Chapter 1
Introduction

1-1. Purpose

This manual provides guidance on evaluating the condition of the concrete in a structure, relating the condition of the concrete to the underlying cause or causes of that condition, selecting an appropriate repair material and method for any deficiency found, and using the selected materials and methods to repair or rehabilitate the structure. Guidance is also included on maintenance of concrete and on preparation of concrete investigation reports for repair and rehabilitation projects. Considerations for certain specialized types of rehabilitation projects are also given.

1-2. Applicability

This manual is applicable to all HQUSACE elements and USACE commands having civil works responsibilities.

1-3. References

References are listed in Appendix A. Copies of all the references listed should be maintained in their most current versions by districts and divisions having civil works responsibilities. The copies should be kept in a location easily accessible to personnel responsible for concrete condition evaluations and concrete repair projects.

1-4. Definitions and Abbreviations

Terms frequently used in this manual are defined in the Glossary (Appendix B). Also, abbreviations used in this manual are explained in Appendix C.

1-5. Methodology for Repair and Rehabilitation

This manual deals primarily with evaluation and repair of concrete structures; however, a basic understanding of underlying causes of concrete deficiencies is essential to performing meaningful evaluations and successful repairs. If the cause of a deficiency is understood, it is much more likely that the correct repair method will be selected and that, consequently, the repair will be successful. Symptoms or observations of a deficiency must be differentiated from the actual cause of the deficiency, and it is imperative that causes and not symptoms be addressed in repairs. For example, cracking is a symptom of distress that may have a variety of causes. Selection of the correct repair technique for cracking depends upon knowing whether the cracking is caused by repeated freezing and thawing of the concrete, accidental loading, or some other cause. Only after the cause or causes are known can rational decisions be made concerning the selection of a proper method of repair and in determining how to avoid a repetition of the circumstances that led to the problem. The following general procedure should be followed for evaluating the condition and correcting the deficiencies of the concrete in a structure:

a. Evaluation. The first step is to evaluate the current condition of the concrete. This evaluation may include a review of design and construction documents, a review of structural instrumentation data, a visual examination, nondestructive testing (NDT), and laboratory analysis of concrete samples. Upon completion of this evaluation step, personnel making the evaluation should have a thorough understanding of the condition of the concrete and may have insights into the causes of any deterioration noted.

b. Relating observations to causes. Once the evaluation of a structure has been completed, the visual observations and other supporting data must be related to the mechanism or mechanisms that caused the damage. Since many deficiencies are caused by more than one mechanism, a basic understanding of causes of deterioration of concrete is needed to determine the actual damage-causing mechanism for a particular structure.

c. Selecting methods and materials. Once the underlying cause of the damage observed in a structure has been determined, selection of appropriate repair materials and methods should be based on the following considerations:

(1) Prerepair adjustments or modifications required to remedy the cause, such as changing the water drainage pattern, correcting differential foundation subsidence, eliminating causes of cavitation damage, etc.

(2) Constraints such as access to the structure, the operating schedule of the structure, and the weather.

(3) Advantages and disadvantages of making permanent versus temporary repairs.

(4) Available repair materials and methods and the technical feasibility of using them.

(5) Quality of those technically feasible methods and materials to determine the most economically viable to ensure a satisfactory job.

d. Preparation of plans and specifications. The next step in the repair or rehabilitation process is preparation of project plans and specifications. When required by a major rehabilitation project, a Concrete Materials Design Memorandum, in the form of a separate report or a part of the Rehabilitation Evaluation report, should be prepared as outlined in Chapter 9. Existing guide specifications should be used to the maximum extent possible. However, many of the materials and methods described in this manual are not covered in the existing guide specifications. If the materials and methods needed for a particular repair project are not covered in the guide specifications, a detailed specification based upon the guidance given in this manual and upon experience gained from similar projects should be prepared. Since the full extent of concrete damage may not be completely known until concrete removal begins, plans and specifications for repair projects should be prepared with as much flexibility with regard to material quantities as possible. A thorough condition survey, as outlined in Chapter 2, performed as close as possible to the time repair work is executed should help minimize errors in estimated quantities.

e. Execution of the work. The success of a repair or rehabilitation project will depend upon the degree to which the work is executed in conformance with plans and specifications. There is growing evidence, based upon experience gained on a number of projects, that concrete work on repair projects requires much greater attention to good practice than may be necessary for new construction. Because of the importance of the attention to detail and the highly specialized construction techniques required for most repairs, it is important that the design engineer responsible for the investigation of the distress and selection of repair materials and methods be intimately involved in the execution of the work. For example, many repair projects require placing relatively thin overlays, either vertically or horizontally. The potential for cracking in these placements is much greater than it is during placement of concrete in new construction because of the high degree of restraint.