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Guide for Obtaining Cores and Interpreting Compressive Strength Results

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Core testing is the most direct method to determine the compressive strength of concrete in a structure. Generally, cores may be obtained to assess whether concrete in a new structure complies with strength-based acceptance criteria or to evaluate the structural capacity of an existing structure based on the in-place concrete strength. In either case, the process of obtaining core specimens and interpreting strength test results is often confounded by various factors affecting in-place concrete strength or measured strength of test specimens. The scatter in strength test data, which is unavoidable given the inherent randomness of in-place concrete strengths and the uncertainty attributable to preparation and testing of the specimens, may further complicate compliance and evaluation decisions.

This guide summarizes practices for obtaining cores and interpreting core compressive strength test results. Factors that affect in-place concrete strength are reviewed so sampling locations that are consistent with objectives of the investigation can be selected. Strength correction factors are presented for converting the measured strength of non-standard core-test specimens to the strength of equivalent specimens with standard diameters, length-to-diameter ratios, and moisture conditioning. This guide provides direction for checking strength compliance of concrete in a structure under construction and methods for determining equivalent specified strength to assess capacity of an existing structure. The materials, processes, quality control measures, and inspections described in this document should be tested, monitored, or performed as applicable only by individuals holding the appropriate ACI Certifications or equivalent.

Keywords: compressive strength; core; hardened concrete; sampling; test.

CONTENTS

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CHAPTER 1—INTRODUCTION

1.1—Introduction

Core testing is the most direct method to determine the in-place compressive strength of concrete in a structure. Generally, cores are obtained to:

- Assess, if required, whether concrete in a new structure complies with strength-based acceptance criteria; or
- Determine in-place concrete strengths in an existing structure for evaluation of structural capacity.

In new construction, cylinder strength tests failing to meet strength-based acceptance criteria can be investigated using provisions given in ACI 318. These criteria specify the circumstances when core tests are permitted, the number of cores to be tested, the conditioning of the cores before testing, the limits on the time interval between coring and testing, and the basis for determining whether the concrete in the area represented by the core strengths is structurally adequate. This guide presents procedures for obtaining and testing cores and interpreting results in accordance with ACI 318.

If strength records are unavailable, the in-place strength of concrete in an existing structure can be evaluated using cores. This in-place strength determination is simplified when in-place strength data are converted into an equivalent specified compressive strength f_c' value that can be directly substituted into conventional strength equations with customary strength reduction factors. This guide presents procedures for performing this conversion in a manner consistent with the assumptions used to derive strength reduction factors for structural design.

1.2—Background

Analysis of core test data can be difficult and can subsequently lead to uncertain interpretations and conclusions. Based on 10 hypothetical core test results, 23 practitioners responding to a survey in 2000 estimated the compressive strength of in-place concrete between 3000 and 5000 psi (21 and 35 MPa) (Hanson 2007). Strength interpretations should always be made by, or with the assistance of, an investigator experienced in concrete technology. Factors contributing to the scatter of core strength test results include:

- Systematic variation of in-place strength along a member or throughout the structure;
- Random variation of concrete strength, both within one batch and among batches;
- Low test results attributable to flawed test specimens or improper test procedures;
- Effects of the size, aspect ratio, and moisture condition of the test specimen on the measured strengths; and
- Additional uncertainty attributable to testing that is present even for tests performed in strict accordance with standardized testing procedures.

1.3—Scope

This guide summarizes current practices for obtaining cores and interpreting core compressive strength test results in light of past and current research findings. Many of these findings are based on older references as the research has reached a mature state. Parallel procedures are presented for cases where cores are obtained to assess whether concrete strength in a new structure complies with strength-based acceptance criteria, and to determine a value based on the actual in-place concrete strength equivalent to the specified compressive strength f_c'. The latter can be directly substituted into conventional strength equations with customary strength reduction factors for strength evaluation of an existing structure. It is inappropriate to use procedures for determining the equivalent specified concrete strength to assess whether concrete strength in a new structure complies with strength-based acceptance criteria.

The order of contents parallels the logical sequence of activities in a typical core-test investigation. Chapter 3 describes how bleeding, consolidation, curing, and micro-cracking affect in-place concrete strength in structures so the investigator can account for this strength variation when planning the testing program. Chapter 4 identifies preferred