Feasibility study of viscoelastic Hybrid self-centering brace (vscb) for seismic-resistant steel frames

Yi-Wei PING 1, Cheng FANG 1\* and Yi-Yi CHEN 1

1 Department of Structural Engineering, College of Civil Engineering, Tongji University, Shanghai, China

E-mail: chengfang@tongji.edu.cn

**Abstract**: The practicability of existing self-centering braces is largely limited by their small deformability and insufficient energy dissipation. This paper presents a new type of velocity-dependent self-centering brace called viscoelastic self-centering brace (VSCB), which employs viscoelastic dampers (VED) and SMA cables as the kernel elements.

The SMA cables can offer large recoverable deformation, and the viscoelastic dampers, which are velocity-dependent, provide considerable energy dissipation under high-frequency loading excitations but tend to have less detrimental influence on the self-centering capability during the shakedown of the system. A comprehensive system-level analysis on three carefully designed prototype buildings was conducted, including a buckling restrained braced frame (BRBF), a pure self-centering braced frame (SCBF) and a viscoelastic self-centering braced frame (VSCBF).

The results show that compared with the SCBF, the VSCBF maintains the benefit of small residual inter-story drift (RID) and in addition, exhibits obviously reduced peak inter-story drift (PID) and peak floor acceleration (PFA). The typical hysteretic response of viscoelastic material is shown in Fig. 1.



Figure 1: Fundamental behavior of superelastic SMA and viscoelastic material.

**Keywords**: Self-centering; shape memory alloy (SMA); viscoelastic; steel braced frame; seismic resilience; hybrid