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Guide to Quality Control and Assurance of High-Strength Concrete

Reported by ACI Committee 363

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High-strength concrete (HSC) has emerged as a viable material to use as an alternative to conventional normal-strength concrete in infrastructure systems to reduce member cross section, extend member span length, reduce the number of system members, or enhance system sustainability. This guide offers general information on the quality control and testing of HSC. Recommendations are based on the current state of knowledge gained from worldwide experimental research, analytical work, and field applications of HSC systems used in concrete structures.

Keywords: acceptance criteria; compressive strength; concrete placement; creep; curing; delivery; modulus of elasticity; sampling; shrinkage; statistical concepts; strength evaluation; testing; trial batching; quality assurance; quality control.

CONTENTS

ACI 363.2R-11 supersedes ACI 363.2R-98 and was adopted and published July 2011.

CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

The cement and concrete industry's interest in high-strength concrete prompted the American Concrete Institute to form ACI Committee 363 in 1979. The mission of the committee was to study and report information on high-strength concrete (HSC). HSC is considered one type of high-performance concrete (HPC) that is most often specified for enhanced strength characteristics, although may also be specified for its improved durability. ACI 363R was the first document produced by this committee in 1984, and contained significant information regarding material selection, mixing and placing, inspection and testing, physical properties, structural design, economics, and examples of applications.

This guide is an extension of ACI 363R and presents guidelines to facilitate the proper evaluation of HSC through correct quality control (QC) and testing. HSCs may be produced with innovative materials and procedures not covered in this guide. This guide is not intended to restrict the use of new or innovative QC practices or testing methods as they become available or necessary. The user is cautioned that this guide is for general usage only, and individual projects may require additional QC and testing effort.

1.2—Scope

This guide discusses QC and testing practices of HSC. HSC usually is associated with structures that have been optimized for performance. Therefore, a high degree of confidence in concrete quality should be achieved through the inspection and testing process. This process can be conducted by the producer and contractor as QC and by the owner or the owner's representative as quality assurance (QA). Those involved in QC and testing need to know the unique characteristics of HSC to better assist the architect/engineer in evaluating the structure's potential performance.

Concrete with a specified compressive strength of 10,000 psi (70 MPa) can be produced from local aggregates in all areas of the U.S. and Canada. When the specified strength substantially exceeds that produced previously in a particular market area, special measures are necessary to make a successful progression to the use of the higher-strength concrete. This guide details those measures.

Because the definition of HSC has changed over the years, ACI Committee 363 defined a range of concrete strengths for its activities, as explained in ACI 363R. For the purpose of this guide, HSC is defined as having a specified compressive strength of 8000 psi (55 MPa) or greater, and it does not include polymer-impregnated concrete, epoxy concrete, or concrete made with artificial normalweight and heavyweight aggregates. Changes in material properties, production and inspection techniques, or testing methods occur continuously from lower-strength to higher-strength concretes. Experience shows that in most cases, the special measures recommended in this guide should be applied for concrete with compressive strength greater than approximately 8000 psi (55 MPa).

CHAPTER 2—NOTATION AND DEFINITIONS

2.1—Notation

f'_c = specified compressive strength of concrete, psi (MPa)

2.2—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.

concrete, high-strength (HSC)—concrete that has a specified compressive strength of 8000 psi (55 MPa) or greater.

quality assurance (QA)—actions taken by an organization to provide and document assurance that what is being done and what is being provided are in accordance with the contract documents and standards of good practice for the work.

quality control (QC)—actions taken by an organization to provide control and documentation over what is being done and what is being provided so that the applicable standard of good practice and the contract documents for the work are followed.

self-consolidating concrete (SCC)—is highly flowable, nonsegregating concrete that can spread into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation. In general, SCC is concrete made with conventional concrete materials and, in some cases, with a viscosity-modifying admixture (VMA). SCC has also been described as self-compacting concrete, self-placing concrete, and self-leveling concrete, which all are subsets of SCC.

water-cementitious material ratio (*w/cm*)—the ratio of the mass of water, excluding that absorbed by the aggregate, to the mass of cementitious material in a mixture, stated as a decimal.