THE PROBLEM OF GLARE IN LUMINAIRES

One of the most important characteristics of any lighting fixture is whether it produces undesirable glare (either directly or indirectly), since glare will have an effect on how well people can work in a space and how comfortable they feel.

When our eyes look at a task, they adapt to the brightness or luminance of that area. As our eyes leave the task and look at an area of different luminance, there is a sudden loss in the eye's ability to see contrast details in the new area until the eye can adapt to the new light levels. To minimize the effort and eye fatigue, brightness of luminance ratios between the task and the immediate surroundings should be kept within a 3 to 1 ratio.

Glare can be described as any unwanted or undesirable brightness variations. The Illuminating Engineering Society of North America (IES) defines glare as "the sensation produced by luminance (brightness) within the visual field that is sufficiently greater than the luminance to which the eyes are adapted to cause annoyance. discomfort, or loss in visual performance and visibility."

Various forms of glare are further defined by the IES.

Blinding glare is so intense that for an appreciable length of time no object can be seen.

Direct glare is produced by poorly shielded luminaires, bright windows, or from reflecting areas of high luminance, such as a ceiling plane receiving the light output from an indirect luminaire that is only a few feet below the ceiling.

Disabling glare causes a reduction in visual performance.

Veiling glare is a disabling glare caused by extreme contrast within a task that prevents the viewer from properly seeing the task: for example, the reflection on a printed page made of coated paper. Someone looking down at the paper will have brightness reflecting from the glossy surface. Such veiling reflections on the paper surface cause loss of visibility.

Discomfort glare is an annoyance that does not necessarily prevent accurate seeing of a task but could affect a person's performance over a period of time by causing eye fatigue.

Reflected glare comes from reflections off highly polished or specular materials that can be viewed by an occupant.

The degree to which glare is a problem in a lighting system depends on many factors: the length of time that the high luminance has to be tolerated, the luminous ratios between the glare source and the surroundings in the major portion of the field of view, the task involved, and the position of the light source causing the high brightness.

The discomfort that a person experiences from a fixture producing too much direct (source) glare might be a sensation of excessive brightness, but the response might be expressed as a complaint of too much light.

FLAT FLUORESCENT LENSES

The plastic or glass flat lenses used for lighting fixtures are categorized as either diffusers or refractors. Various types are available.

- Diffuser lenses will break up the direction of light rays from the lamps and hide or mask the lamp image without providing any precise control of the emitted light rays. This is accomplished either by the use of embedded opaque particles in the lens or by having a rough surface on one or both sides of the lens.
- Clear refractor lenses provide precise distribution of light output through the use of prisms and other shapes that redirect light rays towards specific angles. Conical and pyramid prismatic refractors with either raised (male) and recessed (female) prisms are available in various sizes.

Plastic lenses are available in acrylic, high-impact acrylic, polycarbonate and polystyrene. The most popular fluorescent troffer lens is a 0.125-in. acrylic plastic panel, with female prisms on the bottom surface. However, in hosedown, sanitation areas, prisms can be on the inside surface for improved cleanability. Efficiency may be reduced.

While a polystyrene lens is the least expensive material it will yellow within two to three years because of oxygen cross-linking of the polymers. Aging also increases brittleness of the polystyrene lens.

- Pigmented refractive lenses have colloidal opaque particles suspended in the plastic. A tinted prismatic lens can achieve a greater reduction in direct glare, surface brightness, and lamp obscuration, as compared with a clear lens of the same type, but is less efficient.
- Hemispherical refractor lenses consist of a pattern of constant radius curved surfaces on the bottom, while the top side (towards the lamp compartment) consists of matching concave surfaces. Providing low brightness, this lens pattern is considered as a substitute for the use of parabolic wedge-shaped louvers and has the advantage of being easier to clean. With the refractor lens, lamp image is obscured at normal viewing angles but the lamps are plainly visible from directly below the fixture. An optical interface can be used to obscure the lamp image from directly below.

Because the refractive grid lens with an optional optical interface increases the VCP up to the 80% range, it is an ideal solution for rooms with computer screens. The disability glare caused by direct glare and the veiling reflections caused by indirect glare are decreased. Compared to the use of a tinted lens, the refractive grid lens is more efficient; thus, a lighting layout would generally require fewer fixtures and consume less energy for a given illumination level.

CURVED FLUORESCENT LENSES

A batwing distribution refractor lens directs most of the light in particular zones. This type of lens is most useful when the fixtures are mounted in parallel rows adjacent to desks, so that the occupant does not view the fixture lens crosswise. Prismatic flat lens designs also offer the same type of batwing distribution.

A *wrap-around refractor lens* has a linear prism pattern along the sides to bend light rays downward and upward, thereby minimizing lumen output in the 45° zone. The upward component of light adds luminance to the ceiling and thus reduces the brightness contrast between the luminaire and the ceiling plane.

Overhead ambient lighting fixtures, producing direct light distribution by means of lenses or louvers, achieve the highest conventional footcandles of illumination for lowest levels of energy consumed. But the selection of light control media as part of the fixtures involves many criteria, including their relative cost, which must be considered.

SQUARE LIGHT DISTRIBUTION LENSES

One of the most innovative concepts in lens design for use with point sources (H.I.D. and incandescent) is that of square light distribution. This term identifies a light pattern that traces squares of equal footcandle lines on the floor (or work plane around a center directly beneath the fixture. But it is the logical need for such a light pattern that must be appreciated, and will now be outlined.

1. Lighting fixtures are always layed out in a natural grid pattern of equal center spacing laterally and longitudinally, so the obvious ideal light distribution would be a square. Such a pattern would always allow for full coverage of the work plane at any point in the grid layout — even on the diagonal lines of the grid. It's like laying floor tile — any shape other than a square would create jigsaw puzzle-like problems to the installer.
2. The natural shape of the light pattern from point source fixtures using reflectors and prismatic lenses for glare control is a cone which produces circles of equal footcandle lines on the work plane. And this is true whether the lens is of the Freznel type or the regular array of identical prisms. So full light coverage of the work plane requires spacing fixtures closer together and allowing for overlap of the light circles, and increases the number of fixtures required.

The above factors clearly indicate the value of square light distribution for economical lighting systems. GUTH offers square light distribution lenses on the Squarelume (pages F12 and H3.)

SPECIAL LENSES/HARDWARE

Hospital surgery suites and intensive care rooms use radio- frequency interference (RFI) shielded, general illumination, fluorescent troffers. A thin silver-based coating applied directly to the lens or diffuser in a screen or cross-hatch pattern, provides maximum shielding of any RFI generated in the lighting circuit or ballast, with only a minimum reduction in light transmission. This silver RFI coating must be grounded.

RFI shielded general room illumination fluorescent troffers are also required in hospital and research facilities where sensitive electronic equipment is used.

Cleanroom environments require lenses or diffusers that are sealed in the troffer frame. The gasketed frame, generally has captive stainless-steel frame. retaining screws for this purpose. Cleanrooms, which receive complete washdowns periodically should have troffers that are UL-listed for wet locations.