Guide to Maintenance of Concrete Bridge Members

Reported by ACI Committee 345

ACI 345.1R-16

American Concrete Institute
Always advancing

American Concrete Institute
Always advancing

First Printing
September 2016
ISBN: 978-1-945487-21-7

Guide to Maintenance of Concrete Bridge Members

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 http://concrete.org/Publications/DocumentErrata.aspx. 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.

Participation by governmental representatives in the work of the American Concrete Institute and in the development of Institute standards does not constitute governmental endorsement of ACI or the standards that it develops.

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
Phone: +1.248.848.3700
Fax: +1.248.848.3701

www.concrete.org

ACI 345.1R-16

Guide to Maintenance of Concrete Bridge Members

Reported by ACI Committee 345

Yail Jimmy Kim, Chair

Chris Carroll, Secretary

Jesse L. Beaver
Michael C. Brown
Andrew J. Foden
Oliver K. Gepraegs
Alan B. Matejowsky*
Rita K. Oglesby
Harold R. Sandberg
Johan L. Silfwerbrand
Michael M. Sprinkel
Paul J. St John
Ronald E. Vaughn
Richard E. Weyers
Mark Erik Williams

*Deceased

Consulting Members

James C. Anderson
Byron T. Danley
Fouad H. Fouad
Allan C. Harwood
Yash Paul Virmani
Jeffrey P. Wouters

This guide addresses typical problems and cost-effective maintenance techniques for highway bridges and their members, providing guidance to engineers and maintenance staff. Maintenance is crucial to a bridge's lifespan and continued functionality, as well as to the public safety. Continuous and systematic maintenance of a bridge will extend its service life and reduce its overall operating cost.

Concrete bridge maintenance is defined as those activities that are relatively inexpensive and repeatable, performed when a concrete member is still in good to fair condition, and are intended to prevent or minimize deterioration of the concrete. These activities include sealing, washing, caulking, crack repair, and other minor repairs intended to prolong functionality of bridge members. This guide does not cover major rehabilitation, reconstruction, or bridge inspection. Detailed methods of repairing and inspecting bridges are referenced wherever necessary throughout the guide relative to the subject matter.

Keywords: bridges; cementitious; coating; maintenance; placement; polymer; sealant.

CONTENTS

ACI 345.1R-16 supersedes ACI 345.1R-06 and was adopted and published September 2016.

CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

Bridges represent a substantial investment of public funds and are expected to provide satisfactory performance and remain in service for many years. The longevity of constructed concrete bridges can be expected to be 75 to 100 years if proper maintenance action is executed in a timely manner. Structural concrete members that deteriorate over time and eventually lose functionality could become life-threatening to the public. Aggressive environmental conditions for bridges involve cycles of freezing and thawing and wetting and drying with or without the presence of chloride. Corrosion of reinforcing steel will usually result in spalling of concrete cover and reduction of the cross-sectional area of the reinforcing steel, which reduces the strength of the member. The time required for deterioration to occur varies considerably, depending on severity of the exposure conditions and characteristics of structural concrete and reinforcing steel. Traffic fatigue loading may become more dominant over time. Continuous and systematic maintenance of a bridge will extend its service life and reduce its overall operating cost. This guide presents various technical aspects related to bridge maintenance, including the sources of deterioration and technical action that can improve the performance of existing bridge members.

1.2—Scope

The contents discussed in this guide are classified into two categories: 1) deterioration of constructed bridges; and 2) maintenance activities to address potential problems associated with such bridges. The first category is dedicated to various distressful attributes influencing the performance of existing bridge members and their consequences, whereas the second category is concerned with timely preventive or corrective maintenance actions with an emphasis on drainage, sealing, patching, joint repair, and other relevant topics. The following is outside the scope of the present report: major rehabilitation, reconstruction, inspection, condition evaluation, and load rating.

CHAPTER 2—DEFINITIONS

ACI provides a comprehensive list of definitions through an online resource, https://www.concrete.org/store/productdetail.aspx?ItemID=CT16. Definitions provided herein complement that source.

bridge deck—structural concrete slab or other structure that is supported on the bridge superstructure and serves as the roadway or other traveled surface.

damage—various forms of disruption to a member (cracking, spalling, delamination, scaling, dissolution, and permanent deformation), such as result from environmental (freezing and thawing, erosion), chemical (alkali-silica reaction, sulfate attack), and physical (impact, overload, fatigue) stresses that disrupt its intended condition and function.

grout—mixture of cementitious materials and water, or other binding medium such as magnesium phosphate or epoxy, often mixed with fine aggregate to form a thin, coarse mortar that can be poured into narrow cavities to fill them and consolidate the adjoining objects into a solid mass

overlay—layer of hydraulic-cement concrete, mortar, or asphalt, seldom thinner than 1 in. (25 mm), placed on and usually bonded onto the worn or cracked surface of a concrete slab to either restore or improve the functionality of the previous surface, also a layer of polymeric concrete usually less than 0.4 in. (10 mm) thick.

superstructure—part of a bridge providing the horizontal span.

CHAPTER 3—MAINTENANCE OF BRIDGES

3.1—Bridge maintenance

Initial bridge deterioration occurs slowly and, therefore, is often overlooked. In later stages of deterioration, however, sudden catastrophic events could occur, demanding immediate action. Progressive deterioration can be slowed, and sometimes avoided, if proper systematic preventive mainte-