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VERTICAL WALL INSPECTION USING SIDE SCAN SONAR

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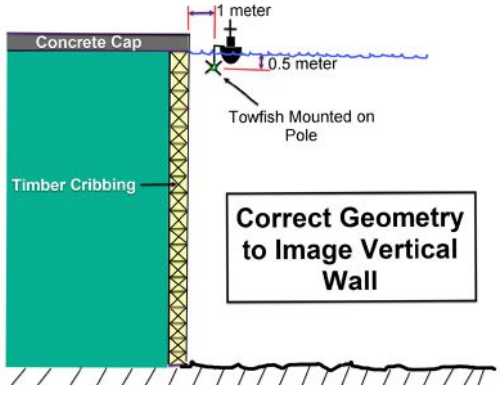
Harbors, Ports, Bridge Supports and Canal Systems have many vertical wall structures which need to be periodically inspected for integrity and possible degradation. Common methods for inspection are the use of divers or ROVs with cameras for visual inspection. These methods work well in water that has some visibility, but in black water, the methods are handicapped. Sonar is an alternative way to get high resolution images which is not limited by visibility and the process of inspection is quicker than by divers or ROV. This article presents the methodology for successfully inspecting vertical walls using side scan sonar.

An engineering firm in the Great Lakes was doing work on a length of harbor wall and needed a method to quickly inspect the crib wall structures. In the past, sector scan sonars have been used to inspect wall structures. This is a good technique for small areas, however if the requirement is for a long section of wall structure, it takes many independent sector scans and this is a time consuming process. Then to get a continuous image post processing must be done to match and blend the individual sector scan images into a mosaic. The sector scan tile matching is typically done manually in Photoshop since there is no software that automatically creates mosaics. The engineering firm requested a trial to see if standard off-the-shelf side scan sonar could be used to produce data of sufficient resolution for inspection of the vertical wall structures. A survey was performed with an EdgeTech 4125 side scan system operating at 1600 kHz. The 1600 kHz frequency was selected to image the crib walls because of its extremely high-resolution capability.

With the proper survey technique, side scan sonar can produce a continuous image of an entire long vertical wall at a very high resolution. The resulting data is geo-referenced and can be processed automatically in software like SonarWiz Map. This is a very efficient technique requiring minimal acquisition and post processing time. The success of inspecting a vertical structure with side scan sonar is dependent on understanding and controlling the geometry of the scan. The correct technique is to place the sidescan sonar towfish about 1 to 2 meters from the wall to be inspected and only about .5 to 1 meter in depth (Image 1).



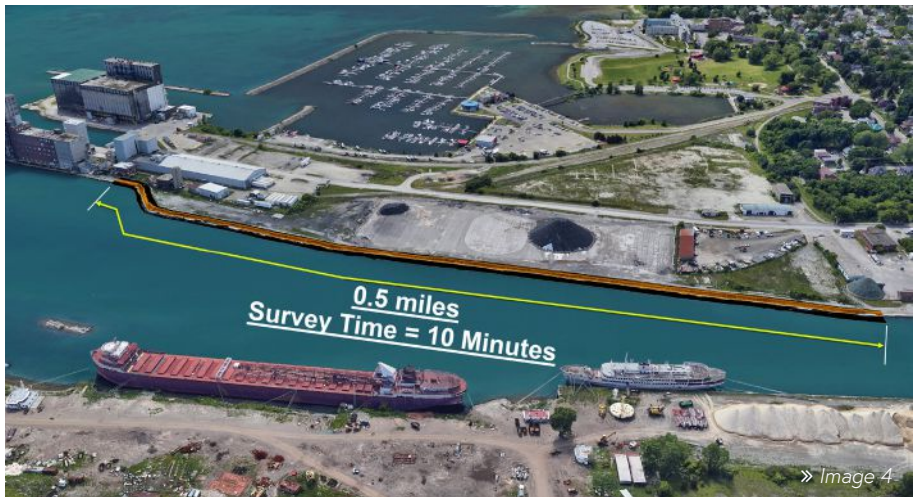
» Image 1

» Image 2

Pole mounting of the side scan sonar and rotating the fish in the pole mount bracket to position the transducer at an optimum angle for imaging the wall would be a perfect setup. However, since the small boat (Image 2) we collected the data out of had no pole mount, the towfish was simply hung on a rope off one side of the boat, 1 meter in depth and towed. No rotation was done to the towfish transducer. Since the sidescan sonar vertical beam is so wide, not rotating the transducer in practice had no negative effects on the quality of data collected.

The EdgeTech 4125 system (Image 3) is a lightweight, portable system which was setup and operational in 10 minutes onboard the small boat of opportunity that was provided for the survey. The sonar was operated on a 15 meter range scale to maximize the ping rate for optimum resolution data.

» Image 3



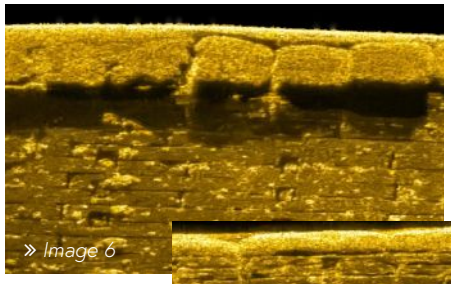
» Image 4

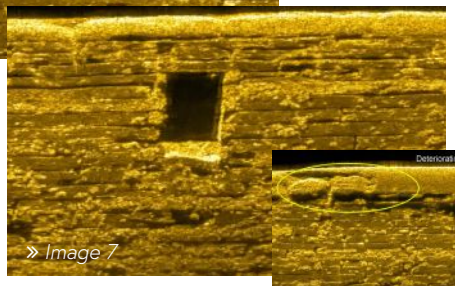
A single survey track was made in front of the wall maintaining the towfish about 1 to 2 meters from the wall face. The length of wall that was required to be inspected was 0.5 miles and the scan was completed in 10 minutes (Image 4).

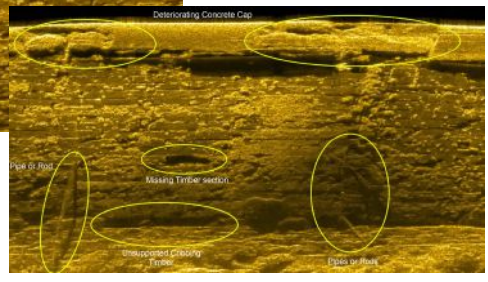

» Image 5

Cribbing walls are constructed of timbers that are layered and secured with tie in timbers to prevent collapsing. An example of cribbing wall construction is shown in Image 5.

The resulting sonar imagery was of very high resolution allowing the viewing of every timber, seam, missing timbers, concrete cap deterioration (Image 6), outflow openings (Image 7), undercutting or areas of non-support of cribbing wall (Image 8), etc. The results exceeded all expectations of the engineering company and met all their inspection requirements. This trial conclusively showed that with the right field data collection technique, side scan sonar is a very effective tool for vertical wall inspections.


» Image 6


» Image 7



» Image 8