Modeling seismic isolation systems for critical infrastructure and contents

by

Henri P. Gavin, Ph.D., P.E.
W.H. Gardner Associate Professor
Department of Civil & Environmental Engineering
Duke University

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Abstract: Telecommunications and public-health infrastructure are critical to post-earthquake recovery operations. The use of seismic isolation in the protection of these facilities is predicated upon an acceptable level of risk associated with the failures of these systems due to excessive displacement demands. The recognition that ground motions close to earthquake faults can have very high velocities at long periods has led many to question the effectiveness of seismic isolation in mitigating near-fault ground motion hazards. At much smaller scales, seismic qualification criteria for telecommunications equipment involves low seismic demands at long periods. These criteria are easily satisfied by equipment isolation systems, but may under-represent the actual hazard in many installations.

This presentation addresses issues in modeling and implementation of seismic isolation at these two very different scales. In Christchurch NZ, the base-isolated Women's Hospital has sustained hundreds of earthquakes and aftershocks over the last two years. Isolator deformations were smaller than would be expected from the largest of the shakes, which were close to the design-level events. Data from aftershock response monitoring is contributing to an understanding of the mechanisms responsible for this behavior. At smaller scales, equipment isolation systems have been deployed to protect thousands of pieces of equipment around the world. The dynamics of equipment isolation systems based upon a rolling pendulum concept have nonholonomic constraints which result in nonlinearly coupled translational and rotational motions. Studies of experimentally-calibrated models illustrate the limitations associated with small displacement capacities.