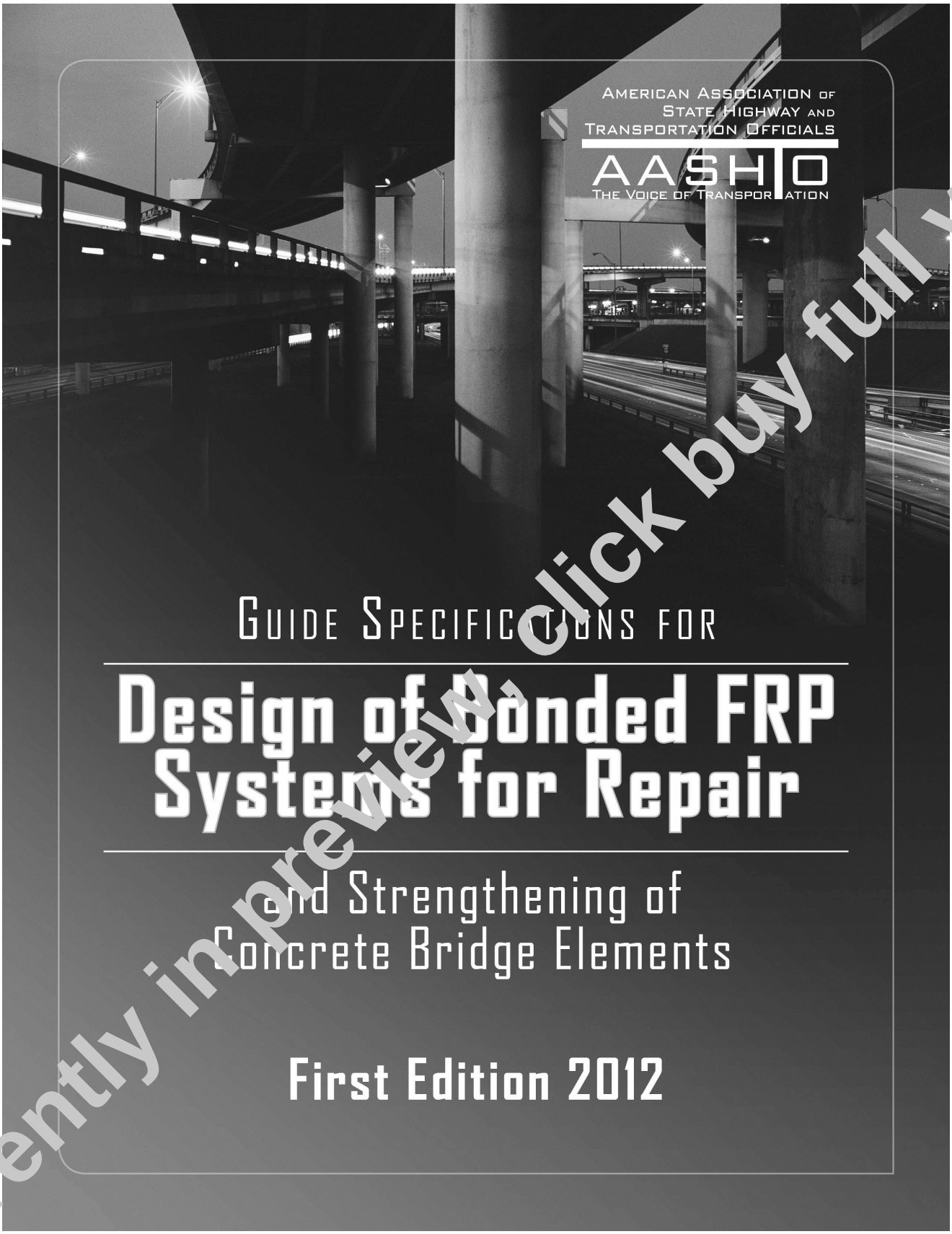
American Association of State Highway and Transportation Officials
AASHTO
The Voice of Transportation

Guide Specifications for

Design of Bonded FRP Systems for Repair

and Strengthening of Concrete Bridge Elements

First Edition 2012



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FOREWORD

Guide Specifications for Design of Bonded FRP Systems for Repair and Strengthening of Concrete Bridge Elements, First Edition (2012) is based on two National Cooperative Highway Research Program (NCHRP) reports.

It was primarily developed from NCHRP Report 655, *Recommended Guide Specifications for Repair and Strengthening of Concrete Bridge Elements* (2010). Subsequently, Section 4, "Members under Shear and Torsion," was modified based on the results of NCHRP Report 678, *Design of FRP Systems for Strengthening Concrete Girders in Shear* (2011).

Additional background information on the Guide Specifications and specific design examples can be found in the above-mentioned NCHRP documents.

AASHTO Subcommittee on Bridges and Structures

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NCHRP Report 655

- Abdul-Hamid Zureick, Georgia Institute of Technology
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- Abdeldjelil Belarbi, Missouri University of Science and Technology
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PREFACE

This new AASHTO publication, *Guide Specifications for Design of Bonded FRP Systems for Repair and Strengthening of Concrete Bridge Elements*, First Edition (2012), comprises five sections:

Section 1—General Requirements

Section 2—Material Requirements

Section 3—Members under Flexure

Section 4—Members under Shear and Torsion

Section 5—Members under Combined Axial Force and Flexure

A list of references is included at the end of each section.

AASHTO Publications Staff
November 2012

TABLE OF CONTENTS

SECTION 1

GENERAL REQUIREMENTS

1.1—SCOPE

These Guide Specifications are intended for the repair and strengthening of reinforced and prestressed highway bridge structures using externally bonded fiber-reinforced polymer (FRP) composite systems. These Guide Specifications supplement the *AASHTO LRFD Bridge Design Specifications*, Sixth Edition, 2012 (AASHTO LRFD). Except where specifically provided below, all provisions of AASHTO LRFD shall apply.

These Guide Specifications state only the minimum requirements necessary to provide for public safety and are not intended to supplant proper training or the exercise of judgment by the Engineer of Record. The Owner or the Engineer of Record may require the structural design or the quality of materials and construction to exceed the minimum requirements.

These specifications employ the *Load and Resistance Factor Design* (LRFD) methodology, in which the load and resistance factors have been developed from structural reliability theory based on current probabilistic/statistical models of loads and structural performance.

Seismic design shall be in accordance with either the provisions in the appropriate sections of AASHTO LRFD or the provisions in the *AASHTO Guide Specifications for LRFD Seismic Bridge Design*.

Except where specifically provided below, all provisions of the *LRFD Bridge Construction Specifications* shall apply.

1.2—APPLICATION OF FRP

1.2.1—General

In general, procedures for the installation of FRP systems are developed by the manufacturer and can vary between different systems. Two traditional types of externally bonded FRP systems are available. The first type consists of dry fiber-fabric sheets saturated with an epoxy resin. This type of system is referred to as the wet-layup technique. The second type of system consists of precured fiber/resin laminates (manufacturer fabricated), which are bonded to the concrete surface with an adhesive resin. The wet-layup system is the more versatile of these systems because the fabric/cloth is flexible and can conform to most shapes in the field. Installation procedures may also vary depending on the type and condition of the structure to be strengthened. The application of FRP systems will not stop the ongoing corrosion of existing steel reinforcement. The cause of corrosion to internal steel reinforcement should be addressed and corrosion-related deterioration should be repaired prior to application of any FRP system.

C1.1

Article 1.1 discusses the scope of the Guide Specifications, their applicability, and their limitations. This Article is analogous to the opening articles, Articles X.1, of each of the sections of AASHTO LRFD.

The commentary is not intended to provide a complete historical background concerning the development of these or previous Specifications, nor is it intended to provide a detailed summary of the studies and research data reviewed in formulating the provisions of the Specifications. However, references to North American and international guidelines (ACI 440.2R-08, 2008; *ISIS Canada Design Manuals*, 2001; *fib* technical report bulletin 14, fib 2001; CNR-DT 200, 2006; JSCE, 2001; and AFGC, 2003) as well as relevant research data dealing with externally bonded FRP reinforcement for reinforced and prestressed concrete structures are provided for those who wish to study the background material in depth.

NCHRP Report 609 presents recommended construction specifications concerning the use of externally bonded FRP reinforcement for strengthening concrete structures.

The commentary directs attention to other documents that provide suggestions for carrying out the requirements and intent of these Guide Specifications. However, the commentary and references herein are not part of these Guide Specifications.