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The Lighting Balancing Act for Laboratories

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Light—it's the difference between a bright and airy space and a shadowy, dull, and uninviting work environment. In designing modern criminal laboratories, one issue to be solved is providing adequate lighting so that scientists can perform the very intricate tasks at hand while adhering to the energy usage codes. Today's energy codes regulate more than just the building lighting and the

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illumination levels but also the entire building and its total energy consumption. A major contributing factor to the energy consumed in a facility is that of lighting.

Lighting fixtures can take on many different styles and looks. The basic overhead general illumination approach would provide the space with an even ambient light source for general tasks. This overhead lighting method can have different styles and mounting variations to achieve this goal. One of the more classic approaches to this type of installation would be the recessed fluorescent fixtures seen in many standard office environments. A second option would be the pendant mounted (or suspended) fixture throwing light up at the ceiling and down on the work benches (or direct-indirect method). This is the option preferred in most laboratory environments because it produces an even and uniform illumination and provides the least amount of shadowing and glare at bench level. When successfully employed, both of these strategies can produce the necessary amount of light for laboratory functions.

To determine the amount of light needed in a space, designers turn to the standards developed by the Illuminating Engineering Society (IES). The level of brightness, measured in footcandles, recommended by the IES is a minimum of 50 footcandles for laboratories, with many laboratory designs targeting a range of 50–70 footcandles. Occasionally, some task areas may require higher light levels for specific examination functions. Producing this much light can use a high amount of energy. Therefore, the lighting level must be tempered with an understanding of the energy codes.

In the United States, the predominant code relating to commercial energy use is ASHRAE 90.1. Part of this standard includes limits on how much energy a building can use for lighting. These limits are based on the tasks performed in the room and the area of said room. Updated versions of ASHRAE 90.1 are published periodically, and each new version pushes the envelope requiring greater energy savings than the previous version. For example, between 1989 and 2010, the allowed energy for lighting laboratories decreased by 22%. While the energy allowed for laboratories has decreased, the lighting levels required by users have not decreased by the same proportion. This places designers in a position of having to produce the same amount of light with significantly less energy.

To compensate for the lower energy levels required by code, task lighting has become an essential part of laboratory lighting. Plug-in task lighting solutions work best for the allowable energy used as well as the portability aspects of the light fixture and where it is needed. Similarly, a task oriented lighting approach can be used, placing permanent recessed or suspended lights over workbenches and exam tables in order to provide the high lighting levels right where they are needed, and then having supplemental lower levels of lighting for the rest of the room.

The advent of new technologies also assists with lowering energy use while maintaining the high light levels required in laboratories. The use of high efficiency fluorescent lamps (such as T5 lamps) and LED (light emitting diode) type lighting has taken hold and is used extensively throughout the industry. New more efficient lighting fixtures also provide huge benefits, as newer volumetric light fixtures operate around 90% efficiency compared to older parabolic fixtures that were only 75% efficient. These technologies by themselves are not a silver bullet for saving energy; the proper application and design with these technologies are required.

Looking at various methods and styles of lighting fixtures and lamp sources are just some of the factors that have to be considered. To produce an effective means of providing the required luminance for a particular work task, the overall area conditions are important elements to consider. These include color, room layout, and natural light.

One critical point that sometimes gets overlooked or not treated with importance is room color. Room color in general would include the bench tops, counter tops, cabinetry, flooring, walls, and ceiling. Failing to use these factors in the room design could be the difference between a bright and airy space and a shadowy, dull, and uninviting work environment. Lighter colors work best for maximum reflectance characteristics and an overall brighter space.

Natural light is another key consideration for lighting the lab space. Using natural light in combination with artificial light can reduce the overall energy in the space. Using light level sensors (photocells) mounted at or near the exterior windows provides a control source to activate or de-activate selected lamps in adjacent fixtures as the light levels from natural light

levels fluctuate. This type of automatic control, based on available natural lighting, is in the process of becoming a mandatory requirement. Rooms with windows are now required to have lights near the windows automatically controlled so that the lights in the room shut off or dim when there is sufficient natural light. For a room with a 10-foot ceiling, this area could extend as far as 20 feet into the room. Employing a system that just shuts off the lights can be rather noticeable to users as the lights suddenly shut off or turn on depending on the natural lighting. Systems that dim the lights are more fluid, as they gradually adjust the lights over the course of the day.

Another key component in meeting today's energy codes is the proper use of automated lighting controls. Present energy codes do not allow lights in a building to be left on all day and night; there must be some level of automated controls to turn the lights off when not in use. This is typically accomplished by either motion sensors in the room or by a building wide lighting control system that operates the lights based on a programmed schedule. Motion sensors can be programmed in two different ways. When set as an Occupancy Sensor, they can turn on the lights when someone enters the room and then shuts off the lights after a preset amount of time without motion; a good application for this type of sensor would be in a restroom. When set as a Vacancy sensor, the user must manually turn the lights on (via a switch or button) and then the sensor turns the lights off after a present amount of time without motion; a good application for this type of sensor would be an office with a window, since there could be sufficient natural light in the room to not require the lights to be on.

It is the responsibility of the designer and engineer to meet the requirements of the user, as well as meeting the energy codes and provide adequate lighting in the space. Helping the designer to understand the tasks being performed in the lab and understanding how the laboratory will be used allows the designer to provide a design that is optimized for both the user and the energy codes. Understanding the process and the options available can better help the end user understand why the lighting design was selected as well as understanding how it functions.

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