Reducing Seismic Residual Deformations in Civil Structures using Superelastic Shape Memory Alloys

Maged A. Youssef, P.Eng., Professor
Department of Civil and Environmental Engineering, Western University,
London, ON N6A 5B9
youssef@uwo.ca

The uniqueness of superelastic Shape Memory Alloy (SMA) bars lies in their ability to undergo large deformations and return to their undeformed shape through stress removal. In conventional seismic design of civil structures, inelastic deformations are allowed to dissipate the seismic energy. Such design philosophy results in permanent residual deformations, which complicate the post-earthquake retrofitting efforts. This keynote lecture summarizes Dr. Youssef's research that utilizes superelastic SMA bars to reduce or eliminate seismic residual deformations.

The lecture will summarize the characteristics of superelastic SMA bars and highlight challenges facing their implementation in future construction projects. It will then cover research addressing their use in Reinforced Concrete (RC) moment frames. Experimental tests of RC beam-column joints provided the initial proof that superelastic SMA bars can upgrade our RC framed structures to sustainable ones that can be easily repaired following a strong seismic excitation. Incremental dynamic analysis identified the optimum locations of superelastic SMA bars in a typical RC frame. Other applications including the use of superelastic SMA bars in brace members, RC walls, steel frames, and modular steel buildings will also be presented.