LIGHT

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LIGHT

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CONTENTS

COVER AND FRONTISPIECE
Coils of rolled aluminum sheet await shipment and in the meantime frame a lighting system in an area where the new high-intensity discharge sources should be welcome. The picture was taken by Tom Knowles of our Photographic Section. The metal shapes at left represent another aspect of lamp manufacture . . . work with rare metals at a General Electric Lamp Division plant. Picture by Dave Ulrich.

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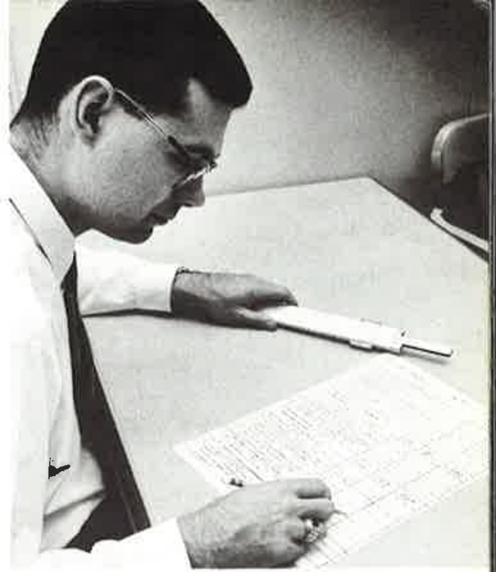
Where Do the Dollars Go?



by **W. B. De Laney**
Lighting Development, Nela Park

Choosing the best lighting system is an increasingly difficult job for the lighting designer. Cost can be used as a basis for comparison and rating of various lighting systems. Perhaps it is the most logical criterion — especially when the lighting costs are so important to the building owners and to the operators.

Determining the total cost of a lighting system is not easy. About 30 items should be considered—not just lamp and fixture costs. A detailed systematic procedure is necessary. In 1951, A.C. Barr and C. L. Amick presented a paper to the I.E.S. called, "Fundamentals of Lighting Cost Analysis"*. This contains the basic format used today for detailed cost comparisons.

How Cost Analysis Works

Cost analysis is essentially a systematic way of determining all of the costs associated with various lighting systems under consideration. Each system is compared to or rated against an arbitrarily selected system—usually the one first considered suitable for the job. It represents the 100-per-cent point in each category of costs. Usually, it is desirable to compare systems that will provide the same average amount of light on the work surface. This is done by determining how many fixtures of a given type are needed to deliver the same amount of light as the BASE SYSTEM (step 11). Frequently, this represents a fractional part of a fixture, but all costs are shown for a whole fixture. The comparison to the BASE SYSTEM is made for the number of fixtures shown in step 11.

Actual per fixture dollar comparisons can be made by omitting steps 11, 18, 28, and 30. In such a case, an analysis should be calculated for the total number of luminaires needed in a unit area such as a bay, section, or room.

Where to Get the Figures

Manufacturers' catalogs contain useful information — product costs and data. Local people, close to the installation, should have helpful material, based upon experience. These would be electrical contractors, maintenance contractors, and the client's own maintenance and plant engineering personnel. Where actual figures on, for example, labor and installation costs are not available, use reasonable estimates.

Short Cuts

Where sources and fixtures are similar to other types, some of the costs might be considered constant. In some cases only initial costs, or only operating costs, are of concern; other cost calculations could be omitted. Remember, that items not applicable to a particular comparison can be omitted.

The Computer

In minutes—even in seconds—a computer can calculate costs. A computer program can use the basic cost analysis format for comparing several lighting systems. And where a person or a company makes many comparisons a year, such a computer program would save much time and effort. It is possible to rent the services of a computer if purchase of one cannot be justified. Some fixture and lamp manufacturers have such programs, and can provide cost analysis computations to designers and customers as a part of their lighting services.

Over-all Cost Analysis

The form used to produce a complete cost analysis looks complex. It is . . . and it has to be to include all of the factors affecting the cost of a lighting system. But because all of the factors are included, it is flexible enough to be used in many ways for evaluating any lighting system. It also permits the changing of some figures—lamp cost, labor cost, fixture efficiency, for example—while other factors remain constant. The designer can see, then, how any one item might affect the total cost. The busy lighting designer might find this analysis procedure too tedious and costly, but lamp and fixture manufacturers do it so that they may determine what combination of qualities might offer the customer the greatest value for his investment.

* *ILLUMINATING ENGINEERING, Vol. XLVII, May, 1952, page 260.*

LIGHTING SYSTEM

A. BASIC DATA

	BASE SYSTEM	SYSTEM I	SYSTEM II
	2-H400C33-1 Twin 18" Aluminum Fix.	1-LU 400 Single 18" Aluminum Fix.	2-F96PG17/CW 2-lamp Porc. Enam. 8' Fix.
1. Rated initial lamp lumens per luminaire	40,000	42,000	31,000
2. Rated lamp life (hours)	16,000+	6,000	14,000
3. Group replacement interval (hours)	16,000	SPOT	8,000
4. Average watts per lamp	400	400	215
5. Input watts per luminaire (includes ballast losses)	880	460	455
6. Coefficient of Utilization	.64	.70	.64
7. Ballast factor	1.0	1.0	.975
8. Lamp depreciation factor	.890	.915	.795
9. Dirt depreciation factor	.90	.90	.90
10. Effective maintained lumens per luminaire	20,506	24,211	13,841
11. RELATIVE NUMBER OF LUMINAIRES NEEDED FOR EQUAL MAINTAINED FOOTCANDLES.	1.00	.847	1.482

BASIC DATA

1. Use lamp manufacturer's published initial lumen figures per lamp multiplied by the number of lamps per luminaire.

2. For incandescent and mercury lamps use manufacturer's figures. Life of fluorescent lamps varies with number of hours operated per start. Basic fluorescent life figures are for three hours per start. Check with manufacturer for other starting intervals.

3. Where group replacement is planned, check with lamp manufacturer. A convenient interval in terms of months and years is usually advisable.

4. Obtain from lamp manufacturer's published data.

5. Use information from **4**, plus ballast manufacturer's published watts' loss.

6. Get from manufacturer's catalog. The figure is determined by the size and shape of space under consideration, and by wall, ceiling, and floor reflectances. Room characteristics remain constant throughout an analysis, usually.

7. Manufacturer's lumen ratings are based on laboratory measurements of lamps operated on standard reference ballasts. Most commercial ballasts cause fluorescent lamps to operate somewhat below rated output. CBM certified ballasts must operate lamps at 95 per cent or more of rated. Other types of ballasts may be lower.

8. This factor converts initial lumens to average or mean lumens. For fluorescent lamps, mean lumen output is that measured at 40 per cent of life; for mercury and similar high-intensity discharge lamps (including quartz iodine regenerative cycle lamps) at 50 per cent of life; for standard incandescent lamps at 47½ per cent of life.

9. Dirt is always present in the air around lighting fixtures, and both lamps and fixtures get dirty, and deliver less light over a period of time. The factor for a dirty atmosphere will be lower than that for an air-conditioned space. Cleaning the fixtures more often raises the factor. Open-top (uplight) fixtures remain clean longer and raise the factor. The I.E.S. suggests several ways of estimating this factor, but experience and local measurements may offer greater accuracy. Some fixture catalogs show a Maintenance Factor based upon "typical" conditions which include lumen depreciation **8**.

10. Useful light is that which reaches the work surface. The average maintenance lumen value is equal to **1** x **6** x **7** x **8** x **9**. Any factors omitted are assumed to equal 1.0 (each).

11. This figure shows the number of luminaires of each system needed to deliver the same amount of light on the work surface as those of the BASE SYSTEM. It is equal to **10** of the BASE SYSTEM divided by **10** of the system being calculated.

B. INITIAL INSTALLATION COSTS

B. INITIAL INSTALLATION COSTS	BASE SYSTEM	SYSTEM I	SYSTEM II
12. Net cost of one luminaire	$110.00	$100.00	$ 50.00
13. Wiring and distribution system cost per luminaire	$ 53.00	$ 27.00	$ 27.00
14. Installation labor cost per luminaire	$ 20.00	$ 17.00	$ 22.00
15. Net initial lamp cost per luminaire (including tax)	$ 13.70	$ 24.75	$ 5.78
16. Total initial installed cost per luminaire	$196.70	$168.75	$104.78
17. Annual owning cost per luminaire	$ 27.45	$ 21.60	$ 14.85
18. RELATIVE INITIAL COST FOR EQUAL MAINTAINED FOOTCANDLES	1.00	.727	.789

INSTALLATION COSTS

12. Check fixture manufacturer's catalog — using appropriate discounts. This figure should include costs of any ballasts, dimmers, or auxiliary equipment necessary to lamp operation.

13. This is the material and installation cost of the wiring and distribution system necessary for the lighting system alone — prorated to one luminaire. Lacking more specific data, a typical value of $60 per KVA of connected load can be used. Only the secondary distribution from the branch circuit panel board is considered, because the primary distribution system is, normally, very similar for all lighting systems, and is common to other power circuits, too.

14. This includes the total time required to install and connect one luminaire. Unless more specific information is available, assume $8.00 per manhour for labor and overhead. One of the procedures for estimating manhours required for the job — based upon local and job conditions — should be followed, wherever possible.

15. This is the lamp cost (allowing appropriate discounts) multiplied by number of lamps per luminaire.

16. Add figures from **12**, **13**, **14**, and **15** to obtain the total cost of installing one luminaire.

17. Capital investment (fixture and installation less lamp costs) is divided by allowable depreciation period (anticipated life of the installation), and added to an allowance for interest, insurance, and taxes on the investment, to provide this figure. Usually, a 10-year write-off is used, with five per cent added annually for the interest, insurance, and taxes. Therefore, it is usually equal to 15 per cent of the sum of **12**, **13**, and **14**.

18. A comparison to the BASE SYSTEM — with equal light delivered to the work surface — provides this factor which relates the initial costs of the system currently being considered to those of the BASE SYSTEM. It is equal to the figures in **16** times **11** divided by **16** of the BASE SYSTEM.

C. ANNUAL OPERATING COSTS	BASE SYSTEM	SYSTEM I	SYSTEM II
19. Burning hours per year	4,000	4,000	4,000
20. Annual energy cost -- 1.5¢/K.W.H.	$52.80	$27.60	$27.30
21. Number of lamps group-replaced per year	.5	--	1.0
22. Number of lamps spot-replaced per year	.05	.666	.025
23. Lamp cost per year	$ 3.43	$16.50	$ 2.89
24. Labor cost for group replacements per year	$ .10	--	$ .20
25. Labor cost for spot replacements per year	$ .10	$ 1.33	$ .05
26. Cost of cleaning luminaires per year	$ 1.25	$ 1.00	$ 1.25
27. TOTAL annual operating cost per luminaire	$57.68	$46.38	$31.69
28. RELATIVE ANNUAL OPERATING COST FOR EQUAL MAINTAINED FOOTCANDLES	1.00	.681	.814

OPERATING COSTS

19. Actual total hours the lighting system will be operated during the year. The typical single-shift plant or commercial installation might be operated 10 hours a day, five days a week, 50 weeks a year . . . or 2500 hours a year. A double shift operation at 16 hours a day would mean 4000 burning hours a year. Continuous operation six days a week would mean 7200 burning hours a year.

20. Use actual local energy costs for the particular class of service involved . . . typically one cent to two cents per KWH.

21. Multiply the number from **19** by the number of lamps per fixture; divide by the figure in **3**. If group relamping will not be practiced, omit this item.

22. If group relamping is practical, and interim burn-outs are replaced on a spot basis, this is equal to the figure obtained for **21** times the per cent of burn-outs expected before the end of the group-relamping interval. If group relamping is not practiced, and all burn-outs are spot replaced, this item is equal to the figure in **19** times the number of lamps per fixture divided by the figure in **2**.

23. Where group relamping is practiced, multiply net lamp cost by figure from **21**. Interim spot replacements are usually obtained at no cost from the best of the old lamps which were put aside for this purpose at the previous group relamping. Where spot relamping is practiced, **23** is equal to net lamp cost multiplied by the figure from **22**.

24. These labor costs are best determined by experience with similar conditions. Maintenance supervisors or contractors may be able to supply cost figures from which the per-lamp costs can be calculated—or, at least—estimated. A typical cost might be 15 cents per lamp. Annual labor costs would be: labor cost per lamp multiplied by the figure **21.** If group relamping is not practiced, this figure is omitted.

25. Labor costs can be determined as in **24**. A typical figure might be $1.50 per lamp. Where group relamping is practiced, the cost of making spot replacement must be included. This is equal to labor cost per lamp multiplied by the figure from **22**. Calculation would be the same for total spot relamping.

26. Most lighting systems should be cleaned more often than they are relamped if lighting value is kept at a maximum. Cleaning once or twice a year is recommended. The higher cost would be offset by a better dirt factor **9**. Local costs should be used, if available, but a figure of $1.00 per luminaire per cleaning is used, often.

27. This includes annual energy, plus lamp, plus labor costs — or **20+23+24+25+26.**

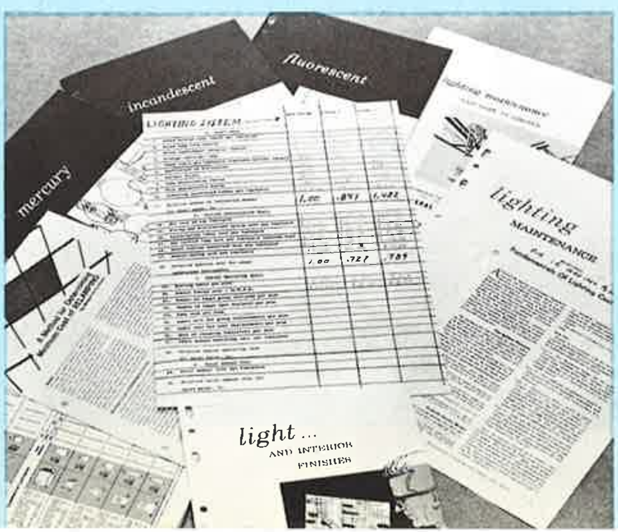
28. Relates annual operating cost of the system under consideration to that of the BASE SYSTEM — assuming equal light delivered to the work surface. This is equal to the figure in **27** multiplied by that from **11** divided by that from **27** of the BASE SYSTEM.

D. TOTAL ANNUAL COST	BASE SYSTEM	SYSTEM I	SYSTEM II
29. Total annual cost per luminaire	$85.13	$67.98	$46.54
30. RELATIVE TOTAL ANNUAL COST FOR EQUAL MAINTAINED FOOTCANDLES	1.00	.676	.810

TOTAL ANNUAL COSTS

29. Annual operating cost **27** plus annual owning costs **17**.

30. Here we have the relative total annual cost of owning and operating a lighting system as compared to that of the BASE SYSTEM (based upon equal light delivered to the work surface). It is equal to the figure for **29** multiplied by that from **11** divided by the figure from **29** of the BASE SYSTEM.



Summary

From job to job, lighting requirements vary. The systems used to illustrate cost analysis here would not, probably, be suitable for a specific one the reader has in mind. Figures were based upon a specific installation, however. The procedure is important, and with the new sources and equipment available today (more improvements foreseeable) each dollar invested in lighting will return a greater value than ever before. Each day provides us with more reasons for following the cost analysis procedure in planning a lighting system.

On View

by **M. Christensen**
Lighting Development, Nela Park

Those visitors to the Lighting Institute who are interested in lighting systems for industrial areas can utilize the new facilities in several ways. They can remain comfortably seated in the Vanguard Room and view the demonstrations through a glass partition; they can walk through the several areas to inspect the various lighting systems close-up; or they can bring in sample tasks from their own plants and determine for themselves which lighting system is most suitable for them.

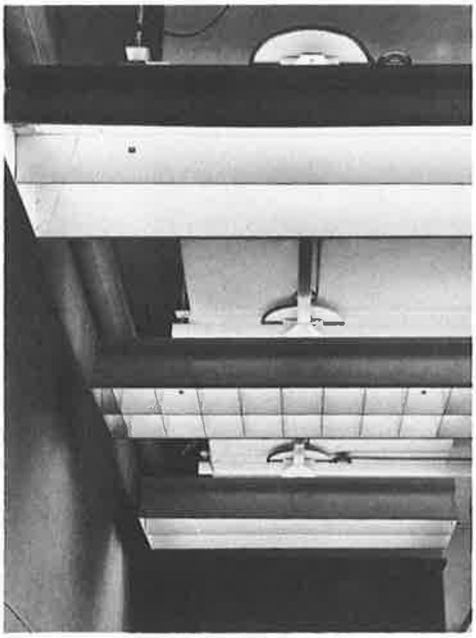
In General

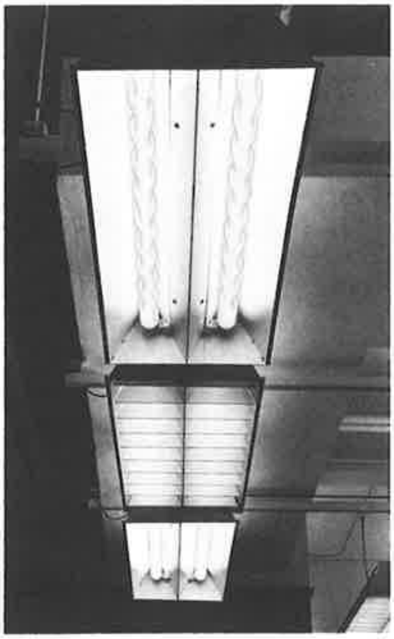
The Industrial Lighting Center consists of four rooms that can be separated from each other by movable partitions. All room surfaces have been finished to meet current standards of reflectance. The ceiling has been painted a high-reflectance white to utilize upward component of light. Wall surfaces of various materials have been finished in light colors. More vivid colors have been used on doors and machinery to create accents and to introduce interest in the space without adversely affecting reflectance values.

Machine Shop

Brightness control — its importance and development — can be demonstrated here. The luminaires can be rotated for viewing at a 90-degree or 180-degree position to the seated observer in the Vanguard Room. In this manner, lighting effects such as those obtained with various types of materials used in luminaires, with shielding devices, with upward light, and by the position of units related to the location of the work surface can all be demonstrated.

A mirror at the top of the movable partition doubles, in effect, the lighting systems. Actually, there are only three fixtures in this one. Each contains two, 48-inch high-output lamps. Fixtures have movable side panels and center V section so that shielding angles from 0° to 45° can be demonstrated (see other pictures). Also, as shielding angle is increased, upward light increases. The maximum amount is 25 per cent.





Six fixtures, each containing four-foot Power Groove lamps, can be rotated to demonstrate crosswise and lengthwise shielding. One side (interior) of each unit is white enamel. The other side is anodized aluminum. The sides reflected in the mirror also help to show the effect of brightness control of a lighting system in a room. Upward light component is variable (depending upon the fixture), and it is pointed out that this component should be about 25 per cent.

Welding and Metalworking Shop

This area simulates those where heavier types of industrial operations take place. All of the light sources are of the high-intensity discharge type, and are mounted in either prismatic glass or processed aluminum reflectors. There are nine 175-watt DeLuxe White Mercury lamps; nine 175-watt Color-improved mercury lamps; and four 400-watt Lucalox lamps. All are mounted at nine feet six inches above the floor.

The DeLuxe White Mercury lamp system provides a uniform level of 150 footcandles; and the Color-Improved lamp system provides 140 fc. The four 400-watt Lucalox lamp fixtures provide 600 fc directly under the units and 300 fc between the units. The color quality of each light source can be demonstrated — by itself, or in combination with the other sources. Effects of direct and reflected glare can be discussed and demonstrated here, also.

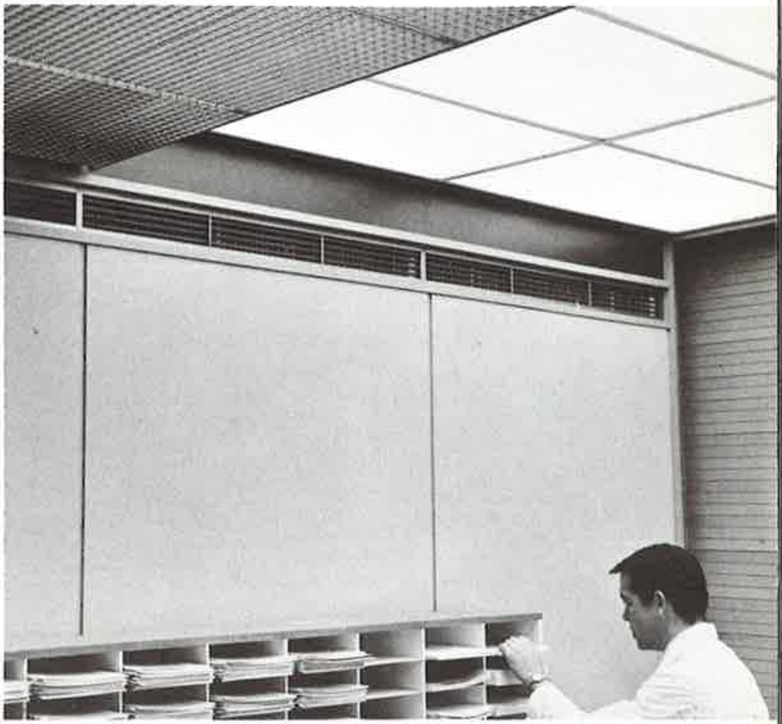
De Luxe White Mercury and color-improved mercury lamps are operated in fixtures providing 10 per cent and 15 per cent upward light component. Low-brightness reflector interiors show that units can be mounted in low-ceiling areas without visual discomfort to occupants. Of course, reflectors have to be deep enough to prevent direct glare from the light sources.

With all of the lamps — color-improved mercury, Lucalox, and De Luxe White Mercury — operating in the same room, the lighting level is 650 fc. However, it can be shown, that where work surfaces are specular, and where long hours are involved, high-intensity sources are not advisable.

The effect of sunlight (simulated by a row of 1000-watt R-60 Quartzline lamps) through fenestration can be demonstrated here, also. Note that the work is in shadow, and that brightness contrasts are extreme—and uncomfortable.

Super-Clean Room

In such areas small, intricate, shiny surfaced items may be manufactured and assembled. Higher levels of diffused lighting are required. Here, the light from fluorescent lamps is diffused by a double-wall, plastic-sandwich type of material. Filtered air enters the space by way of upper wall outlets. Air is exhausted around the plastic panels, past the lamps and ballast channels, thereby removing much of the lighting heat before it enters the space. The lighting can be varied from 100 to 700 footcandles. However, large expanses of luminous ceilings at higher lighting levels can be visually uncomfortable, so the effects of a wedge louver system can be demonstrated by sliding a unit across the ceiling below the diffusers. Brightness is reduced, and it is possible also to achieve the same amount of light as before by increasing the lamp brightness.



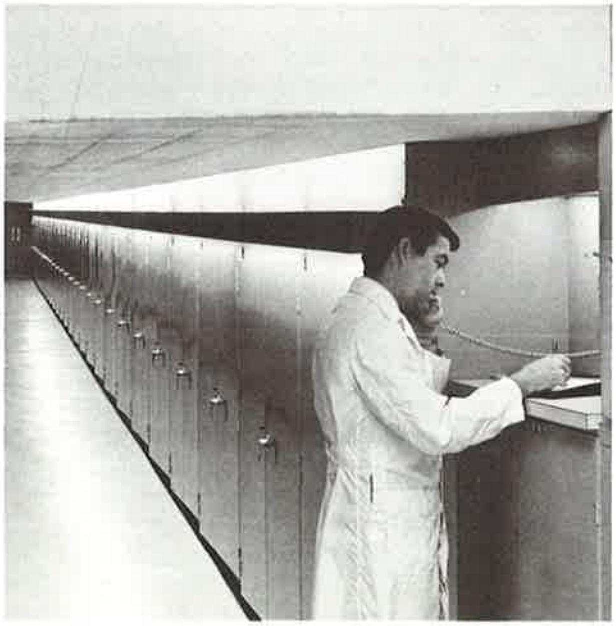
A ceiling that diffuses light reduces glare from specular objects. However, a large expanse of such a ceiling where the lighting level is higher than about 200 fc can be visually uncomfortable. Then, the wedge-louver system reduces ceiling brightness. It can also reduce the lighting level unless this factor is compensated for by adding more lamps. Unless there is a diffuser above the louvers, lamp brightness is reflected from specular surfaces in the room.

Other Demonstration Areas

Adjacent to the Industrial Lighting Center is a woodworking shop, a corridor lined with lockers, and an area where specially designed luminaires for high-output lamps can be viewed.

General illumination is 150 footcandles in this woodworking shop. The suspended, two-lamp units have eight-foot high-output lamps except above the center benches. Here, eight-foot Power Groove lamps provide 200 footcandles.

This fixture was designed at Nela Park, and is now available from several manufacturers. It has four high-output lamps, each eight feet long. There is an upward light component and 35° shielding. Light output is high — resulting in lower initial cost. Low operating costs result from the long life and good maintenance characteristics of the high-output lamps.



In a low-ceilinged passageway (this one also slopes upward) a lighted bracket is practical. Ample light is cast not only on the high-reflectance surrounding surfaces, but also into opened lockers.

A two-lamp, weather-resistant fluorescent lamp fixture supplies the answer. Actually, the number of lamps per fixture should be based upon 6,000 lumens per fixture. In areas where temperatures may drop to zero or below, F48T10/CW lamps with outdoor ballasts should be used. In all areas, outdoor ballasts and outdoor fixtures are needed. The lamps, in warmer climates, might be F48T12/CW. Space between fixtures and mounting height are important.

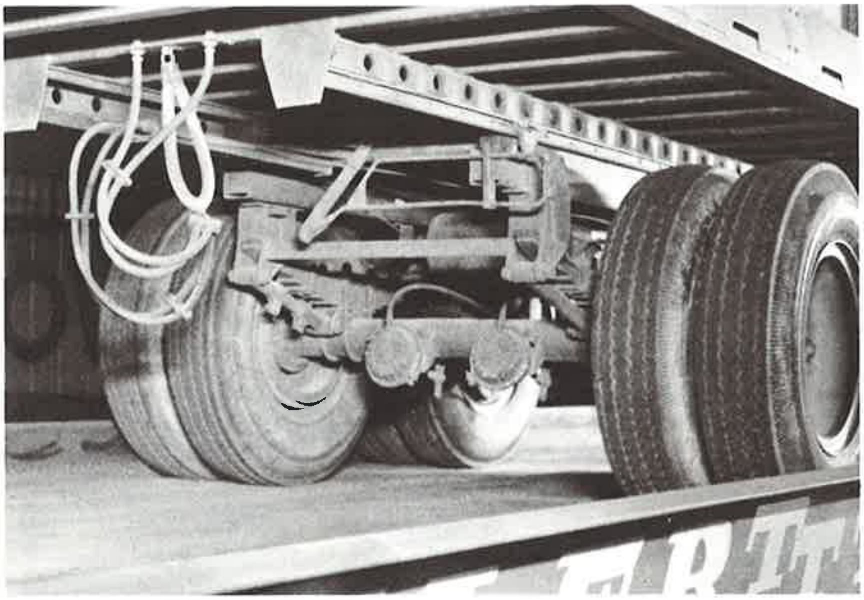
Piggyback Lighting

by **R. L. Henderson**
Special Lamp Applications, Nela Park

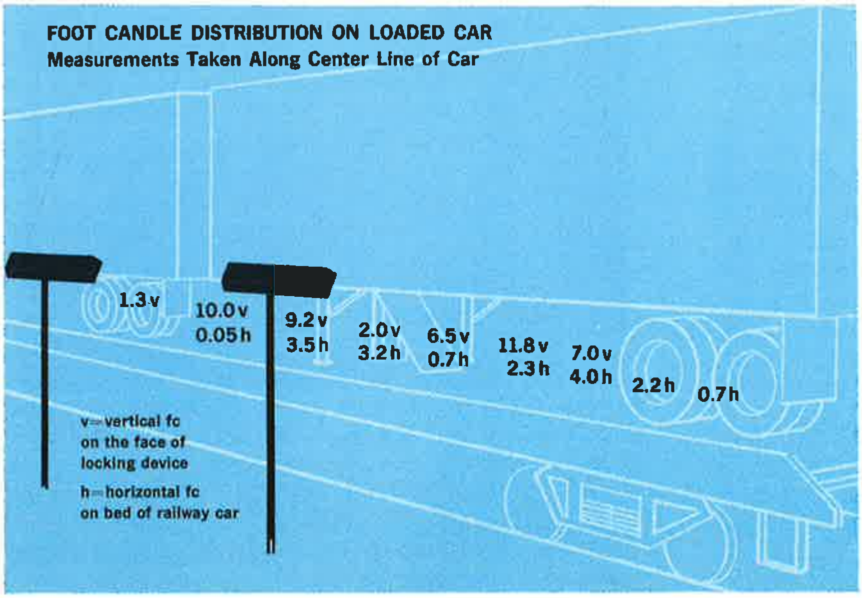
Regardless of the size of a ''piggyback'' yard; regardless of how the trailers go onto the flatcars—the problem is essentially the same. The trailers have to be fastened to the cars for traveling. And these points of fastening have to be lighted so that a workman can make the vital connections easily, quickly and safely. He shouldn't work in his own shadow. He shouldn't have to face the blinding glare of a light source that is supposedly helping him to see his work.

This problem has been of increasing concern to lighting designers, because, for one thing—piggybacking is bound to increase. It is estimated that by 1975 the piggyback will account for 50 per cent of all traffic now moving in boxcars. Merchandise will be picked up and delivered by trailer but will travel long distances by rail—without being removed from the trailer at any point in between.

General Electric has studied the lighting effects of many different types of installations using many different types of lamps —diffusers, refractors, and reflectors. Railroad officials and G-E lighting engineers agree that the fluorescent lamp provides the most effective lighting for the dollars involved— in the system worked out by the G-E men.



The trailer is held in position on the flatcar by sturdy, but adjustable equipment. At these tie-down points, workmen must see clearly. Getting needed light from stationary units alongside the tracks is the problem in the freightyards.



Fluorescent lamp luminaires are spaced about 20 feet apart. Lamps are about six feet above ground level so that light can be directed to the underside of the trailers. The first one is mounted about four feet from the ramp and the units are spaced evenly along the tracks.

Designer: Frank Feagans

The lighted bracket is popular with homemakers, because it is a form of "indirect" lighting. It is functional also — providing light on counters, into cabinets, and reflecting off the ceiling into the room. However, its real popularity seems to result from the fact that the light source is not seen directly, and that the resulting softness of the light is flattering to people, and to colors and finishes of cabinets and appliances. Fluorescent (de luxe lamps) dimming equipment can be used to tone down the lighting for more casual use of the room. Another decorative, yet functional lighting idea is the use of the pendant cluster over the peninsula sink in this large kitchen.

How Many Rooms Is a Kitchen?

PART II

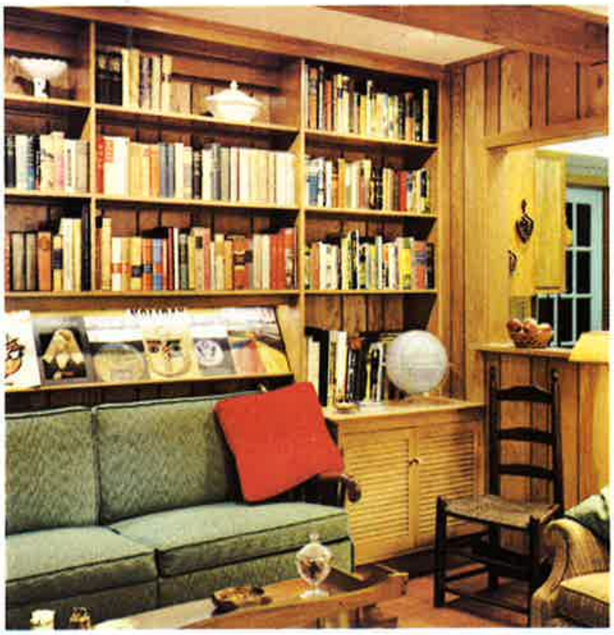
by **J. H. Jensen**
Residential Sales, Nela Park

The homemaker is demanding more and more of her kitchen. It has to be a comfortable and attractive place in which to work, but also it has to be a place where the entire family can gather for family activities and recreation; a place for laundry, sewing, and hobby activities; and a place where friends can be entertained in a casual, informal way. When these demands are combined with the usual meal preparation, family dining, and household bookkeeping functions the kitchen is a busy place—obviously.

Lighting, as much as any other single element, can help to make the kitchen a truly multi-purpose room. The lighting is keyed to family activities. Simple, general lighting plus local work lighting is not enough. Today, kitchen-lighting designers are using the most glamorous of lighting ideas—drawing on their experiences from a wide variety of other lighting fields—as well as using a broad spectrum of modern daylight sources.

Designer: Samuel Mills, Assocs.

In a bachelor's kitchen the emphasis can be on casual and informal entertaining and relaxation. In keeping with the rustic and masculine decor the lighting is a bit dramatic, but the important working centers receive generous amounts of comfortable lighting. Reflector downlights (75 watts) are housed in large cedar boxes which harmonize with the massive and rough-textured surfaces of this remodeled room. The sharp, directional qualities of these luminaires provide well-defined shadow patterns and emphasize glossy surfaces as well as rough textures in the environment.



Designer: Samuel Mills, Assocs.

A pass-through connects family room and kitchen—keeps traffic out of the work area, yet makes the homemaker feel a part of the group. Reflector lamps in ceiling-recessed eyeball units are aimed at the bookshelves. Two fluorescent lamps above the magazines provide light for casual reading.

A Place for Informal Entertainment

A house without a family room is hard to find in today's market. This second living area is usually joined in some way to the kitchen. The lighting problem here is mostly one of flexibility. At different times it must be lighted for children's play, for adult entertainment, for work and hobby activities, for television viewing, and for just plain relaxing. More than one lighting system is called for, usually. Then, both the function and the appearance of the room can be changed at the touch of a switch or at the turn of a dial.

A Place for Family Activities

Today's kitchens seldom resemble the sterile all-white "laboratories" of a few years ago. Today, the emphasis is on color, handsome fabrics, beautifully styled appliances, and unusual surfacing materials. Good lighting is considered an essential part of the decor. In combination with all of the other elements it helps to create kitchens that are beautiful enough to entertain in as well as to work in.

The appearance of an early American room seems to benefit from the use of carefully selected portable lamps. These have three-way switches that help to provide a change of lighting level. However, they cannot provide enough light for active children's play or adult table games played in the center of the room. So, in this room, fluorescent lamp fixtures between beams, and with matching wood sides, provide the needed illumination. Concealed behind the fireplace beam are two downlights that accent the fireplace.

Designer: Robert Turek

Designer: Elton Leppelmeier

The way lighting is used here emphasizes the spaciousness of the combination kitchen/family room. Glass walls contribute during daylight hours, and light-reflecting surfaces help at all times. Texture of the stone wall is emphasized by grazing light from downlights on high-low switches. Dimmer control on such units is also effective. With either method of control the area is glamorized for adults and provides soft background lighting. Note, in the foreground, a Panel Fluorescent lamp in a 2-foot x 2-foot luminaire. This is particularly effective in the work area.

Designer: Samuel Mills, Assocs.

Characteristic of many family rooms is an expanse of window wall. Daylight is welcomed by people and plants. At night a drapery must be drawn or objects in front of the window wall must be lighted to avoid a black-hole effect. Here, reflector lamps on high-low switches are aimed at the plants from adjustable units in the ceiling. These are located far enough away from the front edge of the shelves so that plants on the floor and lower shelves are not in shadow. Blue-white reflector floods are effective on foliage.

A Place for Laundry and Sewing — and for Refreshments

Because today's laundry equipment is so trim and neat, it does not have to be relegated to the basement or utility room. In a kitchen it is a challenge to the lighting designer to make the lighting as attractive as the appliances. Although the laundry equipment is automatic, there is still critical seeing to be done. Even more critical is the eye task of sewing. As many as 200 footcandles may be required for sewing with dark thread on dark material. Where the visual task is not as acute as this more attention can be paid to lighting effects — decorative effects, primarily.

Designer: Aileen Page

This well-organized sewing center has the advantage of a permanently fixed location so that lighting equipment built into the ceiling is always in the proper position for lighting the machine. The lighting recipe calls for a 150-watt PAR-38 floodlamp to the left and in front of the needle so that the light is directed at the machine's "foot". The machine (the operator, of course) faces a light-colored surface so that spill light from this adjustable ceiling unit provides a pleasant background illumination.

Designer: Robert Turek

The luminous canopy, starting at the corner of the room, conceals two rows of 40-watt, de luxe warm white fluorescent lamps. The work surfaces are smoothly lighted, and the light is also directed down into the deep sink and washer basket. The canopy's open top permits the light to spread out over the ceiling so that the entire unit contributes to the general lighting of the work space.

Designer: Nina Faye Bonner

Decorative highlighting and accent lighting are possible in many family rooms. This effect was obtained simply by adding a fluorescent strip under a frosted glass panel below and behind the bar. The glassware on the frosted glass shelves picks up a reflection of the linear source.

Where luncheons and dinners are served, Cam Norton explains some features of a lighting unit to a "client". Overhead are some commercial fixtures lamped and mounted at the heights for which they were designed. Controlled by different switches are other types of units. All are connected electrically to wireways above the acoustical ceiling.

C & I Showroom

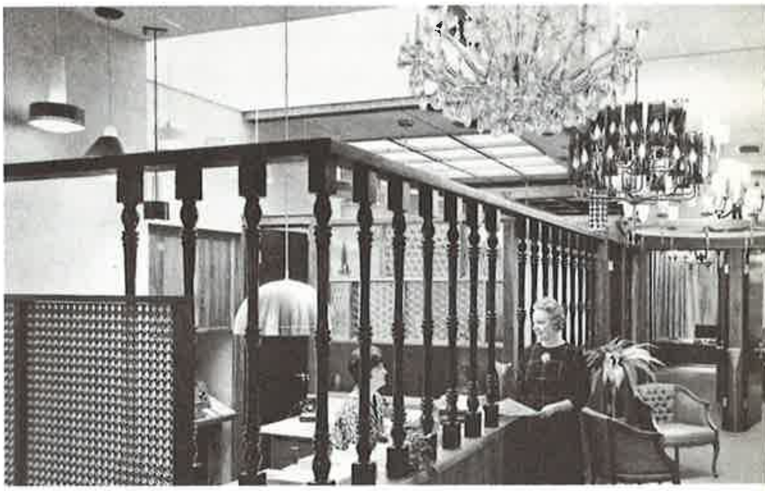
by **G. R. Baumgartner,** *Ret.*
C & I Market Planning, Nela Park

The Cam Norton Company, of Cleveland, Ohio, is a family enterprise—but different. In fact, we know of no other like it in the country. Cam Norton became a manufacturer's agent (actually, he represents about six lighting fixture and electrical supply manufacturers) about 30 years ago. He built up his business, working out of his home, as most agents do. And his wife, Ursula, worked with him. Then, when the children were grown, and two sons, Tom and Jack (who had combined business and electrical courses in college), decided that they liked the work, the Cam Norton Company bought a building downtown. They hired Mike Reese, too. He was in school with Tom, is an associate, and calls on architects and engineers.

The company renovated and leased most of the building but kept the first floor and a lower area for their offices and displays. In the 3000 square feet used by them, they show commercial and industrial lighting fixtures and supply items— combining these with offices, kitchen, and dining areas. In the dining areas, they can, by prearrangement, serve architects and contractors and their clients. They don't sell equipment — they display it. It's sold through electrical wholesalers. They do help make lighting layouts, however, when requested. Their territory covers northern Ohio.

Manufacturers, of course, are delighted that their fixtures and supply items can be displayed in the type of surroundings that the Norton's can provide. Here, the newest lines can be displayed — the fixtures lighted as the designers planned. No catalog, no matter how good, can come close to the real lighted item. So, the Nortons display the fixtures, talk well and knowledgeably about lighting — both from an engineering and esthetic point of view — and help many clients solve lighting problems.

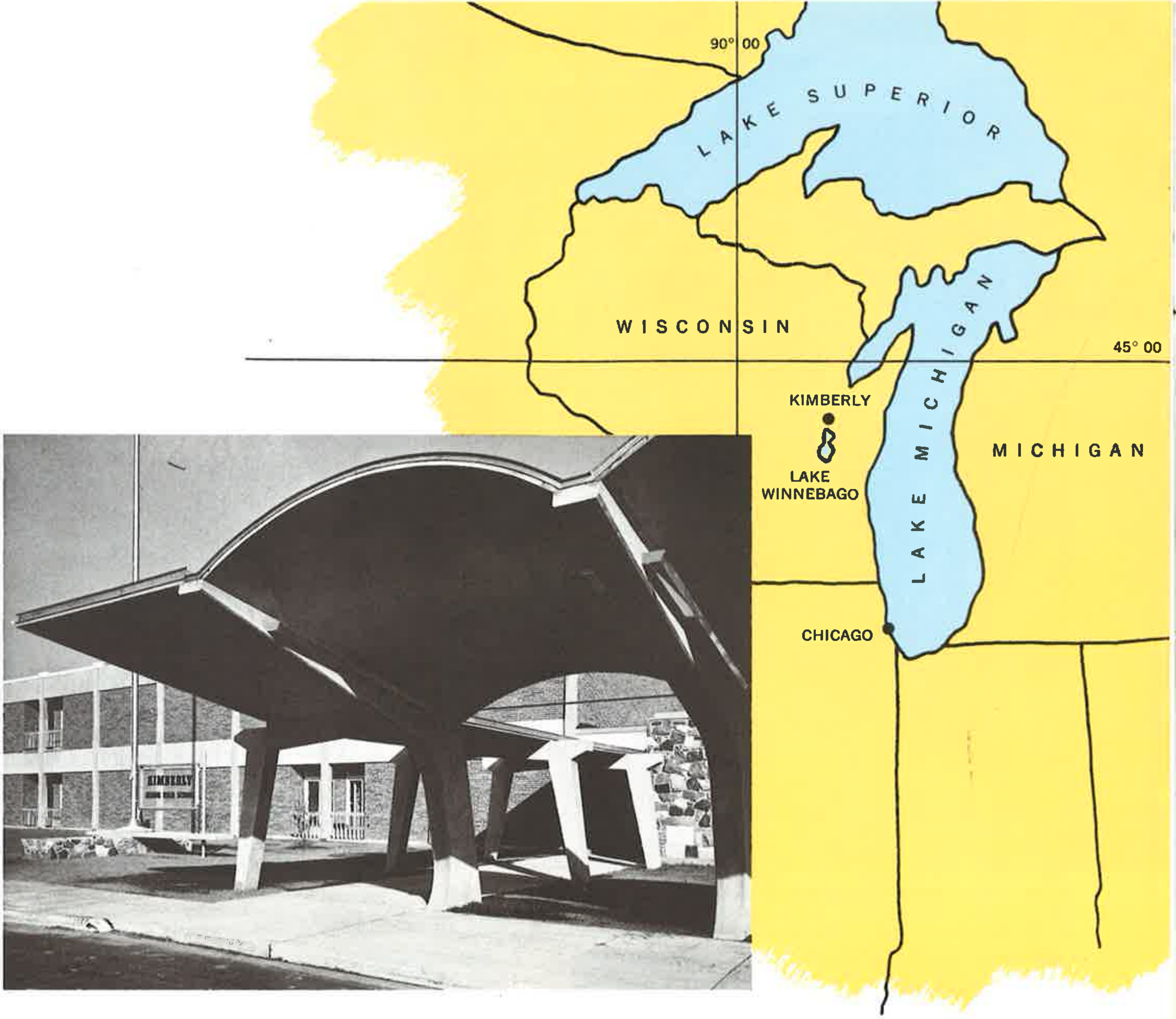
Small fixtures are displayed in the wall cabinets and are switched individually, of course. These wired, walnut cabinets, each measuring four feet by six feet by 14 inches deep, line many of the rooms, With their doors closed, they add to the general decor. Open, various lines of fixtures are displayed without adding clutter to the space.



Opposite the entrance (no show windows) Eudora Smith, an artist and designer, has her office. She handles much of the paperwork, answers and switches phone calls, and knows a lot about fixtures on display. Some are in her office.

Ursula and Cam Norton check a wall cabinet display in son Tom's office. These small fixtures may not be as decorative as those hanging from the ceiling, but they are essential in many commercial and industrial areas. Catalog sheets are hung on the cabinet doors for convenient reference.

Cam's office has a lighted ceiling section above the desk. Here, he looks at a magazine while his son, Jack, takes a phone call from a client concerned about his lighting layout.



Kimberly School Revisited

by **W. S. Fisher**
Lighting Development, Nela Park

A little more than two years ago LIGHT Magazine carried a review on the new high school at Kimberly, Wisconsin, which was in its first year of operation. This was the first school building in which the concepts of Electrical Space Conditioning were fully implemented. The story of its all-electric design and construction was detailed, but little data were available at that early date on its operation or the reactions of those who occupied this facility.

Now, three years of occupancy have been completed in the school, and the experience has been better than anticipated. Operating costs have been even lower than estimated for this all-electric building. And the reaction of students and faculty to the new (for that time) "compact" design has been overwhelmingly favorable.

Design

The "compact" design reduced the ratio of perimeter wall area to the total classroom area compared with conventionally designed schools. It also resulted in some interior classrooms without windows. But even the classrooms at the perimeter of the building had only a single window at the rear corner, totaling 40 square feet of area. This made it practical to provide year 'round air conditioning, by minimizing heat transfer through building walls both summer and winter.

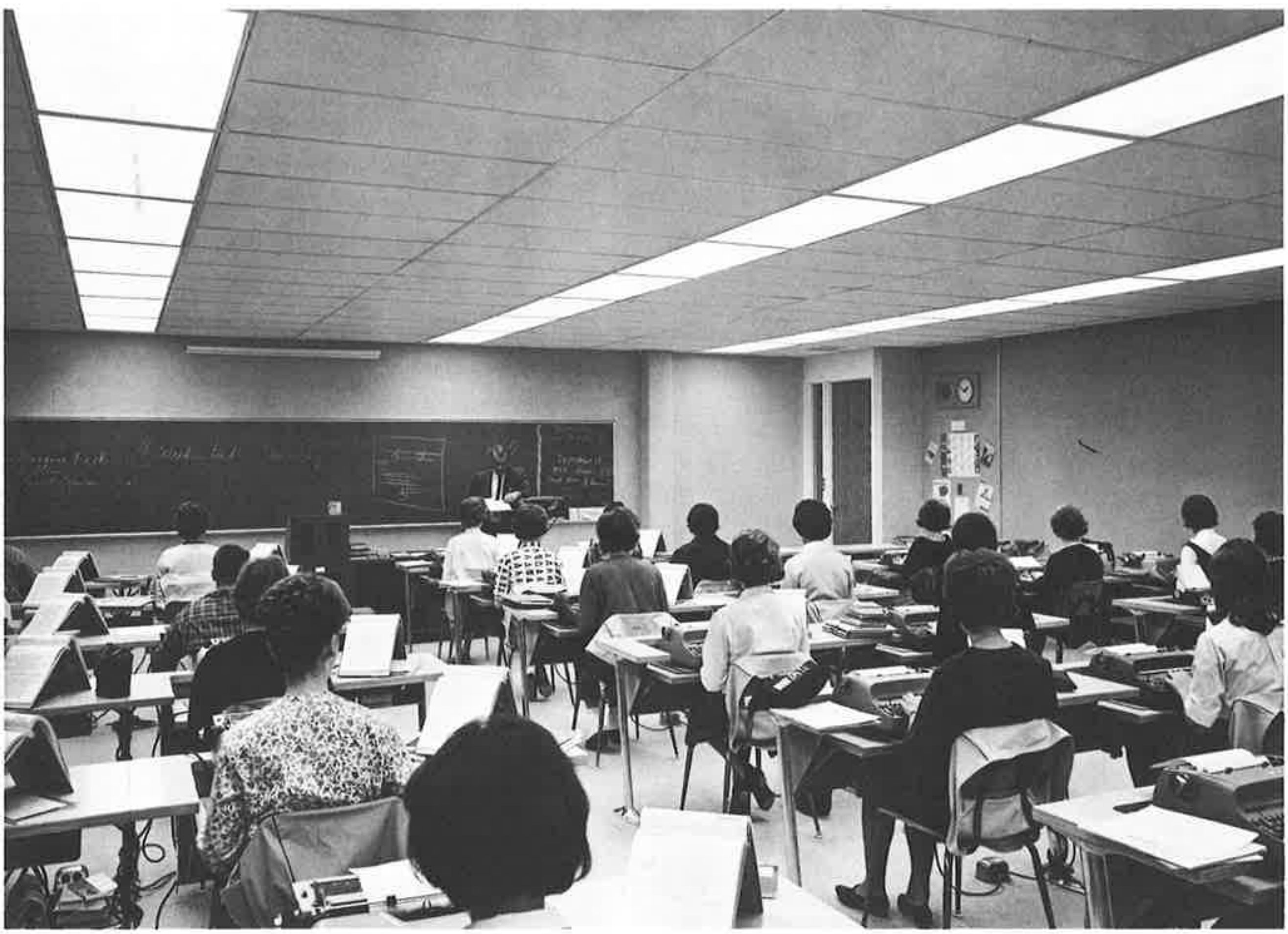
To provide a true picture of attitudes, the faculty was asked to answer a questionnaire at the end of the first school year. About 25 questions were asked on a variety of topics relating to the school design for which one of several answers could be checked. A few questions were asked requiring written, subjective answers. No signatures were required.

Questionnaire Results

A summary of a few of the questions follows:

1. How do you evaluate students' reaction to limited window area?
   a. Students greatly disturbed by lack of windows. 0
   b. Students aware of reduced windows but not disturbed 4
   c. Little or no reaction by students to limited windows 10
   d. Students apparently favor reduced window area 9
2. How do you, personally, respond to limited window areas?
   a. No objection 23
   b. Objection 0
3. Has the school design enabled you to make better or more frequent use of audio-visual aids?
   a. Yes 18
   b. No 3
4. If Kimberly were just beginning its high school building project, would you recommend:

	Yes	No
a. Air conditioning	23	0



This is an interior classroom. Air is circulated through the lighting fixtures, and both body and lighting heat are ducted to the heat pump. Excess energy is stored in tanks of water to be used at night or during the weekends.

(continued)

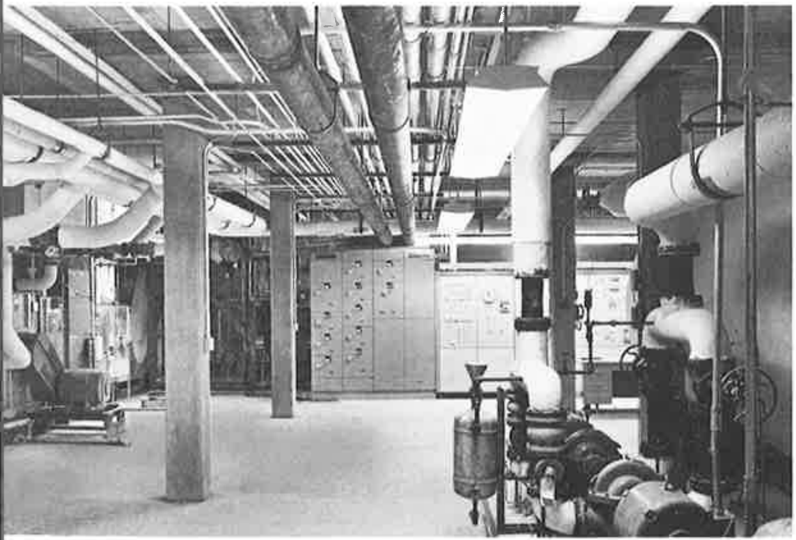
	Yes	No
b. Reduced window area as in this design	22	1
c. Less window area than now	9	14
d. More window area than now	0	22
e. Lighting as in this design	21	2
f. Less lighting	0	23
g. More lighting	2	20

One of the written comments by a teacher was as follows: "Yes. In a conventional building, window area facing the sun tends to become hot and uncomfortable; this is not true in this building. Attention and alertness are easier to attain and maintain in this school."

Another teacher said, "The warm fall and spring days were noteworthy because students maintained their vigor. Students didn't appear anxious for school to end this year as they have in the past. The fact that students and teachers don't get drowsy due to excess heat helped maintain better discipline, more alert classes and more dynamic teaching."

Summer School

Mr. Ray Hamann, superintendent of schools for Kimberly, reports that in 1965 they enrolled 800 children in summer school in academic studies from grades one through twelve. This is a fine attendance considering that the Kimberly school system does not require attendance in a majority of the summer school classes, nor is it required that the students earn credit. Certain summer courses are taken by students for credit, and attendance at those is required. However, attendance for the required classes is no better than at those not requiring attendance.



The mechanical area for this building looks little different from comparable ones in office buildings. The suspended fixtures are well shielded, and placed where the light is needed most. Above the control board is a single-lamp unit that directs light evenly down and across the board so that all of the control devices and meters can be read easily.

Energy Distribution

The mechanical system for Kimberly has performed even better than expected. Temperatures have dropped as low as 23 degrees below zero during Wisconsin winters, yet all classrooms have been comfortable. It is reported that the temperature of many classrooms has not varied more than one degree since the building was occupied in September, 1963.

The heat-pump system redistributes energy within the building during winter from interior zone classrooms to perimeter areas. The measured seasonal coefficient of performance for the heat pump during the 1964-65 season was 4.88—not bad for this latitude. (See map sketch.)

Operating costs for Kimberly have been within estimates. A breakdown for the 1964-65 season is shown. The degree days for that season were about eight per cent higher than the 30-year average.

Operating Costs
September 1, 1964 to August 31, 1965

Lighting	$9399.93
Auxiliary Motors	8150.15
Heat Pump	13312.38
Domestic Hot Water	1329.02
Well Pump	130.29
Unaccounted For	1021.23
Total Cost—all usage	$33343.00
Degree Days—Heating (1964-65)	8136 days
30-Year Degree Day Average	7545 days

The internal energy from lighting and students is enough to keep the building at a comfortable temperature when the outside temperature is 18 degrees. However, during most of the daytime operating hours at Kimberly there is excess heat in the building. The heat pump stores the excess in 24,000 gallons of storage water. This source of heat is then tapped at night and on week-ends. With this scheme, the lighting frequently helps to heat the building, even when it isn't operating!

In General . . .

During long vacation shutdowns and during the coldest part of the winter, well water is available as a source of heat to the heat pump.

The school board and school administration feel they have far more school for no more money than others have invested. However, very few schools, as yet, have features such as year 'round air conditioning, superior lighting and electrostatic air cleaning.

Kimberly's example of a superior environment for learning is benefiting not only the parents, students and teachers of its community. The many hundreds of visitors who have flocked to Kimberly from all over this country (and several foreign countries, as well) are being inspired by its example to do as well in their own areas. Thus, Kimberly is exerting a considerable influence over school design beyond its own region.

Vaulted ceilings, sweeping, soaring ceilings have, traditionally, been difficult to light effectively and efficiently. Now, compact, high-intensity sources may be placed in small units on columns, in coves, in recessed downlights . . . to produce light of coolness or warmth—wherever needed.

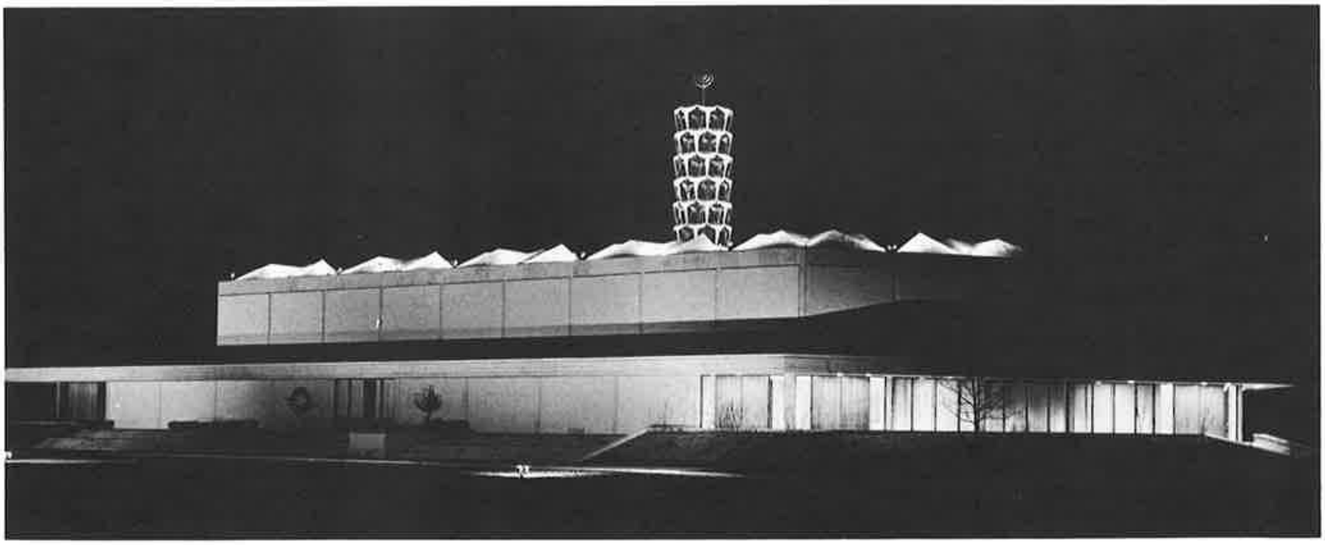
High Intensity... So What!

Architects and lighting designers are being given more freedom in developing adequate visual environments. This design freedom is the result of having more lighting tools to work with—the compact, high-intensity light sources. These include De Luxe White Mercury and Multi-Vapor, which have cool color-rendering properties, and the Lucalox lamp which has a golden-white light. Then there are Quartzline® lamps (incandescent) in many sizes. All are efficient. All can put more light at greater distance than any other source to date.

Now, what does this mean? For one thing, it means that without sacrificing architectural quality, the interior of a large, high-ceilinged room for example, can be illuminated to reveal otherwise hidden splendors without having the light sources obviously, and often obnoxiously, apparent. This fact pleases the client's pocketbook, too, because he may get more light for less cost, and maintenance may be easier and less expensive. There are other advantages, but our objective here is simply to show a few typical places where one or the other of these new light sources might be used.

W. D. Riddle A.I.A

Vaulted ceilings, ceilings with elaborate designs, buildings that are old, but well worth preserving, may benefit from lighting that does not dominate the space architecturally. The new, high-intensity light sources may be recessed in ceiling medallions. They may fit neatly into urns or into chandeliers. There is light — and to spare. The once-considered wasteful indirect lighting system can now be used to serve an architectural purpose — to illuminate the space as well as the activities of the people who use it, and to do it all comparatively inexpensively.



And the lamps may be used outdoors—to wash a wall with cool or warm light — to highlight different sections of a building — to emphasize planting and landscape elements — all less obtrusively than has been possible in the past.

Lighting News

Dear Editor:

The General Electric Lamp Division — like most companies — is today experiencing a labor market where there are more jobs than qualified people. In such a situation there is a problem for a company in getting its story to the job seeker. As a result there are many people who never have the opportunity to hear about the nature of the work done in the lamp industry — work needing the skills of the full scientific gamut from metallurgy and chemistry to engineering physics and mechanical engineering. These people never hear of the opportunities to work with rare earth metals and gases, with lasers and other light sources and emissions, with cryogenics, high vacuum systems, microanalysis and the full scientific range of our problem areas. But these do exist — in addition to our manufacturing and production processes.

Hopefully some of your readers will know some qualified people who might be interested in learning more about this industry — one of the fastest growing in the world, yet characterized by secure employment. If so, I would be glad to send them information about available positions as well as a brochure describing our work, and the nature of opportunities in this, the oldest electrical equipment company and the initiator of the era of electric lighting.

W. C. Buchanan
General Electric Company
Nela Park, Cleveland, Ohio

New Low-voltage Lamps

Because of increasing commercial interest General Electric is offering not one, but a dozen types of 12-volt lamps. These are not automotive lamps, but PAR lamps developed especially for low-voltage applications indoors and outdoors.

There are two sizes and four wattages. PAR-36 lamps, four-and-one-half inches in diameter, come in 25 and 50 watts. PAR-56 lamps are seven inches in diameter. They are made in 120-and 240-watt types. In each wattage, lamps are available in three beam shapes.

Beams are smooth and symmetrical, and available in very narrow spot, narrow spot, medium flood, wide flood, and very wide flood.

Initial peak beam candlepower ranges from 230 for the 25-watt PAR-36 lamp with very wide flood, to 110,000 for the 240-watt, PAR-56 lamp with its very narrow spot.

All of the lamps have filament shields to contain spill light and to reduce glare. Additional control of the light is obtained by aluminized parabolic reflector shapes, unique stippled reflector surfaces, and lens' designs.

The lamps have a design life of 2,000 hours, and will be used for residential, landscape, garden, and swimming-pool lighting; for ground-mounted building floodlighting; for pin-point accent lighting of displays—as a few examples.

Another One

The F40, "3 Plus" line of fluorescent lamps is another example of improvements made in the laboratory which benefit customers and users. The new lamps look the same as the old from the outside, of course, but they incorporate a completely rebalanced set of lamp

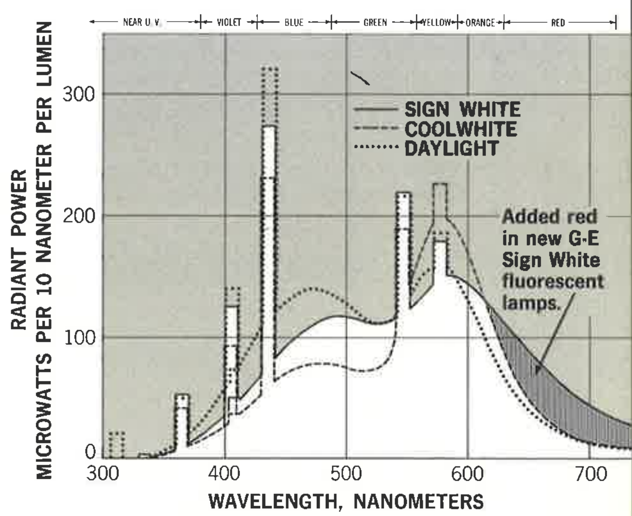
parameters. The result of these changes is increased lumen output and reduced end discoloration. The price has not changed.

Switch Start life (based upon three hours per start) has been increased from 7000 hours to 10,000 hours. Rapid Start life has been increased by 1500 hours based on six and 12 hours per start; by 3500 hours for continuous operation; and on three hours per start it remains the same (12,000 hours).

This is the General Electric 40-watt fluorescent lamp that most people will be using from now on. It is improved both in performance and in appearance. It provides more light than our previous 40-watt fluorescent lamps, and lumen maintenance is better. Naturally, we do not think that we have reached the peak in 40-watt fluorescent lamp performance, but the improvements are noteworthy.

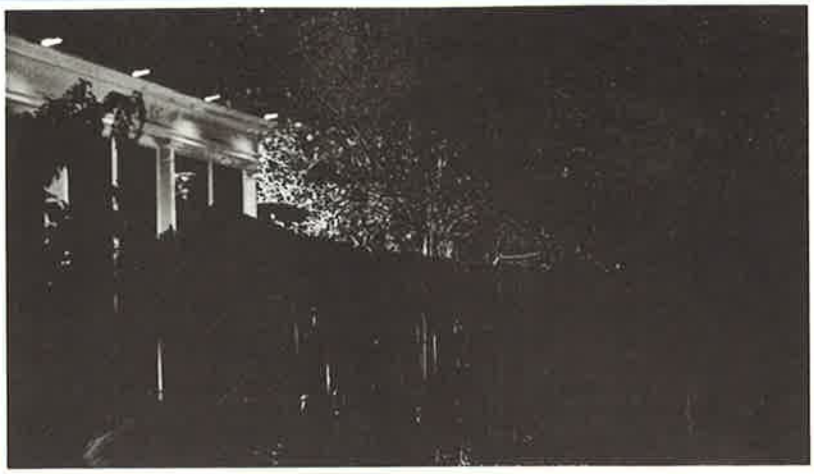
Sign White

This fluorescent, high-output lamp was developed specially for plastic signs. It was believed that these signs could look cleaner and crisper if the white fluorescent lamps



used in them had more red and green energy than, for example, either cool white or daylight lamps. The plastic signs do. And the spectral distribution of the fluorescent sign lamps as compared to cool white and daylight fluorescent lamps shows the effect graphically. These new lamps are designed for 800 ma. operation. Nominal watts range from 35 to 110. Your G-E lamp agent can supply you with prices.

Low Voltage . . . High Intensity



for indoors and out . . .

Both 6-volt and 12-volt PAR lamps from General Electric Large Lamp Department

Use them for:

ground-mounted building floodlighting
(minimum glare for pedestrians and drivers)

pin-point accent lighting
(displays and features in interior decor)

dramatic down-lighting
(no direct glare, because of shielded filament)

precise beam control
(rectangular beams to accent rectangular objects)

And . . . they'll save money!
More fixtures and transformers coming on the market every day. Talk to a lighting equipment manufacturer or to your G-E Large Lamp representative to get more design information . . . more data.

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