

**Guide for Concrete Highway
Bridge Deck Construction**

Reported by ACI Committee 345



American Concrete Institute®



First Printing
September 2011

American Concrete Institute®
Advancing concrete knowledge

Guide for Concrete Highway Bridge Deck Construction

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 via the errata website at www.concrete.org/committees/errata.asp. Proper use of this document includes periodically checking for errata 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 978-0-87031-410-0

Guide for Concrete Highway Bridge Deck Construction

Reported by ACI Committee 345

Richard E. Weyers
Chair

Paul D. Carter
Secretary

Gerald H. Anderson
Michael C. Brown
Robert J. Gulyas*

Dena L. Guth
Alan B. Matejowsky
Harold R. Sandberg

Johan L. Silfwerbrand
Michael M. Sprinkel

Paul J. ...
... Ze ...

*Deceased.

Consulting members

James C. Anderson
Byron T. Danley
Fouad H. Fouad
Allan C. Harwood

Martin ...
Yash ...
Jeffrey P. Wouters

The service-life performance of concrete bridge decks, including maintenance, repair, and rehabilitation needs, is directly related to the care exercised from the preconstruction through post-construction period. This guide provides recommendations for bridge deck construction based on considerations of durability, concrete materials, reinforcement, placing, finishing and curing, and overlays.

Keywords: admixtures; aggregate; air entrainment; bridge decks; concrete curing; concrete finishing; concrete overlays; concrete placing; cracking; durability; polymer concrete; reinforcing bars; scaling; shrinkage; skid resistance.

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.

CONTENTS

Chapter 1—Introduction and scope, p. 2

- 1.1—Introduction
- 1.2—Scope

Chapter 2—Definitions, p. 2

- 2.1—Definitions

Chapter 3—Design and durability considerations, p. 2

- 3.1—General
- 3.2—Concrete and reinforcement materials
- 3.3—Positive protective systems
- 3.4—Arrangement and cover of reinforcement
- 3.5—Deck thickness
- 3.6—Deck drainage
- 3.7—Joint-forming materials and locations
- 3.8—Types and causes of deck cracking

ACI 345R-11 supersedes 345R-91 and was adopted and published September 2011.
Copyright © 2011, 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—Concrete materials, p. 10

- 4.1—General
- 4.2—Concrete-making materials
- 4.3—Chemical admixtures
- 4.4—Effects on concrete properties
- 4.5—Workability and consistency
- 4.6—Bleeding
- 4.7—Air content
- 4.8—Setting time
- 4.9—Shrinkage
- 4.10—Durability
- 4.11—Strength
- 4.12—Skid resistance

Chapter 5—Reinforcement, p. 17

- 5.1—General considerations
- 5.2—Reinforcement placement
- 5.3—Reinforcement supports and ties
- 5.4—Concrete cover over reinforcement
- 5.5—Cleanliness
- 5.6—Reinforcement type

Chapter 6—Placing, finishing, and curing, p. 22

- 6.1—Placing
- 6.2—Finishing
- 6.3—Curing

Chapter 7—Overlays, p. 31

- 7.1—Scope
- 7.2—Need for overlays
- 7.3—Required properties of overlays
- 7.4—Types of overlays
- 7.5—Design considerations
- 7.6—Construction considerations
- 7.7—Other considerations

Chapter 8—References, p. 35

- 8.1—Referenced standards and reports
- 8.2—Cited references

CHAPTER 1—INTRODUCTION AND SCOPE**1.1—Introduction**

The deck of a highway bridge serves both structural and functional purposes for the structure. As a structural component, it provides the load path to safely transfer forces from wheel loads to the supporting superstructure and substructure elements. It may also contribute, through composite action, to the performance of primary superstructure components. Usually the construction and condition of a deck directly impacts serviceability or the ability of the structure to safely and efficiently carry highway traffic by providing smoothness, skid resistance, and resistance to deflections under wheel loads. The riding surface of a highway bridge deck should provide a continuation of the pavement segments that it connects. The surface should be free from characteristics or profile deviations that impart objectionable or unsafe riding qualities. The desirable qualities should persist with minimum maintenance throughout the projected service life of the structure.

Roughness, cracking, spalling, scaling, and poor skid resistance are defects that result when the many details that influence their occurrence are not given sufficient attention. Recognition of the interaction of design, materials, and construction practices, as well as environmental factors, is the important first step in achieving smooth and durable decks.

Many decks remain smooth and free from surface deterioration and retain skid resistance for many years. When deficiencies occur, they usually take one of the forms described in this guide. The contribution of various aspects of deck construction to defects is discussed and guidelines based on theory and experience presented that should reduce the probabilities of occurrence to acceptable levels.

1.2—Scope

This guide presents considerations to take in the design and a summary of construction practices for conventionally reinforced concrete highway bridge decks. Such decks are typically supported by multiple simple or continuous-span steel or prestressed concrete girders, or integral reinforced concrete members. The service life performance of concrete bridge decks, including maintenance, repair, and rehabilitation needs, is directly related to the care exercised from preconstruction through the post-construction period. Recommendations are presented for design and durability considerations, concrete materials, reinforcement, placing, finishing and curing, and the use of overlays.

Although some performance and durability factors discussed may be applicable, design and construction of prestressed bridge decks are presently beyond the scope of this guide. Thus, prestressing steel is not included in the reinforcement section. Guidance for the design of prestressed bridge decks is being developed elsewhere (Swartz and Schokker 2008).

CHAPTER 2—DEFINITIONS**2.1—Definitions**

ACI provides a comprehensive list of definitions through an online resource, “ACI Concrete Terminology,” at <http://terminology.concrete.org>. Definitions provided herein complement that resource.

crack, reflective—a crack that forms in a bonded overlay or wearing course caused by upward extension of moving crack or joint in the substrate.

washboarding—undulations in the finished surface of a deck that cause vibrations of undesirable frequency and amplitude in passing vehicles.

CHAPTER 3—DESIGN AND DURABILITY CONSIDERATIONS**3.1—General**

Chapter 3 emphasizes design factors that may affect the resistance of a bridge deck to chemical and environmental exposure, including potential for freezing and thawing, deleterious chemical reactions with concrete constituents, or chloride-induced corrosion damage. The design considerations of this chapter are not concerned with the structural analysis of the bridge deck. Structural aspects of the design, however, can have implications in the development of internal stresses