Dimensional Imaging Sonar Damage Identification Technology Research On Sea-Crossing Bridge Main Pier Pile Foundations

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Abstract. Sea-crossing bridge mostly in deep water rapids turbid waters, underwater photography traditional imaging techniques can not detect damage identification, there is no specific bridge main pier foundation damage identification technology, thus maintenance management department can not grasp the main bridge pier foundation damage situation, there is a big security risk. The present studies on a variety of underwater detection technology comparison analysis of this situation, according to bridge main pier infrastructure characteristics, proposed for main pier foundation bridge damage identification new technology based on three-dimensional imaging sonar.

Sea-crossing bridge main pier foundation damage identification technology research and analysis

At present the main techniques of underwater structures and hydraulic structures detailed detection of underwater visual inspection, imaging technology, underwater laser imaging, underwater photography, underwater sonar imaging. Underwater testing buildings technical research, according to sea-crossing bridge main pier foundation of the environment, damage detection technology comparison analysis are shown in Table 1.

Tab.1 The detection technique comparison of the main pier foundation damage

Detection Technique	Advantage	Shortcoming	Adaptability Analysis
Underwater vision detection	Having able to distinguish color, stereoscopic observation, and logical thinking brain linked	We shall visit the site, a large deep diving, high risk, high cost; not produce a permanent record; slow to adapt to low light conditions	Not applicable
Underwater photography, video technology	High-resolution images can be enlarged, clearer detail, the control device can be simplified or adjusted in advance	Water quality is affected by the big muddy, you need a light source	Water turbidity not applicable
Underwater Laser Imaging	Can achieve large-area imaging waters	This technology will be a lot scattered in the water, energy dissipation more, reach an area of small, clear imaging, by the influence of big muddy water quality	Water turbidity not applicable
Three-dimensional imaging sonar technology	Underwater Target contour can scan imaging, is the detailed structure of the underwater hydraulic structures more advanced means of detection, water quality is not required by the influence of turbidity and a light source.	Testing technology is relatively more difficult, need professional training	Be applicable

This study selected three-dimensional imaging sonar technology research as a Bridge Main Pier Foundation Damage detection test technique in accordance with Table 1 Main Pier Foundation Bridge Damage Detection Technology Comparison Test Analysis.

Three-dimensional panoramic imaging sonar imaging technology overview

According to the front of the Main Bridge Pier Foundation recognition technology comparison analysis, the study presents a three-dimensional imaging sonar based Bridge's main pier foundation unmanned detection technology to achieve the recognition of cross-sea bridge main pier foundation damage. In this study, three-dimensional panorama BlueView imaging sonar for a number of applications. The imaging system can not only multi-point scanning synthetic full 3D graphics software, you can also zoom in any area, in order to adopt a closer look, unusual structure, region of interest can be rotated at any angle to give the structure of three-dimensional graphics.

Three-dimensional imaging sonar imaging compared with traditional test

Site investigation found across the Bay Bridge is more deep water, flood area, traditional photographic imaging technology can not solve the Bridge Main Pier Foundation muddy water testing problems. In this paper, three-dimensional imaging sonar to address this critical technology.

To verify whether the three-dimensional imaging sonar technology water turbidity will be affected by the impact, in turbid waters image is clear. The project selected flood of muddy water quality Caoejiang Bridge were traditional imaging method and three-dimensional imaging sonar Contrast test trials.

Project Overview

The bridge total length of 1165.3m, bridge span arrangement of 10×20+20×35+13×20m. The bridge superstructure using 20m, 35m prestressed concrete continuous T beams, pile substructure using column pier.

Fig.1 The photo of the bridge

Traditional imaging methods test

(1)experiment method

Divers into the water with a small hand-held tools, attachments first pile on clean surfaces to clean up after, and in the absence of eye floaters and in good condition to start recording, and finally by the testers judged according to the degree of injury pile recording results.

(2)test results

15 # pile underwater video analysis can be seen in the surface pile Tie Beam 0~2m rugged area with exposed aggregate concrete; 2m to the pile surface of the riverbed area has 3~5cm thick sediment cover.

Fig.2 Right 15-1# pile foundation， uneven concrete

Three-dimensional test

Testers use BV5000-2250Blue View three-dimensional sonar system underwater pile testing. When the scene detection, three-dimensional sonar system includes a sonar head, a laptop and a small control box. In order to verify the accuracy of the imaging system in detecting the scene also put down a good measure of the size of the anchor. Site testing Figure 3, Figure 4.

Fig.3 Sonar test on site

Fig.4 Comparison of anchor size

By analyzing the imaging data obtained sonar imaging shown in Figure 5, it can be seen from the figure Pile image is very clear, it is clear that the existing bridge is in good condition overall underwater pile, locally explicit phenomenon, surface uneven, but has little effect on the overall structure, used for verify the accuracy of the maximum diameter of the anchor 1.5cm, the minimum diameter of 1.0cm, the figure from the imaging to be clearly identified, indicating that the accuracy of the imaging device can be achieved 1.0cm .

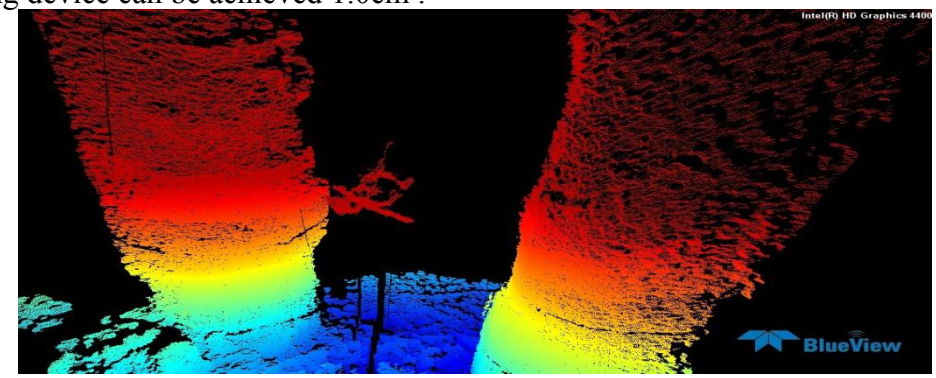

Fig.5 Analysis result of imaging sonar

Conclusions

Through this three-dimensional imaging sonar technology with traditional photographic imaging field compared to the test, let us more insight into the characteristics of three-dimensional imaging sonar imaging, test results showed that:

(1)Three-dimensional imaging sonar from water turbidity affected. Compared to the results of underwater cameras, sonar systems analysis results are not three-dimensional underwater visibility influence to obtain a fine image;

(2)Three-dimensional imaging sonar test range. Underwater cameras can only capture a small range of pile test local image, compared to three-dimensional imaging sonar underwater camera can not only get a partial extent of the damage, but also the overall situation observed pile;

(3)Three-dimensional imaging sonar testing high precision. By measuring the size of a good anchor imaging results showed that three-dimensional imaging sonar testing precision can reach 1cm, with the increase of three-dimensional imaging test frequency sonar, which will gradually increase the accuracy of the test, to meet the main pier foundation Bridge damage identification requirements.

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