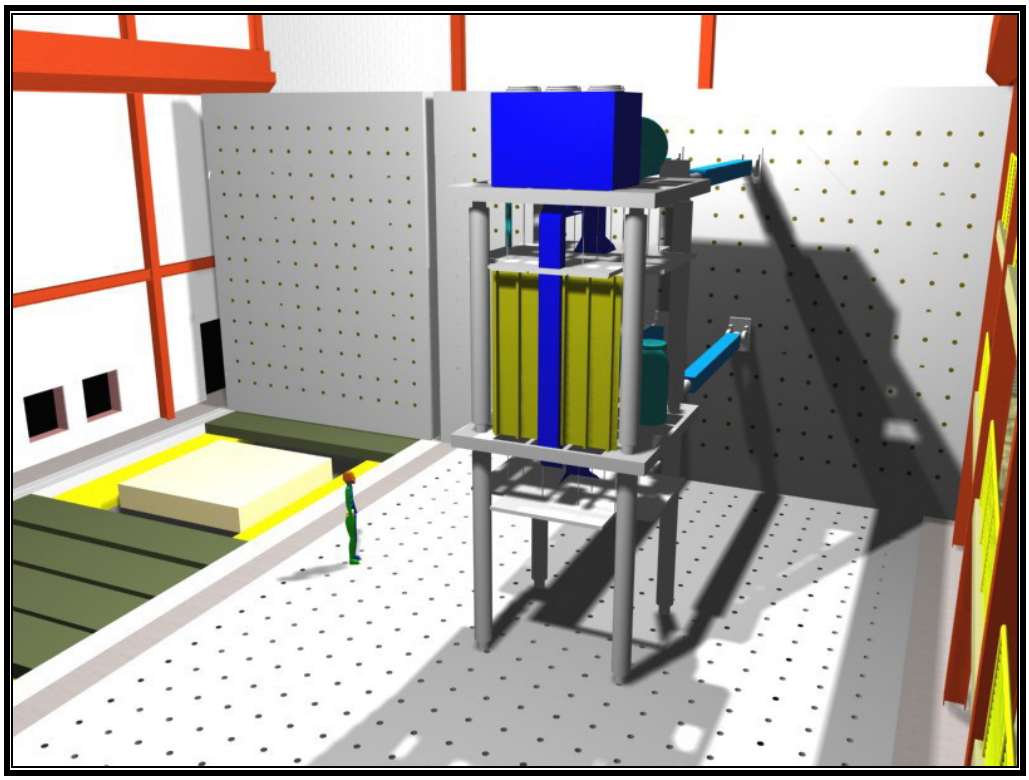
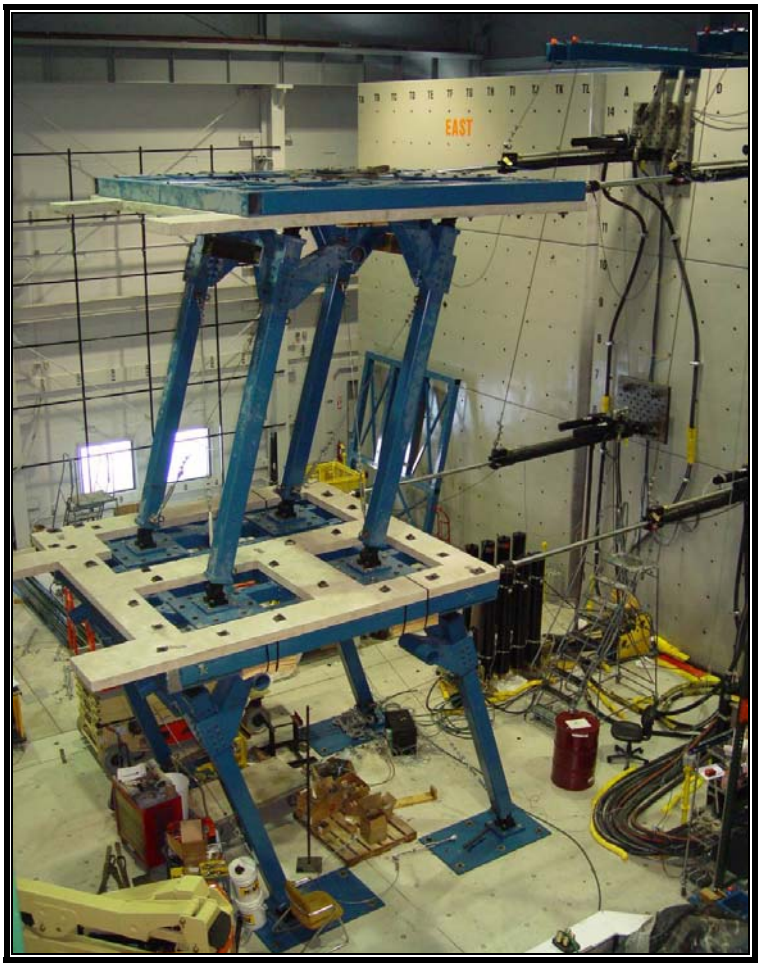
UB-NEES Conducts Successful Tests of the Unique Large-Scale "Nonstructural Component Simulator" (NCS)

Under extended NSF funding (Award CMS-0429331), the UB-NEES Equipment Site developed a unique Nonstructural Component Simulator (NCS). The NCS is a system of modular and versatile two-level shake-table platforms for experimental performance evaluation of nonstructural components and equipment under realistic full-scale floor seismic induced motions. The NCS can provide the dynamic stroke necessary to replicate full-scale displacements, velocities, accelerations and inter-story drifts at the upper levels of multi-story buildings during an earthquake event. Both displacement or drift sensitive and acceleration sensitive nonstructural components and equipment can be experimentally evaluated under full-scale floor motions to understand, quantify and control their seismic response. The NCS test frame system is composed of two square platforms having an inter-story height of 14 ft. Each of the platforms is activated using two identical high performance dynamic actuators, supplied by MTS Corporation. The NCS is capable of subjecting nonstructural components and equipment up to 3g horizontal accelerations, 100 in/s (2.5 m/s) velocities and ± 40 inches (± 1m) displacements for specimens up to 6.9 kips (3.1 mtons) per level. Each actuator has a load capacity of 22 kips (10 mton), a displacement stroke of 80 inches (2 m) and a mid-stroke length of approximately 15 feet (4.6 m). Uni-axial and bi-axial testing configurations are possible.



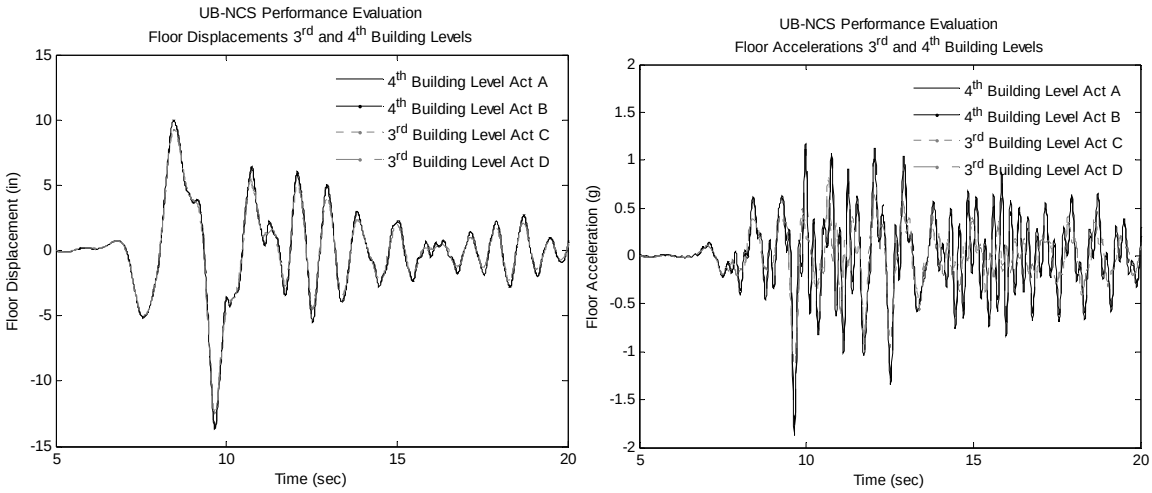
3D-CAD View of the NCS System

On April 13, 2007, University at Buffalo's Ph.D. candidate Rodrigo Retamales under the supervision of Professors Gilberto Mosqueda, Andre Filiatrault and Andrei M. Reinhorn, successfully completed experimental verification tests of this unique UB-NEES system quantifying the dynamic properties, testing capabilities, and limitations using harmonic and seismic motions. The seismic motions were obtained from the simulated floor motion response of an existing medical facility located in the San Fernando Valley, in Southern California. This 4-story steel framed building model has been extensively studied by MCEER researchers. The floor motions were obtained from a nonlinear seismic analysis of the building excited at the base by synthetic ground motions corresponding to a seismic hazard with a probability of exceedance of 5% in 50 years.



Photograph of the NCS System in the SEESL/UB-NEES Laboratory

The following graphs demonstrate the capabilities of the equipment to replicate the full scale floor motions at the top two levels of the building. The left figure shows the displacement histories measured during testing with a maximum floor displacement equal to 13.7 inches. The right figure shows the absolute floor accelerations with a peak of 1.88g.



Within the testing frame, typical rooms in hospital, office or residential buildings can be modeled including partition walls, ceiling systems, piping systems, self-standing and anchored equipment and content, then subjected to motions expected between two typical floors of a building including absolute accelerations and inter-story drifts. Such tests can capture, for the first time, the system interaction between various interdependent components present in a building, some of which may be sensitive to displacements and/or accelerations. UB researchers through MCEER have partnered with the Pan American Health Organization/World Health Organization (PAHO/WHO) to test a fully furnished hospital emergency room. The tests planned for Fall 2007 will include medical equipment donated by PAHO/WHO partners and the results of this research will be applied to improve seismic guidelines in the US and developing countries served by PAHO.

These landmark tests follow many months of development under the NSF grant, NEES-MO&M Equipment Enhancement and internal UB-private funding. The successful development and testing of the NCS system was supported and made possible by the efforts and contributions of several members of the SEESL/UB-NEES staff including: Mark Pitman, Scot Weinreber, Assawin Wanitkorkul, Duane Kozlowski, Bob Staniszewski and Goran Josipovic. Detailed specifications of the NCS system and video replays of this test can be viewed on the SEESL/UB-NEES website at:
http://seesl.buffalo.edu/Facilities/Major_Equipment/ncs.asp