TECHBRIEF

Compilation and Evaluation of Results From High-Performance Concrete Bridge Projects

FHWA Contact: Joey Hartmann, HRDI-06, 202–493–3059

This document is a technical summary of the report *Compilation and Evaluation of Results From High-Performance Concrete Bridge Projects*, Volume I: Final Report FHWA-HRT-05-056, published by the Federal Highway Administration.

Introduction

In 1993, the Federal Highway Administration (FHWA) initiated a national program to implement the use of high-performance concrete (HPC) in bridges. The program included the construction of demonstration bridges throughout the United States. In addition, other States have implemented the use of HPC in various bridge elements. Construction of these bridges has provided a large amount of data about the use of HPC. In addition, the need to update the American Association of State Highway and Transportation Officials (AASHTO) specifications for materials, test methods, bridge design, and bridge construction for use with HPC has been identified.

Objectives

The objectives of the project were as follows:

1. Collect and compile information from each of the joint State-FHWA HPC bridge projects and other HPC bridge projects.
2. Analyze and evaluate the compiled information in comparison with existing AASHTO specifications and guidelines for materials, testing, structural design, and construction.
3. Recommend equations, specifications with commentary, and guidelines for material and structural properties where sufficient research results exist.
4. Produce specific recommendations for needed research where insufficient research results exist.

Compilation of Information on HPC Bridges

Information from 19 bridges located in 14 States was collected. The compilation includes information on the benefits of HPC, costs, structural design, specified concrete properties, concrete mix proportions, measured concrete material properties, associated research projects, sources of data, miscellaneous details, and HPC specifications. The information was placed on a compact disc for easy retrieval.

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

www.tfhrc.gov

Review of the AASHTO Specifications

The following AASHTO specifications were reviewed to identify provisions that directly impact the use of HPC:

- *AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Parts I and II.*
- *AASHTO Standard Specifications for Highway Bridges.*
- *AASHTO LRFD Bridge Design Specifications.*
- *AASHTO LRFD Bridge Construction Specifications.*

Based on the review and available information, proposed revisions or proposed research problem statements were developed.

Proposed Revisions to the AASHTO Specifications

Proposed revisions to 15 material specifications, 14 test methods, 30 articles of the standard design specifications, 17 articles of the Load and Resistance Factor Design (LRFD) bridge design specifications, and 16 articles of the LRFD bridge construction specifications were developed. In addition, a new materials specification for combined aggregates and a new test method for slump flow were proposed. For the two design specifications, most of the revisions involved the use of high-strength concrete. For the other specifications, the revisions involved concrete materials for HPC.

Recommendations for Needed Research

The following research problem statements were developed to provide a basis for future revisions to the AASHTO specifications:

1. Performance requirements for high-performance concrete.
2. Use of wash water in high-performance concrete.
3. Air-void requirements and freeze-thaw testing requirements for durability of high-performance concrete.
4. Penetrability criteria for high-performance concrete.
5. Curing of high-performance concrete.
6. Procedures for measuring compressive and flexural strengths of high-strength concrete.
7. Application of bridge design specifications to high-strength concrete structural members: material properties.
8. Application of bridge design specifications to high-strength concrete structural members: shear provisions except prestressed concrete beams.
9. Verification of stress limits and resistance factors for high-performance concrete.
10. Confinement of high-strength concrete columns for seismic and nonseismic regions.

Evaluation of the FHWA Definition

A review of the FHWA definition of HPC was made to determine if the performance characteristics, test methods, and range of grades were appropriate and to propose any modifications based on experience with the definition since it was published in 1996.

Based on the review, the eight existing characteristics of freeze-thaw durability, scaling resistance, abrasion resistance, chloride penetration, compressive strength, modulus of elasticity, shrinkage, and creep are appropriate, with the addition of alkali-silica reactivity, sulfate resistance, and flowability. Abrasion resistance and creep, however, should only be specified for special situations. Three grades should be assigned to each characteristic, and the values in each grade should be revised to reflect recent data and experience and to raise the performance level of each characteristic. Several modifications to the test methods are suggested.

Researcher—This study was performed by Henry G. Russell, Inc., Glenview, IL, telephone no.: 847–998–9137. Contract No. DTFH61-00-C-00009.

Distribution—This TechBrief is being distributed according to a standard distribution. Direct distribution is being made to the Divisions and Resource Centers.

Availability—The full report will be available in late 2005 and may be obtained from the FHWA Resource Center by e-mail to report.center@fhwa.dot.gov, by fax to 301–577–1421, or by phone to 301–577–0818.

Key Words—Bridges, cast-in-place concrete, high-strength concrete, high-performance concrete, precast concrete, prestressed concrete.