Analysis of Damage Characteristics and Aging Trend of Debris Barriers Using Exterior Condition Assessment

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INTRODUCTION

There are about 12,000 debris barriers in South Korea and 9,034 of them have been built intensively over the past decade. This trend indirectly shows that the maintenance burden is increasing suddenly due to the large increase in the number of debris barriers in South Korea. The maintenance of the facilities starts with checking and recording the changes in condition of maintenance targets. Additionally, it is required to have enough experimental and empirical data for effectively assess the changes in the condition of existing facilities. The objective of this study was to analyze the damage characteristics and the aging trend of debris barrier in accordance with the difference of materials used and the location of the members by using an exterior condition assessment, which is used for the safety inspection of infrastructures such as roads, bridges, and dams.

GENERAL INFORMATION

This study conducted an exterior condition assessment for concrete debris barriers and stone debris barriers to examine the typical damage characteristics of debris barriers. The aging trend of debris barriers was examined by analyzing the relationship between the usage years and the assessment index estimated from the exterior condition assessment.

EXTERIOR CONDITION ASSESSMENT

The exterior condition assessment is a type of detailed inspection that visually inspects and evaluates the condition of a facility. The safety inspection of debris barriers is using the condition assessment standards of dams according to the Work against Land Erosion or Collapse Act. However, it is not appropriate to directly apply the condition assessment standards for large dams to debris barrier, so it was necessary to adjust the assessment method for the study. This is mainly because the debris barrier is built in a mountainous torrent for reducing the sediment disaster and the large dam is built in the river for a water resources management. In short, their installation environments and their functional requirements are different.

This study applied the 4-step exterior condition assessment, which consists of the examination of the defects occurring in the exterior of the facility, the examination of each member's condition, the examination of composite member's condition, and a comprehensive assessment as debris barrier (**Fig. 1**). This is a modified version of the 7-step condition assessment for large dams to meet the characteristics of debris barriers.

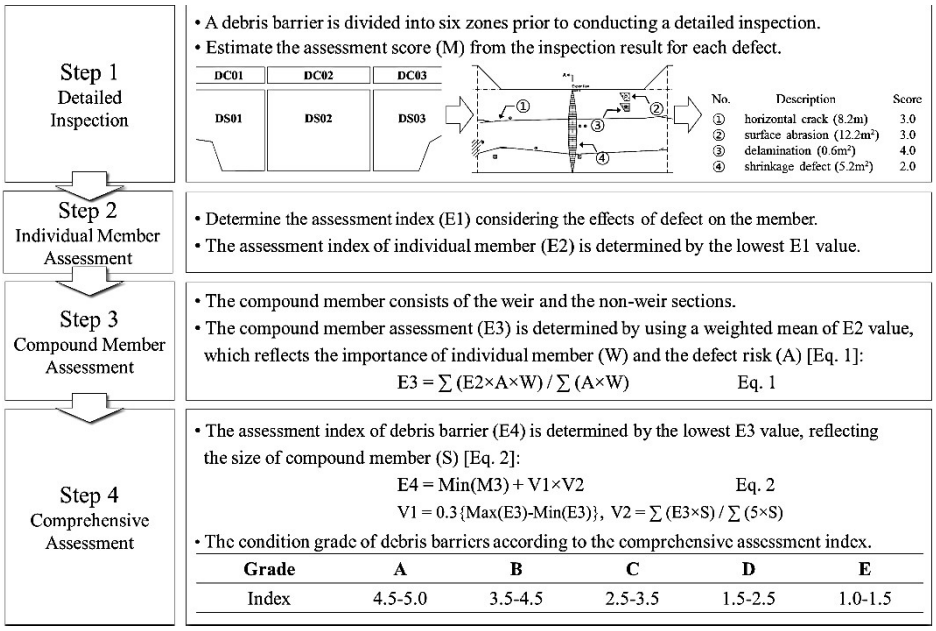

Fig. 1 Procedure of the exterior condition assessment on debris barrier

The examination of the defects was conducted after dividing a debris barrier into six zones depending on the size and location of members. The assessment score of each defect (M) was estimated based on the assessment standards developed by Korea Infrastructure Safety and Technology Corporation [2018] (Safety Inspection and Precision Safety Diagnosis Criteria) and National Institute for Land and Infrastructure Management in Japan [2015] (Guideline for Inspection of Erosion Control Facilities). The condition of an individual member (E2) was determined by the assessment index of the defect (E1) considering the lowest M value among the identified changes in the condition of the member. A compound member was a group of individual members. Moreover, the assessment index of the compound member (E3) was determined by using the weighted mean of E2 value. The result of the comprehensive assessment (E4) was determined by the lowest E3 value, which reflects the size of the compound member.

CONCLUSIONS

The results of this study showed that the concrete debris barriers had ten typical damage types including cracks and joint defects. Moreover, most of defects appeared with a crack, which was caused by environmental factors (e.g., shrinkage crack and freeze-thaw damage). The results of this study also revealed that the stone debris barriers had eight typical damage types including joint-related defects and vegetation invasion. Moreover, the major defects of stone debris barriers (e.g., erosion of the foundation part, vertical and horizontal displacement, and cavity) were associated with the exposure of inner filled concrete.

The aging trend of debris barriers was analyzed by conducting a simple regression analysis between the usage years and the condition assessment index. The results of the analysis indicated that the weir section frequently contacted with water and sediment was deteriorated 1.2 times faster than that the non-weir section for both stone and concrete debris barriers. The aging trend of concrete debris barriers and that of stone debris barriers were compared in the same way. The results revealed that stone debris barriers required maintenance and reinforcement 1.1 times sooner than concrete debris barriers on average.

Keywords: Debris barrier, Maintenance, Facility damage, Safety inspection, Exterior condition assessment