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Pedestrian-Friendly Outdoor Lighting

Outdoor lighting is important to the safety of nighttime travel along streets and roadways, in parking lots, at building entrances, in parks and entertainment venues, and along pedestrian pathways. Conventional lighting design has rightly focused on visibility, as well as on such factors as illuminance/luminance on the pavement, uniformity, and vertical illuminance on faces and targets. This approach works pretty well for motor-vehicle drivers, but what about pedestrians?

In recognition of the fact that pedestrian lighting has its own set of criteria, a new GATEWAY report, Pedestrian Friendly Outdoor Lighting, follows two pedestrian-scale lighting projects that required multiple mockups – one at Stanford University in California and the other at Chautauqua Institution in upstate New York – to gain insight into what those criteria might be, how they differ from street and area lighting applications, and how solid-state lighting can be better applied in pedestrian applications.

The report is based on formal and informal surveys and observations from neighborhood residents and pedestrians, feedback from experienced facility design and engineering professionals, personal observations and discussions of lighting designers and engineers, and input from researchers and scientists. The results are not meant to present a solution for nighttime pedestrian lighting for all neighborhoods and campuses, but to encourage informed discussion among lighting specialists, researchers, and luminaire manufacturers who recognize that good lighting must satisfy human needs that are still difficult to quantify.
Users at both sites felt the daytime appearance of the luminaire was important and considered glare a key factor in luminaire acceptability. They showed a preference for luminaires that produced a soft-edged pattern of light, as well for light with a warm color (in the correlated color temperature \([\text{CCT}]\) range of 2700K-3000K) – not surprising, given that they were used to either incandescent or high-pressure sodium (HPS) sources. Horizontal illuminances could be at the low end of Illuminating Engineering Society (IES)-recommended levels, provided that glare was reduced.

Diffusion was an important characteristic of optical systems deemed less glaring. LEDs and clear metal halide arc tubes exhibit high variation of luminance across the luminaire's face, but diffusion from frosted refractors and flat glass panels was judged as less glaring, even when measured spot luminances were high. Smoothing out the luminance transition from high to low resulted in responses of greater visual comfort, even though glare metrics don't take this into account.

Although the "glare" angles of outdoor luminaires have traditionally been considered to be between 75° and 90° from nadir, the results of the study suggest that while pedestrians may be affected by glare from these angles when at some distance from a post-top luminaire, they're even more affected at shorter distances when the luminaires are within or even above the field of view. This may be related to the phenomenon of overhead glare in interior applications, or it may be due to pedestrians naturally glancing around them as they walk and thus putting the luminaire into view as they look upward.

No two outdoor lighting projects are exactly the same, and there are bound to be tradeoffs between such factors as efficacy, visibility, color, and visual comfort. Because there isn't a reliable glare metric for pedestrian lighting, full-scale mockups can be valuable in getting user feedback. Not every neighborhood is suited for pedestrian-friendly approaches, but for those neighborhoods that are, the following may be helpful:

- If luminaire brightness can be controlled, lower lumen outputs, and illuminances at the lower end of IES recommendations, may be acceptable and even preferred.
- The perception of glare may be reduced by using luminaires that spread luminance over a larger luminous area rather than using those that feature arrays of exposed LEDs.
- A lighted environment that's softer and more visually comfortable may be achieved by using luminaires with less optical punch and less sharp angular variation in candlepower.
- Older, more traditional-looking neighborhoods – especially those that have been using HPS or incandescent outdoor lighting – may be well-served by luminaires that deliver warmer-color light (usually lower than 4000K \([\text{CCT}]\), and often below 3000K).

The problems of pedestrian lighting occur with all technologies, but LEDs offer the industry unique optical options and opportunities. The new report is meant to stimulate discussion among specifiers, users, energy specialists, and industry in hopes that new approaches, metrics, and standards can be
developed to support pedestrian-focused communities, while reducing energy use. It’s available at [www.ssl.energy.gov/gatewaydemos_results.html](http://www.ssl.energy.gov/gatewaydemos_results.html), and a related webinar is also available.

As always, if you have questions or comments, you can reach us at postings@akoyaonline.com.