



Traffic Guidelines Manual

ORIGINATOR Director, Bureau of Traffic Operations		11-2-1
CHAPTER 11	Lighting/Electrical/Electronic Systems	
SECTION 2	Lighting Systems Design	
SUBJECT 1	General Overview, Considerations and Parameters	

POLICY

Unless described otherwise, all Roadway Lighting Designs on State Highways **shall** follow the general guidelines described in this section.

TYPES OF ROADWAY LIGHTING

There are a number of different types of roadway and facilities involving the consideration of lighting, most all of which are covered in more detail in the AASHTO Roadway Lighting Design Guide and ANSI / IESNA Roadway Lighting RP-8-00. In general, the following categories are covered in this document:

- Continuous lighting systems, including Continuous (corridor) Freeway Lighting; Complete Interchange Lighting; Partial Interchange Lighting; and Rural Interchanges.
- Streets and Highways Other Than Freeways, including expressways and urban streets, and rural highways, including spot locations involving special considerations.
- Intersections, including Isolated (stand-alone) Intersections; Signalized Intersections; and Roundabouts. These could include transition lighting and/or coordination with a continuous segment lighting system.
- Aesthetic Lighting

Refer to other TGM sections for specifics on the individual design requirements for these categories.

Continuous lighting is defined as a lighting system incorporating lighting units with overlapping distribution patterns that meet average and uniformity levels as defined by AASHTO for the appropriate roadway area classification and use.

Transition lighting is defined as a gradual increase/reduction in lighting levels when entering or leaving a lighting system, most typically at a Roundabout, when the roadway is not continuously illuminated.

Isolated lighting is defined as lighting at the intersections of non-illuminated roadways or periodic lighting along a roadway where AASHTO defined light level standards for average and uniformity are not applicable.

DESIGN PARAMETERS AND CALCULATIONS

The following design parameters pertain to all roadway lighting systems:

1. Lighting systems *should* be designed in accordance with AASHTO's "Roadway Lighting Design Guide" 2005 Edition, Table 3-5a for required lighting levels. (The IES Design Guide for Roundabout Lighting DG-19-08, and the ANSI/IESNA guide RP-8-00 will be used as references where noted.)
2. Pavement classifications of R1 (concrete) or R3 (asphalt) **shall** be used depending upon the permanent roadway surface.
3. The calculation of roadway lighting levels *should* be performed using Lighting Analysts AGI32 software. This will enable the designer to share the design files generated by the software with the Department for review if necessary.
 - Unless indicated otherwise, the *Illuminance Method* of calculation **shall** be used to determine the *average maintained illumination* (in footcandles), and the *average-to-minimum* (uniformity) lighting levels for roadways, intersections and roundabouts.
 - The designer/engineer **shall** also perform the *Maximum Veiling Luminance Ratio* calculation for all continuous lighting systems. The specified *Maximum Veiling Luminance Ratio* *should not* exceed that defined in the AASHTO Roadway Lighting Design Guide.
4. Wire sizing for lighting circuits *should* be calculated with a target of 3.5% voltage drop per branch circuit, and a maximum of 5% for the total of service/feeder and branch circuit.
5. WisDOT does not currently utilize Curfews of lighting systems on DOT maintained lighting installations.
 - WisDOT *may* consider curfews on permitted locally owned/maintained lighting installation with the appropriate justification.

GENERAL REQUIREMENTS FOR LUMINAIRES

LED Luminaires **shall** be used for WisDOT maintained lighting systems and **shall** be selected from the Department's Qualified Electrical Products List.

- For permitted Locally Maintained Systems, the Luminaires **shall** be selected on the basis of their distribution characteristics as they apply to the roadway geometry to ensure adequate illumination and minimum glare. They **shall** meet the roadway illumination requirements specified in this document.

A Light Loss Factor (LLF) **shall** be applied to initial lamp lumen output to calculate maintained illumination as prescribed in this section.

- The LLF for LED Luminaires on the Department's Qualified Products List **shall** be the value indicated on the List. (This value includes an adjustment for LDD.)
- The LLF for High Pressure Sodium lamps *should* be 0.75.
- When LED luminaires other than those identified on the Qualified Electrical Products List are specified for permitted locally maintained systems, the designer **shall** identify the proposed LLF and furnish justification for it with the permit application.

POLE BREAKAWAY REQUIREMENTS

Poles permitted on the rights-of-way of the State Trunk Highway System for the sole purpose of highway lighting fall into one of two categories:

1. *Breakaway Poles*. This type of lighting support is defined as a pole and/or foundation which when struck by a vehicle will fracture or slip away under the conditions prescribed by the current edition of AASHTO Standard Specifications for Structural Supports for Highway Luminaires.

No portion of the concrete footing **shall** be allowed to protrude above the ground level more than 4 inches.

2. *Non-Breakaway Poles*. Rigid lighting standards are defined as those poles and mountings which under impact conditions do not breakaway within the criteria specified for breakaway poles.

Under normal conditions, the use of lighting pole designs conforming to the breakaway requirements above is encouraged for all lighting installations.

ROADWAY AND LAND USE (AREA) CLASSIFICATIONS

There are numerous documents that define Roadway Classifications. These include:

- AASHTO Policy on Geometric Design of Highways and Streets (Green Book)
- ANSI/IESNA RP-8
- WisDOT FDM 4.1.15
- FHWA Highway Functional Classifications

Policy specifies using the AASHTO "Roadway Lighting Design Guide" 2005 Edition, Table 3-5A, which references the Green Book classifications. However, it is the responsibility of the designer to use the available resources to evaluate the section of roadway where the proposed lighting system will be installed. The functional classifications used to design the road do not necessarily address the issues that are important for lighting. Evaluation metrics include:

- Is this section of Roadway primarily used for through traffic or access, or more to local properties?

- What is the speed limit?
- What is the level of development of the surrounding area?
- What is the pedestrian conflict?

This evaluation will determine which of the AASHTO Table classifications provides the best fit for the project.

Table 1 below contains some of the key points from the 2011 AASHTO Green Book to assist the designer in the evaluation.

Table 1. Classification Descriptions

Roadway Classifications	Description
Other Principal (Major) Arterials	That part of the roadway system that serves as the principal network for through-traffic flow, with low emphasis on local access. The routes connect areas of principal traffic generation and important roadways entering the city. Posted speeds are generally high.
Minor Arterials	That part of the roadway system that serves as the principal network for through-traffic flow between smaller communities, or as a secondary roadway for through traffic. These routes typically have lower traffic levels than major arterials. Although posted speeds are relatively high, these can provide more local access.
Collectors	Roadways servicing traffic between major and local roadways. These are streets used mainly for traffic movements within residential, commercial, and industrial areas. They do not handle long through trips, but can provide travel between towns not served by other systems. These generally have moderate posted speeds.
Local	Local roadways used primarily for direct access to residential, commercial, industrial, or other abutting property. They do not include roadways carrying through traffic, although an arterial passing through a small community <i>may</i> provide local functionality. Posted speeds are low.
Area Classifications (Pedestrian Conflict)	Description
Commercial (High)	The portion of the municipality in a business development where ordinarily there are large numbers of pedestrians and a heavy demand for parking spaces during periods of peak traffic or a sustained high pedestrian volume and a continuously heavy demand for off-street parking during business hours. This definition applies to densely developed business areas outside of, as well as those that are within the central part of a municipality. Areas where significant numbers of pedestrians are expected to be on the sidewalks or crossing the streets during darkness. Examples are downtown retail areas, near theaters, concert halls, stadiums, and transit terminals.
Intermediate (Medium)	The portion of the municipality which <i>may</i> be outside of a downtown area but generally within the zone of influence of a business or industrial development, often characterized by a moderately heavy nighttime pedestrian traffic and a somewhat lower parking turnover than is found in a larger or more active commercial area. This definition includes densely developed apartment areas, hospitals, public libraries, and neighborhood recreational areas.
Residential (Low)	An area characterized by few pedestrians and low parking demand or turnover at night or portions of the night. Although this definition includes areas with housing, it also includes commercial areas with low pedestrian activity. Regional parks, cemeteries and vacant lands could also be included.

PLACEMENT OF LIGHTING POLES

The following criteria **shall** be used to ensure that the placement of poles and other lighting appurtenances adjacent to the roadway will provide an acceptable degree of safety to the public and also comply with good illumination practices. The selection of pole types and their offsets from the traveled portions of the roadway is of considerable importance in minimizing the number and severity of fixed object collisions by errant vehicles. As much as possible, the number of poles *should* be as limited as possible to decrease impact on roadway operations, potential “run-ins”; and maintenance purposes. The Traffic Signal Design Manual and the Roundabout section herein give additional information related to pole locations and co-locations for luminaires, etc.

Minimum Lateral Offset

Table 2 below is attached as a reference for the minimum lateral offset for lighting poles on state trunk highways. The values indicated in the table are based upon the current policy related to objects in clear zones as specified in FDM 11-15-1. All designs **shall** comply with the FDM. Offsets greater than those prescribed *should* be provided where feasible and where special traffic and highway conditions warrant. The designer **shall** coordinate with the Project Manager regarding all pole placement considerations.

Table 2. Minimum Lateral Offsets

FACILITY TYPE	SPEED LIMIT (MPH)	TRAFFIC VOLUME (ADT**)	MINIMUM RIGID (FEET)	OFFSET BREAKAWAY (FEET)
RURAL				SHOULDER width plus
	35 or less 40	ALL	12	2
		0 – 1,000	14	2
		1,500 – 6,000	16	2
		over 6,000	18	2
	45-50	0 – 1,500	20	2
		1,500-6,000	26	2
		over 6,000	28	2
	55	0 – 1,500	24	2
		1,500 – 6,000	30	2
over 6,000		30	2	
URBAN	40 or less	ALL	2 from face of curb	2 from face of curb
	45 and higher	ALL	Offsets same as rural section	(Measured from the edge of thru lane) the greater of 12 or 2 from face of curb

Offset distances are in feet, from edge of the adjacent through traffic lane to the face of the pole; or as indicated for urban sections.

1. The preceding table is based upon pole location in a flat area or without fill slope steeper than 4:1. If rigid poles are contemplated on a slope of greater steepness and significant width, advice *should* be sought from C.O. Traffic. Placement of rigid poles in this situation is discouraged.
2. A reduction in minimum offset requirement by as much as 1/3 *may* be followed where there is a pronounced back slope rising more or less directly from the shoulder. No value **shall** be less than 24 feet for 40 mph or more.
3. Where the offsets given in the above table would place rigid poles off the highway right-of-way, they *may* be permitted at or as near the right-of-way line as practical if it would not result in a significant added hazard to the public.
4. Where the offsets given in the above table require a pole to be in a ditch line, the pole *should* be located beyond the ditch line, but *may* be permitted in front of the ditch line if it would not result in significantly increased hazard.
5. Where the offsets given in the above table would require a pole to be within a sidewalk area, poles *should*, if conditions permit, be located behind the sidewalk. Locations between the walk and roadway *may* be permitted in the event no other alternative is feasible.
6. Where a tree line exists closer to the roadway than permitted by Table 2 above, lighting poles *may* be placed in that tree line, if such poles will not constitute significant additional hazards to the public.
7. Rigid poles *may* be permitted inside the limits shown in the table where they are adequately protected by barriers such as guardrails or retaining walls erected for other purposes. There *should* be at least 4 feet clearance between the guardrail and the pole to allow for deflection at higher speed locations.
8. Offset requirements for poles in the medians of divided highways along added left turn lanes **shall** be measured from the edge of the through traffic lane. A right turn lane is not considered a through lane.
9. Lighting control cabinets for distribution of energy to lighting systems *should* be placed in the least vulnerable locations available.

LIGHTING PLANS

All lighting plans **shall** include the following information:

- Roadway, Area, and Pavement Classifications used in the design
- Legend, describing the Luminaires, poles, arms, cabinet, and circuit information.
- Luminaire symbols **shall** include location and circuit information.
- System wiring diagram including conduit, conductor, and circuit information for all conduit segments.
- Maintenance Authority

A sample lighting plan sheet is located in FDM 15.1 attachment 5.14 for reference.

REFERENCE TO STANDARDS

The installation of highway lighting **shall** conform to applicable provisions of Chapter 9, Section 15 of the WisDOT Highway Maintenance Manual, except as modified herein. In addition, the highway lighting installation **shall** comply with the requirements of the latest edition of the following:

- National Electrical Code
- Wisconsin Electrical Code
- Local codes and ordinances

The following guides apply to all highway lighting installations covered by this policy. Unless otherwise indicated, the latest editions of the following guides **shall** be used.

1. American Association of State Highway and Transportation Officials (AASHTO) Roadway Lighting Design Guide, October 2005.
2. American National Standard Institute (ANSI), American National Standard Practice for Roadway Lighting RP-8-00.

The most restrictive, policy, code, standard, or guide **shall** govern. Central Office will make the final decision on the interpretation of conflicting policies, codes, or standards.

POLICY REVISIONS

The requirements of this policy *may* be updated to reflect changing technology or other conditions appropriate at the time. Such additions, revisions, and modifications will not be made retroactive to lighting installations covered by existing permits.

WisDOT *may* require the updating of all or part of an existing installation to conform to the latest criteria in the event damage to an installation, highway reconstruction, or other reasons requiring the replacement or relocation of all or part of an existing lighting installation offers an opportunity to upgrade the installation.