Perceived Safety as a Function of Light Level, Uniformity, and Spectrum

Parking lot lighting must provide: (1) good visual performance for navigating and avoiding vehicle conflicts and tripping hazards and (2) a personal sense of safety and security for occupants, primarily related to detecting and identifying people, and judging their actions.

Visual performance is well described by the established Relative Visual Performance (RVP) metric. In contrast, the current understanding of the effects of lighting on perceptions of safety and security has been more piecemeal; previous studies by the LRC have related perceptions of safety to average illuminance, spectrum, and uniformity. The study used a laboratory parking lot mockup to create mathematical equations that predict brightness and safety perceptions based on all three of these variables:

\[
\text{Brightness} = 14.2 \log E + 6.73 \log C - 6 \log U - 21.6
\]

\[
\text{Safety} = 2.58 \log E + 0.778 \log C - 1.36 \log U - 3.49
\]

Where:

- \(E\) is average illuminance (lx)
- \(C\) is CCT (K)
- \(U\) is uniformity (max:min illuminance)

All three independent variables — average illuminance, spectrum, and uniformity — had statistically significant effects on the brightness and safety ratings. The study results also match those from previous LRC experiments that were conducted outdoors, showing that the participants judged the laboratory mockup similarly to how they would judge an actual outdoor parking lot. The results of this study can be used to design parking lot lighting to minimize energy use while providing a desired sense of safety for occupants.

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