AASHTO

American Association of State Highway and Transportation Officials

AASHTO Guide for Interlocking Pavements

First Edition

August 2024

Cover Photos: Rockville, MD; Charles City, IA; Elmhurst, IL | All Courtesy of Concrete Masonry and Hardscapes Association

American Association of State Highway and Transportation Officials

American Association of State Highway and Transportation Officials
555 12th Street, NW, Suite 1000
Washington, DC 20004
(202) 624-5800
transportation.org

Publ. Code: AGIP-1 ISBN: 978-1-56051-832-7

2023–2024

Executive Committee

President: Craig Thompson, Wisconsin*
Vice President: Garrett Eucalitto, Connecticut
Secretary/Treasurer: Russell McMurry, Georgia
Executive Director: Jim Tymon

Regional Representatives:

Region I	Vacant William J. Cass, New Hampshire
Region II	Lorie Tudor, Arkansas Jim Gray, Kentucky
Region III	Jack Marchbanks, Ohio Scott Marler, Iowa
Region IV	Joel Jundt, South Dakota Ed Sniffen, Hawaii

Immediate Past President: Roger M. Millar, Washington

*Elected at the 2023 Annual Meeting in Indianapolis, Indiana

Page left blank intentionally.

Committee on Materials and Pavements

Chair
Matt Linneman
North Dakota DOR

Vice Chair
Curt M. Turgeon
Minnesota DOT

STATE DOT MEMBERS

Alabama
Scott W. George
Kaye C. Davis
Steven Ingram

Alaska
Michael San Angelo
Andrew Pavey
Garrett Speeter

Arizona
Jesús A. Sandoval-Gil

Arkansas
Paul Tinsley

California
Tim Greutert
Dulce Rufino Feldman
Tom Pyle

Colorado
Craig Wieden

Conneticut
Eliana Carlson
Chris Angelotti
John W. Henault

Delaware
Jennifer Pinkerton
Hany Fekry

District of Columbia
Rezene Gurmu Medhani
Andrew Kaufmann
Jason Allen Griffin

Florida
Sue Zheng
Howie Moseley
Mary Jane Hayden

Georgia
Ian D. Rish
Patrick Allen
Peter Wu

Hawaii
Mel Chung
Brian Ikehara

Idaho
Chad W. Clawson
John Arambarri
Mike Copeland

Illinois
Brian Pfeifer
Andrew J. Stolba
John Senger

Indiana
Matthew Beeson
Jim Reilman
Kurt Sommer

Iowa
Jeff De Vries
Chris B. Brakke
Scott Schram

Kansas
Richard A. Barezinsky
Christopher Leibrock

Kentucky
Allen H. Myers
Brandi R. Mitchell
Gregory W. Garner

Louisiana
Kris Wascom
Jason Davis
Justin W. Morris

Maine
Richard L. Bradbury
Casey B. Nash

Maryland
Sejal Barot
Eric M. Frempong

Massachusetts
Jason Robertson
Bryan Engstrom
Edmund J. Naras

Michigan
Kevin Patrick Kennedy
Christopher Ronald Byrum
Michael J. Eacker

Minnesota
Curt M. Turgeon, Vice Chair

Mississippi
Griffin Sullivan

Missouri
Brett S. Trautman
Brandi Baldwin
Jason Blomberg
Sarah Kleinschmit

Montana
Ross "Oak" Metcalfe
Jim Davies

Nebraska
Brendon Schmidt
Wally J. Heyen

Nevada
Changlin Pan
Katherine M. Mellon
Peter Nils Schmalzer

New Hampshire
Joseph Richard Blair
Eric Thibodeau

New Jersey
Edward M. Inman
Kevin Sereni
Nusrat Siraj Morshed

New Mexico
Kelly Montoya
Denise Peralta
Hashem Faidi

New York
Russell Thielke
Christopher Euler

North Carolina
Todd Whittington
Myron Lamar Sylvester

North Dakota
Amy Beise
Matt Linneman, Chair
Tyler Wollmuth
Scott W. Wutzke

Ohio
Daniel Ian Miller
Gary Edward Angles
Patrick Bierl
Craig Emerson Landefield

Oklahoma
Matt Romero
Bryce Hanlon
Kenny R. Seward

Oregon
Larry D. Ilg
Christopher Duman
Sean P. Parker

Pennsylvania
Joseph S. Robinson
Timothy L. Ramirez

Puerto Rico
Carlos Hernandez
Alexander Garcia
Miguel Estrella

Rhode Island
Jose S. Lima
Michael P. Byrne

South Carolina
Merrill E. Zwanka
Christopher E. Carroll, Jr.
Temple Short

South Dakota
Tanner Fitzke
Darin L. Hodges
Shea Lemmel

Tennessee
Heather Purdy
Danny L. Lane

Texas
Ryan Barborak
Enad Mahmoud
Jenny Li

Utah
Ken Talbot
Jason Lee Simmons
L. Scott Nussbaum

Vermont
Nicholas R. Van Den Berg
Aaron Schwartz
Ian Anderson
Ryan Darling

Virginia
Charles A. Babish

Washington State
Kurt R. Williams
Mohamed Nimeri

West Virginia
Ron L. Stanevich
Stefanie Elliott
Vincent Allison

Wisconsin
Erik T. Lyngdal
Barry C. Paye

Wyoming
Greg Milburn
Wes M. Bybee

ASSOCIATE MEMBERS—INTERNATIONAL

Ontario
Anne Holt

Quebec
Felix Doucet

ASSOCIATE MEMBERS—OTHER

AASHTO
Ben Sade
Casey Soneira
Ryan Fragapane

Ex Officio—FEDERAL HIGHWAY ADMINISTRATION
Gina Ahlstrom
Jean A. Nehme

CONSULTANTS

GGFGA Engineering, LLC
Georgene Geary

Mark E. Felag, PE, LLC
Mark Felag

Technical Subcommittee 5d: Pavement Design

Chair	Vice Chair
Dulce Rufino Feldman	Mary Jane Hayden
California DOT	*Florida DOT*

STATE DOT MEMBERS

Alabama
Scott W. George
Janney Taylor

Arizona
Nourali Zareh

California
Dulce Rufino Feldman, Chair

Colorado
Craig Wieden

Connecticut
Steven Norton

Delaware
Robin M. Davis

Florida
Mary Jane Hayden, Vice Chair
Rhonda Taylor

Georgia
Ian D. Rish

Idaho
John Arambarri

Indiana
Kumar P. Dave

Iowa
Chris B. Brakke

Kansas
Richard A. Barezinsky
Greg Schieber

Kentucky
Adam Newton Ross

Louisiana
Jeffrey R. Lambert

Maine
Richard L. Bradbury

Maryland
Sejal Barot

Massachussetts
Edmund J. Naras

Michigan
Kevin Patrick Kennedy

Minnesota
Curt M. Turgeon

Mississippi
Thomas M. Booth

Missouri
Brandon Voyles

Nevada
Changlin Pan

New Mexico
Hashem Faidi

New York State
Wes Yang

Ohio
Patrick Bierl
Craig Emerson Landefeld

Pennsylvania
Lydia E. Peddicord

Texas
Ruben Carrasco

Vermont
Aaron Schwartz

Washington State
Karen Carlie

ASSOCIATE MEMBERS—INTERNATIONAL

Ontario
Anne Holt
Stephen Lee

Quebec
Felix Doucet

AASHTO
Ben Sade
Casey Soneira
Deborah Doehr Kim
Ryan Fragapane

ASSOCIATE MEMBERS—OTHER

Ex Officio—FEDERAL HIGHWAY ADMINISTRATION

Tom Yu

CONSULTANTS

GGFGA Engineering, LLC
Georgene Geary

Mark E. Felag, PE, LLC
Mark Felag

Table of Contents

Foreword . . . xvii
Acknowledgments. . . . xix

1 Introduction to Segmental Concrete Pavement Systems . . . 1-1
1.1 Interlocking Pavements . . . 1-1
1.2 Permeable Interlocking Pavements . . . 1-2
1.3 Comparison of Interlocking and Permeable Interlocking Pavement Characteristics . . . 1-3

2 Materials . . . 2-1
2.1 Interlocking Pavement . . . 2-1
2.1.1 Base and Subbase Options. . . . 2-1
2.1.2 Bedding Material Options . . . 2-1
2.1.3 Jointing Sand Between Paving Units . . . 2-2
2.2 Permeable Interlocking Pavement . . . 2-2
2.2.1 Geotextiles . . . 2-2
2.2.2 Open-Graded Aggregates . . . 2-2
2.3 Interlocking and Permeable Interlocking Pavements . . . 2-3
2.3.1 Geotextiles . . . 2-3
2.3.2 Concrete Paving Units . . . 2-3
2.4 References . . . 2-5

3 Structural Design . . . 3-1
3.1 Interlocking Pavement Background . . . 3-1
3.2 Interlocking Pavement Design Method . . . 3-5
3.3 Design Example. . . . 3-9
3.4 Permeable Interlocking Pavements . . . 3-10
3.4.1 Permeable Interlocking Pavement Design Method . . . 3-13
3.4.2 Design Example. . . . 3-20
3.5 References . . . 3-23

4 Construction . . . 4-1
4.1 Interlocking Pavement Production . . . 4-1
4.2 Placement. . . . 4-4
4.2.1 Soil Subgrade Preparation and Base Construction . . . 4-5
4.2.2 Bedding Sand Construction . . . 4-5

4.2.3 Manual Paver Installation 4-7
4.3 Bitumen–Sand Bedding Construction 4-10
4.4 Machine-Assisted Paver Installation 4-13
4.4.1 Equipment for Machine-Assisted Installation 4-13
4.4.2 Pavers for Mechanical Installation 4-15
4.4.3 Job Planning 4-17
4.4.4 Systematic and Efficient Execution 4-20
4.5 Quality Assurance and Quality Control 4-21
4.5.1 Interlocking Pavement Construction Checklist 4-24
4.6 Permeable Interlocking Pavement Construction 4-28
4.6.1 Soil Excavation and Compaction 4-29
4.6.2 Subbase Construction 4-30
4.6.3 Curb and Base Construction 4-31
4.6.4 Bedding Layer Construction 4-33
4.6.5 Paver Installation 4-34
4.6.6 Quality Assurance and Quality Control 4-36
4.6.7 Permeable Interlocking Pavement Construction Checklist 4-37
4.7 References 4-40

5 ***Maintenance and Preservation*** 5-1
5.1 ASTM E2840 Condition Index 5-1
5.2 Interlocking Pavement Distresses and Preservation Actions 5-2
5.2.1 Paving Unit Removal 5-3
5.2.2 Interlocking Pavement Base Replacement 5-6
5.2.3 Interlocking Pavement Bedding and Paver Reinstatement 5-8
5.3 Interlocking Pavement Winter Management 5-11
5.4 Permeable Interlocking Pavement Preservation 5-11
5.4.1 Permeable Interlocking Pavement Surface Winter Maintenance 5-13
5.4.2 Managing Utilities: Subbase and Base Replacement 5-15
5.4.3 Routine/Preventive Maintenance for Pavement Surface Infiltration 5-16
5.4.4 Permeable Interlocking Pavement Surface Infiltration Testing 5-19
5.4.5 Restorative Maintenance of Permeable Interlocking Pavement Surface Infiltration 5-21
5.5 References 5-23

6 ***Sustainability and Resilience*** 6-1
6.1 Sustainability 6-1
6.2 Flood and Seismic Resilience 6-4
6.3 References 6-5

List of Tables

Table 1-1. Comparison of Interlocking and Permeable Interlocking Pavement Characteristics 1-3

Table 3-1. Soil Categories Used in ASCE 58 3-7

Table 3-2. Drainage Characterization of Soil Categories in ASCE 58 3-7

Table 3-3. Characterization of Soil Strengths by Category and Drainage in ASCE 58 3-7

Table 3-4. Sample Structural Solutions Table for Interlocking Pavement Using Asphalt-Treated Base from ASCE 58 3-8

Table 3-5. Example of Interlocking Pavement Structural Design Options. 3-10

Table 3-6. Permeable Interlocking Pavement Structural Design Tables. 3-17

Table 5-1. Interlocking Pavement Distresses and Preservation Actions. 5-3

Table 5-2. Permeable Interlocking Pavement Distresses, Inspection Frequency, and Preservation Actions 5-12

Table 5-3. Guideline for ASTM C1781 Surface Infiltration Test Results for Permeable Interlocking Pavement Cleaning 5-20

List of Figures

Figure F-i. Ancient Interlocking Pavement: The Appian Way near Rome ca. 312 BC xvii

Figure 1-1. The Family of Segmental Concrete Paving Systems (L to R): Interlocking, Permeable Interlocking, Paving Slabs, Planks, and Grids 1-1

Figure 2-1. Climate Zones for Freeze–Thaw Testing per ASTM C936 2-4

Figure 3-1. One of Several Interlocking Pavement Streets in Downtown North Bay, ON, Built in 1983 3-1

Figure 3-2. Main Street in Ripon, CA. 3-1

Figure 3-3. Typical Interlocking Pavement Components 3-2

Figure 3-4. Paving Slab and Paver, Compared 3-2

Figure 3-5. Port of Oakland, CA with 5 Million ft^2 of Interlocking Pavement. 3-4

Figure 3-6. 45-Degree and 90-Degree Herringbone Paving Patterns for Roads 3-5

Figure 3-7. Pavement Crown in an Interlocking Street in Dayton, OH 3-5

Figure 3-8. Flow Chart for Interlocking Pavement Structural Design from CMHA PAV-TEC-04-23 Structural Design of Interlocking Concrete Pavements for Roads and Parking Lots 3-6

Figure 3-9. Permeable Interlocking Pavement Streets in Atlanta, GA, Constructed in 2015 3-11

Figure 3-10. Full-, Partial-, and No-Infiltration Permeable Interlocking Pavement for Vehicular Traffic . . . . 3-12 and 3-13

Figure 3-11. Structural and Hydrologic Design Flow for Permeable Interlocking Pavements 3-14

Figure 3-12. Double-Ring Infiltrometer Test per ASTM D3385 3-16

Figure 3-13. Geocells Preparing to be Filled with No. 57 Base Aggregate 3-18

Figure 3-14. Formula Symbols Used in the Full-Infiltration Design Formula 3-22

Figure 4-1. A Typical Paver Manufacturing Factory 4-1

Figure 4-2. Having Just Been Molded, Paving Units Exit the Production Machine and Head to Kilns for Curing. 4-2

Figure 4-3. Yellow “Finger Car” Stacked with Paver-Filled Pallets Rolls into a Blue “Lowerator” that Delivers Cured Pavers to a Conveyor that Heads to Packaging 4-3

Figure 4-4. Neatly Stacked Layers are Strapped to Wooden Shipping Pallets 4-4

Figure 4-5. Inventory Storage at a Paver Plant with Plastic-Wrapped Bundles or Cubes of Pavers 4-4

Figure 4-6. Screeding Bedding Sand on Pipes 4-6

Figure 4-7. Screeding Bedding Sand Manually 4-6

Figure 4-8. Screeding with Powered Equipment 4-6

Figure 4-9. Screeding Bedding Sand with a Modified Asphalt Spreader 4-7

Figure 4-10. Saw with Diamond-Tipped Blade and Dust Collection 4-8
Figure 4-11. Compaction of Installed Pavers into the Bedding Sand with a Plate Compactor 4-9
Figure 4-12. Compacting Sand into the Paver Joints 4-9
Figure 4-13. Screeding the Hot Bitumen–Sand Mix 4-11
Figure 4-14. Applying Adhesive with a Trowel 4-12
Figure 4-15. Dried Adhesive Receiving Concrete Pavers 4-12
Figure 4-16. Spreading Joint Sand 4-12
Figure 4-17. Compacting the Pavers. 4-12
Figure 4-18. Bitumen-Set Interlocking Pavement in East Aurora, NY 4-13
Figure 4-19. Pavers Manufactured in their Final Laying Pattern for Machine Installation 4-14
Figure 4-20. Example of Motorized Installation Equipment 4-14
Figure 4-21. Another Example of Motorized Installation Equipment 4-14
Figure 4-22. Offsets for Machine-Installed Layers Started with Manually-Installed Areas. 4-15
Figure 4-23. Herringbone Pattern with Half Stones or Pavers Exchanged for Full-Sized Units. 4-16
Figure 4-24. Herringbone Pattern with a Reduced Number of Half Pavers 4-16
Figure 4-25. Vertical Spacer Bars or Nibs on the Sides of a Paver. 4-17
Figure 4-26. Square Concrete Collar Enables a Clean Fit to Pavers 4-18
Figure 4-27. String Course Can Create a More Stable Junction with the Concrete Collar 4-18
Figure 4-28. Two Paver String Courses Against the Curb Provide Space for Mechanical-Installation Equipment Clamp to Place Pavers against Them 4-18
Figure 4-29. Pavers Stored on a Street under Construction in New Hampshire. .4-19
Figure 4-30. Placement of Bundles or Cubes Allow Space for Placing the Layers ahead of Them but Close Enough to Minimize Machine Travel Time to the Laying Face 4-20
Figure 4-31. For Large, Mechanically-Installed Projects, the Paver Manufacturer and Contractor Can Manage Paver Dimensions with a Jig 4-22
Figure 4-32. Observation Well with Exposed Access. 4-30
Figure 4-33. Observation Well with Hidden Access. 4-30
Figure 4-34. Observation Well with Access outside the Pavement 4-30
Figure 4-35. 10-ton Vibratory Roller Compactor on an AASHTO No. 2 Subbase 4-30
Figure 4-36. Transition from an Asphalt Pavement to Permeable Interlocking Pavement. 4-31
Figure 4-37. Transition from a Concrete Pavement to Permeable Interlocking Pavement 4-32

Figure 4-38. A 10-ton Vibratory Roller Compacting the No. 57 Base 4-32

Figure 4-39. 13,500-kip Plate Compactor with Compaction Indicator Lights on No. 57 Stone 4-33

Figure 4-40. Screed Bucket Smooths the Bedding Layer with Assistance from a Skid Steer Loader 4-33

Figure 4-41. Modified Asphalt Spreader Rapidly Screeds the Bedding Layer. 4-33

Figure 4-42. Geogrid in the Bedding Layer is Fastened to Plastic Edge Restraint 4-34

Figure 4-43. Geogrid in the Bedding Layer is Fastened to Metal Edge Restraint 4-34

Figure 4-44. Permeable Interlocking Pavement Street in Meridian, ID 4-34

Figure 4-45. Permeable Interlocking Pavement Street in Portland, OR. 4-34

Figure 4-46. Broom Sweeping Jointing Material on a Small Area. 4-35

Figure 4-47. Powered Sweeper for Efficient Joint Filling on a Large Area 4-35

Figure 4-48. Large Plate Compactor Presses Paving Units into the Bedding Layer 4-35

Figure 4-49. Lightweight Deflectometer Testing Compacted, Open-Graded Subbase Aggregate. 4-37

Figure 4-50. Lightweight Deflectometer Testing Open-Graded Base Aggregate 4-37

Figure 5-1. Performance Curve for Interlocking Pavements 5-2

Figure 5-2. Pavement Marked for Paver Removal and Excavation 5-4

Figure 5-3. Removing the First Paver. 5-4

Figure 5-4. Paver Extractor Used to Remove the First and Subsequent Pavers. 5-5

Figure 5-5. Once the First Paver is Removed, Others Can Be Removed by Tilting and Pulling Out 5-5

Figure 5-6. T-Shaped Trench with Temporary Edge Restraints 5-6

Figure 5-7. Temporary Bracing Helps Hold Undisturbed Pavers in Place 5-7

Figure 5-8. Low-Density Concrete Fill/Aggregate Base Under Bedding Sand and Reinstated Pavers 5-8

Figure 5-9. Undisturbed Bedding Layer just outside the Screed Rails Helps Establish the Thickness of Material between Them When Screeded. 5-9

Figure 5-10. Stringlines Pulled to Align Joints of Undisturbed Pavers with Those to Be Reinstated 5-9

Figure 5-11. Adjusting Joint or Bond Lines with a Pry Bar Prior to Compaction 5-10

Figure 5-12. The Final Blow: The Last Paver Installed Prior to Applying Jointing Material and Compacting 5-10

Figure 5-13. Snowplow Blade with Rubber Edge Clearing Snow from Permeable Interlocking Pavement 5-14

Figure 5-14. Dirty Snow Left on the Permeable Surface from Plowing Will Decrease Infiltration Unless Removed in the Spring 5-14

Figure 5-15. Start of Leaves Accumulating in the Paver Joints 5-16

Figure 5-16. Improver Landscaping Maintenance Practices 5-17

Figure 5-17. Proper Landscaping Maintenance Practices. 5-17

Figure 5-18. Ponding Typical to Permeable Pavements Starts with Sediment Deposited adjacent to Impervious Surfaces and Vehicles 5-17

Figure 5-19. Portable Permeable Pavement Vacuum Cleaning Equipment Example. 5-18

Figure 5-20. Another Portable Permeable Pavement Vacuum Cleaning Equipment Example. 5-18

Figure 5-21. Street Sweeper With a Broom Operating under the Chassis Center and Another on the Rear of the Truck 5-18

Figure 5-22. Regenerative Air Sweeper 5-19

Figure 5-23. Set-Up and Testing Permeable Interlocking Pavement Surface Infiltration per ASTM C1781. 5-19

Figure 5-24. True Vacuum Truck with the Attachment that Removes Debris 5-21

Figure 5-25. True Vacuum Truck Applying Water to Loosen Debris for Removal by the Attachment . . .5-21

Figure 5-26. Restorative Surface Infiltration Cleaning. 5-22

Figure 6-1. Traffic Calming with Interlocking Pavement in Cary, NC. 6-2

Figure 6-2. Interlocking and Permeable Interlocking Pavement Cradle-to-Grave Life Cycle Assessment. 6-3

Figure 6-3. Sustainable Pavement Rehabilitation in The Netherlands 6-4

Page left blank intentionally.

Foreword

The concept of unit pavement has existed since the start of recorded history and remains in every culture. Around 5,000 BC, the Minoans wrote about their stone streets. Later, inexpensive slave labor enabled the Romans to build an interstate highway system equivalent in length to that of the United States. This pavement network across Europe secured their conquered territories and promoted trade.

The principles of pavement construction developed by the Romans remain. The Appian Way, shown in Figure F-i, is an early example of compacted aggregate layers with increasingly smaller particles rising to support a surface of tightly fitted stones. The joints between the stones had to be sufficiently narrow to not accept the head of a Roman spear. If they did, legend says that the crew supervisor was speared by the Roman job superintendent. Adherence to such exacting standards might help explain why Roman roads have lasted for over two millennia.

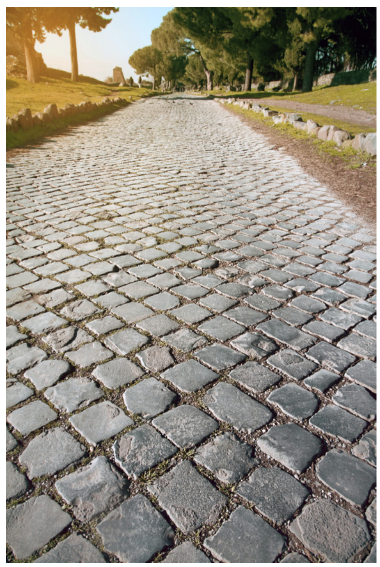

Figure F-i. Ancient Interlocking Pavement: The Appian Way near Rome ca. 312 BC (Source: Interlocking Concrete Pavement Institute)

Fast forward to the 20th century where the invention of the automobile created the need for smooth asphalt and concrete pavements to accommodate fast moving vehicles. Smoother roads replaced many clay brick streets in urban America and resulted in segmental paving fading into history. The clay and stone streets that remained in some historic districts reminded users of the durability and character these pavements add to such neighborhoods.

However, a more modern and smoother expression of segmental paving, interlocking concrete pavement, emerged in the fourth quarter of the 20th century, first in Europe, then in North America, then around the world. Concrete unit materials and pavements made from them were researched and evaluated. Additional research came about from the 1990s on the permeable version for reducing stormwater runoff called permeable interlocking concrete pavements (PICP). Much research on both pavement systems is found in the proceedings of a series of international conferences on concrete block pavements. The papers from these conferences are available on www.sept.org.

This Guide represents a synthesis of that research and decades of experience on materials, design, construction, and maintenance. It is provided as a resource to state departments of transportation (DOTs) and to municipal public works departments. The timing and contents of this publication can help address needed environmental sustainability and flood resilience of urban pavements (see Chapter 6).

The Interlocking Concrete Pavement Institute (ICPI) greatly appreciates the AASHTO Committee on Materials and Pavements for the opportunity to present this book as a tool in the toolbox for use by transportation agencies and the wider civil engineering community.

David R. Smith

Ashburn, VA, USA

Acknowledgments

This *Guide for Interlocking Pavements* originated from and was reviewed by the AASHTO Technical Subcommittee on Pavement Design (TS 5d), initially chaired by John Donohue, P.E. (MO) and then by Dr. Dulce Rufino Feldman, P.E. (CA). This Technical Subcommittee is under the AASHTO Committee on Materials and Pavements, often referred to as "COMP." This Guide was developed by David R. Smith, former Technical Director of the Interlocking Concrete Pavement Institute (ICPI) and Chair of the Small Element Pavement Technologists. He has been involved with all aspects of interlocking pavements since 1984 and permeable interlocking pavements since 2000. COMP appreciates the need to move this research- and experience-based guidance to the forefront, especially on permeable pavements that reduce environmental impacts via stormwater management while increasing pavement resiliency of local roads.

Much information is referenced from national design standards issued by the American Society for Civil Engineers (ASCE) Transportation and Development Institute. One of the standards is on interlocking and another is on permeable interlocking pavements. COMP appreciates the time, effort, expertise, and leadership provided by the two committees that developed these standards, and especially from David K. Hein, P. Eng., who chaired the permeable pavement committee and co-chaired the interlocking pavement committee with Dr. Gonzalo Rada, P.E.

Mr. Hein's and Dr. Rada's experience and expertise with AASHTO pavement design procedures enabled the development of the ASCE design standards on interlocking pavements that built on the concepts of Dr. Matthew Witczak during his tenure at the University of Maryland, as well as research by Dr. John Knapton with Newcastle University, England, and Dr. Brian Shackel with the University of New South Wales, Australia. There are many other researchers and practitioners too numerous to list who influenced the contents of this Guide.

A key contributor to the structural design of permeable interlocking pavements was the University of California Pavement Research Center (UCPRC). Full-scale accelerated load testing validated and calibrated a mechanistic design model on which an easy-to-use design procedure is based per this Guide. COMP appreciates the pioneering efforts by Dr. John Harvey and Dr. David Jones from UCPRC that provided design tools for Caltrans, for other state and municipal departments of transportation (DOTs) and stormwater agencies, and the wider pavement engineering community. This research and testing effort was funded by the ICPI Foundation for Education and Research, the Concrete Masonry Association of California and Nevada, and the California Nevada Cement Association.

COMP gratefully acknowledges all individuals with state departments of transportation who reviewed and added valuable content to this Guide. COMP also expresses gratitude for the valuable input provided by knowledgeable representatives of DOTs, ASCE, consultants, and academia, and for financial support from the ICPI, now the Concrete Masonry and Hardscapes Association, that is, the association of manufacturers and contractors of interlocking and permeable interlocking pavements.

Chapter 1
Introduction to Segmental Concrete Pavement Systems

The types of segmental concrete pavement systems include interlocking, permeable interlocking, paving slabs, planks, and grid units. These are illustrated in Figure 1-1. This Guide provides technical information and references on the first two pavement systems as they are specifically intended for streets, making them of interest to state departments of transportation (DOTs) and municipal public works officials. Moreover, millions of square feet of permeable interlocking pavements have been placed in the United States and Canada.

Figure 1-1. The Family of Segmental Concrete Paving systems (L to R): Interlocking, Permeable Interlocking, Paving Slabs, Planks, and Grids (Source: Concrete Masonry and Hardscapes Association)

1.1 Interlocking Pavements

Interlocking pavements consists of solid, individual, high-strength concrete paving units capable of being grasped and installed with one hand. When installed, the interlock from sand between the units has them resting on a thin layer of sand. Vehicular applications are designed with aggregate bases and subbases, cement- and asphalt-treated bases, asphalt, or concrete bases. Pavements with these bases are considered flexible pavements, except for those with concrete bases, which are considered rigid pavements. Interlocking pavements are also used in pedestrian areas because of their visual appeal and the design flexibility made possible by the various shapes, colors, and patterns available.

Originally developed in Germany and The Netherlands for roads in the 1950s and 60s, manufacturing and installation technology transferred from these countries in the mid-1970s which initiated interlocking pavement manufacturing and installation in Canada and the United States. The advent of mechanized installation in the 1980s