

Underwater Inspections

An Essential Part of the Structural Engineering Process

By John Bogue, Jr., P.E.

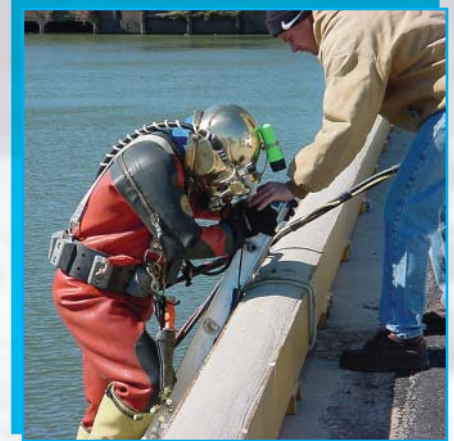
Underwater structural inspections are an often overlooked part of an effective preventive maintenance plan, but a vital one in ensuring the safety of bridge and marine structures. The deterioration of bridge and marine structure elements is primarily due to age and environmental conditions, and is visible to the eye on structural members above the surface. This same deterioration is likely occurring below the water surface, however, and can go undetected without proper underwater inspections. This deterioration, when left unchecked, is often not found until the problem has escalated and caused severe damage above the surface as well as below. Property damage, high repair costs and loss of life are just some of the possible results.

Due to this urgency to identify submerged structural distresses and failures, underwater inspections have become a requirement for all highway bridges located on public roads in the United States. As bridge structures located in a marine environment age, many factors play a role in the rate of deterioration: vessel impact damage, scour, marine borers, and the external environment at the bridge site can all cause these structures to deteriorate more rapidly than their land-based counterparts. It is essential that every structure be inspected and evaluated, both above and below the water surface.

Maintenance of existing in-service structures is just one of the many reasons that underwater inspections are required.

Inspections are also conducted to gather data necessary to generate specifications and bidding documents for repair and rehabilitation of structures, and for construction inspection of new structures. In the latter case, the inspection is used to monitor the status of the new construction to ensure that the design plans and specifications are being followed. This type of underwater inspection can be an invaluable tool used during the construction process to identify errors and omissions early, before substantial costs are realized by the contractor or engineer. Underwater inspections are also performed post-event to assess the damage to bridges and marine structures caused by floods, earthquakes or vehicular accidents on the structure. The vast majority of bridge failures in the United States are caused by flood related scour, undermining, and lateral migration of the streambed adjacent to the structure. Therefore, thorough post-flood inspections are vital for protecting the traveling public.

Some underwater inspections conducted in shallow water do not involve actual underwater diving. Wading inspections or probing inspections are often-used alternatives when the structure is above a shallow body of water. For structures located within deeper waters, a true diving inspection is necessary. There are two parts to every underwater inspection, the dive and the structural evaluation. The dive requires that an inspector proceed to the inspection area safely and efficiently.



P.E. Commercial Diver preparing for the underwater investigation of a municipal pier

The best way to guarantee a safe and effective dive is to use an experienced, properly trained commercial diver. Divers who are not commercially certified may perform the task, but cannot guarantee the safest and best result. Firms using recreationally trained divers with no additional training risk jeopardizing the safety of all members of the dive team, and are likely not in compliance with OSHA regulations. The structural evaluation portion of the underwater inspection requires the inspector to examine the structure and understand clearly what they observe. They must also be able to effectively articulate the results of the dive in an engineering report and accurately describe and document observations related to scour, undermining and other serious signs of distress.



P.E. Commercial Diver performing an underwater investigation of damage to a floating dock system as a result of an oil spill

from experience



P.E. Commercial Diver entering the water to perform underwater investigation of a waterfront facility

sional engineer-commercial divers will also be able to complete a more thorough inspection and identify distress or failures that an untrained eye can miss. Team cohesion, liability and accountability issues related to subcontracted work are eliminated and replaced with efficient, cost effective and productive professional inspection teams.

For good reason, underwater inspection services have become a niche offering for many civil-infrastructure consulting engineering firms. They are essential to the success of a bridge/structural maintenance program, and enhance an owner's ability to provide safe and reliable service on their structures while reducing the overall construction and future maintenance costs of their facilities. ■


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Many firms treat these two functions separately, wherein the engineering firm hired to perform the underwater inspection teams up with a diving company who sends staff on the dive to record the conditions and report back to the structural engineer. In this scenario, the professional engineer (P.E.) and the commercial diver are two separate entities. While this "teaming" method may allow for successful completion of the project, it does not provide the inherent quality assurance and quality control that using professional engineer-commercial divers to perform the inspection does.

Currently, it is estimated that there are less than 30 properly trained professional engineer-commercial divers in the United States. These skilled and highly trained individuals are registered professional engineers as well as certified commercial divers, and have the advantage over companies in a teaming arrangement because they gain first-hand knowledge of the structure as opposed to receiving secondary information. By having the same individual evaluate the structure and then report on it, a level of a continuity of information is achieved that is not available if the information is gained second-hand. As certified structural/bridge inspectors, profes-



P.E. Commercial Diver preparing for the underwater investigation of a marine terminal






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