ASCE Manuals and Reports on Engineering Practice No. 101

Underwater Investigations

Standard Practice Manual



ASCE
American Society of Civil Engineers

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Standard Practice Manual

Edited by
Kenneth M. Childs Jr., Chair

Sponsored by the
Coasts, Oceans, Ports, and Rivers Institute
of the American Society of Civil Engineers



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Abstract: This manual provides guidance to the requestor and provider of underwater structural inspection services. Guidelines representing the standard of practice in the industry are presented for various inspection types, with the inspection types tailored to specific inspection objectives. The scope of work is defined for each inspection type, and guidelines are provided for the inspection of unique underwater structure types. References are provided for obtaining in-depth information on the structure types and defect types commonly found underwater.

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In memory of Chris Crilley
April 30, 1959–September 30, 2000

Chapter 1
INTRODUCTION

1.1 INTENT OF THE MANUAL

The intent of this manual is to provide guidelines and methods for conducting underwater engineering assessments of underwater components of existing waterfront facilities constructed of materials such as concrete, masonry, metals, composites, and wood and located in near-shore, waterfront, and inland locations exposed to freshwater or saltwater. It includes, but is not limited to, bridges, dams, discharge and intake structures, locks, port and harbor structures, waterfront and waterway structures, pipelines and tunnels, and other structures that are located in, store, or transport water. For convenience, in this manual, the term *waterfront structures* is used to refer to any of the types of structures listed here, where it is appropriate and not specifically limited. Offshore structures and nuclear facilities are beyond the scope of this manual.

A structural inspection and condition assessment of a waterfront facility can be undertaken for one or more purposes. They can include determining the existing or baseline condition, recommending and prioritizing maintenance and repair actions, determining the suitability and serviceability for specific uses and loads, ensuring life safety, improving durability, enabling historic preservation, establishing a baseline condition for change of ownership or legal purposes, or many other special purposes on the basis of the specific structure and its current or proposed function.

This manual presents guidelines for assessment procedures, including inspection, investigation, evaluation and testing methods, and a general format for an assessment report. Specific inspection techniques are beyond the scope of this manual because it is presumed that inspection personnel will possess the requisite knowledge based on their qualifications. Because any condition assessment will require "engineering judgment" and contain factors that cannot be readily defined and standard-

ized, this manual is intended as a guide to be used by the professional engineer as part of an underwater structural condition assessment of an existing facility. The adoption or use of some or all of the recommendations contained in this manual by personnel not experienced or qualified in the appropriate areas of waterfront structures is not an acceptable substitute for the use of qualified professional engineering services.

The scope of this manual is limited to the engineering and technical requirements for conducting underwater facility assessments. Diving and related safety issues may be significant factors in conducting the assessments, but they are not covered within the scope of this manual. However, the very nature of the work, in addition to requiring technical competence, also requires proper training and preparation. This training is necessary to offset the inherent special hazards and to allow the safe operation of special underwater equipment and techniques, breathing apparatus, and special suits. Such special hazards may include differential pressures; high-velocity water flow; zero-visibility conditions; underwater entanglement hazards; confined space entries; equipment tag-out and lock-out procedures; penetration diving; contaminated water diving; and diving-related sicknesses and injuries such as embolisms, the bends, nitrogen narcosis, and physical exhaustion. It is therefore imperative that applicable safety and training requirements be adhered to in conducting such work.

1.2 IMPORTANCE OF INSPECTIONS

Underwater inspections are a necessary part of effective structure maintenance and management programs. They play an important part in protecting the public, providing reliable service, and reducing maintenance and construction costs. Structural conditions above water that could lead to failure, loss of life, or property damage are often observed by engineers, maintenance workers, and sometimes passing motorists. Similar structural conditions underwater are almost never observed by these same groups until the distress has progressed to the point that damage is evident above water. Failures of bridges due to underwater causes have led to requirements for periodic underwater inspections of bridges in the United States. Other public and private organizations have also adopted similar policies.

Underwater inspections can play an important part in structure maintenance programs. All structures deteriorate and are subject to environmental and external physical forces. Although individual materials have differing mechanisms of deterioration, the environment at the waterline, with moderate temperatures, moisture, oxygen, and chlorides or other chemicals, is conducive to most forms of deterioration. This distress may not be recognizable from above water, nor can the extent and severity be