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5.25 HYDROGRAPHIC SURVEY

5.25.1 Introduction

Hydrographic survey is often known as underwater or sub-bottom profiling, as well as referred to as water depth soundings. This process is used to obtain underwater surface elevation data for evaluating the channel bottom surrounding a structure and the waterway in general. Similar to a topographic land survey, a hydrographic survey consists of a series of elevation measurements over a particular area in a waterway. Refer to Section 1.3.8 in Part 1 for discussions on scour inspections with hydrographic surveys. The level of accuracy in hydrographic surveying varies greatly based on the equipment and methods used. Although the U.S. Army Corps of Engineers have specifications and general requirements for hydrographic surveying and there is even a process to become a certified hydrographic surveyor, scour inspections typically only require the use of more simplified methods performed by an individual familiar with the applications and limitations of water depth measurements near a structure.

The inspector determines channel bottom elevations, and then compares the values to previous data. It is necessary to measure the water level at the time of inspection against a benchmark of known elevation on a pier or other part of the substructure. This location of known elevation should be documented in the report for future use, and may even be permanently marked on the structure. Such benchmarks may be chiseled into the substructure for use in future inspections. A “crow’s foot” is a common marking.

5.25.2 Applications

Applications for hydrographic surveys are primarily for evaluating channel bottom movement. The methods include: lead line, sounding pole, fathometer, and more complex systems.

5.25.2.1 Lead Line

A Lead Line is a simple device typically consisting of a standard surveyor’s tape with a weight attached to the end. The inspector simply lowers the Lead Line until the weight comes to rest on the channel bottom. The inspector then pulls the line taut and records the reading from the channel bottom to the waterline or top of deck. An inspector working from the top of the deck most often obtains Lead Line readings.

5.25.2.2 Sounding Pole

A Sounding Pole is another simple device that typically consists of an extendable, graduated rod. An inspector in the water or in a boat will typically place the pole vertically on the channel bottom and record the measurement at the waterline. The inspector then records the distance from the waterline elevation to a known elevation on the structure. Refer to Figure 5.25.2.2-1 for a view of an inspector using a sounding pole.

Figure 5.25.2.2-1: Inspector Using a Sounding Pole.

5.25.2.3 Fathometer

The most commonly used electronic sounding device is the 200 kHz Fathometer, commonly referred to as a "fish finder." This device uses a transducer just below the waterline and repeatedly transmits sound energy through the water column. The time interval between the transmission of the sound pulse and the returning echo from the channel bottom is used to automatically calculate a depth measurement that is recorded onto the device. Refer to Figure 5.25.2.3-1 for a view of an example of a black and white Fathometer reading.

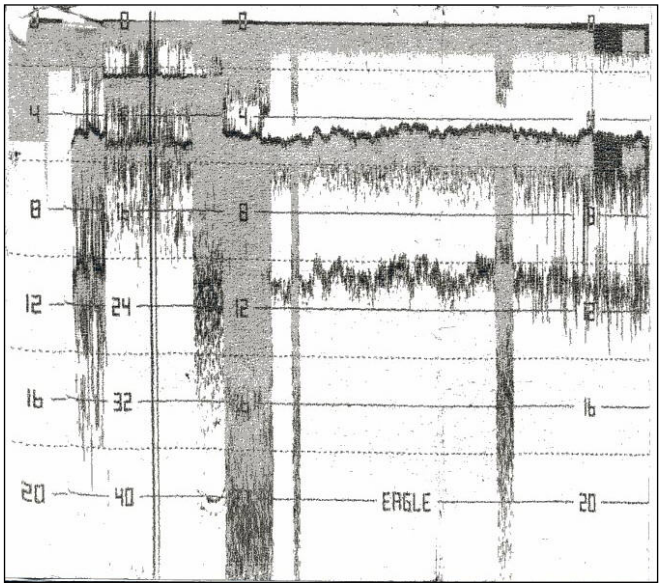

Figure 5.25.2.3-1: Example of a Black and White Fathometer reading.

Fathometers may transmit at a lower frequency (less than 10 kHz) to penetrate up to 10 feet into the channel bottom. The display will indicate materials of different densities as different reflections. This feature can be useful in determining if infilling of previous scour holes by silt or timber debris has occurred. Colors may be assigned to the differing amplitudes of the reflected signals. Fathometers can now color step at 4 dB, meaning small changes in the signal can be observed and displayed on the Fathometer.

5.25.2.4 Complex Systems

Continuous Seismic-reflection Profiling (CSP) systems utilize low frequency sonar that transmit seismic energy from a transducer through the water column and into the channel bottom. They are either fixed-frequency or swept-frequency. The fixed–frequency systems typically use a 3.5-, 7-, or 14-kHz signal, where as the swept-frequency systems typically use a signal that sweeps from 2- to 16-kHz. The swept-frequency CSP system can be used in water as shallow as 1 foot deep, can penetrate up to 200 feet in some silts and clays, and may be able to detect layers as thin as 3 inches. Exposed pier footings, scour depression geometry, and scour depression infill thickness can often be detected with this device.

Ground-Penetrating Radar (GPR) systems radiate short pulses of electromagnetic energy from a broad-bandwidth antenna. These systems typically use a signal of 80-, 100-, or 300-MHz. Dependant on the GPR system used, penetration of up to 40 feet into resistive granular material can be attained and layers as thin as 2 feet can be detected. However, GPR systems will not work in soils or waters that are highly conductive due to chlorides or pollution. Scour depression geometry, scour depression infill thickness, and riverbed deposition can often be detected using this technique.

5.25.3 Limitations

The lead line and sounding pole is limited by the softness of the channel bottom; the swiftness of the current which can introduce horizontal drift into the line or cause a lightly weighted tape to drift downstream; and the time involved in lowering and raising the tape for each new measurement position. This method also may be more prone to inaccuracies based on the experience of the inspector.

Depending on the complexity of the device, fathometers are limited by their ability to detect refilled scour holes; false readings from heavy drift or heavy turbulence; distorted scale on the readout due to varying boat speed; and their inability to provide information about the sub-bottom.

The data collected by a Continuous Seismic-reflection Profiling (CSP) system can be affected by side echoes and by multiple reflections. Side echoes are echoes from the shoreline or piers, and will interfere with the true echo from the channel bottom. Water-bottom multiple reflections occur when the echo is bounced back and forth between the channel bottom and the surface creating multiple readings. These are most evident when the water-bottom reflection coefficient is large, such as in a river with a hard bottom.

Ground-Penetrating Radar (GPR) is typically only useful in shallow (less than 20 feet) fresh water with granular bottom and sub-bottom sediments.