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Smart Superelatic Dampers In Dynamic Control Of Civil Structures

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The objective of mitigating the dynamic effects induced by seismic events in civil structures can be pursued through a variety of control strategies, which may result in different levels of protection for the building and offer diverse degrees of reliability. The significant energy demand requested for operating active systems makes them less appealing from certain point of views, especially with comparison to systems that may be able to offer satisfactory levels of protection of buildings while requiring and allowing to quote lower energetic plans, and thus offering a higher performance in the balance of the involved energy budget, which is now a primary issue more than ever. These observations have addressed in recent years the scientific and factory research to alternative safer and more economic solutions. This is witnessed, on one side, by the further and increasing efforts focused on the development of passive control systems, and, on the other side, by the expansion and the growth of a variety of approaches to structural control able to simultaneously match the economy and performance issues. In this category the coupling of active and passive devices (hybrid control), the identification of activation/deactivation policies (semi-active control), the adoption of special (smart) materials, contributing at increasing the structure dissipative skill at low costs, are included. A particularly interesting class of devices relies upon the "smart" exploitation of properties of special materials to engineering structures. Technologies related to the adoption of such materials show great potential mainly referable to unique properties such as mechanical simplicity, low power demand during operation, skill of generating high intensity forces and, definitively, robustness. The main characteristic of most of these materials is the reversibility of transformations they undergo after the exposition to given fields. In this class, particularly interesting for their properties which appear suitable for structural applications and essentially related to micro-crystalline phase transition processes, are Shape Memory Alloys (SMAs). SMAs exhibit a particular behaviour that makes them quite promising for civil engineering applications, especially for the implementation of effective semi-active control devices. In the paper, the SMAs super-elastic property is focused on and SMA-based control devices are designed able to induce inelastic deformations occurring during the dynamic seismic loading to give rise to damping and re-centering effects onto the structure, which makes the implementation of these alloys particularly attractive in the fields of vibration control and earthquake resistant engineering. The influence of SMA tendons contributing to the overall strength of a mdof structural model undergoing horizontal shaking and subject to vertical loads is analysed, highlighting how super-elastic members may lead to excellent performance in terms of attenuation of the P-□ effects and residual structural deformations.