

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Examination of Lighting Practices at Crosswalks

START DATE: April 2023

REPORT DATE: January 2025

RESEARCH REPORT NUMBER: SPR-1744

PROJECT COST: \$170,000

COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

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Cost-effective solutions to enhance nighttime pedestrian safety

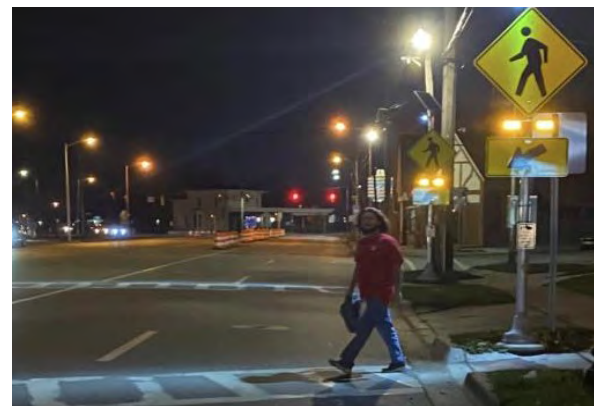
The majority of fatal and serious injury pedestrian crashes occur at night in locations where light is insufficient to ensure nonmotorized road users are visible. Since streetlights may not provide ample light for drivers to clearly see pedestrians, the Michigan Department of Transportation (MDOT) undertook research to better understand the relationship between light levels and pedestrian crashes, test crosswalk treatment lighting strategies and find data-driven solutions to enhance safety for nonmotorized travelers in Michigan.

PROBLEM

While only one-quarter of overall traffic volume is present at night, more than three-quarters of pedestrian fatalities on the roadways occur during nighttime hours. Speeding vehicles and adverse weather contribute to pedestrian crashes, but research increasingly shows that low levels of light can inhibit pedestrian visibility and is a primary factor in nighttime crashes.

In a [previous study](#), MDOT found that time of day was the biggest contributing factor to serious pedestrian and bicycle crashes on higher-speed corridors. Light levels at crash sites were as low as 0.1 to 5.2 lux (a unit of illuminance). Other research has concluded that 25 lux is an appropriate light level for pedestrian crossings.

Reports of nighttime crashes generally only distinguish between lighted and



Cost-effective lighting devices can improve pedestrian nighttime safety at crosswalks and decrease fatal and serious injury pedestrian crashes in areas where lighting is insufficient despite the presence of streetlights.

unlighted conditions because the police completing crash reports lack the tools to collect luminance measurements. Traditional crash reporting also does not distinguish between street lighting and lighting installed as safety treatments at pedestrian crossings. Building on previous research, MDOT sought to further explore the relationship between

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“The in-depth examination of pedestrian lighting conditions and options provides MDOT with data-driven analyses to support lighting choices for different contexts. This research will enhance pedestrian safety throughout Michigan.”

Tim Smerdon
Project Manager

lighting and nighttime crashes, and test new lighting solutions to enhance pedestrian safety.

RESEARCH

A review of studies evaluating the impact of lighting and visibility on pedestrian safety, including MDOT’s previous work, identified variables contributing to optimal or adequate lighting for pedestrian crossings. Among these variables were placement and type of light bulbs, including LED lighting.

To demonstrate the role of lighting intensity in nighttime safety for pedestrians, researchers examined light levels and the presence or absence of LED or traditional lights at hundreds of fatal and serious injury pedestrian crash sites that occurred between 2018 and 2022 in cities across southern Michigan. Reports of crashes noted as occurring in dark conditions provided precise locations where researchers, following strict safety protocols, measured illuminance and identified any lighting improvements made since the reported crashes to ensure valid measurements.

Researchers then evaluated the optimal placement and effectiveness of 8-foot-long LED light bars, each costing \$150, affixed to signal mast arms at two signalized intersections in Kalamazoo. Light measurements before and after light bar installation indicated large improvements in luminance – and improved pedestrian visibility – that the treatments provided.

Additional exploration of smart lighting and rectangular rapid flashing beacons (RRFBs) illustrated the impacts of timing and distribution of lighting on pedestrian safety. Smart lighting, which is attached to RRFBs, illuminates when a pedestrian enters a crosswalk. The research team tested smart lighting RRFB devices at three midblock crosswalks. Under conditions with no RRFBs or smart lighting, RRFBs only and RRFBs combined with smart lighting, researchers measured changes in drivers’ speeds and yielding behaviors when staged pedestrians were present in addition to the luminance provided by smart lighting.

RESULTS

Conclusions across all study elements consistently showed that lighting and visibility are paramount in keeping pedestrians safe at night and reducing crashes. Light level measurements at serious crash sites in southern Michigan illustrated that 64 percent of nighttime crashes that occurred at locations coded as “lighted” had very low lighting levels (less than 5 lux).

The literature indicated that LED lighting is superior to traditional lighting in flexibility of placement, quality of light and cost-effectiveness. Testing the 8-foot-long light bars mounted on mast arms, researchers found that the crosswalks were uniformly lit and pedestrian visibility had improved. The LED light bars highlighted the importance of mounting the fixture to shine at an angle conducive to illuminating pedestrians.

Equipping RRFBs with smart lighting devices resulted in significant increases in drivers yielding to pedestrians. Adding an RRFB alone resulted in a 24 percent to 33 percent yielding increase. Adding smart lighting further increased yielding by up to 67 percent. Additionally, smart lighting produced larger reductions in nonyielding driver speeds than an RRFB alone.

VALUE

The results of this project will support MDOT in measuring safety lighting at fatal and serious injury pedestrian crash locations and identifying options beyond traditional

street lighting for safety improvements and crash reductions. Michigan’s Act 51, which created the Michigan Transportation Fund Act, prescribes how revenues are distributed and gives local governments primary control over urban street lighting. Working within this legal framework, MDOT will consider ways to facilitate the range of low-cost and easily implemented crosswalk safety lighting tools to enhance nighttime pedestrian safety.

Research Administration

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The final report is available online at

MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1744.

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Research Spotlight produced by
CTC & Associates LLC, July 2025.