Seismic Performance of Eccentrically Braced Steel Frames Using Steel Slit Dampers with Shape Memory Alloy

Joo-Woo Kim

[1]Department of Architectural Engineering, Semyung University, Korea.

jw_kim@semyung.ac.kr

Abstract

Eccentrically braced frame (EBF) system has the characteristic that the axial forces induced in the braces are transmitted to a column largely through shear and bending in a beam segment called the link. The energy dissipation may be achieved through the yielding of the link, while the other frame members, such as outer beam segments, braces, and columns, remain essentially elastic. Here, a hybrid link is fabricated from a standard structural wide-flange section with a number of slits cut from the web and shape memory alloy (SMA) bars in order to ensure sufficient energy dissipation as well as re-centering effect. Energy is dissipated through yielding of a number of strips between slits when the frame is subjected to inelastic cyclic deformation. SMAl is the state of the art material that has the capability to sustain large deformations, and can also retrieve their original shape by inducing thermal energy. This phenomenon is known as the superelastic effect. When a large earthquake takes place, inelastic deformation occurs in the brace elements and their connection cause a decrease in the internal resistance force as well as an energy dissipation capacity. Development of seismic resistance system without residual strain is necessary to solve the problem. This paper presents results from a systematic three-dimensional (3D) nonlinear finite element analysis on the structural behavior of the EBF systems subjected to cyclic loadings. Here, the hybrid link and bracing system include superelastic SMA bars to obtain the re-centering effect as well as great energy dissipation capacity. A wide scope of structural behaviors explains the influences of the EBF system parameters. The accurate results presented here serve as benchmark data for comparison with results obtained using modern experimental testing and alternative theoretical approaches.