MARTENSITIC TRANSFORMATION IN SMA. DAMPERS IN FAMILY HOUSES AND EARTHQUAKE EFFECTS VIA ANSYS

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The behavior of Shape Memory Alloys (SMA) allows their use as a smart material. In particular, the existence of a hysteretic cycle in the domain of elementary coordinate strain-stress-temperature suggests its application for self-centering devices in damping. With the appropriate tuning of the physical properties, this characteristic makes SMA potentially available for specific application in mechanical or in civil engineering [1]. We are working in the particular properties of SMA in dampers useful for arthquakes in family houses. The interest of SMA in family houses is increasing recently because SMA can be used as passive elements. Passive elements offer advantages respect the classical dampers, as rubber-lead devices in isolated constructions that require reinforced construction for bearing renewal after 15-20 years. The more efficient semi-active devices via the magneto-rheological fluids is more complex for a family house. The system requires permanent power supply and appropriate computer response (software and hardware) after several years. The SMA proposed for dampers are mainly TiNi and Cu-based ones, but the expected behavior of SMA for each action must be specifically tuned. The available static and dynamic knowledge of the thermo-mechanical behavior (in stress-strain-temperature coordinates) in SMA establishes several relevant macroscopic and microscopic actions: 1) The self-heating induced by the oscillation amplitude and the cycling rate associated to practical conversion from mechanical work to heat. 2) The martensitic phase transformation between meta-stable phases is affected by the summer-winter temperature changes as is expressed by the Clausius-Clapeyron coefficient. 3) The meta-stability suggests the microscopic changes in atomic order. The presentation shows the appropriate properties (macroscopic and microscopic) of the SMA for dampers in the time scale (more than 10 years) of the civil engineering and the helpful effects of the SMA situated in the structure under the quake actions. The SMA models are developed and included in a finite element simulation environment (ANSYS). Using these developing tools a complete damping solution for a family house is achieved.

[1] F. Martorell, A. Isalgué, F.C. Lovey, V. Torra, Materials Transactions **47** (3) (2006) 682.