# DESIGN CRITERIA MANUAL

# CHAPTER 5 LIGHTING

**MUNICIPALITY OF ANCHORAGE**

**PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT & TRAFFIC DEPARTMENT**

**JANUARY 2007**

**DESIGN CRITERIA MANUAL**
**REVISION LOG**

## Chapter 5 - Lighting

| Rev. No. | Date Executed | Description | Sections Revised or Added | New/*Revised* Template |
|---|---|---|---|---|
| 1. | April 2006 | 5.2 Codes, Policies, & Permits | Revised | Removed Reference to Alaska Administrative Code (AAC). |
| 2. | April 2006 | 5.2 Codes, Policies, & Permits | Revised | Switched Sections 5.2C and 5.2D, added additional variance language. |
| 3. | April 2006 | 5.4 Illumination Standards | Revised | Clarified and modified Section 5.4 G. |
| 4. | April 2006 | 5.4 Illumination Standards | Revised | Section 5.4 Parking Lots revised to follow Title 21. |
| 5. | April 2006 | 5.5 Load Centers | Revised | Section 5.5B regarding load center design criteria removed, controlled by M.A.S.S. |
| 6. | April 2006 | 5.6 Luminaire Spacing and Height | Revised | Added language to first paragraph regarding spacing and mounting heights for poles along lower classifications roads than arterials and modified third paragraph to a maximum mounting height of 40-feet. |
| 7. | June 2007 | 5.4 Illumination Standards | 5.4 B | Added language to STV criteria regarding its use as supplemental criteria to other design methods and not a stand-alone method and updated Table 5-3. |
| 8. | June 2007 | 5.4 Illumination Standards | 5.4 C | Section 5.4 C Trail and Pathway Illumination Levels requiring pedestrian facilities adjacent to roadways to meet the minimum requirements of Table 5-4. Modified Table 5-4 title. |
| 9. | June 2007 | 5.4 Illumination Standards | 5.4 D | Section 5.4 D. Provided additional information regarding white vs yellow light and illuminance vs luminance design. |
| 10. | 6/25/07 | Implemented Chapter 5 | All | |
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| | | | | |
| | | | | |
| | | | | |

# TABLE OF CONTENTS

## FIGURES



## TABLES

## SECTION 5.1 OBJECTIVES

The primary goal of lighting is to enhance traffic and pedestrian safety. The objective of this Chapter is to establish design criteria, which accomplishes safety goals and limits design variations. This will maintain a uniformity of appearance, reduce the number of replacement components which must be stocked, and prevent costly duplication of design effort. The designer should also consider potential adverse lighting impacts on adjacent properties when locating lighting fixtures. Discussion on related municipal codes and permits is also provided.

END OF SECTION 5.1

## SECTION 5.2 CODES, POLICIES, & PERMITS

### 5.2 A Objective

Street and trail light design within Anchorage is accomplished by (1) municipal projects; (2) state projects; and (3) as part of private development. These codes and policies are not applicable to state projects, but should be adhered to by designers for all other public and private street and trail projects.

### 5.2 B Municipal Codes

The electrical design of illumination facilities, which are supplied from a master meter, are considered "inside wiring." The design shall comply with the currently adopted edition of the NEC NFPA 70 together with local and state amendments. The authority having jurisdiction over electrical installations for a particular area shall inspect these facilities. Most installations are in this classification.

NESC ANSI-C2

Installations which are not metered, but are supplied from an electrical transformer and maintained by the serving utility are usually considered as "outside wiring" and shall comply with the current adopted edition of this publication together with local and state amendments. The serving and controlling utility shall inspect these installations.

### 5.2 C Permits

AMC Title 24.30 requires Right-of-way Permits for any work within rights-of-way or easements. These are obtained from the Department of Development Services.

M.A.S.S. requires Electrical Permits for all illumination electrical work. Illumination facilities are inspected by Municipal electrical inspectors and approved prior to hook-up pursuant to AMC Title 23.10, Chapter 3. Utilities providing electrical service also require Municipal inspection and tagging prior to energizing. The permit and inspections are obtained from the Department of Development Services.

### 5.2 D Design Variances

Designers, whether Municipal or private, shall adhere to the criteria established in this DCM and other referenced documents, unless compliance with such will compromise their judgment as professional engineers with regard to safety, cost effectiveness, and/or practicality. In such cases, a written variance request of the appropriate standard shall be obtained from the Municipal Traffic Engineer. Written variance requests shall be prepared and submitted through the Municipal Project Manager or Private Development Coordinator for a determination by the Traffic Engineer. Variance requests should contain supporting justification and/or suggested conditions. In addition to the criteria presented in this manual, the Municipal Traffic Engineer may at his/her sole discretion impose greater standards and criteria when deemed appropriate to protect the safety and welfare of the public.

END OF SECTION 5.2

## SECTION 5.3 CLASSIFICATIONS

### 5.3 A General

Lighting requirements are based primarily on the type of facility and volume of use. Therefore, lighting classifications are tied to the type of street, trail, or pathway being illuminated. Brief descriptions of street and pathway types are listed below. However, the designer should note that more in-depth information on roadway and trail types is available in Chapters 1 and 4 of this manual.

### 5.3 B Streets

1. **Freeways** are principal arterial corridors that are intended to provide safe and efficient movement of high volumes of traffic at high speeds. Access is rigidly controlled and all intersections are grade separated.

2. **Expressways** are divided arterial highways designed primarily for through traffic with full or partial control of access. Intersections are at grade and/or grade separated.

3. **Major arterials** are provided for long, through trips between large generators. A major arterial has intersections at grade, and provides direct access to arterials, collector streets, and major traffic generators.

4. **Minor arterials** are provided for medium length urban trips and service high-level commercial and residential generators. A minor arterial has intersections at grade and may provide access to abutting property.

5. **Collectors** form a grid that collects traffic from local streets and carries it to the arterial system. Collectors are low-speed streets that may provide access to abutting properties.

6. **Local or Secondary streets** typically have traffic volumes below 2,000 ADT and serve localized areas. The IESNA handbook refers to these as local roads.

7. **Alleys** are service routes at back property boundaries.

### 5.3 C Trails and Pathways

1. **Sidewalks** are paved or otherwise improved areas for pedestrian use. They are located within public street rights-of-way that also contain roadways for vehicular traffic.

2. **Walkways** are pedestrian facilities which do not parallel streets but provide connection to other pedestrian facilities or destinations.

3. **Bike Trails** are facilities whose primary function is to provide for bicycle travel.

4. **Equestrian trails** are facilities whose primary function is to provide for horse travel.

END OF SECTION 5.3

## SECTION 5.4 ILLUMINATION STANDARDS

In order to consistently meet the objectives identified in Section 5.1, specific design criteria have been developed. This section provides information on illumination terminology and levels, uniformity, and depreciation. Additionally, guidelines are provided for installation at streets, intersections, bus stops, railroad crossings, and parking lots.

Electrolier location and mounting heights shall be selected to provide the required illumination and uniformity levels, minimize adverse impacts on adjacent properties, and improve pedestrian and vehicular safety.

Specific construction specifications and details are provided in MASS.

### 5.4 A Definitions

Color Rendition Index (CRI) A measure of light quality emitted by a lamp.

Electrolier The complete assembly of pole, mast arm, luminaire, ballast, and lamp.

IESNA Full Cutoff A luminaire light distribution where zero candela intensity occurs at or above an angle of 90° above nadir. Additionally the candela per 1000 lamp lumens does not numerically exceed 100 (10 percent) at or above a vertical angle of 80° above nadir.

Illuminance The density of luminous flux incident upon a surface or the amount of light striking a surface.

Luminous Flux The visible output illumination from a light source.

Lumen The unit of luminous flux.

Luminaire The assembly that houses the light source and controls the light it emits. It consists of the hood (including socket), reflector and glass globe or refractor.

Luminance The luminous intensity of any surface in a given direction per unit of projected area of the surface as viewed from that direction, expressed in candela per square meter. This is the amount of light reflected off a surface.

RMC Galvanized Rigid Metal Conduit, called steel conduit in M.A.S.S.

Small Target Visability (STV) A method of illumination design that determines the visibility level of an array of targets on the roadway considering the luminance of the targets; luminance of the immediate background; adaptation level of the adjacent surroundings; and the disability glare. STV is the weighted average of the visibility level of these targets. Veiling luminance is included in the STV calculation methodology.

Veiling Luminance (Disability Glare) The veiling effect produced by bright sources or areas in the visual field that results in decreased visual performance and visibility. It is measured as the ratio of the veiling luminance (directly from lamp sources) to the average pavement luminance.

### 5.4 B Roadway Illumination Levels

Standard practice in continuous lighting design allows for the use of three different criteria. The design methods are

1. Illuminance
2. Luminance, and
3. STV.

It is the designer's responsibility to select the method that will best meet the needs of the individual project. Consideration can also be given to meeting two or all of the design criteria. All roadway lighting methods shall employ only luminaires that employ IESNA full cutoff optics in order to eliminate light trespass and sky glow.

Historically, designs have used the illuminance method, which is based on a calculation of the amount of light on the roadway surface. The illuminance method is typically applicable for low speed (design speeds of 30 mph or less), urban projects with traffic coming from multiple directions, multiple lighting sources, and conflict areas. Lighting design for sidewalks, bikeways, intersections, and high mast installations is often best achieved using the illuminance criteria.

The luminance criterion is typically good for roadways with moderate speeds (design speeds between 30 and 45 mph) and roads with the potential for significant glare. The luminance method is used internationally as the primary method for lighting major traffic routes, or primary streets. This design method determines how “bright” the roadway is by determining the amount of light reflected from the pavement in the direction of the driver.

Small Target Visibility (STV) is a new design approach, which incorporates recent studies of human visual processes and is intended to improve driver safety. The STV criterion is typically applied to high speed roads (design speeds greater than 45 mph) and roads involving critical driving tasks. The STV design table also provides the uniformity ratios and luminance requirements to mitigate the effect of approaching headlights. The STV criteria should not be used as a stand-alone design method but in conjunction with the luminance design criteria to optimize pole configurations to provide the minimum luminance criteria while maximizing the STV.

In urban areas, the maintained average illumination on horizontal surfaces, allowing for lamp lumen depreciation and dirt depreciation, shall not be below the following average levels on streets (assuming R3 type pavement as defined by IESNA):

**TABLE 5-1 ILLUMINANCE METHOD – RECOMMENDED VALUES**

| Roadway Classification | Pedestrian Conflict Area | Illuminance (lux or footcandles) (minimum) | Uniformity Ratio (avg/min) (maximum) | Veiling Luminance Ratio (vmax/min) (maximum) |
|---|---|---|---|---|
| Freeway Class A | -- | 9.0 / 0.9 | 3.0 | 0.3 |
| Freeway Class B | -- | 6.0 / 0.6 | 3.0 | 0.3 |
| Expressway | High | 14.0 / 1.4 | 3.0 | 0.3 |
| | Medium | 12.0 / 1.2 | 3.0 | 0.3 |
| | Low | 9.0 / 0.9 | 3.0 | 0.3 |
| Arterials | High | 17.0 / 1.7 | 3.0 | 0.3 |
| | Medium | 13.0 / 1.3 | 3.0 | 0.3 |
| | Low | 9.0 / 0.9 | 3.0 | 0.3 |
| Collector | High | 12.0 / 1.2 | 4.0 | 0.4 |
| | Medium | 9.0 / 0.9 | 4.0 | 0.4 |
| | Low | 6.0 / 0.6 | 4.0 | 0.4 |
| Local | High | 9.0 / 0.9 | 6.0 | 0.4 |
| | Medium | 7.0 / 0.7 | 6.0 | 0.4 |
| | Low | 4.0 / 0.4 | 6.0 | 0.4 |

The amount of pedestrian activity is typically associated with the abutting land use. The nighttime pedestrian classification levels and the land uses they are generally associated with are provided below:

**High** – Areas with significant numbers of pedestrians on the sidewalks and crossing streets during darkness such as downtown retail areas, theaters and concert halls, stadiums, and transit terminals.

**Medium** – Areas where fewer pedestrians use the streets at night such as downtown office areas, apartments, neighborhood shopping areas, industrial areas, older city areas, and streets with transit lines.

**Low** – Areas with very low pedestrian usage may be found in any of the above cited roadway classifications but are typically found along suburban single-family residential streets, low-density residential developments, and rural or semi-rural areas.

A guideline to determine the pedestrian activity level is to take a pedestrian count during the average annual first hour of darkness. Due to the continuously changing daylight hours found in Alaska in addition to the corresponding variation in pedestrian activity, use a first hour of darkness of 4:00 PM to 5:00 PM, which will approximately cover the period between mid November and the end of January. If 10 or fewer pedestrians are observed, consider the roadway to have low pedestrian activity; 11-100 pedestrians, medium activity; and over 100 pedestrians, high activity. The count should include all of the pedestrians walking on both sides of the street plus those crossing the street at non-intersection locations in a typical block section. Depending on the land use, there may be areas with unusual characteristics that experience peak pedestrian activity at different hours from the surrounding land that warrants increased lighting levels.

Luminance and STV design method criteria are presented in the following tables.

**TABLE 5-2 LUMINANCE METHOD – RECOMMENDED VALUES**

| Roadway Classification | Pedestrian Conflict Area | Average Luminance ($cd/m^2$) (minimum) | Uniformity Ratio (avg/min) (maximum) | Uniformity Ratio (max/min) (maximum) | Veiling Luminance Ratio (vmax/min) (maximum) |
|---|---|---|---|---|---|
| Freeway Class A | -- | 0.6 | 3.5 | 6.0 | 0.3 |
| Freeway Class B | -- | 0.4 | 3.5 | 6.0 | 0.3 |
| Expressway | High | 1.0 | 3.0 | 5.0 | 0.3 |
| | Medium | 0.8 | 3.0 | 5.0 | 0.3 |
| | Low | 0.6 | 3.5 | 6.0 | 0.3 |
| Arterials | High | 1.2 | 3.0 | 5.0 | 0.3 |
| | Medium | 0.9 | 3.0 | 5.0 | 0.3 |
| | Low | 0.6 | 3.5 | 6.0 | 0.3 |
| Collector | High | 0.8 | 3.0 | 5.0 | 0.4 |
| | Medium | 0.6 | 3.5 | 6.0 | 0.4 |
| | Low | 0.4 | 4.0 | 8.0 | 0.4 |
| Local | High | 0.6 | 6.0 | 10.0 | 0.4 |
| | Medium | 0.5 | 6.0 | 10.0 | 0.4 |
| | Low | 0.3 | 6.0 | 10.0 | 0.4 |

| TABLE 5-3 SMALL TARGET VISIBILITY – RECOMMENDED VALUES | | | | | |
|---|---|---|---|---|---|
| Roadway Classification | Pedestrian Conflict Area | STV Criteria (minimum) | Average Luminance ($cd/m^2$) Median < 7.3 m (minimum) | Average Luminance ($cd/m^2$) Median ≥ 7.3 m** (minimum) | Uniformity Ratio (max/min) (maximum) |
| Freeway Class A | -- | 3.2 | 0.5 | 0.4 | 6.0 |
| Freeway Class B | -- | 2.6 | 0.4 | 0.3 | 6.0 |
| Expressway | -- | 3.8 | 0.5 | 0.4 | 6.0 |
| Arterials | High | 4.9 | 1.0 | 0.8 | 6.0 |
| | Medium | 4.0 | 0.8 | 0.7 | 6.0 |
| | Low | 3.2 | 0.6 | 0.6 | 6.0 |
| Collector | High | 3.8 | 0.6 | 0.5 | 6.0 |
| | Medium | 3.2 | 0.5 | 0.4 | 6.0 |
| | Low | 2.7 | 0.4 | 0.4 | 6.0 |
| Local | High | 2.7 | 0.5 | 0.4 | 10.0 |
| | Medium | 2.2 | 0.4 | 0.3 | 10.0 |
| | Low | 1.6 | 0.3 | 0.3 | 10.0 |

**This column also applies to freeways and expressways where the alignment of the two roadways is independent of each other, or where there is a median barrier sufficient to block the direct view of oncoming headlights or a one-way street.

The above values are summaries of information found in the IESNA publication RP-8-00, *American National Standard Practice for Roadway Lighting*. The illumination levels established are not intended to cover special situations or to preempt engineering judgment for any particular design project. These lighting levels represent the lowest average levels that are currently considered appropriate for the kinds of roadways or walkways in the various areas.

### 5.4 C Sidewalk, Trail and Pathway Illumination Levels

Trails have been separated into categories based on their pedestrian activity level; use or area; and proximity to a continuously lighted roadway. The maintained illuminance values for pedestrian and bicycle facilities are shown in Table 5-4. The designer shall ensure that the roadway lighting provides the appropriate lighting levels along attached and separated pedestrian and bicycle facilities. Supplemental lighting may be required to ensure pedestrian facilities are adequately illuminated, particularly where there is separation between the pedestrian facility and the roadway. Lighting levels for attached and separated sidewalk and pathway categories shall not be below the levels shown in Table 5-4 when paralleling a roadway with continuous lighting.

As with roadway lighting, trail and pathway illumination should also employ IESNA full cutoff optics. There may be some cases where other cutoff classifications are allowable, depending on the area being lighted and with approval of the Municipal Traffic Engineer.

When a trail or pathway is completely separated from vehicular traffic and within its own independent right-of-way or the right-of-way of another facility, separate illumination requirements must be met. These lighting systems should be spaced such that users are guided by a consistent luminaire pattern. They must also illuminate hazards in the pathway (small obstacles, depressions, terrain variation) and other users. Under average conditions, a pathway should have an average maintained horizontal illuminance (at ground level) of 5 lux (0.5 fc) with an average to minimum horizontal uniformity ratio of 10:1. Where safety is a concern and it is desired to reduce the potential opportunities for criminal activities, the designer should consider altering the illumination requirements to meet a minimum maintained average vertical illuminance (at 5 feet above the pavement, in both directions) of 5 lux (0.5 fc) with an average to minimum vertical uniformity ratio of 5:1. These design criteria will allow for improved facial recognition, recognition of peripheral elements and movement, and minimize deep shadows.

**TABLE 5-4 MAINTAINED ILLUMINANCE VALUES FOR PEDESTRIAN FACILITIES ADJACENT TO ROADWAYS**

| Pedestrian Conflict Area | Land Use, Area, or Time | Average Horizontal Illuminance (lux or fc) (minimum) | Vertical Illuminance* (lux or fc) (minimum) | Uniformity Ratio (avg/min) (maximum) |
|---|---|---|---|---|
| High | Pedestrian Facilities Adjacent to Roadway | 20.0 / 2.0 | 10.0 / 1.0 | 4.0 |
| | Pedestrian Only | 10.0 / 1.0 | 5.0 / 0.5 | 4.0 |
| Medium | Pedestrian Areas | 5.0 / 0.5 | 2.0 / 0.2 | 4.0 |
| Low | Rural/Semi Rural | 2.0 / 0.2 | 0.6 / 0.06 | 10.0 |
| | Low Density Residential | 3.0 / 0.3 | 0.8 / 0.08 | 6.0 |
| | Medium Density Residential | 4.0 / 0.4 | 1.0 / 0.1 | 4.0 |
| Underpasses | Day | 100.0 / 10.0 | 50.0 / 5.0 | 3.0 |
| | Night | 40.0 / 4.0 | 20.0 / 2.0 | 3.0 |

*The minimum vertical illuminance is measured 5-ft above the walkway/bikeway in both directions parallel to the main pedestrian flow.

### 5.4 D Type of Lighting

Recent studies have shown that the human eye can better perceive objects in low light levels when the source spectrum is in the color temperature spectrum of blue lumens, more commonly known as “white light”. Metal halide, induction, and enhanced color high-pressure sodium lamps, all with a CRI of 65 or greater, can more closely reproduce light in this color temperature range than a typical high-pressure sodium lamp with a CRI of approximately 20. An emerging lighting technology that may soon provide a reliable source for white light is LED. “White light” has been found to improve perception-reaction time by providing roadway users better peripheral vision, it provides for better identification of colors and objects, and better aesthetics, as the color temperature is closer to that of natural light provided by the sun.

Designers shall employ luminaires that provide “white light” for all proposed and rehabilitation projects. Providing “white light” may come at a cost premium versus yellow light provided by high-pressure sodium luminaires depending on the design criteria method used (illuminance versus luminance) and increased maintenance, depending on the light source. Use of the luminance design criteria method may provide the designer a pole spacing advantage versus the illuminance design criteria. It is the designer’s responsibility to determine the most economical method of providing "white light" on a project-by-project basis and keeping current with technological advances in lighting. Occasions may arise in which other lighting sources may be more appropriate to the specific design situation or location. In these cases it is the designers responsibility to obtain a design variance from the Municipal Traffic Engineer.

### 5.4 E Uniformity of Lighting

The illumination levels established in Section 5.4 B are minimum and assume uniformity as discussed here. Uniformity may be expressed a couple ways. The average-level-to-minimum point method uses the average illuminance on the roadway design area divided by the lowest value at any point in the area. Under this method, the average-to-minimum ratio should not exceed the ratio provided in the tables above.

The other method of measuring uniformity is the maximum-level-to-minimum point method. It is essentially the same as the previously mentioned method with the exception of using the maximum illuminance point of a roadway. The maximum-to-minimum ratio should also not exceed the ratio provided in the tables above. Most design methods require that uniformity be calculated using only one of the above methods, while others (such as the luminance design method) may require accounting for both.

### 5.4 F Light Depreciation

The illumination levels established in Section 5.4 B represent average illuminance when the luminaires are at their lowest output. This condition occurs just prior to lamp replacement and luminaire washing. Since illuminance values may depreciate by as much as 50 percent between relamping and lens cleaning cycles it is imperative for the designer to account for lamp lumen depreciation (LLD) and luminaire dirt depreciation (LDD) factors.

### 5.4 G Street Illumination

For ease of winter maintenance and to reduce the chance of an electrolier being struck by an errant vehicle, the optimum location for poles and foundations is 3 feet behind the edge of roadside pedestrian facilities. If the available right-of-way has insufficient width for such positioning, other design options should be explored. Installing electroliers between the vehicular traveled way and a pedestrian facility should be a last resort.

The preferred roadway lighting configuration is to locate all electroliers on the same side of the roadway. Where the roadway is too wide to meet this criterion, electroliers should be located opposite each other on both sides of the roadway. Installing electroliers in medians is appropriate only where the median is sufficiently wide to accommodate snow storage and winter maintenance operations on either side of the electroliers without any conflicts.

Luminaires shall be installed to provide the optimum illumination levels and uniformity in conjunction with the most efficient spacing. A typical target location to begin evaluation is with the luminaire positioned over the fog line of a shoulder or the lip of gutter where there is no shoulder. Luminaire mast arms should typically be oriented such that they are perpendicular to the centerline of the roadway.

In order to reduce overall lighting levels and glare into homes along local roadways, the maximum allowable lamp size on local roads is 165 watts. Larger lamps may be used along primary streets (arterial and collector roadways) with the exception that 400 watts lamps not be used along residential and neighborhood collectors.

### 5.4 H Intersection Illumination

Because of the many pedestrian and vehicular conflict points at intersections, proper intersection lighting is a critical design component. Either silhouette or reverse silhouette lighting can provide appropriate nighttime visibility of pedestrians. Vehicle headlights, possibly in combination with fixed intersection lighting, produce reverse silhouette visibility. Reverse silhouette lighting can result in better identification of physical features of a pedestrian or object and can be further improved if a pedestrian is wearing light colored clothing that will provide additional reflectivity from a vehicles headlights.

Silhouette lighting is produced when the primary light source is behind the pedestrian generally resulting in a darker object being seen against a lighter background. While silhouette lighting may provide good visibility, it also provides for poor conspicuity and recognition. The value of direct visibility by headlighting a pedestrian, or from intersection lighting, is affected by the reflectivity of their clothing. For a street with properly designed continuous illumination, silhouette lighting may actually enhance pedestrian visibility, particularly if the pedestrian is wearing darker clothing.

In order to increase pedestrian visibility, electroliers shall be placed on the far right of the intersection to silhouette pedestrians for the direction of major traffic flow. Such a location provides an increased level of illumination through the intersection where conflicts occur. Near right illumination shall not be used on any approaches, as such a configuration tends to blind the driver and place the actual intersection in relative darkness. Electroliers should be place equidistant to each side of the intersection with sufficient spacing to provide the desired level of illumination at the intersection. At channelized intersections, a minimum of two electroliers shall be used so that the near left unit provides illumination of curb faces in the intersection. Figure 5-1 below shows lighting configurations that will maximize pedestrian visibility at intersections.

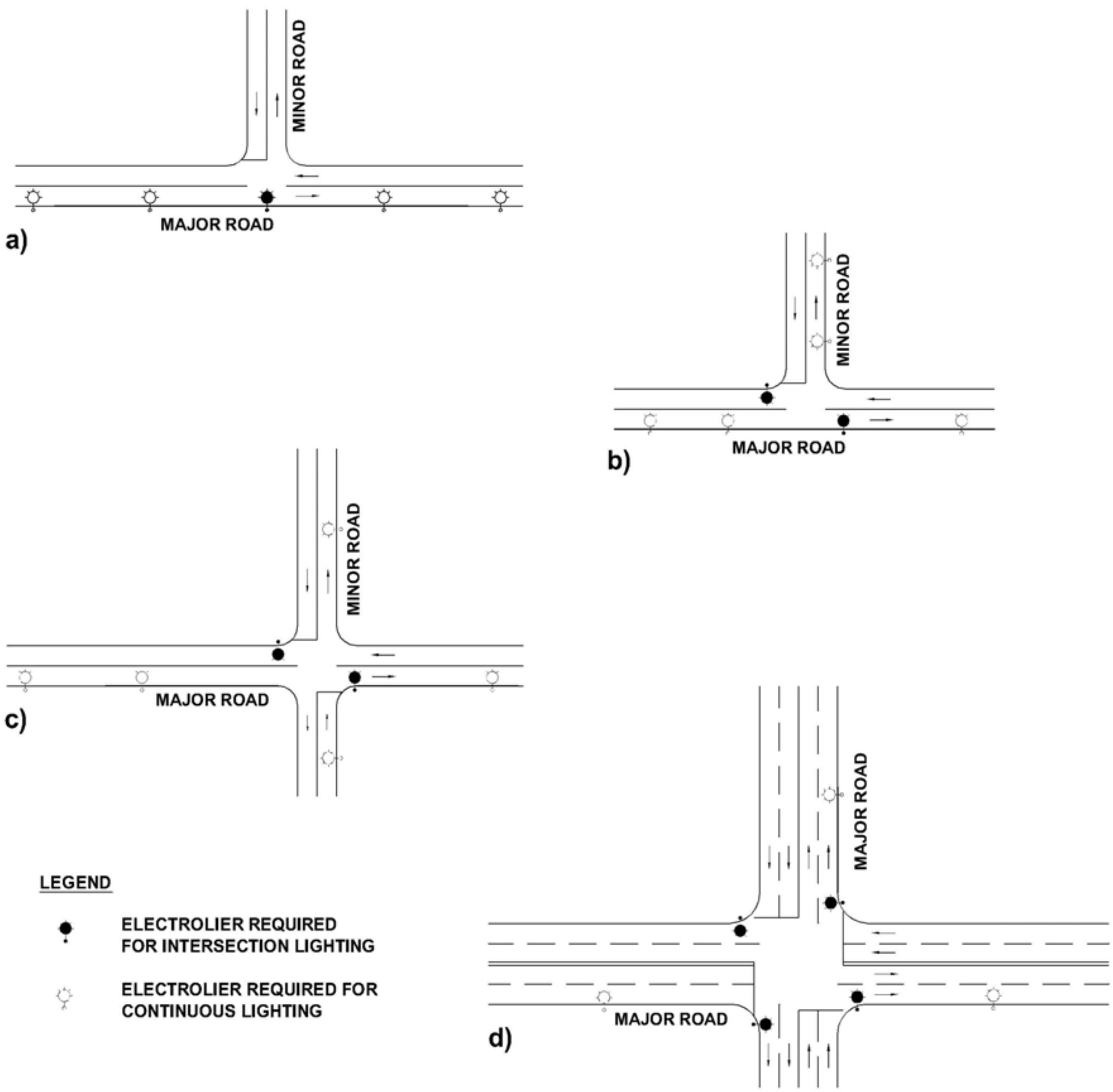


**FIGURE 5-1 INTERSECTION LIGHTING CONFIGURATIONS**

a) T-intersection b) T-intersection alternate (preferred) c) four-way intersection, two-lane main road with two-lane side road d) four-way intersection, four-lane road with four-lane cross road

For the purpose of evaluating lighting at intersections, IESNA uses the following classifications for roadways:

Major……..over 3,500 ADT

Collector…..1,500 to 3,500 ADT

Local………100 to 1,500 ADT

It should be noted that these functional classifications do not apply to standard street classifications.

In urban areas, approximately fifty percent of crashes typically occur at intersections. One of the primary benefits of lighting intersections along major streets (based on the above classification) is the reduction of nighttime pedestrian, bicycle, and fixed object crashes. Table 5-5 below provides intersection illuminance and uniformity criteria.

**TABLE 5-5 ILLUMINANCE FOR INTERSECTIONS**

| Functional Classification | Average Maintained Illuminance at Pavement by Pedestrian Area Classification (lux or fc) (minimum) | | | Uniformity (avg/min) (maximum) |
|---|---|---|---|---|
| | High | Medium | Low | |
| Major/Major | 34.0 / 3.4 | 26.0 / 2.6 | 18.0 / 1.8 | 3.0 |
| Major/Collector | 29.0 / 2.9 | 22.0 / 2.2 | 15.0 / 1.5 | 3.0 |
| Major/Local | 26.0 / 2.6 | 20.0 / 2.0 | 13.0 / 1.3 | 3.0 |
| Collector/Collector | 24.0 / 2.4 | 18.0 / 1.8 | 12.0 / 1.2 | 4.0 |
| Collector/Local | 21.0 / 2.1 | 16.0 / 1.6 | 10.0 / 1.0 | 4.0 |
| Local/Local | 18.0 / 1.8 | 14.0 / 1.4 | 8.0 / 0.8 | 6.0 |

## 5.4 I Bus Stops

When street lighting does not provide the minimum illumination levels established in Section 5.4 B, additional lighting might be required. Luminaires for lighting bus stops shall be placed at the approach side of the bus stop zone.

## 5.4 J Railroad Crossings

Railroad grade crossings shall be adequately lighted to permit identification of a crossing, presence or absence of a train in the crossing, and recognition of unlighted objects or vehicles at or near the railroad crossing.

Silhouette lighting is not effective at railroad crossings because of the massive bulk of railroad cars. The lighting design shall provide for illumination of both horizontal roadway/railway surfaces and vertical faces of the railroad cars. This normally requires that conventional electroliers be located in relatively close proximity (approximately 40 feet) in advance of the nearest rail. Each electrolier should have two luminaire mast arms, one each perpendicular to the roadway and the nearest rail.

Illuminance over the track area, starting at 100 feet before the crossing and ending 100 feet after the crossing, shall conform with the following tables but never less than an illuminance of 6 lux or a luminance of 0.6 candela per square meter with uniformity as provided in the tables below.

| TABLE 5-6 ILLUMINANCE METHOD – RECOMMENDED MAINTAINED VALUES FOR RAILROAD CROSSINGS | | | |
|---|---|---|---|
| Road Classification | Average Illuminance (lux or fc) (minimum) | Maximum Uniformity Ratio (avg/min) | Maximum Veiling Luminance Ration (max/avg) |
| Isolated Traffic Conflict Area | 9.0 / 0.9 | 4.0 | 0.3 |

| TABLE 5-7 LUMINANCE METHOD – RECOMMENDED MAINTAINED VALUES FOR RAILROAD CROSSINGS | | | | |
|---|---|---|---|---|
| Road Classification | Minimum Average Luminance ($cd/m^2$) | Maximum Uniformity Ratio (avg/min) | Maximum Uniformity Ration (max/min) | Maximum Veiling Luminance Ratio (max/avg) |
| Isolated Traffic Conflict Area | 0.6 | 3.5 | 6.0 | 0.3 |

| TABLE 5-8 STV METHOD – RECOMMENDED MAINTAINED VALUES FOR RAILROAD CROSSINGS | | | | |
|---|---|---|---|---|
| Road Classification | Minimum Weighted Average STV | Minimum Average Luminance ($cd/m^2$) Median < 7.3 m | Minimum Average Luminance ($cd/m^2$) Median ≥ 7.3 m | Maximum Uniformity Ratio (max/min) |
| Isolated Traffic Conflict Area | 2.6 | 0.5 | 0.4 | 6.0 |

### 5.4 K Parking Lots

Parking lots and other privately owned, off-street parking facilities shall be lighted in accordance with the guidelines set forth in Title 21.

END OF SECTION 5.4

## SECTION 5.5 LOAD CENTERS

Meters that are located on load centers shall serve streetlights. The designer shall carefully evaluate whether all electrical loads in a particular area should be fed from one meter. If the same agency is paying for all energy, only one load center should be installed whenever economically feasible. The designer, working through the serving utility, should determine whether a single meter is acceptable or whether multiple meters are required.

The designer should coordinate with traffic signal and/or thaw wire maintenance personnel to ensure that a common meter location is satisfactory to serve all loads. The designer shall also coordinate multiple meter locations to minimize visual clutter and the expense of connecting utility service to the meters.

Once the required number of meters is determined, the designer shall contact the servicing utility to coordinate meter base location and determine hook-up procedure. Obtain written approval of the location of the load center as well as the load center components from the serving utility. The submission of required utility applications for hook-up is the responsibility of the designer.

M.A.S.S. requires the contractor to obtain electrical permits and inspections. The contractor is also required to advise the utility when the system is ready for hook-up.

END OF SECTION 5.5

## SECTION 5.6 LUMINAIRE SPACING AND HEIGHT

The spacing of streetlights, also called luminaires and electroliers, is often influenced by the location of existing utility poles, block lengths, driveways, and property lot lines. Along arterials the use of higher wattage lamps at long spacing and high mounting heights is generally superior to the use of small lamps at closer spacing and lower mounting heights. Higher mounted luminaires provide greater coverage, better uniformity, and a reduction of glare, but at a lower illuminance level. Along collector and local roads, particularly residential and neighborhood collectors, higher wattage lamps and mounting heights should not be used as they provide more illumination than is needed over the roadway and result in undesirable spillover light onto private property.

To the extent practical, luminaires should be located at the common lot line between adjacent properties to avoid interference with present or future ingress/egress to the property. Where access is controlled, this is not a significant consideration. The designer should avoid placing luminaires in locations where the light would annoy homeowners or where it conflicts with other utility services.

Luminaire mounting heights above the road surface in residential neighborhoods should be 30 feet. Disability glare becomes an issue for drivers with lower mounting heights, while higher mounting heights are more likely to result in light trespass on residential properties. The mounting height along arterials and collectors is variable in 5-foot increments between 30 and a maximum of 40 feet. Luminaire heads should come equipped with leveling bubbles to ensure they are direct downfiring.

When selecting the mounting height, the designer should attempt to account for the vertical scale of the electroliers in relation to the roadway width. While it does not always provide the optimum illumination and uniformity levels, a good rule of thumb is that the mounting height be approximately 60% of the roadway width from outer edge to outer edge of the pedestrian facilities. This ratio provides a good sense of scale to the roadway, as shown in the figure below. Once the roadway typical section is determined, the luminaire mounting height can be selected by determining the nearest 5-foot increment pole above the 60% ratio distance.

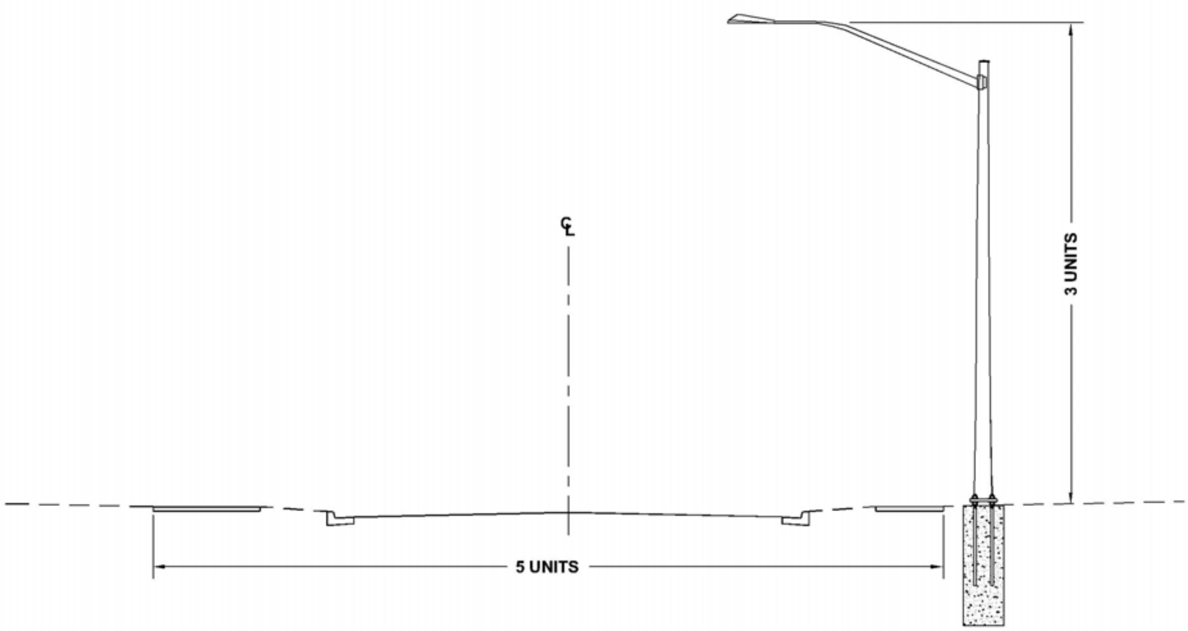


**FIGURE 5-2 LUMINAIRE MOUNTING HEIGHT TO ROADWAY WIDTH RELATIONSHIP**

END OF SECTION 5.6

## SECTION 5.7 POLES

Poles shall be designed to withstand winds of 100 MPH, with gusts of 130 MPH, while equipped with all mast arms, luminaires, signs, etc. Poles shall conform to the construction specifications provided in M.A.S.S. Direct embedded poles are acceptable in residential subdivisions, but in general, poles shall be installed on poured concrete or pile foundations.

The use of poles with breakaway bases shall be considered for all poles along streets with posted speeds of 40 MPH or greater and where the poles are inside the clear zone. A suitable traffic barrier shall protect poles placed inside the clear zone along roadways with speeds in excess of 40 MPH. In urban areas with speeds less than 30 mph and where pedestrians are present, non-breakaway poles should be used, as falling poles will present a greater danger to pedestrians and traffic. In urban areas where speeds are between 30 and 40 MPH, the designer may select either breakaway or non-breakaway poles. Standard details for fixed and breakaway bases are available from the Traffic Department. Breakaway poles shall comply with NCHRP 350 criteria. If the designer elects to use breakaway poles other than those provided in MASS, permission must be obtained from the Municipal Traffic Engineer through the design variance process.

END OF SECTION 5.7

## SECTION 5.8 FOUNDATIONS

Pole foundation specifications shall conform to M.A.S.S. unless otherwise approved by the Municipal Traffic Engineer. Limited experience with driven pile foundation indicates that it is usually more economical; however, soils conditions shall be researched and a qualified foundations or geotechnical engineer consulted if unusual conditions are expected. Screw foundations shall not be allowed. Construction plans shall identify finished foundation elevations unless directed otherwise directed by the Municipal Traffic Engineer.

END OF SECTION 5.8

## SECTION 5.9 UNDERGROUND COMPONENTS

In residential subdivisions where embedded poles are allowed, conductors may be installed in two-inch diameter PVC conduit except under roadways. At all other locations a minimum two-inch diameter steel conduit (also known as rigid metal conduit or RMC) is required. Underground components shall conform to the details and specifications established in M.A.S.S. and the NEC. A few specific undergrounding guidelines are as follows:

1. A type 1A junction box is required near the base of each pole.

2. All conduits will be buried at least 30 inches below final finished grade.

3. A 5/8-inch x 10-foot copper-coated ground rod is required in each junction box.

4. The preferred conductor is 3 Conductor stranded copper cable, typically #8 AWG or #6 AWG. Individual requirements may dictate deviations from this. A single conductor #8 AWG bare copper ground cable shall be run in conjunction with each lighting conductor.

5. An insulated grounding conductor shall be connected to the ground rod and to the pole at each location. However, all splices will be made in the pole.

6. Compaction in trenches shall conform to M.A.S.S. Disturbed areas shall be restored to their original condition.

7. Each electrolier shall have a fused splice disconnect kit installed within its base to maintain power to other electroliers on the same circuit in case of a pole knockdown.

END OF SECTION 5.9

## SECTION 5.10 SELECTED REFERENCES

IES Lighting Handbook, current edition, Illuminating Engineering Society of North America, 120 Wall St. 17th Floor, New York, New York 10005.

American National Standard Practice for Roadway Lighting, (ANSI/IESNA RP-8-00), Illuminating Engineering Society of North America, 120 Wall St. 17th Floor, New York, New York 10005.

Recommended Lighting for Walkways and Class 1 Bikeways, (ANSI/IESNA DG-5-1994), Illuminating Engineering Society of North America, 120 Wall St. 17th Floor, New York, New York 10005.

Lighting for Parking Facilities, (ANSI/IESNA RP-20-98), Illuminating Engineering Society of North America, 120 Wall St. 17th Floor, New York, New York 10005.

An Information Guide for Roadway Lighting, current edition, American Association, of State Highway and Transportation Officials, 444 North Capitol St., N.W., Suite225, Washington, D.C. 20001.

Transportation and Traffic Engineering Handbook, second edition, Institute of Transportation Engineers, 525 School St., S.W. 410, Washington, D.C. 20024.

National Electrical Code, NFPA 70, latest edition, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

National Electrical Safety Code, ANSI C2, latest edition, Institute of Electrical and Electronics Engineers, 345 E. 47th St., New York, New York 10017.

State of Alaska Amendments to the National Electrical Code and the National Electrical Safety Code.

Municipality of Anchorage Amendments to the National Electrical Code and the National Electrical Safety Code.

Municipal of Anchorage Standard Specifications (MASS), latest approved edition. Municipality of Anchorage, Public works Department.

Standard Specifications for Highway Construction, Alaska Department of Transportation and Public Facilities, Chief of Engineering Services, P.O. Box 1467, Juneau, AK 99802.

END OF SECTION 5.10