Versatile Shake Tables and Large-Scale High-Performance Testing Facility Towards Real-Time Hybrid Seismic Testing

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The University at Buffalo's (UB) Structural Engineering and Earthquake Simulation Laboratory (SEESL), which is the flagship laboratory in the Multidisciplinary Center for Earthquake Engineering Research (MCEER), will be a key node of a nationwide earthquake engineering "collaboratory"– the NSF-funded George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES). Through this network, earthquake engineers located at different institutions will be able to share resources, collaborate on testing, and exploit new computational technologies.

The intent of the NEES node project at UB is to develop the most versatile earthquake engineering research facility possible, designed to provide testing capabilities that will greatly enhance the understanding of how very large structures react to a wide range of seismic effects. The authors believe this will be achieved through the following features of the new seismic testing facility:

- A new SEESL 13,000 square feet laboratory that includes a 80'x40' strong floor, a large 80' long reaction wall, and a special trench to house the two new moveable shake tables described below.
- A set of two movable, high-performance, 6 degrees-of-freedom shake tables that can be easily and quickly repositioned in order to accommodate models of various lengths. Together, the tables will be able to host specimens weighing up to 100 metric tons and measuring up to 120 feet, and subject them to fully in-phase or totally uncorrelated synchronous dynamic excitations.
- Large-scale, high-performance dynamic and static actuators, which will provide an immediate capacity for dynamic and pseudo-dynamic testing. These actuators will also allow for the development of new testing methodologies, including the effective force control testing method, in which large structures could be directly subjected to dynamic excitations without the need for shake tables, and, when used in combination with the shake tables and large reaction wall, Real-Time Dynamic Hybrid Testing (RTDHT). The latter is a new form of testing being explored at UB in which shake table and dynamic force experiments on substructures are combined in real-time with computer simulations of the remainder of the structure. This provides a more complete picture of how earthquakes would affect large structures, including large buildings and bridges, without the need to physically test the entire structure. An example of a specimen that could be tested using the RTDHT is shown in Figure 1.

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- Additional equipment required to operate the shake tables and actuators, including a high-capacity, high-performance hydraulic supply and distribution system (up to 1600 gpm), and numerous digital control systems.
- Networked tele-experimentation capabilities using modular and expandable teleobservation and teleoperation equipment, tied to the testing systems using discrete and global sensors, including high-resolution digital video and imaging capabilities.

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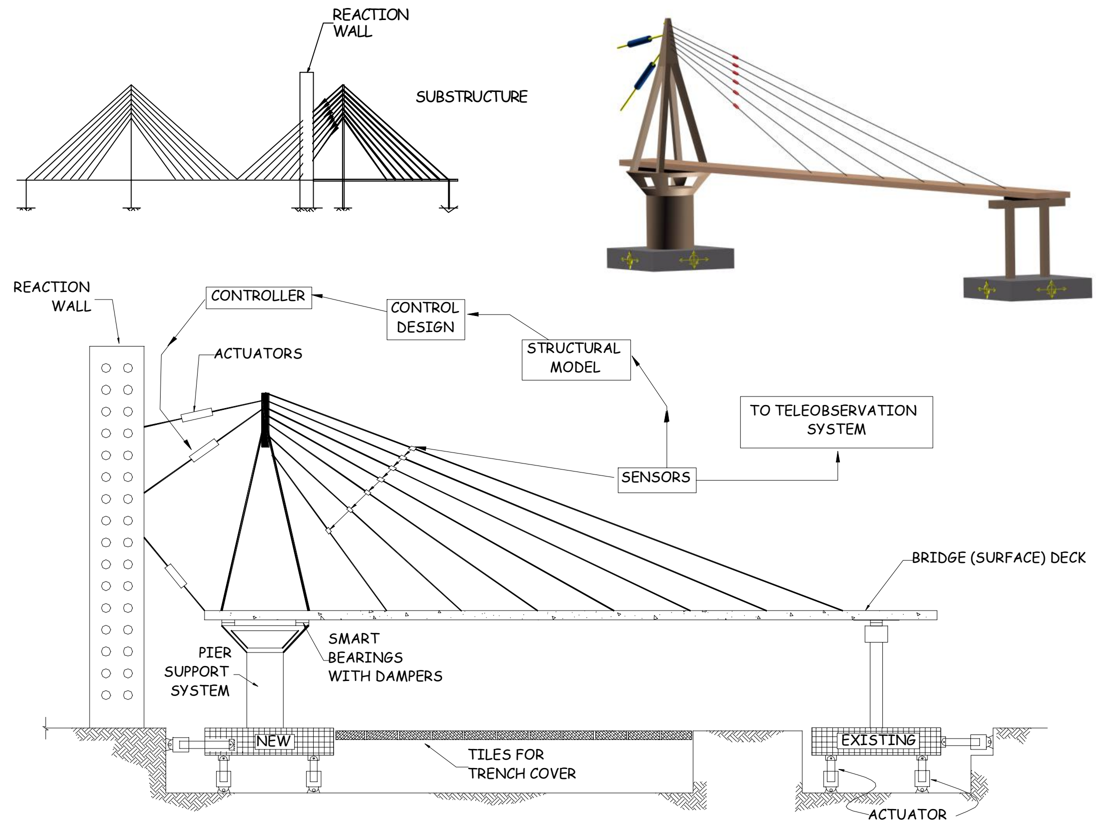

Additional Resources:
http://civil.eng.buffalo.edu/seesl/
http://www.eng.nsf.gov/nees/default.htm
http://www.civil.buffalo.edu/
http://mceer.buffalo.edu/