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Hysteresis behavior of smart eccentric braced steel frames with shape memory alloy

Joo-Woo Kim and **Myung-Jae Lee**
[1]Semyung University, Korea
[2]Chug-Ang University, Korea

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, reamin essentially elastic. However, when a large earthquake takes place, inelastic deformation occurs in the brace elements and their connections cause a decrease in the internal resistance force as well as the energy dissipation capacity. Development of seismic resistance system without residual strain is necessary to solve the problem. Shape memory alloy (SMA) material is the state of the art material that has tha capability to sustain large deformations, and can also retrieve their original shape by inducing thermal energy. This phenomenon is known as the superelastic effect. This paper presents results from a systematic three-dimensional (3D) nonlinear FE analysis on the structural behavior of the smart EBF systems subjected to cyclic loadings. Here, the 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 testings abd alternative theretical approaches.

jw_kim@semyung.ac.kr

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