

# AASHTO Guide for Interlocking Pavements

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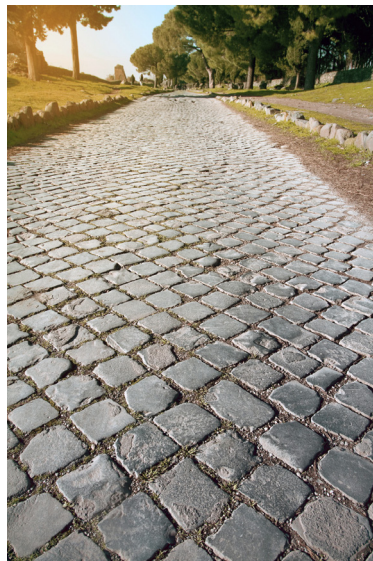
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# Foreword

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](http://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

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# 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.

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# 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