Examination of the effect of repairs using ICT monitoring for bridges damaged in the Kumamoto earthquakes

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1. Introduction

The recovery work of some of the bridges damaged in the Kumamoto earthquakes requires special and advanced technologies. Upon the implementation of recovery work, the effects of the repairs are being checked using ICT monitoring in cooperation with the Kumamoto Restoration Office, which is in charge of the projects. This paper introduces the case of the Aso Choyoo Bridge in which ICT monitoring was conducted at individual restoration steps, and changes in the condition of the bridge during the progress of the repairs and the effects of the repairs were checked.

2. Monitoring at Aso Choyoo Bridge

As shown in the photograph, the Aso Choyoo Bridge suffered significant damage to its members in the Kumamoto earthquakes. Among them, the P3 bridge pier had a crack that penetrated the cross-section at mid-height where the inside was hollow. Therefore, fluid concrete was injected into the hollow section to restore the shear resistance that had been lost due to the crack. The effect of this repair was checked by measuring the frequency of oscillation on the bridge and the oscillation mode of the bridge pier using the characteristic that the filling of the concrete would cause changes in the oscillation of the bridge pier.

For the monitoring, an accelerometer that could accurately measure slight oscillations was installed on the bridge pier to measure oscillations on the bridge before and after the repairs.

Photo: Conditions of major damage on Aso Choyoo Bridge

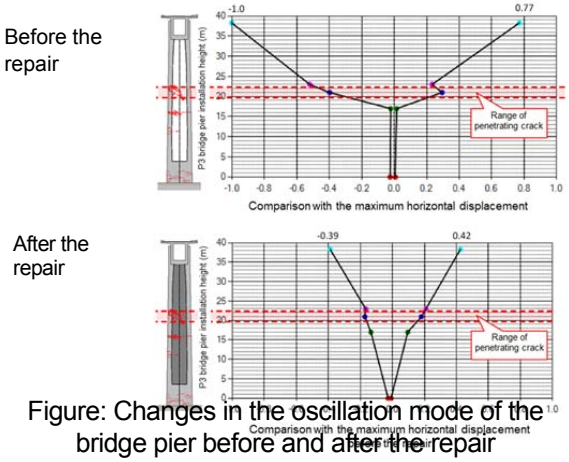

Figure: Changes in the oscillation mode of the bridge pier before and after the repair

The figure shows the comparison of the distributions of horizontal displacement in the direction of the height that occurred to the P3 bridge pier when oscillation was applied to the bridge by dropping a vehicle from a step before and after the concrete filling as an example of the outcome of the measurement. The x-axis in this figure indicates the value of horizontal displacement at the bridge pier which occurs when the maximum horizontal displacement found at the surface of a bridge during a vibration test conducted before a repair is 1.0. Before filling the concrete, the oscillation mode originated near the cross-section area where the crack penetrated. On the other hand, after filling, the oscillation mode changed to originate at the base of the bridge pier. This indicated that the concrete filling was resisting the shearing force that works on the damaged cross-section.

3. Use of monitoring data after recovery

The measured data of the oscillation characteristics of the repaired bridge can be used for maintenance and management, such as future diagnosis of the robustness of the bridge and measures to prevent deterioration. The authors are going to explore methods to use the data in the maintenance phase and the format of recording and saving the data.

☞For detailed information

Website of Kumamoto Earthquake Recovery Division

http://www.nilim.go.jp/lab/pgg/news.html