Modeling of Superelastic Shape Memory Alloy Elements

This topic discusses the modeling of Shape Memory Alloy (SMA) elements in ETABS, SAP2000, and CSI-Bridge. The hysteresis loop of an SMA element looks like a flag. Such a hysteresis has the benefit of some energy dissipation along with minimal residual deformations upon removal of the load, hence is mostly preferred for re-centering devices.

![Idealized Stress-Strain Curve of Superelastic SMAs](image)

Figure 1. Idealized Stress-Strain Curve of Superelastic SMAs


![Schematic diagram of Superelastic SMA Model Using Two Links Element from Adrawes and DesRoches 2005](image)

Figure 2. Schematic diagram of Superelastic SMA Model Using Two Links Element from Adrawes and DesRoches 2005
Define two link properties and assign them to two link elements in parallel. A multi-linear plastic link using the Pivot model is used to define the hysteresis loop, and a multi-linear elastic link is used to shift the hysteresis loop away from the origin. For example, the following flag-shaped force-deformation behavior in Figure 3 can be obtained using the two link properties defined in Figures 4:

![Figure 3. Force-Deformation curve. Example of Superelastic SMA Modeled Using Two Links elements](image)
Figure 4a. Multi-linear Plastic link property using Pivot hysteresis
Figure 4b. Multi-linear Elastic link property

Attachments

sma.sdb