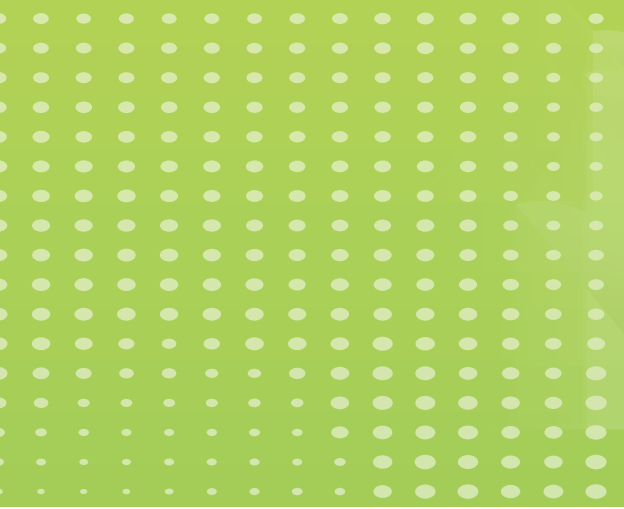




Roadway Lighting Design Guide

Seventh Edition ★ October 2018



This is a preview. [Click here to purchase the full publication.](#)

AMERICAN ASSOCIATION
OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS

AASHTO

Cover photos: Top photo: Garfield Parkway, Bethany Beach, Delaware; photo courtesy of Delaware DOT.
Bottom photo: Photo courtesy of Minnesota DOT.

© 2018, by American Association of State Highway and Transportation Officials. All rights reserved. This book, or parts thereof, may not be reproduced in any form without written permission of the publisher. Printed in the United States of America.

Publication Code: GL-7

ISBN: 978-1-56051-725-2

This is a preview. [Click here to purchase the full publication.](#)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS EXECUTIVE COMMITTEE

2018/2019

Voting Members

Officers:

President: Carlos Braceras, Utah*

Vice President: Patrick McKenna, Missouri*

Secretary-Treasurer: Scott Bennett, Arkansas*

Executive Director: Bud Wright, Washington, DC

Regional Representatives:

Jennifer Cohan, Delaware

Victoria Sheehan, New Hampshire

Russell McMurry, Georgia

Joe McGuinness, Indiana

Mark Lowe, Iowa

Roger Millar, Washington

Marc Luiken, Alaska

Non-Voting Members

Immediate Past President: John Schroer, Tennessee

** Elected at AASHTO's 2018 Annual Meeting in Atlanta, Georgia*

COMMITTEE ON DESIGN

2017/2018

Chair: Carlos Braceras, UTAH

Vice Chair: Joyce Taylor, MAINE

Liaison: Robert Mooney, FHWA

Liaison: Patricia Bush, AASHTO

MEMBERS

ALABAMA

Stan Charles Biddick
Steven E. Walker
William F. Adams

ALASKA

Mark Neidhold
Pat Carroll
Sarah E. Schacher

ARIZONA

Steve Boschen
Todd Emery

ARKANSAS

Trinity Duane Smith
Michael Fugett
Charles Martin

CALIFORNIA

Cathrina Barros
Janice Benton

COLORADO

Ken Brubaker
Neil Joseph Lacey

DELAWARE

Michael Nauman
Brian Thad McIlvaine

DISTRICT OF COLUMBIA

Zahra Dorriz
Mohammed Adil Rizvi
Paul Hoffman

FLORIDA

Paul Hiers
Michael Allen Shepard
Tim R. Lattner

GEORGIA

Andrew John Heath
Andy Andy Casey
Brent A. Story

IDAHO

Kevin Sablan
Ted E. Mason

ILLINOIS

Michael Brand
Dan Mlacnik

INDIANA

Jeff Clanton
Elizabeth W. Phillips

IOWA

Michael J. Kennerly
Tony Gustafson

KANSAS

Tom Rhoads
Scott W. King
Debbie Tanking

KENTUCKY

Jill Asher
Keith K. Caudill
Bradley S. Eldridge

LOUISIANA

Chad Winchester
David Smith

MAINE

Charles S. Hebson
Brad P. Foley
Steve Bodge

MARYLAND

Eric E. Marabello
Jason A. Ridgway
Angela Smith

MASSACHUSETTS

Andrew Paul
Hasmukh M. Patel
Lyris Liautaud

MICHIGAN

Demetrius Parker
Kristin Schuster
Colin Forbes

MINNESOTA

Chris Roy
Andrea Hendrickson
Tom Styrbicki

MISSISSIPPI

Amy Mood
David Seal
James Richard Pittman

MISSOURI

Eric Schroeter

MONTANA

Dustin E. Rouse
James Alan Combs
Lesly Tribelhorn

NEBRASKA

Nathan Sorben
Mike H. Owen

NEVADA

Paul Frost
Casey Connor

NEW HAMPSHIRE

Keith A. Cota
James Andrew Marshall

NEW JERSEY

Robert Marshall
Paul F. Schneider

NEW MEXICO

Priscilla Benavides
Gabriela C. Apodaca

NEW YORK

Bradley J. Bortnick
Richard D. Wilder
Stephen A. Zargham

NORTH CAROLINA

Teresa Bruton
Christopher Werner
Glenn W. Mumford

NORTH DAKOTA

Roger Weigel

OHIO

Kyle A. Brandon
David L. Holstein

OKLAHOMA

Caleb Franklin Austin
Eduardo Elder
Tim Tegeler

OREGON

David Joe Polly

PENNSYLVANIA

Christine Spangler
Melissa J. Batula

RHODE ISLAND

Robert Rocchio
Richard Bernardo

SOUTH CAROLINA

George R. Bedenbaugh, Jr.
Ladd Gibson

SOUTH DAKOTA

Brian Raecke
Mark A. Leiferman

TENNESSEE

Ali R. Hangul
Jennifer Lloyd
Jeff C. Jones

TEXAS

Camille Thomason

UTAH

Ben G. Huot
George C. Lukes
Fred Doehring

VERMONT

Ken Robie
Nick Wark

VIRGINIA

Vernon W. Heishman
Susan Keen
Barton A. Thrasher

WASHINGTON STATE

Edward J. Carpenter
Julie Ann Heilman
Mike Fleming

WEST VIRGINIA

R.J. Scites
Dirar M. Ahmed
Chad Jon Aaron Toney

WISCONSIN

David L. Stertz

WYOMING

Andrea Taylor Allen
Jeffrey E. Brown
Sandra A. Pecemka

COMMITTEE ON TRAFFIC ENGINEERING

2017/2018

Chair: Meg Pirkle, GEORGIA

Vice Chair: Neil Boudreau, MASSACHUSETTS

Liaison: Robert Mooney, FHWA

Liaison: Jameelah Hayes, AASHTO

MEMBERS

ALABAMA
Andrew Harry
Kerry NeSmith
Taylor Stoudenmire

ALASKA
David Epstein
Matt Walker
Pamela Golden

ARIZONA
Maysa Hanna
Todd Emery
William Faber

ARKANSAS
Trinity Smith

CALIFORNIA
Duper Tong

COLORADO
Charles Meyer

CONNECTICUT
Erika Lindeberg
Mark Carlino
Tracy Fogarty

DELAWARE
Mark Luszc

DISTRICT OF COLUMBIA
Emily Dalphy
Ogechi Elekwachi
Wasim Raja

FLORIDA
Fred Heery
Trey Tillander

GEORGIA
Alan Davis
Andrew Heath
Brent Cook
Meg Pirkle

GOLDEN GATE BRIDGE,
HIGHWAY, AND
TRANSPORTATION
DISTRICT
Maurice Palumbo

HAWAII
Bryan Kimura
Karl Kunishige
Peter Chan

IDAHO
Kevin Sablan
Mona Hunt
Ryan Lancaster

ILLINOIS
Kyle Armstrong
Lisa Heaven-Baum

INDIANA
Brad Steckler
David Boruff

IOWA
Steve Gent
Tim Crouch

KANSAS
Brian Gower
Carla Anderson
Eric Nichol

KENTUCKY
Jason Hyatt
Jeff Wolfe
Tamra Wilson

LOUISIANA
Chris Ewing
Hong Zhang
Jody Colvin

MAINE
Steve Hunnewell
Steve Landry

MARYLAND
Cedric Ward

MASSACHUSETTS
Charles Hale
James Danila
Neil Boudreau

MICHIGAN
Garrett Dawe
Mark Bott
Paul Ajegba

MINNESOTA
Jay Hietpas
Peter Buchen

MISSISSIPPI
Andy McNair
James Sullivan

MISSOURI
Nicole Hood
Thomas Honich

MONTANA
Danielle Bolan
Roy Peterson

NEBRASKA
Dan Waddle
Matt Neemann

NEVADA
Denise Inda
Rodney Schilling
Seth Daniels

NEW HAMPSHIRE
Lee Baronas
Susan Klasen
William Lambert

NEW JERSEY
Kevin Dunn

NEW MEXICO
Afshin Jian

NORTH CAROLINA
Dominic Ciaramitaro
Kevin Lacy

NORTH DAKOTA
Shawn Kuntz

OHIO
David Holstein
Jason Yeray

OKLAHOMA
Chad Pendley
David Glabas

OREGON
Michael Kimlinger

PENNSYLVANIA
Daniel Farley
Glenn Rowe

RHODE ISLAND
Steven Pristawa

SOUTH CAROLINA
Mike Bowman
Robert Perry

SOUTH DAKOTA
Christina Bennett
John Less
Scott Jansen

TENNESSEE
Jason Oldham
Phillip Freeze
Zane Pannell

TEXAS
Michael Chacon

UTAH
Glenn Blackwelder
John Leonard
Robert Miles

VERMONT
Amy Gamble
Patricia Coburn

VIRGINIA
Anne Booker
Raymond Khoury
Van Nguyen

WASHINGTON STATE
Brian Walsh
John Nisbet
Matt Neeley

WEST VIRGINIA
Cindy Cramer
Matt Skiles
Monty Khan

WISCONSIN
Bill McNary

WYOMING
Jeff Mellor
Joel Meena
Lee Roadifer

JOINT TECHNICAL COMMITTEE ON ROADWAY LIGHTING

2017/2018

Chair: Mark Luszcz, DELAWARE

Vice Chair: Ahmet Demirbilek, WISCONSIN

Liaison: Joseph Y. Cheung, FHWA

Liaison: Patricia Bush, AASHTO

VOTING MEMBERS

FLORIDA
Ed Cashman

INDIANA
Prakash T. Patel

MINNESOTA
Sue Zarling

NEW YORK
Norman P. Schips

NORTH CAROLINA
Paul Ki-Bun Chan

PENNSYLVANIA
Daryl R. St. Clair

SOUTH DAKOTA
Norris Leone

UTAH
Larry L. Montoya

ACKNOWLEDGMENTS

The Joint Technical Committee on Roadway Lighting would like to thank the following individuals for all of their contributions to the project.

Stacy Bartlett, South Dakota DOT
Ed Sansing, formerly Mississippi DOT
Max Saintil, Delaware DOT
Brent Jennings, formerly Idaho DOT
William Hopkins, formerly Georgia DOT
Wes Dean, Mississippi DOT

Paul Lutkevich, WSP
Mir Wahed, JMT
Robert Macioce, Urban Engineers
Denny Hehman, McCormick Taylor
Dr. Ron Gibbons, Virginia Tech
Paul Carlson, Road Infrastructure

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION.....	1
1.1 Overview	1
1.2 Need for Engineering Expertise.....	2
1.3 Safety Research and Application	3
1.4 Recommended Roadway Lighting Design Methods	3
1.5 Master Roadway Lighting Plans	4
1.6 Modern Roadway Lighting Controls	4
1.7 Emerging Roadway Lighting Technologies.....	4
1.8 References	5
CHAPTER 2: MASTER LIGHTING PLANS.....	6
2.1 Overview	6
2.1.1 Introduction	6
2.1.2 Definition	6
2.1.3 Benefits.....	6
2.2 Plan Development	7
2.2.1 Introduction	7
2.2.2 Participants	7
2.2.3 Gropus Having Concerns About Lighting.....	8
2.3 Goals of a Master Lighting Plan	8
2.3.1 Introduction	8
2.3.2 Improve Roadway Safety.....	8
2.3.3 Increase Personal Security.....	9
2.3.4 Provide Nighttime Aesthetics	9
2.3.5 Consider Environmental Issues	9
2.3.6 Use Energy Efficiently.....	10
2.3.7 Plan Maintenance	10
2.4 Lighting Curfews	10
2.4.1 Introduction	10
2.4.2 Reasons for Curfews	11
2.4.3 Considerations before Implementation	11
2.5 Electrical and Lighting Management Systems.....	12
2.5.1 Introduction	12
2.5.2 Cost.....	13
2.5.3 Benefits	13
2.5.4 Benefits of ELMS Standardization	13
2.6 Conducting Studies.....	14
2.6.1 Introduction	14
2.6.2 Lighting Justification Criteria	15
2.6.3 Electrical System	15
2.6.4 Benefits and Effects of Curfews and Dimming	15

2.6.5	Traffic Studies.....	15
2.6.6	Community Goals.....	15
2.6.7	Budget	15
2.7	References	16

CHAPTER 3: TECHNIQUES OF LIGHTING DESIGN..... 17

3.1	OVERVIEW	17
3.1.1	Introduction	17
3.1.2	Level and Uniformity of Illuminance and Luminance.....	17
3.1.3	Illuminance Considerations	18
3.1.4	Luminance Considerations	18
3.1.5	Visibility-Based Design Methods.....	20
3.2	Warranting Conditions	20
3.2.1	General	20
3.2.2	Benefits of Lighting.....	20
3.2.3	Rural Interchanges	20
3.2.4	Warranting Conditions for Lighting on Freeways	21
3.2.5	Continuous Freeway Lighting.....	21
3.2.6	Complete Interchange Lighting.....	21
3.2.7	Partial Interchange Lighting	22
3.2.8	Special Considerations	23
3.2.9	Bridges	23
3.3	Design Values for Freeways	23
3.3.1	General	23
3.3.2	Design Considerations	23
3.3.3	Lighting Levels on Crossroads	24
3.3.4	Partial Interchange Lighting	24
3.3.5	Adaptation (Transition) Lighting	26
3.3.6	Bridges and Overpasses	26
3.3.7	Other Considerations	26
	3.3.7.1 Aesthetics	26
	3.3.7.2 Future Lighting	26
3.3.8	Area Classifications.....	26
	3.3.8.1 Commercial.....	26
	3.3.8.2 Intermediate	26
	3.3.8.3 Residential	26
3.4	Streets and Highways Other Than Freeways (Including Walkways and Bicycle Ways)	27
3.4.1	General	27
3.4.2	Warranting Conditions	27
3.4.3	Lighting Design Levels	27
3.4.4	Other Considerations	27
3.5	Pole Placement Guidelines	31
3.5.1	Introduction	31
3.5.2	Obstruction of View.....	31
3.5.3	Height Restrictions	31
3.5.4	Center Medians.....	31
3.5.5	Gore Areas	32

3.5.6	Intersections.....	32
3.5.7	Adjacent to Deflecting Barriers	34
3.5.8	General Safety Concerns	34
3.5.9	Design Options.....	34
3.5.9.1	<i>Option 1: Remove the Obstacle</i>	<i>34</i>
3.5.9.2	<i>Option 2: Redesign the Obstacle.....</i>	<i>34</i>
3.5.9.3	<i>Option 3: Relocate the Obstacle</i>	<i>35</i>
3.5.9.4	<i>Option 4: Use Appropriate Breakaway Device.....</i>	<i>35</i>
3.5.9.5	<i>Option 5: Shield Obstacle</i>	<i>36</i>
3.5.9.6	<i>Option 8: Delineate the Obstacle</i>	<i>36</i>
3.6	References	37

CHAPTER 4: TUNNELS AND UNDERPASSES 38

4.1	Overview	38
4.1.1	Introduction	38
4.2	Underpasses	38
4.2.1	General Scope and Guide Application.....	38
4.2.2	Warrants for Night-Time Underpass Lighting	38
4.2.3	Design Values for Underpass Lighting	39
4.2.4	Selection and Placement of Underpass Luminaires	39
4.3	Vehicular Tunnels	39
4.3.1	General Scope and Guide Application.....	39
4.3.2	Short Tunnels.....	40
4.3.3	Long Tunnels	40
4.3.4	Warrants for Tunnel Lighting	40
4.3.5	Visibility Optimization of the Tunnel and Approach Features	41
4.3.5.1	<i>Reduction of Ambient Daytime Brightness</i>	<i>41</i>
4.3.5.2	<i>Portal Design Factors</i>	<i>41</i>
4.3.5.3	<i>Visibility Optimization of Tunnel Interiors.....</i>	<i>41</i>
4.3.5.4	<i>Types of Pavement Surfaces</i>	<i>41</i>
4.4	Daytime Lighting of Tunnel Interiors	42
4.4.1	Short Tunnels—Silhouette Visibility.....	42
4.4.2	Tunnel Approach at Entrance Portal	42
4.4.3	Interior Tunnel Lighting	42
4.4.4	Nighttime Tunnel Lighting.....	43
4.4.5	Emergency and Egress Lighting Systems.....	43
4.4.6	Selection and Placement of Tunnel Luminaires.....	43
4.4.7	Tunnel Lighting Control Systems	43
4.4.8	Maintenance Factor for Tunnel Lighting Design	43
4.5	References	43

CHAPTER 5: WORK ZONE LIGHTING AND TEMPORARY ROADWAY LIGHTING 45

5.1	Overview	45
5.1.1	Introduction	45