7. *A Guide to Standardized Highway Lighting Pole Hardware*, American Association of State Highway and Transportation Officials;

8. *Roadside Design Guide*, American Association of State Highway and Transportation Officials;

9. *Standard Specifications for Road and Bridge Construction*, Illinois Department of Transportation;

10. *Highway Standards*, Illinois Department of Transportation;

11. Electrical Detail Sheets, Illinois Department of Transportation;

12. *Warrants for Highway Lighting*, National Cooperative Highway Research Program Report No. 152, Transportation Research Board;

13. *Partial Lighting of Interchanges*, National Cooperative Highway Research Program Report No. 256, Transportation Research Board;

14. *Illinois Manual on Uniform Traffic Control Devices (ILMUTCD)*, IDOT; and

15. *American National Standard Practice for Tunnel Lighting*, ANSI/IESNA RP-22, American National Standards Institute/Illuminating Engineering Society of North America.

**56-1.02 Responsibilities**

Each district is responsible for the highway lighting projects within their respective jurisdictions (e.g., information gathering and plan preparation). See Chapter 63 for additional information on plan preparation. The district is also responsible for coordination of Central Office or consultant designs and plan submittals. The district will submit all consultant designs of lighting plans to the Central Office for review and approval by the Electrical and Mechanical Unit. Lighting plans for rest areas and weigh stations will also be reviewed by the Electrical and Mechanical Unit.

District 1 is responsible for highway lighting projects within their jurisdiction. This includes both plan review and approval.

**56-1.03 Definitions**

The following defines the more commonly used terms in highway lighting design:

1. Average Initial Illuminance. The average level of horizontal illuminance on the pavement area of a traveled way at the time the lighting system is installed when lamps are new



# Summary of Comments on Chapter_56_080625.pdf

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16. Federal Highway Administration (FHWA) Informational Report on Lighting Design for Midblock Crosswalks. Publication No. FHWA-HRT-08-053, April 2008.

and luminaires are clean; expressed in average footcandles (lux) for the pavement area. See definition of illuminance.

2. Average Maintained Illuminance ($E_h$). The average level of horizontal illuminance on the roadway pavement when the output of the lamp and luminaire is diminished by the maintenance factor (MF); expressed in average footcandles (lux) for the pavement area. See definition for maintenance factor.

3. Ballast. An electrical device used with high intensity discharge lamps to provide proper electrical operating characteristics. It limits the electric current through the lamp and may also transform voltage.

4. Candela (cd). A measure of the luminous intensity of a light source as seen by the eye (a.k.a., "candle"). For example, because the eye is less sensitive to blue light than to green light, a blue light source must radiate more power in watts (W) than must a green light source if the two are to have the same luminous intensity. Most light sources have different luminous intensities when viewed from different directions and so the luminous intensity for a light source may vary with the angle at which it is viewed (1 cd = 1 cp).

5. Candela per Square Meter ($cd/m^2$). The metric unit of luminance (photometric brightness) which is equal to the uniform luminance of a perfectly diffusing surface emitting or reflecting light at the rate of one lumen per square meter ($lm/m^2$) or the average luminance of any surface emitting or reflecting light at that rate (1 $cd/m^2$ = 0.2919 fl).

6. Candlepower (cp). The luminous intensity in a specific direction; expressed in candelas (cd). It is no indication of the total light output (1 cp = 1 cd).

7. Coefficient of Utilization (CU). The ratio of the luminous flux (lm) from a luminaire received on the pavement surface to the rated lumens emitted by the luminaire.

8. Disability Glare. Glare resulting in reduced visual performance and visibility. It often is accompanied by discomfort. See definitions for discomfort glare and glare.

9. Discomfort Glare. Glare producing discomfort. It does not necessarily interfere with visual performance or visibility. See definition for glare.

10. Footcandle (fc). The US Customary unit of measurement for illuminance on a surface one square foot ($ft^2$) in area on which there is uniformly distributed a light flux of one lumen (lm). (1 fc = 10.76 lx).

11. Footlambert (fl). The US Customary unit of luminance (photometric brightness) which is equal to the uniform luminance of a perfectly diffusing surface emitting or reflecting light at the rate of one lumen per square foot ($lm/ft^2$) or the average luminance of any surface emitting or reflecting light at that rate (1 fl = 3.426 $cd/m^2$ ).



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Contrast. The difference between the visual appearance of an object of interest and the visual background against which that object is observed. It also is the basis of an object's visibility.

24. Luminous Efficiency (%). The ratio of the total luminous flux emitted by a luminaire to that emitted by the bare lamp.

25. Luminous Intensity. See definition of candela.

26. Lux (lx). The metric unit of illuminance on a surface one square meter ($m^2$) in area on which there is uniformly distributed a light flux of one lumen (lm), or the illuminance produced on a surface for which all points are at a distance of one meter (m) from a uniform point source of one candela (cd) (1 lx = 1 $lm/m^2$ = 0.0929 fc).

27. Maintenance Factor (MF). A combination of light loss factors used to denote the reduction of the illumination for a given area after a period of time compared to the initial illumination on the same area (MF = LLD • LDD).

28. Mounting Height. The vertical distance between the roadway surface and the center of the light source in the luminaire.

29. Nadir. The vertical axis which passes through the center of the luminaire light source.

30. Overhang. The horizontal distance between a vertical line through the nadir of a luminaire and the edge of traveled way or edge of the area to be illuminated.

31. Setback. The horizontal distance between the face of a light pole and the edge of traveled way.

32. Spacing. The distance in meters between successive light poles.

33. Street Side. The horizontal direction which is toward the roadway from the nadir of the luminaire. See definition of house side.

34. Transverse Roadway Line (TRL). Any line across the roadway that is perpendicular to the curb or shoulder line. See definition of longitudinal roadway line.

35. Uniformity Ratio ($E_h/E_{min}$). The ratio of average maintained horizontal illuminance ($E_h$) to the maintained horizontal illuminance at the point of minimum illumination ($E_{min}$) on the pavement. A uniformity ratio of 3:1 means that $E_h$ — footcandles (lux) is three times the $E_{min}$ — footcandles (lux) at the point of least illuminance on the pavement.

36. Utilization Curve. A plot of the quantity of light falling on the horizontal surface both in front (street side) and behind (house side) the luminaire. It shows only the percent of bare lamp lumens which fall on the horizontal surface and is plotted as a ratio of width of area to mounting height of luminaire.



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Pedestrian Visibility Distance. The distance at which a driver can see a pedestrian well enough to be able to respond appropriately to the pedestrian's presence. The greater the visibility distance the more time a driver will have to react to the pedestrian before a conflict occurs.

1. Facilities with Raised Medians. Consider highway lighting along sections of State-maintained facilities that have raised medians.

2. Major Urban Arterials. Consider highway lighting along all major arterials that are located in urban areas.

3. Intersections. Consider intersection lighting at rural intersections that meet any one of the following conditions:

   - there are 2.4 or more crashes per million vehicles in each of three consecutive years;
   - there are 2.0 or more crashes per million vehicles per year and 4.0 or more crashes per year in each of three consecutive years;
   - there are 3.0 or more crashes per million vehicles per year and 7.0 or more crashes per year in each of two consecutive years;
   - the intersection is signalized and there have been, in the past year, 5.0 or more reported nighttime crashes and a day-to-night crash ratio of less than 2.0;
   - substantial nighttime pedestrian volume exists;
   - less than desirable alignment exists on any of the intersection approaches;
   - the intersection is an unusual type requiring complex turning maneuvers;
   - commercial development exists in the vicinity which causes high nighttime traffic peaks;
   - distracting illumination exists from adjacent land development; and/or
   - there exists recurrent fog or industrial smog in the area.

   Isolated intersections located within the fringe of corporate limits which are suburban or rural in character may be illuminated at State expense provided they meet the above criteria. Every effort should be made to have the Local Agency accept ownership of the system after installation and assume all operational and maintenance costs (see Chapter 5).

4. High Conflict Locations. Consider providing lighting along roadway sections with high vehicle-to-vehicle interactions (e.g., sections with numerous driveways, significant commercial or residential development, high percentage of trucks). Lighting generally improves traffic safety and efficiency at such locations.



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and high vehicle-to-pedestrian/bicyclist

On highways that are not continuously lighted, consider providing underpass lighting where frequent nighttime pedestrian traffic exists through the underpass or where unusual or critical geometry exists within or on an approach to the underpass.

Provide underpass lighting on all highways that are continuously lighted. Favorable positioning of conventional highway luminaires adjacent to a relatively short underpass often can provide adequate illumination within the underpass without a need to provide supplemental lighting. If this action is considered, ensure that shadows cast by the conventional luminaires do not become a visibility problem within the underpass.

**56-2.07 Tunnels**

A tunnel is defined as a structure of any type surrounding a vehicular roadway which requires the use of artificial lighting or equivalent means to provide adequate roadway visibility necessary for safe and efficient traffic operation. Daytime tunnel lighting is justified when driver visibility requirements are not satisfied without the use of a lighting system to supplement natural sunlight. Visibility requirements vary considerably with such items as:

- portal to portal tunnel length (i.e., short or long);
- tunnel portal design;
- geometry of tunnel and its approaches;
- vehicular and pedestrian traffic characteristics;
- treatment of pavement, portal, interior, and environmental reflective surfaces;
- climate and orientation of tunnel; and
- visibility objectives to provide for safe and efficient tunnel operation.

Use the requirements in the *American National Standard Practice for Tunnel Lighting* for tunnel lighting designs.

**56-2.08 Other Locations**

Provide lighting for all pedestrian underpass and pedestrian tunnel facilities. ~~In addition,~~ the need to provide lighting for the following facilities will be determined on a case-by-case basis:

- commuter park-and-ride lots,
- bike paths,
- pedestrian walkways, and
- pedestrian overpasses.



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Pedestrian lighting is affected by fixed roadway lighting, headlamp lighting, pedestrian clothing, and the characteristics of the visual backgrounds. Lighting must respond to the unpredictable nature of these characteristics. For this reason,

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New bullet:
crosswalks

4. Class R4. Class R4 pavement has a mostly specular mode of reflectance. R4 includes asphalt road surfaces with a very smooth texture.

**56-5.04(d) Illuminance and Luminance Design Levels**

Design criteria for highway lighting projects vary according to the roadway classification and luminance. Figures 56-5B and 56-5C present the illuminance design criteria used by the Department. In addition to these figures, consider the following:

1. Crossroads at Interchanges. Lighting levels on crossroad approaches should not be reduced through an interchange area. If existing crossroad lighting currently is deemed inadequate, it should be considered for upgrading to ensure safe and efficient traffic operation.

2. Partial Interchange Lighting. Where partial interchange lighting is provided, luminaires should be located to best light the through lanes and speed change lanes at diverging and merging locations. The design controls of basic level of lighting and uniformity should be subordinated to overall lighting of the roadway area at these locations.

3. Bridge Structures and Underpasses. Where justified, underpass lighting level and uniformity ratios should duplicate, to the extent practical, the lighting levels on the adjacent facility. On continuously lighted freeways and lighted interchanges, the lighting of bridges and overpasses should be at the same level and uniformity as the roadway.

4. Transition Lighting. Transition lighting is a technique intended to provide the driver with a gradual reduction in lighting levels and glare when leaving an illuminated area. The designer should consider transition lighting if a study of the specific conditions at a location indicates a need. Several implementation methods exist. Contact the Electrical and Mechanical Unit in the Central Office for approved methods of implementation. In addition, the designer also may consider extending delineation 1000 ft (300 m) beyond the last luminaire for traffic lanes emerging from a lighted area. This will provide an additional measure of effectiveness. Vision adjustment when approaching a lighted area is not impacted greatly and therefore requires no special consideration.

5. Navigation and Obstruction Lighting. The lumen output for waterway and aviation obstruction luminaires will be based on the requirements of the U.S. Coast Guard and the Federal Aviation Administration, respectively.

6. Other Locations. Where lighting is justified for tunnels, overhead signing, and other facilities not covered under this section, the criteria presented in the publication ANSI/IESNA RP-8 and the AASHTO publication *An Informational Guide for Roadway Lighting* should be used. Contact the Electrical and Mechanical Unit for additional information on lighting criteria.



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, FHWA Informational Report on Lighting Design for Midblock Crosswalks,

| Roadway Facility Classification ④ | Area Classification ③ (Pedestrian Conflict Area) | AVERAGE MAINTAINED ① HORIZONTAL ILLUMINANCE ($E_h$) footcandle (lux) Pavement Classification ④ R1 | R2 & R3 | R4 | UNIFORMITY RATIO (Ave./Min.) | VEILING LUMINANCE RATIO $L_{Vmax}/L_{avg}$ |
|---|---|---|---|---|---|---|
| Freeway ② | Class A<br>Class B | 0.6 (6)<br>0.4 (4) | 0.9 (9)<br>0.6 (6) | 0.8 (8)<br>0.5 (5) | 3:1 | 0.3 |
| Expressway ② | High<br>Medium<br>Low | 1.0 (10)<br>0.8 (8)<br>0.6 (6) | 1.4 (14)<br>1.2 (12)<br>0.9 (9) | 1.3 (13)<br>1.0 (10)<br>0.8 (8) | | |
| Major | High<br>Medium<br>Low | 1.2 (12)<br>0.9 (9)<br>0.6 (6) | 1.7 (17)<br>1.3 (13)<br>0.9 (9) | 1.5 (15)<br>1.1 (11)<br>0.8 (8) | | |
| Collector | High<br>Medium<br>Low | 0.8 (8)<br>0.6 (6)<br>0.4 (4) | 1.2 (12)<br>0.9 (9)<br>0.6 (6) | 1.0 (10)<br>0.8 (8)<br>0.5 (5) | 4:1 | 0.4 |
| Local | High<br>Medium<br>Low | 0.6 (6)<br>0.5 (5)<br>0.3 (3) | 0.9 (9)<br>0.7 (7)<br>0.4 (4) | 0.8 (8)<br>0.6 (6)<br>0.4 (4) | 6:1 | |
| Alleys | High<br>Medium<br>Low | 0.4 (4)<br>0.3 (3)<br>0.2 (2) | 0.6 (6)<br>0.4 (4)<br>0.3 (3) | 0.5 (5)<br>0.4 (4)<br>0.3 (3) | | |
| Walkways/ Bikeways and Intersections | See ANSI/IESNA RP-8 for recommended criteria and specific treatments. | | | | | |
| **REST AREAS AND WEIGH STATIONS** | | | | | | |
| Ramp Gores & Interior Roadways | All | 0.4 (4) | 0.6 (6) | — | 3:1 to 4:1 | 0.4 |
| Parking & Major Activity Areas | All | 0.8 (8) | 1.1 (11) | — | | |
| Minor Activity Areas | All | 0.4 (4) | 0.5 (5) | — | 6:1 | |

*Notes:*

1. *Average illuminance on the traveled way or on the pavement area between curb lines of curbed facilities.*
2. *Both mainline and ramps.*
3. *This assumes a separate facility. Facilities adjacent to a vehicular roadway should use the illuminance levels and uniformity ratios for that roadway.*
4. *See Section 56-5.04 for definitions of roadway facility, area, and pavement classifications.*

**IDOT ILLUMINANCE DESIGN CRITERIA**

**Figure 56-5B**



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Crosswalks/

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and FHWA Informational Report on Lighting Design for Midblock Crosswalks