Development of a divergent fluid wall damper for framed structures subjected to dynamic loads

ABSTRACT

This study developed a new adaptive design for a divergent fluid wall damper (DFWD). This design decreases the dynamic vibration in reinforced concrete (RC) structures subjected to dynamic forces caused by earthquakes, wind, tsunamis, and explosions. The DFWD comprises a tank connected to the lower floor that is filled with a fluid and a plate with fins located inside the tank connected to the upper floor. The DFWD uses a bypass system mechanism that circulates fluid inside the wall damper tank through a divergent pipe and controls the fluid pressure during vibration using a double-acting valve. To evaluate the performance of the DFWD in RC-frame structures, we fabricated and experimentally evaluated a prototype of the device based on a new adjustable design. Two RC frames, a bare frame and a frame with DFWD, were cast with the same geometric specifications. These frames were then examined in terms of the time history of applied displacement with a maximum amplitude of 40 mm under the same conditions. The valves in the design of the DFWD were adjustable, and the fully open valve condition was examined. The results indicated that the failure capacity of the frame was significantly improved compared to that of the bare frame as the DFWD absorbed more dynamic force. The ductility of the RC-frame structure equipped with the DFWD was improved by almost 17.8% compared to that of the bare frame.

Keyword: Damper device; Earthquake; Earthquake energy dissipation; Fluid damper; Viscous wall damper