

Parking Lot Lighting with Improved Uniformity

Present practice for parking lot lighting design is based on recommendations for a minimum illuminance and a target maximum-to-minimum uniformity ratio. Although uniformity is referred to as an important design criterion, there is no documented reason for existing recommendations or understanding of the potential tradeoff between uniformity and light level.

Project Objectives and Demonstration Conditions

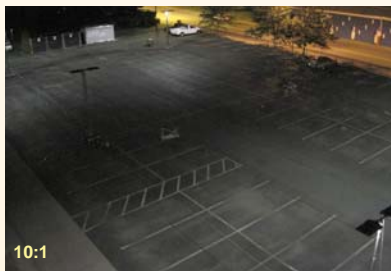
LRC researchers performed a demonstration in an urban parking lot to test the relationship between uniformity and occupant acceptance. The objectives included:

- Confirm the relationship between illuminance, uniformity and:
 - Perception of safety and security
 - Visibility
 - Energy efficiency
- Calculate the advantage LED luminaires offer at producing more uniform beam patterns compared with HID luminaires

A parking lot was illuminated with two uniformity conditions—10:1 (“standard”) and 3:1 (“improved”) maximum-to-minimum ratios—and six light levels (averages ranging from 2 lx to 60 lx). The installation consisted of six evenly spaced poles, each with two LED luminaires mounted back-to-back at a height of 18 ft. The LED luminaires had a Type V square distribution. Dimmers controlled the luminaires on each pole. By turning off the central poles, uniformity was reduced to the 10:1 ratio.



3:1
Demonstration parking lot with “improved” uniformity illuminance.



10:1
Demonstration parking lot with “standard” uniformity illuminance.

Publications

Narendran, N., J.P. Freyssinier, and Y. Zhu. In press. Energy and user acceptability benefits from improved illuminance uniformity of parking lot illumination. *Lighting Research and Technology*, first published on June 4, 2015 as doi:10.1177/1477153515587959

Field Test DELTA Snapshots: Benefits of Improved Uniformity with LED Parking Lot Lighting is available for free download from www.lrc.rpi.edu/programs/DELTA/pdf/FTDELTA_Snap_ParkingLotUniformity_July2015.pdf

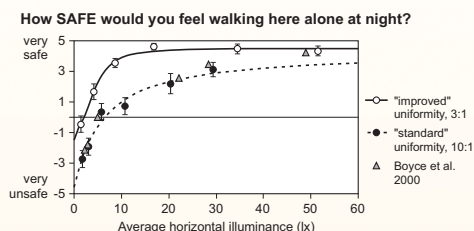
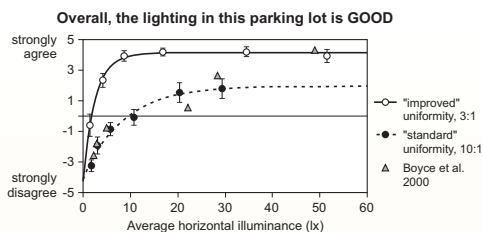


For more details, visit www.lrc.rpi.edu/programs/solidstate/parkingLotUniformity.asp



Results

The LRC surveyed 15 participants about the 12 lighting conditions after dark. The graphs show the responses to each of the conditions for two questions. These two questions are representative of other lighting quality questions in the survey.



Participants perceived the lighting as more “safe” and “good” at lower light levels when presented with improved uniformity compared with standard uniformity. Importantly, even when presented with the highest light levels, participants rated the standard uniformity as less acceptable than the improved uniformity conditions. The results were consistent with past research (Boyce 2000).

Implications for Practice

These results demonstrate that improved uniformity makes lighting parking lots to an average greater than 10 lx unnecessary and that it is possible to save energy (up to 75% in this demonstration) by providing better uniformity at a lower average light level. Because LEDs are small, they can be more effective at creating uniform distributions than HID sources. Computer

models showed that LEDs can not only provide better uniformity but can do so at twice the application efficacy.

Sponsors

New York State Energy Research and Development Authority (NYSERDA)
Alliance for Solid-State Illumination Systems and Technologies (ASSIST)

Equipment Donation

GE Lighting Solutions