Joint Transportation Research Program

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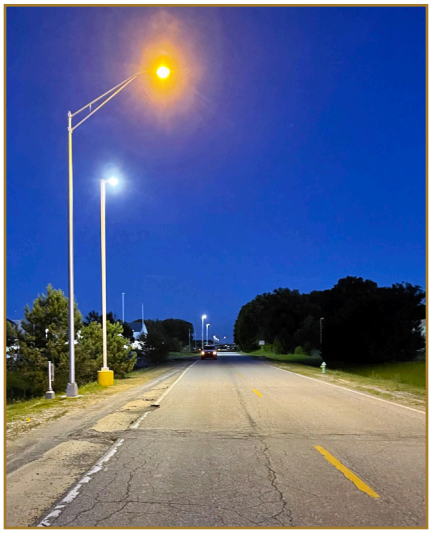
Highway Lighting Test Bed at INDOT Facility (Off-Roadway)

INTRODUCTION

According to the National Highway Traffic Safety Administration (NHTSA), in 2016 there were 7,277,000 vehicle crashes nationally. Approximately 70% of crashes occurred during the daytime and around 30% of crashes occurred during the nighttime. There were 11,375 nighttime fatal crashes that account for about 48% of total fatal crashes (23,714). Given the fact that only 25%–33% of the vehicle miles traveled (VMT) occur at night, the above statistics indicate that the nighttime crash fatality rate is much higher and nighttime crashes are often more severe compared to daytime crashes. Driving at nighttime is inherently demanding, but providing lighting on roadways is one of the proven safety countermeasures for preventing crashes and reducing fatalities. In particular, lighting at roadway intersections can reduce vehicle crashes by 10% to 26%. Improved visibility offered by new light source technologies can enhance drivers' ability to obtain information quickly.

Currently, to conduct lighting field testing, INDOT is using several in-service highways, intersections, interchanges, and rest areas. These locations require traffic control and lane closures, which raises safety concerns and causing inconvenience to the public. Traffic control and lane closures not only incur labor and operation costs, but also pose safety concerns to both motorists and INDOT personnel. In addition to the cost and safety concerns, during the evaluation period the new luminaires being tested actually functioned as lighting sources in place of the existing luminaires that were removed in order to install the new luminaires. This means that the new luminaries were used for roadway lighting in the test sites even before they were proven to meet



Lighting test bed in Indianapolis.

Lighting test bed in West Lafayette.

the roadway lighting requirements. To eliminate traffic control and potential safety concerns, it was proposed to create test beds for field evaluating and to verify the performance of new lighting technologies and luminaires in a controlled, standard setting. The test beds are needed in support of the formally adopted Indiana Test Method for approving luminaires. In addition, well designed and constructed test beds would make luminaire evaluations comprehensive and accurate according to operation conditions, such as weather (temperature and precipitation), on-off cycling, and maintenance. The primary objective of this study was to design, construct, and operate two test beds for INDOT to evaluate new and emerging luminaire models for roadway and underpass applications, according to the Indiana Test Method for approving luminaires.

FINDINGS

The following tasks were accomplished in this study.

- Identify the test bed functions according to INDOT's lighting design parameters and luminaire applications and select the sites to build the lighting test beds.
- Design the lighting test beds with a specified number of light poles, spacing between poles, and mounting heights of luminaires. This includes the number of foundations, wiring, conduits, and switches to control power to the poles. Different lighting pole configurations and lighting distribution types were considered in the design of the test beds to cover the most popular applications of roadway lighting.
- The test bed sites were selected in areas where the effects of adjacent lighting sources would be minimized.
- The lighting test beds were constructed at two select INDOT sites that were in accordance with INDOT's standards.
- Illuminance values of roadway luminaires were measured and analyzed after the construction of the lighting test beds.
- A remotely controlled cart and drone were used to automate the illuminance measurement process.
- A user friendly illuminance data repository was developed to store and display lighting testing data. The Building Information Modeling (BIM) and MicroStation platforms were applied to record and store the measured illuminance data.

IMPLEMENTATION

The following recommendations to implement the research results are provided.

- The constructed lighting test beds can be used as soon as needed to evaluate new lighting devices and luminaires that are submitted to INDOT for approval.
- The efficiency of illuminance measurement can be significantly increased by using remote-controlled electric carts and/or drones.
- It is recommended that a cart with sufficient power be used for illuminance measurement so that the cart is able to carry the illuminance meter forward smoothly during measurement.
- A drone should be used to analyze the vertical distribution of illuminance. A backup battery is needed for the drone to avoid unnecessary delays during illuminance measurement.
- The illuminance data repository model should be used for data input, storage, and analysis to further increase the productivity of illuminance measurement and evaluation.

Recommended Citation for Report

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