Development and Implementation of the Performance Evaluation Method of Nondestructive Testing Techniques

(Research period: FY2018 to FY2019)

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1. Introduction

Non-destructive inspection is effective as a method for detecting damage that cannot be directly checked by visual inspection, such as truss material and fixed part of anchor. However, non-destructive test techniques includes various inspection principles and devices, terms of application, etc. and detailed structure, surface condition, etc. of test objects are different, all of which affect detection accuracy and error characteristics. For this reason, users need to select a technology that meets their purpose and site conditions, after understanding the characteristics of various nondestructive testing techniques. It is also important to reflect the above in interpretation of results obtained (Fig. 1).

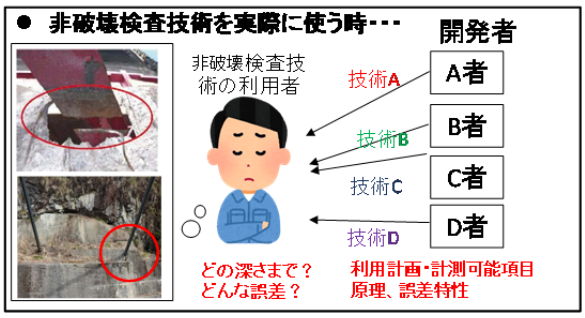

Fig. 1 Relationship between users and techniques

NILIM conducted a joint research from FY2013 to FY2014 with 19 parties from industry and academia using concrete structures with regard to the test method for performance evaluation of nondestructive testing techniques and indication of test results and summarized results, which were reflected in some of "Theme setting types (public solicitation for technology)" of the FY2018 new technology utilization system. Then, this paper introduces the outline of joint research performance and examples of reflection.

2. Outline of joint research performance

In this joint research, we obtained a methodology for evaluating basic performance (by detectable damage type, measurement limit thickness, depth, etc.), applicability, workability, etc. concerning the nondestructive testing techniques for internal damage in concrete structures. There are two points. The first one is that we verified the effectiveness of conducting a step-by-step test according to the depth / size of damage and the complexity of inner / outer surface structure in order to clarify various principles and technical characteristics. The second is that we verified the effectiveness of indicating performance so that error characteristics are clarified under various conditions, such as change in error characteristics according to the depth / size of the relevant damage.

The concept of a step-by-step test is summarized in Fig. 2. Test results are only examples of measurement with certain examples / conditions. Therefore, since performance of each technology should be provided by the developer, we decided to clarify the relevant damage, indicators to be obtained, technology use conditions, and error characteristics under use conditions. This is Step 1. The following shows that applicable conditions and error characteristics under each condition could be clarified by conducting a step-by-step test, such as a test (Step 4) using specimens (Step 2) in which types of simulating inner damage are limited and inner bar arrangement etc. are simple or specimens that have complicated bar arrangement like actual one or of which surface material has deteriorated due to aging. In addition, measurement is always accompanied with errors. Accordingly, users need to know this before they interpret test results. Fig. 3 provides an example of the scatter diagram showing how measurement

Fig. 2: Test flow

error at damaged position will change when the depth of damage changes. Then, simple indicators, such as "right or wrong," cannot represent the principles / characteristics for each device, but if the relationship between changes in the parameter likely to be related to measurement errors and changes in errors are clarified as shown in Figure, it would become possible to choose test techniques from various viewpoints, such as those with a wide scope of application even with large errors.

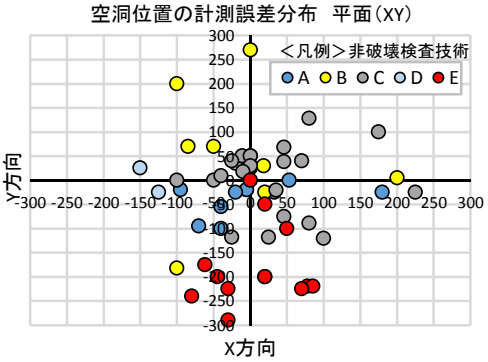

Fig. 3: Example of test result indication

3. Example of reflection (Activities of Regional Development Bureaus and utilization of Technical Note of NILIM,)

"Theme setting type (public solicitation for technology)" of the FY2018 new technology utilization system is conducted in order to accelerate on-site introduction and evaluation of new technologies by using / evaluating technologies publicly solicited in response to technical needs determined based on on-site needs. There are multiple projects of public solicitation for technology in FY2018, including "Technology for simply grasping corrosion in steel material, steel bar, etc." by Chubu Regional Development Bureau and "Technology for non-destructive detection of deformations under the post road surface boundary of road accessories" by Kanto Regional Development Bureau. Both projects aim to create a method of integrated indication of detection accuracy according to conditions and error characteristics regardless of types of technologies and technical data ("table of specifications") indicating the performance of various technologies using the method above so that various technologies are utilized according to their characteristics since non-destructive testing techniques include various inspection principles, devices, and terms of application. For study to this end, it is necessary to conduct public solicitation for technologies and organize the parameters given to the performance of each technology and examine the method of expressing error characteristics, etc.

The solicitation projects above require implementation of a test using specimens and plan the provision of characteristics of each technology and implementation of a test under limited conditions, with respect to the factors that affect the performance of each technology, such as inspection principles and detailed structure of target object, and its surface, and error characteristics related to them. These are based on the results that incorporated the findings obtained from the joint research by NILIM.

The table of specifications aims to organize clearly information necessary for users, including performance of each technology, scope of application, and use conditions, and NILIM is making discussions with each Regional Development Bureau so that it will be useful for users according to items and contents of preliminary survey.

4. Conclusion

For the public solicitation for technology conducted by Regional Development Bureaus, we intend to organize actual tests and the table of specifications from the end of FY2018 to the first half of FY2019. NILIM also intends to use the knowledge obtained from this public solicitation for technology and propose further improvement / enhancement of the performance evaluation method of nondestructive testing techniques and standardization of the performance test method.

Lastly, we'd like to express our gratitude to the persons concerned in the Chubu and Kanto Regional Development Bureaus with whom we are implementing the public solicitation together.

☞See the following for details.

1) Technical Note of NILIM, No. 981
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0981.htm

2) MLIT's website: Results of public solicitation for opinions and public solicitation for technology concerning the performance requirements of the press release "Technology for simply grasping corrosion in steel material, steel bar, etc."
http://www.mlit.go.jp/report/press/kanbo08_hh_000517.html

3) MLIT's website: Results of public solicitation for opinions and public solicitation for technology concerning the performance requirements of the press release "Technology for non-destructive detection of deformations under the post road surface boundary of road accessories (traffic signs, lighting facilities, etc.)"
http://www.mlit.go.jp/report/press/kanbo08_hh_000543.html