

Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Effect of Nighttime Lighting on Construction Worker's Safety

Research Objectives

The primary objectives of this research are to evaluate the effect of lighting on work zone safety, taking the perspectives of construction workers and motorists into consideration for nighttime lighting arrangements, including:

1. the effect of lighting (i.e., glare/ luminance/ visibility) on the visual performance of construction workers.
2. the effect of orientation and placement of light towers on the perception of construction workers and motorists.
3. the identification of unsafe conditions due to inadequate lighting arrangements at nighttime work zones.

Research Benefits

This study will contribute to the state-of-the-practice nighttime lighting guidelines by conducting a series of field prototyping on glare and luminance assessments through a variety of lighting arrangements. The proposed project is prepared based on glare and luminance assessments from the perspectives of construction workers and motorists in nighttime work zones. We will evaluate factors influencing the safety of nighttime construction work zones such as orientation of lights, placement of light towers, type of lights, etc. and provide a list of recommended arrangement of lighting systems for future nighttime construction planning. Specifically, the project will focus on the effect of glare/luminance/visibility on the perception of motorists, the visual performance of construction workers, the interference of construction workers and equipment/vehicles, and the identification of unsafe conditions at nighttime work zones on I-80. The implementation of an NDOT project with a focus on lighting arrangements is a vital addition to be incorporated into NDOT's daily construction operations, roadway design, and traffic control measures.

Background

Current roadway lighting is designed specifically to provide illumination for vehicles and pedestrians in support of residential street and highway operations. However, the illumination levels are usually less than 20% of what is required for work operations and do not take nighttime construction operations into consideration. Many states Departments of Transportation (DOT) use some form of nighttime work zone lighting based on the Federal Highway Administration's Nighttime Lighting Guidelines and NCHRP's Illumination Guidelines to conduct construction and maintenance activities on or near the travel portion of the road system. However, in the past 10 years, light emitting diode (LED) technology has evolved, and the illuminance of lighting sources has increased; the resources for nighttime lighting design from the two national guidelines have been outdated and need improvements and updates. More recently, Indiana DOT and Virginia DOT have conducted research projects about the glare assessment based on the lighting system's parameters and luminance levels of lighting sources, but their demonstration settings were performed in a controlled environment, and no real field test was used to assess the effectiveness of the proposed lighting set-ups. The geometry and characteristics of construction operations and highway profiles vary by place, so lighting arrangements should be conducted in a practical way that would be suitable for the structure of highways in Nebraska. Therefore, this proposal is prepared to provide NDOT, construction organizations (e.g., Associated General Contractors of America, AGC Nebraska Chapter), and contractors with a list of recommendation of nighttime lighting arrangements for construction operations at night as well as to supplement informed knowledge about construction lighting setups and update guidelines to the NDOT "Standard Specifications for Highway Construction".

Conclusion

This research evaluated the effectiveness of nighttime construction lighting systems in improving worker visibility and safety while minimizing glare impacts on motorists in Nebraska work zones. The study combined an industry survey with controlled field testing to assess current lighting practices and quantify lighting performance. Survey responses from construction professionals documented commonly used lighting systems, perceived adequacy, safety impacts, and public concerns related to glare. Field experiments were conducted at the Midwest Roadside Safety Facility using LED, halogen, and balloon light towers. Lighting configurations were systematically varied by mounting height, aiming angle, and rotation angle. Worker visibility was evaluated using horizontal illuminance based on Federal Highway Administration recommendations, and driver glare was assessed using veiling luminance ratios in accordance with Illuminating Engineering Society RP-8-22 standards. Results indicate that lighting performance depends primarily on configuration rather than lighting type alone, and only a limited number of configurations satisfied both illuminance and glare criteria. The findings can be used to guide safer nighttime work zone lighting setup and support the development of NDOT-specific lighting recommendations.

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Final report is available:
[HERE](#)

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NDOT Recommendations Based Off Research Project – 2026 – RRL3

This project provided the Nebraska Department of Transportation with lighting configuration guidance for nighttime construction, including various recommended configurations for both LED and halogen lighting. The NDOT currently provides rudimentary lighting guidelines to contractors, but nothing enforceable for an inspector.

These research findings show that lighting performance is depends mainly on lighting configuration rather than lighting type, with only a limited set of lighting configurations meeting both visibly and glare requirements. These results provide a foundation for safer and more consistent nighttime work zone lighting practices and support the development of NDOT-specific guidance.

Internal discussions will determine whether these results will be incorporated as enforceable contractor lighting requirements or just recommended practices. The Construction Division will collaborate with the Traffic division, Maintenance division, and Roadway Design's Lighting Unit to select preferred configurations and evaluate opportunities for internal implementation.

- *As provided by Devin Townsend and Lorraine Legg, Lead TAC Members*

Research Readiness Level (RRL) Assessment

Level 3: Development/Field Level

Follow up on implementation in 1 year.

RRL 3

Technology Transfer

Principal Investigator did not have any technology transfer for this research project.

**This brief summarizes Project SPR-FY25(041)
“Effect of Nighttime Lighting on Construction Worker’s Safety”
Nebraska Department of Transportation Research Program**