Shaking Table Test of Viaduct Model and its Numerical Analysis Focusing on Damping Modeling

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Summary

In this research, we attempt to propose the introducing method of damping property of the viaduct system based on its damping mechanism. In this method, the damping factors of the viaduct system such as the internal material damping and the hysteresis damping of the pier and the superstructure, the frictional damping of the movable bearing and energy absorption at the base of the pier are incorporated into the numerical model of the integrated bridge structure. In order to confirm the validity of the method, we conduct the shaking table test of the simple specimen of the viaduct which includes the various damping factors, and conduct the dynamic response analysis of the corresponding numerical model employing the proposed damping modeling. The proposed damping modeling method can reproduce the elastic and inelastic behavior of the viaduct model employed in the shaking table test.

Keywords: modeling of damping; shaking table test; dynamic analysis; viaduct model

1. Introduction

In evaluating the performance of the bridge structures subjected to the dynamic load such as earthquake motions and moving vehicles, the dynamic response analysis is often conducted by employing the adequate numerical model. In order to simulate the dynamic response of the actual structure exactly, it is required to construct the precise numerical model so that their natural frequencies and the damping property should agree with the actual ones. While the exact stiffness and mass properties can be evaluated from the design materials, it is not easy to evaluate the damping property of the structure adequately. Therefore, from the empirical standpoint of view, Rayleigh damping[1] is usually employed for the dynamic response analysis of the bridge structure. However, Rayleigh damping is not always based on the exact damping mechanism of the bridge structure.

In this research, we attempt to propose the introducing method of damping property of the viaduct system based on its damping mechanism. In this method, the damping factors of the viaduct system such as the internal material damping and the hysteresis damping of the pier and the superstructure, the frictional damping of the movable bearing and energy absorption at the base of the pier are incorporated into the numerical model of the integrated bridge structure. In order to confirm the validity of the method, we conduct the vibration test of the simple specimen of the viaduct which includes the various damping factors described above, and conduct the dynamic response analysis of the corresponding numerical model employing the proposed damping modeling.

2. Vibration test

2.1 Outline of experiment

In this research, we employ the simple specimen of the viaduct which is composed of the superstructure, bearings and piers as shown in Fig.1. The height of both piers is about 490mm, and

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