

ACI 325.12R-02
(Reapproved 2013)

**Guide for Design
of Jointed Concrete Pavements
for Streets and Local Roads**

Reported by ACI Committee 325



American Concrete Institute®



March 2013
printing

American Concrete Institute®
Advancing concrete knowledge

Guide for Design of Jointed Concrete Pavements for Streets and Local Roads

Copyright by the American Concrete Institute, Farmington Hills, MI. All rights reserved. This material may not be reproduced or copied, in whole or part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of ACI.

The technical committees responsible for ACI committee reports and standards strive to avoid ambiguities, omissions, and errors in these documents. In spite of these efforts, the users of ACI documents occasionally find information or requirements that may be subject to more than one interpretation or may be incomplete or incorrect. Users who have suggestions for the improvement of ACI documents are requested to contact ACI. Proper use of this document includes periodically checking for errata at <http://concrete.org/Publications/DocumentErrata.aspx> for the most up-to-date revisions.

ACI committee documents are intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. Individuals who use this publication in any way assume all risk and accept total responsibility for the application and use of this information.

All information in this publication is provided "as is" without warranty of any kind, either express or implied, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose or non-infringement.

ACI and its members disclaim liability for damages of any kind, including any special, indirect, incidental, or consequential damages, including without limitation, lost revenues or lost profits, which may result from the use of this publication.

It is the responsibility of the user of this document to establish health and safety practices appropriate to the specific circumstances involved with its use. ACI does not make any representations with regard to health and safety issues and the use of this document. The user must determine the applicability of all regulatory limitations before applying the document and must comply with all applicable laws and regulations, including but not limited to, United States Occupational Safety and Health Administration (OSHA) health and safety standards.

Order information: ACI documents are available in print, by download, on CD-ROM, through electronic subscription, or reprint and may be obtained by contacting ACI.

Most ACI standards and committee reports are gathered together in the annually revised *ACI Manual of Concrete Practice* (MCP).

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
U.S.A.

Phone: 248-848-3700
Fax: 248-848-3701

www.concrete.org

ISBN 978-0-87031-076-8

Guide for Design of Jointed Concrete Pavements for Streets and Local Roads

Reported by ACI Committee 325

	Jack A. Scott Chairman	Norbert J. Delatte Secretary	
David J. Akers	Luis A. Garcia	Paul E. Mueller	F. Ymca S. Collins
Richard O. Albright	Nader Ghafoori	Jon I. Mullarky	Robert G. Sharp
William L. Arent	Ben Gompers	Theodore L. Neff	Terry W. Sherman
Jamshid M. Armaghani	W. Charles Greer	Emmanuel B. Owusu-Antwi	James M. Shilstone, Sr.
Donald L. Brogna	John R. Hess	Dipak T. Parekh	Bernard J. Skar
Neeraj J. Buch*	Mark K. Kaler	Thomas J. Pasko, Jr.	Shiraz D. Tayabji
Archie F. Carter	Roger L. Larsen*	Ronald L. Pelt	Suneel N. Vanikar
Lawrence W. Cole*	Gary R. Mass	Robert W. Piggott	David P. Whitney
Russell W. Collins	William W. Mein	David W. ...	James M. Willson
Mohamed M. Darwish	James C. Mikulanec	Steven A. ...	Dan G. Zollinger*
Al Ezzy			

*Significant contributors to the preparation of this document. The committee would also like to acknowledge the efforts of Robert V. Lopez and Dennis Grabe.

This guide provides a perspective on a balanced combination of pavement thickness, drainage, and subbase or subgrade materials to achieve an acceptable pavement system for streets and local roads. Jointed concrete pavements designed for low volumes of traffic (typically less than 100 trucks per day, one way) have historically provided satisfactory performance when proper support and drainage conditions exist. Recommendations are presented for designing a concrete pavement system for a low volume of traffic and associated joint pattern based upon limiting the stresses in the concrete or, in the case of reinforced slabs, maintaining the cracks in a tightly closed condition. Details for designing the distributed reinforcing steel and the load transfer devices are given, if required.

The thickness design of low-volume concrete pavements is based on the principles developed by the Portland Cement Association and others for analyzing an elastic slab over a dense liquid subgrade, as modified by field observations and emanated to include fatigue concepts.

ACI Committee Reports, Guides, Manuals, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

Keywords: dowel; flexural strength; joint; pavement; portland cement; quality control; reinforced concrete; slab-on-grade; slipform; subbase; tie bar; welded wire fabric.

CONTENTS

Chapter 1—General, p. 2

- 1.1—Introduction
- 1.2—Scope
- 1.3—Background
- 1.4—Definitions

Chapter 2—Pavement material requirements, p. 5

- 2.1—Support conditions
- 2.2—Properties of concrete paving mixtures

Chapter 3—Pavement thickness design, p. 9

- 3.1—Basis of design
- 3.2—Traffic
- 3.3—Thickness determination
- 3.4—Economic factors

ACI 325.12R-02 became effective January 11, 2002.
Copyright © 2002, American Concrete Institute.

All rights reserved including rights of reproduction and use in any form or by any means, including the making of copies by any photo process, or by electronic or mechanical device, printed, written, or oral, or recording for sound or visual reproduction or for use in any knowledge or retrieval system or device, unless permission in writing is obtained from the copyright proprietors.

Chapter 4—Pavement jointing, p. 13

- 4.1—Slab length and related design factors
- 4.2—Transverse joints
- 4.3—Longitudinal joints
- 4.4—Isolation joints and expansion joints
- 4.5—Slab reinforcement
- 4.6—Irregular panels
- 4.7—Contraction joint sealants

Chapter 5—Summary, p. 21**Chapter 6—References, p. 21**

- 6.1—Referenced standards and reports
- 6.2—Cited references

Appendix A—Pavement thickness design concepts, p. 24

- A.1—Load stresses and fatigue calculations

Appendix B—Subgrade, p. 27

- B.1—Introduction
- B.2—Soil classification
- B.3—Subgrade soils
- B.4—Expansive soils
- B.5—Frost action
- B.6—Pumping

Appendix C—Jointing details for pavements and appurtenances, p. 30**CHAPTER 1—GENERAL****1.1—Introduction**

The design of a concrete pavement system for a low traffic volume extends beyond the process of pavement thickness selection; it entails an understanding of the processes and the factors that affect pavement performance. It also encompasses appropriate slab jointing and construction practices that are consistent with local climatic and soil conditions.

Concrete pavements for city streets and local roads are often used in residential areas and business districts, and in rural areas to provide farm-to-market access for the movement of agricultural products. The term “low volume” refers to pavements subject to either heavy loads on few vehicles, or light loads and many vehicles. City streets and local roads also serve an aesthetic function because they are integrated into the landscape and architecture of a neighborhood or business district.

Concrete pavement performs well for city street and local road applications because of its durability while being continuously subjected to traffic and, in some cases, severe climatic conditions. Because of its relatively high stiffness, concrete pavements spread the imposed loads over large areas of the subgrade and are capable of resisting deformation caused by passenger vehicles. Concrete pavements exhibit high wear resistance and can be easily cleaned if necessary. Traffic lane markings can be incorporated into the jointing pattern where the concrete’s light-reflective surface improves visibility. Concrete pavement surfaces drain well on relatively flat slopes.

The major variables likely to affect the performance of a well-designed concrete pavement system for city streets and

local roads are traffic, drainage, environment, construction, and maintenance. Each of these factors may act separately or interact with others to cause deterioration of the pavement. Due to the nature of traffic on city streets and local roads, the effects of environment, construction, and maintenance can play more significant roles in the performance than traffic. Nonetheless, complete information may not be available regarding certain load categories that make up the mixture of traffic carried on a given city street or local road.

1.2—Scope

This guide covers the design of jointed plain concrete pavements (JPCP) for use on city streets and local roads (driveways, alleyways, and residential roads) that carry low volumes of traffic. This document is intended to be used in conjunction with ACI 325.9R. References are provided on design procedures and computer programs that consider design in greater detail. This guide emphasizes the aspects of concrete pavement technology that are different from procedures used for design of other facilities such as highways or airports.

1.3—Background

The thickness of concrete pavement is generally designed to limit tensile stresses produced within the slab by vehicle loading, and temperature and moisture changes within the slab. Model studies and full-scale, accelerated traffic tests have shown that maximum tensile stresses in concrete pavements occur when vehicle wheel loads are close to a free or unsupported edge in the midpanel area of the pavement. Stresses resulting from wheel loadings applied near interior longitudinal or transverse joints are lower, even when good load transfer is provided by the joints. Therefore, the critical stress condition occurs when a wheel load is applied near the pavement’s midslab edge. At this location, integral curbs or thickened edge sections can be used to decrease the design stress. Thermal expansion and contraction, and warping and curling caused by moisture and temperature differentials within the pavement can cause a stress increase that may not have been accounted for in the thickness design procedure. The point of crack initiation often indicates whether unexpected pavement cracking is fatigue-induced or environmentally induced due to curling and warping behavior. Proper jointing practice, discussed in Chapter 4, reduces these stresses to acceptable levels.

Concrete pavement design focuses on limiting tensile stresses by properly selecting the characteristics of the concrete slab. The rigidity of concrete enables it to distribute loads over relatively large areas of support. For adequately designed pavements, the deflections under load are small and the pressures transmitted to the subgrade are not excessive. Although not a common practice, high-strength concrete can be used as an acceptable option to increase performance.

Because the load on the pavement is carried primarily by the concrete slab, the strength of the underlying material (subbase) has a relatively small effect on the slab thickness needed to adequately carry the design traffic. Subbase layers do not contribute significantly to the load-carrying capacity of the pavement. A subbase, besides providing uniform support,