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Report on Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions

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This report identifies practices for evaluating the physical properties of concrete in existing structures. Although general knowledge of the structural design used for the principle structures of a project is essential for determining procedures and locations for evaluation of the concrete physical properties, analysis for the determination of structural capacity is not within the scope of this report. This report recommends project design, operation and maintenance records, and in-service inspection data to be reviewed. Existing methods of making condition surveys and nondestructive tests are reviewed; destructive phenomena are identified; methods for evaluation of tests and survey data are presented; and preparation of a final report is discussed.

Keywords: alkali-aggregate reaction; cement; cracking; erosion; mass concrete; post-tensioning; pozzolan; roller-compacted concrete; spalling.

CONTENTS

ACI 207.3R-18 supersedes ACI 207.3R-94 and was adopted and published January 2018.

CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

Accurate information on the condition of concrete in a massive structure is critical to evaluating its safety and serviceability. This information is required to determine if repair or replacement is necessary and to select optimum repair techniques. Guidelines for evaluating the serviceability of concrete described herein apply to massive concrete structures such as dams and other hydraulic structures. The principles in this document can be applied to the mass concrete of bridge foundations and piers, building and reactor foundations, and other applications that qualify as mass concrete. Mass concrete is any volume of concrete with dimensions large enough to require that measures be taken to cope with the generation of heat from hydration of the cement and attendant volume change, to minimize cracking. The practices described pertain to concrete placed either by conventional means or by roller compaction. In addition to this report, other documents such as ACI 201.1R, ACI 201.2R, ACI 224.1R, ACI 228.1R, ACI 228.2R, ACI 437R, and ASTM C823/C823M address evaluation of concrete in existing massive structures.

1.2—Scope

This report focuses on practices used to evaluate concrete in existing massive structures. Design considerations, evaluation of existing operating records and past inspection reports, condition surveys, maintenance reports, determination of in-place conditions, instrumentation, identification of damage, and final evaluation of concrete are principal subjects that are covered. The objective of this report is to present methods for evaluating the capability of mass concrete to meet design criteria under service conditions, and to present procedures to detect the change in physical properties of concrete that could affect the capability of the concrete to meet future performance requirements.

CHAPTER 2—NOTATION AND DEFINTIONS

2.1—Notation

E = modulus of elasticity
k = stress concentration constant
P = applied load
ε = strain
σ = stress

2.2—Definitions

arch dams—concrete dam that is curved upstream in plan so as to transmit the major part of the water load to the abutments and to keep the dam in compression; most likely used in a narrow site with steep walls of sound rock.

borehole gauge—device for measuring the strain of holes dug into concrete.

feeler-gauge—thin metal strip or wire of known thickness used as a gauge.

gravity dams—dam that relies on its weight and internal strength for stability.

petrographic examination—description and systematic classification of concrete through a microscopic examination.

CHAPTER 3—PREINSPECTION AND IN-SERVICE INSPECTION

Before an inspection, arrangements should be made to obtain or have access to all available records and data pertaining to the structure. Data to be reviewed should include design criteria and memoranda; construction progress reports; instrumentation records; operation and maintenance records; and preconstruction data, if available. Information on adjacent projects, additions, repairs, or modifications that may have affected a change in the service conditions should also be reviewed.

3.1—Preconstruction and post-construction evaluation

Engineering data relating to design criteria, design site conditions, purpose of project, and construction planning and procedure should be collected and arranged for ease of information retrieval. Documents that are readily available can be assembled first. Data that are missing but deemed necessary for evaluation should be identified. A suggested list of data to be reviewed is as follows:

a) Project description documents
   i. The applicable license(s)
   ii. For a nuclear plant, the preliminary safety analysis report
   iii. All formal design documents and final completion reports