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Glaring Issues with LED

The Eneref Institute reports on ways of minimizing glare by use of reflectors

We've come a long way since the days when LEDs were used almost exclusively in handheld calculators. Today's LEDs are powerful light sources that often use lenses to protect us from glare. But lenses are inherently inefficient as a solution for controlling glare.

Will the growth of LEDs, a point source of light, pose a visual disruption in many commercial spaces—where, a recent survey by Eneref Institute, found proper lighting design is ignored in well over 60% of commercial retrofits? And will an aging population, more sensitive to glare, find spaces lit with poorly-designed LED luminaires, especially challenging? Is there a better solution for controlling glare from increasingly powerful LEDs than with increasingly diffuse lenses?

The solution to glare may come in the form of reflectors designed to shield us from the LED light source. Well-designed reflector systems made from highly reflective materials have the potential to offer greater light output ratios (LOR) than a typical lens system while reducing or eliminating glare. Lenses, on the other hand, by their very nature reduce light output.

The reflector market has made significant advances in materials and design. For example, Alanod Aluminum's Miro optical material (alanod.com) has found its way into many advanced luminaire designs beyond simple linear fixtures explains George Dieckmann of OEM Lighting Sales, a leading supplier of lighting controls and highly reflective optical materials.

More and more luminaire designers are developing segmented reflectors to optimize efficiency. And for years, HID reflectors have taken advantage of segmented optics and increased light output ratio (LOR) to nearly 90%. Can the next generation of LEDs take advantage of what we have learned about reflectors in fluorescent and HID systems?

In typical HID outdoor lighting system, light distribution, glare control and system efficiency are determined by reflector design and reflector materials. The luminance of the HID lamp is hidden within the luminaire and the light is distributed over a wider area. In this case, light loss is dependent on the reflector.

In many of today's LED outdoor lighting systems, the quality of the lens determines light distribution and efficiency. Preventing glare while at the same time maximize lumens per watt is challenging. And since the light is beamed in one direction, it creates unwanted high luminance spots.

Certainly lenses can reduce glare, however they do so at a cost – reducing light output anywhere from 10 to 30 percent depending on various factors. Lenses are therefore a balance between efficiency and visual comfort: between high transmission rates and reduced glare.

And lenses can increase maintenance. For one thing, lenses are unlikely to hide the appearance of a single LED failure, necessitating replacements. And as lenses age they tend to grow more opaque, losing transparency, and thereby reducing illuminance.

While lenses can offer a cost-efficient solution to glare, their low average efficiency remains a disadvantage. Beyond reduced illuminance, lenses can also add to thermal resistance, chromatic aberration and aging. Glass lenses avoid some of these downsides, but at higher development and production costs.

One solution we will begin to see more often is to shield the view of the light source with a reflector by pointing the LEDs directly into a reflective material and bouncing the lumens off. Not only does this solution hide the LEDs glare, but a material that is somewhat specular could also control the photometric distribution – spreading or focusing the beam as needed for the task.

With a highly reflective material such as Alanod's 98% reflectance MIRO-SILVER, for example, the light output ratio could potentially be much greater than with a typical lens solution. However, this solution assumes the reflector is designed with a minimal number of bounces – or reflections – and the reflector design takes advantage of the light controlled offered by the material. With diffuse white-painted reflectors, distribution control is essentially lost; and placing light on

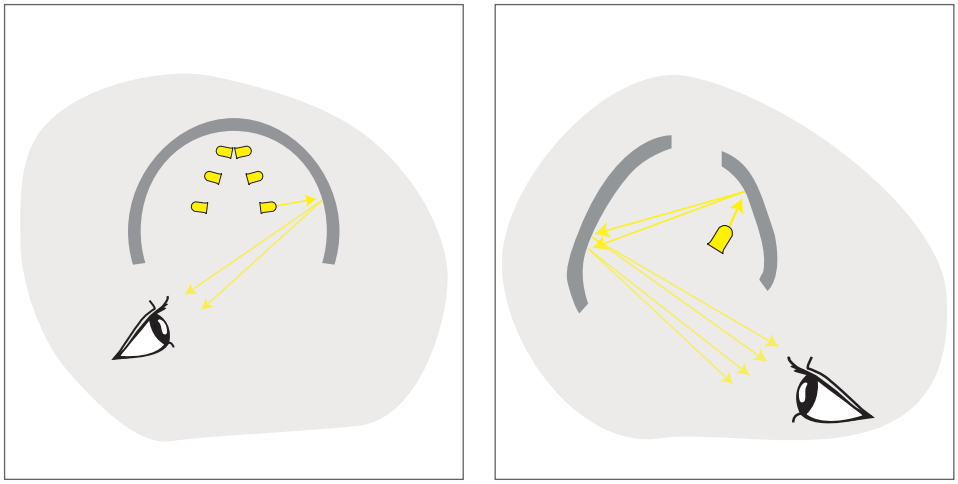
surfaces where light is unwanted or not needed, can be a waste of energy.

Controlling the LED light distribution with a second reflector component part opens the door to some innovative luminaire design options. The first reflector would hide a direct view of the LEDs, and direct the light into a second reflector, which controls light distribution. With a second reflector the distri bution can be increased. Or different surfaces can be mixed.

And as LED modules systems become common, standardization offers opportunities to combine the LED modules with a variety of reflectors; where the same LED modules can be combined with different reflector systems to tailor light distribution to a specific application. In such a case, only the light source would need to change, not the complete optical system.

Modularity will offer other advantages as LEDs become more prevalent. Electronic component parts can fail. Modularity may help reduce maintenance costs. Interchangeable systems should reduce production costs for luminaire manufacturers while at the same time increase the number of light distribution variations. As raw materials grow in cost, replacing modules will not only become more cost effective, but will reduce material waste. And modular systems will offer easier or greater supplier options.

As LEDs grow more common in workplaces and retail environments, will the new luminaires introduce more glare along with new opportunities? Not likely when lighting professionals are involved the decision-making process. However, as Eneref Institute discovered in our recent survey, most commercial retrofit projects are completed without the help of a lighting professional.



The reflector system shields a direct view of the LED point source

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This article is an excerpt of the future Eneref report which assesses the impediments to building zero-energy urban communities in the U.S. A companion film documentary, The Eneref Project, will seek to demonstrate to key decision-makers how zero -energy communities can be commercially viable.