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Guide to Underwater Repair of Concrete

Reported by ACI Committee 546

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Guide to Underwater Repair of Concrete

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This document provides guidance on the selection and application of materials and methods for the repair and strengthening of concrete structures under water. An overview of materials and methods for underwater repair is presented as a guide for making a selection for a particular application. References are provided for additional information about selected materials and construction methods.

Keywords: anti-washout; cathodic protection; concrete removal; deterioration; diver; formwork; marine placement; pile-jackets; polymer(s); repair; surface preparation; tremie; underwater.

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CHAPTER 1—GENERAL

1.1—Introduction

The repair of concrete structures under water presents many complex problems. Although the applicable basic repair procedures and materials are similar to those required in typical concrete repair, the harsh environmental conditions and specific problems associated with working under water or in the splash zone area (Fig. 1.1) create many differences. The repair of concrete under water is usually difficult, requiring specialized products and systems, and the services of highly qualified and experienced design professionals and contractors.

Proper evaluation of existing structural condition is the essential first step in designing long-term repairs. To be most effective, the evaluation procedure should begin with a review of historical information on the structure and its environment, including any changes made to the structure over time and the records of prior on-site inspections or repairs. Accurate repairs can be designed only after the extent of deterioration is documented and the failure mechanism is determined. In addition, proper repair techniques and installation procedures should be followed to produce an optimum repair system.

Underwater concrete deterioration is a serious economic problem (Fig. 1.2 and 1.3). Water containing oxygen and contaminants can aggressively attack concrete. Selecting appropriate repair materials and methods, and maintaining quality control not normally associated with repair above water are critical when working in a marine environment. As such, underwater repair of concrete is a specialized and highly technical part of concrete repair technology. Successful repairs can be achieved when these factors are carefully implemented. This guide provides an overview of the current status of underwater repair technology to assist the design professional, contractor, and owner in making repair decisions.

1.2—Scope

This guide covers the repair of concrete structures in the splash zone and underwater portions of structures located in lakes, rivers, oceans, and groundwater. Concrete deterioration, investigation and testing procedures, preparation, materials and methodology, and inspection procedures are described. Design considerations and references for underwater repair of concrete bridges, wharves, pipelines, piers, outfalls, bulkheads, and offshore structures are identified. Scour repair, however, is not included in this guide.

One option for repairing underwater structures is to construct a cofferdam around the structure and remove the water inside the cofferdam. Concrete repairs can then be installed in the dry, as discussed in ACI 546R.

1.3—Underwater access technology

Underwater work is generally classified into one of two broad categories for accessing the work site: diving or a remotely operated vehicle (ROV).

Diving is the traditional method of performing tasks under water. In this category, the diver is equipped with life-support systems that provide breathable air and protection from the elements. Manned diving systems include SCUBA (self-contained underwater breathing apparatus) and surface-supplied air. When employing SCUBA, the diver is supplied with breathing air (or gas) from a tank carried by the diver. In surface supply diving, the breathing medium is supplied to the diver through a hose connected to the air (or gas) supply above water.

Performance of duties at higher than one atmosphere ambient pressure causes a multitude of physiological changes within the human body. For example, body tissues absorb and shed gases at different rates than those normally experienced on the surface. Because of this, the time available to perform work under water decreases rapidly with increased water depth. For example, industry standards allow a diver using compressed air to work at 30 ft (10 m) for