Roadway Lighting

Design Guide

October 2005

American Association
of State Highway and
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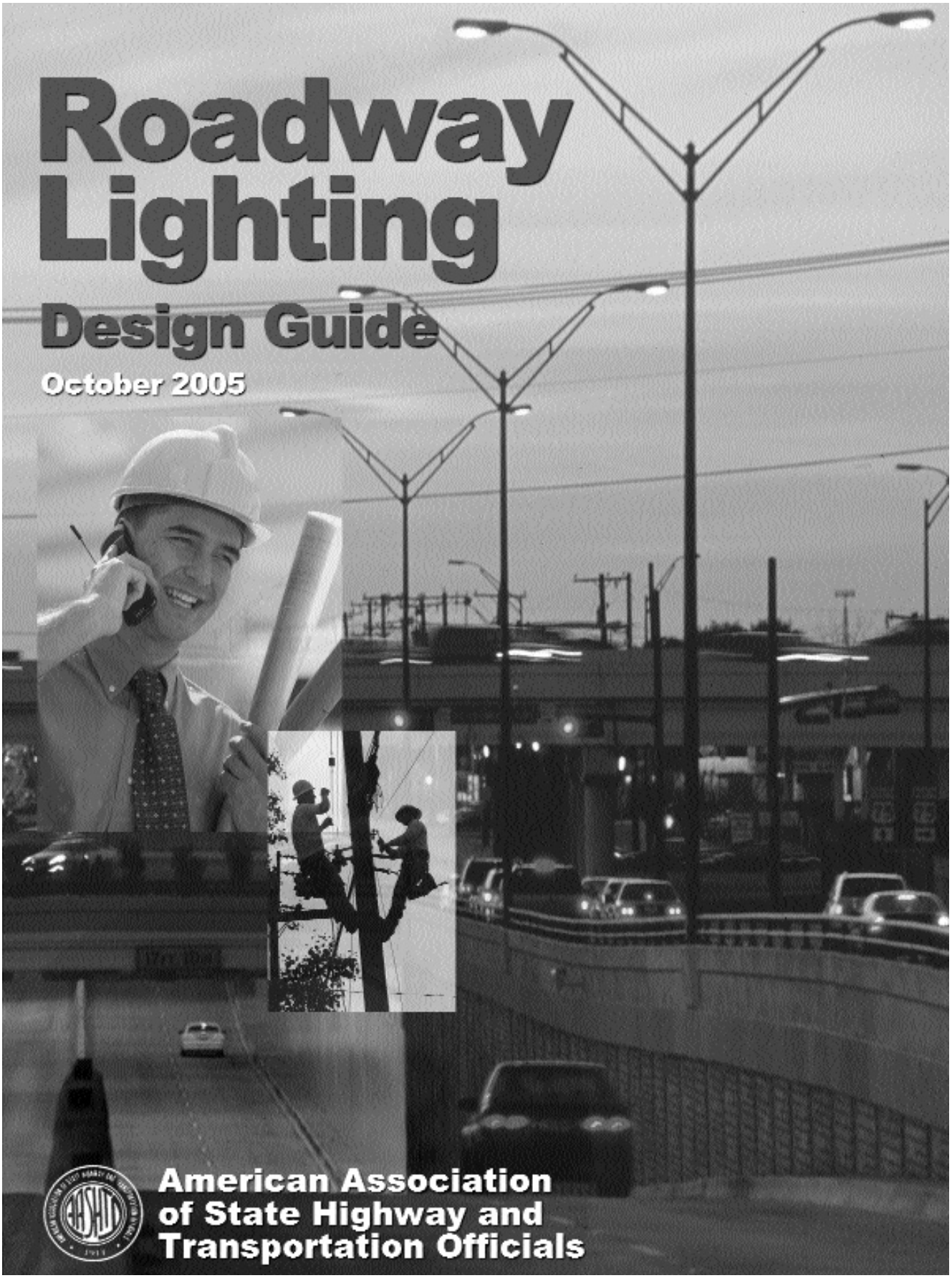

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Chapter 1
Introduction

Overview

This guide replaces the 1984 publication entitled, *An Informational Guide for Roadway Lighting*. It has been revised and brought up to date to reflect current practices in roadway lighting. The guide provides a general overview of lighting systems from the point of view of the transportation departments and recommends minimum levels of quality. The guide incorporates the illuminance and luminance design methods, but does not include the small target visibility (STV) method.

Two appendices to this document are located online for reference purposes at http://downloads.transportation.org/lighting.pdf. Appendix A is entitled *Literature Review and References*, and contains information on research studies related to accidents and highway lighting, driver parameters, pavement parameters, and a summary of further references. Appendix B contains an overview of *Lighting Basics*, including background information on the various issues related to effective highway lighting.

Need for Engineering Expertise

Most states require that final design documents be signed and sealed by a registered professional engineer. The registrant is normally required to only sign and seal documents that the registrant prepared, or documents for which the registrant was responsible for the direction and control of the work. Documents include specifications, reports, drawings, plans, design information, and calculations. Lighting designs, as described in this guide, meet the criteria for requirement of an engineering seal. This is necessary because the public interest is at stake. In addition, the designs integrated with other aspects of the transportation facility that have engineering features. These other aspects include support structures, breakaway devices, pavement characteristics, electrical characteristics, traffic engineering features, traffic management features, and the relative priority of lighting with respect to other safety features on the facility. Proper engineering judgment must be used in the integration of the various aspects of the facility, as well as in the consideration of maintenance and life-cycle costs.

Many of the current problems in outdoor lighting are due to poor lighting designs. These problems include less than optimal benefits from the lighting systems, excessive glare and visual clutter at night, the use of improper deprecation factors and photometric distributions, excessive sky glow and light trespass, and excessive maintenance and energy costs. The primary cause of poor lighting designs is a lack of proper lighting and electrical education.

Necessary Expertise

Departments of transportation (DOTs) that hire consultant engineers are paying for engineering expertise. This expertise is available in the area of roadway lighting and associated electrical systems. The expertise required for DOT lighting designs includes:

- lamp types and characteristics, including depreciation factors
- ballast types and characteristics
- fixture mechanical characteristics

- lens types
- photometric performance of luminaires and factors impacting such performance
- fixture mounting types
- pole mechanical and electrical characteristics
- breakaway device options and when appropriate to use
- clear zone criteria
- pole types, mounting options, and loading considerations
- foundation and support details
- pavement reflection factors
- mounting height and spacing options
- light trespass and sky glow issues including laws and ordinances
- lighting quality requirements, such as illuminance, luminance, veiling luminance, and visibility
- maintenance considerations for individual components and the lighting system as a whole
- energy and life-cycle costs
- coordination with master lighting plans.

Consultants accepting payment for lighting system design should perform that work in an engineering manner. This includes exercising engineering judgement when balancing all of the above characteristics. Training courses are available for engineers wishing to learn how to design lighting systems.

Recommended Design Methods

This guide recommends only the luminance and illuminance design methods but recognizes efforts to turn lighting designs toward visibility-based design methods. A discussion of visibility-based methods is included. The fact that this guide does not recommend the small target visibility (STV) design method should not be interpreted as non-support for visibility based methods and associated research. The STV method is not recommended as standard practice because the increased benefits of using this design method have not been adequately demonstrated and confidence in the ability to achieve design values and better visibility is low. Accurate visibility calculations require the input of all light sources, including off-roadway sources and headlamps from multiple vehicles. Such data are not easily obtained on roadways under even moderate traffic conditions. The fact that lighting is installed on roadways based on, among other things, high traffic volumes lends further uncertainty to the value of visibility calculations. STV or other visibility criteria may be applied as an additional quality criteria in order to gain experience with those methods and to determine the value of such criteria.

Modern Controls and Master Lighting Plans

This guide also addresses modern control methods for lighting systems and encourages the use of a master lighting plan incorporated into the traffic management centers, emergency management centers, or other central locations. Better use of resources can be achieved through innovative strategies such as lighting curfews, special event and weather situation control, and maintenance automation. Curfews can create energy savings. Energy cost savings on one particular lighting system may allow additional lighting systems to be installed and operated in peak traffic times, thereby improving safety of the entire area under the jurisdiction of the master lighting plan.

Maintenance inventory and management can be improved by remotely monitoring percentage of lights burning, diagnosing problems prior to sending out maintenance crews, tracking life-cycle costs, and monitoring the performance level of maintenance contractors.

Chapter 2
Master Lighting Plans

2.1 OVERVIEW

Introduction

The commitment to lighting roadway facilities is a large responsibility. A master lighting plan can help in the fulfillment of this responsibility. This chapter provides general guidelines for implementing a master lighting plan when local authorities determine that such a plan is desirable for their community.

Definition

A master lighting plan is a formal arrangement between local governments and other entities within a regional area to coordinate and standardize the design, operation, and maintenance of public lighting. Master lighting plans can include lighting curfews and sophisticated monitoring systems (described in Sections 2.4 and 2.5, respectively).

Benefits

The basic benefits of lighting include safety, beautification, and security for people and property. Additional benefits derived from a master lighting plan include:

- improved safety through the maximizing of resources
- a consistent image, reflecting the local culture and tastes
- nighttime linking of various sections of the city
- systems that better identify the nature of the site (residential versus "restaurant row," for example)
- better management of energy use
- tighter control of sky glow and light trespass
- aid in implementing lighting curfews
- increased public security (other concerns may warrant immediate turning on or off)
- coordinated maintenance
- easier coordination of maintenance specifications, such as poles, breakaway devices, and luminaires.

2.2 PLAN DEVELOPMENT

Introduction

The master lighting plan development process can proceed as shown in the following table.