

Using Shape Memory Alloys for Structural Engineering Applications

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Abstract : Shape memory alloys (SMAs) have great potential for use in the field of civil engineering. The author of this manuscript has been involved, since 1996, in several experimental and theoretical studies on the application of SMAs in structural engineering, within national and international research projects. This paper provides an overview of the main results achieved, including the conceptual design, implementation, and testing of different SMA-based devices, namely: (i) energy-dissipating braces for RC buildings, (ii) seismic isolation devices for buildings and bridges, (iii) smart tie-rods for arches and vaults and (iv) seismic restrainers for bridges. The main advantages of using SMA-based devices in the seismic protection of structures derive from the double-flag shape of their hysteresis loops, which implies three favourable features, i.e., self-centering capability, good energy dissipation capability, and high stiffness for small displacements. The main advantages of SMA-based units for steel tie-rods are associated with the thermal behaviour of superelastic SMAs, which is antagonistic compared to that of steel. This implies a strong reduction of force changes due to air temperature variations. Finally, SMA-based seismic restrainers proved to be effective in preventing bridge deck unseating and pounding.

Keywords : seismic protection of structures, shape memory alloys, structural engineering, steel tie-rods, seismic restrainers for bridges

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