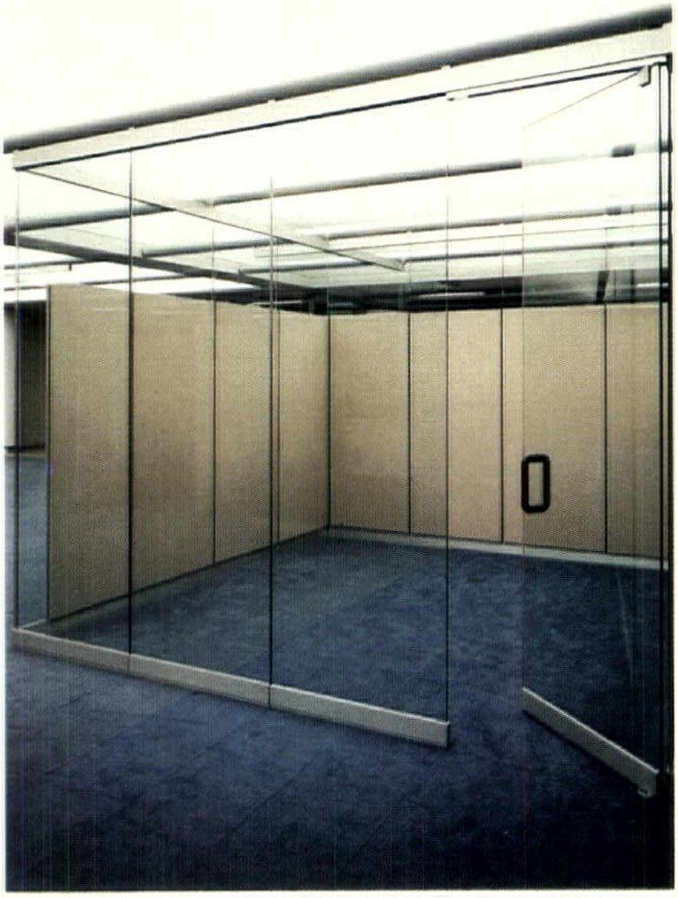
Various researchers have concluded that people function better with a variety of lighting levels, such as those generated by task-ambient lighting. It is visually exciting and relaxing, and it directs employee attention to their tasks. It also helps employees perceive that they can create their own visual environment. These factors are believed to contribute to increased productivity.

Finally, task-ambient lighting is flexible; it can be moved as easily as furniture. Furniture-integrated, task-ambient lighting, then, could be said to have had it all: improved illumination in office areas, reduced maintenance costs, and tax advantages. Furthermore, it offered an interesting and humane environment, which would lead to increased productivity. It tolled the knell for ceiling fixtures.

The potential suggested by the 22-story Atlantic Richfield installation has yet to be fulfilled. Today, more than 90 percent of U.S. offices use downlighting in the ceiling. Task-ambient lighting is a solution used in less than 10 percent of U.S. offices in 1987.

Unrealized Potential

It may be that task-ambient lighting has yet to realize its perceived and predicted potential because of a conceptual flaw. The system may simply be unable to deliver sufficient lighting to primary work surfaces — the desk in the manager's or secretary's work station. Lighting sources that could be accommodated easily and unobtrusively within the furniture could provide only 20–30 footcandles on desks.



LAWRENCE S. WILLIAMS INC.

Renewed interest in suspended indirect lighting was a direct result of the shortcomings of furniture-integrated sources.

STEVE ROSENTHAL

High-powered sources — HID and mercury vapor — that were being developed at the same time were unsuccessful because they were more difficult to integrate into the furniture. These sources also created an unnatural color rendition, and it was difficult or impossible to disperse the amount of light they provided over a wide enough area to minimize intense hot spots of lighting.

A problem at secretarial stations was attaching appendages to the desk or low panels to provide support for the lighting fixture. Because the ambient component of the fixture had to be located below eye level, the uplighting component had to be shielded with a baffle that cut down 50 percent of the light from the fixture.

The effectiveness of this light source was further compromised by the fact that the distance from the fixture to the ceiling was another 5 to 6 feet, so the amount of light from this source contributed to surrounding work surfaces was only 10–15 footcandles. The solutions generated to solve these problems were neither very successful nor aesthetically acceptable on a large scale.

The idea of task-ambient lighting did, however, catch on with furniture manufacturers. In the early 1970s, manufacturers were being asked to incorporate task-ambient lighting into their furniture. By the end of the 1970s, approximately 130 systems furniture manufacturers were selling some kind of lighting integrated with their furniture systems.

Unfortunately, much of what was built into furniture was put in by people who knew little about lighting. Furniture manufacturers really didn't want to design lighting systems. Lighting manufacturers really didn't want to deal with 130 furniture manufacturers.

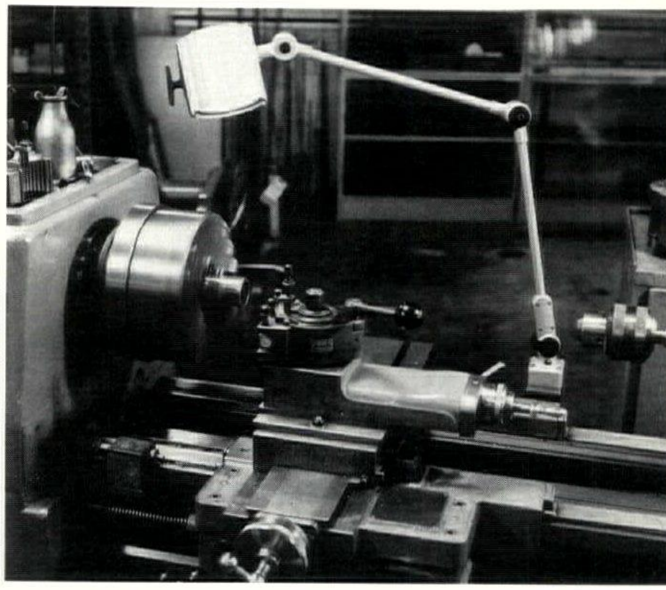
There were and are other disadvantages to furniture-integrated, task-ambient lighting. Irregular patterns of hot spots on the ceiling and areas of darkness appear because it is not possible to put the lighting sources in system furniture at regular intervals or where they are needed from a lighting viewpoint. Cumbersome and costly solutions are often generated to try to get light from a piece of furniture when a ceiling fixture would have been a better solution. Variations in the color and intensity of the lighting on the ceiling is often caused by maintenance people replacing lamps with substitutes for those specified — or failing to replace burned out lamps at all. Despite marketing information to the contrary, it is difficult to move furniture with lighting incorporated into it.

Despite the problems, given the proper set of conditions, successful task-ambient lighting solutions can be and have been achieved and can result in a superior quality office environment — as can be seen in photos of the CIGNA project. Pioneering work in lensed optics took place in the 300,000-square-foot insurance company facility.

The challenge of task-ambient lighting helped force the development of more flexible, more efficient, and better ceiling fixtures. The resurgence of interest in suspended indirect lighting fixtures was a direct result of the inability of furniture-integrated sources to meet clients' lighting requirements.

Coincidental with the movement toward more enclosed offices once again, interest in furniture-related, task-ambient lighting has peaked, but the principal elements of this system are likely to be found in the most successful total office lighting solutions.

With the advent of new compact lamps and low-voltage lighting, new solutions are possible that may overcome many of the problems discussed here. The next advance in task-ambient lighting, however, will be project driven — a response to a sophisticated corporate client's demand for a lighting solution at the leading edge of technology. Such a solution requires the kind of synergistic interaction among the designer, the lighting manufacturer, and the furniture manufacturer as that which occurred for the ARCO and CIGNA projects.



COURTESY WALDMANN LIGHTING CO.

This industrial task light responds to the needs of the people who use it. It does not force the people to adjust to the light.

■Revolution in task lighting

Alfred R. Borden IV, IALD

Al Borden is a lighting designer with the Kling, Lindquist Partnership, Philadelphia.

There is nothing revolutionary about task lighting. But building task lights into a furniture system brought a revolutionary change in office design principles. Previously, light was laid across an office in one smooth, bright coat. Every part of the space, from the manager's desk to the water cooler, received equal intensity. The task-ambient concept brought a new order. Light was parceled out according to need. Primary task areas were identified and given the most light; other areas were ranked and given proportionate amounts.

Such minimalist design required an intimate understanding of how each office worked and a clear vision of the ways it might evolve. This was, of course, nearly impossible. Designs that were too specific in their assignment of light levels generally failed.

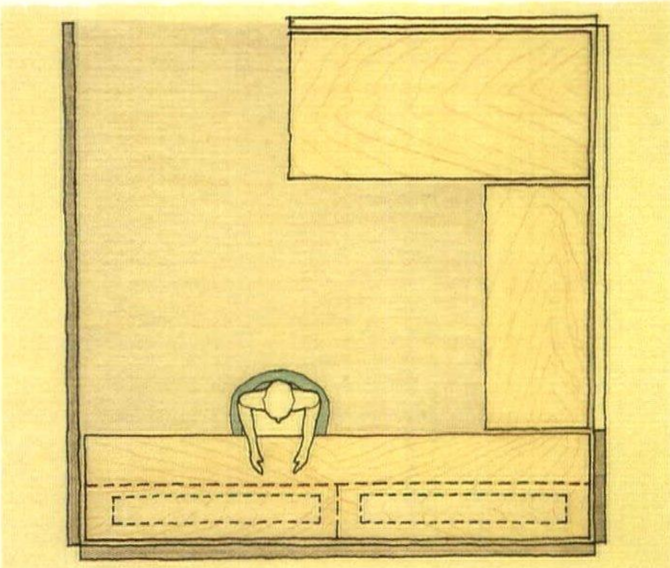
The failure is expressed in a recurring cry: "I don't have enough light." Too often, task-ambient systems are unable to provide sufficient visibility right at the task. The footcandles may be right, but the person in the work station is uncomfortable. The problem is often task lighting that doesn't work.

The rest of the working world uses task lights, as illustrated in the photo of an industrial machine. The person operating this machine needs more light at the task; rather than increase the ambient illumination, the company installed a task light.

That makes sense. The task is repetitive; the worker views the task from essentially the same angle each time and performs the same movements. The task area is specific, and the materials used are of a consistent size and finish. The task light was selected, tested, and adjusted to suit this individual situation. It works very well.

In contrast, look at the plan of a typical office work station. In the illustration, it is possible to identify two horizontal work surfaces, but difficult to predict which is the primary task area. The plan shows a high partition on one side, with a shelf or cabinet above one surface. A low partition is on the other side, with no storage above the second work surface. The plan, however, leaves important questions unanswered.

Does the work station occupant prefer cabinets and a tack surface nearby or a clear view? The high partition is a perfect place to hang charts or printouts — a vertical task. Does the person use it for that purpose? Are tilted task surfaces — such as a keyboard or standing copy holder — used in the space? Which tasks are intermittent? Which are continual? That may change frequently. What are the finishes of the task materials? They probably range from specular to matte in different colors, shapes, and sizes. Answers to all of these questions can describe the complex operation that takes place in the work space.



A plan of a typical work station shows the horizontal work surfaces but does not indicate the primary task area or the occupant's work habits.

No matter what the answers are, however, most workers get a similar, standard solution: a fluorescent tube mounted under the shelf or cabinet above the work surface, as shown in the accompanying section. It has a fixed lens and a switch, and it puts light on one horizontal surface. It also reflects that light directly into the worker's eyes.

If the worker adjusts the seat, moves the work around, and holds the work at just the right angle, it's possible to eliminate the glare — while feeling like a pretzel. This task light actually diminishes visibility. And it does nothing for the other work surface. It also does nothing for the vertical surface, and any of its light that reaches a tilted surface will be glare.

One solution for the second work surface is a light that is essentially the same as the under-shelf light. It is supported on legs and uses a cube louver to reduce the brightness. Such fixtures often include an uplight, making them an example of true task-ambient lighting. Examination of the accompanying illustration reveals some problems associated with this light. The orientation of the light — regardless of the louver — produces disabling reflections. Anyone who wants to talk over the partition needs to be a contortionist; this fixture cancels the advantages of low partitions.

Solving the Problem

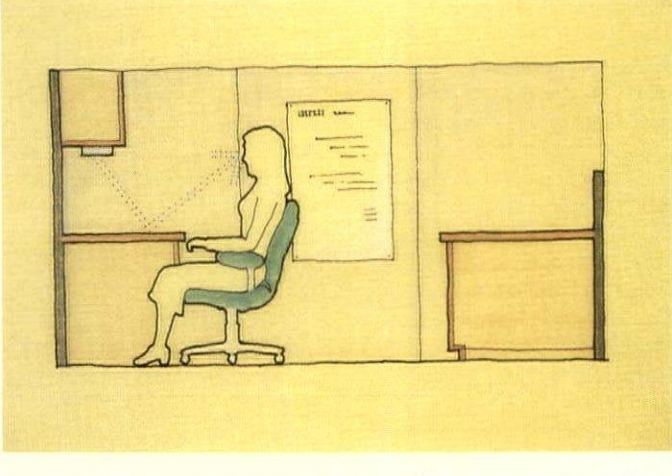
A work station is a multitask space with a variety of task surfaces. Designers cannot fully predict how each surface will be used or the priority of the work to be done there. Only the person who works in the space can describe what happens there — and that description can differ from moment to moment. So, it is important that work station components create a flexible environment — and they usually do. Their various dividers, flippers, doors, and levers can be readily adjusted to accomodate the user.

But the standard task light is quite rigid. It allows no adjustment. It forces the user to sit, to work, and to see in a particular way.

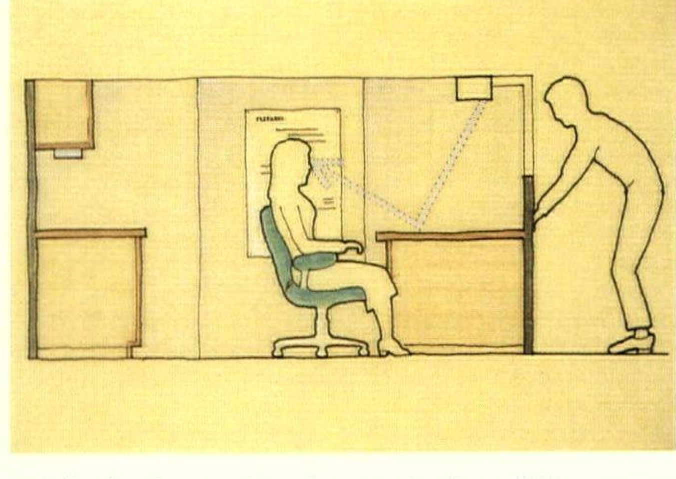
Look again at the task light on the industrial machine referred to earlier. This luminaire has an important feature that is missing from the under-shelf light. It is adjustable. Anyone who operates the machine can aim the light at just the right angle to provide the best visibility. In fact, a technician who is servicing another part of the machine can swing the fixture over to light that task. This task light responds to the needs of the people who use it; it does not force them to adjust to its idiosyncrasies. In concept, it is just what an office work station needs: a tool that is sympathetic to the user.

Yet, obviously, it is not possible to move that exact fixture to an office environment. The quality of light it produces is suited to the needs of a machinist: it is very intense and concentrated on a small area.

Continued on page 37



No matter how an office worker uses the space, work station lighting is likely to be similar — a fluorescent tube mounted under a shelf or cabinet above one of the task surfaces.



Lighting for the second work surface is often a light supported on legs and louvered to reduce brightness — a solution essentially similar to under-shelf lighting.

Effective aperture: Getting the light of day indoors

Douglas E. Mahone and Stephen Selkowitz

Doug Mahone is a senior associate with Charles Eley Associates, San Francisco, and Steve Selkowitz is leader of the windows and daylighting group at Lawrence Berkeley Laboratories, Berkeley, California. This article is adapted from the forthcoming Skylight Handbook — Design Guidelines, *to be published by the American Architectural Manufacturers Association.*

Effective aperture (EA) is a technical term that is extremely useful in describing skylighting systems. EA has been found to be one of the most important parameters in determining optimum energy and cost savings for skylight systems.

The concept of effective aperture is basically quite simple. If a skylight system used an ideal light-transmitting glazing — one with 100 percent visible light transmittance — and if no light well absorbed or blocked some of the daylight, then the only skylight feature influencing the amount of daylight admitted to the building would be the glazing area of the skylights. For convenience, the skylight area can be described as a fraction of the floor area. This fraction is called the *skylight-to-floor ratio,* or SFR.

In less than ideal skylight systems, real glazing materials and light wells reduce the amount of transmitted daylight that enters the building. It is possible to account for these reductions by treating them as equivalent to reductions in skylight area. Thus emerges the definition of the new term, *effective aperture* (EA). EA is a measure of the total light admitting properties of the roof-skylight system; it combines three factors.

SFR. The skylight-to-floor ratio, already mentioned, is the ratio of skylight glazing area to gross daylit floor area.

VT. The visible transmittance of the skylight glazing is the fraction of visible light transmitted through the glazing.

WF. The well factor expresses the fraction of visible light entering through the skylight that makes it past the light well (the rest being absorbed or reflected back to the sky). The well factor is explained later in this article.

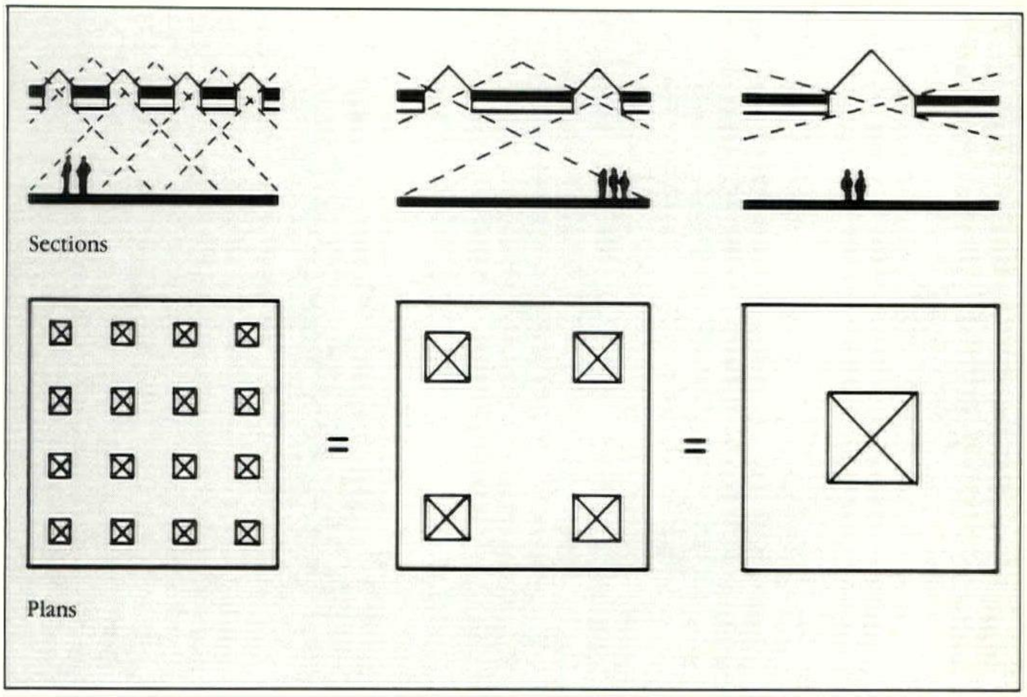
The effective aperture is the product of these three factors, which can be expressed in the following equation:

$$EA = SFR \times VT \times WF$$

Each of these can be readily calculated, estimated, or obtained from manufacturers' literature.

Typical visible transmittances (VT) for skylight glazing	
Single glazing	
Clear glass (colorless)	0.88
Clear acrylic (colorless)	0.92
Clear polycarbonate (colorless)	0.83
Diffusing acrylic	0.17–0.72
Diffusing polycarbonate	0.43
Tinted glass (1/4" bronze)	0.49
Tinted glass (1/4" blue/green)	0.75
Double glazing	
Polycarbonate	
Clear/clear	0.69
Diffusing/clear	0.36
Bronze/clear	0.43
Bronze/diffusing	0.22
Acrylic	
Clear/clear	0.85
Diffusing/clear	0.48
Bronze/clear	0.25
Bronze/diffusing	0.17

Note: All numbers are averages and will vary with material thickness, degree of tint, and skylight design.



Skylight-to-floor ratio (SFR) is the same for each example above, but the light distribution is different for each.

With no skylight well (WF = 1), and with perfectly transparent glazing (VT = 1), the EA would simply be the skylight-to-floor ratio (SFR). The EA is reduced by the VT fraction, and by the WF. Thus, for a given SFR, the EA becomes smaller as the glazing VT decreases and as the skylight well becomes less efficient as a light transmitter.

The skylight systems shown in the accompanying illustration all have the same skylight-to-floor ratio. All will have the same effective aperture if well factor and visible transmittance are equal. They will, however, produce different interior light distributions.

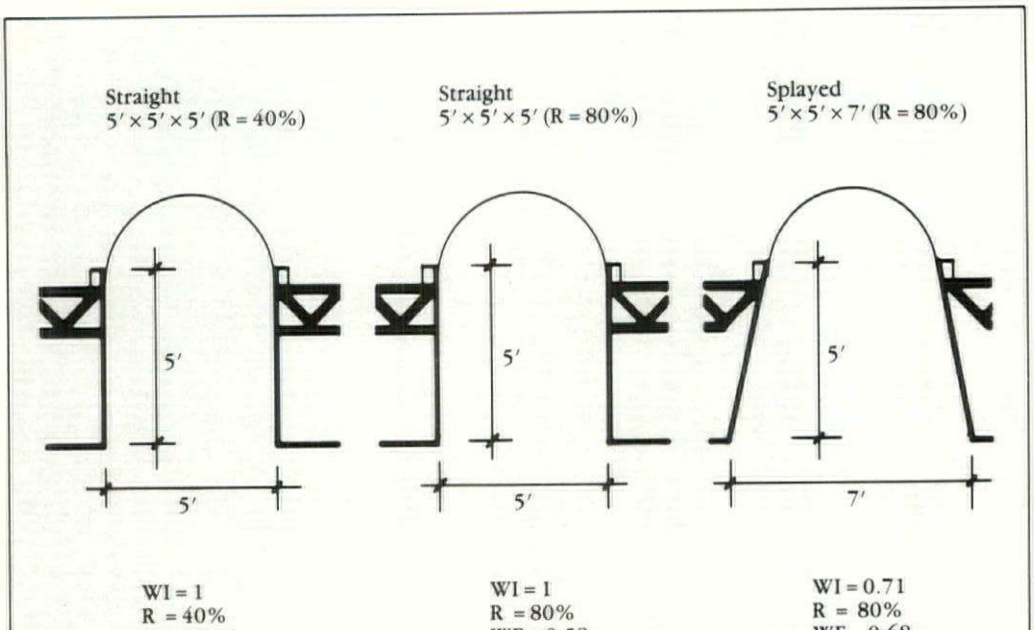
Conceptually, then, EA can be thought of as the skylight-to-floor ratio for any system with perfectly transmitting glazing and skylight wells that would admit an amount of light equal to that of the system in question.

Because three factors make up the EA, many combinations of the three could have the same EA. As an example, each of the three systems outlined in the EA Examples table have the same EA but are otherwise very different. The first two show different skylight systems using different types of skylights; the third illustrates a large, low-transmittance, glass or fiber glass space enclosure system.

There are, of course, differences in the distribution of light and in the thermal properties of the three different skylight systems, but each admits the same gross quantity of light into a building. For this reason, EA is a useful and powerful metric in daylighting analysis. It is a key parameter in the other quantitative information presented in the *Skylight Handbook*.

Effective aperture examples

System 1	System 2	System 3
SFR = 0.050 (5.0% of roof area is skylights)	SFR = 0.094 (9.4% of roof area is skylights)	SFR = 0.50 (50% of roof area is skylights)
VT = 0.92 (clear acrylic)	VT = 0.49 (bronze acrylic)	VT = 0.08 (reflective glass or low transmittance diffuser)
WF = 0.81	WF = 0.81	WF = 1.00
Therefore, EA = .050 × .92 × .81 = .04	Therefore, EA = .094 × .49 × .81 = .04	Therefore, EA = .50 × .08 × 1.0 = .04



Typical light wells and well factors for straight and splayed light wells with different wall reflectances.

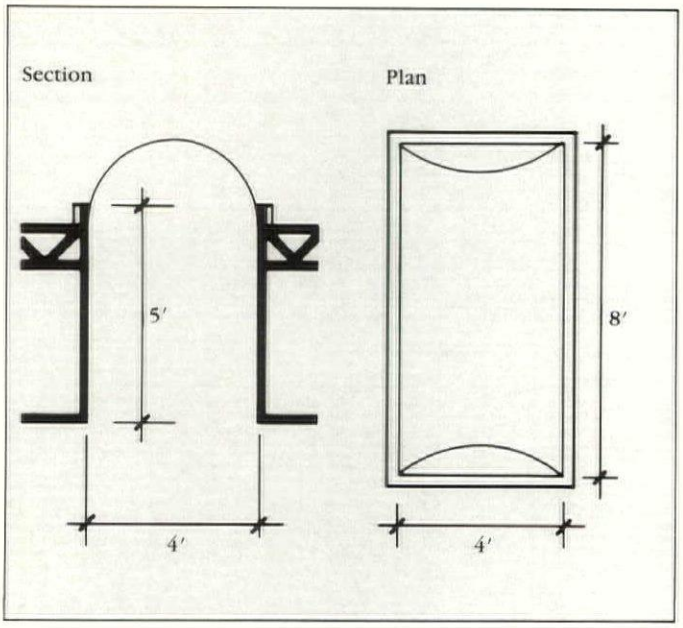
The Well Factor

The well factor (WF) is one of the three measures used to quantify the effective aperture of skylight systems. WF measures the efficiency of a skylight well at bringing daylight from a diffuse source through the ceiling. WF is the ratio of the amount of visible light leaving the well to that entering the well from the skylight. Some daylight shines directly on task surfaces from the skylight glazing, while some arrives by interreflections within the light well; along the way, some of the light is absorbed. The geometry of the light well and the surface reflectances of its walls determine the well factor.

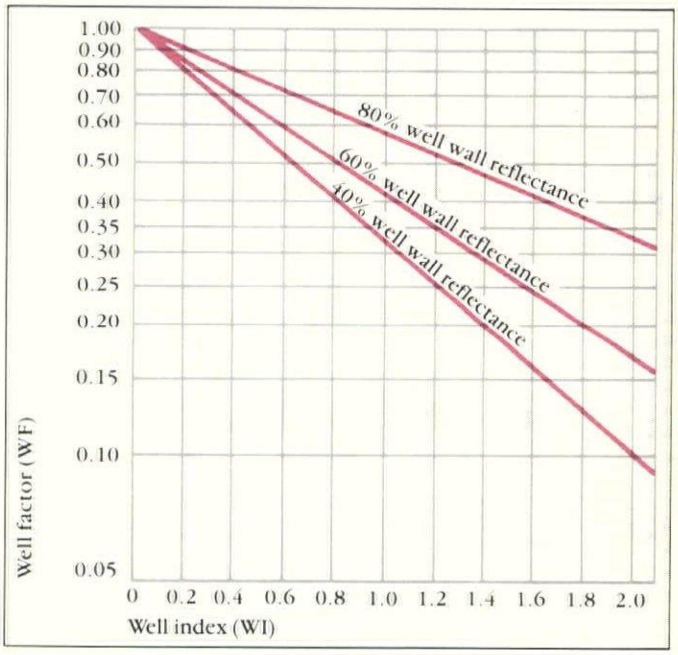
The typical light wells illustration shows a variety of different light well configurations and their associated WFs. In general, deeper wells with steeper walls have lower WFs than shallower, more splayed wells. As reflectance of the wall diminishes, the well factor decreases. As the base of the well gets larger, the well factor increases.

Here is a procedure for calculating the WF for simple square or rectangular skylight wells. First, calculate the well index (WI), which is a measure of the overall shape of the well. The equation for this calculation is shown below:

$$WI = \frac{H(L + W)}{2(L \times W)}$$



Using the formulas explained in the text, the well index (WI) for a straight well — 5 feet deep, 4 feet wide, 8 feet long — is calculated to be WI = 0.93. The reflectance (R) is 80 percent, and the well factor (WF) is 0.60.



Well index graph from IES Lighting Handbook, 1984 Reference Volume, *used with permission of the Illuminating Engineering Society of North America.*

where:
WI = Well index
H = Height of well from glazing to ceiling
L = Length of well
W = Width of well
Use the maximum width and length for splayed wells.

In the accompanying illustration, the rectangular skylight well dimensions are: height, 5 feet; width, 4 feet; and length, 8 feet. The well index is calculated as follows:

$$WI = \frac{5(8+4)}{2(8 \times 4)} = 0.93$$

Notice that wells of similar proportions will have the same well index. A cube-shaped well of any dimension will have a WI equal to one.

Next, determine the reflectance of the walls of the skylight well. In the illustration, the wall reflectance is 80 percent. The Typical Reflectances table gives reflectances for typical light well materials. Reflectance is the fraction of incident light reflected from a wall surface. The rest of the light is absorbed by the surface.

Finally, using the accompanying graph, it is possible to find the WF, the efficiency of the well. Enter the graph on the horizontal axis with the value of the well index, 0.93. Draw a vertical line up to the 80 percent reflectance line. From that intersection, move left to find the well factor. In this case, WF = 0.60.

Notice that lower reflectances in the light well produce lower WFs. This is because more of the daylight is absorbed in the light well, and less reaches the task surfaces below.

Climate and Energy Savings

Seven representative cities can be used to describe daylighting climate in six zones associated with these locations. The map shows the representative cities and daylighting zones.

The *Skylight Handbook* from which this article is excerpted summarizes a large body of research and computer simulation of skylighting system behavior in each of the representative locations. The studies were performed for a typical office building with skylights placed on the roof to provide uniform illumination in the building.

One of the ways this behavior is presented is in terms of lighting energy savings. The savings assume a daylighting control system that turns off electric lighting in response to daylight availability. When there is sufficient daylight to provide the desired level of illuminance, the electric lights are reduced to their minimum level.

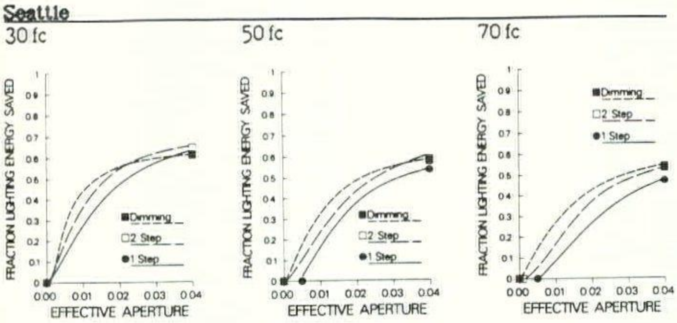
The accompanying graphs for the six zones show the annual lighting energy savings associated with each representative location as a function of effective aperture (EA). All show increasing lighting savings as EA increases, with a tendency to level off at larger EAs. Each set contains graphs for three levels of desired illuminance: 30, 50, and 70 footcandles on the workplane. This is the design illuminance level provided by the electric lighting system, and it is the minimum daylight level at which the maximum lighting energy savings are achieved.

There are three curves on each graph. The dimming curve describes the behavior of a continuous dimming daylighting control system. The 1-step

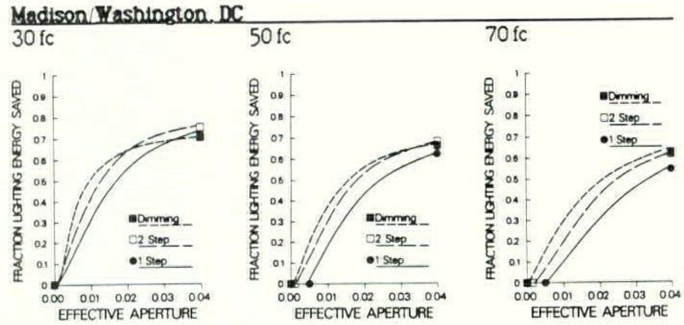
Typical surface reflectances

Material	Reflectance
White plaster	0.93
Aluminum foil	0.85
White paint	0.80
White enamel	0.65
Green paint	0.50
Red brick	0.45
Granite	0.45
Concrete	0.40
Galvanized steel	0.35
Red paint	0.26
Grey paint	0.25
Flat black paint	0.04

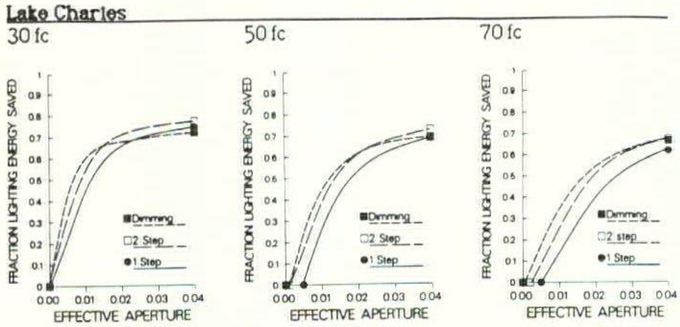
Seattle



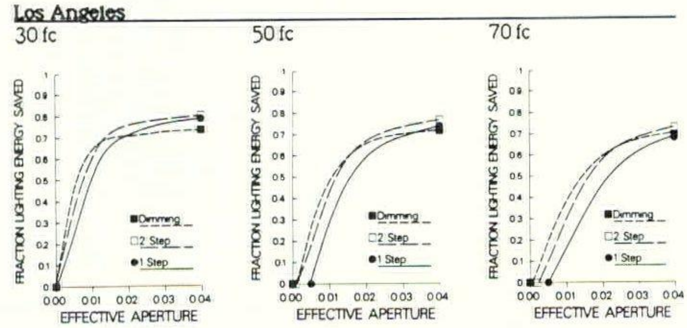
Madison/Washington, DC



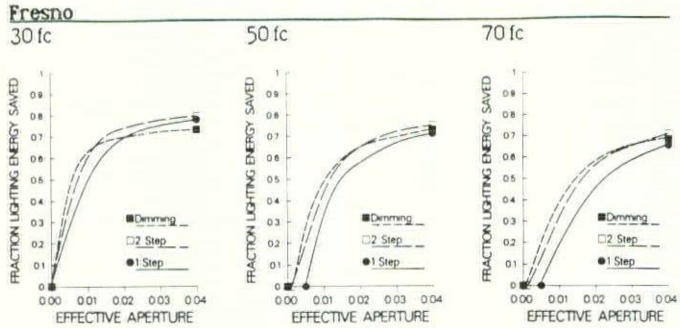
Lake Charles



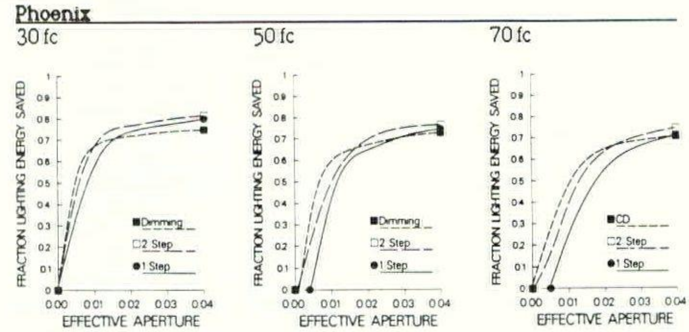
Los Angeles

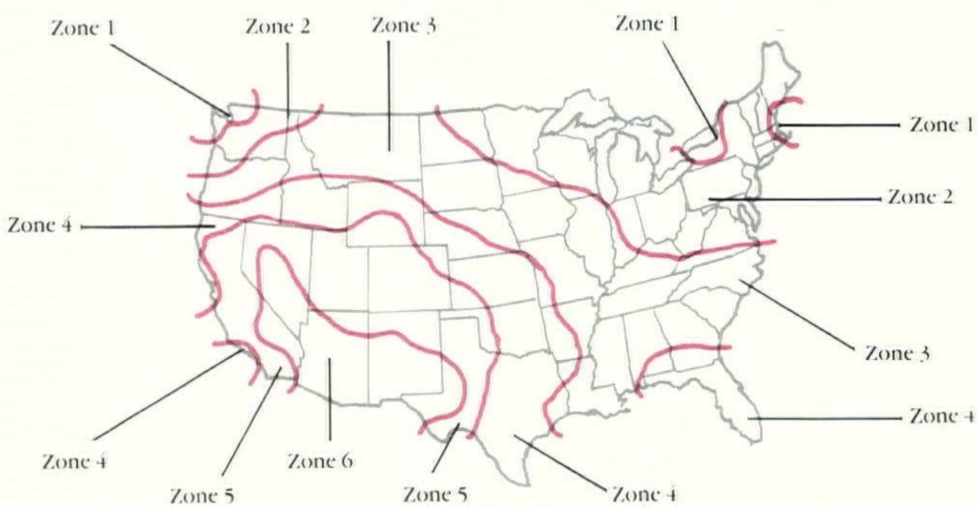


Fresno



Phoenix





Zone 1: Seattle, Washington; Zone 2: Madison, Wisconsin; Washington, D.C.; Zone 3: Lake Charles, Louisiana; Zone 4: Los Angeles; Zone 5: Fresno, California; Zone 6: Phoenix, Arizona.

and 2-step curves describe step control systems that turn lamps on or off in response to daylighting levels.

Reading the graphs is a straightforward process. For example, if a building located in Seattle has a desired illuminance level of 30 footcandles, use the first graph. If the daylighting control system is the continuous dimming type, read the short dashed line.

At an EA of 0.01, the fraction of lighting energy saved is somewhat less than 0.45. This means that nearly 45 percent of the electric lighting energy needed to provide 30 footcandles during working hours over a full year could be saved by using skylights with an EA of 0.01 and a continuous dimming daylighting control system.

The graphs show representative values, of course, based on the typical office building and lighting system assumed in the analysis. Nevertheless, they provide a good starting point for skylighting system design, and they point to the magnitude of savings that can be expected with good design. It is interesting to compare the savings for different locations, for different levels of desired illuminance, and for different daylighting control systems. ■

The Skylight Handbook *also provides information on total building energy savings, including heating and cooling system effects of skylighting. The price is $50, but* Architectural Lighting *readers get a 25 percent discount.*

To order your copy, write a check for $37.50 payable to American Architectural Manufacturers Association, and send it to AAMA, Technical Information Center, 2700 River Road, Des Plaines, IL 60018. They'll pay the postage.

Continued from page 32

Beyond those few inches, it creates excessive shadowing, glare, and other contrast problems. Office tasks are accomplished over larger areas, and larger surfaces require even illumination with soft edges to eliminate shadows and abrupt shifts in intensity. A diffused light is best. The halogen source in the industrial task light produces a great deal of heat, which could be an annoying problem in the close atmosphere of an office work station. Its concept, however, is perfect. The earliest office desk lights were much like it.

It is not necessary to return to earlier models, though. Many new adjustable fixtures are available, featuring a variety of sources, mountings, and controls. Their most important feature is the ability to let office workers become their own lighting designers.

Adjustability must be added to the list of criteria for a successful task light. Others are wide, even light distribution, a diffused pattern with soft edges, and a low-heat, long-life source. All task lights have *some* of these qualities; a few have them all.

Even the maligned undershelf light meets some of the criteria. Its fluorescent lamp is efficient, it casts an even light over most of the desk, and some models come with adjustments. The poor orientation of the light is unchangeable, but the luminaire can be fitted with a high/low intensity switch, a dimmer, or a rotating damper. Its glare problem can be eased by reducing the source brightness.

A twin under-shelf fixture places a lamp on either side of the work surface and aims both toward the middle. It creates more diffused light and keeps the lamp image out of the worker's eyes — as long as tasks take place in the center of the desk. At the sides, stray reflections can be a problem. Some manufacturers put the lamps in separate housings, making it possible to slide them around to get the best light. Still, these products light only the area under the shelf. Other task lights are more flexible.

Several companies offer an adjustable clamp-mounted fixture with a diffused source — fluorescent or silver-bowl incandescent — and a symmetrical reflector. The reflector places light of peak intensity directly below the lamp; placed directly over the work, it creates a glaring lamp image. When placed to the side, its reflector must be tilted to get the brightest light. This can look awkward, create shadows, and offer a direct view of the source.

At least one company makes a desk light with an asymmetrical shade and an indirect source. The base has a low-voltage lamp that bounces light off the shade. The idea works fairly well; the shade diffuses the light and the base dissipates the heat of the lamp. But, the fixture consumes a lot of space and needs to be placed quite close to the task.

Other manufacturers mount a low-voltage halogen lamp at the end of a slender, flexible arm that is easy to adjust. This keeps the fixture from becoming an obstruction, and an asymmetric reflector lets it light the task from a lateral position. Some also have a high/low switch. With all its good qualities, however, a point source lamp in a simple reflector also has a shortcoming: by its nature, it tends to concentrate the light. A pebbled reflector helps, but the source needs to be placed quite high above the task surface to cover a wide area evenly. That can be awkward for the user.

A number of manufacturers make an adjustable fixture that uses a compact fluorescent lamp — an excellent source for task lighting — and an asymmetric reflector. Such task lights can sit below eye level and off to one side while providing wide, smooth light distribution with soft edges even when close to the task.

It should be clear that many task lights provide some of the features needed in a work station — the last one described may even seem to meet all the criteria named earlier. But a work station is a complex environment, and no single task light can meet every possible combination of working needs.

Many stations, in fact, may need more than one type of lighting. The example illustrated would do well with a twin-type fixture under the shelf and an adjustable, partition-mounted luminaire above the other work surface. Such a combination maximizes the usable space, gives each surface the best light that will fit in, and lets the occupant have some control over the task lighting.

This discussion of the example work station leads to a formula for successful task lighting. Select fixtures that provide visibility, not simply footcandles. Mount them clear of the flow of work. Most important, wherever possible and to the extent possible, choose adjustable fixtures. Designers owe it to their clients and office workers to design task lighting systems that are as adaptable as the furniture in which they are mounted.

The remaining two sections of this four-part article will focus on ceiling lighting. ■

The Computer Department

David Lord

David Lord is a professor of architecture at California Polytechnic State University, San Luis Obispo.

This month we look at software from a lighting manufacturer, suggest a way of gaining access to photometric data on floppy diskettes, and review two daylighting programs.

Lighting manufacturers have spurred the development of microcomputer programs by agreeing to an IES standard, computer-readable format for luminaire photometric data. Most manufacturers now make this photometric data available to lighting designers on floppy diskettes. Many companies will run their own custom-made microcomputer programs for designers; some of the programs are available to lighting designers.

Globe Illumination Company (Gardena, California), for example, includes in its catalog binder a series of diskettes containing a lighting calculation program and photometric data bases for its luminaires. The computer diskettes appear alongside traditional lighting data sheets and brochures.

Lighting manufacturers have spurred the development of microcomputer programs by agreeing to an IES standard format for luminaire photometric data.

Globe's electrical lighting calculation program is based on formulas described in chapter nine of the IES *Handbook*, 1981 and 1984 editions. There is one page of instructions on the use of the program, which requires an IBM PC and an Epson FX-80 printer or its equivalent. Colorful, well-designed menus guide the first-time user through several features: simple lighting calculations, creation of a lighting table, and a lighting economic analysis.

The program automatically generates short reports as desired, including tables that compare areas per luminaire, footcandle levels, and energy use. The economic analysis portion of the program compares the simple life-cycle cost of two alternative lighting solutions.

The average user who understands the IBM disk operating system and is familiar with electrical lighting terminology and procedures should be able to master the program in less than an hour. Information useful at the design development stage can be generated quickly. Technical data, such as coefficients of utilization, are provided within the program; but the user must select them and enter them with the keyboard.

Ironically, users must make keyboard entries of the photometric data printed in Globe's catalog description of luminaires. This very same data is recorded on the other three diskettes in Globe's catalog, data that is inaccessible to this simple lighting program.

Data Base Management

For use in microcomputer programs, photometric information must either be tediously entered by hand, or else read by the calculation program from the data contained on diskettes. The photometric data base information on diskette is contained in a format that can be viewed only through a data base management program. This is necessary in order to store the information in the most compact form possible.

Lumen-Data, a data base management program by Lighting Technologies, provides an interface between manufacturer data diskettes and Lighting Technologies lighting calculation programs. Lumen-Data helps the designer by generating reports from manufacturer's data about each luminaire — information such as luminaire dimensions, luminaire and lamp descriptions, the number of lamps, lamp lumens and

Featured programs

Globe lighting program and photometric data

Runs on IBM PC with Epson FX or RX series printer

Globe Illumination Company
1515 W. 178 St.
Gardena, CA 90248
Contact Robert H. Horner, (213) 321-9000

Microlite 1.0

Runs on IBM PC with minimum of 128K RAM

Requires: 2 disk drives
Color graphics adapter card
Color monitor

Send $25 and two formatted floppy diskettes to:
Designers Software Exchange
Department of Architecture
Massachusetts Institute of Technology
Cambridge, MA 02139

Daylite 2.0, $289

Runs on IBM PC with minimum of 128K RAM

Requires: 2 disk drives (one can be a hard disk)
Color graphics adapter card and color monitor
8087 math coprocessor optional, must specify

Versions available for the Apple Macintosh, including the Macintosh II

Solarsoft
1406 Burlingame Ave., Suite 31
Burlingame, CA 94010
Contact Bill Ashton, (415) 342-3338

THE BRIGHT IDEA IS AN IDEA THAT WORKS

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

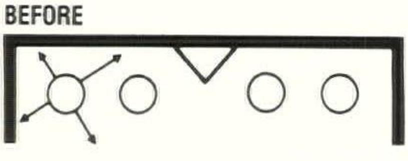
- *40 to 50 percent reduction in lighting energy bills*
- *Lighting maintenance cost reduction (50 percent fewer lamps and ballast to replace)*
- *No significant reduction of light levels*
- *Fixture illumination uniformity*
- *Glare control and reduction*
- *Improve color rendition*
- *Building cooling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

THE BRIGHT IDEA IS SIMPLE

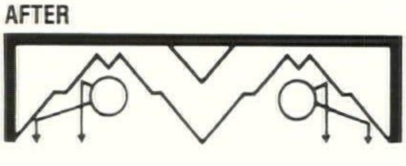
Maximum Technology has engineered the highest performance reflector. The specular silver optical reflector consists of a space age silver film that is bonded to .025" aluminum material creating a highly reflective mirror. Unlike polished metals; the silver film demonstrates superiority in reflectivity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

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

BEFORE



AFTER



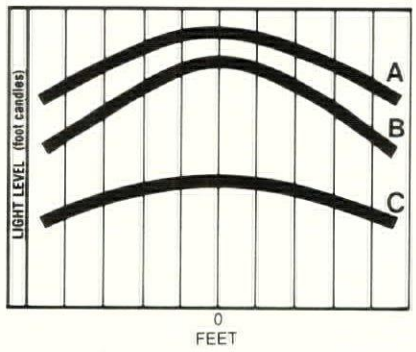
THE BRIGHT IDEA IMPROVES LIGHTING EFFICIENCY

Maximum Technology manufactures **The Bright Idea** *for almost all types of fluorescent luminaires, new fixtures as well as existing fixtures. Over 3,000 custom designs have been produced for a wide range of customer applications. However, the most common fixture is the standard 2×4 foot luminaire. Let's examine how* **The Bright Idea** *improves efficiency, through wattage reduction.*

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

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

FIXTURE



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

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

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

THE DESIGN IDEA IS A QUALITY DESIGN

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

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

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

THE BRIGHT IDEA IS GUARANTEED

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

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

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

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

THE BRIGHT IDEA PAYS FOR ITSELF

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

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

THE BRIGHT IDEA HAS BEEN APPROVED

This is a patented system that is **U.L. Listed** *(for safety).*

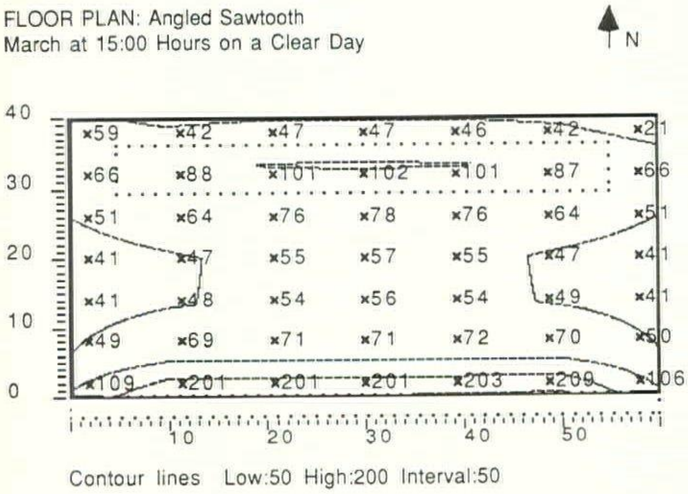
Over 100 major facilities have been successfully retrofitted with **The Bright Idea.** *Customers include: manufacturing facilities, offices, banks, institutions, stores, assembly plants—in large, medium and small buildings. Complete case histories and documented test results are available for your review.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

MAXIMUM TECHNOLOGY

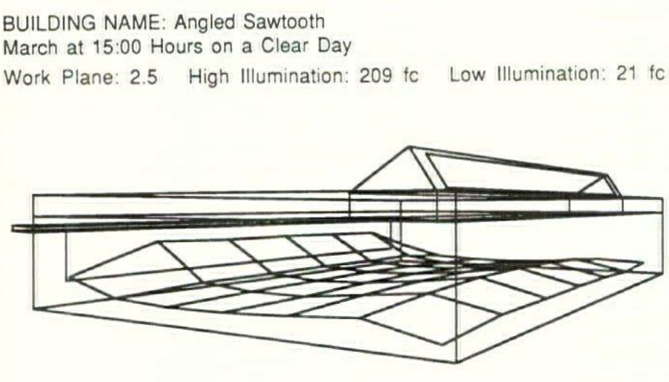
60 Industrial Way
Brisbane, CA 94005
(415) 468-2560

U.S. Patent 4562517 Other patent pending products.

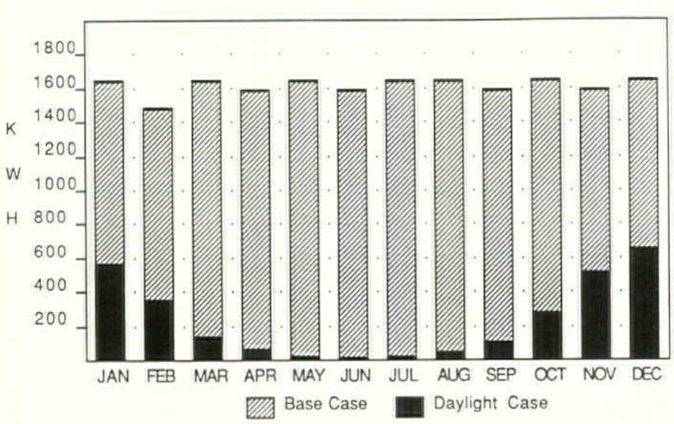
Circle 16



A graphic printout of a Daylite 2.0 analysis, showing isolux illuminance values.



Daylite 2.0 printout of a three-dimensional graph of daylighting values.



Daylite 2.0 printout of yearly lighting power budget, showing base case and daylight comparisons.

input watts, and the luminous intensity of the luminaire along several axes.

Lumen-Data also allows the designer to create photometric data bases when they are not available from the manufacturer. Although useful in its own right, Lumen-Data is incorporated into the Lumen series of lighting analysis software as a module. It is not sold separately, but is included with Lumen-Micro, Lumen$, or Lumen-Point.

Daylighting Analysis

Compared to the number of microcomputer programs for electrical lighting calculations, relatively few are available to perform daylighting analysis. One program for calculating and displaying daylighting designs is Microlite 1.0, available for the Apple II Plus and the IBM PC. The IBM version's input and output routines are more sophisticated, but in general, Microlite 1.0 is still in the developmental stage.

Although there are a few bugs in the user interface, the daylight illumination calculations appear to give satisfactory results. Only rooms with rectangular geometries can be analyzed, and glazing must be vertical and in exterior walls. Neither skylights nor tilted windows can be analyzed, nor can Microlite handle external obstructions, sunshades, or light shelves.

Keeping these limitations in mind, it is possible to model and display daylighting effects in simple spaces using basic climatic assumptions, such as latitude, clear or overcast sky, and ground reflectance. Running the program and displaying the results for a few representative spaces, windows, and climatic variations helps designers to develop a feel for the effects of daylight.

Microlite comes on two diskettes with six pages of user instructions. The program is written in BASIC; it can be listed and modified, line by line, by a technically oriented user adept at programming. Microlite uses a method called the daylight factor for calculation, and determines relative illuminance indoors as a percentage of exterior illuminance.

One of the chief drawbacks to Microlite is its dreadful slowness in execution — especially noticeable in today's world of speedup chips, turbo boards, and fast processors. Microlite may take more time to execute and generate results than the average designer or engineer is willing to spend.

A more recent and far more powerful program for the microcomputer, Daylite 2.0, determines the absolute illuminance in a space, measured in lux or footcandles. Daylite 2.0 uses the flux transfer method of calculation, considered to be more accurate and flexible than the daylight factor.

Coauthored by Claude Robbins, Daylite 2.0 complements his book, *Daylighting: Design and Analysis.* Daylite 2.0 makes use of Solar Energy Research Institute research on daylight and sunlight availability. The program makes it possible to use the data in the Robbins book to study local climates for daylighting potential.

Daylite 2.0 is promoted as enabling designers to explore design options without the time and expense of building physical models. Although it makes extensive use of graphics and allows accurate visualization of daylighting effects, I recommend Daylite 2.0 as an adjunct to a scale model because it presents wireframe views and does not permit solids modeling of interior spaces.

Daylite 2.0 determines the lighting effect of many interior and exterior design elements: window height, room depth, surface reflectance, overhangs,

fins, and light shelves. Roof monitors, light wells, and skylights also can be modeled. The daylight present in a space can be visualized at any time of day during any month of the year. In addition, direct sunlight penetration, heat gain from daylighting, electrical lighting integration, and power budgets can be determined with separate program modules. This program accomplishes a vast amount compared to Microlite.

Daylite 2.0 comes on four floppy diskettes with a 100-page manual. The documentation will leave all but the most experienced, technically oriented user a bit baffled at first. Help screens are useful to those who don't study the manual first.

If a user attempts keyboard inputs beyond the program's limits, the computer beeps; it is impossible to proceed before an acceptable input is made. In many cases, the program provides acceptable default values, referenced in the documentation.

The program is robust enough to survive many of the mistakes that beginners make. After two to three hours, a user experienced in both computer operation and lighting terminology should be getting useful results from Daylite 2.0. ■

The Computer Department welcomes reader comments. Write to David Lord, Architecture Department, Cal Poly, San Luis Obispo, CA 93407.

Additional information on programs and publications appears in the Manufacturer Credits section on page 70.

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.

Lamps and ballasts do not last forever; they require maintenance and updating when they are replaced. Like an automobile, a lighting system needs regular service, not just repair or replacement when a part stops working. A 10-year-old car would not run very well if its oil and grease were never changed or if its spark plugs were replaced one at a time with plugs of different brands, without thought of compatibility.

A fluorescent fixture needs to be maintained with the right parts to ensure best performance for lighting and energy use. New lamps or ballasts must be compatible with other components. Compatibility is especially important when choosing new parts that are designed to save energy.

As discussed in previous Parts Department columns, fluorescent lamps are low-pressure gas discharge light sources. Inside an operating lamp, a mercury arc generates ultraviolet energy that activates light-producing fluorescent powders.

Fluorescent fixtures need regular maintenance, compatible lamps and ballasts.

Like most gas discharge lamps, the fluorescent lamp must be operated in series with a load limiting device — the ballast — that limits the current to the value for which the specified lamp is designed, provides starting voltage, and provides operating voltage. Compatibility of lamp and ballast is critical to the performance of both components.

The life and light output ratings of a fluorescent lamp are based on use with a ballast that provides proper operating characteristics, as specified by the American National Standards Institute (ANSI). Incompatible ballasts can substantially reduce lamp life, light output, or both.

Ballast life can be as long as 75,000 hours with 105-degree Celsius Class A insulation. This means that the ballast coil temperature will not exceed 105 degrees Celsius in the ballast when the fixture maintains a maximum case temperature of 90 degrees Celsius.

Excessive operating temperatures cause deterioration of the ballast insulation, resulting in shortened life, lower lamp efficiency, and possibly the activation of the thermal protection device. Every 10-degree increase in temperature above 90 degrees Celsius reduces ballast life by 50 percent. Average ballast life may be from 12 to 15 years, depending on annual burning hours. Ballasts operating at higher temperatures, however, could fail in as little as 5 or 6 years. Badly depreciated or burned-out lamps, which cause temperature increases, can also shorten ballast life.

Energy Saver Lamps

The 34-watt energy saver lamp was originally developed for operation with standard ballasts at lower wattage and light output than required for standard 40-watt rapid start fluorescent lamps. The actual wattage reduction typically ranges from about 8½ percent to about 20 percent, depending on the ballast used and the basis for comparison.

To create the energy saver lamp, manufacturers changed the composition of rare gas in the fluorescent lamp from argon to krypton, which reduces lamp operating voltage and energy usage. The change also increases the voltage necessary to start the lamp, and so may shorten the life of both lamp and ballast. Lumen output is reduced both by the reduced wattage and by the tin oxide coating applied to the lamp wall to help start the arc.

Avoid using the 34-watt energy saver lamp in fixtures more than 5 years old.

Ballasts have failed when the ballast could not provide the increased voltage required to activate the lamp. Generally, ballasts manufactured before 1978 are *incompatible* with the 34-watt lamp. In fact, it might be inadvisable to use the 34-watt lamp in fixtures more than five years old, especially if there has never been a group relamp. Depreciated lamps and increased starting and operating voltages may have taken their toll on the ballast.

The rated life of an F40 standard lamp is listed at more than 20,000 hours based on 3 hours of operation per start. Typical mortality curves show that 50 percent of the lamps survive this long. Given a 12-hour burning cycle, 50 percent will survive not quite 30,000 operating hours. The curves do not indicate the condition of the surviving lamps — which is probably extreme depreciation, involving lumen and color depreciation and increased strobing.

Based on average ballast condition, the F40 standard lamp appears to have an effective usable life of 12,000 hours, more or less, depending on ballast condition and lamp burning cycle. No mortality curves are available for the 34-watt energy saver lamp; its effective usable life may be as short as 3000 to 6000 hours. At the end of usable life, lamps are generally so depreciated that I recommend group replacement. These life-span figures are based on my experience with actual installations.

The 34-watt lamp produces significantly less light output than the 40-watt lamp. The degree of difference can best be determined by a field test. Performance depends on the condition of the existing ballasts, which generally remain in place after 10 or 12 years of service. The chances of long lamp life and high efficiency with older ballasts are remote.

Testing Performance

It is a good idea to determine the performance of lamps and ballasts currently in use. First, review the history of the lighting system. Check the date of the original fixture installation. Then check the fixture, record the order number and specific information found on the ballast label, and record the specific lamp type in use. Review lighting maintenance procedures to determine whether lamp replacement is group or spot. A record of lamp

purchases over the life of the installation can help you determine the frequency of burnout.

A visual inspection of the lighting system also provides important information. The condition of the lamps based on the hours of use since installation is important. Visible strobing (flicker), existing burnouts, and the degree of darkening at lamp ends give a good reading on the condition of the lamps.

Make comparative tests using the test procedures suggested in the June Parts Department column on ballasts. You will need a light meter, a watt meter, and a reflected ceiling plan of the test area to locate and record light readings and the wattage at specific ballast locations. You can compare existing lamps with new lamps and various other lamp and ballast combinations. Any given lamp may produce different results with various ballasts, and the test can give a strong indication of compatibility.

To thoroughly test the value of an energy saver lamp, determine the most compatible lamp and ballast combination and install the components in a test fixture. Do the same with the standard lamp and the same ballast. Test for input watts and light output. A good test sample is two small offices of similar size, number of fixtures, and interior finish schedule.

Let the lamps burn in for at least two days, and then take your initial readings. Repeat the test at the same time of day every two weeks or every month for six months or more. You can also test new lamps with existing ballasts and compare the performance.

When considering the purchase of energy saver ballasts — and you should if your preference is core and coil — test the different brands of energy saver and standard lamps with the ballasts you're considering to be certain that you get the results you anticipate. The newer electronic and reactance ballasts should also be tested for performance. The 40-watt standard or higher output lamp is preferred. Remember, lamp and ballast compatibility is a major consideration. A field test yields the information you need to make a decision.

My experience has been that when 34-watt energy saver lamps are used with existing ballasts, especially ballasts five years old or older, there is a significant loss in light output, especially when compared to the standard lamp in comparison testing. This will be apparent either initially or during the first year of use. Energy use reductions may not be as anticipated, especially after extended use. Take watt meter readings after 6 to 12 months of use to check performance. I would also expect shorter effective lamp life and possibly shortened ballast life.

Because of its higher cost and the increasing experience of inadequate performance, the 34-watt lamp could actually end up costing the user a premium. Consider lower light levels, more frequent lamp and ballast replacement, and possibly disappointing energy use reductions. Inadequate maintenance or just plain nonmaintenance also contributes to the situation (March Parts Department).

Lighting is a critical part of the work environment. It should be managed to provide optimum performance as related to the environment of the space and the cost of operation. Before you believe anything you see, hear, or read about lighting, try it in your space, and see how it works for you. ■

Book Reviews

IES Lighting Handbook: 1987 Application Volume, John E. Kaufman, PE, FIES, editor; Jack F. Christensen, associate editor. New York: Illuminating Engineering Society of North America, 1987. 530 pages, $200; $80 to IES members.

The *Lighting Handbooks* of the Illuminating Engineering Society are essential reference documents for anyone performing lighting design or lighting engineering functions. In continuous publication since 1949, these handbooks have been the central public archive of lighting information. Recent editions have been produced in two volumes, one titled the *Reference Volume*, dealing with the isolated technical and engineering issues of lighting, the other titled the *Application Volume*, dealing with the issues and processes of lighting design. A new edition of this latter volume was recently published.

The diversity and range of material in the IES* Application Volume *is unlike anything else in the lighting literature.

To review such a compendium is a rather lofty undertaking, not unlike reviewing the *Encyclopaedia Britannica*. The diversity and range of material covered in the *Application Volume* is unlike anything in the lighting literature. And the attention afforded this and its companion volume is disproportionately small considering their value.

As the title implies, this volume provides information necessary for the design of lighting systems, describing a lighting design process and giving important details for different applications. Of the 20 chapters, 14 deal with the design of lighting systems for specific applications and 6 deal with general issues applicable to most of the specific applications.

Unlike other handbooks, which are usually brief and telegraphic listings of important information for a discipline, this one attempts to be pedagogical. Although that makes the handbook somewhat wordy and repetitive, it also makes it reasonable and profitable to *study* this volume. And, because no other books are available that successfully describe lighting fundamentals, this volume is particularly valuable. Its pedagogical style permits each chapter to stand on its own. Each reads like a treatise on a particular lighting application rather than a listing of facts and data.

The chapters are of very uneven quality, which is characteristic of material produced by committees. The very good chapters have excellent organization, a crisp and clear style, and very good examples. The poor chapters lack these qualities.

Unfortunately, the book begins with its poorest chapter, "Lighting Design." Instead of a clear vista of a lighting design process or algorithm, one reads a lugubrious and disconnected set of small paragraphs that are often a litany of questions. The most serious omission in this chapter is a description of what to do with the answers to these questions. Under a section labeled "STEP III, Selection of Luminaires to Fit the Concept of Visual Composition and to Implement the Desired Appearance of Objects," we read, "Brightness, Color, Scale and Form. Does the equipment assume an appropriate textural or pattern role in the architectural composition? Does it contribute to a sense of unity?"

We also read "Space Requirements and Architectural Detailing. Are the physical space allowances sufficient? Is the building cubage and design sufficient to provide for necessary lighting cavities and recesses? Is the detailing and use of materials compatible with the detailing of other elements and systems in the building?"

How does one determine the sufficiency of a "textural or pattern role"? No single, overreaching principle acts as a skeleton for all the ideas in this chapter. Additionally, a reader expects to see more current photographic examples of lighting systems. This chapter contributes so little that it should have been omitted. There are vastly superior discourses on lighting design that can be consulted; the writings of William Lam are perhaps the best.

Design Considerations

The best of the six chapters that deal with issues common to all lighting applications is the second, "Lighting System Design Considerations." One cannot find a more concise and readable account of all major issues in lighting than that contained in these 54 pages. There is enough information on each topic, supplemented with the generous list of references, to refresh the memory of an experienced worker on some detail, or to provide a useful introduction for the novice. Psychological, photometric, physical, thermal, and electrical issues are discussed. The close connection between text and references is particularly apparent here.

The chapter on design considerations is the best of the chapters devoted to issues common to all lighting applications.

This chapter contains the descendant of the hallowed footcandle table, the recommended illuminances that were for many years the most potent manifestation of the knowledge and experience contained in the Illuminating Engineering Society. This manifestation has changed; now one finds a table of recommended *ranges* of illuminances. A specific value results from a consideration of specific application details. This is part of the welcome relief from the biblical significance previously accorded illuminance levels. The issue of illuminance level is presented in a context built from other issues presented in this chapter. The evenness with which all the issues are presented is itself a statement about lighting design. This is easily the finest chapter in this volume.

The chapters on lighting controls and energy management are elaborations of topics introduced in the second chapter. They exhibit a brevity more like other handbooks. Energy management is an important issue in lighting systems design and operation, and it is treated in these two chapters with helpful thoroughness. The unit power density method for establishing a lighting power budget is clearly described, as are methods for the control of light in time. The chapter on energy management succeeds particularly well in providing not only the appropriate questions but also a procedure for using the answers in the lighting design process.

Industrial Lighting

The longest and most detailed chapter is devoted to industrial lighting. It has a character unlike the other chapters devoted to specific application types; it describes in great detail the activities that take place in industrial settings while being vague about the lighting systems.

Constant reference is made to "general lighting."

The other unique characteristic is the different philosophy adopted toward illuminance levels. The writers of this chapter seemed intent on describing (and recommending) what has been found to work out in the field and on providing tables of recommended illuminances for specific types of industrial facilities — no ranges here.

The tone of this chapter matches the level of descriptive detail and specificity of recommendations. We read from chapter nine "The desirable quantity of light (illuminance) for an installation depends primarily upon the seeing task, the worker, and the importance of speed and accuracy in performing the task . . . Illuminance recommendations for industrial tasks and areas are given in Figure 2-1 [the table of ranges]. In addition, in several instances industry representatives have established tables of single illuminance values which, in their opinion, can be used in preference to employing Figure 2-1."

Given the economic importance of industrial visual activity and the subtlety of dealing with workers' unions, this is an understandable, though narrow, point of view. It is important to note that this chapter forms the basis for ANSI/IES Standard RP-7, 1983, dealing with industrial lighting.

The chapter on office lighting is very well organized.

Office and Institutional Lighting

The chapters on office lighting, educational facilities lighting, and institution and public building lighting are of similar character and quality; the chapter on office lighting is the best of the three. Each of these chapters is very well organized and begins with an appropriate overview of the application area and an outline of the principles involved. In each case, specific and detailed recommendations are made concerning lighting parameters, such as reflectances, equipment, luminance and illuminance levels, placement, and so forth.

The office lighting chapter has a strong central theme, stated early in the material: "Though it is convenient to consider the luminous environment and the lighting of visual tasks separately, they must work together to provide both a stimulating environment and good visibility. Indeed, the same lighting system may contribute to both (as in general lighting), or separate luminaires may provide or augment the lighting for the visual task." This important idea is followed by numerous specific issues to be addressed, and methods for achieving the type of lighting system that meets both environmental and visual task requirements.

What is not always clear, however, are the bases for the recommendations made in these three chapters, which are presumably the consensus of the committee participants responsible for these chapters. Both the office lighting and educational facilities lighting chapters form the basis for ANSI/IES Recommended Practices.

Residential Lighting

Residential lighting is treated in great detail. Especially useful and well done are the sections describing the tasks that require lighting. This section includes helpful line drawings and copious notes about the task and its lighting requirements. Equally helpful is the discussion of the specifics of luminaires and their application.

This is the only section of this volume that discusses specific lighting techniques and the resulting effects and that provides examples of execution. The numerous drawings accompanying the text significantly increase the clarity of presentation. This discussion of how to achieve what is recommended is particularly well done and puts into relief the lack of this type of material in some of the other chapters. This is the most self-contained and detailed of all the application chapters and comes close to being a sufficient single source of information for residential lighting design practice.

Other chapters in this volume deal with highly specialized application areas such as theater, roadway, aviation, sports, and transportation lighting. Although steeply priced, this volume and its companion are the essential core of reference material for anyone designing lighting systems. Their completeness, breadth of view, references to important articles and practices in the lighting literature, and level of detail make them required acquisitions for all lighting professionals.

—David L. DiLaura

David L. DiLaura, FIES, is director of engineering with Lighting Technologies, Inc., and an associate professor of civil, environmental, and architectural engineering at the University of Colorado, Boulder. He is also a member of Architectural Lighting*'s Editorial Advisory Board.*

A new quarterly index lists articles of interest to architects and others.

Construction Index 1:87, edited by Susan Greenwald. Chicago: ArchiText, 1987. 52 pages, $75 per year.

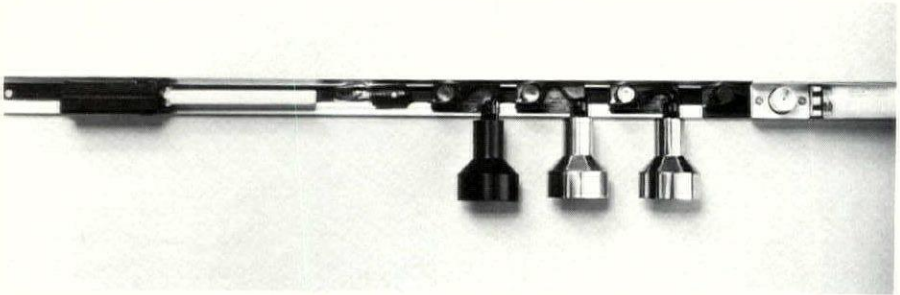
This quarterly annotated index lists technical articles on building envelope design, interior design, and similar topics of interest to architects and other construction professionals. Although its primary focus is on building envelope topics, at least seven categories of lighting issues are covered: illumination, daylighting, lighting design, lamps, lighting fixtures, site lighting, and lighting system controls.

The first issue of *Construction Index* covers 31 periodicals published January through March 1987. Citations for each article include the title, author(s), source, issue, beginning page, and, in many cases, a brief comment on the content and scope of the article. Articles are classified by a combination of two systems — the Construction Specifications Institute's five-digit Masterformat system, also used in *Sweet's Catalog File*, and ArchiText's own supplemental five-digit system for topics too broad to fit the Masterformat categories.

—Susan Degen

Susan Degen is assistant editor of Architectural Lighting.

Product Showcase



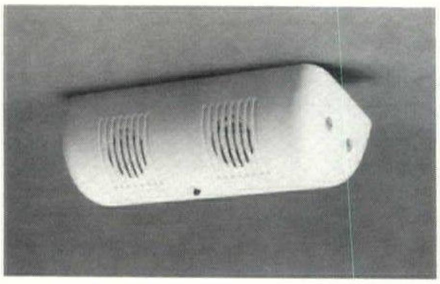
Miniature track lighting

Lightolier's Lytetrim miniature track lighting system enables users to create custom installations with standard products. With two track options and four compact lighting element choices, the system is appropriate for both residential (under shelves and cabinets, along stairways, above plants and art works) and commercial applications (display cases, work stations, food counters).

A permanently wired track and a portable plug-in track, both of extruded aluminum, are available.

Both track systems offer four compact lighting element choices that can be arranged individually or in combinations to provide general, accent, or task lighting: a compact fluorescent light, a basic mini-light, an adjustable spot light, and a linear fluorescent light. All the lighting elements snap in and out of the track and can be positioned anywhere on the track. Lightolier, Secaucus, NJ.

Circle 60

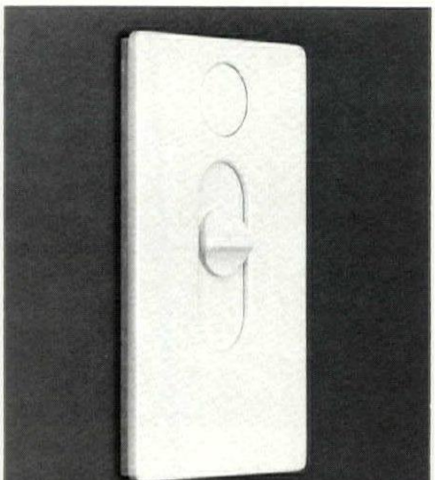


Lighting control switch

Light-O-Matic ceiling switches from Novitas help users reduce lighting expenses by sensing the presence or absence of people in a room and turning lights on or off as needed. Users can preset a switch's timing control to turn lights off at any preset interval from 30 seconds to 12 minutes after the last person leaves a room.

Warranted for five years, the ceiling switches have a life expectancy of 12 to 15 years. Switches in the product line are available to control lighting and other utilities, such as exhaust fans and HVAC units, in corridors, warehouses, and small, medium, and large rooms. Novitas, Inc., Santa Monica, CA.

Circle 61

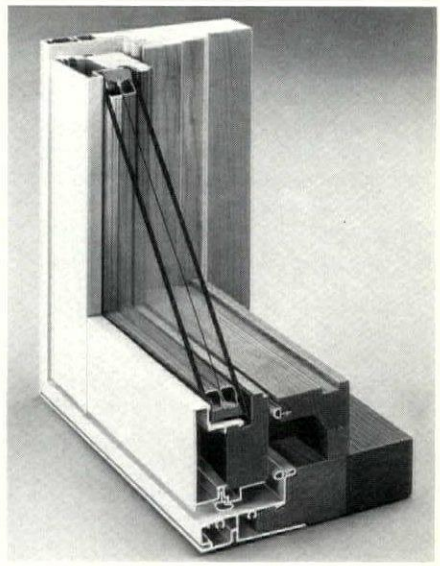


Thin-profile slide dimmer

Prescolite Controls offers the new Horizon line of thin-profile wall box slide dimmers that can control loads of 600, 1000, 1500, or 2000 watts. A top-of-the-line model provides full range dimming and power control of the same load from up to five different locations. A separate on-off switch above the slider allows users to set lighting intensity and turn the lights on or off locally or from a remote dimmer.

All models controlling loads of 600 to 1500 watts are just over 1/4 inch thick, and the 2000-watt model is slightly thicker. Models are available in two types: one controls only incandescent lighting, and a universal type controls incandescent, low-voltage incandescent, fluorescent, and neon or cold cathode lighting. All dimmers and switches are available in ivory, brown, white, gray, or black finishes. Prescolite Controls, Carrollton, TX.

Circle 62



Low-emissivity glass

Southwall Technologies offers Heat Mirror 66 low-emissivity glass, part of a line of special glazing materials that contain a colorless, heat-reflective film sealed inside double-pane glass. The clear insulating glass admits 41 percent less heat than conventional double-pane glass and has an insulating factor of R4.5, 125 percent higher than the R-factor for conventional double-pane glass, according to the manufacturer.

Available for new and retrofit installations, Heat Mirror 66 looks like clear glass yet shades from solar heat, making it possible to cut air-conditioning costs. Heat Mirror products come in a range of five solar energy transmission thicknesses to meet heating and glazing requirements for various climates. Southwall Technologies, Inc., Palo Alto, CA.

Circle 63

Wall fixture

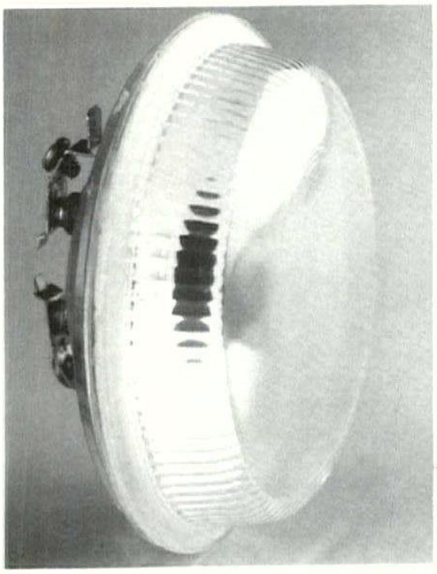
Hadco's new Wall Pak fixture has a precision die-formed reflector system and a partial prism polycarbonate lens designed to eliminate lamp glare by directing light down at an angle below 80 degrees. The die-cast aluminum housing has a knockout mounting template and $3^{1}/_{2}$-inch holes that are NPS tapped and plugged for conduit mounting.

Circle 64

Streetlight

King Luminaire has introduced a new streetlighting luminaire with an acorn-shaped globe. The Coronet K118 EPR distributes light in an IES Type II pattern. Most traditional streetlight designs distribute light in a less efficient IES Type V pattern, according to the manufacturer. King Luminaire Company Inc., Ontario, Canada.

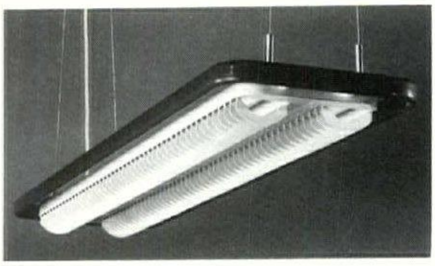
Circle 65



Low-voltage halogen lamp

North American Philips's line of halogen lamps includes the 12-volt, 50-watt halogen PAR 36 lamp. The lamp's multipurpose screw-terminal base makes it interchangeable with incandescent PAR 36 lamps. It is available only with a very narrow beam spread. North American Philips Lighting Corporation, Somerset, NJ.

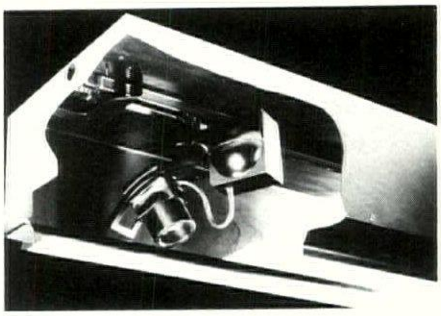
Circle 66



Low-profile luminaire

The low-profile Saturn fluorescent luminaire from Amerlux provides direct and indirect lighting with more than 50 percent uplight, according to the company. The luminaire's design features rounded corners, radial louvers, and aircraft-cable mounting. Measuring 54 inches long, 12 inches wide, and $1^{1}/_{2}$ inches deep, the luminaire accommodates two T8 fluorescent lamps. It has white louvers and is available in a choice of red, blue, or white housing. Amerlux, West Caldwell, NJ.

Circle 67



Recessed track lighting

Alkco's new Recessed-Trak system combines the features of recessed accent lights and track lights in an above-ceiling concealed track system. The two-circuit track rides inside a housing that is UL listed for use in direct contact with insulation and is air-cooled for maximum lamp life. The light is projected through a 2-inch slot with a snap-fit trim.

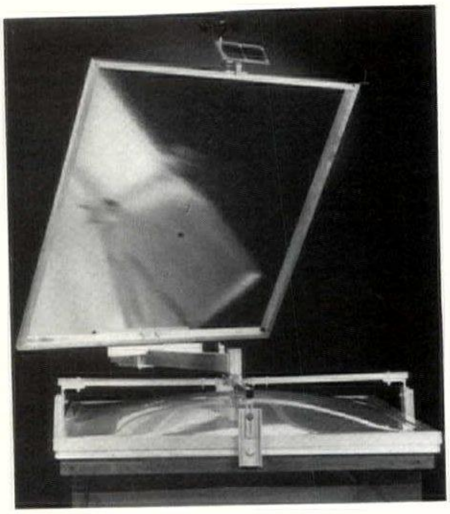
Low-voltage light modules, which mount anywhere along the two-circuit track, can be controlled individually. Each module contains a 12-volt transformer that operates a 20- to 40-watt MR16 lamp in beam patterns from pin spot to flood. A curved arm on the module supports a lamp holder that can rotate 380 degrees and can be angled 0 to 45 degrees from vertical for exact aiming. Alkco, Franklin Park, IL.

Circle 68

Circular skylights

Cadillac Plastic distributes the Circlite, a circular acrylic skylight manufactured by Plasticrafts that mounts on heavy duty aluminum curbs. Available in standard diameters of 10, 12, 14, and 16 feet, the circular skylights are shipped in preglazed half sections to simplify on-site assembly. The skylights can be single- or double-glazed and come in standard clear or bronze colors. Cadillac Plastic & Chemical Co., Troy, MI.

Circle 69

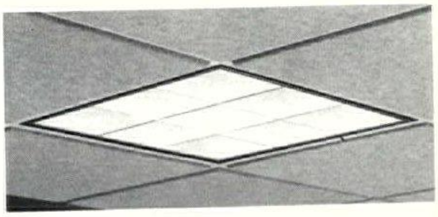


■ Daylighting unit

The Daytracker I from International Daytracking Systems is a reflective mirror and lens system that tracks, collects, and diverts sunlight with roof-mounted mirrors. Lenses transmit light reflected by the mirrors and disperse it inside a building. A 12-volt motor powers the tracking system.

The Daytracker I can be mounted on new or existing conventional skylights. Its ability to track in both clockwise and counterclockwise directions makes it suitable for installations in the northern and southern hemispheres. International Daytracking Systems, Inc., San Diego, CA.

Circle 70



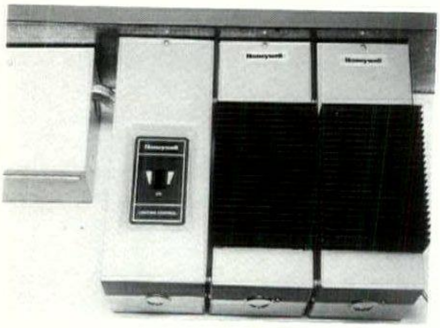
■ Parabolic troffer

The 9030 series Tri-Par troffer from Globe Illumination supports three GTE/Sylvania Octron Curvalume or GE Biax fluorescent lamps in a code gauge steel housing made rigid by full length die embossing. The 2-foot-square luminaire has contoured parabolic lamp compartments and a nine-cell louver of preanodized semispecular aluminum. Self-aligning spring-loaded trigger latches and heavy-gauge steel hook hinges allow users to open the louver from either side for easy maintenance.

Suitable for CRT or merchandising

areas, the troffer has a design compatible with most standard ceiling systems and can be ordered with or without lamps. Globe Illumination Company, Gardena, CA.

Circle 71

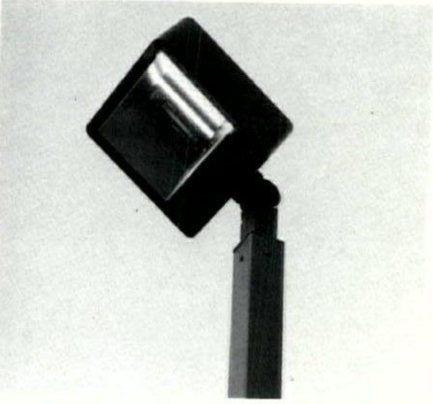


■ Fluorescent control system

Honeywell's new fluorescent lighting control system adjusts light levels in response to signals from light sensors, an automated building energy management system, and/or manual controls. Designed to operate with existing wiring, ballasts, and fixtures, the system can be integrated with any manufacturer's building automation system and installed alongside circuit breaker panels, according to the manufacturer.

The system has four major components — a control module, output modules, an ambient light sensor, and a remote control switch. It offers control capabilities such as power reduction for fixed lighting levels, ambient lighting compensation, lumen depreciation compensation, and demand-limiting and time-of-day lighting. Honeywell Inc., Building Controls Division, Golden Valley, MN.

Circle 72



■ Standard floodlights

Ruud Lighting offers the FS series standard floodlights with a compact, seamless diecast aluminum housing. The 16-inch-square, $6^1/_2$-inch-deep housing encloses computer-designed optics that produce NEMA 7 by 7 distribution. With its flexible fitter, the unit can be tilted vertically.

Suitable for applications such as parking lots, storage facilities, signs, sales areas, and security lighting, the floodlight can be mounted on posts, poles, ground yokes, or walls and is available with brackets or tenons. A multitap, CWA high power factor ballast is standard and comes preinstalled in the housing. The floodlight accommodates metal halide and mercury vapor lamps from 175 to 400 watts and high pressure sodium lamps from 100 to 400 watts. Accessories include a 480-volt ballast, a glare shield, a deep baffle, and a Lexan lens shield. Ruud Lighting, Racine, WI.

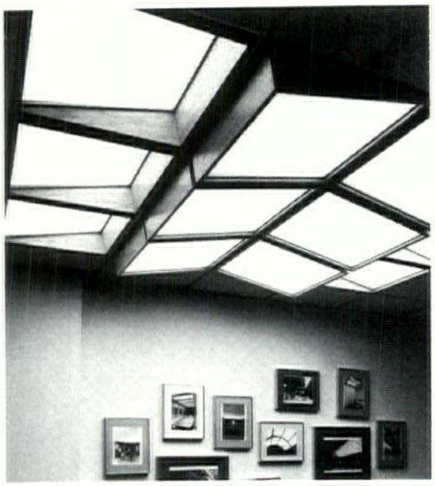
Circle 73

■ Polycarbonate sheet glazing

Lexan Thermoclear from the GE Plastics Group is an extruded polycarbonate sheet with an ultraviolet-resistant outer surface. The high-impact material provides up to 40 percent better insulation than single-pane glass, weighs 85 percent less than double-pane glass, and transmits 83 percent of available light, according to the manufacturer.

Available in double- and triple-walled versions, the sheet is formed easily on site and complies with major building codes. It is suitable as overglazing or primary glazing for sloped, curved, or formed structures, including skylights and greenhouses. GE Plastics Group, Pittsfield, MA.

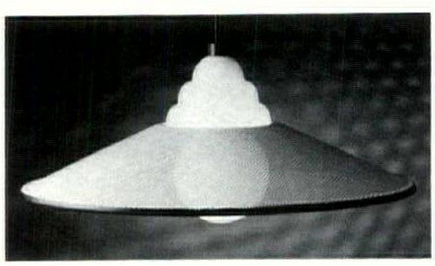
Circle 74



■ Hardwood coffers

Norton Industries has introduced a deep-tapered version of its solid hardwood coffers. Tapered to simulate a skylight, the 6-inch-deep coffer is available in modules up to 4 feet square of standard red oak and a variety of other hardwoods. Norton Industries, Cleveland, OH.

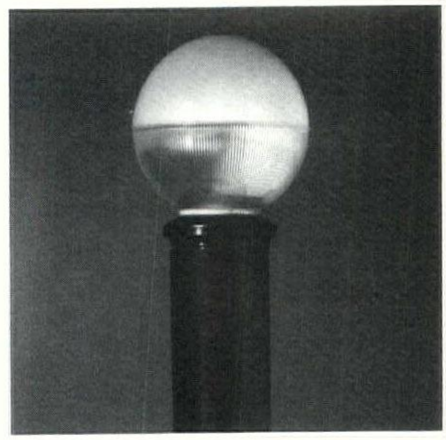
Circle 75



■ Pendant luminaire

The Perf-Oration model pendant is part of a new collection of 11 groups of pendants from Progress Lighting. The luminaire projects light through perforations in its metal shade, which has a beehive top of hand-blown opal glass. The 20-inch-diameter shade has black edges and comes in a choice of five finishes — blue-green, aluminum, dark gray, white, and chrome yellow. The pendant has a black cord and requires one medium-base 150-watt incandescent lamp. Progress Lighting, Philadelphia, PA.

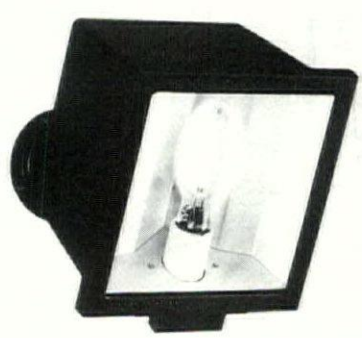
Circle 76



■ Waterproof lamppost

Electro Elf has introduced a waterproof fluorescent lamppost series with an anodized aluminum tube that connects directly to the high-impact polycarbonate base and lens assembly. The lamppost is available in heights of 6, 8, and 10 feet with globes in 8-inch and 10-inch sizes. Models are available to accommodate fluorescent lamps ranging from 5 to 13 watts. Electro Elf, Temple City, CA.

Circle 77



■ Compact HPS floodlight

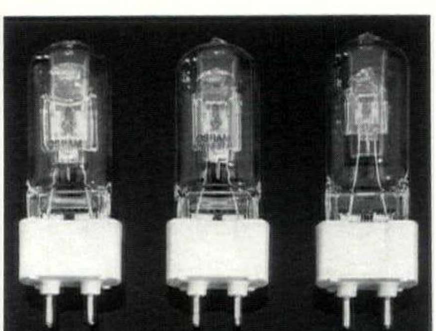
The Garti extra compact floodlight from Spero Electric is designed specifically for medium-base high pressure sodium lamps. The floodlight has a die-cast aluminum housing and is available in wattages from 35 to 150. The floodlight is small enough to replace PAR, R, and other incandescent or quartz lamp fixtures, according to the manufacturer, making it suitable for applications around apartments, commercial buildings, drives, and parking areas. Spero Electric Corporation, Cleveland, OH.

Circle 78

■ Pendant uplight

The Maxwell uplight from American Glass Light features a glass diffuser and an aluminum housing with a satin finish. The luminaire measures 26 inches in diameter and hangs 24 inches from the ceiling. It accommodates three 100-watt A lamps. The American Glass Light Co., New York, NY.

Circle 79



■ Low-wattage metal halide lamps

Osram's family of single-ended metal halide lamps now includes lamps of 35, 70, and 150 watts. Because all three lamps have the same dimensions, they can be used with the same lenses and reflectors. The low-wattage metal halide lamps have a warm color temperature of 3000K, a color rendering index of 81, and a universal burning position. Osram Corporation, Newburgh, NY.

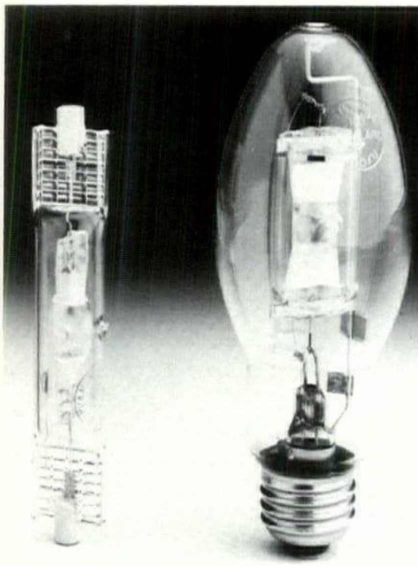
Circle 80

Circle 23

■ Downlight

The Parkway 400-watt downlight is part of Guth Lighting's Castellan Series. The downlight features a heavy duty aluminum housing that resists vandalism and corrosion. The manufacturer recommends the surface-mounted unit for parking garages, roadway ramps, and overpasses because of its low mounting height. Its adjustable design permits directing illumination where it is needed. The downlight is available in 250- and 400-watt sizes for mercury vapor, metal halide, and high pressure sodium lamps. Guth Lighting, St. Louis, MO.

Circle 81



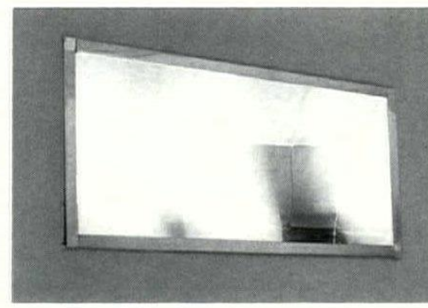
Compact metal halide lamps

GTE/Sylvania has expanded its line of Metalarc metal halide lamps to include compact 100-watt models. The new lamps have a warm 3200K color temperature with a color rendering index of 65.

The lamps are available in a tubular, double-ended model for a horizontal burn position and medium-base models with clear or coated jackets for a universal burn position. Rated at 8500 average initial lumens and 6800 average mean lumens, the medium-base lamps measure 5 1/2 inches high and 2 1/8 inches in diameter. The double-ended tubular version is 4 3/4 inches long.

The new 100-watt lamps can replace incandescent or mercury vapor lamps in commercial and industrial applications such as retail stores, building lobbies, offices, small recreational facilities, walkways, and parking areas. GTE/Sylvania, Danvers, MA.

Circle 82



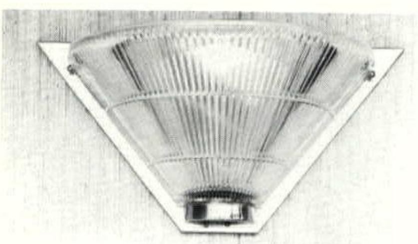
Compact fluorescent wall washer

Engineered Lighting Products offers a rectangular recessed wall washer for 13-

watt compact fluorescent lamps. The curve of the washer's high-purity aluminum reflector is engineered to provide even, unscalloped illumination with neither glare nor a visible lamp image at normal viewing angles. Mounted on the ceiling, it functions as a floor-to-ceiling wall washer, but because it is only 4 inches deep, it can also be recessed in a wall and used to illuminate ceilings or floors.

The luminaire is available in sizes that accommodate one or two compact fluorescent lamps. The model 213 PLWW accommodates two lamps and measures 7 inches high by 16¾ inches long. Model 113 PLWW accommodates one lamp and measures 7 inches high by 8¾ inches long. Optional accessories include a 120-volt high power factor ballast, a 277-volt normal power factor ballast, a 277-volt high power factor ballast (requires larger housing), reflector cleaner, and a clear protective lens. Engineered Lighting Products, El Monte, CA.

Circle 83

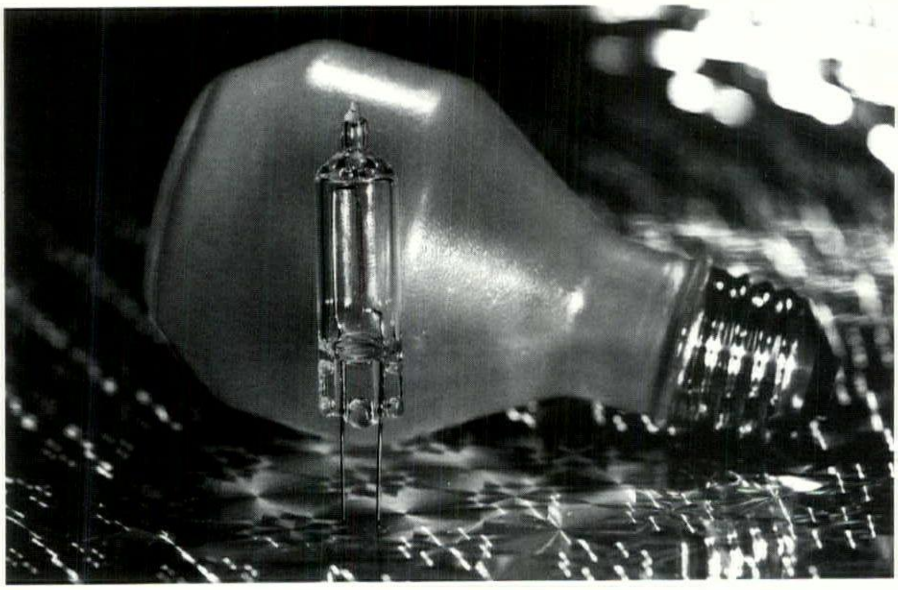


■ Wall sconce, emergency light

Siltron Illumination offers a collection of wall sconces that double as emergency fixtures, providing an alternative to standard industrial-style two-headed emergency light units. Pictured is the Prisma, which has a prismatic glass cone mounted on a polished brass plate and a concealed, built-in emergency battery pack. It accommodates a 13-watt compact fluorescent lamp. If used for decorative lighting only, the fixture may be operated with incandescent lamps up to 150 watts.

All eight sconces in the collection accommodate compact fluorescent lamps, and contain high power factor ballasts and emergency battery packs. With these sconces designers can meet building codes for emergency lighting fixtures without disrupting their design schemes. Siltron Illumination, Inc., Cucamonga, CA.

Circle 84



■ General purpose halogen lamps

The new Performance Plus line of screw-in general purpose halogen lamps from General Electric Lighting Business Group contains the compact halogen filament tube in the foreground. The lamps are flicker free and have a heavy glass bottle-shaped outer bulb. A 90-watt lamp is the first of the series to be available. It produces the same amount of light as a 100-watt incandescent lamp, but has an average rated life of 2000 hours, more than twice the 750-hour life of a standard 100-watt incandescent lamp, according to the manufacturer. The lamp is rated at 1750 initial lumens with an efficacy of 19.4 lumens per watt and a color temperature of 2950K. General Electric Lighting Business Group, Cleveland, OH.

Circle 85

range of applications for metal halide lamps. The 100-watt universal lamp delivers approximately the same mean lumens as a 300-watt tungsten halogen lamp, and the 70-watt universal model has mean lumens comparable to a 250-watt tungsten halogen minican lamp, according to the manufacturer.

The light output levels of the metal halide lamps make them suitable for use in commercial applications with standard 8-foot ceilings and for other applications in which a compact fixture and smaller lumen package are desirable. Both lamps are available in two burn positions: universal and horizontal plus or minus 45 degrees. The 100-watt lamp is also available in a vertical plus or minus 15 degrees burn position. Venture Lighting International, Cleveland, OH.

Circle 88

Halogen troffer

Modulightor's Lux Line II troffer houses tungsten halogen lamps that illuminate a wall from ceiling to floor. Fabricated to lengths specified by the buyer, the troffer measures 3 inches by 3 inches in profile. The manufacturer recommends the luminaire as an alternative to track lighting. Modulightor Inc., New York, NY. ■

Circle 89

■ Floor, table lamps

Carack's Executive Series floor and table lamps have a 14-inch-diameter, 4 1/2-inch-high seamless solid brass shade and a white acrylic diffuser. The table lamp stands 20 inches high on a 7-inch base; the floor lamp stands 49 inches high on a 10-inch base. Both lamps accommodate two 100-watt incandescent lamps and have a built-in high-low switch. The Carack Co. Inc., Linden, NJ.

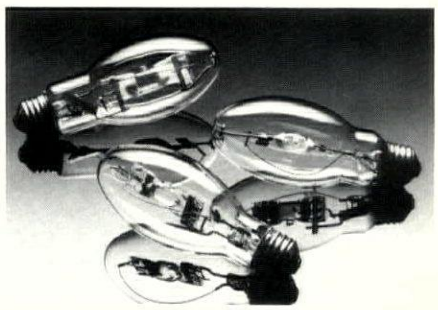
Circle 86

■ Wall washer

The C151 Wallwash series from Lighting Services Inc. is designed for smooth lighting of vertical exhibit spaces from floor to ceiling. The fixture has a molded glass spread lens and an integral metal reflector that creates a uniform wall wash with an incandescent PAR 38 lamp.

The lens and reflector are easily removed, making it possible to convert the fixture into an adjustable spotlight that can be focused in any horizontal or vertical plane. A complete range of accessories, including colored glass filters, louvers, and light blocking screens, can be used with the C151 in its spotlight mode. An optional integral dimmer is also available. The wall washer comes in standard finishes of black, white, and silver aluminum. Lighting Services Inc., New York, NY.

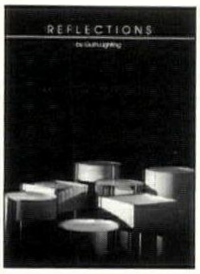
Circle 87



■ Low-wattage metal halide lamps

Venture Lighting's 70- and 100-watt single-ended metal halide lamps increase the

Product Literature



■ Indirect HID lighting

A brochure illustrates Guth Lighting's line of indirect high intensity discharge lighting fixtures and supplemental 13-watt compact fluorescent task lighting units. Guth Lighting, St. Louis, MO.

Circle 120

■ Incandescent luminaires

The Classic and Edmund Stevens collections of stem-, chain-, and wall-mounted incandescent luminaires feature decorative brass and prismatic glass. A brochure illustrates shade and cap styles and available finishes. Holophane, Newark, OH.

Circle 121

■ Lighting controls

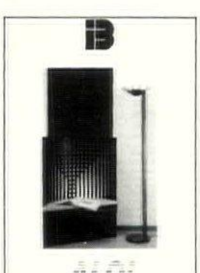
Lutron has released a new design guide that introduces the complete line of Pre-Pack architectural lighting controls and systems. The 16-page brochure presents sample floor plans and system diagrams. Lutron Electronics Co., Inc., Coopersburg, PA.

Circle 122

■ Landscape luminaires

LW series compact landscape luminaires from Imperial Bronzelite are used with low-wattage tungsten halogen and incandescent lamps. A data sheet describes the product line, accessories, lamp sizes, and other features. Imperial Bronzelite, San Marcos, TX.

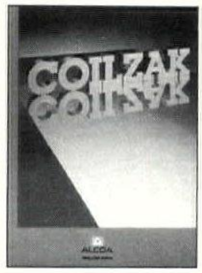
Circle 123



■ Lamp collection

Alo' ceiling, wall, desk, and floor lamps are illustrated in a color brochure from DiBianco Imports. Designed by Mauro Marzollo, the lamps feature Murano glass shades in a choice of two color combinations. DiBianco Imports, Brooklyn, NY.

Circle 124



■ Anodized aluminum sheets

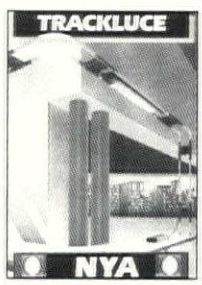
A trifold brochure describes Alcoa's Coilzak products and gives general information about features. The anodized aluminum sheet is available in seven finishes in varying degrees of reflectance. Alcoa, Sheet & Plate Division, Davenport, IA.

Circle 125

■ Custom fixtures

A folder from Visual Comfort Lighting illustrates some of the custom fixtures the company has created in collaboration with architects and designers. Visual Comfort Lighting, Old Bethpage, NY.

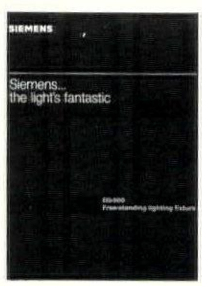
Circle 126



■ Track lighting system

An NYA brochure featuring the Trackluce track lighting system contains photos and dimensions of system components and accessories. New York Associates, a division of Thunder & Light Ltd., New York, NY.

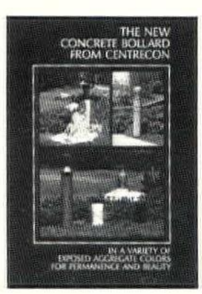
Circle 127



■ Freestanding fixture

A leaflet from Siemens Lighting Systems features the BS-900 freestanding fixture for compact fluorescent lamps. The brochure contains features, specifications, and a color photograph of the fixture. Siemens Light Systems, Iselin, NJ.

Circle 128



■ Concrete bollards

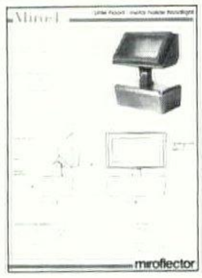
Centrecon's new illuminated concrete bollards come in a variety of exposed aggregate colors. A brochure shows detailed sketches of the bollards with information on heights, colors, styles, and options. Centrecon Inc., Everett, WA.

Circle 129

Bathroom, kitchen fixtures

A catalog from Illuminating Experiences details the company's bathroom lighting collection. It includes color photos and shows available lengths, finishes, and lamps for each type of fixture. Illuminating Experiences, Inc., Highland Park, NJ.

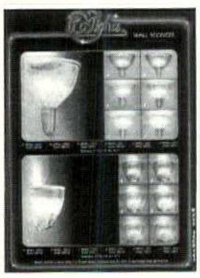
Circle 130



Metal halide floodlight

Miroflector's Little Flood metal halide floodlight is designed to mount easily in indoor or outdoor applications. A data sheet gives dimensions, features, options, and photometric information. Miroflector Company, Inc., Inwood, NY.

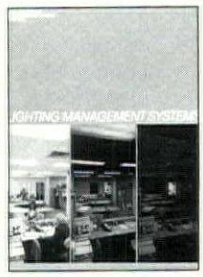
Circle 132



Wall lighting

A brochure illustrates wall sconces and bulkhead lights from D'Lights. Each luminaire is shown in all available colors of housings, diffusers, and prismatic glass lenses. D'Lights, Glendale, CA.

Circle 131

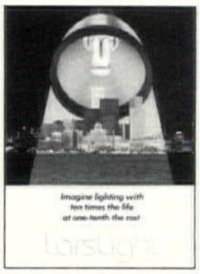


Lighting controller

The PLM 1000 lighting manager from PowerLine Communications is a microprocessor-based controller designed for use with lighting circuits. PowerLine Communications Inc., Williston, VT.

Circle 133

Circle 30



■ Retrofit reflectors, adapters

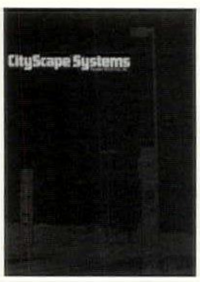
A brochure from Larslight discusses retrofitting existing incandescent fixtures with the company's reflectors and adapters for single and double twin-tube compact fluorescent lamps. Larslight Corporation, Toronto, Ontario, Canada.

Circle 134

■ Chandelier collection

A 36-page catalog contains photographs, sketches, dimensions, and other details of the Gross Chandelier collection of chandeliers and matching wall brackets. Gross Chandelier Company, St. Louis, MO.

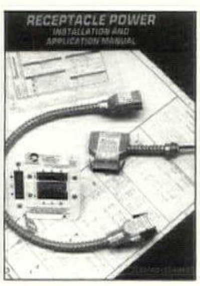
Circle 135



■ Lighting standards

A brochure from Valmont Industries features the CityScape system, which combines luminaires and other elements in a single modular structure. The brochure shows typical applications and describes system components. Valmont Industries, Inc., Valley, NE.

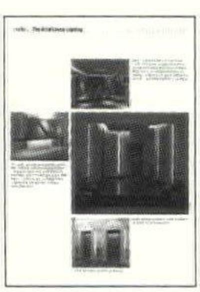
Circle 136



■ Flexible wiring system

A manual from Day-Brite Lighting gives information on installation and applications of the Electro/Connect flexible wiring system. It includes illustrations and descriptions of various system components. Day-Brite Lighting Division, Emerson Electric Co., Tupelo, MS.

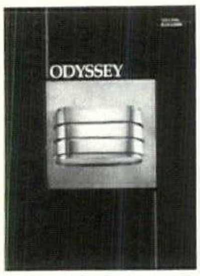
Circle 137



■ Linear lighting

Lucifer Lighting's catalog details a line of low-voltage linear lighting products. It includes photos of components, accessories, and applications for light strips, incandescent tube lights, track systems, recessed downlights, and spotlights. Lucifer Lighting Company, Miami, FL.

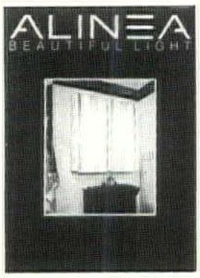
Circle 138



■ Lighting collection

A brochure from RWL details three products from the Odyssey Illuminations collection — an indirect linear system, a floor column, and a door frame. It includes dimensions, lamp sizes, finishes, and photos of applications. RWL Corporation, New Haven, CT.

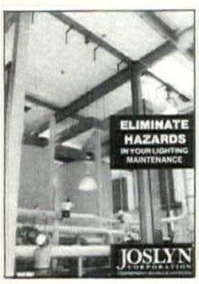
Circle 139



■ Linear incandescents

The Alinea linear incandescent fixtures from Aamsco support a tube incandescent lamp for warm lighting in kitchens and bathrooms. A brochure provides information on lamp sizes and lengths, fixture dimensions, and finishes. Aamsco Manufacturing Inc., Jersey City, NJ.

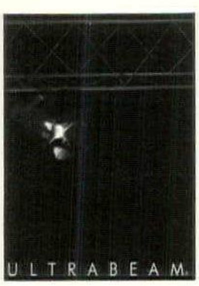
Circle 140



■ Fixture hanger system

With the Thompson hanger system from Joslyn, users can lower fixtures for maintenance from heights of up to 450 feet. A brochure describes the system and illustrates a variety of applications. Joslyn Corporation, Cleveland, OH.

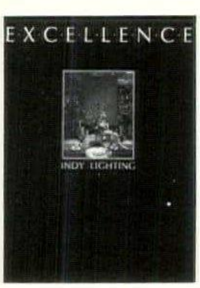
Circle 141



■ Lighting frame system

The Ultrabeam from Interstate Marketing System uses triangular or square steel frames to support fluorescent fixtures, signs, and track lights. A folder illustrates components and accessories. Interstate Marketing System, Inc., San Francisco, CA.

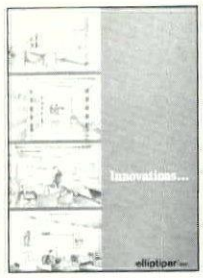
Circle 142



■ Merchandise lighting

A pamphlet from Indy Lighting lists a number of installations and includes color photographs of commercial applications and of the company's manufacturing process. Indy Lighting Incorporated, Indianapolis, IN.

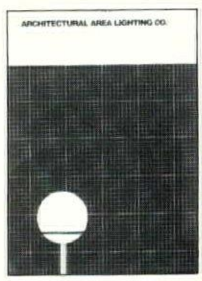
Circle 143



■ Wall illumination

The LePak wall washer and the Ensconce wall sconce, both for metal halide or single-ended tungsten halogen lamps, contain a special reflector that shapes light into a broad asymmetrical pattern. Elliptipar Inc., West Haven, CT.

Circle 144



■ Outdoor lighting

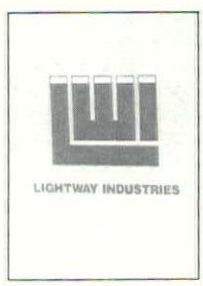
A 105-page catalog from Architectural Area Lighting details the company's line of outdoor lighting fixtures, including standards, bollards, brackets, custom luminaires, and accessories. Architectural Area Lighting Co., subsidary of Kidde, Inc., La Mirada, CA.

Circle 145

■ Linear lighting

A brochure on the Danalite slim-profile linear lighting system illustrates possible applications and details housing lengths, lamp section measurements, mountings, lamping requirements, and other installation information. Danalite, Huntington Beach, CA.

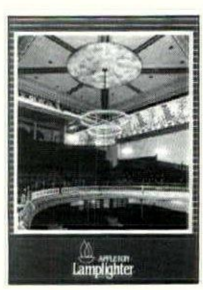
Circle 146



■ Low-wattage fluorescents

A 40-page catalog from Lightway Industries features the company's expanded line of energy-efficient low-wattage fluorescent fixtures. The catalog covers wall, ceiling, and area lighting and retrofits and adapters. Lightway Industries, Valencia, CA.

Circle 147



■ Custom luminaires

Appleton Lamplighter manufactures custom luminaires and related lighting products. A brochure contains descriptions and color photos of a variety of indoor and outdoor applications. Appleton Lamplighter, Appleton, WI. ■

Circle 148

Calendar

July 22–25, 1987 — **Pursuit of Perfection,** American Society of Interior Designers national conference and international exposition, Toronto, Canada. Contact: ASID Conference, c/o Congress Canada, 111 Richmond Street West, Suite 808, Toronto, Ontario, Canada M5H 2G4, (416) 860-1772.

July 27–29, 1987 — **Basics of Lighting Institute,** short course, Independent Testing Laboratories, Boulder, CO. The institute is designed to introduce beginners to the technical side of lighting. Contact: Independent Testing Laboratories, Inc., 3386 Longhorn Road, Boulder, CO 80302, (303) 442-1255.

July 28–31, 1987 — **An introduction to lighting design,** seminar sponsored by Lighting Technologies, Boulder, CO. Contact: Lighting Technologies, 3060 Walnut Street, Suite 209, Boulder, CO 80301, (303) 449-5791.

August 2–6, 1987 — **IES annual conference,** Marriott Camelback Inn, Scottsdale, AZ. The conference will feature educational seminars, technical sessions, and exhibits on lighting design, sources, luminaires, light and vision, roadway lighting, and award-winning lighting applications. Contact: Cindi Altieri, Illuminating Engineering Society of North America, 345 East 47th Street, New York, NY 10017, (212) 705-7269.

August 6, 1987 — **IES daylighting workshop,** Marriott Camelback Inn, Scottsdale, AZ. The one-day workshop will cover prediction and calculation of daylighting. Gary Gillette of the National Bureau of Standards will serve as chair and present the workshop along with other leading experts in daylighting. Continuing education units are available for those who complete the 8-hour program. Contact: Cindi Altieri, Illuminating Engineering Society of North America, 345 East 47th Street, New York, NY 10017, (212) 705-7269.

August 25–28, 1987 — **An introduction to lighting design,** seminar sponsored by Lighting Technologies, Anaheim, CA. Contact: Lighting Technologies, 3060 Walnut Street, Suite 209, Boulder, CO 80301, (303) 449-5791.

September 1–3, 1987 — **Workspace '87,** 5th annual exhibition and conference on the office environment, Moscone Center, San Francisco. Contact: Workspace, 655 Chestnut Street, San Francisco, CA 94133, (415) 776-2111.

September 14–18, 1987 — **Fundamentals I,** short course, General Electric Lighting Institute, Cleveland. The course covers basic aspects of indoor commercial and industrial lighting. Repeats October 26–30 and November 30–December 4. Early registration is recommended. Contact: Janet Allen, Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

September 20–22, 1987 — **Pan Pacific Lighting Exposition and Conference,** The Concourse at Showplace Square, San Francisco. Contact: Robert Zinkhon, Director, Pan Pacific Lighting Exposition, 2 Henry Adams Street, San Francisco, CA 94103, (415) 621-7345.

September 21–23, 1987 — **Modern lighting in office buildings,** conference, General Electric Lighting Institute, Cleveland. Contact: Janet Allen, Registrar, GE Lighting Institute, Nela Park, Cleveland, OH 44112, (216) 266-2614.

September 23, 1987 — **Lighting laboratory tour,** Boston DLF event. Participants will tour a new lighting laboratory at Massachusetts Gas & Electric Light Supply Company. Contact: Paul Chabot, Boston Designers Lighting Forum, P.O. Box 6406, Boston, MA 02102, (617) 367-0910.

September 30, 1987 — **Entry deadline** for IALD's fifth annual lighting awards competition. Contact: Marion Greene, International Association of Lighting Designers, 18 East 16th Street, Suite 208, New York, NY 10003, (212) 206-1281. ■

Manufacturer Credits

From the Editor (Golden Gate Bridge, San Francisco). Roadway lighting fixtures: **Gardco Lighting,** division of Thomas Industries Inc.

New lighting showcases Merchandise Mart (The Merchandise Mart, Chicago). Integrally ballasted wide-beam floodlights: **Appleton Electric Co.** 150-watt high pressure sodium lamps: **GTE/Sylvania.**

Low-brightness lighting — the sweet taste of excellence (World's Finest Chocolate, Inc., national headquarters, Chicago). Fluorescent task lights: **Peerless.** Metal halide uplights: **Forum.** Fluorescent cove lights with aluminum parabolic reflectors: **Peerless.** Energy-saver ballasts: **Advance Transformer Co.**

Simplicity key to lighting transit stop and miniature park (Sixth Street Transit Station, Minneapolis, Minnesota). Pole- and bracket-mounted high pressure sodium luminaires: **MWC Apollo.** Plaza lighting: **Union Metal.** Glazing system for walls and skylights: **Kawneer.** Custom-manufactured glazing system: **Harmon Glazing.**

Golden anniversary brings new light to Golden Gate Bridge (Golden Gate Bridge tower illumination, San Francisco). High pressure sodium lamps and fixtures: **General Electric.** Electrolier castings: **Phoenix Iron Works.** Machining: **Kramer's Machine Shop.** Plastic lenses: **Western Illuminated Plastics.**

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