Development of the Performance Evaluation Test for Equipment for Investigating the Appearance and Properties of Narrow Highway Bridges (Research period: 2013 – 2014)

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Keywords: Narrow part, proximal visual inspection, investigative equipment

1. Introduction

In our country, it is required to conduct proximal visual inspections in periodic inspections of existing highway bridges every five years, as a general rule, from the perspective of securing the quality of inspections. On the other hand, since existing highway bridges have narrow parts that are too difficult to observe directly and proximally, such as the area around the shoe and the back side of the bridge collapse prevention structure, various types of equipment for investigating the appearance and properties of the narrow parts (hereinafter referred to as "investigative equipment") are under development. However, because the shapes and dimensions of the narrow parts of highway bridges are diversified and the specifications of investigative equipment are versatile, it is not easy to determine the applicability of the investigative equipment to actual bridges in advance of an on-site investigation at this moment.

Based on these situations, this research classifies the shapes of the narrow parts of highway bridges into patterns and proposes a test method for confirming the performance of investigative equipment based on a verification experiment on test pieces simulating the narrow parts classified into patterns.

2. Classification of the Narrow Parts of Highway Bridges

In order to understand the structural conditions of the narrow parts of highway bridges that can be observed proximally, we extracted approximately 1,200 bridges with narrow parts from approximately 2,500 bridges whose photos, drawings, and articles are included in periodic inspection records. As a result of classifying the narrow parts of highway bridges extracted by sorting them by material, they were classified into eight cases as shown in Table 1.

Table-1 Classification of narrow parts

	Narrow structure	Number of bridges		Example of narrow part
Case 1	Narrow shoe	547	44.9%	<Example of Case 1>
Case 2	Back side of end crossbeam	220	18.1%	
Case 3	Such as the back side of bridge collapse prevention system	138	11.3%	
Case 4	Installed object (with narrow entrance)	118	9.7%	
Case 5	Installed object (The installed object itself and the intended member are narrow)	107	8.8%	
Case 6	Gerber area	27	2.2%	
Case 7	In upper and lower steel truss chords In cable protection pipes for cable-stayed bridges	31	2.5%	
Case 8	Narrow space under bridge beam	30	2.5%	<Example of Case 4>
	Total	1,218	100.0%	

3. Fabrication of simulation test pieces

In order to determine the applicability of investigative equipment to actual bridges, it is necessary to determine the performance of individual investigative equipment before bringing it into the fields. Therefore, we fabricated test pieces simulating the narrow parts of highway bridges classified as described above and then conducted a verification experiment to determine the performance of the investigative equipment.

The test pieces were fabricated based on variable structures, considering the diversity of the dimensions of narrow parts. Photo 1 shows an example of a test piece simulating a Gerber area.

Photo 1 Example of a test piece fabricated (An example of Gerber area)

4. Verification experiment

We conducted a verification experiment on five pieces of investigative equipment to see whether it is possible to determine simulated damages (such as crack and corrosion) using the test pieces we fabricated. As a result, it was found that the abilities to enter narrow parts and to change the direction of travel, the maximum distance (depth) that the equipment can enter, and the image capturing ability were important in the performance of investigative equipment used for the inspection of narrow parts. In addition, focusing on the ability to enter narrow parts, there were structures that could be inspected even though they were smaller than the enterable dimensions specified as the specifications of the investigative equipment. On the other hand, however, there were also structures that could not be inspected even though they were within the specifications. Therefore, in the determination of the applicability of investigative equipment, it is considered important to evaluate the performance of the investigative equipment individually for the intended narrow part structures by conducting a verification experiment using the test pieces simulating the structures to be investigated as shown in Photo 1.

5. Conclusion

Based on the results of this research, appropriate determination of the applicability of investigative equipment is expected to prevent the rerun of investigations and assist in the efficient maintenance of highway bridges.

☞For details, refer to the following:
Since the NILIM document is under preparation, it is planned to be put on the website of Bridge and Structures Division at a later date.