Using Sonar to Mitigate Your Port's Insurance Risks

By Steve Campbell

On January 15, 2008, the Walter J. McCarthy Jr. was a typical Great Lakes coal ship in the process of shutting down operations as the winter shipping season on Lake Superior was coming to a close. A few hours later it was resting on the bottom of the Duluth-Superior harbor in Minnesota, and a $5 million lawsuit was in the works, a victim of an underwater threat lying hidden on the harbor floor.

Was it sabotage? No. It later came to light that in -40°F weather and lake ice six feet thick — frigid but not unusual winter weather — the 1,000-foot lake freighter had struck a submerged object right beside the dock. This object pierced the hull and began flooding the vessel's engine room. The crew shut off the engines and all hands evacuated the ship as it sank in the shallow water, coming to rest on the harbor floor next to the Hallett Company dock.

What exactly caused the sinking was a mystery at first. More important than finding out what happened, however, was to quickly assess the damage and determine how to fix and refloat the boat before the severe winter weather froze the flooded ship's engine room. Otherwise, refloating the ship would be delayed months into the spring, as the freighter's owner would have to wait until the ice inside melted in the spring thaw, and then have the water pumped out and the engines overhauled. Speed was imperative because costs were rising every day.

Expert underwater commercial divers were brought in immediately to survey the extent of the damage. Brian Abbott of Nautilus Marine Group of Haslett, Michigan found environmental conditions extreme. "We've been in all sorts of rough diving situations, but this was something else. It was forty below, and our divers were dealing with ice six feet thick that was already closing in on the ship. In these conditions and with poor visibility, we had our hands full." His task: assess the damage and find out what had caused the sinking — and do it quickly.

Sonar Discovers an Expensive Underwater "Surprise"

In these freezing, dangerous conditions, his dive team didn't just jump in and feel around; any diving would have to be "get in and get out," so Abbott first went into action using an advanced, portable electronic sonar scanner made by sonar manufacturer Kongsberg Mesotech. Kongsberg's sonar was lowered into the water to deliver real-time sonar viewing, electronic images and records showing the extent of the damage inflicted on the ship. Then he used the same technology to check around the ship on the sea floor to determine what might have been the cause of the damage. The findings were surprising, to say the least.

"We imaged a concrete block about 10x10 feet and six or seven feet tall sitting right on the harbor floor," notes Abbott, whose team is called in to perform commercial diving and survey projects in ports all across the U.S. "The lawyers will determine if this was the cause [responsibility for the estimated $5 million in damage costs caused by the incident is still before the courts], but one thing is certain from my experience diving in ports: it's scary that no one really knows what's under those ships."

What is Really Underwater at Your Port?

The Walter J. McCarthy incident highlights a key issue in port maintenance: what underwater hazards are lurking out there for ships and what is the true condition of the port's underwater infrastructure? Unknown hazards such as sunken barges, lost containers, shopping carts, lost suitcases present a costly insurance and downtime risk to ship owners, and to the harbor owners they might end up suing.

But aside from the risk to ships, many port piers and walls are many decades old, some dating from the early part of the last century. How have these stood the test of time? What crumbling infrastructure is close to collapse?

Unfortunately, out of sight usually means out of mind, and, given tight maintenance budgets, it's likely difficult for port managers to keep on top of potential underwater trouble until something goes badly wrong. Current practices involve sending divers out on an ad hoc basis once a year to physically sample the state of various pilings, piers and walls. However, in murky or low-visibility water, this amounts to hunting and feeling around in the dark, like the proverbial blind man describing an elephant.

Today there is a better way. For the first time, port authorities can now gain detailed visual documentation of underwater infrastructure conditions to analyze and archive. This is something that was not even possible until more advanced scanning sonar technologies began to be applied to map out harbor floors, piers and docks. Prior to this advance, in most cases port authorities relied on descriptions of a pier's sub-surface state from divers feeling around blindly in zero-visibility conditions. Clearly, sonar represents a significant addition to the port manager's insurance risk management toolbox.

Managing Your Port's Insurance Risk

How can sonar be used? According to Abbott, in a proactive maintenance campaign, sonar is used first to map out and image the various targeted infrastructure items to develop a baseline foundation of the port's current condition. The harbor floor bottom around docks and slips, and out into the harbor, should be included, and a composite map drawn up that shows all the unusual items on the sea floor. (These can range from vehicles, dropped containers, lost suitcases and shopping carts to mishandled cargo and enormous concrete blocks.)

In addition, what's called side-scan sonar enables the real-time viewing of underwater pier walls buckling either in or out, any damage or deterioration, and the state of support pilings and their bases; in addition, the sea floor underneath docks can be imaged. Electronic pictures of all of this information, once created and saved, can then be assembled into a mosaic for easy viewing and analysis by port management at their desks, and subsequently printed and archived electronically as a baseline study for future maintenance budget planning.

In Portland, Oregon, for example, city engineering officials charged with maintaining the sea wall along the Willamette River had underwater surveying expert Brian Abbott of Nautilus Marine Group use sonar to develop a composite underwater image of the entire wall. They were able to use this to establish a visual baseline record of possible weak spots and develop a program of maintenance work. "What's valuable is that you can go back down in a couple of years and take similar images," notes Abbott. "Then compare over time to see the changes when you need to prioritize your always-tight maintenance and capital budgets."

"With advances in sonar computing technology, the resolution and quality of underwater images is now quite high. It's very eye-opening for port managers," notes Kongsberg's senior projects' manager Mark Atherton, also the author of the upcoming textbook, *Visualization of Underwater Structures Using Scanning Sonar,* and an expert in the field. "Sonar is the port manager's portal for viewing and monitoring the state of the port's substantial underwater infrastructure assets."

Divers Are Not Enough

Most ports have regular survey programs involving divers going down to check out underwater structures, pilings, bridge supports and pier walls. The problem is that, in murky conditions, visibility is poor and divers are forced to feel around blindly, raising quality-control and safety issues.

At the Port of Montreal, one of the largest port authorities on North America's eastern coast, geomatics engineers have already used sonar to conduct a survey of the port's underwater infrastructure. The goal was to establish a baseline not only for maintenance plans, but also for future infrastructure expansion.

The current economic situation, where global trade and port activity has slowed considerably, provides breathing room for ports to take stock and prepare the foundations for future expansion as the upgraded Panama Canal and other developments impact trade flows and create new port opportunities. Federal stimulus funding is now available, at least for the next few years to upgrade and enhance vital public port infrastructure.

Ports can use sonar to uncover problems to allow maintenance departments to prioritize five- and ten-year work programs. The sonar images can also be used as confirming visual evidence when requesting capital funding for repair and expansion. And, of course, identify significant liability risks.

Ultimately, sonar shows port managers what's really going on with port underwater infrastructure and helps them make better decisions — probably the best benefit of all. *IP*

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