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Next generation smart infrastructure using shape memory alloys

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Shape memory alloys (SMAs) are special materials with a substantial potential for various structural engineering applications. The novelty of such materials lies in their ability to undergo large deformations and return to their undeformed shape through stress removal (superelasticity) or heating (shape-memory effect). In particular, SMAs have distinct thermomechanical properties, including superelasticity, shape-memory effect, and hysteretic damping. These properties could be effectively utilized to substantially enhance the safety of civil infrastructures against seismic hazards. This presentation examines the fundamental characteristics of SMAs, the constitutive material models of SMAs, and the factors influencing the engineering properties of SMAs. Some of the potential applications of SMAs in buildings and bridges are discussed, including the reinforcement and repair of structural elements, and the development of kernel components for seismic devices such as piston based self-centering devices, dampers, restrainers and isolators. The presentation synthesizes existing information on the properties of SMAs, presents it in concise and useful tables, and explains different alternatives for the application of SMAs, which should motivate researchers and practicing engineers to extend the use of SMAs in novel and emerging applications.

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