NHERI@UC SAN DIEGO EXPERIMENTAL FACILITY

LARGE HIGH PERFORMANCE OUTDOOR SHAKE TABLE – LHPOST6

GUIDE FOR

PROSPECTIVE USERS OF THE SHAKE TABLE

REVISION HISTORY

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1 SITE INTRODUCTION

The NHERI@UC San Diego, LHPOST6, is located within the Englekirk Structural Engineering Center (ESEC), 16 km east of the UC San Diego main campus in La Jolla, California. ESEC is an outdoor large-scale structural laboratory complex that, since 2009, has met the requirements of the International Accreditation Service for Testing Laboratories, see Figure 1. It is the first known large-scale structural testing laboratory in the U.S. to demonstrate compliance with International Standards Organization ISO/IEC 17025.

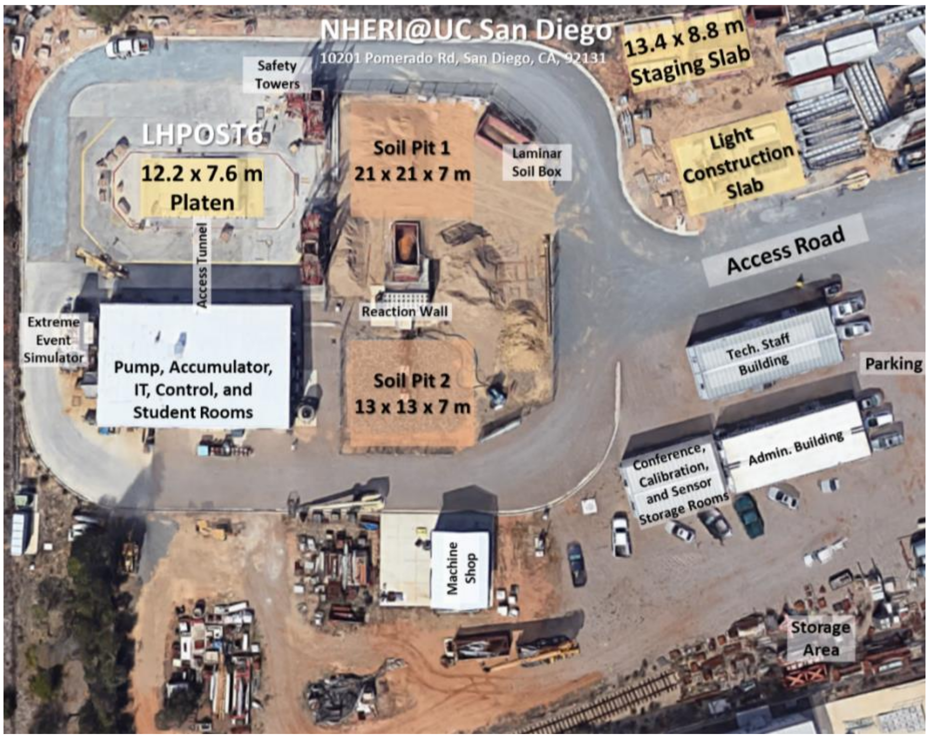


Figure 1. Site Plan of Englekirk Structural Engineering Center (ESEC)

LHPOST6 (Large High Performance Outdoor Shake Table -6 DOF) is a unique outdoor shake table facility designed in 2001–2002 through a joint effort between UC San Diego and MTS Systems Corporation for the seismic testing of large systems, up to a weight of 20 MN, with a capability to accurately reproduce far- and near-field ground motions. In its initial phase of development, it was initially designed as a six-degree-of-freedom (6-DOF) shake table, but due to budgetary constraints it was built as a single-degree-of-freedom (1-DOF) system, previously referred to as LHPOST, with a future upgrade to 6-DOF in mind. In October 2018, NSF awarded UC San Diego the funds to upgrade the LHPOST to 6-DOF. The NSF NEES (2004–2014) and NSF NHERI (2016–present) programs have funded operations to allow the LHPOST, and now the LHPOST6, to serve as a national shared-use research facility, enabling a wide range of landmark experiments on very large- or full-scale systems. The main research objectives of these one-of-a-kind large-scale, system level experiments have been (1) calibration, validation, and improvement of analytical simulation tools to predict the seismic response of these systems, and (2) validation of the seismic performance of systems and components.

1.1 BACKGROUND AND EXPERIMENTAL SITE OBJECTIVES

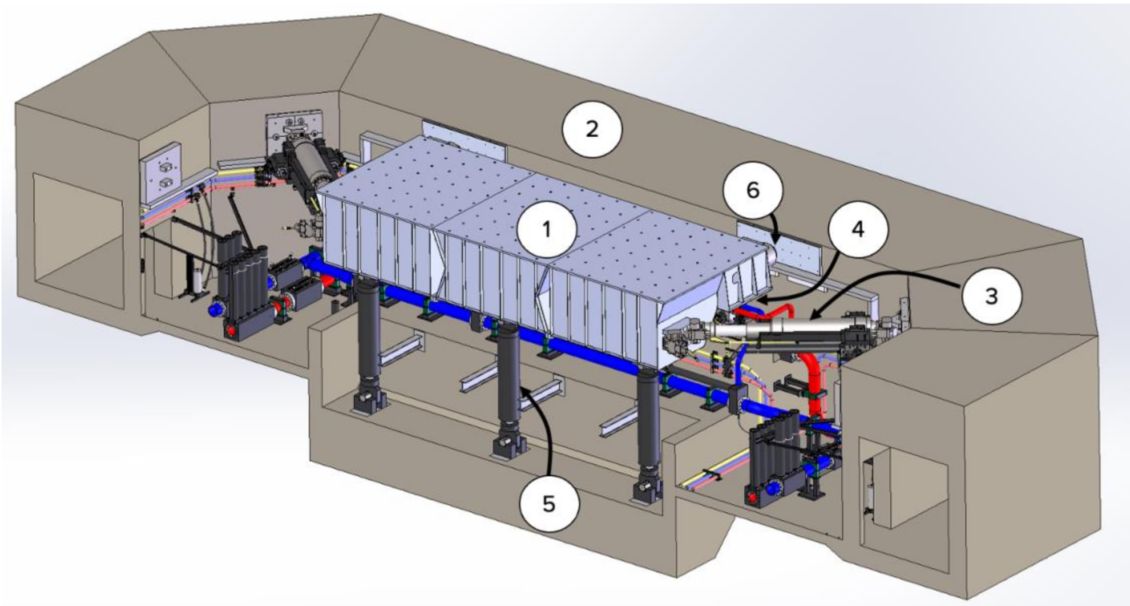
Since its commissioning in 2004, the UC San Diego Large High-Performance Outdoor Shake Table (LHPOST) has enabled the seismic testing of large structural, geostructural and soil-foundation-structural systems, with its ability to accurately reproduce far- and near-field ground motions. To date, 34 landmark projects have been conducted on the LHPOST as a national shared-use experimental facility part of the National Science Foundation (NSF) Network for Earthquake Engineering Simulation (NEES) and currently Natural Hazards Engineering Research Infrastructure (NHERI) programs. Since the LHPOST6 is an outdoor facility, the tallest structures ever tested on a shake table were conducted here -- free from height restrictions. Experiments using the LHPOST have generated essential knowledge that has greatly advanced seismic design practice and response predictive capabilities for structural, geostructural, and non-structural systems, leading to improved earthquake safety in the community overall. However, the LHPOST's limitation of unidirectional input motion (1-DOF) prevented the investigation of important aspects of the seismic response of 3-D structural systems. The newly upgraded 6-DOF LHPOST6 creates a unique, large-scale, high-performance, experimental research facility that enables research for the advancement of the science, technology, and practice in earthquake engineering. Testing of infrastructure at large scale under realistic multi-DOF seismic excitation is essential to fully understand the seismic response behavior of civil infrastructure systems.

The upgraded 6-DOF capabilities enable the development, calibration, and validation of predictive high-fidelity mathematical/computational models, and verifying effective methods for earthquake disaster mitigation and prevention. Research conducted using the LHPOST6 will improve design codes and construction standards and develop accurate decision-making tools necessary to build and maintain sustainable and disaster resilient communities. Moreover, it will support the advancement of new and innovative materials, manufacturing methods, detailing, earthquake protective systems, seismic retrofit methods, and construction methods.

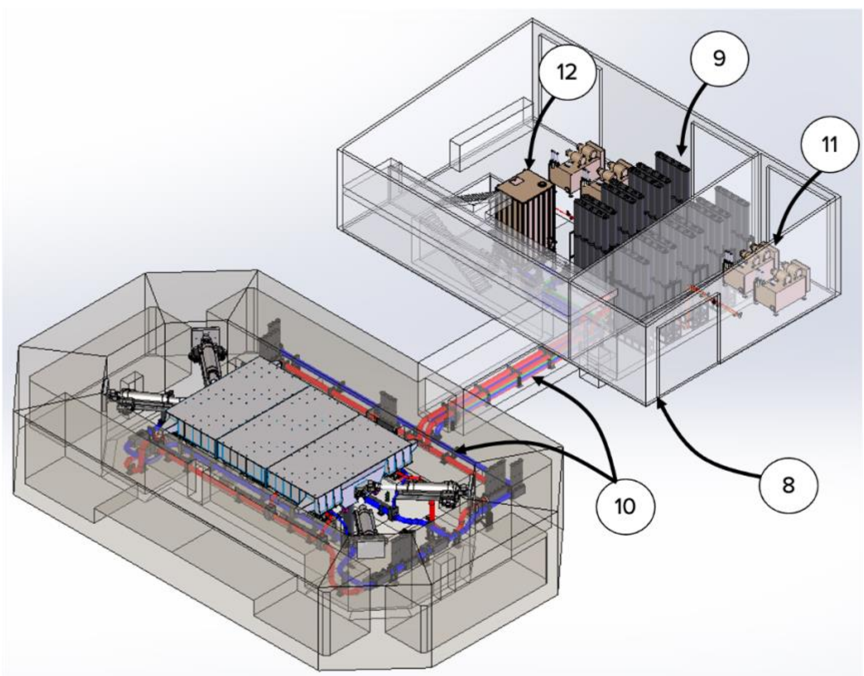
In addition to the Large High-Performance Outdoor Shake Table (LHPOST6), the Englekirk Structural Engineering Center (ESEC) houses a Soil-Foundation-Structure Interaction (SFSI) facility, funded by the California Department of Transportation (Caltrans), which includes a large laminar soil shear box and a refillable soil pit. The Englekirk Center also houses an Extreme Event Simulator (EES), funded by the Technical Support Working Group (TSWG). The combined facility is a one-of-a-kind worldwide resource for real-time testing of large structural and geotechnical systems subjected to earthquake or blast loadings, see Figure 1.

1.2 MAJOR COMPONENTS OF LHPOST6

Figure 2 shows a schematic of the LHPOST6 mechanical components (a) and the servo-hydraulic components (b) for the 6-DOF configuration.



a) Key Mechanical Components of the LHPOST6 system



b) LHPOST6 Hydraulic System Components

Figure 2: Rendering of LHPOST6 Showing Key Components

Component 1 is the 12.2 m long by 7.6 m wide by 2.2 m deep honeycomb steel platen with a grid of multi-purpose, high capacity, tie-down points spaced at 610 mm on center. The platen has an effective weight of 1.45 MN. **Component 2** is the reinforced concrete reaction mass and the service tunnel that connects to the Hydraulic Power System Building. The reaction mass is 33.12 m long, 19.61 m wide, and extends to a depth of 5.79 m. A smaller central area of the foundation housing the hold-down struts extends to a depth of 7.92 m. The reaction mass has a weight of 43.8 MN. The unconventional (low weight) design of the NHERI@UC San Diego reaction mass took advantage of the natural conditions at the site in terms of high soil stiffness to build a lighter and considerably less costly foundation, which resulted in a high characteristic frequency (between 11.2 and 12.5 Hz) and a large effective (radiation) damping ratio (between 32 and 42%) as opposed to conventional design that relies on the use of a massive foundation to achieve a low characteristic frequency. The reaction mass also has a grid of multi-purpose, high-capacity vertical tie-downs for the deployment of safety towers, measurement frames, or reaction frames as needed for hybrid testing. **Component 3** consists of the set of four ±750 mm stroke servo-controlled dynamic horizontal (longitudinal) single-ended actuators (with two actuators at each end arranged in V-formation) having a combined maximum force of 10.6 MN (2,380 kips) in the longitudinal, and 8.38 MN (1,890 kips) in the transverse direction. Each actuator is equipped with two high-flow four-stage servovalves (each rated for a flow of 10,000 liter/min (2,500 gpm) @ 7 MPa (1,000 psi) pressure drop). Thus, the four actuators together can accommodate a peak flow of 38 m3/min (10,000 gpm) which is needed to produce a platen velocity of 2.5 m/s (8.3 ft/s).

Component 4 in Figure 2 consists of six vertical actuators, each ported with a 19,000 liter/min (5,000 gpm) high-flow 3-way servovalve, with a stroke of ±0.127 m (±5 in) which support the shake table platen and provide the vertical, roll, and pitch motion capability. The overturning moment resistance of the LHPOST6 is provided by a combination of gravity loading (test specimen plus platen) and three low-stiffness vertical nitrogen gas-filled cylinders or hold-down struts (**Component 5**). These cylinders passively pre-compress the platen against the sliding bearings (on top of the piston of the vertical actuators), work with a nitrogen pressure of 13.8 MPa (2,000 psi) corresponding to a hold-down force of 2.1 MN (470 kips) each and have a uniaxial stroke of 2 m (79 in). **Component 6** is the crash protection system as a third line of defense (after the software limit detectors and the physical limit switches) in the case of an uncontrolled table motion condition. It is designed to prevent or minimize damage to the shake table system or reaction mass from an uncontrolled motion condition (impact hazard) due to a loss of power or operator programming error. The crash protection system consists of four energy dissipation devices (bumpers) mounted near the four corners of the platen through heavy steel plates bolted to the top and bottom plated of the platen. The main design criterion for the crash protection system in to absorb the kinetic energy of a specimen mass of 1.75 MN (178 ton), moving at 1 m/s into the bumpers (including the actuator driving force) and dissipate this energy over a bumper travel of 0.05 m (2 in). Finally, **Component 7 (not shown)** is the weatherproofing system consisting of removable concrete planks, removable composite concrete-steel planks, and steel cover plates for protection of the servo-hydro-mechanical equipment installed inside the reaction mass against falling debris.

Figure 2b graphically depicts the LHPOST6 Components that comprise the LHPOST6 hydraulic system. **Component 8** is the hydraulic power system building and service tunnel. **Component 9** is the accumulator bank in which oil (hydraulic fluid) is pressurized by the hydraulic power units (pumps) and then discharged at system pressure into the hydraulic pressure lines supplying all the system actuators. **Component 10** shows the hydraulic pressure lines (red colored piping) that transport the high-pressure oil from the accumulator bank to the servovalves of all the horizontal and vertical actuators in the shake table pit area. The low-pressure return flow from all the horizontal and vertical actuators is directed to the surge tank through the hydraulic return lines (blue colored piping). **Component 11** depicts the 3 pumps to pressurize (charge) the accumulator bank before and during a shake table test and one pump to provide the pilot flow to the servovalves of all actuators and **Component 12** is the surge tank that collects return oil flow.

1.3 DESIGN CONSIDERATIONS AND MAIN LHPOST6 SPECIFICATIONS

The design criteria and main specifications of the shake table system were dictated by consideration of several potential research applications involving large or full-scale shake table experiments and a variety of earthquake ground motions. The resulting performance parameters including specifications for actuator stroke, velocity and force capacities, and frequency bandwidth of the earthquake simulator are summarized in Table 1. In deciding on these parameters, far-source (or “ordinary”) and near-source earthquake ground motions to be reproduced by the shake table were considered. Near-source records are characterized by a large velocity pulse in the fault-normal component, and a large ground displacement step in the fault-parallel component. For “ordinary” ground motions, a maximum horizontal peak ground and peak table acceleration of 1g, corresponding to an upper bound to the vast majority of recorded ground motion records, is required. Consideration of a suite of desired large or full-scale specimens for shake table experiments, together with the mass of the platen and accounting for elastic and inelastic dynamic amplification effects (for the base shear), the assumed effective height of the specimen (10 m), as well as dynamic similitude requirements, led to a maximum force of 6.8 MN to be imparted by the shake table actuators and a maximum overturning moment of 50 MN-m to be accommodated by the platen and its support mechanism.

Table 1. Uniaxial performance characteristics of the LHPOST6
Sinusoidal motions - Bare table condition - Centered rigid payload of 4.9 MN (1,100 kips)

Platen size	12.2 m × 7.6 m (40 ft × 25 ft)					
Frequency Bandwidth	0 – 33 Hz					
Vertical Payload Capacity	20 MN (4,500 kip)					
	Sinusoidal motions - Bare table condition			Sinusoidal motions - Centered rigid payload of 4.9 MN (1,100 kips)		
	Horizontal X (E-W)	Horizontal Y (N-S)	Vertical Z (-)	Horizontal X (E-W)	Horizontal Y (N-S)	Vertical Z (-)
Peak Translational Displacement	±0.89 m (±35 in)	±0.38 m (±15 in)	±0.127 m (±5 in)	±0.89 m (±35 in)	±0.38 m (±15 in)	±0.127 m (±5 in)
Peak Translational Velocity	2.5 m/sec (100 in/sec)	2.0 m/sec (80 in/sec)	0.6 m/sec (25 in/sec)	2.5 m/sec (100 in/sec)	2.0 m/sec (80 in/sec)	0.6 m/sec (25 in/sec)
Peak Translational Acceleration	5.9 g	4.6 g	4.7 g (1)	1.6 g	1.2 g	2.0 g (1)
Peak Translational Force	10.6 MN (2,380 kip)	8.38 MN (1,890 kip)	54.8 MN (2) (12,300 kip)	10.6 MN (2,380 kip)	8.38 MN (1,890 kip)	54.8 MN (2) (12,300 kip)
Peak Rotation	2.22 deg (3)	1.45 deg (3)	4.0 deg	2.22 deg (3)	1.45 deg (3)	4.0 deg
Peak Rotational Velocity	21.0 deg/sec	12.4 deg/sec	40.5 deg/sec	21.0 deg/sec	12.4 deg/sec	40.5 deg/sec
Peak Moment	23.1 MN-m (17,000 kip-ft)	31.4 MN-m (23,200 kip-ft)	47.0 MN-m (34,600 kip-ft)	37.2 MN-m (27,400 kip-ft)	49.0 MN-m (36,200 kip-ft)	47.0 MN-m (34,600 kip-ft)
Overturning Moment Capacity	32.0 MN-m (23,600 kip-ft)	35.0 MN-m (25,800 kip-ft)		45.1 MN-m (33,200 kip-ft)	50.0 MN-m (36,900 kip-ft)	

(1) Peak vertical downward acceleration
(2) Peak compressive force in the compression-only vertical actuators
(3) Due to kinematics of the piston seals of the vertical actuators

The design of the LHPOST6 was developed in a collaborative effort between UC San Diego and MTS Systems Corporation. The target performance of the LHPOST6 was defined through its ability to reproduce the six tri-axial strong ground motions defined in Table 2 below. These ground motions are from the 1978 Tabas (Iran), 1994 Northridge (California), 1995 Kobe (Japan), 1999 Chi-Chi (Taiwan), and 2015 Nepal earthquakes, and an AC- 156 compatible artificial earthquake record developed for seismic qualification testing (ICC Evaluation Services Inc., 2007).

Table 2. Tri-axial base input motions considered for the preliminary design of the LHPOST6

Event Name	Station Name	M	PGA (g)			PGV (m/s)			PGD (m)			High pass freq. (Hz)
			EW	NS	UP	EW	NS	UP	EW	NS	UP	
Tabas, 1978	Tabas, Iran	7.4	0.97	0.88	0.72	1.0	0.87	0.33	0.62	0.33	0.11	0.16
Chi-Chi, Taiwan, 1999	TCU065	7.6	0.72	0.49	0.23	0.82	0.73	0.38	0.36	0.24	0.10	0.25
Kobe, 1995	Takatori, Japan	6.9	0.62	0.67	0.28	1.21	1.23	0.16	0.40	0.30	0.04	0.125
Northridge, 1994	Rinaldi Receiving Station	6.7	0.87	0.47	0.96	1.48	0.75	0.42	0.42	0.23	0.04	0.10
Nepal, 2015	Kathmandu, Nepal	7.8	0.16	0.17	0.15	0.43	0.40	0.26	0.30	0.20	0.10	0.25
AC-156 compatible earthquake (1)		-	1.01	0.96	0.71	1.04	1.13	0.77	0.22	0.21	0.12	0.70

(1) Acceptance criteria for seismic certification by shake-table testing of nonstructural components

To achieve the desired design criterion, the hydraulic power system was designed using inverse simulation, which takes a target tri-axial ground motion record as input and computes the system demands in terms of displacement, velocity, acceleration, force, servovalve opening, oil flow and pressure. The peak demand flow rate and total demand flow required to reproduce the six considered tri-axial earthquake records are shown in Table 3 below. It is observed that the Chi-Chi and Nepal earthquake records require a total flow demand exceeding 8.0 m3 (2,100 gallons), dictating the need for a 36.9 m3 (9,750 gallon) accumulator bank (75 bottles of 0.38 m3 (130 gallon) each) which can provide approximately 9.0 m3 (2,300 gallons) of oil at 20.7 MPa (3,000 psi).

Table 3: Peak demand flow rate and total demand flow required to reproduce the tri-axial strong ground motion records defined in Table 2; bare table condition.

Earthquake record	Peak flow rate		Total flow	
	m^3/min	gpm	m^3/min	gpm
Tabas, 1978	79.0	20,859	7.1	1,872
Chi-Chi, Taiwan, 1999	82.6	21,815	8.0	2,125
Kobe, 1995	52.5	13,858	5.1	1,349
Northridge, 1994	89.7	23,687	2.6	687
Nepal, 2015	33.8	8,938	8.3	2,188
AC-156 compatible	106.6	28,158	4.3	1,130

1.4 ENGLEKIRK STRUCTURAL ENGINEERING CENTER

The Englekirk Structural Engineering Center occupies a 2-acre site on the Northwest corner of the UC San Diego Camp Elliott situated on Miramar/Pomerado Rd. near Interstate 15. The site has restricted access, is a gated facility and has ample room for the simultaneous construction and instrumentation of multiple test specimens before placement on the shake table. Hotel and dining services for visiting researchers are available within 1 mile of the site. Networking capabilities are available via the High-Performance Wireless Research and Education Network (HPWREN). In addition, a fiber-based service provides 1.25 Gbps seamless connectivity between the UC San Diego local area network including the San Diego Supercomputer Center (SDSC) and the Camp Elliott site. All utilities at Camp Elliott have been designed for future upgrades.

In addition to the Large High-Performance Outdoor Shake Table (LHPOST6), researchers have access to (i) Two-refillable soil pits. Pit 1 is east of the shake table (21.4 m square by 7.1m deep), and Pit 2 is southeast of the shake table (13.4m square by 7m deep), with a 6m tall, 250 ton capacity reaction wall between the soil pits; (ii) Extreme Events Simulator (EES), a hydraulic-pneumatic blast generator system consisting of two type BG25 (250 kN max force) and two BG50 (623 kN max force) high-speed actuators which can be used to characterize the response of infrastructure to both man-made and natural hazard events or can function as high-speed mass launching apparatus to simulate wind debris; (iii) A staging area slab with dimensions of 13.4m by 8.8m by 0.914m deep including electrical access for construction equipment that can be used for initial construction and partial assembly of specimens. Small to moderate sized specimens (weighing up to 100 tons) can be constructed on the staging area and then lifted onto the shake table platen, or partial assembly of components for large specimens can be constructed on the slab to reduce construction time on the table. For specimen construction, researchers can make use of a 75-ton crane, a Bobcat with a 1.3-m bucket, a Caterpillar F-103 forklift with 44 kN lifting capacity, a backhoe model 460 4x4, a Genie S-80 man-lift with a maximum height reach of 24.4 m, and a welding MIG (a portable welding machine, MIG and Stick), all to be used on a recharge basis under supervision and operated by certified staff member. The site contains a small workshop where various small jobs can be accomplished. For larger jobs, UC San Diego has a complete machine shop that can be used on a recharge basis.

The LHPOST6 can be used in combination with either a 3 m wide by 6.7 m long by 4.7 m high large laminar soil box, funded by Caltrans, or a 4.6 m or 5.8 m wide by 10 m long by 7.6 m high large soil confinement box (LSCB), funded by NSF. Both soil boxes are modular and can be configured to different heights. The soil confinement box can also be configured in two different widths. These large soil boxes enable large-scale seismic experiments on geotechnical and soil foundation structural (SFS) systems.

2. LHPOST6 PERFORMANCE CURVES

For the three components of the 1995 Kobe earthquake record that was used in the Basis of Design (Table 2), Figure 3a shows the target vs. achieved translational acceleration time histories, Figure 3b shows the target vs. achieved translational velocity time histories, and Figure 3c shows the target and achieved translational displacement time histories. A comparison between target and achieved five-percent damped tri-partite (displacement/pseudo-velocity/pseudo-acceleration) linear elastic response spectra is provided in Figure 4.

The fidelity of the responses are strong, and similar levels of signal tracking fidelity were observed for the other tri-axial earthquake records considered in the LHPOST6 design. The level of fidelity in signal reproduction for the vertical component and other motion components will be further improved through experience gained as we implement advanced control capabilities that are built into the MTS 469D shake table controller such as Adaptive Inverse Control (AIC), On- Line Iteration (OLI) and Specimen Dynamics Compensation (SDC).

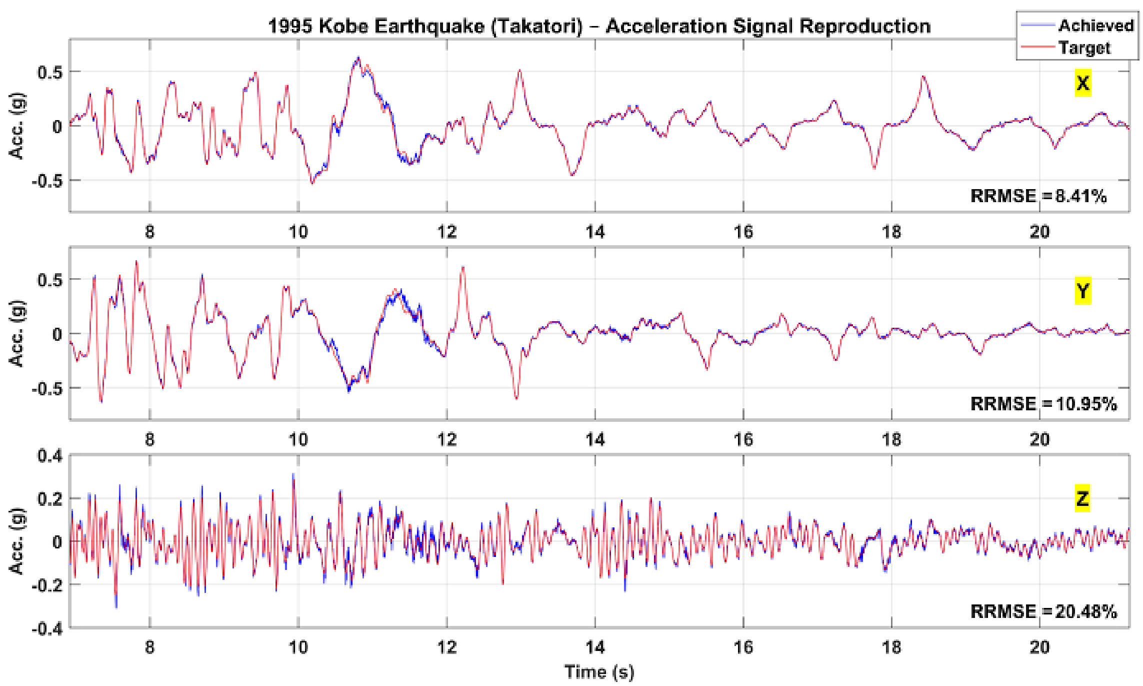


Figure 3a:. Comparison of target and achieved tri-axial acceleration time histories for the 1995 Kobe earthquake record (see Table 2).

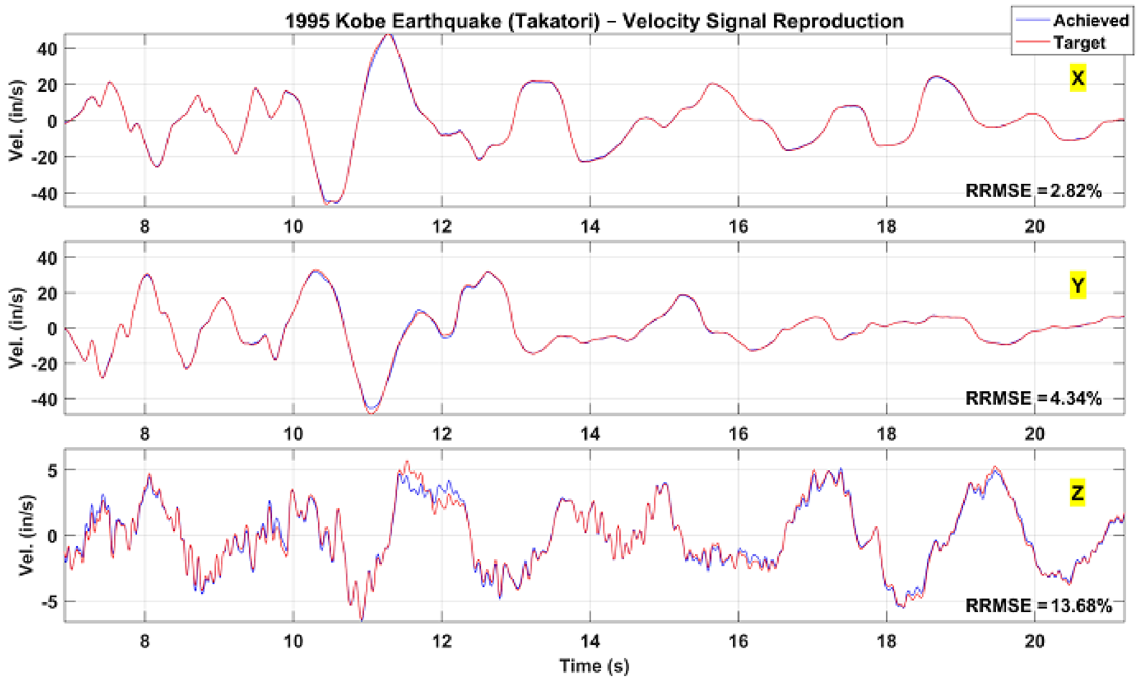


Figure 3b. Comparison of target and achieved tri-axial velocity time histories for the 1995 Kobe earthquake record (see Table 2).

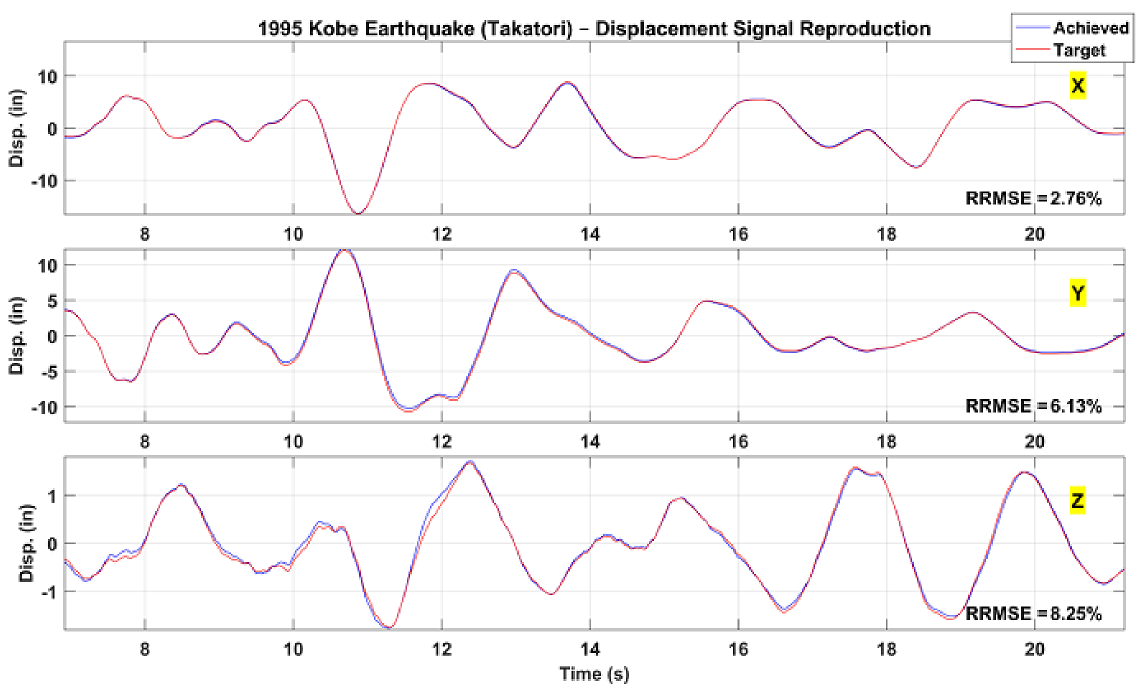


Figure 3c. Comparison of target and achieved tri-axial displacement time histories for the 1995 Kobe earthquake record (see Table 2).

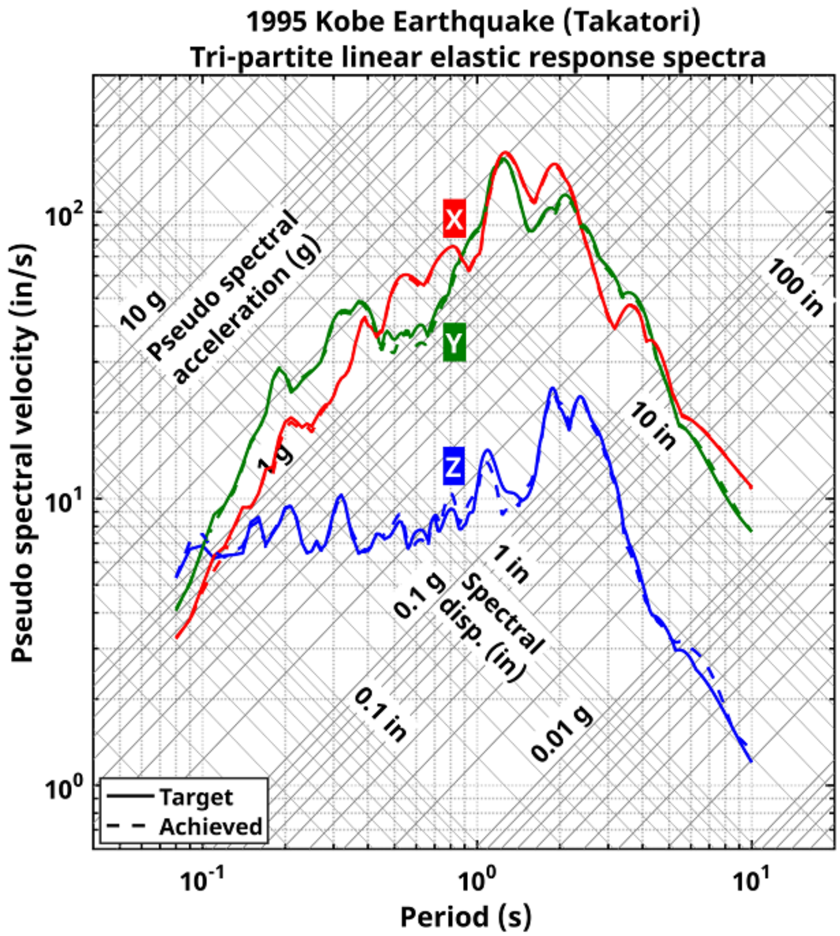


Figure 4. Comparison of the target and achieved 5% damped tri-partite linear elastic response spectra for the 1995 Kobe earthquake record (see Table 2).

3. DATA ACQUISITION SYSTEM

The LHPOST6 facility is equipped with a new data acquisition (DAQ) system manufactured by National Instruments consisting of 12 nodes with 64 channels each (for a total of 768 measurement channels) at 24-bit Analog-to-Digital resolution, simultaneous sampling, and a sampling rate up to 25.6 kS/s per channel. This DAQ provides superior aliasing rejection with user-configurable digital antialiasing filters, and zero skew time between different channels due to simultaneous sampling, thus enabling accurate recordings from very small (ambient vibrations) to very large (seismic testing) motions.

The site is open to explore the use of new measurement/sensor technologies such as Digital Image Correlation techniques to measure the motion and deformation of test specimens. However, the site's top priority is to provide highly reliable measurements and high-quality data to the researchers and/or commercial clients. Research teams using the site are also encouraged to deploy payload projects exploring innovative sensing technologies (e.g., low-power wireless sensors).

The site also has calibration equipment for sensors and data acquisition systems, as required for its ISO/IEC Standard 17025:2005 accreditation. The NHERI@UC San Diego Experimental Facility also has a fully configured, end-to-end, live video streaming production system with high resolution and low latency.

4. AVAILABLE INSTRUMENTATION ON SITE

Due to the nature of shake table testing, experiments conducted on the LHPOST6 typically require anywhere from fifty to six-hundred sensor measurement channels. The LHPOST6 facility has a large inventory of sensors available to instrument test specimens. These sensors and their quantities include: (i) 210 MEMS-based accelerometers, (ii) 142 Linear displacement transducers, (iii)119 String potentiometer displacement transducers, (iv) 4 Load jacks, (v) 31 Load cells, (vi) 32 Soil pressure transducers, and (vii) GPS System with RTD_NET Software by Geodetics with 3 receivers operating at 50Hz to measure translational motions in 3D with a precision of 1.5mm. Strain gauges are used extensively but are considered disposable instrumentation and are provided as needed by the project team. The site also has an array of 4K (UHD) and 1080p high definition (HD) video cameras running at 30 frames per second (fps) that are fully synchronized with the sensors: 15 4K GoPros, 4 Axis 240Q/241Q streaming video servers, and 3 IQeye streaming/timelapse video cameras. The LHPOST6 facility is continuously upgrading and expanding the available instrumentation inventory. A 4K DJI Phantom 4 Pro Drone is also available to capture videos and images from hard-to-reach angles and viewpoints only possible with a drone. Tables 4 and 5 outline the sensor and imaging device inventory at the time of publishing this manual.

Table 4. Current Instrumentation Inventory

Sensor Type	**Full Scale**	**Qty**
Accelerometers	+/- 5g	15
Accelerometers	+/- 10g	195
String potentiometer	+/- 1”	1
String potentiometer	+/- 2.5”	28
String potentiometer	+/- 5”	18
String potentiometer	+/- 10”	27
String potentiometer	+/- 15”	26
String potentiometer	+/- 25”	9
String potentiometer	+/- 30”	10
Linear potentiometer	+/- 1”	65
Linear potentiometer	+/- 2”	28
Linear potentiometer	+/- 3”	17
Linear potentiometer	+/- 4”	32
Enerpac flat jack	2 MN	4
Load cell	20,000 lbs	31
Soil pressure transducer	-	32

Table 5. Current Imaging Device Inventory

Imaging Device	**Qty**
Color WDR HDCVI cameras	16
GoPro HD (4K, 30 Hz)	15
High-definition video cameras	2
DJI Phantom 4 Pro Drone (4K, 30 Hz)	1
Geodetics GPS system with RTD_NET software (3 NAVCOM ANT 2004T antennae)	1
Telestream Wirecast live video streaming package	1
IQeye streaming/time-lapse systems (30 fps)	3

5. WHERE TO START

Projects at LHPOST6 are categorized as either Research, or Commercial in nature. Depending on the category of experimentation, the procedure for planning, developing, securing funding, scheduling, and ultimately successfully completing the experimental program at LHPOST6 varies. The following list is a good place to start planning for a project:

1. Check Table availability. Go to http://nheri.ucsd.edu/ and learn more about our general testing capabilities.
2. Under Projects select "Site Schedule" or follow this link: http://nheri.ucsd.edu/projects/schedule.shtml
3. Check the table availability for the test window that you are interested. If the table is available during your preferred time window, then:
4. Check the required input motions against the table performance curves shown in Figure 3 of this document.
5. Check the footprint of the specimen against the platen dimensions.
6. Check the overturning moment.
7. Check the instrumentation available on site against your requirements. Go to: http://nheri.ucsd.edu/facilities/equipment.shtml
8. If additional masses are needed, please check the masses which are available on site. Go to: http://nheri.ucsd.edu/facilities/added-mass-blocks.shtml
9. If restraining towers that are needed for safety purposes, please go to: http://nheri.ucsd.edu/facilities/restraining-towers.shtml
10. If the above initial verifications are true, then is time to contact us. To find information related to how and who to contact go to the following link: http://nheri.ucsd.edu/about/contact.shtml
11. If you would like to reach other points of contact, go to: http://nheri.ucsd.edu/about/personnel.shtml
12. From this point on we can discuss the details of your project regarding technical aspects, information regarding local contractors, information regarding lodging for your personnel/students and safety training required for all personnel.