The Fifth International Bridge Seismic Workshop (5IBSW)
Hunan University, Changsha, China, June 5-7, 2026

Development of a friction damper following large displacements perpendicular to the damping direction

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Abstract

Cases of applying dampers for seismic retrofitting are increasing for the purpose of damage control in existing bridges. Generally, since dampers are fixed to both the superstructure and substructure, they cannot accommodate displacements perpendicular to the damping direction. For this reason, it is not feasible to apply such dampers in the transverse direction of movable bearings. In this study, focusing on friction dampers whose resistance depends on frictional force, we developed a seismic device designed to function as a damper in the transverse direction while allowing the superstructure to move freely in the longitudinal direction. The developed damper is fixed to the substructure and installed by being sandwiched between brackets attached to the superstructure. Rather than being fixed to the brackets, the ends of the damper are equipped with nylon components that remain in contact with sliding plates on the brackets. This configuration allows the device to follow superstructure displacements by having the nylon surfaces slide along the sliding plates. To verify the seismic behavior of the damper and the overall bridge structure, three-directional shaking table experiment was conducted using a large-scale frame simulating an actual bridge. These tests utilized both sinusoidal and seismic waves, focusing on the behavior of the damper and the responses in the direction perpendicular to it. The results confirmed that the damper consistently provides seismic damping in its axial direction while following perpendicular displacements, regardless of the excitation direction or input waveform.

Keywords*: friction damper, shaking table experiment, seismic retrofitting*