TIP 329: Demonstration of Outdoor Lighting for Maximizing Perceptions of Safety and Security

Context

At present, specifications for outdoor lighting in parking lots and along streets and roadways are based on conventional photopic photometric quantities, but many visual responses relevant to outdoor lighting are not well-characterized by photopic quantities. This means more lighting energy may be used than necessary in order to achieve the objectives of outdoor lighting.

With a proper characterization of the perceptual benefits of lighting, lighting energy used for outdoor lighting could be reduced by 40% to 50% when light sources that are better tuned to human visual responses are used.

Description

Working with project partners from the Seattle Lighting Design Laboratory (LDL), the Lighting Research Center (LRC) identified a suitable outdoor lighting installation in a parking lot and conducted evaluations of energy and power use. Visual responses of people in and approaching the outdoor location were characterized, and subjective ratings were developed of safety and personal security while viewing and occupying the location. The design of the lighting installation used research on the spectral sensitivity of the human visual system for scene brightness perception[i] and on the relationships between scene brightness and perceptions of safety and security[ii] previously published by the LRC.

The project team developed a lighting design procedure for outdoor locations such as parking lots based on brightness perception and sensations of safety and personal security of occupants; documented energy savings and power reductions from designing outdoor lighting based on perceptions of brightness, safety and personal security; measured visual function of occupants in a real-world outdoor lighting installation based on brightness, safety and security perceptions, and on a variety of relevant visual tasks; identified individuals' sensations of brightness and ratings of safety and personal security when approaching and when within an outdoor lighting installation, compared to those under conventional outdoor lighting; and identified opportunities for energy, cost, and greenhouse gas emission reductions from widespread use of the outdoor lighting design procedure based on perceptions of brightness, safety and personal security, compared to conventional lighting design methods.

Benefits

The project extends the potential for reduced energy use in nighttime outdoor lighting in many locations. Of the 118 TWh used annually for outdoor lighting sources (Navigant, 2012, *U.S. 2010 Lighting Market Characterization*), an estimated 2.5 TWh/year are used by public utilities within BPA's service territory. As incumbent technologies are replaced by LED lights, energy savings are being realized of 50% to 80% with conventional design practices. Assuming that 50% of the lighting in outdoor locations is related to providing and maintaining perceptions of safety and security, and that the proposed lighting approach could yield additional energy reductions of 50% versus conventional illumination practices, energy savings of 90% or more may be achievable in some locations.

Accomplishments

The study built upon previous research findings to provide a firm basis for practical lighting design practice that incorporates the research into recognized best practices for outdoor lighting.

Deliverables

Published article serves as the final report (see References below). The article includes:

- Documentation of the light levels at the comparison and test outdoor locations to be used for the demonstration.
- Description of the measurement methodology and survey questionnaire instruments used to conduct the evaluations.
- Guidelines for lighting specifiers describing how brightness, safety and security perceptions can be integrated into outdoor lighting practice.

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Project End Date: September 30, 2015

Funding

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References

This published article is the final report for TIP 329.

Parking lot lighting based upon predictions of scene brightness and personal safety

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End notes

[i] **Toward a model of outdoor lighting scene brightness,** Rea, M. S., L. C. Radetsky and J. D. Bullough, 2011, Lighting Research and Technology 43(1): 7-30. http://lrt.sagepub.com/content/43/1/7.abstract

[ii] **Several views of metal halide and high-pressure sodium lighting for outdoor applications,** Rea, M.S., Bullough J.D., Akashi, Y., 2009, Lighting Research and Technology, Vol. 41(4): 297-320 http://lrt.sagepub.com/content/41/4/297.short?rss=1&ssource=mfc