WOMEN'S OCCUPATIONAL HEALTH RESOURCE CENTER

Good Lighting for the Good Workplace

Most workers choose lighting as the most important aspect of their work environment.

In a recent survey, 900 office workers chose lighting as the most important aspect of their work environment. Most of us would concur. Eighty-five percent of the information we receive from our surroundings is perceived through the eyes. Lighting affects our comfort, efficiency, safety, and even our mood.

Just as an overcast day has an effect on how we feel and respond, so too do dimly lighted areas, areas with large differences in brightness levels, and even very bright rooms.

The best lighting system is one in which the lighting level is geared to the task, the brightness ratios are controlled, the colors and reflectances of ceilings, walls, and floor are carefully chosen, and the people in the room are unaware of the lighting system because everything is "just right."

What affects visibility

There are four fundamental factors in visibility: time, size, contrast, and brightness.

Time is particularly important when working with moving equipment. A machine operator must see quickly. There is no way that she can stop her machinery to get a longer look. So the lighting must be adequate for quick, accurate visibility.

Size comes to the fore when working with small parts. Light must be adequate to see details.

Contrast between the task and its background is critical. One of the hardest known seeing tasks is sewing black fabric with black thread.

Brightness is the most controllable factor in visibility. By putting more light on a task we raise its brightness and thus can increase its visibility in spite of its small size, poor contrast, or lack of time to see well.

How much light people need

Laboratory research has been done on exactly how much light people need under certain conditions. Using this data, the Illuminating Engineering Society has published tables of lighting levels for most major seeing tasks.

However, one does not have to be an illuminating engineer to ascertain the light in a particular workplace. For anyone interested in quick, easy readings, pocket-type meters are available in the $35 price range. The meter should be placed on the surface being measured.

More expensive, low-range meters can be used to read some of the OSHA minimums on steps, stairs, passageways, and in the outdoors.

Older workers

Characteristics of individual workers must also be taken into account in choosing lighting levels. Older workers, in particular, require more light. The amount of light reaching the retina decreases with age. Age also makes us less resistant to glare.

The unit used to measure light falling on a task is a footcandle. In one study, a young age group could perform at 70 units of light, or footcandles. The 36- to 45-year-old group, to perform equally well, needed 100 footcandles, and those 56 to 65 needed twice that.

Shadows and glares

Footcandles alone, however, are not sufficient measure of illumination. Distribution of the light is also important. Lighting that may have been perfectly adequate when first installed can fail if

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Good diffuse lighting overhead combined with direct light on the task makes for an ideal lighting situation.

stacks of work material pile up and cut off its source from the worker, or if new equipment is moved into place and interferes with its beams.

A good way to avoid shadows is to have light come from many, rather than only one direction. This is called diffusion. Lighting directly on work areas combined with diffuse background lighting is generally most desirable. Diffusion can be accomplished through fluorescent lighting, the use of multiple lighting sources, and by utilizing walls, ceilings, and even floors as reflecting surfaces.

In cases where shadows are desirable to facilitate depth perception and the viewing of small details, they may be provided by supplementary lighting.

Glare results from light in the wrong place. It can make seeing difficult, cause eye strain and fatigue, hinder productivity, and be a cause of accidents.

Glaring, uncontrolled light in corridors or on steps can be particularly dangerous. Thus, measurements in stairway areas should include not only the number of footcandles but some subjective appraisal to determine if the brightness causes seeing problems.

Glare can be controlled by decreasing excessive brightnesses. Shielding of light sources is important. Windows should have shades or blinds. Lighting equipment should be mounted so that light illuminates the work rather than shines into the worker's eyes.

If work areas must be brightly lit, workers should be situated so that the bright lights do not intrude upon their angle of vision. Shields in front of lights can help to accomplish this. A shield to an angle of 45 degrees is ideal.

Glare also results from reflections into the eyes from shiny surfaces. This can be a problem in many industrial operations, and can be dangerous if moving machinery is involved.

Because of glare, the Illuminating Engineering Society also specifies reflectance factors of walls, floors, and ceilings. Light-colored, matte finishes are recommended. They also serve to reduce harsh contrast between bright fixtures and dark backgrounds, and make the lighting system more efficient by increasing the amount of useable light.

Fatigue

Research in vision laboratories has shown that it does take energy to see. That is why poor lighting results in a feeling of weariness and eyestrain. Other symptoms of struggling to see may be irritation, watering and reddening of the eyelids, double vision, headache, decrease in the power to focus, as well as in visual acuity, contrast sensitivity, and speed of perception.

All of these can certainly lead to an increase in accidents.

Safety

One study found that poor lighting was the sole cause of 5 percent of industrial accidents, and that in 20 percent, poor illumination and eye fatigue were a factor. In one large forge shop, a lighting increase from 15 to 150 footcandles was accompanied by a 24.8 percent reduction in industrial accidents.

Lighting for safety also includes proper illumination of stairways, corridors, and hallways so that employees are safe from assault or attack.

Still another factor to be considered is the stroboscopic effect—the flickering effect that may result from fluorescent or other high intensity lighting which operates in cycles, actually going on and off 120 times a second. This can, in some cases, make moving machinery seem to be standing still. Although not a common complaint, it can be solved by three-phase wiring and alternate fixtures on different phases. Overlapping the lighting will neutralize the strobe effect.

When identifying colors are relevant to safety, lighting may also be a factor. Tests have shown that when workers are accustomed to a given light source they have no difficulty recognizing standard safety colors down to as low as 5 footcandles. The current OSHA recommendation of ½ footcandle for safety lighting in active areas may have to be reconsidered because of such test data.

For minimum safety light levels, see the 1973 Life Safety Code, Occupational Safety and Health Act, the National Electrical Code of the National Fire Protection Association, and the Federal Construction Industry Safety Act.

Maintenance

No matter how good a lighting system is when new, it may well fall below par if it is not properly maintained. Lamps themselves depreciate in light output over time; dirt accumulates on fixtures, lamps, and room surfaces; and burnouts occur. A good cleaning and maintenance program is essential.

A lighting checklist

The following questions can help you evaluate the adequacy of the lighting in your work area. Compare your answers with the ideal lighting conditions described in the above article.

- What is the main source of lighting in your workplace? Daylight, fluorescent, or incandescent (lightbulbs)?
- Do you have supplemental lighting at your work area?
- Can you adjust the lighting in your work area?
- Does the lighting in your work area create glare that makes it difficult to see or perform your work?
- Does the lighting in your work area produce shadows which interfere with your work?
- How far away is the window nearest to your desk?
- Is the level of lighting in your office: too high, too low, about right?
- Do you feel you must strain to see your work clearly? Do you bend over work, squint, bring work close to your eyes?
- Does lighting in your work area have an effect on your work performance? □

Light-colored, matte-finished surfaces in this hospital minimize glare.