How to Conduct a Lighting Audit

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As designers, we often face situations where an existing lighting system must be made more efficient. The challenge is in trying to maintain, if not enhance, the quality of the lighting in these existing spaces while complying with stringent energy codes.

It is difficult to establish a strategy for meeting this challenge without extensively examining the existing lighting system beforehand. In fact, it is a big mistake to assume that simply adding more efficient lamps and ballasts to a room full of existing fixtures is the best way to save energy.

To help establish a strategy for planning retrofits, it helps to develop a simple lighting audit procedure. Audits help establish the condition of an existing lighting system and the architectural finishes of the space and assess the interaction between the lighting and the occupants. Most importantly, an audit provides benchmarks for determining how effective the lighting improvements will be during and after the completion of the design process.

Site Visit

A site visit to examine the specific characteristics of the existing lighting system is the keystone of the audit. Below are suggested steps to follow:

1. Note the age, condition, and quantity of the existing light fixtures. If there is no accurate reflected ceiling plan with dimensions, this is the time to make one.
2. Record the manufacturers and model numbers of the fixtures to help establish photometrics.
3. Record the wattage of the lamps, the ballast types, and model numbers.
4. Note the condition of the fixtures. Are the lenses yellowed or cracked? If so, they are probably at the end of their useful lives. Observe the painted surfaces. Are there burn marks or greasy smudges? Is there yellowing? Deterioration of the fixtures causes excessive loss of efficiency.
5. Ascertain the environmental conditions of the space for dirt depreciation. More dirt will accumulate in fixtures placed in a sandblasting shop, say, than in an office. This will aid in specifying an appropriate replacement fixture that will minimize future main tenance costs.
6. Note the activities of the end-users in the space. Pay particular attention to occupants' ages, and what type of work is being performed.
7. Observe and record how the lighting is switched, and establish whether there are any automated light ing controls or another type of lighting control system.
8. Check all work surfaces with a light meter to establish existing lighting levels. Note the coloration and reflectances of the walls, floors, and ceiling in the space, and establish all other calculation criteria for the space. This will facilitate the use of lumen method and point-by-point calculations for the replacement lighting system.

Reverse Engineering

Once all of this basic information has been recorded and digested, one can begin to make some useful conclusions about the current lighting system.

- Look at the original intent of the space and the related costs of operating the lighting system installed there. Does the existing system still provide an appropriate level of light for the space as it is now used? Are energy and maintenance costs in line with this use?
- Run some rough lumen method or point-by-point calculations to establish the illumination levels the original lighting system was designed to produce. Compare them to the light meter readings. This will give a good idea of how much the current system has deteriorated.
- Establish the existing lighting power density. How efficient is the existing lighting system in terms of watts per square foot? How efficient is it in terms of the amount of light actually available at the work surface?

This information gives us a basis for deciding how to improve the lighting system's efficiency and also helps justify improvements regarding aesthetics, ergonomics, and the cost of maintaining and operating the new lighting system.

A Hypothetical Problem

Imagine an insurance form processing center located in a high-rise office building. Originally an open office, it has now been subdivided by seven-foot high partitions into 8'x10' cubicles. The walls bear 10-year-old paint, the ceilings are stained, and the vinyl floor tile has not been maintained.

The lighting system in this space is a virtual sea of fixtures, all in terrible condition. The lenses are yellowed and caked with dust. The ballasts are old, core-and-coil types.

The light meter reads an average of 65 footcandles at the work surface. By looking up the photometric data of the fixture, and making some assumptions about the reflectances of the walls, floor, and ceiling, it can be calculated that the system was originally designed to produce 110 footcandles at the work surface. The unit power density is 3.5 watts per square foot.

Although the occupants feel the lighting level is adequate, the facility owners are paying more for light—almost double the amount—than they're actually getting. Apparently, there is room for some improvements here.

Now that it is known how inefficient the existing lighting system is, we can establish energy savings and ergonomics goals by looking at two numbers: unit power densities and recommended illumination levels.

On any project, the first step is to examine local energy codes to establish a maximum allowable unit power density. Generally, it is a good idea to try to use an even lower unit power density than this—the incremental cost can easily be justified by the extra energy savings, and utility company rebates can often help further offset any additional cost.

Next, consult the reference lighting handbook of your choice to determine what lighting levels are suitable for your project. Remember that the quality of the luminous environment is more important than providing a high quantity of light—in many cases buildings are overlit, and less light will result in better vision.

When comparing energy saving strategies, always compare the costs for both a system retrofit and a complete system replacement.

Two Hypothetical Solutions

Solution 1
Complete Re-Design

In this scenario, the lighting system is redesigned from scratch. The lighting level is decreased from 110 footcandles to 65 footcandles by using fewer, more efficient fixtures with high efficiency components. This also reduces the connected unit power density to about 1.2 watts per square foot. Additional energy savings are realized through the addition of a relatively sophisticated control system.

The lighting fixtures might include parabolic troffers with energy saving color-corrected fluorescent lamps (3,000K to 3,500K) and electronic ballasts. The control system might have pre-programmed occupancy scheduling, with telephone actuated after-hours override. The wiring to the fixtures could be split to allow one or two lamps to be dropped out after hours to correspond with building maintenance or security activities.

To make the most of the improved lighting system, the entire room would be refinished with new materials with better reflectance values.

Solution 2
Retrofit

In this scenario, the lighting system is remodeled, eliminating the cost of wiring new circuits and hanging new fixtures. The lighting level is lowered from 110 to 65 footcandles by eliminating lamps and adding reflectors, new aluminum parabolic louvered door assemblies, electronic ballasts, and energy-efficient lamps. The connected unit power density remains slightly higher, at 1.5 watts per square foot, because fewer fixtures could be eliminated than in the first solution. Time clock activated occupancy sensors help save additional energy, although they are not as effective as the control strategy in the first scenario.

Take No Chances

Changing a facility's lighting system to meet today's energy guidelines without losing quality doesn't happen by chance. Even a thorough, well-intended retrofit using all the right tools to reduce energy can still be wasteful if lighting levels remain too high. Conversely, a retrofit that neglects the needs of the users can drastically cut visual comfort and productivity—and that gives energy conservation a bad name. A well-planned and thorough audit procedure helps establish a basis for improving energy efficiency without leaving users in the dark. ·