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Seismic performance improvement of steel moment resisting frame using Shape Memory Alloy

Shape Memory Alloys have a wide range of applications due to their special properties. The properties like shape memory effect, super elasticity and high damping are useful to enhance structural behavior and seismic resistance. In this paper, shape memory effect of two different alloys NiTi and Fe based SMA is used to enhance the structural properties of a steel Moment Resisting Frame and comparison of response of frame with connection of two different alloys is studied. The finite element analysis of moment resisting frames was done using Ansys - 15. The geometry and loading conditions of frames were taken from previous research. For the comparison of structural behavior of the steel frame with Shape Memory Alloy at beam column connection was checked for lateral loading. Also the response of the frame was checked for time history analysis using past earthquake data. Comparison of the time history analysis response of bare frame (Steel only connections) and frame with use of SMA at connection suggested excellent performance of frame equipped with SMA.

The main aim of the study is reducing residual displacement of steel frames after earthquake loading. To check the performance of the frame for loading unloading cycle, incremental lateral loading is applied to the frame up to maximum load and then it is unloaded completely. The SMA equipped frame shows almost 85% recovery of the residual displacement. The reduction in residual displacement of the SMA equipped frame is also seen in case of time history analysis. Though Ni-Ti SMAs show a little more recovery in residual displacement, cost comparison shows using Fe based SMA in Civil Engineering industry will be beneficial for the maximum utilization of material with lesser cost. The result signifies the use of innovative material Ferro SMA excellent performance in steel frames.

Biography

K M Bajoria has completed his PhD at the age of 27 years from Cambridge University on three dimensional aspects of progressive collapse of steel structures and also postdoctoral research at Cambridge University Department of Engineering. He is Professor of Civil Engineering at Indian Institute of Technology Bombay, a premier technical university in India. He has published more than 90.papers in reputed journals and international conferences and has served as chairman of Indian Association for Structural Rehabilitation. His active area of research is application of smart materials to improve the structural performance of traditional steel structures.

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