

ROUNDABOUT LIGHTING

Balu Ananthanarayanan, PE and Paul Lutkevich, PE

The use of roundabouts throughout the United States is rapidly increasing. Their newfound acceptance has created a lag between the implementation of these designs and the criteria to support their development. A key area where guidance is lacking is for lighting roundabouts. Neither the American Association of State Highway Officials (AASHTO) or the Illuminating Engineering Society of North America (IESNA) has design guide for roundabout lighting. The FHWA Publication FHWA-RD-00-067 Roundabouts: An Informational Guide recommends lighting levels which match current intersection lighting levels but more targeted recommendations need to be developed. This vacuum of US resources has caused a wide variety of practices with regard to roundabout lighting in the US. For example, one can find French, Australian, British and other roundabout lighting design guidelines being used. The result is a tremendous lack of uniformity in lighting roundabouts across the US.

In response to this the IESNA Roadway Lighting Committee created a subcommittee to examine this issue and develop design guidelines for roundabout lighting. This article reviews some of the information and research being conducted and considered by that committee as well as the current status of the recommendations. We also wish to thank the members of the Roadway Lighting Committee of IESNA's Roundabout Lighting Subcommittee for their contributions.

Existing US Standards

There currently are existing lighting standards included in the Federal Highway Administration Publication No. FHWA-RD-00-067 Roundabouts: An Informational Guide. A brief review of the major lighting components of these standards shows the following:

For FHWA-RD-00-067 Roundabouts: An Informational Guide:

- Illumination recommended for all roundabouts but not mandatory (rural with no other lighting)
- 80m transition lighting
- Recommends perimeter lighting and approach lighting

Table 1 is included in this document with the guidance that a roundabout should be illuminated to a level that equals the sum of the intersecting roads. For example if a commercial arterial intersected with an intermediate collector the level in the roundabout should be $17 \text{ lux} + 9 \text{ lux} = 26 \text{ lux}$. Using this method the lighting level for roundabouts will range from 8 lux to 34 lux. This method of summing intersecting roads has been used for intersection lighting for many years.

Street Classification	Area Classification	Average Maintained Illuminance Values	Illuminance Uniformity Ratio (Average to Minimum)
Arterial	Commercial	17 lx (1.7 fc)	3 to 1
	Intermediate	13 lx (1.3 fc)	
	Residential	9 lx (0.9 fc)	
Collector	Commercial	12 lx (1.2 fc)	4 to 1
	Intermediate	9 lx (0.9 fc)	
	Residential	6 lx (0.6 fc)	
Local	Commercial	9 lx (0.9 fc)	6 to 1
	Intermediate	7 lx (0.7 fc)	
	Residential	4 lx (0.4 fc)	

Table 1 – Exhibit 7-23 from the FHWA-RD-00-067 Roundabouts: An Informational Guide showing recommended street lighting levels

Recent Research

A study performed by Hasson and Lutkevich, both members of the IESNA Roundabout subcommittee, looked at more than 20 single-lane roundabouts in Maryland. After reviewing the roundabouts in both day and night conditions, 4 roundabouts were chosen for more in-depth study. The lighting conditions on these roundabouts included no lighting, 2 poles-one on opposite sides of the roundabout, 4 poles-one at the quarter points around the roundabout, and one with lighting around the roundabout as well as on the approach roads.

The study examined day and night crash data before and after installation of the roundabouts this was found to be inconclusive. Essentially, there were too few crashes at these new installations to provide reliable estimates of the day and night crash problem or to assign any benefits to the lighting. The study then turned to subjective evaluation, light level measurements, computer modeling, and then offered the following recommendations.

- Lighting located around the perimeter of the roundabout provided better visibility of pedestrian and obstructions than lighting located in the center. The computer models below are renderings from comparisons made between center and perimeter mounting of lights. From these models and observations at the sites perimeter lighting is recommended.



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Lighting produced by a center mounted lighting system with 8-400w hps luminaires shown bottom page 46 and above.



Lighting produced by a perimeter mounted lighting system with 8-250w hps luminaires shown at right, top and bottom.

- Lighting should be provided for all roundabouts. The geometry of a roundabout makes headlamps ineffective in the detection of people or objects in the vehicles path.
- Approach lighting should be used providing 20 to 40 vertical lux in crosswalks, if present, at roundabouts.



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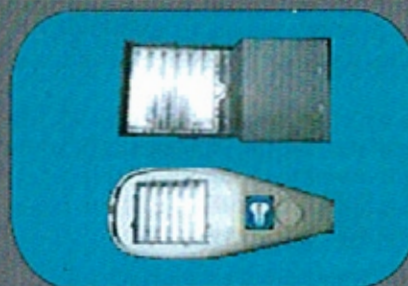
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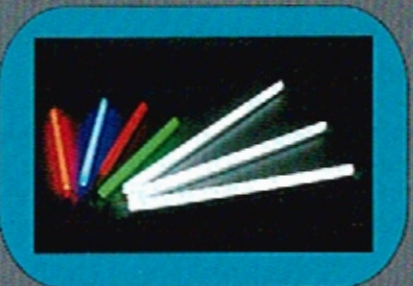
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Roundabout without approach lighting (left) and with approach lighting (right)

- Roundabouts with minimum values of 10 lux (approx. 20 lux average) seem to provide adequate visibility.

The need and required levels for crosswalks are also being considered in other studies. In an extensive research project by the Federal Highway Administration (FHWA) at the Virginia Tech Transportation Institute (VTTI), early results reported by Dr. Ron Gibbons at the Transportation Research Board Visibility Symposium on April 2005 in Washington, DC state that:

- A lighting level of 20 vertical lux seem sufficient for crosswalks considering that further dynamic testing may show the need for a higher levels, complex (urban) environments may require higher levels, and the addition of overhead lighting does not totally mitigate the impact of glare.

The Transportation Association of Canada is currently completing a new guide for the design of roadway lighting. In this guide some of the recommendations for roundabouts are as follows:

- The horizontal lighting level in roundabouts shall be equivalent to the intersection lighting requirements for that class of road.
- The vertical illumination for crosswalks at a roundabout should be equivalent to the horizontal levels recommended.
- Perimeter mounted lighting is recommended for roundabouts.

IESNA Recommendations under Consideration

Based on the research and studies reviewed, as well as experience being gained with roundabouts, the IESNA Roundabout Committee is currently considering the following recommendations and guidance for designers:

- The effectiveness of auto headlights are limited in a roundabout due to the constrained curve radius, making the roadway lighting system very important for the nighttime visibility of obstructions and hazards.
- A roundabout may have continuous lighting on the approach roads. This lighting will help a driver adapt to the roundabout lighting. Where there is no lighting on the approach roads lighting should be added on the approach roads for a distance of approximately 80 m from the start of the roundabout.
- Cutoff or full-cutoff fixtures are recommended, as well as avoiding the use of floodlights.
- The lighting of roundabouts must be coordinated closely with other elements including sidewalks and bikeways, sidewalk ramps, street furniture, signage, plantings, utilities, and other physical features associated with the roadway or roundabout.
- Roundabouts may be located in areas where the control of obtrusive light may be a concern. The designer should follow the recommendations outlined in TM-11-00 Light Trespass Recommendations. Since the lighting of roundabouts enhances safety, lighting criteria should not be compromised to meet locally adopted lighting ordinances that may seek to limit spill light.
- The lighting level used in a roundabout should be equivalent to the intersection lighting level included in IESNA RP-8-00 Standard Practice for Roadway Lighting which ranges average values from 8 lux to 34 lux depending on the functional classification and pedestrian volumes.
- Vertical illumination at the crosswalks of roundabouts should be equivalent to the horizontal level at a height of 1.5 meters, along the centerline of the crosswalk, as seen by the approaching driver.

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Lisbon Roundabout, north view

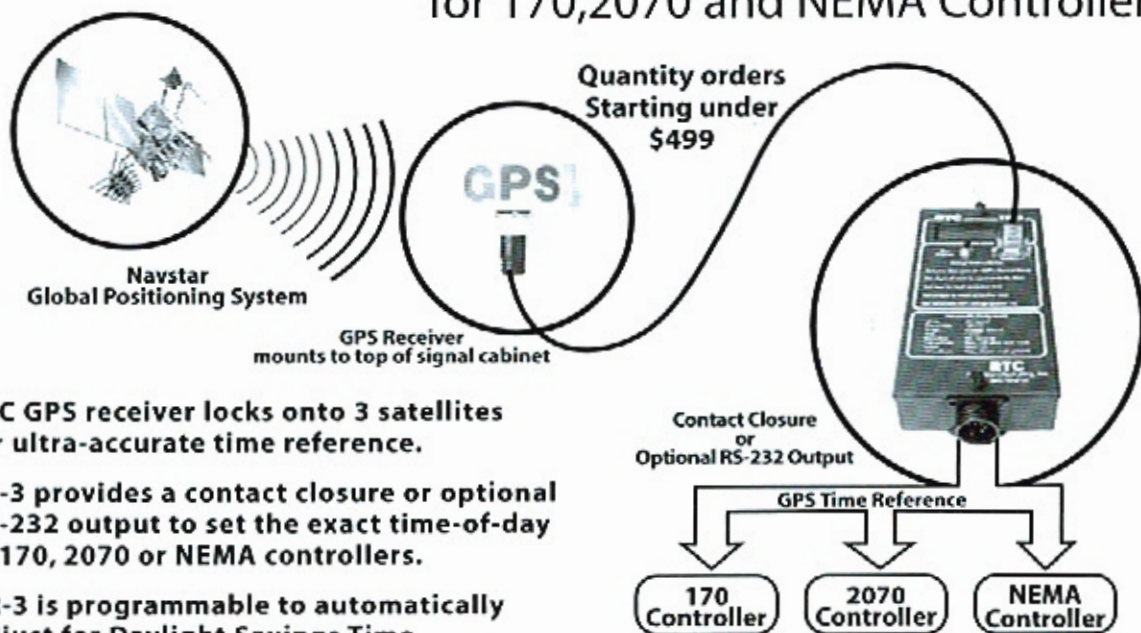


Lisbon Roundabout, south view

The IESNA hopes to complete discussions and evaluations of the proposed recommendations for roundabout lighting in the near future and make a standard available to fill the need of roundabout designers.

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Shepard Roundabout, showing approach and lighting.

Authors

Balu Ananthanarayanan, PE, is the the chair of the IESNA Roundabout Lighting Subcommittee. He works as the State Electrical Engineer for the Wisconsin Department of Transportation in Madison, WI. He is currently responsible for the development of Electrical Engineering Policy and Illumination Standards for the design, operation, and maintenance of all of WisDOT electrical installations. Mr. Anathanarayanan has over 30 years of experience as a practicing electrical engineer and is a member of several national transportation organizations. He is the WisDOT representative to the AASHTO Task Force on Roadway Lighting and also the Task Force secretary. Balu was also a member of the US delegation in the FHWA/AASHTO Bilateral Lighting Technology Exchange Program between outdoor lighting experts and international organizations in Europe. He has also been active on several NCHRP project panels as well as on TRB panels and is past Chair of the Roadway Lighting Committee of the IESNA.

Paul Lutkevich, PE is Past Chair of the Illuminating Engineering Society of North America's Roadway Lighting Committee. He is a member of the Commission Internationale De L'Eclairage (International Commission on Illumination). He is actively involved in the development of national and international standards for outdoor lighting. He has received awards for his work including the International Illumination Design Award and a Roadway Lighting Design Award from the IESNA. Paul was also a member of the US delegation in the FHWA/AASHTO Bilateral Lighting Technology Exchange Program between outdoor lighting experts and international organizations in Europe. He has written and spoken extensively on the subjects of outdoor lighting including urban lighting, lighting for pedestrians, aesthetic considerations in outdoor lighting, and lighting for safety. He is currently co-authoring the Transportation Association of Canada's outdoor lighting standards which is using the latest research from North American and international sources to compile a comprehensive design guide for the outdoor environment.

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