We enjoy 400 Footcandles

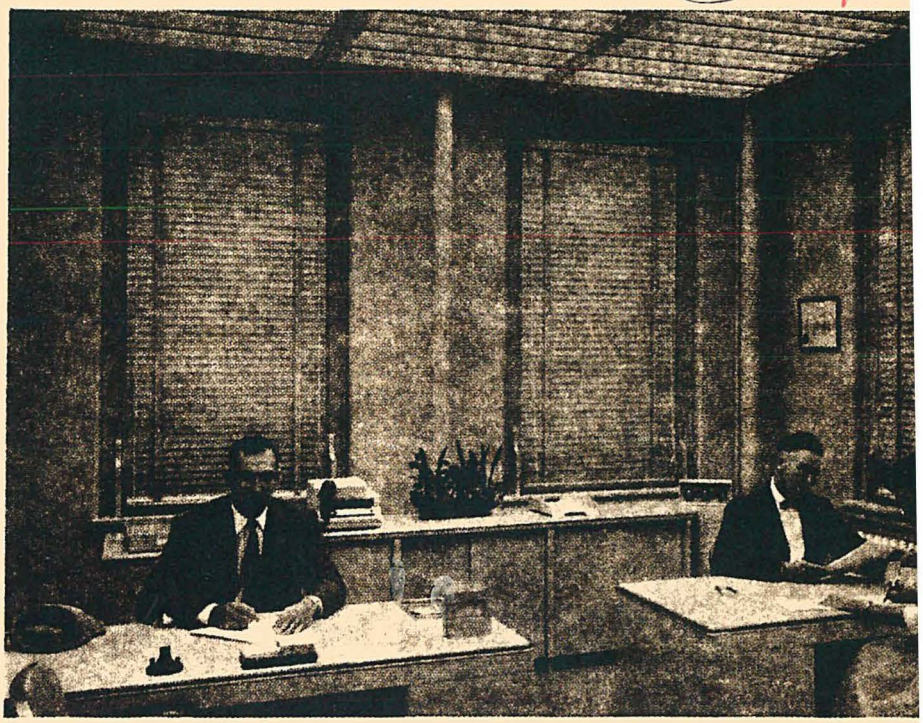
A report by W. S. Fisher and C. J. Allen on their experiences with a high-footcandle office installation at Nela Park

In the indoor and outdoor settings shown on this page, there is a major common factor — the footcandle meter on the desk reads 400 in each location.

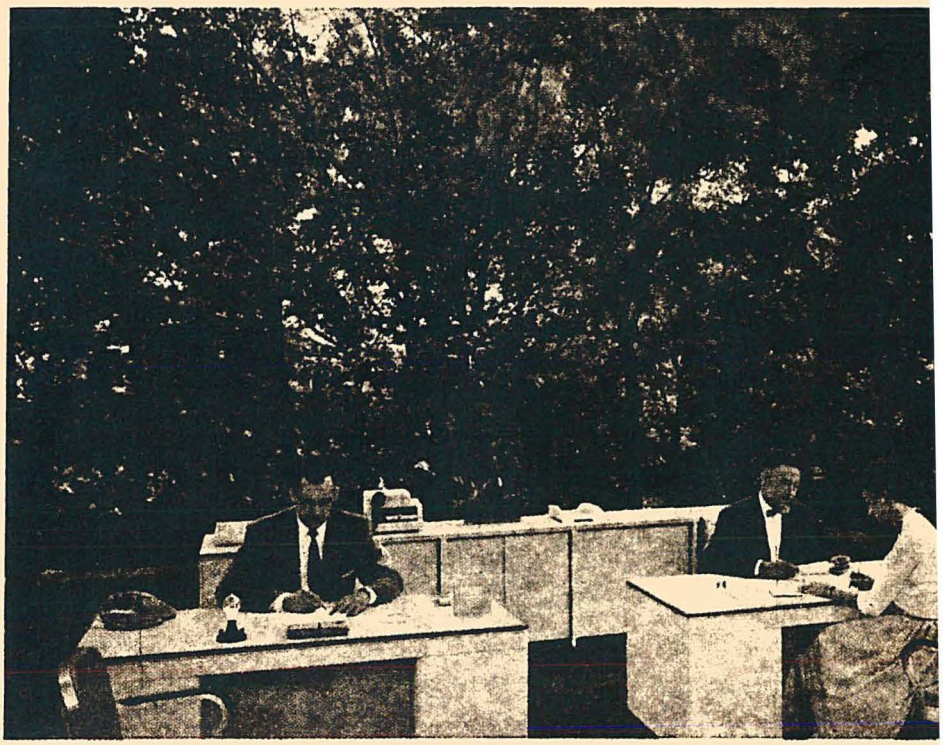
Now why did we bother to haul our office equipment outdoors? We wanted to dramatize a lighting condition which many individuals have described as ideal for reading a book or doing similar close visual work. The 400 footcandles is very typical of what one obtains in the shade of a tree or in the shade of a porch.

The outdoor picture was taken during the first part of the morning, before the direct sunlight entered this tree-shaded area. It was a very pleasant location that became uncomfortable as the western sector of the sky (which we faced) increased in brightness. To work in this natural setting, we would have had to change position frequently to avoid intense glare and shadow as the day progressed.

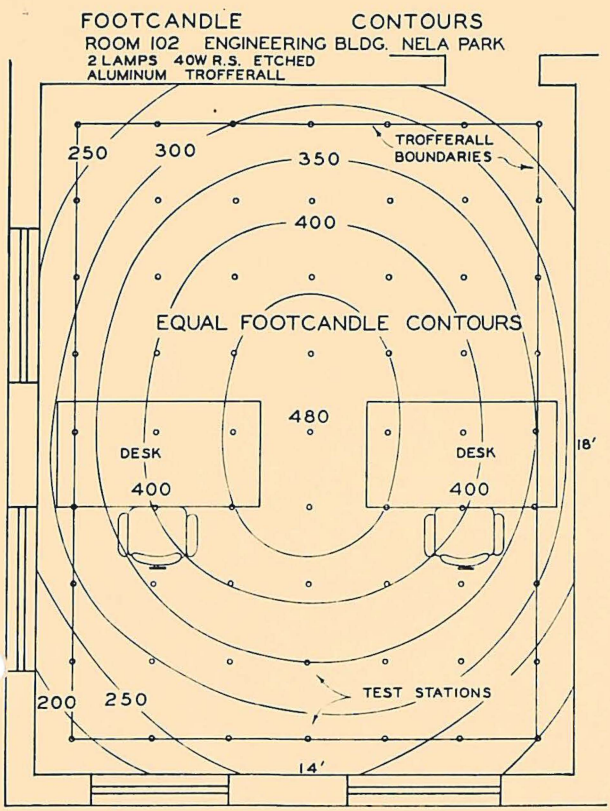
We were, frankly, glad to return to our office, where the lighting was under our control, and where, as a matter of choice, we keep the lighting level at 400 footcandles. We do, however, have a dimming system for research purposes; this is used also by visitors for selecting the amount of light they like. Their reactions follow a pattern. At first, many feel the room is too bright. This is while their eyes are adapting from the lower lighting level of the 30-footcandle corridor. After a short period of adaptation, we seat them at a desk and ask them to adjust the level to that which they would like to have for desk work. After all, there are differences in people and their responses. While manipulating the controls, they do not watch the footcandle meter. Most people select between 200 and 300 footcandles as the level they'd like to have; none have chosen less



400 footcandles with the accent on comfort is the story here. This office was designed to utilize every available technique in obtaining a pleasant, workable surround under footcandle levels recognized as ideal for office procedures. A well-shielded trofferall ceiling, and proper reflectances from walls, floor and furniture are important aspects of the design. Undoubtedly a prototype of more to come.



The same footcandle level outdoors. Comfortable until sky brightness increased later in the morning, and sunlight filtering through leaves created harsh glare and shadow. Then a controlled environment such as they could achieve indoors was preferred . . . proof that today's lighting techniques can give us what we want.

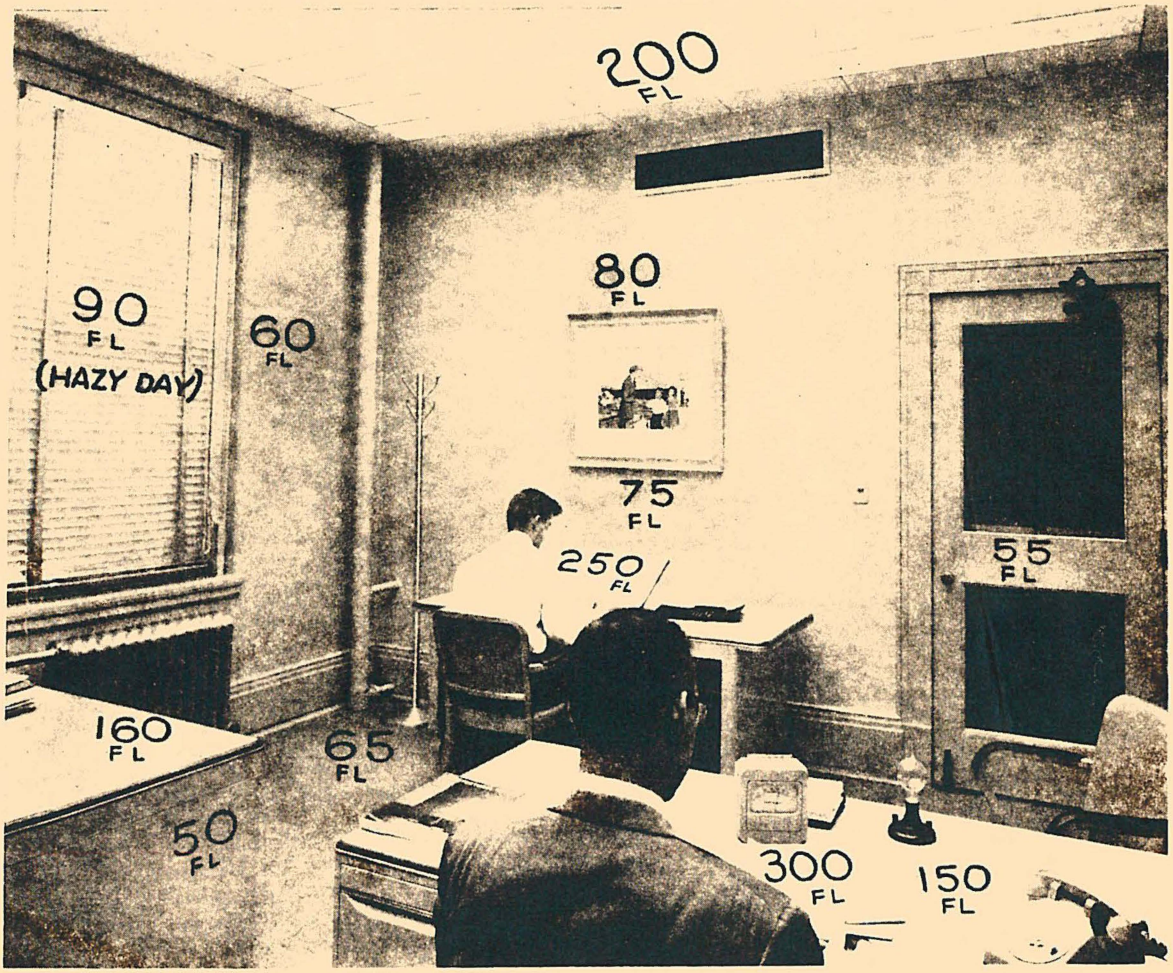


Light distribution from this trofferall system shows unusual symmetry. Note, too, that the 400 footcandles occur in the work area. Average footcandles for this office are 340. In center, 480.

than 100, and a few have expressed a desire for more than the top level of 480. Having lived with, and worked under, this full-scale installation for about a year, we conclude that levels far above the commonly accepted 50 footcandles can be comfortable when luminaire brightnesses are well controlled and the room brightness is well balanced.

It is obvious that the technique used for producing high levels of illumination comfortably becomes more critical as the values increase. While it is desirable to have high luminaire efficiency and room utilization, the more critical factors are shielding angle and low brightness of the unit as seen by the seated occupants. There are several ways these can be obtained, and others will no doubt be developed as similar experimental and demonstration systems are installed.

The etched aluminum troffer selected for the experiment directs light downward, without throwing brightness into the eyes of people seated at the desks. Viewed crosswise, it has very



A more accurate indication of the comfort of an installation is shown by footlambert measurements. We then know the brightnesses to which the eye is subjected. At this level of illumination, the brightness differences in this room are considered comfortable by room's occupants.

low brightness. Notice the orientation of desks to the rows of troffers in the picture. Cross louvers shield the lamps from lengthwise view. It is this view, incidentally, that offers the greater brightness, and we are now experimenting with several louver designs that will considerably reduce the lengthwise brightness.

Our office is 14 feet wide, 18 feet long. The two-lamp troffers are installed side by side in the trofferall technique; 16 rows, with three troffers to a row. There are 96, 40-watt rapid start lamps in the ceiling. At full brightness, the load is close to 5400 watts — about 21 watts per square foot. Dimming ballasts and 120-volt thyratron dimmers provide smooth control of a wide range of footcandles. Ours is not the first trofferall ceiling, although it is the first to produce 480 footcandles. In 1954, our New England District Engineer, Mr. L. S. Cooke, installed such a system in his office, using single-lamp troffers without crosswise louvers. The lamps are low brightness, de luxe cool white, and they provide 165 footcandles of light. That system uses 45 of the 40-watt T17 lamps. The success of this system prompted us to experiment further — using standard, two-lamp, etched aluminum, parabolic troffers with 40-watt T12 rapid start lamps.

You may be wondering about heat at this point. It is discernible — not immediately when the system is turned on, but later in the day after the troffers have been thoroughly heated, and produce long-wave infrared energy. Thermocouple measurements made at the troffers late in the afternoon show 100 to 115 degrees Fahrenheit. Lamps warm up to about 125 degrees. The heat is not considered excessive, as the air conditioning operates at 73 degrees, at a rate of 12 changes an hour. If regular two-lamp ballasts had been used instead of dimming ballasts, temperatures would be considerably lower — with about one less kilowatt in the room, it would perhaps have been enough to prevent radiant heat from being noticed at the day's end.

Now we come to an important engineering aspect of the installation — reflectances and footlamberts, which help to determine the visual comfort of an environment. Although no fundamental researches have been made regarding the VCI's of lighting systems where several hundred footcandles are supplied, it is possible to make "engineering guesstimations." Our calculations indicate a VCI of 85 per cent when the lighting units are viewed crosswise, (our usual viewing direction) and 50 per cent lengthwise of the troffers. However, as we seldom view it from the latter position, it has not been found objectionable in this room.

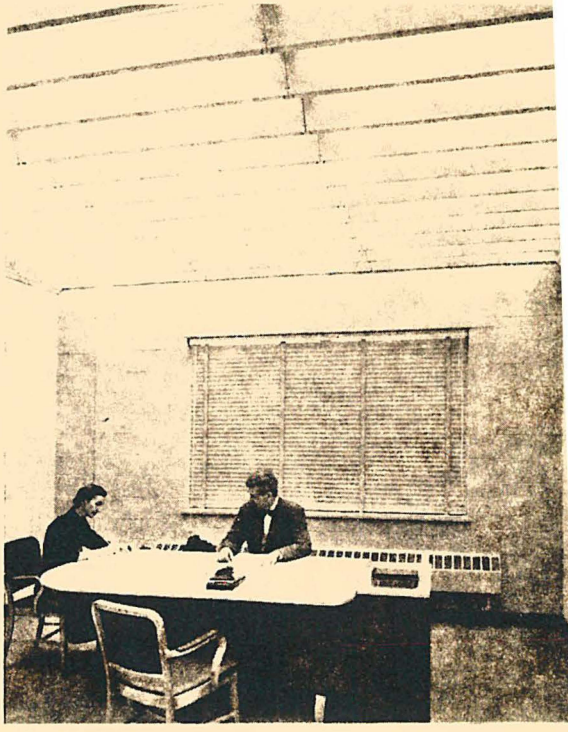
The reflectances, which in turn determine the brightnesses, were chosen to be in keeping with the reflectances as recommended by the IES Recommended Practice for Office Lighting.

	Reflectances	
	Recommended Practice for Office Lighting	400 fc Office
Walls	40-60%	50% & 57%
Blinds	40-60%	60%
Desk Top	26-44%	39%
Furniture	26-44%	47%
Floors	21-39%	20%

We have attempted to make the room as pleasant as possible through the use of attractive colors on walls, furnishings, and floors. Normally, the reflectances of window walls are higher than the other walls, in order to minimize the brightness differences with the outside. In this case, we used a 57 per cent reflectance gray on the two inner walls, and a 50 per cent reflectance blue-green on the two window walls.

This was done partly because the windows, with blinds closed, have so little effect on this room with its high footcandles that we could indulge in a medium light-green color. We picked this color because it compliments skin tones, and is also a dominant color in nature; therefore, appealing to most people. Thanks to advances made in office furniture design and color, we were able to obtain standard equipment with high reflectances. This was true of the paint and carpeting also, and reflects the cooperation of these industries in producing standard colors that have a favorable relationship to the higher lighting levels. In fact, without these, and without air conditioning, the high-level lighting would have been less than satisfactory. All the materials used in this room — lighting fixtures, paint, desk tops, furniture, carpeting — are standard, commercially available items.

This is important, for we hope that others will install such high-level systems for experimentation and demonstration. In fact, we suggest you join the "400 Club." Qualifications? The installation of a comfortable 400-footcandle lighting system in an office where you can demonstrate the feasibility and advantages of high footcandle levels. This can be of considerable value to architects, engineers, contractors, and lighting users in planning new lighting systems. There will be such an office in the new Cleveland Electric Illuminating Company building now under construction. Because of its flexibility, due to the thyratron dimmers, it can be used to demonstrate various lighting levels, and will assuredly help to prove that, if they are visually comfortable, people like lighting levels much higher than those in common use today.



First trofferall system was installed in G. E. Lamp Division office at Boston. This supplies about 165 footcandles; employs low brightness lamps in non-louvered, single-lamp, etched aluminum units.